Long-term Management of North Sea Fisheries

a report to DEFRA and the North Sea Regional Advisory Council

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I. Executive Summary

This report is a key output from a project carried out at the request of the North Sea Regional Advisory Committee (NSRAC) to help inform its discussions, and help it reach agreement on long term management plans for North Sea fisheries. It contains a mix of papers from researchers and scientists, reports from focus groups, outputs from workshops and views gathered during interviews with industry members around the North Sea. This report therefore does not provide a single, clear cut, agreed approach to long term management plans. Rather, it provides a start point for refining ideas and reaching agreement so that the NSRAC can provide advice to the European Commission on long term management plans for North Sea fisheries.

Sustainable development

Long-term management of fisheries is linked closely with the concept of sustainable development. The Report of the World Commission on Environment and Development first proposed the concept of sustainable development in 1987. Since then, FAO and others have stressed that it is only by taking account of ecological, economic, and social factors within an appropriate institutional structure that development can continue without exhausting natural resources. The modern concept of sustainability is seen as having at least four components: bio-ecological; social; economic; and institutional.

The World Summit for Sustainable Development (WSSD) resolution to “maintain or restore stocks to levels that can produce the maximum sustainable yield” cannot be achieved by simply plotting a unique point on the yield or income versus effort curve. The Maximum Sustainable Yield (MSY) concept itself has shortcomings. MSY is not stable over time and it cannot take account of multi-species interactions. Because MSY is not achievable, too strong a concentration on the MSY approach is a recipe for failure. It is better to adopt the more general goal of achieving sustainable fisheries.

However, prioritising one of the components of sustainability to the exclusion of others – for example targeting a high biomass or making profit maximisation the only goal – will not achieve sustainability.

Failures in management and how we should address them

There can be no doubt that management of large volume demersal fisheries has largely failed in the north Atlantic. There are a number of reasons for this failure but the strong focus of management on the bio-ecological component of sustainability to the detriment of the other components has undoubtedly played a part. Two of the most important factors contributing to unsustainable fisheries are inappropriate incentives (to fishermen), and poor governance.

The Common Fisheries Policy has been a particular failure. Many of its fisheries are not biologically sustainable, management is essentially short-term, many fishers feel alienated and do not comply with the rules, discarding is commonplace, the quality of biological advice is impaired by poor data, and fishers distrust the advice. The division of responsibility between the Commission and Member States adds to the institutional complexity. Although the CFP may have curbed the worst excesses of over-fishing and provided some equity in sharing resources between countries, management has been characterised by hostility and distrust between the different participants.
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Where fishery management has been successful it has generally provided incentives to individual fishers, leading to behaviour which is consistent with conservation. The inclusion of objectives aimed at improving the economic and social components of sustainability should result in more rapid progress and should also bring benefits for conservation. However, under the CFP the institutions of management need to change before such progress will be possible.

The institutions of the CFP are not well designed for achieving sustainability as they stand. Co-operative approaches to management have only been used in the most rudimentary way. Co-management has some disadvantages; it requires managers to surrender some of their powers, it needs the full co-operation of stakeholders and it may bring difficulties in addressing long-term goals. However, co-management can bring better communication, greater transparency, stronger involvement and commitment of stakeholders and greater consent to the regulations. Strengthening co-management within the CFP seems the obvious first step to achieving sustainability and the establishment of the RACs should be seen in this light.

From examining recent developments in fisheries management in other parts of the World it is evident that long-term management requires, above all, good governance coupled with appropriate incentives (both positive and negative). Management measures must be tailored to particular fisheries – one size does not fit all – and the approach should be holistic, incorporating social and economic as well as biological objectives. Risk management must be robust, adaptive and flexible.

Where are we now in the North Sea?

Turning to the current position in the North Sea, there are a number of serious ecological concerns. Although some stocks appear to be responding well to recent, strong measures, the fishing mortality is still too high for many stocks. Some spawning stocks are at low levels, and there is the potential for damage to some non-target species.

Quota reductions, restricted days at sea and increased fuel costs have restricted vessel profitability. Many fleets have experienced several years of low average profit levels, and some have contracted sharply in size. Processing plants are closing and the infrastructure which supports fishing is declining. In a number of countries, transferable catch and effort arrangements have been introduced and some fishers believe that these are gradually encouraging economic goals at the expense of social goals.

Socially, the rapid changes in some fleets are uncomfortable for some communities. The attitudes of fishers towards managers are becoming more hostile. There is a perception that the general public no longer takes a positive attitude towards fishers.

Where do we want to go?

In terms of the direction in which we should move, there is a wish to be free of the current top-down “command and control” approach to management and in favour of a more bottom-up co-management or “stewardship” approach. Stewardship is where government delegates management responsibility to stakeholders, while retaining the right to close a badly run fishery. There is agreement that management should focus on fisheries rather than fish stocks.
Ecologically, in particular, there are a range of views about the need to reduce fishing mortality. Few would disagree that we need to establish biological objectives for stocks and mortality and move progressively toward them. Some believe that species such as haddock, saithe and nephrops are currently being exploited at acceptable rates of mortality. Others believe that for some species we still need to reduce fishing mortality by meaningful amounts. Environmental, multi-species and density dependent considerations are considered important in setting targets. Those targets must be reviewed from time to time, as they may well change. It is important to preserve key habitats and mitigate by-catch by appropriate measures. Scientifically, we need to acquire a better understanding of how fleets generate fishing mortality. There is also a serious scientific challenge to develop a description of ecological sustainability that is both fleet orientated and stock orientated.

Economically, fishing businesses need to be prepared for economic shocks that are inevitable when operating in an uncertain natural resource sector and in an uncertain global economy. In order to prevent recourse to unsustainable fishing activities, vessels need to build up economic resilience through having average profit levels which are enough to sustain the businesses through financially lean years. Efforts to improve profitability should not be restricted to cost reduction, but should also focus on maximising return for the sustainable harvest through a co-ordinated approach to marketing the catch.

Socially, changes imposed by governments should ideally occur at rates that local communities can adjust to and absorb.

**How do we get there?**

In the short term, we need to move towards developing long-term management plans that have industry “buy in”, that have not been passed down from above and have more of a co-management ethos.

Ecologically, general reductions in mortality rate might be brought about by agreeing a time scale for reducing fishing mortality significantly. For some species, it may be possible to take advantage of large year classes to ‘bank’ fish. The co-operation of fishers is needed to make sure that cuts in fishing mortality are actually achieved. Vulnerable species may require special protection by giving fishers incentives to avoid catching them.

Economically, where vessel numbers must be reduced, it is better to allow this to occur within the industry through natural economic mechanisms, with decommissioning as back-up when profitability is low. There is a need to rationalise and harmonise various mechanisms, vessel quotas, days at sea etc, and as far as possible to avoid regulations that make fleets less efficient.

Socially, again it is preferable for change to take place at a rate that can be absorbed by communities, especially if change is imposed by government. It is important for those communities to be involved in any decisions that will have significant impact. If structural change is imposed by government then there is a case for the government to take steps to ease the transition for those in the community who suffer the negative impacts of change.

**TAC and days at sea management**

A study commissioned by the Dutch Ministry aims to design a system of effort management that can be used to complement current TAC management. Initial work is based on the beam trawl
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fleet. The approach is to quantify the relationship between days at sea and fishing mortality. This relationship (i.e. the catchability) can be quantified by the $F_{PUE}$, which is the fishing mortality that is generated per day at sea. $F_{PUE}$ can be used as an instrument for the management of a mixed fishery where fishing on the respective species needs to be decoupled to a certain extent. The proposed management system is very preliminary; further work is necessary to develop this concept, which may be an appropriate approach for some North Sea fisheries.

The way forward

Our institutions for managing fisheries need to change. We need bodies like the RACs that will help us work cooperatively to meet common goals. The NSRAC must think carefully about its own long-term development: a key objective is to be responsible, functional and efficient in providing advice to the Commission and other recipients, so that they accept and act on that advice. The NSRAC can make a significant move towards co-management by joining with the Commission in developing long-term management plans for the key fisheries.

Long-term management plans should address all four aspects of sustainability – ecological, social, economic and institutional – and should develop objectives for each of these. However, it is not yet clear how the different aspects of sustainability can be integrated or what kind of balance between the four components of sustainability will be acceptable to all interests. In particular there is tension between having a strong biological basis for setting management objectives, or seeking a strong economic basis.

Bio-economic models have been applied to help formulate management plans in other countries. They are usually tailored to the fisheries and fleets under investigation. There is a history of bio-economic model development for the North Sea, particularly with regards to herring, cod (also haddock, saithe and whiting), plaice and sole. Such models could be particularly useful to help develop long-term management plans for North Sea fisheries.

A series of key principles for long-term management planning were put forward during the Workshop. One of the great benefits of the development of long-term management plans would be to shift emphasis from the tactical to the strategic and to limit the involvement of political actors to the development of long-term objectives rather than year to year adjustments.

There is already a good basis for dialogue with the Commission to develop a long term management plan for the plaice and sole fisheries. Although it may prove difficult to establish an end-point for the plan, we know the direction we wish to move in. A slow and gradual approach will be necessary. Measures already adopted by fishers may already be moving these fisheries in the right direction.

The basis for agreeing a long-term management plan for haddock is less secure. The existing management plan adopted by the Commission is very basic. Any future plan must take into account the strong fluctuations in recruitment which characterise this species. The primary bio-economic objective is for haddock fishing to continue at around the current rate of fishing mortality, with a low risk of collapse. It is important to make the most of good recruitment – to decide how much to bank for the future. A stable future includes retaining a good age structure, bearing in mind sporadic recruitment, giving the fishing industry flexibility and stability and protecting it against risk. In managing haddock it will be especially important to take account of the different gear types/métiers which are used to catch haddock in the various fisheries and to develop fishery-specific regulations that work collectively to meet the overall stock objectives.
Discussion in the workshop generated a list of essential features for any long-term management plan. Each long-term management plan is likely to be multi-annual, regularly reviewed and based on clear analysis of the state of each fishery. Plans will take account of the economic health of the fishery and market considerations as well as fishing mortality and spawning stock biomass.

The material gathered by this project, and the presentations and discussions at the Workshop provided a richness of material which will be invaluable for future action. This report will go forward to the Demersal Working Group of the NSRAC, which will then wish to develop its views on long term management, defining the key fisheries and then setting out plans for particular fisheries. However, it will not be possible for the NSRAC to prepare sensible and robust long term management plans on the time scales envisaged by the Commission. The NSRAC will have to move at its own pace and set its own priorities. The current plans being considered by the EU and Norway must be regarded as transitional; they will allow time for managers and stakeholders time to agree on the current position and future objectives. The immediate need is for the RACs to meet with the EU and third party states like Norway, under the Chatham House Rule, to discuss the institutional changes which will be necessary to move towards more sustainable fisheries.
II. Project Description

A major future driver for change in the approach to fisheries management is the agreement reached at the World Summit for Sustainable Development (WSSD) in 2002. The European Union and its Member States who participated, agreed, among other things, to: “maintain or restore stocks to levels that can produce the maximum sustainable yield with the aim of achieving these goals for depleted stocks on an urgent basis and where possible not later than 2015.”

The WSSD Declaration is one of a package of statements aimed at ensuring sustainable fisheries, building on previous international agreements such as:

- The FAO Code of Conduct for Responsible Fisheries
- The UN Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks
- The Rio Declaration

The European Commission Directorate of Fisheries has issued a Non-Paper, Implementing sustainability in EU Fisheries: strategies for growth and employment, which was revised on 6th August 2005. The communication focuses on paragraph 31(a), of the WSSD Declaration and its commitment to restoring stocks to levels that can produce maximum sustainable yields (MSY) by 2015. The Commission proposes that the Common Fisheries Policy (CFP) should be developed in accordance with the Declaration. The non-paper states that implementation is feasible following the 2002 reforms of the CFP, which took on the objective of ensuring “exploitation of living marine resources that provides sustainable economic, environmental and social conditions”. The introduction of management plans and recovery plans has already been a means towards that end. The Commission suggests that more progress is now required, and that appropriate measures should be taken during 2006.

The Commission’s intention over the next two years is to propose long-term management plans that will, by 2015, return all major fish stocks in Community waters to levels of exploitation at which maximum sustainable yield can be produced. The rationale is that this approach will result in more stable yields from fisheries, which will become more sustainable biologically, economically, environmentally and socially. The Commission intends that this aim should be implemented by managing the fishing mortality (F), rather than by setting biomass targets.

The Commission established Regional Advisory Councils (RACs) in 2004, as a key part of the reform of the Common Fisheries Policy. RACs bring together stakeholders in the fisheries at a regional seas level. For the first time, stakeholders in the fisheries are able to assist the Commission and Member States in formulating fisheries policy, as part of a more inclusive approach towards fisheries management. The Commission intends to consult RACs about the rate of adjustment of fishing mortality rates towards the eventual targets, the stability criteria applied in harvest rules, and any other implementation measures associated with specific plans.

The North Sea RAC (NSRAC) was the first of the RACs to be established; in November 2004. It is therefore the first to address the Commission’s wish to consult stakeholders on the formulation of long-term management plans. The NSRAC began the process of assembling views on the objectives of long term management by holding a Focus Group on Long-term Fisheries Objectives at Schiphol in the Netherlands in August 2005. The Focus Group concluded that there is now an opportunity in to adopt a different, more inclusive approach to fisheries management. That approach should aim to bring all fish stocks within sustainable limits through the management of the individual fisheries. It is particularly important to agree a working definition of sustainability. Achieving the changes will demand a lot from all participants.
Project Description

The NSRAC concluded that next steps in taking its work forward would be to identify the main fisheries and fleet segments and to consider possible sustainability objectives for those fisheries, taking into account biological, economic and social factors. First, however, it would be necessary to examine the possible objectives for North Sea context by bringing together a number of stakeholders and experts to explore the various options.

This project, funded by Defra, focuses on developing possible targets for North Sea fisheries to enable fisheries management to move towards more sustainable fisheries. Plans should reflect stakeholders' views of the balance of objectives and the direction by which and the rate at which the fishery should achieve its objectives. Individual fisheries will probably require their own definition of sustainability and choice of measures for achieving sustainability. Policy makers must reflect on the definition of "fishery" since future economic sustainability may require flexibility in terms of the species exploited and the fishing gears employed. The study group selected two fisheries, on the advice of fishers, to examine in the study.

The purpose of this project was to take the first steps towards achieving long term management plans for North Sea fisheries by reviewing the scientific, technical and economic background and then presenting proposals for discussion and elaboration by key individuals at a workshop. The outcome of the research and the workshop, held in Edinburgh on March 2nd and 3rd 2006 is this report. The NSRAC can use this report to help develop its own plans for long term management of the main demersal fisheries within the North Sea.
III. The NSRAC Focus Group on Long-Term Fisheries Objectives

The starting point for this project was the Focus Group on Long-term Fisheries Objectives held at Schiphol, the Netherlands, in August 2005. The Focus Group brought together fishers’ representatives, environmental NGOs, scientists, economists and social scientists to explore the implications for North Sea fisheries of the WSSD commitment at Johannesburg in 2002 to bring stocks to maximum sustainable yield levels by 2015, and to consider long term objectives for the North Sea fisheries.

The Focus group proceeded under the Chatham House Rule to encourage openness and information sharing. As interpreted by the NSRAC the rule states: “Participants in the meeting are free to use the information received, but neither the identity nor the affiliation of the speaker(s), or participants in the discussion, may be revealed”.

The Focus Group concluded that the European Commission should immediately undertake the key task of persuading stakeholders of the benefits of moving towards low F, high yield fisheries. Many fishers would be sceptical of the benefits of any changes proposed. However, it was important that stakeholders support a gradual and evolutionary change in the approach to managing fisheries in the North Sea. The NSRAC could assist in obtaining that support if it could agree appropriate goals with the Commission.

The Focus Group disagreed with the emphasis placed in the Commission’s non-paper on the single-stock approach. The Group believed that the Commission placed too much emphasis on stock by stock management. The Commission should embrace the need to manage the fisheries that exploit the stocks and should take multi-species interactions into account. The guiding principles outlined in the non-paper provided a starting point from which to develop future management procedures and the interim arrangements which it set out were broadly satisfactory. However, the Focus Group felt that $F_{MSY}$ was too simplistic a target for practical use and that a more general framework which incorporated all aspects of sustainability would be necessary. Each fishery should be looked at case by case, focusing on strategic objectives for each of them. The aim should be to bring all stocks above safe biological limits, with higher biomasses, by controlling effort and applying other measures within the different fisheries. Various alternative strategies should be evaluated with the aid of economic as well as biological modelling.

The Focus Group recommended that the RACs, together with the Commission, and with the advice of technical experts, should commence by identifying the main fisheries and fleet segments. The Commission should then join with the interested parties in choosing targets based on the evaluation of harvest control rules that are robust to uncertainty, rather than through fixed definitions of reference points. The aim should be to move in the direction of more sustainable fisheries at a rate to be discussed by the interested parties (Figure 1). As progress is achieved it would be important to provide incentives for fishers to move further in the right direction.

The Focus Group recognised that currently the information on fishing effort expended by the different fleets was insufficient. It would be necessary to ensure that Member States and the Commission collected appropriate data and that ICES provided relevant multi-species and multi-disciplinary advice.
NSRAC Focus Group – Long Term Fisheries Objectives

Figure 1. It is important to agree robust harvest control rules with stakeholders, which will move fisheries in the desired direction by defining an area, with upper and lower boundaries, to aim for. Absolute values are not important; it is the direction of travel that is paramount.

The Focus Group concluded that there is now an opportunity to adopt a different, more inclusive approach to fisheries management. That approach should be aimed at bringing all fish stocks within sustainable limits through the management of the individual fisheries. It is particularly important to agree a working definition of sustainability. Much will be demanded of all the interested parties to bring the necessary changes about.
IV. Reviewing the Scientific, Technical and Economic Background

The project brought together six presentations:

1. Comments provided at the Workshop on the topic of “Sustainability”: Jean-Jacques Maguire
2. A desk study aimed at pulling together papers, case studies and reports relevant to a long term management of North Sea fisheries: John Pope
3. A literature review of international experiences of long-term options: Diana Tingley
4. Modelling to assess fleet reaction to management: Simon Mardle
5. Consultation with key individuals within the fisheries research institutes, ICES & other international bodies, the Commission, stakeholders & Member States etc. on their thoughts in relation to long term management objectives: John Pope
6. TAC and days at sea management: Sarah Kraak

The presentations are summarised below. The full texts of Parts 2, 3, 4, 5 and 6 are available as annexes to this report.

1. The Sustainability of Fisheries: J-J Maguire

Our Common Future

- The report clearly describes (page 37) how environmental stresses are linked to one another, to the patterns of economic development, and how both are linked to social and political factors
- Continued (sustained) development is needed to reduce poverty and inequalities
- It is only by taking account of ecological, economic, and social factors in an integrated decision-making system (i.e. within the right institutional framework) that development can continue without exhausting natural resources.

Definition of sustainability

The modern concept of sustainability evolved from the Bruntland Commission and is seen as having at least four components:

- Bio-ecological
- Social
- Economic
- Institutional
Reviewing Scientific, Technical & Economic Background

J-J Maguire

The definition of sustainability may change over time, as it is redefined by society. **Sustainability is not a unique point on the yield curve or the income versus effort curve**

**The nature of un-sustainability**

Fishing is not the only cause of fluctuations in fish stocks:

- Un-sustainability is often linked to over-exploitation, but resources do fluctuate naturally
- The abundance and presence of species is dependent on hydro-climatic conditions
- There may be external threats; voluntary or accidental
- Well-managed fisheries do not imply an absence of fluctuations in resource abundance or availability

**Has bio-ecological sustainability been achieved in large scale demersal fisheries in the North Atlantic?**

Bio-ecological sustainability has been the main focus of fishery management in the North Atlantic. After more than 20 years of intensive fishery management, most traditional demersal fisheries are in crisis:

- There are severe restrictions on North Sea cod
- Northeast Arctic cod are outside safe biological limits with TACs set twice as high as the scientific advice
- Icelandic cod are fished at twice the target fishing mortality rate
- Canadian cod fisheries yield only a fraction of past landings
- Georges Bank and Gulf of Maine cod are over-fished and over-fishing is still occurring

There are some positive signs for haddock and yellowtail in the NW Atlantic
Has the economic component of sustainability been achieved?

- It is difficult to say, as data has not been collected, analysed and reported in a systematic way
- The number of offers in buy-back programs suggests it is not
- Increases in fuel prices have certainly had an effect
- It depends on the fishery

Has social sustainability been achieved?

- It is difficult to say, as data has not been collected, analysed and reported in a systematic way
- Press reports would suggest that it is not: the number of boats (and fishermen) is decreasing, and fish processing plants are being closed
- Equity is not enhanced

Has institutional sustainability been achieved?

- Fishery management institutions in the North Atlantic have mostly been concerned with the bio-ecological component of sustainability (conservation)
- TACs have been the main conservation tool; scientific advice has been the main factor in determining TACs
- Landings, and particularly catches, are believed to be unreliable by a large number of interested parties, which undermines the credibility of the scientific advice
- Decision-making is far from transparent, which further undermines the credibility of the entire system
- Although fishery management institutions do continue to exist, it is difficult to describe them as being sustainable
- It is not clear that existing institutions are assets in achieving sustainability

Fishery management of large volume demersal fisheries has failed in the north Atlantic

- Considerable human and financial resources have been invested in fishery management in all countries bordering the North Atlantic since at least the mid to late 1970s
- The most direct result is depleted demersal stocks and unreliable fishery statistics
- It may be that fishery management processes are focusing too much on the bio-ecological component of sustainability to the detriment of the other components

Fishery management successes do exist

Hilborn, Orensans, and Parma (2005) discuss:

- New Zealand lobster, Chilean artisanal fisheries, Canadian sablefish, West Australian rock lobster, Gulf of Carpentaria prawns, Tasmanian abalone, Northeast Chatham Rise orange roughy in New Zealand, Pacific halibut, US hake and pollock cooperatives, Geoduck in British Columbia and in Puget Sound
In these fisheries, successful institutional systems provide incentives to individual operators leading to behaviour which is consistent with conservation

**Fishery management objectives**

- MSY was identified at the 2002 Johannesburg Summit because it was the only one available
- The shortcomings of the MSY concept have been known for at least 30 years (Larkin 1977)
- MSY is not stable over time, the carrying capacity of the environment changes, natural mortality changes, the form of the stock recruitment relationship may change
- Inability to incorporate multi-species interactions is a major shortcoming
- It is impossible to achieve MSY for all species of predators, prey and competitors at the same time in a changing environment
- MSY is a recipe for failure because it is not achievable

**How can a multi-dimensional definition of sustainability help?**

- We must recognise that ecological systems are dynamic and unpredictable with major influences from environmental forcing
- Benefits should be sought for all four dimensions of sustainability (bio-ecological, economic, social, institutional)
- Improvements under the economic, social, and institutional components should be easier to measure and (possibly) achieve
- Improvements in the bio-ecological component will accrue as a fringe benefit

**Summary**

- Sustainable development is clearly a multidimensional concept
- Fishery management in the North Atlantic has been overtly focused on the bio-ecological dimension of sustainability and it has failed under the four dimensions of sustainability
- It should be easier to agree on measures to improve the economic, social and institutional dimensions of sustainability and progress should also be easier to measure
- A directional approach is necessary: start improvements and then gather information to monitor progress
- Institutions need to change

**References**


2. Review of European Literature and Experience in managing fisheries: John Pope

Introduction

Any form of fisheries management has to prevent the race to fish which leads to the tragedy of the commons. In practice there are three ways forward:

1. By making laws that forbid excess fishing
2. By introducing (mostly economic) incentives or disincentives that discourage excess fishing
3. By persuading all fishers that excess fishing should be avoided.

The first approach is traditionally associated with managers, lawyers and some biological scientists who argue that the well-being of fish will automatically lead to the well-being of fishers. The second tends to be the preferred approach of economists. The third is the preferred approach of sociologists and indeed anthropologists. Examples of each are:

1. TACs, Mesh Regulations and Derogations, Effort Controls.
2. Extraction Taxes, ITQs, TIEs.

It is clear that the tools overlap between the three groups but the spirit in which they are applied is quite different. Moreover, the three approaches tend to have three different foci:

1. The Fish Stock. (biologists)
2. The Fishing Fleet. (economists)
3. The Fishing Community. (sociologists)

For a simple fishery these are just three facets of a single problem and it is possible that any of the three management approaches might work. For the North Sea demersal fisheries, simple solutions based upon any single approach are unlikely to work.

The three approaches correspond to three of the four component of sustainability (see figure 2 above). The fourth component is the institutional framework that combines the three approaches. The purpose of this paper is to use some recent European literature to illustrate the advantages, disadvantages and state of development of the various approaches and to consider how and what institutional framework might help in applying them.

Managing by laws that forbid excess fishing

The essence of the CFP approach to managing fisheries is a series of regulations. There has been little direct input from fishers. Its faults are:

- Generally it has not delivered biological sustainability.
- Its political focus is essentially short term.
- Fishers are alienated and some feel justified in non-compliance.
- Poor fishing practices like discarding are common.
- It has fouled up the biological advice on which it is based.
- Fishers distrust the science.
• The response to one law failing is to back it up it with another.
• Only legally definable measures can be applied (e.g. problems with some useful selective gears).
• The system seems to lead to mutual distrust and hostility between groups.

The CFP approach does have some virtues

• Relative stability provides equity in sharing resources between countries.
• Some single species fisheries seem to be managed well.
• Perhaps like a road speed limit, it may have curbed the worst excesses of fishing.

How might the existing system be improved?

1. Adopt approaches to assessment that fishers can understand.
2. Create advisory panels of fishers to predict how new rules will be circumvented

Managing by incentives or disincentives that discourage excess fishing

This approach aims to take away the temptation to fish to excess. The approach has not been used in the CFP though some measures are adopted at national level. Possible approaches are:

• Decommissioning.
• IQ/IE and ITQs/ ITE like structures.
• Extraction taxes.
• Sectoral imposts (offenders are charged for extra enforcement or requirements for observers etc.)
• Area based ITEs (see Sarah Kraak's paper).

Since few of these measures have been applied to North Sea fisheries we are not certain of their effects. Their advantages might include:

• Decommissioning eases graceful withdrawal
• Transferable catches may reduce misreporting
• Transferable effort may consolidate fleets
• Extraction taxes may soak up any supernormal profits, repay science and enforcement costs and pay society a rent for the fish
• Sectoral imposts might either encourage better behaviour or drive offenders out
• Area based ITEs could reduce some of the perverse tendencies of effort management.

What are the disadvantages?

• Decommissioning money may find its way back into fishing
• Decommissioning may not improve the profitability of remaining fishers
ITQs may concentrate fleets and reward the most efficient and are thus inimical to life style concerns. They may also encourage high grading.

The value attached to ITQs creates an inertia towards innovative management.

Non-fishing ITQ holders are a tax on remaining fishers.

Bad behaviour is often a symptom of low profitability and thus might be exacerbated by taxes or imposts.

Data requirements for adequate monitoring of economic measures do not fully exist.

How might things be improved?

- Better economic data and longer term models are needed
- Existing and new fleet based models all need better data
- Decommissioning schemes might be paid for by a deferred extraction tax
- A number of national transferability schemes are ad hoc in nature and might be aligned/tided up to advantage
- A limited experiment with area based ITEs would be justified.

Managing by persuading all fishers that excess fishing should be avoided

Co-operative approaches are only used in the most rudimentary way under the CFP, although they may make either of the alternative approaches more legitimate and more workable. Approaches can be classified under the broad headings of:

- Co-management - government and stakeholders co-operate in management
- Stewardship - government delegates general management responsibility to stakeholders but retains the right to close a badly run fishery
- Community management - government is not involved in management at all.

The first of these, co-management is most relevant to the RACs. What are the advantages of engaging in co-management?

- Better two-way communication
- Greater transparency
- Greater involvement and commitment of stakeholders
- Consent to regulations.

The disadvantages might include:

- Co-management is difficult to arrange if different stakeholders are playing a zero sum game (what I win you lose)
- Long term goals can be difficult for stakeholders who cannot see themselves as part of them
- Long-term thinking is difficult for fishers of wildly fluctuating stocks.
How can we improve things?

- Taking steps up the ladder of co-management (see next section) at EU level
- Adopting higher forms of co-management at national level
- Managing a sustainable local fishery using a high degree of co-management.

**Getting our act together institutionally**

Institutionally it would seem that the CFP is failing and needs to be improved. Strengthening co-management structures within the CFP seems the obvious first step and indeed the establishment of the RACs can be seen in this light. Institutionally, co-management arrangements may be classified into five broad types:

- **Instructive**: government informing users on the decisions they plan to make
- **Consultative**: governments consult users but take the decisions themselves
- **Cooperative**: government and users agree decisions together
- **Advisory**: users advise government of decisions to be taken and government endorses them
- **Informative**: government delegates authority to make decisions to user groups who inform government of their decisions.

Currently, the CFP only reaches the first step of this ladder. RACs may wish to move towards the third and even fourth steps.

What else might help?

- Relative Stability is a cornerstone of the CFP. However, discarding, black landings and quota hopping have undermined it. Can the general concept be retained while its operational definition is reconsidered?
- Days at sea limits appear to be a more effective constraint than catch restrictions. Might the approaches proposed by Sarah Kraak’s review paper be worth experimenting with?

Trying experimental management approaches on fleet sectors may be the best way to break out of the current management sclerosis.

**The full text of this presentation is in Annexe 1.**
3. Long-term Management Options, Experiences from around the World: Diana Tingley

**Over-exploitation and un-sustainability**

We have seen that there are four components of sustainability (Figure 2). Six key factors have been found to contribute most to overexploitation and un-sustainability in the world's fisheries. These are:

1. Inappropriate incentives
2. Lack of good governance
3. High demand for a limited resource
4. Poverty and lack of alternatives
5. Complexity and lack of knowledge
6. Interactions of fisheries sector with other sectors and environment.

The most important factors are (1) inappropriate incentives and (2) lack of good governance. Fisheries management has been found to fail where incentives are created (either directly or indirectly) which lead to unsustainable fishing practices; or alternatively where appropriate incentives are not explicitly introduced to encourage sustainable fishing practices.

The second most important factor was defined as a 'lack of good governance' which can stem from conflicting management objectives, a lack of transparency and openness or a lack of ability to manage fisheries effectively including a lack of (political) will to make the right decisions. Many features of poor governance are linked to the creation of inappropriate incentives. For example, management which does not take the views of key users into account can lead to a reduced incentive to comply with measures.

Experiences around the world have shown that there are a number of possible solutions to the above six problems. Different solution paths which can help resolve these factors are:

- Granting secure rights for resource users (this helps deal with factor 1. Inappropriate incentives)
- Transparent, participatory management (help deal with factors 1, 2 and 5)
- Support – science, enforcement, planning (4, 5)
- Benefit distribution (1, 3)
- Integrated policy (1, 3)
- Precautionary approach (4, 6)
- Capacity building, public awareness (5)
- Market incentives (1, 2)

**Managing fishing capacity**

There are many ways of managing fishing capacity. Incentive-blocking programmes are only effective in reducing capacity in the short-term: in the long-term factors such as the race-to-fish, substitution of uncontrolled inputs for controlled ones and technical change/creep all tend to erode the anticipated benefits of the programmes. Such incentive-blocking programmes include:

- Limited entry programmes (e.g. licensing, days at sea restrictions)
Review of European Literature & Experience in Managing Fisheries

Diana Tingley

- Buyback / decommissioning programmes
- Gear and vessel restrictions
- Aggregate quotas (i.e. Total Allowable Catches (TACs))
- Non-transferable vessel catch limits (e.g. non-tradable Individual Vessel Quotas)
- Individual effort quotas (IEQs)

If management is changed to allow a fisher to internalise the social cost of exploiting the resource and which encourages taking a long-term view of resource health, for example by establishing cooperatives, co-management, or rights-based fisheries, the consequences of over-capacity in the form of over-fished stocks should be corrected. Incentive-adjusting instruments include:

- Individual transferable quotas (ITQs)
- Taxes and royalties
- Group fishing rights (i.e. community quotas/community-based management)
- Territorial use rights (i.e. Several/Regulating Orders)

It should be noted that Individual Transferable Effort Quotas (ITEQs) can be both incentive-blocking and reducing in terms of fishing capacity management. The transferable nature of ITEQs helps fishers to better match their holdings of ITEQs with their amount of fishing capacity and available resources. However the extent to which effort controls (i.e. days at sea restrictions) contain fishing capacity and total catch levels can be eroded where input substitution or technical change is occurring. It can also be difficult to predict the true link between an effort unit and the amount of catch in these circumstances and where the impact of effort controls are being eroded, Total Allowable Effort (TAE) will have to be revised downwards continuously over time.

Most of the world’s major fisheries are either close to, or already are, overcapitalized and overexploited. A survey of major fishing nations in the world found that less than 50% of these nations managed fisheries using some form of rights-based or incentive aligning, territorial, group or community, or taxes or royalty-based fishing capacity management measure. However more than 80% of nations used some form of access, temporal, gear, fish size or access-related restriction.

The management experiences of a range of countries are discussed in more detail in Annex 2, however a brief review of key points from each country is presented as follows.

**Experiences from different countries**

**Canada**

The collapse of the Canadian fisheries Atlantic groundfish fishery was extremely costly to both the general tax payer and the affected fishing industries and communities alike. Huge sums of money were spent on restructuring including projects aimed at moving employment out of fishing as well as providing direct income support to many fishers most affected by the stock collapse during the 1990s. In spite of the sums of money spent, progress has been very slow in terms recovering groundfish stocks.

Fisheries and Oceans Canada (the responsible government department) initiated a fundamental programme of change in response to the collapse and problems in other West-coast fisheries, by placing greater emphasis on conservation, sustainability, economic viability and adopting a co-
management approach allowing fishers more control and involvement in the management process. Most fisheries are now managed using IQs, ITQs or Individual Vessel Quotas. Extensive stakeholder involvement is now evident in Canadian fisheries management; however, this involvement is still, in many cases, in its infancy.

Australia

ITQs have been used in the management of a number of Australian fisheries since the early 1980s - there are currently at least twenty ITQ-managed fisheries, accounting for about 22% of the total value of Australian mostly single species (and one multi-species) fisheries. However, the majority of commercial fisheries within the Commonwealth of Australia are managed via input controls such as limited entry, limited cod-end sizes, area restrictions, seasonal closures and fishing methods prohibited in sensitive areas. The best management tool is selected for each fishery based on a range of bio-ecological and economic/social factors. The majority of attributable fishery management costs are recovered from industry.

Management is highly participatory with various joint Industry/Government bodies being established to advise on fisheries management issues - these bodies often include community and conservation representatives. Specific fisheries management strategies in use are based on publicly available Fishery Management Plans that have been developed through these various Management Advisory Committees and Consultative Committees. They identify, on a fishery-specific basis, objectives, describe fishing concessions (i.e., statutory fishing rights, ITQs, fishing permits and foreign fishing licenses), allocation procedures and detailed rules governing fishers.

The Australian Fisheries Management Authority has recently announced a massive new decommissioning programme in Commonwealth fisheries: in 2006 a one-off decommissioning scheme is planned to reduce the fleet by some 50%. This programme is partly designed in response to the pressures of current over-fishing but also for fleets targeting stocks which are thought to be at risk of over-fishing. Furthermore, the fleet reduction is also intended to address issues related to displacement of fishing capacity from areas being set-aside as Marine Protected Areas.

Faroes

The early 1990s saw a disastrous collapse in fish stocks in Faroese waters. Denmark agreed a loan package on the condition that the Faroese implement a quota system but this was seen as an outside imposition. When it was finally agreed and implemented in 1994, fishermen responded by refusing to comply with the rules. Eventually the industry was asked to come up with an alternative and a new system - based on of days-at-sea restrictions rather than catch limits – was introduced in 1996. Additionally, there are also a system of closed areas designed to protect stocks, especially juvenile fish and spawning stocks.

The new system was successful in that it was accepted by the fishing industry which has played a large part in its development. However, over the period 1996-2001 the Total Allowable Effort inside the main effort control zone was reduced by 17% in response to changing fishing practices, input substitution and technical creep. It was thought that less then one-third of the fleet was actually restricted in their activities by the days-at-sea restrictions and that there was a considerable amount of input substitution. Further, catch–per-day was thought to have increased by 25-30% over the same period due mainly to the introduction of newer, larger vessels. The system has required many revisions over time and in 2005 government proposed that tighter
controls were introduced on effort transfer restrictions between industrial and artisanal fleet in an attempt to deal with problems of equity related to quota concentration.

**Iceland**

In 1976, following the extension of the fisheries jurisdiction to 200 nautical miles, marine scientists warned that fishing mortality in the cod fisheries seemed alarmingly high, that the spawning stock was threatened and that this level of catch could not be sustained. Iceland began to regulate fisheries using effort quotas in the period 1977-83 but they encouraged a ‘race to fish’ - vessel owners rushed to maximise their catch, fishing capacity increased and the number of fishing days had to be reduced.

Iceland’s major commercial fisheries are now managed through ITQs which were introduced in 1984. Support for ITQs in Iceland, is not universal. The small boat sector and fishermen’s unions have complained that the cost of renting quota has reduced the crew’s income. Consolidation has resulted in a profitable fleet but has left some vulnerable fishing dependent communities economically exposed as quota has left their communities and ITQs have also been criticised for promoting concentration of ownership.

However, there is also evidence that ITQs have brought considerable economic benefits. Over-investment in fishing capital has been restrained and the fishing fleet has contracted, fishing effort has been significantly reduced. Most Icelandic fishing firms have become profitable since the introduction of the ITQ system. This was probably also aided by the industry-funded (in retrospect) decommissioning programme implemented between 1990 and 1997 to assist in adjustment out of the fishery.

**New Zealand**

In the period after the extension of fisheries jurisdiction to 200 miles in 1978, the introduction of licence limitations and other input controls failed to check investment in the New Zealand inshore sector. This led to over-capitalisation, a serious decline in the sustainability of fish stocks and poor profitability. The ITQ system was introduced as a result in 1986 and currently 50 key species, of the 130 commercially exploited, are managed by the ITQ system. Over-exploitation has been greatly reduced and the stock size of most species has either increased or stabilised. Profitability has improved and although the fishing fleet and number of fishers at sea has reduced, the number of people employed in the onshore fisheries sector, in areas such as processing, has increased overall. The continual revision of the ITQ system to include more species and improve its performance has lead to criticism about its increasing level of bureaucracy, complexity and cost - the majority of which is cost recovered from the industry. However, the fishing industry is a staunch supporter of the system. This has built a consensus in favour of management based on clear use rights.

Stakeholders now want more control over the management of their activities and the Ministry of Fisheries is currently working towards the use of Fisheries Plans as a form of co-management tool. These Plans will identify objectives and detailed rules governing fishers and allow stakeholders to participate more in fisheries management by encouraging them to propose new and innovative management options tailored to the particular characteristics of a fishery. It is proposed that management measures (tools and services) may be undertaken by both the Ministry and by stakeholders.
New Zealand fisheries management is also subject to a number of management strategies which are seen as key additional long-term management approaches to be used alongside the established quota management system. The Strategy to Manage the Environmental Effects of Fishing has at its core environmental standards, which will be set with input from all stakeholders and these standards will specify the limits of acceptable effects of fishing on the aquatic environment. The Ministry of Fisheries recognises that setting environmental standards will require careful consideration of environmental obligations, value from utilisation of fisheries, social values, and the value for future generations. Some of these factors cannot be maximised simultaneously and, therefore, trade-offs must be made.

The draft Marine Protected Area Strategy sets out to develop and implement a strategy for establishing a network of areas that protect marine biodiversity, including marine reserves, world heritage sites, and other coastal and marine management tools such as mataitai and taiapure areas (customary fisheries management), marine area closures, seasonal closures and area closures to certain fishing methods. This strategy is currently the subject of debate between a number of government agencies on how it should be implemented.

The key points to note are that the two most important factors which contribute to unsustainable fisheries are:

- inappropriate incentives, and
- lack of good governance.

Experience from other countries shows that the most effective ways of tackling these issues are:

- Granting secure rights for resource users
- Transparent, participatory management
- Benefit distribution
- Integrated policy
- Market incentives

The full text of this presentation is in Annexe 2.
4. Modelling to assess fleet reaction to management: Simon Mardle

The assessment of the potential effects of long-term management strategies is an important step in the process of accepting a preferred strategy. Bioeconomic models are designed for this, enabling “what if” analyses to be undertaken that take into account the details of the fisheries system, including the multiple objectives that characterise it. The economic component of the model provides the link between stocks and fleets, making an estimation of fleet reaction to management a key feature.

Models can be invaluable for scenario analysis which by definition enables ‘risk assessment’ to be made. Properly implemented, scenario analysis incorporates ideas from decision-makers and stakeholder representatives. Not only can scenario analysis be used to highlight risks, but it can also highlight opportunities and trade-offs of potential management strategies. This process assists in transparency, accountability and commitment of all interest groups.

Considerable attention has been focused on bioeconomic models in fisheries. In Europe, they have not been used to any extent to assist in the development of fisheries management plans. However, in other countries (e.g. Australia and New Zealand), they have been applied to aid in management plan formulation and analysis, but only on a limited number of occasions. Most bioeconomic models are bespoke to the fisheries and fleets under investigation, even though they follow the same structure. There is a history of bioeconomic model development for the North Sea, particularly with regards to herring, cod (also haddock, saithe and whiting), plaice and sole. There is particular scope for the use of such models for the development of management plans for North Sea fisheries.

The full text of this presentation is appended as Annexe 3.
5. Discussions on long-term management: John Pope

Introduction

The problems of managing a fishery can be compared to those of navigating a ship. To navigate we ask three questions

- Where are we?
- Where do we want to go?
- How do we get there?

We need to look for these positions and courses with respect to each of the four FAO aspects of sustainability discussed in the previous section.

Discussions were held on the subject of long term management of the North Sea with 22 fisheries experts in Scotland, England, Holland, Denmark, Belgium and France. The approach used and a summary of the discussions is included at Annexe 4 and transcripts are available at NSRAC HQ.

Here, suggestions and conclusions based upon the opinions of those experts are gathered into those that reflect the current situation, those that reflect the desired long-term situation and those that reflect the route to take to get there. These are further subdivided into issues of institutional, ecological, economical and social sustainability. A selection of the expert’s comments from which the conclusions were drawn is gathered in the same order in Annexe 6.

Where Are We Now?

Institutionally:

A number of comments reflected on the current state of management institutions. The most emphatic suggested that the institutional framework of the CFP was flawed, under pressure and breaking down in various ways. But additionally there were a number of comments that suggested unease with the way that fisheries management institutions currently work. Conclusions were:

- Currently the CFP does not work well for fisheries for mixed demersal species.
- There are problems with compliance.
- There are problems with the scientific advice.
- There are problems of mutual trust.
- The divisions of responsibility between the EU and the Member States add to the institutional complexity and to short term thinking.

In short, while the fishing industry, managers and scientists have learned to work with or around the current system, it does not work efficiently or effectively!

Ecologically:

The most emphatic comments suggested there are still problems with over-capacity, discarding, recovery measures and concerns for the wider environment. Other comments suggested things might have improved for some stocks. Conclusions were:

- For many target stocks fishing mortality is still too high.
Some spawning stocks are at low levels.
There is the potential for damage to some non-target species
The situation of some target species, notably haddock, had improved in recent years.

Thus, there are a number of ecological and fish stock situations that should still cause us concern.

**Economically:**

The clearest messages were that recently profitability has been affected by quota drops and by increased fuel costs. Presently the question of survival was important because of the shock that high oil prices had given the industry. Key points were:

- Recently fleets have become economically stretched
- Some have contracted sharply
- In a number of countries, transferable catch and effort arrangements exist and these are gradually encouraging economic goals at the expense of social goals.

Economic viability is a concern; currently there seems insufficient buffering against shocks like oil price hikes. There does seem a gradual move toward more economic management but the approaches adopted have often grown up piecemeal and are only applied at national level. Economically, demersal fisheries do not seem to be in a comfortable state.

**Socially:**

Comments related to the current social situation in the fishing industry. Conclusions were:

- Socially, fisheries are in rapid transition; too fast to be comfortable.
- There is some (rather reluctant) move away from life style fishing in some countries but not all.
- In some fleets community ties with fleets may be lessening as crews are imported.
- The attitudes of fishers are changing towards management.
- The attitude of society towards fishers, traditionally positive, is becoming more negative.

There is no socially ideal situation that could last for all time. But where we are does not seem to be particularly comfortable.

**Where Do We Want To Go?**

**Institutionally:**

One comment was that fisheries may need to become integrated with other large uses of marine resources. A number of people suggesting that co-management or stewardship approaches should be used much more widely.

The first of the comments suggests that fisheries might be integrated institutionally with wider issues of marine management and so possibly become even more remote from fishers than the current arrangements. This is not where we want to go but if it is to be avoided then fishers will need to set their house in order and be seen to address the concerns of other users.
Some suggestions are that fisheries institutions need to:

- As far as possible avoid top down “command and control” management.
- Adopt more bottom up “stewardship” approaches to management based on fishing fleets.

The challenge will be to provide the incentives and disincentives that will permit a stewardship system to work. These must be such that individual fleets behave in ways that not only benefit themselves in the longer term but also avoid, or at least moderate, behaviour that adversely affects other fleets or other users. Certainly a system is needed which is institutionally functional. It might be wise if it were also financial efficient since it is worth remembering that in the long-term the fishing industry may end up being told to pay the costs of management.

**Ecologically:**

Where should we go to ecologically was discussed at the NSRAC Focus Group in Schiphol (see section III) and the consensus view from the experts reflected the thinking there. However, there were some views that we should go further in reducing Fishing Mortality Rate. For example, that a low F is needed because we need to protect genetic diversity particularly for those stocks at the margins of thermal distributions. Conversely there were a number of concerns that single species based target reference points for Fishing Mortality Rate were too low. There were also comments that reflected the need to address wider ecological concerns.

Some suggestions as to where we should go ecologically are that we should:

- Reduce fishing mortality progressively and by meaningful amounts.
- Build environmental, multi-species and density dependent considerations into our targets.
- Review targets from time to time, as they may well change.
- Preserve important habitat and mitigate non by-catch by appropriate measures.
- Acquire and use a better understanding of how fleets generate fishing mortality.

There are some serious scientific challenges here. One is to develop a description of ecological sustainability that is both fleet orientated and stock orientated.

**Economically:**

Where we want to get to economically will depend to what extent we wish to trade off number of jobs against total profit generated from a fishery. It also important to decide at what governmental level this trade off should be made. From the comments it was clear that some industries and some experts saw fishing as an economic activity rather than providing social benefits or supporting life style. Others would certainly take the reverse position. However, differences were perhaps more apparent than real since all agreed the need for economic viability while even the more profit-orientated felt that policies to give ITQ holders supernormal profits would prove equally unsustainable.

It was suggested that fishers want:

- To find a way to buffer the effects of economic shocks such as oil price rises.
• Economic resilience based on sustainable level of average annual profits. If need be, super-profits could be prevented through cost recovery or resource rent.
• To find ways to add value to catch and so increase revenue per tonne.
• To develop cheaper and more co-operative research programmes using industry based platforms.

Socially:

The main comments on socially desirable states were that changes should be gradual and related to specific contexts and lifestyle considerations. There was also a need to consider quality as well as quantity of jobs. Society is ever changing so there is no fixed point to achieve.

Suggestions are:

• Changes need to be made at rates that communities can absorb.
• It is important not just to create jobs but to create quality jobs, with due regard for safety and for career progression within the industry.
• Management needs to recognise and as far as possible accommodate the different attitudes to life style of different groups of fishers.

How Do We Get There?

A key difference between where we want to get to and how do we want to get there is that:

• The former – where we want to be - may still be rather vague.
• The latter – the direction we take to get there - should be clear.

Institutionally:

No expert directly addressed how we should immediately modify institutions although many comments from those interviewed suggested a need for change. In the short run a start would be the development of fishing plans, that have industry “buy in”, that have less of a command and control attitude and have more of a co-management ethos.

Ecologically:

Some experts commented on the problem of larger species such as cod or plaice and other on how general reductions in mortality rate might be best brought about.

Suggestions are:

• Agree a time scale for reducing fishing mortality significantly.
• Choose the best years to make cuts by taking advantage of fluctuations in stocks.
• Make sure these cuts actually happen.
• Give special protection to vulnerable species by encouraging fishers to use avoidance tactics.
Economically:

There were a lot of comments that addressed this.

Suggestions are:

- If fleets have to be reduced, allow this to occur within the industry through natural economic mechanisms.
- Decommissioning may be required as back-up when profitability is low.
- Rationalise and harmonise various mechanisms, vessel quotas, days at sea etc.
- As far as possible, avoid regulations that make fleets less financially efficient.

Socially:

Many of the comments related to the need for co-management of fisheries and stressed the need for fishers' involvement and ownership.

Suggestions are:

- Change at a rate that can be absorbed by communities.
- Decide what it is socially that we want to preserve and what we do not.
- Use Co-management and Stewardship approaches as much as possible

The full text of this presentation is in Annexe 4.
6. TAC and days at sea management: Sarah Kraak

A study commissioned by the Dutch Ministry has been aimed at designing a system of effort management that can be used to complement current TAC management. In this study only the flatfish fishery by the Dutch beam trawl fleet has been considered.

The approach is, to quantify the relationship between days at sea and fishing mortality. This relationship (i.e. the catchability) can be quantified with the indicator $F_{PUE}$, which is the fishing mortality that is generated per day at sea.

This quantity can be calculated on a trip basis as follows. The total catch ($C$, here landings) of a species in a certain year can be split up by country. This country’s catch can be split up further by fleet segment, and ultimately – based on the log book data – by trip. From the number of days in a trip, the average catch per day of that trip can be calculated ($C_{\text{trip}}$). Note that Dutch beam trawl trips are generally on a weekly basis (Sunday to Sunday). The fraction $C_{\text{trip}} / C$, multiplied by the total $F$ that corresponds to the $C$ (via the stock assessment), yields the $F_{PUE}$: the partial fishing mortality that is generated per day in that particular trip.

The factors that influence $F_{PUE}$ can be broadly classified into two groups:

1. The efficiency of a vessel, e.g.
   - Gear (beam trawl, otter trawl, twin trawl, etc.);
   - Engine power;
   - Design of the vessel;
   - Other equipment (DGPS, etc.);
   - Experience skipper and crew.

2. The availability of the fish by
   - Season;
   - Area.

It has been found that the efficiency of a vessel is related to the effective engine power (horse power, hp) in the following way:

- For plaice: $F_{PUE} \sim hp^{0.5}$.
- For sole: $F_{PUE} \sim hp^{0.8}$.

If the exponent were equal to 1, the efficiency would be proportional, implying that fishing with 2000 hp generates twice the fishing mortality as fishing with 1000 hp. Exponents smaller than 1 mean that fishing with 2000 hp is less than twice as efficient as fishing with 1000 hp. Hence, hp-days overestimate efficiency, especially for plaice.

The $F_{PUE}$ varies with area and season. Seasonal variation for plaice is about fivefold: $F_{PUE}$ in winter is roughly five times higher than in summer. A time trend can also be discerned from the data: the $F_{PUE}$ has increased over the 15 years’ study period, implying that a 2000 hp beam trawler has become more efficient over time. This phenomenon is called “technology creep”. The technology creep differs with type of vessel and by species. The percentage of technology creep is related to the vintage of the hull of the vessel and the vintage of engine of the vessel. Mutations in the fleet will therefore give rise to sudden jumps in efficiency ($F_{PUE}$).
Below a fictitious example is worked out for a possible direction of effort management, which will deal with the issue of mixed fisheries, i.e. the issue that if two species are caught together, fishing for one species continues when the quota for the other species has been exhausted.

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<th>Sole</th>
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<tr>
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</tr>
<tr>
<td>FPUE</td>
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<td>6.00E-6</td>
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<tr>
<td>Days at sea (10^3)</td>
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<tr>
<td>#vessels</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>#days/vessel (IEQ)</td>
<td>193</td>
<td>136</td>
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</tbody>
</table>

Let us assume that the agreed TACs for next year correspond to fishing mortalities for sole and plaice respectively of 0.40 and 0.30 (via the assessments); note that these are landings-Fs. According to relative stability the Dutch portions of these fishing mortalities are 0.29 and 0.12 respectively. It was calculated that the average \( F_{PUE} \) (= partial fishing mortality generated per day at sea, averaged over the whole study period and all areas, standardized for 2000 hp) was \( 1 \times 10^{-5} \) for sole and \( 6 \times 10^{-6} \) for plaice. It follows from this that 28,900 'standard' days at sea are needed for sole, and 20,400 for plaice, to generate the fishing mortality allocated to the whole Dutch fleet. If we assume that the Dutch fleet consists of 150 vessels, the IEQs (Individual Effort Quota) allocated per vessel would be 193 and 136 'standard' days at sea for sole and plaice respectively.

However, we have seen that a day at sea will generate a different fishing mortality rate depending on the time of the year and the area where fishing takes place. In the table below it can be seen, for example, that a day at sea in Month 1 (January) in the South generates 1.7 times more fishing mortality on plaice than a day at sea in Month 1 in Central. A day at sea in Month 4 (April) in South, however, generates only half the fishing mortality on plaice of a day at sea in Month 12 (December) in Central.

The management system we propose, assumes that fishermen ‘spend’ or ‘pay’ e.g. 1.7 of their plaice IEQ when they fish a day in January in the South but only e.g. 0.5 of their plaice IEQ when they fish a day in April in the South. In both months they will ‘pay/spend’ 1.1 of their sole IEQ. The fishermen are free to fish where and when they want, as long as they do not exceed either of their annual IEQs, while ‘paying’ according to the table. In effect, one ‘pays’ more when fishing in an area at a time where high fishing mortalities are generated than when fishing in areas and at times where low fishing mortalities are generated. If the species-specific IEQs can be controlled in this way, the actual catches will correspond more closely to the respective agreed TACs in this mixed fishery.

In summary, \( F_{PUE} \) is a useful indicator of the efficiency of the fishery; predictable effects are found for season and area, as well as for engine power. A positive trend in efficiency was found (technology creep), of which >60% can be attributed to the effect of vessel (engine & hull); this will give rise to sudden changes. \( F_{PUE} \) can be used as an instrument for the management of a mixed fishery where fishing on the respective species needs to be decoupled to a certain extent. The proposed management system is very preliminary; sensitivity analyses will have to be conducted, drawbacks will have to be identified and dealt with.
<table>
<thead>
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<th>Plaice</th>
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<th>Sole</th>
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The full text of this presentation is in Annexe 5.
V. The Workshop for NSRAC and other Key Participants

The Workshop Programme


The Workshop programme was as follows:

**DAY 1.**

| Welcome and Introduction to the Workshop | Barrie Deas |
| Various delegates gave short presentations in favour of their positions on long term management option | |
| Long-term options. Where do we want to get to and how do we get there? | John Pope |
| Open forum on long term management options | Chair: Barrie Deas |
| How have other countries developed long term management plans? | Diana Tingley; Simon Mardle |
| Achieving all aspects of sustainability; and risk management in fisheries | J-J Maguire |
| General Discussion – features of a long term management plan – areas of principle which must be agreed | Chair: Barrie Deas |
| Specific problems of the North Sea we cannot just ignore e.g.- cod recovery. Ecosystem Effects etc | John Pope |
| TAC and days at sea management: a direction for a possible solution | Sarah Kraak |
| General Discussion – how to arrive at a management plan; issues to overcome in developing a long term management plan for the North Sea fisheries | Chair: Barrie Deas |

**DAY 2.**

| The Case Studies | Tony Hawkins |
| Two Break-Out Groups develop the key elements of Long Term Plans, highlighting potential solutions to anticipated problems for two key North Sea fisheries (under the Chatham House Rule) | |
| I. The North Sea fishery for Flatfish | Chair: Simon Mardle |
| II The North Sea fishery for Haddock | Chair: Hazel Curtis |
| Presentations from each break out group | |
| General Discussion: Where do we go from here? | Chair: Barrie Deas |
Discussions on Day 1.

What does long-term management planning involve?
Long-term management is about moving away from reactive crisis management and towards strategic management.

Where are we now?
North Sea fisheries are not as secure and stable as we would like. We have insufficient data to assess the economic sustainability of fisheries, but it is evident that in the North Sea the fishing industry is experiencing major changes. There has been a shift from share fishing to entrepreneurship and corporate employment. The numbers of vessels are decreasing, processing plants are being closed and the infrastructure which supports fishing is declining. It is evident that economic and social factors are not sufficiently taken into account in fisheries management. Institutionally, fisheries management is geared entirely towards bio-ecological aspects of sustainability. The responsible institutions are not well designed for achieving sustainability as they stand.

Where do we want to get to?
We want to move towards a more comfortable position; with stocks at low risk of collapse, profitable fishing fleets, a fishing industry that generates and supports a more positive society, and more participative and inclusive institutions.

How do we get there?
There are two key aspects to address:

How do we determine the direction we want to go in and how do we measure our progress in that direction?

When can we relax, knowing that our fishery has reached a sustainable state?

Key Principles

- We should manage fisheries so that we do not compromise the future and with an eye to the management of risk. Long-term management is tied to the concept of sustainability.
- To be sustainable we need a fisheries management system that can absorb ecological, political and economic shocks and change effectively. Long term management plans must be adaptable and flexible.
- Sustainability has bio-ecological (target species and non-target species and habitats), economic, social and institutional aspects. Prioritising one to the exclusion of the others – for example a high biomass or profit maximisation – will not achieve sustainability. Long-term management needs to take a holistic approach.
- Any management plans for the North Sea must be developed in the context of fisheries which take a mix of species
- It is necessary to be aware of and avoid conditions which are unsustainable.
• Management plans have to be developed case-by-case for particular fisheries or fishing fleets.
• There will have to be trade-offs and compromises – for example, between profit, catch and employment. It is impossible to exclude politics from long-term planning.
• It is important to determine the direction of progress, rather than setting abstract targets – for example, if a stock is improving, do not reduce fishing effort to meet a pre-defined objective. We have to accept that sustainability is a moving target.
• Long-term management will be a learning process: monitoring and evaluation are important.
• Effort reduction is not the only tool in the box: objectives will need to be achieved by a suite of different measures if we are to address the complex issues of the mixed demersal fisheries of the North Sea.
• Success in long-term planning requires buy-in from the fishing industry.
• Fishers should be given incentives to adopt sustainable practices
• We must beware of seemingly simple objectives. Inter-relationships with other aspects of sustainability will make simple objectives more complex.
• Management must take account of social issues.

Possible benefits of long-term management plans

• Successful long term management will shift emphasis from the tactical to the strategic and will limit the involvement of political actors to the development of long-term objectives, rather than day-to-day, or year-to-year, tweaking with the details and responding to the noise.
• If we have long-term objectives/targets and we are moving in the desired direction, then the immediate worries of scientists and managers become less important.

The practical context

• A political commitment has already been made to long term planning: for example through the WSSD Declaration and the EU Commission’s non-paper on “Implementing sustainability in EU fisheries”. However, there is concern that a commitment to the biological objective of MSY will not by itself lead to long term social and economic benefits.
• Several management plans are already in existence and scheduled for review. However, a distinction needs to be made between transitional measures and genuine long term management plans, produced with the co-operation of stakeholders.
• Bilateral agreements with Norway mean that there are two distinct institutional contexts in operation. The Norway-EU negotiations have traditionally been highly politicised, with little opportunity (on the EU side) for industry or other stakeholder groups to take part.
• The NSRAC needs to develop plans of its own, rather than react to Commission proposals.
• The North Sea demersal fisheries exploit a mixture of species. Individual species cannot be managed in isolation from each other, and it will not be possible to achieve MSY for all target species simultaneously.
• Capacity building is a key issue in a North Sea context – time and specialist resources are scarce.
• The RACs, the Commission and third party states like Norway need to get together to implement a co-management approach in the development of long-term management plans.
Long term management and sustainability

Bio-ecological

There are sound reasons for not setting strict targets for individual fish stocks – for example, for fishing mortality (F) or spawning stock biomass (SSB). Fish stocks themselves cannot be precisely managed. The preference is to set a minimum warning threshold and an acceptable comfort zone as suggested by the NSRAC Focus Group. Immediate and necessary reductions in F or effort need to be distinct from long-term targets. Discards, by-catches and the protection of habitats and non-target species will have to be addressed; otherwise other actors will set the agenda.

We should not get hung up on MSY just because it is the only long-term management approach on the table. MSY has major shortcomings, including its inability to take account of interactions between species. This means that MSY targets cannot be met for all stocks. The important feature of most fisheries is that higher fishing mortality (F) is usually linked with a lower biomass (SSB); while lower F is linked with a higher SSB.

Economic

We must avoid reducing efficiency through regulations. We must rationalise and simplify the regulations we have so that they do what we want. Regulations should enable profitability not hamper it. We must move away from a situation in which annual cuts in fishing capacity are required.

Social

Social issues and priorities will be very context specific. We need to decide what social facilities we want to preserve. As far as possible, change must take place at a rate that can be absorbed by communities.

Institutional

We have had an integrated and holistic conception of sustainability for twenty years; but the fact that sustainability has not been achieved suggests our institutions are inflexible and unfit for the purpose. Bio-ecological sustainability has been the main focus of fisheries management in the North Atlantic and explicit consideration has not been given to the other, non-biological aspects of sustainability.

Our institutions need to change. We must move away from confrontation (between scientists and fishers and fishers and managers); we are pursuing the same objectives. We need institutions that will help us work cooperatively to meet our common goals.

NSRAC must think about its long-term institutional development: a key objective is to be responsible, functional and efficient in advice provision to the Commission and other recipients, so that they both accept it and act on that advice. Communication and collaboration with actual fishers and other stakeholders at the grassroots level will be essential to promote the legitimacy of the NSRAC and enable more successful implementation of measures. Dealing with uncertainty requires value judgements and the RAC provides legitimacy because of its international basis and
because of the ability of the stakeholders involved to make judgements about how we deal with uncertainty.

Participative institutions, rather than hierarchical ones, involve creativity and collaboration between the different actors in fisheries management. For example, a new innovative management approach is being developed at RIVO in the Netherlands that enables a spatial weighting of the value of days at sea (Kraak, the meeting; Rijnsdoorp et al.). This concept could be an instrument for the decoupling of species in a mixed fishery (plaice and sole, also cod).

**Important Questions**

- Who will carry the costs of management in the future? Examples from abroad involve industry accepting at least some of the costs of management and implementation. This, and the provision of credible advice, can reinforce the capacity of stakeholder organisations to take on decision-making roles. Or should Member States be picking up the tab? How can costs be divided equitably between states/groups?
- What will the time scale of long-term management objectives be? The pace of change is as important as the nature of the change.
- How can we manager uncertainty? By finding middle ground between concrete targets and the acceptance of uncertainty?
- What will be necessary to achieve industry buy-in or commitment to all aspects of long-term management objectives?
- What trade-offs are acceptable? And where will the decision-making responsibility lie on this question? For example, which species do we prioritise? Do we aim for social objectives or do we give priority to the profits of individual fishers? How do we address the mixed fishery question?
- Can we adapt the existing management plans? Or are they too simplistic?
- What can we learn from other fisheries management contexts where long-term management is already established? For example, the Canadian Fisheries Sustainable Development Strategy; Australian Fishery Management Plans; Effort management in the Faroes; ITQs in Iceland.
- What can we learn from more stable fisheries in our own seas – for example the northeast Atlantic pelagic fisheries.
- Do we need to know exactly where we are for us to decide where we want to go? It is possible to argue that we only need to know the direction in which we want to go.
- Is it easier to introduce measures that keep us where we are than to introduce measures to move us forward in a particular direction?
- While a general direction for fishery development should be agreed, do we also need to decide the speed of progress? How do we measure progress? Can we set bio-ecological, economic, social and institutional indicators? Should these be prioritised and, if so, in what order?
Conclusions from Day 1

- Management plans should address all four aspects of sustainability and their associated objectives.
- We need a clear time scale; a broad management direction; ideas about economic objectives; interim objectives that can be evaluated; and rules for participants to follow.
- NSRAC should take the necessary time to address long-term management issues and to develop appropriate, consensual, well-informed and balanced management plans. It should not be rushed by the Commission’s existing time schedule.
- Long term management plans can be amended and developed over time.
- It is not clear how the different aspects of sustainability can be integrated or what kind of balance between the four pillars of sustainability will be acceptable to all interests. In particular there is tension between having a strong biological basis for setting management objectives, or a strong economic basis.
- A new interpretation of MSY is required that takes into account the four aspects of sustainability. MSY does not have to be a static one-dimensional concept or target. Alternatively, although we can buy into the idea of integrated sustainability, we do not agree with MSY as a credible objective.
- Institutional reform is necessary, although it may be difficult to achieve. The current management regime makes us go backwards in terms of sustainability and does not integrate stakeholders and their views to a sufficient degree. The industry has to be involved in long term planning in terms of consultation, definition of the objectives, progress reporting and process review. It is also important that long-term management planning is aimed at particular fisheries and not fish stocks.
Day 2. Case Study I: A Long Term Management Plan for Plaice and Sole Fisheries in the North Sea

Background

There is already a Proposal for a Council Regulation establishing a management plan for fisheries exploiting stocks of plaice and sole in the North Sea – COM(2005) 714. The Proposal points out that:

*Plaice and sole have been fished together using beam trawls for many decades in the southern North Sea. ICES ACFM and STECF have advised the European Commission and Member States that plaice and sole are caught together in mixed fisheries and that the stock of plaice is at risk of reduced reproductive capacity; is at risk of being harvested unsustainable; and is over-fished in relation to the highest yields that can be taken from the stock. A very large proportion of the plaice caught are discarded. In 2003 the Committees advised that a recovery plan for plaice was needed. In 2004 the advice was that the stock should be rebuilt to above 230,000 tonnes in 2006 (a 24% increase). Similar advice was provided in 2005.*

*The same Committees advised that sole in the North Sea are at full reproductive capacity at present but are at risk of being harvested unsustainably. The stock is over-fished with respect to the highest long-term yields that could be taken from the stock. ICES further advised a reduction in catch by 36% in order to maintain the sole within safe biological limits in 2007. At current levels of fishing mortality the North Sea sole stock will fall outside safe biological levels in 2007.*

*Advice on long-term management from ICES indicates that at low target fishing mortalities (considerably lower than the present level), low risk to reproduction and high long term yields are achieved simultaneously. The general pattern is that there is no conflict between the two objectives. A low fishing mortality will lead to high yield simultaneously with a low risk to reproduction that is lower than the 5-10% risk which has generally been considered acceptable by managers. Target fishing mortalities in the range 0.3 to 0.4 are considered appropriate. However, a fixed-TAC management method would eventually lead to lower yields and higher risks.*

The stated objective of the Commission’s management plan is:

*to ensure exploitation of North Sea plaice and sole that provides sustainable economic, environmental and social conditions.*

Group Discussion

The Group’s long term objectives for the North Sea plaice and sole fisheries were to achieve:

- sustainable fishing fleets and sustainable fish stocks,
- profitable fisheries,
- stable fisheries, which can be maintained over years of poor recruitment, and
- a small ecological foot-print, with minimal by-catch of sensitive species.

Proposals for a long-term management plan for the fisheries have already been published by the Commission. These proposals suggest procedures for setting the TACs for sole and plaice,
complemented by a system of fishing effort limitation based on geographical areas and groupings of fishing gears. The Group wondered whether such a simple plan can be implemented effectively. There are problems with the institutional arrangements, which offer few opportunities for fishers to engage in dialogue with the Commission over the plan, although much progress has been made in discussing management arrangements within some Member States.

The fisheries concerned are mixed fisheries. The starting point for long term management of the fisheries was sole, a smaller but higher priced species. The sole fisheries are not a problem in themselves. The sole stock is not threatened and the fleet is viable and economically sound, although in the long term similar catches could be taken with less effort if high stock/low harvest rate thinking is applied. However, the small mesh fisheries for sole create problems for the larger plaice in the mixed fisheries, with large numbers of juvenile plaice being discarded.

Analysis suggests that small and gradual reductions in fishing mortality (by 5% per year) for sole would provide some protection for plaice and cod. While sole catches would initially fall this would be largely compensated by price increases. Hence small and gradual reductions can be achieved without adversely affecting the viability of the fleet. Reduction in fishing mortality rate at 10% per year would however generate significant short term losses in both catch and revenue for sole.

For plaice, reducing fishing mortality would increase the size of spawning biomass and bring benefits for the stock. Reducing effort at 5% or 10% per year will initially reduce landings slightly in the early years but these will soon recover. Moreover, price adjustments will largely smooth these losses out.

In the case of plaice changes in selection, which might be achieved by changing the distribution of fishing effort back to more traditional patterns, would create some benefit to the plaice stock. Such changes would not create a short term loss of landings or revenue for either plaice or sole. Clearly, at what rate to reduce effort, and the area distribution with which effort is to be applied should be considered carefully. Reductions in days-at-sea are currently forcing vessels to fish closer inshore which creates poor selection patterns and consequently significant discards for plaice. Tradable spatially-designated allocations (as suggested by Sarah Kraak) may bring benefits without introducing anomalies. The issue of how fishing mortality is to be reduced is an important one which requires dialogue.

For plaice, increasing the mesh size does bring long term benefits to plaice stocks and reduces discards. For sole, the biological benefits of increasing mesh size are small but the economic losses of a significant increase could be high. Currently fishing experiments are underway to obtain further information on the advantages and disadvantages of different mesh sizes. The results of those experiments are important for the long term management plan.

There are several anomalies and perversions which have arisen from current measures and long term management measures must be chosen carefully to avoid these. Member States seeking exemptions for particular fleet sectors creates particular distrust and confusion. NSRAC involvement is important to create discipline amongst all parties and to straighten out anomalies.

The cod recovery plan is currently affecting the fisheries for plaice and sole by requiring reductions in days-at-sea. There is a perception by the Commission that cod are caught as a by-catch within the fisheries. Fishers argue against this conclusion and maintain that the cod by-catch is very small for some sectors of the fleet. Dutch fishers are now including cod in their own voluntary discard programme. If there is a cod by-catch problem with some sectors of the fleet
then the long term management plan will need to include technical measures aimed at allowing cod to escape (for example by lowering the beam height).

Juvenile plaice are caught and discarded in some other fisheries (for example the *Nephrops* fishery). Such fisheries should be considered in long term management plans for plaice and sole.

The Group concluded that there is a good basis for dialogue with the Commission in the development of a long term management plan for the plaice and sole fisheries. Although it may prove difficult to establish an end-point for any plan we know the direction we wish to move towards. A slow and gradual approach will be necessary. Currently, there is little information about the process to be adopted for reaching agreement. The NSRAC is aiming for an adaptive process, where we learn from the measures adopted. Measures already adopted by fishers in the Netherlands and Denmark may already be moving the fisheries in the right direction.

**Day 2. Case Study II: A Long Term Management Plan for Haddock Fisheries in the North Sea**

**Background**

The ICES ACFM advice for haddock is for a single stock. It is based on the precautionary approach and classifies the stock as having full reproductive capacity and being harvested sustainably. There has been a decline in fishing mortality over the past three years, reflecting reductions in fishing effort under the cod recovery plan, and confirming that measures previously adopted have had an effect. Spawning stock biomass for haddock is in a healthy state but is declining. The stock has been characterised by very low recruitment in the last few years and although there may have been an improvement in 2005 at the moment the fishable stock now largely consists of a single year class. The objective of the current management plan, agreed with Norway, is to restrain fishing mortality to ensure continuity of supply in the context of low recruitment. Currently, the fishing mortality is not inconsistent with the general region of MSY. In the longer term, an fishing mortality of <0.3 gives a low risk of F falling below the Blim biomass.

In 1999 the EU and Norway agreed to implement a long-term management plan for the haddock stock, which was subsequently updated in 2004. The plan consists of the following elements:

- Every effort is to be made to maintain a minimum level of Spawning Stock Biomass (SSB) greater than 100,000 tonnes (Blim).
- For 2005 and subsequent years fishing will be on the basis of a TAC consistent with a fishing mortality rate of no more than 0.30 for appropriate age groups.
- Should the SSB fall below a reference point of 140,000 tonnes (Bpa), the fishing mortality rate referred to above shall be adapted in the light of scientific estimates of the conditions then prevailing.
- Such adaptation shall ensure a safe and rapid recovery of SSB to a level in excess of 140,000 tonnes.
- In order to reduce discarding and to enhance the spawning biomass of haddock, the exploitation pattern shall, while recalling that other demersal species are harvested in these fisheries, be improved in the light of new scientific advice.

The management plan for haddock is to be reviewed by the Commission & Norway before 31 December 2006.
Break-Out Group Discussion

The group discussed a possible framework for a long-term management plan for haddock (illustrated in Figure 3).

Figure 3. Framework for long-term management of North Sea haddock

Making such a framework operational would require stakeholder agreement on the following:

1. Clear biological objectives for the stock or stocks affected.
2. Clear economic and social objectives agreed at the North Sea level through discussions within and between Member States and their respective industries. Specific aspects of these are likely to vary between different fisheries on the same species.
3. The draft framework would operate in the context of commitments made within the existing international institutional and political arrangements – for example, the precautionary principle, the ecosystem approach to fisheries management and the commitment to long-term management of fisheries.
4. Management measures/regulations appropriate to particular fisheries or fleets.
5. Clear institutional arrangements, with the NSRAC’s role envisaged as both representing and informing stakeholders.
6. Given the mixed nature of North Sea fisheries, it will also be necessary for such a framework to take account of potential areas of conflict: for example, ecological aspects such as multi-species interactions and predator-prey relationships, and, socio-economic issues such as fishery interactions and overlaps between fisheries. The group acknowledged that a certain level of compromise would be required to develop an acceptable balance of these aspects.

The Group agreed that the existing management plan adopted by the Commission for haddock is very basic. Any future long-term management plan for haddock must take into account the strong fluctuations in recruitment which characterise the species. The assessments for haddock may
show some variability, especially when recruitment has been low for some time. There is a need to build in some recognition of uncertainty.

Stock objectives

The Group considered the eco-biological objectives for a long term management plan for the haddock fisheries;

- The primary bio-economic objective is for haddock to stay in the region of MSY, where it is now, with a low risk of collapse.
- In addition, it is important to make the most of good recruitment – to decide how much to bank for the future. A stable future includes retaining a good age structure, bearing in mind sporadic recruitment, giving the fishing industry flexibility and stability and protecting it against risk.
- It is not appropriate to set a biomass target for haddock, as that is outside our control.
- Finally, it is important that all stocks exploited by the fishery remain within safe biological limits.

Fishery regulations

It is possible to distinguish between the various haddock fisheries in the North Sea. For example, using particular criteria, three specific Scottish haddock fisheries have been identified by scientists:

1. In the southern North Sea, with a low by-catch of other species;
2. In the northern North Sea, with a medium by-catch of other species; and
3. On the Fladden Ground, a joint Nephrops and haddock fishery.

A further fishery is the Danish industrial fleet that lands a by-catch of haddock. Other fisheries may also be partially reliant on catches of haddock.

In managing haddock, it will be important to take account of the different gear types/métiers which are used to catch haddock in the various fisheries. This is one reason why it is important to develop fishery-specific regulations that work collectively to meet the overall stock objectives.

The fishery in the southern North Sea was taken as an example for implementation of a long-term management plan. A number of tools are available for the management of this fishery: including changes in technical measures, effort controls, TACs, trawl design, licensing, etc. Problems with this fishery include:

- Capture of juvenile fish, discarding and problems defining catch composition
- Lack of industry buy-in: requiring better understanding between countries – greater equality, transparency and commitment
- Poor communication: requiring dialogue between fishermen/scientists/managers in particular to promote understanding that with good year classes fishers will catch the same, with less fishing.

Potential solutions to long term management of this fishery include:

1. A long-term commitment to increase mesh size for the directed fishery
2. General reductions in discards in line with best demonstrated practice
3. The NSRAC to be instrumental in promoting communication between the stakeholders and all actors in fisheries management (governments, federations, scientists, Commission, etc)

Other issues, concerns and reservations of the Group with respect to haddock include:

- Is a species specific management plan approach not a retrograde step, when we have been moving towards the management of mixed fisheries?
- The industrial fisheries need to be factored into any long term management plan for haddock fisheries
- Fleet size and fleet profit – who takes decisions on the economic and social aspects?

Discussions on Day 2

General conclusions from the Break-Out Groups

1. Each long term management plan is likely to be multi-annual, regularly reviewed and based on clear analysis of the state of each fishery. It will not just be based on F & SSB but will take account of the economic health of the fishery and market considerations. A long term plan is not the quick fix which is required for stock recovery. Long-term management can provide us with a framework within which management can react to signals, rather than noise.
2. A key question will be how often a long term plan needs to be reviewed and action taken. The review period will in fact depend upon the fishery and the stocks being exploited. In some cases annual review will not be necessary.
3. Transitional plans may be required to allow managers and stakeholders time to agree on the current position and future objectives
4. The views of industry of how stocks are faring should be taken into account by the management system. Fishers are able to observe the state of the fisheries from day to day. Their knowledge, supplemented by up-to-date surveys, sentinel fisheries and fast-tracked information from scientists could provide more accurate picture of the current state of the stocks.
5. It is evident that stakeholders can broadly agree on the characteristics of long term management plans; the devil will be in the details of specific plans.

Essential features of any long-term management plan

A series of features emerged from the Group discussions which were regarded as essential to the success of any long term management plan:

1. Stakeholders, and especially fishers, must be involved in the formulation and agreement of both the objectives of the management plan and the means of achieving those objectives. Stakeholders must not simply be consulted on proposals which are already agreed in advance between other parties.
2. The stakeholders concerned must be clearly defined. There is a role for national forums and for the RACs here
3. Buy-in by fishers is necessary if a management plan is to succeed. The concept of Stewardship is important. Involving fishers in the details of implementation may help here.

4. The objectives for any management plan must be clearly stated, and must be achievable. The objectives must address all the components of sustainability; bio-ecological, economic, social and institutional.

5. Although general principles or guidelines for management plans may be set out and agreed by stakeholders, an actual management plans must be specific to a particular fishery, with regulations appropriate to the individual gear types or métiers. One size does not fit all.

6. The management plan for a particular fishery must not be for one stock only; it must take account of all the stocks taken by the fishery.

7. A wide range of management tools/instruments should be considered within the management plan. The plan should not just be based on the TAC.

8. The changes proposed in a long term management plan must be gradual, evolutionary and adaptive.

9. The need for a degree of flexibility for vessel businesses must be respected.

10. The management plan must take account of uncertainty and must accept that stocks cannot be completely controlled or predicted.

11. The management plan must agree the actions which should be taken if the stock moves outside the safety zone.

12. Flexible rather than fixed rules should be developed within the management plan.

13. Space must be allowed within a management plan for its review and revision.
VI. Final Discussion: Where do we go from here?

The material presented and the discussions at the Workshop provided a richness of material which will be invaluable for future action. This project report for DEFRA will be forwarded to the Demersal Working Group of the NSRAC. The NSRAC may then be able to develop and take forward its views on long term management, defining the key fisheries and then setting out timetables for developing its own plans for particular fisheries.

There are several ideas which require further consideration or development:

1. There is a need to look again at the ‘use it now or bank it for the future’ idea. Is it applicable to all fisheries, or simply to those like the haddock which are characterised by long periods of poor recruitment?
2. The concept of tradable spatially designated effort allocations is currently largely theoretical but should be further developed as it might provide a useful methodology in the future.
3. We are dealing with complex issues. Institutional problems and failure in governance cut across all of them. A meeting is needed between the Commission and the RACs under the Chatham House Rule to begin a dialogue on future improvements in governance.
4. How are the RACs going to develop long-term management plans? Who is going to do it? The NSRAC has made considerable progress in developing its ideas, but is still a long way from developing actual long-term plans and gaining the agreement of the Commission and Norway on those plans. There is a capacity issue - who will do the work and who will fund it - as well as the institutional problem of how the RAC should convey its views to the Commission.
5. A deadline has already been set by the EU and Norway for developing a long term management plan for the fisheries for plaice and sole and management plans for haddock and herring. Plans for these fisheries will have to be in place by the end of November. Interim proposals will need to be lodged with the Commission by July. If not, the negotiating position of Norway with respect to the EU will be strengthened. However, the plans currently under consideration by the Commission are very basic and do not fit the criteria laid down by this Workshop for a long term management plan. They can only be regarded as transitional plans, and the RACs will need to emphasise that in any discussions with the Commission.
6. It will be important for the RACs to take their constituents with them, rather than behaving like a surrogate Commission. A broader dialogue with the grassroots will be necessary and this will take time.
7. On the question of speed, it will not be possible for the NSRAC to prepare sensible long term management plans on the time scales envisaged by the Commission. It will be better for the NSRAC to move at its own pace and set its own priorities.
8. It was noted that a policy day has been set aside at the IIFET conference, Portsmouth, on Wed 12 July. This may provide a further opportunity to discuss and debate long-term management plans.
### VII. Participants in the Workshop

* first day only  
** second day only  
*** observer  

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<tr>
<th></th>
<th>Name</th>
<th>Organisation</th>
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<td>Hazel Curtis</td>
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<td>13.</td>
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<td>17.</td>
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Annexe 1.

Long Term Management

Possible management Approaches: Based upon European Literature and Experience in managing North Sea fisheries.

John Pope NRC (Europe) Ltd.

Introduction.

Hardin’s picture of “the tragedy of the commons” (see a simplified version in section II of the report) shows us that on unmanaged fisheries the fishing effort expands until the point where the fishery is unprofitable. At this point the stock may be degraded and even employment potentially less than might be contrived if the stock was fished in a fashion that gave the maximum sustainable revenue. Some years ago I converted this picture\(^1\) into a triangular diagram that displays the trade-offs, which exist between the objectives of long term yield, profit and employment in a simple fishery. Both pictures illustrate that there is a need to manage fisheries if long-term objectives are to be achieved. Any form of management has to prevent the race to fish which leads to the tragedy of the commons. In other words management has to prevent fishers from catching fish that it would be in their own short-term interest to catch. Its perhaps worth remembering that the old meaning of prevent\(^2\) is, to go before not to forbid. In practice there are three ways the race to fish might be prevented.

1. By making laws that forbid excess fishing.
2. By introducing (mostly economic) incentives or disincentives that discourage excess fishing
3. By persuading all fishers that excess fishing should be avoided.

The first approach is traditionally associated with managers, lawyers and some biological scientists who argue that the wellbeing of fish stocks will automatically lead to the wellbeing of fishers. The second tends to be the preferred approach of economists. The third is the preferred approach of sociologists and indeed anthropologists, who find it used by some First Nation Peoples. Examples of each approach are:

1. TACs, Mesh Regulations and derogations, Effort Controls.
2. Extraction Taxes, ITQs, ITE’s.

\(^{1}\) Pope, 1983.

\(^{2}\) The old meaning is seen in the prayer that begins “Prevent us O Lord in all our doings”. (Book of Common Prayer, 1662. Forms of Prayer to be used at sea),
It is clear that the tools overlap between the three groups but the spirit in which they are applied is quite different. Moreover, the three approaches tend to have three different foci:

1. The Fish Stock. (biologists)
2. The Fishing Fleet. (economists)
3. The Fishing Community. (sociologists)

For a simple fishery such as described by Hardin these are just three facets of a single problem and it is possible that any of the three management approaches might work. But for mixed species, multi-fleet, multi-national fisheries, such as those for the North Sea demersal fish, clearly simple solutions based upon any single approach will probably not work.

The three approaches correspond to three of the legs of sustainability. The fourth leg of sustainability in the JJ diagram is the institutional framework that combines the three approaches together. The purpose of this paper is to consider the approaches use the advantages, disadvantages and state of development of the various approaches, particularly with respect to the North Sea demersal fisheries, and to consider how and what institutional framework might help support and apply them. Where possible recent examples from European (and other) literature is used to support or to illustrate this review.

**Managing by laws that forbid excess fishing.**

The essence of the CFP approach to managing fisheries is a series of regulations, although it is true that financial instruments form a part of the CFP. Indeed past subsidies have encouraged excess fishing. Nevertheless, the approach to managing fishing has essentially been a series of rules developed by administrators, lawyers and politicians advised mainly by biologists though with increasing economic inputs. There has been little direct input from fishers. In part this approach was forced upon the EU by the need to share catches between member states through relative stability and the need to agree sharing arrangements for common stocks with Norway\(^3\). Both required species TACs that were enforced and thus the CFP was already heading down a legalist species orientated track. Even at its inception some predicted it was flawed\(^4\). Because it is the method in use we are all to well aware of its faults. These are

- It generally has not delivered biological sustainability\(^5\).

\(^3\) Symes *et al.*, 2003.
\(^4\) Shepherd *et al.*, 1995
\(^5\) ACFM 2005.
Annexe 1  Long Term Management  John Pope

- Its political focus is essentially short term.
- Fishers are alienated and some feel justified in non-compliance.\(^6\)\(^7\)
- Poor fishing practices like discarding are common\(^8\).
- It has fouled up the biological advice on which it is based.\(^5\)
- Fishers distrust the science and managers\(^9\)\(^3\).
- The response to one law failing is to back it up with another.
- Only legally definable measures can be applied (e.g. problems with some useful selective gears).
- The present system seems to lead to mutual distrust and hostility between groups.

It does have some virtues

- Relative stability gives some equity between countries.
- Some essentially single species fisheries seem to be managed.\(^10\).
- Perhaps like a road speed limit, it may have somewhat curbed the worst excesses of fishing.

How might the existing system be improved?

1. Adopt approaches to assessment such as Management Procedures that fishers can understand.
2. Create advisory panels of fishers to predict how new rules will be circumvented

**Managing by incentives or disincentives that discourage excess fishing**

This approach aims to take away the temptation to fish to excess. The approach has not been used in the CFP though some measures are adopted at national level. Possible approaches and where they have been used are:

- Decommissioning is the only instrument used so far at European level.

\(^6\) Vaze and Tingley, 2004  
\(^7\) SAMUDRA Report, 2005  
\(^8\) ICES WGNSSK, 2005.  
\(^9\) Jentoft and McCay, 1995  
\(^10\) EU Non-paper, 2005
• IQ/IE and ITQs/ ITE like structures exist in several North Sea States.\textsuperscript{3, 7}
• Extraction taxes/Cost Recovery is not yet used.
• Sectoral imposts (charge the bad boys for extra enforcement or requirements for observers etc.)\textsuperscript{11}
• Area based ITEs (see Sarah Kraak's paper)

Since few have been applied we are less certain of the effect of these measures on the North Sea mixed demersal fisheries. What are or could be the advantages?

• Decommissioning eases graceful withdrawal.
• Transferable catches have helped curb misreporting\textsuperscript{12}
• Transferable effort has helped consolidate fleets
• Extraction taxes could soak up any supernormal profits that occurred and repay science and enforcement costs\textsuperscript{13, 11} and possibly pay wider society a rent for the fish..
• Sectoral imposts might either encourage better behaviour or drive the bad boys out.\textsuperscript{11}
• Area based ITEs could reduce some of the perverse tendencies of effort management.\textsuperscript{14}

What are or could be the disadvantages?

• Decommissioning money may find its way back into fishing.
• Decommissioning may not improve the profitability of remaining fishers.
• ITQs tend to concentrate fleets and reward the most efficient and are thus inimical to life style concerns. They may also encourage high grading.\textsuperscript{15}
• The value attached to ITQs creates an inertia to innovative management.
• Non fishing ITQ holders are a tax on remaining fishers\textsuperscript{16}.

\textsuperscript{11} Net Benefits, 2004.  
\textsuperscript{12} Steins & Langstraat, 2003.  
\textsuperscript{13} OECD, 2003.  
\textsuperscript{14} Rijnsdorp et al. 2006.  
\textsuperscript{15} Copes, P. 1986.  
\textsuperscript{16} Flaaten et al 1995.
• Bad behaviour is often a symptom of low profitability and thus might be exacerbated by taxes or imposts.
• Data requirements for adequate monitoring of economic measures do not fully exist.

How might things be improved?

• Better economic data and longer term models are needed
• Existing and new fleet based models all need better data.
• Invest in decommissioning schemes might be paid for by a deferred extraction tax.
• A number of national transferability schemes are ad hoc in nature and might be aligned/tided up to advantage
• Try a limited experiment with area based ITEs.

**Managing by persuading all fishers that excess fishing should be avoided.**

These approaches are only used in the most rudimentary way under the CFP \(^3\) More use is however to be found under North Sea Member States' jurisdictions. \(^3\) \(^12\) For complex North Sea demersal fisheries it is likely that these approaches would in practice be used in conjunction with the other approaches and not in a stand alone fashion. It may be wrong therefore to see this as an entirely separate approach. Instead it might be seen as a way to make either of the other approaches more legitimate and more workable.

Approaches can be classified under the broad headings of:

• Co-management.
• Stewardship
• Community management

Here the former is taken to refer to situations where Government and stakeholders co-operate in management to various degrees. The second is where government delegates general management responsibility to stakeholders and only retains the residual right to close an irresponsibly run fishery. The third describes the situation where government is not involved in the management at all. In practice the first is of most likely use to NSRAC.

What are or could be the advantages?
• Better two way communications.
• Transparency.

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\(^{17}\) Sen & Nielsen, 1996.
Involvement and commitment of stakeholders.
Consent to regulations.

What are or could be the disadvantages?
- Difficult to arrange if different stakeholders are playing a zero sum game (what I win you lose).
- Long term goals can be difficult for stakeholders who cannot see themselves as part of them.
- Long-term thinking is difficult for fishers of wildly fluctuating stocks.

How might things be improved?
- Taking steps up the ladder of co-management (see next section) at EU level.
- Adopting higher forms of co-management at national level.
- Consider making the experiment of managing a sustainable local fishery using a high degree of co-management. (Noup Nephrops?)

*Getting our act together Institutionally.*
Institutionally it would seem that the CFP is failing and needs to be improved. Strengthening co-management structures within the CFP seems the obvious first step and indeed the establishment of the RACs can be seen in this light.

Fisheries co-management arrangements were classified **Error! Bookmark not defined.** into five broad types according to the role government and users play:

- **Instructive:** There is only minimal exchange of information between government and users. This type of co-management regime is only different from centralised management in the sense that the mechanisms exist for dialogue with users, but the process itself tends to be government informing users on the decisions they plan to make.
- **Consultative:** Mechanisms exists for governments to consult with users but all decisions are taken by government.
- **Cooperative:** This type of co-management is where government and users co-operate together as equal partners in decision-making.
- **Advisory:** Users advise government of decisions to be taken and government endorses these decisions.
- **Informative:** Government has delegated authority to make decisions to user groups who are responsible for informing government of these decisions.

The existing CFP only reaches the first step of this ladder of increasing co-management. NSRAC might reasonably aspire to help the CFP reach the third or fourth steps.
What else might help?

- Relative Stability is a cornerstone of the CFP and is still generally accepted and indeed enshrined in national IQ and ITQ arrangements. However clearly it is a concept “more honoured in the breach than the observance”. Discarding and black landing undermine it as does quota hopping. Might the general concept be retained while its operational definition was measured in some running average fashion that could be used to periodically check national fishing effort to re-establish the balance between countries?
- Might a discard ban be worth considering?
- Days at sea limits appear to be a more effective constraint than catch restrictions. Might the approaches proposed by Kraak paper be worth experimenting with?
- Trying various experimental management approaches on fleet sectors may be the best way to breakout of current management sclerosis.

References


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18 Daan et al 2005
19 Rijnsdorp et al 2006
20 Jentoft, S. pers comm.


SAMUDRA, 2005. Fisheries management: Capitulate, dodge, protest... SAMUDRA Report No. 41 July 2005


Long-term Management Plans for North Sea Fisheries

Literature Review of International Experiences

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Introduction

This report provides an overview of international fisheries management experiences of most relevance to the North Sea Regional Advisory Council (RAC) discussion about long-term management options for North Sea fisheries.

It describes in more detail the information presented at the North Sea RAC ‘Long-term Management Workshop’ held 2\textsuperscript{nd}/3\textsuperscript{rd} March 2006 in Edinburgh, Scotland.

The review begins by introducing some key concepts related to long-term management options, namely: (1) factors contributing to overexploitation and unsustainability, (2) possible paths to solution and the (3) range of possible management tools.

The review then provides an overview and discussion of some of the most relevant international experiences in the following countries: Canada, United States, Australia, South Africa, Faroes, Iceland and New Zealand.
**Long-term fisheries management issues**

**Key aims of fishery management**

The key aims of fisheries management are often divided into the following three categories: biological, economic and social. However a fourth, and equally important, category can be added to the list - ‘institutional’.

A review of the most important international legislation or agreements (known as ‘instruments’) was carried out by the United Nations Food & Agriculture Organisation (FAO) to determine the main aims of fisheries management defined within these instruments. These key aims are shown below and categorised as: bio-ecological, social, economic and institutional.

**Main aim of fisheries management incorporated into international instruments**

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<th>Category</th>
<th>Aims</th>
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| **Bio-ecological**| • Protect, conserve, and restore fishery resources, the environment, the habitat, the ecosystem and the bio-diversity.  
                  | • Prevent overfishing. Restoration (of the resource, the habitat, the ecosystem) with aim of conditions capable of producing MSY. |
| **Social**        | • ‘Optimum’ utilisation defined as: maintaining nutritional value of harvested products  
                  | • Ensure safe, healthy and fair working environments and conditions |
| **Economic**      | • Match fishing capacity to productive capacity of the resources, the environment and the ecosystem.  
                  | • Elimination of subsidies  
                  | • Prevent illegally caught fish from reaching their markets |
| **Institutional** | • Need to use best scientific information (on resources, the environment, and the ecosystem) – more recently inclusion of socio-economic studies and traditional knowledge  
                  | • Evaluate cost effectiveness of data collection and revision or elimination of inefficient or useless measures  
                  | • Apply precautionary approach to conservation and management  
                  | • Implement transparent decision making process and involve interested parties  
                  | • Promote awareness of responsible fisheries through education and training  
                  | • Take fisheries interests into account when planning multiple uses of coastal areas |

Source: Abridged from Swan & Gréboval (2003).

As to be expected, the bio-ecological aims related to ensuring that fisheries resources and linked elements of the marine ecosystem and biodiversity are protected or conserved and that overfishing is prevented.
Social aims related to ‘optimal’ use of fish resources, particularly in the context of ensuring that people benefit from the nutritional value of the resources. Safe, healthy and fair working environments and conditions were also highlighted. Social aims are often taken to mean that jobs in the industry should be preserved and local supporting communities maintained but these aims are not explicitly mentioned in international instruments.

Economic aims included ensuring that the amount of fishing capacity (i.e. number and size of vessels and related fishing power) matched available resources. The elimination of subsidies was also included along with the prevention of illegally caught fish reaching the market.

Finally, the fourth, largest and most diverse set of aims were grouped under ‘institutional’. This grouping included making best use of scientific information and ensuring that data collection and management measures were cost effective. One of the most important aims of relevance to the North Sea RAC and governments/European Commission related to making sure that the decision-making process was transparent and involved interested parties.

The review concluded that advice to management still tends to be dominated by bio-ecological information which in turn means that bio-ecological aims probably receive more attention than other aspects of fisheries management and that management decisions are more oriented towards achieving bio-ecological aims. Management advice from an economic and social perspective is included much less frequently in the decision-making process. Finally, the review concluded that advice from an institutional perspective is even less often taken into account.

Factors contributing to unsustainability

In 2003 an international workshop involving participants from 23 countries was organised by the FAO to determine which factors contributed most to overexploitation and unsustainability in fisheries. Six key factors were identified by the participants as being most significant and are listed as follows:

1. Inappropriate incentives
2. Lack of good governance
3. High demand for limited resource
4. Poverty and lack of alternatives
5. Complexity and lack of knowledge
6. Interactions of fisheries sector with other sectors and environment

Each of the six factors is defined in more detail in the box below. The most important of the six factors were agreed to be ‘inappropriate incentives’ and ‘lack of good governance’.

An incentive encourages a certain type of behaviour or activity. Fisheries management will fail if incentives are created (either directly or indirectly) which lead to unsustainable fishing practices. For example, if a single Total Allowable Catch (TAC) is set for the entire fishery, fishers would justifiably race to catch fish (known
commonly as the race-to-fish) and compete with each other for a share of the TAC, but this has been shown to lead to overinvestment in fishing capacity (i.e. boat size, engine power) and often leads to unsafe working practices. In this instance, incentives may also be created leading to the landing of unrecorded fish in order to try and keep the fishery open for longer. Inappropriate incentives can also stem from Effort Quotas (i.e. days at sea restrictions) which can create an incentive to continue to improve catches for each unit of allowable effort by continuously investing in better technology (know as technical creep) or substituting one controlled input to the fishing process for another (known as input substitution) (for example, the UK restriction on Vessel Capacity Units – calculated from boat dimensions and engine power – led to a growth in vessel tonnage as fishers attempted to get round the VCU restriction to improve catches).

Inappropriate incentives do not just stem from inappropriate management tools or the existence of subsidies (which are un-economic incentives). Institutional issues can also lead to a lack of transparency and participation of fishers in the decision-making process which in turn create a lack of support and willingness to support management measures.

Appropriate incentives can therefore include the following elements:

(i) assigning secure rights to shares of fisheries, e.g. in terms of areas, effort units or catch (especially those which are transferable, i.e. Individually Transferable (Catch) Quotas or long-term area-based leases, e.g. for shellfish cultivation);
(ii) using market measures (e.g. certification/labelling schemes or ‘green’ taxes) to discourage unsustainable fisheries;
(iii) allowing all legitimate stakeholders (interested parties) to participate meaningfully in fisheries management including setting objectives, providing input to science, evaluating options and reviewing performance relative to objectives.
(iv) eliminating subsidies in the fishery; where possible recovering the cost of fisheries management and recovering an element of resource rent (i.e. supernormal profit generated from catching society’s resource).

The second most important factor contributing to unsustainability was defined as a ‘lack of good governance’ which can stem from conflicting management objectives (i.e. a desire to achieve sustainable exploitation whilst achieving full employment and profits) and a lack of ability to manage fisheries effectively including a lack of (political) will to make the right decisions. Many features of poor governance are linked to the creation of inappropriate incentives. For example, management which does not take the views of key users into account can lead to a reduced incentive to comply with measures.

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21 i-iii were defined by Swan & Gréboval (2003)
### Six factors contributing to overexploitation and unsustainability

1. **Inappropriate incentives, including market distortions**: Currently, many fisheries operate in response to incentives (economic and others) that promote unsustainable practices rather than sustainable ones.

   Inappropriate incentives lead to a short-term view and overcapitalization as exemplified by the race for fish. Lack of transparency and participation of fishers in the management system undermines confidence and willingness to support management measures. Participants in fisheries should be given incentives for long-term conservation and efficiency.

   Measures that can give appropriate incentives include: (i) assigning secure rights to shares of fisheries, e.g. in terms of areas, effort units or catch; (ii) using market measures (e.g. certification) to discourage unsustainable fisheries; (iii) allowing all legitimate stakeholders (interested parties) to participate meaningfully in fisheries management including setting objectives, providing input to science, evaluating options and reviewing performance relative to objectives. Meaningful participation will vary geographically and by culture but it should always be transparent and provide full access to information.

2. **Lack of (appropriate/effective) governance**: (conflicting objectives, lack of attention, will and authority): The inability to implement required management measures by legitimate authorities (including the absence of appropriate institutions) contributes to unsustainability.

   Fishery management institutions should be appropriately funded, possibly through revenues generated by the fishery itself. Under appropriate conditions, delegation of selected management functions to local institutions can be promoted.

3. **High demand for limited resources**: Demand for fish is seen as expanding for most markets, with sustainable supply becoming increasingly limited. Higher prices may result which provide an incentive for further input expansion - generally more so in fisheries that are already overexploited.

4. **Poverty and lack of alternatives**: Conditions of poverty and lack of employment or livelihood alternatives still occur on a significant scale, particularly but not only, in developing countries.

   Use rights should be designed to satisfy societal views of fairness and equity. Benefits from more efficient fisheries management may be used to create alternative employment opportunities.

5. **Complexity and inadequate knowledge (social, economic, bio-ecological)**: The complexity of many fisheries systems as well as inadequate information and understanding make it hard to identify proper courses of action.

6. **Interactions of the fishery sector with other sectors, and the environment**: These factors are in most cases beyond the control of the fisheries sector but need to be better accounted for.
Annexe 2  Literature Review of International Experiences

Source: Abridged from Swan & Gréboval (2003).

**Paths to solution**

The FAO workshop identified a number of possible solutions to unsustainability which are described in detail in the following box. The links between different solution options and factors of unsustainability are also shown in the figure below.

### Paths to solution

1. **Rights**: The granting of secure rights to resource users (individually or collectively) for use of a portion of the catch, space, or other relevant aspects of the fishery

2. **Transparent, participatory, management**: The granting of a meaningful role to stakeholders in the full range of management (e.g. planning, science, legislation, implementation)

3. **Support to science, planning and enforcement**: Providing the resources necessary for all aspects of management of the fishery

4. **Benefit distribution**: Using economic tools to distribute benefits from the fishery to address community and economic sustainability

5. **Integrated policy**: Planning fisheries, including setting explicit objectives that address all the dimensions of sustainability and the interactions among the factors of unsustainability

6. **Precautionary approach**: Application according to FAO guidance

7. **Capacity building and public awareness rising**: Development and application of programmes to better inform policy makers and the public at large about main fisheries issues

8. **Market Incentives**: Using market tools in situations where they are appropriate for addressing factors of unsustainability

Source: Abridged from Swan & Gréboval (2003).
**Link between solution options and factors contributing to unsustainability**

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**Range of management tools**

As noted in the previous section, one of the key solution options leading to sustainability was identified as the granting of secure rights to resource users (individually or collectively) for use of a portion of the catch, space, or other relevant aspects of the fishery. Another solution option was the use of market-based incentives, where appropriate, e.g. labelling and certification schemes.

The FAO surveyed 80 of its member countries (out of a total of 188) in 2004 to determine what type of management activities they use to control fishing capacity – i.e. the productive ability of a fleet to catch fish. The figure below shows the results for all 80 respondents (grey/light column) and the world’s major producers (burgundy/dark column) with this latter group being defined as the 14 respondent nations that were in the top 25 countries in the world in terms of total output.22

The most frequently reported types of management activities were restrictions or closures relating to area, time (e.g. season, etc.), gear type, fish size or other forms of access-related restriction. Around 65% of major producer used catch restrictions whilst just over 45% used some form of rights-based or incentive aligning restriction. Around 50% used taxes or royalties or territorial, group or community measures. Very few (10%) used performance standards.

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22 which combined comprised around 80% of global marine production.
Annexe 2  

Literature Review of International Experiences

**Fishing capacity management activities undertaken by Member States**

![Bar chart showing fishing capacity management activities undertaken by Member States.]

**International experiences**

**Canada**

**Overview**

Canadian fisheries have changed markedly over the last decade with the collapse of Atlantic groundfish stocks, decline in abundance and economic viability of the Pacific salmon fishery and increase in awareness of public opinion concerning the health of the marine environment. The government’s Fisheries and Oceans Canada has initiated a fundamental programme of change in response by placing great emphasis on conservation, sustainability, economic viability and adopting a co-management approach allowingfishers more control and involvement in the management process. In recent years it has adopted a huge restructuring programme to reduce effort, capacity and employment in the most affected fisheries.

Since the collapse, Canadian fisheries are now primarily managed using a species and area-based licensing system. The majority of groundfish and pelagic species, with a notable exception being Pacific salmon, are also managed using a range of IQs, ITQs and Individual Vessel Quotas (IVQ). The introduction of quotas to the salmon fishery is currently being seriously debated on the west coast by the administration and the three major fisher groups (commercial, sports and ‘first-nation’ fishers).

In the Scotia-Fundy area of Canada considerable progress has been made regarding the development of fisheries management conservation objectives. Both government
agencies and stakeholders got together to form the Fishermen and Scientists research Society, which carries out research and monitoring of stocks and disseminates that information to its members. The results of the joint work has been an increase in the acceptance of the traditional scientific surveys as indicators of trends in groundfish abundance, and an improvement in the credibility of science within at least part of the fishing industry (Sinclair et al., 1999). This has lead to increased compliance on the part of some in the fishing industry, which has contributed to some success in implementing conservation measures (ibid).

Further to this combined work, the Canadian Department of Fisheries Sustainable Development Strategy: 2001-2003 is promoting “sustainable use of marine and freshwater ecosystems through new forms of governance and shared stewardship”. This, it is envisaged, will deliver improved stakeholder involvement in shared stewardship of estuarine, coastal and marine ecosystems and resources by adopting forums and processes that facilitate collaboration and shared decision-making between federal government departments, the provinces and territories, aboriginal organizations, coastal communities and oceans stakeholders. This Strategy is ongoing and its level of success has yet to be determined.

Objectives
Progress is slow in recovery for Canadian groundfish stocks. However, progress is being made in conservation targets of fishing mortality for stocks. This is attributed to the inclusion of fishing industry in the data collection and interpretation process.

High-level objectives for socio-economic objectives are more difficult to assess. Sinclair believes that reduced participation in the 1990’s under the combination of ITQ and “community quota” generated social tensions, with some license holders feeling disenfranchised from their traditional workplace. As a result, compliance was low and the stocks continued to suffer from over-exploitation.

Stakeholder involvement
Extensive stakeholder involvement is evident in Canadian fisheries management, however, this involvement is still, in many cases, in its infancy. As a result it will be interesting to see how the collaboration between government and stakeholders develops.

Impact of management measures
Huge sums of money have been expended on restructuring Canadian fisheries since the groundfish collapse. This has included projects for alternative employment from fishing as well as providing direct income support to many fishers most affected by the stock collapse during the 1990s.

United States
The United States (U.S.) commercial fishing fleet began to increase in number, size and efficiency in the mid 1970s when the U.S. extended its territorial jurisdiction 200
miles out to sea. Scientists and fishermen perceived the marine fisheries as an almost inexhaustible resource that could generate employment, economic growth and help feed the world. This however, was clearly not the case as catches fell and fish tock sustainability came under serious threat.

The Sustainable Fisheries Act (SFA) of 1996 amended previous legislation and redirected government efforts. Greater emphasis was placed on conservation and management by addressing overfishing, reducing bycatch and restoring depleted stocks. While promoting the development of commercial and recreational fisheries remained an official policy, federal programs shifted dramatically to fisheries conservation, stringent management, habitat restoration and reducing overcapacity, which, in many instances, is adversely impacting the industry. (DT’s MEP report)

**Western Seaboard**

Prior to 1995 the federally-managed commercial long-line fishery for Pacific halibut in the U.S. North Pacific was managed as an open-access fishery, with TAC limits and season limitations. The Pacific halibut fishery became a part-time fishery as the “race-to-fish” made the fishing season shorter and shorter each year. This short season lead to low fish prices during the season, halibut was available only for a short period of time to consumers, over capitalisation, poor product quality due to In 1995 the fishery moved from open-access management to systems with individual transferable quotas (ITQs). At that time, the halibut fisheries had the greatest number of participants of any fishery managed with individual quotas (Shotton, ed, 2001).

Initially there were rules surrounding the ITQ system. These included: only boat-owners and skippers to own quota, area-use restrictions, quota allocated to vessel-class.

**Impact of management measures**

While examining the impact of management measures there are a number of changes to note:

- Because fishers can now choose when to fish their quota they report that the price of fish now determines when they go to sea.
- Additionally, the consumer has benefited as fresh halibut is now available to the market on a year-round basis.
- Fishing conditions in the pre-ITQ fisheries were dangerous due to huge risks taken in all weather conditions to fish during the short season, now those risks are no longer taken.

**Enforcement**

There were concerns that enforcement would be more costly in ITQ fisheries. The cost of a short season was minimal compared to that where fishing occurs all year. Under the IFQ programme, the season is protracted, with fishers active throughout a 9-month period. Different limits are imposed on different fishers by their IFQ holdings.
Consequently, enforcement agents must monitor each fisher’s harvest level throughout the season to prevent ‘overages’.

Monitoring is conducted both at the dock and at sea. Dockside-monitoring has been simplified by requiring that all buyers be registered with NMFS. Buyers are required to report all purchases to NMFS through an automated system that records prices and weights of deliveries. In addition, requiring 6-hour advance notice of any delivery provides monitoring agents with the opportunity to be onsite at the time of landing. While some reports of leakage (unreported catch) have been received by enforcement agents, the problem is believed to be minor. At-sea boardings under the IFQ programme are much less burdensome than under the ‘fishing derby’ regime of the pre-IFQ fishery. Fishers in the IFQ fisheries are far less concerned about or constrained by the time away from fishing during an at-sea boarding, given the expansive time period allowed for fishing in the IFQ fishery.

In addition to the monitoring by government agencies, the system is thought to have created some self-monitoring. Some fishers believe that by providing them with an interest in the fishery, the system has led to self-policing. Fishers now consider violations by other fishers as devaluing their interest in the fishery by reducing the TAC in future years.

**Australia**

**Overview**

Australia’s fisheries are managed by a number of agencies using a number of tools and frameworks. The Australian Fisheries Management Authority (AFMA) manages fisheries within the 200 nautical mile Australian Fishing Zone (AFZ), on the high seas, and, in some cases, by agreement with the States and Territory, to the low water mark. As a general rule, AFMA looks after about 20 Commonwealth commercial fisheries from 3 nautical miles out to the extent of the AFZ. The states and territory governments generally look after recreational fishing and commercial coastal fishing.

ITQs have been used in the management of a number Australian fisheries since the early 1980s, with there currently being at least twenty ITQ-managed fisheries, accounting for about 34% of the total volume and about 22% of the total value of Australian fisheries (Arnason, 2002). These are mostly single species fisheries, although one fishery – the south-east trawl fishery – is a multi-species fishery with 16 quota species.

However, the majority of commercial fisheries within the Commonwealth of Australia are managed via input controls such as limited entry, limited cod-end sizes, area restrictions, seasonal closures and fishing methods prohibited in sensitive areas.

So why does Australia use ITQs in some fisheries and not in others? The reason is that some species are biologically more stable than others, whereas others are highly fluctuating and unstable, such as the northern prawn and as a result are better managed through input controls on a seasonal basis.
As a rule, state and territory fisheries agencies have similar types of management strategies, with emphasis on Fishery Management Plans. These plans, on a fishery-specific basis, identify objectives, describe fishing concessions (i.e., statutory fishing rights, ITQs, fishing permits and foreign fishing licenses), allocation procedures and detailed rules governing fishers. The main management methods covering recreational and commercial fishing are: input controls (e.g., gear restrictions, limited entry licenses, area and seasonal closures); output controls (TAC, ITQs, bag limits and size limits); and measures for species and habitat protection. (FAO website).

**Objectives**
The Australian Fisheries Management Authority (AFMA) manages all Commonwealth fisheries under the following essential objectives of the Fisheries Management Act 1991. The objectives of this Act are:
- Implementing efficient and cost effective management;
- Exploitation of fisheries resources in accord with the principles of ecologically sustainable development (ESD);
- Maximising economic efficiency in the exploitation of fisheries resources;
- Accountability of fisheries management; and
- Meeting cost recovery targets set by government.

The measures imposed on Australian fisheries in general via the current management system sought to implement the preceding objectives, the general consensus is that this has been achieved.

**Stakeholder involvement**
At both the State and the Commonwealth level, management is highly participatory with various joint Industry/Government bodies being established to advise on fisheries management issues. These bodies also often include community and/or conservation representatives. Specific management strategies used by AFMA and the States are based on publicly available Fishery Management Plans that have been developed through these various Management Advisory Committees and Consultative Committees.

**Impact of management measures**
Because of strict management controls, most fisheries remain very profitable. Almost all fisheries now operate under a limited access arrangement although access licenses are usually freely tradable. This arrangement has lead to significant increases in access license values, resulting in a concentration of ownership and economic barriers to new entrants. However, the commercial industry is also subject to continuing and increasing pressures, including conservation needs (such as the increasing coastal sea area being set aside as Marine Protected Areas), allocation of resources with the recreational sector and added restrictions to address marine biodiversity issues. This has lead, in most major fisheries, to a significant reduction in the number of operators (within a limited entry management environment) and therefore an increase in the concentration of ownership of access rights.
**Impact on fleet capacity**

Capacity has reduced in some, but not all, Australian ITQ fisheries. In the south-east trawl fishery quotas were set too high initially in an attempt to appease fishers. A resulting decommissioning scheme was required to reduce capacity in the fishery and this eventually led to improved profitability once enough boats had been removed from the fishery.

However AFMA has recently announced a massive new decommissioning programme in Commonwealth fisheries: in 2006 a one-off decommissioning scheme is planned to reduce the fleet by some 50%. This programme is partly designed in response to the pressures of current overfishing but also for fleets targeting stocks which are thought to be at risk of overfishing. Furthermore, the fleet reduction is also intended to address issues related to displacement of fishing capacity from areas being set-aside as Marine Protected Areas.

**South Africa**

**Overview**

In South Africa, since independence and the transition to a new democracy, the fishing industry has had to deal with ongoing instability associated with the process of transformation, including the introduction of many new entrants and the loss or reduction in the rights of the established players in the industry.

The development of a new fisheries policy started shortly after independence in 1994, and culminated in a new fisheries policy. This was followed by the promulgation of a new Marine Living Resources Act in September 1998 (effectively replacing the old Sea Fisheries Act) and a new set of Fisheries Regulations.

The subsequent allocation of medium-term fishing rights from 2003 to 2005 created much needed stability in the main commercial sectors. The issuing of medium-term rights was, however, only a precursor to long-term rights – a process that is currently underway (Oct 2005). Transformation (transfer of rights to persons previously disadvantaged in the old political regime) remains a cornerstone of the new fisheries policy.

Since the writing of the new fisheries policy in 1998 and the subsequent issuing of medium-term rights in 2003, a new set of policies that included a General Policy as well as sector-specific policies were released in the first half of 2005. These policies served as guidelines for the applications of long-term fisheries rights, and will form the basis on which decisions and allocations will be made for these long-term rights. Important elements of these policies included splitting applicants into medium-term rights holders and prospective new entrants. Strict evaluation criteria are laid down, as well as specific criteria for vessels and management measures (such as the Ecosystem Approach to Fisheries).
Integrated environmental management (IEM) principles are being applied to South African fisheries management, within the context of the Consultative National Environmental Policy Process (CONNEPP). In principle, the harvesting of any one species must not endanger the continued existence, or cause the substantial depletion of, any other species, such as destructive methods of harvesting that are detrimental to species or any resources (living or non-living). A further management objective is the designation of Marine Protected Areas (MPAs) for the purposes of scientific study, experimental fishing or conservation. Certain species or populations thereof may be fully protected.

South Africa is also taking the Environmental Approach to Fisheries (EAF) management ethos seriously and is currently critically reviewing all sectors and developing EAF plans on a sector-by-sector basis. In addition, biodiversity issues are also being addressed, which has included the passing of the National Biodiversity Act and the completion of a dedicated biodiversity assessment of the coastal, intertidal and offshore environments.

With regard to regulations, the Marine Living Resources Act (18) of 1998 is currently under review, including the associated regulations. By-catch concerns in many sectors are also being tackled, and in some case fishing grounds closed to protect stocks.

Sector-specific scientific working groups provide scientific advice to Marine and Coastal Management (MCM). This advice is considered by an advisory forum (normally comprising different role players and specialists) that advises the Deputy Director General of MCM, who in turn submits their recommendation for approval to the Minister of Environmental Affairs and Tourism. (FAO website)

**Objectives**
Fisheries in South Africa are regulated by the Marine Living Resources Act, 1998 (Act No. 18 of 1998), which aims to “provide for the conservation of the marine ecosystem, the long-term sustainable utilization of marine living resources and the orderly access to exploitation...”

**Impact of management measures**
There has been a noticeable improvement in compliance. A new system of land-based monitoring of landings has been introduced at all ports and fishing harbours, and a sea-based observer programme established for the collection of scientific data in all offshore fisheries. South Africa also has numerous Memoranda of Understanding (MOUs) with other countries and deploys observers in international waters.

**Impact on fleet capacity**
Vessels active in South Africa’s fisheries are generally reaching the end of their working life (more than 30 years old) and many new vessels are being built (mostly locally). South Africa has introduced effort control, and rights holders have to justify
new vessels within each sector. As a general rule, new effort can only replace existing effort in any sector, with replaced vessels not permitted back into the specific sector from which they came.

In the hake trawl fishery, there are approximately 100 vessels active, of which 65 (35 wetfish and 30 freezer trawlers) fish in the offshore sector and a further 30 smaller trawlers catch hake and sole in the inshore trawl sector. In the hake longline sector, there are about 150 active vessels, although many of these also fish in other sectors, such as the tuna pole and rock lobster fisheries. In the pelagic (purse seine fishery) there is a mixture of small wooden vessels and larger steel boats, making up a fleet of about 60 vessels. Offshore vessels in other sectors include a small prawn trawl fishery (four boats), the south coast rock lobster (6–8 boats), shark longline (about six vessels active) and tuna longline (50 permits, of which 12 are foreign longliners and the rest local boats). In the inshore sectors there are a large number and diversity of vessels, including large deck boats used in the squid fishery (138 boats), many west coast rock lobster boats (>200) and >400 commercial boats in the handline fishery. These figures ignore the thousands of recreational fishing boats.

**Faroes**

**Overview**

The early 1990s saw a disastrous collapse in fish stocks in Faroese waters. Denmark agreed a loan package on the condition that the Faroese implement a quota system. This was seen as an outside imposition and resisted by the industry and Parliament. When it was finally agreed and implemented in 1994, fishermen responded by refusing to comply with the rules. This resulted in substantial discarding and misreporting of catches. Re-organisation of control and enforcement failed to solve the problem.

The fishing industry was asked to come up with an alternative to the quota system in 1996 and developed a system based on of days-at-sea restrictions rather than catch limits. Individual boats were allocated a permissible number of days that they could fish. This system restricts vessels of a certain size and gear type to particular portions of the waters around the Faroes. These allocations were tradable within gear categories (i.e. trawlers, longliners, etc.). All fish that are caught during a fishing trip can be landed and legally sold.

In addition to the above restrictions, there are also a system of closed areas. The closed areas are enshrined in the Act on Commercial Fisheries, 1994. The purpose of closed areas is to protect stocks, especially juvenile fish and spawning stocks.

**Objectives**

One of the problems with input controls in fisheries management is the issue of technical creep. Essentially this means that continual small modifications and adjustments due to ongoing technology improvements and skills training can increase productivity, despite the days-at-sea restrictions. As a result fish stocks are
fished as hard, and the extent to which some input controls are able to manage the stocks effectively becomes less.

**Stakeholder involvement**

The involvement of stakeholders in the development of an acceptable management system in the Faroes is evident and has contributed significantly to the success of fisheries management there.

**Impact on fleet capacity**

There is no system in place for measuring efficiency accurately and therefore there is no reliable evidence available to assess the changes that have occurred since 1996 (Holden, 2004). However, over the period 1996-2001 (ICES, 2002) the Total Allowable Effort inside the main effort control zone was reduced by 17%. It was thought that less then one-third of the fleet was actually restricted in their activities by the days-at-sea restrictions and that there was a considerable amount of input substitution. Further, catch –per-day was thought to have increased by 25-30% over the same period due mainly to the introduction of newer, larger vessels (Pers. Comm.).

Furthermore, in a mixed fishery with species of different value, an effort control system will provide incentives to target the highest value species to maximise the value of the catch. This could prove problematic if the highest value species was a stock in trouble. (Holden, 2004).

**Iceland**

**Overview**

Iceland fish stocks were historically fished by a number of countries. In 1976, following the extension of the fisheries jurisdiction to 200 nautical miles, marine scientists warned that fishing mortality in the cod fisheries seemed alarmingly high, that the spawning stock was threatened and that this level of catch could not be sustained. Iceland began to regulate fisheries using effort quotas in the period 1977-83. These encouraged a ‘race to fish’ whereby vessel owners rushed to maximise their catch in the available fishing days. Meanwhile loose controls on fishing capacity allowed this to increase and the number of fishing days had to be reduced.

By 1984 the cod stock had declined to its lowest point. In response the government introduced individual vessel quotas with limited transferability. These evolved into a system of ITQs, a process made uniform by the Fisheries Management Act of 1990.

Iceland’s major commercial fisheries are now managed through ITQ’s. Approximately 98% of the catch is subject to ITQs, which have the following characteristics:

1. The quotas constitute a right to catch a given proportion of the TAC each year
2. The quotas are divisible and transferable but with restrictions on transfers from one region to another
3. They cover all the major commercial fisheries
4. Quotas were initially allocated on the basis of vessel track records
5. Quotas are subject to a small fee to cover administration and enforcement costs

Objectives
Fisheries management objectives to halt the collapse of groundfish stocks, through managing fishing output, and to manage the recovery of the fishery have been relatively successful.

Stakeholder involvement
Prior to the introduction of the ITQ system in Iceland the management system was described as open and inclusive, with stakeholders and co-management being the norm. However, since the introduction of ITQ’s this situation has changed and involvement of stakeholders in the management process in Iceland is now believed to be limited (Eythorsson, 2000). In the late 1990’s two committees were formed to address the issues surrounding the fisheries management system. Neither of these committees had stakeholder representatives on them, instead they included politicians, lawyers and economists (ibid).

Impact of management measures
Support for ITQs in Iceland, is not universal. The small boat sector and fishermen’s unions have complained that the cost of renting quota has reduced the crew’s income. Consolidation has resulted in a profitable fleet but has left some vulnerable fishing dependent communities economically exposed as quota has left their communities. In addition, a series of bitter industrial disputes in the mid-90s focussed on the high price of quotas and the consequent effects on crew wages. ITQs have also been criticised for promoting concentration of ownership. The top 22 companies held 47% of total ITQs in 1994 compared with 26% in 1991. They are also held to have led to a degree of regional concentration with some communities becoming marginalised as a result of loss of quotas. The Liberal Party, a new anti-ITQ political party, was formed in 1999 and now has a number of MPs in the Icelandic Parliament.

There is evidence that ITQs have brought considerable economic benefits. Over-investment in fishing capital has been restrained and the fishing fleet has contracted, fishing effort has been significantly reduced. Most Icelandic fishing firms have become profitable since the introduction of the ITQ system.

Impact on fleet capacity
ITQs did not result in a rapid reduction in fleet size. The total number of vessels in 1997 was 14% higher in 1997 than the mid 1980s, with most of this growth in the large trawler fleet segment (27% increase) (Eythórsson, 2000). An industry funded decommissioning programme was implemented between 1990 and 1997 to assist in adjustment out of the fishery. The decommissioning scheme specifically targeted the smaller inshore fleet, which declined by around 10% over the period. Of the 459
vessels receiving grants, 398 (87%) were less than 10GRT and only 24 (5%) were greater than 100GRT (Tingley, 2004).

**New Zealand**

**Overview**

In the period after the extension of fisheries jurisdiction to 200 miles in 1978, the introduction of licence limitations and other input controls failed to check investment in the inshore sector. This led to overcapitalisation, a serious decline in the sustainability of fish stocks and poor profitability. The Individual Transferable Quota (ITQ) system was introduced in a small number of New Zealand’s fisheries in 1986 and controls the total commercial catch from all the main fish stocks found within New Zealand's 200 nautical mile EEZ.

The Fisheries Act 1996 currently provides the framework and legal obligations for fisheries management. The purpose of the Fisheries Act is to provide for utilisation of fisheries resources while ensuring sustainability. The Act also establishes strong environmental obligations, including requirements to avoid, remedy or mitigate any adverse effects of fishing on the aquatic environment, meet the foreseeable needs of future generations, and be cautious when information is uncertain, unreliable or inadequate.

Presently 50 key species, of the 130 commercially exploited, are managed by the ITQ system, with separate total allowable catches (TACs) set over a number of different management areas depending on the species being managed. Quotas are allocated to full time fishers only as a percentage of the quota based on catch history. However the system has been continually revised to include more species and improve its performance.

The management of bycatch is being addressed through the further introduction of bycatch species into the ITQ system. If a fisher does not hold quota for a bycatch species, then he will have to pay a deemed value (type of penalty) on landing the fish. The deemed value is set so as to deter fishers from catching fish they do not hold quota for, but not so high as to encourage discarding.

Current stakeholders want more control over the management of their activities and New Zealand is currently working towards the use of fisheries plans as a form of co-management tool. According to the Ministry of Fisheries, fisheries plans will identify objectives and detailed rules governing fishers. The main management methods covering recreational and commercial fishing are: input controls (e.g., gear restrictions, area and seasonal closures); output controls (TACs, ITQs, daily bag limits and size limits); and measures for species and habitat protection. They will allow stakeholders to participate more in fisheries management by encouraging them to propose new and innovative management options tailored to the particular characteristics of a fishery. It is proposed that management measures (tools and services) may be undertaken by both the Ministry and by stakeholders.
For stock with no fisheries plan, Ministry stock strategies will pursue Government objectives for the fishery, analyse risk, and describe the tools and services that will be provided to each fishery.

New Zealand fisheries management is also subject to a number of management strategies including the Strategy to Manage the Environmental Effects of Fishing and the Marine Protected Area Strategy.

The Strategy to Manage the Environmental Effects of Fishing has at its core environmental standards, designed to specify in more detail the outcomes the Government has determined it wants to obtain from fisheries. The Government will set environmental standards, with input from Tangata Whenua (Maori) and other stakeholders. Environmental standards will specify the limits of acceptable effects of fishing on the aquatic environment.

The Ministry of Fisheries has determined that setting environmental standards will require careful consideration of environmental obligations, value from utilisation of fisheries, social values, and the value for future generations. Some of these factors cannot be maximised simultaneously and, therefore, trade-offs must be made.

The draft Marine Protected Area Strategy sets out to develop and implement a strategy for establishing a network of areas that protect marine biodiversity, including marine reserves, world heritage sites, and other coastal and marine management tools such as mataaitai and taiapure areas (customary fisheries management), marine area closures, seasonal closures and area closures to certain fishing methods. This strategy is currently the subject of debate between a number of government agencies on how it should be implemented.

Both of these strategies are seen as key additional long-term management approaches to be used alongside the established quota management system.

**Objectives**

The measures imposed on New Zealand fisheries via the ITQ system sought to reduce fishing effort and the general consensus is that this has been achieved.

However, while the QMS provides an excellent tool for controlling fishing catch, it does not manage species which are outside the QMS including other fish caught as by-catch, the incidental deaths of seabirds and marine mammals, habitat damage from dredging or trawling, and the flow-on effects all these things might cause to marine ecosystems.

Tools such as regulation and the use of fisheries plans and the application of the SMEEF and MPA strategies are proposed to enable New Zealand to achieve its high level management objectives.
Stakeholder involvement
The Fisheries Act 1996 provides for the consultation of stakeholders. There are a number of management processes that stakeholders can currently participate in. These include consultation reports that are sent out to key stakeholders for comment when new management measures are proposed (e.g. reduction in quota, change in regulations, etc.), public meetings and the development and implementation of fisheries plans. However, the Fisheries Minister has the final responsibility for the fishery resources and therefore the final management decision remains with that position.

Additionally, ITQs in New Zealand have also been found to give fishers a much greater say in fisheries management. Fishers are active in research, enforcement and the development of management plans (Bess and Harte, 2000; Hughley, et al., 2000; Yandle, 2003).

Impact of management measures
Since the introduction of ITQ’s, both profitability and investment in the fisheries has increased, as has stock availability (Bess, et al., 2000). Although the fishing fleet and number of fishers at sea has reduced, the number of people employed in the onshore fisheries sector, in areas such as processing, has increased.

However, the continual revision of the ITQ system to include more species and improve its performance has lead to criticism about its increasing level of bureaucracy, complexity and cost, the majority of which is cost recovered from the industry.

Despite this, the outcome of ITQs in New Zealand is generally regarded as having been good. Over-exploitation has been greatly reduced and the stock size of most species has either increased or stabilised. Profitability has improved and the fishing industry is a staunch supporter of the system. This has built a consensus in favour of management based on clear use rights.

Enforcement – it should be noted that there are limited opportunities to circumvent enforcement and compliance systems in New Zealand fisheries. There are in existence, very strict catching and landing reporting where fishers must complete catch data logs. On landing fish may only be landed to licensed fish receivers only, who must also complete licensed fish receiver forms.

Impact on fleet capacity
The total capacity of the New Zealand domestic fishing fleet grew by a net 43% from 1987 to 1998. This is accounted for by growth in the offshore (>33m) fleet to replace charter vessels and increase specialisation. The noteable expanding classes include the 43m vessels and the 60-70m freezer trawlers. The inshore fleet has changed little in aggregate capacity although it has undergone significant restructuring (Shotton, 2001).
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Modelling to assess fleet reaction to management

Simon Mardle (CEMARE)

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Introduction

Fisheries management is characterised by multiple objectives. A range of objectives facing managers has been categorised (e.g. Crutchfield, 1973; Charles, 1989; and Mardle et al., 2002). Generally, objectives fall under three main headings: environmental (including biological and conservational), economic, social and institutional. Mardle et al. (2002) examined the objective structures of several EU example fisheries of different size and structure, and found a wide range of management objectives, from maximisation of profit and employment to maximising sustainable yield but also including conflict minimisation and safety considerations. Pope (1997) notes that it is well documented that generally the multiple objectives of fisheries management cannot be simultaneously optimised.

However, policy direction must still be identified. It has been suggested that a major factor in conflicts between interest groups is caused by a lack of understanding of the importance of objectives held by the various interest groups involved. As a result, the performance of the policy is judged against a group’s own individual set of priorities. For example, an organisation representing fishers could be expected to be closer to the objectives of maintaining employment and maximising profit than say an environmental group that would be expected to be more detached from these objectives. Lane (1989) highlights this fact noting that conflict between objectives in fisheries management is most generally between long-term biological or conservation objectives and short-term economic objectives. However, administration groups such as policy makers naturally hear the concerns from all groups.

Bioeconomic models provide a framework in which the potential impacts of policy can be evaluated. In such a framework, biological and socio-economic components are included directly. In particular, it is the response of fishers to management change that is a major source of uncertainty in implementing fishery management decisions. The economic implications of this to fleets and the resulting effectiveness of policy are key suppositions for analysis. Bioeconomic models provide a management evaluation framework for the investigation of these suppositions before policy is implemented (Hilborn and Mangel, 1997). Also, they are a means by which scientists, policy makers and stakeholders can cooperate in policy formulation and assessment. In this way, the assumptions are transparent and explicitly stated throughout and within the mathematical formulation (specified as a series of equations) of the model.

Considerable attention has been focused on bioeconomic models in fisheries. However, even though for the most part they follow the same structure, most are bespoke to the fisheries and fleets under investigation. Due to the complexity of models, with so many interacting components, the direction of change can be estimated, but the magnitude and impact of the change on any particular fishery system often remains highly uncertain. Hence, the majority of bioeconomic models evaluate the potential effects of scenarios relative to each other rather than in a predictive capacity. In this approach, much of the underlying uncertainty is negated as it is included in the same way in all scenarios.
While the development of bioeconomic models is well established, they have generally not been used to assist in the development of fisheries management plans in Europe. In other countries (e.g. Australia and New Zealand), they have been applied to aid in management plan formulation and analysis, but only on a limited number of occasions. The underutilisation of bioeconomic models in the past in the development of effective management plans may be partially a function of their limited scope. Most bioeconomic models consider only the relationship between the fishing fleet and the stock, whereas management has many wider objectives (as noted above). Indeed, a recent study (Mardle et al., 2004) found that, in the UK, regional employment was a major objective, and in most cases more important than economic performance of the fleet itself. A wide variety of management objectives have also been observed around Europe (Mardle et al., 2002).

**Bioeconomic models in fisheries management**

A schematic of the structure of a fisheries-based bioeconomic model is given in figure 1. Two key components form this basic structure: fisheries science and fisheries economics. The former relates specifically to stocks and the latter to fleets. They are linked by landings and fishing mortality. This leads to the important role of bioeconomic models for the provision of advice: that of the problem of multiple stocks. The impact of fleet activity is typically not on a single stock (except in some fisheries where specific fishing gears are used or only single species live), but on multiple stocks. Simplistically, this would suggest that using only the fisheries science box to provide advice will not fully describe the system. The bioeconomic model is uniquely placed to overcome many of these issues. However, due to the complexities of linking fleet activity to multiple stocks, bioeconomic models have not been widely used in the management and policy arena in Europe.\(^{23}\)

Historically, fisheries assessment (i.e. the fisheries science box) is based on single stock models. Such models are based on the description and analysis of processes such as growth, mortality and recruitment. For the most part, bioeconomic models incorporate single species fisheries assessment models, and link these to fleet activity through an anticipated production process. In recent years, attempts to develop multi-species models (and ecosystem models) have been made.\(^ {24}\) However, in principle this relates to the fisheries science box, but it could be assumed analogous to the expected effects of fleets as multiple species co-exist. There have been few attempts at developing this into a complete bioeconomic framework.

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\(^{23}\) For the most part, this is true in the general case of fisheries management around the world.

\(^{24}\) Throughout this section the terms multi-stocks and multi-species are used to describe different processes: multi-stocks for the activity of fleets in catching multiple species; and multi-species for the natural process of species co-existing in the same environment (i.e. predator-prey interactions etc).
Previous bioeconomic models of the North Sea

Compared with many fisheries around the world, considerable attention has been devoted to the development of bioeconomic models of the North Sea fisheries, reflecting the relative importance of the area to the EU. The majority of target species are managed under the total allowable catch (TAC) system of the Common Fisheries Policy and as a result stock assessment is routinely undertaken. An overview of the main species managed under quota in the North Sea is provided in table 1. Species that have been the focus of bioeconomic models are highlighted in bold, where typically a single or limited range of species are considered.

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25 Data used in this procedure is based on both logbooks of catches submitted by vessels over 10 metres in length and surveys from scientific research vessels.
Table 1. TACs set in the North Sea for species.

<table>
<thead>
<tr>
<th>Pelagic species</th>
<th>Benthic and demersal species</th>
<th>Flatfish</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herring</td>
<td>Plaice</td>
<td>Cod</td>
<td></td>
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<tr>
<td>Horse mackerel</td>
<td></td>
<td>Haddock</td>
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<tr>
<td>Blue whiting</td>
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<td>Saithe</td>
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<tr>
<td>Sprat</td>
<td></td>
<td>Whiting</td>
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<tr>
<td></td>
<td></td>
<td>Norway pout</td>
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<td></td>
<td></td>
<td>Sandeel</td>
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<td></td>
<td></td>
<td>Anglerfish</td>
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<tr>
<td></td>
<td></td>
<td>Ling</td>
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<td></td>
<td></td>
<td>Northern prawn</td>
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<tr>
<td></td>
<td></td>
<td>Nephrops</td>
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</tr>
</tbody>
</table>

Note: does not include Mackerel, Megrims, Hake and Greenland halibut.

Pelagic

Bjørndal and Conrad (1987) and Bjørndal (1988, 1990) developed a dynamic bioeconomic optimisation model of the North Sea herring fishery. The aim of the model was to estimate the harvest rate and biomass that resulted in the maximum discounted net revenue over the period 1947 to 1981. Fleet dynamics allowed for changes in fleet size but not in fleet structure. Bjørndal and Toft (1992) updated these studies using revised and extended data set. The optimal harvest was again estimated, and the discounted net revenues from the optimal fleet was compared with the actual flow of profits over the period 1965-1990 to estimate the cost of sub-optimal management. Related studies of the herring fishery include an analysis of optimal boat size and supply response (Bjørndal and Gordon, 1989; 1993). This analysis was extended by Nøstbakken and Bjørndal (2004) using a discrete-time bioeconomic model of North Sea herring to derive and estimate supply functions. In particular, management scenarios of open-access and optimally managed (i.e. maximising the net present value) are investigated with respect to the state of the fishery.

In a study by Christensen and Lassen (2004), the short term economic impact of quotas for the Danish herring and industrial fleet was assessed. The species included for analysis were herring, sprat, Norway pout and sandeel. The model calculates the net revenue for the fleets in 1999 evaluating seven management options given by the ICES Advisory Committee on Fisheries Management (ACFM).

Flatfish

Due to the Plaice Box in the North Sea, which was established in 1989 to protect juvenile flatfish (i.e. plaice and sole), a significant amount of scientific interest has
been given to the evaluation of the sole and plaice stocks. The most recent study considered the effectiveness of the plaice box and was evaluated by an expert group in 2004 (Grift et al., 2004). However, almost all of the modelling work has related to the biology and has not included an economic component.

Dol (1996) developed a simulation model of the sole and plaice fishery in the North Sea, primarily for the Dutch beam trawl fleet. The model focused primarily on the Dutch beam trawl fleet, and was used to estimate the potential benefit of an area closure for plaice.

Ulrich et al (2002) developed a dynamic bioeconomic model of the North Sea sole and plaice fishery. This included an allowance for increased productivity through changes in average technical efficiency as the fleet changed over time. In addition, total allowable effort quotas (TAEs) were considered an alternative to single-species total allowable catch quotas (TACs). An outcome of this work suggested that variability in catchability has a much greater impact on stock levels than fisheries profit.

In multi-stock models concentrating on demersal species, sole and plaice have been included (e.g. Frost et al., 1993; Mardle et al., 2000). This approach is discussed in more detail in the following section.

**Other demersal**

A number of multi-stock models have been constructed that consider the other demersal fisheries of the North Sea. Kim (1983) developed a surplus production multi-stock model of the demersal fishery to estimate the potential economic rent that could be achieved. Frost et al. (1993) developed two bioeconomic models of the North Sea fishery. A linear programming model was used to estimate the optimal allocation of effort of Danish trawlers, from two ports, between three fishing areas. A larger simulation model was used to estimate levels of effort and catches for eight countries by species and gear type. Mardle et al (2000) developed a multi-objective long run equilibrium model of the demersal fisheries which was used to estimate the optimal level of catch taking into consideration the multiple objectives of the Common Fisheries Policy. The analysis looked at trade-offs between sustainable levels of employment, discarding and fishery profitability in a long run equilibrium setting. The model was further developed by Mardle and Pascoe (2002), who incorporated a short run component to the model, and estimated the trade-off between long and short run objectives in the fishery. In addition, Pascoe et al (1999) also further developed the original model used by Mardle et al (2000) to incorporate market interactions between the North Sea demersal species and farmed salmon. The model was used to examine how market interactions between farmed and wild caught species can affect the development of the fishery.

The dynamic model developed by Pascoe et al (1999) was updated with more recent biological and economic information (e.g. costs, prices, fleet information, stock biomass etc) and used to estimate the long-run economic impact on the UK fish catching industry of a “days at sea” regime for cod stocks implemented from January
2004, embodying tradable effort entitlements (Pascoe and Mardle, 2002). The model included the predator-prey relationships of the earlier versions of the model. The model was used to estimate the ‘optimal’ level of effort reduction in terms of both fleet size and utilisation required to maximise fisheries profits over time. The ‘optimal’ solution was found to roughly halve the fleet size from the 2001 level and also introduce up to a 60 per cent reductions on days at sea for the first 4-5 years. The most recent attempt to incorporate the multiple objectives of the CFP into this bioeconomic model is given in Mardle and Pascoe (2003).

**Multi-species issues**

Issues surrounding multiple species concentrates on the interactions between species. In this case, there is not necessarily a fleet component. For example, it is food web structures and predator-prey relationships that are of focus. Several multispecies fisheries assessment models and ecosystem models exist including MSVPA, 4M and ECOSIM. However, due to the intense data requirements of such models, they are not routinely used in the stock assessment process. ICES has a Multi-Species Assessment Working Group that mostly concentrates on biological interactions.

Examples of bioeconomic modelling studies that consider multi-species interactions are Flaaten (1998) and Mardle et al., 2000. In Flaaten (1998), the interactions between predator and prey stocks are investigated from a biological and economic point of view. This approach is applied to the case of a predator (Northeast Arctic cod) and its prey from a commercially important perspective (capelin, herring, shrimp and small cod) for Norway. A recommendation of this bioeconomic analysis is that “biological and economic factors should be considered simultaneously in management analyses”. In Mardle et al. (2000), predator/prey relationships were used to improve the statistical properties of the biological relationships in the model.

**MSVPA and 4M**

The MSVPA (multi-species virtual population analysis) model couples several single species VPAs through estimates of age specific predation mortalities. This restricts the species involved to those, which are assessed with single species VPA. For example, in the North Sea this includes cod, whiting, haddock, saithe, sandeel and herring. From surveys of stomach contents of sampled fish, investigations show that for instance mackerel and saithe act as predators, cod, whiting and haddock act both as predators and prey and sandeel are prey only. Detailed estimates of stomach contents are required in order to undertake this analysis and this has not been done routinely even for the North Sea.

In order to extend MSVPA by considering fleet and areas, the 4M package (multi-species, multi-fleet and multi-area model) (Vinther et al. 2002) was developed. This

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26 This is in contrast to multiple stocks which focuses on the activity of fleets catching more than one stock.
attempts to handle technical interactions much better but is still dependent on data availability regarding stomach contents. Further, 4M is more dynamic than MSVPA where growth of predators is modelled as a function of the food available. It is reported that 4M is used by the ICES Multispecies Working Group for the Baltic Sea and by the ICES Study Group on Multispecies Assessment in the North Sea, established in 2002. In this forum, economics of the fleets are not included for analysis or evaluation.

**ECOPATH with ECOSIM**

The Ecopath model (Christensen and Pauly, 1992; Pauly et al., 2000) is based on a ‘static mass-balanced snapshot of the resources in an ecosystem and their interactions’. Ecopath data requirements include information from stock assessment or ecological studies including fishery catches, biomass estimates, total mortality estimates, consumption estimates, and diet compositions. As with MSVPA/4M, the last two components relate to stomach contents for which data is not gathered regularly. The parameterisation of an Ecopath model is based on satisfying two ‘master’ equations regarding production and consumption where the whole ecosystem under evaluation balances. Ecosim is an extension to Ecopath that provides for dynamic simulation, expressing biomass flux rates among pools as a function of time with varying biomass and harvest rates (see Walters et al., 1997 and 2000). Components have also been developed to include fleets into the process. However, due to the lack of available data, complexities and unknowns involved, this approach has not been used in the policy arena.

**Economic impact of TAC**

Instead of modelling the complete bioeconomic system, models to consider the economic impact of TACs on fleets in the short term have been developed (e.g. Salz and Frost, 2000; Sandberg et al., 1998; Christensen and Lassen, 2004). In essence, they provide an indication of the economic impact of changes in quotas on key fleet segments.

The EIAA model (Economic Interpretation of the ACFM Advice) (Salz and Frost, 2000) has been used for several years by the STECF to indicate the potential effects of proposed TACs on key fleets in the forthcoming year. It does not therefore contain fleet and stock dynamics. This model has been used to assess the impact of quotas on the key fleet segments operating in the North Sea. The model is not a true bioeconomic model as it does not have an explicit biological component, but works backwards from information on quotas to estimate how fleet costs and revenues may change given a change in quota. The model provides rough estimates of changes in economic performance of particular fleet segments.

In a similar approach, Sandberg et al. (1998) constructed a model to evaluate the economic effect of the TAC for Norwegian fisheries. In this study, northeast Arctic cod and Norwegian spring spawning herring are taken for analysis. Also,
Christensen and Lassen (2004) considered the economic impact of the ACFM catch options for the Danish North Sea herring and industrial fisheries in 1999. In their approach, a model to calculate the short-term economic net revenue was developed.

Management scenario development (long term approaches)

Bioeconomic models can be static or dynamic oriented, where static models consider some potential future in the long-term horizon and dynamic models consider possible effects over time typically on a yearly basis. Such models can be simulation or optimisation based. The main differences here are the assumptions that underlie the model. In the simulation case, a constant fleet over time is the core of the analysis, whereas in the optimisation case, a fleet that maximises discounted net profits over time is considered. The choice of approach to take is determined by the aims and assumptions inherent in the case study under analysis, but it is typically driven by the characteristics of the fleet(s) therein.
**Scenario analysis (options)**

Scenario analysis helps with the understanding of uncertainties arising out of changes in strategic external conditions. Each analysis considers the biological, economic, social or institutional outcomes that drive change in order to highlight unexpected risks. Scenario analysis can be considered a ‘risk assessment’, and incorporates ideas from decision-makers and stakeholder representatives. Not only can scenarios analysis be used to highlight risks, but it can also highlight opportunities and trade-offs of potential management strategies. Overall, the aims and uses of scenario analysis are to (Maack. 2004?):

i) manage risk;
ii) build consensus for change;
iii) augment understanding about the future; and
iv) monitor progress and scan for changes in the environment.

Often uncertainty in biological and economic factors arise through changes that cannot be managed via fisheries management. For example, economic parameters such as fuel price are dependent on changes in international fuel supplies and world oil prices. As seen recently in European fishing fleets, such a dramatic change (i.e. doubling in the course of a year 2004/05) will have an adverse effect on fishing firms. Changes in governments, general inflation rates, consumer tastes and attitudes also affect prices of both inputs and outputs. Similarly, biological parameters are subject to changes in distributions and growth rates of fish species which may be affected by water temperature, a possible result of climate change. It is a hypothesis that future environmental conditions affect the ability of stocks to recover, and in some cases may have contributed to their current low levels (e.g. North Atlantic cod stocks).

An alternative to forecasting such conditions is to derive a range of potential scenarios or options. Bioeconomic models provide a capable tool for this analysis. In this case, scenarios are not necessarily predictions about future events, but rather identify states of existence that may realistically occur. The effects of potential management strategies can then be assessed under these conditions. This allows the robustness of the strategies to be assessed under a range of differing biological and economic conditions. Scenario analysis may also enable stakeholders to consider strategies that would not otherwise be considered.

“Scenarios are useful tools for task managers operating in environments in which long-term thinking, flexibility, and the inclusion of stakeholders in decision-making are needed. Scenarios bring insight to the potential futures in which an intervention will operate, what it will need to do to succeed in each future, and what needs to be done to make that success possible. By addressing rather than minimizing uncertainty, scenarios spur innovative and robust solutions. Because they are developed with a team of knowledgeable stakeholders, they are an effective way to gain buy-in for strategies” (Maack, 2004?; p.81).
The development of scenarios for strategy analysis is not straightforward, and methods for developing such strategies is beyond the scope of this study. Details on the scenario planning process can be found in Maack (2004?) and O’Brien (2004).

**Trade-offs**

Different groups (e.g. fishers, policy makers, fishing organisations and environmental groups) place different importance on individual objectives of management and therefore judge performance of the policy against their own individual set of priorities. Much of the criticism of a management strategy is largely based on a particular set of objectives not being fulfilled as expected by a particular group. The challenge for the successful management of fisheries is to determine strategies that ensure the sustainability of the stocks, improve incomes, not increase prices to consumers, and maintain regional communities that depend on fishing. These objectives cannot be fully achieved simultaneously, but for management to be accepted by participants in the fishery, targets must be established that best reflect the trade-offs between the different objectives. The evaluation of trade-offs between objectives in a bioeconomic modelling framework is one approach that can be taken.

Different recovery strategies will result in differing impacts on a range of differing variables. For example, one strategy may increase the benefits to the recreational sector while reducing the benefits to the commercial sector. Where these changes can be valued in a common currency (e.g. benefits can be measured in economic terms), then the trade-offs are explicit. Trade-offs between non-commensurate variables can be evaluated through multi-objective programming techniques. Such an approach allows for preferences to be identified. These will be based on stakeholders’ perceptions and mis-perceptions of the current and future state of the system. Accordingly, they provide a good starting point for facilitating discussions between different stakeholders.

The triangle of paradigms, as introduced by Charles (1992), where vertices are set to be the objective groups of economic, biological and social/community is particularly relevant. It can be typically shown that the objectives of improving profit from the fishing activity and increasing stock levels are for the most part complementary. This indicates a more efficient fishery with higher stock levels and vice-versa. However, studies by Boncoeur and Mesnil (2001?) and Le Gallic et al. (2006) suggest that a path of least change is followed as far as possible, which relates closest to the social/community paradigm. Hence, the main ‘conflict’ arises between economic / biological objectives and when trying to maintain levels of fisher employment. This could be viewed as maintaining some degree of social cohesion in areas and communities where alternative employment may be scarce. Trade-offs between profit and employment can be explicitly drawn from bioeconomic models. Defining preferences for stakeholders can lead to an indication on the curve as to where a preferred outcome may lie. This could not only lead to a more open and transparent management process but also can aid the definition of targets for the management of fisheries.
Complex versus simple bioeconomic models

In essence, too much complexity leads to too much uncertainty in a bioeconomic model. This must clearly be placed into context with respect to quality of data and known relationships being modelled. However, an over-complex model can lead to problems with interpretation of the model’s dynamics and predictions. In contrast, too little detail results in models that cannot produce relevant results. It must be borne in mind that complexity that is introduced for the sake of completeness may be counterproductive if the resulting model is actually of poor quality. Hence, total “realism” in a model may not give the reliability that is required for indications of effects under analysis. This is a key challenge that faces modellers but it is nevertheless a balance that must be struck.

Relevant case study examples

Northern Ireland Fleet Futures Analysis (2004-2013)

Tingley (2005) undertook a study to evaluate the potential effects of uncertainty in future stock size predictions on the Northern Irish whitefish fleet. The original fleet size modelling work was carried out as part of the Strategy Unit project “Net Benefits”, which gave rise to the new set of analyses for Northern Ireland. As stated by Tingley (2005), the basic premise for the work was to “arrive at a likely range for the number of boats that can be economically sustainable in the long-run, here assumed to be 2013.” (Net Benefits, pp.55).

A futures analytical framework was set up to consider three sets of possible scenarios for the Northern Irish whitefish fleet. The scenarios were tagged optimistic, pessimistic and best Guess. A stakeholder group was convened to discuss the procedures used, and it was agreed that the model and associated analysis would take account of the following (Tingley, 2005):

- the analysis was not intended to provide precise fleet size targets for the future, but used to indicate segments most out of balance with current and possible future fishing opportunities.
- It provides input to the question: “How do we achieve a profitable and sustainable fishing industry?” and in doing so stimulate a discussion about the future and encourage dialogue between key stakeholders in the sector, including policy makers.
- the model and analysis would provide a systematic and structured approach allowing for improved analysis and evaluation of future options.
- the process would help highlight data (scientific and statistical) issues/problems.
the model could be adapted in the future for use as a tool to aid: Business Planning, Lobbying for Regional Policy, Lobbying by Industry, Fleet Management and Development Options and/or Environmental Management Options.

Invest in Fish South-West (2006-2020)

“Invest in Fish South-West will define a strategy for the sustainable management of fisheries in the region during 2006. This strategy will look to further improve fish stocks in the long-term while balancing the needs of the community, regional economy and the wider marine environment.”

IIFSW is a new type of project – it is driven by a steering group that is comprised of stakeholder representatives who together will determine the final strategy. The stakeholders represented each have a direct interest in the management and use of the fish stocks in the South-West, and they represent: statutory and conservation agencies, commercial fishing, fish processors, retailers, restaurateurs, regional development, recreational sea anglers, and environmental NGOs and conservation organisations.

The COBAS dynamic bioeconomic model has been developed under the Invest in Fish South-West (IIFSW) project. The model is to be used to assess a range of management options for stock recovery for the South-West over a 15 year time horizon. The model includes a number of key features:

- it contains the main biological and economic processes in the fisheries;
- it contains the technical interactions in the fisheries;
- it is able to simulate the effects of a wide range of management options proposed by the stakeholder groups;
- it is able to provide information on the key indicator variables of interest to the stakeholder groups; and
- it is able to take into consideration the considerable uncertainty underlying the biological and economic processes.

The model includes the areas of the English Channel and Western Approaches (i.e. ICES divisions VII d – j). The model includes all key stocks and all key fleets. In addition, the model is designed to consider the impact of management options on recreational fishers, the environment and the regional economy as well as on the fleets. After extensive consultation the steering group has decided upon the set of management options to be evaluated. These will be refined towards the end of the project (2006).

The model aims at capturing the interactions and measuring the impacts of management changes on the fleet profitability, the regional economy, the environment and other stakeholders (such as recreational fishers). Both short term and longer term impacts are evaluated. Ultimately, the model will also be able to
estimate the fiscal benefits in terms of increased tax revenue arising from the improved profitability of the fishing industry and regional economy.

The bioeconomic model of the fisheries in the South-West as well as surveys and investigations on the marine environment, marine mammals, sea anglers, fishermen and policy have all been undertaken by experts in their respective fields.

The analysis of other management possibilities

According to the theory, the optimal use of the fisheries resource is to achieve the maximum level of resource rents possible from the fishery (e.g. Arnason, 1994; Cunningham, Dunn and Whitmarsh, 1985). Such a simplification comes closest to maximising social welfare as fishermen and society maximally benefit from the use of the resource. Therefore, the modelling of the outcomes of such is both straightforward and complex. That is, the modelling of the effects is easily justified, however how factors in reality relate to a change in management regime is not so simple. Trade-off analysis is one approach for the evaluation of potential effects.

Whether catches or effort is used as the control variable in fisheries management, two methods of control can be defined. That is command and control or incentive-based systems. The former are discussed above and a brief comment on the latter is given here. Both have advantages and disadvantages, but simplistically the difference is one of so-called transferability. For example, a catch controlled system under command and control would allow for non-transferable quotas, but an incentive-based system would allow transferable individual quotas. Individual quotas in this case implies individual shares of a TAC and transferable implies that they are tradable on a market.

ITQ systems exist around the world, although few European countries have yet to implement such a system formally. Modelling ITQ systems is not generally done through bioeconomic models but with economic models. Several example studies exist that maximise the present value of the future profit flows in the fishery (e.g. Matulich et al., 1996; Vestergaard et al., 2005).

Appendix: Fleet descriptions in the North Sea

The EC Data Regulation that defines fleet segments for the collection of fisheries sector data is summarised on figure A.1.

For several years, economic data for key European fleets has been brought together in the Annual Economic Report (2004, Concerted Action Q5CA-2001-01502). For the countries bordering the North Sea (i.e. Belgium, Denmark, France, Germany, the Netherlands, Norway and the United Kingdom), the key fleets are provided in table A.1.

\[\text{\textsuperscript{27}}\] The standard aim of normative economics is the maximisation of utility or welfare. 
\[\text{\textsuperscript{28}}\] This does not of course take account of all of the intricacies of such management systems, but provides for a discussion as to the role of bioeconomic models. It is not an aim of this section to provide a critique of these management systems.
### Figure A.1: Detailed disaggregation of fleet segments (Appendix III; Commission Regulation (EC) No 1639/2001)

<table>
<thead>
<tr>
<th>Vessel length</th>
<th>Type of fishing technique</th>
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</thead>
<tbody>
<tr>
<td>&gt; 10 m</td>
<td>Beam trawl</td>
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<tr>
<td>10 - &lt; 12 m</td>
<td>North Sea &gt; 221 kW</td>
</tr>
<tr>
<td>12 - &lt; 18 m</td>
<td>North Sea &gt; 221 kW</td>
</tr>
<tr>
<td>18 - &lt; 24 m</td>
<td>Outside North Sea</td>
</tr>
<tr>
<td>24 - &lt; 48 m</td>
<td>Demersal trawl and demersal seine</td>
</tr>
<tr>
<td>&gt; 48 m</td>
<td>Demersal and Scottish seiners</td>
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<tr>
<td></td>
<td>Polysalvet</td>
</tr>
<tr>
<td></td>
<td>Pelagic trawl and seiners</td>
</tr>
<tr>
<td></td>
<td>Pelagic trawl</td>
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<tr>
<td></td>
<td>Pelagic seine and purse</td>
</tr>
<tr>
<td></td>
<td>Polysalvet</td>
</tr>
<tr>
<td></td>
<td>Dredges</td>
</tr>
<tr>
<td></td>
<td>Polysalvet mobile gears</td>
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<tr>
<td>Passive gears</td>
<td>Gears using hooks</td>
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<td></td>
<td>Longhion</td>
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<td></td>
<td>Other gears using hooks</td>
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<tr>
<td></td>
<td>Drift nets and fixed nets</td>
</tr>
<tr>
<td></td>
<td>Pon and traps</td>
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<tr>
<td></td>
<td>Polysalvet passive gears</td>
</tr>
<tr>
<td></td>
<td>Polysalvet</td>
</tr>
</tbody>
</table>

### Table A.1: Key fleets, countries bordering the North Sea re: Annual Economic Report, 2004.

<table>
<thead>
<tr>
<th>Belgium:</th>
<th>The Netherlands:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beam trawlers over 24 m</td>
<td>Shrimp beam trawlers under 24 m</td>
</tr>
<tr>
<td>Beam trawlers under 24 m</td>
<td>Beam trawlers under 24 m</td>
</tr>
<tr>
<td>Shrimp beam trawlers</td>
<td>Beam trawlers over 24 m</td>
</tr>
<tr>
<td></td>
<td>Trawlers over 24 m</td>
</tr>
<tr>
<td></td>
<td>Pelagic trawlers</td>
</tr>
<tr>
<td>Denmark:</td>
<td>Norway:</td>
</tr>
<tr>
<td>Purse seiners / trawlers over 40 m</td>
<td>Coastal vessels</td>
</tr>
<tr>
<td>Trawlers 24 -&lt; 40 m</td>
<td>Trawlers</td>
</tr>
<tr>
<td>Trawlers under 24 m</td>
<td>Trawlers / purse seiners</td>
</tr>
<tr>
<td>Danish seiners</td>
<td>Pelagic trawlers</td>
</tr>
<tr>
<td>Gillnetters</td>
<td></td>
</tr>
<tr>
<td>France:</td>
<td>United Kingdom:</td>
</tr>
<tr>
<td>Atlantic bottom trawlers</td>
<td>Scottish demersal trawlers over 24 m</td>
</tr>
<tr>
<td>Atlantic trawlers/dredgers</td>
<td>Scottish demersal trawlers under 24 m</td>
</tr>
<tr>
<td>Atlantic netters</td>
<td>Scottish seiners</td>
</tr>
<tr>
<td>Atlantic longliners and liners</td>
<td>Beam trawlers</td>
</tr>
<tr>
<td>Atlantic potters</td>
<td>Northern Irish nephrops trawlers</td>
</tr>
<tr>
<td>Germany:</td>
<td>Scottish nephrops trawlers</td>
</tr>
<tr>
<td>North Sea trawlers</td>
<td>Scallop trawlers</td>
</tr>
<tr>
<td>Shrimp beam trawlers</td>
<td></td>
</tr>
</tbody>
</table>
References


Mardle, S. and Pascoe S. (Eds) 2003b. Multiple objectives in the management of EU fisheries: preference elicitation. CEMARE Report No. 64, University of Portsmouth


Sandberg et al. 1998.


Vinther, M., Lewy, P. and Thomsen, L. (2002). Specification and documentation of the 4M package containing multispecies, multi-fleet and multi-area models. Danish Institute for Fisheries and Marine Research, Charlottenlund Castle, DK-2920 Charlottenlund, Denmark (contact mv@dfu.min.dk).


Discussions on long-term management:
John Pope’s discussions with 22 Experts.

John Pope NRC (Europe) Ltd.

Introduction

Between 19th January and 3rd February 2006 I held discussions on the subject of long term management of the North Sea with 22 Fisheries Experts in Scotland, England, Holland, Denmark, Belgium and France. The names of these Experts are given in the text table.

Experts Consulted

<table>
<thead>
<tr>
<th>Surname</th>
<th>First Name</th>
<th>Organisation</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andersen</td>
<td>Michael</td>
<td>DFA</td>
<td>Denmark</td>
</tr>
<tr>
<td>Bailey</td>
<td>Nick</td>
<td>FRS</td>
<td>Scotland</td>
</tr>
<tr>
<td>Beveridge</td>
<td>Doug</td>
<td>NFFO</td>
<td>England</td>
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<tr>
<td>Brander</td>
<td>Keith</td>
<td>ICES</td>
<td>International</td>
</tr>
<tr>
<td>Cook</td>
<td>Robin</td>
<td>FRS</td>
<td>Scotland</td>
</tr>
<tr>
<td>Daan</td>
<td>Niels</td>
<td>RIVO</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Deas</td>
<td>Barrie</td>
<td>NFFO</td>
<td>England</td>
</tr>
<tr>
<td>Degnbol</td>
<td>Poul</td>
<td>DG Fish</td>
<td>EU</td>
</tr>
<tr>
<td>Gislason</td>
<td>Henrik</td>
<td>UiC/DIFRES</td>
<td>Denmark</td>
</tr>
<tr>
<td>Goujon</td>
<td>Michel</td>
<td>CNPNEM</td>
<td>France</td>
</tr>
<tr>
<td>Kirkegaard</td>
<td>Eskild</td>
<td>DIFRES</td>
<td>Denmark</td>
</tr>
<tr>
<td>Kraak</td>
<td>Sarah</td>
<td>RIVO</td>
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</tr>
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<td>Lassen</td>
<td>Hans</td>
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<td>Niels-Axel</td>
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<td>Pastoors</td>
<td>Martin</td>
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<tr>
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<td>Ken</td>
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<td>Rice</td>
<td>Jake</td>
<td>DFO</td>
<td>Canada</td>
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<td>Adriaan</td>
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<td>Netherlands</td>
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<td>Henrik</td>
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<td>International</td>
</tr>
<tr>
<td>Steins</td>
<td>Nathalie</td>
<td>PVIS</td>
<td>Netherlands</td>
</tr>
<tr>
<td>van Balsfoort</td>
<td>Gerard</td>
<td>PVIS</td>
<td>Netherlands</td>
</tr>
</tbody>
</table>

Transcripts of the discussions will be held at NSRAC HQ. In these notes, in keeping with Chatham House rules, Experts are referred to by number rather than by name,. The numbering is random and neither reflects the order of Experts on the list, nor the order in which I saw them. I would like to take the opportunity here to express my gratitude to all the Experts for their clear insights, for making their time available and for cheerfully fitting in with my rather frantic schedule. Each had unique insights into
the problems of managing the North Sea. I left each interview with a sense of having seen the world in a new perspective and I am most grateful to them all. For the purpose of the Edinburgh Workshop these notes were condensed into a digestible series of “sound bytes”. Coupled with my first lecture I made available an auxiliary power-point file of short comments and my conclusions with respect to aspects of long term management, These comments of the experts may be see at Annex 6. Such an approach, whose soul was brevity, risks taking remarks out of context. Here I try to summarise the results of the discussions at greater length but the actual notes are recommended for any one who wishes to understand and contrast the Experts’ own views. It will be immediately apparent to anyone who reads the notes that there are wide ranges of opinions and approaches to all the questions. When appropriate in reporting them I have thus adopted the approach of a 1st iteration of the “Delphi method”. That is to say I try to summarise the average opinion but give the views at the extremes in full so that both the range of opinion can be seen and so that different opinions are presented.

**Approach used in the interviews.**

Where possible the interviews took about 2 hours but some people (particularly those I saw at ICES) were in the middle of meetings and less time was available. To remind people of the topics to discuss, most were provided with the following list of questions before the meetings. A few whom I was able to catch in addition to my scheduled Experts only saw these at the time we met. The questions adopted were as follows.

1. What would you see as a practical interpretation of the 2002 Johannesburg agreement?
2. What other countries’ approaches are relevant to North Sea Fisheries and which are not?
3. What might be a suitable mix of objectives for the long term and how should we approach them in the short term?
4. How rapidly do you think we should approach these objectives a) when stocks are under recovery plans, b) over target for F.
5. What mix of management tools would be best suited to achieving what you see as being the stakeholders objectives?
6. What modelling approaches/scenarios/case studies could be helpful to stakeholders in discussing these questions?
7. Have you any burning issues which should be bought out at a workshop on long term management for the North Sea.?

While these questions formed a rough agenda I was at pains to let everyone talk about what most concerned them and in practice the questions formed more of a checklist that we had addressed all issues rather than a strict agenda. Typically, the discussions rapidly evolved to a lively discussion of what was of most concern to the Experts. As sometimes shows in the notes I tried to keep the discussions light hearted and free flowing. I did not attempt to obtain full verbatim records of the discussions but took brief notes which I later emailed back to the Experts so that they could correct or add to what I had recorded as they wished. Most seemed content that I had captured their main points.
Summary.

In the sound bytes summary (Annex D3) I organised remarks into those that reflected the current situation, those that reflected the desired long-term situation and those that reflected the route to take to get there. These were further subdivided into issues of institutional, ecological, economical and social sustainability.

Here I summarise the comments under each of the original questions but such was the diversity that one question sometimes must be dealt with under several sub-issues.

1. What would you see as a practical interpretation of the 2002 Johannesburg agreement?

This question was answered fairly directly by most Experts and I adopt the “stage 1 Delphi” approach to my summary. There was a broad consensus amongst many Experts that fishing mortality needed to be lower but a number qualified this by noting that the reductions needed to take account of mixed fisheries, multispecies and density dependent effects. Experts 20 and 21 gave a clear summary of this view.

“They agreed that one figure for Fmsy (or BIOmsy) will not always be right! We all agreed it is difficult to set target F due to problems both of estimating and because of the probability of changes in parameters through time or environmental circumstances. An agreed range of sane Fs for each stock might be the best that was possible! Moreover, we always need to consider the mixed fishery problem.”

Expert 11 was in favour of the greatest reduction in fishing mortality.

“Need even lower F than Johannesburg. With lower F controls can be more sloppy and still work well (c.f. Bering Sea)”.

Further emphasis to this view was given in the Expert’s answer to question 7.

“A low F is needed because we need to protect genetic diversity and maintain the stocks ability for adaptive change particularly for those stocks at the margins of thermal distribution (Particularly under the threat of Global Climate change.) Such stocks have the right genetics to operate close to the temperature margins of the species and form its vanguard or rearguard in times of change.”
This is an interesting point that suggests a concern that might be best addressed with suitable targeted closed areas rather than more general reductions in fishing mortality.

By contrast Experts 6 and 7 and Expert 15 perhaps saw the least need for a reduction in fishing mortality.

“The Expert (15) noted that fishers don’t usually believe that low F would make yields greater. Having a science background the Expert was aware that many fisheries models are flawed or incomplete.”

This remark and equivalent remarks elsewhere indicates that there is a need for consultation with fishers to explain the implications of lower fishing mortality in ways that answer their doubts. Some reservations about MSY as a target are of course valid and were the subject of the Schipol Focus Group (Ref).

2. What other countries’ approaches are relevant to North Sea Fisheries and which are not?

Answers to this question were of two types. A number of Experts provided valuable background material on their own fisheries. A few contrasted the situation of the CFP with that in other countries noting that the CFP situation was both unique and difficult. Expert 3’s comments are the widest ranging.

“In western Canada problems of by-catch of vulnerable sebastes species in a mixed fishery have been easily sorted out by the industry after a high seas observer program was introduced. Science lessons can be learned from anywhere. In terms of management Canada’s are somewhat relevant, because the legal basis with wide “ministerial discretion” has a fair number of similarities with thinking behind CFP. USA and Australia less so, because their Magnusson-Stevenson Act and Sustainability Act give very different legal bases for management. (the M-S Act and Sustainability Act differ a lot from each other, but both differ a lot from the CFP as well. No other jurisdiction I know well has to struggle with constraints like the inter-countries sharing formulas that so dominate options available in the EU. For those you might have to look at agencies like the Tuna Commissions, but I don’t know them so well.”

Several Experts speculated that making fisheries into European rather than Member State concerns might help. Expert 18’s view was that:-
“Experience outside the EU would only become relevant if member states (of EU) interests were overcome. Perhaps need internationalisation (Eg) Europeanisation) of fishing industry. National political input is a real stumbling block.”

3. What might be a suitable mix of objectives for the long term and how should we approach them in the short term?

As would be expected the was a wide range of view on the weight to be given to lifestyle and employment objectives on the one hand and economic objectives on the other. Thus no real consensus emerged except perhaps that expressed by Experts 8 and 9:-

“In North Sea they stressed need for approaches to be appropriate to the particular contexts. There is a need to have horses for courses.”

Several other Experts suggested that non-biological objectives were the concern of the Member States, for example:

“Expert 12 views choice of non biological objectives as largely up to national govt’s with the Commissions role mostly being concerned with managing the biology.

The clearest champion of an economic objective was Expert 3:-

“Explicit economic objectives would help, if only to highlight that fisheries are managed in many places for social goals (hence entrenching overcapacity and all its problems) rather than economic ones, and where economic goals do guide decision-making, they reveal the value of economic incentives as big potential contributors to sustainability.”

Experts 6 and 7 also were strong advocates of economic goals

“The Dutch industry mostly sees fishing as an economic activity rather than providing social benefits or life style. Therefore it should be approached from a economic rationale.”

However, their view was tempered with an understanding of the need to maintain rough balance between revenue and costs if rights were to be sustainable. Their response to question 4 states:-
“In a market economy costs and revenues tend to a situation of equilibrium. If for a reason there is an imbalance between the two – if the revenue has (suddenly) grown higher per unit of cost – new people will try to access the activity and/or existing ones will try to increase their production, so that in the end the equilibrium between costs and revenues will be restored. On the other hand, if costs tend to rise this will lead to exits from the activity and – in the end – will lead to higher revenues for the remaining participants.”

By contrast Experts 15, 16 and 17 are the strongest advocates of employment and life style objectives.

Expert 16 stated:

“The French industry has a concern that lifestyle considerations and employment should be conserved rather than excessive profits generated. However, they are against direct subsidy of fishing activities.”

Expert 15’s view was perhaps more equivocal:

“He saw some movement towards a more profit orientated objective. Indeed Denmark was introducing ITQs. However, many fishers still have strong life style based objectives. Presently the question of survival was important because of the shock that high oil prices had given the industry.”

Several other Experts saw a drift towards more economic objectives fuelled both by the adoption of transferable catch and effort allocations and ITQs and by the pressure of higher oil prices. Several noted that crews were sometimes shipped in from the new Eastern Member States and that the attachment of fisheries to local communities was therefore perhaps less.

Other views (Expert 19) were that Ecosystem objectives might be imposed by Green NGO’s using the legal route adopted for example in the USA.

“Notes ecosystem concerns and the fact that NGOs may use international law to circumvent national and EU “backsliding on international agreements).”

In a somewhat similar vein Expert 11 (under question 2) stated:
“Fisheries are small beer and will have to accommodate to the bigger picture and may need to get integrated into large uses of marine resources. Note EU water directive people are getting interested in marine field.”

4. How rapidly do you think we should approach these objectives a) when stocks are under recovery plans, b) over target for F?

There was a fairly broad consensus that progress should be gradual and at a pace that the industry could cope with. This view was expressed by Expert 16 as:

“A gradual approach is to be preferred, largely determined by the preferences of the industry.”

The alternative strategy of a Big Bang approach (in essence, if it’s a good idea go straight there) was seriously considered by several Experts (e.g. in the discussion of this point with Expert 1)

“Expert 1 had made simulations in the past and noted the very real social/economic pain of transition from where we are to where we wish to be. Noted there would still be some of these problems when we got there. We speculated about a big bang (Take the pain and compensate for it in one big lump rather than gradually. A politician doing this might possibly get credit for decisive action to solve a long running disease provided she/he played their cards right. Probably has to be gradual though so how to ease through the pain?”

But, as with Expert 1 those who considered a big bang approach generally rejected the idea as being too expensive. Expert 22 noted that:

“A big bang approach would probably be hopelessly expensive since the current Danish scheme of ¼ billion krone will decommission about 100 vessels out of a total of about 1500.”

This Expert also noted that it:-

“Might be a thought to put Govt. investment into value added production and leave vessels to buy out each other’s days at sea. There are other uses for fish products other than consumption, e.g. medical uses and uses in aquaculture and these might be further pursued. These are possible areas to invest in industry. More value added to catch would provide fleet with better margins and hence more options for management. “
Only Expert 3 firmly adhered to Machiavelli’s\(^{29}\) advice to avoid the middle way:

“I think the track record of “gradual progress” is abysmal (but more of my experience comes from more boreal systems than the North Sea).”

5. What mix of management tools would be best suited to achieving what you see as being the stakeholders objectives?

There were advocates of most of the management approaches and hence no real consensus. However, a number of Experts indicated that co-management or stewardship approaches should be adopted. In several cases these had already been found valuable. Experts 6 and 7 noted:-

“The Dutch industry have also promoted Co-management amongst ITQ holders and this has more or less eliminated miss-reporting of catch through social pressure within the industry.”

Expert 10 (and 15) also held that view:-

“On technical measures the Expert stressed the need for fishers buy in, noting that in the Baltic a reduction from a 120 to a 110square mesh panel produced better conservation results because fishers agreed with it and there was better compliance.”

Expert 18 developed the possibility of Industry Stewardship most forcefully.

“\textit{Much more sympathetic to stakeholder involvement, indeed to stakeholder stewardship but constrained by a reversal of the burden of proof so they had to prove their proposal would work and did work.”}

Under question 7 the Expert clarified this view further

“\textit{Make industry responsible for management but reverse burden of proof to ensure effective and cautious management. This would include placing consequences of data uncertainty in favour of fish rather than fishers.”}

Several Experts viewed the current CFP “Command and Control” approach as ineffective or breaking down. This was expressed most forcefully by Expert 11:

\[^{29}\text{Machiavelli The Discourses Book 2 chapter 23.}\]
“The whole command and control basis of the CFP is flawed as Expert 11 and colleagues predicted in the early days of the CFP.”

Others might limit this to the TAC system. For example Experts 6 and 7:

“They rather agree with the proposition that the TAC system has broken down for the mixed demersal fisheries. Could perhaps transfer relative stability to days but problem would be to transfer the tradable/capital value of ITQs to ITEs.”

Several other Experts viewed effort restrictions as being more effective and means to make effort management more responsive were suggested by Experts 1, 5 and 18.

“Expert 5 argued for move towards effort controls rather than TACs. The Expert explained ideas in papers the Expert and colleagues had produced.”

These ideas were further developed at the Edinburgh Workshop in the presentation given by Sarah Kraak and occasioned considerable interest there.

Some other Experts remained committed to a TAC approach and less keen on effort restrictions. For example Expert 4 noted:

“On effort management the Expert notes that the British Columbia salmon examples is a counterexample the experience goes back to the 1970s and technological creep and adaptation of boats to the regulations killed the approach. There are examples where effort regulations seems to work but in Expert 4’s view these are mainly when the system is not under pressure. Notes experience in Faroes with cod, the F is increasing.”

While Expert 16’s view was (question 7) that

“France quite likes relative stability both between countries and between groups of fishers. They believe that all enterprises need forward vision and fishing plans provide this. Thus, agreed levels of change to TACs etc are desirable. Effort management is difficult because a vessel might change gear within a trip and thus belong to several effort categories. Moreover, effort restrictions may direct effort towards other species without regulations etc.”

Several Experts advocated closed areas or closed seasons. Expert 2 (question 1) suggested

“Hence more closed areas (about 20% coverage of each major habitat type) as part of the deal.”

While Expert 18 (question 4) suggested:
“Closed areas or seasonal fisheries might be one thought. Expert 18 noted the charm of seasonal produce that could command higher prices (eg home grown strawberries) so perhaps we should encourage fisheries for la novelle plaice etc. Noted also poor condition of plaice at certain times might be argument for seasonal lay up.”

Some Experts (e.g. Expert 16) favoured technical measures.

“French fishermen quite like the use of technical measures for management. Measures need to be such that fishers can buy in to them and social pressure can be bought to bear as a major determinant of behaviour.”

Expert 15 view was similar:

“With technical measures the Expert thought social pressures from fellow fishers would largely serve to achieve compliance.”

Some Experts also considered economic approaches to management. In particular Expert 3’s view was:

“The potential tools that are being most under-utilised are adequate MCS and economic incentives.”

6. What modelling approaches/scenarios/case studies could be helpful to stakeholders in discussing these questions?

A number of very useful technical discussions suggestions were made in response to this question. For example Expert 1 provided a clear explanation of the current multifleet models such as MTAC. Perhaps the clearest advice was:-

30 MCS [MANAGEMENT, CONTROL & SURVEILLANCE]
‘Expert 12 saw a particular need to model /illustrate problem of transition towards lower F. For example how much need would there be to support the industry through the period of short term losses?’

7. Have you any burning issues which should be bought out at a workshop on long term management for the North Sea?

This question was designed as a bottom line to clarify what most concerned Experts. The Experts burning concerns are listed below under three sub headings, However, their concerns were varied and the reader is directed to Annex D2 to see these in greater detail.

Management

Compliance, A possible communal approach to avoiding the tragedy of the commons, The use of economic incentives, Adapting a fixed system to changing environment. Appropriate measures for fleets, Transparency, Stewardship with responsibility, More stable TACs, Excessive effort problem,

Science and Conservation

Data, Research costs need to be made efficient and research made closer to industry, Habitat conservation, Need for refugia, Cod recovery, Ecosystems management concerns, Genetic diversity.

Objectives and other issues

Balance of revenue and costs. The need for a level playing field. The sensitivity of the industry to some issues, National fisheries a problem, Lack of trust between countries.
TAC and days at sea management: a direction for a possible solution.

By Adriaan D. Rijnsdorp and Sarah B.M. Kraak (Netherlands Institute for Fisheries Research)

A study commissioned by the Dutch Ministry has been aimed at designing a system of effort management that can be used to complement current TAC management. In this study only the flatfish fishery by the Dutch beam trawl fleet has been considered.

The approach is, to quantify the relation between days at sea and fishing mortality. This relation (i.e. the catchability) can be quantified with the indicator $F_{PUE}$, which is the fishing mortality that is generated per day at sea.

This quantity can be calculated on a trip basis as follows. The total catch ($C$, here landings) of a species in a certain year can be split up by country. This country’s catch can be split up further by fleet segment, and ultimately – based on the log book data – by trip. From the number of days in a trip, the average catch per day of that trip can be calculated ($C_{\text{trip}}$). Note that Dutch beam trawl trips are generally on a weekly basis (Sunday to Sunday). The fraction $C_{\text{trip}} / C$, multiplied by the total $F$ that corresponds to the $C$ (via the stock assessment), yields the $F_{PUE}$: the partial fishing mortality that is generated per day in that particular trip.

The factors that influence $F_{PUE}$ can be broadly classified into two groups:

3. The efficiency of a vessel, e.g.
   a. Gear (beamtrawl, otter trawl, twin trawl, etc.);
   b. Engine power;
   c. Design of the vessel;
   d. Other equipment (DGPS, etc.);
   e. Experience skipper and crew.

4. The availability of the fish by
   a. Season;
   b. Area.

It has been found that the efficiency of a vessel is related to the effective engine power (horse power, hp) in the following way:

- For plaice: $F_{PUE} \sim hp^{0.5}$;
- For sole: $F_{PUE} \sim hp^{0.8}$.

If the exponent were equal to 1, the efficiency would be proportional, implying that fishing with 2000 hp generates twice the fishing mortality as fishing with 1000 hp. Exponents smaller than 1 mean that fishing with 2000 hp is less than twice as efficient as fishing with 1000 hp. Hence, hp-days overestimate efficiency, especially for plaice.
The $F_{\text{PUE}}$ varies with area and season. Figure 1 shows that the seasonal variation for plaice is about fivefold: $F_{\text{PUE}}$ in winter is roughly five times higher than in summer.

In Figure 1 a time trend can also be discerned from the data: the $F_{\text{PUE}}$ has increased over the 15 years' study period, implying that a 2000 hp beam trawler has become more efficient over time. This phenomenon is called "technology creep". The technology creep differs with type of vessel and by species as can be seen in the table below.

<table>
<thead>
<tr>
<th>% increase in $F_{\text{PUE}}$ (SE)</th>
<th>Sole</th>
<th>Plaice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro cutters</td>
<td>7.6 (0.1)</td>
<td>1.4 (0.2)</td>
</tr>
<tr>
<td>Large beamers</td>
<td>3.2 (0.04)</td>
<td>1.7 (0.04)</td>
</tr>
</tbody>
</table>

The percentage of technology creep is related to the vintage of the hull of the vessel (bjc) and the vintage of engine of the vessel (bjm). The results are in the table below.

<table>
<thead>
<tr>
<th></th>
<th>Euro cutters</th>
<th>Large beam trawlers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>sole</td>
<td>plai ce</td>
</tr>
<tr>
<td>bjc</td>
<td>21.2%</td>
<td>71.2%</td>
</tr>
<tr>
<td>bjm</td>
<td>64.0%</td>
<td>11.3%</td>
</tr>
<tr>
<td>tship2</td>
<td>14.8%</td>
<td>17.5%</td>
</tr>
</tbody>
</table>

Mutations in the fleet will therefore give rise to sudden jumps in efficiency ($F_{\text{PUE}}$).

Below a fictitious example is worked out for a possible direction of effort management, which will deal with the issue of mixed fisheries, i.e. the issue that if two species are
caught together, fishing for one species continues when the quota for the other species has been exhausted.

Let us assume that the agreed TACs for next year correspond to fishing mortalities for sole and plaice respectively of 0.40 and 0.30 (via the assessments); note that these are landings-Fs. According to relative stability the Dutch portions of these fishing mortalities are 0.29 and 0.12 respectively. It was calculated that the average $F_{PUE}$ (= partial fishing mortality generated per day at sea, averaged over the whole study period and all areas, standardized for 2000 hp) was $1 \times 10^{-5}$ for sole and $6 \times 10^{-6}$ for plaice. It follows from this that 28,900 'standard' days at sea are needed for sole, and 20,400 for plaice, to generate the fishing mortality allocated to the whole Dutch fleet. If we assume that the Dutch fleet consists of 150 vessels, the IEQs (Individual Effort Quota) allocated per vessel would be 193 and 136 'standard' days at sea for sole and plaice respectively.

However, we have seen that a day at sea will generate a different fishing mortality rate depending on the time of the year and the area where fishing takes place. In the table below it can be seen, for example, that a day at sea in Month 1 (January) in the South generates 1.7 times more fishing mortality on plaice than a day at sea in Month 1 in Central. A day at sea in Month 4 (April) in South, however, generates only half the fishing mortality on plaice of a day at sea in Month 12 (December) in Central.

The management system we propose, assumes that fishermen 'spend' or 'pay' e.g. 1.7 of their plaice IEQ when they fish a day in January in the South but only e.g. 0.5 of their plaice IEQ when they fish a day in April in the South. In both months they will 'pay/spend' 1.1 of their sole IEQ. The fishermen are free to fish where and when they want, as long as they do not exceed either of their annual IEQs, while ‘paying’ according to the table. In effect, one ‘pays’ more when fishing in an area at a time where high fishing mortalities are generated than when fishing in areas and at times where low fishing mortalities are generated. If the species-specific IEQs can be controlled in this way, the actual catches will correspond more closely to the respective agreed TACs in this mixed fishery.
In summary, $F_{PUE}$ is a useful indicator of the efficiency of the fishery; predictable effects are found for season and area, as well as forengine power. A positive trend in efficiency was found (technology creep), of which $>60\%$ can be attributed to the effect of vessel (engine & hull); this will give rise to sudden changes. $F_{PUE}$ can be used as an instrument for the management of a mixed fishery where fishing on the respective species needs to be decoupled to a certain extent. The proposed management system is very preliminary; sensitivity analyses will have to be conducted, drawbacks will have to be identified and dealt with.
Long Term Options: Where do we want to get to? How do we get there?  
A Selection of Comments from Experts Interviewed: John Pope

Introduction

The following extracts were taken from the comments of the experts consulted by John Pope between 19th January and 3rd February 2006. See Annex 4 for a list of the experts. These have been reorganised to address the questions posed by the title.

• Where are we?
• Where do we want to get to?
• How do we get there?

Comments are further organised into concerns about:

• Institutional issues,
• Ecological issues,
• Economic issues,
• Social issues.

These are different though related questions to those posed at the interview (see annex 4). Hence there is a risk of them being taken out of context. However, a number of the experts interviewed also attended the Edinburgh Workshop and they seemed content with this reordering. A short summary of all comments under the original questions is shown at annex D2 and a full summary available the NSRAC HQ.

Where Are We Now?

Where Are we: Institutionally: Comments
• The whole command and control basis of the CFP is flawed
• There is a general level of work overload in advisory and management areas of fisheries
• Lack of trust between countries.
• They rather agree with the proposition that the TAC system has broken down for the mixed demersal fisheries.

Where Are We: Ecologically: Comments
• The industries excessive catching capacity is a real problem.
• In many fisheries discard F is as high as landed F.
• The 2001-2002 cod recovery measures failed.
• The natural protected areas that had existed in the past are now exploited.
• Ecosystems management concerns. Big issues are rates of extinction and extirpation.

Where Are We: Economically: Comments
• Recently profitability has been affected by quota drops and by increased fuel costs but generally it has been somewhat better after decommissioning.
• Presently the question of survival was important because of the shock that high oil prices had given the industry.

Where Are We: Socially: Comments
• Industry was crewed by Dutch people and there was competition for jobs on beamers though not freezers which did long trips.
• Crews are sometimes shipped in from eastern EU.
• Many fishers still have strong life style based objectives.
• Fishers who remembered when fisheries were largely unregulated, have mostly now gone from the fishery and the younger generation were more accustomed to the idea of there being regulations.
• There were political pressures in Denmark which favoured inshore fishers rather than offshore fishers and he thought this was largely driven by emotional // nostalgia
• There were now higher (compliance?) standards but the (media?) focus tended to be on transgressions rather than the law abiding majority.

Where Do We Want To Go To?

Where Do We Want To Go: Institutionally: Comments
• Fisheries may need to get integrated into large uses of marine resources.
• Measures need to be such that fishers can “buy in to them” and social pressure can be bought to bear as a major determinant of behaviour.
• . They believe that all enterprises need forward vision and fishing plans provide this.
• A major concern is to use methods appropriate to a given fleet and to have transparency so all fleets understand the constraints that each fleet adopts to contribute to conservation.
• Need to be fleet based rather than stock based.
• …much more sympathetic to stakeholder involvement, indeed to stakeholder stewardship but constrained by a reversal of the burden of proof so they had to prove their proposal would work and did work.
Where should we go to: Ecologically: Comments

- They agreed that one figure for Fmsy (or BIOmsy) will not always be right! We all agreed it is difficult to set target F due to problems both of estimating and because of the probability of changes in parameters through time or environmental circumstances. An agreed range of sane Fs for each stock might be the best that was possible! Moreover, we always need to consider the mixed fishery problem.
- Basically just that:- the Johannesburg agreement. Fmax or F0.1 as target to be approached.
- Habitat, Habitat, Habitat!
- Also a need to close some areas to preserve habitat and provide a buffer
- Reduce bycatch.
- A low F is needed because we need to protect genetic diversity particularly for those stocks at the margins of thermal distribution.
- Seemed to agree with lower Fs coupled with more industry control of how to get there. Noted that industry is suspicious of need for further reductions.
- In particular noted that simultaneously achieving all Bpa’s (the current objective for individual stocks) is not possible if one looks at the primary food production of the North Sea.
- He noted that fishers don’t usually believe that low F would make yields greater.
- Given his science background he was aware that many fisheries models are flawed or incomplete.

Where should we go to: Economically: Comments

- The UK Govt’s. Net benefits report stresses economic viability and developing an industry that pays for all its costs.
- The Dutch industry mostly sees fishing as an economic activity rather than providing social benefits or lifestyle.
- If Governments insist on maintaining excessive capacity in order to maintain employment then they should be up front about the costs of what is essentially a social program rather than hiding the costs as those of fisheries management.
- Obviously fleets cannot for long run at a loss but in the long term were policies to give ITQ holder supernormal profits this would prove equally unsustainable. This would be because there would then be pressures for extra catch, illegal landings and for new access from the have-nots. They thought in these circumstances industry would support cost recovery for science and inspection (possibly resource rent?) if it ensured the continuation of their rights to the stock.
- ...seems sceptical that there is much movement away from maximal employment thinking toward more economic objectives, citing the annual fight for the biggest quota in evidence.
...choice of non biological objectives was largely up to national govt’s with the Commissions role mostly being concerned with managing the biology.

Governments should do more to develop and encourage Eco Certification of fish as this could be a cheap, transparent and possibly also efficient way of using market incentives to promote sustainable fishing practices. There is pressure from retail chains both for a more stable supply and for “green” certified products.

Where do we want to go to: Socially: Comments

• A gradual approach is to be preferred, largely determined by the preferences of the industry.
• ...they stressed needed for approaches to be appropriate to the particular contexts.
• The French industry has a concern that lifestyle considerations and employment should be conserved rather than excessive profits generated.

How Do We Get There?

How do we want to get there: Institutionally: Comments

•?

How do we want to get there: Ecologically: Comments.

• how to get F off of the larger species i.e. cod and plaice? Closed areas or seasonal fisheries might be one thought.
• Use good year-classes to best advantage.

How do we want to get there: Economically: Comments

•...noted that unprofitable operations only lead to miss-reporting and other non-compliance problems so pace should try to keep the industry within the envelope of profitability
•....profitability is a real constraint and fleet reduces in hard economic times. The current fuel consumption/fish ratio is stupidly high and not environmentally sustainable in the long run.
•In terms of quality there is a lot of variation in fish quality between vessels and hence there should be potential for improving quality and price
•Change (effort reductions) should take place at a rate that could be financed by fishers buying up each others days at sea. This was to be preferred to decommissioning.
• He favoured effort being largely held constant when stocks went down but when stocks increased TAC increases could be less to encourage effort reductions at such times.
How do we want to get there Socially: Comments.

• With technical measures he thought social pressures from fellow fishers would largely serve to achieve compliance. The present control systems were too bureaucratic. The trick was to get fishermen to be part of the agreement and thus buy into the rules.

• He cited the case of a 120mm panel that lacking fishers buy in did not work. However, it did work when with the fishers agreement it was reduced to 110mm panel.

• REMEMBER REMEMBER NEED FOR FISHERS INVOLVEMENT AND OWNERSHIP

• that if fishers have input to decisions they may be more willing to comply with technical measures than when they are imposed from above.

• A similar view was that fishers input into a decision to reduce F might be more likely to lead to it occurring.