Conflict and Complementarity

- An empirical study of conflicts between Danish fishermen and fisheries management aiming to develop an interdisciplinary framework to understand and mitigate conflicts in fisheries

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PhD dissertation: Conflict and Complementarity

– An empirical study of conflicts between Danish fishermen and fisheries management aiming to develop an interdisciplinary framework to understand and mitigate conflicts in fisheries

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- Paper #2: *Bo Sølgaard Andersen and Anne-Sofie Christensen*: Modelling short-term choice behavior of Danish Fishermen in a mixed fishery. Sumaila, U. Rashid and Marsden, A. Dale (eds.) 2005 North American Association of Fisheries Economists Forum Proceedings. Fisheries Centre Research Reports 14(1). Fisheries Centre, the University of British Columbia, Canada, (2006):13-26.
- Paper #3: *Jesper Raakjær Nielsen and Anne-Sofie Christensen:* Sharing responsibilities in Danish fisheries management – Experiences and future directions. Marine Policy 30 (2006):181-188.
- Paper #4: *Anne-Sofie Christensen, Jesper Raakjær and Thomas Olesen:* The voices of Danish fishermen in resource management – An examination of the system of negotiated economy. Ocean and Coastal Management 50(2007):551-563.
- Paper #5: *Anne-Sofie Christensen:* Fewer fish than frustrations**:** An Analysis of Multiplicity in Knowledge Articulation. MAST: Maritime Anthropological Studies, 2009:8(1):53-73.

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Short but genuine: *Tak!*

Anne-Sofie Christensen, Ballerup, August 27th 2009

PART 1
Synthesis

Synthesis

0.0.Background

Without knowing it back then, the work for this dissertation began in February 2003, when I was conducting a series of qualitative sequence interviews with Danish demersal fishermen as part of the projects 'Temas' and 'TecTac'. The fishermen told me about their reactions to the days-at-sea system that had just been introduced. The EU had added a set of regulations to the quota system by introducing a system of days-at-sea for all EU fishermen starting from January 2003. The main incentive for the Council of Ministers to introduce the days-at-sea regulation was to reduce the fishing mortality for cod by restricting the fleet fishing for cod in the North Sea. But segmenting the fleet so that only the cod-catching part of the fleet is restricted by the regulations is a difficult task. The fishing fleet in the North Sea is complex as the fleet comes from many different countries, uses many different types of gear, fishes for many different species of fish etc. The Council of Ministers decided on segmenting the fleet according to mesh size as statistics showed that the vessels using the smaller mesh sizes mainly landed soles and other flatfish or Norway lobster, whereas the vessels using the bigger mesh sizes mainly landed cod. Hence, the vessels using the bigger mesh sizes were given fewer days at sea. At the same time some of the quotas were reduced – the North Sea cod quota by 45 per cent for the second year in a row. The Danish demersal fishermen, whose main income came from the cod fishery, were initially given nine days-at-sea a month. During the interviews, the fishermen told me about four different reactions to the new regulation:

1) Some fishermen changed to other fisheries, e.g. Norway lobster fisheries in which fishing mortality increased. These new fisheries had heavy by-catch of cod, which had to be discarded if not landed illegally.

2) As the reduced cod quota caused less income to the fishermen, some fishermen started *high-grading* cod. High-grading implies that only the bigger and more expensive fish are landed in order to maximise the landing value of the quota. Some fishermen threw away the smaller, but target-sized cod, while others sold them at the black market for about a fourth of the price of legally landed cod.

3) Some fishermen changed their mesh sizes that were earlier up to 130 mm to smaller ones of less than 100 mm in order to gain more days-at-sea to fish for species without quota. This was possible because of the system of allocation of days-at-sea. As the sizes of the quotas are not proportional to the allowed number of days-at-sea, these fishermen had an increased over-catch of cod, which they had to get rid of somehow.

4) Other fishermen stated a smaller mesh size in the logbook than the one actually used. The fishermen did this in order to avoid increased by-catches and investments in new gear – an investment they would only have made for the sake of the regulations in order to get the larger number of days-at-sea. They risked being caught and heavily fined by the fisheries inspection, even though their non-compliance was likely to benefit the state of the resource.

These responses to the days-at-sea system were highly unfortunate in the eyes of the fishermen and against the political intention of the regulation. All the interviewed fishermen believed that the fishing mortality for cod was higher after the introduction of the days-at-sea system. The results of the regulation were, according to the fishermen, increased catches of cod and frustrated fishermen among whom some were using unnecessarily small mesh sizes, while others had become criminals by using too big mesh sizes. An even bigger crisis in fisheries was certainly not what the EU's Council of Ministers had in mind when introducing the days-at-sea system (Christensen 2004).

Given the good intentions of fishermen and fisheries management, the outcome seemed almost too irrational and too frustrating when you know how important the cod is to the local communities[1] and fisheries in general.

So *why study fisheries conflicts*? Fisheries conflicts are unfortunate as they tend to make a bad situation worse. The conflict presented above was the fisheries conflict that was my motivation for applying for funding to synthesize my research work into this PhD dissertation. Conflicts can ultimately lead to the mismatch between the intentions and the reality of a regulation and cause damage to the fish resources, the fisheries and the local communities. Hence, understanding fisheries and the persistence of the conflicts is critical to ensuring sustainable fisheries for the future.

[1] Paper #5 (Christensen 2009) looks into the importance of cod to the local communities on the west coast of Denmark.

0.1.Readers' guidelines

The title of this dissertation is: *Conflict and Complementarity - An empirical study of conflicts between Danish fishermen and fisheries management, aiming to develop an interdisciplinary framework to understand and mitigate conflicts in fisheries.* The work was conducted at IFM, Innovative Fisheries Management – an Aalborg University Research Centre. The core of the dissertation is the outcomes of four research projects on Danish fisheries. They are presented through five research papers (Part 2) that are braided together in this synthesis (Part 1) in an interdisciplinary framework to understand and mitigate conflicts in fisheries. Danish demersal fisheries, which are mixed with regard to target species, waters, gear and vessel types, are the empirical pivotal point of the dissertation.

The PhD-project has two levels of relevance – an empirical and a methodological one: Since the mid 1980'es conflicts between (Danish) fishermen and fisheries managers have occurred frequently. Often the conflicts lead to unfortunate mismatches between management intentions and the practical outcome of fisheries, leaving both fish and fisheries in a situation of crisis. This happens even though both fishermen and managers aim at biologically, economically and socially sustainable fisheries. Insight into fisheries and fisheries conflicts seems essential in order to solve the situations of conflicts and crises - or even try to prevent them. However, fisheries as empirical field are complex and take place where natural, economic, social and legal systems meet and interact. Hence, fisheries as a scientific field do not acknowledge the formal disciplinary boundaries; several scientific disciplines offer their contribution to fisheries research using different theoretical frameworks, terminologies, and methodologies. This means that fisheries (conflicts) are well-studied, but little research is conducted in collaboration between disciplines or on the consequences of the various research methods applied. When added together, these two levels of relevance make fisheries conflicts complex to understand and to mitigate.

The overall aims of this dissertation is to study various conflicts between Danish demersal fishermen and fisheries management in order to

- examine the challenges that fisheries research is facing when studying fisheries conflicts, and
- outline ideas for how to mitigate the fisheries conflicts.

The aims were met in two steps. The first step was to study various fisheries conflicts between Danish demersal fishermen and fisheries management as part of four independent research projects[2]:

- Temas (TEchnical MeAsureS – Development of evaluation model and application in Danish fisheries)
- TecTac (TEChnical developments and TACtical adaptations of important EU fleets)
- RESPONSIBLE (Sharing responsibilities in fisheries management)
- PKFM (Policy and Knowledge in Fisheries Management)

Temas and TecTac can be seen as one project as their outcome, in terms of research papers (Paper #1 and Paper #2), is the same. The parts of the Temas and TecTac projects that have fed into this dissertation focused on the fishermen's tactical and strategic decisions in relation to a number of factors, including fisheries management. Both papers from the RESPONISBLE project, Paper #3 and Paper #4, focus on the institutional set-up in the decision-making processes in fisheries management. The input from PFKM (Paper #5) examines a conflict between fishermen and fisheries managers, focusing on knowledge articulations in the public debate in the newspapers. The research papers constitute Part 2 of the dissertation. Hence, the research projects had different scopes, different theoretical and methodological approaches, and reach different conclusions. Yet they work on common ground – namely the Danish fisheries and its conflicts.

The second step was to meet the overall aims of the dissertation: 1) examining the challenges that fisheries research is facing when studying fisheries conflicts and 2) outlining ideas for how to mitigate the fisheries conflicts. This was done by synthesising the outcomes of the research projects. The main points of the synthesis are:

- Danish fisheries have often been in crisis and conflicts. The conflicts have often lead to unfortunate mismatches between management intentions and the practical outcome of fisheries. Hence, fisheries conflicts should be mitigated, but how to do so is a difficult question.
- It is a challenging task to study fisheries and the conflicts that surround fisheries for (at least) four reasons that are somehow interconnected as they are all expressions of the complexity in fisheries:

[2] A detailed overview of the projects can be found in Appendix A.

- Firstly, fisheries as empirical field are complex and take place where natural, economic, social and legal systems meet and interact. This complexity is demonstrated by means of Anthony Charles' model of the fishery system (Charles 2001).
- Secondly, fisheries, fishermen and fisheries management are multiple (Mol 2002). The analytical units – e.g. *fisheries*, *fishermen* or *fisheries management* - in the various research papers refer to different phenomena. Hence, a set of analytical constructions are needed in order to enable us to understand fisheries conflicts in spite of diversity in terminology. The multiplicity is caused by differences in enactments.
- Thirdly, fisheries as a scientific field do not acknowledge the formal disciplinary boundaries; several scientific disciplines offer their contribution to fisheries research using different theoretical frameworks, terminologies, and methodologies.
- Fourthly, fisheries scientists are players on the fisheries political arena. Degnbol *et al* (2006) point out that the researchers tend to develop *tunnel vision*, which is a notion for the situation where researchers get too focused on their own enactments and ignore other aspects.

- An empirical framework for studying fisheries conflicts is presented. It stresses the importance of studying formal as well as practical aspects of both fisheries and fisheries management when studying fisheries conflicts.

	Fisheries management	**Fishermen/fisheries**
Formal aspects	• The fisheries management expressed in laws, regulations, implementation etc • Structures of decision-making processes	• The reports of the fishermen; logbooks landing reports, catch journals etc • The internal organisational structure of the fishermen
Practical aspects	• Fisheries management in practice when implemented in fisheries • Decision-making processes in practice	• Fishermen's everyday practice at sea • Fishermen's tactics and strategies • Fishermen's knowledge • The implications of fishermen's organisational structure

- It is argued that all the aspects in the framework need to be taken into account in order to understand fisheries conflicts. This automatically implies that different research methods and research disciplines have to be employed.
- The keyword in studying fisheries conflicts is *complementarity.* Rather than seeing other scientific disciplines as opponents or competitors, other disciplines have to be seen as complementing. Hence, if fisheries scientists reach different results, the results should be compared and discussed.
- A number of ideas are presented on how to mitigate the fisheries conflicts. The ideas are given to fisheries management, fishermen and fisheries research.

Apart from the synthesis, Part 1 also includes three appendices:

- Appendix A: Overview of the research projects that have contributed to this dissertation.
- Appendix B: Summaries in English and Danish
- Appendix C: Danish fisheries from 1996 to 2006. This appendix is included to ensure that readers not familiar with the developments in Danish fisheries and fisheries management in the decade in question can get a contextual overview. The appendix also gives an overview of the empirical coverage of the case studies in the research papers.
- Appendix D: Methodological framework for studying fishermen's tactics and strategies. Research papers often leave limited space for methodological considerations. The methodological approach in the projects Temas and TecTac is here presented in more detail.

0.2.Contents of the synthesis

The first section is an empirical and theoretical introduction to the field of fisheries (conflicts) and fisheries research. The section shows the challenges of studying fisheries and the conflicts that surround fisheries for (at least) four reasons. These reasons are somehow interconnected as they are all expressions of the complexity in fisheries. Firstly, fisheries as empirical field are complex and take place where natural, economic, and social systems meet and interact. This complexity is demonstrated in Section 1.1. by means of Charles and his model of the *fishery system* (Charles 2001) that shows the compoundness of fisheries. Secondly, fisheries, fishermen and fisheries management are multiple concepts. The multiplicity is introduced in Section 1.2. to enhance an analytical understanding of fisheries, fishermen and fisheries management. Thirdly, fisheries as a scientific field

do not acknowledge the formal disciplinary boundaries; several scientific disciplines offer their contribution to fisheries research using different theoretical frameworks, terminologies, and methodologies. This is demonstrated in Section 1.3. by presenting the key literature in the various disciplines of fisheries research that are relevant in this dissertation. Fourthly, the multiplicity of fisheries research poses political challenges. In Section 1.4, focus is on relations between fisheries research and fisheries politics. Degnbol *et al* (2006) show the (lack of) collaboration between various disciplines in fisheries research; that the researchers tend to develop *tunnel vision*, which is a notion for the situation where researchers get too focused on their own enactments and ignore other aspects. The tunnel vision can have negative consequences as it usually presents a preferred solution, a technical fix, to the challenges of fisheries management.

Section 2 focuses on complementarity in fisheries research: Complementary research can provide a stronger knowledge base and hence, provide better understanding of what drives the conflicts in order to solve and prevent them. Rather than seeing other scientific disciplines as opponents or competitors, other disciplines have to be seen as complementing. Hence, if fisheries scientists reach different results, then the results should be compared and discussed. The framework for empirics is presented; it stresses the importance of focusing on formal as well as practical aspects of fisheries management and fishermen. The framework shows that no simple study or research perspective can grasp all the important aspects of fisheries conflicts. When studying fisheries conflicts, we are facing the dilemma of needing a systemic/global overview but only being able to study from the local perspective. This is followed by a short presentation of the individual research papers, and they are placed in the framework.

Section 3 focuses on how fisheries conflicts can be mitigated according to the research papers. The papers present a number of ideas for conflict mitigation and for improving the situation of the fisheries. These ideas are synthesised with reference to what the fisheries management, the fishermen and fisheries researchers respectively could do to improve the situation according to the five research papers.

1.0.About the challenges of studying fisheries and fisheries conflicts

It is a challenging task to study fisheries and the conflicts that surround fisheries for (at least) four reasons that are somehow interconnected as they are all expressions of the complexity in fisheries. Firstly, fisheries as empirical field are complex and take place where natural, economic, and social systems meet and interact. Secondly, fisheries, fishermen and fisheries management are multiple concepts. Thirdly, fisheries as a scientific field do not acknowledge the formal disciplinary boundaries; several scientific disciplines offer their contribution to fisheries research using different theoretical frameworks, terminologies, and methodologies. Fourthly, the multiplicity of fisheries research poses political challenges. I will elaborate further on these four reasons in the following.

1.1.Fisheries system

Anthony Charles (2001) introduced the concept of *fishery system*, which is an analytical construction for describing the overall interaction between the various actors and the dynamics around the activity of fisheries[3]. Figure 1 shows the fishery system according to Charles. According to him, the fishery system consist of three systems: *the natural system* – the fish, the ecosystem and the biophysical environment; *the human system* – the fishermen, the fishing households and communities, the post-harvest sector and consumers, and the social/economic/cultural environment; and *the fishery management system* – fishery policy and planning, fishery management, fishery development, and fishery research. The arrows and dotted lines indicate that this can be seen as a dynamic whole. The model of the fishery system is based on a Canadian setting and may look a bit different in the European/Danish context. It is archetypically simplified; as such models tend to be. It does, however, provide an insight into the dynamics of fisheries.

[3] Nielsen and Holm (2007:671) and Raakjær (2008:17) have developed this model further.

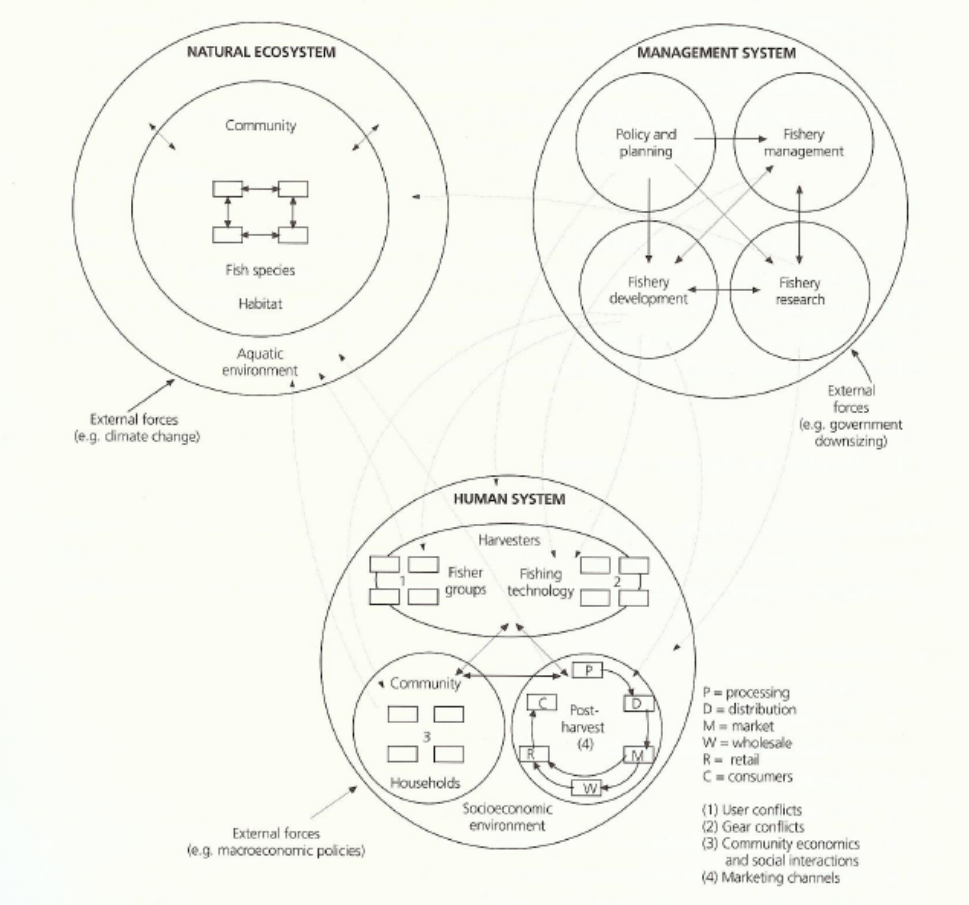

Figure 1 The fishery system (Charles 2001:10)

About conflicts in the fishery system, Charles sees them going on between the subsystems, he says (Charles 2001:250):

> *'It is hardly surprising that conflict tends to be prevalent in a biosocioeconomic system as complex and as dynamic as a fishery system, with its many interactions between natural resources, humans and institutions.'*

Charles argues that there are fundamentally four different kinds of conflicts in fisheries (Charles 1992:381):

> *1) Fishery jurisdiction involving fundamental conflicts over who 'owns' the fishery, who controls access to it, what is the optimal form of fishery management, and what should be the role played by governments in the fishery system.*

(2) Management mechanisms - concerning relatively short-term issues arising in the development and implementation of fishery management plans, typically involving fishers/government conflict over harvest levels, consultative processes and fishery enforcement.

(3) Internal allocation - involving conflicts arising within the specific fishery system, between different user groups and gear types, as well as between fishers, processors and other players.

(4) External allocation - incorporating the wide range of conflicts arising between internal fishery players and 'outsiders', including foreign fleets, aqua culturists, non-fish industries (such as tourism and forestry), and indeed the public at large.

This dissertation only focuses on the conflicts of fishery jurisdiction and management mechanisms. Charles (1992:379) argues that *'conflict can often best be understood as rising from natural tensions between three differing fishery paradigms (or 'world views'), each based on a different set of policy objectives'*. The three paradigms are: The conservation paradigm, which focuses on the policy objective of conservation in the sense of resource maintenance; the rationalization paradigm, which focuses on economic performance in the sense of productivity; and the social/community paradigm, which focuses on community welfare in the sense of equity. According to Charles, attempts for conflict resolution usually balance the policy objectives in the paradigm triangle (Figure 2).

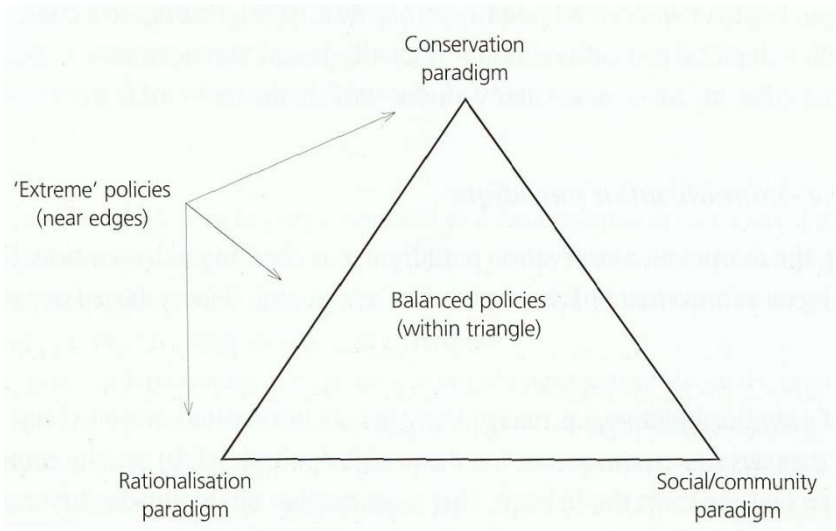

Figure 2 The paradigm triangle (Charles 2001:251)

According to Charles, it is these paradigms (underlying goals for fisheries) that drive fisheries conflicts. The three paradigms need to be in balance in order for a fishery system to be sustainable. Throughout this dissertation, I indirectly argue that Charles' approach to conflicts is simplified; that fisheries conflicts cannot be reduced to two (or more) parties with different aims for fisheries. Yet, Charles makes two important points, which are: 1) that fisheries conflicts most often are going on between people with different objectives for fisheries, and 2) that different policy objectives are supported by different scientific disciplines. The policy arguments within the conservation paradigm are based on biological perspectives; the arguments within the rationalization paradigms on the economic theory; and the social/community paradigm on the anthropologists and sociologists' worldview. I will come back to these connections between research and politics in Section 1.4. Before doing so, multiplicity of fisheries has to be introduced:

1.2.Multiplicity

Intuitively and empirically[4], it makes sense to talk about conflicts between fishermen and fisheries management. What is a fisheries conflict? Who or what is a fisherman and fisheries management? The analytical units - *fishermen* or *fisheries management* - in the various research papers refer to different things. For example the term *fisherman* refers to a person doing a certain job in e.g. papers #1 and #2, while it refers to a group of people represented by an organisation in e.g. papers #3 and #4. This has been one of the challenges when synthesizing the research papers – to argue that it makes sense to talk about fisheries management even though the term refers to different things in different settings. This implies that a set of analytical constructions are needed in order to enable us to understand fisheries conflicts in spite of diversity in terminology. Multiplicity, enactment and heterogeneous networks are central terms in this analytical construction.

[4] In the individual study, the fishermen and the fisheries management are empirically defined. I will not go into detail with the Danish fishermen and the Danish and European fisheries management in this synthesis. Papers #1 (Christensen and Raakjær 2006), #2 (Andersen and Christensen 2006), #4 (Christensen *et al* 2007), #5 (Christensen 2009) and Appendix C provide more details on Danish fishermen. For further details on the Danish fisheries management take a look at the Papers #1 (Christensen and Raakjær 2006), #3 (Raakjær Nielsen and Christensen 2006), #5 (Christensen 2009), and Appendix C. The papers #3 (Raakjær Nielsen and Christensen 2006), #4 (Christensen *et al* 2007), and #5 (Christensen 2009) contain presentations of the decision-making system of the EU. Please note that Danish fisheries management has changed fundamentally since January 2007 when a new system for distributing quota among the Danish fishermen was introduced. However, in the following the system before 2007 is presented as all the case studies of the papers refer to this system.

1.2.1.Fisheries, fisheries conflicts, and multiplicity

Ontologically, conflicts can be understood in (at least) two different ways depending on the assumed relationships between the involved parties. One understanding of conflict (perspectivalistic conflicts) occurs when the parties agree on the object of conflict, but take different positions in the conflict. In the case of fisheries, a perspectivalistic analysis of fisheries conflicts would imply that the different actors have different perspectives, which are rooted in their different positioning to fisheries, their different political and economical interests, and/or their different institutional roles. I will not go into more detail on perspectivalistic studies here; Paper #5 provides more explanation and several examples. Another type of conflict occurs when the object of conflict (fisheries) is *multiple*. This understanding is inspired by Annemarie Mol (2002), who argues against the unification of objects:

She introduces (Mol 2002) the concept of multiplicity as an ontology of objects/phenomena, saying that no object/phenomenon is singular; objects/phenomena are enacted in practices that produce different realities. Mol focuses on *enactment*, which is essential in understanding multiplicity; to enact connotes that objects/phenomena are attuned to, interacting with, and shaped in various practices (Mol 2002:vii)[5]. Multiplicity can be translated into the world of fisheries as follows: Fishermen enact fisheries in one way (they fish) and fisheries managers enact fisheries in another (they manage).

It would be too easy to say that fishermen and fisheries management live in two different worlds[6] that are completely separated – this is too simplistic as fishermen and fisheries management do not just enact fisheries in *one* way. Both parties enact fisheries in many ways, depending on the context (political, economic, personal, position, situation of fish stocks etc), and in some situations they cross

[5] Mol wrote her book on ankles. Fisheries are not an ankle and fisheries conflicts are not equal to a physical disease; therefore objections can easily be made to the application of Mol's conception of multiplicity to the case of fisheries. Three main objections can be made: Firstly, the differences in the nature of fisheries and ankles (e.g. ankles are a compact object, fisheries are spread out geographically; ankles are not assigned a moral political value, fisheries are highly political). Secondly, the definitions of enactors: in hospitals the roles are set and respected by all enactors; in fisheries the roles are less clear and less respected by all enactors. Thirdly, the institutional ability of the enactors to gather into one solution. In her book, Mol shows the ability of the hospital to patch up the multiplicity and turn a common solution into the treatment of the patient. In Mol's case study of the ankles, there is an institutionalised hierarchical system ensuring that multiplicity of the disease does not turn into its fragmentation. So even though the doctors apply different ontologies to the disease, they are able to combine these into a treatment of the patient. The doctors have a common framework for how to combine the multiple enactments into one solution. The goal of all the enactments is clear to everybody involved in atherosclerosis: The patient needs to get better or at least be released from his/her pain and the risk of the situation getting worse. The objective of curing a sick ankle is relatively clear and disembedded. This is not the case in fisheries – both the objectives of fisheries and the means to reach them are highly political. This means that the enactors are not able to agree on the tradeoffs that often exist between biological, economic, and social sustainability (Mathiesen *et al* 2003).

[6] 'To live in different worlds' means to have different practices and enactments.

borders, e.g. when fishermen engage in fisheries management. Yet, when speaking of a particular situation, differences in the patterns of the enactments between the fishermen and fisheries management will become clear.

The enactments will be expressed when the parties speak of fisheries (e.g. in interviews or in public media): When a fisherman speaks of fisheries, he often refers to the practice at sea or to the driver of the local community, and when representatives from fisheries management speak of fisheries, they refer to the fish stocks and talk about fisheries as something that needs to be restricted. Hence, the multiplicity in phenomena will become noticeable when the enactors (in this case fishermen and fisheries management) speak of fisheries: Even if semantically using the same terms, they refer to different phenomena. This means that the fisheries conflicts are not one compact phenomenon, but multiple. Multiple phenomena are phenomena, which are different things in different contexts (Mol 2002).

Both fishermen and fisheries management apply a set of rationales, values, and explanations intertwined with their enactments. This is not problematic per se; this is only natural. Fishermen and fisheries managers do have things in common: they are parts of the same national state/international community, they relate to the same ecosystem and the same situation (political, ecological, economical etc) of fisheries. Multiplicity becomes essential when fisheries are in crisis. Then fishermen and the people managing the fisheries are forced to discuss fisheries. What kinds of fish that exist in the sea, how many and how they are (supposed to be) caught are no longer issues that are reserved for the fishermen alone, but a matter for society. Sustainability of fisheries is a political objective and fisheries management is the institution to ensure sustainability. In situations of crisis, the multiplicity will appear and be expressed (and often ignored) for instance in the public media (Paper #5: Christensen 2009). In these conflicts, fishermen and fisheries management find it difficult to cooperate in solving the problems behind the crisis. Formally, management will often have the stronger hand, because they have more political and scientific resources at their disposal, whereas the fishermen do not have the same type of resources to back up their view. In practice, fishermen can react strongly upon management decisions and make a tough situation worse (e.g. Section 0.0.Background and Paper #5: Christensen 2009). This makes it difficult for fisheries to meet the political objectives of biological, economic and social sustainability of the fisheries. The two types of analysis, *'perspectivalistic'* and *'multiple',* are described in more detail in Paper #5 (Christensen 2009).

When speaking of conflicts in the following sections, I refer to conflicts where the object of the conflict (i.e. fisheries) is multiple. Focus will be on the enactments since they are the underlying drivers of conflicts, and I will begin by taking a closer look at the actors in fisheries conflicts.

1.2.2.Fishermen and fisheries management

Who or what are the fishermen and the fisheries management in the conflicts? In order to use *fishermen* and *fisheries management* as general analytical terms, an understanding of fishermen and fisheries management is needed – an understanding that encompasses the various meanings of the concepts.

Jahn Petter Johnsen (2005) offers an ontology of the fisherman showing that the category *'fishermen'* does not only refer to a basic actor or individual of the fishing fleet, only constituted by the activity of fishing, but that fishermen should be considered *'as such a heterogeneous network of human action, politics, laws and regulations, technology, science, social relations, and economic responsibilities, folded out in time and space, but also punctualised in the human beings who represent and speak for the rest of the complex'* (Johnsen 2005:484). Johnsen's ideas of fishermen can be combined with Mol's ideas of multiplicity. Depending on how you enact fishermen, including how you study them, the understanding of fishermen will take a different form.

Fisheries management also refers to a number of fundamental different phenomena: 1) a body of public organisations (acting at both national and supra-national level) to ensure that the interests of society are served in fisheries, and hence fisheries management is a mediator between society and the individual; 2) an institutional framework consisting of laws and regulations; or 3) (a number of) people with positions in a political and bureaucratic set-up for managing fisheries. Fisheries management can be one of the three, any two of the three or all of them. Holm (2001) offers a different, yet consolidating, view on fisheries management as he sees fisheries management at the same time as an actor and as a distributed network by contemplating fisheries management as a number of connected institutions. This understanding of fisheries management is in line with Johnsen's understanding of fishermen.

This can be summarised as follows: Neither fishermen nor fisheries management can be regarded as a unified actor isolated from the fishery political situation; both are multiple concepts that need to

be regarded as heterogeneous networks framed in a context. Heterogeneous networks are, of course, analytical constructions for research purposes, and you cannot find analytical constructions 'out there'. When doing research on the fishermen and the fisheries management, the networks are not tangible, measurable, or visible. However, as a researcher, you can only talk to and interact with the people, read the laws, the minutes of meetings, or the newspaper articles. Hence, the idea of heterogeneous networks can only help us to see the relations between the various enactments of a multiple phenomena. The implication of this shift in analytical focus from perspectivalistic studies to studies of multiplicity highlights the need for awareness of the relations between the enactments and the conclusions of the study.

1.3. Literature on fisheries research

Looking at Figure 1 and reading the previous section on multiplicity, it is obvious why fisheries research has to be complex. Each of the subsystems of the fishery system is studied employing different disciplines. Research focusing on what is going on between the three subsystems is a relatively new, interdisciplinary field. The scientists studying fisheries represent many different disciplines and the disciplines employ different research methods and different theoretical frameworks. The natural system is mainly studied by biologists and ecologists, but also oceanographers and other scientists provide input on this system. A broad range of disciplines within social science and art studies offer their understanding of the other two sub systems – amongst these are ethnography, anthropology, sociology, history, political science and law science, various kinds of economics and probably many other disciplines. The communication of knowledge between the disciplines has been limited until recently, but now it is a field in development. Yet, neither a common theoretical framework nor a common set of key concepts has been developed up until now. So there is no such discipline as *fisheries science,* and no scientific discipline can claim exclusive rights to the domain of fisheries even where the scope is narrowed down to focusing on the conflicts between fishermen and fisheries management.

Given that the main focus of this dissertation is on conflicts between the management system and the human system in Charles' fishery system, I will mainly focus on the key literature within the disciplines that are the most relevant to this field.

Even though the Danish economist Jens Warming back in 1911 presented some interesting observations on the insufficient economic usage of the common fishing grounds by the society (Warming 1911), it was Hardin, who – in 1968 – started the debate regarding open access to common properties with his paper "The Tragedy of the Commons". He argued that the rational fishermen had to be restricted and controlled in order for fisheries to become sustainable, as the fisherman has no incentive to disregard his own short-term gain and hence damages the long term gain of the group: *'Freedom in the commons brings ruin to all'* (1968:1244). Hardin's solution was to introduce private property rights or establish a public management scheme for the exploitation of the resources. This economic theory is called common property theory (CPT) and it still plays an important role in the fisheries economics. The breakthrough of the fisheries management on a big scale since the 1970s has often been legitimated with reference to Hardin's *Tragedy of the Commons* (Nielsen and Holm 2007).

Other economists have been concerned with the optimisation of the outcomes of fisheries; the economist Scott Gordon (Gordon 1954) introduced the concept of the *Maximum Economic Yield* (MEY). According to Gordon, it is possible to optimise the yield from fisheries by looking at the relations between fisheries effort and the economic yield. Gordon's concept did not play an important role until the biologist Schaefer combined the model with fish stock reproduction rate. When optimizing this model, you will find the *Maximum Sustainable Yield* (MSY) (Schaefer 1957). The MSY approach initiated the bio-economic modeling that still plays an important role in both fisheries research and fisheries management[7].

Scientists from the arts studied fisheries as a social and cultural phenomenon. In the 1980s, the CPT was heavily challenged by social scientists. These attacks on the CPT were usually based in the empirical validity of the theory (e.g. Brox 1990; McCay and Acheson 1987; Berkes 1985; Feeny *et al* 1990; Jentoft 2000). In the same period of time, these sciences moved away from studying fisheries communities as closed entities and towards studying them as part of the (national) society (Vestergaard 1989, 1993 and 1997; Christensen 2002; Nordberg 2001). The themes of these new studies were: 1) the compatibility between the fishermen's practical everyday life (their tactic and strategic choices) and the formal set-up of the management system, 2) co-management and sharing

[7] MSY is a lead principle in many fisheries management systems, e.g. in New Zealand (www.fish.govt.nz 2009). Also the EU Commission announced in 2006 that MSY should be a lead principle when deciding the levels for fishing (www.ec.europa.eu 2006).

of responsibilities between fishermen and fisheries management, and 3) differences in knowledge between fishermen and fisheries management ('s biologists). The three themes have an underlying dimension of conflict, and they are incorporated in this dissertation as follows:

Theme 1: In the Papers #1 and #2, the key conflict is the lack of compatibility between the fishermen's practical everyday life (their tactic and strategic choices) and the formal set-up of the management system. The main conclusions in Paper #1 (Christensen and Raakjær 2006:259) are:

> *Fishermen are aware of overexploitation of the resource, but are locked into competition and forced to react in a short-sighted manner (Maurstad 2000). They simply adapt to regulations and other changes in order to benefit or at least to compensate for potential losses. If regulations are in direct conflict with fishing practices or are less manageable from an enforcement perspective, the regulation will not meet the intended objective (Raakjær Nielsen and Mathiesen 2003). Gaertner et al (1999) pointed to one of the elements that can lead to conflicts between regulations and fisheries, namely the mismatch between the timeframes for the assessments and the implementation of the management scheme (the time span between when a problem is discovered and when management responds).*
>
> *In order to establish an efficient management of the fisheries, it seems to be a minimum requirement that the managers know the fisheries and know how they impact on the everyday life of the fishermen (Wilen et al 2002). Management needs insight about fishermen's tactical and strategic decisions.*

Management needs information on the practical fishery, but that kind of information is hard to enter into the models that management usually consults. In Paper #2 it is stated that (Andersen and Christensen 2006:13):

> *An issue raised in fisheries science during the past years has been the low precision in predictions of the biological and economic impacts of changes in the technical measures (closed areas, mesh size regulation, etc). In particular, the concern has been the narrow focus on only the biological analyses, disregarding the responses of the fishermen to changes in resource availability, market conditions and management regulation itself (Hilborn and Walters 1992; Wilen et al 2002). The importance of*

> *including fishermen's behavior to improve the development of efficient fisheries management has long been realized (Wilen 1979; Hilborn and Walters 1992; Charles 1995), but practical progress towards integrating the issues into the processes of stock assessment and management have been slow. The study of fishermen's behavior is not a new discipline in fisheries sciences, however, most of these are descriptive work studies of the spatial and temporal effort allocation of selected fisheries whereas only a few studies have attempted to develop predictive models for fleet dynamics and fishermen responses to changes in external factors (Walters and Martell 2004).*

Theme 2: Another line in the fisheries social-science debates regards co-management and sharing of responsibilities between fishermen and fisheries management. In this literature co-management is often seen as the proper solution to the conflicts between fishermen and fisheries management and it is therefore the set-up of co-management systems and the outcomes of such systems that are in focus in this literature (Pinkerton 1992; Raakjær Nielsen *et al* 1997; Jentoft and Mikalsen 2003). Paper #4 (Christensen *et al* 2007:552) says:

> *When the process* [of negotiated economy – the Danish framework for inclusion of stakeholders] *itself becomes a goal, it is because of the assumption that devolution of responsibilities will increase the legitimacy of the enforced actions and regulations by getting the fishermen directly involved in the management decision-making process (Hernes and Sandersen 1998). The increased legitimacy is assumed to have some beneficial effects on the compliance and support of the involved parties (Raakjær Nielsen 1998). Even if this is debatable (Jentoft 2005; Jentoft et al 1998), the process is assumed to indirectly steer towards defined goals.*

Theme 3: The theme on the differences in knowledge between fishermen and fisheries management('s biologists) is dealt with in Paper #5 (Christensen 2009:54-55):

> *Differences in the kind of knowledge that there is of fisheries have purportedly caused misunderstandings and even conflicts between fishers, authorities and scientists (Delaney et al 2007; Butler 2006; Charles 1992; Smith 1991). Hence, anthropologists, sociologists and other social scientists have turned their attention to fishers' knowledge with interest, and have connected fishers' knowledge with conflicts. Various notions have been used, such as traditional ecological knowledge (for example Berkes*

> *1993; Turnbull 1997), fishermen's environmental knowledge (for example Johannes et al 2000) or local ecological knowledge (for example Mackinson 2001). These concepts describing fishers' knowledge are often defined in opposition to western science: qualitative versus quantitative, embedded versus disembedded, intuitive versus rational, et cetera. It is argued that fishermen have a fundamentally different kind of knowledge than, for example, scientists (Berkes 1993).*
>
> *In the literature mentioned above, fishers are argued to possess a different kind of knowledge than biologists regarding topics such as fish fluctuations and seasonal changes due to their family or local history and to their everyday work at sea (Menzies and Butler 2006; Berkes 1993; Johnson 1992). The literature often emphasises the benefits in fisheries from either taking fishers' knowledge into account when making management decisions, or from integrating fishers' knowledge with that of scientists (McGoodwin 2006; Menzies and Butler 2006; Nadasdy 1999; Sejrsen 2002; Eythorsson 1993).*

These three fields of research that I have pointed out are not mutually exclusive. For example is 1 and 3 connected in Paper #5 (Christensen 2009:55):

> *In 'Tragedy of the Commons' theories, the fishers become economic actors without any sensitivity towards or knowledge regarding the resource (Hardin 1968; Anderson 1991; Arnason 1984; Clark 1985); in 'anti-Tragedy of the Commons' theories, the fishers are often described as individuals who are intimately knowledgeable of the ecosystem who disregard personal economic gain (Berkes et al 1989; Brox 1990; Feeny et al 1990).*

1.4.Politics and fisheries research

Just as fishermen and fisheries management enact fisheries differently and hence produce multiplicity, so does the fisheries researchers enact fisheries differently and hence produce fisheries multiple. Mol argues in her book that: '*If reality is multiple, it is also political*' (Mol 2002:7). John Law (2004) is in line with Mol as he argues that research methods do not just describe social realities but also helps in creating them. This argument stresses that research methods are not politically disembedded and ultimately raises the question of what kind of social realities, we want to create

rather than how social realities can be grasped. When Law uses the term political, he does not refer to *political* in a conventional way (i.e. what is going on in certain institutions). He applies a broader understanding of the term *political,* i.e. that the study when communicated affects the situation of the phenomena studied.

Degnbol *et al* (2006) have some interesting perspectives and arguments on the issue of relations between fisheries politics and fisheries research. They argue that all disciplines each have a preferred methodology for studying fisheries: The political scientists most often take an institutional perspective focusing on the decision-making processes and the development in policy frameworks – they often work through case studies of documents and the like. Anthropologists, sociologists, and ethnologists tend to focus on the fishermen and the fishing communities, applying inquiry methods in the more qualitative part of the methodological spectrum. Economists often rely on methods requiring large amounts of data, which gives them the perspective of registers. Biologists study fisheries from a resource, ecosystem, or gear selectivity perspective. The many approaches are a strength for fisheries research, but it also leaves perfect conditions for *tunnel visions* (Degnbol *et al* 2006). Tunnel visions have negative consequences, according to the authors, because they are an institutionalised way of allowing scientists to disregard other scientists' perspectives in their work.

Degnbol *et al* (2006) further argues that fisheries scientists are often highly political in their understanding of conflicts between fishermen and fisheries management as the various disciplines each tend to have a preferred solution, *a technical fix*, to the challenges and conflicts of fisheries management: Biologists and ecologists promote marine protected areas (MPAs), economists suggest that the market through individual transferable quotas (ITQs) solve problems of most fisheries (management), and anthropologists and other social scientists will argue for co-management and empowerment of local communities and fishing people as the ultimate solution.

Degnbol *et al*'s perspectives translate into this synthesis in the following way: Different scientific enactments tend to produce different answers to political questions. When studying conflicts, the term conflict itself yells out to the scientist for solutions and atonement of the situation. Even though reconciliation of conflicts between fishermen and fisheries management is a political matter, the scientists still interfere and make suggestions more or less directly to the management: Some

scientists are asked directly through boards (e.g. the ACFM[8] or the STECF) that are advisory to the EU Commission, other researchers publish their results addressing them, more or less, directly to the management system (e.g. Papers #1; #3; Salas and Gaertner 2004; Branch *et al* 2006). The papers of this dissertation indirectly provide advice to the fisheries management. They derive from three research projects funded by the EU and one project funded by the Danish Ministry of Food, Agriculture and Fisheries and the Danish Directorate for Development. These three institutions are the key institutions in the management of the Danish fisheries. Hence, each of the projects was expected to provide advice on a given problem for the management system in their conclusions – this was part of the deal when funding was agreed on.

So far I have argued that everyone (fishermen, fisheries managers, fisheries researchers etc) working with fisheries enact fisheries. Given that fisheries is a highly political field and that many fish stocks are scarce, a situation of crisis and potential conflict is always just around the corner, and the demand for answers from science becomes more intense. As research and answers cannot be disembedded, as Merton (1973) archetypically thought would be the proper role/function for science in society, then it becomes critical, who is asked.

Who is asked, is a political question that scientists can do something, but not much, about as the path dependencies in the *TAC Machine* of the CFP are strong (Holm and Nielsen 2004). Bearing in mind what Law stated, namely that methods often help creating social realities rather than uncovering them, it is of the utmost importance that scientists are aware of their own methodological biases – and not just the biases that the methods create in the data, but in the overall research project. In order to avoid – or at least reduce – the scientists' tunnel visions, the fisheries researchers need to pay attention to the multiplicity of fisheries.

The below quote from Nielsen and Holm sums up the challenges of mitigation of fisheries conflicts. In this quote they offer their solution to the crisis in fisheries, which is to invest heavily in interdisciplinary evaluation frameworks (Nielsen and Holm 2007:669):

> *Since fisheries comprise cultural, social, and political elements as well as natural and technological ones, a range of perspectives is relevant for their evaluation. Without*

[8] Advisory Committee on Fisheries Management – the ICES working group which translates the stock assessments into political advice to the EU Commission. Please see Papers #5.

heavy investment in interdisciplinary evaluation frameworks, the diagnosis of a given fishery crisis will reflect the evaluator's disciplinary bias.

I agree with Nielsen and Holm; interdisciplinary evaluation frameworks are a way forward in order to avoid crisis and conflicts in fisheries. Yet, such a framework is not just around the corner; in fact it may be difficult to even see the contours of it given the state of the arts with tunnel visions and technical fixes as presented by Degnbol *et al* (2006). In the next section, I will present how I have studied fisheries conflicts and discuss the political outcomes of these studies.

2.0.Complementarity in fisheries research

Complementarity is the keyword in studying fisheries conflicts and in how to begin overcoming the challenges of fisheries research. Rather than seeing other scientific disciplines as opponents or competitors, other disciplines have to be seen as complementary. I understand the term *complementarity* in line with Niels Bohr, Danish physicist, and his *Komplementaritets-teori*: The theory of complementarity is epistemological insight explaining how two theories, which exclude each other, can be convincing and inevitable within each one's own context (Bohr 1985). Hence, when fisheries scientists reach different results and solutions, these should be compared and discussed.

When asking the question of how to study conflicts between fishermen and fisheries management, no simple recipe and no straightforward answer is going to come out. Fisheries conflicts are a diffuse object for research; they are not tangible. Fisheries conflicts have no borders to ensure you that you know the field when you reach them. There will always be new perspectives and new enactments.

Figure 3 presents a framework for studying fisheries conflicts that encompass the multiplicity of fishermen and fisheries management. It stresses the importance of focusing on formal as well as practical aspects of fisheries management and fishermen; it in between the formal and the practical aspects of fisheries that most conflicts emerge. Square 1 focuses on the formal aspects of fisheries management i.e. the laws and regulations of the fisheries management and the formal structures of the decision-making process, including the scientific advice. Square 2 focuses on the formal expressions of the fishermen and the fisheries: The reports and logbooks and other paperwork they do in their every day and their organisational structures. Square 3 focuses on how fisheries

management work in practice: how the decisions are made, how scientific advice is given and entered into the decision-making processes etc. Square 4 focuses on the fishermen's everyday life – what do they do at sea; how do they make their decisions; what are the implications of their organisational structures etc.

	Fisheries management	**Fishermen/fisheries**
Formal aspects	• The fisheries management expressed in laws, regulations, implementation etc • Structures of decision-making processes	• The reports of the fishermen; logbooks landing reports, catch journals etc • The internal organisational structure of the fishermen
Practical aspects	• Fisheries management in practice when implemented in fisheries • Decision-making processes in practice	• Fishermen's everyday practice at sea • Fishermen's tactics and strategies • Fishermen's knowledge • The implications of fishermen's organisational structure

Figure 3 A framework for studying fisheries conflicts

	Fisheries management	**Fishermen/fisheries**
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Figure 3 can be seen as a list of reminders of the important aspects of the conflicts between fishermen and fisheries management. The contents of the list are rather diverse, and no simple study or research perspective can grasp all the aspects. When studying fisheries conflicts, we are facing the dilemma of needing a systemic/global overview but only being able to study from the local perspective. The anthropologist Tim Ingold (1994) makes a similar point regarding the global outlook: He argues that a global, omnipresent perspective cannot be taken; you can only study the global perspective by taking a close look at the local. You can analytically connect and combine the information you gather in networks afterwards – but in the actual research you cannot avoid taking a specific and empirical position that will affect your study.

The solution to the dilemma is twofold: 1) The concepts researched need the take this into account. Defining the research objects as heterogeneous networks can help us see the relations between the various enactments of a multiple phenomenon. The shift in analytical focus from perspectivalistic studies to studies of multiplicity highlights the need for awareness of the relations between the enactments and the conclusions of the study. 2) Multi-sited ethnography has to be conducted. Multi-sited ethnography was developed by the ethnographer, George Marcus (1995), and is looking at phenomena as embedded in macro-constructions. Multi-sited ethnography often takes interdisciplinary approaches to fieldwork, bringing in methods from cultural studies, media studies, research and technology studies, and others. Through this methodology greater insight can be gained when examining the impact of world-systems on local and global communities. Marcus' multi-sited ethnography and Mol's suggested research method, *praxiography,* share a number of qualities, e.g. shift of research focus and a reflexive approach to validation of research methods. But whereas praxiography is mainly well-suited for compact and fairly localised studies, multi-sited ethnography can grasp the complexity of diffuse objects like fisheries. When researching a particular fisheries conflict; the conflict is usually rooted in two (or more) of the squares – see Figure 4 for an overview the papers related to Figure 3.

2.1.Analytical approaches in the research papers

Before moving on to discussing the analytical complementarity between the research papers, a short presentation of the individual papers is needed.

The parts of the Temas and TecTac projects that have fed into this dissertation focused on the fishermen's tactical and strategic decisions in relation to a number of factors, including fisheries management. The overall objective of the projects is to address the poor understanding of the links between management tools, fleet developments and the pressure exerted on fishing communities, and more precisely to supply fisheries managers with a modeling tool that will allow them to evaluate the impact of regulations (TACs, MAGPs, area and season closures, subsidies) on the dynamics of fleets and fishing mortality.

- In Paper #1, the problem base was twofold: 1) Despite the differences between the fishermen, fisheries management in Denmark considered all fishermen to be alike and often ignored the fact that fishermen responded to new regulations by changing their fishing tactics or by making strategic decisions reducing the impact of the new regulation on their business[9]. 2) Denmark and the EU approach fisheries management through an output control (control of the landings) that is rooted in the idea that it is possible to predict nature. Both problems are often in conflict with the practices of the fishermen and their ideas of how the fisheries are supposed to operate. Methodologically both in-depth sequence interviews and a questionnaire were employed to do the underlying research. It shows that the fishermen often include an array of conditions in their decision-making process with reference to tactics or strategies – the degree of flexibility concerning geography and gear, expectations of time off (family and friends), safety, comfort, expectations of economic outcome, or willingness to take financial risks. The paper concludes that there is scope for management to become more flexible in order to better accommodate the specific challenges that the different fisheries are facing.
- Paper #2 emerged from the same study as the previous paper and, hence, presents the same problem base of mismatch between fisheries management (focusing on technical measures such as closed areas, mesh size regulation, etc) and fisheries practices. This paper focuses on the gill-netters of the North Sea and studies register data in order to gain insight into fishermen's short-term choice behaviour through a random utility model. The main objective of this study is to construct an analytical tool to describe, analyse and model how Danish North Sea gill-netters allocate their effort among a defined number of fisheries (i.e. tactics). Firstly, the information from questionnaires with fishermen is applied to identify important factors influencing the short-

[9] The section is written in the past tense as the fisheries regulations in Denmark have changed fundamentally since the beginning of 2007.

term decision-making process. Secondly, the obtained knowledge forms the theoretical background for modelling the behaviour of fishermen based on quantitative information from the commercial fishery (from logbooks, sale slips and vessel register data). This paper can be seen as a methodological expansion of the previous paper and, hence, does not provide any political advice beyond that in Paper #1.

Both papers from the RESPONISBLE project, Paper #3 and Paper #4, focus on the institutional set-up in the decision-making processes in fisheries management. The aim of RESPONSIBLE was to improve the management of fisheries by evaluating the division of responsibilities within six European fisheries management systems, investigating decentralisation and delegation of responsibilities in these management systems and taking into account the relations between national management systems and the CFP. Both papers are based on desk studies of meeting minutes, laws etc and key informant interviews.

- Paper #3 investigates the dynamics and constraints of the devolution process in general and in relation to Danish demersal fisheries. It focuses on the everyday interaction between Danish demersal fishermen and the national fisheries management.
- Paper #4 describes the interaction between fishermen and fisheries management in more unusual situations: The first case study analyses the clash between cormorant management and pound net fishermen, and how the pound net fishermen failed to establish proper representation in the decision-making process. The other case study focuses on a small group of herring fishermen who argued for exclusive fishing rights and managed to bypass the decision-making system through effective lobbying and good understanding of the decision-making system. The two cases show that a decision-making system, like that of negotiated economy, does not always ensure democratic decision-making processes. Representation of the stakeholders requires skills or qualities (structural, strategic or financial) that they do not necessarily possess.

PKFM was politically ambitious: Its aim was to identify and understand shortcomings in the CFP, and to devise means for their rectification focusing on the knowledge production and the decision-making process regarding the cod fisheries in the North Sea. Yet the paper from PKFM had a more limited scope:

- Paper #5 examines a conflict between fishers and fisheries managers over the sudden closure of a large part of the North Sea, known as the *cod box*, during the winter and spring of 2001. It focuses on the reasons for the conflicts and their persistence. The paper is based on a qualitative analysis of newspapers articles, fieldwork and key-informant interviews. The paper is in line with the theoretical framework of this synthesis as I argue that conflicts are not simply based on different views of the object of the conflict. Instead, as in this case, conflicts may arise from differences of ontological kind: *Cod*, *cod box*, and *fisheries* are all multiple phenomena (Mol 2002). This paper shows that the arguments of the fishers and managers (the Danish Ministry of Fisheries, other politicians, and the biologists providing advice to the management system) are different: the fishers speak of fisheries in order to show that fisheries is not just an activity at sea, but is omnipresent in and vital to the community. The fishers refer to their everyday practice at sea where they use gear and vessels, and where there is a particular smell and a moving deck. The managers de-contextualise the fishing industry and reduce it to a manageable phenomenon with established management causalities, such as equating reduction of quota with reductions in landings. The managers primarily see fisheries management as the protection of fish. Some politicians talk of cod and the cod box from their own position in the political field, and the cod and the cod box become weapons in a political game. They speak of the cod and the cod box as they would do of any other topic for political debate, and they assume their usual ideological positions. Hence, each restriction on fisheries – such as the cod box – is multiple: it may be seen as a restriction on local communities, as a means for the protection of fish stocks, or as just another political issue.

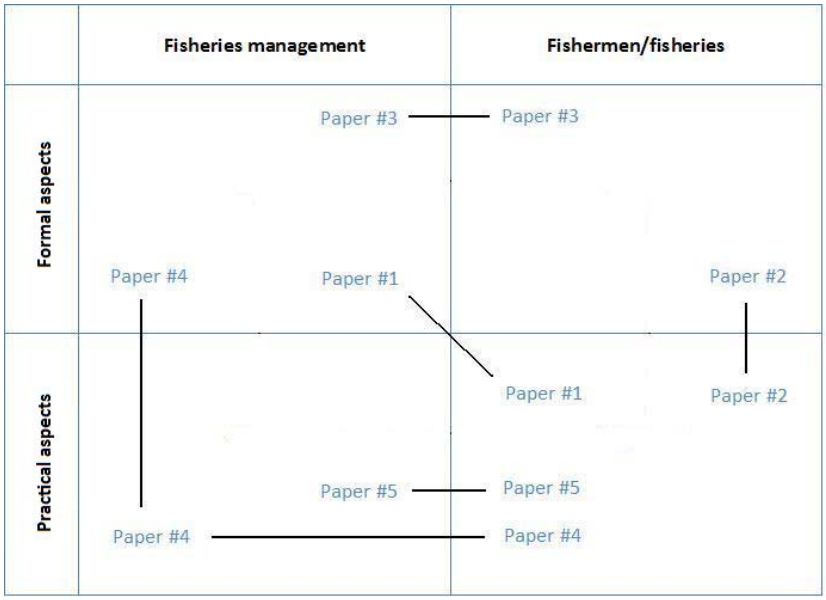

Figure 4 The positioning and coverage of the papers in the framework

Figure 4 shows the distribution of the papers in the analytical framework presented in Figure 3. The Papers #1 and #2 on one hand and Papers #3 and #4 on the other hand are the most obvious to complement each other. They ask the same question but with opposite emphasis: Papers #1 and #2 examine fisheries focusing on demersal fishermen's tactics and strategic decisions; and the Papers #3 and #4 explore fisheries from institutional perspectives. This difference in analytical perspective also shows in their political guidance: Papers #1 and #2 explore the possibilities for management to adapt from a fishermen perspective (the scope for flexibility of the management system by taking fishermen's behaviour into account in management decisions and the encouragement of the system to explore output-controlled fisheries management systems). Papers #3 and #4 explore the possibilities for fishermen to adapt to management from a systemic perspective. In Papers #3 and #4, we argue that before fishermen can be further included in the decision-making processes they have to develop skills to navigate the system. Paper #5 focused on how different kinds of knowledge influence the public debate surrounding the fisheries management system (Paper #5). Hence, the various research papers have complementing analytical perspectives; let's take a closer look at was the political advices that have emerged from the papers.

3.0.To begin mitigation of fisheries conflicts

In Section '0.0.Background' I argued of the importance of studying fisheries conflicts that emerged from a political wish of improving the relations between fishermen and fisheries management. It is now time to see if the research papers can contribute with answers to the question: *How can we mitigate the conflicts in fisheries?* The question is the agenda for this section, which presents a synthesized version of the results and the lessons learned from the research projects that I have been involved in during my PhD program. The question is ambitious and perhaps it is also too high an ambition to expect to be able to answer it – so let me stress that this section should only be seen as a status report of my work so far.

The papers present a number of ideas for conflict mitigation and for improving the situation of the fisheries. Let us take a closer look at what the fisheries management, the fishermen and fisheries researchers respectively could do to improve the situation according to the five research papers:

3.1.Fisheries management

Both Papers #1 and #2 focus on how fisheries management could be improved to adapt to the practical everyday life of the fishermen. Paper #1 (Christensen and Raakjær 2006:266) outlines this problem:

> *The findings in terms of policy orientation reveal that the present management regime will be undermined by the tactical and strategic adaptation by fishermen. Fishermen are running a business and they will seek to compensate economic losses from regulation by adapting to the management schemes. Further, the fishermen are forced to make long-term strategic decisions in a fundamentally short-term environment and often within a system that neglects the practical reality of fishing, often resulting in fishermen becoming reluctant to making investments.*

Later on in the paper, we present our ideas for accommodating the situation (Paper #1: Christensen and Raakjær 2006:266):

> *Our findings indicate the need for flexibility to accommodate the specific challenges in specific fisheries, and that requires tailor-made solutions according to the different kinds of fishermen, rather than the present cobbling together of regulations, each of*

which adds another layer of regulation, solving some problems, but often creating new ones in the process. It is important to realise that fishing has its own dynamics, and our findings showed that regulations only came out fourth of the index variables influencing the tactical behaviour of fishermen, and compliance behaviour is highly influenced by the meaningfulness and efficacy of the imposed regulations.

So the main conclusions are that management needs to become more flexible in order to better accommodate the specific challenges facing the different fisheries, and further that management has to make sense to the fishermen in order to increase fishermen's everyday compliance and, hence, for management to become more effective. We suggest that a system of input-controlled fisheries management could accommodate these problems (Paper #1: Christensen and Raakjær 2006:266):

It is our conclusion that input-control management will be more suitable to cope with the impact from tactical decisions of fishermen as well the best approach to effectively control fishing capacity by enforcing strong limitations on the number of vessels that can participate in a specific fishery, and to ensure space for development of the businesses for the involved fishermen.

These overall conclusions are elaborated on in Paper #3. The conclusions are formulated in eight bullet points followed by the initial steps to be taken to reach the goals (Paper #3: Raakjær Nielsen and Christensen 2006:187):

There is a need for reforming the EU and Danish management of demersal fisheries in order to:

- *break the path dependency of the TAC system,*
- *improve legitimacy of the management system,*
- *increase user participation and enhance user perspectives,*
- *change the management perspective from fish stocks to ecosystem and fleet perspectives,*
- *move from prediction to adaptation,*
- *base management on indicators rather than on reduction to process details,*
- *control fishing effort (input) rather than landings (output),*
- *ensure that fleet capacity is balanced with resource reproduction.*

These eight points have two overall issues: 1) The CFP needs to be rethought down to the fundamental parts and 2) the fishermen should be included in the various processes. Yet, the first issue makes it difficult to make specific recommendations or models for changes in the sharing of responsibilities as (Paper #3: Raakjær Nielsen and Christensen 2006:187)

> *... there is no easy answer to the question, ''Who is to share responsibilities in the management of Danish demersal fisheries and how should this be institutionalised?'' It all depends! However, a number of co-management case studies worldwide indicate that efficient, equitable and sustainable resource management requires an institutional resiliency within the co-management institution. Based on the present changes in the organisational structures of Danish fishermen and the on-going changes in the Danish demersal fishery, we are uncertain whether this can be achieved at the moment because of the resource crisis.*

This means that the crisis in fisheries pose new institutional challenges for both fisheries management and fishermen.

3.2.Fishermen

Even though Paper #3 points to many shortcomings of the CFP, it does find that there is a potential for devolution of responsibilities that could improve the situation (Paper #3: Raakjær Nielsen and Christensen 2006:187)

> *There is a potential for devolution in order to integrate information and knowledge about resource fluctuations, fishing patterns and market trends into the decision-making process. Institutions need to be flexible and able to adapt to external conditions. However, it is not certain if Danish fishermen have the capacity (structural, strategic or financial) to undertake such a task. It is difficult to see even if the situation has improved since Raakjær Nielsen and Vedsmand made their rather pessimistic assessment of the capability of Danish fishermen's ability to undertake increased responsibilities for management.*

Yet, Paper #3 does not point out what the challenges and requirements are to the fishermen who wish to participate in and take responsibilities for the fisheries management. Paper #4 takes a closer

look at the possibilities for sharing responsibilities between managers and stakeholders and the particular requirements to be met by participants in the decision-making system in Danish fisheries management. The paper outlines the high requirements for participation in the Danish decision-making system and that not all groups of fishermen are prepared to take on the required responsibilities (Paper #4: Christensen *et al* 2007:561):

> *Although Danish fishermen have a long history of participation in formally set consultative boards, they still operate in the mode of second generation of corporatism. The cases demonstrate that herring fishermen had a good feel for the game and were close to meeting the requirements for participation in a third generation of corporatism system. The pound net fishermen were lacking the ability to manoeuvre in the negotiated economy system and struggled just to meet the requirement mentioned for the second generation of corporatism. The tendency in Denmark towards third generation of corporatism and lobbyism leaves the stakeholders behind, with the pelagic sector as the exception. We do not see any indication of this tendency changing back, nor do we see any new movements towards changing the situation. The increasing demands on the stakeholders will probably continue as third generation of corporatism, and a fourth generation will develop.* […] *In order to manoeuvre in the increasingly complex political environment, it will be important for the fishermen to develop their organisational and institutional capabilities to penetrate the decision-making process.*

So the Danish fishermen should adapt to the new situation in the decision-making system and be proactive rather than traditionalists when entering the decision-making system. In the same paper, Paper #4, we foresee that the challenges will be even greater in the future (Paper #4: Christensen *et al* 2007:562):

> *In Denmark, conservationist or environmental groups (e.g., Society for a Living Sea and World Wildlife Foundation) are increasingly gaining influence, and currently have a voice in the matters such as those discussed in this paper* [Paper #4]*. Further, the system of negotiated economy in natural resource management is challenged by international political declarations, such as the Johannesburg Declaration on Sustainable Development, which commits Denmark and the EU to introduce an*

> *ecosystem approach to fisheries management by 2010. This approach is likely to include several new and perhaps stronger stakeholders than has been the case in Denmark for the last couple of decades. Our point is that fishermen need to rapidly adapt their organisations to such changes; otherwise they will be marginalised in the fourth and fifth generations of corporatism.*

These speculations about the future stress the importance for the fishermen to adapt their organisation to the surrounding society, to accept and enter into the decision-making system under the new conditions (e.g. documentation of knowledge, participation in relevant boards, accepting other stakeholders etc).

3.3.Fisheries research

Paper #5 demonstrates the multiplicity of fisheries in the public debate and argues that multiplicity plays an important role in the persistence of the conflicts (Paper #5: Christensen 2009:67):

> *Multiplicity is essential in understanding the persistence of fisheries conflicts. The argument is twofold. On one hand, the multiplicity of the objects of conflicts makes the focus of the debate unclear, since the debaters assign different meanings to the key issues, which are the cod and the cod box. On the other hand, given the differences in enactments, fishers and fisheries managers can justify their own understanding and thus dismiss each other's arguments by disputing the other's enactment of fisheries. Given that fishers and fisheries management enact fisheries differently and that these enactments produce different perceptions of the world, these perceptions can justify the dismissal of the other party's arguments. This is a circular effect, leaving little space for resolution of the conflict.*

Based on this I argue of the importance for researchers to become aware of the multiplicity and to work together in comparing results (Paper #5: Christensen 2009:68):

> *Multiplicity of fisheries exists not only between fishers and fisheries managers. It also exists between fisheries researchers. Many disciplines feel that they have input to the solution of the conflicts within fisheries, and the various disciplines enact fisheries differently through their various methods and theories (Degnbol et al 2006). Since no*

discipline can make exclusive, empirical claims to fisheries, a number of parallel disciplines work on finding a solution to the problems in fisheries. While doing this they disregard the multiplicity of the objects and the research of other disciplines. As thorough understanding of fisheries conflicts and their complexity is needed in order to solve them, researchers are obliged to work together in understanding the fisheries conflicts.

The perspectives of Paper #5 have been elaborated on in Section 2 in this synthesis; I will not repeat these perspectives here.

Paper #2 also focuses on the challenges of fisheries research, i.e. how information on practical fisheries can be entered into models used in fisheries management[10] (Paper #2: Andersen and Christensen 2006:24):

The applied behaviour model was designed to predict the spatial effort distribution in a mixed fishery under the closure of a larger area in the North Sea. Overall the model succeeded to predict the redistribution of effort among the defined fishing areas and target species under and after the closure. But the findings illustrated that the level of prediction also depended on both the temporal and spatial accuracy of interest. Modelling spatial choice behaviour in terms of effort allocation based on catch and effort information from fishermen's logbooks (such as in this study [Temas-TecTac] *and many other studies of European fisheries) is restricted to the spatial resolution of the size of the predefined ICES statistical rectangles. As short-term closures (e.g., seasonal closure, protection of aggregations of juvenile and spawning fish) are being more frequently used as a management instrument, the demand for more spatial catch and effort information from individual fishermen is increasing (such as satellite data combined with catch data).*

The next step is to implement the identified short-term behaviour rules into a fisheries management evaluation framework, a framework that includes both biological and

[10] None of the papers have focused on collaborative research, i.e. research in collaboration between science and fishing industry. This has been one of the stronger directions in European fisheries science within the last five years. When the research papers were written, these trends were not strong in Europe – but if I were to redo this PhD project now, then it would have been included.

economic elements, to evaluate how changes in technical measures, such as closed areas, will affect both the dynamic of the fish stocks and the profitability of the fleet.

3.4.Final remarks

There have been several changes in Danish and European fisheries management since I finalised my field work back in 2005. Nevertheless, the overall conclusions of this dissertation still stand: Fisheries conflicts often lead to unfortunate mismatches between management intentions and the practical outcome of fisheries. Although I admit that some of my detail findings might have been outdated as changes have occurred. The general picture of my empirical findings clearly demonstrates that fisheries conflicts are complex. I have tried to capture this situation in the framework I have developed by emphasising the importance of considering formal as well as practical aspects of fisheries and fisheries management in studying fisheries conflicts. The framework requires that various kinds of information and various methodologies are employed, and therefore the framework inevitably leads to interdisciplinary considerations. My main conclusion is that fisheries research best contributes to understanding and mitigating fisheries conflicts, if they take complementing perspectives into account. Thus, I am arguing for an inter-disciplinary approach, because what solves one problem may create another, and what is need is an approach that can capture several perspectives.

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List of acronyms

ACFA	Advisory Committee for Fisheries and Aquaculture
ACFM	Advisory Committee for Fisheries Management
CEC	Commission of the European Community
CFP	Common Fisheries Policy
Commission	Commission of the European Communities
Council	Council of the European Union/Council of Ministers
CPQ	Common pool quota
CPT	Common property theory
DFA	Danish Fishermen's Association
DG FISH	Directorate-General for Fisheries and Maritime Affairs
EU	European Union
ICES	International Council for the Exploration of the Sea
IFM	*Institute for Fisheries Management and Coastal Community Development,* from July 1st 2007 renamed *Innovative Fisheries Management - an Aalborg University Research Centre*
IQ	Individual quotas
ITQ	Individual transferable quotas
MEY	Maximum Economic Yield
MFAF	Danish Ministry for Food, Agriculture and Fishery
MPA	Marine Protected Area
MSY	Maximum sustainable yield
PKFM	Policy and Knowledge in Fisheries Management
RAC	Regional Advisory Council
RESPONSIBLE	Sharing responsibilities in fisheries management
STECF	Scientific, Technical and Economic Committee for Fisheries
TAC	Total Allowable Catch
Temas	TEchnical MeAsureS – Development of evaluation model and application in Danish fisheries
TecTac	TEChnical developments and TACtical adaptations of important EU fleets

Appendices

Appendix A

Overview of the research projects

The core of this dissertation – the articles – is the outcome of research projects in which I have participated. This section gives an overview of both the papers vs. projects and of the projects and their overall focus, partners and funding. The synthesis part of the PhD is funded by the Danish Ministry of Science, Technology and Innovation under the Industrial PhD-programme.

Paper #	Reference	Project
Paper #1	Anne-Sofie Christensen and Jesper Raakjær: Fishermen's tactical and strategic decisions – A case study of Danish demersal fisheries. *Fisheries Research*, 81, (2006):258-267	Temas and TecTac
Paper #2	Bo Sølgaard Andersen and Anne-Sofie Christensen: Modelling short-term choice behavior of Danish Fishermen in a mixed fishery. In: Sumaila, U. Rashid and Marsden, A. Dale (eds.) *2005 North American Association of Fisheries Economists Forum Proceedings*. Fisheries Centre Research Reports 14(1). Fisheries Centre, the University of British Columbia, Canada, (2006):13-26	Temas and TecTac
Paper #3	Jesper Raakjær Nielsen and Anne-Sofie Christensen: Sharing responsibilities in Danish fisheries management – Experiences and future directions. *Marine Policy* 30 (2006):181-188	RESPONSIBLE
Paper #4	Anne-Sofie Christensen, Jesper Raakjær and Thomas Olesen: The voices of Danish fishermen in resource management – An examination of the system of negotiated economy. Ocean and Coastal Management 50 (2007):551-563	RESPONSIBLE
Paper #5	Anne-Sofie Christensen: Fewer fish than frustrations: An Analysis of Multiplicity in Knowledge Articulation. *MAST: Maritime Anthropological Studies*, (2009):8(1): 53-73	PKFM

Temas

Temas: 'Technical measures – Development of evaluation model and application in Danish fisheries' (2000-04)

The background for Temas was this: Technical measures are an important tool in fisheries management. While limitations in effort or catch quotas aim at limiting the overall fishing mortality, technical measures are used to regulate the selectivity of fisheries within this mortality level. Technical measures are thus used as an adjustment tool within management systems based on other means, rather than as the basic management principle. The objective is typically to protect the resource base of fisheries through selective protection of sensitive or exposed stocks or size groups, but it can also be to reduce the overall impact of fisheries in the marine ecosystem. It is, however, difficult to predict to which extent a specific technical measure is expected to achieve the objectives for which it was introduced, and how it will influence the practical fisheries. These difficulties are partly due to insufficient knowledge about the technical selectivity of fisheries, partly due to uncertainties about the reactions of the practical fishery to specific regulations. The objectives of the project were 1) to develop a tool for evaluation of technical measures in terms of efficacy in achieving objectives: cost efficiency and acceptance; and 2) to develop and implement this tool in an evaluation of technical measures in three Danish fisheries where various aspects of technical measurements have been implemented and are of special importance: the flatfish fisheries in the North Sea (area-based mesh-size regulations), industrial fisheries in the North Sea (by-catch regulations), and Norway lobster fisheries in the Kattegat, Skagerrak and North Sea (mesh-size regulations and closed areas).

Research partners: DIFRES and IFM, Denmark.

Temas was funded by the Danish Ministry of Food, Agriculture and Fisheries, and the Danish Directorate for Development.

TecTac

TecTac: 'Technological developments and tactical adaptations of important EU fleets' (2002-05)

The fish stocks managed under the European Common Fisheries Policy are considered to be in danger because of excessive fishing mortalities. A common concern of fisheries managers is to be able to reconcile the objectives of maintaining fisheries profit whilst safeguarding the fish resources, especially when these are exploited beyond biological safe limits. In EU waters, the management of fisheries and fish resources has been adversely affected by, (i) the lack of consensus on management targets and strategies and also, (ii) the poor understanding of the links between management tools, fleet developments and the pressure exerted on fishing communities. The overall objective of this project was to address (ii), and more precisely to supply fisheries managers with a modeling tool that would allow them to evaluate the impact of regulations (TACs, MAGPs, area and season closures, subsidies) on the dynamics of fleets and fishing mortality. The carrying idea was the investigation of the dynamics of the elements that cause changes in fleet dynamics: the technological advances in both gears and vessel equipment, and also the overall tactical adaptation of fishing vessels. How do they occur? Why do they occur? What are their consequences for the resource and the socio-economics? In order to address these issues, in relation to the overall objective, the study aimed at achieving three sub-objectives. Examples were drawn from a wide selection of demersal fleets operating in the Baltic Sea, the North Sea, the Eastern Channel, the Celtic Sea and the Bay of Biscay.

Research partners: DIFRES and IFM, Denmark; IFREMER and Université de Bretagne Occidentale, France; Netherlands Institute for Fisheries Research, the Netherlands; Centre for Environment, Fisheries and Aquaculture Science (UK).

TecTac was a project under the EU 5th Framework Programme.

RESPONSIBLE

Responsible: 'Sharing responsibilities in fisheries management' (2002-04)

This research project focused on the possibilities for decentralisation and delegation of responsibilities in fisheries management. Decentralisation and delegation were considered for the CFP's Conservation and Structural Policies. The research therefore focused on the chain of responsibilities from the EU level down to individual fisheries in Denmark, France, the Netherlands, Spain and the United Kingdom respectively. Fisheries management in Norway was also included in this project because of the importance of the Norwegian fisheries and the expected added value from country comparison.

The following research questions were asked: How is the actual division of responsibilities and competences in the Common Fisheries Policy and in the fisheries management of Denmark, France, the Netherlands, Spain, the United Kingdom and Norway? Has there already been a development towards more devolved fisheries management within the CFP and within these six countries in the past ten years? Are there gaps or overlaps in the chains of responsibilities from the CFP to the fisheries in the five EU countries? Is there support amongst different stakeholders for decentralisation and delegation of responsibilities? Is it possible to formulate different alternatives for division of responsibilities for the Common Fisheries Policy and the fisheries management of these six countries? What are the dynamics of change in fisheries management?

Research partners: LEI-DLO, the Netherlands; IFM, Denmark; Pharos Fisheries Consultants Ltd., the UK; Institut du Développement Durable et des Ressources Aquatiques, France; Universidad de Sevilla, Spain; University of Tromsø, Norway.

RESPONSIBLE was a project under the EU 5th Framework Programme.

PKFM

PKFM: 'Policy and Knowledge in Fisheries Management' (2003-05)

The objectives of the PKFM project were to identify and understand shortcomings in the European fisheries policy and its implementation, which have contributed to the problems evident in several European fisheries, and to devise means for their rectification. The project focused on the knowledge production and decision-making within the fisheries management system, the interrelationships between these processes and the role of stakeholders. Fisheries for North Sea cod were adopted as a case study.

Research partners: Denmark: IFM (Institute for Fisheries Management & Coastal Community Development) and DIFRES (Danish Institute for Fisheries Research), UK: CEFAS (The Centre for Environment, Fisheries & Aquaculture Science) and MARLAB (FRS Marine Laboratory), Norway: University of Tromsø and NIFU (Norwegian Institute for Studies in Research and Higher Education), the Netherlands: RIVO (Netherlands Institute for Fisheries Research) and France: CEDEM (CEntre de Droit et d'Economie de la Mer).

PKFM was a project under the EU 5th Framework Programme.

Appendix B

English summary

The title of this dissertation is: *Conflict and Complementarity - An empirical study of conflicts between Danish fishermen and fisheries management, aiming to develop an interdisciplinary framework to understand and mitigate conflicts in fisheries.* The work was conducted at IFM, Innovative Fisheries Management – an Aalborg University Research Centre. The core of the dissertation is the outcomes of four research projects on Danish fisheries. They are presented through five research papers (Part 2) that are braided together in this synthesis (Part 1) in an interdisciplinary framework to understand and mitigate conflicts in fisheries. Danish demersal fisheries, which are mixed with regard to target species, waters, gear and vessel types, are the empirical pivotal point of the dissertation.

The PhD-project has two levels of relevance – an empirical and a methodological one: Since the mid 1980'es conflicts between (Danish) fishermen and fisheries managers have occurred frequently. Often the conflicts lead to unfortunate mismatches between management intentions and the practical outcome of fisheries, leaving both fish and fisheries in a situation of crisis. This happens even though both fishermen and managers aim at biologically, economically and socially sustainable fisheries. Insight into fisheries and fisheries conflicts seems essential in order to solve the situations of conflicts and crises - or even try to prevent them. However, fisheries as empirical field are complex and take place where natural, economic, social and legal systems meet and interact. Hence, fisheries as a scientific field do not acknowledge the formal disciplinary boundaries; several scientific disciplines offer their contribution to fisheries research using different theoretical frameworks, terminologies, and methodologies. This means that fisheries (conflicts) are well-studied, but little research is conducted in collaboration between disciplines or on the consequences of the various research methods applied. When added together, these two levels of relevance make fisheries conflicts complex to understand and to mitigate.

The overall aims of this dissertation is to study various conflicts between Danish demersal fishermen and fisheries management in order to

- examine the challenges that fisheries research is facing when studying fisheries conflicts, and

- outline ideas for how to mitigate the fisheries conflicts.

The aims were met in two steps. The first step was to study various fisheries conflicts between Danish demersal fishermen and fisheries management as part of four independent research projects[1]:

- Temas (TEchnical MeAsureS – Development of evaluation model and application in Danish fisheries)
- TecTac (TEChnical developments and TACtical adaptations of important EU fleets)
- RESPONSIBLE (Sharing responsibilities in fisheries management)
- PKFM (Policy and Knowledge in Fisheries Management)

Temas and TecTac can be seen as one project as their outcome, in terms of research papers (Paper #1 and Paper #2), is the same. The parts of the Temas and TecTac projects that have fed into this dissertation focused on the fishermen's tactical and strategic decisions in relation to a number of factors, including fisheries management. Both papers from the RESPONISBLE project, Paper #3 and Paper #4, focus on the institutional set-up in the decision-making processes in fisheries management. The input from PFKM (Paper #5) examines a conflict between fishermen and fisheries managers, focusing on knowledge articulations in the public debate in the newspapers. The research papers constitute Part 2 of the dissertation.

Hence, the research projects had different scopes, different theoretical and methodological approaches, and reach different conclusions. Yet they work on common ground – namely the Danish fisheries and its conflicts.

The second step was to meet the overall aims of the dissertation: 1) examining the challenges that fisheries research is facing when studying fisheries conflicts and 2) outlining ideas for how to mitigate the fisheries conflicts. This was done by synthesising the outcomes of the research projects. The main points of the synthesis are:

- Danish fisheries have often been in crisis and conflicts. The conflicts have often lead to unfortunate mismatches between management intentions and the practical outcome of fisheries. Hence, fisheries conflicts should be mitigated, but how to do so is a difficult question.

[1] A detailed overview of the projects can be found in Appendix A.

- It is a challenging task to study fisheries and the conflicts that surround fisheries for (at least) four reasons that are somehow interconnected as they are all expressions of the complexity in fisheries:
  - Firstly, fisheries as empirical field are complex and take place where natural, economic, social and legal systems meet and interact. This complexity is demonstrated by means of Anthony Charles' model of the fishery system (Charles 2001).
  - Secondly, fisheries, fishermen and fisheries management are multiple (Mol 2002). The analytical units – e.g. *fisheries*, *fishermen* or *fisheries management* - in the various research papers refer to different phenomena. Hence, a set of analytical constructions are needed in order to enable us to understand fisheries conflicts in spite of diversity in terminology. The multiplicity is caused by differences in enactments.
  - Thirdly, fisheries as a scientific field do not acknowledge the formal disciplinary boundaries; several scientific disciplines offer their contribution to fisheries research using different theoretical frameworks, terminologies, and methodologies.
  - Fourthly, fisheries scientists are players on the fisheries political arena. Degnbol *et al* (2006) point out that the researchers tend to develop *tunnel vision*, which is a notion for the situation where researchers get too focused on their own enactments and ignore other aspects.
- An empirical framework for studying fisheries conflicts is presented. It stresses the importance of studying formal as well as practical aspects of both fisheries and fisheries management when studying fisheries conflicts.

	Fisheries management	**Fishermen/fisheries**
Formal aspects	• The fisheries management expressed in laws, regulations, implementation etc • Structures of decision-making processes	• The reports of the fishermen; logbooks landing reports, catch journals etc • The internal organisational structure of the fishermen

Practical aspects	• Fisheries management in practice when implemented in fisheries • Decision-making processes in practice	• Fishermen's everyday practice at sea • Fishermen's tactics and strategies • Fishermen's knowledge • The implications of fishermen's organisational structure

- It is argued that all the aspects in the framework need to be taken into account in order to understand fisheries conflicts. This automatically implies that different research methods and research disciplines have to be employed.
- The keyword in studying fisheries conflicts is *complementarity.* Rather than seeing other scientific disciplines as opponents or competitors, other disciplines have to be seen as complementing. Hence, if fisheries scientists reach different results, the results should be compared and discussed.
- A number of ideas are presented on how to mitigate the fisheries conflicts. The ideas are given to fisheries management, fishermen and fisheries research: Conflicts between fisheries management could be mitigated -
- if fisheries management
  - becomes more flexible to accommodate the specific challenges in the specific fisheries, which would require solutions that are tailor-made to the different kinds of fishermen.
  - breaks the path dependency of the TAC system and focuses on management of fishing effort (input) rather than landings (output): An input management will be more suitable to cope with the impact of fishermen's tactical decisions, it will be the best approach to effectively managing fishing capacity by enforcing strong limitations on the number of vessels that can participate in a specific fishery, and also be the best approach to ensuring space for development of the businesses of the involved fishermen.
  - changes the management perspective from fish stocks to ecosystem and fleet perspectives.
  - moves from prediction to adaptation.
  - bases management on indicators to reduce process details.
  - improves its legitimacy by increasing the user participation and enhancing user perspectives.
  - ensures that fleet capacity is balanced with resource reproduction.
  - adapts to new insights.
- if fishermen

    - develop their organisational and institutional capabilities to penetrate the decision-making process in order to manoeuvre in the increasingly complex political environment.
- if fisheries research
    - acknowledges fisheries as being a complex and interdisciplinary field that requires research from many different disciplines. A complementary understanding of fisheries conflicts is needed in order to solve or mitigate them.
    - focuses on how feed into the management system.

Apart from the synthesis, Part 1 also includes three appendices:

- Appendix A: Overview of the research projects that have contributed to this dissertation.
- Appendix B: Summaries in English and Danish
- Appendix C: Danish fisheries from 1996 to 2006. This appendix is included to ensure that readers not familiar with the developments in Danish fisheries and fisheries management in the decade in question can get a contextual overview. The appendix also gives an overview of the empirical coverage of the case studies in the research papers.
- Appendix D: Methodological framework for studying fishermen's tactics and strategies. Research papers often leave limited space for methodological considerations. The methodological approach in the projects Temas and TecTac is here presented in more detail.

Danish summary

Denne afhandlings titel er: *Konflikt og Komplementaritet – En empirisk undersøgelse af konflikter mellem danske fiskere og fiskeriforvaltning med henblik på at udvikle et interdisciplinært rammeværk til at forstå og mindske fiskerikonflikter*. Afhandlingen er blevet til på IFM, Innovative Fisheries Management – et AAU forskningscenter. Kernen i afhandlingen er resultaterne af fire forskningsprojekter, som er beskrevet i fem forskningsartikler (Del 2). Artiklerne er flettet sammen i afhandlingens syntese (Del 1), der præsenterer et interdisciplinært rammeværk med henblik på at forstå og mindske fiskerikonflikter. Afhandlingens empiriske omdrejningspunkt er det danske demersale fiskeri, som er blandet med hensyn til målart, farvande samt redskabs- og fartøjstype.

PhD-projektet er relevant på to niveauer, et empirisk og et metodologisk niveau: Siden midt i 1980erne er der jævnligt opstået konflikter mellem (danske) fiskere og forvaltningen. Ofte har konflikterne ført til uheldige misforhold mellem forvaltningens politiske intentioner og fiskeriets praksis, hvilket har bragt fiskene og fiskeriet i en endnu større krise, end det var tilfældet som udgangspunkt. Dette er sket på trods af, at fiskere og forvaltning principielt har samme forsæt – nemlig at fiskeriet skal være biologisk, økonomisk og socialt bæredygtigt. Det forekommer essentielt at have indsigt i fiskeriet og fiskeriets konflikter, hvis man ønsker at løse konflikterne og kriserne. Fiskeri som empirisk felt er komplekst – naturlige, økonomiske, juridiske og sociale systemer mødes og interagerer i fiskeriet. Dermed er fiskeriet vanskeligt at indplacere som et videnskabeligt felt inden for de traditionelle videnskabelige retninger. Adskillige videnskabelige discipliner har hver deres input til løsningen af problemerne i fiskeriet, og disse discipliner anvender alle forskellige teoretiske rammeværker, forskellige terminologier og forskellige metoder. Fiskeriet og dets konflikter er således et velstuderet felt, men mængden af tværfaglig forskning på området er dog begrænset. På grund af disse forhold udgør fiskerikonflikter en kompleks problemstilling, som det både er vanskeligt at forstå og at mindske.

Afhandlingens overordnede formål er at studere forskellige fiskerikonflikter mellem danske demersale fiskere og fiskeriforvaltningen med henblik på:

- at beskrive fiskeriforskningens udfordringer i forbindelse med studier af fiskerikonflikter, og
- at skitsere ideer til, hvordan man kan mindske fiskerikonflikterne.

Første skridt til opfyldelse af disse målsætninger var at studere forskellige fiskerikonflikter mellem danske fiskere og fiskeriforvaltningen som en del af fire uafhængige forskningsprojekter[2]:

- Temas (TEchnical MeAsureS – Development of evaluation model and application in Danish fisheries),
- TecTac (TEChnical developments and TACtical adaptations of important EU fleets),
- RESPONSIBLE (Sharing responsibilities in fisheries management)
- PKFM (Policy and Knowledge in Fisheries Management).

I denne afhandling bliver Temas og TecTac refereret til som ét projekt, eftersom resultaterne fra projekterne bliver præsenteret i de samme forskningsartikler (Paper #1 og #2). De dele af Temas og TecTac, som indgår i afhandlingen, angår fiskernes taktiske og strategiske beslutninger set i forhold til et antal forskellige faktorer, herunder fiskeriforvaltning. Begge RESPONSIBLE artikler, Paper #3 og #4 fokuserer på det institutionelle set-up i fiskeriforvaltningens beslutningsprocesser. Inputtet fra PKFM (Paper #5) ser nærmere på en konflikt mellem fiskere og forvaltning i de offentlige medier. Projekterne havde forskelligt fokus, forskelligt teoretisk rammeværk og forskellig metodologisk tilgang, og de nåede frem til forskellige konklusioner. Fælles for dem er, at de alle beskæftiger sig med (danske) fiskerikonflikter.

Andet skridt var at nå afhandlingens overordnede mål, det vil sige 1) at undersøge fiskeriforskningens udfordringer i forbindelse med studier af fiskerikonflikter, og 2) at skitsere ideer til hvordan man kan mindske fiskerikonflikterne. Resultatet af det andet skridt bliver præsenteret i afhandlingens syntese, hvor hovedpointerne er:

- Dansk fiskeri har ofte været i krise og konflikt, siden EU's fælles fiskeripolitik blev introduceret. Konflikterne har ofte ført til uheldige vekselvirkninger mellem den politiske intention med forvaltningen og det praktiske udkomme.
- Det er udfordrende at studere fiskeri og fiskerikonflikter af fire årsager, der ved nærmere eftertanke er internt forbundne:
    - Fiskeri som empirisk felt er komplekst, da det foregår, hvor naturlige, økonomiske, sociale og juridiske systemer mødes og interagerer. Denne kompleksitet bliver præsenteret ved hjælp af Anthony Charles' model af 'the fishery system' (Charles 2001).

[2] Appendiks A indeholder en mere detaljeret oversigt over projekterne.

- Fiskeri, fiskere og fiskeriforvaltning er multiple (Mol 2002). De analytiske enheder – f.eks. *fiskeri*, *fiskere*, *fiskeriforvaltning* – har forskellige betydninger i de forskellige forskningspapirer. Der er derfor behov for et sæt analytiske begreber, der gør os i stand til at forstå fiskerikonflikter på trods af denne multiplicitet.
- Fiskeri som videnskabeligt felt passer ikke ind i de formelle disciplinære rammer inden for akademiet. Adskillige videnskabelige discipliner har hver deres bud på fiskeriforskningen, hvor de bruger forskellige teoretiske rammeværker, terminologier og metoder.
- Fiskeriforskningen spiller væsentligt ind på den fiskeripolitiske scene. Degnbol *et al* (2006) pointerer, at forskere har en tendens til at udvikle tunnelsyn. Tunnelsyn er en betegnelse for den situation, at forskere bliver så fokuseret på deres egen forskning, at de kommer til at glemme andre relevante aspekter.

- Et empirisk rammeværk til brug for studier af fiskerikonflikter bliver præsenteret. Det understreger vigtigheden af formelle såvel som praktiske aspekter af både fiskeri og forvaltning, når man skal studere fiskerikonflikter.

	Fiskeriforvaltning	**Fiskere/fiskeri**
Formelle aspekter	• Fiskeriforvaltning udtrykt i love, reguleringer, implementeringer etc. • Strukturer i beslutningsprocesser	• Fiskernes rapporter: logbøger, landingsrapporter, fangstjournaler etc. • Fiskernes interne organisationsstrukturer
Praktiske Aspekter	• Fiskeriforvaltning i praksis, når den er implementeret i fiskeriet • Beslutningsprocesserne i praksis	• Fiskernes hverdag til havs • Fiskernes taktiske og strategiske beslutninger • Fiskernes viden • Implikationerne af fiskernes organisationsstruktur

- Alle aspekter i dette rammeværk skal tages i betragtning, hvis man ønsker at forstå fiskerikonflikter. Dette medfører automatisk, at forskellige forskningsmetoder og forskningsdiscipliner skal tages i brug.
- Komplementaritet er nøgleordet til, hvordan man kan studere fiskerikonflikter, og hvordan man kan begynde at løse fiskerikonflikterne. I stedet for at se andre videnskabelige discipliner som

opponenter eller konkurrenter burde de anses som værende komplementerende. Dette betyder, at når fiskeriforskere opnår forskellige resultater, så skal de sammenlignes og diskuteres.

- Et antal ideer til, hvordan man kan begynde at løse fiskerikonflikterne. Ideerne retter sig mod fiskeriforvaltningen, mod fiskerne og mod forskerne. Fiskerikonflikterne ville kunne mindskes:
- hvis fiskeriforvaltningen
  - bliver mere fleksibel mht. at imødekomme udfordringer i de forskellige fiskerier, hvilket kræver løsninger, der tager højde for de forskellige typer af fiskere;
  - bryder stiafhængigheden i TAC-systemet og fokuserer på forvaltningen af fiskeriindsatsen (input) frem for af landinger (output). Et input-baseret forvaltningssystem vil være bedre egnet til at håndtere fiskernes taktiske beslutninger;
  - flytter forvaltningsfokus fra fiskebestande til økosystem- og flådeperspektiver;
  - går fra forudsigelse til tilpasning;
  - baserer forvaltningen på indikatorer;
  - forbedrer forvaltningens legitimitet ved at fremme brugerinddragelse;
  - sikrer at flådekapaciteten passer til ressourcen;
  - indpasser ny viden.
- hvis fiskerne
  - udvikler deres organisatoriske og institutionelle evner i forhold til at indgå i forvaltningens beslutningsprocesser, som i stigende grad bliver komplekse.
- hvis fiskeriforskningen
  - anerkender fiskeri som værende et komplekst og interdisciplinært felt, der kræver forskning fra mange forskellige fagdiscipliner. En komplementær forståelse af fiskeriets konflikter er essentiel, hvis man ønsker at mindske konflikterne;
  - fokuserer på at arbejde sammen med forvaltningen.

Ud over syntesen består Del 1 også af tre appendikser:

- Appendiks A: En oversigt over de forskningsprojekter, der har bidraget med artikler til Del 2.
- Appendiks B: Resume på engelsk og dansk
- Appendiks C: Dansk fiskeri fra 1996 til 2006. Dette appendiks er medtaget for at give et overblik til de læsere, der ikke kender udviklingen i dansk fiskeri og fiskeriforvaltning i det årti, som afhandlingen vedrører. Appendikset indeholder også en oversigt over, hvordan artiklerne dækker empirien.

- Appendiks D: ‘Methodological framework for studying fishermen’s tactics and strategies. Her gives en detaljeret gennemgang af den anvendte forskningsmetode i Temas og TecTac.

Appendix C

Danish fisheries from 1996 to 2006

Introduction

Looking at a map of Denmark (e.g. in Figure 2), you can see that all parts of the country are close to water. In fact, you cannot find a single spot in Denmark with more than 50 km to the sea or a fiord, and therefore fisheries have, historically, been very important to Denmark. Archaeological findings show that most of the people having lived in the area of Denmark have lived by the water, and fish and shellfish have been essential to their diet far back in time. Much later in history, during the cultural golden age (late 19th century and early 20th century), many Danish writers and painters focused on fisheries, and fisheries communities were often portrayed, e.g. the brave fishermen rescuing people at the sea or bringing in food for their hungry children and hardworking wives. Among these paintings are the Skagen paintings that are probably the most famous Danish pieces of art.

Today, fisheries are not important in Denmark. Compared to most of our Scandinavian brother-countries, like Norway, Iceland and the Faroe Islands, fisheries in Denmark play an almost vanishing small role, both economically and in terms of number of jobs. The value of the landings in 2004 was less than 0.3 per cent of the gross domestic product (Christensen *et al.*, 2005).

Yet fisheries are not treated like any other industry in Denmark: Fisheries obtain a lot of attention in the public media. This can be seen in Christensen (2009), which is a paper on the public debate in newspaper articles regarding a North Sea cod closure in 2001. Every time when the TACs are set or other regulations are made in the EU, or parts of the fishing fleet are not performing well economically, it causes attention and debate on a level which hardly compares with any other industry in Denmark, apart from agriculture. Another indicator of the exceptional position of fisheries is that fisheries have one third of a ministry – the minister of fisheries in Denmark is minister for food, agriculture and fisheries. No other industry in Denmark (apart from agriculture) has one third of a ministry.

In some areas, like the west coast and the northern part of Jutland and the islands of Læsø and Bornholm, fisheries are still important, economically as well as socially, but even in some of these areas, the importance of fisheries is going down. Either new industries take over (e.g. Bornholm in Christensen and Hegland, 2007) or the local fishing communities just vanish over time (e.g. Lild Strand described in Christensen, 2002).

Table 1 shows the development in the number of people employed in fisheries and fisheries-related industries from 1996 to 2005: 27 per cent of these jobs have disappeared during the period and 43 per cent of the fishermen have left the industry. Please note that the numbers of the fisheries-related industries also include business from imported and aqua-cultured fish – the share of these fish cannot be separated out. However, the picture is fairly clear: The number of people employed in both fisheries and fisheries-related industries is decreasing.

Table 1. People employed in fisheries and fisheries-related industries from 2000 to 2005 (own calculations based on data from The Danish Directorate of Fisheries (years 2000 to 2005), and Danish Technological Institute and IFM, 2003B (years 1996 to 1998 – these numbers originally came from The Danish Directorate of Fisheries, but have since then been removed from the webpage of The Danish Directorate of Fisheries)

	1996	1998	2000	2002	2004	2005	Development	
Capture fishery	5,656	5,228	4,611	4,258	3,497	3,241	-2,415	-43%
Fishmonger	909	955	935	849	778	824	-85	-9%
Wholesale trading and auctions	3,237	3,292	5,546	5,107	4,275	4,065	828	26%
Fish meal factories	603	488	382	408	350	366	-237	-39%
Smoking and salting of fish	1,512	1,578	1,669	1,718	1,493	1,299	-213	-14%
Tinning -, mincing -, and fish filleting factories	6,473	5,251	4,582	4,185	3,641	3,544	-2,929	-45%
Total	18,390	16,792	17,725	16,525	14,034	13,339	-5,051	-27%

Another indicator of the regression of the fisheries is the age of the fishermen. Figure 1 shows that the age of the commercial fishermen stays between 44 and 46, which means that the oldest fishermen left the fisheries (as the number of fishermen has decreased), but also that some, but very few, new younger fishermen have entered the fisheries. The main problem revealed in Figure 1 is that the age of the vessel owners has increased by four years over the span of nine years, and at the same time the number of vessel owners has decreased. This means that it has not just been the oldest owners that left fisheries, but also that almost no newcomers have bought vessels from 1997-2006.

Figure 1. Development in the age of Danish fishermen from 1997 to 2006 (The Danish Directorate of Fisheries)

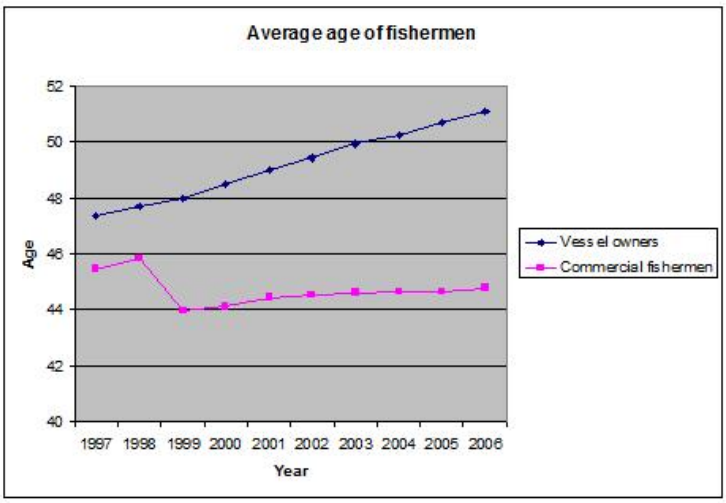
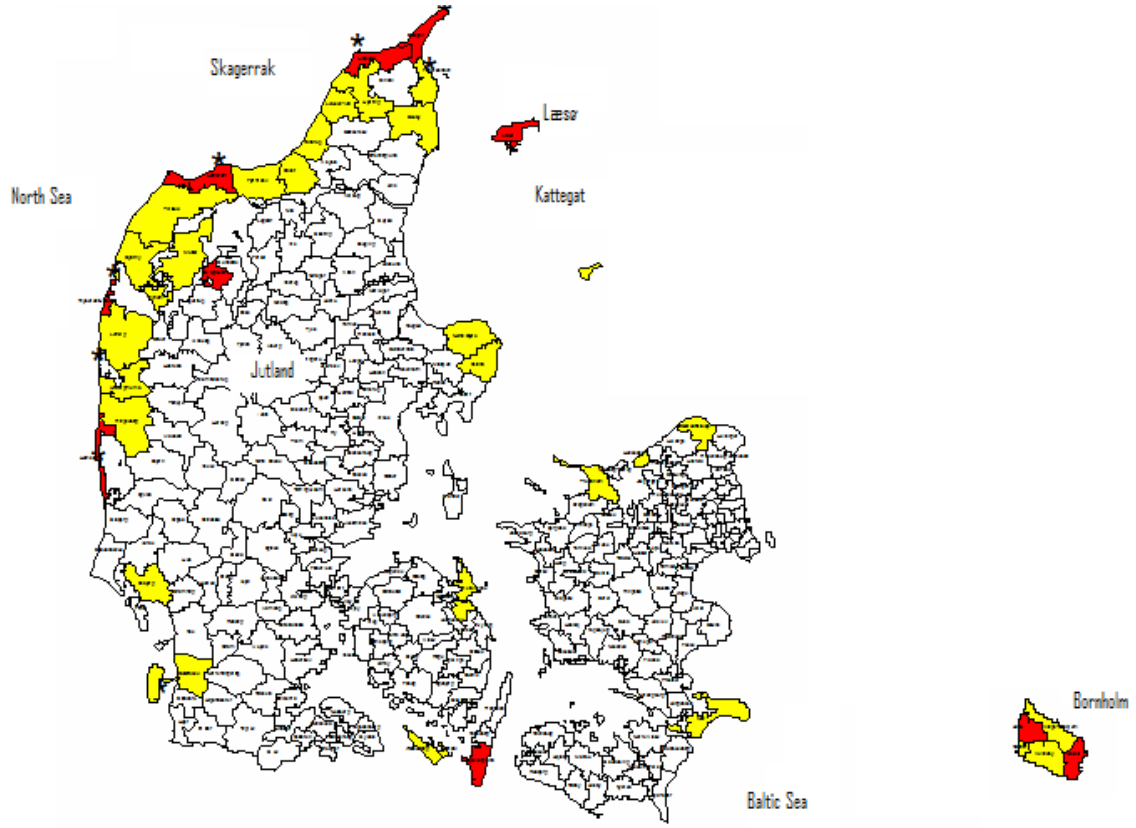


Figure 2. Map of Denmark showing the most fisheries dependent municipalities in 2002. Red: highly dependent. Yellow: dependent. The ten largest landing ports are marked with a *. (Danish Technological Institute and IFM, 2003A:80)



Management of Danish fisheries

Danish fisheries can be divided into four different types: (1) demersal fisheries, (2) pelagic fisheries (herring and mackerel), (3) fisheries for non-human consumption and (4) fisheries for mussels and Waddenzee shrimps. These fisheries differ, not only in target species but also in fleet structure and in kind of management (Table 2). Please note that Denmark changed management system for the demersal fisheries, pelagic fisheries and non-human consumption fisheries from January 1st 2007.

The new management system is an individual vessel quota (IVQ)[1] system for the demersal fisheries, where each vessel was allocated a share of the national quota based on history. The quota is only transferable together with the vessel. A feature of the new system is that it allows co-ops of vessels; and when the vessels are owned by co-ops, quotas can be transferred between vessels in the same co-op. This has changed Danish fisheries completely in terms of fleet structure (large reductions in number of vessels within a very short time), economic performance of the fleet, and the number of harbours etc. The pelagic and the non-human consumption fleets have been given individual transferable quotas (ITQs) from January 2007[2]. The final results of these changes remain to be seen. Currently (March 2008), discussions are taking

[1] In Danish *FKA*, which is short for *fartøjskvoteandele*. This translates directly into vessel quota shares.
[2] As Table 2 shows, these two fleets have had different kinds of IQs and ITQs for different periods of time before 2007.

place whether a large part of the fisheries for mussels (the part in the Limfiord) should be managed through ITQs. This appendix only provides an overview of Danish fisheries as it was before the introduction of the IVQ system.

Table 2. Overview of Danish fisheries and management instruments (Raakjær Nielsen and Christensen, 2006:183)

	Demersal fisheries	Pelagic fisheries	Non-human consumption fisheries	Fisheries for mussels and Waddenzee shrimps
No. of vessels	Many	Few	Few	Few
Size of vessels	Mixed	Larger vessels	Larger vessels	Smaller vessels
Geography	Spread	Centred	Centred	Centred
Management instruments	CPQ[a]/IQ[b] Segmentation of the inshore fleet (is discussed)	Herring ITQ Mackerel ITQ (is discussed)	IQ (is discussed)	Licences scheme
Levels and importance of decision-making				
Regional	No influence	No influence	No influence	Important
National	Important	Some influence	Some influence	Some influence
Supra-national	Important	Important	Important	Some influence

[a]CPQ is common pool quotas.
[b]IQ is an option in the cod fishery in the Baltic Sea.

So, the management of most Danish fisheries has until recently been based on a common pool quota (CPQ) regulation, where catch rations (from one week to two months depending on species and fishing water) have been distributed according to vessel length. Annual quotas have been used for the cod fishery in the Baltic Sea and in the pelagic fisheries since 1995. The more regionally based fisheries, mussels and Waddenzee shrimps, have been managed through a licence scheme and are under regional management.

The management of the demersal fisheries is the most important issue and the one where the challenges are by far the largest. The Danish demersal fisheries are complicated, because they are multi-species, multi-fleet and multi-water fisheries. In particular, there is a high degree of internal heterogeneity among the fishermen participating in these fisheries. Christensen and Raakjær (2006) explain that Danish demersal fishermen are individuals (a heterogeneous group) and may thus apply different fishing tactics and investment strategies.

Danish fishing opportunities

Denmark is a member of the European Union (EU) and Danish fishing opportunities for demersal fisheries, pelagic fisheries, and non-human consumption fisheries are determined in the EU[3]. The Council of Ministers in the EU sets an annual TAC (total allowable catch) for each species in each water; the TAC is allocated to the member states trough a set key, i.e. the relative stability. The Common Fisheries Policy (CFP) in the EU is dealing with a number of fisheries policy areas[4]. Denmark usually uses up all the allocated quotas, or trades the extra quota with other member states or third party countries like e.g. Norway.

Danish fish quotas include quotas for many species for both human and non-human consumption in the four waters around Denmark: the North Sea, Skagerrak, Kattegat, and the Baltic Sea. The most important

[3] Fisheries in in-waters like fiords are regionally managed.
[4] See Christensen and Raakjær, 2006; Christensen *et al.* 2007; Raakjær and Christensen, 2006; Schwach *et al.*, 2007 for more details on the CFP.

species for human consumption are cod, haddock, saithe, herring, mackerel, plaice, sole, flounder, Norway lobster, and mussels. The most important species for non-human consumption are sand eel, sprat, Norway pout, blue whiting, horse mackerel, and capelin.

Table 3. Total landings in tonnes by Danish fishermen, 1996-2006 (The Danish Directorate of Fisheries)

	1996	1998	2000	2002	2004	2006	Development
Cod	90,742	69,040	57,018	37,867	30,463	29,586	-61,156
Other codfish	228,715	145,079	220,968	146,965	117,374	110,852	-117,863
Plaice	22,573	18,930	23,904	22,998	20,705	21,185	-1,388
Sole	2,083	1,056	1,782	1,210	1,224	1,362	-721
Other flatfish	12,947	11,930	12,174	12,376	12,003	9,148	-3,799
Mackerel	26,300	27,417	31,642	33,046	26,250	24,234	-2,066
Herring	153,009	139,711	153,899	112,582	136,809	139,641	-13,368
Sprat	226,135	270,438	276,878	237,466	274,129	183,793	-42,342
Sand eel	669,035	646,905	567,350	662,402	299,606	256,763	-412,272
Other fish	147,538	100,165	61,903	47,530	48,450	17,640	-129,898
Norway lobster	4,176	4,983	5,084	5,439	5,205	4,498	322
DW shrimps	9,090	8,100	5,721	5,540	8,068	7,923	-1,167
Other crayfish & mollusc	2,718	5,015	4,899	6,004	9,931	6,351	3,633
Mussels	86,002	108,330	110,560	110,873	99,500	54,693	-31,309
Total	1,681,063	1,557,098	1,533,782	1,442,298	1,089,717	867,670	-813,393

Table 4. Total landings in 1000 DKK by Danish fishermen, 1996-2006 (The Danish Directorate of Fisheries)

	1996	1998	2000	2002	2004	2006	Development
Cod	689,838	836,763	823,915	609,621	409,844	457,834	-232,004
Other codfish	212,196	215,405	216,396	255,276	172,746	217,471	5,275
Plaice	286,760	263,074	286,106	294,361	266,394	294,604	7,844
Sole	123,821	76,265	106,308	81,516	84,501	121,331	-2,490
Other flatfish	159,093	156,501	189,737	194,764	168,550	162,819	3,726

Mackerel	138,586	121,850	148,028	224,594	214,562	210,576	71,990
Herring	192,062	209,649	176,574	294,626	228,895	383,336	191,274
Sprat	146,713	276,094	182,744	239,708	208,250	200,246	53,533
Sand eel	413,661	555,813	347,731	572,344	210,101	269,956	-143,705
Other fish	226,693	195,505	162,930	158,775	156,053	146,729	-79,964
Norway lobster	181,946	263,899	324,913	408,644	251,159	334,739	152,793
Deep water shrimps	140,534	135,618	122,256	94,268	120,006	121,634	-18,900
Other crayfish & mollusc	48,195	49,762	56,461	101,448	96,283	121,737	73,542
Mussels	54,599	79,677	120,918	140,171	100,733	69,457	14,858
Total	3,014,697	3,435,874	3,265,016	3,670,113	2,688,076	3,112,469	97,772

According to Table 3, Danish landings of all types of fish have decreased in weight from 1996 to 2006, except for Norway lobster and other crayfish and mollusc landings. However, Table 4 shows that the total value of the Danish fishermen's landings has increased by 97,772 tDKK over the same period of time.

So, in general the economic status for the fishermen is not too bad, on average. However, you rarely find an average fisherman, and therefore the picture is almost never correct. The different segments have performed differently – some had a very difficult decade, while others made good business.

Downwards trends

The larger group of fishermen is the demersal fishermen, and they had the most difficult decade. The main species for these fishermen is the cod, and even though the value of cod landings has decreased by 33 per cent from 689,838 tDKK in 1996 to 457,834 tDKK in 2006, cod is still the economically most important species. The quotas for cod have been reduced by 67 per cent over the period, but the Danish fishermen have partly been helped by increasing prices on cod from 1996-2006.

Most Danish demersal fishermen land cod, but most of them participate in mixed fisheries of different kinds – that is different combinations of other codfish, plaice, sole, other flatfish, Norway lobster, other crayfish and mollusc, and other fish. The value of the fisheries for these species has increased by 160,726 tDKK[5], which partially compensates for the decrease in cod landings.

The fisheries for non-human consumption also had a hard decade seen from an economic viewpoint. They mainly fish for sand eel and sprat. Landings of both species have decreased: sand eel by 412,272 tonnes and sprat by 43,342 tonnes. Translated into value these fishermen lost 143,705 tDKK (35 per cent) on sand

[5] The demersal fishermen do not catch all the landings in all the groups. It is not possible to sort out which landings actually come from the demersal fishermen, but it is the vast majority.

eel in spite of increasing prices on sand eel, but they earned 53,533 (36 per cent) more on sprat in 2006 than 1996. The net result for this group of fishermen is minus some 90,000 tDKK, which is 16 per cent of their income in 1996. Some of the landings for non-human consumption are coming from the pelagic vessels.

Upward trends

The landings of the pelagic species (herring and mackerel) also decreased over the period, but not as dramatically as cod (herring by 9 per cent and mackerel by 8 per cent). However, again the prices have developed in favour of the fishermen, and the pelagic fishermen have doubled their turnover of herring and increased their turnover of mackerel by more than 50 per cent.

Landings of Norway lobster had a peak in 2002 with 5,439 tonnes landed at a price of 75,000 DKK per tonne on average (which is an increase in the prices by more than 40 per cent, and the prices have remained at this high level until 2006). The overall development is that landings have increased by 8 per cent over the decade.

In spite of decreasing catches (-31,309 tonnes), the fisheries for mussels have a higher turnover in 2006 than in 1996 (14,858 tDKK).

Target species

The four different groups of Danish fishermen target different species: The pelagic fishermen target herring and mackerel. Some of them also have quota for some of the species for non-human consumption. The non-human consumption fishermen target a range of species: sand eel, sprat, Norway pout, blue whiting, horse mackerel, and great silver smelt. The licensed fisheries target the species they have license for, e.g. mussels or shrimps. All these three categories of fishermen are fairly pure fisheries as they mainly catch the species they target.

The fourth category of fishermen is the demersal fishermen, who target mixed species: Cod, other codfish, plaice, sole, other flatfish, Norway lobster, and other crayfish and mollusc.

In 2003/04, we did a questionnaire survey among the demersal fishermen (Christensen and Raakjær, 2007). In the questionnaire there was a question regarding target species: 'Which of these species did you target within the last year?'

Table 5 shows the percentages of respondents that answered 'Yes' to the suggested species. Please note that they all probably had some by-catch of all the species except Norway lobster, which needs to be targeted.

Table 5. Responses from questionnaire 2003/04

Which of these species did you target within the last year?	
Target species	'Yes'
Cod	92%
Other codfish	10%
Plaice	43%
Sole	28%
Other flatfish	15%
Norway lobster	29%
Other fish	27%

In how many different waters did you fish within the last year?	
Waters	Respondents
1	91 (34%)
2	101 (38%)
3	55 (21%)
4	20 (7%)
Total	267 (100%)

In how many different ports did you land your catches within the last year?	
Landing ports	Respondents
1	77 (29%)
2	50 (19%)
3	45 (17%)
4	42 (16%)
5	16 (6%)
6	12 (5%)
7	11 (4%)
8	4 (2%)
10	5 (2%)
11	1 (1%)
12	2 (1%)
Total	267 (100%)

In the questionnaire, there were another two questions illustrating the high degree of flexibility in the fleet segment.

Table 5 also shows the answers to these questions: 'In how many different waters did you fish within the last year?' and 'In how many different ports did you land your catches within the last year?'. The table shows that most of the demersal fishermen (about two thirds) fished in several waters that year and that more than half of them landed in three different ports or more.

Developments in the Danish fishing fleet

Not only the number of people employed in the capture fisheries in Denmark and the landings have decreased, also the Danish fishing fleet has decreased over the period from 1996 to 2006. Table 6 shows the decrease in the number of vessels (-34 per cent), tonnage (-21 per cent), engine power (-25 per cent), and insurance value (-2 per cent). The insurance value indicates that large investments have been made in the remaining fleet.

Table 6. Overview of key figures for the part of the Danish fishing fleet that weighs more than 5 tonnes. Most of these vessels are commercial fishing vessels, but a few of them are used for sideline fisheries (The Danish Directorate of Fisheries)

	No. of vessels	BRT	kW	Insurance value in 1000 DKK	Average age of fleet
1996	1,886	104,767	362,159	4,510,947	32.5
1997	1,753	104,543	348,721	4,612,022	32.4
1998	1,709	104,500	345,395	4,685,822	32.7
1999	1,671	104,284	345,015	4,700,440	33.0
2000	1,666	107,181	351,280	5,183,794	33.3
2001	1,631	104,533	343,406	5,261,358	33.7
2002	1,498	101,654	324,915	5,303,781	33.1
2003	1,383	95,197	304,906	5,185,884	32.6
2004	1,310	92,690	296,418	5,208,677	32.4
2005	1,277	88,246	287,317	4,812,336	32.8
2006	1,195	82,594	270,622	4,410,580	33.3
Development	-691	-22,173	-91,537	-100,367	0.8

Table 7 shows the development in the Danish fleet. From 1996 to 2006 the number of vessels has decreased in all vessel groups in this table (except for the two categories for the largest vessels). It is mainly the vessels under 18 meters that have left the fleet, either by decommissioning (the vast majority) or by being sold out of the country.

Table 7. Development from 1996 to 2006 in the number of vessels in the Danish fleet, in terms of length overall of the vessels. Please note that many of the smaller vessels are used for sideline fisheries (The Danish Directorate of Fisheries)

Length overall	Year						Development	
	1996	1998	2000	2002	2004	2006		
0 - 5.9 meter	1,838	1,661	1,517	1,370	1,237	1,120	-718	-39%
6 - 11.9 meter	1,861	1,668	1,585	1,523	1,371	1,300	-561	-30%
12 - 17.9 meter	709	640	627	536	461	439	-270	-38%
18 - 23.9 meter	215	203	210	197	169	137	-78	-36%
24 - 29.9 meter	44	38	39	36	39	39	-5	-11%
30 - 35.9 meter	89	77	78	70	54	38	-51	-57%
36 - 41.9 meter	51	59	57	56	46	37	-14	-27%
42 - 47.9 meter	12	14	14	13	13	11	-1	-8%
48 - 53.9 meter	7	5	6	5	6	6	-1	-14%
54 - 59.9 meter	2	2	3	4	4	3	1	-50%
60 - 65.9 meter	2	5	5	5	7	6	4	200%
> 66 meter	.	.	.	.	.	1	1	.
Total	4,830	4,372	4,141	3,815	3,407	3,137	-1,693	-35%

Figure 3. Danish vessels distributed on main gear types from 2000 to 2006 (The Danish Directorate of Fisheries, 1996, 1998, 2000, 2002, 2004, and 2006). Please note that many of the purse seiners are combination vessels that can switch between purse seine and trawl while at sea.

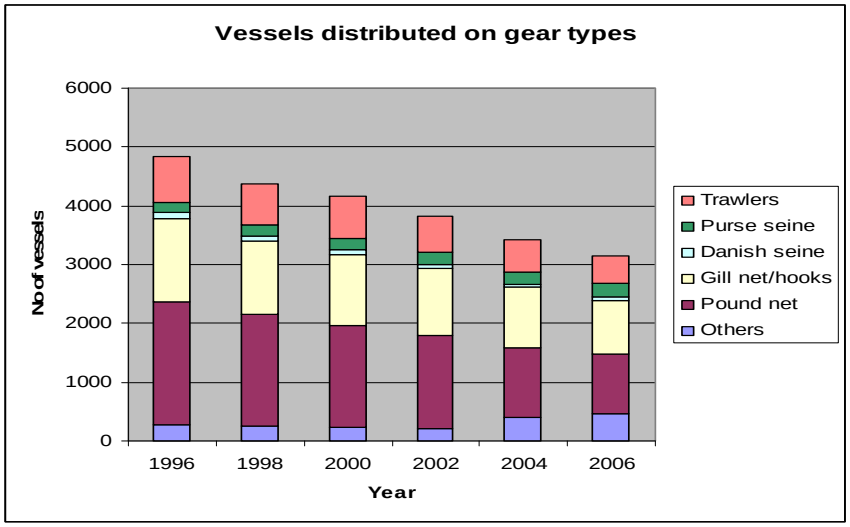


Figure 3 shows the Danish vessels distributed on main gear types. The figure supports the information in Table 7, namely that it is the smaller vessels that have disappeared, since the highest decrease is seen in the numbers of gill netters and pound netters.

The different types of fisheries employ different types of gear. All vessels in the pelagic fleet employ trawl and some of them also purse seine. Many of them are combination vessels and many of the non-combination vessel owners consider having their vessel rebuilt so that they can change gear at sea, so they more easily can catch mackerel in purse seine in the fall when prices are high. The pelagic fleet also catches part of the non-human consumption quota. The main part of the non-human consumption quota is caught by bigger trawlers.

The most complex and by far the largest group of fishermen in Denmark is the demersal fishermen. They are mixed with regard to gear types and some of them switch between different types of gear. The questionnaire survey from 2003/04 mentioned above (Christensen and Raakjær, 2007) contained two questions regarding gear: 'What is your main gear type?' and 'How many different main gear types have you used within the last year?' Table 8 shows frequency tables for the two questions from the questionnaire:

Table 8. Responses regarding gear types in the questionnaire from 2003/04

What is your main gear type?	
Main gear type	No. of fishermen
Trawl	139
Gill net	100
Danish seine	20
Hooks, pound net, other	9
Total	268

How many different main gear types have you used within the last year?	
No. of types	No. of fishermen
1	212
2	45
3	6
4	5
Total	268

Fleets in the dissertation

The six articles in this dissertation study different parts of the Danish fleet.

Paper number 1 (Christensen and Raakjær, 2006) studies all demersal fisheries in Denmark across water, species and gear type.

Paper number 2 (Andersen and Christensen, 2006) focuses on the North Sea fleet of gill netters for mixed demersal species.

Paper number 3 (Raakjær Nielsen and Christensen, 2006) describes the possibilities for devolution of management responsibilities within the framework. The management of all fleets, except the fisheries for mussels and Waddenzee shrimps, is discussed, but the main part of the paper studies the demersal fleet.

Paper number 4 (Christensen *et al.*, 2007) focuses on the pound net - and the pelagic fisheries. The pound netters are demersal fishermen.

Paper number 5 (Christensen, 2009) focus on the cod fisheries in the North Sea.

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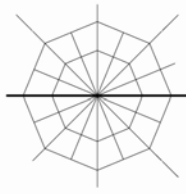
Appendix D

Working Paper 18 2007

Methodological framework for studying fishermen's tactics and strategies

Anne-Sofie Christensen



Technology, Environment and Society

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Colophon

Methodological framework for studying
fishermen's tactics and strategies

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Abstract

This paper presents an inductive, mixed methodological framework for studying fishermen's tactics and strategies. Various social sciences offer their approach for studying fishermen's tactics and strategies, but they do not suffice, as the single disciplinary methodological approaches face constraints. Hence, the primary aim of the methodological framework is to increase the validity of bio-economic modelling studies and to increase the reliability and generalisability of the qualitative studies of fishermen's strategies and tactics. The methodological framework is presented step-by-step starting with the explorative sequence interviews conducted with fishermen, followed by a survey and data reduction via factor analysis and construction of indexes. In the end of the paper, an application of the framework is presented.

Keywords: Bio-economic modelling, Fishermen's behaviour, Fishing strategies and tactics, Mixed methodology.

Methodological framework for studying fishermen's tactics and strategies

Anne-Sofie Christensen

Introduction

Among scientists working with fisheries, it is increasingly acknowledged that fisheries, as an area of research, is an empirically defined field, which does not acknowledge the formal disciplinary boundaries; several disciplines offer their contribution to the research. But multi/inter/cross-disciplinarity poses new challenges for the researchers as the different disciplines focus on different kinds of questions using different theoretical frameworks, terminologies, and methodologies.

Degnbol et al. (2006) argue that the contribution of biology, economics, sociology and other relevant disciplines to fisheries research would be improved if they originated from broader, more integrated analytical perspectives that are attuned to the empirical realities of fisheries management. Under the notion of *tunnel vision*, Degnbol et al. also argue that the different disciplines tend to have a preferred solution, *a technical fix*, to the challenges of fisheries management: Biologists and ecologists promote MPAs, economists often argue that the market through ITQs can solve fisheries management problems, and anthropologists and other social scientists often argue for co-management and empowerment of local communities and fishing people.

The aim of this paper is to present a mixed methodology for studying fishermen's behaviour in terms of tactics and strategies: Tactics are to be understood as short-term decisions, such as where to go fishing or which specific gear to use, and so on. Strategies are to be understood as decisions made in longer term perspective, like modernising or buying vessels, investments in catch handling equipment, and so on. By mixing methodologies of different disciplines, the aim is to increase the validity of the bio economic modelling and other statistical studies and the reliability and generalisability of the qualitative studies of fishermen's strategies and tactics.

Why study fishermen's strategies and tactics? The regulations made by fisheries management do not always work as according to the political intention. There are several reasons for this, but to a great extent it can be due to the dynamics in fisheries (Maurstad 2000). This means that when fisheries management implement regulations in fisheries, fishermen will adapt to the new condition by modifying their fishing practice, and a disproportion between intention and result will arise. From a management perspective, it is important to provide insight into fishermen's strategies and tactics and thus the implications for fisheries management (Christensen and Raakjær 2006; Hil-

born and Walters 1992; Charles 1995; Salas and Gaertner 2004). The basis of understanding the complex dynamics of fisheries is to understand fishermen's motivations, their strategies and tactics and the factors influencing their choice of tactics and strategies. In order to understand fishermen's strategies and tactics and thus their response to externalities such as management, different approaches to science have to be invoked.

In this paper, an inductive, mixed methodological framework for studying fishermen's tactics and strategies is presented step-by-step starting with the explorative sequence interviews conducted with fishermen, followed by a survey and data reduction via factor analysis and construction of indexes. This framework provides improvements to the classic single-disciplinary approaches: The qualitative descriptions are tested/supported statistically, which improves reliability and generalisability. The validity of quantitative studies, such as bio economic modelling, are improved in a number of ways as the framework provide a foundation for: 1) understanding the dynamics/ causality between variables in the model, 2) ensuring that relevant variables are in the model or at least knowing which are missing, 3) input to the model in terms of proxies etc, and 4) interpretation of the results. In the end of the paper, the study, from which this framework was developed, is presented. The tables throughout the paper are examples from this study.

Contributions of different disciplines

Fishermen's strategies and tactics are rather complex matters. Danish, and other, fishermen have historically been flexible and adaptive in their fisheries (Vestergaard 1997) as they are constantly in a situation where they have to adapt to weather conditions, changes in fish prices and migration of the fish stocks, or changes in management schemes. The effectiveness of the fisherman is determined by his ability to respond to the changes in his external environment (Hart and Pitcher 1998). But what do they do? What has influence on their decisions? When and what triggers their business investments? How do fishermen operate their vessel to accommodate management regulations? How do they know where and when to go fishing using which specific gear? etc.

No common theoretical or methodological framework for understanding fishermen and fisheries has been developed in social science, but this does not mean that the area has not been studied. Several social science disciplines have contributed to the research done regarding fishermen from different perspectives.

These disciplines can be seen in a spectrum: In one end are the bio economic modelling and other statistical studies. In the other end are the hermeneutic disciplines (e.g. ethnography, anthropology, ethnology and history), which are flirting with humanities. In-between the poles are a range of disciplines, such as sociology and institutional economics, etc. These disciplines tend to orient themselves methodologically more to one side of the spectrum than the other.

Studies such as bio-economic models of fishermen's behaviour are usually based on the general premise that the objective of the fisherman is to maximise his individual profits. Profit maximising behaviour does not necessarily mean that fishers actually obtain the highest level of profits possible, but rather that they respond in a way they think would increase their profitability. Whether or

not the premise of the models is a fair representation of reality is debateable: anthropologists and other social scientist have often argued against (North 1990; Berkes et al. 1989). But no matter which position is taken in this debate, fishermen have to deal with a complexity of variables when deciding where to fish, which gear to use, etc. In bio economic modelling, it is considered almost impossible to identify and model all the possible factors, only the accessible factors in a specific analysis are included in the description of fishermen's behaviour (Knudsen 1991; Andersen 2005). But the assumptions made about fishermen's behaviour are critical for the results, and thus also for the conclusions. If the statistical studies are not rooted in a profound understanding of fisheries and fishermen, the assumptions about their behaviour may implement unusable conclusions (McFadden 1999; Holland and Sutinen 1999; Wilen 1979). The understanding of fisheries and fishermen needs to take into account the relevance of both assumptions on fishermen's behaviour and the variables included in the analysis.

The hermeneutic sciences are in the other end of the spectrum. These tend to have ideals as holism in their understanding of phenomena. Hence, fishermen are most often seen as part of a social and cultural context, namely fisheries and fisheries communities: They follow changes in nature and weather, they respond to changes in management conditions, and they interact with market changes and each other. The main purpose of the research done in this end of the spectrum is to make explorative descriptions of fishermen and fisheries per se. The description of fisheries and fishermen often becomes the goal with little regard to the lacking generalisability. Looking into the body of anthropological literature on Danish fishermen's communities, only few studies have been conducted (Christensen 2002; Vestergaard 1989; Højrup 1989). From a methodological perspective these ethnographic descriptions all point in the same direction; when studying fishermen and fishermen's behaviour, a non-reductionistic and non-formalistic approach is needed. Fisheries have to be described and understood as part of a broader picture; the everyday exchange of knowledge with other fishermen (colleagues and competitors), the management of time in order to make fishermen's activities on land fit with the time at sea and so on.

So far the interaction between the pole-disciplines has been rather limited. This can be due to several reasons; from my perspective at least three reasons are obvious: 1) The key questions asked in the disciplines are fundamentally different, and the theoretical and methodological frameworks are developed to answer the kind of questions, they ask. 2) This also leads to different terminologies making it difficult in practise to cross the disciplinary boundaries. 3) The institutional setup in universities and other research institutions is usually according to discipline rather than empirical orientation.

Methodological framework

The paradigms, *the worldviews*, sketched above suggest different methods for research: The positivist approach of the bio economic modelling and other statistical studies implies the *quantitative* approach, while the hermeneutic orientation implies the *qualitative* approach (Tashakkori and Teddlie 1998). Terms such as paradigm *wars* (e.g. Gage 1989; Guba & Lincoln 1994; House 1994) with the researchers as *wrestlers* or *warriors* have been used to describe the relations between these research orientations. Luckily, more pragmatic, mixed-methods approaches are welcomed today.

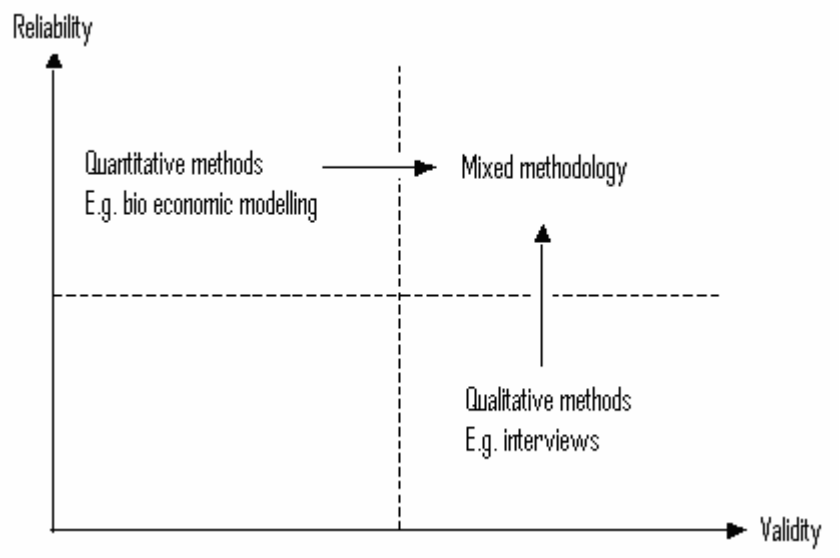

Figure 1 shows the strengths and weaknesses of qualitative and quantitative research methods, where quantitative methods are high on reliability (the extent to which the research yields the same results on repeated trials) but low on validity (the extent to which the research is measuring/ answering the questions that it is supposed to measure/answer)

You often meet the distinction that qualitative sciences deal with words and text, whereas the quantitative sciences deal with numbers and spreadsheets. This is a pragmatic definition, but it does not cover differences comprehensively. Drawing lines between the two approaches is not important here, it is sufficient to point to Figure 1, which shows the strengths and weaknesses of the two approaches and indicates that mixing the methodologies benefits the studies, and Figure 2, which shows the framework as a research process, but also indicates that it allows feedback in the various stages. The validity of quantitative studies are improved in a number of ways as the framework provides a foundation for: 1) Understanding the dynamics/causality between variables in the model, 2) ensuring that relevant variables are in the model or at least knowing which are missing, 3) input to the model in terms of proxies etc., and 4) interpretation of the results. The qualitative descriptions are tested/supported statistically, which improves reliability and generalisability.

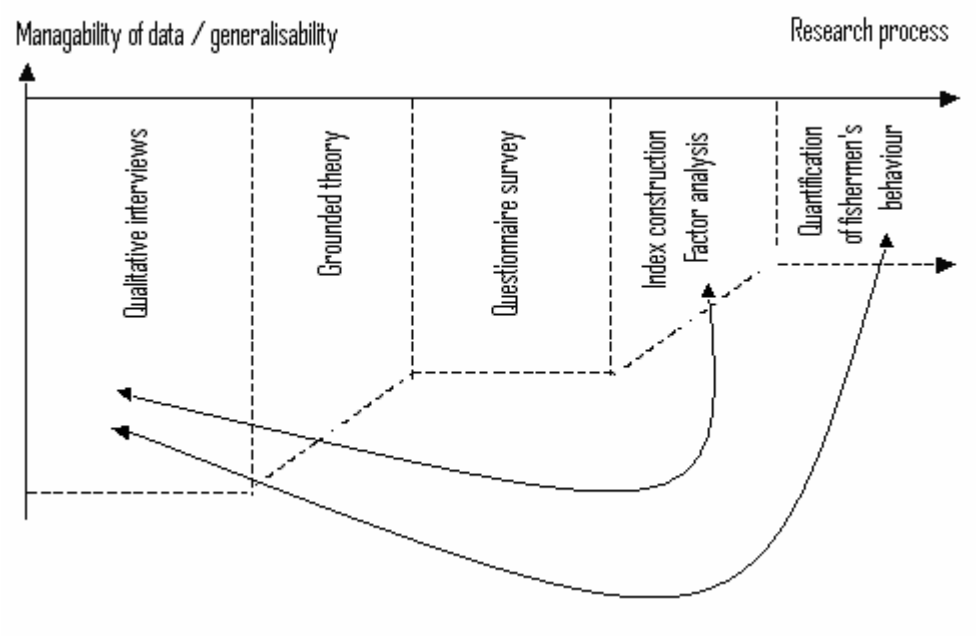

Figure 2 shows the steps in the methodological framework presented in this paper. The arrows from the 'qualitative interviews' indicate the possible feedback between the methods: On one hand, the explanation and validation of the variables in the model and on the other hand, generalisation of the interviews.

Qualitative interviews

As a starting point for the research, a profound understanding of the dynamics in fisheries is needed. This means getting to know the fishermen, their fisheries and their everyday challenges and appreciations. This requires the interviews to be conducted in a way that balances on one hand openness to the informant's associations/answers and on the other hand an agenda for the overall topics of the interview.

Methodologically, the guide for interview can be based on Bernard's ideas for semi-structured interviews (Bernard 1995) and Kvale's writings on *dynamic, positive interaction* (Kvale 2004). Semi-structured interviews are based on tight-rope walking between on one hand openness to the informant's associations from the questions – the informant can, through his answers, influence the directions of the interview. On the other hand, the interviewer has to ensure during the interview that the overall objectives and focuses of the interview guide are covered. Positive and dynamic interaction, according to Kvale, is about translating the research questions into everyday questions in order to promote the informants' motivations to tell about the topics behind the research questions instead of the just answering them shortly.

In order to get fishermen to tell about their fisheries in detail, slow progress is needed. Revisiting informants is often more fruitful than continuing the interviews for longer time. Interviewing in se-

quences further allows an evaluation of the information from one interview when planning the next. By the end of sequence interviews the fishermen often allow access to important information, which is hard to obtain, such as balance sheets, their own (or others'), non-compliance to rules in detail and so on. This information is hard to access when you are outside fisheries, but it is very important when studying fishermen's behaviour.

The sequence interviews need different scopes and purposes for the interviews. For example: The first interviews could be focused on five topics in order to get to know the informant: The informant's, at that time, present fishery, his annual fishing patterns, his history in fisheries, his decision-making from a short term/fishing trip perspective (tactics), his decision-making on a long term /investments perspective (strategies) and the general background of the fisherman.

The overall objective of the second interview could be the establishment of an understanding of the informant in a historical context; how does his experience influence his long-term strategies and short-term tactics? The interview guides have to be made for each interview, based on the analysis of the first interview. The second interview will often contain personal data/information about the informant.

The objective for the third interview could be to get to know the informants' economical performance in exact figures. The informants can be asked to bring their balance sheets, and the interviews can be carried out as a dialogue based on the balance sheet: Why did the fisherman prioritise the way he did this year? What went wrong/well? Which changes in future tactics and strategies are based on the balance sheet? etc.

Each interview can be followed by an evaluation, e.g. considering the questions: 1) Which new information (concepts, reasoning etc.) did the interview provide? 2) Does any of this new information open new perspectives in the answering of the overall research question? 3) How can this new information be tested/broadened in later interviews? and 4) How does the new information fit into information from previous interviews?

Qualitative research does not aim at being representative in a statistical sense (Kvale 2004; Wadel 1991; Spradley 1980). This does, however, not mean that any combination of informants would make a good sample to explore from. The interviewed informants have to be strategically chosen from relevant background variables such as: age, seniority in fisheries, number of days at sea per year, size of vessel, type of gear and participation in fisheries politics.

The interviews will probably show that fishermen apply complex tactics and strategies when adapting to changes in the context of fisheries. The fisherman often includes an array of factors in his decision-making process of tactics or strategies – the degree of flexibility concerning geography and gear, expectations of time off (family and friends), safety, comfort and expectations of economic outcome or willingness to financial risks.

According to Holland and Sutinen (1999, p.148), *'Ethnographic interviews conducted with fishers before conducting the statistical analysis are critical because they allow construction of models that go beyond traditional expected profit formulation and provide a basis for interpretation of the*

results'. Here, further steps will be taken, as qualitative data are used for producing quantitative input to e.g. a bio-economic model.

From interview to questionnaire

The tangible outcome of the interviews is transcriptions (when using a voice recorder) and reports (when taking notes during the interviews). As the interviews are open and explorative, these transcriptions and reports are not structured in an immediately comparable mode. In order to keep the inductive element in the making of the comparable, analytical categories, a methodological approach based on *grounded theory* can be used (Glaser and Strauss 1967). Grounded theory is a general method of comparative analysis, which builds theory through interaction with qualitative data. According to Glaser and Strauss, grounded theory is a strategy for handling data in research, providing modes of conceptualization for describing and explaining behaviour in practical applications. Grounded theory suggests inductive analysis by means of coding and recoding of the text. It is an applied hermeneutic circle, which develops the theoretical categories inductively from the data. In this context, *inductive* means that the codes/categories applied to the text grow from the data material. These are changeable in the process – in most studies; the codes change as the process prospers (Chamaz 1983). If grounded theory was to be followed strictly, the order of work would be: interview, transcription, coding, interview etc. This would increase the degree of inductiveness of the study (Chamaz 1983). Inductiveness is an ideal picture of how social science should work – it is not feasible and probably not even desirable, as it would mean that the interviewer and researcher worked with a tabula rasa in principle, leaving no room for knowledge accumulation process in science. Consequently, an alternative framework for ensuring the highest degree of inductivity as possible has to be applied.

The amounts of text coming out of interviews are rather solid. In order to make the coding process workable, all documents can be inductively analysed using the qualitative data analysis software like NUD*IST. From a theoretical perspective there is a clear connection between the usage of qualitative data analysis software and applying grounded theory to data material. However, it needs to be stressed that making the categories does not ensure that the inductive process takes place as suggested by the grounded theory. The making of the categories for the coding is, of course, what is essential for the outcome of the analytical process - and thus for how the process should be properly described in methodological terms. The inductive research process is ongoing from the interviews until the report of the results of the investigation. Qualitative data analysis software is merely a tool to help getting a general view of and some structure into the unstructured data material right before and during the reporting of the research. As categories are added and changed in the coding process, the coding process is in principle never ending according to grounded theory. This is, of course, not a workable way forward; instead the interviews were coded and recoded leaving a workable database.

Survey by questionnaire

Transforming the qualitative data into numbers is a process that requires standardised methodology such as a scaled questionnaire. The questionnaire for the survey has to be based on the in-

formation from the interviews and the analytical categories from data processing described above.

The questionnaire can contain different kinds of questions; 1) about the respondent and his fishery, 2) about importance of different factors concerning fisheries tactics, 3) about importance of different factors concerning fisheries strategies, and 4) others, for example about the respondent's view on other aspects of fisheries and fisheries politics. The questions in the groups of number 2 and 3 can be posed as 'when deciding [where to go fishing, which target species to go for, or which specific gear to use (mesh size, specific kind of trawls, gill nets or seine)], how important are the following factors for your decision?'. It is very important for the later analysis that the questions are posed in as high a scale of measurement as possible. A number of different factors can then be listed for the respondents to mark the degree of importance.

Table 1: The setup of the questionnaire

In the following questions, we would like you to mark how important the factor is for your decision …

	Very important	Important	Less important	Not important	Don't know
How important are the following factors in general for your choice of fishing ground?					
Experience from previous fishing trip					
Season					
Information about other people's fishery					
Limitation of by-catch					
Use of fuel					
Regulations					
Winds and current					

After making the questionnaire, it has to be tested. A pilot version can be given to relevant informants. They can fill out the questionnaire and give their opinions of the questionnaire; the relevance and sufficiency of the questions, the adequacy of the formulations.

Table 2: The overall questions of the questionnaire divided in two sections

Fishing tactics	Strategies ~ investments
How important are the following factors in general for the choice of fishing ground?	How important are the following factors in general for your considerations concerning investments in rebuilding your vessel? (e.g. prolonging of the boat, flat rear end)
How important are the following factors in general for the choice of target species?	How important are the following factors in general for your considerations concerning investments in mechanic equipment? (e.g. new engine, hydraulics)
How important are the following factors in general for the choice of specific gear? (e.g. mesh size)	How important are the following factors in general for your considerations concerning investments in search and navigation equipment? (e.g. echo sounder, sonar, radar, GPS)
	How important are the following factors in general for your considerations concerning investments in catch handling equipment? (e.g. cold-storage, packaging- and sorting technology)

Distribution of questionnaire and randomisation

The most important thing when conducting a survey is to get people to answer. Fishermen often dislike paper work, bureaucracy, or anything like that. The presentation of the questionnaire to the fishermen is therefore crucial. Careful consideration of distribution of the questionnaire is important. A combination of distribution ways may be advantageous; e.g. face-to-face distribution and by mail.

Fishermen are more likely to answer a questionnaire if they are asked face to face than if they receive it by mail. Notifying the fishermen through relevant newspapers or putting up posters a couple of days before coming to the harbour, may be feasible. Outreach distribution like this has obvious advantages: If the interviewer reads the questionnaire to the fisherman, discussions on the contents are likely to arise. Hence, the process can ensure that proper interpretations of the questionnaire are made later on when analysing the data.

Even though face-to-face distribution ensures high validity of the questionnaires, the method is slow and requires many, many hours in the harbours to provide useful data for a statistical analysis. Most of the fishermen therefore have to participate by mail. Mail survey can follow the face-to-face distribution; the advantage of doing so is that rumours in the local ports can encourage the fishermen to answer back.

The methods sketched above will provide a so-called non-probability sampling and thus do not fulfil the criteria for a randomised sampling (Hellevik 1999; Agresti & Finlay 1997). Due to the general difficulty in getting fishermen to answer questionnaires and in many countries a lack of a cen-

tral register of fishermen, a completely statistically randomised distribution is neither feasible nor possible. To compensate the lack of randomisation in the distribution of the questionnaire representativity has to be ensured by testing the sample against official statistics: Often fishermen are heterogeneous in a number of ways; the size of the vessels, the main target-species, the gear in use, the geographical mobility, the number of days spent at sea per trip or during a year and so on. From register statistics, approximate distributions in each of these categories are known. Hence, the correspondence between the register distribution and the survey distribution in each explaining variable can be tested. The composition of the respondents has to be approximately representative according to registers.

Identification of factors in dependent variables

The information from the questionnaire is entered into statistical software like SPSS. In order to reduce the complexity of the data, a Q-type factor analysis (or other cluster analyses) can be conducted. Factor analysis is a method to reduce the number of variables according to the *assumed latent dimensions*. Two approaches are possible in the factor analysis: An *explorative* and a *confirmative*. When making a *confirmative* factor analysis, two properties of the data must be fulfilled: 1) all variables must be normally distributed, and 2) there must be linearity between all pair-combinations of variables. Our data did not suffice these standards, as most data will not. An explorative approach is in most cases the more feasible approach. Here all relevant (e.g. all variables regarding fishing tactics in the questionnaire.) variables are entered asking the computer to maximise the explained variance, i.e. eigen value when suggesting the latent dimension (the factors) by suggesting which variables are clustered together. In this process, one or two variables may not interact with any of the other variables. These variables have to be removed from the analysis.

Such analysis requires high data quality. Data from strategic variables may often be of a lower quality than the data from tactic variables: When fisheries are in crisis, which is often the case, strategic investments are not a real issue for very many fishermen. This can undermine the data and hence the quantification of fishermen's strategic considerations as many answers would be missing or answered 'don't know'.

Reduction of independent variables

After conducting the factors analysis, the number of independent variables has to be reduced. This can be done trough construction of indexes. The construction of indexes is in principle the same as the factor analysis except that the researcher, a priori, has an idea of which underlying dimensions are desirable to have represented in indexes. Three obvious indexes can be made from the independent variables in Table 3: *mobility* (number of landing harbours, number of fishing waters, number of days at sea per trip), *investmentablity* (Solvency ratio, number of investments within the last five years, age of the vessel) and *size of fishery* (number of horse power, length of boat, number of days at sea per year and number of crewmembers).

Table 3: The list of the explaining variables in the questionnaire concerning the respondent, his fisheries and investments

The age of the fisherman	Number of years in fisheries
Number of years owning a vessel	Length of the vessel
Number of crewmembers other than the skipper	The building year for the vessel
The home harbour of the vessel	Number of different landing harbours in 200X
Number of days at sea in 200X	Most often used landing harbour
Main gear (trawl, gill net, Danish seine or pound net/ hooks)	Regular length of fishing trip (1 day, 2-4 days, 5 days or more)
Number of different kinds of gear used in one year	Number of horsepower
Fishing areas in 2002 - North Sea, Skagerrak, Kattegat, Baltic Sea, other. (More crosses possible)	The two most important target species? Cod, other cod fish, plaice, sole, other flat fish, Nephrops, other.
Do you know who takes over your vessel when leaving fisheries?	Sole owner of the boat?
In the last 5 years, which investments have you made? Building a vessel, rebuilding the vessel, mechanical equipment, electronic equipment, catch handling equipment, safety/work, environment/ comfort, regular maintenance (more crosses possible)	Number of expected years left in fisheries
	How was the revenue in 200X compared to other years? Over average, average, below average.
The debt in the vessel in 200X	Turnover in 200X
The insurance value of the vessel in 200X	Member of the board in the local fishermen's organisation?

If following the structure of the questionnaire suggested in Table 1, the variables have to be recoded so that all variables are on a scale from 1 to 4; 1 being the biggest fishery/most investment-inclined/most mobile and 4 being the smallest fishery/most investment averse/least mobile. Before adding the variables together, two validity tests have to be made: one to see how the variables interacted with each other (item-item analysis where all relations must have a gamma over 0.3) and one to see how the variables interacted with the index (item-scale analysis where all relations must have a gamma value over 0.3). It is likely that there will be more variables in the index from the start than by the end, but a reliability test, an alpha test, is deciding which combination has the highest degree of explanation of the variance.

The index variables from the factor analysis can be cross tabulated with all independent background variables from the questionnaire plus a number of constructed variables of underlying dimensions such as mobility or size of fishery. This is an explorative process allowing a mean value comparison of importance of the index variables on subgroups with a range of independent variables.

Application

This methodological framework was developed as part of two projects: 1) A Danish project *Temas* (Technical measures – Development of an evaluation model and application in Danish fisheries). The aim of the Temas project was to construct a tool for evaluation of technical measures in terms of efficacy of achieving objectives, cost efficiency and acceptance. The tool had to incorporate a fleet selectivity model as an essential component including gear selectivity and the fishing practice. 2) The European project *TecTac* (Technological developments and tactical adaptations of important EU fleets). The overall objective of the TecTac project was to address the poor understanding of the links between management tools, fleet developments and the pressure exerted on fishing communities, or more precisely to supply fisheries managers with a modelling tool that will allow them to evaluate the impact of regulations on the dynamics of fleets and fishing mortality. In the Danish part of both of the two studies, three demersal fisheries were in focus: 1) the mixed demersal fisheries in the North Sea, 2) the Nephrops fisheries in Kattegat, Skagerrak and the North Sea, and 3) the cod fisheries in the Baltic Sea.

How was the methodological framework applied in terms of numbers? As a starting point for the research, 16 fishermen were qualitatively interviewed in sequences: Each fisherman participating was interviewed for an hour and a half or more at least twice over a couple of months. Some informants were interviewed three times. Altogether some 40 interviews were conducted. The fishermen were chosen on the basis of experience of heterogeneity from previous studies among fishermen (Mathiesen et al. 2003 and Christensen, 2002).

When planning the tour around Danish harbours, we wrote an article to Fiskeri Tidende (Fiskeri Tidende 2003), the weekly newspaper of the Danish Fishermen's Association that is distributed to most Danish fishermen, telling the fishermen about the survey and the objectives of the research. Before going to a harbour, we contacted the chair of the local fishermen's organisation telling him about the survey and asking him to spread the word that we were coming. These steps, we think, were essential to the relatively high respondent rate when mailing the questionnaire: 789 questionnaires were sent out – 271 responses, equal to 34%, were returned. No exact statistics are available as to how many fishermen/skippers fished within the three categories in Denmark in 2003. A rough estimate (Economic Situation of the Danish Fishery 2004 and The Danish Directorate of Fisheries) would be less than 1,350 fishermen. This estimate is calculated in the following way: Number of relevant vessels minus the number of irrelevant vessels. Following this method of estimation the real number has to be lower than 1,350 fishermen.

After conducting the factor analysis, the 19 variables were distributed in seven index variables, which were named according to the interpreted dimension (See Table 4). In the two cases where

the factors only consisted of two variables, the scores were multiplied with 1.5 in order for us to make a ranking of the variables as to importance.

Table 4: The distribution of variables in factors suggested from the factor analysis on the tactics variables

	Interpreted dimension	Variable concerning 'fishing ground'	Variable concerning 'target species'	Variable concerning 'specific gear type'
Factor 1	Season	Season	Season	
Factor 2	The present situation	Experience previous trip	Fish prices	
Factor 3	Regulations	Regulations	Regulations	Regulations
Factor 4	Winds and currents	Winds and currents	Winds and currents	Winds and currents
Factor 5	(By-) catch and quality	Limitation of by-catch	Limitation of by-catch	Quality of landed fish
Factor 6	Fishing efficiency/ distance	Use of fuel	Distance to landing port	Fishing time
Factor 7	Information from other fishermen	Information from other fishermen	Information from other fishermen	Other fishermen's gear choice

Concluding remarks

From here we were able to make comparative analyses of how fishermen's decisions are made on where and how to fish by testing the data obtained from this study against the logbook data based on an integration of fishermen's behaviour to a fleet/fishery bio-economic framework based on the example of the gill-netters in the North Sea. The study showed that essential factors such as regulations and weather had to be left out of the logbook analysis (Andersen and Christensen 2006). Another analysis resulted in qualitative descriptions of the different kinds of fishermen in the Danish demersal fishery, showing their different challenges in present management framework, and discussed the possibilities for management to accommodate issues arising from the heterogeneity (Christensen and Raakjær, 2006).

This framework is to be seen only as initial steps towards mixing methodology. The methodology presented is much more time consuming than traditional studies of sales slips, logbooks or other registers. Time consumption increases if for instance time serial data is required. Hence, the next steps would be to consider how to transform or update these data without having to go through this process repeatedly.

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