Uses of fishers' knowledge in fisheries management

Selina Stead[1], Tim Daw[1, 2] and Tim Gray[2]

[1]School of Marine Science and Technology and [2]School of Geography, Politics and Sociology, Newcastle University, Ridley Building, Newcastle upon Tyne, NE1 7RU, UK

Abstract (100-150 words)
This article reviews methods used in the increasing use of fishers' knowledge in contemporary fisheries management. During the last 100 years, fisheries science has been used extensively to inform management decisions for the regulation of sea fisheries. However, the decline of many fish stocks has cast doubt on the sufficiency of fisheries science, and has led to demands from fishers that their own expertise – fishers' knowledge – should be taken into account in decision-making. In this paper, we examine four case studies of such attempts to take account of fishers' knowledge in the management of North Sea fisheries, comparing their different methods of identifying and using fishers' expertise, and assessing their respective outcomes. Our conclusion is that the value of fishers' knowledge improves according to the extent to which the method of obtaining it is participative and interactive.

Keywords: fishers' knowledge, fisheries science, North Sea fisheries management, co-management, stakeholder participation, cod **(up to 8)**

Introduction

In most fisheries in developed countries around the world, a leading part is played by fisheries science in management decisions which regulate them, partly because the marine ecosystem is highly complicated, requiring scientific research to understand it, and partly because politicians need scientific advice to bring closure to otherwise endless debate on the need for particular regulations. However, the role of fisheries science has come under scrutiny in recent years because of declining fish stocks, and the scientists' methodology has been challenged by fishers who claim that their own expertise has been ignored (Rossiter and Stead, 2003). This distinction between fisheries science and fishers' knowledge reflects a broader distinction between scientific ecological knowledge and traditional ecological knowledge, which has been characterised by some scientists in a pejorative contrast between the objective, neutral, rigorous and systematic character of modern science, and the subjective, value-laden, flaky and anecdotal character of traditional, indigenous folklore (Gray 2002). Fishers reject such pejorative characterisations, and claim that the scientists' conclusions are fatally flawed, because, for instance, their surveys are conducted in the wrong areas, and their data is outdated. In an attempt to overcome these divisions, since the late 1990s, there has been growing interest in finding ways to involve and engage fishers in the management process. This has led to researchers from natural science disciplines (for example in the International Council for the Exploration of the Sea (ICES - oldest intergovernmental organisation in the world concerned with marine and fisheries science working groups) working with social scientists in applying well-tested social survey methods to elicit information such as fishers' perceptions on the relative health of fish stocks.

In our case studies, we examine and evaluate four different ways of obtaining this indigenous information on North Sea fish stocks. But first, we must clarify the methodologies of the case studies. The range, richness and potential utility of indigenous, local and resource users' knowledge has been emphasised by many publications in the natural resource governance literature. Fishers possess many different types of knowledge which may be important to fisheries management, and there are many ways to classify such knowledge. For instance, much of the initial literature focussed on fishers' knowledge of the ecosystem, (hence the commonly used term 'local ecological knowledge'). However fishers also possess intricate knowledge of social, economic, technical, behavioural or even political aspects of fisheries. This knowledge is clearly relevant for management with the increasing realisation that fisheries management, far from being exclusively about fish biology, operates within a complex system with social, economic and ecological dimensions.

The methods used to derive fishers' knowledge determine whether information is gathered in a quantitative or qualitative form. Some knowledge is naturally quantitative (e.g. the number of boxes of fish landed on a typical day), while others may be forced into a quantitative form during the process of formalisation (e.g. asking a fisher to estimate the percentage change in a resource). Qualitative methods allow knowledge to be recorded as text, arguably more accurately capturing the richness and depth of fishers' knowledge. However, this usually precludes statistical analysis and straightforward integration with (typically numerical) scientific knowledge.

Some initiatives simply collect data from fishers in its raw form (e.g. landings data), while others collect perceptions (e.g. thoughts about the status of a fish stock). Data are collected or observed by fishers and passed on with no interpretation by the fishers. Perceptions, on the other hand are accumulated through time from experience and information networks and are the result of fishers' mental processing of data, which is informed by their own prior knowledge, theories and instincts. Although several projects exist to collect data from fishers (e.g. official EU logbooks, the Dutch F-Project), all the cases examined in this paper are involved in engagement with fishers' perceptions.

Within perceptions, we define 3 levels, state-of-nature, process and management perceptions. First, perceptions may be about individual states of nature, such as abundance of a particular fish species. Second, fishers hold perceptions about the processes which lead to fisheries dynamics, such as causative links between parts of the marine ecosystem (e.g. the impact of a predator on a fish stock). Third, fishers have perceptions about how such 'state-of-nature' and 'process' perceptions relate to appropriate management of fisheries (e.g. whether decommissioning of fishing vessels is an appropriate response to declines in cod abundance). Such 'management perceptions' are related to the former levels of perception but also to a fisher's worldview and normative positions on such issues as equity, rights and responsibilities to nature.

The four case studies that we examine have four different methods of obtaining fisher's knowledge relating to a range of approaches. Extractive approaches aim to collect knowledge and use it *ex-situ* while participative approaches offer fishers the opportunity to actively participate in the process (Table 1).

Table 1. Cases studies of engaging with fishers' knowledge using different methodologies.

Case study	**Methodology used to engage with fishers**	**Level of participation**
1. North Sea Stocks Survey	Postal questionnaire	Extractive
2. EFIMAS	Focus Groups	More participative
3. North Sea Demersal Study	In-depth interviews	Even more participative
4. North Sea Regional Advisory Council	Direct participation	Entirely participative

In discussing the cases, we focus on the following questions:

1. What types of fishers' knowledge is accessed?
2. What methodologies are used?
3. Are scientists using fishers' knowledge to inform management in a meaningful way?

CASE 1: The North Sea Stocks Survey (NSSS) Postal Questionnaire

Aim

The NSSS was initiated by the fishing industry in 2000, to provide an opportunity for fishers to have an input into the scientific stock assessment process, letting scientists hear about the fishers' views on the abundance of individual fish stocks experienced on fishing grounds.

Methods

The information is collected by a structured questionnaire, translated into each national language and distributed via the fisher's organisations in Denmark, Belgium, Netherlands, Scotland and England. The anonymous, closed questionnaire collects views with simple tick boxes (5-point scale of Much less, Less, Same, More, Much more) and one final comment box in which respondents can add any further information or views.

Types of knowledge

The questionnaire focuses on ecological knowledge (stock health of 8 key demersal – fish that live on or near the sea bottom such as cod (*Gadus morhua* L.) - species) but also collects basic technical data (boat size, fishing gear used and areas fished) and some perceptions of economic conditions, relative to the previous year, covering

difficulties in obtaining or retaining crew, operating costs, profits and optimism about the future. Quantitative data are not requested, only the perspectives of fishers according to semi-quantitative scales. All of the knowledge is at the level of simple descriptions of the current state of nature or perceived trend since the previous year. No questions ask about the processes causing these changes or appropriate management responses.

Results

Responses to the questionnaire largely agreed with indications from scientific surveys and assessments on spatial patterns of stock abundance, including the fact that cod abundance appears to have persistently increased since 2003 in the North and NE North Sea, but has shown no persistent trends in the Western, central and southern North Sea (Figure 1).

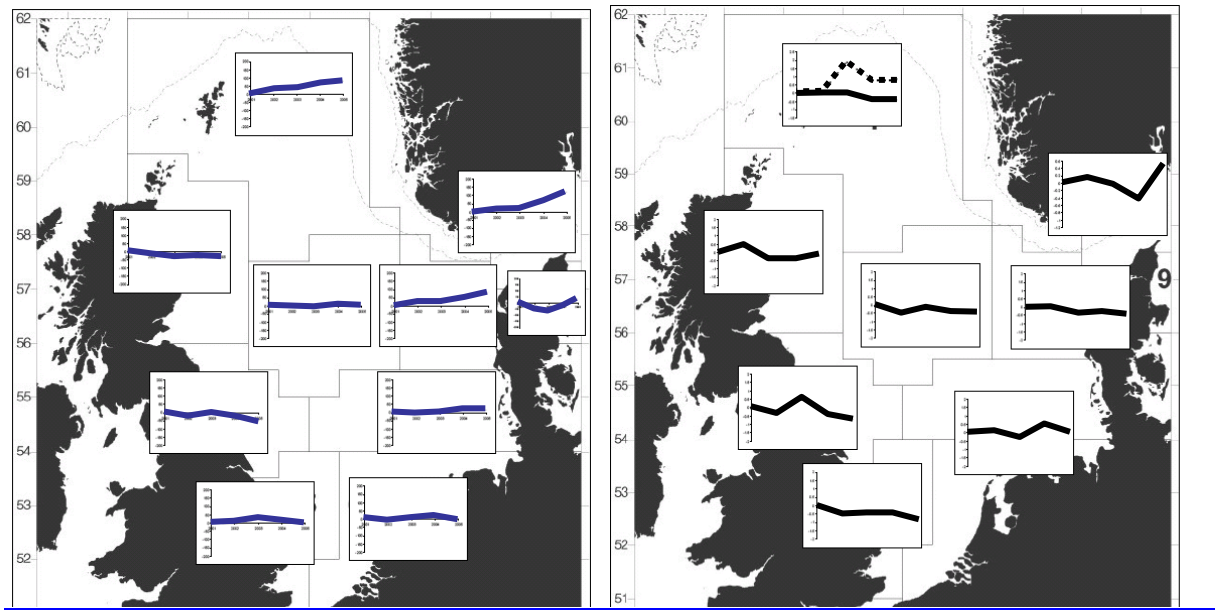

Figure 1. Figures from the report of 2005 ICES Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK) showing similar spatial trends in cod abundance recorded in the NSSS and the Scientific International Bottom Trawl Survey (ICES WGNSSK (2006).

Outcomes

Although the relevant ICES stock assessment working group consulted and commented on the results of the NSSS, it was not used directly in the stock assessment. In the assessment report (ICES WGNSSK 2006), only 16 lines are addressed to the NSSS in 15 pages of discussion on cod, though this may be because, at the level of knowledge collected (state-of-nature only), perceptions of fishers, scientists and managers are similar, particularly in the all-important case of cod, on which all are in agreement that stocks are currently particularly low.

Issues

Three issues arise out of the NSSS. The first issue is about the reliability of the survey, because there is a suspicion that some fishers may have inflated their perceptions of fish stock trends in the hope that this might lead to increased quotas. Also, the results of the NSSS are difficult to interpret because of their qualitative form. The second issue is about the relevance of the survey, in that the basic dispute between fishers and the current management is about the processes which are causing, for example, cod populations to remain low (process-level perceptions), and, more importantly, what the appropriate management is (management perceptions) whereas the NSSS only collects state-of-nature knowledge. Fishers insist that the lack of recovery of cod stocks is not caused by over-fishing but by natural processes like climate change or seal predation, so that the further decimation of their fishing industry is unnecessary. ICES scientists generally agree that external factors affect cod abundance, but management advice from ICES and actioned by the European Commission concludes that it is necessary to cut fishing effort in an attempt to reduce cod mortality and allow stock recovery. The NSSS does not directly relate to this fundamental controversy. The third issue is about the problem of managing expectations: fishers are filling in the survey in the hope/belief that it will benefit them in terms of better quota allocations or management measures more agreeable to them. But lack of clear evidence that the NSSS results

are feeding into the stock assessment, and the continued implementation of catch restrictions, led to a lack of motivation for fishers to complete the survey (of 300 questionnaires distributed in Scotland in 2006, only 40 were completed).

CASE 2: Operational Evaluation Tools for Fisheries Management Options (EFIMAS) – Work package 5, Stakeholder Focus Groups

Aim

The overarching aim of EFIMAS (www.efimas.org) is to facilitate better fisheries management regimes in Europe through developing models that can simulate and assess a range of alternative fishery management regimes taking broader, more long-term perspectives, and considering not only the biological consequences of managing a fish stock but also the social and economic impacts of different options. This will provide an evaluation framework that takes account of the dynamics in fisheries systems, as well as uncertainties, and will include risk assessments.

For example, the model could be used to predict changes in the performance of fisheries management achieved by a radical change from a stock-based (e.g. cod) to fleet-based (e.g. large-mesh demersal trawlers) management paradigm in Europe.

The design of the model is intended to reflect stakeholder concerns by engaging directly with stakeholders during its development. Focus groups were piloted in August 2006 and it is this part of the project, work package 5, which we examine in this paper.

Methods

Focus groups were chosen to act as operational evaluation tools for the fisheries management models used and were a method to get participants to talk with each other about a topic in their own terms. Five focus groups consisting of meetings with between 3 and 9 stakeholders (fisheries managers, environmental interests, women in fisheries, onshore and fish capture sectors) involved in the fishing industry were held between 9 and 11 August 2006 at the University of York, UK. The stakeholders were asked about their views on fisheries management and science before a scientist made a short presentation on one of the fisheries management models being developed. The focus group members were then asked for suggestions on how the model could be improved and made more accessible for stakeholders, and advice was sought on how best to collect feedback on the evaluation of the fisheries management models being tested.

Types of knowledge

The focus groups sought knowledge on six topics: meaning of "science", fisheries science, management, fisheries management, computer models and the EFIMAS model. To keep the group discussions focussed questions posed by the focus group facilitator included: What is science to you and when do you use science? What things come to mind when you think about fisheries science? What do fisheries scientists do? Who do you trust to do science? What is management? What makes management effective? What are different ways that fisheries science is used in fisheries management? What other sources of knowledge are important for fisheries management? Do these sources work well or poorly with fisheries science? Where do you run into computer models in your daily life or work? When do you find them useful and unhelpful? What about in respect to fisheries? When should a model be used in fisheries management? Are there things that should be modelled that are not being modelled? Are there times when models are being used inappropriately in fisheries management? What thoughts arose during the presentation on the EFIMAS model? What do you consider are strengths and weaknesses of this approach? Are there scenarios you would want to include in the model to be applied to and in what situations would you like to see it used?

Results

Most of the information collected from the focus group meetings was positive in that the majority of stakeholders welcomed the development of a fisheries management model that took account of socio-economic factors as well as biological data. The scientist present was able to collect useful advice on various parameters that were presented by the stakeholders and will be able to modify some of the model's assumptions based on the experiences shared.

Outcomes

Prior to presenting the EFIMAS model to each of the focus groups, most participants were sceptical about the value added aspects of the fisheries computer model being developed over existing models. Many issues raised reflected a lack of confidence in the state-of-nature knowledge, for example, data collected by scientists on cod abundance was questioned by fishers because the gear used in these surveys were considered unrepresentative of those used by commercial fishers. However, following the presentation of the EFIMAS model by a fisheries scientist most respondents became more positive about the model in view of economic and social data being added to information on state-of-the-nature. Suggestions were also made as to possible ways the model could be further tested and used more widely by stakeholders. In summary, the inclusion of the presentation by a scientist that could respond and reflect on questions posed enhanced the focus group method used.

Issues

Numerous issues arose from the pilot focus group meetings, a selection are illustrated for the purpose of this paper. First, lessons' were learnt from the piloting of the focus group questions and topics (an aide-mémoire was used to facilitate discussion of all topics for which feedback was sought among participants), and various changes were made to the questions asked (including exploring the distinction between the terms 'management' and 'science'), and to the way in which the scientist presented the PowerPoint slides on the EFIMAS model. The scientist asked the participants for suggestions on different fisheries management scenarios that the model could be used to test. Responses included a request that the model be able to help with longer term financial planning of different fishing activities such as implications for increasing costs due to higher fuel prices and reduced number of days allowed to fish. The question was raised as to what added value EFIMAS had over current fisheries management models? The scientist explained that this was currently being tested on North Sea cod, that is, that the EFIMAS model was being used to compare what management measures it recommends compared to those that are already in the public domain. Second, we were informed that fishers' perceive science as restrictions in one form or another. This information, combined with fishers having little confidence in the scientists fish monitoring surveys, go some way to explain why there remains distrust among fishers and scientists (Rossiter and Stead, 2003). The scientist present realised that perhaps there was a need to explain why they had to conduct surveys in the same place each year so to make clear that they have to standardise their survey methods over time for comparative purposes. Third, most of the stakeholders indicated that compliance of fishers with rules and regulations was difficult and expensive to monitor and enforce in practice.

In summary, communication is clearly a common issue that needs to be improved so that all stakeholders have a common understanding of the various issues facing fisheries management. EFIMAS plans to help this process through building in examples learnt during the focus group meetings (a number of focus groups are planned for different case study areas around Europe during 2006 and 2007) to develop models that can be used in contemporary fisheries management. For example, what are the options for cod to be managed sustainably? Are closed areas, reduced days at sea, increased mesh sizes on fishing nets or a complete ban appropriate?

CASE 3: North Sea demersal skippers' knowledge on fisheries

Aim

The main aim was to investigate how fishers' knowledge could be used to enhance management and science of the Scottish demersal fishing industry. The objectives of the project were (1) to determine appropriate methods for collecting and analysing alternative forms of stakeholder derived data; (2) to explore the underlying variables that influence skippers' decision-making processes about fishing behaviour; and (3) to assess whether fishers' knowledge can be applied to fisheries management and science in practice.

Methods

Face-to-face, semi-structured interviews of 80 skippers of demersal boats were conducted at ports in the Northeast of Scotland (Aberdeen, Fraserburgh and Peterhead), which account for approximately 60% of Scottish fish landings. The interviews were designed to find out what motivated fishers in their fishing practices and related activities. The methodological approach, semi-structured interviews, also allowed the researcher to gain an insight into attitudes, behaviour, culture and perceptions of skippers on a wide range of topics. The interviews consisted of a defined set of questions, framed to allow the interviewer to range over a variety of subjects whilst ensuring that the central issues were covered. Skippers were encouraged to raise their own issues, and if these were relevant to the study, they were investigated further. Some of the questions initially set proved not as valuable as anticipated, and, as the interviews developed, new questions were substituted for them.

In April 2001, a pilot study was conducted on five skippers, then the survey was revised and a further 50 interviews were held between April and November 2001. Throughout March to October 2002, a follow-on study

focused on collecting more detailed information on 25 fishers' local knowledge of fish ecology with the added use of maps and charts. This led to the development of a database with the longer term aim of it being linked to a Geographical Information System (GIS) to store and aid understanding of the data collected. All interviews were recorded, transcribed verbatim and analysed using a qualitative data analysis package (QSR NVivo 1.3).

Types of knowledge

There were three main types of knowledge provided by the skippers – revelations about personal motivation factors, based on introspection; environmental factors, based on external observation; and perceptions about management, based on value-judgement.

Results

The skippers interviewed identified management restrictions, market conditions and the need to retain experienced crews, as among the most important factors affecting their current decision-making (see Table 1 for full list of factors identified). Personal aggrandisement was less important now than in the past, because straitened times meant that the main aim of skippers was simply to protect their investment in sustaining a viable business. The fishers also indicated that they closely observed factors linked to fish biology and fish stocks such as noting spawning areas, abundance and distribution of fish populations. Skippers viewed the existing management system for fisheries in Europe as scientifically biased and recommended that a more balanced approach be adopted that gives equal consideration to socio-economic factors. Linked to this, skippers indicated a need for their involvement in, or views to be made clear at the start of any plans for, changes in management and policy.

Table 2. Factors important in Skippers' decision making.

Bank	Conservation	Costs
Crew experience	Dangerous conditions	Distance to travel
Familiarity with fishing grounds	Intuition/risk	Management Restrictions
Market conditions	Peer pressure	Personal motivation
Recent trip	Reports	Tides and weather

Outcomes

The study showed that semi-structured interviews aided collection of data on a diverse range of topics related to the fishing industry, in particular, this technique delivered a better understanding of the cultural, economic and social issues facing fragile coastal communities dependent on fishing. The interviews in 2002 coincided with the European Commission's announcement on its proposed formation of Regional Advisory Councils (RACs) as a means of increasing stakeholder participation in fisheries management. All 25 of the skippers interviewed agreed that a move towards local or regional management was a step in the right direction, however, 20 (80%) stated they did not wish to get involved personally in the work of RACs, rather they saw this as a task for fishing industry representatives.

Issues

The findings highlight the individuality of skippers' views regarding their decision-making processes, which makes the task of formulating management and policy that will be endorsed by all stakeholders very challenging. This challenge can partly be addressed through improved communication between stakeholders and decision-makers, and the best way to achieve this, along with demonstration of the mutual benefits of such communication, requires careful thought. Interdisciplinary case studies such as those used in EFIMAS that foster effective working of multidisciplinary teams towards developing sustainable environmental management will certainly help. The best solutions on how to improve communication and cooperation will come from the fishers themselves thus greater effort needs to be placed in processes that can achieve this, particularly when applying skippers' knowledge to fisheries management in practice.

CASE 4: The North Sea Regional Advisory Council (NSRAC)

Aim

Regional Advisory Councils were set up during the 2002 reform of the EU's Common Fisheries policy. The principal aim of the NSRAC is to prepare and provide advice on the management of fisheries of the North Sea on behalf of stakeholders in order to promote the objectives of the Common Fisheries Policy (www.nsrac.org). Much of this advice is based on fishers' knowledge.

Methods

The NSRAC aims to put stakeholder perspectives and information directly into the heart of European fisheries management by providing a political forum where positions can be discussed between the two thirds industry members and the one third 'other' interests (including environmentalists, anglers and the North Sea women's network) with the intention of achieving a consensus opinion which can be forwarded as management advice directly to the European Commission. At the heart of the council is an Executive Committee of up to 24 members who are elected by, and draw upon consultation with, a larger General Assembly. Working groups are created to examine and provide advice on particular issues (for example, a working group on demersal stocks) and frequently include scientific members.

The methods employed are designed to integrate scientific and fishers' perspectives with that of other stakeholders through an open dialogue with the express aim of reaching consensus. Fishers' perspectives are presented by representatives of the industry in each country and thus the NSRAC largely relies on fishers' knowledge to be passed to industry representatives for inclusion in advice (although individual fishers are permitted to attend meetings as observers). Fishers' knowledge is, therefore, not collected by researchers to be used for management, but conveyed directly by fishers themselves, or their representatives. However, because RACs can only advise and make propositions to the Commission, they have no direct fisheries management powers, and so discussion occurs in a forum which is one step removed from implementation.

Types of knowledge

All topics relevant to fisheries management are open to discussion on the NSRAC, and they include knowledge of the implementation of gear regulations, and observations of stock parameters. Indeed, as fishers have become part of the management advice process, they can contribute all levels of perception on all topics, from specific state-of-nature perspectives on stock abundances to broad management perspectives on management principles. The NSRAC can provide a forum for the structured collection of data (for example by conducting a socio-economic assessment), but knowledge is more normally included in the form of perspectives and informed opinions of the resource users.

Results

During the first year and a half of its existence, the NSRAC has operated five working groups and produced advice or opinion documents ranging from advice on particular management legislation to more general opinions about the appropriate structures for fisheries policy. An important example of its work is the advice specific to cod, which is normally management perceptions with statements on the scope, focus and format for a review of the European Commission's Cod Recovery Plan, and the efficacy of particular management policies and instruments. Surprisingly, fishers' state-of-nature level knowledge does not seem to form a large part of the advice, with the position papers instead citing external scientific findings to assert the RAC's perception of the state-of-nature. For example the NSRAC's position paper on the review of Cod Recovery measures states, "According to STECF [the European Union's Scientific, Technical and Economic Committee for Fisheries] the effort control regime has had the effect of reducing the effective mesh size in the North Sea".

Outcomes

There is evidence that the advice tendered by the NSRAC to the European Commission is listened to, and in some cases has been favourably received, and that it has even influenced a few policy decisions on the Cod Recovery Plan. However, the Commission is resolutely opposed to giving executive powers to the NSRAC, and it will remain an advisory body for the foreseeable future. Evidently, the Commission is willing only to receive fishers' knowledge, not to be bound to act on it.

Issues

The main issue raised by the NSRAC is whether the Commission will consistently listen to them. Sometimes, the Commission seems to treat the NSRAC with disdain. For instance, in 2005, the NSRAC flatfish and demersal fish stock working groups were anticipating commenting on Commission's annual proposals for fishing regulations in 2006, but they were not advised of the commission's proposals and no Commission representative attended the WG on Demersal stocks. Another issue whether the stakeholders that NSRAC is supposed to be representing: are the industry representatives on the board really representing the views of their members? Many fishers see the NSRAC as merely another talking shop, rather than an effective vehicle for their

views. However, in reality it is very difficult to represent the views of all individuals and the NSRAC should be congratulated on attempting to do this where possible.

Conclusion

The main conclusion emerging from these four case studies on the use of fishers' knowledge in North Sea fisheries management is that the method of obtaining fishers' knowledge, which varies greatly between the cases, critically determines type, value and influence of fishers' knowledge obtained. For example, the extractive method of postal questionnaires used in the NSSS, weakened the value of fishers' knowledge obtained, both because of a low return rate, and because of the restricted nature of questions asked. The more interactive method of focus groups in EFIMAS improved the range and depth of knowledge obtained. Having a fisheries scientist make a presentation on the EFIMAS computer model part way through the focus group discussion greatly increased the exchange and understanding of shared knowledge between stakeholders and the scientist. The more participative method of one-to-one interviews in the North Sea demersal skippers' knowledge on fisheries survey yielded some valuable insights from fishers, especially on state-of-the nature to do with life history strategies of cod. The most participative method of all was employed in the NSRAC, where the breadth and depth of fishers' knowledge was probably at its greatest, articulated by several distinguished fishers' leaders, and where the potential impact of fishers' knowledge on fisheries management was the highest. Initiatives aimed at using fishers' knowledge in fisheries management continue to proliferate as part of a general shift towards participatory fisheries governance (Gray, 2005) and we forecast that greater benefits will result from those in which personal participation of fishers is maximised

References

Gray, T (2002) 'Fisheries science and fishers' knowledge' ENSUS Conference on Marine Science and Technology for Environmental Sustainability, 16-18 December 2002, Newcastle University.

Gray, T (Editor) (2005) Participation in fisheries governance. Springer, Netherlands.

ICES WGNSSK (2006) Report of Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. International Council for the Exploration of the Seas. Advisory Committee on Fisheries Management. ICES CM 2006/ACFM:09 (available at http://www.ices.dk/iceswork/wgdetailacfm.asp?wg=WGNSSK)

Rossiter T and Stead S (2003). Days at sea: from the fishers' mouths. Marine Policy 27 (3): 281-288.