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Governance Issues in Mixed-Fisheries Management: An Analysis of Stakeholder Views

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Publication date:
2009

Document Version
Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

Citation for published version (APA):
Wilson, D. C., & Jacobsen, R. B. (2009). *Governance Issues in Mixed-Fisheries Management: An Analysis of Stakeholder Views*. IFM - Innovative Fisheries Management.

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Governance Issues in Mixed-Fisheries Management: An Analysis of Stakeholder Views

**A framework for fleet and area based fisheries management
(AFRAME) Project**

EU Sixth Framework Programme Contract no.: 044168

Deliverable 6.3

Douglas Clyde Wilson and Rikke Becker Jacobsen

Innovative Fisheries Management

- an Aalborg University Research Centre

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1 Introduction

The term mixed fisheries refers to fisheries where more than one species are present in the area being fished and are vulnerable to being caught in the fishing gear. In most cases this also means that more than one kind of fishing gear are also being used. For many reasons mixed fisheries present an immensely more difficult challenge for fisheries management than single species fisheries do. Many important fisheries in Europe are found in mixed fisheries so finding more effective ways to govern such fisheries is a high priority for the European Union and Member States.

Mixed fisheries are a serious political challenge for managers because questions of fairness to different groups of fishers arise more quickly than in any other set of fisheries management problems. Perceptions of fairness play an important role in the politics of fisheries management. Social psychologists have shown that these perceptions of fairness depend mainly on three things: people having their needs taken into account; being treated equally; and, getting out something that is proportional to what they put in (Loomis and Ditton 1993). Even more critical for our purposes here, people's judgements about fairness are not related to some abstract ideal of what should be, but come rather from comparisons of their situation with the situation of other groups they see as similar (Loomis and Ditton 1993). Mixed fisheries provide many opportunities for such comparisons. One senior manager from the European Commission described the problem this way:

Q1. When ICES advises a closure for cod, haddock and whiting and not for plaice, sole and nephrops there is a perception in the whitefish sector that the flatfish sector is not taking up its share of the conservation burden.

From a technical perspective, one can produce advice for mixed fisheries by making assumptions about the relative effort of different fishery units and the catch compositions of the different fleets. The data requirements, such as catch composition data, discards, and possibly catch-at-age for all species and fleets, however, are extremely daunting (Reeves 2005). This is especially true as international cooperation is needed to not only collect the right data but to store it in comparable form. Economic information is also needed in order to assess how fishers will respond to mixed-fishery management measures. The models are very sensitive to changes in fisher behaviour, including changes in response to these same management measures (Reeves 2005).

In sum, mixed fisheries present a combination of high uncertainty, high political sensitivity, and complex science. They are a cocktail bound to produce a governance headache.

The most important change in governance during the 2002 reform of the CFP was the creation of the Regional Advisory Councils (RACs). These are fora with broad stakeholder representation, albeit dominated by the fishing industry. The role of these RACs is to provide advice to the Commission on CFP issues in order to increase the legitimacy and effectiveness of fisheries decisions by taking a tentative step in the direction of increased stakeholder participation (Symes et al. 2003). Mixed fisheries have proven to be a major challenge for the RACs as different stakeholders, as well as different member states, find it hard to come to a compromise when the complexity and uncertainty are so high. In an interview a RAC staff

member explained that mixed-fishery problems could not be resolved because no one was able to assign priorities among species.

The present report is Deliverable 6.3 of the “A framework for fleet and area based fisheries management” (AFRAME) project. It focuses on the governance issues around mixed fisheries. The report is a result of the examination of information produced by the following sociological research activities: the observation of nine scientific deliberations and three meetings of Regional Advisory Council (RAC) working groups; interviews with six fisheries scientists, five government fisheries managers and short interviews with 12 RAC members; three focussed group interviews with fisheries stakeholders; and interviews with fishers in 12 fishing ports around Europe. With one exception the short interviews with RAC members were carried out through an e-mail questionnaire. The observation of the RAC working groups, one scientific meeting, the 12 interviews with RAC members and the visits to the 12 fishing ports were supported by the AFRAME project, the remainder of the information reviewed was generated by activities supported through three other research projects on fisheries governance¹. These projects were not focussed on the problem of mixed fisheries, but that subject was touched on in many of the interviews and meetings observed for those projects.

After this brief introduction the second and third sections focus on background problems in mixed-fisheries governance. Section 2 is a discussion of four basic challenges in the governance of mixed fisheries. All of these challenges are part of the general problem of mixed-fisheries management, but they have been particularly salient for European fisheries management in recent years. The first of these is the intersection of mixed fisheries and the implementation of recovery plans for depleted stocks. The second is the problems of internationally shared stocks in mixed fisheries. The third is the acute problem of bycatch and discards experienced in mixed fisheries. The last is the difficulties in preparing scientific advice for mixed-fisheries management. Section 3 briefly reviews three types of management measures for mixed fisheries: the use of selective gears, effort management, and spatial measures.

Section 4 begins the more in-depth analysis of the mixed-fishery governance challenge in Europe and discusses the “essentially contested” concepts that reflect areas where governance objectives are not easily reduced to compromise. Managers, scientists, fishers and conservation NGOs are all responding to institutional imperatives to define mixed fisheries in different ways. Sometimes these different definitions have damaging results for other participants. This is particularly true when they are the result of trying to manage fisheries through command and control governance pitched at too broad a scale creating unwieldy definitions of fisheries that do not reflect the realities that the industry faces on the sea. Section 5 maps some of these basic differences of the scale and scope of stakeholder interests into a framework of strategy and tactics for mixed-fishery management. The RACs are places

¹ The other projects that supported these governance research activities were the Fifth Framework supported Policy and Knowledge in Fisheries Management (PKFM), Contract no: Q5RS-2002-01782; the Sixth Framework supported Scientific Advice for Fisheries Management at Multiple Scales (SAFMAMS), Project no: 013639; and the Sixth Framework supported Operational Evaluation Tools for Fisheries Management Options (EFIMAS), Project no.: SSP8- CT-2003-502516.

where both of these things are going on simultaneously to their detriment. This analysis leads to the conclusion in which we suggest that a results-based management framework in which two different stakeholder roles, which we call co-operative management and co-management, operate in respect to different kinds of questions may both be more effective and suggest an alternative to the current model of both of these dynamics being given form by RACs.

2 Challenges in European Mixed-Fisheries Governance

2.1 *Mixed Fisheries and Recovery Plans*

The governance challenge of mixed fisheries has been very apparent in the implementation of recovery plans. Historically, most real change in fisheries management has happened after a major depletion of stocks. So recovery plans are an important opportunity for reform. Recovery plans in Europe have been used to not only recover stocks but to move the overall system towards institutional goals. Placing fisheries management on a longer term rhythm than the current yearly cycle is the most prominent among these goals.

Recovery plans for depleted stocks confront participants in fisheries management with the question of whether some key species should be saved at the price of foregoing yield on other species. In a mixed fishery, a recovery plan for one species has implications for many. These implications may be positive in the long run. The North Sea RAC position on Cod Recovery Measures points out that the measures taken for cod recovery reasons have had significant positive consequences for several related stocks. However, they also involve real costs. As the NSRAC document goes on to argue, the plan must be reviewed to explore how recovery measures can be effective for cod “without resulting in adverse economic consequences for the non-cod fisheries in the North Sea” (NSRAC 2006 p4). The need to place recovery plans in a mixed-fisheries context has been high on the agenda of RACs:

Q2. RAC Staff Member: [Discussing the RAC Symposium on cod recovery plans] and the other thing that came forward was the idea that cod were caught in mixed fisheries. It seems to me that up until that point the Commission thought there was a cod fishery as such, whereas in fact lots of different fisheries pursuing different patterns were landing significant cod catch ... Interviewer: When it is decided that something has to be done about a depleted stock, is a recovery plan a good way to approach that problem? RAC Staff Member: No, the big thing with recovery plans of course is, as you mentioned it, that the focus is on a particular species or stock. Because the fisheries are mixed that inevitably limits its value ... and I think this is the problem with the cod recovery plan, that the Commission thought in terms of simply stopping fishing on cod without realising that that would actually jeopardize some fisheries on quite sustainable stocks.

The sense of the quote is to not simply recognize that cod is caught in a mixed fishery but also that the recovery of stocks should be seen as a goal for mixed-fisheries management overall. Failing to approach stock recovery from this broader context reduces the value of the recovery plan.

2.2 Mixed Fisheries and Shared Stocks

Mixed-fishery management also has international implications. Within the EU a political cornerstone of the CFP is “relative stability”, the idea that the CFP cannot change the relative access that member states have to fisheries resources. This requirement often clashes with fisheries management objectives. Almost all fisheries management measures have some implication for the allocation of fisheries resources, including many only intended for conservation. Relative stability places a hard constraint on management by requiring that no measure can shift resource access between member states. An administrator from the Commission describes this problem:

Q3. Interviewer: When you are looking towards the interaction between stocks then, of course, the problems with relative stability are becoming much more difficult?
Commission Fisheries Administrator: Yes it's clear that the balance in terms of the exploitation rate and this mixture of stocks will be affected by people's preferences in terms of which stocks they would prefer to be in a very healthy state. So clearly, you know, we have a very strong fraction of German interests in saithe and a strong British interest in haddock, I suppose Danish and British interests in cod, but you know that the British sometimes ask themselves whether it matters more than haddock, whereas for the Danes it clearly does matter more than haddock.

Across EU borders scientists and managers from Norway and the EU work together on several levels to synchronize the longer term plans with the annual international negotiations over the quotas of shared stocks. Mixed fisheries is less of a problem here than within the EU. A Commission scientist told us that an effort is in place to negotiate long-term management strategies for stocks. He pointed to the bilateral agreement with Norway about a harvest control rule of the North Sea herring stock as a possible model, though he also argued that long-term management plans should also cover technical measures and management targets, as well as harvest control rules. Herring is a less complex challenge than demersal mixed fisheries, but it still has some important mixed-fishery aspects regarding both mixed herring stocks and age classes.

2.3 The Pivotal Question of Bycatch and Discards

The regulation of mixed fisheries must also face the highly emotional problem of bycatch² – i.e. the catching of non-targeted or unwanted fish and other animals, and discards – i.e. the subsequent dumping out of unwanted fish caught by fishing gear. Discarding is an issue that gets a high level of political attention from many different angles. Discards are politically important for both the fishing industry and marine conservation groups. Conservation groups use high discard rates as a central talking point in arguing that modern fishing is an environmental disaster. Discarding is perhaps the single most important reason for the poor quality of the fisheries-dependent data that could be used to improve stock assessments. Discards are a specific area of contention between Norway and the European Union because Norway bans discards and the EU does not. The Norwegian ban on discards encourages those in the EU who would like to see a similar ban. This measure has powerful implications for

² Sometimes a distinction is made between bycatch, which is discarded, and by-product, which is landed and sold. It is more common, especially when discussing mixed fisheries, to use the term bycatch for both, which is the convention I follow here.

both the economics of the fishery and the practical functioning of other management measures.

The most basic issue is that discarding inflicts a tremendous amount of fishing mortality on fish stocks while gaining nothing in return. In fisheries using mobile gears, which include most important fisheries in Europe, most discarded fish die. Often the fish being discarded are smaller, juvenile fish that have not yet been “recruited” to the fishable stock, nor have they spawned and hence contributed offspring to future stocks. One scientist we interviewed sees the juvenile cod caught as bycatch, and subsequently discarded as they are illegal to land, as the central problem in the recovery of the North Sea cod stock. He is also particularly relieved that he can stay away from the issue because it creates so much political friction:

Q4. Interviewer: Anything we have missed ... you haven't actually been involved in anything to do with the cod recovery plan? Fisheries Scientist: No, thankfully. Interviewer: Why do you say that? Fisheries Scientist: Well, because it's so political. And the real problem with cod is that people are catching it when they're fishing for haddock or whiting. And they're catching the cod before it has had a chance to breed ... And in the case of cod, if they can solve that one, I think they might solve the cod stock problem.

Fishers discard for many reasons. They may be dealing with unwanted bycatch of species or sizes of fish that they do not wish to catch. They may be “high-grading”, meaning that they are making room for more valuable fish by throwing away less valuable fish. When in excess, these activities are frowned on by the fishers themselves as poor fishing practices, and high levels of bycatch and discards are often seen as a sign of poor fishing skills. A voluntary bycatch reduction programme, which has been credited with reducing bycatch rates in the North Pacific fisheries in the United States, worked by providing vessels with information about which vessels were having high bycatch and where this was happening. This not only told the fishers which areas to avoid, it created peer pressure to reduce the bycatch rates by publically identifying the more bycatch-prone skippers (Fishing News International 1998).

One particularly important reason for the political importance of discarding is that it often happens as a direct result of management measures. The most emotional discarding problems arise from “regulatory discards” where useful fish are discarded to meet the requirements of management measures. A scientist who works closely with the fishers put it this way:

Q5 Recently many fishers complained that on traditional grounds where for days clean pelagic fisheries were performed they were getting substantial quantities of cod. As these boats do not have quotas for cod this by-catch had to be discarded. It is clear that for a real fisher discarding 2-3 tonnes of high quality cod is simply a crime. In herring/sprat fisheries often substantial quantities of young fish occurred. For Polish fishers herring and sprat are species mainly for human consumption, thus such cases are considered as very negative.

Fishers see regulatory discards as an artificially created problem for which they blame the management system. As Q5 indicates, fishers don't simply see this as an economic loss; they see it as good food that could otherwise be feeding people. This has also been used as a mechanism for building public sympathy for the industry. In one case in the United States, a fisher called both the enforcement agency and the press and announced he was going to give to a food charity the fish that regulations required him to discard. He was arrested on the dock in front of reporters and the resulting coverage received a great deal of attention.

Another way of understanding discards is as an inevitable part of the fishing process. In this argument fishers simply cannot retain everything that comes up in their nets. The European Commission had recently asked for comments in respect to the EU discard policy. In their response to this paper the Baltic Sea RAC wrote:

Q6. On some points the BS RAC finds that the paper does not fully reflect this in the proposed methodology for reducing discards. On certain points it does not appear to be well linked to the reality at sea. A certain amount of discards must be expected, regardless of all the good intentions (BSRAC 2008 p2).

Because of the damage they do and the emotions they arouse, discards are a central issue in management debates within mixed fisheries. Everyone agrees in principle that discards should be reduced through better management, but conflicting interests are involved and constructing discards as “natural and inevitable”, or the result of either “bad fishing practices” or “regulations” are important discourses in these debates. Debates over discards are linked to most other management debates because a great many regulations have an impact on discarding behaviour. The BSRAC again:

Q7...it should be pointed out that much of the discards that do occur is a consequence of the regulations of the CFP. Rather than discussing how to regulate discards in a particular set of rules, it might therefore be more appropriate to consider the subject every time a new regulation is discussed, and ensure that the new rules do not lead to increased discards. It could even be made a "rule-of thumb" that new regulations should lead to reduced levels of discards (BSRAC 2008 p2).

They recognize the importance of the issue but argue that discards need to be seen within the context of the overall fisheries system if the problem is going to be effectively addressed. The BSRAC is also concerned that the emotional issue of discards do not result in overly stringent management measures. They would prefer that the industry be held accountable for reducing discards by improving practices rather than facing hard discard reduction goals:

Q8.The BSRAC recommends the use of a trend-driven approach rather than setting up goals of specific discard levels, which fishermen have no chance of reaching. The policy on discard should focus on what is achievable. Positive incentives should drive the trends, there are already examples of this, for instance in the Norway lobster fishery in Kattegat, where fishermen who use a particular sorting grid in their gear are allocated more fishing days (BSRAC 2008 p2).

The question of the interaction between discards and other management measures is also an important topic for the North Sea RAC. For one thing, they do not want the discard issue to be used as an additional reason for reducing overall fishing effort:

Q9. A reduction in days-at-sea would not directly address the problem of discarding to any significant degree as restricting time at sea does not constrain the level of discarding when the vessels are at sea (NSRAC 2009a p2).

Indeed, they are interested in what kinds of trade-offs might be possible between these different kinds of measures. In the following case they wish to link discard reduction measures to increases in total allowable catch (TAC).

Q10. If the TAC for North Sea cod is set towards the upper range of ICES projections for catches in 2009, it will be incumbent upon the fishing industry and member states to ensure the establishment of extensive accompanying measures to reduce or eliminate discards of marketable cod. (NSRAC 2009a p2)

The rationale here would be that the existing discards are part of current fishing mortality, so if discards were reduced then it would be reasonable to increase the TAC, which does not include discards in a formal way. Discarding is, however, an important consideration used by scientists in the setting of the TAC. Issues around discarding are powerful ones in fisheries debates and they can be made in support of many different interests.

2.4 Mixed-Fisheries Governance and Scientific Advice

The following quote illustrates how the problem of mixed fisheries is a challenge for governance at the European level in respect to one of its most visible aspects, the recovery plan for cod. It lays out of the key question that science is being asked about mixed fisheries in Europe.

Q11. Interviewer: But how does that work when the council has adopted a recovery plan, then it's binding itself in the next year's decision? Is that it? Commission Fisheries Scientist: It binds itself in the decision for which it makes concerning the cod quota and the effort in the North Sea and the areas where the cod... Interviewer: Can you explain what the procedure is? Commission Fisheries Scientist: In principle, when we come to the 2004 December and 2005 we will look at the latest scientific advice for cod. We will look at the commitments in the recovery plan. So given the advice in order to reach the commitments in the recovery plan, then the TAC should be this and the effort should be this. And that's what we propose to the Council... The problem comes when we want to radically change fishing mortalities. We want to reduce fishing mortality for cod. What effect is it going to have, a change in TAC on cod by itself, if a large part of the cod is being caught in mixed fishing with other species? It's a problem which ICES has not addressed. And we try to address it within the STECF mixed-fisheries group. The approach is to break down of the data from each of the fleets, to separate out catches of each of the species. Look at the activity of the fleet and then use a sort of optimization technique where you put a score on the outcome that you want to have: So what fishing mortality do you want to have for cod, haddock and all the others?

The Commission is looking for a top down, technocratic solution that “optimizes” the distribution of fishing quota and effort allocations among the various fleets. The results of these calculations will be the basis for the allocation of quotas among member states. Hence the Commission has to consider the implications for 20-odd fleets and 60-odd métiers in order to arrive at a distribution among the Member States that fish in the North Sea.

This lack of scientific advice about the problem that “ICES has not addressed” (Q11) is a frustration for the Commission. In fact, ICES has been very reluctant to answer these questions. They point to the need for catch and effort data at the necessary level, which calls for increased consistency in the sampling of fleets. In the 2003 ACFM report they explain:

Q12. It is not currently possible to provide analytical forecasts for input into mixed-fishery evaluation models. The main obstacle is that ICES does not have access to discard data for most fisheries. Development of such capability furthermore requires better catch monitoring, fishery analyses, and management decisions. The lack of such mixed-fishery forecasts necessitates the development of complementary processes that do not require analytical short-term forecasts. ...mainly because discard data for most fleets are not available, ICES is unable to provide the required scenarios at this time (ICES 2003, pp. 5-6).

ICES' problem is discards. The "optimization" (Q11) that the Commission wants requires fairly precise data on what the fleets are catching. ICES is certainly working on the required models, and in Q12 they hold out the possibility of eventually providing "the required scenarios", but the degree to which the discard problem is endemic to mixed fisheries raises a serious question about ever having the precise data required to achieve the optimization. This reluctance on ICES' part is not well received by others in the fisheries system. The following comes from an interview with a high-level fisheries manager for a Member State:

Q13. But they [ICES] give us no options here because of the uncertainty on these assessments. They would not give them to us. They are developed in the ICES working group, but ACFM will not take the responsibility. And they do not believe in these calculations, or they are so uncertain that they simply cannot endorse them. So they say zero cod. It is the same in the North Sea. And it is the same, I think, for some other species. And this is really, I must say, a very sad development because if ICES cannot deliver scientific advice, what is the objective of ICES? Maybe we will have to develop other systems? That is a real threat to ICES, I must say, because in the EU, we have to take decisions, we cannot just say or accept that ACFM concludes it a zero, so we have to make our own calculations. We have to go back to the working group, we have to ask our own scientists, and say you have to give us all the information that you have. And then we start calculating ourselves and coming up with different calculations, and so I think that ICES has an obligation to offer us options.

If one takes the attitude of this fisheries manager far enough, the problem of discards in mixed fisheries would be raising an existential threat to ICES. This issue, among others, has led to some serious rethinking of how the scientific advice system for the EU should be shaped. The following is from an interview with a Commission scientist:

Q14. Interviewer: So then you can sort of see a situation where ICES is a VPA factory, and then you have all the sort of the new developments like long-term planning, long-term advice and mixed-fisheries advice, ecosystem advice developed within the STECF. Commission Scientist: Well, I'd have to admit that's the way things have been going in the past couple of years, but it's not a good break. And we'd much prefer ICES to take up the challenges of dealing with this business properly from top to bottom. Interviewer: Why? Why is that? Commission Scientist: Well, it doesn't make a lot of sense to have our advisory activities split across three different areas. ICES for one part, STECF for another and the third layer will be this EC/Norway expert group. ... We'd start getting contradictory advice and you can find that you start to need one group to give advice on what other remedies has done, which also wastes time and slows the process down, especially when essentially the same people have to attend the meeting in different places.

Indeed, the uncertainties created by both the difficulties with data and the sheer number of interacting fleets would guarantee "contradictory" advice. ICES' reluctance to offer mixed-fisheries advice given the uncertainties, and this problem of needing an answer that is not contradicted, has created pressures for a more centralized scientific advice system. Mixed fisheries has been one area where there has been a greater willingness on the part of STECF to respond to Commission advice needs than there was on the part of ICES. In 2003 after ICES declined, as in the quote above, to provide mixed-fisheries advice, STECF proved willing to give advice on mixed-fishery impacts on North Sea stocks, although they still refused to provide the fleet-based advice that the Commission was also requesting. We interviewed one of the scientists involved in this meeting:

Q15. Interviewer: Do you have any qualms, but...I was at STECF a few weeks ago and there was talk about how the Commission uses what's put in the report?
Scientist: I can't think of any particular examples where I have real qualms about what the EU has done...The ones I've been involved in have been the mixed-fisheries meetings, and it has always seemed to me transparent that what we're preparing in there is something which is going to be the basis of the Commission's position that the negotiators at the Council of Ministers are going to...No, I have no illusions about what we're doing, that's what it's there to do.

An important aspect of the problems that mixed fisheries present for science is the idea that the unit of management should be a fishery rather than a fish stock. The European Commission is often forced to deal with fisheries as the main unit of management. They are confronted with the problem of calculating fish quotas in cross-national, mixed-fishery situations and need to understand the impact of the various fisheries on the stock, both as targeted species and as bycatch. The difficulty they have with this question is seen as reluctance by some stakeholders (Q16 below), further increasing the pressure for a way forward. The Commission has turned to the scientists at both ICES and STECF in search of a technical solution to this allocation problem (See section 2.3).

The group that cares the most about using fisheries as the key unit for management is the fishing industry. Fleets and boats are, after all, the units that they have to make decisions about. It is particularly important for them that scientific advice and fisheries management find ways to recognise the fishery as the basic unit of management. Industry members of the RACs are clearly frustrated with the difficulties that the management bureaucracy faces with shifting from stocks to fisheries as the main unit of management. The following is from an interview with a RAC staff member:

Q16. We had a really important meeting where we laid down our ideas for long-term management plans, and the most important thing that came out of that was that it was the fisheries that the plans ought to relate to, not the stocks. Now, that's been diluted since, whenever we discuss management plans with the Commission they still try to refer to stocks, so the concept has become diluted within the RAC, but I think, you know, people like [he names several representatives of the fishing industry] still try to bring us back to the fact that it is the fisheries that we're managing, and that the management plans ought to relate to those fisheries.

As is to be expected when boundary objects are developed between different social fields, and as discussed more extensively below (Section 4.2), the RAC's idea of what a "fishery" consists of is also quite different from that of the managers and the scientists.

Scientific advice for fisheries has historically taken the form of advice based on the condition of a particular fish stock because that is the unit that makes sense from a biological point of view. Fisheries, on the other hand are, complexes of fishing ports, boats, and gears that are hard to put boundaries around, but they are the units that managers actually manage (Wilson and Delaney 2005). The following quote comes from the discussion that produced the document quoted in Q12. The scientists are faced with the classic mixed-fishery problem. They believe that no North Sea cod should be caught, but also know that this would mean shutting down other healthy fisheries because of cod bycatch, so they want to advise the Commission that catches of cod stay at a "minimum":

Q17. Scientist One: I think really we need to say there is no science-based way of establishing what "minimum" means and how it should be distributed among the

fisheries. The managers have to deal with the ratio between the fisheries... Scientist Two: Last year we gave strong advice because the stock was in desperate and dire state and we wanted to prevent its commercial extinction, this kind of wording takes us back to wording that got us criticism in the past "as close to 0 as possible" what is that?Scientist One: This should not be seen as a retraction from last year or the seriousness of the situation, I agree to anything that says it is as bad as it was, but in mixed fisheries if we say the catch should be zero then we are saying close all demersal fisheries. There is no way of getting around saying that mixed fisheries should prioritize clean fisheries, but there will not be 0 catches..... We could have an opening statement saying the catch [of North Sea cod] should be 0 and that all fisheries should close, then continue with this text. Scientist Three: I agree [that we should say as close to 0 as possible] but it should be made conditional on the implementation of the recovery plan as that would take account of the mixed fisheries. Scientist Four: The evaluations of the recovery plan last year shows that that would take eight years. Scientist Three: That may be acceptable to managers. Scientist Five (an observer from the Commission): This is, of course, a management decision, but you need to decide if you are giving stock advice or fisheries advice. This is the mixed-fisheries issue, you stated in your evaluation of the recovery plan that it would work, so why say 0 here? Scientist Three: We are saying that you give advice contingent on a recovery plan. We need input from managers on priorities if we are to give fisheries-based advice (*ACFM, October 2003, Observer's notes*).

Fisheries scientists are much more comfortable dealing with fish stocks, biological units that are only co-produced by other fish, than they are with fisheries, which are a complex hybrid of social, economic, technical and biological relationships. So scientists "have to decide", as the Commission observer made clear in Q17, if they are "giving stock advice or fisheries advice", and therefore they have to deal with all the implications of the differences between the two.

Mixed-fisheries advice, indeed all scientific advice for fisheries, is what is called in science and technology studies a "boundary object". Boundary objects exist at the interface of different kinds of social activities where they are "co-produced" (Jasanoff 2005) by different groups that find it convenient or necessary to cooperate in these ways. This kind of activity is increasingly common between scientific and non-scientific institutions because in many aspects of policy, scientific and social issues are woven together into complex hybrids like fisheries (Holm 2007). Because boundary objects are developed at the interface of different groups with different interests they are always defined and used differently by these groups. Scientific advice for fisheries, because fisheries are a mixture of many different elements, will end up being used and interpreted in ways that the scientists did not intend. Hence Q17 ends with the unusual idea of "contingent" advice that is conditional on how the managers use that advice. This is a stark change from the traditional role that ICES, the Commission, and indeed the public at large generally see for scientific advice for public policy (Wilson 2009).

3 Management Measures in Mixed Fisheries

The basic system for European fisheries management is the distribution of quotas based on a total allowable catch. This system applies to mixed fisheries as well. However, the mixed-fishery problem has led to experimentation with a variety of supplementary measures. The

three most prominent such strategies are requiring more selective fishing gears, effort management, and spatial approaches.

3.1 Selective Gears

How well a fishing gear selects between fish of different species and sizes is obviously extremely important in mixed-fisheries management. Selective gears provide technical solutions, or the promise of technical solutions to many problems. The following comes from a scientist working on the Baltic Sea:

Q18. Interviewer: What would you say are the most important lessons from past experience with recovery plans in Europe? Scientist working with RACs: They are working if adhered to and are effective particularly when understood and supported by fishers. It is clear that the problem of selectivity or rather proper use of selective gears is a challenge and essential for final success.

Currently, for example, the demersal working group of the North Sea RAC is considering an eliminator trawl that can be used for fishing whiting and haddock while very effectively avoiding cod and smaller whiting. However, this example also highlights some of the challenges in making decisions about selective gear because they also show a reduced catch of both flatfish and monkfish. This limits the appeal of the gear to fishers as both of these kinds of fish are commercially important. These technical solutions are less controversial, in and of themselves, than many other approaches. Technical measures are often easier to implement politically because they raise fewer issues of fairness than many other management measures. Regulations about net sizes, for example, are easier to implement in a way that is seen as equitable than regulations, for example, about fishing areas that often hit one port harder than others. But selectivity-based measures still leave room for disagreements that reflect differences in overall management approaches, as seen in Section 5.

3.2 Effort Management in Mixed Fisheries

More controversial than selective gears is the idea of using effort management in mixed fisheries. Effort management means controlling the amount of fishing that is allowed, it is the most basic form of “input management” in fisheries. It contrasts with “output management” meaning controls on how many fish are caught. The basic EU system is output management: the allocation of fish quota based on a predefined Total Allowable Catch (TAC).

The trade-offs between these two approaches are well understood in the fisheries world. Quota management is more politically expedient and economically efficient for essentially the same reason: the quotas can be allocated according to easily measureable quantities in as fine a unit as needed (e.g. kilos of fish). This means the fish is easily divided between member states or traded among fishers. The main problem with quota management is that it makes the development of scientific advice more difficult. It not only requires the calculation of a total allowable catch it tends to bias the information used in these calculations by increasing incentives for discarding and illegal landings. Effort management can be carried out using a simpler scientific advice system. It does not require the separate allocation of species in a mixed fishery. Fishing effort, however, is much more difficult to define and allocate than fish quotas.

In the following a scientist provides the basic rationale for using an effort system in a mixed-fishery context:

Q19. Interviewer: But anyway, the problem of mixed fisheries needs to be dealt with in some way or another. And if this won't work, do you have an idea of what will work? Fisheries Scientist: Well, the only idea I have that could work would be an appropriate form of effort regulation. And I was very careful to say "an appropriate form of effort regulation" because I am not really sure what that is yet. [laughs] Conceptually, that should solve all the problems. But practically implementing and getting people to agree what that should be is a huge political problem, I think. Interviewer: why does it solve everything conceptually? Fisheries Scientist: Well, if you don't fish, you don't catch any fish so there's no fishing mortality. And if you have a low level of fishing then you can't blame fishing mortality for the change in stocks.

The problems with quotas in mixed fisheries are well established in global experience. Canada, for example, has an individual transferable quota (ITQ) system in which each fisher has an allocation of fish that he or she can buy or sell. ITQs are the most economically efficient way to allocate access to fishing because they allow the trading of precise amounts of fish quota to exactly the people who are able to make the most efficient use of them. However, even supporters of ITQ systems in general question their effectiveness in mixed fisheries (Rescan and Wilson 2009). The following is from one such advocate of ITQs in Canada:

Q20. Industry Representative: [after asserting that the ITQ system is a nightmare] ITQ is probably perfect in a single-species context. Interviewer: You are speaking of a nightmare from a fisheries business perspective? Industry Representative: Yes.... We have a multispecies fishery, with 5 or 6 quota species and others with bycatch restrictions. In a heterogeneous fishery and fishing community, bycatch is one of the true issues. You have a basket of holdings of quota and you catch more of one and less of another. ... theory would assume the market would operate and you would buy or sell this quota. But it quite quickly proves that it is easier to discard that quota than it is to buy it.

However, the problems with the measurement of effort are complex and multifaceted. This makes doing mixed-fisheries management using an effort approach nearly as unsatisfactory. These complexities, and what they have tried to do about them, are described by an administrator from the Commission:

Q21. Commission Administrator: Managing outputs has not stopped the decline of fish stocks. The implementation of reform and recovery plans has been about moving from managing outputs to managing inputs. Problems with catch controls lead to the need to monitor all catches and take discards into account. Effort is a very complex notion because so many different kinds of measurement and terminologies are used. A ton is always a ton but a kilowatt is not always a kilowatt! To make this work we have to move towards a consensus on instruments. We will not necessarily apply effort to all fisheries. You want to go to effort where you have multispecies fisheries and catches and where control over the definition of gear types and time spent fishing are possible. We do not want a competition between each unless each system is considered as compulsory. We are condemned to live with TACs and quotas because they are the measuring stick for allocations, and effort is less easy and transparent for finding an objective and verifiable indicator of allotment. To take historical effort may mean legitimizing a lot of illegal fishing.

The result of having neither of the two basic approaches to fisheries management work well in a mixed-fishery context has been hybrid schemes using both effort (defined as days-at-sea) and quota limitations. This hybrid has also not proven very satisfactory. The piling of measure on measure, and the cumulative effects and growing complexity, that result, finally lead to problems in the political support for recovery plans in mixed fisheries:

Q22. Member State Fisheries Manager in an interview: If you have this philosophy in a clean, purified version then if you have one stock in trouble, then you have to reduce fishing on all stocks taken together with that species. In a way probably the politicians have said 'that's the way we want to do it because that's the way the Commission told us was a good way to do it'. But I don't think the Ministers are prepared to take the consequences of this approach. ... One of the big challenges that we have now, that is to elaborate the system where we have TAC quotas, but also limit the fishing effort. I think that is important. I don't think my minister agrees with me. He is not very fond of days-at-sea. It is a new signal from my minister. We have to see how far he will go here, but he actually agrees with the fishermen, that it is not reasonable to have two management systems, quotas and days-at-sea, at the same time.

Because the CFP is so dependent on the output-based TAC quota system for allocating fish it is the input-based effort approaches that lose out when political challenges arise. It is in mixed-fishery situations that the advantages and disadvantages of both the input and output-based systems really begin to tilt more in the direction of making the input-based approaches seem more attractive.

3.3 Spatial Area Measures

One area where the fishing industry is proving to be a source of innovation is in spatial approaches to management, and the RACs are providing an important forum for this. It is also one of the key areas where conservation and industry RAC members are able to find some common ground. The Baltic Sea RAC sees a spatial approach as critical for the reduction of by-catch and discards.

Q23. A policy on by-catch and discard reduction should complement, and not replace key management measures. Generally, such measures should be applied in areas where concentrations of juveniles are congregated (by-catch hotspots), where spawning aggregations can be found, or when fish are in post-spawning recovery (BSRAC 2008).

Following this logic, one particularly innovative area where spatial management is being promoted by the fishing industry is the implementation of voluntary "real time closures". The basic idea here is that when fishing boats encounter spawning events, cod concentrations, or other areas where there is a high danger of bycatch, they call for a temporary closure of that area. The system in Scotland is the most advanced and implementation is being facilitated by the Scottish Government. This is a measure aimed directly at the mixed-fishery problem as the aim is to reduce cod bycatch. A real time closure of an area of not more than 50 square miles that will last for 21 days is triggered when 40 or more cod are caught in one hour of fishing effort. According to an oral report given at the RAC demersal working group in 2009, Scottish fishers closed 14 areas to fishing for 21 days in 2008, and this reduced cod landings by 61 tonnes. Meeting their targets in 2009 would mean closing 140 areas. To help increase the number of real time closures they have begun to use satellite information linked to the

vessels' fishing logs. The number of simultaneous closures is limited to 9, and there are some special restrictions on the closures in areas of particular commercial importance.

This is an innovative approach to mixed-fisheries management. One of its strengths seems to be that it is voluntary and depends on detailed information provided by the fishers. It has required the support and compliance of these fishers. Here is one Scottish fisher's opinion of the real time closures programme:

Q24. Interviewer: What is your opinion of the real time closures? Fisher: I'm all in favour of it, I think it's a great idea. In the Norwegian sector they had a real time closure, where the area closed for the three weeks where the cod was spawning. I think it's a brilliant idea. In fact we turned up to it this week and have been up there for eight days, so I say I'll go up and see if there's any cod there. We got up there and we saw very, very few cod. So the cod has spawned and they're gone. So I think it's a great idea. Interviewer: One fellow just said they thought 21 days were too short a time to be effective... Fisher: Well, I would agree with that. Yes certainly. Six weeks, two months. Because it's, the actual area, well, they did it the wrong way, they did it a seven mile square. They shouldn't have done that because that covers from sixty-two fathom to a hundred and ten fathoms. Well the cod spawned with seventy-five to ninety fathoms. They should have taken at depths, maybe twenty mile long, because it is depths that define those areas.

The fisher is not just enthusiastic about the approach, he is also critical of its implementation. He feels that the implementation is not only insufficiently restrictive; it also does not fully reflect the fishers' knowledge about how it could be made more effective. This indicates an attitude of ownership towards the programme on this man's part, at least. As the programme expands, its voluntary nature becomes a challenge. The concept of real time closures has already appeared as part of the fisheries negotiations within the EU, and soon it will also involve Norway. Indeed some of the closures are taking place in Norwegian waters. This led to the following interchange at a NSRAC working group meeting:

Q25. Industry RAC Member from Country One: By what right can Scotland close areas in Norwegian waters to English vessels? Industry RAC Member from Country Two: It is voluntary but last year people respected them. Industry RAC Member from Country Three: All member states have respected it? Industry RAC Member from Country Two: Up there it is basically the UK, Norway and Denmark. Industry RAC Member from Country Three: Is there an agreement with Norway that Norway will respect those areas? Industry RAC Member from Country Two: We tell them, this is Scotland's response. Commission Representative: Working groups are coming up in March and May that will be discussing real time closures with Norway to get something manageable, and we would like all the information you can give us. Another Industry RAC Member from Country One: This is for Scotland but we have just heard from the Commission that people are talking about making them broader and mandatory (*Observer's notes at the North Sea RAC Demersal Working Group, Berlin, Feb 2009*).

The Scottish fishing industry has overcome, with facilitation from the Scottish Government a very difficult collective action problem that responds in a detailed way to some of the basic problems in mixed-fisheries management. The challenge is keeping the system effective as it comes more and more into play in broader scale fisheries management systems. This initial voluntary aspect is important because the information required for the real time system is coming directly from the fishing boats. Making the system compulsory, if done carefully, would not necessarily undermine this. It could increase legitimacy by giving fishers greater

assurance that other fishers would comply. If the system was changed beyond what the fishers now recognize as “their” system it could easily lead to a “use our data against us” situation.

4 Contested Definitions and the Dangers of Reification

Part of the complexity of dealing with the sorts of science/policy boundary areas that mixed-fisheries management entails is the definition of entities. It is not simply, as we often hear, that things are not “clearly defined”. It is more than that. Many of the concepts we have to deal with in mixed fisheries are ‘essentially contested’ (Gallie 1955) concepts, meaning that their definition always depends on the speaker’s interest in how it is defined. The meanings of two kinds of things in particular are contested among different stakeholder groups. One is the distinction between target species and bycatch, the other is the way fishing fleets are defined for purposes of management.

4.1 *Defining Target Species and Bycatch*

From the viewpoint of the industry, the problem of defining which species are target and which species are bycatch is very serious, particularly as they fear that important details about these issues will be ignored:

Q26. Industry RAC Member: There is a problem with identifying which species are by-catch and which are not. For example a beam trawler in the northern North Sea can legitimately target plaice and they do so. However, a Scottish whitefish trawler will work alongside the beam trawler targeting haddock and catch very little plaice; so, while plaice is a directed fishery for the beam trawler it is nothing more than a by-catch of a few boxes, among hundreds of boxes, for the Scottish vessel. This highlights the complexity of identifying what are in effect by-catch fisheries, given that there are complexities relating to method, spatial and temporal factors.

In the industry’s mind, this issue become more acute in the context of recovery plans for particular species:

Q27. Industry RAC Member: A recovery plan for a species should be aware of the fact that the species can be targeted by some vessels and caught as bycatch by others. It is therefore important to adapt the measures to the métiers concerned.

They are also concerned that the management system reflects how quickly these ideas about what is bycatch and what is a target species change as species abundance and ecological factors change. Another RAC member:

Q28. Interviewer: Is there an important issue in mixed-fisheries management with identifying which species are target species and which ones are bycatch? If so what, if any, should the role of RACs be in making these distinctions? Industry RAC member: The only certainties are change and uncertainty, especially against the background of increasing sea temperatures. It is important not to define the fleets and fisheries into artificial categories that are either unnecessarily restrictive or devoid of meaning. At the same time vessels will fall into categories by virtue of their characteristics and activities. This can be used for management purposes. Monkfish and nephrops have moved from discards, to by-catch, to target species over a couple of decades.

However, from the viewpoint of conservation NGOs, the problem is perceived as less serious, except to the extent it raises questions about fishers' compliance with measures such as selective gears:

Q29. Interviewer: Is there an important issue in mixed-fisheries management with identifying which species are target species and which ones are bycatch?
Conservation NGO RAC member: I wouldn't see this as a major problem, except in that in some fisheries the fishermen are reluctant to apply as selective gear as they could to minimise bycatch because they see commercial value in that bycatch, e.g. the Nephrops fishery in West Scotland where the whitefish/monkfish bycatch is seen as a bonus. By the same token, the reluctance of the Dutch beam trawl fishery for plaice to increase mesh size >80mm arises from the high value of the sole caught thereby.

The response of another conservationist to the same question also suggests that the idea of target species and bycatch is determined at a higher level than that of a fishing boat.

Q30. Conservation NGO RAC member: I believe we know generally what the target species are, although we may have less information on the importance of bycatch species, in terms of their economic importance to the fleets.

Species that fishers are catching can still be bycatch even if they are economically important. The fishers are interested in catching a mix of species to make a living, and they want it understood that they are catching more than one species as a sometimes important part of their normal operations. In both quotes, the conservationists are focussed on larger scale conservation questions, and it is easier from this perspective to think about fishers as primarily targeting a smaller number of species. For example this makes the question of selectivity easier to translate into regulations. We return to these patterns of tactical and strategic concerns among different stakeholders in Section 5. The following interaction at ACFM suggests that from a biological point of view, scientists are willing to allow the industry to take the lead on this question.

Q31. Scientist One: At the NSC [North Sea Commission Fisheries Science Partnership, a forum where scientists and fishers discuss issues about the North Sea] meeting at the beginning of the week the question of mixed fisheries and defining fisheries was discussed. Fishers would say that if you look at catch composition you may decide it is bycatch when it is not. We should not try to make distinctions between bycatch and targeted fisheries (*ACFM, October 2003, Observer's notes*).

The question of what is a targeted fish and what is a bycatch fish is a classic boundary problem where different groups have different interests in what is defined as what, and in how fine those distinctions are. The scientists, who prefer to focus on fish stocks, are happy to leave it to the fishers to determine which species are target and which are bycatch. As long as they have a fishing mortality rate, it is not of direct concern for a stock assessment whether that mortality resulted from catching a targeted or non-targeted fish, although if this results in unrecorded discards then that is of concern from a data perspective. The conservationists are more concerned. They would prefer a clearer distinction between the two categories because it makes it easier to require more selective gears to exclude the clearly defined bycatch. Fishers want to be able to catch as many marketable fish as possible and do not want certain fish assigned to a category like bycatch that may be more subject to restrictions, unless there is a strong reason to do so.

4.2 *Defining Fleets*

These definitional problems become even more complex and disputed with the question of defining the different fleets, i.e., a group of vessels, and métiers, i.e., the different kinds of fishing activity that fleets carry out. Métiers were created by scientists and managers as analytic and bureaucratic management units, they define the fleet in terms relevant to management measures such as the size of the boat, the gear being used and the mesh size. These kinds of definitions are necessary for both promulgating and analyzing the impacts of management measures. Stakeholders recognize the need for such definitions:

Q32. Interviewer: If we are to manage mixed fisheries how badly do we really need clear definitions of fisheries and fishing fleets? RAC Staff Member: Many years ago now, French scientists put forward the notion of métiers, a combination of gear, fishing ground and target species. It can be called by other names (e.g. fisheries), but it is probably inevitable to invoke this kind of notion in searching solutions for mixed-fisheries.

And they understand that these concepts are primarily for the use of scientists and managers:

Q33. Industry RAC member: Some matrix of fleet activities and catches is required, although taking into consideration the 'data rich' nature of the material I would suggest that tracking remains the remit of those who hold the material.

As should be evident, the definitions of fleets and métiers used in management are driven by the needs of bureaucratic decision rather than by the realities of fishing. These definitions have been "reified", meaning transformed from abstract categories to concrete realities, with substantial consequences for both fishing operations and the environment.

Industry Members of RACs argue that these tendencies should be resisted:

Q34. We can only conserve stocks if vessels can freely change; targeting the stocks they are able to land. RACs should campaign for free interchangeable fishing.

This kind of flexibility was often an issue that came up when we were discussing the categorization of boats for management in the fishing ports. Most fishermen preferred categories that were large enough to allow seasonal flexibility. The preference for flexible gear categories over exact species categories in the coastal fishery is a good example of this.

A member of a local fishers' organization in Denmark told us:

Q35. It is self-evident that if you have to operate with those 'days at sea', you have to say that the rules cannot be the same for a trawler and a net boat. Of course they cannot be the same. But once you've been put into boxes, it is just so difficult to come and say "I would actually like to try and do something different from what I used to do". You cannot do that. It's over. If you have not been in Kattegat fishing, then you will never come into Kattegat fishing.

French fishers in the port of La Turballe, for example, all called themselves small pelagic boats, which is a very specific category in many ways such as area, fishing time, and boat size. But one of these fishers said that he could not classify his métier in terms of species he catches, and this is the reason he gives for disliking the quota system. In our research, coastal fishers in general would argue that if vessels are grouped according to gear it says very little about what kind of fish will be caught, and that this means that the categories used for management must be flexible.

Q36. Here, it is a bit difficult. The métier we do is a function of the fish that pass by this area. So one year you are going to fish sea bream and there are years when you will catch hake and other years when you will catch whiting. It is never the same. One cannot define from one year to another what métier we are going to do, how many fish we are going to catch. If our biologists are going to tell us that we have to fish this and this...if the fish are not there, it is not worth going to sea.

In Scotland in the 1960'es and 1970'es there was an explosion in multipurpose boats, and the fishermen described how boats would shift between different fisheries according to season. But the trend these days is a growing polarization of the fleet, based on different kinds of licenses. More and more boats stay with one kind of fishery instead of shifting according to season. The following quote from a Scottish fisher demonstrates how this is a progressive process as different kinds of management measures interact with one another:

Q37. Well these groupings have actually come about in the last few years. They are a natural sort of progression. Because, well take myself. In 1999 the boat that I had sunk. And I was, it was a sort of crossroad what we were going to do. I had to build a new boat, and I built the new boat looking at what I was entitled to catch, what was the best, most efficient way to catch my quota, and that's what I came up with. So we are getting more and more, the groups are getting more and more polarized as time goes by, getting more and more difficult to jump. If I were to say later that I want to catch langoustine, that's a sort of no go. If I say I'd better go catch langoustines, I would then have to look at ways for me to exchange my demersal quota for a langoustine quota, and then I would have the expenses of making my boat capable of pursuing that split. So when it gets at it, I may not bother.

For the Danish fishers in Hanstholm the lack of freedom and flexibility are among their main concerns with respect to management fleet categorization. Some fishers we spoke with were familiar with the concept of fleet based management from the days-at-sea regulation, and they are very concerned with the implications of fleet based management in terms of bureaucratization and the putting of people into 'boxes'. A member of the local fishermen's organization:

Q38. We know about fleet-based management from the days-at-sea regulations. I have spent much time on it. They keep changing it all the time, and now we are trying to figure it out again. Interviewer: What are the categories you have got to work with and how have they conflicted with the ways things really are, if it is possible to put it like that? Fisher: Well you can take a smaller trawler that changes gear, or the fishery in general that changes gear or want to do something in another sea, you can only do that as off the 1st of the month. You cannot change gear in the middle of it all. But fishermen have always been flexible and shifted if that's what they want to. Now you are being put into boxes. And when you put people into boxes it is difficult. I mean, if you do the same every day, then it is easy to put people into boxes, but if they don't, then it becomes very difficult. That's why I get afraid when you start to talk about fleet based things.

This concern is echoed by a Danish fisheries manager:

Q39. I think personally that this is not so bad, but the way we have introduced the days-at-sea (DAS) system is very stringent, it is very inflexible. It is based on past performance. The fishermen are offered fishing days corresponding to the ways they fished some years ago, and they do not take into account how they would like to fish in the future. If they could try to conduct a new type of fishery or do it in a different way with less cod, and different areas. They don't get the chance because they are offered a limited number of fishing days, based on calculations on their

behaviour in the past, so if they have been very dangerous to cod in the past, they will be very heavily punished by the new system. If they have not been so dangerous to cod then they can have more days in the future. So the fishermen that were harmful to cod, they will suffer from that also for the future and have no chance to try to develop a new fishing pattern. That is one of the examples of how rigid the system is so I think we need to elaborate on the DAS system in order to have better support from the fishermen. And, at the moment we don't have very much support from the fishermen.

However, stakeholders also understand that much of this is unavoidable, completely so under the current large-scale command and control system. It is seen as part of the economic competition of a modern industry. The following is from a RAC staff member:

Q40. Like it or not, there is little option but to restrict shifts. It's part of the winners-losers story... Note that it would be an inherent feature of individual quotas that so many folks are advocating: in the end, you are allowed access to some species, barred from others. RACs are much more effective than administrations or scientists in persuading the industry that something has to be done along these lines.

Many argue, as the following quote does, that the focus of the fishing industry on particular species has reduced the ecological resilience of the fisheries system by making it difficult for fishers to fish for one species when another becomes less valuable or more difficult to catch:

Q41. Industry RAC Member: The degree to which we need clear definitions of fisheries and fleets is dependent on the degree to which they have become discrete entities. For bureaucratic, management and control reasons there has, over the years, been a move towards single species fisheries. However, this reduces the resilience of the fishing industry as the flexibility to change target species, gear etc. in response to stock depletion or changing markets is removed..... It is important not to define the fleets and fisheries into artificial categories that are either unnecessarily restrictive or devoid of meaning.

This respondent links bureaucratic management directly to a move towards single species fisheries. He points to a contradiction between the imperatives of management bureaucracies and the realities of mixed fisheries. These classification were argued to increase discards by another RAC member from the industry who said:

Q42. Effort should be sufficient to target whatever stock is sustainable. If vessels were not pigeonholed into single fisheries there would be much less dumping of one species while looking for another.

The ecological implications of reducing the flexibility of the fishing industry extend to energy use as well as fisheries conservation:

Q43. Industry RAC Member: Restraining the fishing strategies of vessels too much can reduce their profitability if they do not have the possibility of adapting themselves. Will they be able to turn to other species with the equipment they have? The price is very heavy to pay. Furthermore, in view of the crisis context, the vessels should reduce their energy expenses as much as possible and use less fuel consuming fishing methods, which is not necessarily compatible with a shift in target species. Finally, if too many turn to the same species, this species could also come to see a degradation of its state of stock.

The importance of defining fleets and fisheries, and the implication of these management-based categories for management, can be an area of substantial disagreement between the industry and conservation stakeholders. Indeed, it is a topic that is interpreted differently

among conservationists. While fishers will argue as above that fishing flexibility provides ecological benefit, some conservationists see the greater value in the control of fishing behaviour. A Conservation NGO RAC member told us:

Q44. The constraint on moving between species, like the one-net rule, can be a good thing, reducing opportunity for malpractice. A dull answer, I know, but the best recipe for ensuring latitude for flexibility is for the RACs to support efforts to improve the sustainability of stocks across the board.

Another conservationist, however, is more sympathetic to the industry view, as long as it is seen as part of a broader shift towards an ecosystem approach:

Q45. Interviewer: As we attempt to manage mixed fisheries, do you see a serious problem with management reducing the ability of vessels to shift between species? If so what, if any, should the role of RACs be in alleviating this problem?
Conservation NGO RAC Member: Not necessarily, I am an advocate of the ecosystem approach – which I believe needs to be integrated into the recovery plans if they are to deliver. The plan should allow, if that's what the industry requires to be viable, the option to switch between fisheries, provided that the overall take of all species and individual species is within the limits determined by scientific assessments. RACs should assist in developing the plan, whether they can fully alleviate the problem remains to be seen.

Not all RAC stakeholders agree that defining fisheries and fleets is even a requirement. Indeed, this same advocate of the ecosystem approach believes that if we did put effective limits on overall take the general knowledge already held about fishing activities would be quite sufficient:

Q46. Interviewer: If we are to manage mixed fisheries, how badly do we really need clear definitions of fisheries and fishing fleets? Conservation NGO RAC Member: I think we already know what these areas are. I don't think they need defining. What is required is a logical way of managing these interactions so that recovery is more likely than under the current approach.

Even if these definitions of fleets and métiers are driven more by the needs of bureaucracies than fishing fleets, there are substantial challenges in formulating them as analytic definitions. An economist who works for the fishing industry told us the following in respect to the difficulties of defining fleets for bio-economic modelling:

Q47. Models run into difficulties because it's very difficult to get a meaningful average or representative type of vessel, because each vessel is so dissimilar in terms of catch rates, type of fishing, profitability. It's very difficult to actually get any sense out of a model that's based on an average performance and average types of vessels because within the fishing industry, with any sort of broad category that you want to try and describe, there is such an enormous variation of employment: that is characteristic of fishing as a hunting industry. And there isn't really an average performer or an average class of vessel. Because of that, economic models, which have been developed with some success and some uptake, have limits.... in terms of trying to produce anything for the viability of the fleet, you've got to have a much greater understanding of the different subsectors of vessels in the various categories and how they're likely to respond to changing scenarios, and how their profitability is likely to respond to changing scenarios. I'm not saying do get to the point where you have to have one model for each ship but, you know, it's a lot more than one model of four or five broad classes of vessel category.

The mismatch between the needs of fishing and hence fishing behaviour, feeds back into the process of analysis. A challenge for scientific analysis is that fishers' behaviour, and hence their definitions of fleets and métiers, does not remain static in spite of the bureaucratic management:

Q48. Scientist One: the working group last year used averages of three years for a subset of the fleets we have here, it is hard to be comparable with last year, so the short answer is: No, we don't know, but we have some data that we can use to answer the questions. Scientist Two: The plenary touched on this kind of model not trying to make long-term averages, but to be based on recent data, that is part of this locking fleets into patterns. Scientist Three: The variance also tells us how they behave. Scientist Two: You want to base the variance on partial Fs because this would be strongly affected by behaviour as well. Scientist Four: This is not fleet, this is fisheries, so there are many boats moving between them, we need effort data which would be a better way of moving through fisheries (*Observer's notes ACFM, October 2003*).

Broader scale once again intensifies this dilemma. Different member states collect and use the needed data in different ways. The systems to bring these data together, indeed both the systems and the people able to use them, are being put together but this will take a great deal of time.

Q49. Scientist One: Knowing what a North Sea vessel is in Denmark and Scotland is hard. Scotland does it by home port and Denmark does it by source of revenue. The Data Collection Regulation (DCR) will take 10 years or something to get good data. Between now and then we need to find a way to deal. Scientist Two: There is no commitment from other countries like Norway to follow what is in the DCR. The North Sea may be dominated by the EU, but other areas are not. Scientist Three: whatever comes out of DCR will drive what our country will do, and we will not go farther because of resources. Scientist Four: Mixed fisheries is really an EU problem, though, it goes from NS south. Scientist One: I removed all métiers of less than 100 tonnes a year and folded the less than 100 métiers into others. For the North Sea I have 18 fleets and 62 métiers. Not only between institutes but within institutes there are different ways of compiling data. The people that do it for WGs are not the same as those who do it for STECF.... (*Observer's Notes, Meeting of the Study Group on Mixed Fisheries Management, SGMIXMAN*).

The quote also shows that the scale at which scientists are trying to analyze mixed-fishery behaviour is sobering. 18 fleets and 62 métiers result when all the métiers below 100 tonnes are folded into others. Given the concerns with the fine distinctions needed to understand fishers' behaviour mentioned in Q47 and trying to keep track of shifts among these distinct behaviours mentioned in Q48, it is difficult to see how models of 18 fleets and 62 métiers, based on data collated from several countries in mixed fisheries subject to bycatch and discarding, can contribute to the management of sustainable mixed fisheries.

In one interesting development the North Sea RAC is also defining fisheries in order to develop long-term management plans. The fisheries they are defining bear no resemblance to the kinds of fisheries and métiers that the Commission is asking scientists for in order to resolve their allocation problems in mixed-fishery management. The following is from an interview with a RAC staff member.

Q50. Interviewer: Is defining a fishery a problem? RAC Staff Member: We didn't find it difficult; actually we defined the five key fisheries for the North Sea without any difficulty at all. After relatively short discussions we decided on the sort of

mixed white fish demersal fishery that the catch is cod, haddock and whiting and so on, the saithe fishery, which we felt really was a targeted fishery for saithe, but it did have by-catches too, the nephrops fishery, which those called the nephrops fishery, does have a significant catch of other species which is important to the fishery, and to the fishermen the monk fish fishery, and I think descriptively that monk fish is the name that's used, but it's the fishery that essentially takes place in fairly deep water, to the west, and to the north; is that four or is that five? Interviewer: I think it was four. RAC Staff Member: and there is another one, ha, ha [it is flatfish]. Interviewer: How does this thing relate to the fleet definitions, that the Commission uses. RAC Staff Member: Not at all, I mean, we simply, I think sat down at an executive committee meeting or working group meeting and said: You know, what the key fisheries that we need to have management plans for, so we, we re-invented the wheel in that respect, it didn't relate to gear type at all. Interviewer: Didn't at all? RAC Staff Member: No. Interviewer: So, did the RAC see there is a problem that all the data gathering is based on a different system? RAC Staff Member: I think it didn't specifically, didn't have its attention specifically drawn to that particular problem.

Different parts of the fisheries management community are raising some very hard questions about the definition of fleets, métiers, and fisheries. Managers and scientists are trying to solve what is essentially allocation problems among the member states by developing very complex mixed-fishery models, based on large numbers of fleets and métiers. Fishers are trying to figure out how to maintain flexibility in their fishing activities in the face of large-scale bureaucratic management. Others, like the conservation NGOs and now the NSRAC are raising some big strategic questions about how useful these kinds of fleet definitions actually are. In respect to two major institutional goals, long-term management and an ecosystem approach, ideas are emerging that do not anticipate being drawn into discussions of fine definitions of fleets and fisheries.

5 Strategic and Tactical Thinking in Mixed-Fishery Governance

Complex interactions between measures, fleets, fish species and the environment are the nature of mixed fisheries. Institutional complexities add to this melange. The sources of rules and laws range from global agreements to local ordinances regulating coastal access, and fisheries are often regulated by two or more ministries. Not only are laws and regulations complex, they have cumulative effects (Murray et al. 2008) on fishing operations and fishers' access to their livelihood. With respect just to the cod recovery plan for the North Sea the NSRAC complained:

Q51. The current scheme has become excessively complex, causing difficulties in implementation for vessel owners and member state administrations. This does nothing to enhance the credibility of the Cod Recovery Plan or increase support for it (NSRAC 2006).

Partly as a result of trying to respond to this complexity, the institutional picture in regard to mixed-fisheries management in Europe is very much in flux. The basic approach remains top-down, command and control management, but there are movements towards more participatory and decentralized decision-making. The Common Fisheries policy is one of the few areas where competence is entirely ceded by the member states to the European Union, making fisheries much more politically important than its economic contribution would suggest. However, once quotas are allocated to member states the allocation of the quota

within the member state is carried out by the relevant ministry. This line is not as clean as it may seem, particularly in respect to mixed fisheries. The Commission is often forced to make very detailed management decisions, which in turn leads to a constant flow of requests for modifications to and derogations from European rules. The overall system is operating at too large a scale and is too constrained by its political role within Europe, most directly by the rules of relative stability, to develop effective management measures for mixed fisheries.

That fisheries management must remain at its most fundamental level a top-down, command and control affair. One reason is that 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. Beyond this basic legal imperative, command and control is the most effective basic approach to the management of resources that cover a large geographical scale, because it can bring about relatively predictable outcomes across wide areas. In doing so, however, it pays a steep price in terms of lost local legitimacy and support and having to make decisions based on much poorer information than is available on the smaller scales (Wilson 2003). Command and control regimes are also better able than purely participatory approaches 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.

Nevertheless, fisheries cannot be managed through a command and control system at a continental level. The Commission's recent green paper on the CFP also argues that regional approaches to management must be increased (CEC 2009). The information problems alone make the current approach impractical, as described by the North Sea RAC:

Q52. The CFP has to manage a very wide range of fisheries, some of them highly complex, ranged across 40 degrees of latitude. Each regional sea also needs to be viewed from its particular perspective. The multi-gear, multi-species and multi-jurisdictional fisheries within the North Sea are among the most complex, and therefore the most difficult in the world to manage. The design and formulation of management measures across these varied fisheries cannot readily be undertaken by a small group of civil servants based in Brussels. Nor can they be managed through a centralised command and control approach. The development of a very large body of highly prescriptive and complex rules must be avoided (NSRAC 2009b p2).

These problems of legitimacy, complexity and scale have led European managers to a search for complementary approaches to command and control in the form of limited stakeholder participation. The RACs are the main expression of this. It is hoped that RACs can make the management system more responsive:

Q53. RAC Staff Member: The problem at the moment is that the EU decision system is much too "heavy" and lacks responsiveness to decide quickly on the most effective technical measures (e.g. restrict access temporarily to places where the mix of species or sizes is inadequate). Potentially, RACs might take this sort of responsibility, but they also should be structured to take decisions very quickly, close to real-time. In any case, the mixed-fishery issue needs a judicious mix of the various management instruments (all well known, with their pros and cons). Compromises have to be found, and someone has to decide firmly and quickly, and enforce the consensus decision. Great if RACs can do it!

Our interviews suggest that two other institutional patterns are emerging, both of which are commonly found in fisheries management in other developed countries. These two patterns are co-management and cooperative management. The RACs are the current institutions where both these patterns are seen.

“Co-management” (Wilson et al. 2003) involves a group of fishers working with the government in various ways, ranging on one side from nearly independent community management that reports to the government and relies on it only for local legitimacy, to the other end of the spectrum where fishers have a limited advisory role in government management (Sen and Nielsen 1996). Co-management is argued, particularly at local scales, (Wilson 2003) to facilitate access to information needed for both resource assessment and the enforcement of management measures (Pinkerton 1989). Others have suggested that it increases the flexibility of the institutions to respond to ecological changes (McCay and Jentoft 1996). It is also argued to increase the perceived legitimacy of management decisions through increased transparency (Jentoft 1989), greater accountability for managers (Magrath 1989), and increased respect for fishers’ views of management (Pomeroy 1993).

It is helpful to contrast “co-management” with “cooperative management”. The difference is that co-operative management involves a greater number of stakeholders and a wider range of decisions. Where the point of co-management is to involve fishers in the hopes of better crafted, more effective management and enforcement, the point of cooperative management is to ensure that a wide number of voices are available to management decisions. The most critical group here is the marine conservationists, who commonly participate in cooperative management through NGOs. The exclusion of the conservationists from the very early fisheries co-management developed in the United States in the 1970s turned out in the long run to have been a critical error. This error was manifest in both the failure of the system to conserve fish stocks and the legal paralysis inflicted on the system during the 1990s as a result of law suits driven mainly by these NGOs.

In Europe the RAC system is an attempt to move the command and control system a few steps in the direction of both co-management and cooperative management. The RACs include a broad group of stakeholders, including conservation NGOs, but two thirds of the seats are reserved for the fish harvesting sector. In interviews with RAC members the two patterns are very clear. Industry members conceived of the RACs’ role mainly in terms of co-management. Co-management-type input into the crafting of management measures is particularly useful in trying to address the complexity of mixed-fisheries management. Here is how one industry member describes the role of RACs in relation to mixed-fishery measures:

Q54. Interviewer: How should quotas, effort and technical measures be balanced within mixed-fisheries management? How can the RAC facilitate this balance?
Industry RAC Member: Quotas are a convenient means of sharing the resource. Effort control is an economically perverse control measure that indicates a failure of structural policy. Technical measures can help to improve the exploitation pattern in mixed fisheries. RACs should work to reduce the negative features of a TAC system, without throwing the baby out with the bath water. TACs, compliance, technical measures and fleet profitability will all be enhanced if there is a balance between capacity and available resources.

The respondent is pointing to the complexity of interactions among management measures and describing the RACs' role as essentially getting the best they can for the industry out of a difficult management situation. This second industry member emphasises the role of fishers' knowledge:

Q55. Interviewer: What is the main challenge for recovery plans in a mixed-fisheries context? Industry RAC Member: Developing avoidance and discard reduction plans on the basis of industry knowledge about selective gear, and spatial and temporal patterns of fish distribution.

A third industry respondent makes it clear that the need for fishers' input into the crafting of management measures is seen directly in economic terms. RACs are a mechanism for reducing the pressure of management while achieving conservation goals in ways that respect the realities that the fishing fleets face:

Q56. Interviewer: What would you say are the most important lessons from past experience with recovery plans in Europe? Industry RAC Member: It is possible to draw the following lessons from these experiences. It is not compulsory to put in place a management/restriction of fishing effort to recover a stock. The important thing is to find measures that can be adapted to the species that one wishes to protect and that can be adapted to the activity of the fleets (technical measures, area closure, management of effort or capacity, etc.)

While the industry respondents define the role of RACs in mixed fisheries in ways that fit the co-management pattern, the NGOs have a very different take on these questions of governance and complexity in mixed fisheries:

Q57. Interviewer: How should quotas, effort and technical measures be balanced within mixed-fisheries management? How can the RAC facilitate this balance? Conservation NGO RAC Member: Quotas should be set at the appropriate level, so that interactions within the ecosystem are not significantly affected. Technical measures, including spatial measures, should be applied to complement output controls but also to ensure that the overall footprint of the fishery is within set limits. The same theory should apply to the total amount of effort applied to the ecosystem - which can then be divided up into the respective fleets or fisheries.

Here the emphasis is on reducing the complexity of management measures by taking a broader ecosystem-based approach. The stress here is on overall limits on human activities. The view is more strategic. This does not mean that the NGOs do not recognize an important role for fishers' knowledge; they do indeed as the next quote shows. But their outlook remains much more strategic. As both the following quote, and other quotes below, will show, this can lead to real disagreement not only about directions, which is to be expected, but about the roles that RACs should play:

Q58. Interviewer: How should quotas, effort and technical measures be balanced within mixed-fisheries management? How can the RAC facilitate this balance? Conservation NGO RAC Member: The RACs should focus on long-term measures - as they were intended to do - and spend proportionately less time on short-term issues like TACs and quotas (on which decisions quickly become impossible for the consensus of the stakeholder breadth of the RACs, i.e. the fishermen will mostly agree among themselves, but taking the other (third of) stakeholders with them is generally intractable). That said, the sector in the RACs has a huge contribution to make on using fishermen's knowledge to advance the development/implementation of technical measures, as the Scottish demersal fishermen are already doing with real-time closures.

This tension between the strategic and tactical thinking reflects, but is not the same as the standard disagreements one would expect between the NGO and industry participants. Within the RACs the tensions over these two different kinds of roles form the context for discussion of management measures.

6 Conclusion

Three dilemmas stand out from this review of governance issues around mixed-fisheries management in Europe.

The first dilemma is the intersection of scale and complexity. The current European governance system is attempting to mobilize detailed knowledge, across very broad scales, which will allow them to manage sets of mixed fisheries as complex wholes. This attempt does not appear feasible. For one thing, it is caught between the difficult divisibility of input management and the scientific problems of output management. Output management makes the allocation job easier in principle, but it exacerbates the uncertainties of stock assessments even while relying more intensely on their ability to forecast future numbers of fish. Added to this is the sheer numbers of fleets and métiers, whose fishing activities they hope to simultaneously optimize, as well as the reluctance of fisheries scientists to hand them answers based on so much uncertainty. Give all this, the ability of this governance system to develop the knowledge base it requires is questionable.

The second dilemma is the number of competing definitions of the objects of governance, particularly the very basic concept of fisheries. The management system requires analytic and bureaucratic definitions of fisheries. And it is true that any management system must define and gather information about the units that it is managing. However, the industry, and possibly even the environment, pays some real costs when these definitions become overly detailed and restrictive. They can end up forcing fishing vessels to endure restrictions that arise only from the imperatives of management, without reflecting the realities that fishers face. Meanwhile, scientists are more comfortable addressing fish stocks than they are fisheries. Finally, the RACs are proposing definitions of fisheries for the sake of long-term management that are the polar opposite, at least in terms of breadth, of the finely outlined fleets and métiers. They proceed to build ideas for long-term management without really worrying that the units they would like to work with do not in fact even exist within neither the scientific nor the bureaucratic views of the mixed fisheries.

The third dilemma is the differences between the various stakeholders, particularly between the conservation NGOs and the industry, on the roles of the RACs. The industry is much more oriented around questions associated with co-management, i.e. the participation of user groups in management in order to produce better crafted management measures. The NGOs are oriented around co-operative management, i.e. the participation of stakeholders in management in order to ensure that all relevant objectives are on the table. The combination of these two different kinds of participation, with their complementary yet differing objectives, into a single institution may not be the most effective or efficient approach.

One direction that may help resolve these three dilemmas, and improve European fisheries management overall, is one currently being considered in the Green Paper on CFP reform (CEC 2009) under the terms “results-based management” or “self-management”. A results-

based management approach envisions two complementary processes. One of these is the setting of management objectives and corresponding limits on the environmental impacts that will be allowed by user groups. In an ecosystem approach this process would be developing operational constraints based on limits set by a government process. The second process is the development of exploitation plans that allow the user groups to make a profit while remaining within these limits. This second process would be carried out by the user groups, in cooperation with scientists, under a requirement that they bear the responsibility for demonstrating that they are staying within the limits. In this view, the NGOs would be a critical part of the strategic first process but would not need to be involved in the second process. How the industry will be monitored and held accountable for staying within the set limits would have to be part of their plan.

This is an approach that has been used successfully in various places around the world, a few of which, for example the community management boards of Nova Scotia, are within mixed fisheries. Implementation in Europe, even with Commission support, would be a great challenge because of the complex international nature of the many mixed fisheries. But it is a promising model. For one thing, this approach does not have to define fisheries from an analytic or bureaucratic perspective; they will be defined by whoever is trying to establish themselves as the licensee. They will certainly have to be defined in a political sense, because of the possibility of two groups offering plans that cannot both be accommodated. However, this model does suggest a strategy for handling the broad-scale, multi-stakeholder problem of processing information and making decisions for mixed-fisheries management.

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