P. Salz (ed.)

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BIO-ECONOMIC EVALUATION OF MULTI-SPECIES AND MULTI-ANNUAL FISHERIES MANAGEMENT MEASURES

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ABSTRACT

BIO-ECONOMIC EVALUATION OF MULTI-SPECIES AND MULTI-ANNUAL FISHERIES MANAGEMENT MEASURES
Salz, P. (ed.)
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The consequences of introduction of multi-annual, multi-species and effort measures in fisheries management are evaluated. Methodology is developed and applied to three specific cases. The evaluation is based on biological, economic and institutional considerations.

The methodology follows a matrix approach. Economic, biological and institutional criteria are formulated. Subsequently, definitions are developed of multi-species, multi-annual and effort measures. First, these definitions are evaluated in general terms in the light of the specified criteria. The case studies define the management problem in terms of the criteria and determine to what extent the new measures may contribute to its solution.

Some measures offer a little more flexibility to the fleet without causing serious threat to the biological base of the fishery. Particularly, limited transfer of TACs from one year to the next one (multi-annual) or from one species to another (multi-species). Effort measures appear most promising in mixed fisheries. Major problems overcapacity and race for fish are not resolved by the introduction of new measures. These can only be resolved by privatizing the common property resource and setting up appropriate institutional arrangements.

The results of this study are potentially useful in various respects. First, the developed methodology can be applied to the assessment of other fisheries management measures. Second, the discussion of new measures contributes to further development of the CFP. Thirdly, the analysis of major EU fisheries (beam trawling in the North Sea, roundfish trawling in the North Sea and mixed bottom trawling in the Celtic Sea) provides insights into the problems and possibilities of their management.

Fishery management/Resource conservation/Economics/Biology/Institutions/Flatfish/Roundfish/Trawling/Quota/France/United Kingdom/The Netherlands/Common Fisheries Policy/Fishing effort/Multi-annual/Multi-species

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CONTENTS

SUMMARY FOR NON-SPECIALISTS

Management of fish resources within the Exclusive Economic Zone of the European Union in the North Sea and in the Atlantic areas takes place within the legal framework of the Common Fisheries Policy (CFP). After the review of the CFP in 1991 a new basic regulation has come into force (EC Reg. 3760/92) and will be applicable until 2002. The objective of the CFP is formulated as:

> 'to provide for rational and responsible exploitation of living aquatic resources and of aquaculture, while recognizing the interest of the fisheries in its long term development and its economic and social conditions and the interest of the consumers taking into account the biological constraints with due respect to the marine ecosystem.'

To achieve this objective the CFP may introduce specific measures in five areas:

- TACs and quota;
- technical measures;
- structural policy;
- market policy;
- access to third countries' waters.

EC Reg. 3760/92 mentions specifically the possibility of introducing multi-annual and/or multi-species measures for specific (groups of) fisheries. Further details of such new measures have been elaborated in a proposal of the Commission to the Council.

The present study is directly related to the multi-species and multi-annual measures. Its *objective* is:

> 'bio-economic evaluation of the consequences of the introduction of multi-annual and multi-species measures, consisting of the formulation of an appropriate methodology and its application to three specific cases. The study intends to include in the evaluation biological, economic and institutional considerations relevant to the future implementation of these measures.'

The research team was composed of a relatively large number of individuals - economists, biologists and industry representatives - who all have a proven experience with fisheries matters. The aim was to produce a profound appreciation of the multi-disciplinary complexity of the questions raised and as far as possible a consensus on the consequences of the various measures.

The research project was carried out in two main phases. In the first phase an appropriate multi-disciplinary methodology was formulated. Measures were specified and a method for their evaluation was developed. In the second

phase, the definitions and methodology were applied to three major EU fisheries: North Sea flatfish, North Sea roundfish and a mixed fishery in the Celtic Sea.

Multi-disciplinary methodology

The methodology for evaluation of the measures is explicitly based on the need for a multi-disciplinary approach. Therefore economic, biological and institutional considerations are included. Furthermore attention is given to the relation between these points of view.

The *economic* perspective is defined as the viewpoint of the firm. It is the fishing vessels and companies which pursue their objectives and interpret the management policy in that light. The economic criteria regard therefore: 1. short term flexibility to choose fishing grounds and/or target species.; 2. long term decisions regarding investment; 3. consistency with the market forces; 4. consistency with the daily practice of fishing; 5. influence on the race for fish; and 6. economic performance or profitability.

The *biological* evaluation regards the measures from the perspective of stock preservation, not only for its economic potential but also for its intrinsic value. The specific criteria regard: 1. spawning stock; 2. fishing mortality; 3. high-grading; 4. discarding of non-commercial species or those of which the quota has been exhausted; and 5. effects on ecosystem.

A number of different institutions are involved in fisheries matters - government at local, national and EU level, industry organizations and local communities. These institutions have regularly diverging or even contradictory interests. Therefore inconsistencies may occur even within the institutional assessment.

The *institutional* criteria used are: 1. political acceptance; 2. sectoral acceptance; 3. maintenance of relative stability; 4. feasibility of enforcement; 5. subsidiarity; 6. role of local communities; and 7. potential for CFP beyond 2002.

Finally, the *relations* between the three perspectives are assessed in terms of: 1. mutual consistency; 2. transparency of the measures; and 3. potential new problems. Attention is also given to the conditions which are required for the successful implementation of a certain measure.

Definitions of measures

The feasibility of various specific definitions of multi-species, multi-annual and effort measures is explored. The definitions range between high degree of flexibility, for instance unlimited exchange (of TACs or effort allocations) between years or species and 'absolute stability' (fixing constant TAC or effort allocation for a period of several years). The potentially most interesting options are those which provide a limited possibility for adjustment.

The general evaluation shows that it is rather difficult to develop definitions which would not lead to inconsistencies, particularly between the short term interests of the fishing enterprises on one hand and the long term preservation of the fish stocks. Certain existing problems, for instance race for fish,

will not be resolved by the proposed measures. In some respects the available knowledge is largely insufficient for a reliable scientific assessment - forecasting of future recruitment is impossible, inter-species relations are not well known and implications on the eco-system are difficult to assess. Various institutional or political considerations depend on specific conditions of the moment, for instance pressure by special interest groups.

North Sea bottom trawling for roundfish

The case discusses fishing on cod, haddock and whiting by eight European countries. The fishery is heavily regulated, with TACs being the main policy instrument. Despite this all three stocks are heavily exploited and the fishery is very dependent upon juvenile year classes. There is particular concern that North Sea cod could be on the verge of collapse. Attempts to conserve stocks by implementing restrictive TACs simply exacerbates the problem of illegal landings and wasteful discarding.

The management problem lies in the excessive fishing mortality caused by a structural overcapacity of the fleets. In other words, the economic instinct of the vessels to survive in the short run puts the long run maintenance of the stocks in peril.

Multi-annual and multi-species measures, if defined in terms of quantities of fish, are not considered very promising in this context. Prediction of stock abundance more than two years ahead is difficult. Multi-species measures complicate even further the protection of individual stocks. Neither of these two types of measures addresses the major problem of overexploitation and overcapacity.

Effort measures have been interpreted as 'days-at sea' limitations. These measures may be more attractive as they do affect the inputs and may be also administratively more simple to implement. Among the drawbacks, however, are the poor links between effort and mortality and the general problem of operational effort definition. In the medium and long run it is expected that input substitution will offset the positive effects realized in the short run.

None of the measures under review consider long run economic solutions to the problem of overexploitation of roundfish stocks. The case study concludes that to eradicate overfishing, it is necessary to change the cost function that the vessel is confronted with to include the full social costs of fishing. This suggests instituting some form of charging mechanism involving fishermen paying for their fishing rights.

North Sea beam trawling for flatfish

The case discusses the exploitation of sole and plaice, mainly by the Netherlands, United Kingdom and Belgium. This fishery is mainly regulated by annual TACs, which are supported by various accompanying measures. In the past few years the stocks of plaice have deteriorated. The sole stock is temporarily in good shape due to a few strong year classes, but it is under high fish-

ing pressure. Therefore the MAGPIII imposes a reduction of 15% on the beam trawl fleet.

The general management problem is that the stocks have still allowed operators to attain reasonable economic results. The existing technical overcapacity has not yet become economically visible. However, if the sole stocks deteriorate as well, very serious economic problems can be foreseen.

Multi-annual and multi-species measures are only considered realistic and feasible under well specified restrictions. Unlimited transfer of catching possibilities from one species to another or one year to the next would be detrimental for the state of the stocks. Limited transfer would increase somewhat the needed flexibility of the fishing enterprises.

Management by effort is already applied in this fishery, as the Netherlands operates a days-at-sea system. Setting a more or less constant effort for a period of several years will meet political opposition in the Netherlands. An acceptable method must be found to translate quota and ITQs into individual effort allocations so that the fishing companies do not loose the heavy investments made over the past years. Management by effort will require solid monitoring of its efficiency to take into account technological progress.

Breton fisheries in the Celtic Sea

The fisheries of the Celtic Sea (ICES area VII) are characterised by a large diversity in terms of métiers, target species, gears, seasons, etc. Commercially successful exploitation of fishing vessels is only feasible with a significant degree of flexibility - allowing a choice of where, when and what to fish.

Compared to the other two case studies, the dependence of the fleets operating in area VII on quota species is lower. Furthermore, the quota remain often underexploited. The management problem lies primarily in an overall high level of exploitation, leading to low catches per unit of fishing effort. The low catches are a threat to profitable fishing in the long run.

Consequently multi-species and multi-annual measures specified in terms of quantities of fish which may be caught are of little relevance. First, the fleet does not face problems in these terms. Second, implementation of such measures would be extremely difficult and would face serious opposition from the industry because they would not be well adapted to the nature of the fishing activities.

Overall management of fishing effort seems to be the most promising alternative. Flexibility could be maintained while at the same time the level of fishing effort (and fishing mortality) could be reduced. Selective fishing methods could be promoted. The new system would, however, put in question the principle of relative stability. Some resentment from the industry could be expected, as its activities would be more restricted and private property rights may have to be introduced.

INTRODUCTION

Management of fish resources within the Exclusive Economic Zone of the European Union in the North Sea and in the Atlantic areas takes place within the legal framework of the Common Fisheries Policy (CFP). After the review of the CFP in 1991 a new basic regulation has come to force (EC Reg. 3760/92) and will be applicable until 2002. The objective of the CFP is formulated as:

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The present study is directly related to the multi-species and multi-annual measures. Its objective is:

> *'bio-economic evaluation of the consequences of the introduction of multi-annual and multi-species measures, consisting of the formulation of an appropriate methodology and its application to three specific cases. The study intends to include in the evaluation biological, economic and institutional considerations relevant to the future implementation of these measures.'*

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1) Proposal for a Council regulation (EC) fixing management objectives and strategies for certain fisheries or groups of fisheries for the period 1994 to 1997, COM(93)663 final, EC Off. J. 94/C 17/06; and Communication de la Commission au Conseil at au Parlement Europeen, La mise en oeuvre des nouveaux elements de la PCP, COM(93)664 final of 15.12.1994.

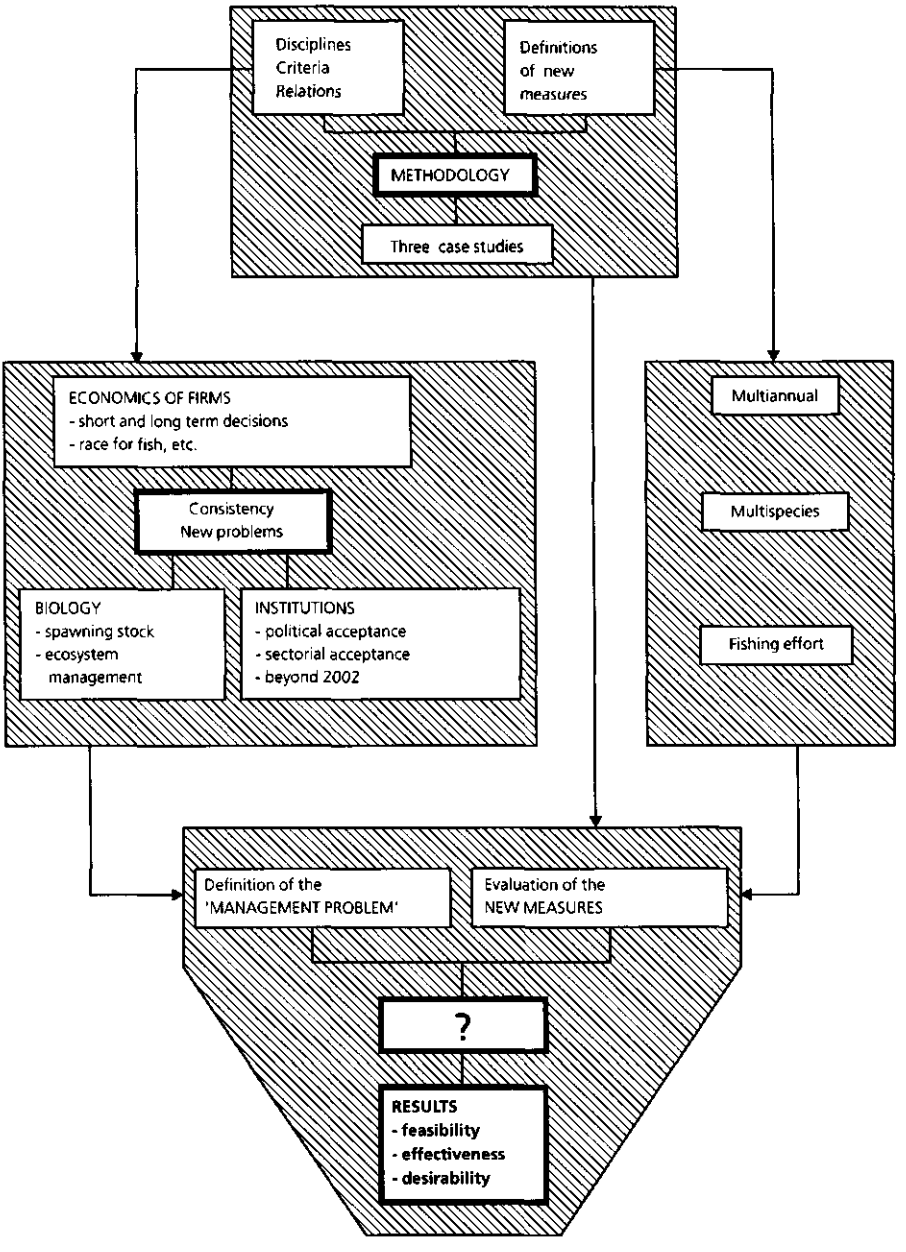

Figure 1.1 Overall structure of the project

The research team was composed of a relatively large number of individuals - economists, biologists and industry representatives - who all have a proven experience with fisheries matters. The aim was to produce a profound appreciation of the multi-disciplinary complexity of the questions raised and as far as possible a consensus on the consequences of the various measures.

The research project was carried out in two main phases. In the first phase an appropriate multi-disciplinary methodology was formulated. Management measures were specified and a method for their evaluation was developed. In the second phase, the methodology was applied to three major EU fisheries: North Sea flatfish, North Sea roundfish and a mixed fishery in the Celtic Sea. The structure of the project is presented in figure 1.1 on the previous page.

The report is composed in parallel manner of four main parts: elaboration of the methodology and three case studies.

Methodology

The first part, which deals with the development of the methodology is composed of four chapters.

The first chapter is a brief evaluation of the past experiences with the CFP. It puts these experiences in the context of the current situation in the fisheries in the EU. The chapter demonstrates the need for explicit criteria in order to allow for a comprehensive assessment of any future situation. Twenty-one evaluation criteria are formulated to be used in the subsequent chapters. Finally, the characteristics of the basic situation are reviewed, i.e. the situation which is taken as a starting point and to which comparisons are made. The single most important characteristic regards the ownership of fishing rights.

The second chapter discusses the multi-annual quantity measures. It explores the feasibility of various definitions of multi-annual TACs, but also of other multi-annual approaches to catch restrictions. Similarly, the third chapter analyses the multi-species quantity measures. A number of definitions are formulated and evaluated on the basis of the 21 criteria. The fourth chapter deals with effort measures, which are considered as a combination of multi-species and multi-annual characteristics.

The three chapters on new measures are set up in three sections. First, the measures are discussed in general terms - the reasons for the consideration of the given principle, its advantages and disadvantages. The second section presents a discussion and evaluation of a number of specific definitions of the measure under consideration. Finally, the evaluation is generalized and approached in terms of economic, biological and institutional considerations. Finally, attention is given to the level of consistency among various points of view which may be achieved and to the potential problems which may arise.

Three case studies

The methodology is applied to three major EU fisheries: beam trawling for flatfish in the North Sea, trawling for roundfish in the North Sea and mixed bottom trawling in the Celtic Sea. These fisheries have been selected because of their diverse characteristics and the potential relevance which the new measures may have. However, they primarily serve for analytical purposes. The

study does not pretend to offer the 'final word' on the application of new management measures in these fisheries.

The three case studies are all presented in a similar manner. The first four chapters are devoted to a general description of the fishery. After a brief introduction, each fishery is characterised in terms of the composition of the countries and fleets involved. The biological base of the fishery is assessed reviewing the size of the stock, recruitment over past years, level of fishing mortality, etc. EU and national management regulations are presented. The general description is concluded by a 'definition of the management problem', which is put in terms of the criteria used for the subsequent evaluation of the new management measures.

The second part of each case study (chapters 5-7) is devoted to the evaluation of the multi-species, multi-annual and effort management measures. The most promising definitions selected in the methodological part of the report are scrutinized as to their applicability under the specific conditions of each case study. The findings are summarized in case specific conclusions.

Final comments

The approach followed during the execution of the project may be best characterised as an 'adjusted Delphi method'. The research team is composed of a relatively large number of individuals, who all have a proven experience with fisheries matters. A significant share of the available time has been devoted to meetings and discussions. Their aim was to produce an appreciation of the multi-disciplinary complexity of the questions raised and as far as possible, a consensus on the consequences of the various measures.

Two general problems should be mentioned - *perception* and *comparison*. Fisheries problems are sometimes (if not often) perceived rather differently by fishermen, scientists, politicians and the general public as well as individuals within each of these groups. This applies to the appreciation of the gravity of any situation as well as to the assessment of the consequences of management measures.

The report represents the perception developed by the research team. Making a well founded comparison of a hypothetical future situation with a real situation which exists is difficult because both situations may be perceived differently by the individuals involved. The perception may range from idealistically positive to sceptically negative. Expectations/assumptions regarding the behaviour of fishermen as well as of the executing agencies play a crucial role. The comparison is further complicated because quantification presents problems in a multi-disciplinary analysis. Finally, the comparison is not between extremes, but much rather between 'degree/extent in which' an objective is or is not achieved.

The study applies 21 criteria to evaluate the pros and cons of the various measures. It may be clear that specification of a scale of each of them would require a study in itself. This report is not meant to be read 'from cover to cover'. Rather it may be used as reference in respect to multi-species, multi-annual and effort measures, to the three analysed fisheries, or to the various definitions of measures and evaluation criteria.

1. METHODOLOGY

P. Salz (ed.)

1.1 Evaluation of fisheries management

1.1.1 Past experiences with the CFP

The objective of the CFP stated in the first basic regulation 170/83 is almost identical to the one quoted above. It may be freely interpreted as:

1. protection of stocks;
2. promotion of viable fishing industry in the long term;
3. regular supply of fish to the market.

Various documents, including those of the European Commission, have pointed to the intrinsic inconsistency of these objectives 1).

In order to evaluate the need for new management measures, it is necessary to review first to what extent the past measures have or have not produced the results hoped for. This review is presented briefly in the following sections from three points of view - economics, biology and institutional considerations. It is neither a complete nor an in-depth analysis.

1.1.1.1 Economics

Two objectives of the CFP are of economic or social nature. One regards the promotion of an economically viable fishery sector and the other regular supply of fish to the market. The failure or success of the CFP therefore has to be viewed in terms of these objectives.

The term 'sector' is defined in this report as the 'fleet' only. Upstream and downstream activities are not included, as they are only partially dependent on fish resources in the European waters. Furthermore, the fleets of Mediterranean countries (Italy and Greece) are excluded, as a comprehensive Mediterranean CFP does not yet exist.

Disregarding some significant statistical problems 2), the main indicator that may be considered is the gross value of landings. Between 1979 and 1989/90 the real gross value of landings was maintained between 4.4 and 4.8 bln ECU 3). However, between 1987 and 1992 there has been a continuous de-

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1) For example: EC, COM(93)664 final.

2) See Regional Socio-Economic Studies in the Fisheries Sector - Summary Report, EC, DG-XIV/243/93, pp. 6-9.

3) These values include most of aquatic production, including fresh water and fish culture (mainly bivalves). They also include the Mediterranean areas of France and Spain.

cline from the peak of over 4.8 mln ECU to below 4 bln ECU in 1992 1). Preliminary figures indicate that this decline continued in 1993 and 1994.

The decrease of value has been caused partly by the decrease in the total landed volume and partly by depressed prices.

In order to evaluate the *landed volumes* in relation to the CFP it would be necessary to distinguish between catches for human consumption from the EU waters and other landings, i.e. fish meal and catches in non-EU areas. Within the landings from EU waters distinction may be made between quota and non-quota species. Quantitative analysis faces a number of problems in this respect.

- The precise volumes of fish destined for fish meal are not known.
- It is not possible to distinguish clearly the landings from EU and non-EU areas.
- For Spain and France landings from the Mediterranean need to be separated.
- Development of quota may not be representative because of the political influence in the final decision.
- Among the non-quota species there are significant and increasing volumes coming from aquaculture (trout, salmon, bivalves), which again have to be separated from the 'wild fishing'.

According to FAO 2) the total *aquatic production* of the nine EU Atlantic countries remained relatively stable between 6.2 and 6.6 mln tonnes between 1982 and 1989 and it decreased subsequently to about 5.8 mln tonnes in 1991, i.e. 9%. (Some figures are still preliminary estimates only.) The catches of '*seafish*' 3) for human consumption represent about 50-60% of the total volume (circa 3.5 mln tonnes). The decrease of production of this group amounted to about 15% over the given period ('82-'91). A significant part of this decrease was caused by a drop in catches of the *roundfish* species 4) from 1.1 mln tonnes in 1982 to 460,000 tonnes in 1991. However, a certain part of this decrease cannot be ascribed to the EU waters, but rather it was caused by reduced fishing opportunities in other North Atlantic waters.

Evaluating the development of *prices* of fish is even more difficult as comprehensive statistics, comparable to FAO catches data, do not exist. Furthermore the market segmentation makes many different market trends possible. The interpretation of one aggregate average is ambiguous because of the many contrary trends which it may contain. The opening up of the EU fish mar-

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1) The values of 1991 and 1992 are partially estimated, but the estimates do not affect the negative trend itself, only its extent.

2) FAO Statistical Yearbook, Catches and Landings, Vol 72; data for 1992-'93 are not yet available.

3) Adjustment has been made for fresh water fish, tuna, shellfish, landings from Mediterranean and fish meal. Fish meal production was assumed to be based on the Danish catches of sandeel, Norway pout, sprat, horse mackerel, capelin and blue whiting.

4) Cod, haddock, saithe, pollack and whiting.

ket to imports from third countries has depressed the price level since about mid-1992. However, in this case it is clear that autonomous developments, beyond the reach of CFP, are of importance.

Finally the economic viability of the sector depends not only on the revenues, but also on the level of production *costs*. Labour and fuel are in the case of fisheries the main cost components. The price level of fuel decreased by about 50% in 1984 and has remained at low levels since. The larger vessels in particular, for which fuel costs represent an important share of total expenses, have profited from this. To draw conclusions on the aggregate level of the EU fleet would require an in-depth analysis, which is well beyond the present study.

The varied trends described above have countervailing effects. The significance of these trends to the large number of fleet segments has been different. Therefore it is not possible to draw general conclusions regarding the *economic performance* of the EU fishing fleet.

As for the labour, the *employment* on board fishing vessels has been decreasing gradually. This is typical for primary industries. Although reliable time series do not exist, the trend in Spain underlines the general conclusion. There employment decreased from about 107,000 fishermen in 1982 to about 85-90,000 in 1991. In view of the continuing decrease of the number of fishing vessels in many EU Member States, the overall employment on board fell probably by at least 5-10% since the beginning of the eighties.

While the CFP has not produced a 'flourishing' fishing industry, it has contributed to a '*managed decline*'. Given a certain natural resource base such decline (in terms of vessels and men) was unavoidable due to rising productivity.

It may be questioned whether a greater *restriction* of fishing effort (and thus catches) would have improved the state of certain stocks significantly. It may also be questioned whether a restriction of catches which would have made an impact on the state of stocks would have been *politically and socially acceptable*.

It seems essential to stress that a number of factors of significant importance to the economic health of the fishery sector are well *beyond the scope of the CFP*:

- trends in prices of fish as a result of world markets;
- trends in costs, mainly fuel;
- decreases of employment resulting from the given level of natural resources and its value and the pursuit of ever higher standards of living through increases in productivity;
- adjustment of exchange rates.

As for the *regular supply* of fish to the EU market, some of the above points are particularly relevant. The high net dependence on imports from non-EU countries (estimated at about 50%) makes the role of CFP in this respect a-priori limited. Even assuming that 70% of all landings for human consumption are quota species destined for EU market, this would represent about 35% of

EU consumption. If an improved state of stocks would allow an increase in catch of 20%, this would represent 7% of the internal EU consumption.

1.1.1.2 Biology

On the basis of landings data it could be concluded that the *CFP has not succeeded in maintaining* the natural resource base of the *roundfish species*, which represents the main group of species for human consumption. However, Holden 1) concludes that the deterioration of the landings of roundfish has to be ascribed to excessively high expectations on the part of the managers, which was based on high recruitment rates of cod throughout the seventies. Recruitment fell again at the start of the CFP.

Still, in the past decade many stocks managed by TACs showed an increase in fishing mortality to historically high levels or remained at very high levels. The 'Mid Term Review' 2) gives the following classification of stocks which have been subject to TAC:

Table 1.1 Level of exploitation of stocks under TAC

	Pre 1983	1990
Lightly exploited	4	4
Fully exploited	17	15
Heavily exploited	32	41
Depleted	0	5
Unknown	24	12

In general, the *state of stocks* has not improved and, in some cases it has deteriorated since the inception of the CFP. The stocks of roundfish (including hake and anglerfish) are all at least fully exploited. Many of these stocks are heavily exploited and some are approaching or are already in the state of depletion.

As for the small pelagics, herring stocks are generally fully exploited, despite a considerable improvement of many stocks, compared to previous years. The Western mackerel stock is at present fully exploited. North Sea mackerel has been in a depleted state for at least 20 years.

The state of many other stocks is unknown, but given the high level of fishing activity of all types in the EU waters, it seems probable that they are at least fully exploited and most are heavily exploited.

Discarding has also contributed to the deterioration of a number of stocks. Discards are a general phenomenon in many fisheries. It occurs for two

1) M. Holden, The Common Fisheries Policy, Fishing News Books 1994, pp. 151-156.
2) Report 1991 from the Commission to the Council and the European Parliament on the Common Fisheries Policy, SEC(91)2288 def, 4.12.1991.

reasons mainly. First, there may be a legal obligation which prohibits landing of certain species or sizes. Second, it is sometimes more 'economic' to discard some catches rather than keep them on board, for instance because of inadequate space in the fish hold. High-grading is a special case of discarding for economic reasons. Although some progress has been made in the development of more selective fishing gears, in most fisheries there are no indications that discarding has been reduced significantly 1).

Little is known about the impact of fishing on the *ecosystem*. Only the response of the commercial stocks to the level of exploitation is visible. However, bycatch species of fish, birds, marine mammals as well as other marine organisms are also affected. The changes in the composition of the catches may point to a changing composition of marine fauna.

The Mid Term Review concludes that there is a general scientific and technical agreement that stocks are at risk owing to excess fishing mortality, which affects mainly juvenile year classes. Still, fishing is not solely responsible for this situation. It must be stressed that this overall picture has to be adjusted and assessed case by case, taking into account the various individual species, stocks, fisheries and regions.

1.1.1.3 Policy and institutions

The *main achievement of the CFP* has probably been the prevention of 'fishery wars' within EU waters through well structured political negotiations towards an acceptable compromise.

One of the serious points of critique of the CFP is the *inconsistency between the conservation and the structural policy*. While greater restrictions on catches may not have been politically feasible, the necessity of subsidising new investments is far from clear. This is a direct result of the formulation of a set of the CFP objectives which are mostly incompatible, while priorities are not specified.

The *decision making process* at the Union level is a complex one. Not all decisions are arrived at in a comparable manner, which may be one of the reasons for the complexity and inconsistency of some regulations. As for the determination of TACs and quota (biologic advice), the basic research is carried out within ICES, which provides its conclusions through the ACFM to the EC, DG XIV (Fisheries). The scientific value of the ACFM advice is reviewed by the STECF. STECF plays the role of a continuous scientific advisor to the DG XIV. It is expected to provide answers to various ad hoc questions which the Commission may have. As for special issues, the EU may also bring together an ad hoc expert group. The EU develops proposals (based on scientific advice or on its own analysis), which are destined in the end for the Council. However, these proposals are often discussed first in one of the Working Groups (Internal, External or Markets) or at a COREPER meeting. At this stage, the proposal may be altered

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1) Report from the Commission to the Council on the discarding of fish in the community fisheries: causes, impact, solutions, SEC(92) 423 final, 12 March 1992.

to the specific 'desires' of the Member States. Final adjustments may be introduced during the Council meeting.

The decision making process is a mixture of scientific analysis and political considerations. The results of the scientific analysis are expressed in probabilities and therefore they are not unambiguous for policy makers. Political considerations search for a compromise among contrary interests. This leads to inconsistencies within the totality of the management measures implemented under the CFP.

At the institutional level, a number of issues in the area of *interaction between the European Union and the individual Member States* should be considered as they are of prime importance to the evaluation of failure of success to the CFP.

The *legislation* formulated at the level of the Union is not always fully consistent with the national legislations 1). This fact has several consequences. First, there is necessarily a lag of several years between approval of EU legislation and the necessary adjustments of the national one, despite the fact that the first overrules the second. Second, it takes even longer to adapt the national agencies charged with the implementation of the new measures. In a realistic analysis it seems essential to take these lags into account and accept them as institutionally unavoidable.

*Effectiveness*of implementation depends on the political will, the available economic means and the support/acceptance of the policy by the industry. The political will should make the necessary funds available and it should open the possibilities for the required organizational adjustments in the implementing agencies. Policies which have little support from the industry require evidently more pronounced political will in terms of funds and organization.

Among the various Member States there are gradual to significant differences in the *interpretation of the obligations* which the EU legislation imposes. Such obligations may regard control of landings, application of technical measures or implementation of the structural policy. One extreme interpretation may be that the obligations must be implemented at full and at once. Another one, which seems also more realistic, is that the obligations must be implemented in as far as feasible within a certain (or unspecified) time frame, given the political will/acceptance or means available.

These differences in interpretation are illustrated in the EU report on Control 2). Unless it is clear at the outset which interpretation is given to certain obligations (policy objectives), it is not possible to evaluate success or failure of a policy.

The Common Fisheries Policy is mostly formulated in Regulations. This is contrary to for instance Common Transport Policy where Directives prevail.

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1) Prof. J.A.E. Vervaele, Hands and teeth of the (Community) law, Oration at the occasion of accepting his Chair in Enforcement of National and European Law, University of Utrecht, 18 February 1994, Published by Kluwer, Deventer, 1994.

2) Control report on the Implementation of the Common Fisheries Policy, SEC(92) 394 def., 6 March 1992.

However, it could be maintained that the Regulations of the CFP are almost interpreted as Directives in the various Member States.

The above considerations demonstrate that there is a *trade-off* between the pursued level of perfection and the feasibility of practical implementation. At the level of political decision making everything is 'possible' as it is assumed that what is decided can be also implemented. At the level of 'institutions' (e.g. ministries), the possibilities are limited by organization and available funds.

1.1.2 Criteria for policy evaluation

The required improvements of the CFP are discussed in the ECs Mid Term Review (section 8). The introduction of multi-annual or multi-species TACs is favoured for the following reasons:

- to make catch constraints more flexible and realistic;
- to incorporate the multi-species character of many fisheries;
- to allow for multi-species stock management;
- to reduce discards;
- to simplify procedures of annual TAC determination;
- to allow fleets timely adjustment to new conditions;
- to promote selective gear;
- to allow for implicit adjustment of the 'key' (relative stability) resulting from the development in the first decade of CFP.

The reasons for the introduction of new measures do not regard so much the principles, but much rather the implementation of the CFP. The present study proposes to evaluate the potential improvements, which may be expected from new multi-annual and multi-species management tools, from four points of view:

1. Economic/commercial/social - concerns the level of individual enterprises (vessels);
2. Biological - approaches CFP from the point of view of stocks/fish species and ecosystem;
3. Political/institutional - deals with sectoral, national or public interests;
4. Other considerations - deal particularly with the consistency of the above three points, new problems and other remaining issues.

These points of view are more or less explicitly contained in the general objective of the CFP. Several criteria may be applied within each of these points. These criteria may indicate that a specific measure may produce positive results in one area, while in another area the consequences may be unacceptable. This inconsistency problem is dealt with under the fourth point.

A distinction needs to be made between objectives and criteria. Formulation of desirable policy objectives is a task for administrators and politicians who also bear the responsibility in this respect. An objective may be considered as a 'fixed point' to be attained. In a scientific analysis an evaluation of policy

measures may be based on criteria. A criterion is than a qualitative or quantitative scale of a parameter. It allows one to indicate whether the value of the parameter goes up or down, without questioning the actual desirability of such change. Clearly, in many instances objectives and criteria may be formulated in similar terms, for instance employment or income.

In the following sections a number of criteria are formulated. These criteria may serve as guidelines to define a set of concrete and (as far as possible) consistent policy objectives for a specific fishery or a group of fisheries. The criteria have to be interpreted in a certain time scale. Unless specified otherwise, a period of 3-5 years is assumed as a working hypothesis.

The defined criteria are (overview is presented in appendix 3):

Economics

1. flexibility
2. possibility of planning
3. market consistency
4. realism of daily practice
5. race for fish
6. economic performance

Biology

7. spawning stock
8. fishing mortality
9. high-grading
10. discarding
11. ecosystem management

Policy and institutions

12. political acceptance
13. sectoral acceptance
14. relative stability
15. national enforcement
16. subsidiarity
17. local communities
18. policy beyond 2002

Other considerations

19. consistency
20. transparency
21. new problems

A few preliminary remarks on the criteria should be made. First, within the short time available it proved impossible to formulate unique definitions. Consequently, various criteria are mutually linked or they overlap to a certain extent. Secondly, the criteria are presented in an arbitrary order. Their relative importance (hierarchy) is to be determined at a political level. Finally, an overall evaluation of a measure has to be based on a set of criteria which are selected in advance, unless an absolute priority is explicitly given to a single one.

1.1.2.1 Economics

Economic criteria regard the policy consequences at the level of individual enterprises. They indicate the reaction or behaviour of the enterprises. A reaction which goes against the objectives of the policy will evidently have consequences for the effort required to impose the policy effectively. Three areas of reaction could be distinguished, although they are strongly interrelated:

- decisions within the enterprise - regarding short term and long term choices (flexibility = selection of fishery, planning = investment);
- actions related to natural environment - reality of the daily work at sea;
- direct competition with other fishermen - race for fish.

Flexibility

Long term survival of a commercially healthy enterprise requires sufficient operational flexibility to react to changing conditions and to make efficient use of the fishing opportunities. It regards the choices of time, species and space, i.e. when, what and where to fish. These are mostly *short term* decisions, particularly relevant for non-specialized vessels.

Possibility of planning

The fishing industry maintains that under the system of annual TACs and quota, it is not possible to plan the commercial operations sufficiently and consistently with the life span of investments, i.e. in the *long term*.

Market consistency

Management measures may have influence on the vessels as *(des)incentives* to act in a certain manner. They stimulate market (in)consistent behaviour, for instance (not) restrict investments when production possibilities are limited (low TACs) or when profitability outlook is poor 1).

Realism of daily practice

Fishing vessels are confronted with rather specific conditions of production. Their output cannot be planned in a similar way as in other land based production units. Abundance or scarcity of fish depends on factors beyond vessel control. Effective policy will have to take these realities into account. Otherwise significant effort and expense will have to be put into effective prevention of non-compliance with the regulations. The criterion of 'realism' regards the *frictions between what is administratively desirable and what the natural environment makes possible*. Behaviour of fishing enterprises is crucial in this re-

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1) The experience with the Common Agricultural Policy (CAP) demonstrates that in the long run it becomes financially unfeasible to support a sector through a system of subsidies. This applies even more strongly to fisheries than to agriculture as the fishing industry will be always of much less public importance and thus subsidizing it will have less political support. Protection through restrictions on international trade, subsidies or price regulations create a situation in which the sector is not commercially viable in the long run.

spect. 'Accessible simplicity' of the regulations also seems relevant, i.e. policy should be easy to explain and well understood.

Race for fish

This is one of the serious problems of many fisheries, where each vessel tries to obtain as large a piece of the cake as possible. Other reasons for the race are uncertainty about future catches, expectations of bad weather, danger of closing of a fishery, etc. The race leads to *irregularities* in utilization of the fleet capacity, exploitation of the stocks, supply to the market and consequently to fluctuations in price level.

Economic performance

The perception of economic results by the vessel owners and crews is evidently a major driving force behind the fishing operations. It determines the decisions, behaviour as well as the expectations. It is of prime importance in relation to the *reactions to management* measures which may be restrictive. Greater fishing opportunities (more fish) will be interpreted as a short term improvement of economic performance.

1.1.2.2 Biology

The biological criteria concern aspects of the natural environment, i.e. catches of commercial and non-commercial species and effects on the ecosystems in general. A solid natural resource base is a sine qua non for any fishing industry. Stock conservation is therefore an important component of the fisheries policy. Effects on commercial stocks may be evaluated in terms of size of spawning stock, recruitment and fishing mortality; items which are closely related.

The quality of the environment should not deteriorate through discards or other negative effects on the ecosystem. However, the 'precise' objectives in these two areas may be considered as exogenous to the fisheries policy. They are formulated within a much broader framework of environmental issues and subsequently imposed on fisheries.

Spawning stock

The spawning stock has to be maintained above a certain minimum level to allow for regular reproduction.

Fishing mortality

Stabilization of fishing mortality at a certain level contributes to regular reproduction and recruitment.

High-grading

Discarding of commercial species may occur either because of administrative regulations (minimum sizes, TACs) or because keeping the fish on board is considered uneconomical. It leads to inefficient use of the available resource base.

Discarding

Discarding of non-commercial species has potentially negative consequences on the ecosystem (e.g. food chain). It is also politically sensitive (birds, turtles, marine mammals). The expected discarding behaviour of the vessels is an issue to consider.

Ecosystem management

This concept receives increasing attention, although it is not precisely defined yet. A possible interpretation may be in terms of ecosystem stability, prevention of fluctuations or irreversible processes caused by human interference. Scientific ecosystem management would require in practice extensive and long term monitoring, but environmental concern of the public will determine acceptable level of fisheries influences, even without precise knowledge. The precautionary principle will set the standard.

1.1.2.3 Policy and institutions

Political and institutional criteria concern the private (sectoral) and public interests at aggregate level (regional, national or international). They touch upon the strengths and weaknesses of implementing institutions, sectoral organizations, political traditions and/or international arrangements. Short term and long term considerations are not always easy to separate.

Political acceptance

Severeness of measures taken under the CFP in the past has been diluted, first through the political negotiations at the level of working groups and Council in Brussels and subsequently at the level of implementation. In the latter case, the political will to implement effectively has not been always unambiguous and the industry has had an irrational resentment of some measures. Political acceptance regards the will/commitment of politicians and executing agencies to implement the measures as agreed upon. Pressure of public opinion is a factor to be reckoned with in this respect. This applies also to the feasibility of political compromise.

Sectoral acceptance

Currently the credibility of the CFP seems low, because the administrations have put insufficient effort into its implementation. In other words scientific objectives could not be achieved by the measures taken. Consequently the industry expects a benevolent approach in the future. Credibility can be only increased if the sector can be convinced that the taken measures contribute to an improvement and that they will be effectively implemented. Sectoral acceptance is partly linked to the above criterion of 'realism'.

Relative stability

Fixed allocation of TACs is the founding stone of the current CFP. As such it is valued highly as it maintains peace between the EU fleets. At the same time it goes counter to the principles of the EU and it is an obstacle to Euro-

pean wide commercial development of the fishing industry. Therefore the consequences on relative stability have to be considered seriously.

National enforcement

National and EU legislation determine the feasibility of effective implementation and control of any measures. The legislation has to meet principles far beyond the scope of the fisheries policy (e.g. proof of guilt). The expense of enforcement must be within acceptable limits, compared to prosecution of other offences. The feasibility of enforcement is given explicit attention, under the assumption that the executing agencies will not be provided with significantly greater means.

Subsidiarity

This is a recognized principle regarding all EU policies. Measures may be evaluated in terms of the possibility to delegate the implementation to local/regional institutions away from the national capitals, which may be more efficient. Local interests and specific conditions may be taken into account more directly through an integrated approach to regional problems 1).

Local communities

The socio-economic impact of restrictive fisheries management on coastal communities, which are dependent on fishing, requires explicit evaluation. The link between local communities and management may be especially clear when the measures affect only specific fisheries.

Beyond 2002

It may be expected that after the year 2002 the CFP will have to be reformulated, as the derogation from the Treaty of Rome on which it is based may not be extended. In the long run measures will have to be more consistent with the principles of the EU (free access to resources, free movement of people and goods, etc.). New measures, like those considered in this report, may well be viewed in respect of their potential role in a new system.

The last three criteria (subsidiarity - local communities - beyond 2002) are closely related. Free movement of fishing rights would put some communities in a particularly favourable position to maintain and support fishing as an integral part of their economy. The extent to which such local policies would be successful would depend significantly on the links between the community and the fishing companies.

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1) This has been stressed at the EC Conference 'Coastal Resources and Integrated Coastal Development', Porto, 7-8 October 1993.

1.1.2.4 Other considerations

Consistency

The past inconsistencies of policy objectives and measures have been criticised broadly. Policy measures will be only effective if their economic, biological and political consequences are mutually consistent and when priorities have been defined clearly. New measures have to be consistent with the already existing ones.

Transparency

Clear justification and explanation of new measures is expected to improve their acceptance. Simplicity of formulation of the measures (and their principles) allows for clear communication between the policy makers and the fishermen.

New problems

New measures may cause new problems which may not be identified under the above criteria. It seems essential to search consciously and specifically for such pitfalls. These may regard such varied issues as quota swaps, technical progress as well as conditions under which a measure may or may not be effective.

A special consideration which must be taken into account regards paper fish. Under the current decision process some quota are set 'too high', expecting that the actual level of exploitation will be acceptable because some of the countries to which the quota is allocated do not in reality participate in the fishery. However, under a multi-annual or multi-species management scheme paper fish will allow additional fishing effort - either in a different period (e.g. next year) or aimed at other species - which is undesirable.

Any new measures which may be considered within this study will be evaluated on the basis of the 21 above-mentioned criteria in order to assess their likely effectiveness in the various respects. As no one single measure will provide solution to any one specific problem, the required accompanying measures will also be given attention.

The practical feasibility of such measures depends on the required economic, biological and institutional conditions and expected consequences. An important component of the research is '*formulate conditions under which the measures may work and when will they not*?' It is not only relevant to ask what the measures should 'look like', but also who will execute them and which accompanying measures need to be taken.

1.1.3 Characteristics of the basic situation

The effects of any new measures will evidently depend on the precise characteristics of the situation in which these measures are applied. These characteristics may be described in four elements:

- group of species concerned;
- technical measures;

- *ownership of fishing rights;*
- fleet size and structure.

The conclusions of any analysis will depend largely on the assumptions made about these characteristics. It is not possible to generalize. As for the general evaluation in chapters 2-4, the assumptions are specified below. Evidently, the case studies will specify the actual situation.

Regarding the species, it is assumed throughout that *bottom species* are discussed. Pelagic species have significantly different reproduction characteristics, as occasional very large year classes may be produced by a weak stock. Fishing on pelagics as schooling fish is also different. Bottom species depend generally on a larger number of year classes and the fluctuations in abundance are not as great. The consequences of any management policy will depend on the actual state of the stock. In line with the Mid-Term Review it is assumed that the stocks under discussion are fully exploited.

Short and medium term effects of management policy depend significantly on the *economic performance/situation* of the fleet at the moment of the introduction of the new measures. If the fleet had faced poor results over the past several years, it will be more sensitive to policy incentives. On the other hand if the past results have been reasonable, the enterprises have built up certain financial reserves and they are able to withstand pressure from management policies (e.g. to decommission vessels). The role of the banks is in this respect crucial. Experience shows that the banks will support their clients at least for 2-3 poor years. It is assumed that the sector operates at its break-even point (no profit - no loss). Restriction of production opportunities will have socio-economic consequences only in medium term (4-5 years).

A number of further *economic assumptions* have to be made:

- prices of fish and inputs are constant;
- variable costs per unit of fishing effort are constant;
- investments do not increase productivity within the time horizon of the analysis.

Technical measures may be extremely varied, according to fishery, season or area. They cannot be dealt with in general but only on case by case basis. In the general discussion it is therefore implicitly assumed that 'appropriate' technical measures are taken.

The issue of *ownership of fishing rights* is an essential one. The question is whether the fishing rights are privatized or not. Privatization may be at the level of individual vessel or fishing companies, but also at the level of groups of fishermen (producer organizations). This is contrary to the situation of a common property. Unless the individual (or groups of) fishermen are allocated specific fishing rights (in terms of quantity of fish or fishing effort), none can be made responsible for excessive exploitation of the available resources. Only effective guarantees of these production rights will prevent a continuous

racefor fish 1). It will be demonstrated that the problem of the 'race for fish' needs to be resolved in order to allow an improvement on certain other criteria discussed in section 1.2. In the general analysis two options will be discussed when necessary, i.e. with private fishing rights and without. Both situations will occur in the case studies.

Structure of a national fleet may be described in terms of fisheries in which the fleet participates, i.e. combination of technologies and target species. The speed and the extent to which the structure changes in short and long term may be restricted by the ownership of fishing rights and certain policy measures. A fair amount of flexibility is assumed. The intended and unintended structural changes as a consequence of policy measures form an essential part of the analysis.

The *(over)capacity* in a certain fishery is determined by the size and structure of the involved fleet. Due to the dynamics of the fleet (changing fisheries), it is difficult to determine capacity unambiguously. Furthermore, a distinction needs to be made between *'technical' and 'economic'* capacity. The first refers to the *maximum fishing effort (fishing mortality) which the fleet is able to exert* in relation to available fishing opportunities. The second represents the level of fishing effort (size of the fleet) with which the fleet can continue operating economically in the long run, assuming a certain price level. Economic overcapacity is usually smaller than the technical one. It is assumed that overcapacity exists in both respects.

Technical overcapacity of the fleet is not easy to eliminate. Gradual reduction of the fleet capacity will improve the average economic results, assuming a given size of stocks and constant prices. However, the fleet may well become profitable before the technical overcapacity is eliminated, because a certain underutilization of the capacity is commercially acceptable. In other words it is possible to eliminate economic overcapacity, but further reduction of the fleet size may not be feasible.

Technological progress increases gradually the average productivity of the fleet. In order to contain the technical capacity at a constant level, a continuous reduction of the size of the fleet would be required equal to the rate of technological progress. In the past an average technological progress of 2% per year has been applied. However, little is known about this issue. It is assumed that there is no (significant) technological progress in the medium term (see also chapter 4.1).

Structural policy is based on the MAGP III (1993-1996). It distinguishes size and level of activity by fleet segment. Specific objectives are set: 15% reduction of the beamtrawl fleet and 20% reduction of the roundfish fleet. Other fleet segments do not have to be reduced. When necessary, it will be assumed that these objectives will be achieved and also maintained in the MAGP IV. Such an

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1) This is illustrated in various contributions in P.A. Never, R. Arnason and N. Mollett (eds), Rights based fishing, NATO ASI Series no.169, Kluwer Academic Publishers, Dordrecht, 1989 or in D.W. Bromley, Environment and economy: Property rights and Public policy, Blackwell, Oxford, 1991.

assumption is consistent with the statement of the Mid Term Review that the fishing mortality should be reduced by 40%.

The *diversity of real situations* justifies the question as to the extent to which it is possible to apply one management system under differing conditions and to what extent specific management systems need to be developed to meet the requirements of these conditions. Application of specific technical measures to various fisheries is an example of *diversified management*. It may be expected that a more direct link to the local conditions will improve the sector's understanding/appreciation of the management system. Consequently, the credibility and political acceptability will also improve.

Forecasting of the effects of any fisheries management measures is further complicated by the fact that the *starting situation is not in equilibrium*. Autonomous developments would have taken place in any case. However, it is considered infeasible to compare two hypothetical future situations - one with and second without the measure being introduced. Therefore it has to be assumed that the starting situation is in equilibrium, so that it can serve as a reference to the comparison.

1.2 Multi-annual quantity measures

1.2.1 General discussion

Certain multi-annual measures (in a broad sense) have been used already for quite some time 1). These are:

- all technical measures (gear, closed seasons or areas) as they are adjusted only when the need arises, but not necessarily annually;
- structural policy (MAGP) specifies objectives and measures for a period of four to five years;
- the 'key' for division of the TACs and maintenance of relative stability has been set for a period of 20 years, 1983-2002;
- principles of market policy.

Although some of these measures are disputed on details, their sensibility and principles have been generally accepted by the industry.

The stress on a multi-annual approach originates from a rather specific interpretation regarding the annual character of the TACs and the wish of the industry to plan its production over several years. Therefore the term 'multi-annual' relates particularly to TACs. The industry claims that multi-annual TACs (MATAC) would increase the intertemporal flexibility of the enterprises.

An interpretation which may be less common, but is also in discussion relates to fishing effort. This approach is particularly favoured by the biologists as fixing fishing effort for several years would in principle stabilize fishing mortality. This approach is discussed in Chapter 4.

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1) Very little documentation appears to exist on this issue.

Pope 1) states that MATACs can be only reliably quantified and implemented if three conditions are met:

- stable stocks;
- sufficient biological information to develop analytical TACs; and
- no fleet overcapacity as otherwise it would remain difficult to contain the fleet to its fishing allocations.

These three conditions are not easily achieved through institutional actions (policy or research). Stability of stocks depends on fishing but also natural conditions, which cannot be influenced. For some species analytical TACs are being calculated. For others it would require significant additional research effort and thus funding.

Determination of future TACs will depend on the realism/accuracy of *biological assumptions* regarding the current and future values of:

- stability and rate of recruitment;
- size and age composition of the stock;
- age composition of the catch;
- catch per unit of effort;
- annual degree of utilization of the TAC.

In the case of lack of scientific evidence on the above biological or economic indicators 'guesstimates' may be developed on the basis of:

- lowest or highest values realized over the past 'x' years;
- average values realized;
- stochastic distribution of the known values.

These statistical approaches are likely to be correct over a long period of time, but a MATAC will be a measure for a medium term of maybe up to 3-4 years. A serious error has to be expected, unless recruitment has been fairly stable.

It is not very likely that a MATAC can be set correctly for the whole period. There are in principle two possible situations: MATAC is set too high or it is set too low.

If the *MATAC is set too high* the fleet will increase the total fishing effort to 'consume' the annual allocation. The situation of overfishing will occur, the average size of caught fish going down, and so also the average price. Average cpue falls which leads to falling ratio of profit/cpue when the ratio of variable costs/cpue is constant. However, the total aggregate profit may still be rising until the marginal costs/cpue exceed the marginal revenues. Total aggregate profit will remain positive until the total average costs exceed the average revenues. This is a brief description of the movement along the well known 'picture of MSY and MEY'.

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1) J. Pope, Working document on multi-species and multi-annual TACs, STCF meeting, October 1992.

The medium term economic consequences of a MATAC which is too high will therefore depend very much on the actual state of the fishery. In a situation of underexploitation the short term profits will increase. In the case of overexploitation the losses will increase.

If the *MATAC is set too low*, the fleet will exhaust it within a shorter period of time because of high cpue. In this situation cash flow must be positive, as otherwise it would not be feasible at all to make the fishery profitable. However, because the allowed landings could have been increased, a better economic performance could have been achieved.

The 'correctness' of the MATAC should not be interpreted as a fixed value, but much rather as a range within which the catches should fall. Such flexible interpretation is more consistent with the stochastic nature of biological predictions. It will also make the implementation of the policy more realistic. Relatively low fishing mortality will lead to a growing stock composed of a larger number of year classes. Consequently, improved forecasts of future MATAC should be possible for bottom species.

1.2.2 Possible definitions

MATAC may be interpreted in several ways: setting TAC for several future years or specifying the approach to be followed in setting annual TACs. In the latter case the approach may 'guarantee' that 'administrative fluctuations' of the TACs would remain within certain limits.

MATACs may offer a new instrument for the period after 2002 if certain conditions are met:

- elimination of overcapacity in the concerned fisheries;
- intensification of biological research to allow for calculation and forecasting of analytical TACs;
- individualization of fishing opportunities would prevent the race for fish.

Economic, biological and political evaluation of each definition is presented below. It is also summarized in the evaluation matrices in appendix 3. Section 2.3 contains an evaluation of the MATACs explicitly in terms of the 21 formulated criteria. The following definitions are elaborated:

1. Equal quantity for several years
2. Limited compensation
3. Limited adjustment
4. Minimum quantity
5. Maximum quantity
6. One total quantity for several years
7. Anti-cyclical approach
8. Minimum size of spawning stock
9. Constant precautionary TACs

1.2.2.1 Equal quantity for several years

A constant annual quantity of one species would be set for several (e.g. 2-4) years.

The *economic* performance or conditions would not improve significantly. The intertemporal flexibility would remain the same, although the fishing enterprises could make investment plans for the period, as at least administratively the output would be given. Evidently the natural conditions would be more or less favourable than expected. Particularly because of this last point, the forecasts would be even less realistic than in the case of annual TACs as they would be made under greater uncertainty. The race for fish would not ease, unless the MATAC were allocated to individual producers.

The *political* negotiations would not become easier. Firstly, multi-annual interests are greater, therefore the negotiations may be expected to be more intense. Furthermore, it may be expected that particularly when the MATAC was set too low, special interest groups would insist on reopening the discussion. Relative stability on individual TACs would be maintained. However, if some TACs were multi-annual and others annual, a shift still might occur in terms of total fishing opportunities. Some countries may be faced with greater fluctuations than others. The required enforcement effort would probably remain at its original level.

There is also little reason to expect that this approach would lead to better *stock management*. The scientific and practical conditions under which a MATAC could be formulated as specified by J. Pope are rather severe. Analytical TACs can be quantified only for a few stocks and those are often exploited by an excessively large fleet. Discarding may increase in certain situations. If the MATAC were fully utilised, then the fishing mortality would fluctuate inversely to the development of the stock. This would not contribute to a stabilization of the human impact on the ecosystem.

New problems will certainly arise. It the MATAC is set at a wrong level economic, political and biological considerations will become incompatible. For example, a MATAC set too low will unnecessarily reduce the economic results while extra enforcement effort will be required to prevent excessive landings.

It may be possible to consider applying MATACs to the stocks which are currently managed by precautionary TACs. These TACs often remain constant for many years. Paradoxically, in a situation of significant lack of biological knowledge, the TACs might just as well be set on a multi-annual basis.

1.2.2.2 Limited compensation

Either in the situation of the annual or of the multi-annual TACs it could be considered possible to allow overfishing (or underutilization) of the allowable catch of the current year (up to a certain maximum). A negative compen-

sation 1) in the following year should discourage overfishing, while a positive compensation could encourage saving of the stocks for the future. Without a compensation, continuous overfishing can be expected.

The precise results of such measures will depend significantly on its precise formulation regarding the extent to which overfishing can take place and the level of compensation to be accounted for. The allowed overfishing must be large enough to make a difference for the fleet concerned, but without making too serious an assault on the state of the stock. Specific values would have to be set for a maximum annual 'deficit' as well as for a maximum accumulation over several years.

The level of compensation should be high enough to make it an explicit consideration of the vessel operators whether to fish this year or next. An inclusion of a compensation seems essential. Extra revenues now will carry interest revenues in the future, so that it would be often 'economically logical' to fish as much as possible now and possibly less later. The price level may deteriorate due to high landings, but prices do not depend only on the landings of that specific fishery, so that the link between prices and landings is not straightforward.

The system of compensations may be relevant in some special situations. One is for example when a new year class is recruited to the fishery towards the end of the year. Suddenly high catches may be realized, which were not fully accounted for when setting the TACs. This was the case for North Sea sole at the end of 1989. Overfishing of the quota is than acceptable as a strong fishery can be expected for the following year. The calculated compensation will provide the protection for the stock, while the fleet may not be affected. In a contrary case, underutilization of the quota may not be 'wasted' as the fleet could hope for a positive compensation later.

A potentially interesting option of 'limited compensation' would be the shift of the quota year. Under certain conditions the various fleets could be allowed to develop a structurally new pattern of the utilization of the quota. For example, it is undesirable to close a fishery at the end of the year because of the fairly high price level. With a gradual shift it could be achieved that a quota which is set in December would in fact come into force only in March and be exploited until February next year. In this way it would be possible to develop a different quota years economically suitable for different fisheries.

From the *economic* view point a system of annual compensations has some rationale. The flexibility of the vessels would be increased as they could take advantage of good catches at a given time. Economic performance could be expected to improve. They could also 'save fish' for later. It seems closer to the reality of fishing operations. However, measures would be essential to prevent an intensification of the race for fish. Otherwise quota overfishing by

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1) It is more appropriate to consider a 'compensation', rather than an 'interest rate'. The latter has an explicit time dimension, which is difficult to interpret in this context. It cannot be ascertained when the compensation takes place.

some vessels would have to be compensated for by the whole fleet later. The possibility to plan would improve only marginally, in the short run.

Acceptance at the *political* level should not face significant obstacles. There are no direct adverse social consequences. Relative stability would be maintained, although not entirely on an annual level. The shift would be comparable to international quota swaps as long as the overfishing of a stock by some countries would not endanger the future fishing opportunities of others. Control of landings would have to be intensified as they would have consequences for the future.

If the conditions are set correctly, the *biological* requirements may be met. Discarding may be limited, as fishing would take place more in line with actual availability. This may also work towards the stabilization of the human impact on the ecosystem. As stated above, the precise quantification of the conditions (compensation limits, interest rate) would be of utter importance. Some specifications would lead only to a one time shift of the quota year.

As annual adjustments could be made, the consistency between economic, political and biological considerations would be taken into account regularly.

A major *new problem* with limited compensation regards saving fish which is not there or 'paper quota'. If the quota is set too high (for political reasons or because of a biological overestimate) then the savings which may occur will not be justified by the biological reality. In that case the fleet will attempt at a later stage to catch fish which was never there. For this reason creation of a possibility to save must be viewed with great caution.

1.2.2.3 Limited adjustment

One of the objections against the annual TACs is that the industry is sometimes faced with 'excessive' adjustments from one year to the next, which are not 'understood' on the basis of their experience with the natural environment. Either the biological analysis arrives at certain conclusions too late or the conclusion are premature, produced by the applied methodologies.

The principle of 'limited adjustment' would not allow the changes of annual TACs to exceed a certain maximum value, for instance a percentage of the total of the previous year. The shift of fishing opportunities up or down would be only gradual. The question is how this percentage should be determined. Historical data may provide some indication. It would have to be determined whether such an approach is justified or whether in fact the natural fluctuations are so large that a 'limited adjustment' is simply not realistic.

A specific application of the principle of limited adjustment may be for example utilization of a 'moving average' or another mathematical formula to determine next years TACs.

It may be that once in several years the basic level of the TACs may have to be adjusted. In this case, this approach would be a little more flexible than the first option of constant annual quantities.

The only *economic* reason in favour of this approach is that it would offer greater administrative stability. Natural fluctuations would have to be accepted

as they come. While the industry would probably welcome this system if the set quota were higher than the traditional ones, it may be expected that the principle would be disputed as soon as stock abundance would seem to offer greater fishing opportunities than the increase of quota would permit. Flexibility would barely change. Planning in the medium term could improve slightly. It is difficult to assert a-priori whether this approach would be more realistic.

A fair acceptance may be expected at the *political* level. Relative stability would be maintained. Enforcement effort would not have to increase. If the margins were not too high, politicians would be left with only two choices: maintain quota at the original level or make the maximum adjustment (up or down) depending on the development of the stock.

From the *biological* point of view, limited adjustment may not offer sufficient scope for effective stock management under adverse conditions.

Potential *new problems* would have to be expected. The speed of natural changes will probably be different to that of the administratively agreed ones. The question is whether this difference will be significant. If so, serious inconsistencies between the three areas (economics, policy, biology) would occur.

1.2.2.4 Minimum quantity

It would be possible to set one minimum quantity for several years to come. This may be based on rather pessimistic expectations in terms of the lowest experienced levels of recruitment over the past 'x' years. The industry would know the minimum level of production and subsequently there could be only 'pleasant surprises'.

This approach carries the 'precautionary principle' almost into extreme. It indicates the minimum level of production and thus also the minimum size of the fleet which could remain in operation. The discussion of the actual (higher) level of TAC would remain. However, this discussion would have to be structured in a way to make the 'minimum level' still meaningful. Otherwise it seems likely that the practice of traditional TAC negotiations would return.

Economically, this is also a minimum option. It would impose restrictions which would, on average, probably be more severe than necessary. Flexibility of the enterprises would be restricted. At the same time the race for scarce resources would intensify, if the fishing rights were not be privatized. The realism would depend on the extent to which the minimum level is adhered to. The possibility of realistic planning would not improve. Economic performance would deteriorate.

Political acceptability is questionable. Relative stability would be maintained, but the administration and the industry would have to accept a size of sector which would be smaller than necessary. Consequently, control and enforcement would have to be expanded.

From the *biological* point of view this option may lead potentially to an improved state of stocks which may allow an increase in the minimum allowed. Whether discarding would be limited is not certain. High-grading to achieve a higher value with the same volume could be expected.

As indicated above, new problems would arise on the political and economic level. The principle of minimum quantity does not guarantee any consistency of policy.

In view of the above, evaluation of this measure is considered of little practical interest and therefore will not be included in the case studies.

1.2.2.5 Maximum quantity

This case is an opposite one to the above option 4. A maximum annual quantity would be set for several years, allowing for certain downward adjustments.

This seems a purely theoretical option mentioned for completeness, rather than for its relevance. While the fleet knows what its potential maximum production may be, it has to expect 'unpleasant surprises' annually. At the political level, the industry would probably always call for the maximum value, while this is undesirable for biological reasons.

In view of the above evaluation, this measure is considered of little practical interest and therefore will not be included in the case studies.

1.2.2.6 One total quantity for several years

Setting one total quantity for several years without annual subdivision evidently entails the danger that the race for fish would be intensified. The fleet may land the whole quantity during the first year (or its part) and than have to stop. This resembles somewhat the 'pulse fishing' approach applicable for very large pelagic stocks composed of a specific year class where the recruitment is rather independent of the size of the stock.

Economically, this option does not seem to offer any advantages. Even more, unrestricted landings in a short period of time would certainly depress the prices. The total realized revenue would remain below the potential one. Professional management of enterprises in terms of planning, choices etc. seems irrelevant. Economic performance may improve in the short run, but that would only intensify the problems later.

In *political* terms this is far reaching, but not necessarily unacceptable in the case of certain biological characteristics of the resource. Relative stability is not in danger as long as exceeding national TACs can be prevented. Regular supply to the market will be difficult to achieve.

Biologically, pulse fishing is only acceptable for pelagic stocks, which are only of theoretical interest in this study as the cases presented in second part of the report all deal with bottom fisheries.

In view of the above, evaluation of this measure is considered of little practical interest and therefore will not be included in the case studies.

1.2.2.7 Anti-cyclical approach

Setting anti-cyclical TACs would mean relative reduction of TAC when recruitment is good and an increase in poor years. In this way stabilization of

landings would be pursued while taking the annual fluctuations of stocks into account. A thorough methodology would be required.

This approach seems possibly more unconventional than it is. In the current practice the biologic advice may well be inclined to save stocks when they are already abundant. On the other hand at times of scarcity, TACs are set relatively high for 'socio-economic reasons'.

The *economic* viability is questionable. On one hand the fishing opportunities may be stabilized, but at the same time the average medium or long term productivity would deteriorate. In years with a poor state of stocks (low productivity) the costs per unit of production (kg of fish) would be relatively high and thus profit limited. On the other hand in good years, the fleet could not take full advantage of high productivity because of the relatively low TAC. In this respect the management measures would not be consistent with daily fishing practices. Indeed commercial viability would only improve if stabilization of the stock (and TACs) could be achieved, which is not certain due to non-fishery influences. Flexibility and possibilities of planning would improve only if stabilization were achieved.

In the absence of unfavourable pressure on prices from imports from third countries, the anti-cyclical approach would probably lead to higher average prices in the long run.

The *political* acceptance would depend largely on the actual level of fishing opportunities. The relative stability (per stock) would be maintained, but a new issue would be raised regarding the extent to which anti-cyclical adjustment should be applied. This may favour some countries and prejudice others. More vigilant control of landings would be required when the state of stocks were improving and consequently TACs would be relatively low.

The *biological* consequences depend on the actual state of stock. A weak spawning stock (small size, few year classes) will be negatively affected. For a strong stock, the anti-cyclical system may be in fact beneficial. Discarding will be generally a greater problem. When the stock is in a good state, allowed catches are in fact too low and high-grading may be expected. In the case of a poor stock, effort will be high so that greater discarding of bycatches may be expected.

The principal new problem would arise in determining the scale of the anti-cyclical component, particularly given the problems of forecasting changes in stock availability.

In view of the above evaluation, this measure is considered of little practical interest and therefore will not be included in the case studies.

1.2.2.8 'Minimum' size of spawning stock

The traditional TACs are focused on the amount of fish which can be caught, i.e. a surplus. However, it would be also possible to aim the policy at the quantity of fish which should remain in the sea, i.e. a minimum size of spawning stock. This minimum may be defined in different ways according to the precise objective. One such definition could be related to the spawning stock which can assure a 'regular' recruitment. What is regular would have to

be determined on the basis of stochastic analysis which would provide various options relating the size of the stock to the likelihood of annual regular recruitment. This approach should not be confused with maintaining the spawning stock at a minimum level to prevent the extinction of the species. The TAC would be set at a level of the excess of the existing stock over the set minimum. The recent EU management proposals specify in fact objective spawning stocks 1).

In this situation the fishing sector would bear significant responsibility. It would be the sector organizations themselves which could decide whether indeed to exploit fully the allowed catches or whether the fishing should be restricted in the medium term in order to bring the minimum size of the stock to a higher level and possibly to greater fishing potential in the future. Since the size of the recruitment stock is not a central issue in the current quota management system, the above choice does not present itself as directly.

The *economic* performance of the sector would depend almost exclusively on the fluctuations of nature rather than on the administrative decisions. In this way the realism of the policy would improve. The flexibility and the possibility of planning would not increase necessarily.

The *political* process may be improved. The minimum sizes of major stocks are set almost 'forever'. Annual negotiations would not have to take place, although it is possible that the attention would turn to the biological estimation of the total stock itself. The principle of relative stability may have to be redefined. Although the relative access to stocks could remain unchanged, the new system would undoubtedly have consequences for the actual fishing opportunities. The future of various fleets would therefore be affected. It is not clear whether the enforcement efforts would be affected. This depends largely on the possibility of monitoring the spawning stock rather than the fleet. Some accompanying measures would have to be taken to prevent the fleet from excessive fishing. Restrictions on effort seem particularly suitable. This concept does seem to offer interesting possibilities in the long run (after 2002) as it would globalise the approach to management. A possible disadvantage is that it gives complete priority to biological considerations.

The *biologic* approach to management would depart from the notion of MSY. Maintaining certain 'objective' levels of stocks may contribute to a stable management of the ecosystem. Consequently however, the actual fishing opportunities (TACs) may fluctuate significantly from year to year. Two biological problems remain. First, there is the difficulty of determining the 'minimum' stock size. which may increasingly become a political figure. Secondly, not only the size of the stock, but also its age composition is of importance.

1.2.2.9 Constant precautionary TACs

A number of smaller stocks are managed currently with precautionary TACs. There is insufficient biological information to set analytical TACs. At the

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1) COM(93) 663 final.

same time it is considered necessary to impose limits on the exploitation of these stocks. The TAC is set on the basis of past recorded catches. However, as in previous years where the catches were restricted by a TAC, the future TAC is likely to remain at past levels. In this situation, one might just as well set the precautionary TACs on a multi-annual basis, coupled possibly with some annual compensations as presented in the first section.

Of the 106 TACs fixed in 1995, 66 were precautionary 1). A full list is included in appendix 2.

Setting precautionary TACs on a multi-annual basis does not seem to face serious economic, political or biological objections. It would concern the management of a number of smaller fisheries. General evaluation is identical to the one presented in the first section 'Equal quantity'.

1.2.3 Evaluation of the quantity measures

Nine possible definitions are discussed in the previous section. Evidently this list is not complete. In specific situations other more appropriate definitions may well be formulated. Overall the above definitions present a selection of the following choices:

- MATAC is constant or not;
- the possibility of adjustment may be based on:
  - catch in relation to TAC;
  - results of stock assessment in combination with a previously agreed institutional approach to the assessment (this is also the current practice);
- policy is defined in terms of TACs or spawning stock.

1.2.3.1 Economics

Flexibility

MATACs may theoretically offer greater flexibility in the choice to fish now or later. The discussed options will increase the possibility of intertemporal choices only marginally. The only exceptions are option 2 'Limited compensation' and 6 'One quantity for several years', although the latter one is not very realistic. Effective privatization of fishing rights is always a prerequisite. It is self evident that such flexibility is particularly relevant for specialized fleets, which would have to cease fishing otherwise.

Due to the 'biology of fish' which is governed by annual reproduction cycles, high flexibility to fish now or later is not desirable. An exception may be a situation where significant incentives would be given to postpone catches into the future. Apart from administrative prohibition to fish, such incentives may be developed in terms of compensation for temporary laying-up of vessels or for underutilization of (individual) quota.

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1) Holden, p. 195.

Possibility of planning

In most specified options the possibilities for medium term planning by the enterprises do not seem to improve significantly. The options 2 'Compensation' and 3 'Limited adjustment' seem most promising in this respect. The dependence on natural variations will continue.

Market consistency

Some MATAC specifications do seem interesting in this respect. The possibility of shifting fishing activities in time would allow the fleet to adjust to the seasonal changes in demand. Flexible adjustment of the quota year to the needs of particular fisheries appears the advantage. Other multi-annual definitions would not affect the market process.

Realism of daily practice

Option 2 'Compensation' seems to offer an improvement in relation to fishing practice compared to the existing system. The major problem of MATACs is that there is a significant chance that the level of MATAC will not be correct which would produce new frictions.

Race for fish

While the TACs are divided among countries, the national quota are often not explicitly divided among the individual fishermen. Consequently, on a national level, the producers compete with each other for a common resource, each one trying to get the largest possible share. The race for fish will only be restricted when the production is effectively managed at the level of the individual producer/fishing vessel (or groups) through individual rights.

The principle of MATAC does not contribute in this respect. In some discussed options the race for fish may be expected to intensify.

Economic performance

Multi-annual measures will improve short term performance in a s far as they may allow larger landings in the short run. However, this may be at the expense of the level of landings in the long run. The anti-cyclical approach would probably lead to an overall lower level of profitability. Under favourable biological conditions, limited compensation may offer an opportunity for improvement.

1.2.3.2 Biology

A multi-annual approach to stock management leads necessarily to a more generalized policy, in which it is recognized that controls to the last landed tonne are not feasible. In this respect the 'spirit' of stock management would change.

Spawning stock

A reliable biological quantification of MATACs requires stable stocks and sufficient knowledge to set analytical TACs. Only option 4 'Minimum quantity'

would be a-priori promising in terms of improvement of the state of stocks. Most other definitions contain the danger that the allowed catch would be (seriously) inconsistent with the biological reality, particularly in the years towards the end of the multi-annual period. Spawning stock is then threatened.

Charging an interest rate in some of the definitions may help to preserve the spawning stock.

Fishing mortality

Most of the definitions imply irregular fishing mortality. Especially in later years the fishing mortality cannot be well managed. Fishing mortality could be maintained at acceptable levels only in the case of minimum spawning stock, which allows for sufficient annual adjustments.

High-grading

The level of high-grading depends mainly on the relation between the actual fishing opportunities and the allowed catch as specified administratively. If the MATAC set is in fact too low, abundant catches will allow the crew to keep only the most valuable species/market sizes and still exhaust the quota. If the MATAC is set too high, high-grading will be restricted as it would be difficult to exhaust the available quota anyway.

Discarding

Discarding of non-commercial species will be a process opposite to high-grading. Relatively too high MATAC will lead to an increased fishing effort and greater catch of non-commercial species. A low MATAC is expected to be coupled with low catch of non-commercial species.

Ecosystem management

Too little is known about ecosystems to allow for a clear conclusions. Some options might contribute to a certain stabilization.

1.2.3.3 Policy and institutions

Political acceptance

The weight of the political process would be shifted from the annual meetings of the Council of Ministers to the meeting where multi-annual decisions would be taken. Once the decisions are taken, the process may be simplified, though not in all cases. However, taking a multi-annual decision may be more difficult.

Political acceptance depends on the pressure of various interest groups (mainly fishing sector and environmental movement). The definitions show clearly which policies would be supported by whom. An additional problem may be that in the case of adverse developments, multi-annual management approach in principle excludes expansion of fishing opportunities for socio-economic reasons.

Sectoral acceptance

Introducing new measures alone will not increase the credibility of the CFP. Political will needs to be demonstrated regarding the implementation of the new measures. MATACs do not seem easier to implement than annual TACs.

Acceptance by the industry is likely as long as the fishing opportunities would improve. While the sector would mostly want to take advantage of situations where TACs have been underestimated and increase them, it is less common that the industry would ask for a decrease in TAC when catches seem low in relation to the set TACs. Consequently, there is always a push towards higher exploitation. A multi-annual approach in itself may be appreciated as the past experience demonstrates that annual management has not always produced the results hoped for.

Relative stability

Relative stability means traditionally the maintenance of the percentages for the division of TACs. Its implicit consequence is the maintenance of certain sizes of national fleets in operation. It is this second aspect which plays a major role in the considerations at the level of political negotiation. Thus the relative stability is about fleets, stocks being only instrumental.

In this perspective the relative stability concerns also the size of individual TACs, as various countries depend differently on various stocks. It may not be politically feasible to impose one multi-annual system on some stocks/fisheries and maintain annual TACs in others as various fleets would be affected differently.

Enforcement/control

The enforcement effort may be affected under MATACs as compared to annual TACs. Under some options, which would restrict fishing opportunities relatively more severely, an intensification of controls would be needed. This would also be the case when the TAC was set too low in relation to the actual fishing opportunities, leading to landings of 'black fish'.

The option 2 'Limited compensation' offers an important advantage as the threat of closing down a fishery strictly when a TAC is exhausted would be eased. However, the problem may present itself several years later anyway, when the allowed accumulation limit for overfishing is reached.

Subsidiarity

Bringing responsibilities down to low levels of administrative or professional organizations may be more appropriate on a multi-annual basis rather than on an annual one. Responsibility for annual changes in TACs puts institutions in a similar position as the fishing enterprises.

Local communities

Effect on local communities seems rather uncertain. As long as these communities are not allowed to manage effectively the natural resource on which

their industry survives, there will be no difference between annual or multi-annual approaches.

Beyond 2002

In view of the above conclusions, MATACs specified in quantity do not yet seem an interesting option in the long run. The only positive aspect may be that the awareness of intertemporal choices may make the sector more sensitive to certain management issues. Subsidiarity may profit as well, but its effect on stock is uncertain.

1.2.3.4 New problems

Consistency

Evaluation of the consistency between economic, biological and political considerations depends on assumptions made regarding the actual situations which may be created, in terms of biological pressure on stocks or economic pressure on the fleet and consequently pressure at the political level. The presented options will potentially produce new conflicts of interest, but their extent cannot be assessed.

Transparency

The discussed definitions show that a multi-annual approach is composed of two steps. First, biological evaluation of stocks is required. Second, a translation into a multi-annual perspective takes place. In the current system, only the first step has to be taken. A multi-annual system seems therefore even less transparent.

New problems

Several new problems will arise. Forecasting over a period of 2-4 years is necessarily coupled with an increasing margin of error. Once this error becomes apparent, the credibility of the policy may seriously suffer.

Multi-annual fisheries management may require adjustments at regular intervals. Such adjustments may create confusion for everyone involved.

Political determination of the technicalities of the new system may be a problem in itself.

A major problem may occur in the later years of the multi-annual period if unjustified savings of 'paper fish' have occurred.

Table 1.2 Evaluation of multi-annual measures (2.2.1-2.2.4)

	2.2.1 Equal quantity for several years	2.2.2 Limited compensation	2.2.3 Limited adjustment	2.2.4 Minimum quantity
Economics				
FLEXIBILITY	Remains constant over the given period; if MATAC too low flexibility is unnecessarily limited and vice versa.	Will improve as individual operators can wait till the end of the year to profit from good market prices.	No effect.	Extremely restricted.
PLANNING	Is subject to individual expectations of natural phenomena; i.e. largely based on recent experience.	Planning during the year improves slightly.	Multi-annual planning becomes theoretically possible as administrative fluctuations would be restricted; evidently natural fluctuation will play all that greater a role.	Reduced to minimum level.
MARKET CONSISTENCY	Does not contain any specific market incentive.	Fishing can take place during periods of favourable market, market consistency improves. If significant borrowing takes place, supply shortage may occur in the following year.	Supply to market may be smoothed, if the stocks allow exploitation at the given administrative level.	Highly inconsistent, but depends on subsequent annual adjustments.
DAILY PRACTICE	It is likely that the annual quantities will not be met.	Little effect, apart from above considerations.	Uncertain; depends largely on the difference between the set TAC and truly correct TAC; it is difficult to ascertain whether an improvement would be achieved compared to the current situation.	Minimum level is incompatible with daily practice, subsequent annual adjustments would offer an improvement.
RACE FOR FISH	Continues unless property rights are privatized.	Will be only limited if individual rights are introduced, otherwise the above benefits will be jeopardised.	Limited only if fishing rights were privatized.	Will intensify even if access is privatized.
ECONOMIC PERFORMANCE	May be stabilized, if catch rates do not fluctuate.	Improvement in the short run can be expected.Llong run performance depends more on recruitment than on the measure itself.	As ad. 2.2.1.	Deterioration is likely as first priority is given to the stocks.

	2.2.1 Equal quantity for several years	2.2.2 Limited compensation	2.2.3 Limited adjustment	2.2.4 Minimum quantity
Biology				
SPAWNING STOCK	Is positively affected only if quota set correctly or too low.	Effect depends on the extent of possible 'overfishing'; stocks may be threatened if significant overfishing is allowed; charged 'interest rate' is crucial in this respect.	Effect depends largely on the correctness of the set TAC; little can be said in advance.	Setting TAC below the actually feasible level will benefit the stocks.
FISHING MORTALITY	May be too high if fishing opportunities overestimated. Will vary according to the relation between variable stock and fixed quota.	Forecasts of fishing mortality will become less 'precise', as over- or underutilization cannot be foreseen; this may not be a serious problem in view of other uncertainties (e.g. size of stock).	As above.	As above.
HIGH-GRADING	Will increase if quota too restrictive.	May be limited, as quota permits some flexibility. However, high-grading may occur if in later years substantial compensation for overfishing in previous years is imposed.	As above.	Intensification of high-grading has to be expected.
DISCARDING	If quota too large in relation to stock, effort will increase and discarding of non-commercial species will rise in absolute terms.	No effects expected.	As above.	May be reduced along with the reduction of overall level of catch.
ECOSYSTEM MANAGEMENT	Is uncertain, due to uncertainty about the correctness of the level of annual quota.	Greater fluctuations in fishing mortality may have negative effects.	As above.	As spawning stock.

	2.2.1 Equal quantity for several years	2.2.2 Limited compensation	2.2.3 Limited adjustment	2.2.4 Minimum quantity
Policy/institutions				
POLITICAL ACCEPTANCE	Uncertain; setting MATAC for only some species will affect only certain countries. All Member States may identify relative (dis)advantages. Negotiations not necessarily simplified. Problems may arise in medium and long term when early closures or other unpopular measures have to be taken.	Main problem is to determine a) extent to which overfishing is allowed and b) interest rate to be taken into account. Good sectoral acceptance will also affect political acceptance positively. Control more complicated.	System is 'one step away' from what is biologically desirable (annual TACs), political acceptance seems therefore questionable.	Would be difficult due to economic pressure. Setting minimum levels in various fisheries would be politically difficult.
SECTORAL ACCEPTANCE	Depends on specific situation and assessment of potential gains. Credibility of the policy will deteriorate if quota forecasted at a significantly wrong level.	Positive acceptance is expected in view of the above economic advantages.	At first sight sectoral acceptance seems fair, as lower TAC fluctuations may be expected. However, if the actual state of stock (and annual TACs) could in fact allow greater catches, the sector will certainly push for a change.	Highly unlikely.
RELATIVE STABILITY	Unchanged.	Is maintained in the long run, but not necessarily annually.	The principle is not threatened, but in practice some fleets may be better off than others for reasons of the system rather than for biological ones.	Principle is maintained, but in practice much will depend on the minimum levels and possible annual adjustments.
NATIONAL ENFORCEMENT	Black fish will be landed if MATAC too low in relation to the stock and/or economic need of the sector; then greater enforcement costs have to be expected.	Control may become more complex.	Greater enforcement problems may be expected when stocks allow greater catch than the TAC.	Intensified control will be required if TACs are set at low levels.
SUBSIDIARITY	No improvement in relation to current situation.	Inter-annual borrowing regards all administrative levels, but responsibilities have to be put to lowest possible level.	No effect.	No effect.

	2.2.1 Equal quantity for several years	2.2.2 Limited compensation	2.2.3 Limited adjustment	2.2.4 Minimum quantity
LOCAL COMMUNITIES	Uncertain; if MATAC too high unjustified economic expectations may be raised.	Effect on local communities will primarily depend on the distribution of the fishing rights. If the current system is continued (national quota only) local communities will not profit.	No effect.	Low catches will affect adversely local communities.
BEYOND 2002	Long term relevance particularly for the precautionary TACs; otherwise questionable.	Improved economic conditions offers greater consistency between economic and political considerations. The system offers more flexibility which is desirable in the long run.	Little potential in view of the above considerations.	Little potential.
Other considerations				
CONSISTENCY	No particular improvement or deterioration in comparison with the current situation.	Economic and political consistency improves. Danger of inconsistency with biologic objectives depends on the extent to which overfishing is allowed.	Inconsistencies will potentially increase as in practice the stocks will get either too much or too little protection.	Level of consistency depends very much on the annual adjustments above the minimum level.
TRANSPARENCY	Seems clearer than annual changes, but greater discrepancy with daily reality may occur.	Annual positive or negative compensations, coupled with an 'interest rate' charge may make the system less transparent.	System is less transparent as the determination of the TACs depends first on biological assessment (as now) and secondly on the set formula.	Making adjustments to the minimum level will not be very transparent.
NEW PROBLEMS	Sector faced with natural fluctuations. Early closure of fishery likely if overcapacity and/or MATACs too low.	In various fisheries different compensation systems may be appropriate, which may not be considered fair by the fishermen. When a fleet reaches the maximum allowed overfishing, it must restrict its activity in the following year, which may lead to political difficulties, for instance if stocks are poor - extra hardship, if stocks are good - unnecessary restrictions.	Different systems may have to be applied in different fisheries. Formula for adjustment is subject to political discussion and may have to be reviewed regularly.	Significant political pressure may be expected when setting the minima. Bycatch problems will increase.

	2.2.1 Equal quantity for several years	2.2.2 Limited compensation	2.2.3 Limited adjustment	2.2.4 Minimum quantity
ACCOMPANYING CONDITIONS	Privatization of fishing rights should ease race for fish and allow better planning. Short term annual effort management; would also limit effects of overcapacity. Quota management by POs may stabilize markets somewhat.			It is assumed that the minimum quantity will be adjusted upwards, but the resulting TAC will be lower than the one which would be set in the current system.

Table 1.3 Evaluation of multi-annual measures (2.2.5-2.2.8)

	2.2.5 Maximum quantity	2.2.6 One total quantity for several years	2.2.7 Anti-cyclical approach	2.2.8 Minimum size of spawning stock
Economics				
FLEXIBILITY	Higher flexibility would be achieved.	Unless fishing possibilities could be effectively privatized, flexibility of an individual enterprise would be rather restricted and determined by the actions of the entire fleet involved.	Flexibility would be stabilized: in poor years there would be greater fishing opportunities; in good years the fishing possibilities would be restricted; there is little change from current system	Little effect compared to current situation.
PLANNING	Theoretically good possibilities to plan, but in practice highly dependent on actual (lower) quota and biological situation.	Planning would become impossible due to general race for fish if the rights were not privatized.	Stabilized fishing opportunities would improve possibility of planning. Average production costs would be probably higher than in the case of 'correct' annual TACs. Price level may be stabilized, but it is not certain whether the long run average would be lower or higher than under the current system.	Annual fishing opportunities are as unpredictable as in the current situation - no effect on planning.
MARKET CONSISTENCY	Poor market consistency; danger of depressed prices due to expectations of high landings.	Serious danger of flooding the market at certain times and serious shortages at others.	Smoothing effect on landings and prices can be expected.	May be accidental, but the basis for the policy is purely biological.
DAILY PRACTICE	Maximum quantity has little relation to practice.	Individual vessels could not make decisions on any rational basis.	Regulations will not follow the line of daily practice: fishing is restricted when stocks are good and expanded when the productivity is low.	TAC fluctuates with the state of the stock so that daily practice is fairly reflected.
RACE FOR FISH	May be eased if excessive fishing opportunities would be open.	High intensification can be expected.	Dependent on privatization of fishing rights.	Continues, unless fishing rights are privatized.
ECONOMIC PERFORMANCE	Short term improvement is likely at the expense of long term.	As ad. 2.2.5.	On average poorer results can be expected.	Performance depends on the size of the stock agreed upon in relation to the stock prior to the introduction of the measure.

	2.2.5 Maximum quantity	2.2.6 One total quantity for several years	2.2.7 Anti-cyclical approach	2.2.8 Minimum size of spawning stock
Biology				
SPAWNING STOCK	Serious danger of overfishing.	Disastrous consequences.	Effects depend on the state of stock - good stock will improve further, poor one may deteriorate.	Regular recruitment is assured. This is the central principle of this approach.
FISHING MORTALITY	Excessive.	High fluctuations; probably very high mortality at the beginning and much lower fishing mortality late on.	Too low in good years and too high in poor ones.	Is determined by the exploitable surplus.
HIGH-GRADING	Little reason to high grade.	There is little reason to upgrade. This may occur when the quota is almost fully exhausted.	Will occur during good years, when catches are relatively large in relation to TACs.	Will occur when relatively large minimum stock is to be maintained compared to the total exploitable stock.
DISCARDING	High fishing effort would lead to significant discarding of non-commercial species.	High discards may be expected.	Little effect on long term average.	Will fluctuate with the size of the TAC.
ECOSYSTEM MANAGEMENT	High chances of destruction of ecosystems.	Erratic exploitation patterns will have adverse consequences on the ecosystem.	May have a positive effect if stock stabilization occurs.	Ecosystem considerations may be included in the concept of minimum stock size. Minimum stock size assures regular recruitment.
Policy/institutions				
POLITICAL ACCEPTANCE	Even if the sector were to favour such an approach (which is not certain in view of market inconsistency), it would be unacceptable for the environmental lobby.	Unlikely in view of pressures from industry as well as environmental groups.	This system has been accepted in the current practice, although not explicitly as such; it is a result of political compromise.	Setting TACs on basis of socio-economic considerations is precluded.
SECTORAL ACCEPTANCE	Uncertain; economic advantages of greater production may be outweighed by the chaos which would probably arise.	Outlook of irregular production would cause protests from fleet as well as trade and processors.	As above.	AS above.

	2.2.5 Maximum quantity	2.2.6 One total quantity for several years	2.2.7 Anti-cyclical approach	2.2.8 Minimum size of spawning stock
RELATIVE STABILITY	Principle is maintained, but in practice the actual production would largely depend on the biological possibilities.	Principle unaffected, in practice 'law of the jungle'.	Maintained.	Maintained for the set TACs.
NATIONAL ENFORCEMENT	Would not be a major problem.	Serious problems can be expected when TAC is exhausted long time before the expiration of the period for which it was set.	Stricter enforcement required during the relatively abundant years.	Will have to be intensified when TACs low in relation to stock.
SUBSIDIARITY	Does not seem to be relevant in this respect.	In theory, if the group of concerned fishermen could be well determined, it may be possible to develop an arrangement for 'responsible fishing' (implicitly privatization of fishing rights). Otherwise subsidiarity has little meaning in this case.	No direct effect.	Potentially significant role for professional organizations, who may decide to bring the 'minimum stock' to a higher level in order to assure greater landings in the long run.
LOCAL COMMUNITIES	As above.	As above.	No direct effect.	As above, if institutionally involved in the decision making process.
BEYOND 2002	Irrelevant.	Not a sensible option, unless a number of stringent conditions are met: privatization, fishing plans, knowledge of stocks, etc.	Formalization of an anti-cyclical system may be a component of the management in the long run, especially in view of the already existing acceptance.	This approach implies a significant change from the existing principles, but potentially interesting for some species/fisheries.
Other considerations				
CONSISTENCY	Highly inconsistent, particularly for biological reasons.	Highly inconsistent.	Stabilization of markets and stocks improves consistency.	Management is based on biological considerations, consistency with the market requirement would have to be achieved on initiative of professional organizations.
TRANSPARENCY	Little transparency; setting a maximum value is questionable while downward adjustments would further blur the decision process.	Race for fish will make the operation of this system rather obscure.	Little difference from the current system.	Depends on the procedure of determining the minimum stock size and the annual exploitable stock.

	2.2.5 Maximum quantity	2.2.6 One total quantity for several years	2.2.7 Anti-cyclical approach	2.2.8 Minimum size of spawning stock
NEW PROBLEMS	Number of problems - mentioned above.	Determination of the total quantity.	Explicit anti-cyclical approach may not be preferable to 'political negotiation' which leads to the same result as in the latter case the outcome is not set in advance. Determination of the anti-cyclical component.	Determination of stock size. Determination of annual TAC. Control of the stock size.
ACCOMPANYING CONDITIONS	It is assumed that the maximum quantity will be adjusted downwards, but the resulting TAC will be greater than the one which would be set in the current system.	This definition would be almost equal to 'unlimited compensation', as opposite to 2.2.2. It is assumed that rights are not allocated to groups or individuals.		This approach does not specify the measures to be taken, but rather the basis/principle on which they are deduced.

1.3 Multi-species quantity measures

1.3.1 General discussion

Multi-species management is an ambiguous term. Three different interpretations are possible:

1. Taking the environment as a starting point, multi-species means the interaction between species, i.e. predator-prey relations 1).
2. A fleet may have several target species.
3. A fishery may be characterised by one target species and one or more bycatch species.

The basis of the *predator-prey relation* is the place of the species on the trophic ladder 2). This place changes with the progressive age of every species. In different fisheries there is different competition between fishing and natural predation 3). In principle vast knowledge of the predator-prey relations would be desirable to describe complete ecological processes. In practice this is not feasible. It has be questioned when and to what extent it is necessary to know the interrelations between the managed species and/or 'ecological place' of species during their life time in order to aim multi-species research in the direction most needed.

In *multi-target* fisheries, problems arise when the quota of the species concerned are exhausted at different rates due to differences in catchability. This leads to a closure of the fishery on one species, making it impossible to exploit the others. In order to avoid such closures fishermen may either discard catches or try to hide landings, depending on the particular situation. Both situations result in unreported catches, blurring the view of the biologists on the fishing mortality and development of the stocks.

Similar situations may arise when quota of *bycatch* species are exhausted.

Almost all fisheries are of multi-species character, i.e. various target/bycatch species are caught at the same time 4).

Management relevance of the predator-prey relation lies primarily in the potential disequilibrium which may occur if one or the other is harvested too intensively, so that the predator-prey equilibrium is disturbed. Environmental as well as fishery considerations may be of importance. The relation between

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1) This interpretation is common in most of the 'multi-species' literature.

2) Ecological system consists of different levels in which species feed on the same means of subsistence. These levels are called trophic levels. P.O. Eikeland, Distributional aspects of multi-species management, Marine Policy, July 1993, pp. 256-271, (p. 258).

3) C.W. Clark, Strategies for multi-species management: Objectives and constraints, in R.M.May (ed), Exploitation of Marine Communities, pp. 303-312, Dahlem Konferenzen, Springer Verlag 1984.

4) An exception may be some pelagic fisheries, but these are not included in this study.

the fishmeal fishery and some bird populations is an example of the first. The relation between herring and cod is an example of the latter.

The problem of management of multi-species fisheries lies in the difference between desired and actual fishing mortalities per species. Each species, having different biological characteristics, can support different fishing mortality. However, these different mortalities are difficult to achieve when the species are exploited concurrently. Therefore the question may be raised whether it should always be attempted to manage a number of species at the same time or whether the management should concentrate only on a small number of selected species. In fact in the current system a number of valuable species are not subject to TACs 1). The intensity of management may also differ and it may be partly determined on the expected effectiveness. This may be summarized in the following methodological table:

Table 1.4 Intensity of management

Qualification of stock	Feasibility of management	Target species	Bycatch species
Major	acceptable	++	+/0
	difficult	+/0	-
Minor	acceptable	+	+/0
	difficult	+/-	--

The above table shows that, despite the fact that most bottom fisheries are multi-species 2), realistic management does not necessarily have to be a multi-species one. This should depend on the evaluation of each individual situation. Qualification of the stock as major or minor may depend on its total size (volume of catches), the economic importance or its role in the ecosystem. Feasibility of management depends on the expenses which have to be incurred for implementation, the consistency of the required management measures with other concurrent measures (mesh sizes), the biological knowledge of the stock and/or its dependence on natural phenomena.

The policy maker is faced with a multi-species management problem when:

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1) 25-50% of the total value of landings of the individual Member States is composed of non-quota species, according to Regional, Socio-Economic Studies in the Fisheries Sector, Summary Report, Appendix 2, EC, XIV/243/93.

2) Definition of a multi-species fishery could be formulated as follows: a fishery in which a group of vessels (not necessarily using the same techniques) exploits a group of species in a given area at a given time. The group of species is part of one ecosystem. One species or a group of species may be the target. Various vessels may have a different target, for instance according to gear. Volume of bycatches is significant.

1. A given level of fishing effort results in different fishing mortalities for different species caught. Some of these mortalities may lead to overfishing and others to underexploitation.
2. Management of major individual species seems feasible within a multi-species package of measures.

Multi-species management should ideally be based on biological as well as economic considerations, i.e. role of species in the ecosystem and the monetary value of the catch.

From the *biological* point of view, the volume/quantity is the starting point as it is linked directly to the stocks, fishing mortality, etc. Volume may be interpreted in several different ways in absolute (number, kg) or relative (%) terms.

From the *economic* point of view the value of a given (group of) species is a relevant starting point. It is theoretically possible that a relatively small volume of a high valued species represents a major source of revenues and vice versa. The second economic consideration concerns an improved operational flexibility of the vessels to allow them to exploit new fishing opportunities.

Management *measures* are either administrative regulations (quota, technical measures) or economic incentives (subsidies). Their effectiveness will depend on the economic importance of the individual species.

A significant number of (if not all) management measures currently in force have 'multi-species' consequences:

- structural policy is aiming at the reduction of the overall fishing effort in certain fleet segments;
- technical measures, for instance mesh size regulation, affect all species caught;
- a given level of TACs necessarily affects all bycatch species.

However, these measures are not always considered as multi-species because they are either induced from single species considerations or their multi-species effects are not explicitly elaborated.

Certain current quantity measures are in a way multi-species, particularly the bycatch regulation. These may be expressed in absolute terms (kg of a species) or relative ones (% of total catch on board). Their particular relevance within fisheries management may be quite different:

- conservation of quota;
- definition of fishery with consequences regarding technical measures (a certain minimum bycatch of sole in the North Sea as percent of total allows using smaller mesh size);
- quota distribution between fleet segments.

Particularly national regulations contain arrangements to distribute target and bycatch species among various groups of fishermen.

Multi-species measures must be economically 'neutral' in order to prevent economically rational shifts from one species/stock to another which would lead to overexploitation of the first and under-exploitation of the latter. These

measures should be primarily aimed at 'gradual' adjustments to make some serious restrictions less stringent, but not to take them away altogether.

In this respect the problem of 'paper fish' or biological overestimate of the size of the stocks has to be raised again. If the MSTAC is based on an unjustified optimistic assessment of one of the species, the fleet may swap this species for another one which offers better revenues. The method of deriving an MSTAC will be therefore of prime importance.

The discussion of the definitions below assumes implicitly an annual approach to MSTACs. Annual changes in the definitions would be possible to meet changing biological and/or economic conditions. A combination of multi-species species and multi-annual measures is discussed in chapter 4.

1.3.2 Possible definitions

Five possible definitions are discussed:

1. Total quantity in a common denominator
2. Limited transfer
3. Bycatch arrangements
4. Two tiers system
5. Total value

Definitions 1 and 2 allow swaps within a given group of species according to a specified key. In order to promote swapping in one direction and discourage that in the opposite one it may be considered possible to use entirely different ratio's instead of just the inverse. For instance one tonne of species A may be exchanged for 5 tonnes of species B, but 1 tonne of species B may not be exchanged for 200 kg of species A, but only 100 kg.

1.3.2.1 Total quantity in a common denominator

A common denominator would allow for an unlimited transfer from one species to another. In the past a common denominator of 'cod equivalents' has been used. The question is how such a denominator of 'fish equivalents' should be specified, for instance what is the relation between the individual species involved. There are two general approaches: a biological and an economic one. Once the denominator is specified, a total quantity (MSTAC) for the group of species could be set.

The *biological denominator* would have to be specified starting from the 'place/role in the ecosystem'. The knowledge will be in most cases insufficient. The autonomous dynamics of the ecosystems (e.g. changes in recruitment and predation) will change this place/role and thus may require regular adjustment of the calculation. The changes in the relative composition of the species have to be taken into account.

The *economic denominator* would have to be based on prices. This would be feasible in principle. Price relations are given at a given time and place, so that one species could be translated into another one in monetary terms. How-

ever, such a static approach is less suitable when time and place are not fixed 1):

- average prices of fish are not equal in different geographic areas. Some ports are 'specialized' in certain species, attracting the sellers as well as the buyers. Consequently, the mix of species which would offer the optimum value of a given MSTAC may differ from one port to another;
- prices of fish change in time, due to the local production but also due to flows in world trade. Therefore the ratios between the individual species and the 'fish equivalent' would have to be reviewed and adjusted regularly.

Using one common denominator for a group of TACs implies that unlimited transfer between the species would be possible.

From the *economic* point of view of the individual enterprise, this seems an attractive option. The vessel would be able to pursue the apparently most profitable fishery at any time of the year. There would be a high degree of flexibility. The short term fishing tactics could be adjusted regularly to the prevailing conditions (catches and prices). The race for fish may or may not intensify depending on the perception of fishermen of the economic opportunities.

This system has undoubtedly serious *biological* drawbacks. It would not be possible to determine in advance a desired level of fishing mortality of one species. Conservation of individual stocks would be virtually impossible. The fact that the biological relations change over time complicates the determination of the denominator. The level of high-grading will depend on the total allowed catch in relation to the realized one and the weights applied to calculate the denominator equivalents. In view of existing economic pressure, increased high-grading may be expected. The effects on the ecosystem are unclear.

The *institutional* acceptability is probably limited. The relative stability would be lost. It is not certain whether additional requirements on enforcement would be required. Although a fair support from the sectoral organizations could be expected, environmental organizations would probably protest against the looming chaos.

A special case of the 'common denominator' approach would be to allow for free exchange, but only to a maximum of 'fish equivalents' with a lower monetary value than the separate TACs. In this way the fleet would have an incentive to fish on individual TACs as those would potentially offer higher total value. This approach maintains flexibility, but at the same time it penalizes excessive transfer.

One of the main questions in the case of the 'common denominator' regards the 'stability'. It could be expected that a high level of effort on a profitable species/fishery will deplete the stock leading to low physical productivity. If price increase does not offset the productivity drop, profitability will deteriorate. Part of the fleet may than move to alternative fisheries and the stock may

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1) See P. Salz, Some considerations on multi-annual and multi-species quota, paper presented at V EAFE Conference, Brussels, 24-26 March 1993.

get a chance to recover. World trade in fish should indeed prevent excessive price increases in the long run. On the other hand, possible lack of experience in other fisheries may prevent the vessels from abandoning their activity. The question is whether the short run equilibrium which may occur could have major consequences for the long term state of the stock. This cannot be answered in general.

In view of the above evaluation this measure is considered of little practical interest and therefore will not be included in the case studies.

1.3.2.2 Limited transfer

A MSTAC could be formulated in a way so that the TACs of separate species would only be interchangeable within certain limits, for instance maximum 10% of any individual TAC. Instead of setting a maximum it would be also possible to require that a certain minimum percentage of a TAC would have to be used up before it could be exchanged into another species. Limited transfer would provide a little more flexibility and prevent unnecessary discards, but it would at the same time prevent large scale high-grading or unpredictable shifting of vessels/effort from one species to another.

In general this approach would not have such extreme consequences as the one of common denominator. The *economic* advantages seem quite similar. The race for fish would be tempered as the advantage to shift from one fishery to another would be less pronounced. Extent of transfer possibilities will determine the economic advantages.

The problem of *biological* conservation would not be as extreme. The danger of potential overfishing of one of the stocks involved would be contained by the limits on transfer. To some extent the errors of TAC estimates could be compensated in this way. The problem of discarding remains. In a situation of abundant catches high-grading may still take place.

Also from the *institutional* point of view this option seems more promising. The relative stability would be blurred, although not lost altogether. Enforcement may require more attention. If fishing rights were privatized, it would be necessary to ensure that no vessels exceeded its 'transfer rights'.

1.3.2.3 Bycatch arrangements

In some situations one species may be a target species in one fishery and a bycatch in another. The multi-species character of the fishery may then be taken into account in various ways, which are listed here.

- Species are specifically allocated to the various fleets segments and managed further as single species quota.
- Maximum and minimum 'bycatch' indications are set (e.g. minimum percentage of sole to qualify for smaller mesh size; maximum volume of bycatch species per trip, etc.).
- Recalculation of the bycatch in terms of the target species and its inclusion in the target quota (this is comparable to common denominator).
- Introduction of ITQs for the species involved.

The bycatch arrangements must be conceived in such a way that the composition of the catch remains unchanged after the introduction of the new measures. The shift of the fleet toward other fisheries/species must be prevented as far as possible.

The main *economic* advantage of the bycatch arrangements is that the fleet can better exploit the stock of its target species. The fishery is not stopped as quickly when a given level of catches of bycatch species is achieved. The policy reflects better the daily practice of fishing. Economic performance would improve.

*Biological*acceptability of such an arrangement depends on the evaluation of the stocks as indicated in table 3.1. The bycatch species will often be exploited too intensively. If target and bycatch are expressed in common denominator, the target species may in fact be saved if there is too much bycatch.

Institutionally, bycatch arrangements seem fairly acceptable because they do not imply any far reaching adjustments. The approach couples the advantages of the traditional mono-species stock management with a management by fleet, making it possible to utilise the available quota as much as possible.

1.3.2.4 Two tier system

In a multi-species fishery where the composition of the catch can be influenced somewhat by the fishing skippers, a two tier system could be considered. The 'first tier' are the TACs for individual species. The 'second tier' is a total TAC, as a (weighted) sum of all species involved.

The fishery can be closed in two situations. Either one individual TAC is fully exhausted, so that any continuation of the fishery will lead to excessive fishing mortality of that species. Or the MSTAC is exhausted. Which of the two 'moments of closure' is more attractive to the fleet depends on the catchability rates and prices. Setting MSTAC at an economically proper level (higher total value) may induce the fleet to attempt an equitable exploitation of all the species involved, instead of concentrating on one species only.

In the seventies a 'two tier system' had been used in codfish fishery in the NAFO area.

*Economically*this approach would offer a little more flexibility and possibility of planning. Fair market consistency and realism can be expected. There is no reason why the race for fish should intensify, but neither would it ease.

*Biologically*there is a danger that the fleet would attempt to exploit all stocks to their upper limit, which would increase the potential danger of overexploitation. However, this danger could be accounted for when setting the limit. The need for discarding would be lessened. Looking at the original scientific analysis, there is no reason why a two-tier approach would not be acceptable.

There may be some *institutional* problems - it will be less clear when a fishery is closed as two limits are applicable. Furthermore, a fishery would be closed in its entire scope, not leaving the vessels any room to attempt a 'clear fishery'. From a management point of view this in fact may be an advantage. The relative stability could not be maintained in its original form. Its principles

would have to be reformulated in terms of ranges by country according to the original division.

1.3.2.5 Total value

An economically interesting MS approach could be based on the total value of catch instead of its volume. The exploitable stock could be well valued, given its composition by age-class (market size) and some average prices. Similarly the value of the biologically determined TAC could be also calculated. In a multi-species fishery a total value of all involved species would be accumulated and their sum set as a production limit. Evidently, this is a very theoretical option, but it has some interesting practical consequences.

Economically, the total fleet would know what its potential production could be, if the expected prices are realized. The vessels could only improve their results by greater efficiency. They would search for fishing areas with the highest financial productivity per unit of effort. There would be perfect consistency with the incentives of prices. The measure in itself would not contribute to higher profitability.

Biologically, the fishing mortality of one species could not be managed in detail. Some stocks may be fished more heavily than others. High-grading would be reduced to zero, as it would not offer any benefit.

The main *institutional* drawback seems to be the departure from the principle of relative stability. Given long term production costs, it would be fairly clear what size of the sector would be able to survive, or on the other hand what support is needed to maintain a certain number of the vessels in operation, for instance because of short term fluctuations.

In view of the above, evaluation of this measure is considered of little practical interest and therefore will not be included in the case studies.

1.3.3 Evaluation of multi-species quantity measures

1.3.3.1 Economics

Flexibility

If a number of species are put together in one MSTAC the vessel may choose more freely between going for one or another species. In general, greater flexibility may be expected, although choices between species may not always be relevant. If the catch is already composed of these species, the relative composition may be only marginally influenced by choice of fishing grounds in a given season.

The vessel should theoretically pursue a composition of catch which offers the maximum contribution margin (gross revenues minus costs per unit of catch). The maximum contribution margin will depend on prices of individual species, physical productivity and costs/unit of catch (distance to fishing grounds).

Whether flexibility of vessel operation will increase will depend on various factors:

- composition of MSTAC in relation to its average composition of catch;
- other regulations which may allow or restrict access to certain species involved (areas closed for certain types of vessels, mesh size regulations, etc.).

MSTAC will not necessarily prevent early closure of fisheries.

Possibility of planning

MSTACs are mostly discussed on an annual basis. However, an MSTAC will contribute to long term planning in as far as the improved short term flexibility will also increase the likelihood of profitable exploitation of new investments.

Market consistency

Greater flexibility to shift within an MSTAC from one species to another will make the fishing operation more consistent with the prices offered on the market.

Realism

In fisheries where a group of species are caught concurrently, the application of an MSTAC seems more realistic. It may prevent closing fisheries when one TAC is exhausted but the other is not yet fully consumed. Discarding of certain species because the quota has been exhausted may be restricted.

Race for fish

Unless other measures are taken, a MSTAC in its own right will not prevent or diminish the race for fish. All vessels will try to get the largest possible 'piece of cake', but the pieces would be only differently specified. However, even if the fishing rights are privatized, the race for fish may intensify if the multi-species rights are not be specified by individual species.

Economic performance

The greater flexibility and realism of multi-species measures should contribute to improved profitability in short and long run.

1.3.3.2 Biology

Stock conservation

Conservation of one specific stock is in danger, particularly if vessel flexibility increases substantially, so that high and unpredictable fishing mortality could occur.

Fishing mortality

Fishing mortality cannot be managed by individual species, but only for the total of all species included. The definitions which allow only limited transfer offer better opportunities to control fishing mortality by stock.

High-grading

High-grading will occur when transfer between species offers a higher revenue while production costs do not increase as much. Only under the 'Total value' definition will high-grading be banned.

Discarding

Discarding is expected to decrease as bycatch regulations may be eased. However, it was indicated above that bycatch regulations have also other reasons than direct conservation of stocks, for instance distribution, definition of fishery. These reasons may have to be maintained.

Discarding of truly non-commercial species will depend on the level of total exerted fishing effort.

Ecosystem

As long as ecosystem is not well defined it is not certain whether MSTACs would produce a positive contribution.

1.3.3.3 Policy and institutions

Political acceptance

To determine an acceptable common denominator may pose significant political problems, because of the above mentioned differences in prices as well as differing physical composition of the catches in time and space. The weights to be used for various species would necessarily have a 'political' component.

Sectoral acceptance

It is not clear whether the sectoral acceptance (credibility) would improve or not. Greater flexibility is a clear advantage. The moment of closing a fishery would not, however, be as uniquely determined, which may not be well understood. A multi-species system may become rather complex and require extensive international consultation.

Relative stability

The application of a MSTAC would blur the principle of relative stability, as that is based on a monospecies approach. The practical consequences will depend very much on the actual flexibility which would be possible within the multi-species approach, i.e. actual composition of catch and accompanying measures which would affect the composition of landings.

National enforcement

It is not certain whether it is easier to count kg of fish in general rather than of specific species. MSTACs could mean a more holistic approach to management instead of a rather administrative one, in which quantities would be followed, but not necessarily to the 'last kg'. Implementation would seem less demanding, although explicit species swaps would have to be administered. Again accompanying measures, like conjunctural adjustment and structural

reduction of capacities, would also contribute significantly to an effective execution.

Subsidiarity

If entire fisheries could be managed on a multi-species basis, it could be considered possible to delegate some of the management powers to lower administrative levels. This depends very much on the precise characteristics of the situation.

Local communities

Local communities may profit if certain definitions could be adopted in a way mentioned under 'Subsidiarity'.

Beyond 2002

A multi-species approach may become politically acceptable under two related conditions. The CFP would have to give up the principle of relative stability and preferably also that of national allocations (quota). In that situation TACs would be set at the EU level only and allocated to individual vessels or groups of vessels. Management by fishery would become feasible and in some fisheries application of MSTACs may be applied.

The multi-species problem could be particularly well resolved in the long run by introducing an ITQ system which would allow the individual skippers to adjust their fishing rights as farl as possible to their realized catches.

1.3.3.4 Other considerations

Consistency

The multi-species approach offers more flexibility to the individual vessels. This flexibility is at the expense of certain individual stocks/species. The political process will improve only if certain other conditions are met as well. In general improved consistency is not a-priori certain.

Transparency

The determination of the relations between various species will be an additional complication of the system. It remains to be seen whether under specific conditions it will be outweighed by advantages in other areas.

New problems

A number of new problems can be expected. Specification of the relation between the various species within an MSTAC may be in the end a highly political issue as major economic interests may be involved. New conflicts of interest may arise as various fleet segments may find themselves in a new competitive position. Regular changes of weights used in the MSTAC will lead to confusion.

Table 1.5 Evaluation of multi-species definitions (3.2.1-3.2.5)

	3.2.1 One common denominator	3.2.2 Limited transfer	3.2.3 Bycatch arrangements	3.2.4 Two tiers system	3.2.5 Total value
Economics					
FLEXIBILITY	Fishery does not have to be closed when one TAC/quota is exhausted. Flexibility is also increased when a number of target species can be 'swapped'.	Limited improvement; its practical importance will depend on precise definition and fishery concerned. Improvement depends on the difference between composition of catch and of quota.	Unchanged.	Some improvement due to choice between two 'exhaustion strategies'.	Improves - most cost efficient fisheries can be pursued.
PLANNING	Little effect on long term decisions. Greater short term flexibility increases chances of profitable investment.	Slight improvement can be expected.	Unchanged.	No change as future fishing opportunities are fully administratively determined.	Not affected, as long term production is not known.
MARKET CONSISTENCY	Improves - fishing can be oriented towards species demanded.	As above, but in certain situations instabilities may occur, for instance early exhaustion of transfer possibilities without full utilization of all quota.	Unaffected.	Slight improvement due to better short term flexibility.	Improves, due to better flexibility.
DAILY PRACTICE	Fishing strategy can be freely adjusted in view of catches and prices. Mixed fisheries are recognized as such.	Improvement can be expected.	Improves, fishery is not stopped when bycatch species is exhausted.	No change.	Improves, no unnecessary restrictions.
RACE FOR FISH	Excessive pressure in most profitable fisheries can be expected. Extent of transfer, (number of species involved) is of major importance.	May be slighter in general, but exhaustion of transfer possibility may lead to an intensification. Extent of transfer, (number of species involved) is of major importance.	Continues, if rights not privatized.	Unaffected.	Unaffected.
ECONOMIC PERFORMANCE	Short run improvement.	As ad. 3.2.1.	As ad. 3.2.1.	Uncertain.	No effect.

	3.2.1 One common denominator	3.2.2 Limited transfer	3.2.3 Bycatch arrangements	3.2.4 Two tiers system	3.2.5 Total value
Biology					
SPAWNING STOCK	One species cannot be protected separately; spawning stock has to be interpreted as a 'sum' of individual species.	Fair protection could be achieved as long as weights reflect relative catchabilities and prices.	Spawning stock of bycatch species may be endangered.	Can be well maintained.	Exploitation depends on relative prices, individual stocks cannot be protected.
FISHING MORTALITY	Mortality of one stock cannot be well managed. Fluctuations have to be expected depending on catchability and prices.	Can be maintained under a certain maximum.	Little or no effect on target species; bycatch species may be adversely affected.	Can be well controlled as long as the system is implemented effectively.	As above.
HIGH-GRADING	If total MSTAC too low compared to potential catch, low value species will be discarded - high-grading will increase.	Will be limited only as long as MSTAC is sufficient to allow all landings.	Unaffected.	Not affected.	There is no high-grading as that increases inefficiency.
DISCARDING	Will increase if catchability too low in relation to MSTAC.	Depends on relation catchability-quota; slight improvement can be expected.	Discarding of bycatch species because of quota exhaustion is limited.	Not affected.	Not affected.
ECOSYSTEM MANAGEMENT	Effect is uncertain; MS seems closer to ecosystem management, but concentration of fishing on certain species or areas would have adverse consequences.	Uncertain.	Little effect.	Uncertain.	Uncertain.
Policy/institutions					
POLITICAL ACCEPTANCE	Is rather uncertain: economic advantages are matched by biological uncertainties, (see also below).	Fair equilibrium between economic and biological considerations should allow political acceptance.	System seems acceptable as it affects only less important species.	No significant problems can be foreseen.	Questionable because of completely new approach.

	3.2.1 One common denominator	3.2.2 Limited transfer	3.2.3 Bycatch arrangements	3.2.4 Two tiers system	3.2.5 Total value
SECTORAL ACCEPTANCE	Sector will welcome economic advantages, but new conflicts of interest may arise, for instance between different gears on same fishing grounds.	Limited economic advantages would be welcomed.	Good due to improved catching opportunities.	As above.	Depends on the overall potential result.
RELATIVE STABILITY	Principle is undermined.	Would not be upheld altogether, but neither would it be completely lost.	Needs only marginal adjustment.	Slightly less clear when one Member State makes use of the second tier.	Principle is abandoned.
NATIONAL ENFORCEMENT	Continued control of landings is required.	Stricter controls would be required to prevent exceeding the maximum allowed transfer.	Unaffected, all landings of quota species must be recorded.	Unaffected.	More complex, as not only landings but also prices have to be controlled.
SUBSIDIARITY	Local management of the 'total fisheries' may be preferred to a stock by stock approach.	Improvement similar to 3.2.1.	Slight improvement if local administrations are made responsible.	Limited effect.	Little effect.
LOCAL COMMUNITIES	Prevention of early closures may be beneficial.	Improvement similar to 3.2.1.	As above.	Limited effect.	Potential stabilization.
BEYOND 2002	Pssibly interesting if relative stability is abandoned and new concepts of biological management are developed.	Possibly interesting, as a new equilibrium between economic, biological and institutional considerations may be developed.	Seems an interesting option for certain marginal adjustments.	Uncertain.	Questionable.
Other considerations					
CONSISTENCY	Within the existing framework the system is highly inconsistent.	Reasonable consistency may be achieved.	Improves; biological principles are not seriously threatened while administrative and fisheries realities are brought more in line.	Reasonable consistency.	Questionable because of potential biological problems.

	3.2.1 One common denominator	3.2.2 Limited transfer	3.2.3 Bycatch arrangements	3.2.4 Two tiers system	3.2.5 Total value
TRANSPARENCY	Application of 'weights' to different species does not seem a great disadvantage.	Problem of transparency may occur as certain fisheries still may have to be closed unexpectedly for some fleet segments.	Acceptable, no significant complications.	Using two limits may be confusing.	Poor.
NEW PROBLEMS	Determination of the denominator and its adjustments in time. Problems may occur on the level of individual stocks.	New conflicts of interest may arise. Determination of denominator, its adjustment in time and maximum transfer values. Consequences for individual species may be different, causing different reactions from various fleet segments.	Precise identification of fisheries and their target and bycatch species. Definition of relations between target and bycatch species.		Changes in fish prices over time.
ACCOMPANYING CONDITIONS		Privatization of fishing rights implies also allocation of transfer rights.			

1.4 Effort measures

1.4.1 General discussion

Restriction of effort has almost always a multi-species and often also a multi-annual character. Currently, effort is already being restricted in the national regulations in several ways.

- MAGPs set objectives to reduce the size of specific fleet segments over a given number of years.
- Technical measures restrict the efficiency of vessels and gear.
- In some countries fishing time is limited by days-at-sea arrangements, weekend bans, temporary closures of seasons and/or areas, etc.

The new proposals put forward by the European Commission 1) aim at the reduction of fishing mortality in specific fisheries particularly through reduction of fishing effort. Furthermore, allocation of standard effort units (standard vessel-days) has been proposed in connection with the new management regime of the access of Spanish and Portuguese vessels 2).

Analysis of fisheries management by effort measures raises a number of questions, which are briefly discussed below. An exhaustive research of these questions would go far beyond the scope of the present study. Clear definition of fishing effort is an issue of major importance. The following issues illustrate that in practice 'one effort rule' may be required.

Reduction of effort aims to reduce *fishing mortality*. The relation between the two is determined by the catchability (or catch per unit of effort as a percentage of the exploitable stock). In the biological analysis, fishing mortality and catchability are percentages related to stock, not absolute volumes of fish. Consequently, constant effort (fishing mortality) produces a volume of catches which fluctuates with the state of the stock. This is rather important from the economic and political point of view 3).

Marginal fishing mortality is decreasing with the expansion of a fishery. There are rich and poor fishing grounds as well as there are more and less productive vessels. The fleet will tend to operate preferably in the richer areas, but with increasing effort, the relatively poorer areas will also become gradually exploited. As long as a fishery is profitable, less productive vessels will be able to join it. Measures aimed at the reduction of fishing mortality through fishing effort will first affect the least productive vessels, i.e. those working on the poorest fishing grounds or with the least skilled crew. Therefore the relative

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1) EC, COM(93) 663 final.
2) COM(94)308 def.
3) The used terms can be defined as follows:
   - fishing mortality = percentage of exploitable stock (over a given size/year class) caught in one year;
   - catchability = percentage of exploitable stock captured by one unit of fishing effort.

reduction of fishing mortality will be smaller than the relative reduction of effort.

In order to evaluate the likely *effectiveness* of effort measures, it is desirable to specify the relation between effort and fishing mortality. Biologically, reduction of effort will lead to a less than proportionate reduction of fishing mortality. Economically, assuming constant prices, the financial results will deteriorate more slowly than the restriction of effort, for instance vessels will forego catches in the poorest fishing grounds but also save on some production costs 1). Therefore it is increasingly difficult to reduce fishing effort, as economic pressure works in the opposite direction.

A further question regards the *consistency with the correct TAC*. In other words, once an appropriate level of fishing effort has been reached, will it be necessary to adjust the fishing effort annually (similar to TACs) or not? If the TACs were be set at a fixed level of fishing mortality and there was a constant relation between effort and fishing mortality the TACs and TAEs (total allowable effort) would be perfectly consistent. But in practice, TACs are 'adjusted' for socio-economic reasons. And as indicated above, average fishing mortality changes with the level of exerted fishing effort. Technological progress and changes in the structure of the fleet are further complicating factors. Consistency between TACs and TAEs is not straightforward.

In a dynamic perspective over several years, *technological progress* has to be explicitly considered. It leads to an increased fishing power of an existing fleet, but this increase needs to be quantified. For example, a given vessel with an improved fishing technique will become more productive. However, the replacement of two smaller vessels by a large one of a size of the sum of the two in terms of kW or GRT may well lead to a reduced fishing power. This is because of the diminishing marginal productivity. If the policy objective were to maintain a constant level of fishing effort, the nominal size would have to be gradually decreased because of increasing average productivity due to technological progress. From the above it follows that the *definition of effort* itself is of major importance to effort based management. Fishing effort is in principle composed of two elements: size of fleet and its level of activity. However, these elements have both qualitative and quantitative characteristics which are not easy to define and to bring under the same denominator. As for the fleet the determinants are:

- number of vessels;
- gross tonnage;
- engine power;
- gear used;
- technological progress.

As for the activity level:

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1) How quickly the results will deteriorate in the short respectively long term will depend also on the relation between fixed and variable costs. Certain savings of variable costs will be achieved due to less sea time. The precise initial situation and the characteristics of the fishery are therefore also of importance.

- time at sea and time fishing;
- know-how of skipper and crew;
- fishing area.

It seems clear that it is difficult to find fisheries which would be fairly homogeneous in all these respects 1). A common denominator for different fisheries may be developed on the basis of respective fishing mortalities, which requires a considerable research effort in itself.

A particular problem related to effort and technological progress regards the possibility of *input substitution*. There are a large number of well-known examples where effort measures were circumvented by further development of those effort components which were not restricted. Restrictions on gear may be offset by adjustment of vessel or engine. Restrictions on engine may be compensated for by changing the transmission ratio or the characteristics of the propeller. The only question is how fast such adjustments may be introduced and to what extent they are technically possible.

Different measures affecting fishing effort have different consequences on stocks. Mesh size regulations changes affect especially the age composition (mortality by ageclass). Technical measures particularly affect the efficiency of effort. Sea time regulations affect the overall mortality, etc. Some measures may also be more acceptable to the fleet than others for traditional or social reasons.

Traditional TACs implicitly contain a certain fishing mortality. They also indicate the potential earnings of the fleet, assuming a certain price level. However, a TAE does not by itself provide this information. Relations to fishing mortality and to total potential landings have to be specified separately.

Setting a TAE may also have significant *multi-species effects*. Without further accompanying measures the fleet may shift from one fishery/stock to another. While the TAE is maintained constant, the mortality of various stocks/species may be changing significantly. Therefore effort management is only applicable in specialized fisheries where the vessels cannot choose an alternative target species. Otherwise additional regulations are required to limit the fleet's mobility.

The relevance of the issues discussed above is difficult to indicate in general. It has to be evaluated in the specific conditions of the situations encountered in the case studies. The discussion of the definitions assumes that TACs are not applied alongside with the TAEs or that TAEs are more restrictive than TACs.

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1) See P. Salz, L'effort de pêche - les problèmes et l'utilité d'un concept, Paper presented at the Colloque 'Nouvelles Dimensions Concurrentielles et Financières des Pêches Maritimes', Nantes 7-8.3.1994 and J.W de Wilde, Some remarks on the ambiguity of tonnage measurement, Proceedings of the IVth EAFE Annual Conference, Salerno, March 1992.

1.4.2 Possible definitions

Four definitions are discussed below:

1. Constant effort over several years
2. Limited adjustment of effort
3. Minimum level of effort
4. Anti-cyclical approach

1.4.2.1 Constant effort over several years

Constant effort means that a given number of vessels using a given technology would be allowed to fish a given number of days-at-sea per year, during several years. This would lead to a constant fishing mortality and consequently to catches fluctuating with the natural changes of the exploitable biomass, providing a constant mix of fisheries.

In a multi-annual perspective, a constant level of allowed effort and thus fishing mortality may be set too high or too low. Stocks will then be continuously over or under exploited in a constant manner. However, there is a significant difference from the MATAC case, which produces fluctuating over- or underexploitation.

The gross revenues will fluctuate parallel to the catches and depending on the change in prices and catches, *economic* results of the sector will improve or deteriorate accordingly. As long as the effort is set for the whole fleet and not for individual vessels, the race for fish will continue. Improvement regarding the operational flexibility or possibilities of planning would depend very much on the scope of the fishery for which the effort allocation is introduced. If the scope is narrow (e.g. few species/limited area) there would not be any improvement. There would be a gain in terms of 'realism' as within the effort allocation fishing could take place fairly efficiently. Stopping a fishery because of exhaustion of bycatch species would be avoided, but an early exhaustion of the TAE remains possible.

Improvements would be achieved from the *biological* point of view. Fishing mortality would be kept fairly constant, if shifting from one species to another could be prevented. Human impact on the ecosystem would be stabilized. Discarding would lead to a direct economic loss and is therefore unlikely.

The *political* acceptability would pose problems. New international agreements would have to be achieved to define 'fishing effort'. The current relative stability may be jeopardised. National enforcement would have to be reorganised to follow effort instead of landings.

It could also be possible to develop incentives to steer fishing effort to certain species and away from others, for example by offering extra effort allocations.

1.4.2.2 Limited adjustment of effort

Once a basic level of fishing effort is set, for instance the current one, regular (annual) adjustments according to the state of stocks or other consider-

ations may be required. In principle downward as well as upward adjustment should be possible.

Economic activity of the fleet would partly depend on the scope of the possible adjustment. In general an improvement may be expected compared to the current situation as the vessels can pursue a greater efficiency.

A possibility of adjustment offers *biologically* greater protection for threatened stocks, for instance recruitment failure may require reduction of fishing mortality. The impact on the environment is less stable than in the above case.

Allowing for (annual) adjustment may be *institutionally* appreciated by policy makers as well as by the sector as it offers a certain political flexibility. At the same time the process of negotiations may become more burdensome.

1.4.2.3 Minimum level of effort

In order to achieve a good protection of the stocks, it would be theoretically possible to set the level of effort at some minimum. Minimum level of effort would mean a broad application of the 'precautionary principle'. This case is comparable to the 'constant effort over several years', but at a low level of activity.

Short run *economic* performance would deteriorate. The sector would become profitable only in the long run after a significant reduction of the size of the fleet. Flexibility, possibility of planning and market consistency will be seriously reduced. A large discrepancy between the regulations and daily practice can be expected. The race for fish will intensify, even if effort rights are allocated to individual producers, in an attempt to survive under the new restrictions.

Optimum *biological* protection of the stocks is achieved. Fishing mortality is reduced to a minimum as is the effect on the ecosystem. High-grading should be negligible.

Severe problems may be expected at the *institutional* level. Political and sectoral acceptability will be low due to the short term socio-economic consequences. Relative stability is lost just like in all other cases of effort based management. Enforcement would have to be intensified to contain the 'illegal' attempts of the fishing companies to survive. The precise definition of the 'minimum' would be of crucial importance.

In view of the above evaluation, this measure is considered of little practical interest and therefore will not be included in the case studies.

1.4.2.4 Anti-cyclical approach

This option is comparable to the anti-cyclical MATAC option. At times of good recruitment, the allowed increase of fishing effort would remain below the biologically allowed possibilities. On the other hand at times of poor recruitment relatively high fishing effort (and mortality) would be permitted. Good stocks would therefore be spared, while recovery of poor stocks would be slowed down. Such a system could be particularly applicable to stocks which

have been maintained at a fairly good level and are characterised by regular recruitment.

Increasing effort at times when the stock goes down would deteriorate the average *economic* results due to depressed average productivity. Short term flexibility is reduced in good years, when it may not be so essential. But it is greater in poor years when correct choices may be crucial to a firm's survival. Long term (investment) planning will be based on a more stable effort level, which will, however, be coupled with a sub-optimal level of productivity. New investments will be discouraged. Stabilization of effort and supply should lead to good market consistency. The regulations do not mirror well the daily practice of the vessels, as it is not possible to take full advantage of abundant stocks. The race for fish will not be affected.

Biologically, the anti-cyclical approach is not logical as it protects more the good stocks and less the poor ones. Fishing mortality goes contrary to the desired trends. The precise characteristics of the stocks concerned and the specification of the anti-cyclical approach will determine in the end the biological acceptability of the system.

Institutional considerations lead to mixed conclusions. Political and sectoral acceptance could be reasonable because of the pursued stabilization. Relative stability would have to be completely redefined. The consequences in terms of subsidiarity and the impact on local communities seem uncertain.

In view of the above evaluation, this measure is considered of little practical interest and therefore will not be included in the case studies.

1.4.3 Evaluation of effort measures

1.4.3.1 Economics

Flexibility

Effort measures increase vessels' short term flexibility 'when' and 'where' to fish. A new problem which arises is that it may be necessary to impose restrictions as to 'what' to fish, i.e. species/stocks in order to prevent an excessive fishing mortality of certain species on which a fleet may concentrate.

Planning

Independently of the precise definition, effort management implies a certain stabilization of the fleet's activity in the medium and long term. It may also pursue a specified trend, as is the case under the MAGP III objectives. Therefore the possibility of long term (investment) planning is expected to improve, although the outlook may not be in all situations equally favourable. Evidently, the natural fluctuations of stocks will remain as a main component of risk.

Market consistency

Effort measures will be market consistent as the vessels will be in the position to decide when, where and how much to fish, according to the incentives

of the market. Special arrangement are required to prevent large scale shifts of effort from one species to another.

Daily practice

To what extent an effort based policy will be experienced as realistic will largely depend on the precise situation of stocks and the specification of the effort measures. The fleet could operate fairly freely within its effort allocation. Certain inconveniences, for instance bycatch regulations, could be eliminated. Early closure of the fishery still remains possible when the effort allocation is exhausted.

Race for fish

If the allocation of effort is made on a vessel by vessel basis, the race for fish would be avoided. Allocations by countries or groups of vessels, without further arrangements, will lead to an internal competition and a continued race.

Economic performance

A general conclusion on economic performance cannot be drawn. Catches and revenues will depend on the change in size and composition of the stock. At the same time changes in production costs will occur.

1.4.3.2 Biology

Stock conservation

Constant/stabilized fishing mortality could be pursued, which is desirable. However, shifts of the effort from one species to another would have to be contained within certain limits. Short term adjustment of effort needs to remain possible in order to allow for specific natural developments, for instance recruitment failure.

Fishing mortality

Effort measures allow stabilization of the fishing mortality within specified ranges. One of the main biological conditions for effective stock management is met.

High-grading

High-grading makes no sense under effort based management. Discarding commercially valuable species will always represent a loss of revenues for the vessel. High-grading may still occur under some conditions, for instance when the volume of the fish hold would impose a restriction on fishing operations.

Discarding

Discards of non-commercial species are directly linked to the level of effort. Setting this level, the discarding problem may be explicitly included among the considerations.

Ecosystem management

Fixing fishing effort to a (fairly) constant level would contribute to stabilization of the human impact on the ecosystem. Setting the level of TAE may also account for protection of the ecosystem, particularly for specific marine areas.

1.4.3.3 Policy and institutions

Political acceptance

Political acceptance is uncertain. Introducing a new system may raise new conflicts between fleets and countries. Complex negotiations between Member States as well as between administrations and the sector have to be expected. A set of accompanying measures will have to be developed, for instance access to stocks. The link to the TACs is not straightforward.

Sectoral acceptance

Sectoral acceptance will depend on the perception of achieved economic advantages and the likelihood of effective implementation. Several economic considerations allow for 'careful optimism', which should be reflected in the position of the professional organizations. On the other hand, any new management regime offers not only new opportunities but also new (unknown) threats which may lead to scepticism on the part of the industry.

Relative stability

Relative stability will be lost unless an unambiguous link between effort-units and TACs/quota could be established. However, this does not seem very easy. Therefore the principle of relative stability would have to be fully reviewed and reformulated, which will require extensive negotiations.

Enforcement

To control fishing effort in terms of days-at-sea of a certain fleet segment seems relatively more simple than counting precisely the landed tonnes. The method of control of presence in port or at sea is also less direct, which should lessen the potential frictions between the controlling institutions and the fleet.

The total EU-12 fleet is composed of some 100,000 vessels (including coastal small scale). Its total activity will be in the order of 15 mln vessel-sea-days. This number may be compared to about 6-7 mln tonnes of landed fish of a large number of species.

Subsidiarity

Implementation of a TAE system at a low administrative level does not seem to pose any special new problems as long as the legal 'rules of the game' specify the rights and responsibilities of the involved institutions at various levels.

Local communities

The local communities will probably profit from the general stabilization which is the core of an effort based management. However, this does not imply an increase in the economic role of the fisheries sector. Regional distribution of fishing rights and their transferability will determine the future potential of fisheries for specific communities.

Beyond 2002

Effort measures seem to offer an interesting option for fisheries management beyond 2002, assuming that a completely new system will be put in place in which national allocations will not play a role. Clearly, an EU system of fishery specific licences and allowed activity allocations (e.g. days-at-sea) would need further analysis.

It seems likely that management by effort would be particularly suited for vessels beyond a certain minimum size. The total EU fishing fleet is composed of some 100,000 vessels, but taking the 12m limit, only about 25,000 would have to be controlled. Furthermore, activity of larger vessels can be more easily monitored as most of them rely on a relatively small number of harbours.

Separate attention would have to be given to the small coastal fleet. While its catches may not be very significant, in some areas it operates in the biological reproduction zones, so that its effect on the stocks may not be negligible.

1.4.3.4 Other considerations

Consistency

Some specifications of effort measures will provide a high degree of consistency between stock management, economic considerations and management of the structure of the fleet.

Introducing a fairly new concept into the existing fisheries management system will call for withdrawal of certain regulations which have become obsolete. Otherwise new inconsistencies can be expected.

Transparency

Several transparency problems will have to be expected. Specification of a common denominator of effort in fisheries where different technologies are used will require special attention. The link between fishing effort, fishing mortality and the current TACs will have to be quantified. A fair transparency can be expected only after operating the system for several years.

New problems

The new problems may arise in particular conditions. Technological progress or changes in fleet structure may require a continuous restriction of fishing effort. Shifting of the effort from one species to another may aggravate stock fluctuations. New conflicts between fleets can be expected.

Table 1.6 Evaluation of effort definitions (4.2.1-4.2.4)

	4.2.1 Constant effort over several years	**4.2.2 Limited adjustment of effort**	**4.2.3 Minimum level of effort**	**4.2.4 Anti-cyclical approach**
Economics				
FLEXIBILITY	Improves depending on the freedom to use the allowed effort during the year or in different fisheries.	Improvement as fishing activity matches state of exploitable stock.	Depends on the precise level of the minimum and the size of the fleet to which it would apply. Probably seriously restricted.	Reduced, as fishing is restricted in good years. Relative improvement in poor years.
PLANNING	Increased short term flexibility improves long term planning as investments may be better evaluated in long term perspective.	Improvement depends on the scope of the limited adjustment. Wwill be difficult if broad adjustment ranges are allowed.	Possibility of planning seems reasonable under restriction of minimum production.	Difficult, as future state of stock unknown so that allowed effort uncertain.
MARKET CONSISTENCY	Extent of improvement depends on the improved flexibility.	As ad 4.2.1.	In the short run supply shortage may be expected. In the long run (stock recovery and increased productivity) good consistency may be expected.	No market consistency as fishing possibilities are restricted when potentially good catches could be realized. Market smoothing effect could be expected.
DAILY PRACTICE	Good consistency is achieved.	As ad 4.2.1.	Relation between stocks and effort may be unrealistic.	Goes contrary to daily practice.
RACE FOR FISH	Continues as long as effort is not allocated to individual vessels.	As ad 4.2.1.	Depends on the allocation of effort. Intensification may be expected as vessels 'struggle' to survive.	As ad 4.2.1.
ECONOMIC PERFORMANCE	Depends on the development of the stock.	As ad. 4.2.1.	Deterioration is likely due to low catches.	Average productivity will drop so that performance will deteriorate.
Biology				
SPAWNING STOCK	Can be maintained if the relation between fishing mortality and effort is known. Some stocks may be endangered if the TAE can be applied indiscriminately to several independent stocks.	Improved protection as annual adjustment is possible. Restrictions of shift between stocks/species is required.	Recovery may be expected. Danger of over-intensive exploitation of various stocks is limited.	Poor stock recovers slowly, good stock is protected.

	4.2.1 Constant effort over several years	4.2.2 Limited adjustment of effort	4.2.3 Minimum level of effort	4.2.4 Anti-cyclical approach
FISHING MORTALITY	Can be kept well under control only if the TAE is applied to one specific fishery so that the vessels cannot move from one stock/species to another. Allowances for technical progress must be taken into account.	May be varied with annual adjustments. Restrictions of shift between stocks/species is required.	Reduced to a minimum.	Fluctuates contrary to the desired trends.
HIGH-GRADING	Is eliminated as it does not offer any advantages.	As ad 4.2.1.	As ad 4.2.1.	As ad 4.2.1.
DISCARDING	Is directly proportionate to the TAE.	As ad 4.2.1.	As ad 4.2.1.	As ad 4.2.1.
ECOSYSTEM MANAGEMENT	Certain degree of stabilization may be achieved.	Human effect on ecosystem is less stable than in case of 4.2.1.	'Maximum' protection is achieved.	Uncertain.
Policy/institutions				
POLITICAL ACCEPTANCE	Uncertain as the system is new to all parties involved (government, industry, interest groups). Choice of effort level may be a serious problem.	Setting the annual adjustments of TAE may be a problem comparable to TACs. This applies also to setting the system for adjustment.	Unlikely. Accompanying economic measures would have to be taken.	May be reasonable as production possibilities (volume) could be stabilized. But complex international negotiation process;
SECTORAL ACCEPTANCE	Will depend on the recently achieved productivity: if allowed effort sufficient for continued fishing on that basis, good acceptance may be expected.	Within the adjustment range the sector has a possibility to negotiate.	Serious objections to be expected as the sector would be reduced in the short run to its 'minimum' level of production.	As above.
RELATIVE STABILITY	Current interpretation of relative stability is lost; it would have to be replaced by a new concept based on effort.	As ad 4.2.1.	Is lost.	Is lost.
NATIONAL ENFORCEMENT	Control of sea-days seems more simple than that of landings. Problem of 'black fish' landings would be resolved. Problems may arise if further specifications of effort have to be adhered to (gear, engine, vessel).	Seems easier than in the case of controlling landings, but annual changes may be slightly more demanding than the case ad. 4.2.1.	Severe legal prosecution is required against vessels not complying with the system.	May be more difficult because in good years there would be pressure to increase effort and because of the annual fluctuations of TAE.

	4.2.1 Constant effort over several years	4.2.2 Limited adjustment of effort	4.2.3 Minimum level of effort	4.2.4 Anti-cyclical approach
SUBSIDIARITY	Uncertain.	Uncertain.	Not workable, as a seriously restrictive system has to be imposed from a high administrative level.	As ad 4.2.2.
LOCAL COMMUNITIES	In general uncertain. Regional allocation of effort will have effects.	Will only profit if the TAE is allocated to regional professional organizations.	Conflicts within and between local communities have to be expected.	As ad 4.2.2.
BEYOND 2002	Management by effort offers new instruments which are potentially valuable in the long run (resolution of all problems should not be expected).	As ad 4.2.1.	This may be only an option in case of a broad collapse of the major commercial stocks.	Potentially interesting in certain cases.
Other considerations				
CONSISTENCY	Link between mortality and effort improves the consistency between economic and biological considerations.	Good consistency between economic and biological considerations should be achieved.	Serious conflict between economic and biological considerations.	Seriously inconsistent in short run, but not so over a longer period of time.
TRANSPARENCY	Definition of effort may pose problems when different technologies have to be compared.	Annual adjustments may lead to a certain confusion.	Although the minimum as such may be clear, the method of its determination may be questioned.	Probably rather poor.
NEW PROBLEMS	New conflicts between countries or fleet segments.	As ad 4.2.1. Specification of a common effort denominator. Formulation of the adjustment definition.	Large scale reduction of the size of the sector calls for accompanying measures.	New conflicts between fleets and/or countries. Setting the anti-cyclical component at a wrong level.
ACCOMPANYING CONDITIONS	TACs may be maintained but not as the main restrictive condition. Composition of fisheries or species must be fixed. It is assumed that effort is not allocated to individual vessels.			Technological progress must be accounted for.

1.5 Methodology - summary and conclusions

General

1. The methodology explores unknown situations. The main method applied to develop and apply the methodology can be characterised as an 'adjusted Delphi method', i.e. development of gradual consensus of the Research Team.
2. Evaluation of specific situations and their comparisons depend heavily on the assumptions made. These are specified as far as possible in the text.
3. Although the CFP needs to be improved, some unfavourable trends in EU fisheries should not be interpreted solely as CFP failures. Economic problems are partly a result of world trends (trade, exchange rates, etc.). Biological expectations were too optimistic at the outset of the CFP. The political and institutional will to implement the CFP was 'constrained by other considerations'.
4. An important number of multi-annual and multi-species measures are already included within the existing management system.
5. Introduction of new measures should be only considered if they are fully consistent with other measures in force and if there is full commitment to effective implementation within a well defined time frame.
6. Different sets of measures will be effective in different situations. There is no generally valid blueprint for management.
7. The specified measures are evaluated on the basis of 21 qualitative criteria. Their effects are different depending on the characteristics of the actual situation.
7. The Mid-Term Review formulates specific expectations regarding multi-species and multi-annual measures. The general analysis indicates that these expectations are at best only partly justified.
8. Nine specifications of multi-annual measures are presented, five multi-species measures and four effort measures (combination of multi-species and multi-annual). Not all specifications are equally realistic so that only some are treated in the case studies. The aim is not to solve all problems, but rather to develop a framework of thinking about the new measures to be applied in the case studies.

Multi-annual quantity measures

9. Multi-annual measures will meet certain objections of the sector and prevent early closure of a fishery. However, simple shifting of the quota year for some species may produce a comparable result.
10. Unlimited transfer of catches from one year to another has to be prevented by setting a limit, possibly the introduction of an 'interest rate' as a 'fine' for fishing now rather than later (or to promote postponing fishing to later years). Otherwise a multi-annual approach does not seem biologically feasible.

Multi-species quantity measures

12. Multi-species management may be an approach to resolve certain bycatch problems. However, free transfer between species may lead to unpredictable shifts of fishing mortality and consequently to collapse of some stocks. There is a serious danger of large-scale high-grading of catches.

Effort measures - combination of multi-annual and multi-species

13. Management by effort offers potentially interesting possibilities in the long run, after 2002. However, until then it seems institutionally unacceptable because the relative stability would be completely lost.
14. Technological progress, input substitution and ambiguous effort definitions may dilute the effects of effort management in the long run.

New measures and old problems

14. Potential effectiveness of the new measures will depend on the conditions under which they are implemented. The ownership of fishing rights (common property vs. private ownership) is the single most important issue, which will affect the pressure from the fleet to avoid the regulations and the possibilities of prosecution.
15. High-grading will only be eased if greater flexibility can be achieved.
16. Discarding of non-commercial species and the effect on the ecosystem are not related to multi-species or multi-annual measures, but rather to the level of allowed fishing activity.
17. Involvement of professional organizations in fisheries management and the role of local communities (subsidiarity) can only be achieved by specifying the fishing rights at the appropriate levels.

New problems

18. When introducing new measures various new problems have to be expected, for instance formulation of the new definitions or new conflicts between fleets or countries, with a consequent complex political negotiation process.

Table 1.7 General evaluation of multi-annual, multi-species and effort measures

	Multi-annual measures	**Multi-species measures**	**Effort measures**
Economics			
FLEXIBILITY	Greater flexibility in the choice to fish now or later. The discussed options will increase the possibility of intertemporal choices only marginally. The only exception is option 2 'Limited compensation'.	Greater flexibility may be expected. MSTAC will not necessarily prevent early closure of fisheries.	Increase of vessels' short term flexibility 'when' and 'where' to fish. It may be necessary to impose restrictions as to 'what' to fish, i.e. species/stocks.
PLANNING	In most specified options the possibilities for medium term planning do not seem to improve significantly. The options 2 'Compensation' and 3 'Limited adjustment' seem most promising.	Above MSTAC is set on annual basis. Will contribute to long term planning through short term flexibility.	Stabilization of the fleet's activity in medium and long term. Possibility of long term (investment) planning is expected to improve.
MARKET CONSISTENCY	Some MATAC specifications seem interesting to adjust to seasonal changes in demand. Flexible adjustment of the quota year to the needs of particular fisheries appears the advantage.	Greater flexibility to shift within from one species to another will make the fishing operation more consistent with the prices offered on the market.	Vessels will be in the position to decide when, where and how much to fish, according to the incentives of the market.
DAILY PRACTICE	Option 2 'Compensation' offers an improvement. Major problem is the significant chance that the level of MATAC will not be correct which would produce new frictions.	More realistic when a group of species is caught concurrently. May prevent closing fisheries when one TAC is exhausted and the other is not.	Largely depends on the precise situation of stocks and specification of the effort measures. Fleet could operate fairly freely within its effort allocation. Closure of a fishery remains possible when the effort allocation is exhausted.
RACE FOR FISH	Race for fish will be only restricted when the production is effectively managed at the level of the individual producer/fishing vessel (or groups) through individual rights; - principle of MATAC does not contribute in this respect - in some discussed options the race for fish may be expected to intensify.	Will not prevent or diminish race for fish. Even if the fishing rights were privatized, race for certain species may intensify if the multi-species rights are not specified by individual species.	If the allocation of effort were made on a vessel by vessel basis race for fish would be avoided. Allocations by countries or groups of vessels, will lead to an internal competition and a continued race.
ECONOMIC PERFORMANCE	Short run improvement is likely. Deterioration probable in the long run.	Short run improvement is likely. Deterioration probable in the long run.	Uncertain because of contrary trends in landings, prices and costs.

	Multi-annual measures	*Multi-species measures*	*Effort measures*
Biology			
SPAWNING STOCK	Multi-annual approach to stock management leads necessarily to a more generalized policy, in which it is recognized that controls to the last landed tonne are not feasible. In this respect the 'spirit' of stock management would change. Reliable biological quantification of MATACs requires stable stocks and sufficient knowledge to set analytical TACs.	Conservation of one specific stock is in danger, particularly if the vessel flexibility would increase substantially.	Shifts of effort from one species to another would have to be contained within certain limits. Short term adjustment of effort may be required to allow for specific natural developments, for instance recruitment failure.
FISHING MORTALITY	Most of the definitions imply irregular fishing mortality. Especially in the later years the fishing mortality cannot be well managed. Fishing mortality could be maintained at acceptable levels only in the case of minimum spawning stock, which allows for sufficient annual adjustments. Charging an interest rate in some of the definitions may help to reduce fishing mortality.	Fishing mortality cannot be managed by individual species, but only for the total of all species included. Definitions which allow only limited transfer offer better opportunities to control fishing mortality by stock.	Effort measures allow stabilization of fishing mortality within specified ranges. One of the main biological conditions for effective stock management could be met.
HIGH-GRADING	Level of high-grading depends mainly on the relation between the actual fishing opportunities and the allowed catch as specified administratively. If the set MATAC is in fact too low, abundant catches will allow the crew to keep only the most valuable species/market sizes and still exhaust the quota.	High-grading will occur when transfer between species offers a higher revenue while production costs do not increase as much. Only under the 'Total value' definition will high-grading be banned.	Makes no sense in general: discarding commercially valuable species represents loss of revenues. May still occur under some specific conditions.
DISCARDING	Discarding of non-commercial species will be a process opposite to high-grading. Relatively too high MATAC will lead to an increased fishing effort and greater catch of non-commercial species.	Expected to decrease as bycatch regulations may be eased. Depends on the level of total fishing effort.	Directly linked to the level of effort, when setting this level, the discarding problem may be explicitly considered.
ECOSYSTEM MANAGEMENT	Too little is known about ecosystems to allow for a clear conclusions. Some options might contribute to a certain stabilization.	As long as ecosystem is not well defined it is not certain whether MSTACs would produce a positive contribution.	Constant effort would contribute to stabilization of the human impact on the ecosystem. Setting the level of TAE may also account for protection of the ecosystem.

	Multi-annual measures	Multi-species measures	Effort measures
Policy/Institutions			
POLITICAL ACCEPTANCE	Weight of the political process would be shifted from the annual meetings of the Council to the meeting where multi-annual decisions would be taken, taking a multi-annual decision may be more difficult. Political acceptance depends on pressure of various interest groups.	To determine an acceptable common denominator may pose significant political problems; the weights to be used for various species would have necessarily a 'political' component.	Uncertain. New system may raise new conflicts between fleets and countries. Complex negotiations between Member States as well as between administrations and sector have to be expected. Link to the TACs is not straightforward.
SECTORAL ACCEPTANCE	Introducing new measures alone will not increase the credibility of the CFP; Political will needs to be demonstrated to implement them. MATACs do not seem easier to implement than annual TACs. Acceptance by industry is likely as long as the fishing opportunities improve. MA approach in itself may be appreciated as annual management has not always produced the results hoped for.	It is not certain whether the sectoral acceptance (credibility) would improve or not. Greater flexibility is a clear advantage. The moment of closing a fishery would not be as uniquely determined, which may not be well understood. A multi-species system may become rather complex and require extensive international consultation.	Will depend on the perception of achieved economic advantages and the likelihood of effective implementation. New management offers new opportunities but also new (unknown) threats which may lead to scepticism.
RELATIVE STABILITY	It may not be politically feasible to impose one multi-annual system on some stocks/fisheries and maintain annual TACs in others as various fleets would be affected differently, compromising relative stability.	Principle of relative stability is blurred. Practical consequences will depend very much on the actual flexibility which would be achieved.	Will be lost unless an unambiguous link between effort-units and TACs/quota could be established.
NATIONAL ENFORCEMENT	Under some options, which would restrict fishing opportunities relatively more severely, an intensification of controls would be needed. 'Limited compensation' offers an important advantage as the threat of closing down a fishery strictly when a TAC is exhausted would be eased. The problem may present itself several years later anyway, when the allowed accumulation limit for overfishing is reached.	Could mean a more holistic approach to management, catches would be followed, but not necessarily to the 'last kg'. Implementation would seem less demanding.	To control fishing effort in terms of days-at-sea of a certain fleet segment seems relatively more simple than counting precisely the landed tonnes. The method of control i.e., presence in port or at sea is also less direct, which should lessen the potential frictions between the controlling institutions and the fleet.
SUBSIDIARITY	Bringing responsibilities down to low levels of administrative or professional organizations may be more appropriate on a multi-annual basis rather than on an annual one; responsibility for annual changes in TACs puts these institutions in a similar positionto the fishing enterprises.	If entire fisheries could be managed on MA basis, it could be considered to delegate some of the management powers to lower administrative levels.	Implementation of a TAE system at low administrative level does not seem to pose any special new problems as long as the legal 'rules of the game' specify the rights and responsibilities of the involved institutions at various levels.

	Multi-annual measures	Multi-species measures	Effort measures
LOCAL COMMUNITIES	*Effect seems uncertain.* As long as these communities are not allowed to manage effectively the natural resource on which their industry survives, there will be no difference between an annual or multi-annual approach.	May profit if effective subsidiarity could be achieved.	Will probably benefit from the general stabilization. Regional distribution of fishing rights and their transferability will determine future potential of fisheries for specific communities.
BEYOND 2002	Does not seem an interesting option in the long run. Positive aspect may be that the awareness of intertemporal choices may make the sector more sensitive to certain management issues. Subsidiarity may profit as well, but its effect on stock is uncertain.	MSTAC may become politically acceptable if relative stability were abandoned; management by fishery would become feasible and in some fisheries application of MSTACs may be applied. MS-problem could be resolved by introducing ITQs which would allow the individual skippers to adjust their fishing rights to their realized catches.	Interesting option for fisheries management beyond 2002, if a completely new system can be put in place. Management by effort would be particularly suited for vessels beyond a certain minimum size. Coastal fleet may require separate attention;
Other considerations			
CONSISTENCY	Presented options will potentially produce new conflicts of interest, but their extent cannot be assessed.	Greater flexibility may be at the expense of individual stocks/species. Political process will improve only if certain other conditions are met. In general *improved consistency is not a-priori certain.*	Some specifications of effort measures will provide a high degree of consistency between stock management, economic considerations and management of the structure of the fleet.
TRANSPARENCY	MA is composed of two steps. First, biological evaluation of stocks is required. Second, a translation into multi-annual perspective takes place. In the current system, only the first step has to be taken. A multi-annual system seems therefore even less transparent.	Determination of the weights of various species will be a complication.	Specification of a common denominator of effort in fisheries with different technologies may be complex. Link between fishing effort, fishing mortality *and current TACs will have to be quantified.*
NEW PROBLEMS	Forecasting over a period of 2-4 years is necessarily coupled with increasing margins of error so that credibility of the policy may suffer. Multi-annual fisheries management may require adjustments at regular intervals, which may create confusion. Political *determination of technicalities of the new system* may be a problem in itself.	Specification of the relation between the various species within MSTAC may be in the end a highly political issue as major economic interests may be involved. New conflicts of interest may arise as various fleet segments may find themselves in a new competitive position. Regular changes of weights used in the MSTAC will lead to confusion.	Technological progress or changes in fleet structure may require a continuous restriction of fishing effort. Shifting of effort from one species to another may aggravate stock fluctuations. New conflicts between fleets can be expected.
ACCOMPANYING CONDITIONS	Effective privatization of fishing rights is always a prerequisite.		

APPENDICES

Chapter 1

Appendix 1.1 Summary of the criteria and their content

Economics	*Level of individual enterprises*
FLEXIBILITY	short term decisions - where, when and what to fish
PLANNING	long term decisions - investment
MARKET CONSISTENCY	(dis)incentives - policy in line with market forces
DAILY PRACTICE	frictions between what is administratively desirable and what the natural environment makes possible
RACE FOR FISH	irregularities of production process
ECONOMIC PERFORMANCE	change in profitability due to volume of landings
Biology	*Natural environment*
SPAWNING STOCK	minimum level
FISHING MORTALITY	stabilization
HIGH-GRADING	discards of commercial species
DISCARDING	non-commercial species and commercial species when quota is taken
ECOSYSTEM MANAGEMENT	prevention irreversible processes - precautionary principle
Policy/institutions	*Private (sectoral) and public interests at aggregate level*
POLITICAL ACCEPTANCE	will/commitment to implement
SECTORAL ACCEPTANCE	credibility, scientific objectives vs. measures taken
RELATIVE STABILITY	fixed allocation of TACs
NATIONAL ENFORCEMENT	feasibility of effective implementation and control, given available funds
SUBSIDIARITY	delegation of the implementation to local/regional institutions
LOCAL COMMUNITIES	socio-economic impact
BEYOND 2002	*principles of EU - free movement*
Other considerations	
CONSISTENCY	economic, biological and political objectives and consequences
TRANSPARENCY	clear justification and explanation
NEW PROBLEMS	

Appendix 1.2 List of precautionary TACs in 1995

A total of 106 TACs was set at the beginning of 1995 (excluding arrangements with third countries - Greenland, Faroes, etc.) 67 TACs were precautionary.

Species	*ICES-area*	*Species*	*ICES-area*
Herring	4c, 7d	Norway lobster	7
Herring	5b, 6aN, 6b	Norway lobster	8ab
Herring	6aS, 7bc	Norway lobster	8c
Herring	6a Clyde	Norway lobster	8de
Herring	7a	Norway lobster	9, 10, Cecaf 34.1.1
Herring	7ef	Plaice	3a Skag
Herring	7ghjk	Plaice	3a Kat.
Anchovy	8	Plaice	3bcd
Anchovy	9, 10, Copace 34.1.1	Plaice	5b, 6, 12, 14
Cod	3a Skag.	Plaice	7bc
Cod	3a Kat.	Plaice	7hjk
Cod	5b, 6, 12, 14	Plaice	8, 9, 10, Cecaf 34.1.1
Cod	7b-k, 8, 9, 10, Copace 34.1.1	Pollack	5b, 6, 12, 14
Megrim	5b, 6, 12, 14	Pollack	7
Megrim	8c, 9, 10, Copace 34.1.1	Pollack	8ab
Anglerfish	5b, 6, 12, 14	Pollack	8c
Anglerfish	8e	Pollack	8c
Anglerfish	8c, 9, 10, Cecaf 34.1.1	Pollack	8d
Haddock	3abcd	Pollack	8e
Haddock	5b, 6, 12, 14	Pollack	9, 10, Cecaf 34.1.1
Haddock	7, 8, 9, 10, Cecaf 34.1.1	Saithe	7, 8, 9, 10, Cecaf 34.1.1
Whiting	3a	Mackerel	8c, 9, 10 Cecaf 34.1.1
Whiting	5b, 6, 12, 14	Common sole	3a-d
Whiting	7a	Common sole	5b, 6, 12, 14
Whiting	7b-k	Common sole	7bc
Whiting	8	Common sole	7hjk
Whiting	9, 10, Cecaf 34.1.1	Common sole	8cde, 9, 10, Cecaf 34.1.1
Blue whiting	2a, 4	Sprat	3a
Blue whiting	5b, 6, 7	Sprat	2a, 4
Blue whiting	8abd	Sprat	7de
Blue whiting	8e	Horse mackerel	2a, 4
Blue whiting	8c, 9, 10, Cecaf 34.1.1	Horse mackerel	5b, 6, 7, 8abde, 12, 14
Norway lobster	3a-d	Norway pout	2a, 4
Norway lobster	2a, 4		
Norway lobster	5b, 6		

Appendix 1.3 List of abbreviations

ACFM	Advisory Committee for Fisheries Management
ANOP	Association Nationale des Organisations de Producteurs
bln	billion
CFP	Common Fisheries Policy
cpue	Catch per unit of effort
DAS	Days-at-sea
DG	Directorate General
EAFE	European Association of Fisheries Economists
EC	European Commission
ECU	European currency unit
F	Fishing mortality
FAO	Food and Agriculture Organization of the United Nations
FEDOPA	Federation des Organisations de Producteurs de la Pêche Artisanale
GR	Gross tonnage
GRT	Gross registered tonnage
HP	Horse Power
ICES	International Council for Exploration of the Sea
IFREMER	Institut Francais de Recherche pour l'Exploration de la Mer
ITQ	Individual transferable quota
kW	kilowatt
LEI-DLO	Agricultural Economics Research Institute
LOA	Length over all
MAFF	Ministry of Agriculture, Fisheries and Food (UK)
MAGP	Multi-Annual Guidance Programme
MAM	Multi-annual measures
MATAC	Multi-annual total allowable catch
MBAL	Minimum biologically acceptable level
MEY	Maximum economic yield
mln	Million
MSM	Multi-species measures
MSTAC	Multi-species total allowable catch
MSY	Maximum sustainable yield
NAFO	North Atlantic Fisheries Organization
RIVO-DLO	Netherlands Institute for Fisheries Research
SFIA	Sea Fish Industry Authority
SFO	Scottish Fishermen's Organization
SOAFD	Scottish Office Agriculture and Fisheries Department
SSB	Spawning Stock Biomass
STECF/STCF	Scientific, Technical (and Economic) Commission for Fisheries
TAC	Total allowable catch
TAE	Total allowable effort

2. NORTH SEA ROUNDFISH FISHERY

C. Egner, J. Pope and P. Rodgers.

Summary

Fishing effort in the North Sea roundfish fishery focuses on the cod, haddock whiting and saithe species. While the fishery is predominately mixed in character, the fishery for saithe is relatively distinct geographically, being located close to the Norwegian coast. It is fished mainly by France and Norway.

Analysis in the case is directed at the mixed aspects of the fishery and thus cod, haddock and whiting. Eight European countries have been identified as participants in the fishery (i.e. on cod, haddock and whiting) and by order of landings volume are Scotland, Denmark, England, the Netherlands, France and Germany. The Belgian and Norwegian share of the fishery is very small indeed.

While there appears to be a great deal of international interest in landing cod, the fishery for haddock and whiting is almost exclusively targeted by Scottish vessels.

The fishery is fairly heavily regulated at present through both national schemes and those promulgated at the EU level. National regulations are largely directed toward the control of capacity via licensing systems and restrictions on vessel replacement. However, some countries are also imposing days-at-sea limitations on their fleets. EU regulations consist of technical measures, structural measures and the implementation of TACs.

Despite the management regulations, all three species of North Sea roundfish are currently being heavily exploited with some 50-60% of each being removed annually by fishing. Recruitment is in most cases, highly variable (particularly for haddock) and as a result, there is considerable variability in the abundance of each species and in resultant landings. The fishery has become very dependent upon juvenile fish.

TACs, which are the principal instrument of fisheries management, do not appear to have excercised restraint on the exploitation rates of roundfish. It is generally recognized that there is currently excessive fishing capacity in the fishery. As a result, more recent attempts to reduce TACs to attain reductions in fishing mortality appear to have simply exacerbated the problems of illegal landings, mis-reporting and discarding.

There is particular scientific concern about North Sea cod which is currently perceived to be on the verge of collapse. The spawning stock biomass (SSB) is currently well below the 'safe' level considered appropriate to avoid recruitment failure.

The concerns about the abundance of roundfish have prompted the Advisory Commitee for Fisheries Management (ACFM) to recommend that the exploitation rates for all three species be reduced by an amount corresponding to a 30% reduction in fishing mortality. The issue therefore is whether the alternative measures under review can in fact achieve this aim.

TAC-based multi-annual measures suffer from similar defects to the existing TAC management system and cannot be expected to achieve the required reduction in exploitation rates. They do not address the issue of fleet overcapacity which is contributing to excessive fishing and do not force vessels to bear the marginal social costs of overfishing which manifest themselves in higher fishing costs for other vessels (because of congestion) and a reduction in fishing opportunities (and revenues) for the fishermen of the future.

The problems of overfishing are therefore economic in character and stem from the incorrect price signals being sent to fishermen regarding the true costs of fishing.

Many variants of multi-annual measure (MAMs) considered involve setting TACs a number of years in advance. The variability in recruitment of roundfish makes it extremely difficult to predict actual stock abundance more than two years ahead. It is therefore very likely that a multi-annual TAC (MATAC) for roundfish species would fail to track changes in stock abundance. This would cause particular conservation problems in years where there was unexpectedly poor recruitment during a multi-annual period.

While many forms of MAM eradicate the need for annual negotiations in December to set the TAC, they would be replaced by an altogether more contentious negotiation process every three or four years.

TAC-based multi-species measures (MSMs) remove the requirement for individual species TACs and do acknowledge the realities of fishing in a fishery which is mixed in character. However, once again they are variants of the existing management regime to the extent that they rely upon TACs to constrain the fishery and do nothing to address the issue of excessive capacity which is the cause of overexploitation. MSMs which involve interchangeability of TACs between species are likely to create numerous negotiating difficulties given the difficulties associated with agreeing at what rates individual species TACs can be swapped (i.e. exchange rates). In addition the MSTAC weakens the ability of managers to protect individual species.

As is the case with the current system of TACs, any attempt to attain the required reduction in fishing mortality through a restrictive multi-species TAC is likely to exacerbate the problems of illegal landings, misreporting and discarding. It is difficult to be optimistic about the conservation benefits of such measures.

Effort measures have been considered in the context of days-at-sea (DAS) limitations in the case study. They differ from the other two forms of management regime in controlling inputs as opposed to outputs. There are obvious attractions associated with the implementation of a DAS scheme in terms of the administrative simplicity of the measure and the relative ease of enforcing it.

If the DAS scheme was effectively enforced and allocated days were set at the correct level, there would undoubtedly be some conservation benefits in terms of reduced fishing mortality. However, establishing the correct level of effort is problematic. DAS are very imprecise conservation instruments and are likely to prove poor predictors of catches and landings given the scope that they offer vessels for input substitution. Moreover the link between effort

(measured in days) and fishing mortality is likely to be notoriously difficult to predict and unstable over time. The catch capabilities of vessels naturally vary according to size and technical specification and this emphasizes the difficulties associated with defining effort in a way that facilitates comparison across fishing fleets.

'Capital stuffing' to increase catch (i.e. investing in equipment/technology) is likely to be the long-run industry response to days-at-sea allocations in efforts to make the best use of available sea time. Allocated days would therefore have to be progressively reduced to compensate for more powerful vessels. This suggests financial hardship for a number of vessels a factor that cannot be ignored, given that the promotion of an economically viable fishing industry is a CFP objective in addition to the more familiar conservation of stocks.

Thus days-at-sea, which will force an increasing degree of idleness, are not long-run economic solutions to the problems of the fishery which really are economic in character.

None of the measures under review consider long-run economic solutions to the problem of overexploitation of roundfish stocks. To eradicate overfishing, it is necessary to change the cost function that the vessel is confronted with. This suggests instituting some form of charging mechanism involving fishermen paying for their fishing rights. These are the sorts of issues which future research should be addressing.

Part A Description of the fishery

2.0 Introduction

Fishing effort in the North Sea roundfish fishery is mainly directed at cod, haddock, whiting and saithe. In reality, the roundfish fishery comprises of two relatively distinct segments i.e. a mixed fishery on cod, haddock and whiting and the more geographically distinct saithe fishery which is located in close proximity to Norway and is exploited by both Norway and France.

Because management problems appear particularly acute in a mixed fishery, it was considered appropriate to limit much of the analysis to the mixed aspects of the fishery and thus the cod, whiting and haddock species.

North Sea TACs and Landings Trends

The 1994 TACs for cod, haddock and whiting were set at 102,000 tonnes, 160,000 tonnes and 100,000 tonnes respectively. Only around half of the whiting TAC is allocated to Member States for the purposes of human consumption, the remaining 50% accounts for industrial bycatch. At average 1994 prices the fishery is valued at approximately 320 mln ECU per year.

Figure 2.1 illustrates how annual TACs for each of the roundfish species have fallen over the past decade since their establishment. The TAC for cod has been reduced by almost 150,000 tonnes from its 1985 peak whilst the haddock

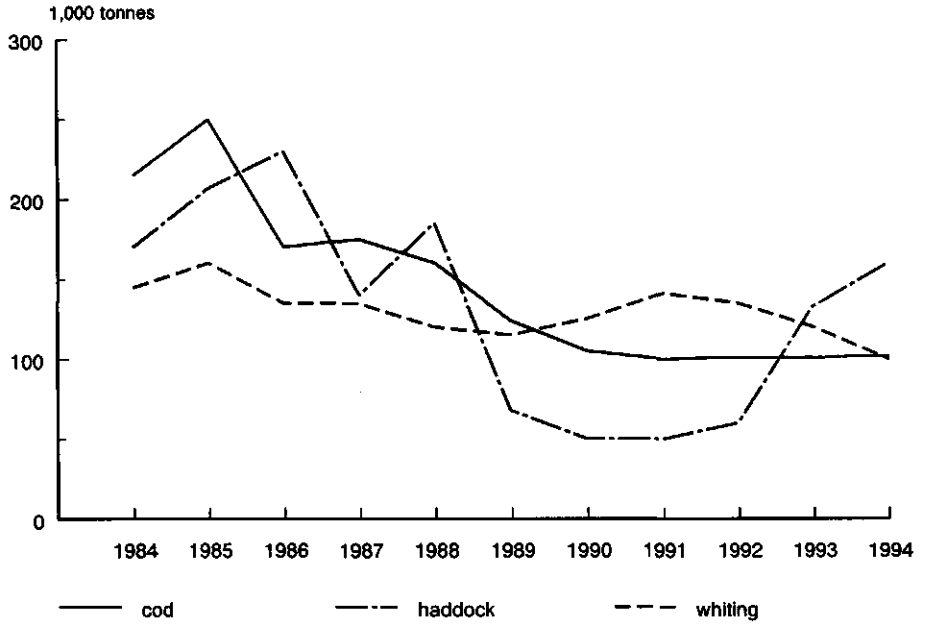

Figure 2.1 TACs in ICES area IV, 1984-1994
Source: Official Journal of the European Communities, various issues 1984-94.

TAC for 1994 is only around 70% of its 1986 peak. It is evident that the TAC for haddock has been particularly volatile over the decade having been cut by over 60% between 1988 and 1989.

The reductions in TACs in more recent years reflect increasing concern about species availability given poor and variable recruitment and excessive levels of fishing mortality. Indeed, the ACFM has consistently recommended that fishing effort be reduced by the order of 30% in order to conserve both cod and haddock as well as whiting.

Despite this, and as will be discussed in section 2.2, TACs have proved ineffective in reducing the exploitation rate of cod and haddock stocks which have been subjected to very high levels of fishing mortality.

Figure 2.2 plots international catches of North Sea cod, haddock and whiting for the last 35 years. From a brief review, it is clear that there has been a considerable degree of variability in the catches of the three round-fish species being considered. The variation is most marked in the case of haddock where catches rose to exceptionally high levels in the late 1960s and early 70s but subsequently fell over the latter half of the 1980s.

Similar trends are evident in the catches of North Sea cod where landings rose fairly markedly over the period from the mid 60s to the early 80s and declined rapidly thereafter.

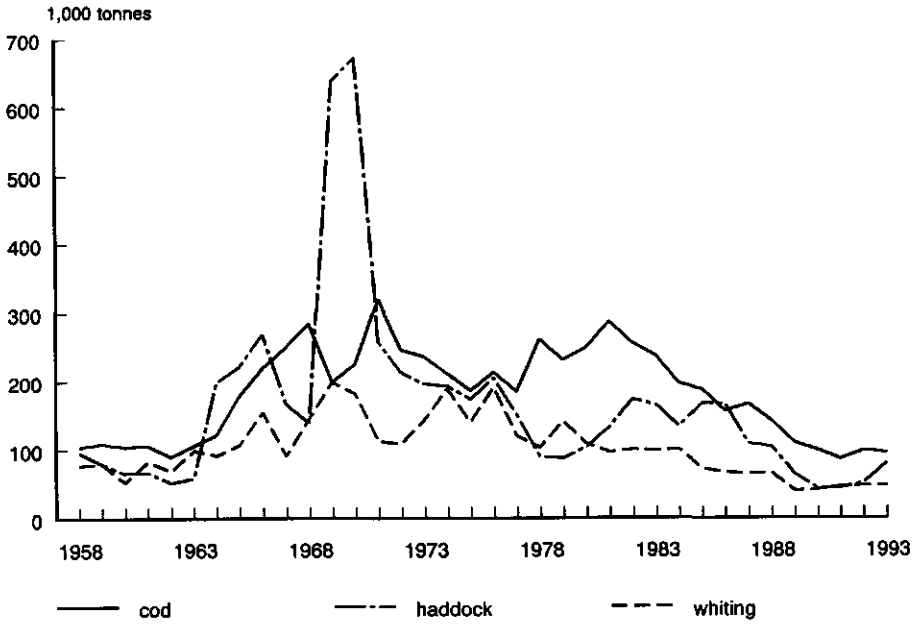

Figure 2.2 Human consumption landings of North Sea roundfish, 1958-1993
Source: ICES Bulletin Statistique des Pêches Maritimes, Volumes 43-65 and Reports of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. ICES C.M 1993/Assess 5, 1994/Assess 6, 1995/Assess 8.

The surge in landings of cod and haddock over the 60s and 70s has come to be recognized as the *gadoid outburst* and appears to have been attributable to record levels of recruitment probably induced by environmental factors. The precise reasons for this phenomenon have never been adequately explained but its policy implications are quite profound.

Many fishermen originally cited the depressed catches and their coincidence with the introduction of TACs as evidence of the excessive restrictions placed upon them by fisheries managers. However, examination of figure 2.2 suggests that catches in the latter half of the eighties may simply have returned to the more normal levels last seen in the early sixties i.e. levels consistent with more normal recruitment patterns.

This said, catch levels of cod and haddock in the 1990s are sufficiently low to give rise to concerns about their longer term availability. Consistently high levels of fishing mortality and variable recruitment have left these species heavily pressured (see later).

One of the most damaging legacies of the gadoid outburst is the effect that it has exerted on the catch expectations of fishermen prosecuting North Sea roundfish. Catch expectations subsequent to the ending of the outburst do

not appear to have been adjusted downwards and are accordingly unrealistically high at present. This has not only fuelled conflict between the industry and fishery managers but has undoubtedly contributed to excessive levels of effort being applied to the fishery.

The reductions in species availability coupled with successive reductions in TACs have also effectively exacerbated the problems of overcapacity in the North Sea roundfish fishery given the fact that a consequent reduction in EU fleet size has not been achieved.

2.1 Countries and fleets involved

Table 2.1 profiles the characteristics of the North Sea roundfish fishery in terms of the countries and fleets principally involved. The data was sourced from the database of the North Sea roundfish working group and as such does not have complete information for all the countries concerned. In particular, no effort data was available for the trawl and seine fleets of Denmark. Effort data associated with the activities of Belgian and German vessels was also unavailable.

The effort figures presented in table 2.1 should be viewed with caution given that definitions of effort vary from country to country. Some countries record effort in terms of hours fished (e.g. UK, Norway and France) whilst others (e.g. Netherlands and Denmark) use more arbitrary measures based on days and kW. For this reason, it is not possible to compare effort directly between countries. To give some measure of the relative importance of each fleet in the fishery however, total landings of roundfish in 1993 have been presented.

Table 2.1 identifies 8 countries of significance exploiting the North Sea roundfish fishery. On the basis of aggregated 1993 landings (by weight) of cod, haddock, whiting and saithe. Scotland is clearly the dominant player in the fishery accounting for some 41% of fish landed. Norway is the next most important country, followed by France, Denmark, England & Wales, Germany, the Netherlands and lastly Belgium.

The inclusion of saithe in the analysis of effort makes a considerable difference to the ranking of countries. Whilst the dominant Scottish fishing fleet is largely involved in the mixed cod, haddock and whiting fishery (chiefly in the northern and middle North Sea), the Norwegian fleet is predominately involved in fishing for saithe in close proximity to the Norwegian coast. Saithe is also targeted in the northern North Sea by French freezer and high sea trawlers as well as German cutters.

As indicated earlier, the proximity of the saithe fishing grounds to Norway, suggests that it can almost be considered a separate fishery in the North Sea, distinct from the mixed gadoid fishery in which cod, haddock and whiting are exploited. Given that management problems are particularly acute in the latter sub-fishery most of the remaining analysis of the case focuses on the cod, haddock and whiting species.

Scottish vessels still exert the dominant influence in the mixed gadoid fishery accounting for over half of human consumption landings. Denmark is

the next most important country with around 11% of human consumption landings although it should be noted that the actual Danish share of the fishery is somewhat higher given that a substantial whiting bycatch is taken by Danish industrial trawlers (section 2.2). The other countries of significance in order of catch volume are England & Wales, the Netherlands, Norway, France and Germany. The participation of the Belgian fleet is of relatively small magnitude.

Figure 2.3 presents information on the catch origins of the three roundfish species respectively. The landings pattern for North Sea cod is relatively international in its dimensions with Scotland, Denmark, England & Wales and the Netherlands all being significant participants. By contrast, there is much less international interest in landing haddock and whiting for human consumption purposes and as a result the bulk of landings of both species are made by Scottish vessels.

Scottish fleet

The Scottish fleets presented in table 2.1 mainly deploy seine or trawl gears in the exploitation of roundfish. The demersal trawl (heavy towed gear) and seine fleets tend to prosecute fishing grounds along the east coast of Scotland and Shetland while the larger vessels in the light trawl and pair trawl fleets often fish as far out as the Viking Bank (Norwegian coast) and also fish for cod, haddock and whiting in the central North Sea.

The pair trawl fleet is essentially a component of the light trawl fleet and together these fleets account for the largest share of roundfish landings by Scottish vessels. Seiners also land a large volume of roundfish although they tend to target haddock taking a significant bycatch of cod and whiting in the process.

Landings from the heavy trawl fleet are now very small indeed given the uneconomic nature of trawling using heavy ground gear. The number of vessels in the fleet has accordingly declined to a very low level.

Denmark

From the Danish perspective, North Sea roundfish is predominately targeted by Danish gill netters with the principal onus being on the landing of North Sea cod. Cod is also landed by the Danish seine fleet although these vessels tend to target plaice.

While the larger Danish trawlers target pelagic fish, the smaller trawlers also direct their operation to the landing of cod and haddock. The industrial trawl fleet catch a significant volume of whiting as bycatch.

England & Wales

There are two major fleets prosecuting the North Sea roundfishery i.e. the seine and trawl fleets respectively. The latter in fact consists of vessels adopting pair trawl and otter trawling methods. There are possibly around 400 otter trawl vessels targeting mixed demersal finfish (e.g. cod, haddock, saithe, whiting and plaice) principally operating around the north east coast of England.

Table 2.1 The North Sea roundfish fleet (1993)

Country	Fleet	No Vessels	Annual Effort	Landings (1993) a) Cod	Haddock	Whiting	Saithe	**Total**
Scotland	Trawl	15	11,657(h)	331	1,006	263	266	1,866
	Seine	220	268,413(h)	9,072	26,069	13,093	1,759	49,993
	Light trawl	285	447,064(h)	9,508	16,516	8,307	2,121	36,452
	Pair trawl	-	23,542(h)	7,801	22,285	8,738	1,567	40,391
	Other	-	-	1,119	637	820	71	2,647
	Total			27,831	66,513	31,221	5,784	131,349
Norway	Trawl	217	24,383(h)	-	-	-	25,596	-
	Light trawl	15	3,978(h)	-	-	-	2,805	-
	Other	-	-	-	-	-	20,381	-
	Total			8,384	2,574	89	48,782	59,829
France	Higs sea trawl	-	79,452(h)	1,238	8	3,346	28	4,620
	Bottom trawl	-	237,219(h)	480	951	2,146	15,816	19,393
	Freezer trawlers	-	8,863(h)	118	152	29	6,485	6,784
	Static gear	-	-	122	0	5	0	127
	Total			1,958	1,111	5,526	22,329	30,924
Denmark b)	Human con trawl	143	-	5,076	2,290	1,303	-	-
	Gill net	-	20(a)	10,739	715	27	-	-
	Danish seine	219	-	3,709	572	-	-	-
	Total			19,524	3,577	1,330	4,154	28,585
England & Wales	Otter trawl	403	264,934(h)	6,341	2,593	1,847	2,269	13,050
	Pair trawl	50	29,300(h)	1,395	756	202	80	2,433
	Anchor seine	25	51,414(h)	471	30	2	1	504
	Fly seine	14	6,221(h)	330	370	167	8	875
	Other	-	252,465(h)	6,315	421	529	68	7,333
	Total			14,852	4,170	2,747	2,426	24,195

Country	Fleet	No Vessels	Annual Effort	Landings (1993) a) Cod	Haddock	Whiting	Saithe	Total
Germany	Cutters	-	-	6,800	347	440	14,812	22,399
Netherlands	Pair trawl	-	2,900	5,039	-	-	-	-
	Beam trawl	-	-	3,612	-	-	-	-
	Otter trawl	-	400	1,145	-	-	-	-
	Gill net	-	-	537	-	-	-	-
	Total			10,333	188	4,918	75	15,514
Belgium	Otter trawl	44	-	-	-	-	-	-
	Pair trawl	9	-	-	-	-	-	-
	Total		-	3,374	292	944	113	4,723
	Grand Total b)			93,056	78,772	47,215	98,475	317,518

a) Figures do not include industrial bycatch; b) 1993 landings by vessel type unavailable. Share by each type of vessel in the 1992; Danish Fishery Statistics Yearbook have been applied to the 1993 total; (h)=total hours fished; (a)=arbitrary units; Netherlands effort data in 000 HP-days.
Sources: Database of the Working Group on the Assessment of Demersal Socks in the North Sea; Danish yearbook of Fishery Statistics 1992; de Belgische zeevisserij, aanvoer en besomming 1993.

The pair trawl fleet by contrast, tends to target cod and operates in the western segment of the mid North Sea.

Cod is also the target species for the seine fleet (around 40 vessels) which tends to operate in the central portion of area (IV(b)).

Netherlands

Otter trawl and pair trawl are the main gears being deployed by the Netherlands in the targeting of North Sea roundfish. The Dutch roundfish fleet has been reduced from about 216 vessels (300-1,500 HP) in 1987 to 72 vessels in 1993, mainly as a result of decommissioning. Vessels remaining in the fleet segment also fish for flatfish and operate in both the southern and central North Sea.

The pair trawl fleet operates in a similar region to the otter trawlers and the catch composition is also much the same, with the exception of plaice (which is only caught in very small quantities).

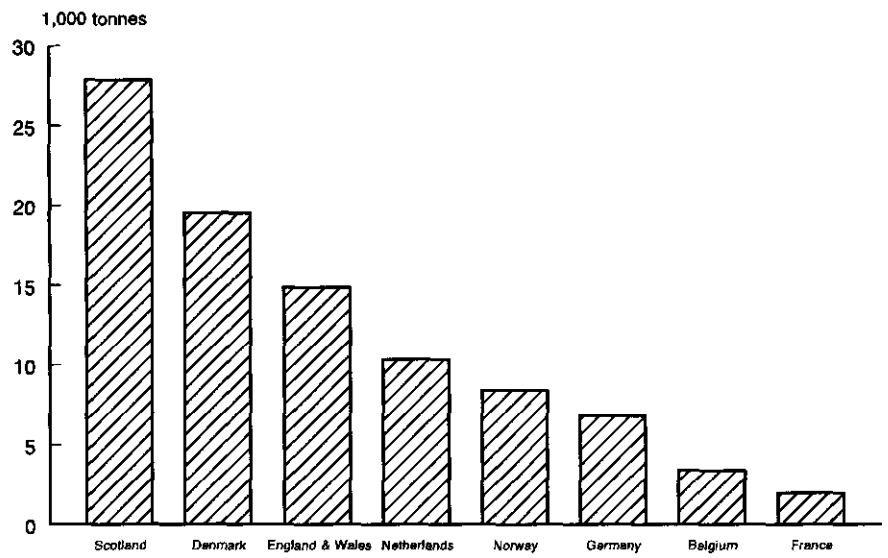

Figure 2.3a International Landings of North Sea Cod, 1993
Source a,b,c: Report of the Working Group on the assessment of Demersal Stocks in the North Sea and Skagerrak. ICES C.M 1995/ Assess 8.

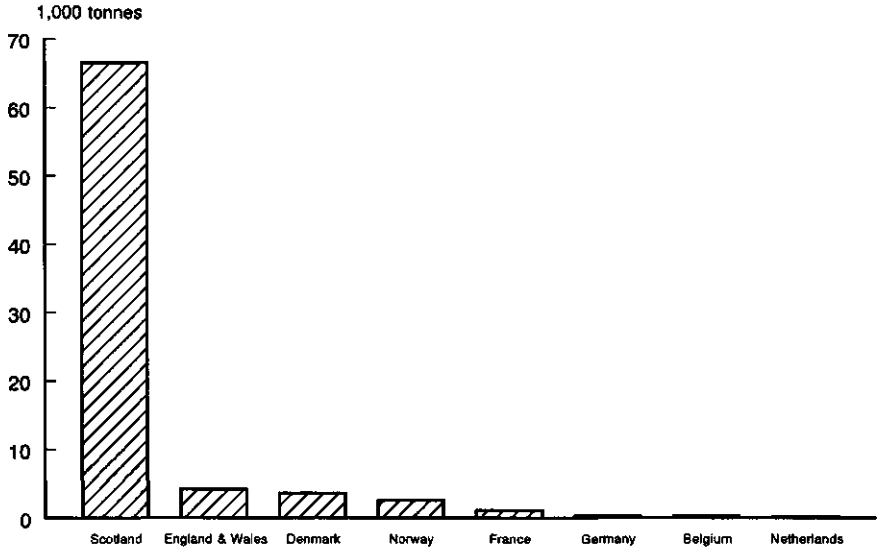

Figure 2.3b International Landings of North Sea Haddock, 1993

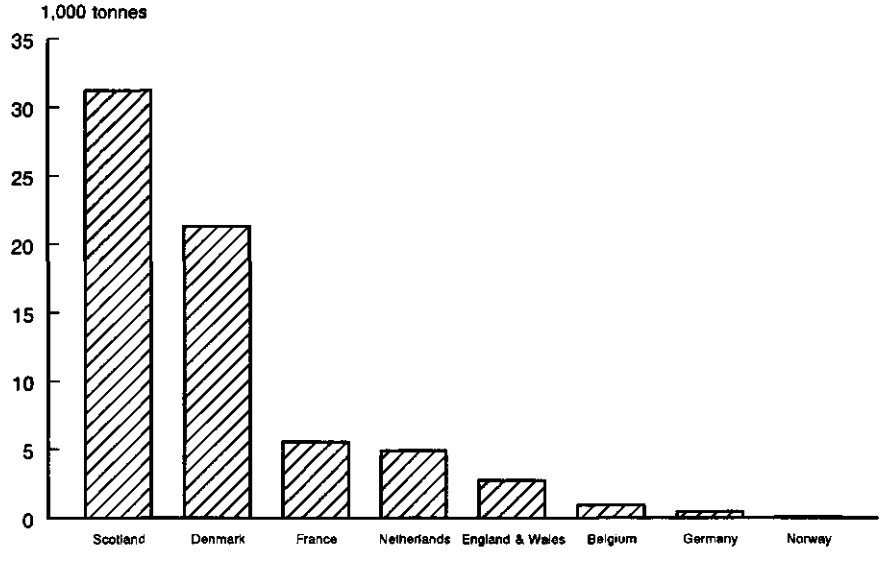

Figure 2.3c International Landings of North Sea Whiting, 1993
Note: Danish figures for whiting include industrial bycatch.

France

The bulk of French roundfish landings are made by the various trawl fleets listed in table 2.1. The bottom trawlers and freezer trawlers tend to target saithe and ling with cod, haddock and whiting usually being taken as a bycatch of these fisheries. The freezer trawlers operate in both the northern and central North Sea.

The French high sea trawlers which took the largest volume of cod, haddock and whiting amongst the French fleets do most of their fishing in the northern North Sea, west of Scotland and the Faroes. Again the principal target species is saithe, with a significant bycatch of cod and whiting.

Other Countries

The other countries worth mentioning are Belgium and Germany. The larger German cutters (36 m) operate almost exclusively in the northern North Sea and predominately target saithe. However, the smaller vessels in the cutter fleet exploit cod and their operations extend to the central North Sea (ICES area IV(b)).

The Belgian fleet is not all that significant in the roundfishery in terms of landings volume. The Belgian otter trawl fleet principally targets cod (bycatch of plaice and whiting) with around 35 vessels operating in the central and southern North Sea. There is also a directed pair trawl fishery for cod which tends to operate in close proximity to the Belgian coast.

Fishing capacity

It is widely conceded that there is substantial overcapacity in the fishing fleets exploiting the North Sea roundfish fishery. In an attempt to address this issue, all EU countries are subject to MAGP targets specifying required reductions in the capacity of beam trawl and demersal trawl fleets. The reduction targets are 15% and 20% respectively and require to be met by the close of 1996. The effectiveness of the MAGP targets are, however, likely to be eroded to some extent by technical progress in the fleet (possibly of the order of 2% per annum).

The UK fishing fleet which has the dominant stake in the fishery mainly on account of the size of Scottish interests is overcapitalized and may have substantial problems in meeting its MAGP targets despite the extra 28 mln pounds which the government has pledged to the decommissioning programme.

The adoption of scientific advice to cut roundfish mortality by 30% will undoubtedly exacerbate capacity problems. Thus overcapitalization is likely to remain problematic. This factor coupled with observed fragility in North Sea cod and haddock stocks (see next section) indicate that the problems faced by the North Sea roundfish fishery are likely to become acute.

2.2 Biological base

Cod, haddock and whiting are all members of the same family of fishes, the gadoids. Although haddock are more or less absent from the southern North Sea, the distribution of the species overlaps considerably and all three species are commonly caught together in the same gears. While there are similarities in their biology and there are predatory interactions between them, it is convenient to discuss their population dynamics separately. The overview of the stocks given below is drawn predominantly from assessments made by the ICES Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (Anon, 1995). Detailed data on these stocks are available from the early 1960s.

Cod

This is the largest of the three species commonly growing to over a metre in length. The fish mature comparatively late, at about age 4, spawning annually in the first quarter of the year. They are highly predatory, feeding on fish and invertebrates. They are also cannibalistic.

Figure 2.4 summarizes the stock trends for cod since 1963. The fishing mortality rate, F, which measures the proportion of the stock removed by fishing annually, has risen gradually over the period. The magnitude of F is such that about 50-60% of the stock in weight is removed each year. The removals have to be replaced by new fish entering the stock if the population is to be sustained. These new fish, the recruits, are the fish of a single spawning which later enter the fishery. For cod these recruits are aged about one year when they are first taken by the fishery. Figure 2.4 shows these recruits for the last three decades. It is noticeable that there are large fluctuations in recruitment from year to year and this inevitably leads to variability in the stock. The stock variability is most clearly seen in the total stock biomass but is less apparent in the biomass of mature fish, the spawning stock biomass. An important feature of recruitment is that although recruitment is variable, there has been a period of relatively low recruitment since 1986. This is related to a decline in the spawning stock which reached its lowest recorded levels in the early 1990s.

Something which is not immediately obvious from the figure 2.4 is the extent to which the fishery is dependent on immature fish. Figure 2.4 plots the total stock biomass and the spawning stock biomass. The separation of these two lines is testimony to the fact that most of the fish in the sea are immature since the spawning stock is a subset of the total stock. The fact that the landings closely follow the trajectory of total stock biomass (which is mostly immature) shows the dependence of the fishery on these young fish. It means that most fish are caught before they have a chance to spawn and is inevitably a cause for concern.

A major question when assessing fish stocks is whether a declining spawning stock leads to a declining level of recruitment. Clearly, if erosion of the spawning stock through high exploitation occurs and this in turn results in lower recruitment, then the stock faces a serious problem. It is usually very difficult to discern these so-called stock-recruitment relationships but in the case of

cod there is some evidence of lower recruitment at low spawning stock sizes. Figure 2.5 shows the stock recruitment data plotted with a fitted conventional Shepherd stock-recruitment curve. The points are joined as a time series and it can be seen that the more recent and low recruitment values lie to the left of the graph. Also shown in the figure is the 'replacement line' for the present survival rate of the stock (labelled F 93). This line shows the level of recruitment required for a particular spawning stock size to sustain itself.

The significant feature to note is that the realized recruitment for any spawning stock size is typically below that required for sustainability at the present survival rate. This means the stock is expected to decline in the long term and may well collapse. The only way to rectify this situation is to increase the survival rate by decreasing the fishing mortality rate. This would lower the slope of the replacement line on the graph. A 'safe' level would be a replacement line which separated the recruitment values in such a way that 50% of the points lay above the line. This is the so-called Fmed level. It is the level at which the stock would be expected to be able to sustain itself.

Fishery managers have attempted to reduce the exploitation rate of cod (and the other two species) by setting TACs since 1989 which have corresponded to a reduction in fishing mortality rate. From 1991, the Advisory Committee on Fisheries Management (ACFM) recommended a reduction in fishing effort of 30% (Anon, 1990). The hope was that when the TAC was taken, the fishery would close. Figure 2.6 shows the time series of the TAC, landings and the exploitable biomass since the beginning of the CFP. While the TAC mirrors the trend in exploitable biomass well, and is close to the realized landings, the TAC has actually failed to constrain the exploitation rate. This is because the TAC has generally been somewhat above the actual landings and is indicative of the fact that over this period there was a tendency for the stock assessment to overpredict the likely landings. However, in 1993 the TAC was set at a level which clearly was restrictive but this simply resulted in landings being made illegally and no reduction in the exploitation rate appears to have occurred.

Haddock

Of the three species considered here, haddock are of intermediate size typically reaching a maximum size of about 60 cm. They mature between the ages of two and three. Spawning begins during the first quarter of the year and lasts into the second quarter. Haddock are benthic feeders; that is they feed on the sea bed eating a variety of small animals, mostly invertebrates which inhabit the mud.

Figure 2.7 shows the historical stock trends determined from the most recent ICES assessment. Unlike cod, where most of the catch is landed, a large proportion of the catch is discarded. This is seen in figure 2.7 where discards may on occasion exceed the landed component. A small proportion of the catch is taken in the industrial fisheries, mainly targeted at Norway pout. The fishing mortality rate is high and results in about 60% of the stock being removed each year. The level of exploitation has remained at a similar level for a number of years but with some indication of a long-term increase. Recruitment in haddock shows extreme variability. There appears to be a weak cyclical

effect with high recruitment followed by about four years of much lower values. This leads to substantial variability in the stock biomass. Notwithstanding the exceptionally large 1967 year class, there has been a tendency for recruitment to be lower in recent years and successive 'good' year classes have tended to be smaller than their predecessors. This in turn has led to a long term decline in the spawning stock. Because haddock mature at a younger age, the fishery is less dependent on immature fish, and most of the landed catch is of mature fish. However, the discarded portion of the catch is large and most of these fish are immature. This means that the mortality of juvenile fish as a result of fishing is large and, as with cod, a high proportion of fish never reach spawning age.

The analysis of stock recruitment data for haddock does not reveal the same problems as that seen with cod. Thus, at present, there is not the same concern that the stock is being fished unsustainably. It is clear however, that the level of exploitation is high and as a result the fishery is highly dependent on young (albeit mature) fish. The dependence on young fish of just a few year classes means that the stock fluctuates considerably from year to year in tune with recruitment. Thus the landings are highly variable and difficult to predict. A lower exploitation rate would result in more year classes in the stock at any one time, dampening the fluctuations and leading to lower variability.

The haddock stock reached its lowest recorded level in 1991 following a series of poor year classes. The decline by 1989 was such that, in line with other roundfish, the TAC was set at a level corresponding to a reduction in fishing mortality rate. Since 1991, however, landings of haddock and the TAC have been rising. The time series of TACs, landings, and exploitable biomass are shown in figure 2.8. The TAC has reflected biomass trends but clearly up to 1989 was well above the realized landings and did not have any constraining effect on the exploitation rate. This was partly the result of political pressure to set high TACs and partly the result of assessments over-predicting the catch. From 1989, the TACs were set at lower levels. However, as can be seen from the figure, the actual landings exceeded the TAC. This is because the catch in excess of the TAC was simply mis-reported or was landed without record. Thus there has been no effective control of the exploitation rate.

Whiting

Whiting are the smallest of the three species, typically reaching a maximum length of 40 cm. They mature at an early age and many fish are capable of reproduction during their second year of life. Spawning takes place over a longer period than the other two species beginning in March and lasting as late as June. Whiting are predatory fish feeding on a wide variety of other fish including haddock and cod.

Figure 2.9 shows the stock trends estimated by ICES. A substantial component of the total catch comprises the industrial bycatch. This bycatch is taken in fisheries directed at Norway pout, sandeel and sprat and may exceed the part of the catch landed for human consumption. The fish in the bycatch are mostly small, resulting in a sequential competition with the human consumption fisheries which take large fish. This is because the smaller fish are removed

before they have time to grow large enough for the consumption fishery. Despite this, the consumption fishery itself, is responsible for a large quantity of discards. The fishing mortality rate shows no obvious trend and, on average, is somewhat lower than that for cod and haddock. Recruitment is less variable than the other two species, possibly due to the longer spawning period. Recent recruitment appears to have been lower than earlier years and as a consequence the stock biomass has declined latterly.

The analysis of stock recruitment data for whiting does not reveal any problems and the current exploitation rate is believed to be close to the 'safe' level of Fmed. Although the present exploitation regime could be improved in biological terms, there are no major concerns about the stock. The principal difficulty when evaluating appropriate TACs for whiting is related the nature of the mixed fishery. Because whiting are taken along side cod and haddock, any TAC needs to be consistent with the other species. Thus the TAC for whiting should be exhausted at the same time as that for cod and haddock. If this was not done, the cod and haddock TACs may be taken before that for whiting. This would allow a fishery for whiting which would take an unacceptable bycatch of cod and haddock that in theory would have to be discarded. As a result, the TAC for whiting in recent years has been set corresponding to a reduction in fishing mortality of the same magnitude as the other two species.

Figure 2.10 shows the time series of exploitable biomass, TAC and landings for the period of the CFP. The most notable feature in this figure is that the TAC, despite recent attempts to set it at lower levels, has been well above the landings. This means the fishery is effectively uncontrolled. The reason for the mismatch between the landings and the TAC is twofold. Firstly, for many years political pressures have resulted in much higher TACs than were recommended. Even in the most recent years, the TAC was set at the so called *status quo* level as opposed to the recommended 30% reduction level. Secondly, the assessment for whiting has a history of being unreliable and recent analysis by ICES (Anon, 1995) suggests the conventional assessment is biased. This appears to be because the estimated catch is unreliable. As is indicated above, the catch is made up to a large extent by industrial bycatch and discards. These by their nature are difficult to measure and are subject to incomplete sampling.

Multi-species considerations

Many of the major exploited fish stocks in the North Sea interact biologically as a result of predation by one species on another. Both cod and whiting are major predators not only on other fish species but on themselves. Thus the way a fish stock is exploited will have a biological effect on the stocks by altering the relative balance of predators and prey. One argument often advanced is that since whiting are a low value species and are highly predatory on haddock and cod, the stock should be kept at a low level to improve the level of the more valuable species. It is a matter of opinion whether this is desirable, and in any case, the predictive power of existing multi-species models is uncertain which means it would be very difficult to determine an optimal exploitation level precisely. An important conclusion from multi-species work, however, is that simply reducing exploitation levels does not necessarily lead to very

large increases in the stocks concerned. This is because the reduced level of exploitation allows fish to survive longer, grow bigger and become more effective predators. The higher abundance of big predators counteracts to a greater or lesser degree the effect of reduced exploitation on young fish.

Summary

All three stocks are heavily exploited with about 50-60% of stock removed by fishing annually. This high removal rate has to be balanced by incoming recruitment which in most cases is highly variable. This means the stocks themselves are very variable and the fishery has become dependent on young recruiting fish. The dependence of the fishery on recruiting fish and the absence of a precise stock-recruitment relationship means that it is very difficult to forecast future stock sizes and catches. It also means future supply is unpredictable. Paradoxically, both the cod and haddock stocks are presently increasing after a period of decline as a result of recent good year classes. However, the underlying problem with cod is serious and there are reasons to expect this stock to decline further in the long term or even collapse. Landings trends were outlined in figure 2.2 and it is interesting to note that the value of roundfish landings has more than halved in the period 1980-1993.

During the early period of the CFP, TACs were set at levels which did not restrict the fishery. More recent attempts to reduce the exploitation rate by setting TACs at levels corresponding to a 30% reduction in fishing mortality rate have simply resulted in a component of the catch above the TAC being landed illegally. Thus there has been no effective managerial control of the fisheries. Recent scientific recommendations have been for managers to reduce effort directly rather than rely on TACs (Anon, 1990) to control exploitation rate.

For figures 2.4 - 2.10 the following source has been used:
Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (ICES, 1995) and Extract of the Report of the ACFM on the Stocks in the North Sea to the NEAFC (ICES, 1995).

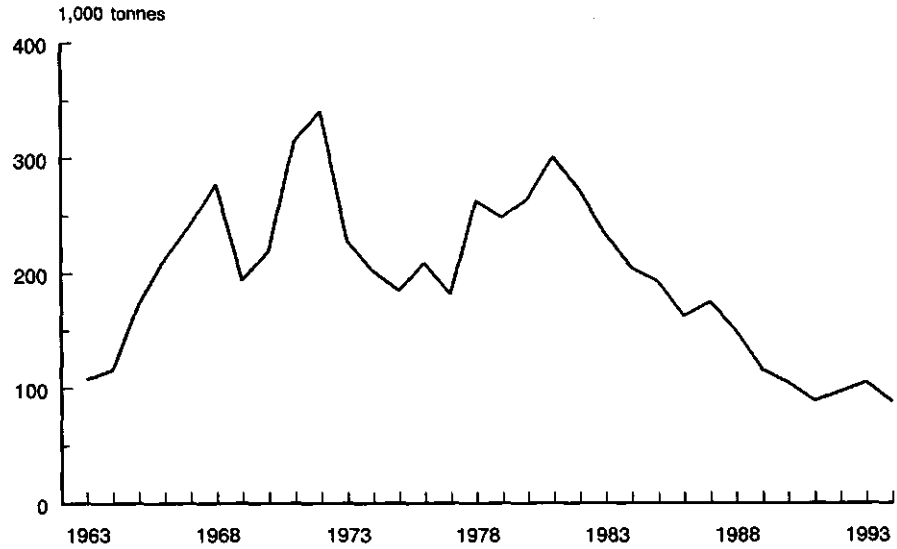

Figure 2.4a Cod - long term stock trends, yield

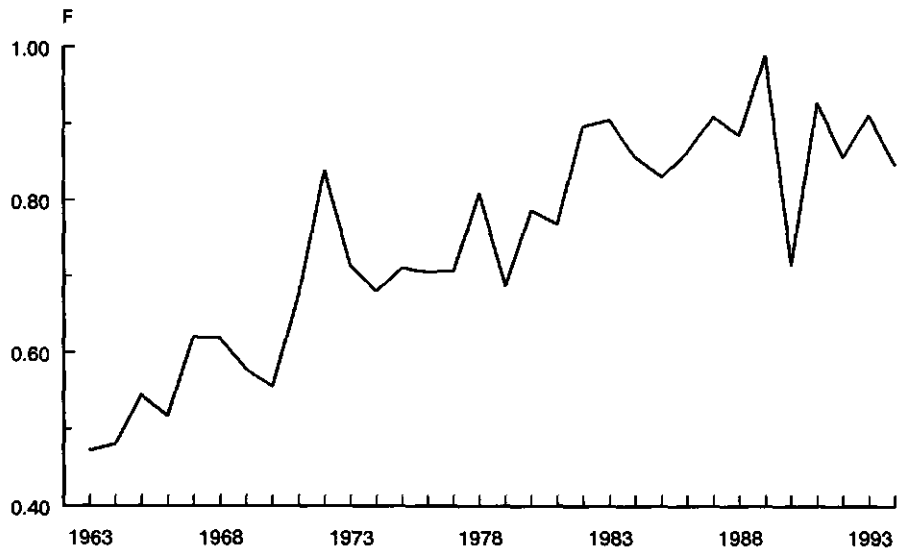

Figure 2.4b Cod - long term stock trends, Mean Fishing Mortality

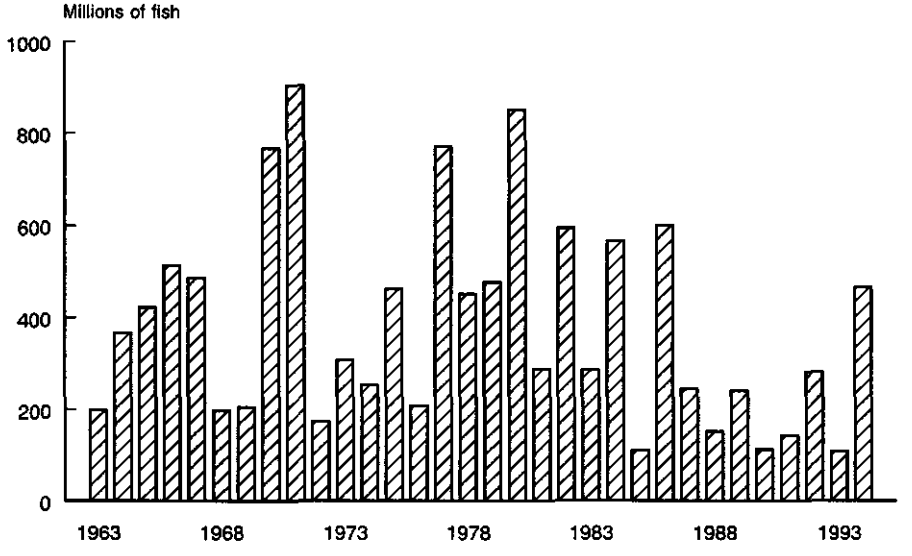

Figure 2.4c Cod - long term stock trends, Recruits at age 1

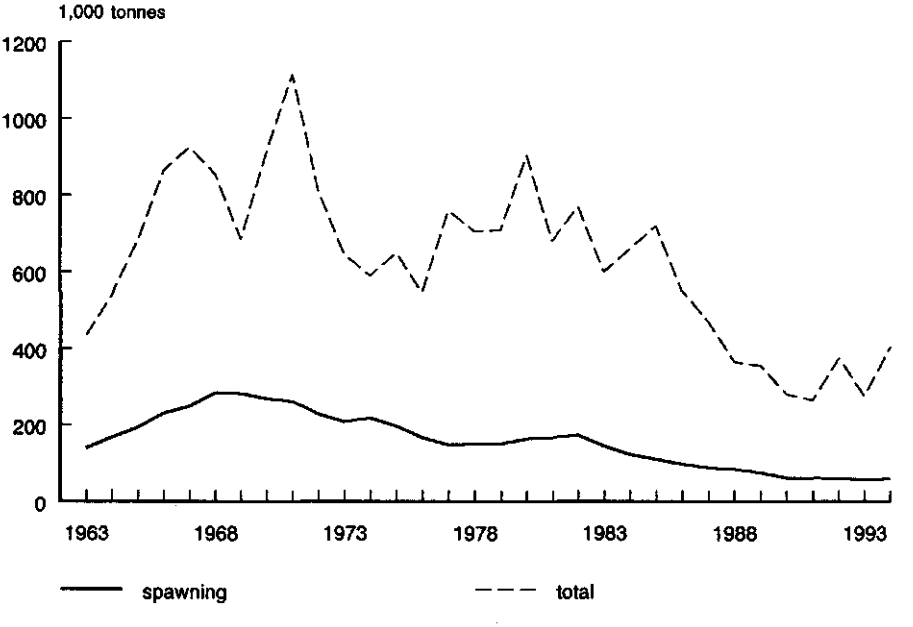

Figure 2.4d Cod - long term stock trends, Biomass

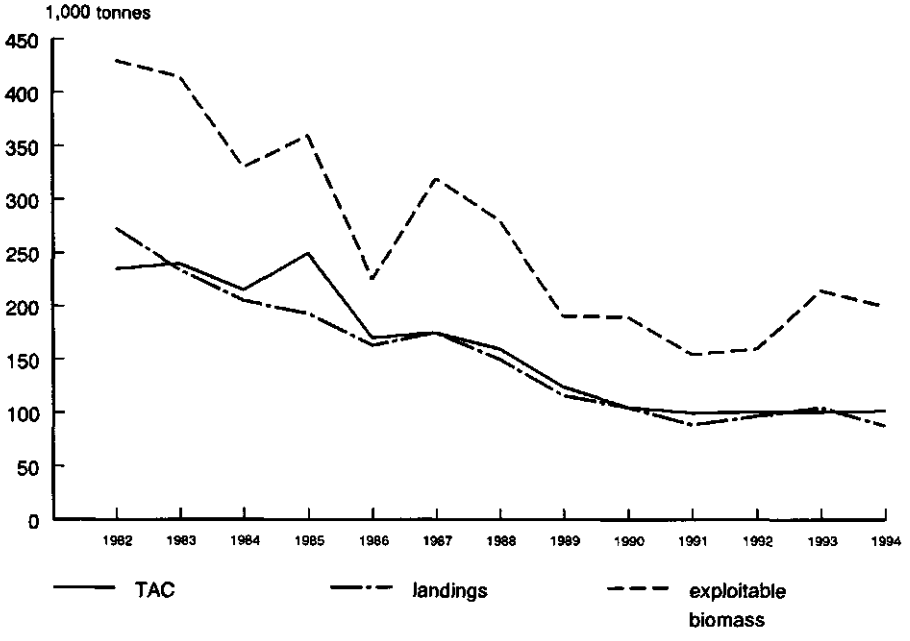

Figure 2.5 Cod - Recent trends in TAC, landings and biomass

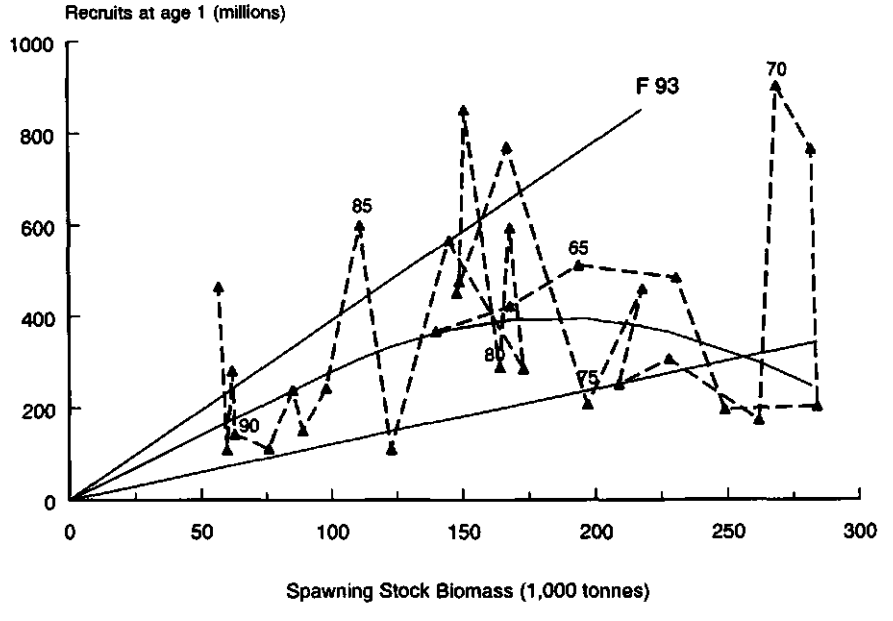

Figure 2.6 Cod - stock recruitment data. The observed points are joined as a time series; the fitted curve is a Shepherd function

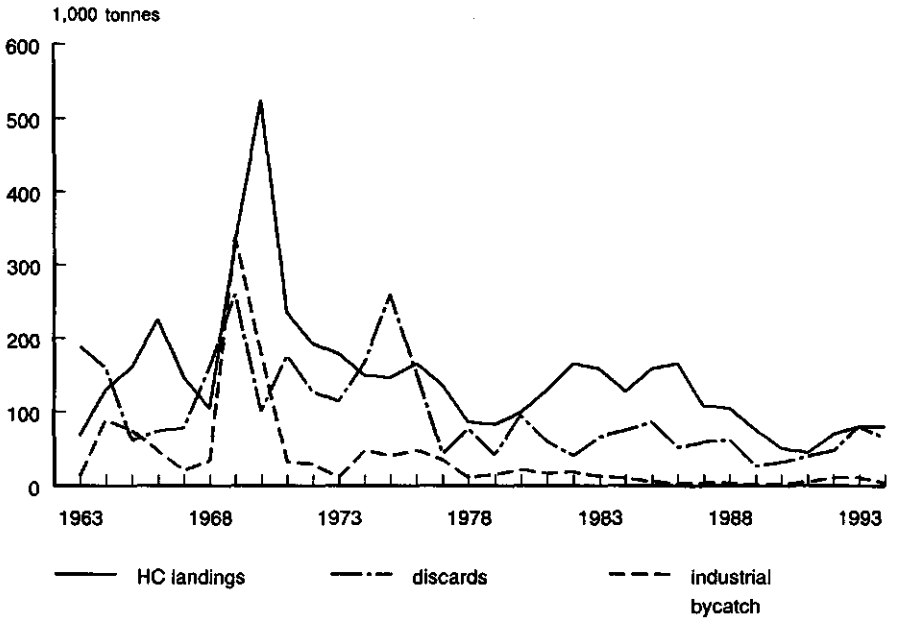

Figure 2.7a Haddock - long term stock trends, yield

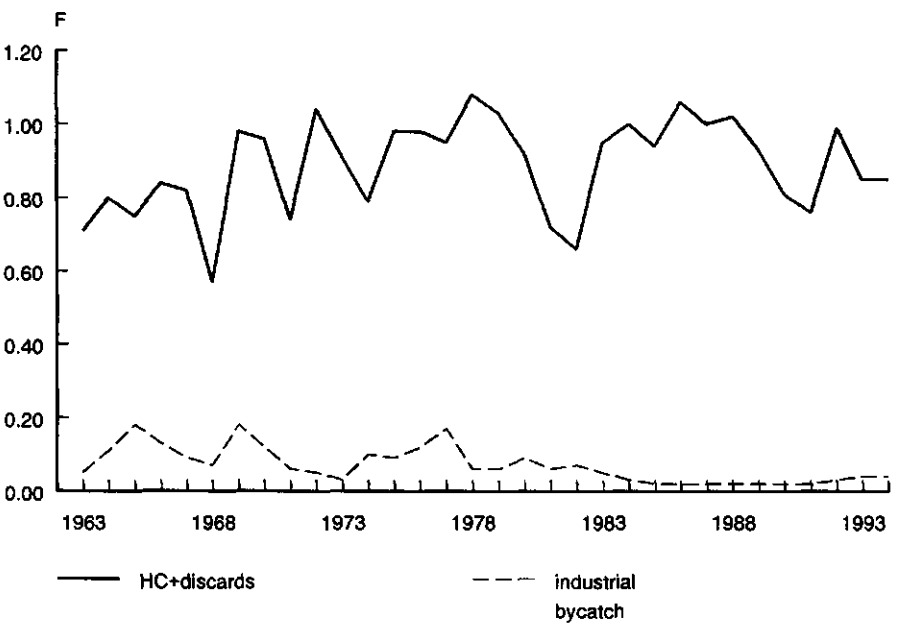

Figure 2.7b Haddock - long term stock trends, Mean Fishing Mortality

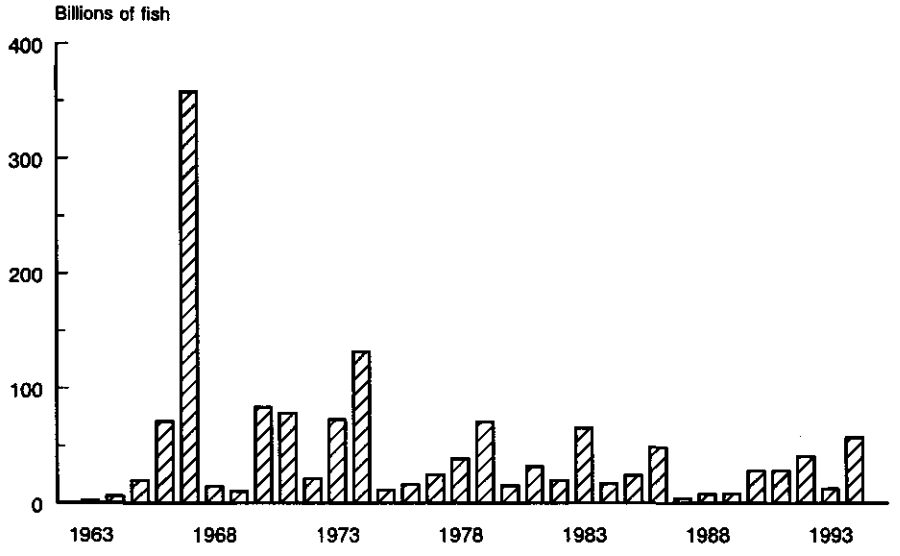

Figure 2.7c Haddock - long term stock trends, Recruits at age 0

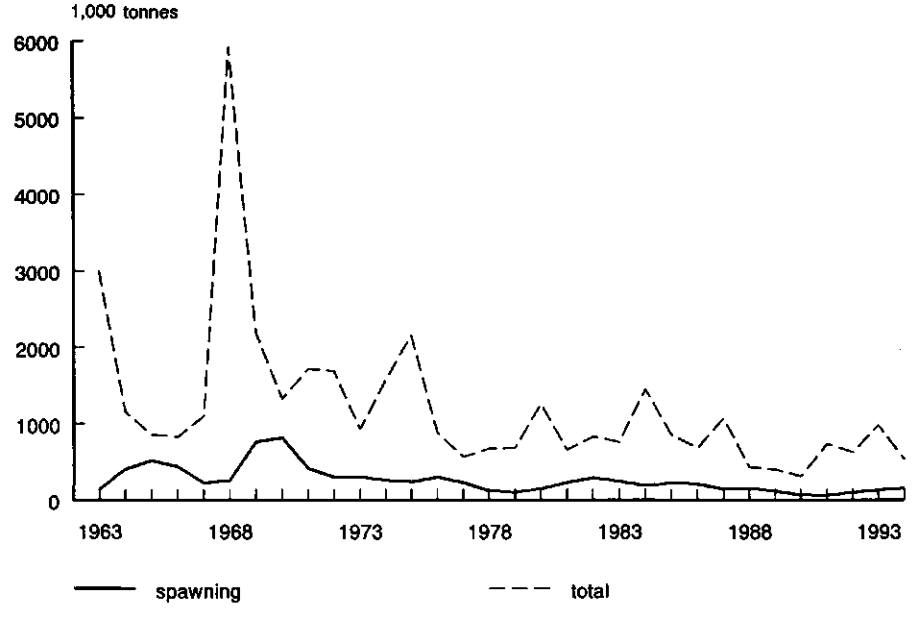

Figure 2.7d Haddock - long term stock trends, Biomass

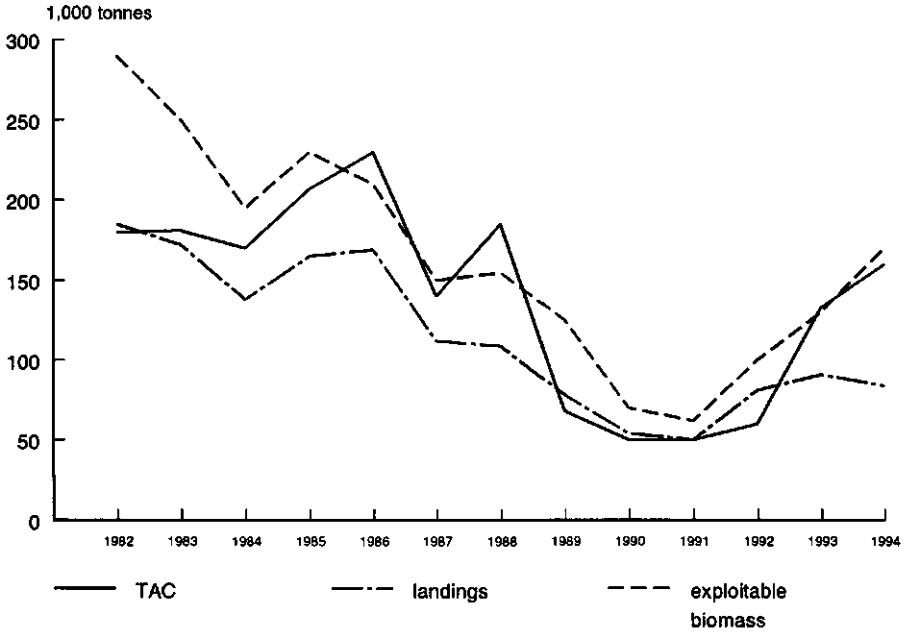

Figure 2.8 Haddock - recent trends in the TAC, landings and biomass

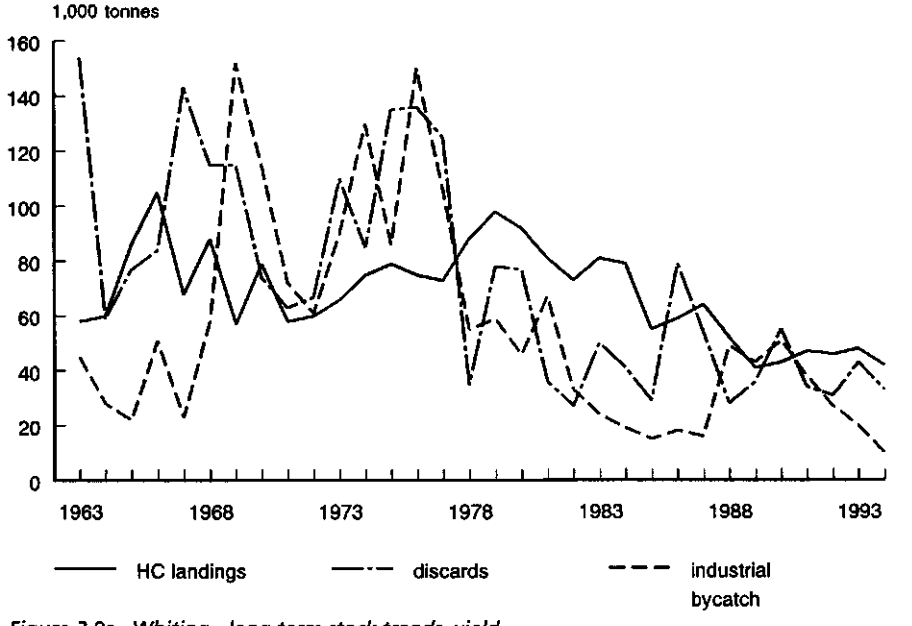

Figure 2.9a Whiting - long term stock trends, yield

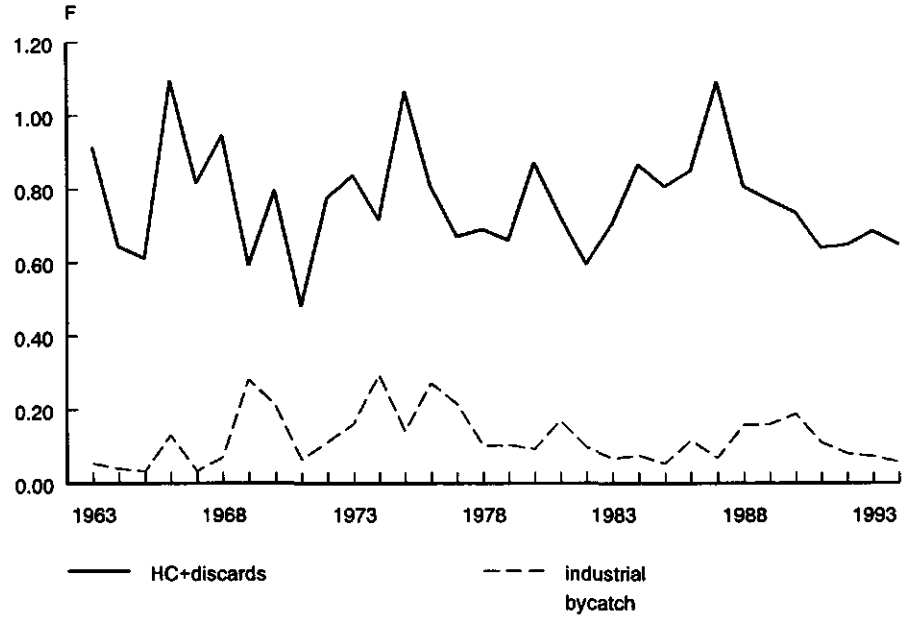

Figure 2.9b Whiting - long term stock trends, Mean Fishing Mortality

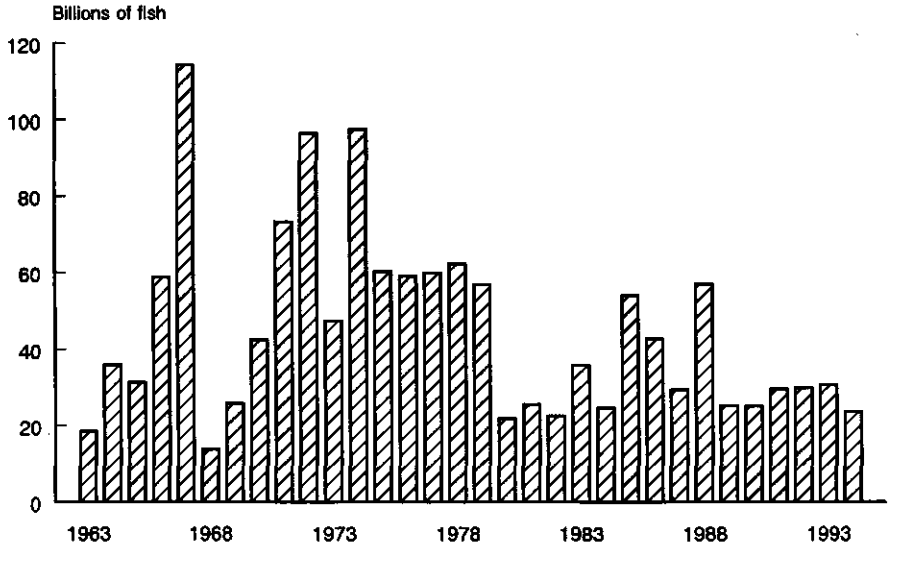

Figure 2.9c Whiting - long term stock trends, Recruits at age 0

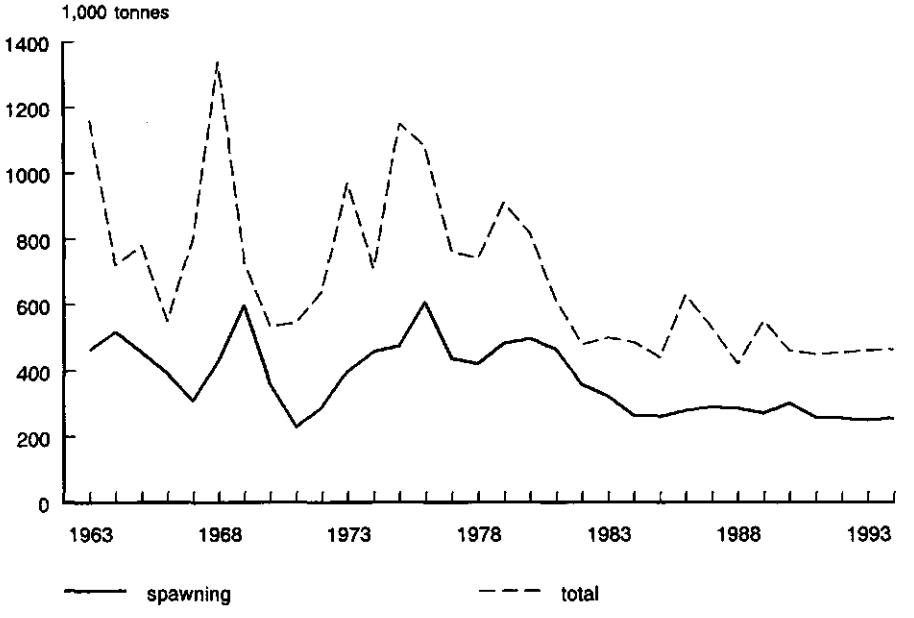

Figure 2.9d Whiting - long term stock trends, Biomass

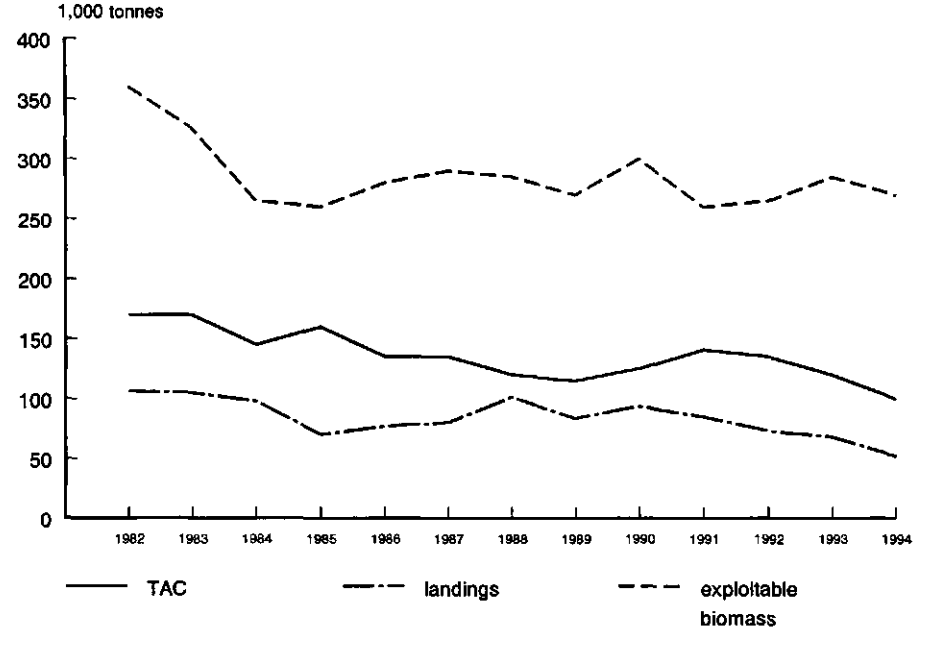

Figure 2.10 Whiting - recent trends in the TAC, landings and biomass

2.3 Regulations

Existing regulations governing fishing activity in the North Sea are formulated at both national and EU levels. However, enforcement of each of the regulations is the responsibility of Member States.

2.3.1 EU Regulations

The major EU regulations can be considered under the following headings:

- TACs and quota;
- structural policy;
- technical conservation measures.

TACs and quota

Total Allowable Catches and associated Member State shares form the core of fisheries management in the North Sea and govern how much of each pressure stock Member States are permitted to catch. Cod, whiting and haddock are all subject to TACs which are formulated annually on the basis of scientific advice.

The total cod TAC for 1994 was set at 102,000 tonnes. The UK received the largest share of this quantity with an allocated quota of 43% followed by Denmark 19%. Germany's quota for 1994 was approximately 12%, the Netherlands 11%, Norway 9% and France 4%.

The haddock TAC for 1994 was set at 160,000 tonnes of which approximately 138,000 tonnes was allocated to the human consumption fishery. The remainder of the TAC constitutes an unallocated allowance for industrial bycatch. The UK was allocated the largest portion of the human consumption TAC (67%). Norway was the next most important country (15%) followed by France (7%), Denmark (6%) and Germany (4%).

The whiting TAC for 1994 was 100,000 tonnes. However, only around 77,000 tonnes was allocated to countries involved in the human consumption fishery, the remainder being the unallocated industrial bycatch allowance largely taken by Danish industrial trawlers. The UK quota share of the TAC after deduction of the industrial bycatch component was 46%, France had just over 17%, Norway 13%, Denmark 12% and the Netherlands 7%.

Structural policy

The principal tool of the EUs structural policy is the Multi-Annual Guidance Programme (MAGP) which specifies targets for the reduction of fishing capacity in each Member State by fleet segment. The targets do not apply to Norway. The reductions which are specified in terms of both GRT and kW are required to be met by the close of 1996.

Roundfish in the North Sea are caught using the trawl or seine method. MAGP III, which outlines capacity reductions for the period 1993-1996 acknowledges there is excessive capacity in the trawl and seine fleets of the UK and Denmark and also overcapacity in the French trawl fleet. Each of these fleets

is required to reduce capacity by 20% from their 1992 levels by the close of 1996. The trawl fleets of Belgium and Germany are also required to meet the same percentage reduction targets. However, their fleets are much smaller in terms of kW and GRT, hence the capacity reductions are of much smaller significance (e.g. the combined GRT of the Belgian trawl fleet is only 7% of the corresponding UK fleet).

The Netherlands has no specified capacity reductions to attain for its trawl fleet although capacity in its cutter fleet is to be reduced by 15%. However, these vessels are largely involved in catching flatfish.

Technical conservation measures

A plethora of technical measures is currently in force in the North Sea to support the TAC-based management regime and structural measures listed above (see table 2.2).

The minimum permitted mesh size for fishing nets deployed in the North Sea is currently 100 mm (diamond mesh). However, nets of 100 mm or greater can legally be equipped with a panel or window in the upper part of the cod end (attached to the joinings or selvages) consisting of square mesh netting with diameter equal to or greater than 90 mm. Nets with minimum mesh sizes greater than 90 mm are prohibited to have circumferences of more than 100 meshes excluding the net joinings and selvages.

Technical measures are complicated by the existence of a number of mesh derogations which permit the use of smaller mesh sizes if certain species are targeted. The principal mesh derogations are outlined in the table overleaf and are associated with whiting (90 mm), nephrops (70 mm), sole (80 mm), pelagic stocks (40 mm), prawns (40 mm) and industrial fisheries (16 mm).

It should be emphasized that vessels fishing under a mesh derogation are required to observe specified bycatch rules to ensure that excessive quantities of other pressured species are not landed.

The following minimum landing sizes are currently being enforced for cod, whiting and haddock:

- cod 35 cm;
- haddock 30 cm;
- whiting (UK) 27 cm;
- whiting (EU) 23 cm.

A number of closed/restricted areas in the North Sea have been designated with the aim of protecting certain species and spawning stocks. The following merit brief comment:

- the Shetland box;
- the Plaice box;
- the Norway pout box.

Shetland box

This covers an area of sea to the north of Shetland into which fishing access is restricted. All vessels fishing in this area must be licensed and registered with the UK government.

Norway pout box

The Norway pout box is an area of some 30,000 square miles within the British 200 mile fisheries limit off the coast of Scotland in which it is prohibited to fish for Norway pout using small mesh nets. The box was designated in 1977 with the aim of reducing fishing mortality on juvenile haddock and whiting.

Plaice box

The regulations associated with the Plaice box are enforced by the Dutch government. Beam trawlers with engine powers of more than 221 kW are prohibited from fishing in the box between the 1st of April and the 31st of December. The box was designated with the aim of protecting juvenile plaice.

Table 2.2 Existing mesh derogations in the North Sea

Target species	Minimum mesh size (mm)	Minimum % a) target species		Maximum % a) protected species
Sole b)	80	5		100% of which not more than 10% is cod, haddock and saithe.
Whiting	90	70		100% but plaice must not exceed 10%.
Mackerel	40	50		10
Horse mackerel	"	50		10
Herring	"	50	or 80%	10
Pelagic cephalopods	"	50	cumulative	10
Pilchards	"	50		10
Blue whiting	"	50		10
Norway lobster	70	30		60
Prawns	40	30		50
Argentines	30	50		10
Eels	16	20		10
Norway pout c)	16	50		10
Sandeels d)	16	50		10

a) Relates to permitted catch on-board; b) Except Pout box; c) Minimum mesh size only operates from 1st of November until the last day of February. Bycatch restrictions are enforced outside this period; d) Applies to North Sea south of latitude 55° N.
Sources: Sea Fisheries Protection Agency, Scottish Office; Agriculture and Fisheries Department.

2.3.2 Local/national policies

United Kingdom

In the UK, all boats fishing commercially require to hold a fishing licence. While previously this legislation only applied to vessels over 10 metres in length, it has now been extended to all vessels irrespective of length.

Rules governing licences are rather complex and one vessel may in fact be required to hold a number of licences to fish legally. Pressure stock licences have been used as the principal mechanism to constrain capacity in the pressure stock sector. Under existing licence aggregation rules, vessel owners wishing to replace a vessel with a newer craft of greater capacity must effectively purchase licences equivalent to 120% of the capacity of the new vessel. The aggregation penalty is reduced to 110% if the new vessel is of the same capacity as the one leaving the fleet.

Responsibility for the management of quota is delegated to POs (Producer Organizations) who are allocated fishing quota by the UK government on the basis of track record and then left to distribute fishing rights to their member vessels. The UK government is, however, responsible for allocating quota to vessels who are not members of Producer Organizations. These vessels belong to the 'Non Sector'.

The UK has a number of MAGP targets to attain by the end of 1996 and so far has organised two annual decommissioning rounds based on a tendering process. A total of £ 53 mln in decommissioning money has been allocated to the process over a five-year period.

Netherlands

In the Netherlands the legislative regime governing the allocation of quota is fairly elaborate. A days-at-sea regime is also enforced.

Currently vessels engaged in the North Sea roundfishery must be in possession of a 'document' which is essentially the equivalent of the UK pressure stock licence. Three such documents now exist:

Cod document - These were first issued in 1981 and reserved for a small group of vessels deemed totally dependent upon roundfish.

Roundfish/Year document - First issued in 1988 these documents were issued to vessels which had been over 65% dependent upon roundfish in two of the years 1984-86.

Seasonal document - For those who had been dependent on roundfish for over 25% in 1987.

Since the beginning of 1994 an ITQ regime has been in operation whereby document holders are allocated individual roundfish quota which may be traded subject to certain rules. Quota may also be pooled within a PO-group. In 1994, non-document holders were permitted to land 2,200 kg of cod and 2,000 kg of whiting per month.

Dutch fishing effort is currently controlled by additional days-at-sea restrictions which in 1994 allowed cod and year document holders to fish for 172 days and seasonal document holders 152 days. In addition to the Dutch decommissioning scheme, fleet capacity is restricted by HP-licences which constrain engine power. On transfer these are reduced by 10%.

While the ITQ system in the Netherlands is fairly elaborate, it would appear that the effort controls limiting days-at-sea have in fact exercised the principal constraint on the fleet.

Denmark

In Denmark, the government controls the allocation of quota. In the case of vessels fishing for cod and haddock, quota is set on a quarterly basis to avoid a 'run' on the species and an Easter stop is imposed on fishing for both species. Cod quota is also distributed on the basis of vessel length. It should be emphasized that Danish regulations governing minimum landing sizes for cod and haddock are somewhat more stringent than those imposed by the EC. Restrictions on bycatch of protected species are also tighter.

To attain the goal of capacity reduction, capacity is managed by a 'Committee for Capacity'.

France

There is not an elaborate system of quota management for vessels involved in fishing for roundfish in the North Sea. Vessels fish against a national quota.

France is currently engaged in a process of decommissioning in order to attain its MAGP targets. It also operates a permit system entitled PME (Permis de Mise en Exploitation). Under this regime, investment in fishing capacity (measured in kW) must be accompanied by a higher reduction in capacity of the existing fleet.

Norway

Norway not being a member of the European Union does not have any MAGP targets to attain to eradicate overcapacity. It is, however, currently operating a decommissioning scheme.

Norwegian vessels are predominately involved in the saithe and industrial fisheries and consequently cod, haddock and whiting tend to be taken as a bycatch of these fisheries. Vessels involved in the saithe trawl fishery must be in possession of a valid licence.

While there is no national days-at-sea legislation in operation, discarding is currently banned by the Norwegian government.

Germany

In the deep sea fisheries in which Germany is involved fishing quota tend to be allocated to fishing companies. Similary to Norway, the larger vessels in the cutter fleet tend to target saithe and individual saithe quota are issued to each vessel. However, for the remainder of the cutter fleet in the North Sea fishing for cod and other roundfish there appears to be no formal system of quota management and as a result, vessels are entitled to fish against general quota.

In order to control capacity, Germany does operate a formal decommissioning scheme and vessel licensing system. All vessels which have fished during the period 1986/87 have a legal claim to hold a fishing licence. Access is only permitted in the case of vessel sinkings, replacements, constructions or modernizations if the MAGP fleet segment target has been attained.

The above measures are deemed sufficient to constrain national fishing effort and hence there are no formal days-at-sea limitations.

Belgium

The Belgian impact on the roundfish fishery is small in terms of landings volume. While special arrangements exist for vessels fishing for sole, there does not appear to be any formal quota management system for vessels fishing for cod, haddock or whiting.

Capacity is controlled through a decommissioning scheme and the operation of a vessel licensing system; the latter came into force in 1988. No new licences have since been issued and new constructions must be replacements of old vessels in terms of horse power and gross tonnage. This said, since mid 1994, the Belgian government has been permitting the aggregation of licences to entitle vessel owners to build a larger vessel. However, the new construction is limited to a maximum of 385 GT, 1,200 HP and 38 m in length.

There are currently no days-at-sea restrictions in Belgium. This instrument of effort control was dispensed with at the end of 1992.

Conclusion

From an examination of the EU and national regulations it would appear that the North Sea roundfish fishery is very heavily regulated. The regulations are, however, very difficult to enforce and do not appear to have substantially reduced the overexploitation of roundfish stocks.

2.4 Definition of the management problem

The management problems which exist in the North Sea roundfish fishery are best examined in the context of the evaluation criteria which are discussed in the chapter on Methodology. As the UK exerts the dominant influence in the roundfish fishery, it would seem appropriate to examine the management problems from the perspective of this country.

2.4.1 Economic considerations

Flexibility

While theoretically TACs should have a constraining effect on the operations of North Sea fishermen they have not, in practice, been effective in fulfilling this function. As discussed in section 2.2, attempts to reduce fishing mortality by reducing TACs have exacerbated the practices of mis-reporting, discarding and illegal landings. It is therefore questionable to what extent the existing management mechanisms have constrained the activities of fishermen.

Planning

The annual December Council meetings at which TACs are set, undoubtedly cloud the planning horizon for fishermen. This is likely to be particularly problematic for the Scottish fleet, given its dependence on the haddock TAC which has been relatively more variable than that set for cod in successive years.

Investment in fishing capacity is further constrained by a number of factors including the requirement to hold a pressure stock licence and the rules governing new and replacement vessels (i.e. 120% of capacity must be purchased to secure a licence for a new vessel).

While the above may constrain investment, planning is enhanced by the system of quota management which effectively allows Producer Organizations to manage quota and allocate it to member vessels.

Market consistency

The existing extent of overcapacity in the fishery and consequent 'race to fish' undoubtedly serve to destabilize the supply of fish to the market. It is arguable that 'racing to fish', constitutes rational behaviour at the level of the individual vessel. For example, there is a strong reason to fish heavily at the beginning of the year if it is believed that the full quota will not be fully taken due to inadequate levels of stock abundance. Moreover, there is a time preference associated with catching fish sooner rather than later given that income has an opportunity cost with respect to forgone interest and there is reason to suspect that fishermen may operate with high discount rates. Lastly, bad weather towards the end of the year makes it rational to fish harder for cod, haddock and whiting in earlier months.

Daily practice

The mixed nature of the roundfish fishery inevitably makes it difficult to manage individual species particularly when they have different characteristics in terms of size, spawning age and abundance as do the gadoids. To that end, individual TACs may not appear to be all that realistic in terms of their consistency with the daily operations of fishing vessels.There are further problems associated with applying technical measures to the fishery. The 100 mm minimum mesh size has proved ineffective in protecting stocks of juvenile cod and it is possible that a mesh size of 130-140 mm would be required to ensure adequate protection. Clearly the imposition of such a measure would have serious of implications for the ability of the Scottish fleet to capture significant quantities of haddock and whiting.

Race for fish

The current quota management system does have an attenuating influence on the race to fish given that many Producer Organizations allocate quota to individual vessels. This is significantly preferable to fishing against a general quota. However, there are factors in the fishery which still serve to cause vessels to race for fish which are discussed under 'market consistency'.

Economic performance

It is difficult to make a judgement on the effects of the current management system on economic performance without detailed analysis of cost and earnings information. However, excess capacity does suggest that there may be a depressing effect on the earnings of individual vessels, given the large number of vessels competing in the fishery.

The factors which contribute to this capacity problem and the associated excessive levels of exploitation of roundfish are economic in character and are caused by the existence of an inherent market failure. The market failure manifests itself in the divergence of the marginal private and marginal social costs of fishing with the latter being the higher of the two. This is also a cost which, in the current regime, is not borne by the individual fishing vessels in the course of their activities. These costs are commonly known by economists as *externalities*.

Congestion cost externalities are particularly prevalent in the North Sea roundfish fishery and exist because there is substantial overcapacity in the fleet relative to the abundance of the stock. The activities of one vessel therefore raise the marginal fishing costs for others in the fleet which exploit the fishery.

A potentially more prominent cost externality is the inter-generational cost externality associated with the current levels of fishing. Excessive exploitation of North Sea stocks at present has serious implications for the catching and consumption of fish by future generations and thus for those generations to derive an income and employment from fishing. The inter-generational costs of current fishing practices are thus the potential revenues lost by future generations of fishermen.

None of the existing management regimes being implemented in the North Sea involve the above costs being implemented into the cost functions of fishing vessels, the price signals which govern fishing behaviour and the decision to enter/exit the industry are fundamentally distorted. Overfishing is the result and the fishery is economically inefficient. Those inefficiencies manifest themselves in rent dissipation, rising average fishing costs and excessive fishing capacity.

2.4.2 Biology

Spawning stock/fishing mortality

The spawning stock biomass (SSB) for North Sea cod is currently estimated to be only a third of the 150,000 tonnes which the ACFM contends is the safe biological level. The SSB for haddock also declined to an historic low in 1991 but has since made some recovery and is currently estimated to be in the region of 80,000 tonnes. There do not appear to be serious concerns at present about the abundance of whiting.

The North Sea roundfish fishery is in general, very heavily exploited with around 50%-60% of the stock being removed annually by fishing. These problems are compounded by the variability of recruitment (particularly for haddock) which in turn explain the variability of landings.

High-grading

This is discussed at length in section 2.5. The dependence of the fishery on juvenile fish, however, and therefore lack of mature fish suggest that a concerted strategy of high-grading is unlikely to occur in the fishery at present. This is not, however, to say that high-grading will not occur on an ad hoc basis from time to time.

Discarding

There is a fairly high incidence of discarding in the North Sea roundfish fishery at present which may partly be a symptom of the more recent reductions in the levels of TAC which have been implemented with the intention of achieving a reduction in the levels of fishing mortality. Although cod does not appear to be heavily discarded there are fewer countries involved in the fishery for haddock and whiting with the Scottish fleet being the only major country exploit these species. As a result there is a fairly high level of discarding of these two species of roundfish.

Ecosystem management

The environmental implications of the existing fisheries management measures in the North Sea are as yet unclear although it is notable that there has been a switch away from using the more destructive heavy ground gear to a lighter more economical trawl which may potentially have environmental benefits.

The incidence of discarding undoubtedly has environmental impacts to the extent that it is both wasteful and may serve to swell the population of scavenging sea birds.

As discussed in section 2.3, a number of restricted fishing areas in the North Sea have been created with the intention of protecting juvenile roundfish stocks. They are:

- the Shetland box;
- the Norway pout box;
- the Plaice box.

2.4.3 Policy and institutions

Political acceptance

The responsibility for implementing the current management system based on TACs and technical measures belongs to the Ministry of Agriculture, Fisheries and Food (MAFF) and the Scottish Office Agriculture and Fisheries Department (SOAFD). In the UK as a whole, some 230 shore-based and administrative staff are involved in the enforcement process. In Scotland, most successful prosecutions involve the application of a fine or the confiscation of gear. As many as 300 cases may go to the Procurator Fiscal every year with around a third going to court and successfully convicting the offender. Licence suspension does not appear to occur in the UK as a penalty for breaking management regulations.

Sectoral acceptance

The current system does give rise to numerous disagreements between the government and the industry and therefore sectoral acceptability is often tenuous. There are frequent verbal conflicts when TACs are reduced and it is probable that these would increase in intensity if TACs were reduced in line with the ACFM recommendations seeking a cut of 30% in the level of fishing mortality for roundfish.

The quota management system (i.e. via POs) appears to have been accepted by the industry but there are some concerns with respect to the complexity of the licensing system. In addition licences have been extended to vessels smaller than 10 metres in length.

In addition there were serious disagreements between the UK government and the industry over the proposed 1992 Sea Fish Conservation Bill whichsought to limit days-at-sea for UK fishermen. The fishermen took their case to the European Court.

National enforcement

On the basis of resources devoted, enforcement in the UK appears to be fairly stringent. Scottish waters are the responsibility of the Sea Fisheries Protection Agency while the English segment of the North Sea is policed by the Ministry of Agriculture, Fisheries and Food. In England & Wales enforcement is strengthened by the existence of thirteen Sea Fisheries Committees responsible for enforcement within the six mile limit (four of these oversee inshore activity in the North Sea).

Total government expenditure on enforcement in 1992/93 totalled £ 6.5 mln (MAFF, 1995). Of the 230 shore-based staff, 170 are shore-based inspectors. A squadron of 5 aircraft performs aerial surveillance duties and some 17 vessels are involved in surface surveillance, 9 belonging to the Royal Navy and 8 to the respective Departments.

Subsidiarity

As indicated in previous sections, the current management system does facilitate subsidiarity given the role of Producer Organizations in the management of quota.

Local communities

Many locations (particularly in Scotland) are heavily dependent upon fishing given a lack of employment diversification in their local economies. Large swings in haddock TACs may fall very heavily on those communities.

Beyond 2002

This does not seem to be a particular issue at present amongst fishermen although there is a movement in the industry which now supports full withdrawal from the CFP.

While it is likely that the fishing sector would like to see some increase in its flexibility to fish, this is unlikely to happen until the problem of overcapacity and resultant overfishing is eradicated.

2.4.4 Other considerations

Consistency

The current management system is reasonably consistent given that there is a clear division of responsibilities in respect of its implementation.

Transparency

The quota management system does add a degree of transparency to the existing regulatory regime given that in most cases, vessels who are members of POs will receive an allocated quota. The licensing regime, however, is more complex as are the rules governing new construction or replacement. Technical measures can also become relatively complex.

New problems

Given the way in which the existing management regime in the roundfish fishery functions, the problem of overexploitation is unlikely to weaken. While there are measures in place which ensure that access to the fishery is not totally unrestricted (e.g. requirement to hold a pressure stock licence, rules governing vessel replacement in which a replacement to the fleet must buy-out 120% of the capacity it replaces), the vessels already fishing are not in current circumstances forced to bear the marginal social costs of their activities and as such, the true costs of overfishing are not apparent to them.

Further attempts to reduce fishing mortality by restricting TACs alone are unlikely to prove effective in conserving roundfish stocks. They will instead, given current fleet overcapacity, further worsen the problems of misreporting, illegal landings and discarding. This will place further pressure on finite enforcement resources. In addition, the age structure of the stock is likely to narrow further a particularly worrying issue for North Sea cod given scientific concerns about the possible collapse of the stock.

Part B Evaluation of management measures

2.5 Multi-annual quantity measures

Five variants of MAMs are explicitly evaluated in appendix 2.1. Most such measures involve the setting of annual TACs for each species a number of years in advance (possibly 2-4 years ahead of the data available).

Under a hypothetical MAM regime, the annual process of negotiation associated with the fixing of TACs is eradicated but the necessity of forecasting changes in stock abundance and obtaining accurate scientific advice becomes ever more apparent.

The five forms of MAM regime considered in appendix 2.1 are listed below. Definitions of these measures can be found in the methodology section of the report:

- annual equal quantity;
- limited compensation;
- limited adjustment;
- minimum size of spawning stock;
- constant formula.

2.5.1 Economic implications of MAMs

Setting a TAC a number of years in advance reduces its ability to track unexpected annual changes in stock availability. While this is less problematic in fisheries where stocks have been historically stable, for instance in the case of North Sea flatfish, clearly it is inappropriate in the case of the mixed roundfish fishery where catches and recruitment of haddock and cod have been very variable in the past.

It is anticipated that the application of most forms of MAM to the North Sea roundfish fishery would impede the *flexibility* of the fishing operation relative to existing regimes. Observed variability in the availability of North Sea haddock and cod stocks (and the problems of forecasting changes) together with the removal of the annual TAC setting process suggest that MATACs for these species would become increasingly misaligned with stock availability thus resulting in an increasing mis-match between the permitted levels of fishing and fishing opportunities.

Limited compensation MAMs might well alleviate these problems to the extent that they would permit a limited degree of borrowing of the following year's TAC if stocks proved to be more buoyant than forecast. In the short term, this would avoid early exhaustion of certain TACs (for administrative reasons) and would probably have some short term beneficial influence on the *economic performance* of the fishing fleet. It also appears a more *realistic* management regime in terms of adherence to *daily practice*. It is to be expected however, that there would be a multitude of longer term problems associated with this measure which are discussed below.

Excessive EU fishing capacity relative to the availability of roundfish stocks could lead to excessive borrowing and it is thus to be expected that in the medium to longer term, economic conditions for vessels would become increasingly tight as TACs for future years were progressively reduced. The implications for the *economic performance* of vessels in the medium to longer term are likely to be detrimental. This factor coupled with the scientific advice seeking a 30% cut in the level of fishing mortality suggests that the level of permitted borrowing per vessel would in fact be very small, the positive impacts on vessel flexibility are therefore likely to be marginal.

It is conceivable that MAMs might serve to enhance *market consistency* in the longer term by ensuring some degree of annual supply stability over several years. In most cases, however, MAMs still involve the setting of annual TACs; early quota exhaustion (e.g. as happened with the haddock TAC towards the end of 1991) is still possible with the attendant problems of supply scarcity and rising price levels. These problems are magnified if TAC measures alone are used to achieve the required cut in fishing mortality without directly restricting the effort applied to the fishery.

The compensation scheme differs slightly from the type of MAM discussed in the paragraph above. However, given the fact that there is a time preference for taking catch now as opposed to later, excessive fishing capacity in the North Sea is likely to result in an acceleration in the *race for fish* with associated market gluts and poor prices. Any form of MAM allowing quota to be

transferred would either require to charge interest on borrowing or would have to set administrative ceilings on the extent of permitted borrowing. Still, borrowing would not solve the problem given the overcapitalized nature of the fleet. The current rigidities would remain.

MAMs in the North Sea would be economically beneficial to the extent that they would enable vessel operators to *plan* more effectively as they would be spared the annual uncertainties associated with the December Council meetings and subsequent changes in TACs (assuming allocation at the level of individual vessels). Of course it would not be possible to plan the effort required to take the quota.

While MAMs have been evaluated on the basis of economic criteria, it must be emphasized that none of the measures considered even address the economic problems which are endemic in the fishery. To recall, the problem of overcapacity and excessive exploitation of roundfish are undoubtedly explained by the failure of vessels to internalise the full social costs of fishing in their production decisions. The wrong signals are sent, fish are viewed as a free resource by those already involved in the sector and excessive fishing occurs. The *race for fish* problem remains and may even intensify under an MAM regime if the scheme and the forecasting advice of scientists are not viewed by fishermen as credible.

One variant of a MAM regime discussed only briefly involves the application of a constant formula to the fishery (e.g. achieving an x% reduction in fishing mortality per annum). It is difficult to make a generalization as to the economic benefits of this type of regime as the economic implications are ultimately dependent upon the rule that is implemented.

2.5.2 Policy and institutions

In many ways the MAMs under consideration are similar to the existing conservation regimes operating in the North Sea. It is very unlikely that their application would have a detrimental impact on *relative stability* in the EU (ie. the quota shares allocated to each country). It is also conceivable that the measures would depoliticize aspects of the decision making process by eradicating the annual meetings which set the TACs.

In the longer term, it is possible to envisage MAMs running into problems of *sectoral and political acceptability* because of factors specific to the North Sea round fishery.

The observed variability in recruitment and catches of haddock and cod over the years increases the chances of TACs failing to track unpredicted changes in stock availability. In years where the species are particularly scarce, the retention of a TAC agreed a couple of years earlier is unlikely to be resisted by the industry. Although it would present numerous conservation problems.

Problems would arise where a particularly good year class emerged but the TAC was not raised to compensate for the improvement in the availability of the species. While this may have obvious conservation benefits, particularly in such an overexploited fishery, the industry is likely to resist it, possibly in-

creasing the volume of juvenile fish landed illegally. This would exacerbate *enforcement* difficulties.

The political acceptability of MAMs is also likely to be weakened in the longer term. While in the short term the removal of the annual December negotiations might appear to depoliticize the TAC setting process, it would undoubtedly politicize the decisions of scientists and lead to an even more contentious and protracted debate every three or four years to replace the annual negotiating process. The overexploitation of North Sea cod in particular makes it imperative that scientists set the MATAC at a sustainable level.

Change becomes ever more complicated to implement as a fishery becomes more heterogeneous in nature. As evidenced in section 2.1, despite the relative dominance of the UK, the North Sea roundfish fishery is fairly diverse in terms of the variety of countries involved and the diversity of fishing methods employed. This increases the likelihood of conflicts arising as a manifestation of different fleet and country objectives.

In considering the compensation variant of the MAM, the pressured nature of most of the roundfish stocks under consideration and the relative overcapacity in the fleets prosecuting the fishery suggests that there would be excessive borrowing of quota between years. In light of the heterogeneity of the fishery, an elaborate transfer system with the possibility of introducing an interest charge on inter-year borrowing of TAC is likely to lead to ever more complex negotiations between countries. The administrative complexities (i.e. the extensive paper chase) associated with borrowing would be apparent as would the enforcement difficulties.

MAMs which fail to track changes in stock abundance (e.g. equal quantities, limited adjustment) would possibly have negative implications for *subsidiarity* in years where the TAC was low in relation to stock abundance. As the problem of blackfish emerged it is to be expected that local enforcement would be made more onerous for POs. A Limited Compensation MAM could have positive implications for subsidiarity as there is no reason why the borrowing of quota between years could not be administered by POs.

MAMs which allowed TACs to become misaligned with stock abundance would have detrimental implications for *local communities* particularly given the heavy dependence on fishing in many areas of Scotland and the lack of employment diversification. While a TAC borrowing facility might alleviate this problem in the shorter run, longer run constraints would emerge given the large numbers of vessels involved in the fishery.

Most of the TAC based MAMs are unlikely to be particularly relevant to management after *2002*. The only possible exception might be a form of limited compensation scheme which could give vessels an additional degree of flexibility if capacity in the fishery were reduced and a charging mechanism was introduced.

Such a scheme could permit vessels to carry over unused quota from one year into the next. Even under a system of individual vessel quotas, there is still a tendency to race for fish given concerns that the full vessel quota will not be taken because of bad weather towards the end of the year. This problem could

be attenuated with a 'carry-over' mechanism with consequent benefits for supply stability.

2.5.3 Biological considerations

The necessity of ensuring a biologically sustainable fishery is of paramount importance in considering the application of any of the MAMs to the North Sea roundfish fishery. Section 2.2 shows quite clearly that there have been considerable swings in recruitment and landings for haddock and cod over the years. The swings in availability are impossible to forecast more than two years ahead.

The fact that cod is perceived to close to collapse supports the contention that current management regimes have proved ineffective in constraining the fishery and underlines the importance of implementing a management regime which will succeed in reducing fishing mortality.

The specific conditions within the roundfish fishery suggest that annual TAC settings are in fact necessary but also not sufficient within themselves to protect stocks. Variability in recruitment for cod and, more significantly, haddock is such that TACs set for a number of years will become misaligned with stock abundance.

On the one hand, failure to alter the TAC because of an unexpected downturn in the state of the fishery is likely to have serious implications for spawning stock biomass with consequent scarcity and price rises. On the other hand, failure to make an interim adjustment to the TAC because of unanticipated improvements in species availability would lead not only to opposition and unpopularity with the fishing industry, it would also result in an increase in the incidence of *discarding* which could have detrimental implications for the *ecosystem*. These problems are more than likely to arise in the North Sea roundfish fishery given the large swings that have been seen in TACs in past years as a result of changing recruitment levels. For example under a MAM, the large increase in the 1993 haddock TAC which emanated from particularly healthy recruitment may not have occurred. Given the high catching capacity relative to resource availability, this could have exacerbated discards.

Linked to the practice of discarding is that of high-grading. It is feasible to envisage the occurrence of two distinct forms of high-grading in the North Sea roundfish fishery. In the first instance, high-grading might involve different size grades of the same species, for example, the discarding of smaller less valuable cod in order to increase the average size of cod retained on board and thus the value of landings.

Alternatively in a mixed fishery such as that of North Sea roundfish where there are sizable and volatile price differentials between the constituent species, high-grading might result in excessive levels of discarding of lower value species (e.g. whiting) in the quest for a higher catch of the more lucrative species of fish.

To determine whether these problems would worsen visibly under a MAM regime, it is necessary to examine the degree to which high-grading is economically viable in the current North Sea climate. The economic incentives

for high-grading effectively turn upon the bio-economic realities in the fishery itself. These realities encompass the availability of the larger fish, the marginal costs of fishing, prices of the varying grades or species of fish, and the responsiveness of those relative prices to the change in quantity landed.

Implicit in the perceived high-grading problem is the fact that vessels are not able to land all the fish that they catch because of space limitations on board the vessel or because of restrictive TACs. Restrictive TACs may have had some impact on the extent of discarding, some countries will have exceeded their quota while others will have undershot it.

However, it is necessary to examine the price differentials between different species and grades as well as the estimated marginal costs of fishing for these species to assess the extent to which high-grading is likely to be problematic.

Dealing with the first form of high-grading, i.e. between different sizes of the same species, table 2.3 below shows price differentials between grade 1 and grade 5 cod (1992-1994) and also between grade 1 and grade 4 haddock.

Table 2.3 Price differentials between high and low grade roundfish (£) a)

Year	Cod (1)	Cod (5)	Margin	Hadd (1)	Hadd (4)	Margin
1992	1,541	1,214	327	1,655	726	929
1993	1,512	975	537	1,479	591	888
1994	1,413	977	426	1,311	649	662

a) Average marginal trawling costs (1992) £ 370 per tonne.

The table does show that there are significant price differentials between the higher and lower grades of haddock and to a lesser extent cod. Using Scottish cost and earnings survey information, a marginal trawling cost per tonne of fish landed has been calculated (this consists mainly of fuel and omits costs of a more fixed nature, for instance gear expenses and vessel insurance costs).

Superficially, a comparison of margins relative to trawling costs suggests that the practice of high-grading is economically rational. However, this ignores the fact that the fishery is heavily dependent upon juvenile fish with larger more mature fish being relatively scarce. An examination of annual landings data for the Scottish fishing fleet indicates that around 50% of cod landings and over 60% of haddock landings comprise of small juvenile fish. The cod figure was derived by calculating the share of total cod landings accounted for by un-graded fish and grades 4 and 5. The haddock figure was computed by expressing the share of ungraded and size 4 fish as a proportion of total landings. 1993 data was used in both cases.

It is not unrealistic to assume that the structure of North Sea landings in terms of size grades broadly reflects the age structure of the North Sea haddock and cod stocks themselves. High-grading implies the discarding of lower value fish to accommodate fish of a higher commercial value. The discarding

involved in this practice usually occurs because of space limitations in the vessel itself or quota constraints.

The UK cod quotum in 1993 was more than 100% utilised. On the basis of the Scottish data examined, it is not unreasonable to assume that around 50% of those landings comprised of small fish (i.e. grades 4 and 5). In this respect, it seems completely infeasible to imagine that this quantity could itself have been discarded and a similar quantity of larger cod located to utilise the UK quota.

High-grading as a persistent problem is unlikely to arise in the North Sea cod fishery on account of the level of overcapacity in the fishing fleet and the resulting scarcity of mature cod. The Scottish landings data indicate that only around 8% of 1993 landings consisted of grade 1 cod.

The idea of high-grading for haddock appears to be even more untenable given the fact that in the UK only 90% of the haddock quota was taken in 1993. The fact that over 60% of haddock landings consisted of the smallest grade suggests that it would be impossible in the fishery to discard this portion of fish and successfully locate sufficient larger haddocks to utilise the UK quota. High-grading is unlikely to be problematic in instances where the full quota is not utilised by the fishing fleet.

The high quayside prices for the larger grades of cod and haddock are symptomatic of the relative scarcity of mature fish in the North Sea roundfishery. If high-grading was attempted to any level of intensity, the margins would simply shrink as price adjustment took place. More importantly, the marginal costs of fishing would quickly accelerate as vessels incurred greater degrees of effort in searching for scarcer higher grades of fish.

In conclusion, the heavily exploited nature of the roundfish fishery appears to render high-grading relatively uneconomic. The very high levels of fishing capacity relative to species availability have resulted in a fishery heavily dependent on small (juvenile) fish. All grades are, as a result, likely to be scarce given the current bio-economic realities in the fishery but particularly so for the higher grades of fish. While there may be cases of high-grading on an ad-hoc basis, it seems unlikely that a concerted high-grading strategy would emerge on a significant level. In short, conditions within the fishery are such that fishermen are likely to be only too happy to land whatever fish they are able to catch.

There are no strong reasons for believing that this conclusion would change significantly if MAMs were instituted. While theoretically it is possible to envisage improved recruitment occurring during the period of the MAM and hence (given overcapacity) the potential for high grading, the length of time it takes cod and haddock to reach maturity coupled with the intense competition for fish still appears to render high-grading uneconomic and infeasible.

It is still assumed that the concept of individual species TACs would be retained under a MAM regime and hence the second form of high-grading, (ie.between species) is likely to be less problematic. In contrast, this is more likely to worsen under a MSM, where individual species TACs are dispensed with.

Table 2.4 below examines average price differentials between the three constituent roundfish species for the years 1992-1995.

Table 2.4 Price differentials between roundfish species a)

Year	Cod/haddock	Haddock/whiting	Cod/whiting
1992	483	309	792
1993	442	215	657
1994	374	235	609

a) Marginal trawling costs = £ 370 per tonne.

The table suggests that the only potentially economic high-grading possibilities are between haddock and the more valuable cod and also between cod and whiting. For the reasons discussed above the increasing scarcity of cod in the North Sea as a result of overfishing is likely to render such a strategy relatively infeasible. In any case, it seems unlikely that the institution of MAMs would have any effect upon the level of high-grading between different roundfish species.

Given that MAMs in themselves do nothing to deal with the problems of overcapacity and the subsequent race for fish, it is to be expected that the introduction of MAMs would do nothing to reduce the persistently high levels of *fishing mortality* experienced by North Sea roundfish stocks. TACs in themselves do nothing to restrict a fishery where catching capacity is misaligned with resource availability, they only result in a proliferation of illegal landings and complicate the tasks of enforcement. The institution of TACs in themselves have been shown to be consistently ineffective in reducing the level of fishing mortality.

2.5.4 Other considerations

Other considerations relate to the *simplicity* of the MAM under consideration, its *consistency* with existing EU measures and potential *new problems* that could emerge as a result of applying it to the North Sea roundfish fishery.

Potential problems associated with MAMs are considerable given the characteristics of the fishery i.e. stock variability, diversity of players, overcapacity etc. and have already been discussed at some length.

Superficially, the scheme may seem advantageous given that the annual negotiation process associated with setting the TAC would be eliminated. However, this would be supplanted by an altogether more complicated process every 2-4 years.

2.5.5 Applicability of MAMs to the North Sea roundfish fishery

The applicability of MAMs in general have been assessed on four broad sets of criteria: economic, political/institutional, biologic and additional. To evaluate the measures in the context of the North Sea roundfish fishery, it is necessary to understand the problems facing the fishery and then question whether or not these can be alleviated by instituting MAMs.

In short, the answer appears to be no.

Because of excessive capacity and consequent overfishing, North Sea roundfish stocks are under sustained pressure and recruitment is very unpredictable. The reliance of the fishery on juvenile fish suggests that conservation factors must assume precedence over economic and political considerations in its management. While the necessity for setting annual TACs is clear (to ensure that the TAC tracks closely changes in stock abundance), these mechanisms in isolation are insufficient to restrict and manage the fishery effectively. This must be achieved by restricting effort through the use of economic instruments which incorporate a charging element. This effectively alters the cost function faced by the fishing enterprise.

While superficially the MAM regime might appear to depoliticize the TAC setting process by eliminating the requirement for annual negotiation, this is effectively supplanted by an even more contentious negotiation process every two or three years.

The information demands placed on scientists in terms of forecasting changes in stock availability more than two years ahead are beyond the current state of knowledge and the heterogeneity of the fishery in terms of countries involved and methods used, makes a compensation scheme seem highly implausible. In all, MAMs appear to be completely inapplicable to the North Sea roundfish fishery failing to deal with the fundamental problems of overcapacity and overexploitation. The latter problem manifesting itself in declining vessel earnings, smaller fish caught and smaller stock size.

2.6 Multi-species measures

The North Sea roundfish fishery is the prime example of a mixed fishery where cod, whiting and haddock co-exist and where, despite the existence of single species TACs, resulting catches tend to be mixed in character. The key problems associated with managing a mixed fishery are the differing exploitation rates of each constituent species.

MSMs attempt to alleviate the apparent inflexibilities associated with single species TACs by allowing for a degree of transfer between species caught. This typically can involve TACs being interchangeable within certain limits between species thus enhancing flexibility and attenuating the problems of illegal landings, misreporting and discarding.

Appendix 2.2 has evaluated in detail the following variants of an MSM regime in the context of the North Sea roundfish fishery.

- One common denominator.
- Limited transfer.
- Bycatch arrangements.
- Two tier system.

These are defined in the Methodology section of the report.

2.6.1 Economic evaluation

The installation of most forms of MSM in the North Sea would undoubtedly have a beneficial impact on the *flexibility* of individual fishing operations relative to the existing position. The enhancement of flexibility (what to fish) would, however, be critically dependent upon the allowance governing the interchangeability of TACs for individual species. Limited transfer, cod equivalent and quota by value regimes all facilitate interchangeability between species.

There are reasons to believe that MSMs could have some beneficial implications for *market consistency*. While MSMs would still involve TACs being set annually, a TAC involving a 'sum' of individual species is likely to be less variable than its individual components. In addition, an allowance for some degree of interchangeability between target species might reduce the possibility of supply dislocation associated with early quota exhaustion.

In reality however, the heavy exploitation of North Sea haddock and cod suggests that interchangeability between these stocks and the lower value whiting would have to be severely restricted. This said, section 2.6 suggested that the possibilities for profitable high-grading were fairly limited anyway despite the fact that the price differentials between cod and haddock and also cod and whiting are fairly significant. The bio-economic realities of the North Sea roundfishery appear to render a concerted high-grading strategy relatively infeasible on account of the increasing scarcity of high value species such as North Sea cod.

The MSM in the context of the North Sea is most definitely a more *realistic* form of management operation (i.e. consistent with *daily practice*) to the extent that it acknowledges the mixed nature of the fishery and that in any catch there is always going to be a significant bycatch to augment the target species be it cod or haddock. Premature quota exhaustion in the fishery might be marginally less likely although the competition for fish caused by the large number of vessels in operation will not in any way remove this possibility.

Implicit in the MSM is the acknowledgement that scientific advice cannot always be expected to be exact and a degree of flexibility is introduced to compensate for potential margins of error in the recommended TAC. This is particularly applicable in the case of North Sea cod and haddock where there is a considerable degree of variability in recruitment, and catch levels are thus highly variable. The adoption of an MSTAC is an acknowledgement of the confidence limits associated with scientific advice.

Again the *race for fish* problem can only be attenuated by an economic method which ensures that quota is allocated to individual vessels and capacity

is reduced substantially. MSMs based on TACs do not address these important issues. Indeed the race for fish may in fact be exacerbated if the new regime is not seen to be particularly credible.

2.6.2 Policy and institutions

Superficially, the apparent flexibility offered by MSMs to fishermen might enhance the *political acceptability* of such a scheme. However, the potential complexities associated with the annual process of negotiation and the setting of appropriate rates of exchange (or weights) between North Sea roundfish stocks are likely to undermine its acceptability in the longer term.

Many of the potential political problems arise because of the heterogeneity of the fishery in terms of the diversity of players and consequently the differing objectives (eg target species, fishing method, interaction of other species). Deciding upon rates of exchange between species is likely to be extremely contentious and detrimental to *relative stability* in the CFP arrangements.

Political considerations must also encompass issues of *enforcement*. In the North Sea roundfish fishery, given the diversity of players and the potential complexity of the scheme, it is likely that there would be a sizeable paper chase associated with enforcing the regime and policing the transfer of quota.

Sectoral acceptance is contingent both upon the degree to which the flexibility of the fishing operation is enhanced and the work involved for the POs in ensuring the smooth running of the revised scheme. The enhanced flexibility of the scheme is not in doubt but POs might be more concerned about the paperwork involved in a scheme which facilitated the transfer of TACs between species.

It is possible that the greater degree of flexibility which facilitates the transfer of TAC between fisheries may have a beneficial impact on *local communities* particularly in Scotland where there is a considerable degree of fisheries dependence. This improvement would stem from the reduced possibility of early quota exhaustion. In addition the MSM could have beneficial effects on *subsidiarity* given that local management of 'total fisheries' may be preferred to a stock by stock approach. If fleet capacity and fishing mortality were effectively reduced, it is possible that an MSM approach to fisheries management could become an interesting management concept post *2002*, if the principal of relative stability were dispensed with.

2.6.3 Biological considerations

As indicated earlier, the heavily exploited nature of roundfish stocks in the North Sea makes biological considerations paramount in the evaluation of alternative management measures. Any scheme which allows the transfer of TAC between species which have sizeable price differentials (i.e. North Sea roundfish) can have detrimental impacts on the conservation of high value species. This said, it is not evident that the problem of *high-grading* would worsen considerably under a MSM regime.

However, the current extent of overfishing of cod and haddock stocks in the North Sea suggests that there would have to be fairly stringent limits governing the transferability of TAC between roundfish species. Section 2.5 indicated that there were sizeable price differentials between North Sea haddock and cod and also between North Sea cod and whiting. The scarcity of cod in particular suggests that *high-grading* is unlikely to be widespread, but, by the same token, scientific concerns about the very low *spawning stocks* suggests that it would be very unwise to take the risk of further 'running-down' the fishery. Given the large number of vessels prosecuting the fishery, the actual permitted level of transfer between species is likely to be very small.

It is unlikely that MSMs which continue to rely on TACs as the principal constraint on the operations of fishermen will be any more successful than the current management mechanisms in halting excessive fishing mortalities of roundfish. The impacts of MSMs on the ecosystem are difficult to predict. Some degree of interchangeability in TACs could reduce discarding with the attendant ramifications for the seabird population. However, with a TAC-based MSM, there is also a danger of environmental imbalances being created as vessels target one particular species more heavily.

Transfer allowances might also exacerbate the *race to fish* for commercially more valuable species, further increasing already high levels of fishing mortality.

2.6.4 Other considerations

The *transparency* of an MSM system in the North Sea could be undermined by the rules governing transfer of quota between species. It is possible that these rules could become increasingly difficult to communicate to the industry. Linked to these issues are the potential *new problems* that would manifest themselves in the annual negotiation process governing exchange rates given the number of countries involved in the fishery and the diversity of fishing objectives therein. Moreover the increasing incidence of mis reporting by species is a distinct possibility under this type of regime.

2.6.5 Applicability of MSMs to the North Sea roundfish fishery

One of the principal stumbling blocks associated with the operation of an MSM regime in the North Sea roundfish fishery is the potential complexity of such a scheme given the heterogeneity of the fishery in terms of players involved and objectives. It is likely that the annual process of negotiation to determine at what rates TACs for species could be swapped would become increasingly contentious. This difficulty cannot be understated.

Biological considerations also tend to militate against the introduction of MSMs. MSMs recognize that there are confidence limits associated with scientific advice. This consideration must be balanced against the potential for allowing excessive degrees of transfer between species, particularly where there is a sizeable degree of variation in the abundance of the species constituting the MSM and accordingly a sizeable price differential. While the economics of

high-grading are questionable, it must again be stressed that TACs in themselves are not sufficient mechanisms to conserve this fishery as long as those currently involved in fishing it do not incur the marginal social costs of their activities.

Given the high levels of effort being applied to the fishery which is inducing persistently high levels of fishing mortality for roundfish, it is clear that measures which fail to address the issue of fishing capacity are likely to exacerbate the conservation problems faced by the fishery and effectively exacerbate the hardship faced by those remaining in the sector.

In addition, any attempt to achieve the required cut in fishing mortality through the use of an MSM alone based on a TAC, is likely to enlarge the extent of the imbalance between catching capacity and catch opportunities increasing the proliferation of illegal landings, misreporting and discarding.

A further problem associated with the MSM is likely to arise when an MSTAC is set according to the condition of the most fragile species' spawning stock in the fishery. This reduces the scope for landing other less fragile species.

2.7 Effort measures

Effort measures are more familiar regimes for managing fisheries and have been used in the past by a number of Member States. However, none have been a complete success.

Effort restrictions can take the form of activity limitations (e.g. days-at-sea restrictions) or structural measures (MAGP targets). For the purposes of the case study, only activity restrictions have been considered since structural measures are already in force in the form of the MAGP.

Appendix 2.3 evaluates the following two forms of effort measures:

- constant effort over several years;
- limited adjustment.

2.7.1 Economic impact of days-at-sea restrictions

To be at all workable in the context of the North Sea roundfish fishery, a DAS scheme would require effort allocation at the level of the individual vessel. If this allocation was not secured, the race for fish problem would become acute with potentially disastrous implications for already heavily exploited North Sea roundfish stocks.

It is conceivable that the application of effort restrictions in the North Sea would enhance the *flexibility* of fishing operations if single species TACs were to be dispensed with and the effort measure became multi-species in character. In reality, however, it is likely that some degree of directivity would require to be maintained to enable broad classes of species to be protected (e.g. separate allocations would exist for gadoids, flatfish, nephrops etc.) Moreover, given the mixed characteristics of the fishery, DAS would require to be set at the level considered appropriate to protect the most heavily exploited species. This fac-

tor, coupled with the size of the North Sea fleet suggests that the increase in individual vessel flexibility might not be all that significant.

If the effort measure had multi-species characteristics, it is possible that, in the shorter term, the improved flexibility associated with effort measures might serve to smooth out supply of product and enhance *market consistency*. In the longer term however, most of the measures would involve the setting of annual effort levels which might lead to unpredictable and variable supplies of roundfish to markets, given that effort rather than catch itself is being controlled. Days-at-sea alone are a very crude measure of activity and are likely to prove poor predictors of catches and landings given the heterogeneity of the fleet in terms of the catch capabilities of individual vessels and also the longer term scope for substituting inputs which are not directly controlled (i.e. more advanced equipment, double crewing etc.). In the longer run therefore, there is likely to be a decoupling of the link between effort (measured in days) and eventual output.

Effort restrictions are clearly very imprecise conservation instruments. Moreover, given the size of the existing fleet, setting effort in line with the ACFM advice for the conservation of North Sea roundfish (i.e. 30% cut in fishing mortality) would result in individual vessel effort allocations being insufficient to guarantee economic survival for many vessels, which could have detrimental implications for *economic performance*.

These problems are likely to accelerate the race for North Sea gadoids with the consequent destabilizing impacts on markets for cod and haddock (i.e. supply gluts of smaller fish early in the year).

Constant-year effort measures might enhance the ability of vessels to *plan* their operations. However, to the extent that many of the proposed measures would involve the annual setting of days-at-sea, it is unlikely that the introduction of effort restrictions would facilitate planning for vessels fishing in the North Sea.

2.7.2 Policy and institutions

Superficially the theoretical ease of *enforcing* days-at-sea restrictions in the North Sea might make it appear a politically attractive option. However, recent experience in the UK with the industry going to the European Court in its opposition to the government's Seafish Conservation Bill (which proposed days-at-sea restrictions for the UK fleet) shows that there is vociferous opposition to these measures in the UK industry. However, the nature of the opposition does vary between the different fishermen's organizations.

It is fair to say that there are problems associated with the *sectoral acceptability* of DAS regimes in the UK which would probably have some undermining effect on their *political acceptability* also.

Most sectoral arguments associated with tie-up measures focus on the unfairness of the measures and the fact that they may force fishermen to take risks and put to sea in poor conditions in order to make sufficient revenue to survive.

Whatever the case, the complexity of the roundfish fishery in terms of the diversity of countries involved, suggests that there could be lengthy conflicts associated with allocating effort between countries. It is quite possible that the subsequent negotiations would undermine *relative stability*. One of the fundamental problems associated with the practical application of effort measures is in fact in the initial definition of what constitutes fishing effort.

Hanneson (1994) discusses the impossibility of deriving a stable and valid relationship between effort and fishing mortality and also between effort and the diverse input mix that comprises it. In reality, the fishing fleets which prosecute the North Sea gadoids are not homogeneous in character and their technical specifications and thus catch capabilities may vary to a very large extent. Because of this it becomes very difficult indeed to measure fishing effort in a way that facilitates comparison of effort across fleets. While days-at-sea are likely to be fairly poor predictors of output given the above observations, in practice, implementing progressively more complex measures which incorporate additional vessel-specific details, is likely to become increasingly difficult as the task of *enforcement* becomes more onerous.

Despite the comments made earlier on the issue of directivity, a DAS scheme which is multi-species in character would tend to involve days allocations being set with the aim of protecting the more heavily exploited cod and haddock species in the North Sea. It is conceivable that this would curtail some countries from exploiting the fishing opportunities available for less pressured species eg.whiting and saithe. This problem might be attenuated somewhat by applying the days-at-sea restriction to fixed fisheries, for instance where the fishery is more geographically distinct, it might be possible to have differential permitted effort levels for the saithe and cod/haddock fishery. This would again become decidedly more complex to *enforce*.

Where a fishery is truly mixed, however, and the constituent species vary in abundance, conflicts of interest are always likely to arise when applying a single non-discriminating regulatory measure.

Effective enforcement of days-at-sea measures would probably require that enforcement effort was harmonised between countries. This might have negative implications for *subsidiarity*. The impacts of a DAS scheme on *local communities* is difficult to predict although there is a possibility that, given existing overcapacity in the North Sea fleet, days allocations would be insufficient to guarantee economic survival for many vessels. The local impacts on income and employment might therefore be significant.

While there may be conservation benefits associated with a DAS scheme, it does not offer a long-term economic solution to the problem of overfishing. While DAS restrictions most certainly offer managers an alternative regulatory approach (being based on input control), problems associated with the decoupling of the link between effort (measured in days) and landings do not suggest that it would offer managers a particularly effective management tool *beyond 2002*.

2.7.3 Biological considerations

It is difficult to dispute that there would be conservation benefits associated with a stringently enforced DAS scheme or other form of effort restricting measure. Unlike the TAC-based measures, effort restrictions do attempt to address the issue of fleet capacity (albeit inefficiently) and therefore to align this capacity with actual stock abundance. However, the precise impacts on the level of *fishing mortality* would be difficult to assess because of the impossibility (discussed earlier) of defining a predictable and stable relationship between effort (measured in days) and the level of fishing mortality. Any relationship between effort and fishing mortality is also likely to decouple completely over time.

If constant annual effort allocations were to be introduced, it would be necessary to remove a portion of the fleet annually to account for the increased catching capacity associated with technical progress otherwise there could be damaging implications for *spawning stocks*. As indicated previously, it is likely that in the absence of TACs, vessels faced with a set number of fishing days will invest in technology intensive equipment in efforts to increase their productivity, a strategy also referred to as 'capital stuffing'. As a result, allocated days would have to be continually 'wound-down' to compensate for this. This would then effectively be a measure involving annual adjustment of fishing effort.

An example of the problems discussed above emerges in the case of the Pacific halibut fishery. In 1923, a closed season of three months was introduced to protect Pacific halibut. By 1928, it was clear that the closed season by itself was not going to be sufficient to protect the species. In 1972, the area 2 (off British Columbia) fisheries had become restricted to an open season of 101 days. (International Pacific Halibut Commission 1974.) By 1989 area 2A was open for just three 24 hour periods. The remainder of area 2 showed a similar decline.

In the above example, the entry of new vessels to the fishery was undoubtedly part of the reason behind the rapid rise in fishing mortality. The rules governing the entry of vessels into the fleet in the UK (e.g. licence aggregation) suggest that the problem in the North Sea is unlikely to be as severe although stocks are already heavily exploited and as such the impact of input substitution and capital stuffing cannot be dismissed.

When considering effort measures, the overexploited nature of North Sea cod and haddock stocks make it imperative that estimated catch/effort relationships are well described. This is not really the case in the North Sea roundfish fishery at present. DAS measures which can potentially be multi-species in character also make it increasingly difficult to protect *spawning stocks* for individual species.

One possible environmental benefit associated with effort measures is the associated benefit that they might have on the levels of *discarding*. Assuming that individual species TACs are dispensed with, fishermen could be permitted to land all that they catch.

2.7.4 *Other considerations*

As indicated earlier, an effort restricting regime (e.g. days-at-sea) in the North Sea would potentially be relatively *transparent* and easy to enforce. The *new problems* are likely to manifest themselves in the process of allocating effort between Member States and also in the failure to predict the impact of those measures on the level of fishing mortality.

Conflicts are likely to be greatest if the days-at-sea restriction was non-discriminating and applied to all vessels irrespective of species fished - days would be set with the objective of safeguarding the most heavily exploited stocks. However, the more the authority attempted to set differential effort restrictions, the more difficult the measures become to enforce.

The measures are not particularly *consistent* with existing policies as mentioned previously and are likely to be resisted by some sectors of the industry.

2.7.5 Applicability of effort measures to the North Sea roundfish fishery

Effort restrictions which are largely temporary by nature (e.g. days-at-sea restrictions) do not effectively tackle the major problems endemic in the North Sea roundfish fishery. They are also highly contentious from the point of view of the UK fishing industry.

The principal problems associated with effort restraints are in effectively defining a measure of effort which allows a sensible comparison to be made across fleets where technical specifications and thus catch capabilities may vary between vessels to a large extent. Expressing fishing effort as a simplistic multiple of vessel power or fishing time is fundamentally flawed in that it ignores the likelihood of input substitution in the complex mix of inputs which determine the output of a vessel. In addition the link between this basic form of effort measurement and fishing mortality is difficult to predict and likely to prove highly unstable.

In the short term, there are likely to be conservation benefits associated with a tightly enforced DAS regime but these are temporary measures and are not long term solutions to the problem of overfishing.

Overfishing in the North Sea roundfish fishery is evidence of excessive capacity relative to stock abundance and the failure of fisheries managers to charge vessels for the right to fish such that the cost function faced by the fishing enterprise is altered.

Relative to the TAC-based MAMs/MSMs, effort restrictions are more relevant management measures to the extent that they partially address the issue of fishing capacity in seeking to reduce the extent of overfishing. However, activity restrictions are an extremely blunt and rather short-term mechanism for tackling the problem of overfishing.

It is necessary to institute a more permanent system of management which constrains the growth of fishing capacity. The argument that the MAGP is the tool being used to effect permanent reductions in fishing capacity is not credible. Capacity and fishing mortality can, in the longer term, only be effi-

ciently constrained by imposing realistically high fishing costs on the fishing fleet, not by rules alone.

2.8 Conclusions

The case has stressed that North Sea haddock and cod stocks are very heavily exploited at present and that the fishery has, as a result, become heavily dependent upon juvenile fish. In recognition of this fact, the ACFM has recommended that fishing mortality for North Sea roundfish be reduced by some 30%.

The current system of fisheries management based on TACs and technical measures has failed to limit fishing capacity and effectively constrain the fishery. More recent attempts to reduce TACs to effect reductions in the level of fishing mortality, have exacerbated the problems of illegal landings and discarding. Unless fundamental changes to management policy are effected, there is a possibility that the North Sea cod stock might collapse.

MAMs and MSMs which are TAC-based are really variants of the existing ineffective management regime and cannot be expected to solve the problems of the fishery.

Effort constraints can take a number of forms although for the purposes of the case study, a days-at-sea scheme was explicitly considered on account of its potential administrative simplicity and ease of enforcement.

If the DAS regime was effectively enforced it would undoubtedly have some constraining effect on the level of fishing mortality. However, DAS are likely to prove poor predictors of catches and landings given the scope that they offer for input substitution by individual vessels and do not appear to provide a long term solution to the problem of overfishing. Fishing vessels differ markedly with respect to their technical specifications and catch capabilities and this underlines the difficulties associated with defining effort in a way that allows a sensible comparison to be made across fleets.

Given the extent of overcapacity in the North Sea fleet and the degree of capital stuffing that could accompany a days-at-sea measure, it is predictable that the days allocation for each vessel would have to be progressively reduced in order to compensate for increased catch capabilities. This would undoubtedly cause increasing hardship for certain vessels and underlines the fact that a DAS scheme does not provide a long term economic solution to the problems of overfishing in the North Sea. It should be emphasized that the objectives of the CFP are not entirely conservationally orientated, indeed, the promotion of an economically viable fishing industry is also a goal. Thus it is quite legitimate to consider the longer run responses of the industry to days-at-sea measures.

The measures under review in the study have been formulated solely from a biological perspective and fail to address the fundamental economic problems in the North Sea roundfish fishery. It seems improper to partially evaluate the measures on economic criteria when economic solutions to the problems of overfishing are not addressed by any of them.

Economists have long contended that to eradicate the overfishing seen in the North Sea and manage the fishery efficiently, it is necessary to alter the cost function faced by the fishing enterprise. This involves the institution of some form of charging mechanism which dictates that fishermen pay for their fishing rights. The correct economic signals and realistically high fishing costs would serve to constrain effort, capacity and subsequent overfishing.

A possible line of future research might conceivably examine the impacts on a specified fishery of introducing a management regime based on charging fishermen for their fishing rights.

It may emerge that there are elements of the MAMs, MSMs or effort measures discussed which could be incorporated into such a management regime. However, such questions are beyond the scope of the current study.

APPENDICES

Chapter 2

Appendix 2.1 Evaluation of multi-annual measures - North Sea roundfish fishery

	1.1 Equal quantity for several years	1.2 Limited compensation	1.3 Limited adjustment	1.4 Minimum size of spawning Stock	1.5 Constant formula
Economics					
FLEXIBILITY	Reduced: Variability in recruitment of roundfish indicates that TAC would become increasingly mis-aligned with abundance. For instance large increase in haddock TAC (1993) which emanated from particularly healthy recruitment would not have occurred during a multi-annual period. Catch opportunities would be unnecessarily restricted.	Short term flexibility might increase given that early quota exhaustion could be delayed. However, extent of overcapacity in the fleet coupled with requirement to reduce fishing mortality (by 30%) suggests that extent of permitted borrowing might be very limited. Borrowing would be most common. Saving of quota rare.	No improvement on existing regimes.	Not much difference relative to existing situation. Early quota exhaustion very likely in the fishery given size of UK fleet (eg haddock fishery shut 6 weeks early in 1991). May actually exacerbate inflexibilities given that sole consideration is being given to the level of spawning stock.	Depends upon nature of formula. However, it is unlikely that there would be a strong impact on the flexibility of the fishing operation given that TAC could change from year to year.
PLANNING	Long term planning improved if quota were individualized at the beginning of MAM period.	Unlikely to benefit planning discipline. Indeed in N. Sea may slacken planning discipline given overcapacity. Fishermen will borrow in the belief that TAC may never have to be repaid in the following year.	Might be benefits to the planning functions of North Sea roundfish fleet given that potential for surprise changes in TACs is reduced. Potentially most beneficial for Scottish haddock fleet given large historical swings in TAC for this species.	Effect on individual vessels is unclear. If TAC is set in advance and there is individual allocation at the outset for a number of years, there may be an improvement.	Again depends upon the specifics of the formula. However, a formula that sought to attain a 10% cut in fishing mortality per annum would still involve the annual setting of TACs. No obvious benefits for the planning function.
MARKET CONSISTENCY	No real improvement. Indeed early quota exhaustion in the UK would be very probable given recommendations for cutting fishing mortality by 30% without consequent capacity reductions in N Sea fleet. Supply instabilities likely.	Short and long-term impacts. Short term, may serve to smooth market supplies. For instance reducing possibility of early quota exhaustion of cod and haddock. In long term, may well result in supply shortages of cod and haddock in later years.	In fisheries where there has historically been large adjustment in TACs, may in fact improve. Large upward increases in TACs (e.g. haddock 1992-1993) would be avoided hence smoothing supply to market and reducing quantities of small fish.	Very dependent on variability in stocks. Given that cod and haddock SSBs are estimated to be below minimum, substantial reductions in TACs are likely. Without large capacity reductions, race for fish might result in glut followed by shortage.	Race for fish may well worsen if a formula were applied which attempted to attain annual reductions in fishing mortality through the application of TACs (without reducing capacity). Potentially destabilizing.

	1.1 Equal quantity for several years	1.2 Limited compensation	1.3 Limited adjustment	1.4 Minimum size of spawning Stock	1.5 Constant formula
DAILY PRACTICE	Unrealistic. TAC will become mis-aligned with availability given observed variability in roundfish stocks.	Technically more realistic given that quota from previous year can be carried over if bad weather prevents fishing. But saving unlikely as a result of overcapacity in the fleet.	Limit is placed on adjustment of TAC for administrative convenience. May be unrealistic when upward revision of TAC is restricted.	Is not particularly well aligned with the realities of the fishing operation, given that it gives total priority to stock conservation.	As with minimum spawning stock, this measure tends to give priority to biological considerations.
RACE FOR FISH	Problem remains given overcapacity in the roundfishery. Could even worsen if policy is not credible. For instance downturn in availability during MAM period may cause the race for fish to accelerate as skippers fear that they will be unable to catch their full fishing entitlement.	Some alleviation Race may partly reflect fear of losing quota (e.g. bad weather). Ability to carry-over quota would alleviate this. Race in N. Sea is also caused by large number of vessels chasing scarce cod and haddock stocks. This won't be alleviated by MAM and would still predominate.	Problem still remains given that measures don't tackle capacity problems. Improved availability coupled with a restrictive increase in TAC may intensify the race for fish.	Current biologic advice suggests that spawning stocks for N. Sea cod and haddock are too low. Suggests TACs for these would be reduced markedly. Given overcapitalization, race for fish would undoubtedly accelerate.	Given overcapitalization in the fishing fleet and the required reduction in TACs to enlarge spawning stocks, likely that the race for fish would worsen.
ECONOMIC PERFORMANCE	Variability in stock abundance suggests that MAMs may fail to track changes in stock abundance from year to year. Given overcapacity, may well have negative impacts on profitability.	Short term benefits associated with a borrowing facility. However, excessive capacity suggests that this facility would be heavily utilised to the detriment of long term profitability.	Might have some stabilising impact on vessel profits. However, might also suffer from the problems discussed in equal quantity measures.	Not an economic measure, focuses totally on biological issues. If successful, profitability might improve in the long term. However, does not address problem of overcapacity, hence unlikely to increase stock abundance or improve economic performance.	Depends on the rule. Again however, a TAC-based measure is unlikely to lower overexploitation and enhance the long-run economic performance of the fleet.

	1.1 Equal quantity for several years	1.2 Limited compensation	1.3 Limited adjustment	1.4 Minimum size of spawning Stock	1.5 Constant formula
Biology					
SPAWNING STOCK	Almost impossible to set the haddock MAM at the correct level given recruitment variability. Threat to North Sea roundfish stocks is exacerbated by excessive capacity in the fishery. Hence even a restrictive TAC set at correct level will exacerbate mortality resulting in discarding, mis-reporting and illegal landings.	Really depends upon limits placed on borrowing. Excessive capacity does suggest that borrowing option would be heavily utilised with the possibility of detrimental impacts on cod and haddock spawning stocks.	Difficult to assess. In the medium term greater TAC stability for haddock, cod and whiting might have beneficial impacts on spawning stocks (if effectively enforced). Particular problems with haddock, however, for instance failure to adjust TAC sufficiently downwards following poor recruitment (e.g. 1987).	Given high fishing mortality for cod and haddock, measures would be welcome to the extent that they place most importance on conservation. Problem particularly with variable stocks is estimation of what constitutes minimum spawning stock given uncertainty over stock-recruitment relationships for roundfish.	Similar conclusion to that for 'Minimum spawning stock'. Given overcapacity, it is unlikely that a TAC alone can achieve the required cut in fishing mortality in the North Sea roundfish fishery.
FISHING MORTALITY	Given that capacity is excessive, fishing mortality is likely to remain high for the roundfish species. It will be impossible to keep fishing mortality for roundfish stable given recruitment variability, particularly for haddock.	Already much too high for cod, haddock and whiting given the extent of overcapacity. If permitted borrowing is excessive, the problem could worsen.	Same as above.	Technically, fishing mortality for both N. Sea cod and haddock should be reduced. Policy may not, however, be enforceable given overcapacity in the fishery.	See above.
HIGH-GRADING	Unlikely to worsen. There are doubts as to the economics of high-grading between roundfish species. Despite price differentials, scarcity of cod and haddock suggest high-grading is uneconomic. High-grading for same species unlikely to worsen.	Generally, this practice is likely to prove uneconomic given the scarcity of mature cod and haddock.	No worsening of the problem.	Probably no worse than at present.	No likely worsening of the problem. Is unlikely to be significant anyway given the bio-economic realities in the fishery.

	1.1 Equal quantity for several years	1.2 Limited compensation	1.3 Limited adjustment	1.4 Minimum size of spawning Stock	1.5 Constant formula
DISCARDING	Failure to make an interim adjustment to a MAM because of improvement in availability (e.g. improved haddock recruitment in the early 90s) could worsen discarding.	Depends on the level at which TAC is set relative to existing levels. Borrowing option could marginally reduce the incidence of early quota exhaustion and thus discarding.	Could possibly be problematic in situations where upward revision of the TAC is limited despite increased availability. Particularly likely given recruitment variability.	Scientific advice suggests that SSB for cod and haddock is well below 'safe' minimum. Without significant capacity reductions, short term discarding will worsen.	May worsen see 'Minimum spawning stock'
ECOSYSTEMS	Uncertain due to doubts about correctness of the haddock/cod quota.	Excessive borrowing may have damaging implications for species balance in the ecosystem.	Positive and negative effects. Greater TAC stability. But failure to adjust TAC to reflect changes in availability may have negative impacts given variability in roundfish recruitment.	Theoretically should be beneficial. However, given existing pressure on roundfish, mortality induced by illegal fishing may remain high. Detrimental impacts on the ecosystem.	See 'Minimum spawning stock'
Policy & Institutions					
POLITICAL ACCEPTANCE	Removal of annual negotiation may depoliticize TAC setting process in short run. However, setting MATACs for variable roundfish species may exacerbate controversies in the meetings every 3-4 years. information demands associated with setting MATACs for roundfish are beyond current state of knowledge.	Attractive, given potentially favourable response from N. Sea fishermen. However, given extent of overcapacity inthe fishery and current advice, only borrowing is likely. Setting the ceiling on borrowing and the interest rate may be politically contentious given diversity of fishery in terms of countries involved and their associated objectives.	May be politically acceptable given the smoothing effect on TACs. For instance historical volatility seen for N Sea haddock TAC would be avoided. Stability for cod TAC over the years also supports this measure's applicability. Annual negotiations could probably be dispensed with.	Would eradicate the annual negotiations. However, problems concerning what constitutes minimum SSB given absence of precise stock recruitment relationships would further politicize scientific advice.	Potentially politically contentious for similar reasons to 'Minimum spawning stock'.

	1.1 Equal quantity for several years	1.2 Limited compensation	1.3 Limited adjustment	1.4 Minimum size of spawning Stock	1.5 Constant formula
SECTORAL ACCEPTANCE	Stability in TAC might be welcomed particularly for haddock. However, problems are bound to arise when TAC is not adjusted to reflect improved recruitment (e.g. better haddock recruitment in the 90s).	Short term attractiveness must be set against the longer term impacts of excessive borrowing and subsequent reductions in following year's TAC.	Attractive given the potential for stability in TACs. Probably welcomed by those fishing for haddock given variability of TAC for this species. Stability in cod TAC over recent years suggest measure might be accepted.	A policy that puts the onus on biological protection only may well be resented by the industry. Given extent of overfishing of cod and haddock, the industry is likely to be squeezed financially.	May still be resented by the industry given that the onus is on biological protection.
RELATIVE STABILITY	Unchanged.	Unchanged in long term.	Unchanged.	Unchanged.	Unchanged.
NATIONAL ENFORCEMENT	Possible that black landings of North Sea cod and haddock would rise if stocks were more healthy than anticipated during the MATAC period. Would increase burden on enforcement.	Enforcement associated with policing the extent of borrowing would be quite complex, particularly in this fishery which is characterised by excessive capacity and fragile cod and haddock stocks.	Enforcement would become more onerous in years where there was only limited upward revision of the TAC despite improved availability. Particular problem for N. Sea haddock given historic recruitment volatility.	Given current size of the fleet and heavy exploitation of cod and haddock it is likely that enforcement would become much more onerous.	Could be an increase in enforcement problems given overcapitalization of the fishing fleet.
SUBSIDIARITY	Given variability in recruitment for haddock and to a lesser extent cod, misalignments between stocks and TAC could worsen, increasing blacklandings and making local enforcement more onerous.	May be beneficial implications if more responsibility for policing could be devolved to PO groups but, this said, not all fishermen are members of POs.	PO-management will be more difficult for N. Sea haddock and, to a lesser extent, N. Sea cod.	Local management may become much more onerous for reasons noted in 'Minimum spawning stock'.	See 'Minimum spawning stock'.
LOCAL COMMUNITIES	Despite superficial stability, TACs that fail to mirror changes in availability will have detrimental effects.	Benefits of improved flexibility may have favourable short run effects. Longer term hardship is likely.	Beneficial impacts associated with improved market stability.	Possible problems of hardship at the local level given size of fleet and current extent of overfishing.	See 'Minimum spawning stock'

	1.1 Equal quantity for several years	1.2 Limited compensation	1.3 Limited adjustment	1.4 Minimum size of spawning Stock	1.5 Constant formula
BEYOND 2002	Does not offer managers anything new for the post 2002 period.	Could add a degree of flexibility to vessels fishing for roundfish and have a smoothing effect on supply (i.e. reduce race for fish) if capacity was reduced and a charging mechanism introduced.	No detectable effects.	No effect.	No effect.
Other Considerations					
CONSISTENCY	No obvious improvement or deterioration relative to current situation.	Adverse weather in North Sea undoubtedly contributes to race for fish. Ability to carry over quota might enhance flexibility and smooth market supplies (if problems of overcapacity are resolved.)	No detectable improvement on current situation.	Less consistent given that total priority is given to SSB.	May be less consistent.
TRANSPARENCY	Superficially, application may appear simplistic. Becomes difficult to justify MATAC for haddock and cod because of historic variability in estimated exploitable biomass.	Potentially very complex in detail. Only really workable assuming individual allocation.	Would be easy to explain given that it is designed for administrative simplicity.	Relatively easy to explain.	Could be difficult to justify and explain the choice of formula to the industry.
NEW PROBLEMS	As above, unpopularity because of misalignment between allowed and potential fishing opportunities. Politicization of scientific advice.	Very difficult to decide the extent of permitted borrowing given already high levels of fishing mortality for roundfish. Setting the interest rate and monitoring borrowing could be complex.	Agreeing level of limitation contentious- insensitive to changes in availability of exploitable biomass. Possible conservation problems given continuing increases in catching capacity.	Problems of assessing SSB. But probably no worse than at present.	Problem of agreeing formula. Also unlikely to be a beneficial impact on the levels of fishing mortality for roundfish given overcapitalization of the fishing fleet.

	1.1 Equal quantity for several years	1.2 Limited compensation	1.3 Limited adjustment	1.4 Minimum size of spawning Stock	1.5 Constant formula
ACCOMPANYING CONDITIONS	If conservation problems are not to be exacerbated, fleet capacity must be permanently reduced in N. Sea.	Only seems workable if there continues to be individual allocation. Improved flexibility depends on a large reduction in fleet size.	Reduction in capacity.	Reduction in capacity.	Reduction in capacity.

Appendix 2.2 Evaluation of multi-species measures - The North Sea roundfish fishery

	2.1 Total quantity in common denominator	2.2 Limited transfer	2.3 Bycatch arrangement	2.4 Two tier TAC
Economics				
FLEXIBILITY	Considerable improvement in flexibility given the mixed nature of the roundfish fishery (i.e. multi-species) catch composition.	Limited Transfer might reduce the incidence of early quota exhaustion and enhance the flexibility of fishing operations. However, concerns about the size of cod and haddock SSBs may mean that the amount of permitted transferability is small. Improvements in individual vessel flexibility very marginal.	Little benefit to flexibility. Only whiting is a significant bycatch of another fishery (i.e. Danish Industrial). However, the whiting TAC is never fully taken. Very high level of discarding, hence no real benefits in terms of keeping a fishery open for longer.	Offering fishermen two alternative exploitation patterns might serve to enhance the flexibility of the fishing operation. Extent to which the two TACs differ could well be very marginal however given heavily exploited cod and haddock stocks.
PLANNING	North Sea TAC would still be subject to annual negotiation hence there would be little effect on long term planning.	Long term planning may worsen. TAC will vary annually as will permitted exchange rates. Hence two uncertainties instead of one. Given historic variability of roundfish recruitment, variations in permitted exchange rates likely to be large.	No real benefit.	TAC would still be set annually hence little benefit to the planning function.
MARKET CONSISTENCY	Closure is still likely, given overcapacity. However, there may be some benefits given that a TAC involving a sum of individual species is likely to be less variable than individual TACs.	Intra-year consistency might improve somewhat if catchers can respond more flexibly to demand.	Unaffected.	Small improvement.
DAILY PRACTICE	Acknowledges the fact that individual species TACs in the North Sea roundfish fishery are unrealistic given mixed species catch composition.	Certainly more realistic given the mixed nature of catch composition. Might also reduce the incidence of discarding.	Very marginal improvement. No evidence that bycatches of roundfish in other fisheries has in the past speeded the closure of the target fishery.	The MSM element acknowledges the mixed nature of the North Sea roundfish fishery and the fact that catch composition will inevitably be multi-species in nature.
RACE FOR FISH	Depending on transfer ratios, race for fish may well worsen.	Could worsen given the scope for transfer to more commercially valuable species eg cod	Will continue unless capacity is substantially reduced in the fishery.	Again the race for fish is not likely to be alleviated by this measure since it does not address the problem of overcapacity and the time preference associated with earnings.

	2.1 Total quantity in common denominator	2.2 Limited transfer	2.3 Bycatch arrangement	2.4 Two tier TAC
ECONOMIC PERFORMANCE	Some short term benefit for profitability if there is interchangeability in TAC. TACs alone will not halt overexploitation or boost the long run economic performance given excessive capacity.	See 'Total Quantity'.	No real benefits.	No real benefits.
Biology				
SPAWNING STOCK	Removing individual TACs for roundfish makes it very difficult to predict impacts of fishing on SSB of individual fisheries. Protecting individual species in a mixed fishery may be *difficult*.	Still possible to protect the more vulnerable cod and haddock species provided that transfer rates reflect relative scarcity.	Fishing mortality for whiting could possibly be increased. To the extent that cod and haddock are a bycatch of the nephrops fishery then fishing mortality for those species could also rise.	Really depends on the weights set for this MS Tier. Provided these reflect catchabilities there should be no worsening of the already serious stock situation for cod and haddock.
FISHING MORTALITY	Given removal of TACs for individual species, fishing mortality becomes increasingly difficult to predict particularly in the North Sea roundfish fishery where price differentials have historically been large and variable for cod, haddock and whiting.	Clearly depends on level of TAC set. Will not reduce fishing mortality and could possibly worsen it if there is excessive transfer permitted.	No effect. Will still remain much too high for roundfish.	No obvious worsening.
HIGH-GRADING	Despite large price differentials; quantity elasticities and scarcity of more valuable cod suggests that increase in high-grading is unlikely to be economic.	Is unlikely to worsen in this fishery.	Unlikely to worsen.	Unlikely to worsen given the scarcity of cod and haddock and hence uneconomic nature of the practice.
DISCARDING	For reasons noted above this is unlikely to worsen under this measure unless TAC is set too low relative to availability.	Some degree of transfer between species might serve to reduce quota exhaustion.	Would possibly be reduced.	MS element of TAC might alleviate the problem somewhat.
ECOSYSTEM	May be threatened if there is more excessive fishing of one species.	Difficult to predict.	Little or no effect.	Unaffected.

	2.1 Total quantity in common denominator	2.2 Limited transfer	2.3 Bycatch arrangement	2.4 Two tier TAC
Policy/Institutions				
POLITICAL ACCEPTANCE	Improvement in flexibility might be welcomed politically. Setting levels at which N. Sea cod, haddock and whiting are weighted might present a problem.	Probably acceptable, assuming that there might be some benefits to the flexibility of the fishing operation.	The roundfish species tend to be caught largely as part of a targeted fishery with the possible exception of whiting. Improved flexibility negligible but probably few political problems.	Approach has been used before in other fisheries hence no obvious problems.
SECTORAL ACCEPTANCE	As above provided that there was agreement on weights. Heterogeneity of the N. Sea roundfish fishery in terms of countries and fleets suggests that this might prove problematic.	Economic advantage might be welcomed although given concerns about the availability of N. Sea haddock and cod (coupled with overcapacity), extent of flexibility improvements is likely to be small.	Would be welcomed particularly if it enhanced catching opportunities for vessels targeting cod and haddock. However these species tend to be caught as part of a targeted fishery. Not clear to what extent catch opportunities would improve.	The additional flexibility might be welcomed. However, excess capacity in fishery indicates that degrees of permitted transfer between species would be small.
RELATIVE STABILITY	Would be undermined in the N. Sea given the removal of single species TACs.	Would not be upheld.	Not really affected.	Might be impinged upon if some countries use the second tier.
ENFORCEMENT	A lot depends on the level of TAC. Improved flexibility may serve to alleviate illegal landings of the higher valued cod and haddock species.	The enforcement task would become much more onerous given that strict controls would be necessary to ensure that maximum transfer levels were not exceeded.	Might become more difficult.	Will become more onerous particularly when second tier TAC is used. Also becomes fairly complex to enforce.
SUBSIDIARITY	May make the task of localised management somewhat easier.	Some improvement.	Difficult to predict.	Uncertain.
LOCAL COMMUNITIES	There may be benefits to local communities to the extent that fishery stays open longer. Unlikely however, that the early closures for UK cod and haddock fisheries seen in the 80s and 90s would be avoided given overcapacity in the fishery.	Some improvement.	As above.	Perhaps marginal benefits if second tier TAC was adopted. However overcapacity is still likely to result in, for example, the UK running out of quota from time to time.

	2.1 Total quantity in common denominator	2.2 Limited transfer	2.3 Bycatch arrangement	2.4 Two tier TAC
BEYOND 2002	Perhaps an interesting management concept if relative stability was abandoned and the fishery was rid of its capacity problems. TACs alone will not halt overexploitation or boost the long run economic performance given excessive capacity.	Interesting concept but really only beneficial if excess capacity were reduced first.	Probably not applicable to this particular fishery.	Uncertain.
Other considerations				
CONSISTENCY	Highly inconsistent with existing measures in the N Sea roundfish fishery.	Deviation of regime from existing N Sea regime could undermine consistency.	Reasonably consistent.	Reasonably consistent.
TRANSPARENCY	Not that difficult to explain to the fishermen assuming that weights were calculated on the basis of species abundance.	Could be quite difficult to explain to fishermen the rules governing transfer between species.	Fairly simplistic.	Potentially confusing given the two tiers involved.
NEW PROBLEMS	Given the capacity problems in the N Sea roundfish fishery, fishing mortality for pressured species *more difficult to predict (could* even worsen). Additional negotiation problems associated with determining appropriate weights for each species.	Can become more complex from management standpoint given that TAC and transfer ratios are both set. Negotiation difficulties concerning transfer ratios and extent of permitted borrowing, might become acute given diverse nature of the fishery.	Will not halt the excessive exploitation of cod and haddock.	Setting weights for MSM contentious. Degree of flexibility for each vessel might be very limited given overcapacity and current state of cod and haddock stocks.
ACCOMPANYING CONDITIONS	Full enforcement by all countries and reduction of overcapacity.	Full enforcement by all countries and reduction of overcapacity.	Full enforcement by all countries and reduction of overcapacity.	Full enforcement by all countries and reduction of overcapacity.

Appendix 2.3 Evaluation of effort measures - North Sea roundfish fishery

	3.1 Constant effort over several years	3.2 Limited adjustment of effort
Economics		
FLEXIBILITY	Would undoubtedly enhance flexibility for the North Sea fleet if days allocation was sufficient to retain economic viability and single species TACs were removed.	Probably more flexible than constant effort given characteristics of roundfish ie.recruitment variability. Some adjustment in effort could be made if there were changes in abundance.
PLANNING	Effort has been shown to be an imprecise 'economic angel'. Output is not directly controlled. Constant effort may have some beneficial impacts on planning.	May be improved somewhat if major surprises in terms of effort allocation are avoided.
MARKET CONSISTENCY	Some improvement although being of multi-annual nature, effort not necessarily adjusted to reflect biological changes. A particular problem for roundfish i.e. haddock, where there has been marked variability in availability and in subsequent TACs.	See under 'Constant effort'.
DAILY PRACTICE	Would render a scheme unworkable if individual vessel allocation was not ensured. Even with allocation, biological advice for roundfish (i.e. 30% cut in fishing mortality) is likely to result in effort allocations being insufficient to guarantee economic survival for many vessels. Race for fish could well intensify.	If effort allocations were to replace individual species TACs then some improvement in flexibility could be expected. The possibility of making adjustments to reflect changes in abundance, further enhances realism relative to the constant effort approach.
RACE FOR FISH	If nothing is done to reduce the size of the fleet before introducing such measures, effort allocations may well prove insufficient to guarantee economic survival (in view of current ACFM advice for roundfish). Race for fish could well intensify	Application of effort measure in the absence of individual species TACs is likely to accelerate the race to fish given the extent of overcapacity.
ECONOMIC PERFORMANCE	In view of the ACFM advice for N Sea roundfish (ie 30% cut in fishing mortality) effort allocation is not likely to be sufficient to guarantee economic survival for many vessels. Race for fish could worsen with destabilizing effects on markets (ie supply gluts early in year).	See 'Constant effort'.
Biology		
SPAWNING STOCK	DAS are a poor measure of activity in terms of their ability to predict catches and landings. Long-term decoupling of relationship between days and fishing mortality undermines the effectiveness of the measures in conserving spawning stocks. Effort allocations would require to be continually 'wound down' to account for technical progress and input substitution in the fleets.	Still problems associated with measuring effort in days and in the lack of stability in the relationship between effort and fishing mortality. Could be benefits for spawning stocks if the adjustment was sufficient to counter the effects of technical progess/input substition and changes in abundance.

	3.1 Constant effort over several years	3.2 Limited adjustment of effort
FISHING MORTALITY	Rigourously enforced DAS scheme could reduce fishing mortality for roundfish. However, problems associated with potential instability of mortality/effort relationship makes it difficult to define the precise impacts on fishing mortality. If multi-annual period was too lengthly, conservation benefits could be eradicated by input substitution/technical progress.	A well enforced DAS scheme could reduce the level of fishing mortality although the precise impacts are difficult to determine due to the lack of a stable effort/fishing mortality relationship.
HIGH-GRADING	Assuming effort allocations replace individual species TACs, the measures have multi-species characteristics. Despite significant price differentials between species, high-grading for haddock and cod is likely to prove uneconomic given the scarcity of those commercially valuable species. Unlikely that high-grading would worsen.	Unlikely to worsen to any extent (see under 'Constant effort').
DISCARDING	If individual species TACs were dispensed with, the discarding problem would possibly lessen under this management regime.	Given relative scarcity of cod and haddock there is unlikely to be a significant increase in discarding as a consequence of high-grading. Removal of TACs may actually decrease the levels of discarding.
ECOSYSTEM	Reduction in the extent of discarding could have beneficial impacts.	As for 'Constant effort'.
Policy/Institutions		
POLITICAL ACCEPTANCE	Problems of political acceptability in the North Sea given the intense opposition to the UK Government's Sea Fish Conservation Bill. Real problem of deciding upon sea days given that there would be no interim adjustment in effort to compensate for stock variability - a particular problem for N. Sea haddock.	Perhaps some improvement relative to constant effort measure given interim adjustment. Could be substantial negotiating problems associated with defining level of adjustment allowed.
SECTORAL ACCEPTANCE	Possible hostility to days-at-sea.	Similar to the problems with 'Constant effort'.
RELATIVE STABILITY	Major country involved in the fishery (UK) does not have a days limitation scheme. If days limitations replace TACs, then relative stability is lost.	If TACs are replaced by days limitations then relative stability could be lost.
ENFORCEMENT	Very attractive in the North Sea on the criteria of enforceability. Illegal landings would be reduced also if TACs were to be removed.	Enforcement task becomes much easier relative to existing regime in the North Sea roundfish fishery.
SUBSIDIARITY	Given the highly pressured nature of the fishery, enforcement may have to be harmonised between countries.	See 'Constant effort'
LOCAL IMPACTS	Depends on size of days allocation.	Depends on size of days allocation.

	3.1 Constant effort over several years	3.2 Limited adjustment of effort
BEYOND 2002	Does offer an alternative regulatory regime to the existing one although if TACs were removed, relative stability would have to be abandoned. Longer term decoupling of the link between DAS and fishing mortality suggests constant effort would not be feasible over a lengthy time period.	Preferable to 'Constant effort' given the scope for downwards adjustment of effort to compensate for technical progress. Still not a long-term economic solution to the problem of overfishing.
CONSISTENCY	Not all that consistent.	As under 'Constant effort'.
Other considerations		
SIMPLICITY	Simplistic in terms of enforcement. Difficulties, however, in definition of effort. Days are likely to be a poor predictor of actual fishing mortality.	Similar problems to those for 'Constant effort' Additional difficulties associated with determining the appropriate level of adjustment.
NEW PROBLEMS	Heterogeneity of North Sea roundfish fleet in terms of objectives and fishing methods suggests that the negotiating process by which effort was allocated could become very contentious.	Similar problems to constant effort given heterogeneity of the roundfish fishery in terms of countries fleets and objectives.
ACCOMPANYING CONDITIONS	To be at all workable there would have to be individual vessel allocation. Not a long term solution to the problems of the fishery unless excessive capacity is permanently removed. Better understanding of the link between effort and fishing mortality is required.	As under 'Constant effort'

3. NORTH SEA FISHERY FOR FLATFISH

J.W. de Wilde and F. van Beek

Summary

The major North Sea flatfish species plaice and sole are mainly exploited with beam trawl by the Netherlands, the United Kingdom and Belgium. In this fishery sole and plaice are generally caught together, but catching sole can be avoided by using a large mesh size. Denmark is another major operator having more directed fisheries for plaice and sole.

The plaice stock, which for a long period was strong and stable, has deteriorated since 1990 and was below the minimum biologically acceptable level (MBAL) in 1994. The sole stock is in good shape, due to a couple of strong year classes. Both stocks are growth overfished, meaning that in the long run they tend to fall below MBAL. For plaice, a reduction of fishing effort has been recommended, and for sole this is desirable as well.

The fishery is mainly regulated by annual TACs, accompanied by various other measures, like minimum mesh sizes and area restrictions (Plaice box). The Netherlands and the United Kingdom have rather complex sets of national regulations for the implementation of the quota system.

The stocks, particularly that of sole, have allowed reasonable economic results since 1990. The technical overcapacity of the fleet which, in spite of decommissioning, is still there, has not yet become economically visible, so fishermen want to maintain or even expand their capacity. But the beam trawling fleet is very vulnerable to reductions of the sole catches and fuel price rises, and these may cause serious economic problems. Combined with the rather high level of fishing mortality this is the main management problem.

Multi-annual and multi-species measures are only considered realistic and feasible under well specified conditions and restrictions. Setting a constant TAC over a range of years could only be feasible with plaice, after recovery of the stock, but it would provide no improvement of management. Borrowing limited amounts of next years quota is a feasible and attractive proposition, although it does not attack the major management problem. Limited adjustment of the quota could, with sufficiently strict enforcement, eventually have a positive effect on the sole stock and on stability of supply, but again it would have no effect on the management problem. A policy of keeping the stocks above a certain minimum size is not considered to be feasible (yet). Application of a fixed formula to reduce the fishing mortality would require very strict enforcement and accompanying decommissioning of boats. If these conditions can be fulfilled, this is an effective policy.

Unlimited transfer between plaice and sole quota, using a common denominator would be detrimental for the state of the stocks, even if the right denominator can be found. Like limited compensation of quota between years, limited transfer between species can be a feasible and attractive management

measure, even if it does not address the major management problem. Allowing limited bycatches of plaice in the sole fishery after an early closure of the plaice fishery would be feasible, but would not contribute to solving the management problem. Application of a two tier system, devised to encourage fishing for the less vulnerable species, appears to be too complex and intransparent to be useful.

Management by effort is already applied in the North Sea flatfish fishery, as the Netherlands operate a days-at-sea system as an accompanying measure to the individual transferable quota system. Nevertheless a complete change over from quota management to effort management would meet political opposition in the Netherlands, as the ITQs represent considerable financial value and most fishing firms have invested heavily in bringing their ITQs into line with their fishing capacity. To meet this opposition, an acceptable and transparent method must be found to translate quota and ITQs into (individual) effort allocations. The effectiveness of effort management will highly depend on solid monitoring of the efficiency of fleets and fishing methods, to take into account technological progress.

3.0 Introduction

The major fishery for flatfish in the North Sea (ICES areas IIa(EC) and IV) is a mixed fishery for plaice (*Pleuronectes platessa L.*) and sole (*Solea solea L.*) with beam trawl. Other single species directed fisheries occur applying seine nets and gill nets. Since the inception of the Common Fisheries Policy in 1983 it has developed into the most important North Sea fishery in terms of aggregate value. The 1994 TACs - plaice: 165,000 tonnes and sole: 32,000 tonnes - represent a total value of around 470 mln. ECU (at mid '94 Dutch auction prices).

Management of the sole and plaice fishery by TACs and quota started in 1975 in the framework of the North East Atlantic Fisheries Convention. Country quota were allocated according to catch performance in the previous years 1972, '73 and '74. The initial regulations had the character of gentlemen's agreements, as enforcement was generally lacking. Consequently the system had a rather false start, with quota being more or less ignored.

After the general extension of the fishery zones by the Member States, the EC in fact took over the regulation of the North Sea (and other) fisheries in 1978. But it became only effective after agreement on the Common Fisheries Policy was reached. In the CFP the original key for allocating quota to member countries was greatly maintained, for the sake of 'relative stability'. This has been a source of contention, as the considerable shifts in the relative shares that had occurred since the early seventies, particularly in the plaice fishery, were not taken into account.

Other North Sea flatfish species, like dab (*Limanda limanda* L.), turbot (*Scophtalmus maximus* L.), brill (*Scophtalmus rhombus* L.), flounder (*Platichthys flesus* L.), lemon sole (*Microstomus kitt* L.), are not regulated by the EU. They are mostly caught as bycatch in the sole and plaice fisheries.

3.1 Countries and fleets involved

All EU Member States surrounding the North Sea are participating in its flatfish fishery. Table 3.1 gives a survey of catches by country in 1993 as reported to ICES 1) and the allocated quota for 1994 2).

Table 3.1 North Sea catches and quota of plaice and sole by country (1,000 tonnes)

Country	Plaice		Sole	
	catch 1993	quota 1994	catch 1993	quota 1994
Belgium	10,814	9,440	2,783	2,665
Denmark	16,452	30,680	1,661	1,220
France	593	1,770	484	535
Germany	6,896	8,850	1,378	2,135
Netherlands	48,552	59,000	22,015	24,075
United Kingdom	31,163	43,660	688	1,370
Total EU	114,470	153,400	29,009	32,000
Non EU countries a)	760	11,600	60	-
Total reported	115,230	-	29,069	-
Unreported	-5,279	-	2,101	-
Grand total	109,951	165,000	31,170	32,000

a) Mainly Norway.

The table gives the basic quota before transfers and exchanges. Annually around 15,000 tonnes of plaice are transferred from the UK to the Netherlands in exchange for its small quota of flatfish and roundfish outside the North Sea, which are abandoned for control reasons. In this arrangement also a transfer of about 500 tonnes of North Sea sole from the Netherlands to the UK is included.

1) Extract of the Report of the Advisory Committee on Fisheries Management; Demersal Stocks in Division IIIa and the North Sea. ICES, Copenhagen, Oct/Nov 1994.

2) Council Regulation (EC) No 3676/93 of 21 December 1993 fixing, for certain fish stock and groups of fish stocks, the total allowable catches for 1994 and certain conditions under which they may be fished. Official Journal of the European Union No L 341, 31. 12. 93.

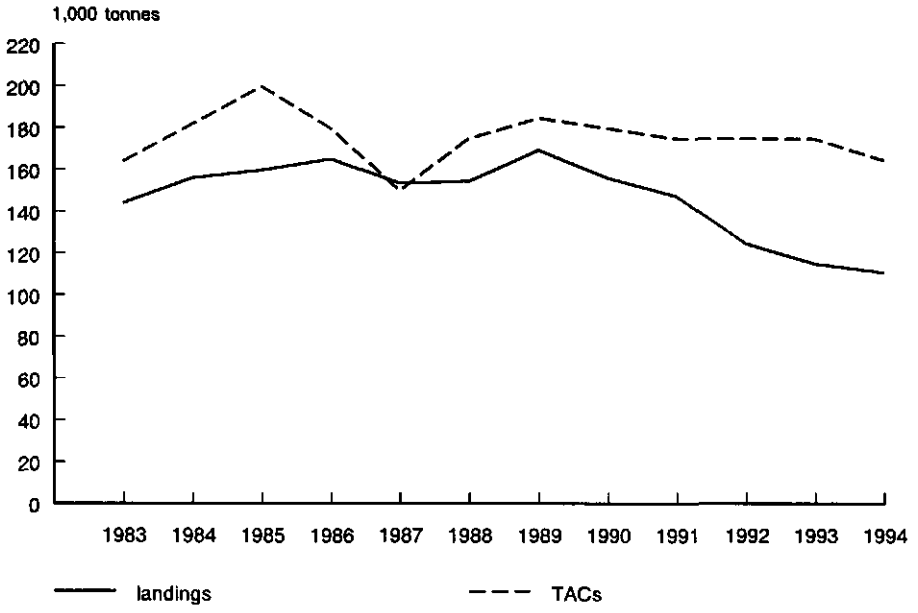

Figure 3.1a Total international landings of North Sea plaice and TACs set at start of year, 1983-1994

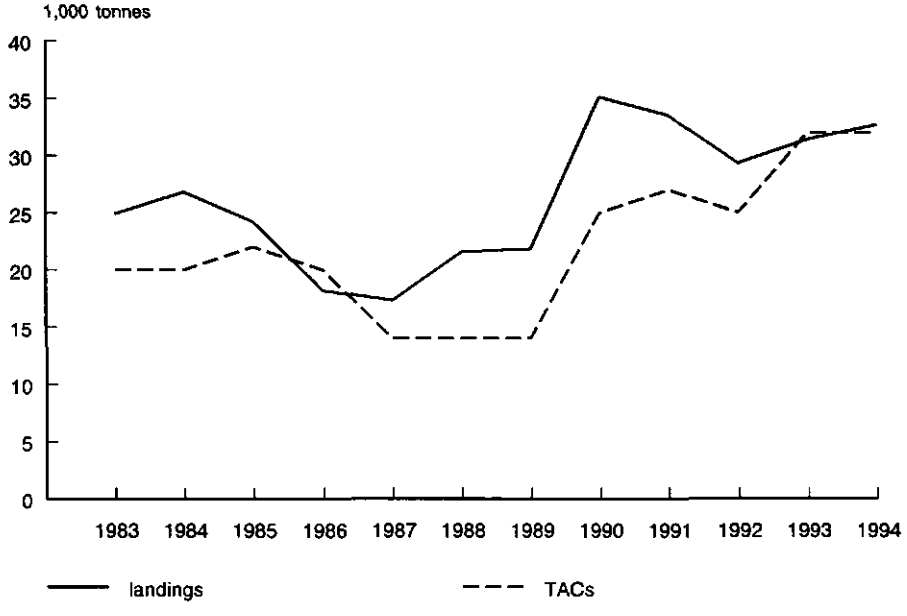

Figure 3.1b Total international landings of North Sea sole and TACs set at start of year, 1983-1994

A picture of the North Sea plaice and sole TACs and landings since the inception of the CFP in 1983 is given in figure 3.1.

The Netherlands is the main operator in the North Sea flatfish fishery, having a share of about 45% of the plaice TAC (after the swap) and 75% of the sole TAC. Denmark and the UK follow at some distance with shares of 18% and 17% (after the swap) respectively of the plaice and just under 4% and 6% (after the swap) respectively of the sole. Belgium and Germany have slightly larger shares of the sole TAC, with 8% and 7% respectively, but their plaice quota are rather small: 6% and 5% respectively. France has only a small share in the North Sea flatfish fishery. Figure 3.2 shows the country shares in the landings of plaice and sole from 1983 onwards.

North Sea sole is exclusively caught by EU Member States. Norway is the only third country participating in the North Sea plaice fishery, but its landings are much smaller than the available quota.

The main fishing gear used for exploiting plaice and sole in the North Sea is the twin beam trawl. This gear is used by virtually all Dutch and Belgian flatfish vessels and a large part of the British flatfish fleet. It contributes approximately 80% to the total fishing mortality of flatfish (70% of plaice and 90% of sole).

Since the abundance of sole increased again as a result of the 1987 and following good year classes, the effort of most beam trawlers appears to be primarily directed at catching sole. But in beam trawling for sole, plaice is an inevitable bycatch. A directed fishery for plaice with beam trawls is always possible by using sufficiently large meshes in the codend.

Apart from beam trawls, plaice and sole are caught by otter trawls, Danish and Scottish seines and set nets. Denmark still has a small otter trawl fishery directed at plaice, but generally plaice is just a bycatch of otter trawling. Very little sole is caught by otter trawls.

With Danish and Scottish seining, a directed fishery for plaice is practised, mainly by Danish and British vessels. Bycatch of sole are practically nil in this fishery. On the other hand the fishery with set nets is primarily directed at sole, with little bycatch of plaice. This is a seasonal fishery, mainly practised by Danish fishermen. Apart from that, Danish netters have a directed fishery for plaice. The North Sea beam trawl fleet is composed of the following segments by nationality.

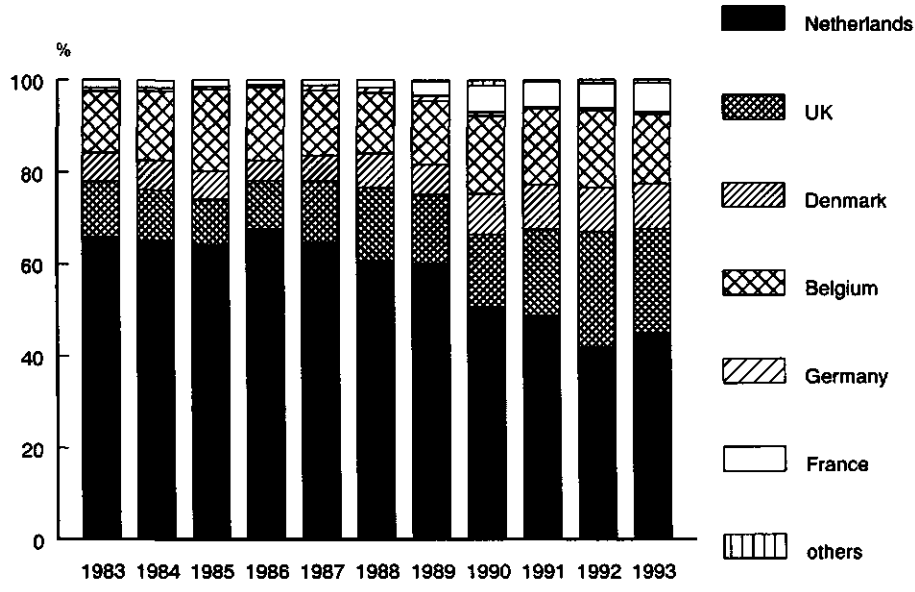

Figure 3.2a National shares of North Sea plaice landings, 1983-1993

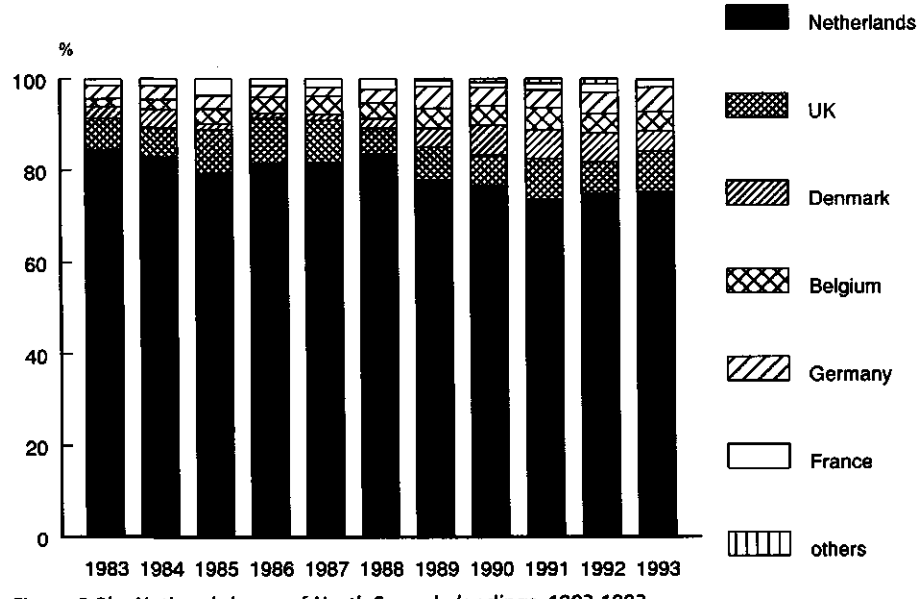

Figure 3.2b National shares of North Sea sole landings, 1983-1993

Belgium 1)

In 1993 a fleet of 149 beam trawlers, with an aggregate engine power of 66,000 kW operated under the Belgian flag. The total beam trawling effort was 14.1 mln kW-days. Approximately 70% of the effort was exerted in the North Sea.

The total crew of the beam trawler fleet is estimated at 680, so the labour involved in North Sea beam trawling is equivalent to 475 man-years.

Some of the Belgian beam trawlers are owned by combined Belgian and Dutch interests.

Denmark 2)

Has no beam trawling of any significance.

France 3)

France has a small fleet of relatively small beam trawlers: 25 to 30 boats of 10 to 29 m length over all. Less than a quarter of their effort is directed at the North Sea.

Germany 4)

At the end of 1993, Niedersachsen and Bremen had 9 beam trawlers fishing outside the coastal zone and 28 coastal fishing vessels partly engaged in beam trawling for flatfish. Schleswig-Holstein had 17 vessels fishing for white fish in the North Sea; part of this activity was beam trawling for flatfish.

Part of the German beam trawlers is owned by combined German and Dutch interests. Those boats are generally manned by Dutch crews and operating from Dutch ports.

The Netherlands 5)

The Dutch fleet of beam trawlers consists of 294 vessels, having a combined engine power of 327,700 kW and an aggregate gross tonnage of 82,200 G(R)T. Out of this fleet, 100 boats with a total engine power of 38,400 kW participate also in other fisheries, like those for roundfish, herring or shrimp. The

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1) Ir. M. Welvaert; De Belgische zeevisserij, aanvoer en besomming, 1993; Dienst voor de Zeevisserij, Oostende, 1994.
2) Fiskeristatistisk årbog 1992; Fiskeriministeriet, Copenhagen, 1993.
3) Report of the Working Group on the Assessments of Demersal Stocks in the North Sea and Skagerrak, 6-13 October 1992; Ch.6: Matters relating to technical interactions; ICES C.M. 1993/Assess: 5, Copenhagen, 1993.
4) Die Kleine Hochsee- und Küstenfischerei Niedersachsens und Bremens im Jahre 1993; Jahresbericht des Staatlichen Fischereiamtes Bremerhaven; Die Kleine Hochsee- und Küstenfischerei Schleswig-Holsteins im Jahre 1993; Jahresbericht des Fischereiamtes Kiel; Das Fischerblatt, Jahrgang 42, Nr. 2, 3, 4, 5, Kiel, Febr. - May 1994.
5) Drs. W. Smit et al.; Visserij in cijfers 1993; LEI-DLO, Periodieke Rapportage 31-93, Den Haag, 1994.

total beam trawling effort amounted to 56.5 mln kW-days in 1993. Just over 1,600 man-years of labour were involved in the fishery.

United Kingdom 1)

The British beam trawler fleet fishing in the North Sea numbered 187 vessels in 1993, spending about 0.25 mln fishing hours. Part of those are relatively small coastal fishing vessels, and part of the fleet is based in ports at the south and west coasts, only fishing in the North Sea occasionally. It is estimated that around 70 vessels ranging between 24 and 40 m loa have their main fishery in the North Sea.

About 60% of these boats are owned by combined British and Dutch interests. They are generally manned by Dutch crews and operate from Dutch ports. Amongst those are 20 vessels based in Scotland, having a combined engine power of 24,000 kW and an aggregate gross tonnage of 5,200 GRT.

The total North Sea beam trawler fleet is estimated to comprise nearly 600 vessels, having an aggregate gross tonnage of around 120,000 G(R)T and a combined engine power of about 470,000 kW. The total beam trawling effort of this fleet in the North Sea was around 75 mln kW-days in 1993. The fishery has a labour input of around 2,500 man-years.

The non-beam trawl fisheries cannot be described with a similar precision. Those fisheries are generally only seasonally directed at flatfish. The main directed fisheries are:

- otter trawling for plaice in Denmark;
- seining for plaice in Denmark and the United Kingdom;
- netting for sole, plaice or turbot in Denmark and Germany.

Only very general data on the fleets involved are available.

Denmark

Nearly 40% of Danish plaice landings from the North Sea in 1992 were the result of seining. The seiner fleet of the North Sea fishing districts numbered 148 vessels, having a total gross tonnage of 5,500 G(R)T, a total engine power of 21,600 kW and a total crew of 455 men. The effort is more or less concentrated in the period from March to September, when nearly 80% of the North Sea plaice landings are made.

The Danish fleet of netters in the North Sea districts counted 408 boats in 1992, having an aggregate gross tonnage of 5,600 G(R)T, a combined engine power of 34,800 kW and a total crew of 920 men. According to the landing value, over 40% of the effort of these vessels concerned fishing for flatfish. Netters account for 80% of the Danish North Sea sole catch (75% of that of turbot) and 30% of that of plaice. The sole fishery is highly seasonal, the season running from March until August. It peaks in April, when nearly half the total catch is made.

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1) a) United Kingdom Sea Fisheries Statistics 1993, Ministry of Agriculture, Fisheries and Food, London, 1995; b) C. Egner, (SFIA) personal communication.

In 1992 about 15% of North Sea plaice landings in Denmark was made by (otter) trawlers under 100 GRT. Most of this probably was the result of directed fishing. Another 15% was landed by trawlers over 100 tonnes, mostly as a bycatch probably, or as the result of a mixed fishery. Data from 1988 show that about 40 trawlers of 10-70 G(R)T were fishing specially for plaice in that year, making about 1,000 trips in total. The size of this fleet has probably decreased since.

Germany

A small fleet of about a dozen German Baltic netters also profit from the sole season in the North Sea.

United Kingdom

The UK North Sea seiner fleet counts only about 40 boats. They are generally of a similar size and operate in a similar way as the Danish seiners.

The total non-beam trawling North Sea flatfish fleet is estimated to consist of nearly 650 boats, having an aggregate gross tonnage of around 14,000 G(R)T, a combined engine power of around 70,000 kW and a total crew of some 1,700 men. At a 60% dependence on fishing for flatfish, this would mean a total employment of around 1,000 man-years.

The total fleet of vessels engaged in directed fishing for flatfish in the North Sea, both beam trawl and non-beam trawl together, so is estimated at 1,250 boats, with an aggregate gross tonnage of around 134,000 G(R)T and a combined horse power of around 540,000 kW. The North Sea flatfish fishery provides an employment equivalent to around 3,500 man years, but the number of crew members engaged in it for at least part of the year is probably over 4,500.

3.2 Biological basis

Plaice and sole occur in a large area in the northeast Atlantic. They are managed in separate management areas as separate stocks.

The distribution of sole extends from the north African Atlantic coast, the Mediterranean to the southern part of the North Sea (IVc and IVb south). In the North Sea the species is on the northern limit of its distribution area. The North Sea stock is the largest of the exploited sole stocks. Nurseries are situated in shallow waters along the continental and English coast at 5 to 10 m depth.

The distribution of European plaice extends from the Barents Sea, Iceland, west of Ireland and Baltic Sea to the Bay of Biscay, the latter also being the southern limit of its distribution area. The North Sea stock is the largest plaice stock. Nursery areas are situated in coastal and inshore stretches along the North Sea coast of Britain and the continent. The most important nursery areas are the Wadden Sea and the German Bight.

In many cases both plaice and sole are exploited by the same fleets in the North Sea. Both species show a considerable overlap in distribution area of the adults on the fishing grounds and juveniles in the nurseries. Peak spawning of

plaice occurs in the 1st quarter and for sole in the 2nd quarter in coastal areas. High densities during spawning time attract a more directed fishery for these species. Juveniles of both species start recruiting into the fishery as 2-year-olds in the second half of the year in coastal areas. Most of the catch of both species is taken by beam trawlers. The minimum mesh size, used in this fishery, is 80 mm and is, by derogation of the general minimum mesh size of 100 mm, set in accordance with the selection characteristics of sole. Due to this minimum mesh size, large numbers of plaice are discarded. Discards in the beam trawl fishery are estimated to be around 50% (plaice in numbers) and sole 15%. These percentages may vary between years, pending on the strength of recruiting year classes. There are no predatory interactions between the two species.

The overview of the historical development of both stocks is given below and is drawn predominantly from assessments made by the ICES Working Group on the Assessment of Demersal stocks in the North Sea and Skagerrak (Anon, 1995) 1).

3.2.1 Plaice

Trends in landings, recruitment, fishing mortality and spawning stock biomass are shown in figure 3.3.

With the exception of three exceptionally strong year classes, all born after a strong winter, recruitment of North Sea plaice shows less variation, compared to many other exploited species for which information on recruitment is available. In the period 1957-1994 annual recruitment varied between 235 and 1,270 mln 1-year-olds. Average recruitment in this period is 465 mln. The level of recruitment increased significantly in the seventies but appears to decline again since the end of the eighties. All year classes born after 1988 are at or below average strength.

In the first half of this century landings of plaice in the North Sea have fluctuated between 30 and 70,000 tonnes. Since the end of the 2nd World War landings have started to increase continuously. After a period with historically high landings at a level of around 150,000 tonnes in 1979-1991, landings in 1993 declined to 110,000 tonnes the lowest since 1975.

The fishery is dependent on the success of incoming year classes. In the period 1984-1993 on average 45% (32-51) of the landings in numbers were 3 years old or younger and 70% (53-84) were 4 years old or younger.

Fishing mortality has increased steadily between 1960 and 1980. Since 1990 it has increased further and is currently believed to be at a record high level. The trends in fishing mortality are very similar to sole.

Historically the spawning stock biomass has varied between 300 and 500,000 tonnes since 1957. Despite a steady increase in fishing mortality, spawning stock had remained rather stable and even increased to a level of 415,000 tonnes in 1989, mainly due to the increase in the average level of re-

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1) Anon; Report of the working Group on the Assessments of Demersal Stocks in the North Sea and Skagerrak; ICES C.M. 1995/Assess: Copenhagen, 1995.

cruitment in the 1970s and 1980s and to an increase in growth in the 1960s. Recently SSB has fallen to 250,000 tonnes in 1994, the lowest recorded in the assessment period. The 1994 level of biomass is well below the minimum biologically acceptable limit (MBAL) of 300,000 tonnes. The recent fall in spawning stock biomass is due partly to a decrease in the growth rate of plaice, partly to a decrease in the level of recruitment and to an increase in fishing mortality.

The reduced growth results in a direct reduction of the total production capacity of the stock. The reduction in growth also extends the pre-recruit period of the juveniles, therefore recruitment in the fishery is delayed and pre-recruits are exposed to discard mortality for a longer period. Consequently apparent recruitment in the fishery is reduced.

In 1989 a closed area, the Plaice box, was introduced in the coastal waters of the continental coast in the German Bight and along the Dutch and Danish coast, with the intention of reducing discarding of juvenile plaice, which is most abundant in the area. In the box, the fishing conditions for the 12 coastal miles zones are applicable.

Since 1975, plaice in the North Sea are managed by annual TACs and quota. Problems with the quota management occur because the allocation key of the TAC into national quota does not correspond with the distribution of fishing capacity. This situation resulted in structural underexploitation of the quota by some nations, while other nations structurally overshot their quota. The resulting enforcement problem has tempted managers to set TACs above the status quo catch predictions indicated by scientists. These predictions, however, in recent years (1990-1993) also appeared to be overestimates of the realised status quo catch. In those years scientists had overestimated the stock and recruitment as a result of unreliable estimates of unreported landings. Therefore TACs for plaice in recent years have not been restrictive in the North Sea.

3.2.2 Sole

Trends in landings, recruitment, fishing mortality and spawning stock biomass are shown in figure 3.4.

In the period 1957-1994 recruitment varied between 12 and 550 mln 1-year-olds. Average recruitment is 134 million. Although there is considerable variation in the level of recruitment from year to year, recruitment of year classes born in the periods 1956-1964 and in the period after 1975 has been higher than the period in between. The pattern of recruitment is characterized by the incidental occurrence of exceptional strong year classes which have had a great impact on the development of landings, stock and fisheries. These strong year classes were all born after severe winters or cold springs. Severe winters can also cause severe mortality. Recruitment of year classes 1961, 1962 and 1978 were reduced by the winters of 1963 and 1979. In recent years two outstanding year classes were born (1987 and 1991), which presently dominate the stock and the fishery.

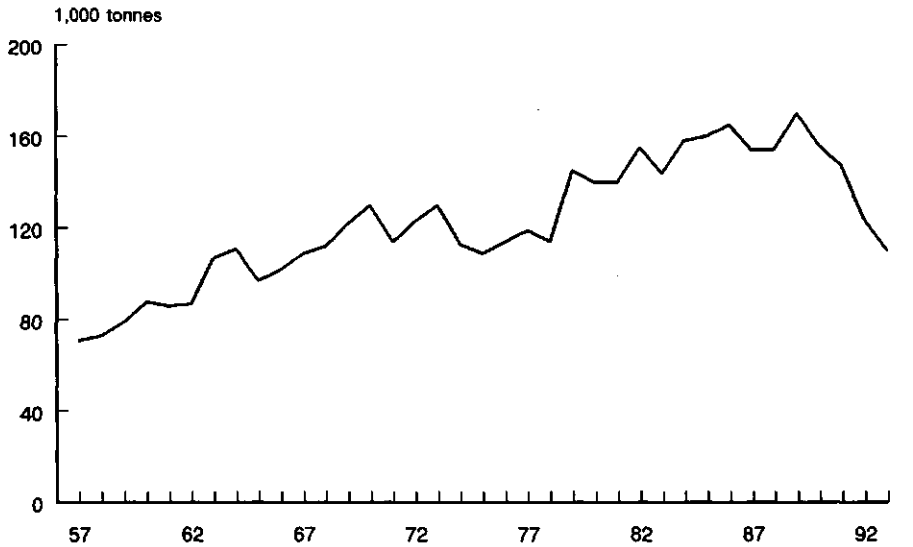

Figure 3.3a North Sea plaice landings, 1957-1994

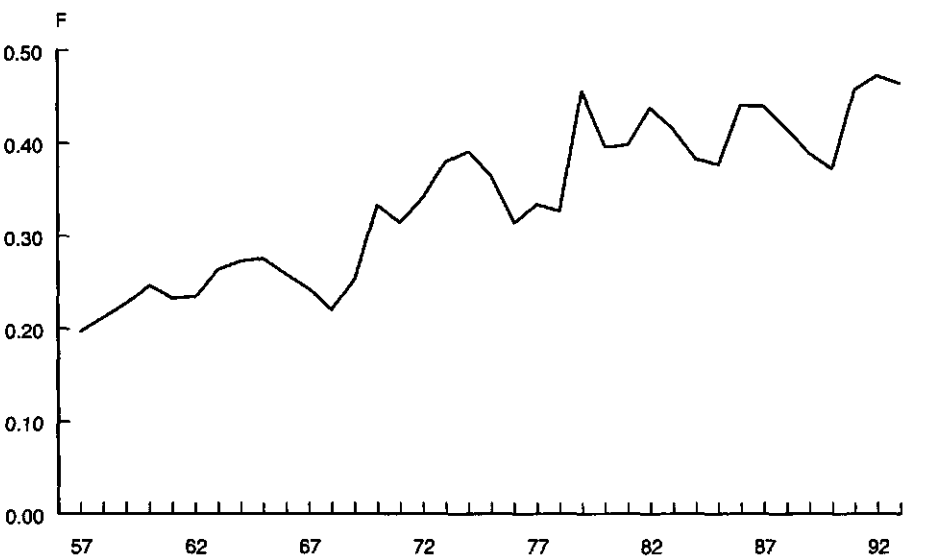

Figure 3.3b North Sea plaice fishing mortality, 1957-1994

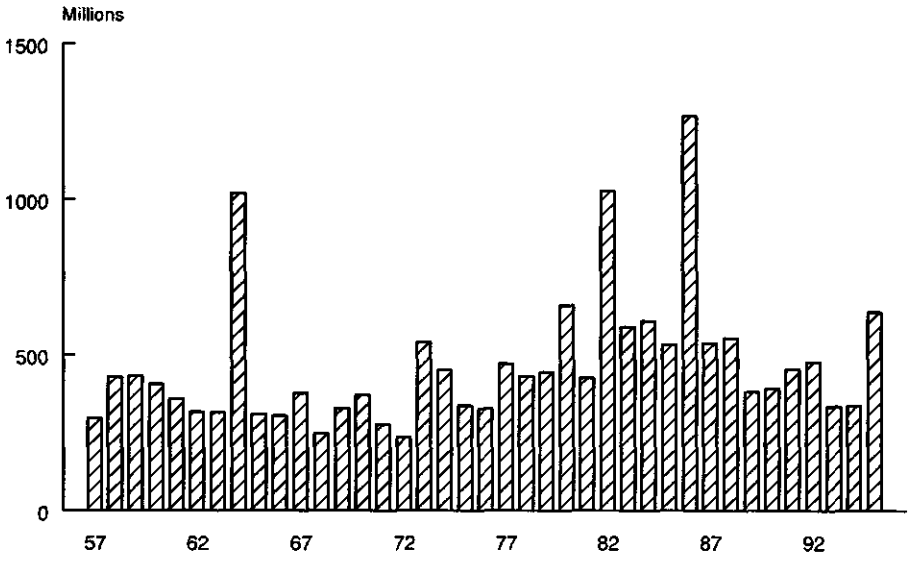

Figure 3.3c North Sea plaice recruitment (year class), 1957-1994

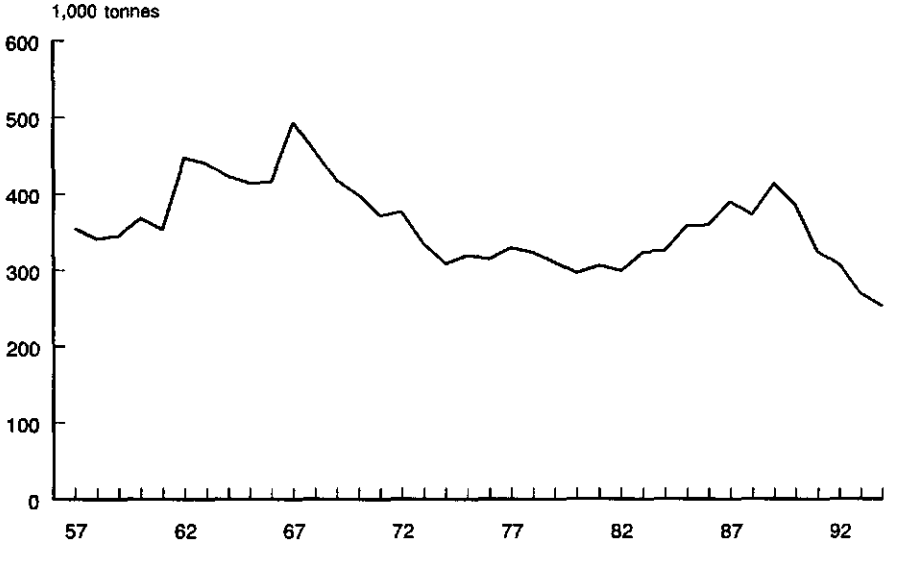

Figure 3.3d North Sea plaice Spawning Stock Biomass, 1957-1994

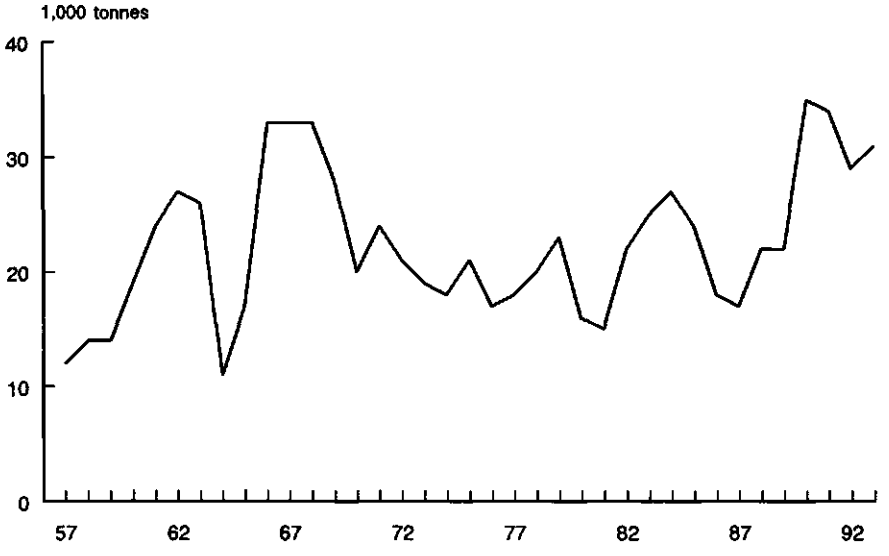

Figure 3.4a North Sea sole landings, 1957-1994

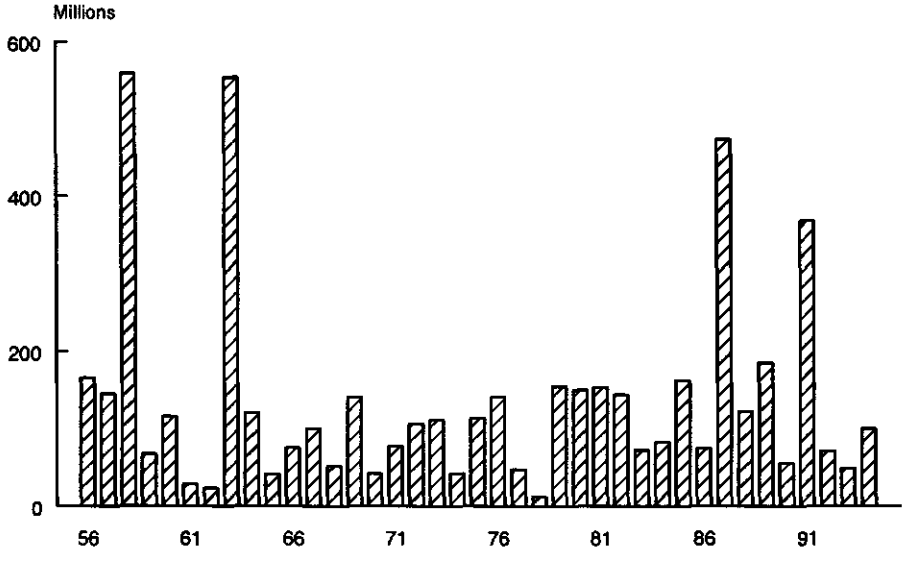

Figure 3.4b North Sea sole fishing mortality, 1957-1994

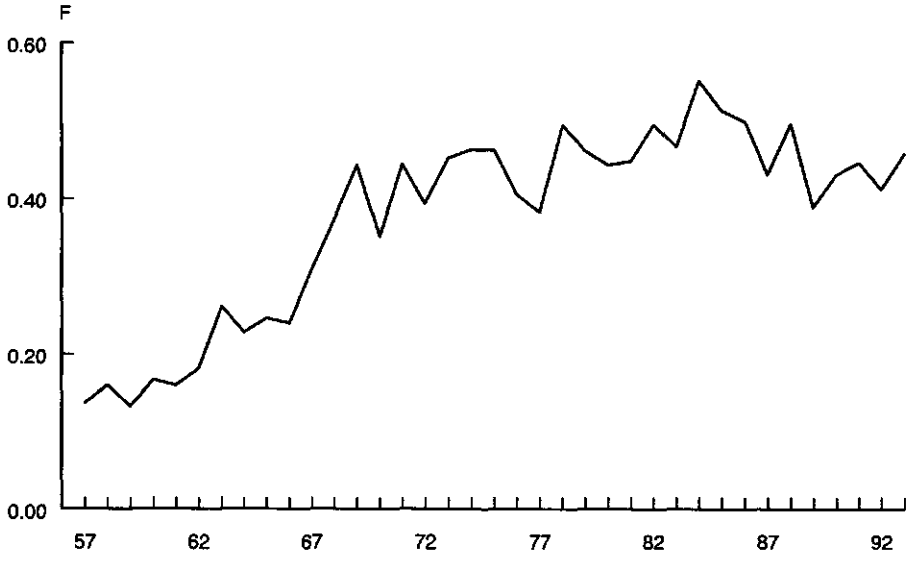

Figure 3.4c North Sea sole recruitment (year class), 1957-1994

Figure 3.4d North Sea sole Spawning Stock Biomass, 1957-1994

Landings in the first half of the century gradually increased from levels around 1,500 tonnes in the beginning of the century to about 10,000 tonnes around 1950. Trends in landings are related to the recruitment of strong year classes in the fishery and a gradual increase in fishing mortality. In the period 1957-1963 landings increased from 12 to 26,000 tonnes, mainly because of the good 1958 year class. They declined sharply in 1964 as a result of a reduction of the stock caused by excessive mortality of adult fish in the severe winter of 1963. Landings increased thereafter in the period 1965-1969 from 17 to 33,000 tonnes, because of the record 1963 year class and an increase in fishing mortality. In the period thereafter they declined to a level around 20,000 tonnes with variations reflecting variations in recruitment. In 1991 they increased sharply to an historically high levels and remained high in 1992 and 1993 by two strong year classes born 1987 and 1991.

In the period 1984-1993 on average 58% (44-81) of the landings in numbers was 3 years old or younger and 81% (60-90) was 4 years old or younger. Even more than for plaice the level of the landings depend on the success of incoming year classes.

Fishing mortality increased gradually in the period 1957-1966. It increased sharply in 1967-1969, mainly because of the introduction of the beam trawl and continued to increase gradually until the mid eighties. In the last five years it has been somewhat reduced and is fluctuating at around a level of 0.42.

Spawning stock biomass was high in the early period. The historically high value of 149,000 tonnes was in 1961. It dropped after the cold 1993 winter and increased again to 105,000 tonnes in 1966. Thereafter it decreased gradually because of an increase in fishing mortality and low recruitment. In the period 1973-1989 it has fluctuated between 25 and 45,000 tonnes. It increased sharply in 1990 to 97,000 tonnes when the 1987 year class recruited to the fishery and remained at a high level thereafter. At observed levels of biomass, the stock has not shown signals of recruitment failure. Management is directed to maintain the spawning stock biomass above a minimum biologically acceptable limit (MBAL) of 35,000 tonnes.

In the past fisheries managers have attempted to reduce the exploitation rate of sole by setting restrictive single species TACs which have corresponded to a reduction in fishing mortality. In most years, however, the actual landings exceeded the TAC (figure 3.1) and were closer to the status quo catch forecast.

3.2.3 Conclusions

The exploitation rate of flatfish is much lower compared with roundfish. The level of fishing mortality of plaice and sole is around 0.5 while cod, haddock and whiting are twice as high.

The main reason for the difference is related to their habitat and their behaviour. While roundfish can be exploited with various gears everywhere in the North Sea, flatfish is relatively more protected in several (stony and muddy) areas, which are difficult to fish with beam trawlers. Therefore the flatfish stocks are less volatile compared to roundfish stocks in the North Sea.

In recent years both sole and plaice yields and stock biomasses in the North Sea have been in an 'above average' situation and profited from increased levels of recruitment or a few outstanding year classes. This situation is not expected to continue. Outstanding sole year classes occurred about eight times in this century with possible intervals of 25 years. The present size of the adult sole stock is dominated by 2 outstanding year classes, which contribution is expected to decrease rapidly. The spawning tock of plaice has recently declined below the biologically acceptable minimum level by a reduction in recruitment since 1988, it is expected to remain below this level if present level of exploitation and average future year class strength will not change.

Although both stocks have not shown signs of recruitment overfishing at historical levels of spawning biomass, they are both overfished in terms of growth. Management advice for both stocks has been to reduce fishing mortality by reducing fishing effort. Such a reduction is required to reduce the probability that the stocks drop or remain below their minimum thresholds.

Yields in the fishery for plaice and sole have been dependent on the size of recruiting year classes. Therefore predictions of future yields depend on the accuracy of estimates of year class strength. In practice most problems with predicting year class strength have been with the outstanding year classes, which already have a great impact on the predicted yields in the first year when they recruit in the fishery.

3.3 Regulations

3.3.1 EU Regulations

The North Sea flatfish fishery is extensively regulated by the European Union: rules and regulations are in force in all four fields of the Common Fisheries Policy. These concern TACs and quota, technical measures, structural measures and marketing measures.

3.3.1.1 TACs and quota

Since 1975 the North East Atlantic Fisheries Commission has regulated the fisheries for plaice and sole in the North Sea by a system of TAC and quota. This system was adopted by the European Union and integrated into its Common Fisheries Policy. EU is now the dominant partner in the fisheries regulation of the North Sea. TACs are still agreed upon in the NEAFC but the EU has a decisive vote. The EU distributes its share of the TACs over the Member States according to a fixed key.

Table 3.2 gives TACs of plaice and sole over recent years; table 3.3 shows the shares of the Member States.

Table 3.2 Total Allowable Catches of plaice and sole in the North Sea (IIa and IV) 1989 - 1995 (1,000 tonnes)

	1989	1990	1991	1992	1993	1994	1995
Plaice total TAC	185.0	180.0	175.0	175.0	175.0	165.0	115.0
EU plaice TAC	182.7	176.9	171.9	168.8	168.8	153.4	106.9
Sole TAC	14.0	25.0	27.0	25.0	32.0	32.0	28.0

Table 3.3 Basic quota shares of Member States in the EU TACs of plaice and sole in the North Sea (IIa and IV) (%)

	Belgium	Denmark	France	Germany	Netherlands	Un. Kingdom
Plaice	6.2	20.0	1.2	5.8	38.5	28.5
Sole	8.3	3.8	1.7	6.7	75.2	4.3

By exchanging its quota of demersal species in waters outside the North Sea (and part of its North Sea sole quota) with Belgium, Denmark and, particularly, the United Kingdom, the Netherlands has annually increased its share in North Sea plaice by around 7.5%. This solved two problems: it relieved the shortage of plaice that existed during the eighties; and it made controlling the fishery a lot easier, as all quota for demersal species were concentrated in one management area, the North Sea. The necessity for making these swaps to provide for sufficient plaice became less evident when, coinciding with the increased availability of sole, the Dutch catches dropped gradually to even below the basic quota level. The other reason for the swaps, ease of control, was as yet never challenged by the Dutch industry.

3.3.1.2 Technical measures

Technical measures have been laid down in Council Regulation (EC) No 3094/86 and successive amendments.

Minimum landing size

The following minimum landing sizes are in force for 'protected' flatfish species in the North Sea (in cm):

- Plaice *Pleuronectes platessa* 27
- Witch *Glyptocephalus cynoglossus* 28
- Lemon sole *Microstomus kitt* 25
- Sole *Solea vulgaris* 24
- Turbot *Psetta maxima* 30
- Brill *Scophtalmus rhombus* 30
- Megrim *Lepidorhombus spp.* 25
- Dab *Limanda limanda* 23
- Flounder *Platichthys flesus* 25

Minimum mesh size

The minimum mesh size for fishing for demersal species in the North Sea is 100 mm. Of the few derogations to this general rule, one is particularly relevant to the flatfish fishery: fishing for sole south of 55° N is allowed with 80 mm meshes in the cod end, provided that at least 5% of the catch is sole, and no more than 10% of the catch is composed of cod, haddock and saithe.

The 80 mm mesh used in most of the flatfish fishery results in substantial discards of undersized plaice. Dutch fishermen are of the opinion that for sole the minimum landing size and the mesh size are not optimally tuned, as they tend lose considerable amounts of marketable sole when a new year class recruits to the fishery.

Maximum beam length

An additional technical measure concerning the fishing gear is the restriction of the aggregate beam length of beam trawlers to 24 m. This limits the fishing power of beamers over about 1,300 kW to a certain extent, by reducing the swept area, but this may be partly compensated by increasing the fishing speed.

12 mile zone

Beam trawling is not allowed in a 12 nautical mile (22.2 km) wide zone along the British coast, except for vessels having an engine power not exceeding 221 kW and an overall length of 24 m maximum.

In the 12 mile zone extending from the French coast at 51° N to Hirtshals in Denmark trawling is not allowed for vessels over 8 m overall length. However, otter trawling is allowed for vessels of maximum 221 kW and 24 m overall length, provided that catches of plaice and sole exceeding 5% of the total amount of fish on board are discarded. Beam trawling is only allowed for vessels included in a list that has been drawn up for the purpose. The number of vessels on this list is bound to a maximum, but the vessels on it may be replaced by other ones, provided their engine power does not exceed 221 kW and their overall length is 24 m maximum. Vessels on the list are allowed to fish within the twelve mile zone with beam trawls having an aggregate width of 9 m maximum. To this rule there is a further derogation for vessels having shrimping as their main occupation. Such vessels may be included in an annually revised second list and are allowed to use beam trawls exceeding 9 m total width.

Plaice box

In addition to the twelve mile zone a 'Plaice box' was established in 1989, extending from 53° N to 57° N along the coasts of the Netherlands, Germany and Denmark and about 30 nm (55 km) wide, where the same restrictions are in force as in the twelve mile zone that is part of it (in effect no beam trawling by vessels over 24 m overall length with engines over 221 kW). Initially the restriction applied only to the second and third quarter, in 1994 it was extended to the fourth quarter.

The Plaice box was established in order to protect the nurseries and ongrowing areas of young plaice, which should result in increased yields of

plaice, possibly to an extent of 25%, related to a situation without the box. An evaluation by an ad hoc study group in 1994 1) has confirmed the opinion of the fishermen that the predicted effects have not been realized. But a maximum effect of the box can only be reached by excluding all discard producing fleets.

Apart from the fact that the box was closed to the larger beamers only during half of the year, an important factor in not achieving the expected effects has been the expansion of the fishery within the box. The protection offered by the box, and earlier by the twelve mile zone, has led to substantial investment in powerful 221 kW, 24 m loa vessels, mostly replacing smaller, obsolete boats on 'List I'. In the Netherlands, for instance the number of boats with engines from 192 to 221 kW increased from 107 to 124 between the end of 1989 and the end of 1993, while the total fleet size decreased by nearly 100, from 573 to 474 boats.

Since the beginning of the eighties, when such 'Eurocutters' measured around 85 GT (at that time the maximum allowed vessel size in the 12-mile zone still was 70 GRT), the size of the newly built vessels has almost doubled to 160 GT. It is hardly conceivable that the extra investment involved in the extra volume would not be compensated by an increase in fishing power to a similar extent. So not only the number of top of the range boats allowed to fish within the protected areas has increased, but also their average fishing power.

In addition to this the activity of the Dutch up to 221 kW beam trawling fleet in the box has more than doubled, as is indicated in the ACFM evaluation report. The combined effect must have been an increase in fishing effort and resulting mortality in the box rather than the expected decrease.

Compared to this, the expansion of Danish netting, for sole in particular, in the lee offered by the box exactly during the season, has been of negligible influence.

3.3.1.3 Structural measures

According to the framework of the present Multi-Annual Guidance Programme, covering the period 1-1-'93 to 31-12-'96, benthic fishing fleets, i.e. beam trawling fleets, should be reduced in engine power and gross tonnage by 15%. Demersal fleets should be reduced by 20%. For other fisheries no reductions are required. Of the required reductions, 45% may be realized by a (permanent) reduction of effort.

The Dutch MAGP already takes into account a capacity reduction of 8.2 % realized by a limitation of the days-at-sea in the former period.

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1) a) Report of the study group on the North Sea Plaice box, 12-15 April 1994; ICES C.M. 1994/Assess: 14, Copenhagen, 1994; b) Extract of the report of ACFM to the European Commission: North Sea Plaice box; ICES, Copenhagen, May 1994.

3.3.1.4 Marketing measures

A number of flatfish species are included in the common withdrawal price system, pursuant to Regulation (EC) No 3759/92. These are: plaice, megrim, dab, flounder and sole. The withdrawal price for 1995 is set at 83% of the guide price for all of those, except for megrim, where it is 80%.

Not all species have to be included in the withdrawal systems of the individual Producer Organizations. The Dutch POs have no withdrawal price for sole, as it would serve no practical purpose.

The withdrawal prices for plaice are set at two levels: they are lower for the first four months of the year in order to discourage landing of lean, low quality plaice during the spawning season. This could have some stock conservation effect as well, although in practice the effect is very limited.

3.3.2 National regulations

In most participating countries the North Sea flatfish fishery, particularly of plaice and sole, is subject to more or less specific national restrictions. These may concern access to the fishery or landing restrictions and are quite complicated in some instances.

3.3.2.1 Belgium

The fishing capacity of the Belgian fleet is controlled by a vessel licensing system, which allows no increase in aggregate engine power and tonnage. A decommissioning scheme serves to stimulate capacity reduction as required by the MAGP. Vessels can be replaced by boats of the same horse power and gross tonnage, or licenses can be joined for new building up to a maximum tonnage of 385 GT, an engine power of 883 kW and a length of 38 m.

The fishery for plaice is not subject to any national restrictions. Individual quota of North Sea sole are allocated on the basis of engine power. The allocations may be adapted during the year, according to the recorded catches. For instance in 1993 after successive increases, vessels of 221 kW or less were eventually allowed to land 93 kg/kW and more powerful vessels half of that.

3.3.2.2 Denmark

The fishing capacity in Denmark is in general limited by a licensing system. New capacity can only be commissioned after withdrawal of a similar old capacity. The capacity of individual vessels is expressed in six parameters: gross tonnage, length, width, depth, hold volume and engine power. Increases in any of these parameters require the consent of the Ministry of Fisheries. Conversion of vessels having an engine power over 368 kW to beam trawling is not allowed.

There is no direct regulation on the catch of plaice, as the quota remains underutilized. In fact the plaice fishery is stimulated through a kind of multi-

species regulation: fishermen get extra cod quota if their plaice landings exceed 40% of the landed weight of cod.

Catches of sole are regulated by boat quota per unit of time, varying during the year with the season. In 1994 for instance, sole catches were restricted to 300 kg per week, only as a bycatch of the plaice fishery, during the first quarter. In the second quarter the boat quota varied between 600 and 1,800 kg per two weeks, depending on boat length. The sole fishery was free during the third quarter, but quota were reintroduced in October to a level of 100 kg per boat per week.

3.3.2.3 France

France has no national regulations on the North Sea flatfish fishery.

3.3.2.4 Germany

The fishery for plaice has no national regulation in Germany. Catches of sole are restricted by boat quota per calendar month. In 1994 these quota increased quarterly from 3,000 kg/month in the first quarter to 12,000 kg/month in the last quarter.

3.3.2.5 The Netherlands

A complex system of national regulations has been introduced in the Netherlands in order to regulate the fisheries, in particular that for flatfish.

Since 1985 licenses on engine power have restricted the capacity of the fleet. The licenses are transferable, but since 1994 have been reduced in size by 10% on transfer. At the start of 1995 a total of 553 licenses were 'active', i.e. had been issued to vessels, having an aggregate engine power of 374,000 kW. The size of the actual flatfish fleet has been given in section 3.1: 294 licensed vessels having an aggregate engine power of 327,700 kW.

The catches of plaice and sole are regulated basically with a system of individual transferable quota. These were introduced in 1976, shortly after the inception of the NEAFC quota management. Originally the ITQs were allocated on the basis of track records in the same reference years as the national quota allocation had been based upon: 1972-1974. The ITQs are expressed in kg per year and annually adapted in proportion to the changes in the national quota, so in effect the ITQs are shares in the national quota. Transfer of quota is restricted in time and in relation to the extent of exhaustion of the relevant quota of both letter/seller and hirer/buyer.

From the start, the ITQs proved very difficult to control and enforce. On one hand the obligation of first sale of landed fish through auctions had been dropped due to EU market regulations, so fishermen were free to land their fish wherever and whenever they wanted, and sell it to whoever they wanted. On the other hand it appeared to be legally virtually impossible to end the fishing activity of vessels that had exhausted their quota (as they could still go fishing for non-quota/other species). Another aspect of the problem is, that the

Dutch government is primarily responsible to enforce the national quota and the ITQs, as a tool of equitable allocation, are only of secondary concern.

Very strict rules on and control of landings were introduced during the eighties in order to curb illegal fishing and landing practices. Landing of fish is only allowed in fifteen ports, at designated quays, between certain hours. The inspection service has to be notified of the intention to land 8 hours beforehand (on trips lasting more than one day), and unloading of the catch is not allowed without the consent of the inspection service. All fish on board has to be unloaded in one uninterrupted action.

In order to support the enforcement of national quotas, restrictions on effort were introduced. From 1987 onwards, vessels having ITQs of plaice and sole were allowed to spend a certain number of days-at-sea. Vessels having more quota than could be caught in the standard number of days were given a derogation. Since 1992 these derogations are based on a combination of ITQs and fishing (=engine) power 1).

The basic number of days-at-sea is now reduced to 100 days, and virtually all flatfish cutters have a derogation, so in fact this is equivalent to an individual days-at-sea regulation. (Some vessels with very ample quota in relation to their engine power could stay at sea all the year round.)

It should be noted that the days-at-sea allocation system is implicitly based on the assumption that TACs are set at status quo level. As a result allowed sea time does not vary with variations in TACs, but in fact has gradually increased as a consequence of the reduced catchability of plaice.

In 1993 the management and control of ITQs and days-at-sea was to a certain extent transferred to PO-groups. In the groups ITQs and days-at-sea are pooled and can be transferred more freely than outside the groups, subject to the rules of the group. Group members are obliged to sell all fish landed through an auction. All flatfish fishermen have joined one of the eight groups that have been formed and signed a contract to abide by the rules set by the group.

3.3.2.6 United Kingdom

The UK operates a fairly complex system of licences for the regulation of its so called 'pressure stock' fisheries. Both plaice and sole in the North Sea are considered to be 'pressure stocks' and for each a licence is required. These licences are not only connected to the stock, but also connected to the capacity of the vessel expressed in a figure compounded from tonnage and engine power. All fishing vessels require to hold a licence of one form or another and although licence aggregation is permitted, any vessel owner wishing to replace a vessel with one of greater capacity must purchase licences equivalent to 120% of the capacity of the replacement vessel. The 20% capacity penalty is

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1) Jan Willem de Wilde; Capacity and effort limitations in the Netherlands; EAFE Conference, Brussels, March 1993.

reduced to 10% if the replacement vessel is the same size as the one leaving the fleet.

A decommissioning scheme, involving funds to a total of £ 53 mln over a period of five years, has been set up, in order to reach the MAGP targets. For the beam trawler fleet this involves a reduction by 15% to 17,600 G(R)T and 81,500 kW.

Management of quota has been partly devolved to Producer Organizations. Shares of the national quota are allocated to POs based on the aggregate track records on the species concerned of their members. In 1994 27 % of the North Sea plaice quota was allocated to POs and 74% of the North Sea sole quota. The POs can manage their quota as they wish, for instance by setting monthly quota related to boat size, or by allocating annual quota to individual boats. The activities of vessel who are not members of a PO are managed by the government by fixing 'non-sector' quota.

3.4 Definition of the management problem

The management problem in the flatfish fishery will be defined on the basis of an evaluation of the present situation according to the criteria developed in chapter 1. As the flatfish sector of the Netherlands is the dominant participant and is best known, this evaluation is restricted to the Dutch situation.

3.4.1 Economics

Flexibility

The present national management system, with PO-group management of ITQs and days-at-sea, has exerted very little restrictions on the freedom of operation of Dutch fishermen. On one hand the quota of sole and particularly of plaice were ample until 1993-94. On the other hand, a surplus of more or less freely transferable days-at-sea was available. This resulted from the generous allocation of sea time to small boats with small ITQs, left unused. Only the different rates of exhaustion of the quota interfered with operational freedom, regularly obliging fishermen to shift their effort from sole to plaice. Generally, it can be stated that fishermen rather prefer to cope with the whims of nature than with those of managers.

Planning

Planning the future development of a fishing firm no longer mainly concerns investments in vessels and their equipment but as much or even more so the availability of fishing rights: ITQs and HP-licences. Possibilities for expansion of individual firms are curbed by the scarcity of free HP-licenses on the market, as a result of the decommissioning programme and the policy of licence reduction on transfer. The 2,000 HP limit stimulates the development towards more efficient propulsion systems, giving the new big beamers probably as much fishing power as their 3,000 + HP predecessors, or even more. As long as the

economic results remain attractive, the fishermen will tend to expand their operation. This makes a further reduction of the size of the fleet very difficult; in fact to the industry it is out of the question.

By introducing ITQs and HP-licences the 'unpriced access' to fish has become a market good, and access is 'governed' by supply and demand. However, the level of prices for ITQs and licences appears to be too high. Generally only relatively small quantities are traded, supplementing already availale quota or licence HPs. As a result from the fact that a large share of licences and quota originally has been handed out free of charge the marginal prices are higher than the average prices. Consequently the 'average price' of fishing rights in possession of an enterprise is still lower than a price which would be realized if large quantities of the rights would be on the market.

Even so the fishing rights owned by a company represent very substantial financial interests, becoming a hampering factor on transfer to successors, when fiscal considerations play an important role. Also because of this, changes in the system are not welcome to the industry. As quota are (curiously enough) generally traded on a kg basis and not as shares in the total quotas, fluctuations of quota from year to year are perceived as an 'investment risk'. Uncertainty about the future continuity of the quota system makes that ITQs as assets are not fully accepted as security by banks.

Market consistency

PO-group management has brought little change with respect to regulating landings and spreading them over the year. As a consequence prices of fish have not been affected, neither positively nor negatively.

Daily practice

The discrepancy between the catch rates of plaice and sole in relation to their quota makes the fishermen both wish they were allowed to exceed the sole quota, and ask for an increase in sea time to be able to exhaust their plaice quota.

When good year classes of sole recruit to the fishery, the fishermen are complaining that the allowed mesh size for sole fishing is not consistent with the legal minimum size, resulting in a loss of marketable sole. Pleas from industry leaders as well as researchers that it would be better to leave these small fish in the sea have had little effect.

Race for fish

This has not been a serious problem in the first half of the nineties, because the quota have not been very restrictive. The system of PO-group management has yet to prove itself in this respect in a situation where a catch rate is high in relation to the quota. The situation with excessive landings of small sole shows that there is still a tendency to race for fish and sub-optimal use of quota, in spite of the strict enforcement of ITQs.

Economic performance

The economic results of beam trawling have varied between very good ('91) and moderate ('93 and '94) during the first half of the nineties, moderate meaning: operating around the economic break even point. These good results were mainly due to two factors: good fishing opportunities for sole and low oil prices. Both are rather uncertain factors and may change unfavourably in the future. For the sole fishing this danger is already imminent (see 3.3), but here rising landing prices may partly compensate reduced landings. With its highly energy intensive character, oil costs even at the low price level of '93-'94 representing nearly 20% of total operating costs, the beam trawl fishery is very vulnerable to oil price rises.

The historically generally good financial results of the fishery has enabled the industry to finance investments with substantial commercial bank loans at normal interest rates.

3.4.2 Biology

Spawning stock

The spawning stock of plaice had dropped below MBAL (300,000 tonnes) in 1994 to 250,000 tonnes, so it requires special protection. The industry disputes the set level of MBAL, but it also had complained for a succession of years that the plaice promised by the quota just was not there.

The sole spawning stock was at the sound level of 90,000 tonnes in 1994, considerably above MBAL (35,000 tonnes). However, it is composed mainly of a few strong year classes and tends to go down rather rapidly as long as no new good year class recruits to the fishery. As recruitment of sole is rather volatile, the success of the fishery is somewhat precarious. A more even year class composition of the stock would be preferable from an economic point of view, but this would require a considerable lowering of the fishing pressure, particularly on the smaller sole.

Generally maintenance of the minimum spawning stock MBAL and a solid age composition are not assured because the decision making process (Council of Ministers) gives a certain priority to the short term interests of the fleets.

Fishing mortality

The fishing mortality rate of both species is high at about 0.4. This results in a high probability of the stocks decreasing to below MBAL. Only a number of good year classes have kept the stocks at a sound level; the plaice stock during the eighties and the sole stock from the beginning of the nineties. In the longer run a reduction of fishing pressure is required to assure sound stock levels.

High-grading

High-grading of sole is virtually out of the question for Dutch fishermen. As for plaice it probably does not occur intentionally.

Until the early nineties excessive bycatches of cod and whiting had to be discarded in order to meet bycatch regulations.

Discarding

The small mesh size used in beam trawling for sole results in continuous discarding of small plaice and of undersized sole when a large year class is entering the fishery. In spite of its negative effects on the stocks, fishermen accept this as normal practice, for which there is no economically feasible alternative. Non-commercial species are also discarded continuously.

Ecosystem management

Little is known yet on the interactions of flatfish with other marine life and the position of the various species in the ecosystem.

There is still insufficient scientific evidence to support allegations on the destructive effects of beam trawling on the ecosystem. Still some protective actions have been and will be taken, like the establishment of the Plaice box; restrictions on fishing in the Wadden Sea, which is an important nursery area for plaice; the intentions to close selected areas in the North Sea for fishing. Also some technical measures have positive effects (shorter beam trawl, restrictions on effort).

Pressure from environmental (special interest) groups obliges the government to take precautionary actions. The industry is as yet little interested in these issues and tends to react to such pressures and actions in a strongly defensive manner.

3.4.3 Institutions

Political acceptance

The responsibility to implement quota management has been fully accepted by the Ministry of Agriculture in 1986/87. A new set of very strict rules and regulations was issued and a large number of controllers (120) were put into action in fisheries. However, the prosecution is the responsibility of the Ministry of Justice, which has shown different priorities, mainly in terms of the rate at which the severeness of the prosecution was increased. Pressure from the Parliament has been mainly directed at the Ministry of Agriculture, which was supposed to coordinate with the Ministry of Justice.

In this the Dutch legal tradition plays an important role: application of administrative sanctions (fines) is not a custom in the Netherlands (apart from traffic). The Ministry of Agriculture is reluctant to take over this responsibility from the Ministry of Justice (and the other way round!). Immediate prosecution (or in the short term) was not feasible; court cases regularly lag(ged) several years behind the date of offence. Only by 1991/92 had coordination between Agriculture and Justice become adequate and prosecution fairly effective; various persons have been jailed and heavy fines have been imposed. As a result fishermen have realised that the government is serious about the full implementation of the rules.

Sectoral acceptance

In spite of this change in attitude, the credibility of the quota system does not seem to have improved. The scientific assessment is still disputed by the

sector whenever it results in restrictions. As there were little restrictions between 1992 and 1994, management through ITQs, HP-licences, days-at-sea and group responsibility has been fairly well accepted. However, it is still uncertain what would be the point of view of the sector in the case of low quota and the prospect of serious economic problems.

Relative stability

The original set of keys to allocate quota to Member States in the CFP does not well reflect the shares of the participating countries in the plaice fishery as they had developed during (and even before) the lengthy negotiations on the CFP. In fact the Netherlands was permanently short of plaice, and Denmark and the United Kingdom had a structural surplus. Adjustments to this situation have been achieved in two ways:

1. swaps of quota of plaice in the North Sea in exchange for virtually all demersal quota outside the North Sea (mainly with the UK);
2. relatively high plaice quota to accommodate the Dutch fleet as other fleets could not exploit their share.

As the available quota is still insufficient to be exploited by the fleet on a legally and economically sound basis, apart from decommissioning, expansion of fishing opportunities has been achieved through reflagging, mainly to the United Kingdom.

National enforcement

Very significant funds have been made available for the controlling agency of the Ministry of Agriculture: 120 full-time men on 600 vessels, costing 10 mln NLG per year on a total gross revenue of about 650 mln NLG. As a result illegal landings have been virtually eliminated. Although PO-groups have assumed a substantial part of the control of landings since February 1993, the Ministries of Agriculture and Justice are maintaining their strict control, as the system still has to prove its effectiveness. This will be evaluated by the end of 1995.

PO-group management of ITQs and days-at-sea is partly based on the assumption that greater social control may be expected, as those who paid for their rights cannot accept that others would be 'cheating on landings'. Only adverse (economic) circumstances can really test the validity of this assumption.

Subsidiarity

Subsidiarity has gone quite far with delegation of the responsibility of most of the national quota management to eight PO-groups.

Local communities

In various local communities the fishing sector plays a very important or even dominant role. The commercial interests of individual firms within those communities regularly prevail above the community interest.

Some auctions are operated by the local councils, which try to attract new business by modernisation and offering other advantages. The resulting competition has led to economic problems in some cases.

Beyond 2002

The fisheries policy beyond 2002 is not yet an issue in the Dutch discussion on the CFP. Anyway, the sector would desire greater international flexibility. The fleet reduction required for free movement within the EU in order to make overexploitation of most fish stocks unlikely is far from being achieved. In fact the industry as well as the government are not able to comply with the 1993-96 MAGP.

3.4.4 Other considerations

Consistency

A good level of consistency is achieved thanks to a clear division of responsibilities. The Ministry of Agriculture feels only responsible for the maintenance of a certain level of stocks (adherence to quota). Economic results are the sole responsibility of the sector itself.

The allocation of ITQs and days-at-sea to individual vessels gives a clear indication as to their production capacity in a given year. This is fully consistent with the national quota. Inconsistencies may arise in a situation of low quota. It then remains to be seen whether the groups will be able to face up to their responsibility for social and legal reasons.

The consistency with the MAGP is less straightforward.

Transparency

Disregarding the various technical measures, the management system is quite transparent: each vessel gets in fact only three figures: ITQ of sole and plaice (for some also cod and whiting) and a number of allowed days-at-sea. However, the background of the quota and number of sea-days may still be obscure to many fishermen.

3.4.5 Conclusions

From the economic point of view there appears to be little problem. On closer examination, however, the industry feels restricted in its possibilities for investment. It has not found ways to optimise the use of the quota, and it is very vulnerable to decreases of the sole stock and oil price increases.

The fishing mortalities of plaice and sole are both too high to assure sound stock levels in the longer run. In fact the plaice stock has already fallen below MBAL and can only recover with a reduction of mortality. At the present level of fishing pressure good year classes of sole are exhausted in a few years.

Also from the political and institutional point of view there appears to be little problem since the revision of the national management system and the transfer of part of the responsibilities for implementation and control to the industry. But the latter system has not yet operated under the adverse condi-

tions that can really put it to the test. Government as well as industry leaders are still unsure about its robustness.

Summarising, the management problem in the North Sea flatfish fishery is excessive fishing pressure, apparent in the high levels of fishing mortality of plaice and sole, caused by the continued urge from the industry to expand, or at least not further reduce its activities.

In the following sections five multi-annual, four multi-species and two effort measures are more closely defined with regard to their application to the North Sea flatfish fishery. Where necessary the special conditions required to make the measures effective are specified. The results of the evaluations are broadly discussed and conclusions are drawn for each measure. Comprehensive surveys of the evaluations are given in the appendices 3.1-3.3.

3.5 Multi-annual quantity measures

3.5.1 Equal quantity for several years

Until the early nineties, plaice was considered to be a species with a sufficiently stable stock and recruitment, where a constant TAC for several years might work. But the experience since 1990 of dwindling plaice catches makes this less certain. Sole is notorious for its variable recruitment, with occasional strong year classes. It must be very difficult to arrive at a 'right' level of 'constant MATAC'. This difficulty is enhanced by the high value of the species.

Some experience exists with practically constant TACs with both species. The plaice TAC was kept nearly constant from 1989 to 1993. As catches gradually decreased, the Dutch fishermen were no longer able to catch their quota in the sea time they had been allocated. This gave rise to heavy pressure from the industry for extra sea time, which for a succession of years was eventually given. Also the days-at-sea allocation system was so devised, that decreasing catch rates experienced in former years automatically resulted in an increase in allocated days-at-sea;

The sole TAC was constant for a period of three years from 1987 to '89. In the second half of '89 the strong 1987 year class recruited to the fishery. This gave rise to serious control and enforcement problems in combination with considerable illegal landings pressure (eventually resulting in the fall of the Dutch Minister of Agriculture and Fisheries).

Both examples illustrate the problems that may arise with constant TACs over several years. A high MATAC in relation to the catching opportunities will result in pressure to increase fishing effort. A relatively low MATAC will result in overfishing pressure, even with a very strict control system as exists in the Netherlands. It is not certain that the present system of devolution of control and enforcement to PO-groups will be able to cope with such pressure.

From an economic point of view this measure only seems to stabilize supply. With the present national management system, in practice landings will continue to vary, particularly those of sole. As for both species the best fishing season is early in the year, in years of relatively low MATAC, the quota will tend to be exhausted before the attractive end of year period, in spite of regulatory efforts of POs (race for fish). In order to effectively stabilise supply, the effort

has to be adapted rigorously to the fluctuating fishing opportunities. This is not an attractive prospect neither for industry nor for administrators.

A constant TAC for several years does not offer any benefit with respect to management of the stocks, as direct control is lost. If the allowed effort is in effect adapted to the fishing opportunities, particularly with a sole MATAC the fishing mortality and discarding in certain conditions could rise to an unacceptable level.

Constant TACs for several years may seem attractive at first sight to fisheries managers, but they create a false sense of stability. Particularly if applied to sole, the management and enforcement of the quota by the PO-groups can meet severe difficulties. Negotiations on this kind of multi-annual TACs will most probably be much tougher than the present ones on single year TACs.

Conclusions

Regulating the flatfish fishery by equal quantities for several years at appropriate levels could be feasible for plaice only after a recovery of the stock, when recruitment has stabilized again, and provided the fishing effort is well controlled and not allowed to rise irresponsibly. For the management of sole, this type of measure is not recommended because of its variable recruitment.

Even if the measure is feasible for plaice under certain conditions, it is neither desirable, nor effective, as it leads to no apparent improvement over the present management system.

3.5.2 Limited compensation

In this case limited compensation will mean: the possibility to borrow fish from next years quota to a limited extent and possibly with a penalty. Only borrowing is included, as saving for next year almost certainly would amount to saving 'paper fish' (quota that could not be caught, because the fish just was not there, for instance the plaice quota in recent years).

The extent to which quota can be borrowed could for instance be limited to the level of uncertainty of the assessment of the stock involved. For plaice and sole this is in the order of magnitude of 10-15%. But if the situation of the stock(s) allows it, higher limits may be justified.

A penalty, meaning that the deduction from next year's quota is greater than the overshoot of this year's, can be considered in order to discourage borrowing. The size of this penalty could be related to the vulnerability of the stock. In view of the probably high personal discount rate of fishermen, such penalties should be substantial in order to have the intended effect.

In the flatfish fishery, generally the quota of one species tends to be exhausted before that of the other. Limited compensation would primarily help to overcome this problem. In this case it is in fact a solution to a multi-species problem.

The measure appears to be economically attractive, as it ensures fishermen, more than in the present situation, that they can fish on till the end of the year, even if one, or both of their ITQs are slightly overshot. Also overshooting by others need not bother him, as long as the total of what remains

within the allowed limit by species. In effect this measure more or less compensates for the inadequate legal protection of the ITQs.

A certain tendency to permanently borrow from next year up to the allowed limit should be counteracted by the level of the connected penalty.

From a biological point of view this measure is more or less indifferent, as long as the level of borrowing remains within the margins of uncertainty of the biological assessments. The time schedule of biological advice - assessment of stock, recruitment and fishing mortality in year t-1, estimates including catches for year tonnes at status quo fishing mortality, predictions and advice for year t+1 - makes it impossible to take borrowings into account in the advice. So pressure to raise the TAC from countries already aware of substantial borrowings has to be dealt with at a political level.

Political and sectoral acceptance will be good, as this measure could solve the problem of a now and again looming threat of early closure of the fishery, giving rise to a race for fish in spite of the ITQs. However, it may prove difficult to arrive at generally acceptable levels of compensation and even more so of penalties. It will be possible to relieve the enforcement pressure, as the quota need not be strictly enforced, so there is less reason to 'hide' fish.

Limited compensation as it is defined here appears to improve consistency of the management system, as it can relieve some problems of the fishing enterprises, by taking into account biological uncertainties.

Conclusions

Limited compensation, meaning borrowing limited amounts of fish from next year's quota at a penalty, appears to be well feasible, as it meets no serious objections from any of the considered points of view.

The measure can be considered to be desirable as well, as it meets one of the annoying points of the present management policy: the very strict enforcement of the quota.

But only in that respect can limited compensation be considered to be effective. With regard to tackling the major management problem of high fishing pressure in the flatfish fishery, the measure can hardly be called effective. On one hand it may somewhat reduce the pressure in the short run, by reducing the race for fish, on the other hand its positive effects will encourage fishermen to stay in the fishery, who otherwise might have given up. So the measure does not really address the management problem.

3.5.3 Limited adjustment

Limiting the extent to which TACs can be adjusted from year to year is a multi-annual management option that lies somewhere between constant TACs for several years and the present system, which basically allows unlimited adjustment. In practice, as recent history of the North Sea flatfish fishery shows, unlimited upward adjustment (sole 1989-'90) appears to be happily accepted by industry as well as decision makers, but substantial downward adjustment meets strong opposition (plaice 1994-'95).

The limitation can have the character of an absolute amount, or of a relative amount, that is a percentage of the present TAC. For this case the latter is chosen, which implies a slightly more conservative approach, as generally speaking downward adjustments from a high TAC level will be larger than upward adjustments from a low TAC level. A more conservative approach, allowing larger downward adjustment percentages than upward does not appear necessary for the present. The limit should bear some relation to the variability and the vulnerability of the species. So for sole the relative level of maximum adjustment should be higher than for plaice.

This measure can and will give rise to fluctuating discrepancies between catching opportunities and allowed catches. Particularly when an upward adjustment has been limited, the effort has to be curbed by adjusting the allocation of days-at-sea according to the reduction of fishing mortality involved. An extra complicating factor is the multi-species character of the beam trawl fishery, where effort on sole unavoidably implies effort on plaice.

Reductions of days-at-sea will have to be well tuned in order to avoid serious enforcement problems (overfishing of quota) or angry fishermen (underfishing of quota of more abundant fish). Enforcement will have to be very strict in order to make the measure work and let its possible benefits materialize.

From an economic point of view, limiting TAC adjustment does not have a decisively positive or negative effect. On one hand, it will have a stabilising effect on supply of plaice and sole, which can positively affect prices. On the other hand, it will bring about discrepancies between the availability of fish in the sea and allocated quota that have to be controlled with unattractive adaptations of allocated days-at-sea.

If strictly enforced, the measure can have some beneficial effect in saving strong year classes of sole from instant exhaustion, thereby contributing to stabilization of the sole stock. This supposes that reductions in stock size are eventually followed by reductions in TACs, in order to avoid negative surprises. From a biological point of view it would be preferable not to raise effort when a downward adjustment is limited (and in fact more effort would be required to exhaust the TAC). In this, the complications of the multi-species character of the fishery are left out of consideration.

At first sight the measure may seem attractive from the institutional and biological point of view, but on looking closer some negative aspects appear. Decision makers may like to have well defined rules to arrive at decisions, but they may like to have a free hand better. Also limited adjustment of TACs has a lot of unpleasant regulatory consequences, like adjustment of effort and more difficult enforcement.

Conclusions

With sufficient enforcement, limited adjustment of TACs is a feasible policy in the North Sea flatfish fishery.

Although neither the industry nor the administrators are actually waiting for this kind of measure, it can be considered to be desirable for its potential

positive effects, being stabilization of particularly the sole stock and of market supply.

Limiting adjustment is not effective in the sense of addressing the major management problem of high fishing pressure in the North Sea flatfish fishery.

3.5.4 Minimum size of spawning stock

The concept of 'minimum size of spawning stock' was developed at the Dutch Directorate of Fisheries as an ultimate consequence of the Dutch fisheries law, that leaves only room for regulation of fisheries on biological grounds and not for economic reasons. Any regulation of fishing, doing more than preventing stocks to drop below the minimum biologically acceptable level (MBAL), must be considered as an interference in the economic process and should be left to the industry.

This approach is not in line with the objectives of the CFP, mentioning explicitly the economic and social conditions of the fisheries. However, it should not be rejected right away, without evaluating it more extensively.

The concept has met strong opposition from Dutch fisheries biologists, as it leaves no buffer zone at all, if applied literally. But 'minimum stock size' needs not to be taken equal to MBAL. Some reserve can be built into it, for instance by adding an amount corresponding to the margin of uncertainty of assessment of the stock concerned. Another matter of concern from the biological point of view is the high pressure on the marine ecosystem.

Under this rule, without further regulation (by the industry) the fishery would have more of a stop and go character than presently. Whereas the measures discussed before had a tendency to stabilize the fishery, this measure in itself appears to be destabilizing. In order to redress this to an acceptable, or - even better - an improved situation, the industry will have to accept its intended responsibility and take up further management of the fishery.

Little can be said on the economic and biological consequences of this devolution of fisheries management, as they depend on the type of measures chosen. A full evaluation according to the methodology developed in chapter 1 is therefore considered useless, so the measure is omitted from the tables in appendix 3.1. But it is very worthwhile to expand a bit on the institutional and other aspects of this type of measure.

Of the participants in the North Sea flatfish fishery, the Dutch industry presently seems to be the best geared to take up the required level of self management. But it is not (yet) able to take full responsibility for a variety of reasons.

In the first place an international framework would have to be developed, where POs would arrive at agreements on management strategies and measures. If only the Dutch PO-groups were to reach mutual agreement, without the POs from other countries joining in, they could not reap the full benefits of any conservatory action, and unacceptable shifts in relative stability could occur. This would be particularly so with plaice, as here the share of the other countries is larger than the Dutch.

Even reaching agreement within the Dutch industry would be a problem now, as here again the required (legal) framework is lacking. One aspect of this for example is the limited control and enforcement power of the PO-groups. At the moment it is questionable whether the EU and subsequently the Dutch government would be prepared to consider transfer of these kinds of responsibilities and powers to the industry.

Conclusions

The policy of just maintaining the spawning stocks above a certain minimum level and letting the industry decide on the actual level of fishing is neither feasible, nor desirable or effective at present. But provided the fleets are really brought into line with the fishing opportunities and the industry can be left to regulate its activities without fear of endangering the stocks, this management system might be reconsidered after 2002.

3.5.5 Fixed formula

Management of the North Sea flatfish fishery according to a fixed formula could for example be applied to reduce the fishing mortality gradually, in order to make the sole fishery less volatile and/or to reduce the pressure on the plaice stock. The desired mortality reduction could be effected over a number of years, for instance 4 or 5, by small steps of for instance 4 or 5% of the original mortality level. TACs would result 'automatically' from the annual assessments, once the strategy had been agreed upon.

Reduction of mortality does not have to go on endlessly: once the level of mortality aimed at has been reached, the strategy and formula could change to 'status quo' mortality. The pro's and con's of this realistic example are discussed, as it appears more useful than considering the measure in more general terms. This means that the conclusions may not apply to other conceivable strategies like for instance keeping fishing mortality at a constant level.

It has to be noted that a measure like this will in practice have to assume a multi-species character:

- a reduction of the fishing mortality of sole will automatically result in a reduction of the fishing mortality of plaice, unless the directed fishery for plaice is expanded to compensate for this;
- a reduction of the fishing mortality of plaice is hardly possible without reducing the fishing mortality of sole at the same time.

So it is assumed that the fixed formula will apply to both species simultaneously. The strategy has to be reflected by the national management measures. In the Dutch case this means an adjustment of the days-at-sea regulation is required, to bring the allotted sea time at least in line with the proposed reduction of fishing mortality. Even then the available ITQs will be low in relation to the available sea time, due to the 'slack' in the system (see 3.4). Combined with a catch rate that will basically not fall, but rather tend to rise, this will give rise to enforcement problems, as fishermen will try to seize opportuni-

ties to overfish their (reduced) quota. This would put the PO-management system to a severe test.

These problems can only be alleviated by a reduction of the fishing capacity, in line with, or even in excess of the MAGP. This would allow a reallocation of ITQs to the remaining vessels, allowing them to make a better use of the catching opportunities. A decommissioning programme to achieve this would probably require some strong incentive, or even coercion, as generally the industry is not happy about a further reduction of the fleet. Dwindling earnings as a result of the policy may well provide part of the required pressure.

Eventually, if the policy, including decommissioning, is effective, the government may find itself in the embarrassing position of having created a group of 'happy few'. It is a little outside the scope of this study to indicate how to deal with that, but the introduction of royalties or levies on the ITQs could be considered. By that at least part of the rent could be retrieved for redirection to aims decided by society.

In the short run the policy will have negative economic effects for the fishing sector. Its flexibility will be curbed (again) by the reduction of available days-at-sea and ITQs. The discrepancy between catch rate and allowed catches will renew the race for fish. Planning should improve, as the strategy is clear, but the actual possibilities depend heavily on the success of decommissioning.

Supposing effective enforcement, initially the economic performance probably will go down, but in the end an improvement can be expected, as catches per unit of effort will increase. The positive effect will be enhanced by decommissioning.

From a biological perspective, the measure would have positive effects on all scores, with the exception of possible high grading of plaice. This might be removed provided the reductions of ITQs and days-at-sea can be successfully enforced.

The real problems of this kind of measure lie in the political and institutional field. Political and sectoral acceptance will very much depend on how the short term 'costs' and the later benefits are weighed up by the various parties concerned. Politicians may be more inclined to consider the longer term effects, although the considerable enforcement effort required will weigh heavily. The industry is known to have a rather short term time preference and it will be difficult to convince the fishermen, that in the long run they will be better off, the more so as this will only come true for those who can stay in the industry.

The problems of enforcement to be expected were amply discussed above, and implementation of the strategy may mean putting a bomb under the group system of devolved management. Local communities would not benefit from reduced fishing activity, certainly not when this is accompanied by decommissioning of vessels.

In the perspective of management beyond 2002, this measure, combined with implementation of the MAGP, could be a useful start.

Summing up, the balance on this aspect tends to be quite negative, in spite of the positive prospects of the results of the measure. In that respect the measure considered seems to be inconsistent, or at least to be not sufficiently

transparent to the people involved. On the other hand, it is fairly consistent as regards being in line with the objectives of the CFP, apart from the 'socio' aspect.

Conclusions

Application of a fixed formula to implement a gradual reduction of fishing mortality does not appear to be feasible, given the resistance that can be expected from the industry and the ensuing difficulties of enforcement.

From a fisheries management point of view the implementation of the proposed strategy is a desirable one, as it improves the state of the stocks and provides a more solid basis for the fishery, assuming the reduction of effort is accompanied by a sufficient level of decommissioning.

A fixed formula applied in the described way can (only) be effective if it is strictly enforced and is accompanied by adequate decommissioning of vessels. Under those conditions it is actually attacking the major problem of the fishery.

3.6 Multi-species measures

In the previous paragraphs regular reference was made to the fact that sole and plaice have to be managed together. This section will look into four management measures explicitly directed at this combined management. They are basically meant to more or less even out the differences in catch rates of plaice and sole, as far as they are not expressed in the single-species TACs.

3.6.1 One common denominator

Instead of separate quota for plaice and sole, multi-species flatfish quota can be allocated to the participating countries. The multi-species quota can be expressed in for instance 'flatfish equivalents' as a common denominator. These can be arrived at by allocating weighting factors or 'exchange rates' to the single species quota.

Annual decisions on these weighting factors are an extra complication of the already complex decision making process. This can be avoided by devising a fixed procedure, stating exactly how to arrive at the common denominator. But a fixed procedure takes away the possibility to direct the fishery more towards one of the species by carefully tuning the weights).

The weighting factor(s) can be chosen out of a variety of possibilities, such as weight ratios (e.g. between stock sizes, TACs, catches in previous years) or price ratios (e.g. between landing prices in previous years). From an economic point of view a prices based denominator appears the most rational, as it would weigh the quota according to their relative value. From table 3.4, given the average auction prices of plaice and sole and their ratios in the Netherlands over the period 1989-1994 it appears that these are highly variable, which makes using them as a basis for a common denominator rather precarious. To make a well-founded choice out of the various possibilities would require a special study.

Table 3.4 Average auction prices of sole and plaice in the Netherlands and the ratio between them; 1989-1994, NLG/kg

	1989	1990	1991	1992	1993	1994
Sole	18.12	12.78	14.57	15.93	13.60	12.25
Plaice	2.57	3.16	4.12	3.11	3.20	3.39
Ratio sole/plaice	7.05	4.04	3.54	5.12	4.25	3.61

Another complicating factor is that the biologists will not be able to make a reliable estimate of the level of mortality of the species concerned in the ongoing year, nor of the development of the stocks. This undermines the foundation for sound biological advice. Although in practice the fishing mortalities need not vary much with a well-chosen and tuned common denominator, if anything goes wrong in the balance between weightings, actual catch rates and (unpredictable) economic conditions, substantial shifts in mortality may occur.

Economically, a multi-species TAC expressed in a common denominator for plaice and sole appears to be attractive. It would leave the fishermen free in their choice of landing mix, enabling them to optimise their fishery, according to their own capacities and preferences. This may result in some improvement of economic performance. An improvement of planning possibilities is not expected, as future developments will be as uncertain as they used to be. Improved economic conditions might tempt people to make investment decisions.

The biological consequences of this type of multi-species TAC are at best unclear and at worst disastrous. If substantial shifts from one species to the other do occur, with consequently large fluctuations in mortality by species, it will become virtually impossible to arrive at a proper biological advice. stocks and mortality will be out of control and will probably only by chance stay within acceptable limits.

From a political point of view the potentially serious biological consequences and the additional complexities of the fixing of the weighting factor(s) this measure is unattractive. Upsetting the relative stability may add to that. On the other hand the sector would welcome the ensuing freedom of action and its expected positive economic consequences.

Enforcement and devolution will not give serious problems. The measure may be more acceptable in a situation with a reduced fleet and without the constant threat of overfishing.

In the situation of 1995 the measure is quite inconsistent, and although it may be transparent in general terms, it would pose a lot of extra problems.

Conclusions

Setting multi-species TACs with unlimited transfer between plaice and sole is only feasible if the right weighting of the species can be found. Even

then the desirability of the measure is doubtful, as the biological consequences will still be uncertain.

The measure is not effective at all, as instead of addressing the main problem, it tends to slacken control of the fishery and thus increase the disequilibrium between stocks and fleets.

3.6.2 Limited transfer

Limiting the possibilities for transfer of quota between plaice and sole may remove some of the negative aspects of unlimited transfer as discussed above. As with limited borrowing of quota from next year (see 3.5.2) transfer could for instance be limited to the levels of confidence of the biological assessment. This would leave room for a more or less 'natural correction' of assessment errors, without losing control completely. Again the stock situation may justify higher transfer limits.

The setting of the 'exchange rate' would not be as critical as with unlimited transfer. Simply, the average over a couple of years of one of the ratios mentioned above could be chosen, or even a rough rule of thumb figure, that is politically acceptable, could be used. Adaptations can be made if a strong bias towards one of the species becomes apparent, but also to create a bias, if one of the species needs special protection. In this case it is not considered necessary to create different rates for exchanging plaice for sole and for exchanging sole for plaice.

Opening the possibility of a limited transfer of quota between plaice and sole would positively affect the economic situation of the firms in the fishery. Flexibility regarding the size of the quota by species enables fishermen to adapt their fishery (to a certain extent) to the circumstances at sea and on the market. This could result in a better economic performance.

As long as the possibilities for transfer between plaice and sole quota stay within the limits of the levels of confidence of the biological assessments and predictions, an acceptable level of control of stocks and mortality is possible. Only minor shifts of fishing pressure are to be expected, so there will be little change in high grading and discarding practices and no special effects on the ecosystem.

Political acceptance will be good, as some criticisms on the present system can be met at a small cost, and so will sectoral acceptance. Only minor and temporary shifts away from relative stability will occur. National enforcement and quota management and PO-groups will have to deal with minor administrative complications, resulting from exchanges between quota.

Limited transfer between plaice and sole quota appears to be a reasonably consistent management measure, that can well be explained and does not pose significant extra problems.

Conclusions

If transfer between plaice and sole quota is limited and a reasonable exchange rate is set for the transfers, this is a feasible management measure.

It is also a desirable measure, as it meets one of the criticisms of the present system, by providing more flexibility and allowing fishermen to operate closer to daily practice.

Again it is only effective in that respect, but not when it comes to addressing the major management problem of the North Sea flatfish fishery.

3.6.3 Bycatch arrangement

In the Dutch fishery for flatfish traditionally two bycatch problems occur:

- continued fishing for one flatfish species, when the quota of the other one has been exhausted and its fishery is (formally) closed;
- the roundfish bycatches, particularly of cod, in beam trawling.

Reduced catch levels and changes in national roundfish management have more or less solved the latter problem for the moment.

The former problem has been latent since 1993, but it is still looming for individual fishermen, PO-groups and the sector as a whole. If the individual, group or national plaice quota is exhausted before the end of the year, the fishery for flatfish has to be ended, as it is virtually impossible to beam trawl for sole without catching plaice. On the other hand, if the sole quota is exhausted early, it is possible to continue with a directed fishery for plaice, using nets of sufficiently large mesh size (12-13 cm).

Seeing this, a bycatch arrangement allowing to land small amounts of plaice after its quota has been exhausted as a bycatch of the (continued) fishery for sole, would be useful. An arrangement for bycatches of sole in case of closure of the sole fishery would not really be necessary. The allowed bycatch of plaice should be really small, in order to discourage looking for a mixed fishery. The rule that a vessel is considered to be fishing for sole if the content of sole is over 5% of the total amount of fish on board may have to be changed in this case.

Introduction of a bycatch arrangement for plaice in case of early exhaustion of the plaice quota would have minor positive economic effects. Apart from the allowed small landings of plaice, this could result in (minor) improvements of sole catches, thus enhancing economic performance slightly more.

Provided the level of allowed bycatches is sufficiently small, the negative effects on the plaice stock and mortality will not be significant. Monitoring may even improve slightly, as unavoidable bycatches of plaice will now be landed legally.

A measure like this will meet no objections in the political field, as it will have little or no negative effects. Enforcement could become slightly easier, as it would be less necessary to chase after possible illegal bycatches of plaice after the closure of its fishery.

Conclusions

An arrangement allowing small landings of plaice as a bycatch of a continued sole fishery after exhaustion of the plaice quota is very feasible, as it has no serious negative effects and is simple to implement.

A bycatch arrangement for plaice is also desirable, as it can provide minor, if even psychological, improvements to the individual fishing firm and by that to the sector as well.

This kind of bycatch arrangement cannot be considered to be very effective, not simply because it has only minor positive effects, but mainly because it does not address the major management problem of the North Sea flatfish fishery.

3.6.4 Two tier system

Since the strong 1987 sole year class recruited to the fishery there has been a tendency to overfish the sole quota. This was enhanced by the gradual reduction of the catch rate of plaice. For some years landing of sole had to be discontinued by the Dutch fleet, whereas fishing for plaice was allowed to continue. In spite of that and the extra days-at-sea allowance for fishing in northern waters, the plaice quota remained unused to an increasing degree.

In this situation a two tier MSTAC might have helped to promote fishing for plaice, in order to reduce the pressure on sole. To that effect, the single species TACs should be counted together in a second tier multi-species TAC, giving the sole a relatively high weight and plaice a relatively low one. The MSTAC has subsequently to be reduced by a certain percentage in order to provide the required pressure. Without that, the second tier would remain without effect. Catches will be deducted from the MSTAC or quota using the same weighting factors, so it will be exhausted faster by fishing primarily for sole than by fishing for plaice mainly.

Finding the right levels for the weighting factors and particularly for the percentage of reduction of the MSTAC in order to bring about the desired effect, will not be easy. This will make for an extra complication of the decision making process.

Since the 1994 assessment of the plaice stock, indicating that it has dropped below the minimum biologically acceptable level, a shift of pressure towards it is not wanted, and a shift the other way around seems to be not preferable either. Evaluation of a two tier system therefore becomes of an even more academic nature than those of most of the other measures presented.

The economic consequences of a two tier system are negative, as fishermen are pushed away from their (personal) optimum fishery. In order to have the desired effect of deflecting pressure from one species to the other, the system has to work against the signals that come from the market and the fishing opportunities.

The biological effects are basically ambiguous, as the fishing pressure on one species will be relieved, while that on the other will increase. But as this is exactly the objective of the measure, this can be considered as positive. It is clear that this kind of measure should not be introduced in a situation where stock and mortality of both species does not allow an increase of fishing pressure.

Politically the system does not appear to be attractive. To the decision makers it means an extra complication with rather uncertain results. The required levels of weighting factors and percentage of reduction of the MSTAC for bringing about the desired shift of fishing pressure probably can only be found after some experience has been gained and even then may be unpredictable.

To the sector the working of the measure will not be transparent and the negative economic effects will not be liked. Serious difficulties concerning enforcement and subsidiarity are not to be expected, but some shift away from relative stability may occur.

The two tier system does not contribute to the consistency of the fisheries management policy, is rather untransparent and poses the new problem of setting the proper parameters for the MSTAC.

Conclusions

The feasibility of the application of a two tier system of management to the North Sea flatfish fishery is doubtful. Its complexity and dubious results make it unattractive from the political as well as from the sector point of view.

It is also not desirable as, for neither of the species involved is an increase of fishing pressure recommendable. It will have short term negative economic effects in return for rather uncertain biological improvements.

Given that, the measure does not even appear to be effective in its own right, as a consequence it does not seriously attack the major problem of excessively high fishing pressure.

3.7 Effort measures

In the Dutch fisheries, effort management has been used as an additional tool to quota management since the middle of the eighties. From temporary laying up periods this gradually developed via general days-at-sea restrictions into a system of individual allocation of numbers of days-at-sea, taking into account the fishing rights and, as far as flatfish vessels are concerned, the fishing power of the vessels. This section will discuss the possibilities of a further development of effort management, where quota no longer play a role, but effort regulation is the main tool of management.

In order to be able to manage a certain fishery by effort regulation, some preliminary conditions have to be met:

- effort is allocated to the fishery concerned, not in general;
- access to that fishery is restricted by capacity licenses;
- the development of capacity or fishing power is monitored and changes are taken into account in the allocation of effort;
- some translation method is available to express effort of one fishing method into that of another one.

Without these conditions being met simultaneously, the effort exerted on the stocks involved in the particular fishery may get completely beyond con-

trol, and with it the fishing mortality of those stocks. Even so, in the flatfish fishery the eventual distribution of effort over the plaice and sole stocks will depend on the balance between the forces of nature (catch rates) and the market (prices).

Additional limitations and conditions to the allowed effort, like area, period, mesh size etc., are further refinements that could contribute to the precision of management of the fishery. On the other hand they would lead to a more complicated control and enforcement.

Fishing effort is generally considered to be the product of fishing capacity or power and a factor expressing the duration of the application of the fishing power to the stock(s). In a situation where the fishing capacity is well controlled, effort regulation mainly concerns limiting the activity of the fleet(s) involved. For the Dutch flatfish fishery this means in practical terms: the capacity of beam trawlers has been found to be closely connected to their main engine power. Vessels have licenses limiting their engine power. The activity of the licensed vessels is restricted by the allocation of days-at-sea. The total effort is basically expressed in an aggregate number of kW-days.

In the Dutch situation two practical problems with some political weight occur:

- the actual level of effort in the flatfish fishery is significantly below the level allowed by the days-at-sea allocation system combined with the PO-group system. A change of the management system from quota as the primary instrument to effort will tend to activate the latently available effort;
- some multi-purpose vessels switch fisheries during trips, for instance beam trawling for flatfish by night and otter trawling for roundfish by day. In such cases control of effort in a specific fishery is difficult and would require special arrangements. Introduction of a one gear rule might solve the problem, but it could seriously affect the economic basis of firms that contribute very little to the problems of the flatfish fishery.

3.7.1 Constant effort over several years

In the North Sea flatfish fishery, constant effort over several years could mean freezing the fishing effort at the status quo level. This is not very much different from the actual practice since individual days-at-sea allocation started in the Netherlands, as this implicitly supposes that the quota are based on status quo fishing effort.

Allowing a constant (status quo) effort for several years can have generally positive economic effects. Apart from the restriction on effort, the fishermen are completely free in what they catch and land, so they can arrive at an optimal solution under their particular conditions. It will depend partly on the level of enforcement of individual allocations of effort whether the potential benefits can fully materialize, or will be spoilt by a race for effort.

The biological consequences of managing the flatfish fishery by restricting effort to, for instance the status quo level are rather uncertain in the sense that it is not known to which stock the allowed effort will be (mostly) directed.

On the other hand, the possibilities of monitoring the fishery will probably improve, as there is no longer an incentive to under- or misreport catches. At least the total level of effort will be restricted and the possibilities for shifts in effort are limited by the character of the fishery. Additional conditions may influence the directivity of the fleet. Eventually it may become possible to predict the distribution of mortality as experience is gained with the system.

Initially, opposition to a change of the management system from TACs and quota to effort limitations has to be expected from the fishing sector as well as from the politicians. Both will not like the shifts in relative stability, as it has been defined at the outset of the CFP, that may result from managing effort only. In the Netherlands the fishing firms have substantial vested interests in the ITQ-system and they are not prepared to let those be wasted by a change of system. In order to get effort management without quota accepted, at least a method of transformation from quantity quota to effort quota has to be devised, maintaining the value of the individual fishing rights. National effort allocations will have to adequately reflect the quota allocation keys that represent the relative stability of the CFP.

With simple and effective parameters for effort, like (standardized) engine power and sea time as used in the Dutch days-at-sea regulation, subsidiarity and enforcement pose no particular problems. In fact, initially enforcement probably will be easier, as the fact that a boat is in or out is easier to establish than the amount of fish caught, or even landed. But it has to be expected that gradually fishermen will adapt to the new system by finding new ways to dodge restrictions.

Although constant effort over several years is basically inconsistent with the prevailing system of management by quota, it does not appear to be very inconsistent on its own. Even without overseeing the consequences, its principles are rather easy to explain. This may be deceptive, as maintaining control over effective fishing capacity will become a major problem.

Conclusions

The feasibility of management of the North Sea flatfish fishery by keeping the fishing effort constant over a number of years is restricted by the opposition that initially can be expected from both politicians and industry.

From an economic point of view the system is desirable, as it is from the point of view of enforcement. It even has some merits in the field of biology, the more so when the uncertainty on the effects on stocks and mortality is reduced by additional restrictions to influence the directivity of the fleet.

But most of all it is desirable as it appears to be effective: limiting effort opens possibilities to tackle the problem of the pressure on the flatfish fishery more directly, although this cannot be done by maintaining status quo.

3.7.2 Limited adjustment of effort

One of the problems with managing the fishery by effort regulation is the uncertain effect of a fixed amount of physical effort on the mortality of the stocks because of changes in directivity of the fleet. Opening the possibility to

adjust the effort annually to a limited amount, for instance by 5 or 10%, would allow some fine tuning of the physical effort to desired levels of fishing mortality. This could even take the form of a strategy to gradually reduce the level of mortality. Also it would allow to correct for developments in the efficiency of effort.

Apart from taking away part of the biological uncertainties, this option is not essentially different from the fixed effort measure. The full evaluation in the tables of appendix 3.3 leads to generally identical remarks.

Conclusions

Limited adjustment of effort as a management measure would not make effort management more acceptable to politicians and industry. They might even object more strongly to it, as negotiations on adjustment would be involved, with the ensuing uncertainty on future levels of activity.

The desirability of limited adjustment of effort is certainly greater than that of fixed effort, as it meets part of the biological problems. In addition it opens the possibility to correct for changes in efficiency and to set out a strategy to arrive at desired levels of fishing mortality.

The latter aspects particularly can make limited adjustment of effort an effective management measure in the North Sea fishery for flatfish.

3.8 Conclusions

Multi-annual measures

1. Regulating the flatfish fishery by *equal quantities for several years* at appropriate levels could be feasible for plaice only after a recovery of the stock, when recruitment has stabilized again, and provided the fishing effort is well controlled and not allowed to rise irresponsibly. For the management of sole this type of measure is not recommended because of its variable recruitment.
   Even if the measure is feasible for plaice under certain conditions, it is neither desirable, nor effective, as it leads to no apparent improvement over the present management system.
2. *Limited compensation*, meaning borrowing limited amounts of fish from next year's quota at a penalty, appears to be feasible, as it meets no serious objections from any of the considered points of view.
   The measure can be considered to be desirable as well, as it meets one of the annoying points of the present management policy: the very strict enforcement of the quotas.
   Only in that respect can limited compensation also be considered to be effective. With regard to tackling the major management problem of high fishing pressure in the flatfish fishery the measure can hardly be called effective. On one hand it may somewhat reduce the pressure in the short run, by reducing the race for fish, on the other hand its positive effects will encourage fishermen to stay in the fishery, who otherwise

might have given up. So the measure does not really address the management problem.

3. With sufficient enforcement, *limited adjustment of* TACs is a feasible policy in the North Sea flatfish fishery.
   Although neither the industry nor the administrators are actually waiting for this kind of measure, it can be considered to be desirable for its potential positive effects, being stabilization of (particularly) the sole stock and of market supply.
   Limiting adjustment is not effective in the sense of addressing the major management problem of high fishing pressure in the North Sea flatfish fishery.
4. The policy of just maintaining the *spawning* stocks above a certain *minimum level* and letting the industry decide on the actual level of fishing is neither feasible nor desirable nor effective at present. Provided the fleets are really brought into line with the fishing opportunities and the industry can be left to regulate its activities without fear of endangering the stocks, this management system might be reconsidered after 2002.
5. Application of a *fixed formula* to implement a gradual reduction of fishing mortality does not appear to be feasible, given the resistance that can be expected from the industry and the ensuing difficulties of enforcement.
   From a fisheries management point of view the implementation of the proposed strategy is a desirable one, as it improves the state of the stocks and provides a more solid basis for the fishery, assuming the reduction of effort is accompanied by a sufficient level of decommissioning.
   A fixed formula applied in the described way can (only) be effective if it is strictly enforced and is accompanied by adequate decommissioning of vessels. Under those conditions it is actually tackling the major problem of the fishery.

Multi-species measures

6. Setting *multi-species TACs with unlimited transfer* between plaice and sole is only feasible if the right weighting of the species can be found.
   Even then the desirability of the measure is doubtful, as the biological consequences will still be uncertain.
   The measure is not effective at all, as instead of addressing the main problem of the fishery, it tends to slacken control and thus increase the problem.
7. If *transfer* between plaice and sole quota is *limited* and a reasonable exchange rate is set for the transfers, this is a feasible management measure. It is also a desirable measure, as it meets one of the criticisms of the present system, by providing more flexibility and allowing fishermen to operate closer to daily practice.
   Again it is only effective in that respect, but not when it comes to addressing the major management problem of the North Sea flatfish fishery.

8. An *arrangement* allowing small landings of plaice as a bycatch of a continued sole fishery after exhaustion of the plaice quota is very feasible, as it has no serious negative effects and is simple to implement.
   A bycatch arrangement for plaice is desirable as well, as it can provide minor, if even psychological, improvements to the individual fishing firm and to the sector as well.
   This kind of bycatch arrangement cannot be considered to be very effective, as it has only minor positive effects and (more importantly) does not address the major management problem of the North Sea flatfish fishery.
9. The feasibility of the application of a *two tier system* of management to the North Sea flatfish fishery is doubtful. Its complexity and dubious results make it unattractive from the political as well as from the sectoral point of view.
   It is also undesirable as, for neither of the species involved is an increase in fishing pressure recommended. It will have short term negative economic effects in return for rather uncertain biological improvements.
   Considering that, the measure does not even appear to be effective in its own right, it cannot seriously deal with the major problem of excessive fishing pressure.

Effort measures

10. The feasibility of management of the North Sea flatfish fishery by keeping the *fishing effort constant over a number of years* is restricted by the opposition that initially can be expected from both politicians and industry, due to the potential threat to relative stability.
    From an economic point of view the system is desirable, as it is from the point of view of enforcement. It even has some merits in the field of biology, the more so when the uncertainty on the effects on stocks and mortality is reduced by additional restrictions to influence the directivity of the fleet.
    But most of all, it is desirable as it appears to be effective: limiting effort opens possibilities to tackle the problem of the pressure on the flatfish fishery more directly, although this is not done by maintaining the status quo.
11. *Limited adjustment of effort* would not make effort management more acceptable to politicians and industry. They might even object more strongly to it, as negotiations on adjustment would be involved, with the ensuing uncertainty on the level of activity.
    The desirability of limited adjustment of effort is certainly greater than that of fixed effort, as it meets part of the biological problems. In addition it opens the possibility to correct for changes in efficiency and to set out a strategy to arrive at desired levels of fishing mortality.
    The latter aspects particularly can make limited adjustment of effort an effective management measure in the North Sea fishery for flatfish.

APPENDICES
Chapter 3

Appendix 3.1 Evaluation of multi-annual quantity measures

	1.1 Equal quantity for several years	1.2 Limited compensation	1.3 Limited adjustment	1.5 Fixed formula
Economics				
FLEXIBILITY	Is not improved and may even deteriorate as MATACs, particularly of sole, will rarely reflect catching opportunities.	Fishermen are better ensured of the full use of their quota, so they can better plan their fishery, for instance by postponing catches till the end of the year, to profit from good market prices.	Reductions of days-at-sea in case of limited upward adjustment imply reduction of flexibility.	Gradual reduction of TACs (relative to stocks) will reduce flexibility in the short run; it can only increase again, if sufficient decommissioning takes place.
PLANNING	May only seemingly improve; actual catches will still fluctuate, so in fact there will be no improvement.	Improved short term planning may have some positive effect on long term planning.	May improve somewhat, as surprises on the available amounts of fish will be limited.	As the projected time path is clear, planning should be well possible, but the eventual capacity level is theuncertain factor.
MARKET CONSISTENCY	Plaice and sole have best fishing in first half of year; in good years, relatively low MATACs may increase problem of regularity of supply till end of year.	As fishing can take place during periods of favourable market, market consistency improves; if substantial amounts are borrowed, a supply shortage may occur in the following year.	Market consistency will improve somewhat, as large fluctuations of the available amounts of fish (sole 1989-90) are avoided.	Market supply will be gradually, but probably temporarily reduced, not unlike natural fluctuations. Regularity of supply not different from present: depends on possibility to fish till end of year.
DAILY PRACTICE	Does not reflect daily practice, as fishermen will continue to experience catch fluctuations.	Will allow fishermen to continue the mixed fishery when one of the target species is exhausted early; optimization may require complicated calculations.	Will be less in situations where actual fluctuations of catches are larger than changes in TAC.	Fishermen will increasingly see more fish than they are allowed to catch, unless decommissioning leads to reallocation of quota and days-at-sea.
RACE FOR FISH	In years with relatively low MATACs the race for fish will increase in spite of ITQs.	PO-management, combined with pooled ITQs can see to it that the above benefits fully materialize.	Tends to increase the race for fish when an upward adjustment of TAC has been limited and vice versa.	The above will tend to increase the race for fish, as all will expect the quota to be exhausted early.
ECONOMIC PERFORMANCE	Uncertain, but will probably get worse.	Some improvement to be expected as result of better prices.	Uncertain.	At least initially revenues will go down. Depending on success of decommissioning programme, economic performance will improve.

	1.1 Equal quantity for several years	1.2 Limited compensation	1.3 Limited adjustment	1.5 Fixed formula
Biology				
SPAWNING STOCK	There is no direct control of the spawning Stocks. Setting sole MATAC at appropriate level will be virtually impossible, as recruitment fluctuates strongly.	Supposing the allowed level of compensation and penalty on borrowing are well set, the stocks will not be negatively affected.	Strong year classes (sole) will no longer be caught instantly, but are allowed to contribute to an improved age structure. Downward limitation may have very negative effect occasionally.	Reduction of fishing mortality will increase stock size and improve its age structure.
FISHING MORTALITY	Will vary particularly for sole, according to recruitment, and consequently stock variations. May increase to undesirable levels in certain situations.	In the short run mortality may rise somewhat, particularly of sole, but in the longer run this will even out.	Fluctuations more or less in line with sea days restrictions.	The strategy is directed at lowering the fishing mortality.
HIGH-GRADING	Will increase if quota too restrictive; more likely in the case of plaice than of sole, for which fishermen will try to find 'other ways'.	High-grading of plaice may be less than without this measure (after recovery of the stock).	High-grading of plaice may occur when an upward TAC adjustment is limited.	Some high-grading of plaice may occur, as quotas are restrictive.
DISCARDING	If quota too large in relation to stock, effort will increase and discarding of non-commercial species will rise in absolute terms.	A higher level of effort on sole in the short run will increase discards of plaice, in longer run no significant effect.	Discarding of particularly plaice will fluctuate with fishing effort.	Discarding will decrease with fishing effort.
ECOSYSTEM MANAGEMENT	Is uncertain, due to uncertainty about the correctness of the level of particularly the sole quota.	Will probably not be negatively affected.	Wen downward adjustment is limited, particularly of sole TAC, fishing pressure will increase, so ecosystem will suffer.	Reduced fishing effort and mortality is beneficial for the ecosystem.

	1.1 Equal quantity for several years	1.2 Limited compensation	1.3 Limited adjustment	1.5 Fixed formula
Policy/institutions				
POLITICAL ACCEPTANCE	Uncertain. Negotiations on sole certainly not simplified, as it is high valued and highly variable as well. Problems may arise in medium and long term when early closures or other unpopular measures have to be taken.	May be good, as appears simple and attractive, apparently solving end of year problems. Negotiations on allowed level of compensation and penalty may be difficult.	Political acceptance may be good, as this seems to introduce some stability in fluctuations of TACs. On the other hand the decision makers may not like this reduction of their degrees of freedom.	Uncertain. On one hand improvement of stock situation appears attractive. On the other hand a reduction of the level of fishing activity is not very attractive. Connected to decommissioning may give rise to 'happy few' problem.
SECTORAL ACCEPTANCE	Probably good for plaice; for sole less certain, as: credibility of the policy will deteriorate if quota are forecast at a significantly wrong level.	Appears attractive to fishermen, allowing them some more freedom in managing their operation.	Fishing sector acceptance may be good as well, for the same reason. When applied, fishermen would mutter both ways: upward: that the quota was too small; downward: that sea days were too little.	In general the fishing sector will not like a (further) reduction of their activity. Some of the stronger firms may see the potential benefits, offering a chance to strengthen their position further (in case of sufficient decommissioning).
RELATIVE STABILITY	Unchanged.	Basically no change in the long run, but *may shift temporarily.*	Unchanged.	Unchanged.
NATIONAL ENFORCEMENT	'Black fish' (sole!) will be landed in years when the MATAC is low in relation to the stock; then greater enforcement costs have to be expected.	Annually the required compensation has to be brought into account, and the allocated effort has to be adjusted to the remaining available quota.	Enforcement will be more difficult when upward adjustment is limited, particularly in case of sole. *Downward limitation will* cause little (extra) trouble.	Enforcement will be more difficult as allowed catches will be (increasingly) low in relation to catching opportunities; *adjustment of the allowed sea* time will only partly redress this.
SUBSIDIARITY	PO ('Group') management will be more difficult in view of the above.	No change, as the principle can be devolved to PO-groups.	In line with more difficult national enforcement, management by POs will be more difficult.	POs will have difficulty in managing quota and sea time, as they will be increasingly restrictive and members will try to avoid restrictions.
LOCAL COMMUNITIES	Future prospects will only seemingly be stable; if MATACs are set too high, unjustified economic expectations may be raised.	Slight improvements in flexibility and market consistency will improve socio-economic prospects slightly.	Increased market stability might have a positive effect on prosperity at local level.	Reduced fishing activity will have a negative effect on the socio-economic situation of the fishing communities.
BEYOND 2002	No difference from present situation.	No difference.	No difference.	No difference.

	1.1 Equal quantity for several years	1.2 Limited compensation	1.3 Limited adjustment	1.5 Fixed formula
Other considerations				
CONSISTENCY	Some deterioration, as the MATACs bear less direct relation to the state of the stocks.	Some improvement in the economic field is expected.	Ambiguous outcome on different points of view.	In spite of the (short run) negative socio-economic effects, the strategy is consistent with the CFP.
TRANSPARENCY	Seems clearer than annual changes, but for sole a greater discrepancy with daily reality is to be expected.	Compensation system may be easy to explain globally, but complex in detail.	Easy to explain, particularly to outsiders who have no knowledge of the peculiarities of fish production.	Difficulty in explaining probably will lie in unwillingness of fishermen to accept reduced activity level.
NEW PROBLEMS	In situation of too low MATACs, POs may have difficulty to manage ITQs adequately and early closures of the fishery may return. With high MATACs there will be pressure to increase allowed sea days.	Establishing the maximum level of compensation by species and setting the penalty level. The timing of the biological advice is such, that there is an incentive to raise the TAC excessively, to 'compensate' for the borrowings.	The level of limitation has to be agreed upon, both for sole and plaice. If the adaptation of the sea days is not well tuned, the same problems as with constant TACs will occur.	The 'slack' will have to be taken out of the sea days allocation.
ACCOMPANYING CONDITIONS	Sea days restrictions have to take into account fluctuations in catchability.	Borrowing should be limited to level of uncertainty in assessment. Penalty on borrowing should take into account strong time preference of fishermen.	Sea days allocations have to take into account fluctuations in catchability, particularly with limited downward adjustments of TACs.	Mortality reductions should be implemented for plaice and sole simultaneously. Decommissioning of accompanying overcapacity has to be made attractive eventually, in order to avoid enforcement problems.

Appendix 3.2 Evaluation of multi-species definitions

	2.1 One common denominator	2.2 Limited transfer	2.3 Bycatch arrangements	2.4 Two tiers system
Economics				
FLEXIBILITY	Flexibility increases substantially, as the choice between fishing for plaice or sole is completely free, so the fishery can be adapted to the preferences of the individual firm and to the catching opportunities.	Flexibility increases distinctly, as the quota of the single species need not be adhered to as strictly as before.	Marginal increase of flexibility by leaving more freedom of movement in case of closure of plaice fishery.	Flexibility will be reduced slightly, as fishermen are pushed away from their preferred pattern of activity.
PLANNING	No significant improvement of planning, as future will be as uncertain as before. But greater freedom of action may give illusion of improved grip on future.	No significant change.	No change.	No change.
MARKET CONSISTENCY	Freedom of choice between plaice and sole enables fishermento adapt to market signals.	Some adaptation to market signals is possible.	No significant change.	Reduced market consistency, as weighting factors work opposite to market signals.
DAILY PRACTICE	The system is very much in line with daily practice, as fishermen do not have to bother about the composition of their catch.	Good accordance with daily practice, as small deviations from biological prognoses can be met without a problem.	Slight improvement, as small bycatches of plaice are no longer illegal after exhaustion of the plaice quota.	Push from sole towards plaice is working against daily practice.
RACE FOR FISH	Uncertain: early exhaustion of the multi-species quota is still possible, but rate of exhaustion is less apparent.	Will probably reduce tendency to race for fish, as some overshooting of one of the quota is allowed.	No effect.	Possibly a reduction, as fishing for the less wanted species is stimulated.
ECONOMIC PERFORMANCE	Some improvement can be expected, as the species mix can be optimized.	Better market consistency could result in a slight improvement of performance.	Can improve as some extra plaice can be landed legally.	Performance will be slightly poorer as the system works against the signals of the market and fishing opportunities.

	2.1 One common denominator	2.2 Limited transfer	2.3 Bycatch arrangements	2.4 Two tiers system
Biology				
SPAWNING STOCK	Development of the single stocks can no longer be controlled by setting TACs by species.	Provided the transfers stay within the confidence levels of the assessments, no serious extra problems.	Effect on stock of plaice would be small.	Positive effect on sole stock and negative effect on that of plaice.
FISHING MORTALITY	Fishing mortality of the single species can vary beyond control. Economic conditions in relation to the weighting factor(s) will decide which way the fishery tends to go.	Depending on circumstances (prices, denominator, catchabilities) one of the species can come under some extra pressure, but this can be corrected in next year.	Marginal increase of plaice mortality.	Mortality of sole (the species under high pressure) will be reduced and that of plaice will increase.
HIGH-GRADING	No special incentive to high-grade, as long as the MSTAC is not very restrictive.	No high-grading expected.	High-grading is not stimulated.	High-grading of sole is stimulated and of plaice discouraged.
DISCARDING	Will probably not differ much from single species TACs.	No extra discarding expected, rather a slight reduction;	Some reduction of discarding of illegal plaice bycatches.	Indifferent.
ECOSYSTEM MANAGEMENT	Uncertain. A very high mortality of one of the species as a result of this system would certainly be negative.	No special effect expected.	No effect.	Indifferent.
Policy/Institutions				
POLITICAL ACCEPTANCE	Seeing the extra complexity of the decision making process and the uncertain biological outcome, the measure is probably not politically acceptable.	Could be acceptable, as complaints about rigidity of the system are met without causing serious new problems.	A measure like this would probably not meet political objections.	The extra complication of deciding on weighting factors and the uncertainty of the effects will make political acceptance of this system dubious.
SECTORAL ACCEPTANCE	The fishing sector would welcome a measure like this, as it leaves them much more freedom of operation.	Increased flexibility and better accordance with daily practice going with this measure make it attractive to the sector.	Sectoral acceptance will be good because of minor, nearly symbolic, improvements in economic field.	The sector will not like the intransparency of the measure and its negative economic effects.
RELATIVE STABILITY	Would be upset, as substantial shifts in landings composition are possible.	Can be affected temporarily and marginally, but remains basically intact.	No significant effect.	Minor shifts are possible, in line with the extent of shifts between species.

	2.1 One common denominator	2.2 Limited transfer	2.3 Bycatch arrangements	2.4 Two tiers system
NATIONAL ENFORCEMENT	MSTACs will complicate enforcement only slightly, as catches of plaice and sole will have to be discounted against MS-quotas.	Some administrative complication will result from bringing transfers into account.	May give some problems as fishery will not be closed completely and content of plaice in landings has to be controlled.	Some mostly administrative complications, as the rate of exhaustion of the MSTAC is not instantly apparent.
SUBSIDIARITY	ITQs by species have to be transformed into MS-ITQs, and sea days regulation needs revision, but this is not expected to pose special problems. Group management may be easier as less quota transfers between members may be required.	Quotas are still allocated by species, so there is no change basically. Group management will meet with the same administrative complication as national enforcement.	No difference.	Similar to the situation with 'limited transfer'.
LOCAL COMMUNITIES	The slightly positive economic effects may affect local communities similarly.	Only minor positive effects to be expected.	Very minor positive effects	Possibly some minor negative effects, as a result of the negative economic effects.
BEYOND 2002	In a situation with reduced fleets, this may work out better than with the 1995 fleets, as they will be less able to overfish one species very heavily.	This may work well in a situation where fleet size has been adapted to catching opportunities and a more relaxed management is possible.	Applicable after reduction of capacity.	Indifferent.
Ohter considerations				
CONSISTENCY	Unlimited exchange between species within one flatfish quota appears to be quite inconsistent, as it has opposite economic and biological effects.	The measure is reasonably consistent, as it provides some improvement in the economic field, without giving away too much in the biological field.	Consistency of the fisheries management policy is hardly affected by this measure.	The measure does not make a significant contribution to the consistency of the management policy.
TRANSPARENCY	The system as such is very transparent, only the choice of the weighting factor(s) may be difficult to explain.	The measure, working with a simple exchange rate is quite transparent.	The measure is very transparent.	The measure is not very transparent, as it works rather indirectly, and against the short term interest of the sector.
NEW PROBLEMS	To arrive at a proper (way of setting the) common denominator for plaice and sole will be difficult. The biological assessment and advice procedure cannot provide estimates of mortalities and stock development in the ongoing year with any reliability.	No particular new problems expected. As long as the transfers are limited as proposed, the time lag in the biological advice procedure will not pose a big problem.	No new problems expected.	Setting the weighting factors and the percentage of reduction of the MSTAC can pose a problem, as the size of the effects can not be predicted very well.

	2.1 One common denominator	2.2 Limited transfer	2.3 Bycatch arrangements	2.4 Two tiers system
ACCOMPANYING CONDITIONS	A useful and acceptable common denominator with the accompanying weighting factor(s) has to be established.	Transfer should be limited to the levels of confidence of the biological assessments.	Small plaice bycatch allowed in sole fishery after plaice quota is exhausted. No arrangement the other way around.	There must be room for a shift of pressure from one species to the other.

Appendix 3.3 Evaluation of effort definitions

	3.1 Constant effort over several years	3.2 Limited adjustment of effort
Economics		
FLEXIBILITY	Flexibility increases as the fishermen are free to react to the signals of nature and the market within the restriction of the allocated sea time.	As 3.1.
PLANNING	As far as is possible in a fishery with uncertainty on catch rates and prices, good possibilities for planning as the allowed level of activity is known for a number of years.	Planning possibilities slightly less than with 3.1, unless an explicit strategy is followed.
MARKET CONSISTENCY	Market signals can be taken into account freely.	As 3.1.
DAILY PRACTICE	No pressure towards one of the main target species, so catches can be landed as they come.	As 3.1.
RACE FOR FISH	Depends on the way the effort quota are managed and enforced. If individual effort is less strictly enforced than national, there will be a race for effort = fish; With equally strict enforcement of individual effort, apart from the normal competition for the best performance, no incentive to race for fish.	As 3.1.
ECONOMIC PERFORMANCE	Some improvement of performance to be expected, asfishery can be optimized.	Basically as 3.1. A strategy to gradually reduce effort would initially affect performance negatively.
Biology		
SPAWNING STOCK	Developments of the stocks due to fishing is uncertain, as it can not be predicted how the effort will be distributed over plaice and sole. Undesired developments cannot be corrected within the period the level of effort is fixed.	Distribution of effort over stocks as uncertain as with 3.1. Some corrective action to prevent undesired developments of the stocks is possible annually.
FISHING MORTALITY	The actual levels of mortality by stock will depend on catch rates and market prices and can not be foreseen. No correction of effort level within the period over which it is fixed. Excessive shifts are probably not to be expected, due to the multi species character of the sole fishery.	As with 3.1 the actual mortality levels can not be foreseen, but excessive shifts are not to be expected. The general level of mortality can be corrected annually, for assessment errors as well as for changes in efficiency, or even to gradually arrive at a lower level of mortality.
HIGH-GRADING	No incentive to high-grade catches.	As 3.1.
DISCARDING	Levels of discarding of undersized and non-marketable species will not change.	As 3.1.

	3.1 Constant effort over several years	3.2 Limited adjustment of effort
ECOSYSTEM MANAGEMENT	No change.	In the case of a gradual reduction of effort a positive effect can be expected.
POLITICAL ACCEPTANCE	The system would be a complete change from the original management system based on TACs and quota and for that reason alone will not be easily accepted. The reluctance to accept will particularly concern the loss of relative stability as it is defined in the existing CFP; in order to meet this, the allocation keys of effort should leave the original relative stability intact as much as possible.	As 3.1. The possible necessity to annually decide on adjustment of the level of effort can be considered as an extra negative aspect.
SECTORAL ACCEPTANCE	Dutch fisheries organizations have repeatedly stated that they are not willing to accept an ending of the quota system; apart from the relative stability connected with it, this is mainly due to the fact that the (individual) quota have acquired a financial value and substantial investments have been made in them. Only a very convincing and generally accepted method to accurately convert ITQs into individual effort quota with the same legal and financial status and transfer possibilities might make a change over to effort management acceptable.	As 3.1, on both points. Annual decisions on adjustment will add to the uncertainty, so will be considered negative.
RELATIVE STABILITY	Relative stability, in the sense that shares of participating countries in the available fish are constant, will be lost. This, however, can be replaced by a relative stability of shares in the allowed effort.	As 3.1.
NATIONAL ENFORCEMENT	Enforcement would no longer be concerned with the level of landings, but would concentrate on sea time and fishing capacity; particularly control of the latter may become a problem.	As 3.1. A gradual reduction of effort, implying increasing restrictions, would enlarge the capacity control problem; in that case some relief could be found with a good decommissioning programme.
SUBSIDIARITY	For the Netherlands this will pose no particular problem. For other participating countries an adequate effort allocation system (including capacity and time elements) has to be established.	As 3.1.
LOCAL COMMUNITIES	Some improvement may occur due to the expected positive economic effects.	On one hand as 3.1. On the other hand a gradual reduction of the allowed effort, eventually resulting in decommissioning of part of the fleet, will have negative local effects.
BEYOND 2002	Effort regulation may be a useful tool of management after the capacity of the fleets has been reduced to sustainable levels.	As 3.1.

	3.1 Constant effort over several years	3.2 Limited adjustment of effort
Other considerations		
CONSISTENCY	Effort regulation is not consistent with the present CFP, which gives rise to rather strong political opposition. In itself the system appears to be at least as consistent as the TAC-system.	As 3.1, or even better.
TRANSPARENCY	Although the consequences for the stocks are not apparent, the system of allocating constant effort for several years can be easily explained.	As good as 3.1.
NEW PROBLEMS	Fishermen will invent new ways to dodge effort regulations, particularly when they become restrictive	As 3.1.
ACCOMPANYING CONDITIONS	Effort has to be measured in simple but effective parameters for all gears in the flatfish fishery. Changes in the relation between effort parameters and fishing mortality have to be monitored and taken into account.	As 3.1.

4. BRETON FISHERIES IN THE CELTIC SEA

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Summary

This case study first describes the specific features of high sea fisheries in area VII (except VIIa and VIId) of the Celtic Sea, and particularly trawling by French vessels.

Part A surveys fleets and targeted stocks. It highlights the multi-species nature of the fishery and the flexibility of fishing strategies, i.e. the ability of vessels to make the best, in the short or medium term, of available resources and market opportunities.

Multi-annual quota, which may result in the quota adjustment being inadequate to reflect resource fluctuations, can also cause aberrant transfers of fishing effort to the most fragile stocks.

Multi-species quota raise the problems of acceptance of exploitation rate differentials, of definition of equivalence rules, of setting enforcement measures, and more generally political and sectoral acceptance.

Establishing quota according to the various métiers seems at first a more realistic approach to the fisheries as they stand. Management of this scheme proves, in actual fact, to be exceedingly difficult on technical and political grounds. It also does little to optimize economic gains.

Management by individual effort quota is not optimal on biological grounds. It raises the problems of effort definition and maintaining relative stability.

However, it provides for flexibility of fishing strategies and sets itself logically in the effort control measures which have recently been established by area. It is also consistent with MAGP. This scheme can gradually be improved upon - to include, for instance, specific management of the area in line with the principal of subsidiarity - through encouragement or penalization of fishing strategies according to their targeted species and/or according to selectivity of fishing gears and techniques.

4.0 Introduction

This case study which surveys the 'mixed fisheries' of ICES area VII is made of two parts.

Part A outlines the selected fishery, its present biological condition and management problems.

Because of the complexity and variety of the region's fisheries, it was not possible to include all of them. A large part, namely the high sea demersal fish-

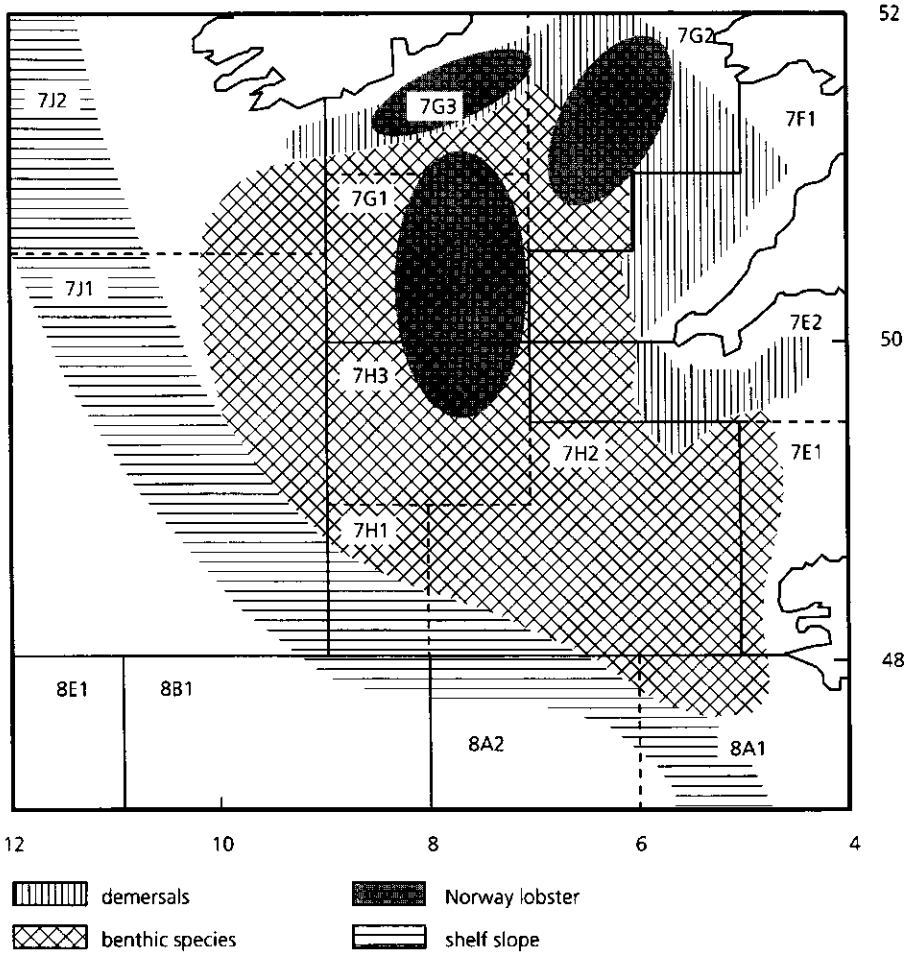

Figure 4.1 Major fisheries in the Celtic Sea

eries of area VII (except VIIa and VIId) was selected. Particular attention has been given to highlight specific features:

- diversity of métiers (combining size of vessels, target species ect.);
- multi-species captures of most métiers;
- multi-strategies for a large part of the fleets.

This first descriptive section of the study is necessary in order to understand the implications of possible management regulations; particularly to evaluate multi-species or effort measures. Chapter 4.2 briefly assesses the biological situation of the main targeted stocks. Chapter 4.3 describes the present regulatory measures in the fishery: technical measures, TACs and quota, MAGP, etc. Chapter 4.4 offers an analysis of current management problems based on the different criteria that have been defined in methodology.

Part B presents an analysis of potential measures multi-annual, multi-species and effort measures.

A global assessment of the implications contained in the various definitions of these new measures is offered. The matrices of appendices 4.1-4.3 provide a detailed analysis based on the different criteria. Certain hypotheses have been adopted to suit the context of the fisheries, in particular to take into account the notion of 'métier'.

This case study focuses on French operations. The specific conditions and consequences of MATACs, MSTACs, TAE on other fleets will not be commented upon.

Part A Presentation of the case study

4.1 Description of the fishery

4.1.1 Presentation of the area

Initially, the French case study was to deal with 'The mixed bottom fisheries' of ICES area VII and area VIII. It was considered more appropriate to limit the scope of the analysis and to retain only those fisheries in area VII where Breton vessels operate (figure 4.1).

Area VIId, i.e. East Channel, was excluded because few Breton vessels go there. Area VIIa (Irish Sea) was not included because it makes up a particular unit from an ecological and socio-economic point of view. Most French vessels operating in area VIIa are semi-industrial units from the port of Lorient which target gadidae, especially whiting. That fleet is at present going through a marked decline.

In this approach, all the fleets operating in areas VIIb-k, including non-trawling fleets (netters, longliners) which may have a significant impact for a number of species (hake, anglerfish ect.) have been retained. However, the bulk of the catches are made by trawlers.

The fisheries of area VII seem particularly interesting to illustrate the debates on new management measures because they present at the same time:

Elements of homogeneity

- a geographical unit = the Celtic Sea, to which some adjacent areas can be appended (West Ireland, entrance of the Channel);
- a socio-economic unit = this fishery is markedly dominated by French artisanal high sea fleets, particularly those based in southern Brittany.

Elements of singularity

- multi-métiers fisheries;
- to a very large extent, multi-species métiers;
- significant flexibility of fishing strategies;
- a damaged, but not too deteriorated, biological base.

Table 4.1 International landing of main species from the area VII (1,000 tonnes)

	83	84	85	86	87	88	89	90	91	92
White anglerfish	27.2	26.9	26.9	20.4	19.1	17.8	18.6	18.4	15.5	12.2
Black anglerfish	11.0	8.1	7.5	9.9	7.9	9.6	9.7	8.9	8.9	8.0
Megrim	24.5	16.7	17.9	16.7	16.9	17.7	18.3	14.0	14.7	15.0
Nephrops	4.2	3.9	3.8	2.8	3.1	2.9	3.8	4.3	3.3	4.2
Pollack	6.7	4.9	4.3	6.4	6.3	6.4	5.6	4.7	4.8	3.2
Ling	10.2	8.4	7.4	8.8	11.4	9.5	8.6	8.0	7.5	5.2
Whiting	8.5	7.2	7.3	6.8	8.7	9.4	12.4	10.1	9.5	8.7
Hake	57.5	63.3	58.9	57.4	63.4	64.8	66.5	60.0	5.8	56.6
Cod	5.3	5.6	6.2	8.0	7.9	12.0	15.3	8.7	6.0	6.4
Sole	1.4	1.3	1.3	1.6	1.2	1.1	1.0	1.2	1.1	9.8

4.1.2 Fleets and countries involved

Table 4.1 gives the tonnage of catches from 1983 to 1992 for various species subject to quota in an area that corresponds most to the one being surveyed. Figure 4.2 shows the share of French fleets in the landings.

One should note that for hake the area includes VI, VII and VIII. This emphasizes the importance of Spain. Area VII and area VIII are also included in the anglerfish figures.

Table 4.2 Fisheries units identified by the southern shelf ICES working group (adapted from ICES, 1987)

Fishery unit	Country	Number of boats	kW	GRT	Target species	Bycatch
1. Long line in medium to deep water	France	8	110	50	skates, dogfish	
	Ireland	4	428	130	hake	ling, greater, forkbeard, cod
	Spain	48	428	130	hake	monk, ling
	UK	13	536	202	hake, ling, cod	whiting
2. Long line in shallow water	France	42	144	34	pollack, ling, dogfish	skates
	UK	23	179	37	gadoids, skates, spurdog	
3. Fixed net	France	38	156	25	hake	pollack
	UK	152	128	18	hake, monk, cod, pollack	spurdog
4. Non-nephrops trawling in medium to deep water	France	106	421	163	monk, megrim	hake, skates, gadoids
	Ireland	13	760	240	hake, megrim, monk	cod, witch
	Spain	124	557	207	hake, megrim	cod, nephrops
	UK	18	693	242	hake, monk	megrim
5. Non-nephrops trawling in shallow water	France	108	549	166	gadoids	monk, skates, dogfish
	Ireland	<130	230	65	gadoids	megrim, monk, ray, place, sole
	UK	342	152	29	monk, gadoids	flatfish, skates, rays
6. Beam trawling in shallow water	Belgium	15	740		sole	place, rays
	UK	117	389	78	monk, sole	megrim
7. Nephrops trawling in medium depth water	France	72	341	54	nephrops	hake, gadoids, monk, megrim
	Ireland	<25	330	70	nephrops	whiting, hake, monk, megrim
	<17	400	110		nephrops	unknown
	<20	330	60		nephrops	hake, monk, whiting, megrim

a) Average per vessel.

For the main species in the area (anglerfish, nephrops, cod, whiting...), French landings are particularly important. Globally, contributions by fleets from other nations remain comparatively low, though they may be quite significant for a particular species, for instance megrim in the Spanish fleet.

4.1.2.1 Fleets other than French

Though French vessels are dominant in the area, other nationalities are also present (see table 4.2).

- The *Spanish fleet* is made of trawlers, netters and longliners operating more particularly in west of Ireland. Its share is fairly important in the case of hake, megrim and anglerfish.
- The *Irish fleet* is made of small trawlers predominantly, and also some netters. It operates mostly in coastal areas.
- The *UK fleet* is made of units with low engine power and tonnage. It practices various types of fishing.
- The *Belgian fleet*, marginally present in the area, numbered about 15 beam trawlers in 1989. They pursue flatfish (sole, plaice).

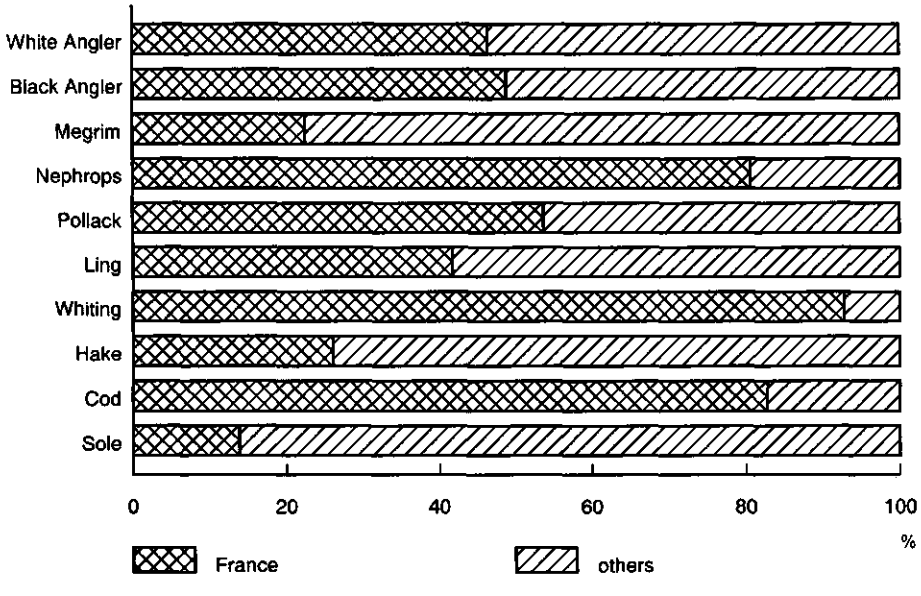

Figure 4.2 French share in landings for the main species managed by TACs in area VII (1992)

4.1.2.2 The French fleets

The French fleets operating in area VII can be broken down in four main categories.

'*Petits artisans*': vessels of 16-18 m length and 330-350 kW engine power. The word 'artisan' means a vessel whose owner works on board. The fleets based in Port-en-Bessin, Cherbourg and other harbours in the Cotentin peninsula also belong to that category. But most of them operate in the Channel; and their fishing strategies are fairly different from the ones used in the Celtic Sea.

'*Gros artisans*': vessels of 20-24 m length and 360-400 kW engine power. Most of them are based in southern Brittany, but some units come from Saint-Malo, La Rochelle and Les Sables-d'Olonne. They are the hard core of the fleets studied here. Most of them operate almost exclusively in area VII.

'*Semi-industriels*': vessels of 24-38 m length which are owned by fishing companies. They represent an important part of the fishery, though several of them also exploit other areas (west of Ireland and west of Scotland). Their operative logic therefore goes beyond the patterns of the Celtic Sea.

Some '*Industriels*': vessels of 38-55 m length also owned by fishing companies. They operate in area VII only occasionally, either on their way back from fishing grounds in west of Scotland or in deep waters on the edge of the shelf of area VII.

Table 4.3 sums up the mean technical characteristics of each of the above segments. The figures give a first insight into the structural heterogeneity of the French fleet in area VII. Out of the 498 listed vessels, more than half come from southern Brittany ports (Le Guilvinec, Concarneau, Lorient, Douarnenez). The others come from various ports along the Atlantic coast, mostly La Rochelle, l'Île d'Yeu, Cherbourg and Port-en-Bessin.

Table 4.4 summarizes the main data of 1993. A breakdown of fishing effort and production by sub-areas (VIIh, VIIg, VIIe etc.) highlights the importance of each particular sub-sector.

Qualitatively, catches in area VII include a multitude of species which belong to various zoological groups. Figures 4.3 and 4.4 show the tonnage and value of the 15 most important species which appeared in the 1993 French production of area VII. The two main species (anglerfish and nephrops) represent 30% of the aggregate value. And the first 15 species represent only 79% of the aggregate value, and 70% of the volume.

This shows the diversity of the region's resources. In addition to standard species, some less common ones such as squid, cuttlefish, orange roughy, John Dory are of importance.

Table 4.3 Mean technical characteristics of French fleets involved in area VII (except VIIa & VIId) in 1993

Type	Industriels					Semi-industriels					Gros artisans					Petits artisans					Total				
Port	Nb	kW	GRT	Size	Age	Nb	kW	GRT	Size	Age	Nb	kW	GRT	Size	Age	Nb	kW	GRT	Size	Age	Nb	kW	GRT	Size	Age
CC	2	883	322	38	9	33	637	223	34	13	30	432	79	21	9	2	312	52	17	7	67	543	156	28	11
DZ						3	1030	275	38	17	19	379	76	20	10	7	245	32	15	12	29	414	86	21	11
GV						1	348	107	26	33	114	364	68	20	11	18	271	39	16	12	133	351	64	20	11
LO	8	1435	632	54	21	17	548	206	31	21	25	377	76	20	10	8	332	55	19	17	58	567	188	28	16
Total	19	1344	546	51	18	65	597	202	31	15	278	372	71	20	11	136	324	57	18	13	498	425	102	22	12

CC = Concarneau; DZ = Douarnenez; GV = Le Guilvinec; LO = Lorient

Table 4.4 Main data of the French fishery in the area VII (except VIIa & VIId) in 1993

Total fleet: 499 boats			
among which:	*Mean length (m)*	*Mean power (kW)*	*Mean jauge (GRT)*
20 'industriels'	51	1351	551
65 'semi-industriels'	31	597	202
278 'gros artisans'	20	372	71
136 'petis artisans'	17	322	56

Effort and production		of which in area (%)			
		VIIe	VIIf+g	VIIh	others VII
Effort	1,034,676 fishing hours	17	48	25	10
Landings	71,124 tonnes	21	47	16	15
Production value	874,8 mln FRF	18	46	20	15

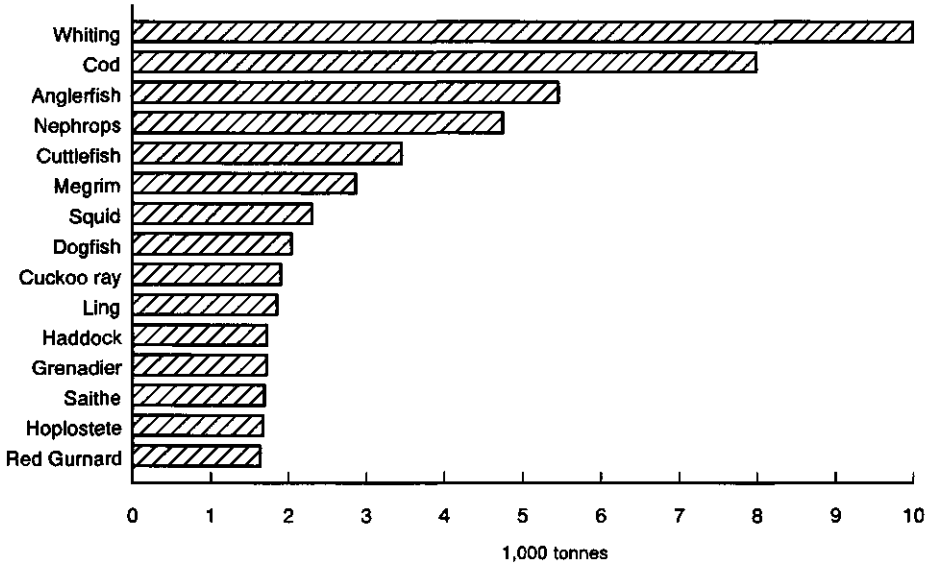

Figure 4.3 French landings of the 15 main species caught in area VII (except VIIa and VIId) in 1993, 1,000 tonnes

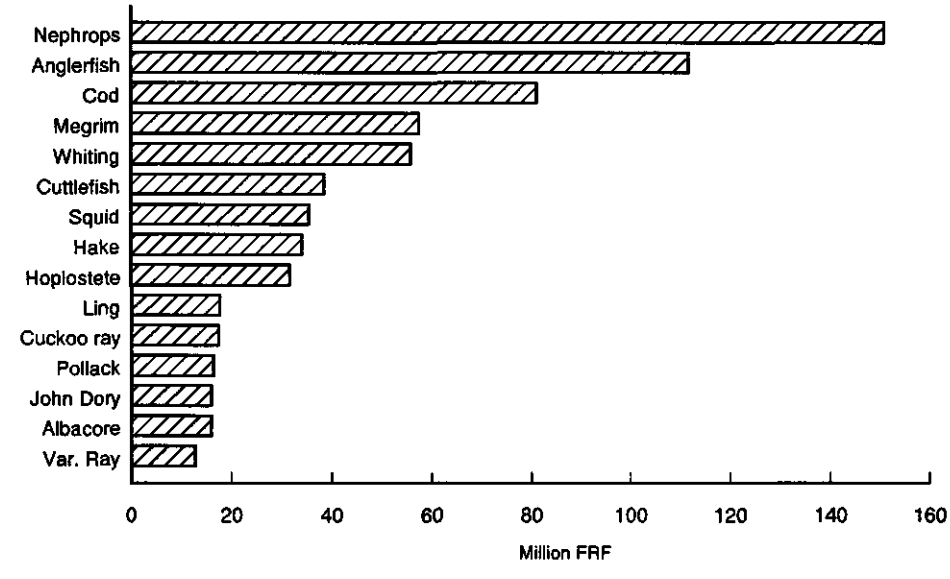

Figure 4.4 French landings for the 15 main species caught in area VII (except VIIa and VIId) in 1993, million FRF

4.1.3 Métiers and fishing strategies

The French fleets have been presented above in four segments, according to size of vessels and status of owners.

This general approach tends to overshadow the actual complexity of the fishery which is linked to:

- the diversity of métiers;
- the multi-species nature of métiers;
- the flexibility of fishing strategies.

In the first place the word 'métier' refers to *the type of gear used.* Some netters, potters, longliners, occasional mid water trawlers and seasonal driftnet vessels targeting albacore are to be found operating in area VII. Bottom trawlers are nevertheless largely predominant in the French fleet. The analysis shall therefore deal with trawling mostly.

For a given type of vessel, and here this means trawlers in particular, the word 'métier' refers also to:

- the targeted species (single or multi): nephrops, anglerfish, gadoids, etc.;
- the fishing area: the grounds at the bottom of the Celtic Sea vary appreciably from one sector to another.

However, these two criteria intermingle largely.

In order to highlight the diversity of the métiers, the multi-species features and the flexibility of the fishing strategies, a file of 7,628 entries was studied representing the 'vessel-area' combinations for each month of 1993. Each such entry states the characteristics of the vessel (size, engine, kW, GRT, port...), the fishing effort as well as tonnage, and value of landings for about 30 species (anglerfish, cod, megrim, haddock, albacore, grenadier, orange roughy, pollack, saithe, ling, blue ling, whiting, hake, nephrops etc.).

4.1.3.1 Methodology

The ICES working group (1987) segmented the French trawlers into 3 main categories according to the major species in their catches:

- nephrops (fishery unit 8);
- benthic species (anglerfish, megrim, ray) (fishery units 4 and 14);
- gadoids (cod, whiting) (fishery unit 5).

The case study endeavoured to carry the analysis further in order to clearly work out the issues resulting from the implementation of new management measures, in particular multi-species and effort measures.

Table 4.5 Production in value by species and by métier ('000 FRF)

Species	Mét 1	Mét 2	Mét 3	Mét 4	Mét 5	Mét 6	Mét 7	Mét 8	Mét 9	Total
Nephrops	7,512	84,261	1,521	46,793	260	2,398			8,140	150,884
Anglerfish	58,514	10,405	6,103	13,148	2,801	551		1,203	18,955	111,681
Cod	11,197	7,204	33,290	5,475	2,307	1,174		105	20,348	81,100
Megrim	30,468	4,631	3,208	12,939	705	207		40	5,218	57,415
Whiting	5,375	3,582	31,000	2,230	1,977	1,083		6	10,512	55,766
Squid	5,457	152	1,632	183	273	29		74	30,718	38,518
Cuttlefish	3,096	17	32	17	7	3		3	32,333	35,507
Hake	7,931	2,654	4,075	2,921	517	112		389	15,588	34,186
Hoplostete	22							31,585	128	31,735
Ling	3,943	1,314	2,378	1,216	264	85		105	8,335	17,638
Cuckoo ray	12,082	127	888	150	182	13		53	3,880	17,374
Pollack	2,058	301	2,629	163	184	58		78	10,981	16,452
John dory	4,279	499	969	489	133	28		74	9,531	16,003
Albacore							15,989			15,989
Various rays	497	282	1,308	330	47	13		68	10,196	12,740
Lemon sole	2,899	452	2,903	389	299	42		19	4,799	11,802
Bass	62	18	135	9	3	2			10,586	10,814
Grenadier	50		17		2			9,867	323	10,259
Haddock	2,249	129	2,033	169	262	20		112	4,425	9,398
Sole	2,257	699	384	636	108	51			4,517	8,652
Red gurnard	393	7	83	6	6	1		6	7,937	8,437
Saithe	1,083	369	874	235	116	42		368	5,275	8,362
Picked dogfish	1,218	846	792	926	47	36		39	4,164	8,067
Goatfish	793	19	36	10	4	1		3	7,032	7,897
Grey bream	6	1	0	0	0			2	7,850	7,859
Turbot	3,077	459	751	550	139	58	0	1	2,747	7,782
Ray do.	1,225	119	1,026	183	179	18		1	3,859	6,609
Dogfish	1,191	438	689	592	80	21		10	3,369	6,390
Blue ling	21		6	0	0			636	278	942
Others	12,959	3,874	6,152	4,899	663	207	792	13,121	33,231	75,898
Total	181,913	122,858	104,916	94,657	11,564	6,250	16,781	57,965	285,253	882,157
Effort (hours)	283	149	111	130	16	9	8	28	313	1,047
Number of trips	1.9	1	0.9	0.9	0.1	0.7	1.1	3.1	2.3	7.6

Among the most recent studies focusing on a similar approach, one should quote Biseau (1994) who, on the basis of catch components, defines for each trip target métiers (major species captured), and for each vessel types of métiers (yearly average). This approach leads to a more realistic view of the prevailing situation in the area under scrutiny. It highlights the flexibility of the fishing strategies. In order to define the métiers, the 7,628 monthly entries of vessels visiting the area were classified into 8 target métiers on the basis of the specific contents of catches. Métier 9 covers entries that could not be otherwise classified in line with fixed thresholds. Percentages refer to the share of major species in that value of landings.

Métier 1: + 25% anglerfish and megrim
Métier 2: + 30% nephrops
Métier 3: + 30% cod and whiting
Métier 4: + 25% anglerfish and megrim, + 30% nephrops
Métier 5: + 25% anglerfish and megrim, + 30% whiting and cod
Métier 6: + 25% nephrops, + 30% whiting and cod
Métier 7: + 20% grenadier and orange roughy (deep sea)
Métier 8: + 40% albacore
Métier 9: other métiers

Such typology comes close to the classification of activities as observed by Biseau (op. cit.) while retaining the 3 main métiers traditionally associated with the Celtic Sea: benthic, nephrops, gadidae (Charruau & Biseau, 1989).

It also makes it possible to outline albacore fisheries (métier 8) and deep sea species fisheries (métier 7). These diversifying métiers may represent the main activity for some vessels. For others they remain a seasonal, though essential, diversification of effort.

This typology highlights the 'mixed métiers' and the importance of the 'unclassifiable'. More generally, it underlines the heterogeneous nature of the fishery in terms of catch composition.

Such typology based on monthly rather than annual data has one particular advantage: it makes it possible to describe the diversity of operational patterns and the flexibility of fishing strategies.

Our methodology, and therefore the typology, could be further refined through additional segmentation based on the type of fishing enterprises (petit or gros artisan, semi-industriel) and by isolating the métiers that use various fishing gears other than trawls. It was possible to tackle all the main points within the scope of the present study by using the above methodology.

4.1.3.2 Multi-species métiers

The data in table 4.5 and the graph of figure 4.5 provide a general picture of the results. Some features can clearly be distinquished.

The 8 métiers defined by thresholds of catches of specific species account for only 68% of the value of catches. The three 'pure' métiers of bottom trawling (benthic, gadidae, nephrops) account for only 47% of the value of landings. The contribution of other métiers, which represent a significant diversification of fishing strategies, should not therefore be neglected. Targeting of certain species - albacore, grenadier, orange roughy, ling, squid, etc, is primarily done by vessels engaged in these 'secondary' métiers.

If the three major mixed métiers fisheries are added up, they account for 15% of the aggregate value. One of them mixing anglerfish+megrim/nephrops (métier 4) accounts for 12%. The other métiers that mix majors therefore represent only 2.5% of the total. Métier 7 (deep sea) accounts for 6.6%. Métier 8 (albacore) accounts for 1.9%.

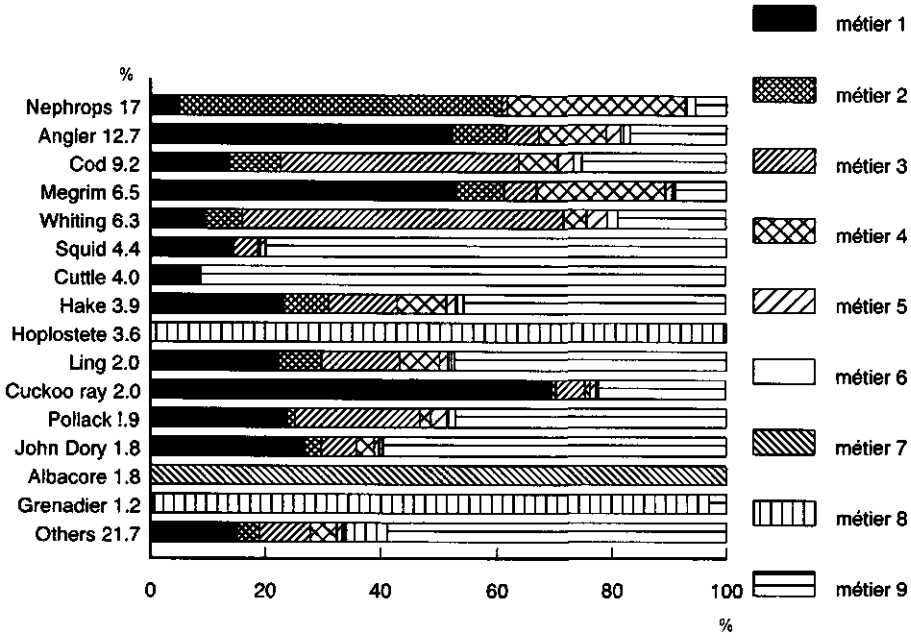

Figure 4.5 Effort, total value and value by species and by métier in 1993

Métier 9 (others) refers to:

- petits artisans operating at the entrance of the Channel, in particular;
- industrial métiers (ling, saithe etc.);
- gros artisans targeting other species (ray, sole, cephalopods particularly) during certain seasons.

The five main decisive species of the first 6 métiers account roughly for only 51% of the aggregate catches. The sum of the 29 other species that have been analysed, amounts to 91% of the value of landings. The share of TACs species stands at 60% of the production (value).

Analyses of the composition of catches of each métier indicates that target species seldom represent more than 50% of the production. This proves the importance of bycatches.

Apart from albacore and deep sea species, most other species are captured at the same time by vessels engaged in several métiers (figure 4.6).

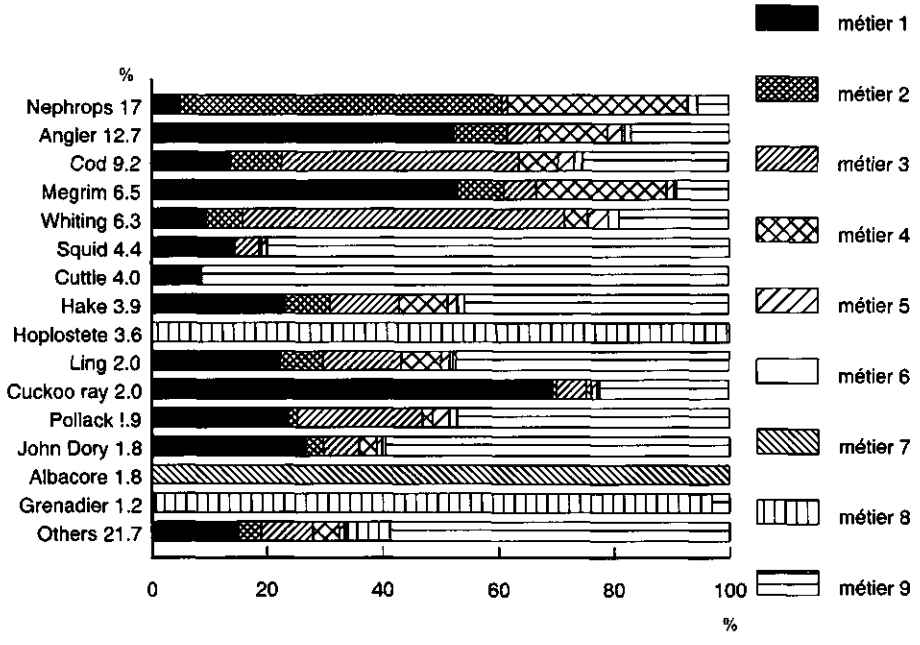

Figure 4.6 Composition of the production by species and by métier in 1993 (value)

4.1.3.3 Flexibility of fishing strategies during the year

In order to evaluate the significance of changes of strategies for vessels visiting the area, the file of 7,628 entries for 1993 was processed. Having classified the entries for each month and each vessel, all the transfers between métiers, together with entrances and exits from area VII were listed (table 4.6).

For a total number of 498 vessels, 3,238 changes were recorded throughout that year.

Métier 1 (anglerfish) totalled 1,908 trips. 646 'exits' were recorded, 115 of them going to métier 2 (nephrops), 86 to métier 3 (gadidae), 172 to métier 4 (nephrops+anglerfish), 41 to the other mixed métiers and 232 to métier 9 (other). The rate of change stands at 34% from which 30% is to basic métiers and 70% to mixed and other métiers.

Globally, switching to other métiers occurs as follows:

- 14.7% between 'pure' métiers (1 to 3);
- 28% between métier 4 and 'pure' métiers;
- 8% between métiers 5 or 6 and 1/2/3/4;
- 1% between métiers 1 to 6 and métiers 7 and 8;
- 35% between 1 to 8 and métier 9 (others).

The remainder are changes of areas.

Table 4.6 Number of observed changes from one métier to another

From: *To:*	Mét. 1	Mét. 2	Mét. 3	Mét. 4	Mét. 5	Mét. 6	Mét. 7	Mét. 8	Mét. 9	Out of area	To-tal
Métier 1	0	120	92	161	48	16	3	2	180	32	654
Métier 2	115	0	31	263	13	19	0	0	63	6	510
Métier 3	86	32	0	34	14	8	1	1	224	11	411
Métier 4	172	237	41	0	14	13	2	0	65	13	557
Métier 5	32	13	30	14	0	1	0	0	25	2	117
Métier 6	9	21	8	18	1	0	0	0	5	3	65
Métier 7	2	0	1	0	1	0	0	0	4	27	35
Métier 8	1	0	3	0	0	0	0	0	11	18	33
Métier 9	196	55	201	68	21	5	11	13	0	87	657
Out of area	33	21	15	6	0	0	12	19	93	0	199
TOTAL	646	499	422	564	112	62	29	35	670	199	3,238

Nearly half of the changes occur between the 3 basic métiers, more than 30% of them taking place between 'pure' métiers. The rate of incidence of such changes stands at 41%. If the mixed métier 4 is included, this percentage increases to 66%. Interestingly, less than 50% of the changes to métier 4 originate in métier 2 (nephrops). The rate of incidence is then 45%.

Changes between métiers 1 to 6 and métier 9 ('others') are also fairly frequent. They are quite often due to a significant occurrence of species other than the main ones (cephalopods in particular).

Each métier remains very heterogeneous. Within a particular métier, the composition of catches varies with vessels and seasons. For example, the total number of entries listed under métier 1 (+25% anglerfish and megrim) breaks down as follows:

Table 4.7 Composition of entries by share of major species

	No. of Entries	Share of total (%)	Percentage of major species
	551	28.9	25 - 35
	464	24.3	35 - 45
	341	17.9	45 - 55
	325	17.0	55 - 65
	227	11.9	+ 65
Total	1,908	100	

The seasonal nature of the métiers is indicaded in figure 4.7. The global production of each particular métier varies markedly over different periods. For instance, the total value produced by métier 1 goes up significantly from September to January. For métier 2, on the contrary, production is highest between March and July. As for métier 3, catches are at their best at the beginning of the year.

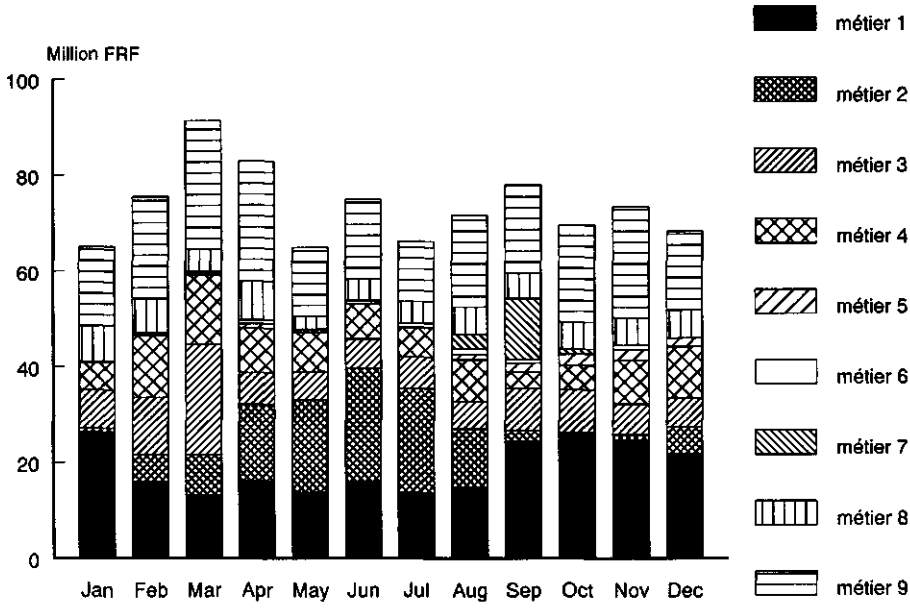

Figure 4.7 Seasonal variation of production by métier ('000 FRF)

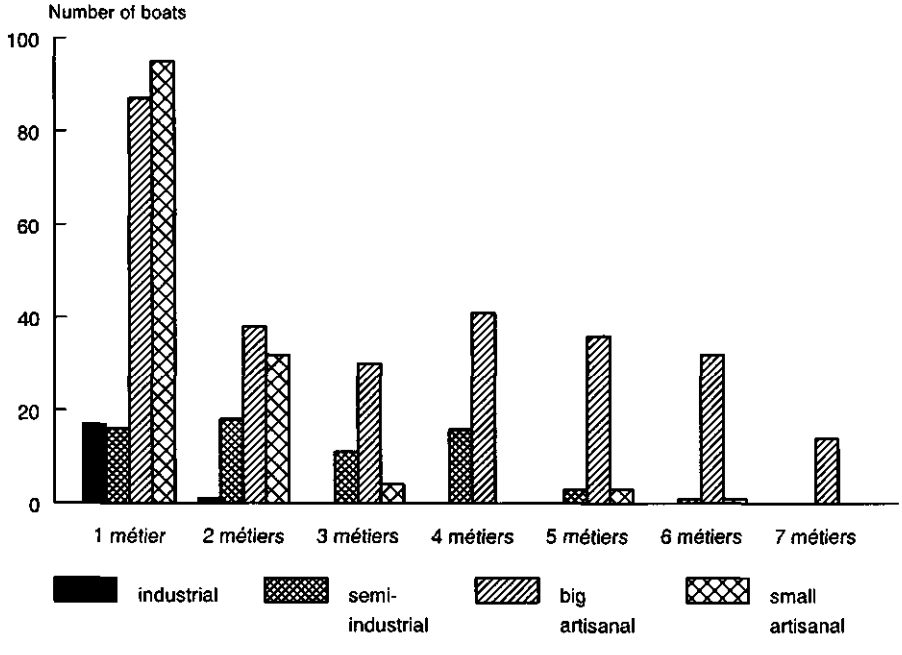

Figure 4.8 Number of boats which practised several métiers during the year 1993

Most vessels engage in several métiers. Figure 4.8 shows that a majority of gros artisans engage in different target métiers. Though 31% of vessels keep to one métier, 44% of them engage in more than 4. Fishing strategies are therefore flexible. Flexibility characterises the practices of French artisanal high sea fleets. This is also true for the semi-industrial fleets. Flexibility seems to be important among the petits artisans. However, a majority of them are classified under métier 9, which in fact includes different types of métiers.

Because of the demonstrated flexibility, cautious action is required when tackling resource management on the basis of 'métiers'.

4.1.3.4 Switching to different métiers over the years

It is difficult to follow the evolution of the various métiers over the years as this includes:

- evolution of the composition of catches for one particular fishing strategy (= same species targeted in same area), because the resources that are available or that can be captured vary in time;
- evolution of the distribution of vessels among various métiers. Shifting from one to another being at times a very slow process.

A fluctuating resource leads to a changing distribution of the main métiers. It also significantly changes the composition of catches for vessels engaged in the same métier. The statistical series which have been studied are not long enough to trace such evolution. Biseau (1994) has carried out a retrospective analysis of target species percentages in the catches made by the main fishery units of area VII. By examining the relative importance of the various target métiers, the author shows that specific features of the 'métiers types' in the Celtic Sea are undergoing constant changes.

As a consequence, the catch composition in particular varies. For instance, figures for 1985 and 1992 (table 4.8) show that the anglerfish percentage went down markedly in the landings of fishery units 4 and 14 (benthic trawling). By contrast, the cod percentage went up. Scientists who specialise in demersal fish observe that cod and whiting are now representing a bigger share. An analysis of the evolution of métiers between two different years based solely on catch data may therefore be thwarted by a varying resource.

Evolution of the composition of activity by métiers can be illustrated by changes in activity (fishing effort) by fishing zone. For example, figure 4.9 gives the evolution of fishing effort (1991-1992) of vessels registered at Le Guilvinec. The transfer from area VIIh to area VIIg and area VIIj-k means that units of métier 1 (anglerfish+megrim) shifted to métiers 2 to 4 (in VIIg) or to métier 8 (deep sea species in VIIj-k).

Likewise, between 1989 and 1992 there occured a significant shift of the Concarneau semi-industrial fleet from the Celtic Sea (- 57% of fishing effort) to west Scotland (+50% of fishing effort).

The evolution of activity according to métiers can also be outlined through statistical data on gears. Between 1990 and 1993, use of gears other than bottom trawl increased: driftnet for tuna, midwater trawl, gill net, etc. Although by 1993, these gears played still a relatively small role only.

Table 4.8 Evolution between 1985 and 1992 of characteristics. Mean (ecart-type) of various species share (%) in landings for all trips and all boats in main fishery units

Fishery-unit		Angler-fish	Me-grim	Cuckoo ray	Ling	Hake	Cod	Whit-ing	Nephr-ops
Bottom trawl-ing in Celtic Sea (4)	1985	36(15)	8 (4)	13 (8)	5 (4)	4 (5)	3 (4)	2 (4)	2 (6)
	1992	24(13)	9 (6)	13(10)	5 (4)	4 (4)	6 (6)	2 (3)	2 (4)
Bottom trawl-ing in Bay of Biscay (14)	1985	48(11)	7 (4)	18 (8)	2 (2)	3 (4)	0 (1)	0 (1)	1 (2)
	1992	29(17)	8 (5)	14(10)	3 (4)	4 (5)	1 (2)	1 (2)	3 (6)
Bottom trawl-ing in Celtic Sea shallow water (5)	1985	12(10)	3 (4)	3 (4)	5 (5)	6 (5)	11 (9)	12(12)	1 (4)
	1992	7 (5)	4 (3)	3 (3)	3 (3)	4 (3)	17 (8)	21(18)	3 (5)
Nephrops trawling in Celtic Sea (8)	1985	14 (4)	8 (4)	1 (2)	5 (3)	3 (2)	10 (4)	6 (7)	31(12)
	1992	11 (4)	9 (4)	0 (1)	3 (1)	3 (2)	11 (4)	10 (8)	31 (9)

Source: Biseau, 1994.

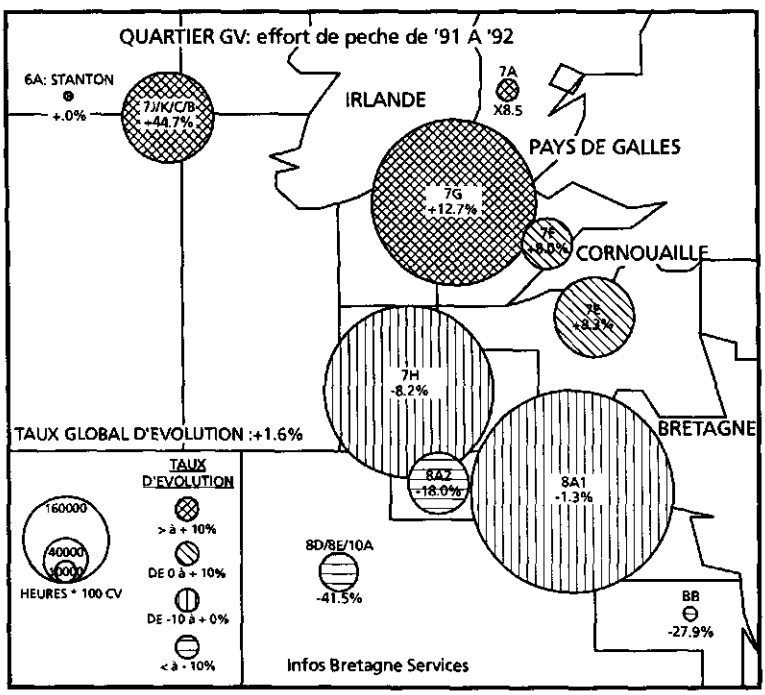

Figure 4.9 Fishing effort in Le Guilvinec' 'quartier' (1991 and 1992)

4.2 Biological basis

Another feature of this area is the great diversity of the ichthyological population. Almost all the species encountered are exploited to various degrees. But the fishery is based largely on the exploitation of about 30 species, some of which are of great economic interest. Among the high commercial value species, only 10 or so are being regularly monitored by scientists within the framework of ICES working groups. These are species subject to a TAC regime.

4.2.1 Stocks exploited by the French fleets

The analysis of the biological basis adopts the assessments made by the ICES working group (1994a, b) together with relevant elements of the IFREMERs report (Mellon et al.,1994).

A synoptic compilation of topical data is shown on table 4.9, with significant indicators on stocks and exploitation rates.

The case study sticks to the conclusions of biologists with respect to the main species exploited by the French fleets. These are: nephrops, anglerfish, cod, megrim, whiting, hake, ling, cuckoo ray and pollack. These nine species account for 55% of French tonnage produced in area VII (except VIIa and VIId), and more than 60% in value.

Available data on biological and ecological aspects of the fish population remain inadequate. This lack of information may in some cases unsettle assessments of stocks.

Nephrops

Within area VII, two different populations are to be found, the Celtic Sea one (VIIf,g,h) and the Porcupine Bank one (VIIb, c, j, k).

In both cases, the male and female components of the population are considered separately and treated as independent stocks in scientific analysis. This distinction is based on differing biological and behavioural features.

Celtic Sea nephrops stock

Because they are less accessible and smaller in size, nephrops females have a lower fishing mortality than males. They account for only a small part of the catches (10% of landings). As for males, the yield curve per recruit shows that the present level of exploitation is slightly above the Fmax value. IFREMER biologists note that *'despite this slight overexploitation, the stock does not seem to show alarming signs of spawning biomass decline'.*

Porcupine nephrops stock

Assessment indicates that the current level of exploitation of nephrops is slightly above optimal level. It is true that landings and yields have been in decline ever since 1987. According to scientists, though, this situation is due to changed accessibility and catchability for that species rather than to stock decline.

Table 4.9 Some data on the situation of stocks exploited in area VII by the French fleet

	Value	Volume	Fishing mortality			SSB		Recruitment (4)		Age class number	
SPECIES	%	%	F 93	F max 93	F mean (1)	SSB 93	SSB mean	R 93	R mean	exploited	90% of land
Nephrops (m)	17	7	0.49		0.38	208,339	20,474	3,310,442	409,044	7 (1-7)	4 (2-5)
Nephrops (f)			0.44		0.35	5,825	6,386	140,084	246,881	7 (1-7)	3 (2-4)
White anglerfish	13	8	0.28	0.13	0.32	30,813	44,155	13,135	15,058	11 (0-10)	7 (1-7)
Black anglerfish			0.18	0.13	0.19	32,919	40,778	16,334	14,112	10 (1-10)	9 (1-9)
Cod	9	11	0.93	0.27	0.69	8,166	8,000	1,293	3,277	7 (1-7)	2 (2-3)
Megrim	7	4	0.26	0.15	0.27	85,001	80,534	316,881	280,774	10 (1-11)	9 (1-9)
Whiting	6	15	1.05	0.42	1.14	19,714	15,848	28,618	3,5142	7 (1-7)	2 (2-3)
Squid	4	3									
Cuttlefish	4	5									
Hake	4	2	0.36	0.1	0.28	129,190	182,412	310,032	313,489	11 (0-10)	7 (0-6)
Hoplostete	4	2									
Ling	2	3	0.32	0.38				6,402		16 (2-17)	6 (3-8)
Cuckoo ray	2	3	0.18	0.2							
Pollack	2	2								11 (2-12)	4 (3-6)
John Dory	2	1									
Albacore	2	2									
Various rays	1	2									
Lemon sole	1	1									
Bass	1	0									
Grenadier	1	2									
Haddock	1	2									
Sole	1	0	0.43	0.19	0.37	2,283	3,315	4,673	4,950	10 (1-10)	5 (2-6)

	Value	Volume	Fishing mortality			SSB		Recruitment (4)		Age class number	
SPECIES	%	%	F 93	F max 93	F mean (1)	SSB 93	SSB mean	R 93	R mean	exploited	90% of land
Red gurnard	1	2									
Saithe	1	2									
Picked dogfish	1	1									
Goatfish	1	0									
Gray bream	1	1									
Turbot	1	0									
Ray do	1	1									
Dogfish	1	3									
Blue ling	0	0									
Others	9	14									

Notes: 1. Set used in mean calculation are different species; 2. Biomass in metric tonnes; 3. Recruitment in thousands fish;
4. m=male, f=female.
Source: Working Group on the Assessment of Southern Shelf Stocks (ICES, 1994b).

Table 4.10 Discards, landings and discarding rates for main species (thousand fish)

Species	Discards	Landings	Discard rate (%)
White anglerfish	318	5,225	6
Black anglerfish	219	1,615	12
Megrim, male	2,012	507	80
Megrim, female	2,281	7,428	24
Whiting	2,132	17,138	11
Hake	307	1,818	14
Cod	161	1,873	8
Cuckoo ray, male	454	470	49
Cuckoo ray, female	495	430	51

Source: Charuau and Biseau, 1989.

Anglerfish

Though fisheries statistics do not make a distinction between the two species (white and black), scientific analysis is carried out separately. Landing figures are divided by applying proportional coefficients based on fish auctions sampling.

The yearly assessment of both stocks is done jointly in area VII and area VIII, integrating two sectors respectively subject to a particular TAC.

White anglerfish (Lophius piscatorius)

Daily yields and landings have declined significantly over the last years. Fishing mortality, which remains comparatively low, is appreciably higher than the mean figure (1989-1993). The present figure is well above Fmax.

After undergoing a drop, recruitment seems to have been picking up since 1992. Its 1993 level, remains below the average figures as observed in the series which is available.

According to IFREMER and ACFM reports, the stock does not seem to be in danger, despite overexploitation. From available data, one cannot define its minimum acceptable biological limit.

Black anglerfish (Lophius budegassa)

Landings have remained comparatively stable over the last years, while yields have shown a marked decline. Stock assessment concludes that the situation is satisfactory. The levels of fishing mortality, spawning biomass and recruitment are close to average.

Megrim

Statistics put together two species of megrim. Scientists monitor only one (in area VIIb-k and area VIIIa, b). Structural analysis is made difficult because of biological features (differences between sexes and between year classes, etc.).

The situation of the stock is said to be globally satisfactory. Though remaining at a low level, fishing mortality has been on the increase since 1984. Its present level practically equals Fmean. After markedly declining between

1989 and 1992, spawning biomass now shows an upward trend. Biologists are advising continuing caution and the maintenance of the biomass at the current level.

Cod

Strong variability characterises the stock. The situation varies with fluctuating recruitment as only a small number of year classes are exploited. Landings and yields are currently at their lowest annual level. Fishing mortality is rather high (0.93): it exceeds its historical mean and is well above Fmax. Spawning biomass is also in a critical state. But according to ACFM, the stock is staying within the minimum biologically acceptable limit. In order to go back to F optimal level, it is recommended that present fishing mortality be reduced by 80%.

However, one should note again that a gap between current mortality and Fmax has always been observed among gadoids in the Celtic Sea (Ould el Kettab, 1993). Even during periods of high recruitment, the difference between the fishing mortality level and the theoretical optimal level remains significant. One should also notice that evaluation is conducted only in a portion of the stock's habitat (VIIf,g,h), which is the region where cod concentration is highest. But also exchanges between the Celtic Sea stock and those in neighbouring zones (Irish Sea, Channel) are not known.

Whiting

Similary to cod, fluctuations of biomass and production are closely linked to variations of recruitment three years earlier. Dependence on exploitation of only two year classes renders the stock most vulnerable.

Thanks to comparatively large recruitment in 1990 and 1991, the stock is not in danger at the present time, despite a fishing mortality which remains high. ACFM recommends a significant reduction of fishing mortality, while admitting that the stock is not threatened.

Hake

Hake exploited in area VII is part of the so-called 'north stock' which spreads all over the North-East Atlantic (areas IV, V, VI, VII, VIII). Scientific evaluation is conducted over the whole region whereas TACs are set for more limited areas. In addition to this wide geographical dispersal, another significant feature is the gradient like localization of various year classes. Younger fish stay in coastal areas while older ones live in deep water. As a result, exploitation takes place in a sequential manner: the particular segments of the fleets come in successively to capture different year classes. Hence the importance of bycatch rates and discards.

Assessments show that F level remains low (0.36) but has been following a slow upward trend for several years. Since 1986, the spawning stock biomass has been drastically eroded. It is now at its lowest level. The hake stock is seen as being below the minimum biologically acceptable limit.

Observers are therefore advocating a significant reduction in the fishing effort applied to the stock and to the younger population in particular. Exploi-

tation of juveniles is indeed the main problem of particulary together with nephrops in mixed coastal fisheries.

Pollack, ling and cuckoo ray

These three species are not regularly monitored within the framework of ICES. IFREMER has been analysing the stocks for some years. Published reports show that their situation is relatively healthy. They constitute bycatches for fleets which focus on other species. This makes forecasting difficult and caution in their management is desirable.

4.2.2 Discards and bycatches

This multi-species fishery inevitably produces bycatches. The above section has shown that most resources in the area are exploited by vessels pursuing them as target species or by vessels catching certain species occasionally.

When bycatches contain substantial quantities of juvenile or undersized fish which are not marketable, discards may reach high levels. This may have damaging effects on the stocks concerned.

In the Celtic Sea, for instance, the 'Langoustiniers' capture large quantities of young whiting. According to IFREMERs estimates (Mellon et al.,1994), discards may vary seasonally between 45 and 70% of the total whiting catch. Discarding rates are also quite significant for other species, for instance anglerfish, megrim and ray (table 4.10).

4.2.3 Conclusion

All the stocks which have been analysed are at present fully exploited. Indeed, some are overexploited with regard to biological criteria (Fmax, SSB, R). But, on the whole, the situation of the resource is considered less alarming than in other EU regions (North Sea, west Scotland).

The very mixed nature of the fishery, coupled in some cases with exploitation patterns that affect younger year classes, leads to high levels of bycatches and discarding.

4.3 Current regulations

4.3.1 EU regulations

Area VII fisheries come within the remit of the Common Fisheries Policy (CFP). As regards conditions of access, quantitative limitation of captures and technical and enforcement measures, the standard rules and regulations apply, without any derogatory clause.

The Commission has recently presented a draft regulation which sets as a management objective for area VII demersal stocks for the 1994-1997 period '*preventing any increase of fishing effort*' (COM (93) 663 final).

4.3.1.1 TACs and quota

Eleven of the demersal species exploited in the area are subject to the TACs regime (table 4.11). These TACs are generally 'precautionary' and based on historical levels of capture, not on scientific assessments and advice. They cover at times wider areas than the one studied here. At times, they cover only sub-areas of the same area.

Table 4.11 TACs by species and quota by country in 1993

Species	Area	TAC		France	UK	Ireland	Spain	Belgium
Anglerfish	VII	19,240	quota	10,478	4,390	1,865	1,232	1,050
			landings	700	4,153	1,768	1,062	328
			utilization rate (%)	67	95	95	86	31
Cod	VIIb-k	17,500	quota	13,815	1,560	1,345		780
	VIII		landing	12,121	1,600	1,212		556
			utilization rate (%)	88	103	90		71
Megrim	VII	19,000	quota	6,930	2,520	3,340	4,500	510
			landing	3,139	2,381	2,341	4,145	40
			utilization rate (%)	45	94	70	92	8
Saithe	VII-VIII	14,000	quota	7,870	2,150	3,940		40
			landing	2,317	2,093	1,837		8
			utilization rate (%)	29	97	47		20
Whiting	VIIb-k	22,000	quota	14,700	2,470	4,540		290
			landing	14,061	2,307	4,271		213
			utilization rate (%)	96	93	94		73
Haddock	VII-VIII	6,000	quota	3,800	600	1,530		70
			landing	2,047	670	1,487		58
			utilization rate (%)	54	112	97		83
Neprops	VII	20,000	quota	4,860	6,565	7,375	1,200	
			landing	4,600	6,162	2,766	1,011	
			utilization rate (%)	95	94	38	84	
Pollack	VII	14,000	quota	9,965	2,440	1,135	30	430
			landing	2,347	2,002	913	7	46
			utilization rate (%)	24	82	80	23	11
Hake	V, VI,	40,200	quota	17,112	7,190	2,920	12,488	150
	VII		landing	3,294	6,731	2,361	12,118	30
			utilization rate (%)	19	94	81	97	20
Sole	VIIf,g	1,100	quota	85	310	55		650
			landing	120	295	16		532
			utilization rate (%)	120	95	29		82

Source: DG XIV Data.

The TACs of the two main species have been appreciably adjusted downwards. In 1993, the anglerfish quota went down from 19,620 to 10,478 tonnes. In 1990, the nephrops quota went down from 6,320 to 4,620 tonnes.
France's share in the distribution of quota (51.7% of aggregate TACs) seems noticeably less important than French activity in the Celtic Sea.

The reason is that TACs are set on areas which spread beyond the Celtic Sea. The nephrops TAC in particular covers also area VIIa, which increases Ireland's and the United Kingdom's shares. The hake TAC covers area V and area VI, which increases Spain's share.

An analysis of quota uptake in 1993 (table 4.11) shows that the main French TACs are not exhausted despite having been adjusted downwards.

Since 1988, some cases of overshooting have been occasionally observed. This is linked with high availability of resources (cod in 1988 and 1989) or exceeding of small quota for bycatches (sole). Overshooting of TACs has only occurred regularly for whiting. This trend is disappearing with the decline of the semi-industrial fleet of Lorient which targets that species.

After the 1992 adjustment, the nephrops TAC is presently well utilized. Returning to catch levels of some past years would lead to the overrunning of quotas. Same applies to anglerfish.

Exceeding of quota is therefore limited and largely occurs with bycatches. As a whole, the TAC and quota regime has not really restrained French fisheries in area VII over these last few years.

This explains why France has not so far implemented a real system of quota management. Allocation by producers' organizations (POs) concern only a few sensitive TACs in area VII: cod, whiting and sole. There is no allocation of individual quota in the area.

On the other hand, utilization rates for the main English and Spanish quota go beyond the 90% mark. On the English side, underutilization occurs only for pollack (<90%). On the Spanish side, uptake of anglerfish and nephrops is only of the order of 85%.

For English fleets and, to a lesser degree, Spanish fleets which visit the area, the TACs regime seems to impose real constraints. For the Spanish vessels, the main limiting factor is the system of access to EU waters.

Irish quota are not exhausted except for anglerfish and haddock. The TACs system is no real constraint there.

4.3.1.2 Technical measures

Technical measures in area VII apply to minimum mesh size and minimum size of catches.

Mesh size

The technical features of fishing gears used in EU waters have always been subject to strict regulations.

In its 1978 report (ICES,1979), the ACFM Committee of ICES had advocated minimum mesh sizes of 80 mm for fish trawls and 70 mm for nephrops

trawls. These recommendations were integrated by the European Commission in its resource conservation policy (Regulation EEC n° 171/83).

For several years now, the prescribed 70 mm size for the French 'langoustiniers' of the Celtic Sea has not been used. These vessels have rather adopted an 80 mm mesh size so that they could simultaneously operate on fish and nephrops stocks. Such practice enhances the selectivity of gears as regards the target species. Over the last years, a size growth was observed.

Minimum landing size

Mesh size regulation is generally associated with the minimum size of fish. The prescribed sizes for each species appear in appendix II of EU Regulation n° 3094/86. Until recent years, the French 'langoustiniers' operating in area VII had been respecting a minimum size of nephrops of 11.5 mm that was above European standard (8.5 mm).

4.3.1.3 MAGPs

Compared to MAGP II objectives, the third Multi-Annual Guidance Programme covering the 1993-1996 period imposes a 20% reduction of capacity for trawling fleets and a stabilization of aggregate capacity for other fleets. This applies to the other fishing zones of the Union as well.

The French MAGP does not differentiate between fleets targeting benthic species such as nephrops and those pursuing demersal species. This is not always the case in other countries.

4.3.2 National regulations

4.3.2.1 'PME' and 'Aides au retrait'

In 1989, the French established a PME system (Permis de mise en exploitation) whereby the building of a new vessel entails the simultaneous decommissioning of greater capacity. Because of favourable circumstances in the 1985-1990 period, the measure was viewed as too restrictive in the first stage. This resulted in an appreciation of kWs meant for decommissioning.
The authorities also launched various decommissioning (aides au retrait) schemes which have facilitated the permanent laying up and writing off of vessels whose profitability was often rather marginal. Thanks to such schemes, France came very close to meeting its MAGP II objectives.

Since the beginning of 1993, fish prices have experienced a drastic drop. Because of that, the PME system is no longer viewed as constraining. Decommissioning aids are no longer a decisive factor, the economic plight of the fishing enterprises acts as the trigger.

MAGP III: Objectives within easy reach

The French MAGP II virtually reached its objectives. As the country has not decided to reduce the fishing effort, the expected fall in the aggregate capacity of the trawling fleets is in the order of 20%.

On December 31 1994, for the main segments of southern Brittany's fleets, the following reductions were achieved:

- 16 to 25 m units (gros artisans): 9.4% from the beginning of 1992 to the end of 1994 (6.7% since the beginning of 1994);
- 25 to 38 m units (semi-industriels): 21.5% from the beginning of 1992 to the end of 1994) (9.8% since the beginning of 1994).

As the 16-25 m fleet includes vessels other than trawlers, one may consider that a fall of 9.4% is quite in keeping with objectives after 3 years of MAGP III. The trend seems even to have markedly accelerated during 1994. A significant effort reduction of the fleet in area VII can therefore be expected, though individual vessels might have increased their effort because of the present crisis.

The reduction of the semi-industrial fleet goes on faster than MAGP recommended objectives. The trend is quite apparent in area VII.

4.3.2.2 Market management

French producers organizations enforce withdrawal prices on almost all species that are landed.

Stabilising systems may have been viewed as an encouragement to overfishing in the case of species which were not properly commercialized. Withdrawal prices can also be tuned up to discourage a particular fishery, for instance restraining the exploitation of size 4 whiting.

The producers organizations which intervene vigorously on the market could act also as intermediaries in the implementation of resource management measures.

4.4 Definition of the management problems in the area

This chapter evaluates the current system of resource management. It identifies the problems from a French point of view, using the criteria specified in the methodology of this report.

4.4.1 Economics

4.4.1.1 Flexibility

Flexibility of fishing strategies (between various métiers) is one of the prominent features of high sea fisheries in area VII. This is in no way the result of arbitration or bargaining linked to resource management pressures. It stems from economic considerations which result from an awareness of constraints regarding catchability, prices and production costs.

Most vessels must necessarily maintain such flexibility to secure a fair return on investments, insofar as this means optimization of effort and optimization of commercial value.

4.4.1.2 Planning

For French fishermen, planning, which here means a yearly or medium-term organization of fishing activities according to resource management constraints, is not a real problem because quota have had little limiting impact so far.

The present TACs regime does not interfere with the principles of investment. Limitation of investment at the moment is rather linked to MAGP and reduced profitability.

The notion of planning taken as forecasts of returns which make it possible to depreciate the means of production is no longer meaningful. For a large number of vessels, profitability on capital goods is in itself quite difficult to attain.

4.4.1.3 Market consistency

Because it has so far led to little constraints, the current quota system has not given rise to market consistency problems. One must, however, emphasize the potential impact of fishery closures during the last weeks of the year. This period offers excellent market opportunities for high value species like nephrops, anglerfish, etc.

Another aspect of market consistency is that for certain species, restrictive measures in terms of limitation of guaranteed prices may discourage landings.

4.4.1.4 Daily practice

The quota system hardly influences the habits and practices of skippers. If it were to become restrictive, the skippers may come up against serious difficulties because of the multi-species features of the various métiers.

Indeed, if it is decided to stop fishing a bycatch species (which is inevitably caught with the target species), the closure would lead to increased discarding. If the closure is anticipated, 'high grading' may occur as well.

If the importance of the species whose quota is exhausted is such that going on with the métier is being questioned, vessels will turn to other métiers because of flexibility of fishing strategies. Considering the present level of information on stocks, it is uncertain whether such transfer of effort would be beneficial to the resource. Paradoxical situations may arise. For example in case of a fishery with two main target species (anglerfish and nephrops), quota of one of them may be quickly exhausted because of stock improvement or cannot be fully utulized because of stock depletion.

Closure of fishing for the species whose stock is in better state leads to a transfer of effort on the species whose stock may be poor or declining.

4.4.1.5 Race for fish

Race for fish is non existent because there is practically no closure of fishing.

If the system were to become more restrictive present choices between fishing strategies would be modified. Vessels wishing to operate with strategies limited by quotas, will in the first stage favour such strategies for fear that they might not be able to take advantage of them after quota become restrictive.

4.4.2 Biology

4.4.2.1 Spawning stock, fishing mortality

Stock assessments and the small significance of TACs in the Celtic Sea have already been discussed. Control over capacity through MAGP in France and limited access for Spanish vessels are objectively the determining factors of resource management in the area.

It is quite obvious that Celtic Sea stocks suffer less from overfishing than stocks in the North Sea, west of Scotland and the Bay of Biscay. Even if more elaborate assessments are needed, one may suggest among possible explanations:

1. Exploitable biomass is perhaps less abundant here than in the other important European zones in the North-East Atlantic. Hence it takes more time for vessels to reach the profitability and the effort remains limited in the area.
2. Targets are essentially benthic species (anglerfish, megrim, nephrops etc.) which cannot be spotted with current fish finding technology (unlike demersal species). There is less concentration and this reduces catchability. Knowledge and experience of skipper are the determining factors. In the Celtic Sea, gadoids stocks (whiting, cod) are indeed more affected by overfishing.
3. Operating costs are high, for the French fleets in particular (high sea vessels, built rather recently). This raises the profitability threshold and restricts the pressure that can be exerted. For French fleets an additional problem is the relative fall of fish prices caused by revaluation of the French franc against the currencies of France's main commercial partners (United Kingdom, Ireland, Spain).

4.4.2.2 High-grading and discarding

Discarding

Discarding remains fairly important in the Celtic Sea for various technical reasons, for instance composition of species and sizes (anglerfish, megrim) and mesh sizes regulations which lead to bycatches of juveniles (hake, whiting).

A large number of scientists agree that protection of juveniles should be the central line of any resource policy, even taking precedence over a quota policy.

Restrictive quota can generate further an appreciable development of discarding, in particular of bycatch species whose quota has been exhausted.

High-grading

The causes of high-grading are not related to resource management. They are rather linked to the market. For instance, producer organizations sometimes put a ceiling on landings of small whiting for each vessel because of market considerations.

The setting of restrictive quota may lead to greater high-grading of target species as well as of bycatch.

4.4.2.3 Ecosystem management

To date, little assessment of damage caused to the ecosystem has been conducted.

The debate on the protection of marine mammals has focused on drift nets. This technique can, in fact, be associated with the fixed gear category which is not subject to fleet reduction measures.

4.4.3 *Policy/Institutions*

4.4.3.1 Political acceptance

The present quota regime has not led to strong state intervention. An exception is the collection of the statistical data which is quite reliable because the bulk of catches goes through auction halls.

French authorities never had to sanction an overrunning of quota. When taking a chance, vessels do so vis-à-vis the national authorities who govern the waters where they fish.

Fishery closures have been comparatively few, with little restrictive impact on the fleets.

The government has no real experience of coercive management of quota. Having to deal with the sector's economic difficulties, it gives little attention to questions of resource.

It has not been decided yet whether the principle of allocation of fishing rights, let alone the practical details, should apply to groups or to enterprises. For the time being, quota are allocated only for sensitive species at producer organization, region or port levels.

4.4.3.2 Sectoral acceptance

Because of the reasons already mentioned, the sector does not find the present quota regime very constraining or credible.

A lot of debating and strong opposition from people in the industry would inevitably follow the setting up of more restrictive quota, as happens everywhere whenever such coercive systems are established. All the more so in this case given multi-species métiers and multi-species fleets.

4.4.3.3 Relative stability

Respecting relative stability in area VII through the TACs and quota system is not currently seen as the major issue. In France, because the main quota were underutilized, abiding by the MAGP is rather seen as the limiting factor. The situation is much the same in Ireland.

In Spain, limitation of the number of vessels allowed in the area is seen as the limiting factor.

It is only in the UK that the quota system appears to be the main instrument intended to limit the exploitation of the resource. But in this country, applying the MAGP proves to be more difficult than respecting the quota.

The distribution of rights in terms of fishing capacity (hence of effort) therefore seems to become the major framework for relative stability well before the TACs and quota system.

One should finally bear in mind that it is possible to get round the realities of relative stability through reflagging.

4.4.3.4 National enforcement

This point has been dealt with under 'Political acceptance' to some degree.

Implementation of control measures should be possible thanks to tradition, i.e. landing and selling at auction halls and producers organizations intervening on the market. It should not be that difficult to make people respect some simple rules, for instance announcing arrivals and unloading time.

4.4.3.5 Subsidiarity

In theory, the quota system must be established within a framework which adheres to the principle of subsidiarity. However, the involvement of POs in its implementation remains very limited.

Only a few stocks targeted by industrial fisheries (saithe) are really managed by POs.

Many questions remain to be answered in relation to subsidiarity, for instance:

- should quota be allocated to POs or to vessels? (vessels may find themselves confined to rigid fishing strategies);
- definition of the practical details of quota distribution among POs (to date, the two POs federations disagree on the basic terms of such distribution);
- the practical details of quota management, for instance ways for exchanging quota between POs, what kind of sanctions should be imposed and by whom if any member brakes the rules of management.

It is desirable that the allocation of quota be conducted with a sense of responsibility at the PO level. But technical and human resources of PO are

rather scarce. This hardly puts them in a position to carry out the practical work of quota management.

4.4.3.6 Local communities

Today the interests of local communities are threatened on two respects:

- relative stability is not respected. If controls are not strictly and equally enforced everywhere, the rights of a 'national' fishing community may not be guaranteed and retained;
- individualization of fishing rights in terms of inputs (PME) and outputs (ITQ) leads to transfers of rights between regional fishing communities and between countries (reflagging).

4.4.3.7 Beyond 2002

The take-over of some French fishing companities by foreign groups (vessels staying under French flag, but with part of the crew or entire crew being foreigners) is a decisive step towards 'Beyond 2002', if this is considered as a free circulation of fishing rights in Europe.

4.4.4 Conclusion: definition of the management problem

As it is not really restrictive, the present system remains rather 'virtual' indeed.

It is rather inconsistent because, in spite of underutilization of quota, stocks are declining (they are in better condition than in other areas, though). It is indeed inconsistent with the structural policy because the MAGP makes it compulsory to reduce fleets operating on stocks whose quota have not been fully exhausted.

If the system were to be more restrictive, it would lead to serious technical problems at administrative, political and commercial levels. Because of the multi-species nature of the fisheries and the multi-strategies nature of the fleets, enormous defects may arise.

The system is not satisfactory because, in the absence of any clear definition of fishing rights allocation to local communities, it allows transfers to be made, which in turn challenges the relative stability to the detriment of these communities.

Looking for new measures they should:

- be conducive to improved resource management at grassroots level in accordance with the principle of subsidiarity;
- ensure improved consistency with current structural policy;
- take into account the multi-species and muti-strategies nature of the fisheries;
- ensure lasting fishing rights to local communities (relative stability).

These are well founded endeavours as regards area VII fisheries and French fleets in particular.

This is the subject matter of Part B which scrutinizes the different multi-annual and/or multi-species measures.

Part B Evaluation of new management measures

4.5 Multi-annual measures

Four definitions of multi-annual measures are addressed successively:
- constant TAC for several years;
- multi-annual TACs with limited adjustments;
- limited compensation from one year to the next (carrying over and/or borrowing);
- multi-annual biological objective.

Detailed evaluation of these definitions is presented in appendix 4.1.

Possible compensation from one year to the next is not necessarily linked to fixed multi-annual quota. Some measures are even contradictory. For instance, in view of the variability of recruitment, a stable biomass objective requires a yearly setting of TACs.

4.5.1 Equal quantity for several years

4.5.1.1 Economics

Looking for improved planning of activity and trying to avoid hard bargaining during the annual setting of quota are the main motives that favour MATACs. As regards area VII, these motives are not really relevant with French fleets at least.

So far, fishing activity has not really been limited by the quota system. Furthermore, if a major quota is exhausted, it is possible to transfer the effort onto other métiers.

For area VII fisheries, the MAGP (creation of PME and institution of a decommissioning scheme) is a limiting and structuring factor which today plays a more decisive role than quotas.

At a time of fleet capacity reduction, setting guarantees for investors appears to be in contradiction with the structural policy. Moreover, in the absence of constraining quota, the objective of intra-annual planning to avoid the race for fish remains an abstraction.

4.5.1.2 Biology

Compared with the present system, MATACs increase the risks and the uncertainty as to what should be the optimal quota level because they do not allow upward or downward adjustments to account for the abundance or scarcity of the resource. Indeed, it will not be possible to take into account certain

factors such as annual fluctuation of recruitment or variation of fishing mortality.

In case of relative abundance of a target species, the risks of high-grading increase. In the case of growing scarcity, discarding of bycatch species occurs more frequently. In the case of abundant bycatch species, the risk of high-grading, and later of discarding, increases. The risks are higher when the number of exploited year classes is low, when the level of fishing mortality is high, when the spawning stock is small and when recruitment varies.

In area VII, these various indicators are rather positive (see table 4.9) for benthic species (anglerfish, megrim, nephrops) but not so for gadoids (whiting, cod) because fishing mortality is high and exploited year classes are few. The indicators are not positive for hake either because of low spawning stocks.

Setting multi-annual quota is therefore less risky here than in the North Sea, at least for benthic species.

4.5.1.3 Policy/Institutions

Equal quantitiy for several years means little change. Indeed, area VII quota have, until now, been 'precautionary' ones, aimed at maintaining fishing mortality at the previous years' mean level.

TACs have remained relatively stable for anglerfish, nephrops, hake, pollack, megrim and whiting. Admittedly, adjustments have been made for anglerfish and nephrops; but they were based on a decision to reduce excessive catching capacity rather than on a diagnosis of stock deterioration.
For some species, the small variation of annual quota may also be explained by the facts that exploitation applies to numerous year classes, that variability of recruitment is limited and that catchability is lower for certain benthic species which are not detectable and do not concentrate in shoals.

The establishment of multi-annual quota would not therefore be something really new in area VII.

Annual quota may paradoxically lead to risky transfers of fishing effort from stocks whose biological conditions are picking up to stocks whose conditions are declining.

If MATACs levels in area VII happen to be below fleet capacity, in addition to problems described in Part one, specific problems that are linked with the flexibility of fishing strategies and the diversity of métiers targeting the same resource may arise.

When the stock situation improves, increasing availability leads to higher catchability, and earlier consumption of quotas. Because of flexible fishing strategies, the fleets involved would then transfer their effort onto target species whose quota have not yet been fully utilized. That is to say, stocks whose conditions may have been declining.

This paradoxical situation may threaten the credibility of the system. It can be remedied only by putting in place measures to limit transfers between métiers. This takes us back to multi-species measures and effort measures per métier which are analysed below.

4.5.2 Limited adjustments

Limited adjustments allow upward or downward variations from a mean TAC level set for several years.

Only economic considerations can lead to downward adjustments while upward adjustments may stem from economic or biological considerations.

4.5.2.1 Economics

When a drastic cut in the quota is deemed necessary to quickly reach a sound biological equilibrium but when such a decision may in the short-term badly disrupt the economy (drop of profitability, loss of markets), a plea for a more limited cut may be justified. The risk of surplus supply on the market may also justify a limited upward adjustment.

As regards area VII fisheries, such economic considerations on the impact of excessive TAC variations are not really relevant, except for gadoids.

4.5.2.2 Biology

On this point, the wish to capitalize good recruitment may justify a limited upward adjustment. The wish to limit discarding or high grading for associated species in a multi-species fishery may also justify limited adjustment of the TAC. This system does not ease problems that arise from a multi-species population.

4.5.2.3 Policy/Institutions

At the political level, determining the percentage of adjustment may prove to be rather tricky as biologists' recommendations have to be confronted with social and economic considerations.

Political pressure may be even stronger than in the past insofar as the social and economic foundations of quota definition are recognized.

4.5.3 Limited compensation

Limited compensation allows carrying over a portion of a quota from one year to the next or overshooting a quota by 'borrowing' from next year.

The motives in such a scheme are purely economic:

- good prices at the end of the year;
- avoiding the risk that quota cannot be caught because of poor weather at the end of the year;
- making the best of isolated high availability of the resource, and being able to 'borrow' it from next year's quota;
- allowing the 'carrying-over' of behind schedule activity when adverse weather conditions prevent end of year fishing activity.

However, the possibility of carrying over the portion of quota that is left from one year to the next may be excluded on the grounds that under-utilizitation of quota globally improves the resource and that incompletely consumed quota can be traded at the individual level.

4.5.3.1 Economics

The possibility of limited compensation is clearly of economic interest for area VII fisheries. Some of the catches fetch very good prices at the end of the year.

4.5.3.2 Biology

As the level of borrowing is limited, so is its negative impact on biological factors. To correct this impact, one may slightly reduce the quota in the first year.

4.5.3.3 Policy/Institutions

The system of limited compensation entails improved awareness and sense of responsibility among operators who exceed quota. This may speed up the establishment of a system of individualized management of quotas, hence the involvement of POs in a system/logic of fishing rights allocation/distribution.

4.5.4 Multi-annual biological objectives

Biological objectives may be defined in terms of:
- levels of spawning stocks;
- fishing mortality rates.

Such objectives can be stable or progressive (improvement of a particular criterion). The setting of multi-annual biological objectives does not entail multi-annual quota. On the contrary, fluctuations of recruitment and variations of fishing mortality modify the TAC from one year to the next, hence annual quota for the same multi-annual biological objective.

4.5.4.1 Economics

As this system is reverting to annual quota per species, evaluation is similar to the present system.

4.5.4.2 Biology

For area VII, which has so far been managed mostly by precautionary TACs, *defining biological objectives would constitute progress* - subject to avail-

ability of scientific data - because it would help to an improved determination of quota levels.

For multi-species fisheries as those in area VII, defining identical objectives for associated target species or bycatch species inevitably leads to discrepancy between capture levels hoped for and levels ascertained by technological criteria. Absolute respect for biological objectives then requires reduced quota levels for the stocks which are in a relatively better situation.

The risk of paradoxical transfers between various métiers and the risk of increased discarding, as explained above, are also greater.

4.5.4.3 Policy/Institutions

Insofar as stocks conditions in area VII are not excessively deteriorated, the trend should be to define and combine biological objectives which may differ among the various species while remaining technically coherent (according to mean levels of bycatches). This type of compromise corresponds in fact to multi-species or effort measures.

4.6 Multi-species measures

Multi-species measures are prompted by the technical constraints of the fisheries, benthic fisheries in particular where catching various species simultaneously is the rule. Because of the importance of multi-species and benthic métiers in area VII, these motives are of great significance here.

The multi-species and multi-métiers aspects of the fisheries and the multi-strategies feature of vessels combine and multiply possible arrangements. This of course brings more complexity to multi-species measures than in the other two cases which are also studied in the report.

The first multi-species measure being scrutinized, i.e. a total quantity calculated by a common denominator (cod equivalent type), raises the problem of integrating into the calculation of this global quota species that are not subject to capture limits (cephalopods, ling ect.).

The second measure allows limited transfers between species. These limited transfers are insignificant except when they are made between species that come under the same métier.

The third measure, i.e. bycatch arrangements, can be envisaged only in relation to specific métiers. Indeed, a bycatch species for a particular métier can be a target species for another one or an associated target species for a third one, etc. A particular vessel may, in the course of one year, pursue these different métiers.

As regards area VII fisheries, measure one and measure two (limited transfers between species and bycatch 'limitation/arrangements' are therefore evaluated here at the same time.

4.6.1 Total quantity in one common denominator

The total quantity and its utilization are recalculated on the basis of a set of coefficients, cod equivalent type.

As regards multi-species fisheries of area VII, where resources are highly mixed and fleets highly flexible, the MSTACs system may alleviate some negative impacts in a system of restrictive quota per species, for instance:

- increased discarding for species with overexploited quota;
- shifting the effort of métiers hit by closure of fishing for their target species to other métiers where quota are still available.

4.6.1.1 Economics

Flexibility of the fleet is maintained. Each vessel seeks optimal economic performance according to available opportunities within the limits set by the global quota.

If this quota is allocated among vessels, a vessel's total activity will be limited by its catching capacity. The more competitive vessels will therefore have fewer days-at-sea than the others because they consume their quota more rapidly. This reduces competition between vessels and constitutes a significant sociological change for fleets that have so far been exerting their own effort level freely.

If this quota limits the yearly fishing effort, market opportunities become, on the other hand, a decisive factor for effort planning over the year. If the total quantity is restrictive, the trend will be to privilege species with the highest price/costs ratio in the given season. Effort may be oriented towards species which are not subject to quota. Vessels may also turn first to species whose (low) quota may be exhausted first, thus worsening that races for fish further.

4.6.1.2 Biology

A MSTACs scheme means setting different exploitation rates among species. It is, however, very difficult to simultaneously maintain the various levels that have been determined. Indeed, the spontaneous behaviour of the fleets concerned tends to show disregard for the combinations that were hoped for. This finally leads to a disruption of the recommended exploitation scheme.

As regards bycatch species, the situation is not fundamentally different, except when a system of monospecies quota leads to discarding. Excessive exploitation of certain target species stocks remains a major threat.

That threat can be alleviated by acting on specific coefficients to penalize excessive capture of a given species or to orientate the fishing effort on alternative species. In the case of species suffering from excessive captures of juveniles the system can be theoretically corrected by increasing the coefficient for small sizes.

Such adjustments raise technical and political problems which are difficult to overcome.

The risk of high grading is not done away with either, especially if one penalizes small sizes. Besides, certain species with low market value may be systematically discarded if the quota is too restrictive in relation to fishing opportunities.

In area VII, where the monospecies TACs regime is not too limiting, especially for French fleets, a restrictive global multi-species TACs regime will not generate a further decline of the resource.

4.6.1.3 Policy/Institutions

From an economic point of view, the multi-species total quota scheme is appealing in many respects, for instance continued flexibility, looking for optimal value, limitation of discards, etc.

If these advantages are not offset by disadvantages which may be too serious from a biological point of view, the scheme can be easily defended at the political level. Serious problems may, however, arise at technical and political levels when defining total quotas.

First, the existence of 'paper quota' (i.e. quota which are never consumed) in the area leads to a potential total quota which is well above actual availability of resource and fleet capacity. In order to make this total quota restrictive, a negative coefficient would have to be assigned to its calculation or at least to the calculation of some specific quota. At first sight, it would seem very difficult to gain acceptance for this.

If relative stability among species is fundamentally challenged, so will global relative stability, unless the impact of paper quota, whose significance varies from one country to another, is dealt with.

The system of global multi-species quota presupposes that the various partners agree on coefficients (cod equivalents?). Value differentials, varying shares and significance of species among countries and stocks exploitation differentials all mean lengthy negotiations.

In terms of quota technicalities, this system raises, in theory, fewer problems of individualized management than the monospecies quota regime. Calculation of quota and transfers between vessels is made globally, and no longer separately for each species. Within this framework, the possible role of POs is less demanding. For instance, they can easily reallocate the global quota which have not been utilized.

Under such a scheme, fishing rights can be easily allocated per vessel, and possibly privatized (ITQs). This raises the risky question of transfers of rights between regions to the detriment of local communities that are dependent on fishing activities.

4.6.2 Limited transfers between quota and bycatch arrangements

In area VII, these two points are linked. They relate to a quota system per métier.

The notion of limited transfers, where any particular species may, to some extent, replace each one of the rest, cannot be envisaged globally within a

fishery that numbers about ten target species. Limited substitution of that kind can only apply within a given métier (for instance, between megrim and anglerfish, or between cod and whiting).

Likewise, as one species may be a bycatch in a particular métier and a target species in another one, bycatch arrangements become significant only within a given métier.

A system of quota per métier would have to be installed, each vessel being 'appointed to' a particular métier for every trip; and each vessel, or the POs, owning quota per métier.

Within that regime, vessels operate under a métier's quota. They must therefore respect minimum catch percentages of target species. Utilization of quota corresponds to volumes of target species, with limited transfers between target species allowed. Bycatch arrangements are defined per métier.

If it becomes necessary to reduce the effort on a particular species, the cut will affect the métiers which have it as a target species, not the métiers which have it as a bycatch.

The following question is then raised: should the rate of bycatch arrangements be the only way to limit capture of species which are mere bycatches?

4.6.2.1 Economics

Under such a system, if each vessel is tied to predetermined volumes of activity per métier, the flexibility of the fishing strategy is restricted.

If the rights are owned by a group (PO), the group may allow vessels to transfer to another métier within the limits set by availability of quota. Should a quota reduction happen in a particular métier, negotiating within the PO a redistribution of the effort of vessels concerned among the other métiers' quota will prove difficult.

Fishing strategies can no longer adapt to market opportunities or catchability of species. This will affect the economic performance of the fishery, in particular vessels used to deciding on the right strategy.

Profitability differentials will be difficult to accept especially during the years of quota reduction for a particular métier, whilst flexibility might have ensured some degree of uniformity.

If switching to other métiers remains free until quota are fully consumed, the risk of vessels rushing to the most profitable métier is still there.

If the species not subject to quota (cephalopods, ling, John Dory) are not integrated in the definition of quota limits per métier, differentials between vessels will ensue. This will negatively affect the equity of the system.

4.6.2.2 Biology

The notion of limited transfers between quota rests on the wish to restrict the effort per target species while allowing some degree of adjustment to the natural composition of catches (anglerfish/megrim, cod/whiting). Likewise, bycatch arrangements rest on the acceptance of landing captures which are unavoidable.

As compared to the multi-species quota without permission to transfer, this system cares more about preventing biological threats of overexploitation while safeguarding consistency with the technical realities of each métier: target species/bycatch ratio. As compared to the monospecies quota, it also leads to a reduction of discard levels.

4.6.2.3 Policy/Institutions

The notion of limited transfers between quota and limitation of bycatches is fairly easy to envisage in the case of a 'dual' fishery (plaice-sole in the North Sea). It would be difficult to implement it in area VII fisheries.

This kind of measure first raises the question of properly defining the métiers. The description of the French high sea fishery, with its great variety of practices, has helped to outline this difficult point.

It then raises the question of attaching each vessel or each trip to a particular métier. And then comes the problem of acceptance by skippers who are used to freely deciding between various strategies.

The definition of MSTACs per métier challenges the present relative stability without offering a basis for a new definition of relative stability. In that respect, it raises enormous problems of implementation in area VII.

- Definition of quota per métier entails a lot of research work i.e. analysis and measures of fleets'activity in the various countries involved.
- Transparency in the establishment of such scheme is extremely difficult to obtain, at international level in particular.
- Implementation at national level raises the same problems as the setting of restrictive monospecies quota when it comes to control of landings.
- The implementation of the notion of subsidiarity becomes rather delicate when POs have to manage numerous métiers, for instance handling of transfers, distribution of effort reductions, etc.
- Handling exchanges of quota becomes more complicated.
- Finally there is the problem of defining the areas coming under quota per métiers, as the areas defined for monospecies quota already differ from one species to another.

4.7 Effort measures

4.7.1 Definition

Effort measures limit inputs. TACs limit outputs. As a policy of input restriction is already being implemented through MAGPs, effort measures appear to be complementary. Their aim is to:

- ensure that no compensation for fleet reduction takes place through an increase of each vessel's mean effort;
- encourage the effort reduction policy while alleviating social consequences in terms of employment (in favour of effort cuts for each vessel instead of fleet reduction).

A regime of effort quota may be viewed as more realistic in area VII than a TACs system for two reasons:

- difficulties in implementing control of captures in the area;
- the system of quota per species has proved unconvincing in the conservation of stocks. Its implementation has not prevented an imbalance between catching capacity and available resources.

In fact, MAGP measures and effort ceilings presently appear to be the limiting factors for the exploitation of stocks in area VII, well before the quota system.

In addition to the above considerations, an effort-based regime may constitute an interesting instrument for area VII.

- It allows continued flexibility of fishing strategies and a continued variety of multi-species métiers.
- It connects to technical measures aimed at achieving a more rational exploitation of the resource (reducing capture of juveniles, which is a major aspect of area VII).
- It allows a simple appropriation of fishing rights by enterprises (or POs) without a complicated system of multiple quota per species or multi-species quota per métier.

In the first stage, the case evaluates a system of effort quota allocation per individual vessel. The multi-annual feature is of secondary importance compared with the choice of management through effort measures.

In the second stage, the case evaluates a more complicated system of effort quota per métier, with adjustments according to stock conditions of target species, as well as the possible adoption of more selective practices by vessels.

4.7.2 Effort quota per vessel

4.7.2.1 Economics

Effort quota ensure lasting fleet flexibility, within the authorized fishing time limits. In that sense, it is a measure which is more compatible with the real nature of area VII fisheries.

Optimization of vessels management is achieved according to potential captures prices/costs ratio.

As compared to a regime of global multi-species quota, allocation will be conducted a little more on the basis of expected captures and a little less on the basis of commercial value.

Each vessel will be able to plan activity throughout the year. The choice of possible periods of non activity can be expected as a commercially rational decision.

In a system of effort quota, race for fish is, by definition, limited. An effort quota implies that a vessel will pursue a high rate of utilization of its allocation of fishing time. This can deteriorate working conditions and safety on

board. In fact, high sea trawlers of area VII are already working virtually non-stop.

On the other hand, the setting of restrictive effort quota would lead to an increase in the number of days off, and consequently an improvement in living conditions.

4.7.2.2 Biology

From a biological point of view, effort quota present the same risks as multi-species quota i.e. concentration of effort on high value species, whose stocks are already fragile.

In area VII where people have so far been quite free to switch fishing strategies, where no stock is being unsustainably exploited, risks are relatively limited. This is particularly true of benthic species (anglerfish, megrim, nephrops). It is less so for gadoids (whiting, cod) and hake. If a particular stock is thought to be fairly endangered, an effort reduction on the species may be considered:

- either by penalising the effort pursuing that species through days-at-sea restrictions;
- or by encouraging more selective practices in case the problem is linked with excessive capture of juveniles.

That system offers another advantage: limiting the waste of resource arising from discarding. In fact, discarding occurring because of overshooting of quota is, by definition, abolished and so is high-grading.

4.7.2.3 Policy/Institutions

Compared with the restrictive systems of quota per species, a restrictive system of effort quota offers advantages in economic terms (ensuring flexibility of fleets, optimization of yearly effort) which make it more acceptable for a fishery of area VII type.

In biological terms, it does not appear as a setback compared with the present situation where quota per species are not particularly restrictive and no particular stock is considered to be really threatened. The system also prevents discarding and can encourage more selective practices.

It is possible to limit its disadvantages (excessive effort on certain species) through penalization of efforts targeting species whose conditions are fragile (see point 3.3).

This system may therefore prove to be well suited for area VII particularly as it is easier to carry out controls on efforts than controls on landings. However, implementation of that scheme presupposes that three types of problems have been solved.

1. Distinction must be made between fleet overcapacity and implementation of resource management through effort quota.

Within a particular fishery, effort quota cuts cannot be accepted by the operators of a particular country if rival fleets would not face comparable restrictions. Therefore, the countries concerned should not have the right to choose between fleet reduction and effort reduction for the MAGPs. They must abide by the same policy, at the same tempo. The effort quota must be a regulatory and steering instrument for the fishery. By itself, it can only correct a marginal percentage of overcapacity (10-20%). The rest must be taken care of within the framework of fleets reduction.

Acceptance of potential overcapacity curbed by effort quota is not absurd in itself. This occurs in other sections of the economy too. Some overcapacity may be acceptable as it may limit job losses in regions with few alternative activities.

2. Relative stability in the area must be defined and managed according to the principle of subsidiarity.

Relative stability will have to be redefined on the basis of fishing areas which will not be the same as the present ICES areas under quota per species (different areas for different species). The new relative stability will therefore will be based on fishing effort per area, possibly segmented into vessel sizes (or métiers).

In order to maintain relative stability through the structural and segmental evolution of fleets, captures per segment will have to be monitored. This will make it possible to define equivalents between segments (or métiers). The evolution of fishing effort quota in a given area can be managed according to the principle of subsidiarity through an area conference, gathering the various partners from all the countries involved (sector representatives, administration, scientists). The conference may propose the effort limitations (and possibly encouragement for more selective practices) but the European Commission remains the decision-making body.

3. A temporary aid scheme should be created while the effort based system is being established.

Acceptance of a new kind of regime by the operators is always doubtful as they are not convinced that lowering the effort would conserve the resource. Above all, they do not think they could withstand any reduction of effort. One may then envisage a temporary aid scheme (one or two years) to accompany that transformation, as provided for by the CFP regulations.

The system of effort quota constitutes the easiest way to distribute fishing rights. A system based on numerous mono-species TACs is in area VII less suitable for this purpose. A system of licences that could be traded only globally may be considered.

Here again there are risks of transfers between regions occurring to the detriment of the local communities.

4.7.3 Limited adjustment of effort per métier

This relates to a system of effort quota with segmentation per métier. According to the target species and selectivity levels of fishing gears and techniques, effort quota per métier will vary. It is a matter of fine-tuning the system of effort quota to take into account differentials in the conditions of target stocks.

4.7.3.1 Economics

Flexibility will be maintained if vessels remain free to switch métiers as long as effort quota per métier are globally respected.

One encounters the same problems as in multi-species quota per métier, for instance vessels stuck in one particular métier and handling tricky transfers of effort from one métier to another.

4.7.3.2 Biology

Adjustment of effort to the situation of targeted stocks constitutes a progress compared with a basic system of effort quota management. The problems arising from the bycatch species stocks remain unsolved.

4.7.3.3 Policy/Institutions

Here again, one finds the problems of definition of métiers and listing of vessels or trips under a specific métier, as pointed out above. The system of control acquires greater complexity as the catch composition of each vessel has to be checked.

Definition and monitoring of activity for the various métiers at international level may lead to a recognition of the 'historical rights' of certain fleets, and therefore to a preservation of the relative stability on some particular stocks (nephrops in south Ireland, longline for hake).

The system of resource management through effort quota per métier can be established at the end of a period where a system of individual management of effort and a system of TACs per country will be simultaneously enforced.

4.8 Conclusions

Area VII (except VIIa and VIId) is characterised by diverse and mixed resources, a variety of fleets and flexibility of their fishing strategies. The activity is largely due to French vessels; and most of them are registered in southern Brittany's ports.

The French fleet is structurally composed of different categories of vessels (size: 16 to 35 m). Most units belong to the 'artisans' category (owner on board). But quite a number are listed as 'semi-industriels' (owned by fishing companies).

These fleets are engaged in a number of métiers. The métiers are generally multi-species in nature. Furthermore, each vessel shows a degree of flexibility in her fishing strategy. A choice can be made between various métiers throughout the year or in the medium-term. Such flexibility is a fundamental factor for the bio-economic stability of the fisheries.

The main stocks of the area are currently subjected to maximum levels of exploitation. Some are overfished. However, decline is thought to be less than in other large zones (North Sea, west Scotland, Bay of Biscay).

So far, the resource management regime through TACs and quota has not generated major constraints for the French fleets, though downward adjustments of TACs for important species (nephrops, anglerfish) may lead to premature closure of fisheries whilst stocks are may be picking up.

The setting of MATACs gives rise to three types of criticism:

- possible inconsistency in terms of natural variation (or incorrect estimates) of the resource. However, this is generally less important with benthic species than with gadoids;
- unsolved multi-species problems, for instance how to handle exhausted bycatch quota or associated catch quota (e.g. megrim/anglerfish) whilst the target species quota has not run out;
- because of the flexibility of fishing strategies, possible paradoxical transfers of fishing effort from stocks which are picking up (consumed quota) to declining stocks (quota not fully consumed) may occur.

Multi-annual measures are no solution to the problems of the area, except on one point - in the case of limited compensation for overshot quota. Fishermen may go on working at the end of the year to make the best of traditionally good prices.

A MSTACs system based on interspecies equivalence proves to have little credibility on biological grounds. It also raises problems at technical and managerial levels.

In order to take into account the technical constraints of simultaneous capture of mixed species with exploitation rate differentials, setting MSTACs with transfer arrangements between species may appear to be an interesting proposal. However, this means that each particular vessel (or each trip of the said vessel) must be attached to a specific métier according to catch composition.

Defining the notion of métier is a difficult task, because exploited areas are heterogeneous in nature, because changing factors affect the relative availability of species and because fishing strategies are flexible.

Management of a particular stock involves the setting of coherent measures for the métiers pursuing it for target species, on one hand, and those pursuing it for bycatches, on the other.

At the national level, defining the métiers and setting up controls is no easy task. At the European level, it is much more complicated, especially when relative stability is to be maintained. Defining fishing rights on the basis of multi-species measures is just as difficult.

In general terms, attaching vessels to a particular métier hampers fleet flexibility, which negatively affects economic performance.

Resource management through effort quota seems to suit the realities of the area better. It ensures fleet flexibility while making it possible to penalize or encourage strategies according to which stocks are pursued or which techniques are used (selectivity of gears).

This regime opens new possibilities for a gradual fine-tuning of resource management through effort measures, which are being adopted today. At the same time, it ensures consistency with the structural policy (MAGP).

This orientation requires a new definition of relative stability. It allows joint management of the area with all parties involved (sector, research, adminimstration) on the basis of subsidiarity. Progressive fine-tuning of management (through penalties or bonuses) entails concomitant upgrading of information on the fishery and of means of control.

Defining fishing rights, individual or collective, at the group level such as POs, is relatively easy even when one includes the preservation of certain 'historical rights' on stocks that have been traditionally pursued.

APPENDICES
Chapter 4

Table 4.1 Evaluation of multi-annual measures

	1.1.1 Equal quantity for several years	1.1.2 Limited adjustment	1.1.3 Limited compensation	1.1.4 Biological objectives
Economics				
FLEXIBILITY	Strategy adjustments according to resource availability are limited by quota. Risks of effort transfers from stocks that are picking up to stocks that are deteriorating.	Depending on possible adjustment levels, negative impacts of rigid quota are reduced.	Borrowing permitted. Hence improved flexibility for end of year activity.	One same biological objective does not mean a similar level of effort variation for all species. Hence new balance to be found between métiers, different from present balance, which is spontaneous.
PLANNING	So far, decisions to invest depend little on TACs. Multi-annual TACs set low, possibly act as a deterrent to investments, and decommissioning accelerated.	The level of authorized adjustments allows more or less adaptation of fishing strategies according to availability.	One can plan activity for the end of the year without taking a chance.	A multi-annual objective of F reduction may encourage decommissioning and reduce investment.
MARKET CONSISTENCY	Softens the negative impact of catch fluctuations from one year to the next (both ways). Limited impact in area VII, because of lesser significance of volatile species (gadoids).	May limit the impact of excessive fluctuations of supply.	One can make the best of end of year market opportunities.	Present balance between exploitation rates of the various resources is also linked to prices. In this system, only the biological objective matters.
DAILY PRACTICE	For volatile resources, risks of fluctuating fishing effort. If choice between several métiers, risk of inconsistent transfers, as noted above.	A downward limited adjustment avoids excessive drop in activity.	If quota is restrictive, and compensation not possible, little understanding by people in the trade.	Arbitrations between fishing strategies challenged if they now lead to exploitation rate differentials. according to stocks.
RACE FOR FISH	In the absence of fishing rights, goes on in theory. If quota are restrictive, need to allocate the rights.	Same remark as 1.1.1.	This measure has to be clearly framed so that it cannot be used as an excuse for increased race for fish.	If a new balance has to be found between métiers, a tendency to first exhaust quota subject to restrictions.
ECONOMIC PERFORMANCE	Risk of unnecessary catch reduction in the short-term. However, with species generally fully exploited, low risk.	A limited downward adjustment may limit excessive drops in earnings. Upward adjustment allows spreading of the impact of good recruitment.	Positive impact in terms of end-of-year opportunities, especially on benthic species (nephrops, anglerfish ect.).	Negative impact if present arbitration between fishing strategies (supposed to be economically optimal) have to be reviewed.

	1.1.1 Equal quantity for several years	1.1.2 Limited adjustment	1.1.3 Limited compensation	1.1.4 Biological objectives
Biologic				
SPAWNING STOCK	More acceptable if R variations low, numerous year classes exploited... It is often the case for benthic species, not for gadoids nor for hake.	One can correct the flaws of previous system for sensitive species. If starting point low, it is a positive thing.	Not very serious if the biological criteria quoted under 1.2.1. are 'positive'. Otherwise, the negative effects will have to be offset through a system of 'interests on borrowing'.	In theory, improves stock situation, by definition. Contradiction between biological constraints according to species and technical constraints of multi-species remains.
FISHING MORTALITY	Does not guarantee fishing mortality reduction, except by imposing very restrictive quota.	A limited upward adjustment allows one to capitalize a good recruitment in the stock. Upward limitation reduces pressure on target species.	May sometimes anticipate positively on unforeseen improvement of resource, at least for bycatches, otherwise discarded.	With mixed resources, control of mortality according to species is difficult. Effort/mortality is not clear because of diversity of métiers pursuing the same species.
HIGH-GRADING	Possible increase with target species if target species quota are set too low, or with bycatches if quotas are set too high.	Upward limitation of target species quota may increase high grading for these species.	If permitted borrowing is too limited in volume, may increase. If the limits are sufficient, may, on the contrary, decrease.	May increase with stocks under restrictive quota.
DISCARDING	Absence of yearly adjustments may increase discarding of bycatches (or associated target species) whose stocks are picking up (e.g. megrim, anglerfish).	Upward limitation of target species quotas may limit discarding of bycatches or associated species whose quota are exhausted.	May avoid discarding linked with punctual overrunning of quota.	No improvement in comparison with present system, except if one accepts different biological objectives because of technical constraints of multispecies fisheries.
ECOSYSTEM MANAGEMENT	Less credible at biological level, because not adjusting to observed recruitment trends (or F). Does not solve problems linked with multi-species fisheries.	Positive effect of upward limitation for limiting the negative effects linked with multi-species (discarding), and for capitalising good recruitments. Negative impact of downward limitations.	Acceptable if biological criteria (low fluctuations of recruitment, numerous year classes, SSB below critical points) are positive. Especially for benthic species.	Does not solve the problems of multi-species fisheries, which are even more complicated in multi-métiers fisheries.
Policy/institutions				
POLITICAL ACCEPTANCE	More simple, but more contested, either because of biological risks (TACs too high) or because of excessive social and economic constraints (TACs too low)?	Difficulties for negotiation, definition of adjustments, arbitration between biologists, pressure to limit rise and trade's pressure for the opposite.	Meets economic interests, but very difficult to implement, especially if interest on borrowing necessary.	Clearly established primacy of scientific advice. In the case of multi-species, however, faces arbitration problems.

	1.1.1 Equal quantity for several years	1.1.2 Limited adjustment	1.1.3 Limited compensation	1.1.4 Biological objectives
SECTORAL ACCEPTANCE	A priori, more stable, but if too low, possible protests, especially if recruitments happen to be good.	Protests against adjustment levels decided upon as soon as the resource seems to be picking up. Opposed interests of multi-species métiers and specialised métiers.	Desirable...but involves in return good control of borrowings and sense of responsibility among borrowers.	Possible conflicts between métiers pursuing the same species, some as target species, others as bycatches.
RELATIVE STABILITY	Does not change.	No change.	Same as 1.3.1.	No change, except if métiers differ between countries; leading to different approaches as regards arbitration between various objectives.
NATIONAL ENFORCEMENT	Difficult to exercise control, same as in current system.	Same as 1.3.1.	Handling borrowings and giving a sense of responsibility to borrowers cannot be done by the State's authorities for each particular vessel.	No major change compared with present situation.
SUBSIDIARITY	Is not encouraged.	Same as 1.3.1.	Possible management by POs.	Taking into account the multi-species feature according to métiers means particular consultation for the area. Enhanced sense of responsibility if...
LOCAL COMMUNITY	If quota very restrictive on main exploited stocks, localised protests may occur.	Same as 1.3.1.	May be a step towards allocating fishing rights to POs.	No specific new impact.
BEYOND 2002	Problems remain the same. No progress.	Same as 1.3.1.	May be a step towards privatization of fishing rights.	No specific new impact. The problem of definition of fishing rights remains identical.
Other considerations				
CONSISTENCY	Not very consistent with concern for a more elaborate resource conservation policy. Inconsistent with MAGP in the short-term.	Adjustments subjected to antagonistic pressures. Adjustments not consistent with phased reduction of fleets (MAGP).	More market consistency. Must not open the door to uncontrolled excess catch.	Not necessarily consistent with MAGP: possible upward quota adjustment together with effort reduction through MAGP.
TRANSPARENCY	Low justification at biological level. Uneasy definition of biological assumptions which are the basis of MATACs.	Difficult to set the limits and adjustment rules.	Complex implementation.	Multi-species and multi-strategies features render objectives rather incompatible. Hence difficult to explain arbitrations, hence little transparency.

	1.1.1 Equal quantity for several years	1.1.2 Limited adjustment	1.1.3 Limited compensation	1.1.4 Biological objectives
NEW PROBLEMS	Possible effort transfers by métiers whose targeted stocks are picking up to métiers whose targeted stocks are declining.	Possible divergent interests between countries when defining adjustment limits (the impact of multi-species feature may differ).	Giving a sense of responsibility to POs.	Politicization of scientific advice.
ACCOMPANYING CONDITIONS	Setting multiannual quota involves guaranteed minimum stability of the stock, hence good information on the stock's situation.	Improved biological information of the resource and of technical constraints of multi-species feature is a must.	May be, only for species with end of year price appreciation.	Improved biological information on the resource and on technical constraints of the multi-species features is a must.

Table 4.2 Evaluation of multi-species measures

	2.1.1 Total quantity in common denominator	2.1.2 Limited transfer by métier with by catch arrangement
Economics		
FLEXIBILITY	Total flexibility within the limits of total quota, unless dissuasive coefficients are set for species whose stocks are the most fragile.	Hampers flexibility between métiers unless one imagines a system of fishing rights allocation to groups (POs) with such groups being in charge of distributing the rights according to métiers.
PLANNING	Each vessel may plan own tempo of capture. Thanks to limited compensation, waiting to fish for end of year market opportunities might be without risks.	If vessels are attached to a specific métier, each one can plan its own activity throughout the year; but no longer enjoys the option of transfer. If system operated by POs, complex management of métiers over the year.
MARKET CONSISTENCY	As volumes of capture are fixed, each vessel will optimize according to prices. This formula optimizes, a priori, the value of removals from the resource.	Fishing strategies more consistent with market opportunities.
DAILY PRACTICE	Possible concentration of activity on higher value métiers. With individual quota, the most competitive vessels are penalized (exhaust quota quickly, then have to stop).	Profitability differentials are no longer corrected by spontaneous flexibility. Vessels involved in low return métiers may no longer transfer to a more profitable one.
RACE FOR FISH	Compulsory IQ (or catch limits per period of time). Possible favouring of higher value species (and species not subject to quota, if not included in the calculation of total quota).	May intensify for métiers subject to restrictions, if transfer to other métiers allowed.
ECONOMIC PERFORMANCE	Optimization of the turnover under limited total volume constraints.	In the absence of possible arbitration between fishing strategies, economic performance will be reduced.
Biologic		
SPAWNING STOCK	Concentration of effort on some species may worsen the situation of stocks that are already fragile. Limited risks for benthic species. Problems mostly with gadoids and hake.	Makes it possible to limit effort on target species (but not on bycatches).
FISHING MORTALITY	Fishing mortality varies according to stocks. One may adjust effort quota according to selectivity of fishing methods or according to composition of catches (penalization of strategies pursuing fragile stocks).	Adjustable according to métiers; but does not solve the problem of rate differentials between associated target species.
HIGH-GRADING	By definition, wiped out, unless adjustments penalize small sizes.	May develop, to comply with thresholds set for the métier (maximum percentage of bycatches). Possible increase of small size discarding, for bycatches in particular.

	2.1.1 Total quantity in common denominator	2.1.2 Limited transfer by métier with by catch arrangement
DISCARDING	Discarding linked with mono-species quota disappears, unless adjustments made according to catch components. Discarding of juveniles reduced if more selective practices encouraged.	Risks linked to compliance with métier's thresholds.
ECOSYSTEM MANAGEMENT	Effort limitation and penalization of non selective practices may offset risk of excessive exploitation of some species.	Effort limitation is adjusted according to the situation of target species stocks.
CONSISTENCY	In area VII, possible inconsistency with concern for improved resource management may occur with gadoids and hake mostly. Consistency with MAGP, because if early exhaustion of quota, compulsory additional effort reduction.	It is difficult to clearly outline the complex and flexible structure of the fishery. To attach vessels to particular métiers is inevitably a rather reductionist approach. Inconsistency with MAGP if MAGP not managed per métiers.
TRANSPARENCY	Hard bargaining for defining coefficients according to species.	Numerous arbitrations to be justified (métiers, thresholds, levels of transfer allowed, bycatch arrangements).
NEW PROBLEMS	Activity differentials among vessels. Definition of coefficients.	Disrupts the balance between métiers and penalizes some groups in relation to others. Problems of evolution of métiers. Problems of exchange of quota.
ACCOMPANYING CONDITIONS	A system to enforce strict control.	Necessary redefinition of a new relative stability. Ever stricter control of vessels' activity.

Table 4.3 Evaluation of effort measures

	3.1.1 Constant effort over several years	3.1.2 Limited adjustment of effort by métier
Economics		
FLEXIBILITY	Flexibility maintained within the limits of effort quota.	Limits flexibility between métiers unless effort quota per métier is managed at group level (POs). Group allocates, effort quotas still available.
PLANNING	Planning activity throughout the year possible. Thanks to limited compensation, one can wait for end of year activity.	A drop of activity more likely.
MARKET CONSISTENCY	Arbitration will be conducted on the basis of turnover. Influence of price factor in the fishing strategy is lessened by catchability factor.	Absence of arbitration between fishing strategies (unless management at group level).
DAILY PRACTICE	Working conditions: tempo stepping up.	Activity stepping up. Arbitration between fishing strategies depends on possession of corresponding rights.
RACE FOR FISH	Stops race for fish except, of course, for high value species with high seasonal catchability.	Avoided if vessels tied to a particular métier. Intensified for high return métiers if choosing between various fishing strategies within a group is allowed.
ECONOMIC PERFORMANCE	Economic performance (excluding medium or long-term biological considerations) is optimal for a given effort level.	Reduced because arbitration between fishing strategies impossible or at least curtailed.
Policy/institutions		
POLITICAL ACCEPTANCE	If risks of stock overexploitation are not high, the system offers economic advantages; it encourages selective practices; and its implementation is easy.	Definition of métiers difficult. Problems of allocation and monitoring.
SECTORAL ACCEPTANCE	Difficult to accept the notion of effort reduction, especially if reduction levels differ among countries. Effort measures must concern all the fleets visiting the area. They must not interfere with MAGP (implementation through capacity reduction only).	Difficult to accept vessels being tied to a particular métier. Possible conflicts should constraints differ markedly among the various métiers.
RELATIVE STABILITY	Challenged. A new relative stability has to be defined (see current problems with definition of permitted access by area).	A new relative stability must be defined by taking into account the cited problems of definition according to effort and métier.
NATIONAL ENFORCEMENT	Effort is easier to control. It is, however, necessary to monitor captures to respect global proportions of relative stability.	Control of effort and catch composition.
SUBSIDIARITY	Possible specific management of area VII. Setting up a particular dialogue and management structure for area VII.	Desirable; but heavy responsibility for POs if vessels must be monitored according to métiers.

	3.1.1 Constant effort over several years	3.1.2 Limited adjustment of effort by métier
LOCAL COMMUNITY	Trend leads to fishing rights allocation in terms of effort. Should these rights be allocated to vessels or to groups (POs)?	Same remark as 2.3.2.
BEYOND 2002	Possible definition of fishing rights in terms of effort. But the question of equivalence (exchange coefficients) remains to be solved.	Same remark as 2.3.2.
Other considerations		
CONSISTENCY	Consistency with the structural policy of fleet reduction (MAGP). Effort quota becomes an instrument for additional adjustment and qualitative steering of the fishery.	Same as 3.4.1. Definition of métiers. Adjustment rates.
TRANSPARENCY	The methodology for defining the new relative stability and, within that framework, managing the evolution of métiers is a critical point in the implementation of such a system.	Difficult.
NEW PROBLEMS	Activity stepping up. Definition of fishing effort taking into account evolution of technologies.	Same as 3.4.1. Inter métiers conflicts.
ACCOMPANYING CONDITIONS	Technical measures to modify particular composition of captures and encourage selective gears.	Same as 3.4.1. Strict monitoring of activity and captures to define the rules of a new relative stability.

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