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Contents

Executive summary

In our review of current research with implications for how ICES provides advice two key issues emerged: A) The widening of the remit of policy in this sphere to marine, rather than fisheries, policy; and B) the increased access of stakeholders to the policy process.

Re A) The European Marine Strategy will have implications for ICES as demands for advice come to reflect a more integrated approach. Integrated management requires integrated scientific advice on the level of risk, and on the expected impact of proposed new developments given the degree of pressure and impact from existing human activities

Re B) The RACs are the major form of stakeholder participation to which ICES must respond in the near and medium-term future. They have many roles. The most important ones are in policy making, setting long-term objectives, and dealing with fisheries management (in a broader context than ICES does) in the short-term. The RACs represent a decisive change towards a more systematic involvement of stakeholders in fisheries management. ICES needs to identify and clarify the demands and expectations that RACs may have on ICES.

The WGFS identified a number of specific implications for ICES' role as a provider of scientific advice:

1) It is imperative that ICES identifies the lead organizations with whom it will collaborate; e.g. EC, OSPAR, HELCOM, RACs etc.
2) ICES can support and facilitate the work of its collaborative partners by providing science for their objective-setting, policy choice and monitoring and evaluation processes and by using such methods as *participatory modelling*.
3) ICES needs to be explicit about what questions it can answer scientifically, and about its capacity and skills.
4) ICES should adopt a regional focus in its future advisory and science activities. At least some of the new review groups should be organised with a regional structure.
5) ICES' review groups could benefit from extended stakeholder participation and must develop an appropriately balanced relationship with RACs.
6) ICES currently undertakes both basic and applied science. Basic science must be protected for its own sake and as a check on quality for the more applied science.
7) Broadening of the ICES activities could be achieved by continued integration between different ICES committees, Regionally focussed review groups have an important role to play here.

Our review of lessons about effective scientific support to policy in other, non-fisheries arenas contains several possible lessons for the CFP.

A critical one is the importance of creating *ad-hoc* working groups involving scientists, stakeholders, and managers to address scientific issues at scales appropriate to those issues. It is the fact that scientific issues emerge at scales that do not necessarily reflect how scientists are organized that requires these groups to be *ad-hoc*, and we need systems to support these kinds of short term groupings.

Another important lesson is the importance of "boundary objects" which are policy-useful scientific efforts such as models and collaborative research that allow scientists to work directly with the consumers of their advice. The nature of fisheries means that it is easier than in many arenas to develop boundary objects and this is happening rapidly through collaborative research and developing scenario-based modelling. New kinds of boundary organizations such as the North Sea Commission Fisheries Partnership are also possible.

In writing advice ICES should choose which basic messages should be made salient in the report and this is not necessarily the information needed for setting TACs. Furthermore, the advice reports, or summaries of them, can be prepared with a large public in mind. The emergence of ecosystem issues means that a much broader group is looking for scientific information about the marine ecosystem.

Ensuring the credibility and saliency of scientific information in relationship to developing and defining an ecosystem approach will also be greatly facilitated if the design of the middle level review groups in the new advice structure is strongly influenced by regional considerations. Part of this is creating an appropriately balanced relationship, close but not to close, between the review groups and their respective Regional Advisory Councils.

As we move toward the ecosystem approach a problem has emerged with EU Framework research projects. While fisheries oriented projects nearly automatically see ICES as an important outlet for their work this is not the case for projects working on other aspects of the marine ecosystem. Many of these projects are based on university networks that are more distant from ICES than the fisheries institutes. The Annual Science Conference is one important tool to reach out to these other marine science projects.

1 Opening of the meeting

The meeting was opened 1 May 2007 at 10:00 am at ICES headquarters in Copenhagen.

2 Adoption of the agenda

The agenda was adopted as laid out in Annex 2.

3 Terms of Reference 2006

a) review and report outcomes of research on European fisheries management systems which is of relevance to ICES' role as provider of advice;

b) review and report the literature on best practices in the provision of scientific advice in other policy areas that may contain lessons for ICES. Initial work on this subject is being carried out in the SAFMAMS project;

c) review and report on the applicability to fisheries systems analysis of three methodologies currently being used in the comparative evaluation of fisheries and other natural resource systems: the Institutional Analysis and Development Framework being used by the International Forestry Resources and Institutions *(IFRI)* programme to comparing forestry management strategies; the fuzzy sets approach being used in the CEVIS project; and, the Bayesian approaches being used in the PRONE project;

d) finalize the table of contents for the Cooperative Research Report on the North Sea cod management evaluation and to develop a process for completing that research report.

4 ToR a): Review and report outcomes of research on European fisheries management systems which is of relevance to ICES' role as provider of advice

4.1 Introduction

The role of ICES is to promote and encourage research and investigations for the study of the sea, in particular in relation to its living resources. This role has traditionally been focused on fisheries science. However, the political context of ICES is changing, as society's priorities and interests have changed.

The principle of social choice presupposes that where society, or any section of society, has an interest in an issue they are entitled to participate in the policy process. This principle has been raised, for example, in connection with the ecosystem-based approach to fisheries management (EPAP, 1999:35; Frid, 2005:243; Frid *et al.*, 2005, 2006; Laffoley *et al.*, 2004:37–40; Richardson, 2000:769; Defra, 2004:127; Degnbol, 2002; EFEP, 2004; Paramor *et al.*, 2004). Gray and Hatchard (2007) propose that this normative imperative to consider society's views constitutes an ethical relationship between stakeholder participation and the ecosystem-based approach.

Two key issues have emerged that ICES needs to address:

- the widening of the remit of policy in this sphere to marine, rather than fisheries, policy; and,
- the increased access of stakeholders to the policy process.

The intersection of this expansion of both the substantive remit and the related social processes bring two key questions:

- At what *scale* is participation appropriate?

- And what *role* should that participation play?

National or **local** fisheries co-management – where resource users and managers work collaboratively to *manage* fish stocks – is well established as one form of the participative mode of fisheries governance.

Broadening the remit of fisheries management to take in socio-economic and ecological interactions with fisheries requires a concurrent broadening of participation to bring other interested parties into the process. How this participation should be structured depends on its objectives. Two areas in particular stand out where participation can benefit an ecosystem approach to fisheries management:

- Well structured participation can contribute directly to the knowledge base for management; and,
- Well structured participation can increase the legitimacy and hence effectiveness of management.

Both of these potentials are related to the questions of role and scale. Participation can make rich information generated at local levels directly available to help the ecosystem approach. But characterizing systems at higher levels of resolution requires that information be gathered systematically. When this is needed, participation, especially by user groups, can contribute information to improve the systematic data gathering processes. This has often proved difficult in practice, especially in situations where cross-scale linkages have involved trying to translate complex information into a form that is useful at a higher level (Degnbol and Wilson 2007). From the perspective of legitimacy the challenge of participation at higher than local scale levels is representation. The number and complexity of stakeholders in marine management process means that the question of who speaks for whom is constantly raised.

The problems with trying to manage both knowledge and legitimacy across multiple scales make it obvious that the CFP's attempt to manage European fisheries at a continental scale is a quixotic one. A small step has been made in the direction of more seeking more appropriate scales for decision making and advice in the form of the Regional Advisory Councils (RACS) RACs are fora where environmental non-governmental organizations, onshore fisheries interests, organizations representing communities and recreational fishing groups sit alongside direct resource users – the fish catching sector – in a stakeholder *advice-making* forum (Dunn, 2005; Symes, 2005). It has also been paralleled by local, regional and national multi-stakeholder forums in fisheries. One example from Scotland is the Inshore Advisory Group

The scale level of participation is correlated with the scale level of an issue. However, where more interests are involved, participation shifts to contributing ideas rather than practical interactions, such as advice-making and management. For example, if the political field of interest were to be expanded still further, so that it encompasses the **entire European seas marine environment** and all its users and no longer has fisheries as its sole focus, then participation would need to be further extended, perhaps to the whole of society. If this is the case, the role of non-user stakeholder groups would be to *contribute to the debate about objectives*, helping to answer the question: 'what kind of marine environment do "we" want?'

What does this mean for ICES? With participation at multiple scale levels - from society, finally represented by the politicians, down to stakeholders dealing with a problem in a particular local – ICES may well find itself having to operate in a political context where fishery objectives are influenced by policy objectives which have a much wider scope, instead of standing in isolation. It may also have to deal with competing demands for advice relevant to issues on multiple scale levels.

4.2 Wider marine policy

In recent years, the need to incorporate environmental requirements into fisheries management – the ecosystem approach to managing living aquatic resources – has been endorsed in many international agreements (e.g. FAO Codes of Conduct for responsible fisheries, UN Law of the Sea as well as the Convention of Biological Diversity). The European Union has taken an active role in promoting this approach (CEC, 2002). Similarly in the field of marine protection the Council's political agreement from December 2006 on the Proposal for a Directive of the European Parliament and of the Council establishing A Framework for Community Action in the field of Marine Environmental Policy (Marine Strategy Directive) states that: "Marine Strategies shall apply an ecosystem-based approach to the management of human activities while enabling the sustainable use of marine goods and services."

There is thus a clear political message to broaden approaches in fisheries policies. Regarding scientists' role in this, the European Commission has emphasised that research should clearly support "progressive implementation of an ecosystem-based approach to fisheries management to the extent permitted by scientific knowledge" (CEC, 2002:1) and that "fisheries science has traditionally been highly specialised, in particular in the field of stock assessment, but lacking the broader view required by the complexity of problems faced by managers" (CEC, 2001:13) when a larger environmental perspective is needed.

The European Commission has a responsibility for the protection, conservation and sustainable use of the marine environment and exclusive competence for the conservation, management and exploitation of living marine resources under the Common Fisheries Policy. Under the European Marine Strategy (EMS), policy measures to protect and conserve the environment are to be well founded, proportional to the desired effect and easy to implement. Marine environmental policies would be integrated and would not only consider fisheries but also the many other pressures on the marine environment. It is not possible to control nature or to manage ecosystems in a way which would establish highly predictable outcomes.

A new Directive is planned, aimed at achieving or maintaining good environmental status in the marine environment, including fish stocks, by the year 2021 at the latest. This will apply an ecosystem-based approach to its aims of carrying out an initial assessment of the current environmental status of community waters, establishing environmental targets, implementing monitoring programmes and developing a programme of measures to protect the environment. The Directive would be applied on a regional scale and Member States would be required to act jointly. Fisheries are thus set to become part of a wider marine policy framework and two different legal frameworks, the CFP and the EMS, may have to be merged or at least be consistent with one another.

It has been noted that the present management regimes have been built for managing fisheries of commercial stocks – often in a single-species management framework (e.g. Richardson, 2000; Sinclair *et al*., 2001; European Commission, 2001). Consequently, Sinclair *et al*., (2001) note that traditional fisheries management regimes cannot handle the new tasks and the ecosystem-based management requires new governance approaches. Implementing an ecosystem-approach to fisheries management is a difficult task. It has to handle more complex problems than traditional fisheries management and has to be based on a multi-disciplinary approach. (Richardson, 2000; Sinclair *et al*., 2001).

The implementation challenges in the ecosystem-approach to fisheries management have been identified as follows (Garcia and Cochrane, 2003):

1) <u>The policy-makers need to</u>: improve fisheries governance; decide on the main operational ecosystem objectives; allocate resources through appropriate systems of rights; identify a manageable set of stakeholders; equitably deal with exclusion; maintain capture fisheries production at about 100 million tonnes to avoid unbearable price increases and food security crises; reduce the

environmental impact of fisheries; and lobby for reduction of coastal pollution and degradation.

2) The industry needs to: actively change its public image; effectively reduce fishing capacity; adopt more environmentally friendly gear and practices; lobby for allocation of fishing rights; lobby for integrated management of fisheries (e.g. in a coastal areas management context) and nest its short-term interests in longer term ones.

3) The public has a significant role to play: as citizens, using votes to influence politicians; as consumers, using buying power to influence producers and, as tax payers, agreeing to bear some of the transition costs of change.

4) The scientific community needs to: identify a parsimonious set of ecosystem indicators; identify ecosystem boundaries that make both ecological and institutional sense; elaborate viable targets and limits for ecosystems as well as precautionary thresholds; develop a credible assessment of ecological risk; elaborate rehabilitation and rebuilding strategies (including appropriate MPAs); design affordable transition pathways, adapted to local conditions; integrate social sciences in the decision-support process.

Integrated management requires integrated scientific advice on the level of risk, and on the expected impact of proposed new developments given the degree of pressure and impact from existing human activities. Some of these activities, such as oil and gas development, aggregate extraction and wind farm development, are managed through the issue of licences that apply over relatively small spatial scales. Fishing management regulations are by contrast set at much larger spatial scales. Spatial discrepancies and the difficulty in obtaining accurate geo-referenced data describing pressures caused by each of these activities acts as a serious impediment to the development of integrated assessments of risk and impact.

Ecosystem managers will also need to address questions related to rights and responsibilities, allocation and equity, and conservation, resources and environment in a transparent framework in which stakeholder participation, public information and performance assessment are part of the routine and the culture (Svedrup-Jensen and Degnbol, 2005).

4.3 Participation

4.3.1 Participation and the Knowledge Base

Argylis and Schön (1978) defined learning as the ability to detect and correct error. Evaluation and learning are linked since claiming that something is a failure is an act of evaluation. Furthermore, evaluations can be considered advanced learning instruments, when mobilized towards improving a given state of affairs, i.e. as in formative evaluations (Scriven, 1991). The notions of evaluation and learning could prove useful for refining ICES' role in a changing context. This, however, needs attention to be paid to the way this context conceptualized, i.e. the fisheries system in which ICES provides advice. Nielsen and Holm (2007) aimed at developing such a systemic view on evaluation and learning, relevant to a fisheries system.

Argylis and Schön (1978) distinguish between single loop learning and double loop learning. The single loop learning is the process of detecting and rectifying errors within a given system or organization. This is for example when ICES evaluates the adequacy of its previous advices, and thereby learns to address systematic problems in its provision of advice. Stock estimates and forecasts turned out to be recurrently highly uncertain and biased for North Sea cod and plaice especially (Pastoors, 1999; Nielsen, 2003; Bertelsen and Sparholt, 2002; Reeves & Pastoors, 2007; van Densen & McCay, 2007). This suggests that current methodology for arriving at these estimates should be evaluated as a regular procedure (e.g. retrospective analysis), and such evaluation outcomes should be communicated to the outside community.

Double loop learning should become particularly relevant for ICES, as its context is changing. This is when norms and procedures themselves are rendered objects of change in the learning process. This implies that not only the form of resource advice and the technical instruments of management are addressed, but also the objectives, norms and policies of the fisheries system. In a double loop learning process, both the relevant framing of the object to be evaluated, as well as the relevant objectives on which to ground that evaluation need to be considered as dynamic and interactive elements, subject to possible change.

Such a learning process, however, cannot be confined to a single actor (e.g. ICES), but needs to be discussed in a broader context, including ICES clients and other stakeholders.

Currently, different reform concepts are launched in the context of fisheries management, including the discourses on ecosystem based management, area based management, participatory management, and rights based management. To some extent, these are disciplinary responses, launched as “technical fixes” to solve problems of the whole fisheries system but which should rather be recognized as emphasizing problems in specific aspects of the system (Degnbol *et al*., 2006).

Without evaluation, learning is slow both with regard to improved diagnostic tools (single loop learning), and concerning the fisheries management systems at large (double loop learning). In the US, for example, assessment quality is reviewed and openly discussed, and, thereby, the evaluative capacity is enhanced (Mayo and Terceiro, 2005). In this regard, the WGFS could be ideally suited for providing a trading zone for theoretical and practical experiences of different disciplines, working to enhance systemic learning about fisheries systems in their broader context in an ongoing learning process. More particularly, we suggest the following two measures to be pursued:

- Establish routine procedures for evaluations of ICES assessments and advice, and communication of these to the interested community external to ICES.
- Promote evaluations of the broader fisheries system, in which ICES is a provider of advice, to promote systemic learning.

4.3.1.1 Collaborative Research

Collaborative research has become a part of an emerging realignment of the actors involved in fishery management. Fisheries laboratories, with the encouragement and funding of member state governments, have initiated collaborative research in order to improve overall fisheries governance through enhanced cooperation. Fishermen and biologists are increasingly working together towards the common goal of providing accurate stock assessments, evaluating technical measures, mapping fishing effort, identifying other spatial information such as the location of spawning grounds, reducing bycatch and developing more selective fishing gear. All of this is related, directly or indirectly, to scientific advice for management.

Paukszat’s (2005) comparative research on several instances of collaborative research in Germany, Ireland and England concluded that collaborative research should be seen in relation to participants’ perception of their relationship with each other in the context of seeking larger goals. It is a means to an end, rather than an end in itself. For the biologists, it is a way to obtain data of high quality and to use approaches that are informed by fishermen. It can also increase the legitimacy of scientists’ findings in the eyes of the fishermen, reducing conflict in the fisheries-science interface. For the fishermen, it is a strategy to increase their involvement in the management of the fishery and maybe ultimately influencing the regulations affecting the fishery. This is perceived as a two-step process. The first step is to make the stock assessment and provide the biological advice, in such a way that it corresponds as closely as possible to the actual stock size. In the second step, politicians decide on regulations on the basis of the biological advice.

Collaborative research plays a role in both steps. With regard to the first step, collaborative research is seen by participants as the easiest way to ensure both the relevance of the research to the fishery's and the biologists' needs (by initiating relevant projects) and the accuracy of the findings (by allowing input from all involved). This was reflected in sound biological advice. With regard to the second step, it was expected that aligning the position of the fishery with the biological advice would make it more compelling to politicians. Consequently, Pauksztat (2005) concludes that collaborative research projects were evaluated mainly in terms of their usefulness in this endeavour to provide sound biological advice and (especially by the fishermen) to influence the regulations affecting the fishery.

As most collaborative research will remain at the member-state level and below, the relationship between ICES and collaborative research is mainly an indirect one. ICES needs to recognize that instances of such research have become more and more frequent and ambitious. ICES can play a facilitating and encouraging role. It can identify areas where such research would be useful and organizing study groups or symposia in order to share the lessons being learned about effective collaborative research processes. ICES can continue to review such research for quality, as it did in the 2005 review of the North Sea Stock Survey.

ICES should also be aware that funding is becoming available for collaborative research from non-fisheries related sources at the European level that are interested in encouraging common endeavours between scientists and lay people in general.

This is particularly relevant when the research relates to stocks on which ICES gives advice. In these cases the results, after careful review, can be incorporated into advice. There may also be research questions at an international level where collaborative research would be useful and ICES would play an initiating and coordinating role.

4.3.1.2 RACs and the knowledge base

National or local fisheries co-management – where resource users and managers work collaboratively to manage fish stocks – is well established as one form of the participative mode of fisheries governance. Broadening the remit of fisheries management to take in socio-economic and ecological interactions with fisheries requires a concurrent broadening of participation to bring other interested parties into the process. A move in this direction has been made at the regional seas level with the RACs. RACs have important roles in contributing to policy making, long-term objective-setting, and addressing strategies to meet short-term objectives in fisheries management (in a broader context than ICES does).

The scope and extent of scientific and advisory interactions between ICES and RACs needs to be defined. RACs will need to be involved in some way at the national laboratory level (discussion of data and sampling issues), at the ICES assessment working group level (mainly through cooperation with national WG members), at the review level (as was the case at the ICES NSCFP meetings in 2002-2005), as observers at the ACFM level, and, further, at levels outside ICES' remit, such as socio-economic and political levels.

Therefore, ICES needs to identify and clarify the demands and expectations that RACs may have on ICES. Any increased demands on ICES from the RACs will require commitment of resources from member countries. The RACs have not specified these demands beyond wishes from the North Sea and Pelagic RACs for presenting and explaining the assessment and advice.

Useful links could be established between the RACS and ICES new scientific advice production system if some or all of the review groups have a geographical focus at the shared seas level. However, until the needs of RACs are clarified and their associated costs are calculated, a detailed discussion, agreed processes and a decision by ICES cannot be taken.

4.3.2 Participation and legitimacy

The most fundamental way in which the principle of social choice is articulated is through democratically controlled governments. For this reason, most fisheries and marine management regimes in developed countries are fundamentally command-and-control regimes in which a central agency representing a government makes fisheries management decisions, which have the force of law and which are enforced by government agencies. All of the innovations we are considering in fisheries management and the science that supports it will take place within an essentially command-and-control framework for European fisheries management.

The reasons for this are threefold:

1) Most fundamentally, in all Western fisheries management regimes the fisheries resource belongs to all citizens and it is the responsibility of the government to manage those regimes on their behalf. For this reason all proposed innovations are in a final sense commanded and controlled by the government on behalf of the people.

2) Command-and-control is the most effective basic approach to the management of resources that cover a large geographical scale because they produce relatively predictable outcomes across wide areas. However, they pay an important price for this in both local legitimacy and support and having to make decision based on much poorer information than is available on the smaller scales (Wilson, 2003).

3) Command-and-control regimes are able to respond and deal with problems where negotiated outcomes are difficult to achieve. In Europe, which faces great problems with multiple jurisdictions and competition over resource allocation, there are simply decisions that are best made by central authorities.

Most of these points are fairly clear and well accepted. The basic practical result is that at the end of the day social choice is done through the duly constituted fisheries managers and stakeholder *participation*, in all its forms, takes place at their behest. This does not mean that stakeholder participation is irrelevant or powerless, only that the power of any participatory forum derives in the final analysis from the democratically elected government.

Beyond this legal legitimacy, there are other sources of the effective legitimacy that is reflected in stakeholder acceptance and support of management. It is useful to distinguish between process legitimacy, which means that a decision is seen as having been arrived at in a fair manner, and outcome legitimacy, which means that the decision itself is seen as sound and rational. Participation can, but does not necessarily, contribute to both of these kinds of legitimacy.

It is to increase these kinds of legitimacy that managers promote participation and both process and outcome legitimacy are closely linked to science. Scientists from the ICES community often express a need for interaction with fisheries managers (Wilson and Hegland, 2005). This reflects the desire of the scientists to participate in the management system in a broader way, not because they are seeking influence beyond offering good science, but because producing good science requires that they stay constantly in touch with what managers need.

Science’s, and therefore ICES’ relationship to legitimate decision making is not as direct or obvious as it is to the development of the knowledge base. However the ways that scientists structure their relationship to management has implications for the legitimacy of decision making.

While some have argued that managers don’t follow scientific advice, Patterson (2006) demonstrates that managers do not ignore advice as much as lag behind it while following its general trend. Scientists are also frustrated that managers fail to decide on precautionary reference points and are insufficiently active in suggesting management strategies. Science is, after all, only one basis for negotiations because there are multiple objectives. To take the extreme example, if society wants to wipe out a stock, that might be a valid decision. On the other hand, the impression is often that a manager, or society, does not understand the scientists' message on the consequences of decisions.

This may be a communication problem, but we should not underestimate the capacity of stakeholders. A stakeholder may choose to "not understand" for tactical reasons. Increasing use of the sea by different users will bring about conflict among stakeholders – for example: fish farmers, fishermen, energy companies, aggregate dredgers, shipping, and tourism. This will cause competitive behaviour to arise, potentially having damaging effects on the marine environment, and adding to existing competition between features of the marine environment, including fish predators, and fisheries (Sava and Varjopuro, 2007).

Science-based marine management decisions are influenced by policy choices involving environmental, economic, social, or other concerns. Stakeholders' negotiation interests (objectives) cause them to negotiate, and to take a particular negotiation position. Stakeholders argue about each other's knowledge and other mental attitudes (e.g. goals) in order to justify their own negotiation positions, and to influence each other's negotiation positions. Stakeholders with conflicting interests and a need to cooperate are negotiating in an attempt to reach agreement over the balancing of their interests in translating science-based advice into agreed management decisions. Stakeholders with conflicting interests and a need to cooperate are negotiating in an attempt to reach agreement over the balancing of their interests in translating science-based advice into agreed management decisions. Argumentation analysis (Rahwan and Amgoud, 2006) provides a means for understanding the nature of conflicting interests as well as for forming fisheries management decisions on the basis of incomplete, conflicting or uncertain information. Techniques such as participatory modelling (Wilson and Pascoe, 2006) are available for facilitating stakeholder interactions in ways that help them separate discussions about the real situation with the ecosystem and stocks from discussions about policy and allocation issues.

4.4 Summary: The European marine strategy, RACs and ICES

For marine ecosystems to be healthy, the status of commercial stocks has to be good. Any environmental policy aimed at protecting and conserving the marine environment has to take fish stocks into consideration. Fishing was probably the most important pressure exerted upon marine biodiversity. However, existing legal and institutional arrangements put the management of fisheries in the hands of the Common Fisheries Policy (CFP). The reform of the policy in 2002 offered many opportunities to incorporate environmental concerns into the management of fishery resources. The policy aimed to reduce fishing pressure (catches, mortality and effort) and improve the status of stocks; to improve fishing methods and diminish by-catch and physical destruction; to eliminate incentives to overcapacity and improve profitability and compliance. In addition, the policy had to contribute to implementing any relevant environmental policy.

The European Marine Strategy (EMS) is a new policy. Under this policy, measures to protect and conserve the environment would be well founded, proportional to the desired effect and easy to implement. Marine environmental policies would be integrated and would not only consider fisheries but also the many other pressures on the marine environment. It is not possible to control nature or to manage ecosystems in a way which would establish highly predictable outcomes.

Integrated management requires integrated scientific advice on the level of risk, and on the expected impact of proposed new developments given the degree of pressure and impact from existing human activities. Some of these activities, such as oil and gas development, aggregate extraction and wind farm development, are managed through the issue of licences that apply over relatively small spatial scales. Fishing management regulations are by contrast set at much larger spatial scales. Spatial discrepancies and the difficulty in obtaining accurate geo-referenced data describing pressures caused by each of these activities acts as a serious impediment to the development of integrated assessments of risk and impact.

The RACs have many roles. The most important ones are in policy making, setting long-term objectives, and dealing with fisheries management (in a broader context than ICES does) in the short-term. The RACs represent a decisive change towards a more systematic involvement of stakeholders in fisheries management.

It is still a rather open question what roles the RACs will play in the advisory process. However, RACs will need to be involved at the national laboratory level (discussion of data and sampling issues), at the ICES assessment working group level (mainly through cooperation with national WG members), at the review level (like done at the ICES NSCFP meetings in 2002–2005), as observers at the ACFM level, and further at the levels outside ICES remit, like socio-economical and political levels.

ICES needs to identify and clarify the demands and expectations that RACs may have on ICES. Any increased demands on ICES from the RACs will require commitment of resources from member countries. The RACs have not specified these demands beyond wishes from the North Sea and Pelagic RACs for presenting and explaining the assessment and advice. . However, until these demands are clarified and their associated costs are calculated, a detailed discussion, agreed processes and a decision by ICES cannot be taken.

There is no doubting that the scientific advice on fish stocks must be of the highest quality and that improvements are needed. It is especially important to improve the quality of data on landings, catches and discards. The better the data the less cautious the scientific advice will have to be. Strong partnerships between scientists and fishermen will improve the quality of the data and promote better understanding between the two groups. Initiatives are needed to promote closer cooperation. The advisory system itself also needs reform, as the advice emerging from ICES is too limited in scope, and often inappropriate. Closer engagement of stakeholders in the advisory process, provided undue pressure is not placed upon scientists, can only lead to improvements.

The RACs, ICES and the EC need to work together on management strategies and ensure that any new learning gets incorporated into a continuously improved system.

4.5 Implications for ICES

In line with the current review of ICES, the WGFS recommends a more systematic approach to addressing ICES roles and suggests considering the following points:

1) ICES have a number of Commission and client customers for whom advice is provided. Requests for scientific advice and supporting studies broadly address the following management goal:

To promote sustainable use of the seas and the conservation of marine ecosystems.

2) And it is plausible to assume that all such customers will wish to ensure that human activities in the marine ecosystem are carried out in a sustainable manner with one overarching aim:

To make our seas clean, healthy and productive.

However, whilst the aim may be simply stated it has not been translated into specific objectives and targets which can be monitored and assessed. ICES can contribute to this process.

3) Although it is essential that ICES clarifies clients' aims before it can restructure/refocus its work in the short- to medium-term, ICES' role may be broadly summarized as:

To collaborate in the development of a coherent, streamlined, and integrated framework for the management of human activities.

4) It is imperative that ICES identifies the lead organizations with whom it collaborates; e.g. EC, OSPAR, HELCOM, RACs etc.

5) ICES can play a key role in supporting and facilitating the work of its collaborative partners, for example, by providing science for their objective-setting, policy choice and monitoring and evaluation processes (Hatchard and Stead, 2006; Wittmer *et al*., 2007), and by using such methods as participatory modelling (Wilson and Pascoe, 2006). ICES' role as a bank for meta-data is an important part of this.

6) In fulfilling its role of collaborating with partners, ICES needs to be explicit about what questions it can answer scientifically, and about its capacity and skills. Where it cannot respond to requests for information, further dialogue with partners about their requirements will be useful.

7) ICES should adopt a regional focus in its future advisory and science activities to enable it to address issues of marine ecosystem management which vary on a regional basis. At least some of the new review groups should be organised with a regional structure.

8) ICES' review groups could benefit from extended stakeholder participation and must develop an appropriately balanced relationship (close but not too close) with stakeholders, such as by building links with RACs or RAC-like organizations laterally.

9) ICES currently undertakes both basic and applied science. In the context of a wider marine policy remit, applied science, geared towards management objectives will become increasingly important. Basic science must be protected both for its own sake and as a check on quality for the more applied science.

10) Broadening of the ICES activities could be achieved by continued integration between different ICES committees, as a great deal of the necessary science is already covered by ICES. Regionally focussed review groups have an important role to play here.

11) ICES should rename the Fishery Systems WG as the Working Group on Marine Systems. The role of the group would continue to be understanding the broader systems in order to improve the quality and targeting of ICES scientific advice. This group would address wider ecological legislation and management, in addition to fisheries: for example, the Habitats Directive and Water Framework. This working group would have a role to play in interacting with the other ICES working groups – for example, SGRAMA has suggested developing a conceptual risk management framework with several levels of participation.

5 ToR b): Review and report the literature on best practices in the provision of scientific advice in other policy areas that may contain lessons for ICES

Deliverable One of the Scientific Advice for Fisheries Management at Multiple Scales (SAFMAMS) reviewed the use of scientific advice by international environmental management regimes in hopes of identifying lessons that will be of use to the European Union as it seeks to manage European fisheries under the Common Fisheries Policy (CFP). This document (Wilson, 2006) is summarized here and responses by the working group are reported.

The research area is still a fairly recent one. All its major theoretical approaches have their genesis in the 1980s and even the early 1990s. While a number of tentative lessons have emerged there are few undisputed conclusions. The test of the usefulness of this material for fisheries will lie mainly in the degree to which fisheries professionals find it coherent and reflective of their own experiences.

The attributes that make a set of scientific findings useful for policy are saliency, credibility and legitimacy:

> "Saliency reflects whether an actor perceives the assessment to be addressing questions relevant to their policy or behavioural choices;
>
> Credibility reflects whether an actor perceives the assessment's arguments to meet standards of scientific plausibility and technical adequacy; and
>
> Legitimacy reflects whether an actor perceives the assessment as unbiased and meeting standards of political fairness."

There are often trade-offs between these attributes and efforts to bolster one often only succeed at the expense of another. The main differences among science policy institutions are how they shape the tradeoffs among saliency, credibility and legitimacy.

The boundary between what is science and what is not science must by recognized and respected. It cannot be treated naively; neither by assuming that the distinction between what is science and what is policy, advocacy or values is easily made in concrete situations, nor by assuming that it does not really exist. Well designed boundary spanning arrangements are the most essential tool for maintaining salience, credibility and legitimacy. Two such arrangements are boundary organizations, where scientists and other stakeholders are able to interact, and boundary objects. Examples of such objects would be models, indicators, collaborative research designs and data collection efforts that are used to provide a way to structure discussions.

The review examines three established theories of the science-policy interface.

Epistemic communities are a particular type of policy network that is characterised by scientific consensus. The Epistemic Community approach posits an ideal situation: a strong consensus among scientists reflecting truth about nature that has clear normative implications and policy alternatives that all of the scientists can gather around. This describes what has happened in several successfully negotiated environmental protection regimes. These examples, while few, do show that success is possible and provide a set of experiences of success from which lessons can be drawn. The weakness of the approach is that it does not address the majority of environmental problems where uncertainty is high and consensus difficult to obtain.

The second well establish theory Post-Normal Science (PNS), which restricts itself to high uncertainty / high stakes policy arenas. A central concept is the "extended peer community" where an open dialogue is required because the quality of the science depends on an "extended peer review". The other important concept is that within the high stakes, high uncertainty context, it is scientific skills rather than scientific knowledge that becomes more important. This means that scientists must act more like consultants than traditional scientists to help address high stakes uncertainty.

The third theory is Mode Two Science. The argument here is that science is shifting from a search for truth to a more pragmatic aim of providing a provisional empirical understanding of the world that works in a practical sense. This has forced science, particularly though the way it is financed, to become less privileged, more flexible and less disciplinary. In this new way of producing knowledge quality control based on results is replaced with quality control based on procedures and processes. Such quality control is more dependent on non-scientific mechanisms.

The majority of ways to help maintain credibility, legitimacy and salience in situations of high uncertainty allow scientists to work closely with non-scientists without sacrificing legitimacy and credibility. One such mechanism is "polycentric networks". These are multiple connections between researchers and decision makers which cut across various political and organizational levels. They are able provide methodological coherence across scale levels while still allowing local specialization and provide for multiple pathways to encourage innovation and flexibility. A polycentric network also facilitates stakeholder capacity building and involvement. It is an institutional design that gives form to the consultant-like relationships envisioned in Post-Normal Science while mobilizing transparency and the inclusion of multiple interests to keep these relationships from being so close legitimacy and credibility are impaired. The multi-scale level nature of the problems that science-based policy must address also suggests a polycentric approach.

The review concludes with a discussion of four principles distilled from a number of the studies.

The first principle is built in evaluation and reflection. Many potential problems can be anticipated even in conditions of uncertainty and the taking tentative, reversible action is important. A close relationship between science and policy facilitates the treatment of management measures as tentative tests of hypotheses about the social and natural environment.

The second principle is to search for consensus. The examples that are the basis of the Epistemic Community approach show that where consensus is possible it is a powerful tool for effective policy. Boundary spanning arrangements should facilitate a consensus among scientists and decision makers over the questions to be addressed, the evidence and expertise needs, and the processes that scientific assessments employ. However, many scholars warn against too strong an emphasis of consensus. We must not overemphasize the finding of common ground or create a situation in which people feel it is simply in their best interest to follow the consensus.

The third principle is participation. How to involve stakeholders in science-based policy remains a challenge. The reason for doing so is the legitimacy that can be gained though public buy-it, and in some cases such buy-in can be critical to outcomes. In the past the public has often been approached ineffectively. Much of the literature exaggerates or mischaracterizes the public's lack of knowledge. Almost all of it misses the importance of the public's own experience-based knowledge in arenas such as fisheries.

The fourth principle is transparency, which becomes critical where uncertainty is high because of the need for openness about the limits of scientific knowledge. Transparency, in the form of involving several parties with different interests in the “consultancy” relationship, seems to be the only way to gain the advantages in terms of saliency and uncertainty while maintaining legitimacy and credibility. However, when transparency is poorly structured, especially with formal “openness” requirements, it can reduce legitimacy.

This review contains many possible lessons for the CFP and a tentative list if offered in the conclusion. Some highlights include the ways that interactions between and among scientists and RACs are already creating ad-hoc working groups of various sizes that take the form of a polycentric network and perhaps they should be encouraged and supported. The nature of fisheries means that it is easier than in many arenas to develop boundary objects and this is happening rapidly through collaborative research and developing scenario-based modelling. New kinds of boundary organizations such as the North Sea Commission Fisheries Partnership are also possible.

In the discussion of the literature review several points emerged that the WGFS though relevant.

For one thing, in writing advice ICES should choose which basic messages should be made salient in the report and this is not necessarily the information needed for setting TACs. As the advisory process focuses more on the ecosystem, the most pressing issues for each fishery (or region) should be highlighted in the introduction to the advice. If, for example, the main problem with understanding a fishery is illegal landings then that issue should be made very prominent.

Furthermore, the advice reports, or summaries of them, can be prepared with a large public in mind. The emergence of ecosystem issues means that a much broader group is looking for scientific information about the marine ecosystem. ICES should seek to ensure where appropriate vis-à-vis our relationship with clients, that this information, is easy to find and accessible for public use.

Ensuring the credibility and saliency of scientific information in relationship to developing and defining an ecosystem approach will also be greatly facilitated if the design of the middle level review groups in the new advice structure is strongly influenced by regional considerations. Part of this is creating an appropriately balanced relationship, close but not to close, between the review groups and their respective Regional Advisory Councils. Such appropriate balancing would make use of boundary organizations and boundary objects where collaboration on particular problems allows the review groups to develop a rich understanding of the available data and the detailed needs for advice without being overly influenced by these interactions in terms of producing science seen as both credible and legitimate.

Related to this point in the further encouragement of short-term groups of scientists that work with the RAC working groups on specific issues at various scale levels. This should be considered a priority use of resources. These ad hoc groups will be a key instrument for increasing the salience of ICES’ work and encourage its more effective uptake into policy decisions.

Finally, as we move toward the ecosystem approach a problem has emerged with EU Framework research projects. While fisheries oriented projects nearly automatically see ICES as an important outlet for their work this is not the case for projects working on other aspects of the marine ecosystem. Many of these projects are based on university networks that are more distant from ICES than the fisheries institutes. The Annual Science Conference is one important tool to use to reach out to these other marine science projects.

6 ToR c): review and report on the applicability to fisheries systems analysis of three methodologies currently being used in the comparative evaluation of fisheries and other natural resource systems

Unfortunately the invited speaker that was to address the WGFS about the IFRI project was taken ill and was not able to attend and the representative of the PRONE project was also not able to come. Questions had also been raised by working group members during the year about whether focussing on comparisons of fisheries management regimes was really what the WGFS needed to do rather than maintaining a focus on aspects of the fishery system directly relevant to the ICES role as provider of scientific advice. In light of these things the working group decided spend the time allotted to ToR c) on ToR b).

7 ToR d): finalize the table of contents for the Cooperative Research Report on the North Sea cod management evaluation and to develop a process for completing that research report

Members of the WGFS observed that all the papers – seven in all - that had been prepared for the WGFS research report had been submitted to and accepted by the special issue of the ICES Journal of Marine Science coming out of the Symposium on Management Strategies held in Galway in 2006. In light of this fact the WGFS decided that a Cooperative Research Report would be redundant.

Annex 1: List of participants

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Annex 2: Agenda

Working Group on Fishery Systems 2007 - Final Agenda			
	Tuesday 1 May	**Wednesday 2 May**	**Thursday 3 May**
Morning	10:00–10:45 ToR b) presentation Doug Wilson Kellerman 10:45–12:30 ToR b) Working Session	9:00–11:00 Wim Van Densen Anne McLay Discussion of Part I 11:00–12:30 ToR a) Part II Fisheries and the Broader Ecosystem Rauschmayer et. al. Varjopuro *et al*.	9:00–12:30 ToR a) Working Session Continued
Afternoon	14:00–17:00 ToR a) Part 1 - Participatory Approaches in Fisheries Kjellrun Hauge, Kåre Nielsen and Knut Korsbrekke Kåre Nielsen Ditte Degnbol and Doug Wilson Robert Aps	14:00–17:00 Gray and Hatchard ToR a) Working Session	14:00–15:00 WGFS Business meeting New Directions for the WGFS?

Annex 3: WGFS Terms of Reference for the next meeting

The **Working Group on Fishery Systems** [WGFS] (Chair: D. Wilson, Denmark) will meet in Aberdeen, UK from 10–14 October 2008 to:

a) engage with experts from outside of fisheries to review how uncertainty, complexity and ambiguity are addressed in related policy regimes. This review will inform tool development, the design of adequate participation procedures and comparative research on approaches being used in fisheries;

b) assess forms of quality control and external accountability for participatory approaches to making decisions about the fisheries knowledge base in terms of both tools and practices. The objective of this is to begin to identify appropriate mechanisms and practices for facilitating extended peer review of the growing number of stakeholder driven scientific fora appearing in European fisheries using quantitative and qualitative assessments of uncertainties.

WGFS will report by 30 November 2008 for the attention of the Resource Management Committee.

Supporting Information

Priority:	The main focus of WGFS is the fishery system and the role of scientific advice within that system. The system-based approach relates directly to priorities such as developing an ecosystem-based approach to management and the effective implementation of the precautionary approach. Consequently, these activities have a very high priority. The work of the Group is also essential if ICES is to advance the development of realistic projections of fisheries development that take into account the reaction of other parts of the overall fisheries system.
Scientific Justification and Relation to Action Plan:	The Group met in 2000, 2001, 2003, and 2004 to develop a framework for case study analysis and has identified European (North Sea cod) and North American (Georges Bank mixed fisheries) case studies. Funding for the European case study had been granted from 2003 under the EU Framework V Programme; funding for the North American study was granted from 2004. This effort resulted in seven papers that were published in the special issue of the ICES JMS based on the Symposium on Management Strategies held in Galway in 2006. The key role for the WGFS is to integrate across disciplines to develop analytical and investigative methods/approaches for studying fishery management systems. The main but not exclusive focus of these investigations of the overall fisheries system is to improve the effectiveness of scientific advice. The Group met in 2005 in conjunction with the PKFM, FEMS and EASE projects all of which dealt with organizational and institutional aspects of the production of scientific advice. The 2006 meeting placed a strong emphasis on the ecosystem-based approach and particularly the issue of spatial planning. This meeting also considered and provided specific recommendations in relation to ICES current reorganization of the advice system. In general, the remit of this group addresses Action Numbers 4.13 and 5.3.
Resource Requirements:	Secretariat support for meeting.
Participants:	These include scientists working with fisheries management, both from an economic, social and biological perspective. Participation is from ICES countries and scientists both from disciplines and scientific circles not traditionally represented at ICES.
Secretariat Facilities:	No additional software/hardware is anticipated beyond that which is currently available.
Financial:	None
Linkages to	The goal for this Working Group is to better understand fishery management

Advisory Committees:	systems which is a central element of the work of ACFM.
Linkages to other Committees or Groups:	Close links to SGMAS. Methodological issues are within the mandate of this Group, but fish stock assessment methods are referred to WGMG.
Linkages to other Organisations	ICES will seek to widen participation for this group, including contact with relevant academic and inter-governmental organisations (including FAO, OECD and IIFET).

Annex 4: Recommendations

RECOMMENDATION	ACTION
1.Generally to working groups: ICES should support the work of clients and partners by providing science for their objective-setting, policy choice and monitoring and evaluation processes by further developing such methods as scenario-based simulations and participatory modelling.	
2. To the process restructuring the ICES advice system: ICES should adopt a regional focus in its future advisory and science activities to enable it to address issues of marine ecosystem management which vary on a regional basis. At least some of the new review groups should be organised with a regional structure.	
3. To the process restructuring the ICES advice system: Broadening of the ICES activities could be achieved by continued integration between different ICES committees, as a great deal of the necessary science is already covered by ICES. Regionally focussed review groups also have an important role to play here	
4. To advisory group in general: writing advice ICES should choose which basic messages should be made salient in the report and this is not necessarily the information needed for setting TACs.	
5. To the process restructuring the ICES advice system: The further encouragement of short-term groups of scientists that work with the RAC working groups on specific issues at various scale levels. This should be considered a priority use of resources. These ad hoc groups will be a key instrument for increasing the salience of ICES' work and encourage its more effective uptake into policy decisions.	
6. To ICES in general and ASC organizers in particular: While fisheries oriented projects nearly automatically see ICES as an important outlet for their work this is not the case for projects working on other aspects of the marine ecosystem. Many of these projects are based on university networks that are more distant from ICES than the fisheries institutes. The Annual Science Conference is one important tool for reaching out to these projects.	
7. To To the process restructuring the ICES advice system: Establish routine procedures for evaluations of ICES assessments and advice, and communication of these the interested community external to ICES.	
8 To ICES in General: Promote evaluations of the broader fisheries system in which ICES is a provider of advice to promote systemic learning.	

Annex 5: Limits to transparency - an exploration of conceptual and operational aspects of the ICES framework for providing precautionary management advice - Kjellrun Hauge, Kåre Nielsen and Knut Korsbrekke

(Forthcoming in ICES Journal of Marine Science: doi:10.1093/icesjms/fsm058)

As fisheries assessment science remains relatively uncertain, the conceptualisation and handling of uncertainty in fisheries advice is fundamental for the potential of successful management. ICES' precautionary approach to fisheries management advice is based on limit reference points (LRP) reflecting stock status and precautionary reference points (PRP) reflecting risk levels.

Since LRP are intended to be exclusively science-based, while PRPs are intended to be management-based, this framework is deployed towards satisfying the ideal of a clear division of science and management's responsibilities. Accordingly, the ICES PA framework can be regarded as serving two purposes: to reflect and handle uncertainty in a simple and thus understandable way, and to provide such a clear division. We explore these two transparency dimensions of the framework through an examination of the variety of technical definitions of reference points, and their use in the advisory process.

The reference points that comprise the backbone of the ICES PA framework are defined in terms of fishing mortality rate, F, and spawning stock biomass, SSB.

B_{lim} delimits an unwanted situation in terms of reproductive potential. ICES uses several terms to describe characteristics of this unwanted situation, including "impaired recruitment", "serious decline in recruitment", "hampered recruitment", "reproduction failure", "stock depletion", and "stock collapse". It was not possible for us to determine whether these different terms have equivalent meanings.

The technical definitions of B_{lim} for individual stocks can be divided into three groups:

(i) Statistical approaches or expert judgements based on empirical stock–recruitment (SSB/R) plots. The statistical approaches have in practice shown to yield inconclusive results in most cases;

(ii) Setting B_{lim} equal to the lowest historically observed SSB, which is the case for most stocks;

(iii) Derivations from independent estimates of B_{pa}. In some cases B_{lim} is based on B_{pa}.

Whereas the first group is related directly to the concept of recruitment-overfishing, the second is rather pragmatic, and the last breaks with the idea of the PA framework. B_{lim} has not been defined for several stocks because of lack of data.

F_{lim} is defined as the F value that if maintained is expected to drive the stock to B_{lim}. Its technical definition can be divided into two approaches:

i) The mathematical relationship with B_{lim}, either from plots of SSB on R, or from the estimated stock–recruitment function;

ii) Otherwise. For instance, F_{lim} may be linked to historical averages, defined as to prevent a decline in catches, or be based on F_{pa}.

While the first group matches the definition of F_{lim}, the calculations are associated with large uncertainty. The second group does not conform to the framework**.** F_{lim} has not been defined for the majority of stocks.

The purpose of defining PRPs is to allow the provision of management advice that provides a low probability of crossing the LRPs. We divide them into three groups:

(i) An approach to reflect the uncertainty of the current stock estimate;
(ii) An approach to reflect the uncertainty associated with stock forecasts; and
(iii) Pragmatic approaches not relating the PRP directly to the LRP (and hence not corresponding to the PA framework).

For many stocks, PRPs have not been defined because of lack of data. The discussion of whether or not PRPs should reflect assessment uncertainty or prediction uncertainty does not seem to be concluded, but many PRPs have shown to underestimate the implied forecast uncertainty.

In general, the conceptual simplicity of the framework is not met by the practices for defining reference points, and their use in the advice. Methods for defining the reference points are highly diverse, largely pragmatic, and occasionally in conflict with the conceptual framework. For most stocks, the practices of defining reference points do not match the framework, which therefore largely comes out as a conceptual goal rather than something actually implemented. Because the LRP and the PRP, respectively, are presented as common classes, although they are derived from heterogeneous practises, the PA framework is likely to produce a false expectation of transparency to the lay readers of the advice. Consequently, we argue that the apparent transparency of the framework (owing to its conceptual simplicity) to some extent is compromised by ambiguities stemming from the contrast between reference points as a homogenous set of benchmarks, and their heterogeneous derivation in practice.

Obviously, hence, there is a potential for improvement and clarification of the PA framework, in particular in relation to its ambiguity regarding past, present, and future uncertainty. Nevertheless, we suggest there are limits as to which conceptual clarity can be matched with operational clarity. First, each stock is unique, and so is our knowledge about its SSB/*R* relationship, which refers to a specific period, characterized by a specific set of environmental conditions. Our knowledge may not apply when conditions change. Second, data collections for different stocks are of heterogeneous form and quality. Third, there may be practical dilemmas regarding which uncertainties should be included in the advice, for instance those pertaining to illegal catches or discards. Taken together, this implies that methods for defining reference points may not always be simultaneously plausible and generally applicable. Consequently, the potential for handling of uncertainty in a standardized way will not be without limits.

As a result of the underlying uncertainties, the roles of science and management become intricately interwoven. The LRPs cannot be purely science-based because there is no exact threshold in nature that helps to define a distinct “unwanted state”. Similarly, the PRPs cannot be expected to be solely based on the managers’ decisions because of the complexity of the involved uncertainty issues. When managers are invited to decide on the acceptable probability level of crossing LRPs, the complexity of this request should not be underestimated – which to some extent may explain why such invitations only have met few responses.

When the respective roles of science and management become interwoven, they should be rendered an issue of explicit deliberation rather than acting as if they are not. While the current focus on the ecosystem approach and harvest control rules may improve how uncertainty is handled in the ICES advice, we expect that it will not make the division of tasks between science and management less complex. Instead we suggest that a closer communication and interaction across traditional boundaries is likely to increase the potential for collective learning in relation to dealing with management under uncertainty.

Annex 6: A brief catalogue of failures: Framing evaluation and learning in fisheries resource management - Kåre Nolde Nielsen and Petter Holm

(Forthcoming in Marine Policy)

While failure of fisheries management is often claimed, the reasons and bases of such judgments diverge. Since fisheries are complex, non-standard entities we cannot expect automatic convergence regarding the standards for evaluating their performance. Further, since fisheries comprise a mix of social, natural and technological elements, a range of perspectives are relevant for their evaluation. Without investment in interdisciplinary evaluation frameworks, such an evaluation is prone to be partial, and similarly, a given fishery crisis diagnosis is prone to reflect the evaluator's disciplinary bias.

Taking off from basic evaluation theory, we address the twin problems of non-standard evaluation objects and disciplinary fragmentation by proposing a simple framework for enabling a systematic evaluation of a fisheries resource management system, which we define as a feedback mechanism coupled to a fishery (Figure 1).

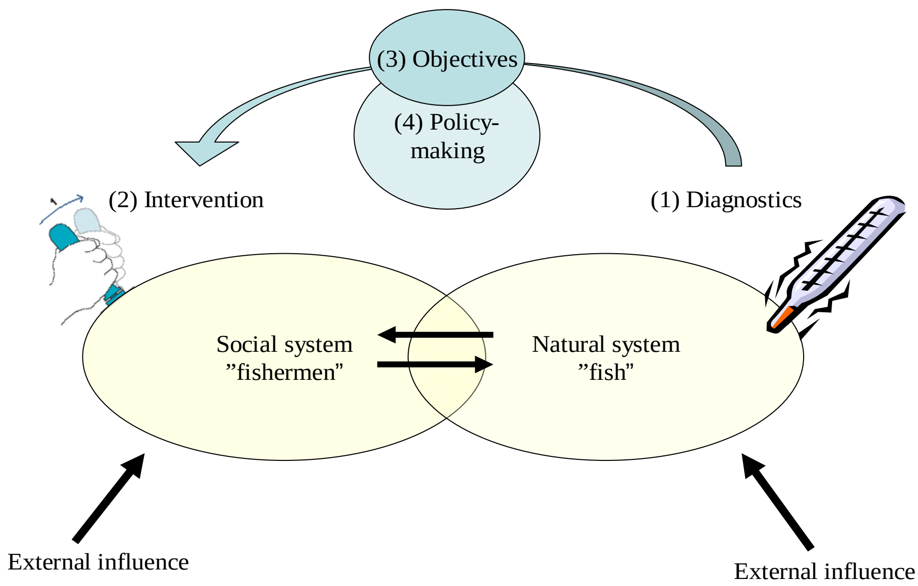

Figure 1. Fisheries resource management as a system of feed-back control imposed on a fishery.

The resource management system includes four basic functions: diagnostics, intervention, goal setting, and decision making. This model allows for the development of an evaluation framework for fisheries resource management, i.a. by facilitating a typology of failures. We exemplify and discuss failures within each subsystem, and more complex types of failures pertaining to cascade effects proliferating through subsystems.

This conceptualization of a fisheries resource management system provides an opportunity to address the issue of systemic learning. Argylis and Schön (1978) defined learning as the ability to detect and correct error. Evaluation and learning are intricately linked since claiming that something is a failure is an act of evaluation, and since evaluations when mobilized towards improving a given state of affairs (i.e. in what Scriven (1991) termed "formative" evaluations) can be considered advanced learning instruments.

We exemplify and discuss North Sea demersal fisheries management (Swach *et. al.*, 2007) as a case of limited ability for systemic learning. The fisheries resource management system, as laid out in Figure 1, comes with an integral evaluation system, connected to an intervention mechanism. The cyclic feature of the system allows for learning by the implicit evaluations that are performed by each annual turn of the cycle, permitting errors to be discovered and corrected. Hence, the resource management system is a potential learning system. However, in the case of North Sea demersal fisheries management, the predominant form of learning here seems to be what Argylis and Schön (1978) termed single loop learning, which works like a thermostat that turns the heating off when it becomes too warm, and turns it on again when it becomes too cold.

Such a system may lock into a non-adaptive mode, exemplified by Degnbol's comment on TAC based systems: "This approach is closely linked to single-species stock assessment, and has often developed into increasingly complex micromanagement; with new regulations accumulating as the shortcomings of the TAC approach are revealed or new issues emerge" (Degnbol, 2005). "Micromanagement'' illustrates error detection and learning of the single-loop type, analogous to the working of a thermostat. The micromanagement within a TAC machinery (Holm and Nielsen 2004), also illustrates another major assertion of Argylis and Schön (1978), namely that organizations tend to create learning systems that inhibit double-loop learning. Double loop learning is when error is detected and corrected in ways that involve the modification of an organization's underlying norms, policies and objectives, and as such calls for a more substantial system reorganization (e.g. substituting the forecast/single species/TAC model with another way of representing resources and intervening in the fisheries).

A system that is failing to learn to learn, is experiencing a kind of meta-failure, and the identification of barriers towards double loop learning is a way to examine the reasons why this is so. For example, the EUs strong commitment to its TAC sharing rule, the so-called principle of "relative stability", works as a very strong barrier towards systemic learning, since this (at least presently) almost untouchable resource sharing rule locks in with single species management by way of TACs. Accordingly, this may go some way towards explaining the strong resistance to replace TACs with other management instruments even when they seem to be perform rather inadequately, such as for demersal fisheries management in the North Sea.

While the framework is fairly basic and needs substantial development to be of practical utility, it serves as an invitation for cross-disciplinary deliberation on the principles for evaluating fisheries resource management, and its further development is likely to stimulate (systemic) learning within fisheries resource management.

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Annex 7: The Development of Institutions for Participation in Marine Spatial Planning on The North Sea: A Case of Cross-Scale Linkages – Ditte Degnbol and Doug Wilson

The present paper considers issues of the mobilization of knowledge in respect to developments around marine spatial planning (MSP) on the North Sea. Various forms of marine spatial planning (MSP), particularly various forms of marine protected areas (MPAs) and ocean zoning are emerging as a critical management tools in Europe and across the world. Spatial tools play a central role in the EU Marine Policy Green Paper and are also being considered, and increasingly implemented, in a number of North Sea bordering countries. Extensive networks of MPAs with varying degrees of restrictions to fisheries are underway under the EU's Natura 2000 programme and the OSPAR Convention

No single, overarching process exists for the development of MSP on the North Sea; rather a number of initiatives are proceeding simultaneously. The North Sea Regional Advisory Council (NSRAC) is the main forum through which fisheries interests are becoming involved in MSP. The NSRAC is itself a relatively new and fragile forum that is part of a broader set of evolving institutions, involving stakeholders in fisheries management. The North Sea Commission (NSC) is a league of regional governments and is one of seven Commissions under the Conference of Peripheral Maritime Regions. The North Sea Commission Fisheries Partnership (NSCFP) was created by the NSC with the help of EU funding. The basic idea was to create a space for regular meetings between fishers and fisheries scientists. One of the earliest initiatives of the NSCFP was to become involved in a "sandwich process". The sandwich process is a series of two meetings between interested parties and scientists from the International Council of the Exploration of the Seas (ICES) before and after the meetings of its Advisory Committee on Fisheries Management (ACFM) where ICES collates the results of the stock assessment working groups and develops the annual scientific advice for the management of EU fish stocks. The purpose of these meetings is to give the fishing industry a chance to give input on how they see the condition of the stocks before ACFM, and then to have the results of ACFM explained to them. A second initiative began from the ICES side. Annual Science Conference in the autumn of 2002 ICES decided to establish a Study Group on the Incorporation of Additional Information from the Fishing Industry into Fish Stock Assessment (SGFI) that was to be co-chaired by an ICES scientist and a fishing industry leader active in the NSCFP. The idea from ICES perspective was to reach out and react positively to the NSCFP initiative, while at the same time channelling this new and growing relationship into the familiar form of the ICES Study Group. Another significant part of the developing relationships around scientific institutions in North Sea fisheries has been collaborative research involving scientists and the fishing industry.

The Regional Advisory Council system was set up by the European Council in 2002 (EC 2002) and fleshed out in detail in a Council Decision in 2004 (EC 2004). The system that was set up involved a group organizing themselves and bringing a proposal to the Commission. The existence of the NSCFP acted as a springboard to allow the NSRAC to be the first RAC to come into being, its relationship to the NSCFP being quite self-conscious. What setting up the NSRAC basically entailed was the NSCFP reaching out to these other interest groups, notably the conservation NGOs whose participation on the RAC is the second leg of it legitimacy after the participation of the fishing industry itself. Of the 31 members of the NSRAC General Assembly 19 are from the fishing industry - fishers or fish processors - and six are conservation NGOs. The NGOs are not only outnumbered, they also face very strong resource pressures. NSRAC work requires a great deal of time and this time in increasing all the time as management becomes more complex. They have deep misgivings about being used by the industry for "green-washing" unsustainable fisheries management.

MSP now confronts this fragile group with a series of broader marine environmental issues such as *inter alia* wind farms, transportation, and marine protected areas.

The spatial focus involves a both a reduction and a multiplication of the levels of geographical scale at which the environmental information needed for management must be resolved. This together with the cross-sectoral approach presupposes spatially specific high-resolution information, both in relation to the marine resources, the various activities at sea and the different interests in management. The need for high-resolution mapping, among other things mapping of fishing activities, has triggered resistance among fishers towards engaging in the MSP process. They have a number of fears in connection with sharing information concerning their activities at sea. First of all, industry representatives have expressed concerns about loosing control of who will have access to the data and how it will be used. Secondly, the mapping of fishing activities is meant to form the basis for ocean zoning, i.e. allocating particular spaces for different uses. However, fishing varies with seasons, TACs, days-at-sea, the market and a number of other dynamic factors. The dynamic nature of fishing and the resulting varying spatial needs conflict with permanent or long-term distribution of marine space for different uses. The industry have concerns about how the information will be interpreted if the mapping of fishing activities is to inform the spatial planning of other activities at sea, for example in order to reserve important areas for fishing. Fishing involves a range of very different activities and hence very different spatial needs. Hence it is not possible to make a coherent picture of the most important fishing grounds for the industry as a whole. Finally, there are concerns that arguments about certain areas being important fishing grounds will not be considered important when weighed against other stakeholders' needs:

Notwithstanding all these fears, the industry also has reasons to support MSP. They have expressed concerns that they will be excluded from the North Sea by the increasing number of other users. One important competitor is off-shore wind farms. MPAs is another important factor which to an increasing degree is limiting the space for fishing. Extensive networks of MPAs with varying degrees of restrictions to fisheries are underway under the EU's Natura 2000 programme and the OSPAR Convention. All EU member states are to nominate their Natura 2000 sites by 2008, and the complete Natura 2000 network should be in place by 2010. Hence, the general attitude towards MSP is changing, and the fishing industry is becoming more proactive. MSP provides a possibility of being consulted in the planning of other activities, conservation measures and other factors having an impact on fisheries. Other ways of advocating fishers' interests within the framework of MSP is by contributing to the mapping of fishing activities.

Another way the NSRAC can contribute to MSP is by providing other perspectives on which kinds of data should form the basis for political decision-making. The need for spatially specific high-resolution information is perhaps the main reason for the industry's reservation towards MSP. However, the spatial orientation and the consequent new needs for information also hold a number of potentials for an enhanced involvement of the fishing industry in the knowledge base for fisheries management. The industry is increasingly becoming aware of this and is engaging still more proactively in MSP.

The development of MSP can take many directions, and the facilitating role of the NSRAC in relation to the dialogue across sectors is still not determined. However, the short history of the NSRAC already hints at some of the potential dynamics with which it could feed into the MSP process. The NSRAC has to strive for consensus in order to maintain its legitimacy. Another outcome that could be anticipated is a coordination of conservation and fisheries related objectives for protected areas. The lack of coordination between these two types of protected areas till now has contributed to the shaping of an environmental policy with little backing from the fishing industry. If the NSRAC is to inform MPA policies, the marine conservation interests and the industry will have to find some common interests – something that might inspire an environmental policy that is more motivating for fishers. Finally, a potential outcome of the cooperation between marine conservation interests and the industry in the NSRAC concerns the way uncertainty is handled. There seems to be a tendency on the green side to deny the uncertainties of for example the effects of MPAs. Critical questions from the industry provide an opportunity for the marine conservation interests to find other ways of handling these uncertainties.

Annex 8: Science and Conflicts of Interest - Robert Aps

Background

Conflicts are inevitable in marine (fisheries) management systems in which stakeholders pursue their own goals. Conflicts are arising due to resource limitations or/and knowledge conflicts resulting due to discrepancies in viewpoints or opinions. Argumentation analysis provides means for understanding the nature of those conflicts as well as for forming marine management decisions on the basis of incomplete, conflicting or uncertain information.

Argumentation analysis

Argumentation analysis is building on conceptual framework imported from the research on Distributed Artificial Intelligence and Multi-Agent Systems. According to Rahwan and Amgoud (2006) the process of argumentation may be viewed as a kind of reasoning about arguments in order to determine the most acceptable of them. Normally, argumentation is mainly concerned with theoretical reasoning: reasoning about propositional attitudes such as knowledge and belief. Reasoning about what to do is captured by practical reasoning. This requires capturing arguments about non-propositional attitudes, such as objectives and plans. Three distinct argumentation frameworks are referred to for arguing about 1) knowledge (beliefs) – is it true and relevant, 2) what objectives should be adopted and how they are justified, and 3) what plans should be intended in order to achieve the justified objectives.

Science based advice

Science based advice is of informational nature and therefore, in principle, it can be checked against the current world for its correctness. When arguing about the science based advice stakeholders aim at reaching the truth, which is somewhat objective and independent from what they initially believe. Using knowledge, stakeholders are constructing arguments, which have a deductive form. Science based advice related arguments should involve only one kind of information: the knowledge. Stakeholders are reasoning about propositional attitudes such as knowledge and the science based advice is believed because it is true and relevant.

Stakeholder’s objectives

Rahwan and Amgoud (2006) argue that explanatory arguments are used as a means for generating objectives from the knowledge, and since explanatory arguments involve two kinds of information: knowledge and objectives, their strengths depend on both the quality of knowledge (using the notion of certainty level) and the importance of the supported objectives. Stakeholder’s objectives may be adopted because they are justified and achievable. An objective is justified because the world is in a particular state that warrants its adoption (e.g. status of a particular fish stock or a socio-economic situation of a particular fishing industry). An explanatory argument for some objective can be defeated either by a knowledge argument which undermines the truth of the underlying knowledge justification, or by another explanatory argument which undermines one of the existing objectives the new objective is based on.

For example, representatives of the fisheries sector argue that for socio-economic reasons it is important to them to secure allocation of sufficient fishing possibilities to satisfy the needs of actual fishing capacity in place. At the same time, in generating, justifying and adopting objectives it is important to stakeholder’s to observe that the state and the dynamics of the fishery resources are the main constraints for economic expansion of the fisheries industry, or for achieving desired social conditions. It is these constraints that should be taken into account in order to keep the fisheries resources in a state where the economic and social objectives could be obtained sustainably with high likelihood. Stakeholder’s objectives should be justified against the long-term viability criteria of the fisheries sector taking account that environmental, economic and social objectives can only be achieved through sustainable exploitation of fishery resources.

Management decisions

Decision maker's task is to balance stakeholder's justified objectives, and to decide which ones of them will be pursued and with which plan (e.g. fishery resource allocation scheme, fisheries management plan etc). In order to be pursued, an objective should be both justified (i.e. supported by an acceptable explanatory argument) and also achievable. The worth of objectives and the cost of resources are taken into account by decision makers when comparing supporting arguments of stakeholder's objectives. The strength of a certain argument is measured by benefit or utility which is the difference between the worth of objective and the cost of the corresponding plan. A single objective/plan pair is preferred to another set with two or more objective/plan pairs because the utility achieved by this objective is higher than the other ones.

In EC context, decision makers (negotiating parties) have their commitments and obligations under CFP to ensure the exploitation of the fishery resources at sustainable level indicated by the scientific advice. At the same time, decision makers inter-operate within a shared social context and perform actions to achieve their individual and collective objectives. They are subjected to obligations that may contradict each other's performance, and forcing them to make a choice about which obligation to honour.

In some occasions related to fisheries management decisions, in order to balance the stakeholder's objectives decision makers may accept from each other different upper bounds on the amount by which e.g. agreed TAC might deviate from ICES advice, based on the belief that a negotiated decision, justified by socio-economic arguments, may to some extent exceed the sustainable level of exploitation with a low risk of serious or irreversible harm to the resources (Aps et al., 2007).

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Annex 9: Do managers recognize the governmental consequences of the management system in place for North Sea fisheries? – Wim Van Densen

The EC has set five principles for good governance that have been adopted in the Common Fisheries Policy: transparency, accountability, efficiency, participation and coherence. These principles have not been translated yet in operational terms. The principle on transparency requires at least readable and accessible information on the assessments and on the decision-making for taking measures. The principle on accountability requires a parameter or a set of parameters with sufficient statistical power to evaluate whether progress towards the management objectives set has been made. For the major North Sea fisheries these parameters now are the size of the spawning stock (SSB) and the fishing mortality (F), both model estimates.

The extent to which the principles of transparency and accountability are met has a direct bearing on the legitimacy of the management and the measures it takes. The questions then are whether the present “science-based” management of North Sea fisheries in potential allows for sufficient transparency and accountability and thus legitimacy and if not whether managers recognize the possible consequences?

The present short-term management with its annual assessments and decision-making is hardly accountable. The annual change in stock size is regularly smaller than the variance in successive estimates for a particular year. The SSB of North Sea plaice for example increased in 2002 from 210 to 233 thousand tones (ACFM, 2007), whereas the estimates for 2003 have ranged over the years from roughly 150 to 240 thousand tones. This variance is due to both inherent uncertainties in model estimates as well as to changes in data use - discards are included since 2004 - and in calculating F as a management parameter (arithmetic mean of F per age group for a changing set of age groups).

Moreover, part of the variance is bias that is not fully to explain, neither for North Sea stocks nor for groundfish stocks along the NE coast of the USA. When it turned out that fishing mortality had been underestimated for years in succession, Dutch fishermen were annoyed. They were accused by conservationists and by the public at large for overexploitation after they had complied for years with the TAC as set by the management. It has lead to the F-project aimed at improving cooperation and communication between fishermen, scientists and managers on flatfish management. During the project governance scientists from outside fisheries were invited to reflect on the need for management evaluations. They were astonished about the high frequency of model estimates and decision-making that quite predictably invokes high transaction costs (work, discussion, misunderstanding, explanation).

Monitoring and managing on the basis of model estimates has a bearing on the transparency of the management. When discussing assessment procedures and results in the F-project, fishermen did not question the methodology as such but criticized the same five issues throughout:

- The assumption on natural mortality (M) as 0.1 per year for plaice and sole is too low relative to the fishing mortality F and is unrealistically constant;
- The calibration series based on surveys are statistically powerless with sometimes only one haul per 30x30 nm (ICES-quadrant) made with small-scale technology. The series based on catch rates in the fishery are biased due to fishing behaviour that is modified by TAC-constraints;
- The discard surveys are powerless due to the low sampling effort;

- Assuming that fishing pressure in the current year is higher than allowed ($F_{sq} > F_{TAC}$) incorrectly suggests noncompliance and leads to unjustified lower TAC-options for next year;
- It is not realistic to keep to a biological limit for SSB (B_{lim}) as estimated with data from a series of years when the ecosystem was that different from nowadays (higher water transparency, higher temperature).

On top of these five, some recurring cognitive problems or misconceptions had to be tackled that pointed at problems with transparency:

- F as a time constant in the exponential change in numbers might better be communicated as relative catch (catch over average biomass present).
- Fishing pressure, although common language, is better be specified as the consequence of the fishing effort (poorly monitored and standardized) on fish survival and thus to be expressed in terms of fishing mortality F (model outcome);
- Some fishermen take it that assessments completely rely on survey results. This misperception is regrettably enhanced when high fishing pressure makes it that catch options for next year are strongly influenced by incoming year-classes. Knowing that the survey data for flatfish become available just several weeks before the TAC-advice is formulated, these data then quite predictably govern the debate. When these fishermen are told that not surveys but the catch per age group in the fishery is the starting point in the assessments, many then conclude erroneously that the TAC-constraint will certainly bias the stock estimates;
- Some perceive the TAC-advice as roughly proportional to stock size. Theoretically a 0-catch advice should repair such misconception, but such 0-catch advice is not seen as informative but as unrealistic.

Transparency and accountability are as important in communicating on the long-term management, the MSY-policy especially. The optimum fishing pressure or mortality (F_{MSY}) that corresponds with the MSY is inferred and explained from the yield curve based on a static model (equilibrium situations) for relating total yield (Y) with F. For flatfish fishermen this target fishing mortality is that low that it belongs to the “nonexperienced unknown”, to the rebuilding period of the fishery after the Second World War.

Moreover, in search for legitimacy in setting F_{MSY} it is good to realize that it is influenced by natural mortality M, by age at first capture and by the growth rate and, if accounted for, by recruitment patterns as well. The influence of the age at first capture is yet hardly discussed. The potential growth is difficult to assess with only the weight at age data available that are strongly modified by the size-selective impact of an intensive fishery. Accounting for recruitment patterns implies that F_{MSY} is not simply set equal to F_{max} as the optimal fishing pressure in the Yield per Recruit curve, but that F_{MSY} is influenced by incompletely known relationships between stock and recruitment as well. Setting a target F in line with the MSY-policy that is internationally agreed upon in Johannesburg in 2002, should be highly transparent. The same holds for the monitoring of F to make the management accountable. But are both to achieve via the science base presently in use?

The fisheries management for the North Sea is as much science-driven as science-based. Managers not only ask for annual assessments and the updating of reference points, but they ask for scientific advice as well. Still, the advice is generally not more than combining assessment results with simple harvest control rules politically agreed upon. The public articulation of this advice by scientists, however, seems highly important for the management to ground the legitimacy of measures taken successively. The more so when subtle changes of a 10% reduction in the F from this year to the next are foreseen as in the flatfish management plan. The management wants the science base only be made more transparent for the stakeholders. At the same time, however, managers and scientists seem to perceive the unchanged essentials of this science base nowadays as more uncertain and complex than before.

In view of the above, it might be worth to evaluate whether adaptive management - using catch and effort and average weight at landings based on market categories only – would have done worse than the science-based, read analytic, type of management applied so far. Such management certainly needs proper effort statistics, but the monitoring would have been more direct and the management thus more transparent and accountable. The only governmental problem is the political vision and power needed to set, explain and defend a soft long-term target. A target that is not scrupulously predicted and legitimized on scientific grounds only, but that is adapted after successive evaluations of progress made.

Annex 10: New Developments in Inshore Fisheries Management in Scotland - Anne McLay

In 2005, following a three year consultation, the Scottish Executive published a Strategic Framework for Inshore Fisheries in Scotland. The Strategy addresses recognised deficiencies in the current management system including the distance between decision makers and processes on the ground; management that is largely reactive; and the disassociation of fisheries from other broader environmental and ecosystem issues. It proposes a new co-operation between government, the fishing industry and the environmental sector, and places fishers at the heart of the decision making process. Central to the Strategy, are plans for the formation of a network of twelve Inshore Fisheries Groups (IFGs) around the Scottish coast, reflecting the diversity of resources and local nature of the fisheries. http://www.scotland.gov.uk/Publications/2005/03/20860/File-1

The Strategy sets out high level objectives for inshore fisheries management as follows:

BIOLOGICAL – Conserve, enhance, and restore commercial stocks in the inshore and its supporting ecosystem

ECONOMIC - Optimise long term and sustainable yield:

ENVIRONMENTAL - maintain and restore the quality of the inshore environment

SOCIAL - recognise historical fishing practices, traditional way of life, to manage change and interact with other activities

GOVERNANCE - develop and implement a transparent, accountable and flexible structure with fishermen at the heart of decision making, underpinned by adequate information, legislation and enforcement.

Within this context, the remit of the IFGs is to develop local objectives for management of commercial inshore fisheries and plans to deliver these objectives.

Each IFG will have an Executive Committee comprised of fishermen, and a Coordinator, appointments funded by government. Each IFG will be supported by an Advisory Group which will include scientists from Fisheries Research Services (FRS), Scottish Natural Heritage, the Scottish Fisheries Protection Agency and representatives of fish processors, local councils, tourism, the aquaculture and energy industries and environmental NGOs as appropriate to local circumstances. Management plans advanced by the IFGs will be scrutinised by an over-arching body, comprised of government and fishing industry representatives, a reformed version of the extant Scottish Inshore Fishery Advisory Group (SIFAG). This body will be responsible for the overall framework, ensuring that the IFG's management plans are consistent with the high level objectives and be a forum for resolving any disputes between IFGs.

Progress in establishing the IFGs has been slower than anticipated. This is due to a number of factors including protracted discussions about IFG constitution and advisory group composition (the devil is in the detail), possible implications for fishermen in terms of licensing or other costs and delays in appointing IFG coordinators. However, more recently progress has been made as fishermen see possibilities offered by local management. Over the past year, staff at FRS has presented information on stocks and stock status at meetings aimed at raising awareness of the up and coming IFGs and taken part in discussions with fishermen and other stakeholders about IFGs will work and what they could do. In areas where IFGs formation is more advanced, FRS been involved in more detailed discussions, which are in effect the early stages of the development of local management plans.

The stocks and fisheries in question vary from area to area as do the issues which fishermen are concerned about. The former are mainly shellfish: *Nephrops*, scallops, crabs and lobsters, other bivalves including, razor clams and mussels. Squid fisheries are locally important as are whitefish. The issues are numerous and include management of creel fisheries, changes in minimum landing sizes, stock conservation measures and issues related to access. It is likely that that the rate at which the IFGs develop will vary from area to area. Most progress is being made in areas where fishermen's leaders are actively promoting the approach and in close knit communities where fisheries are particularly important to the local economy.

The formation of the IFGs will require changes in the way FRS approaches inshore stock assessment work. In some cases it will be necessary to adopt a more local dimension and to acquire detailed local knowledge of the fisheries or evaluating new resources and fishing methods. In this context, it will be important to manage the expectations of the IFGs, particularly as to what they can expect from science and the time scales required to bring about change. FRS will need to be selective with respect to areas of research (it will not be possible to do all the work the Groups are likely to want) and try to identify generic or important projects areas and research areas, preferable those of relevance to more than one group. It will also be important to acknowledge areas where information is lacking and areas of 'uncertainty' and to work with fishermen to develop data and information collection and evaluation frameworks. It is an exciting time and FRS looks forward to working closely with the Scottish fishing industry in a new participatory system aimed at sustainable fisheries in the Scottish inshore waters.

Annex 11: Institutional Challenges for Resolving Conflicts between Fisheries and Endangered Species Conservation – Felix Rauschmeyer, Heidi Wittmer and Augustin Berghöfer

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Summary

Successful species conservation typically results in conflicts between wildlife protection and economic uses of natural resources as in fisheries and aquaculture. This article shows why managing these conflicts requires a more comprehensive approach than currently pursued by endangered species conservation programmes. Against the background of several case studies focussing on wildlife conflicts in European waters this article derives the institutional challenges involved, when species conservation becomes too successful.

While EU law and associated policies have supported species conservation programmes for almost three decades now, literature on biodiversity related conflicts suggests that more encompassing concepts, such as the Ecosystem Approach, are necessary to make the protection of endangered species sustainable. The conflicts examined for this article support this view.

The article shows that a shift from species thinking to systems thinking – i.e. the consideration of a larger set of socio-ecological variables – implies several changes with regard to the processes of conflict resolution, and of conservation management in general. These changes are analysed in terms of four sets of criteria: information management, legitimacy, social dynamics and costs. They have been developed based on environmental conflict literature.

Our empirical analysis shows that two major challenges for institutional response arise in all cases: First, the question of mandate – which societal actor initiates management related processes that require multiple actors to collaborate? Second, how can continuous processes of collaboration be sustained? Both challenges are intrinsically linked to participation thinking and to the normative requirements of ecosystem management.

We then discuss in which form citizen and/or stakeholder participation can contribute to address these challenges. The differentiated analysis of the two challenges, facilitated by our set of criteria, also sheds light on general difficulties for the implementation of the ecosystem approach. In this perspective, efforts to implement the Ecosystem Approach can draw valuable lessons from experiences of environmental conflict resolution.

Annex 12: Technology or deliberation? Technical development projects and stakeholder forums as forms of co-management of interactions between environment and fisheries – Riku Varjopuro

Finnish Environment Institute, Finland

In the studied case located in the Northern Baltic Sea the interaction between environment and fisheries is a controversy between conservation of the grey seal and the interests of coastal fishing. The grey seals take fish from fishermen's nets and also break the nets. Thus, the grey seal causes economic losses to fisheries – to the extent that the seal population is perceived as a real threat to the future of coastal fishing in Finland. But is not only the fishery that is suffering: occasionally seals get entangled in the nets and drown. The number of grey seals declined dramatically almost throughout the 20th century, and in early 1980s the risk of extinction was still taken very seriously. Since then a successful conservation policy has changed the situation and now the number of seals is growing rapidly. (Harding and Härkönen, 1999; Halkka *et al*., 2005.) Seal by-catch is not thus threatening the population, but the size of the population is not yet satisfactory from the perspective of conservation interests, while it is already too numerous from the perspective of the fishery sector. The controversy is very difficult to solve, since there does not seem to be any easy solutions available to considerably reduce the seal-induced damage on the fishery. Therefore, the solution is to seek for strategies that allow fishermen to adapt to (again) abundant seals. This brings into the picture wider social, economic and ecological conditions of coastal fishing and necessitates an approach highlighting complexity of this socio-ecological system (see e.g. van Ginkel, 1999).

The interaction takes its most concrete form during the course of fishing activity. More specifically it is localised in or near the nets that fishermen use. Fishing grounds are the places where fishermen come to catch fish, but they are also the places where seals forage. It is there where seals can tax the fisherman's catch or wreck the nets and it is there where the young seals get entangled in the nets and die. The crucial interaction is paradoxically very local (in space and time) in a sense that from fishermen's point of view it is on the fishing grounds during the fishing activities where the success of maintaining a dynamic stability (Haila and Dyke, 2006) of the socio-ecological system of coastal fishing is largely decided.

The paper analyses two processes that dealt with the seal-fishery controversy. The first one is a collaborative project conducted by actors in one coastal region. This was a rather typical stakeholder process that created a forum for interest groups to deal with the controversy and to outline common understanding of a way forward. The other process is a technical development project to reduce seal-induced damage on coastal fishing. In this process participation played a minor role, since only researchers and fishermen were involved. The processes are described and analysed in more details in Sava and Varjopuro (2007) and Varjopuro and Salmi (2006). The point of this paper is to discuss how these two different kinds of stakeholder processes can contribute to maintaining a dynamic stability in coastal fishing.

Consensus-seeking stakeholder forum approaches may be important in giving emphasis on the regional characteristics of such complex controversies. If successful that may also help to find resources for adaptation strategies needed for maintaining the dynamic stability in a changed environment. Therefore, an approach supporting multi-faceted perspective on the systems characteristic is useful, because it may help to elucidate various views and, what is especially important, can support utilisation of various knowledge forms necessarily needed to get grasp the dynamics involved and resources available. Too much emphasis on finding consensus may, however, lock out the possibility to handle complexities in a productive way (van den Hove, 2006).

A consensus-oriented approach operates strongly on a cognitive and conceptual level where different ways of conceiving parts of the socio-ecological system as well as preferences put on them by stakeholders are emphasised. Furthermore, the goal is to find such constructions or framings that can mediate the different perceptions, values and preferences. Reaching such constructions or framings is useful, but such consensus-seeking process has one crucial weakness: it has a weak link to actual practices through which the dynamic stability is maintained (see Healy, 2005). In the studied process the links were created in its sub-projects, but the main activity was targeted towards higher-level policy-processes.

The technology development project was directly linked to fishing practices without much attention on cognitive aspects except the researchers' knowledge of seals, fish and fishing technology. Even the participating fishermen's knowledge on fishing devices was largely neglected. The project resulted however in heightened understanding of technical aspects of fishing, and, furthermore, of such aspects that can help to take into account fishermen's and nature conservationists interests. Such a technology project could create a boundary organisation (see Carr and Wilkinson, 2005) to enhance communication and collaboration of different groups necessary in finding ways to maintain the dynamic stability of coastal fishing. A boundary organisation could create an operational modality to allow handling complexities and maintaining the dynamic stability as well as allows larger constituency than traditional science and technology projects (Middendorf and Busch, 1997). This is important for reaching the dynamic stability, because it is not only the fishermen whose interests are significant in the socio-ecological system of coastal fishing. The analysis showed that traditional, 'linear' approach to science and diffusion of technology has serious weaknesses in this respect.

The two stakeholder processes aimed to find solutions to the complex seal-fishery controversy. The analysis suggests that both of the approaches have important contribution to maintaining the dynamic stability. The stakeholder process with its focus on regional consensus and higher level policy-advocacy can create a forum for joint regional activities. Its attention to higher level-policies is also important in showing discrepancies between different policy sectors. The technology project, for one, directly addressed the fishing practices that are an important locus of the interaction. Shortcomings of the analysed processes suggest that a boundary organisation that can approach the policy aspects and fishing practices would be an important, participatory way to approach the controversy that does not allow easy solutions and is relevant to various conflicts.

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Annex 13: Bed-fellows or fellow-travellers? The relationship between ecosystem-based management and stakeholder participation in marine fisheries – Tim Gray and Jenny Hatchard

Introduction

The relationship between stakeholder participation (SP) and ecosystem-based management (EBM) of marine fisheries is often taken for granted, but it is actually very complicated. The literature reveals four possible interpretations of this relationship: that they are 1) logically linked; 2) ethically linked; 3) instrumentally linked; and 4) complementarily linked. We examine these four formulations in the light of recent research on interactions between fisheries and their environment. We conclude that the SP-EBM relationship manifests itself as predominantly instrumental in character – EBM benefits particularly from SP; while complementary and ethical links are less common but, respectively, command pragmatic and moral force.

Four interpretations of the SP-EBM relationship

1. Logical

SP logically entails EBM and vice versa. In this understanding of the relationship between the two, ecosystem-based management of fisheries requires stakeholder participation; and, stakeholder participation in fisheries governance requires an ecosystem approach. Thus, the definitions of the two concepts each entail the other and are so closely linked that they are logically inseparable.

2. Ethical

SP and EBM are *ethically* linked. On this view, the moral value judgments that are incorporated within EBM ought to be made by “a broad array of stakeholders” (EPAP 1999:35), because the sea is a societal resource, and we are all entitled to participate in determining how public resources are managed and what uses they are put to (discussed by Coffey, 2005).

3. Instrumental

Stakeholder Participation and EBM are *instrumentally* linked. On this view, SP and EBM need each other to achieve their respective ends: enhanced democratic decision-making and improved stakeholder access, on the one hand, and better ecological management, on the other. Thus, each of these concepts has something to gain from interaction with the other.

4. Complementary

Finally, the fourth theoretical interpretation of the relationship between SP and EBM is that they are *complementarily* linked. On this view, SP and EBM are separate principles that work well together in parallel to improve fisheries governance. Each principle independently enhances the quality of fisheries governance, and their different contributions harmonise with one another. They pull in the same direction rather than in opposite directions: there is no contradiction or tension between them. Good governance of fisheries requires both EBM and SP.

Findings

The **instrumental interpretation** was the most evident of the four constructs in both the literature and the research projects. It was also found acting in combination with logical, ethical and complementary interpretations of the relationship. However, the instrumental exchange between SP and EBM was far from even. EBM gains, first, in terms of knowledge or information – technical, ecological and socio-economic. Second, EBM benefits from the take-up of practical roles – such as research, monitoring and management – by stakeholders. Third, EBM also benefits from the added systemic stability – in terms of legitimacy, acceptance and improved social dynamics, such as effective conflict management – that is brought by having stakeholders involved in the management system. In contrast, SP only gains in terms of a widening of stakeholder participation under EBM, due to greater knowledge demands and the need for a balance of objectives to be set – ecological, social and economic. Thus, in the short-term, the benefits of this relationship are felt more strongly by EBM than by SP.

1) Stakeholder participation has tangible benefits for ecosystem-based management;
2) There are strong ethical reasons for bringing SP and EBM together;
3) The two can be used concurrently to pursue common goals;
4) Any logical link is thus far conceptual, rather than substantive.

Conclusion

In conclusion, we have found that these two parallel developments in European Fisheries management do complement each other in the pursuit of common objectives, such as sustainable development. However, if implementing EBM is to be an objective of fisheries management governance – as stated in the CFP – it will require SP. This is most clear with regard to its tangible benefits (the instrumental link). However, there are also normative reasons why EBM should feature SP (the ethical link). Stakeholders in fisheries management thus have legitimate grounds on which to argue that their views and their experiences should be factored into EBM. Similarly, fisheries policy-makers need to recognise the short and long-term benefits of SP for the success of any management system based on EBM.

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