

Report

**Collaborative research around the North Sea:
two case studies from Denmark**

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Summary

Part of an ongoing research project on collaborative fisheries research in Northern Europe, Canada and the USA, this report provides an overview over ongoing collaborative research in Germany, Ireland, England and Denmark, and describes in detail two Danish research projects that involved fishermen in various ways and to different extent: the Kattegat Sole Project, and the North Sea Sandeel Projects. Participants' perception and evaluations of these projects are considered with regard to the place of collaborative research in Denmark today.

The main source of information underlying this report are seventeen semi-structured interviews conducted in May – July 2005 with individuals involved in collaborative research projects (biologists in national fisheries research institutes, fishermen and fishermen's representatives, and employees in national fisheries departments). Published, unpublished and confidential DIFRES and ICES working papers and reports were another important source of information.

As described in *Section 1*, there are considerable differences between countries both with regard to the number of collaborative research projects, and the way in which fishermen are involved in these. While in Germany there are no collaborative research projects at the moment, collaborative research has since c. 2003 received financial and institutional support through a government initiative in England. In Ireland, pelagic fishermen are taking on responsibility for resource management in two Pelagic Management Committees. In Denmark, a formal agreement between DIFRES and the Danish Fishermen's Association (Danmarks Fiskeriforening) has since 1995 made possible a large number of collaborative research projects, including the Kattegat Sole Project, and the North Sea Sandeel Projects.

Section 2 provides a detailed description of the Kattegat Sole Project. Its goal was to substantiate fishermen's claims that the sole stock in the Kattegat and Skagerak (ICES area IIIa) was larger than estimated by ICES, and to establish a CPUE index for sole in the area. The project had three main elements: an analysis of private logbook data, a joint fishery-independent survey, and a monitored commercial fishery. Representatives of the Danish Fishermen's Association and the two skippers participating in the surveys were involved in the planning of the project. Participants agreed that the project had been successful in showing that the stock was 2-3 times larger than estimated previously, and in conducting the first part of a new CPUE index. There was considerable disappointment however that this did not immediately lead to the expected increases in the TAC for that stock.

The North Sea Sandeel Projects, described in *Section 3*, comprise a series of ongoing research projects, some of which go back to the late 1990s: research surveys, collection of information on fishing grounds, detailed monitoring of catches, monitoring of a closed area, fishery-independent surveys, and real time monitoring. Against the background of a variable but until recently overall stable stock, most of these address various aspects of sandeel biology; only the last-mentioned, initiated in 2004 after a sharp decline in stock size, aims specifically at stock assessment. Projects are planned by DIFRES staff, taking into account information and comments from fishermen. Ongoing for almost a decade, the collaboration between DIFRES and fishermen has become routine, and seems to run smoothly, possibly to a large extent due to direct communication between DIFRES staff, fishermen's organizations and individual fishermen.

Drawing on interviews with participants in the Kattegat Sole Project and the Sandeel Projects, *Section 4* describes their perspectives on collaborative research in Denmark today. Both the

Kattegat Sole Project and the Sandeel Projects were described as "collaborations" (*samarbejde*) by participants, characterized by a dialogue, with listening and openness to the other's suggestions by both parties.

In spite of occasional "ups and downs" it was said that relations between fishermen and biologists had been improving in recent years, and that the number of collaborative research projects had increased. Indeed, collaborative research in Denmark seems to be part of a new alignment of the actors involved in fishery management. This is seen as a consequence of an increasing public concern with environmental issues and the entrance of new stakeholders into fisheries management, resulting in a more central role for biological advice. Now, instead of facing each other as opponents, fishermen and biologists are increasingly perceived as working together as partners towards the common goal of providing accurate stock assessments and realistic biological advice. By contrast, it seems that politicians, and especially those in Brussels, are increasingly regarded as a rather removed and almost inscrutable third party.

Collaborative research has to be seen in relation to participants' perception of this social space. It is a means to an end, rather than an end in itself. For the biologists, it is a way to obtain data of high quality. For the fishermen, it is a strategy for influencing the regulations affecting the fishery. This is perceived as a two-step process. The first step is to make the stock assessment and provide the biological advice, in such a way that it corresponds as closely as possible to the actual stock size. In the second step, politicians decide on regulations on the basis of the biological advice.

Collaborative research plays a role in both steps. With regard to the first step, collaborative research was seen as the easiest way to ensure both the relevance of the research to the fishery's and the biologists' needs (by initiating relevant projects) and the accuracy of the findings (by allowing input from all involved). This was reflected in sound biological advice. With regard to the second step, it was expected that aligning the position of the fishery with the biological advice would make it more compelling to politicians.

Consequently, it seems that collaborative research projects were evaluated mainly in terms of their usefulness in this endeavour to provide sound biological advice and (especially by the fishermen) to influence the regulations affecting the fishery.

Although this description of changes in the alignment of actors in social space is based on the statements by Danish fishermen and biologists, this may reflect a larger trend that might deserve further investigation.

Note

The following report is based on seventeen semi-structured interviews conducted in May – July 2005 with individuals involved in collaborative research projects: biologists in national fisheries research institutes, fishermen and fishermen's representatives, and employees in national fisheries departments. Unless indicated otherwise, information presented in this report is based on these interviews.

Interviews were conducted in English or Danish; quotations from the fourteen Danish interviews have been translated into English by the author.

For reasons of confidentiality, individuals are not mentioned by name in the project descriptions. Direct quotes from interviews and expressions of opinions are not attributed to particular individuals. "Nordhavn" and "Sydhavn" are pseudonyms for the home ports of the two skippers participating in the Kattegat Sole Project, located in the northern and southern part of the Kattegat, respectively.

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1 Collaborative research around the North Sea

1.1 Collaborative research projects around the North Sea

Based on interviews with fishery biologists and government employees, and on the meeting reports of the Study Group on the Incorporation of Additional Information from the Fishing Industry into Fish Stock Assessments (ICES 2003, 2004a), there seem to be considerable differences between countries both with regard to the number of collaborative research projects, and the way in which fishermen are involved in these.

1.1.1 Germany

In Germany, there are **no collaborative research projects** at the moment (ICES 2003, 2004a). This may be due to the relations between fishermen and scientists, which in an interview were described as "pretty tough at the moment". Reportedly cooperation of any kind has to be "bought", that is, fishermen are reluctant to take biologists onboard, or to provide any information unless they are paid for it (see also ICES 2004a: section 3.4). In addition, it was said that the German government [including a green party in the federal and, until recently, in the state governments] seemed to be reluctant to delegate any decision-making power or increase the influence of fishermen.

However, biologists have taken **on board samples** "for at least 15-20 years" (ICES 2003: section 2.4). Reportedly, no fishermen are involved in the planning, and there are no particular feedback procedures for the sampling programme. In spite of considerable difficulties in some cases – "On a number of occasions the scientists are, at very short notice, not allowed on board, allegedly due to a lack of space" (ICES 2003: section 2.4) – some of the personal contacts established during this programme made cooperation in other projects possible.

Commercial vessels are also chartered as research platforms. One example considered very successful is a **selectivity study of the Bacoma trawl net for the Baltic Sea cod fishery** (Dahm et al n.d.; ICES 2004a: section 3.4). Conducted over five months in 2003, the study was initiated and organized by biologists, in a cooperation between Germany, Denmark and Sweden, but drew on information and suggestions by the fishing industry (ICES 2004a: section 3.4). The study's results were presented at a seminar in Rostock attended by fishermen, scientists and representatives of the EU Commission. In keeping with the preferences of the fishermen, as a result, EU regulations were changed to adopt the modified Bacoma net and ban the use of alternative nets in the Baltic Sea cod fishery (ICES 2004a: section 3.4).

Over the last ten years, there have been regular **meetings** (twice per year) between biologists and representatives of the fishing industry to inform about and discuss recent ICES advice (ICES 2003: section 2.4).

More recently (in c. 2003), **informal roundtable discussions** have been initiated between representatives of the German Baltic Sea fishery and biologists (ICES 2004a: section 3.4). In contrast to the formal meetings, during these half-day meetings the point is that participants can "talk straight", without the pressure of a specific agenda. There is an agreement that participants can talk to non-participants about the topics discussed at these meetings in general terms, but without quoting each other. One of the aims is for the industry to agree on common position statements regarding the issues discussed. These statements are then passed on to Danish and Swedish fishermen's organizations, and together these statements can have considerable impact on EU policy – the endorsement of the modified Bacoma net by the three nations' Baltic Sea fisheries representatives and its very fast passing into legislation is a case in point. The meetings are considered a great success by a German biologist I interviewed, who described them as "very constructive", and the fishery as "very proactive" with suggestions. These roundtable discussions were thought to have "significantly improved" the relations between the industry representatives and biologists involved, and may create the basis for collaborative projects in the future.

1.1.2 Ireland

In Ireland, there are close relations between the fishing industry and the Marine Institute (responsible for stock assessment and provision of advice). An Irish biologist I interviewed attributed this to the fact that (1) the industry is quite small, and "you see the same faces everywhere"; and (2) the Marine Institute (with only one research vessel of its own) frequently charters commercial vessels for research surveys, which allows for interactions and establishment of contacts.

The main contacts of the Marine Institute are with the Producer Organizations (members of which include a mix of processing industry and skippers) rather than local Fishermen's Organizations. A notable exception is the Greencastle Codling Project (Ó Cuaig 2003, 2004).

The **Greencastle Codling project** is a tagging study of juvenile cod ("codling") in an area in the north of Ireland, around the fishing port of Greencastle. It was an initiative from the local fishermen's association (Killibegs Fishermen's Organization), in response to ICES advice that recommended restrictive measures to rebuild the stock in this area, and EU encouragement for industry initiatives that prevented increasing exploitation of cod in that area. The objective of the study, set by the Killibegs Fishermen's Organization, was to ascertain the stock boundary (the fishermen doubted that it coincided with the ICES area VIa), and to show that cod were only found within a specific area. The study was conducted by the Marine Institute, in collaboration with the Killibegs Fishermen's Organization, who supplied commercial vessels as research platforms for the tagging, and contributed to a fund for rewards for recaptures. The tagging part of the study has been completed in 2003/4, but it is expected that the recapture phase will last until c. 2006.

Irish fishermen are not only involved in collaborative research, but also to some extent responsible for management through the **Northwest Pelagic Management Committee and the Southwest Pelagic Management Committee**, both established in 2000 (ICES 2003: section 2.5), and officially recognized as management institutions. Committee members include representatives of the fishermen's and producers' organizations, staff of the Department of Communications and Natural Resources, as well as staff of the Marine Institute (the latter in advisory function). The Committees are "functioning as pro-active instruments to focus research and encourage dialogue between the industry, scientists and managers" (ICES 2003: section

2.6). The Committees formulate management objectives, suggest additional research programmes, and help to "achieve consensus at critical periods in the assessment and advisory process" (ICES 2003: section 2.5), thus improving data quality and, consequently, the accuracy of the assessment (ICES 2003: section 2.5; ICES 2004a: section 3.5). Relations between scientists and one of the Committees are described as becoming "more strained" in recent years by an Irish biologist I interviewed, who thought that this might be because the fish stocks are still regarded as "below limits" by the scientists – contrary to expectations and in spite of rather restrictive measures that were self-imposed by the fishermen.

1.1.3 England/ UK (except Scotland)

In England, there reportedly is a general move into the direction of increasingly collaborative research. Apart from a **seminar arranged by DEFRA in March 2005** in order to receive input from industry, scientists and environmental organizations on DEFRA's marine fisheries programme and possible future directions, the most notable initiative is the government's **Fisheries Science Partnership (FSP) programme**, established in 2003 (ICES 2003: section 2.3.2; ICES 2004a: section 3.3; Horwood 2005). Initial funding of £1 million for one year has been extended, and the programme is now in its third year.

The aim of the FSP is to improve relations between the fishing industry and CEFAS, by providing a framework and funding for collaborative research. Project proposals are submitted by NFFO, and then discussed and selected jointly by representatives of NFFO, CEFAS, and DEFRA. So far, most proposals are stock assessment and gear selectivity studies. The selected projects are then developed by CEFAS staff, taking into account information provided by the fishermen. The research is carried out on chartered commercial vessels. In addition to the charter fee, the skippers can sell the fish caught during the survey.

The initiative was a response to the "great concern that the relationship between fishermen and scientists has deteriorated in recent years" (Bradshaw 2004). Before the launch of the Fisheries Science Partnership programme, there had been **regular meetings** between CEFAS scientists and fishermen's representatives in a variety of contexts (ICES 2003: section 2.3.1), and several **ongoing research programmes** – private logbook programme for inshore vessels, discard sampling programme, and charter surveys (ICES 2003: section 2.3.1) – relied on the voluntary cooperation of fishermen.

The FSP programme has been well received, and, by and large, it seems to have contributed to improving industry-science relations. However, relations can still be strained by incidents such as the passing on of confidential private logbook data to DEFRA by a member of CEFAS staff (Lockley 2005).

While the FSP programme reportedly contributed to improving relations between biologists and fishermen, in 2005 Irish Sea fishermen launched their own **alternative research project** (Oliver 2005), setting up their own laboratory in Kilkeel, with scientific and financial support from the Northern Ireland Fisheries Department, and financial support from the EU (FIFG funds). The project has two separate strands: 1. research into prawn gear selectivity; 2. research into alternatives to orthodox fisheries science, in collaboration with Icelandic fisheries scientist and consultant Jon Kristjansson, who argues that "fish stocks benefit from fishing because it creates a better balance between the fish and available feed and allows fish to grow faster"¹. This is

¹ No information is provided on the details of the plans for this research.

described as the first project of its kind in Europe initiated by a fishing organization.

1.2 Collaborative research projects in Denmark

There has been a formalised cooperation between DIFRES and the Danish Fishermen's Association since 1995 (ICES 2003: section 2.2.1). Its aim is to improve the collection and use of data from the commercial fishery, in order to improve biological advice. The cooperation is based on a formal "memorandum of understanding" outlining the framework for this cooperation. A steering committee, comprised of representatives of DIFRES and the Danish Fishermen's Association, supervises the cooperation. This includes the planning and coordinating of data collection by DIFRES staff onboard commercial vessels, as well as the assessment of the quality (accuracy and representativeness) of the raw data. There is an agreement that data are not to be used for surveillance purposes, and that they will not be traceable to individual vessels by outsiders. Projects carried out under this cooperation are financed with support from the European Commission and the Danish government. Further details are provided in the reports of the ICES/ NSCFP Study Group on the Incorporation of Additional Information from the Fishing Industry into Stock Assessment (ICES 2003: section 2.2.1 and 2.2.2; ICES 2004a: section 3.2).

Since its inception, a large number of research projects have been carried out as part of the collaboration between DIFRES and the Danish Fishermen's Association. The report of the ICES/ NSCFP Study Group on the Incorporation of Additional Information from the Fishing Industry into Stock Assessment (ICES 2003: section 2.2.1) lists the following:

- ✍ **Discard sampling.** Observer programme monitoring discard rates in the Danish fisheries.
- ✍ **Technical measures.** Changes in fishing behaviour caused by implementation of technical measures.
- ✍ **Monitoring of incidental by-catch of sea bird in gill net fishery.** By-catch monitoring.
- ✍ **Monitoring of incidental by-catch of marine-mammals in gill net fishery.** Trials of devices that prevent by-catch.
- ✍ **Gear selectivity trials.** Trials of new gears/gear-devices that reduce by-catch and discards.
- ✍ **Management of mussels stocks.** Cooperation on data collection for the assessment of the stocks.
- ✍ **Miscellaneous smaller projects.** Sandeel and sprat sampling on fishing bank and haul levels.

The following sections, based on interviews unless indicated otherwise, provide a short description of some ongoing research projects. The Kattegat Sole Project and the North Sea Sandeel Projects are described in sections 2 and 3.

1.2.1 Discard project

The discard project is the largest of these collaborative projects. Since 1995, observers on board commercial vessels have taken catch samples to assess both total catch and discards. For further details see the 2003 report of the ICES/ NSCFP Study Group on the Incorporation of Additional Information from the Fishing Industry into Stock Assessment (ICES 2003: section 2.2.1).

Selection of vessels (from a list of vessels who expressed their willingness to participate) and fishing trips is stratified by fishery, quarter of the year and area. The programme covers the whole Danish fleet, including all species, areas, and gear types. Onboard, DIFRES technical staff record information about the vessel and the trip, and record on a haul-by-haul basis information on species composition and amount of catch, both for discarded and nondiscarded fish.

With about 400 days-at-sea annually (ICES 2004a: section 3.2), the discard project is of considerable scale:

In the period 1995-2001, 1138 observer trips with commercial vessels were completed and the catch was measured at 4388 stations altogether (trawl hauls and net sets). The duration of the trips vary by area. Thus, in the North Sea an average of 11.4 stations per trip were sampled, while the corresponding figure for the Baltic Sea is 2.4. Altogether there have been observers aboard vessels for app. 2200 fishing days. (ICES 2003: section 2.2.1)

Taking stock of the project after a decade, participants noted occasional problems, but overall, the evaluation was positive. DIFRES staff underlined the extent and usefulness of the data collected under the scheme (ICES 2003: section 2.2.1), noted occasional minor problems when vessels refused to take observers on board (ICES 2003: section 2.2.1), and pointed to the positive effects of the successful collaboration on other research projects, as well as on the relation between biologists and fishermen more generally:

One of the side effects of the cooperation is that it now is possible to put forward informal comments and have discussions in a non-political forum, to exchange ideas of how to design projects, to communicate fishery science to the fishermen in a popular form and to be able to create person to person contacts more easily. Furthermore, the cooperation has resulted in more support from the fishermen and acceptance of the results and findings obtained during sampling and trials. (ICES 2003: section 2.2.1)

Danish Fishermen's Association representatives agreed, noting that although there had been some "ups and downs" and numerous "discussions" around the project, it was now settling into becoming quite routine. From the 2003 report of the ICES/ NSCFP Study Group on the Incorporation of Additional Information from the Fishing Industry into Stock Assessment (ICES 2003: section 2.2.2) and from statements about "one-day trips with biologists" by some of the fishermen I spoke to, it seems that some of these "discussions" may have related to the use of the data collected, and their effects on regulations:

Recent events in the fisheries and restrictions have destroyed much of the good will but not at individual level. Fishermen believe that 'the system' is not using the data correctly, and point to a lack of agreement between the results of assessments and their evaluation of the state of the stock. They raised the question why the data are used against them when, alternatively, they could for instance be used to identify areas where discards of cod are not significant. (ICES 2003: section 2.2.2)

In particular, the fishermen I spoke to thought that the number of fishing trips and fishing places

covered was insufficient. Comparing the one-day trips with the longer joint survey during the Kattegat Sole Project, one explained:

Well the main difference is ... Let's say they call tomorrow and ask if they may come out with us tomorrow evening. Then we go out and do one haul that night and catch nephrops. And that's it. Then they determine the sex of those nephrops, and weigh them, and see how many small ones there are and how many big ones. And then they go home. So they got a tiny piece of the Kattegat, and they can see that maybe there have been no nephrops that night, or there have been a lot. But they cannot really use that for anything. [...] And they send out somebody maybe four times a year. [...] Or maybe eight times – the maximum, that's ten times per year, at least for this port. And then they can risk that we are at exactly the same fishing place those eight times. So what's the point?

Further, fishermen were dissatisfied that there was no perceivable effect:

No matter how often we had them out with us, nothing happened. And I asked them time and again "When do we get to see the results of when you have been out with us?" [...] For at least ten years I have always said "I cannot understand that you count and count, but one never sees the result of that!"

This was attributed to the slowness of data processing and analysis, as well as to the inadequacy of the data:

There is this whole system it has to go through. And if they want to get it through, the biologists, then I believe they need a lot of evidence. And they cannot really do that based on those one-day trips. Because if they have been out [on a fishing trip] this one time in January and seen that there are lots of cod, they won't get through with that.

Thus, it was difficult for fishermen to "see the point" of this, and one wondered whether there might be a hidden intention to harm fishermen:

Well those one-day trips, I don't know if I would call that a collaboration with biologists, I have more the impression that they are interested in all this discard in order to constrain us (*bremse os*). With the other one [Kattegat Sole Project] you could see what it was for. But with this, personally I have the impression that it is mainly in order to damage (*skade*) us.

1.2.2 Survey of North Sea cod

Inspired by the success of the 2004 Kattegat Sole Project, a similar project has been started for North Sea cod. This will be a collaboration between DIFRES and fishermen of Hanstholm, Thorsminde, Thyborøn, and possibly Hirtshals. The initial meeting between DIFRES staff and the chairmen of the local fishermen's organizations that will be involved in the project took place in March 2005. At the last meeting, the survey area has been defined. Applications for funding are currently on their way.

1.2.3 Baltic Sea cod tagging study

The aim of this tagging study of cod in the Baltic Sea is to map the migration patterns of cod. Cod are caught in collaboration with fishermen, and tagged with tags that register, for every tenth minute, the depth, salinity and temperature of the water. In connection with a hydrographic

model, this information allows to retrace the migration of the cod. Cod are re-caught by the fishermen, who receive 300 kr per fish and 300 kr per tag returned to DIFRES. To date, more than 100 cod have been re-caught.

1.2.4 Size selectivity of round fish in nephrops trawls

In this project, carried out in 2003, commercial vessels were used as research platforms to test a new nephrops trawl design, in order to improve selectivity to avoid bycatches of large numbers of undersized roundfish (ICES 2004a: section 3.2). The modified trawl was accepted and included in regulations by the European Commission, allowing additional three days at sea for vessels using this gear, starting in 2005.

1.2.5 Other

In addition to the projects described above, the 2004 report of the ICES/ NSCFP Study Group on the Incorporation of Additional Information from the Fishing Industry into Stock Assessment (ICES 2004a: section 3.2) lists the following projects:

Improving the effect of pingers in order to avoid by-catch of marine mammals in gillnet

Commercial vessels are used as platforms for trials testing different designs of pingers in order to improve the effects of the device.

[...]

Estimating by-catch of sea birds in gillnets

This program combines a list of information in order to combined surveys in a hot-spot which it is likely to be an area where you can expect potential problems with by-catch of sea birds. The sampling period was a year. The project includes:

- ? Monthly fishing with a research vessel using the same gear as the commercial gill-netters in the area.
- ? Private logbooks which includes records of by-catch of birds. (2 years back).
- ? Observer program including most gill netters in the area.
- ? Special extended logbooks for most fishermen performing gillnet fishery in the area.
- ? Simultaneous aerial surveys for estimation of the abundance of birds in the area.

2 The Kattegat Sole Project, 2004

2.1 Project description

2.1.1 Background

The project was initiated in response to fishermen's discontent and complaints about existing biological advice and TAC levels on sole in Kattegat and parts of the Skagerrak (ICES division IIIa). Retrospective analyses of the spawning stock biomass (ICES 2005b: 14) show an increase in stock size until the mid 1990s, followed by a decline in stock size. From c 2002/3, the stock size increased rapidly. ICES TAC recommendations at that time were based on landings and logbook data². However, because of the low TAC level at the time, these data did not reflect the high actual catches of sole, resulting in discards and black landings.

To substantiate fishers' claims about large actual catches, the Danish Fishermen's Association (Danmarks Fiskeriforening) collected private logbooks from three fishermen, haul-by-haul data from one vessel, and annual catch averages from two vessels, and provided them to DIFRES (ICES 2004b: 196, 204 table 3.4). Analysis of these data by DIFRES staff showed an at least twofold increase in catches in comparison to preceding years, a trend that was consistent with observations by DIFRES discard observers (ICES 2004b: 196).

In their report, the ICES Baltic Fisheries Assessment Working Group acknowledges the fishermen's criticism, describes the private logbook data that were collected, and highlights the discrepancies between catch rates based on the private logbook data, and data from the standard tuning fleet used in the assessment. The following paragraphs are an excerpt from this report (ICES 2004b: 196):

The regulation of the Kattegat sole fishery has been severely criticised by the fishermen who claimed that the sole abundance was high and that the abundance indicators ("the tuning fleet") used in assessment were inadequate. The critique of the tuning fleet information was that catch rates reflected the regulation scheme (two-week rations) rather than stock abundance. The fishermen pointed out that the low catch rations set for 2003 were taken at 1-2 designated sole hauls and that the remaining effort for the period was used in other fisheries implying that the aggregated tuning fleet effort used in the assessment would not reflect the effort directed for sole.

DIFRES consulted with local representatives of the fishermen's association to evaluate their views and to determine whether they could provide supplementary and

² Standard scientific surveys were not directed at sole, and the DIFRES scientists and fishermen I spoke to agreed that they therefore were only of limited usefulness.

detailed information from 'private' logbook recordings. This information has been provided. [...] These data show that most catch rates have increased by at least 2-fold in 2002-2003 compared to the early 2000s and late 1990s (Fig. 3.4). [...]

The catch rate increases seen in private logbooks and records from commercial fishermen are consistent with other fisheries information collected by DIFRES from the commercial fishery. Catch rates by a commercial trawler in the Kattegat observed each autumn since 2000 by DIFRES discard observers also show a doubling of catch rates in 2002-2003 compared with 2000 and 2001 (Fig. 3.5). The Danish fisheries inspection staff also reported to DIFRES that sole catch rates have increased.

These patterns contradict the CPUE pattern seen in the fleet data used for assessment tuning, which show either little or no increase in catch rates. The difference is possible related to the fact that the private logbook information describes trawling directed towards sole whereas the standard tuning fleet aggregates all fishing activities regardless of targeting practice.

The Working Group acknowledges the doubt that these data raised about the validity of a CPUE based on the standard tuning fleet data that are used in the assessments. However they did not include the private logbook data into their assessment, as evident from the following excerpt of their report (ICES 2004b: 199):

The assessment is uncertain because i) reliable survey data do not exist (too few sole captured by surveys), ii) unknown and variable levels of targeting may influence effort indices derived from commercial fisheries, and iii) catch misreporting occurs in some years.

The assessment relies only on commercial catch-effort data for XSA tuning because both the IBTS and the Havfisker surveys catch too few sole to provide precise indicators of sole abundance. Commercial effort data in the existing tuning fleet database do not distinguish between effort directed to sole vs. effort for other species. Such a distinction becomes more important when the fisheries have to adapt to major changes in the TAC regime as has been experienced since 2001.

Additional information, not used in the formal tuning, i.e. from surveys, discard observers and control officers and from private logbooks of commercial fishermen indicates a clear increase in stock abundance since 2001. For the same period the XSA estimates that SSB has declined. [...]

In reaction to this, the fishermen and DIFRES staff decided to expand the Kattegat Sole Project in order to provide data that would not only be used as "anecdotal evidence". This second or main phase of the project is described in the following sections, based on interviews with participants and several DIFRES working papers (DIFRES 2004; Jørgensen 2005a, b).

2.1.2 Goals

The project's goal was twofold. First, to substantiate fishers' experience of a large stock. In order to do this, they collected further private logbooks, and monitored commercial fishing (see below). Second, to provide more and more accurate data on the development of the sole stock in the Kattegat/ Skagerak area for use in future stock assessments. To this end, they conducted a fishery independent survey, initiating a recruitment index and a time series of fishery independent CPUE data specifically for sole (see below).

2.1.3 Participants

The project was initiated by the Danish Fishermen's Association. Together with DIFRES staff, their representatives planned the project, and acted as liaison between DIFRES and two commercial fishermen who participated in the project. DIFRES staff took on the overall coordination of the project and responsibility for research design, as well as for project administration and budget. Eleven members of DIFRES technical staff collected catch data during the joint fishery-independent survey, and acted as observers during the monitored fishery. Chairs of two local fishermen's associations were consulted in selecting the two commercial fishermen participating in the project.

Figure 1, based on information from the interviews, shows the pattern of communication between project participants. It clearly reflects the mediating role of Danish Fishermen's Association's staff: apart from limited contact between DIFRES senior staff and one of the skippers ("Skipper1" in the diagram), communication between DIFRES senior staff and the fishermen is through Danish Fishermen's Association's staff.

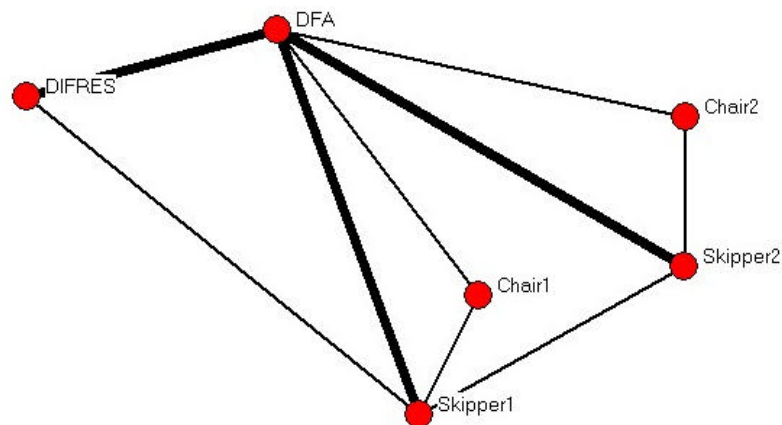


Fig. 1: Communication between participants in the Kattegat Sole Project. DIFRES = DIFRES senior staff; DFA = Danish Fishermen's Association; Skipper1, Skipper2 = Skippers participating in the Project; Chair1, Chair2 = Chairs of local fishermen's associations. Thickness of lines indicates frequency of communication. DIFRES technical staff not included for sake of clarity. Created with Ucinet 6 (Borgatti et al. 2002).

The fishermen's motivation to participate in this project was their wish to contribute to "proving that there were a lot of sole", in the hope that this would affect TAC levels. In addition, it was said that participating might be interesting, offering a chance to fish at a variety of places that were not fished at normally, and thus providing new insights. The payment was considered adequate by the two skippers, but apparently was not the most important reason for their choice to participate. DIFRES staff participating in the project found it interesting because it involved collaboration with fishermen.

2.1.4 Project overview

2.1.4.1 Private logbook programme

In 2004, further private logbooks were collected by the Danish Fishermen's Association and provided to DIFRES. To protect the identity of the fishermen, the logbooks were provided anonymously. In a collaboration between the Danish Fishermen's Association and DIFRES staff, data were interpreted and entered into a database. Data from nine vessels were available for inclusion in the report of the Baltic Fisheries Assessment Working Group in April 2005 (ICES 2005a: 222).

2.1.4.2 Joint fishery-independent survey

A joint fishery-independent survey was conducted in the Kattegat/ Skagerrak area (ICES division IIIa), using two commercial vessels with standardised gear (see below). The survey area was divided in a southern and a northern part, each surveyed by one of the commercial vessels. 120 haul positions were selected, half of them in the southern area, the other half in the northern area. In each area, half of the positions were selected by the skipper of the vessel covering that area, the other half was randomly selected by DIFRES staff (see below). For each haul, two members of DIFRES technical staff sorted the catch by species, and took length measurements of all specimen (in large catches only for samples of species other than sole). In addition, samples were taken to analyze on land for weight, age, sex, and maturity. The survey was planned for 8-28 November 2004, with five hauls of one hour's duration per night, for four nights per week. Due to adverse weather conditions, it took four weeks to complete the survey for the southern area. In total, 119 of the 120 hauls were completed. A detailed description of the methods and results is presented in Jørgensen (2005a, b).

2.1.4.3 Monitored commercial fishery

The joint fishery-independent survey was followed by a three weeks' monitored commercial fishery, conducted by the same vessels and in the same areas as in the fishery-independent survey. The skippers used their usual gear and followed their usual fishing patterns with regard to place, time and duration of tows. This was in order to ensure comparability with the private logbook data. For each haul, skippers were asked to complete a detailed questionnaire with information on location, time, duration, gear, wind, current and bottom conditions. In addition, the catch (or a catch sample) was sorted by species, weighed, counted and measured, and otoliths were taken from samples of sole and certain other commercially important species. One member of DIFRES technical staff accompanied each vessel as observer. A detailed description of the methods and results is presented in Jørgensen (2005a, b).

2.1.5 Further details on survey and monitored fishery

2.1.5.1 Selection of vessels

The two commercial vessels were selected by the Danish Fishermen's Association, in consultation with the chairs of local fishermen's associations in Sydhavn and Nordhavn, respectively. The choice was based on several considerations, including vessel size (c 50 t, or large enough to provide working space for both crew and DIFRES technical staff), detailed private logbooks for at least one of the vessels, experience with sole fishery, as well as interest in the project and a pragmatic attitude towards collaboration with DIFRES staff and compliance with the survey protocol. Both of the skippers approached agreed to participate.

2.1.5.2 Gear selection

During the monitored commercial fishery, each skipper used his usual gear. For the joint fishery-independent survey, by contrast, DIFRES requested that both vessels use the same gear (trawl, mesh size, otter doors, wire). The trawl was selected by the skippers in consultation with each other, taking into account their experience with particular gear types, as well as different bottom conditions in the northern and southern area. Based on the skippers' specifications, DIFRES commissioned three sets of trawls for each vessel. Mesh size was 55 mm in the codend to allow catches of small sole, in order to be able to establish a recruitment index. The skippers and DIFRES staff agreed to use the otter doors normally used by the skippers, which were of the same type.

2.1.5.3 Dispensations

Dispensations from quota restrictions and for use of mesh sizes smaller than the legal minimum of 90 mm were obtained by DIFRES from the Fishery Directorate (Fiskeridirektoratet).

2.1.5.4 Selection of 120 haul positions for the joint fishery-independent survey

The two skippers selected 30 haul position each within their area. The positions had to be at least five nautical miles apart, although DIFRES agreed to make an exception from this where differences in depth were large. The skippers selected positions where they expected sole to be abundant, based on their knowledge of sole occurrence and fishing places, and taking into account the minimum distance requirement. While the Sydhavn skipper selected all positions himself, the Nordhavn skipper received positions for the area north of Hirtshals (where he did not usually fish himself) from another fisherman in a nearby harbour who had experience fishing in that area. Other local fishermen were not involved in the selection of positions, because the skippers were widely recognized for their expertise as sole fishermen, and because by and large these places are common knowledge among fishermen.

After the two skippers had made their selections and passed them on to DIFRES, DIFRES staff added 60 randomly selected positions to cover the remaining area. To this end, the skipper of one of the DIFRES research vessels compiled a list of known fishing places³ in the Kattegat/Skagerak area, which served as a sampling frame.

2.1.6 Budget

The project was financed through a combination of EU and Danish funding. The former came from the EU's Financial Instrument for Fisheries Guidance (FIFG).

Each vessel was paid a fixed amount per day, based on their usual average income. Income from the sale of fish caught during the survey was subtracted from this amount; when this exceeded the agreed daily rate, the difference fell to DIFRES.

³ Places where fishing was possible, that is, places where commercial vessels were known to fish or to have fished in the past.

2.1.7 Electronic logbooks

Simultaneously with the joint fishery-independent survey and the monitored fishery, the Fishery Directorate (Fiskeridirektoratet) ran a test of an electronic logbook. Both of the vessels participating in the sole project were required to participate. However, this test had no connections with the sole project.

2.1.8 Results

In the joint fishery-independent survey, hauls at 116 of 119 positions included sole. Catch rates for sole ranged from 0.7 to 182.3 kg/h, with an average of 29.8 kg/h. As expected, on average the catch rates at positions selected by the skippers was higher than at those selected by DIFRES (42.1 and 17.3 kg/h). In the monitored commercial fishery, average catch rates for two vessels were 16.4 kg/h and 24.5 kg/h, respectively. The differences were due to differences in mesh size and in relative abundance of sole at the fishing places. For details see Jørgensen (2005a: 3-4, 5-8; 2005b: 4-8, 9-13). These results supported the data recorded in private logbooks, and suggest that the stock size is larger than previous estimates.

2.1.9 Some notes on the use of the data

2.1.9.1. "Out of curiosity": An SSB estimate

The data collected during the joint fishery-independent survey were intended to provide the first data points of a CPUE time series and a recruitment index. Thus, the survey design was not geared towards estimating biomass. However, "just for fun", DIFRES staff also tried a SSB calculation based on these data (Jørgensen 2005b: 3, 5, 6). Their estimate of 2282.6 tons (Jørgensen 2005b: 6) is below the SSB estimate (4564 tons) of the Baltic Fisheries Assessment Working Group for 2005 (ICES 2005a: 231). Because half of the haul positions were selected nonrandomly, calculating SSB from these data is not a standard procedure, and, unsurprisingly, the results are not included in the report of the Baltic Fisheries Assessment Working Group (ICES 2005a). However, DIFRES staff are now considering whether it might be possible to expand the fishery-independent survey in the future in such a way that it would also allow a SSB calculation.

2.1.9.2. Private logbook data

According to DIFRES staff and the Danish Fishermen's Association, there were questions about the use of private logbook data. This was described as "a big discussion about a matter of principle, about how one should treat 'unofficial' data", and it seems that ICES Working Group members were divided on this issue. Attitudes on collaborative research as well as political attitudes may have played a role as well (see section 2.3.5.1).

2.1.9.3 In the ICES Baltic Fisheries Assessment Working Group

The data from the monitored commercial fishery were considered by the ICES Baltic Fisheries Assessment Working Group in their stock assessment, together with the private logbook data (ICES 2005a: 220):

Several new activities have been initiated inter-sessionally by DIFRES to 1) investigate how sole fisheries and catch data are influenced by catch regulations and 2) improve the quality of commercial and survey data used in stock assessments. These initiatives include the following:

1. An evaluation of CPUE of sole taken as by catches in trawl and gill net fisheries outside the sole seasons (Hovgård 2005);
2. Evaluation of catch and effort data in private logbooks of individual fishermen (Christensen 2005);
3. Implementation of a monitored commercial fishery to quantify commercial catch rates and discard practices (Jørgensen 2005);
4. improvements in the quality and amount of survey data for calibration (tuning) of commercial catch rate data, including development of age-based indices and spatial mapping of catch rates (Jørgensen 2005; MacKenzie et al. 2005);
5. Initiation of a sole directed scientific survey programme with commercial trawlers (Jørgensen 2005).

Results from the new initiatives 1-4 are all included in the 2005 assessment whereas results from the scientific sole survey will be used when a time series is established in a few years.

The data collected in connection with the Kattegat Sole Project described here were used in several ways by the Working Group. First, they were taken as indication of incentives for misreporting of landings (ICES 2005a: 221):

Analyses of private logbooks (Christensen, 2005), survey data (Jørgensen, 2005) and observer data Hovgård (2005) indicate that there was considerable economic incentive to misreport landings in 2002-2004 as the entire two week ration in many cases could be taken in just a few hauls.

The Working Group report continues by noting that it is unclear how this would affect the statistics for catch and for effort (ICES 2005a: 221):

However, it is not known to what extend [sic] the catches are discarded or landed as black landings (i.e. excluding both catch and effort data from the official statistics), or distributed to and landed by vessels not having caught their rations, i.e. the catch data would be correct but the corresponding effort would (most likely) be overestimated.

Further, private logbook data, together with catch rates data from the joint fishery-independent survey and the monitored fishery, were compared to other available data. Catch rates were said to be consistent with DIFRES discard observer data and observations by fisheries inspection staff (ICES 2005a: 222).

Finally, private logbook data were used for calibration in XSA analyses, and included both in exploratory XSA runs and in the final XSA run (ICES 2005a: 222, 226-7). Resulting XSA SSB estimates were 165% higher than those in 2004, while prediction results were 229% above those of the previous year (ICES 2005a: 231).

The report concludes by noting that the difference in the 2005 assessment is mainly due to calibrating the XSA with CPUE data from the private logbooks and from official bycatch data:

... this year comprehensive new data were made available for the working group, in particular, tuning series based on private logbooks and tuning series of sole by catches outside the main sole fishing season based on official logbooks. These data all indicated an increase in catch rates in most recent years. The information obtained from the logbook time series was supported by the scientific survey and the monitoring fishery implemented by DIFRES in November and December 2004. Furthermore, the present assessment proved robust to different assumptions about the level of misreporting. Only minor changes in SSB were observed assuming 50 and 100% underreporting in 2003 and 2004. (ICES 2005a: 230)

The present assessment gives substantial different estimates of SSB and $F(4-8)$ than the assessments from the most recent years. This is mainly an effect of calibrating XSA with CPUE data (private logbook data and official by catch data) believed not to be biased by misreporting. (ICES 2005a: 232)

2.1.9.4. In ACFM

Building on the report of the ICES Baltic Fisheries Assessment Working Group, the ACFM report concurs with its major conclusions. The private logbook data are seen as indication for extensive non-reporting, although the effects of this non-reporting on catch and effort statistics could not be quantified (ICES 2005b: 11):

Analyses of private logbooks, survey data, and observer data indicate that there was considerable economic incentive to non-report landings in 2002-2004 as the entire two week ration in many cases could be taken in just a few hauls. However, it is not known to what extent the catches are discarded or landed as black landings (i.e. excluding both catch and effort data from the official statistics), or distributed to and landed by vessels not having caught their rations. Thus, this information could not be used to quantify discarding and/ or non-reporting.

Thus the stock assessment is regarded as highly uncertain (ICES 2005b: 10):

Due to considerable non-reporting, discarding of fish above minimum landing size caused by restrictive quotas since 2002 and to a lesser extent mis-reporting to other species in recent years, the assessment is considered uncertain in relation to the estimate of F in the final year. The forecast presented is based on the best available information from the industry and inspection regarding non-reporting and discards in 2002, 2003 and 2004 but this information is by its nature uncertain.

The ACFM also accepted the use of the private logbook data as one of the data sources for the commercial CPUE series underlying the stock assessment (ICES 2005b: 11). They are acknowledged as providing a "new perspective" on the stock, indicating "an increasing trend in SSB and decreasing F since the late 1990s" (ICES 2005b: 12).

2.1.9.5 Setting the TAC

Based on the advice given by the ACFM in June 2005, in July 2005 the European Commission raised the TAC for Kattegat sole for 2005 from 520 to 900 tons. Thus the Danish quota increased with 73 percent from 437 to 755 tons. In a press release by the Danish Department for Food, Agriculture and Fisheries, this was explicitly related to the collaboration between fishermen and biologists in the Kattegat Sole Project (Fødevareministeriet 2005).

2.1.10 Challenges encountered during the project

Participants agreed that by and large the project had run smoothly. The main challenge was doing a lot of work within a limited amount of time. This was a recurrent theme in regard to the joint fishery-independent survey, where the plan to do five hauls in four nights each week seemed rather too optimistic in retrospect. In both areas, adverse weather conditions slowed down the work even further. To allow for the completion of the survey in the southern area, the survey was extended for one week in that area. In addition, this theme (large work load and time constraints) was also mentioned with regard to the data analysis carried out by DIFRES staff.

Another challenge, mainly in regard to the logbooks, was the fishermen's widespread concern that the data might be used against them. Further, containing a source of information frequently consulted by fishermen when deciding where to fish, fishermen were reluctant to give them away for any length of time. However, the fishermen agreed to provide their logbooks to DIFRES through the Danish Fishermen's Association anonymously, as they were also interested in improving the stock assessment, and ultimately the TAC.

Other difficulties were mentioned occasionally, that is, they were mentioned once or more by one informant, or once by two informants. These were budget constraints, startup problems with getting dispensations in time, the challenge (for the skippers) of choosing high-yield haul positions for the joint fishery-independent survey (due to limited predictability of fish abundance), lack of familiarity with a particular survey area (requiring consultation with other experts), difficulties in getting data accepted and used in stock assessment⁴, and (although not related to the sole project itself) difficulties with the electronic logbook.

2.1.11 Continuing the project

The joint fishery-independent survey will be continued as a yearly survey as long as this is regarded as useful, and as long as funding is available. Ideally, the same vessels will be used in the future as well.

2.2 Fishermens' influence on the project

For the description of fishermen's influence on the project, it seems useful to distinguish several stages, involving different groups of actors.

The project was initiated in response to fishermen's discontent and complaints about existing biological advice and TAC levels.

The basic set-up was worked out in collaboration by the Danish Fishermen's Association and DIFRES staff and representatives. This included the private logbook programme, the joint fishery-independent survey (with half of the hauling positions selected by fishermen), and the monitored commercial fishery. Asking the fishermen to select half of the positions for the

⁴ See also section 2.3.

fishery-independent survey seems to have been a suggestion by Danish Fishermen's Association staff, who had heard of similar research designs being used elsewhere (in Iceland?). They also agreed on the duration of the monitored commercial fishery.

This planning process was described as a collaboration, rather than a tug-of-war with two opposing parties:

It was a result of holding meetings about how we were going to do this. This is how I think a collaboration works. [...] It's a good collaboration where both parties make suggestions and we set up a shared project.

Next, the two skippers participating in the project (who had not been involved in these early planning stages), were involved in decisions regarding some details of the fishery-independent survey. Most importantly perhaps they selected half of the hauling positions. Further, at the request of one of the skippers, the five-nautical-miles distance criterium was relaxed in two cases where positions were characterized by large differences in depth. In addition, the skippers selected the trawl type and the otter doors. They were consulted regarding the time frame (feasible number of hauls per night) and fishing depth, and asked to comment on the survey plan.

This was described as "a dialogue back and forth about what would be the smartest thing to do". However, apart from the choice of the hauling positions, these decisions seemed less essential to the skippers. Nevertheless, compared to one-day trips with observers (probably referring to the onboard sampling under the discard project described above in section 1.2.2.1), they perceived the project as a "real collaboration".

The chairs of the local fishermen's associations of Nordhavn and Sydhavn were consulted in the selection of the two skippers. Apart from that, they were not involved in the project. Two other fishermen were consulted regarding the choice of hauling positions. No other local fishermen's associations or individual fishermen were directly involved in the project.

2.3. Participants' evaluation of the project

2.3.1 Overall evaluation

The overall evaluation of the project by those I spoke to is most eloquently summarized by the following statement:

I think it has been successful (*vellykket*). Both the joint fishery-independent survey itself, the results of the monitored fishery, and the logbooks, and what came out of it. I think it has been a success all the way. There is just one thing missing: it's sad that you just cannot get it through as advice as well.

Participants agreed that, all in all, the project had been a success. In particular, they pointed to the findings which strongly suggested a large stock, and noted the good working relations and the positive attitude of those involved. On the other hand, the lack of any notable effect on the TAC was regarded as a serious shortcoming by everybody.

To understand these comments on the TAC, it is important to keep in mind that the interviews

were conducted in June 2005, all but one *before* the publication of the ACFM's report. Thus, most of the comments on TAC levels related below refer to ICES recommendations given in 2004, and the TAC set by the EU Commission in December 2004. Some of the comments relating to the 2005 ICES advice, as well as comments on the EU decision about the 2005 TAC (taken in July 2005) are speculative.

The following provides a more detailed description of the evaluation of the project by those I spoke to, during some part of the interview. Note that the following is based on explicit statements, in answer to open-ended questions. Thus, a given view may actually be shared by more informants than indicated by these statements.

2.3.2 Participants' thoughts on the research design

All in all, there was agreement that the project's set-up and research design was reasonable. While the selection of half of the hauling positions by the two skippers seemed sensible to all involved, the random selection of half of the hauling positions did not make sense to everybody, possibly because it did not directly relate to the(ir) goal of documenting that "there are a lot of sole". Thus, it was thought to be unnecessary, as sole only occur at a few well-known places, and suggested that biologists did not trust the information on sole occurrence volunteered by the fishermen:

It's a bit difficult to understand (*at sætte sig helt ind i det*). Sole are fished at a few small places, so one thinks maybe that it's a bit unnecessary to go looking for sole in the most peculiar places where there simply are no sole, so that seems a bit idiotic. If you are looking for sole, you should look in the places where they live. That's just the way it is. And these kinds of things might be done in a more rational way. But they want to look in all kinds of mystical places. And that's also, I think, a sign that they don't really believe the fishermen.

On the other hand, covering a large area turned out to give even more support to the fishermen's claim that the stock was large. Sole were found even in places where nobody would expect them:

It shows that it's not the way people often say it is, that "Well fishermen always go after the places where the fish is". Because it [sole] is everywhere! So it was good the positions were spread out like this.

Finally, the large number of hauling positions was also thought to give a much more realistic image of the stock than the data collected on the very limited number of hauls or short trips usually documented by DIFRES observers.

One of the fishermen also expressed doubts about the timing for the planned repetitions, because the timing of the movement of sole may vary from year to year. He also questioned the comparability of repeated surveys:

Well during the first three weeks, we took all these samples ... I don't quite know what they want to use that for. Because it's like they think that now it's 30 November and [you are] at that position and did a one-hour trawl, and then again on the 31st and the 1st and the 2nd, and all for one hour. And then [you] do this again next year – if this shows that there is 200 g more per minute, then there are more sole, and if there are 200 g less, then there are less. That does not lead to anything. There is the weather, which has an influence, and the conditions. But these things should be

based on your experience (*det skal man bruge sin erfaring på*).

2.3.3 Positive points

As mentioned above, the outcome itself – finding support for the fishermen's assessment of the stock size – was unanimously regarded as positive: "I think it was a good project, we proved that there were enough sole." In this way, the project results were sometimes taken as evidence against the common notion that fishermen "lie" or that their statements about stock size cannot be trusted:

Now I think what was so positive about this project, that we had said that there was so much sole, and more sole than we had ever seen before, and it was just so clear as daylight that what we said was correct.

It shows that it's not the way people often say it is, that "Well fishermen always go after the places where the fish is". Because it [sole] is everywhere!

The results also impressively showed the knowledge and skill of the fishermen:

And it proved that there was much more sole than they [DIFRES biologists] had expected. [...] It was their own vessels that were unable to catch more. But when the fishermen came into the collaboration, it was evident that there was much more of everything they said there was nothing of.

While the information about the stock size itself merely confirmed what fishermen already knew, it was also said that the project provided new information on fishing places not used normally, as well as on the impact of weather conditions on the amount of catch. Thus, interestingly, participation in the fishery-independent survey generated new experience-based knowledge.

Relatedly, several informants noted that in contrast to other projects, it was possible to see the point of this project as it was oriented toward a clear and meaningful result, and that it was possible to "see the red thread all the way".

Participants also praised the positive and supportive attitude of individuals and institutions involved, and the dedication of those participating in the project. As noted above, the relations between DIFRES staff and fishermen was described as a "real collaboration". In particular, working relations with DIFRES technical staff were described as "excellent":

Very very good. For that they definitely deserve a lot of praise. Helpful, and they were also good at explaining to us how we could help. [...] Both with taking measurements, and then they needed to write down the precise positions where we set the trawl, and the time. And instead of them going back and forth, I could also write that down in the forms. So in that way we saved maybe five minutes here or there, because we did not have a lot of time – but for them it certainly did feel long [because there was so much work to do].

This resulted in work well done, and (at least in part), enjoyable:

Then we got [three] weeks where we could fish just as we pleased. That was just like twenty years ago, - it was great!

2.3.4 Negative points

Participants had three main criticisms, deriving from their experience of the problems they encountered during the project (see above). As mentioned above, most of those I spoke with acknowledged the time constraints during the joint fishery-independent survey, and this was also one of the major flaws they identified.

Slowness in the analysis of the data by DIFRES staff was another criticism, as this was believed to delay the re-setting of the TAC. This slowness was rather incomprehensible to those I spoke with, and was variously attributed to slow work pace, and economic reasons/ shortage of staff.

Finally, some participants indicated that they would have liked more direct communication (as opposed to written communication and indirect communication through the Danish Fishermen's Association's staff) between senior DIFRES staff in Charlottenlund and the fishermen.

2.3.5 Effects

As noted above, the outcome of the project was the overarching concern of all those I spoke with. This included the findings themselves, but also the actual and possible effects of the project and its findings on the TAC, on relations between fishers and biologists, and on other collaborative research projects were a recurrent theme in the interviews.

2.3.5.1 Effects on the TAC

Mentioned by everybody, and discussed in 23 instances, the effect of the project's results on TAC was clearly the most prominent theme in the evaluation of the project. Most informants noted that the results had little or no effect on the ACFM advice and/ or the TAC, and expressed their disappointment:

In our opinion it [the quota] should have been raised from 1 January, that time we got nothing. It should have been risen straight up to a huge number, it was so logical that it should have, but nothing happened.

We got one ton more in Kattegat. Until now at least. That's to laugh at! One ton, that's what one boat can catch in three nights, if you are lucky.

They had a hard time understanding this lack of effect in spite of excellent evidence. One thought the slow work of the staff doing the data analysis might be one of the reasons. Others thought this was because using such data (in particular the data based on private logbooks) raised questions of principle about the use of such data, and, more generally, about research in collaboration with the fishing industry:

They cannot come to an agreement about how to treat this suggestion for advice. So they still have not set a TAC on sole. This is, as I understand it, a big discussion about a matter of principle, about how one should treat "unofficial" data.

There are apparently some people who do not think one should work together with the fishing industry. I believe there are some people who think this is "unscientific". There are some people who have a kind of sacred attitude about what is scientific, and what is not scientific. That's my view.

Some believe that political attitudes may play a role as well:

In particular, there has been a [man of X nationality] involved in this who does not believe anything. He has a completely different political goal, [namely] that these fish should not be fished at all. And he tried to oppose an increase in the TAC.

Others believe the lack of an effect on the TAC may be due to political negotiations in Brussels:

But it's a long way, and it's a long process, because it has to go through Brussels.

I can see that it is difficult when it gets down to the EU Commission, and there are some people from ICES sitting there and it's them who are setting the TAC for that year ... - and I don't know what is happening down there, but ... and it just crumbles every time!

In the end, however, this lack of effect seemed quite incomprehensible to everybody:

If the result is so positive as the sole fishery, that one then doesn't ... - I simply can't understand that.

2.3.5.2 Effects on fishermen-biologist relations and collaborations

The effects of the Kattegat Sole Project on relations and collaborations between fishers and biologists was a major concern for those who are or had been involved in setting up such collaborations. Relations between fishermen and biologists were described as oscillating, and there was agreement that it was a difficult and time-consuming process to establish good working relations, with negative experiences resulting in major set-backs. Thus, there was much concern about negative effects on fishermen's trust in biologists and the management system, if the findings of the Kattegat Sole Project would *not* result in an increase in the TAC, and that this would have repercussions for future collaborations between fishermen and biologists.

Now I don't know what it [the ACFM advice] will be, but if the quota isn't increased for some strange reason, then the fishermen will be really disappointed, and that will have consequences for these kinds of projects.

Because we now had this project on sole, and it shows that there are huge numbers of sole. [...] And when we get to the setting of the quota for next year, it says status quo again. So there won't be any increase. An increase of one ton. [...] That's nothing. You can say it's just transferred from last year, that it's the same as last year. And then you think why. And then they say it would have been reduced, and now they left it as it was. And you think "what's the point". And so there is a crack again. And these kind of things annoy people. If I just could see an effect of what we are doing ...

... if it [increase in TAC] won't happen this year, for instance. That will have consequences for all collaboration. [...] It's a question of trust ... that you enter such a collaboration. Because you have to remember that the general attitude has always been "The more biologists, the less fish". That's the general attitude. And if you want to change that and have a better collaboration, then it is necessary that if there now is a demonstrable positive result that has positive implications for the fishery, that this *has* perceivable effects.

Here again there is a notable focus on the outcome of the project and its possible negative effects. By contrast, it is mentioned only once that the successful *process* of collaboration during the project might have positive effects on the relation between fishermen and biologists.

2.3.5.3 A model for other collaborative research

Finally, some of those I spoke with think that the Kattegat Sole Project – the organization of the collaboration, the use of commercial vessels, and its research design allowing a large number of hauls at low cost compared to ordinary scientific surveys – might serve as a model for other projects.

2.3.6 Notes on project evaluations: participants' criteria for evaluating the project

As evident from the above, for participants by far the most important criterion in the evaluation of the project was its actual outcome, namely the findings themselves, and their effects on the TAC. The result-orientedness of the project was one of the things fishers appreciated, - it made the project meaningful to them. Inversely, the importance of positive results was also clear from fishermen's regret that at some hauling positions they caught less sole than expected:

We were somewhat unlucky, there has been sole there before, but there were not very many when we were there [during the joint fishery-independent survey].

The importance of the actual results (as opposed to the way in which the project was done) is obviously due to the fact that the fishermen's economic survival depends on the TAC level. On the other hand, the fishermen also found it important that the biologists' stock assessments and TAC levels reflect their current experience of the stock:

It is of course important for us to get the stock assessment to be in agreement with the situation that we experience. It's of course also important to get some more fish here and now, because we are in a bad situation economically. But in the long run, the most important thing is to get a better agreement between what the fishermen observe, and what the biologists observe. Because it should obviously be the same.

As noted above, indirect effects on relations between biologists and fishermen, and effects on other collaborative projects, were a concern for those involved in setting up such collaborations.

The second most important criterion, but apparently far less crucial than the first, concerned the process itself, namely the nature of the working relations between those involved in the project, including their attitude towards the project, amount and quality of communications, and the degree to which the project was "collaborative" (see section 4.1).

Other criteria included feasibility of the project's time frame. Personal benefits such as new information and enjoyment were positively valued extras.

While the first criterion – the outcome of the project and its effects on the TAC – was mentioned by all, and seemed to be the *most* important criterion to everybody, there are obvious parallels between individuals' background and motivations to participate, and their evaluation of the project according to the other criteria (such as the effect on relations between fishermen and biologists).

3 The North Sea Sandeel Projects, 1995-2005

3.1 Project description

3.1.1 Background and goals

For this outline, the sandeel research projects carried out by DIFRES over the last decade can be divided into three groups, according to the main purpose of the projects. These are, in roughly chronological order, (1) projects exploring sandeel biology; (2) a monitoring fishery in the closed area of Firth of Forth, on the west coast of Scotland; and (3) stock assessment projects.

In the second half of the 1990s, DIFRES priorities in sandeel research shifted from stock assessments to the collection of more basic information on sandeel biology. Among other things, biologists were interested in patterns of sandeel distribution, movement of larvae, and stock structure, - issues that were to become an important theme for much of the research on sandeel over the following decade, as one of those I talked to explained:

... before [then], they [DIFRES] had only done stock assessments. But now there is an increased need for knowledge (*viden*) for stock assessment and advice giving (*rådgivningsarbejde*). So this means one needs more basic research to be able to answer these questions. Among other things, sandeel is an important food source for other animals, and people were concerned that there might be local effects of fishing. And based on what was known about sandeel biology, there were also some indications that the stock divisions were somewhat more complicated than it was generally assumed at that time. So one needed to know a whole lot of more basic biological things to be able to answer these kinds of questions. So that was what DIFRES wanted to do, [...] [they] thought it would be useful to study these things.

According to DIFRES staff, in much of this research they drew on sandeel fishermen's knowledge and experience. This started with collecting information on fishing places through **interviews** with fishermen in 1995. This information was used to select survey areas for a scientific survey. Since the late 1990s, several fishermen have been invited to participate as **observers on Dana surveys**.

In 1999, this was extended to include not only fishing places, but also information on fishing patterns and amount and composition of catches (Jensen et al. 2001: 10-11; Jensen et al. 2002: 11-12). Reportedly the fishermen suggested to provide catch samples as well, thus allowing the detailed analysis of catches with regard to age and length measurements carried out under the **detailed monitoring programme** since 1999.

Since 2000, after the closure of the Firth of Forth area (on the west coast of Scotland) to the sandeel fishery, there has been an annual **monitoring fishery** in that area. The area was closed

because of a decline in the sandeel stock in the area from 1995-1999 (Wright et al. 2002: 1). This was of particular concern as there were indications that the Firth of Forth sandeel might be a separate stock, and because the decline in the sandeel stock coincided with low breeding success of seabird populations in that area (Wright et al. 2002: 2). Following ICES advice, a commercial monitoring fishery has been conducted since 2000 "to maintain a time series of CPUE and biological sampling data on sandeels in the area" (Wright et al. 2002: 2).

While sandeel catches could vary between fishing places, as well as between years, overall the total catch of sandeel had been at a relatively high level until 2002 (DIFRES 2005). During that time, the collection of fishery-independent survey data for stock assessment purposes had not been a priority. This changed with a marked fall in landings in 2003 and 2004, when the lack of such data became painfully apparent. In the report from their meeting in February 2005 (STECF 2005a: 33), the STECF Ad hoc Working Group Sandeel Fisheries summarized:

There is no fishery independent time series of sandeel abundance in the North Sea because the ICES co-ordinated surveys are not suited to measuring densities of this species and there are no other annual dedicated research sampling programmes. Although a range of surveys have been carried out by Danish, English, German, Norwegian and Scottish research institutes, to investigate different aspects of sandeel biology, no time series of fishery independent data exist for sandeel abundance on a North Sea scale. The different field investigations have been targeted to answer specific questions about the biology in smaller localised areas, more than to investigate overall changes in sandeel abundance.

This was addressed in two ways. First, in order to estimate the size of the age-1 year class and provide immediate advice on sustainable fishing levels, a **real time monitoring scheme** was introduced in 2004, and has been continued in 2005 (DIFRES 2005; STECF 2004, 2005a, b). Further, DIFRES initiated **fishery-independent surveys** using commercial vessels during and after the sandeel season (STECF 2005a: 33).⁵

Much of the data and insights on sandeel derived from these projects will be incorporated into a case study on North Sea sandeel forming part of the EU-funded research project **PROTECT**. Started in January 2005, PROTECT aims at the evaluation of marine protected areas (MPAs) as management tools.

3.1.2 Participants

The projects were initiated by DIFRES staff, in some cases taking up information provided by Danish sandeel fishermen. Projects were planned and organized by DIFRES. Data collection took place in collaboration with fishermen, who provided catch samples and information on commercial fishing (detailed monitoring programme; Firth of Forth monitoring fishery), provided research platforms (fishery-independent survey), and took plankton samples (fishery-independent survey). Fishermen's associations helped to establish contacts between DIFRES staff and skippers, especially during the early stages of the projects. DIFRES technical staff collected data onboard during the fishery-independent surveys, and recorded information from skippers participating in the Firth of Forth monitoring fishery. Together with DIFRES senior staff, they were important contacts for skippers participating in the Sandeel Projects.

⁵ To improve effort measures, DIFRES has also received permission from fishermen to analyse satellite records from 1999 onwards for 35 vessels.

Participating in collaborative research was interesting for economic reasons and to obtain interesting and useful information. For DIFRES, collaborating with fishermen was said to provide "an incredibly inexpensive way to collect a huge amount of information, which we [DIFRES] would not have been able to do ourselves".

For the skippers, economic considerations were important as well. Through participating in the monitoring fishery, they gained access to the Firth of Forth closed area where they had fished in the past as well, and where catches had been high again in 2000-2002⁶. By contrast, the compensation for participation in the fishery-independent surveys was not regarded as very high. One of those I spoke with noted that DIFRES had had difficulty finding skippers willing to participate in the fishery-independent surveys. However, as the surveys took place outside of the fishing season or could be combined with the skippers' usual commercial fishing activities, participation did not result in financial losses. Curiosity about biologists' working methods (in regard to Dana surveys) and about sandeel biology (in regard to fishery-independent surveys) and the wish to help the biologists to improve their knowledge of sandeel were mentioned as well. Finally, the relevance of the project to the fishing industry and the acceptability of project goals were considered as well.

3.1.3 North Sea Sandeel Projects

3.1.3.1 Dana surveys

Since the late 1990s, several fishermen have been invited to participate as observers on Dana surveys, including surveys in February 1999 and August 2003. This was to allow the fishermen to obtain first-hand experience of biologists' working methods and data collection. In at least one of the surveys, the fishermen were also asked to select some of the hauling positions.

3.1.3.2 Information on fishing grounds

Expanding on interviews with fishermen in 1995, in 1999 DIFRES, in collaboration with the Danish Fishermen's Association (Danmarks Fiskeriforening), collected information on fishing grounds from Danish fishermen (Jensen et al. 2001: 10-11). Sandeel fishermen from the main industrial harbours in Jutland provided GPS positions of their fishing grounds. This information was compiled into a map of the fishing grounds. In addition, detailed information on a number of fishing grounds was collected by questionnaire. Fishermen from six harbours completed this questionnaire, providing information on name and location of the fishing ground, as well as when and with what gear it is fished.

3.1.3.3 Detailed monitoring programme

Commercial vessels participating in the detailed monitoring programme provide information on time and position of capture, as well as a sample of the catch, on haul basis (Jensen et al. 2001: 10-11; Jensen et al. 2002: 11-12, 35-38). The catch sample is frozen and at the end of the trip given to the fish meal factory where the catch is landed. The factory passes the samples on to DIFRES for further processing and analysis.

⁶ Reportedly there was considerable resentment among skippers who were not selected to participate in the Firth of Forth monitoring fishery.

About 15 vessels from different Jutland ports participated in project since 1999 (Jensen et al. 2001: 10; Jensen et al. 2002: 11, 12; ICES 2004a: section 3.2). There are no plans for recruiting more vessels as DIFRES is reaching the limit of its capacity to process the data generated. Participation in the programme is voluntary, and there is no economic compensation (STECF 2005a: 38).

3.1.3.4 Firth of Forth commercial monitoring fishery

The Firth of Forth monitoring fishery started in 2000 with three participating vessels, and was extended to six participating vessels from 2003. To be eligible for participation, vessels must have fished in the Firth of Forth closed area prior to the closure. This is to make the fishery as comparable to the pre-closure fishery as possible. From the eligible vessels, participating vessels were selected by lot. After that, these skippers are contacted before the start of each season to confirm their intention to participate.

Each year, six fishing days for commercial fishing in the month of June are allocated to each of the participating vessels. The vessels fish following their usual patterns, but collect the same haul-by-haul information as under the detailed monitoring programme. Apart from the samples taken for DIFRES, the vessels can land and sell their catch.

3.1.3.5 Real time monitoring scheme

The real time monitoring scheme draws on data collected routinely by Danish fishery control authorities as part of the monitoring of the fishery for compliance with rules on target species and bycatch. The procedure is described in detail in the STECF Ad hoc Working Group Sandeel Fisheries report (STECF 2004: 61):

The Danish sandeel fishing fleet mainly consists of large fishing vessels (>24 m. LOA). All these vessels are obliged to have a VMS system onboard and to fill information on the fishing activities in a logbook. Furthermore, in Denmark all vessels are obliged, 3-5 hours before expected landing, to inform the Danish Directorate for Fisheries (FD) on where the landing is going to take place and the size (tonnes) of the landing. All the landings are weighed by the fish meal factories and the actual size of the landing can therefore be recorded.

Monitoring of the Danish sandeel fishery has for many years been carried out in close co-operation between the Danish Directorate for Fisheries (FD) and the Danish Institute for Fisheries Research (DIFRES).

A random sample monitoring system is routinely used to select industrial landings which are to be checked for compliance with the rules on target species and by-catches. A computer application selects the landings to be sampled based on the pre-notification of the landings.

The landings from the small meshed fishery meant for reduction purposes are sampled for species composition on a routine basis by the Fishery Inspectors. One standard sample of 10 to 15 kg is taken from each landing sampled. The samples are sorted by species and the total weight by species and the position of capture (ICES statistical rectangle) are recorded. The data are stored in the species composition database in the Danish Directorate for Fisheries. Before data are used to calculate the landings by species a quality check is carried out using information from

research and commercial vessels surveys, historical data and informal contacts in the most important ports. [...]

The Fishery Inspectors also collect samples to DIFRES from the industrial fisheries in order to obtain information on the species composition, length, weight and the age of the fish landed. These samples are stratified by month, area and fishery.

For the real time monitoring scheme, this existing data collection was adopted unchanged, but the frequency of sampling was intensified.

Thus, strictly speaking, the real time monitoring scheme is not a collaborative research project. However, it is included here because it is very much embedded in the working relations established between the fishing industry and DIFRES in connection with previous and ongoing collaborative sandeel research. This allowed frequent communication and feedback from the fishing industry. In 2005, this resulted in an extension of the monitoring scheme for two weeks in 2005, based on information from the fishing industry and the fish processing plants that indicated a late start of the fishery in 2005 compared to other years, possibly due to colder temperatures and insufficient food available to the sandeel (DIFRES 2005).

3.1.3.6 Joint fishery-independent surveys

Fishery-independent survey of sandeel have been conducted with two commercial vessels in 2004 and 2005. The vessels were selected based on practical criteria (for instance, to take samples of the seabed, a crane was required), but also because they also participated in the Firth of Forth monitoring fishery, and thus were well known to DIFRES staff.

In December 2004, DIFRES chartered the two vessels to conduct a one-week survey of the sandeel stock. The vessels were accompanied by one member of DIFRES technical staff. During the survey, they collected various kinds of data on the sandeel banks, at positions selected by DIFRES staff. This includes seabed samples, samples of plankton and larvae using a particular type of net, and samples of sandeel taken with a modified scallop dredge.

In 2004 and 2005, the two vessels collected plankton and larvae samples for DIFRES. The samples were collected by the fishermen using a particular type of net provided by DIFRES, and following instructions from DIFRES:

... we [DIFRES staff] taught the fishermen how to collect these data themselves, and we had one member of DFU staff on board for one trip or two trips, and we made a detailed manual to explain to them [the fishermen] how to do it, and then they do it on their own ...

The samples are taken during April and May at sandeel banks in the North Sea. For the plankton and larvae survey, positions are not predetermined. Instead, samples are taken at the vessels' usual fishing places at night, after their commercial fishing has ended.

3.1.3.7 PROTECT

North Sea sandeel is one of three case studies under the research project "Marine Protected areas as a tool for ecosystem conservation and fisheries management (PROTECT)". The aim of PROTECT is to evaluate marine protected areas (MPAs) as management tools. This includes the development of methods for the assessment of the effects of MPAs both on fish populations and

on the fishery.

The project, running from January 2005 through June 2008, is funded under the EU's 6th framework programme. It is coordinated by DIFRES, and involves seventeen research institutions as partners. The three case studies analyzed in detail as part of PROTECT are North Sea sandeel, Baltic Sea cod and North Sea deepwater corals. A detailed description of the project is given in the Annex I of the project proposal (European Commission 2004). PROTECT draws on existing data. Thus, for the sandeel case study, much of the data and insights on sandeel derived from previous and ongoing sandeel research projects will be incorporated.

Although the European Commission expressed their wish for "stakeholder involvement" in the project, this has not been specified. During the first phase of the project, DIFRES staff and other partners are planning to present the project at meetings such as RAC meetings and ICES meetings to those who might be interested. At a later stage, they hope to involve stakeholders more intensely to obtain feedback and input. However, costs for extensive meetings with stakeholders are not covered by the budget.

3.1.4 Budget

To a large extent, the Sandeel Projects are funded by Denmark. However, DIFRES also seeks to integrate the work on sandeel with international projects such as PROTECT (funded by the EU), in particular for the data analysis part.

Participation in the detailed monitoring programme, the Firth of Forth commercial monitoring fishery, and in the real time monitoring scheme is not compensated economically, although fishermen retain the catch (apart from small samples).

For participation in the fishery-independent surveys, the vessels were chartered by DIFRES at a fixed daily rate. For taking plankton samples, the fishermen received a certain amount per sample.

3.1.5 Some notes on the use of the data

As intended in the planning of the projects, the data collected in collaboration with the sandeel fishermen have been incorporated into a number of reports. (The data collected in the joint fishery-independent surveys conducted in 2004 and 2005 are currently being processed and analyzed, and thus have not been used yet.)

As DIFRES staff explained, the data are of very high quality. This was said of the data collected under the detailed monitoring programme:

And based on the material we [DIFRES] have received, it seems like it is working really well. There are no problems with these samples, or these journals, they are quite simply of very high quality, and very high reliability (*pålidelighed*). So there is no reason to assume that there is any cheating (*at der bliver snydt med det*). So it looks like it's really great (*rigtig fint*).

The same was said with regard to the demersal (dredge) samples collected by fishermen as part of the fishery-independent surveys in 2004 and 2005:

Q: And there was no scepticism [about these data, from biologists]?

A: There would certainly be scepticism if there were concerns about cheating with regard to the data collection. But we [DIFRES] have analysed some of the data, and there are so clear biological signals in the data that we can completely exclude the possibility that there has been any cheating, the data they collect are simply of so high quality. If we check them at the level of individual samples, it seems to be completely trustworthy.

Q: How do you check that?

A: There are so strong signals in the individual samples ... If a sample was taken at a different place or time than the others, you would see that it would differ from the other samples, [...] and it would look quite strange, because the signals are so strong.

While the data apparently were readily accepted by biologists, it seems that fishermen remained more sceptical about biological data and, deriving from that, biologists' knowledge, on sandeel. DIFRES staff noted that there was "enormous scepticism" among fishermen about biological methodology, including data collection:

There is an enormous scepticism. I would not say distrust (*mistro*). The fishermen don't think we'll misuse the data, but they are worried that the data we have aren't good enough, or that we don't know enough so that our results are believable. [...] I think their scepticism is about our [lack of] skill to use the data, and that the data are not good enough to say something about the stock. I think that's their biggest scepticism that what we are doing isn't good enough.

This was also apparent in conversations with all of the fishermen I spoke to, who agreed that biologists had a very limited knowledge of sandeel. Their statements clearly reflected their current concern with the closure of the sandeel fishery following scientific advice based on stock assessment using data from the real time monitoring scheme. They felt that "the biologists don't know what's out there" with regard to stock size, but also with regard to the reasons underlying the decline in stock size. Thus, they questioned the basis for the biological advice underlying the closure and, perhaps most importantly, possible future regulations:

Yes, there is very close collaboration with regard to sandeel, and I heard the biologists say that it's an incredible amount of work the fishermen have done. And without this collaboration, the biologists would not know anything about sandeel. What they know about sandeel, that's what we told them, by and large. And now we have to be careful that they don't think they know everything, and can start to recommend future catch levels. Because that's not possible.

Data collected on fishing grounds through interviews and questionnaires, as well as the samples collected under the detailed monitoring scheme have informed a report on population dynamics (Jensen et al. 2001) and into a DIFRES report giving an overview over sandeel biology, population dynamics and stock structure (Jensen et al. 2002). DIFRES staff noted that the results from the analysis of the samples collected under the detailed monitoring programme corresponded closely to the fishermen's experience:

It [the detailed monitoring programme] started in 1999, and then it just continued, and we simply continuously reported our findings back to the fishermen. And that was very interesting (*spændende*), because our findings corresponded closely with what the fishermen say and what they know, or know intuitively (*have på fornemmelsen*). And it's great (*fint*) for them to get that documented. Because we

document it for use in fishery management.

The data collected from the commercial monitoring fishery in the Firth of Forth area have been included in a report to the European Commission (Wright et al. 2002). The effects of the closure will be evaluated again in 2005 in connection with PROTECT. PROTECT will also draw on data collected during the fishery-independent surveys conducted in 2004 and 2005. Together with hydrographic data, the larvae data will be used to map patterns of larvae movement between banks.

3.1.6 Challenges encountered during the projects

Participants agreed that by and large projects had become routine. For the most part, they were running smoothly. Perhaps the main challenge encountered was the establishing and maintaining of good working relations between DIFRES and fishermen. There was (and is) by no means undivided support among fishermen for the collaboration with biologists:

Well, there always has been a lot of scepticism as well about working together with biologists. And I am sure there were some who thought it was wrong to establish that collaboration with [DIFRES]. There are many fishermen who think that the more biologists know, the worse the situation becomes for fishermen – that regulations become more idiotic (*åndssvag*), and the more regulations there will be. So there are many different opinions about how advantageous (*godt*) it is to collaborate with biologists.

Relations became especially tense at times when regulations became more restrictive:

For instance at the moment, the sandeel stock is said to be very low, and of course this means a lot for our collaboration, it becomes very tense, because [DIFRES'] work can have some very serious consequences for [the fishermen]. So it's obvious that the collaboration will become very tense, and you cannot avoid that.

Thus, participants noted that setting up and maintaining the collaboration required considerable time, attention and energy. To this end, personal meetings between DIFRES staff and fishermen, as well as information about the research and explanations about research procedures and findings, and openness for fishermen's suggestions on part of DIFRES were seen as crucial.

In contrast to relations with DIFRES staff, skippers noted that relations with UK observers onboard were not always as good.

Other difficulties were mentioned occasionally (by only one individual, or not more than once by two individuals). These included time/ staff constraints, incompetence in one member of DIFRES technical staff participating in one of the surveys, differences in measurement systems used by fishermen (*favn*) and biologists (metres), and finding skippers willing to participate in fishery-independent surveys. Finally, because of low catches in the Firth of Forth area in 2005, vessels participating in the monitoring fishery did not use all of their allocated six fishing days.

Being still in its early stages, PROTECT experienced its own challenges. These included the involvement of stakeholders, which had not been clearly defined (thus raising the question of whom to involve, and in what ways), and for which there had not been allocated much of the budget. Stakeholder involvement also presented a "communication challenge", namely to overcome pre-conceived stereotypes and clearly explain the nature of MPAs as a management tool to stakeholders. Further, there was some concern that existing conflicts between fishermen

and biologists in some of the participating countries might have negative effects on PROTECT.

3.2 Fishermens' influence on the projects

The projects have been initiated and organized by DIFRES staff. Fishermen are involved in several ways. First, some of the projects take up information provided by Danish sandeel fishermen. For instance, Dana surveys were planned based on information on fishing grounds obtained from the fishermen. Another example are the fishery-independent plankton surveys, following up on fishermen's statements that they could estimate the yields in the next year's fishery from the number of young sandeel they observed in the preceding fall:

But the other kind of data collection originated from what the fishermen told us, namely that at the end of a season they have a good idea of how good the next year's fishery will be. And that's because they have sporadic catches of young of the year (*ynge*), and they can see young of the year on their acoustic instruments. So they say if they see a lot of young a lot of places, then it will be a very good sandeel year. [...] But this [this information] was not acceptable in the scientific community (*Men det vil man ikke i videnskabelige kredse acceptere*), you (*man*) cannot say "the fishermen say at there will be a large year class, so let's set the catch limit based on that". You cannot do that (*det vil man ikke*), you have to document it in some way (*man vil have en eller anden form for dokumentation*). And that's of course ... I can certainly understand that. And that's in fact what we tried, we simply gave the fishermen a tool (*et redskab*) so they can collect samples of what they are observing, in such a way that you can base calculations on it, and quantify what they see. So it actually originated in what fishermen observed, and we then tried to document it in collaboration with the fishing industry.

According to DIFRES staff, fishermen also suggested to provide samples of their catches to DIFRES, a suggestion taken up in the detailed monitoring programme.

Second, projects are sometimes modified because of information and suggestions from fishermen. One example is the extension of the real time monitoring scheme with two weeks in 2005, based on information from the fishing industry and the fish processing plants that indicated a late start of the fishery in 2005 compared to other years (DIFRES 2005). This may have been due to colder temperatures and insufficient food available to the sandeel (DIFRES 2005), as a DIFRES member of staff explained:

A: [The fishermen's] biggest concern was that the fishery started very late this year because it has been very cold, so the sandeel have been at the bottom, and that resulted in very small catches. And then, that the basis for our calculations was wrong. And that's what we so have been in dialogue with them about.

Q: And that was also why you extended the monitoring period this year?

A: Yes. Because among other things the [fish processing] factories showed us some data that showed that the oil content in sandeel had been much lower this year than previously, and that could be an indication that they haven't been eating. They can have been out, but then they have simply not got enough food, because then the oil content would have been higher. And that could mean that they [fishermen] have been right that a larger part of the sandeel hasn't been as active as they usually are.

And the numbers have shown that as well, that they were in part right, because there was a marked increase in the catch rates, and that has changed the calculations. So one can say it has been really good (*ganske udmærket*) that we have been in dialogue with them.

Third, as described above, data collection takes places in collaboration with particular skippers, or by skippers themselves. They provided catch samples and information on commercial fishing (interviews; Dana surveys; detailed monitoring programme; Firth of Forth monitoring fishery), provided research platforms (fishery-independent survey), and took plankton samples (fishery-independent survey). Much of this is described as "routine" by participants. However, especially in the beginning of the project, the skippers involved are consulted regarding some of the practical details of the proposed data collection. In one case, a skipper also spontaneously suggested an additional haul during a survey:

A: Yes, there were some positions that the skipper selected. [...] There were some positions where he said "we'll just try there". And they [these positions] were better. And in one place called ABC, [DIFRES] had set one position at the northern end – but [the fishermen] never catch fish there. So he did a haul in the middle of the bank, and then there were fish in the dredge.

Q: Was that spontaneously, or had that been planned beforehand?

A: No, that was just something that [DIFRES staff on board] and [the skipper] ... He said that "we never catch any fish there", and there was nothing in the sample either that they had taken [there that day for the survey]. So he said "let's just try there in the middle of the bank".

Fourth, fishermen are informed about the outcome of surveys at regular bi-annual meetings in Charlottenlund that are held to inform fishermen about the most recent ICES advice. In addition, two large conferences were held in 2002 and in February 2005 to inform the fishing industry about the results of the sandeel research. At these meetings, fishermen have the opportunity to comment. In addition, fishermen can and do contact DIFRES staff directly with questions and/or comments.

3.3 Participants' evaluation of the projects

This section provides a description of the evaluation of the projects by those I spoke to, during some part of the interview⁷. Note that as with the evaluation of the Kattegat Sole Project, this is based on explicit statements, in answer to open-ended questions. Thus, a given view may actually be shared by more informants than indicated by these statements.

Going back to the late 1990s, participants agreed that by and large the collaboration between fishermen and DIFRES staff in research projects on sandeel has become "routine". For the most part, they seem to be running smoothly. Overall, the projects seemed rather unremarkable routine activities to those involved, and did not occasion strong statements, neither positive nor negative.

⁷ Descriptions in this section do not include PROTECT, as this is just starting.

Participants noted the "goodwill" on both sides, the accessibility of DIFRES staff and their willingness to listen. All of those I spoke to seemed to have a balanced view of the relationship, characterized by occasional "rough going" and slow reactions to enquiries, but by and large a good collaboration.

The effects of the collaboration in the Sandeel Projects on relations and collaborations between fishermen and biologists was a major concern of DIFRES staff. They hoped that the successful process of collaboration might have positive effects on other similar projects, and on the relation between DIFRES and the fishing industry more generally:

... because it will be good for them to know that it is possible to influence us, that if they come with arguments that we then follow up on that. So that this is nothing that is just decided over their heads, without making any sense. And it has also been great (*rart*) for us that we can show that we of course listen to them, and if we think there is something in what they say we take note of that and do something about it. And we hope that this contributes to more credibility (*større troværdighed*) for what we are doing, and more trust (*større tiltro*) that what we are doing is right, and that one then can more readily accept the results coming out of it.

Several of those I spoke to felt that the collaboration had indeed improved with time, as a result of a series of collaborations that led to increasing mutual understanding:

I think that the collaboration between fishermen and biologists has been strengthened in the last years. There is much better understanding of the biologists by the fishermen, and also the other way round. I think that has been strengthened, and there is a better understanding both ways. You can say that if there are some minus'es – and there are always some of course – I am not sure if they really understand each other. In a lot of questions there is often disagreement (*man er tit uenig*) with regard to the approaches taken. The fishermen think what the biologists do is somewhat wrong (*arbejder lidt forkert*). And the biologists probably think as well that the fishermen XXX. But generally speaking, the collaboration has improved a lot.

For DIFRES staff, the high data quality was another positive point. It was also felt that extending the real time monitoring scheme with two weeks in 2005 had improved the quality of the assessment provided on basis of these data.

Most of the projects aim at more general questions of sandeel biology rather than stock assessment *per se*. The fishermen who participated in the projects found them relevant and necessary in order to obtain a better understanding of sandeel biology, and were personally interested in the results. Although some of the other fishermen were curious about the results, most were less interested, as the results were not regarded as having an immediate direct effect on the fishery:

... there are one or two who ask frequently, but apart from them there is nobody.
[...] I don't think they think it's that important, they are indifferent about it.

With regard to the Firth of Forth monitoring fishery, this may also be due to a certain degree of resignation:

We would like to have it opened, but they want to keep it closed, because of the precautionary principle. Once they have closed some area, we know it will never be opened again. Even if there is no basis for keeping it closed.

Similarly, a member of DIFRES staff noted that they had received no response from the European Commission to their 2002 report evaluating the closed area (Wright et al. 2002).

By contrast, there probably was no lack of interest in the advice based on the real time monitoring scheme. While the finding that the stock was at a very low level corresponded to the fishermen's own experiences, they did not see the point of closing the fishery:

Yes, they [the estimates based on the real time monitoring scheme] are sensible enough. Because there isn't as much sandeel as there has been. We have to face that. We can see that ourselves. We lack the fish we need. So ... It's sensible enough, but ... I don't think it will help anything to close the fishery. I don't think so. I think we'll catch just as little, or just as much.

Further, fishermen were concerned that the closure might set the precedent for future regulations based on stock assessments. As mentioned above, all of the fishermen I spoke to had serious doubts about the biologists' knowledge about sandeel in general, and about their current ability to estimate stock size in particular, as indicated by two of those I spoke to:

But how certain/ safe (*sikker*) is that? How likely is it that there is less – there could as well be 50% more, just because we were at the wrong places, it gets 50% less. I don't think they can calculate how many fish there are. Not at all. Just look at the blue whiting, and how they overfish it one year after the other. And they still catch two and something million tons. Per year. And it's set down to 800 000 tons that they are allowed to catch. So ... I don't think they can tell how many fish there are.

What they know about sandeel, that's what we told them, by and large. And now we have to be careful that they don't think they know everything, and can start to recommend future catch levels. Because that's not possible.

4 Informants' perspectives on collaborative research in Denmark

4.1 "Collaboration"

Participants both in the Kattegat Sole Project and in the Sandeel Projects described these as "collaboration" (*samarbejde*). They were described as a dialogue (*dialog*) between the fishermen and DIFRES staff, characterized by listening (*lytte*) and openness (*lydhørhed*) for suggestions made by the fishermen. This resulted in joint decision making, rather than decisions made single-handedly by DIFRES staff, as described by two of those I spoke to:

So one can say it has been really good (*ganske udmærket*) that we [DIFRES] have been in dialogue with them [fishermen]. Also because it will be good for them to know that it is possible to influence us, that if they come with arguments that we then follow up on that. So that this is nothing that is just decided over their heads, without making any sense. And it has also been great (*rart*) for us that we can show that we of course listen to them, and if we think there is something in what they say we take note of that and do something about it.

[The decision] was a result of holding meetings about how we were going to do this. This is how I think a collaboration works. [...] It's a good collaboration where both parties make suggestions and we set up a shared project.

Motivation to help, rather than to harm, the other was mentioned as criterion by two of those I spoke to. Thus, comparing trips with on board observers under the discard project to the Kattegat Sole Project, one remarked:

Well those one-day trips, I don't know if I would call that a collaboration with biologists, I have more the impression that they are interested in all this discard in order to constrain us (*bremse os*). With the other one [Kattegat Sole Project] you could see what it was for. But with this, personally I have the impression that it is mainly in order to damage (*skade*) us.

Mutual trust (*tiltro; tillid*) and understanding (*forståelse*) for the others' way of thinking and working were said to contribute to improving the collaboration.

4.2 Increase in collaborative research

Many of the people I spoke to noted that there were more collaborative research projects now than earlier, or "even five years ago", and that the collaboration between fishermen and DIFRES had been "strengthened", in spite of occasional ups and downs:

I think that the collaboration between fishermen and biologists has been

strengthened in the last years. There is much better understanding of the biologists by the fishermen, and also the other way round. I think that has been strengthened, and there is a better understanding both ways. You can say that if there are some minus'es and there are always some of course I am not sure if they really understand each other. In a lot of questions there is often disagreement (*man er tit uenig*) with regard to the approaches taken. The fishermen think what the biologists do is somewhat wrong (*arbejder lidt forkert*). And the biologists probably think as well that the fishermen XXX. But generally speaking, the collaboration has improved a lot.

"Disagreement" was occasionally linked to the personality of particular individuals, but it was said to be especially pronounced at times when regulations became more restrictive:

But if there are concrete problems or restrictions, then the going gets a bit rougher (*så bliver banen kridtet lidt op*). And the fishery sector will scrutinize the biological work for any mistakes or problems, and then they [the fishery sector] will of course point this out quite strongly – and that's of course what they should do as well. And it is clear that the fishery is very much characterized (*præget*) by regulations, and the stock has been going up and down. And it's evident that that also affects the debate, and collaborations.

The general increase in collaboration was attributed to several reasons by the fishermen and biologists I spoke to. First, faced with **increasing research costs and limited funding**, collaboration with the fishing industry became an attractive option for DIFRES, according to some of those I spoke with:

And this is of course also a time where money is not growing on trees, so it is necessary to think in untraditional ways, and find a way to generate the knowledge one needs. Because resources are limited, and it is certainly not getting easier to get funding.

Second, **regulations** had become stricter over the last years:

It's completely mad, the whole thing. It's been like that for the past fifteen years, and the regulations are becoming more and more strict. The mesh size has to be larger, and now there are so and so many days-at-sea and so and so many hours. We are under surveillance by satellite and everything, even during our spare time. The whole fishery (*erhvervet*) that I started in – what we are doing today has nothing to do with that any longer.

This put increasing pressure on fishermen and their associations to act to improve the situation. On the other hand, stricter regulations could lead to misreporting or nonreporting of catches and/or landings, thus casting doubt on the data basis for biological advice. For biologists, collaborative research therefore became attractive as a way to improve the quality of their data.

Third, the increase in collaboration was related to **better mutual understanding** between fishermen and biologists. Some thought that this was a result of previous collaborations, while one of those I spoke with saw it as part of general development in Denmark:

Well, the world we are living in the communication is getting better, and there is more understanding for the other's problems. There is not that big a distance between different social groups (*befolkningsgrupper*), and I think that it is this general alignment (*udjævning*) of attitudes and various things.

One thought this might be due to a generation shift both among the fishermen, and among the

biologists:

But I think it's also the case that there came some new people, among the biologists, who are more interested in listening (*lydhør*) to the fishermen, and their practical experiences. [...] They are more willing to listen. I also feel that this agenda where each party blames the other, that's over. That the fishermen always scold the biologists, and the biologists always scold the fishermen. We have left that behind. Now we are talking to each other. We have different attitudes, but it's not like ...

Fourth, a number of **changes in Danish society** were pointed out, that made an increasing collaboration with biologists necessary for fishermen, especially as regulations had become stricter over the last years. These changes, described in more or less detail by many of those I spoke to, can be summarized as follows. As a consequence of an increasing public concern with environmental issues, effectively highlighted by the media, the fishery now receives much more attention than previously. Thus, politicians feel no longer accountable to fishermen only, but also take into account the attitudes of other interest groups in their decision making. These interest groups are often much more powerful – in terms of funding and membership – than the fishermen's organizations. This is perhaps most elaborately explained in the following statement:

What other ways are there? Yes, there is of course the political way, where you say to the politicians "You cannot do this, because that's the death of the fishery." That's the way that has been used to date. [But] it is also because of media attention, both on fish stocks, on marine mammals, discard of fish, and all these issues, that the politicians can't ... It's no excuse to be a friend of the fishery (*erhvervsvenlig*). That's not a legitimate excuse for not following the advice of some scientists. Maybe it was ten years ago, where you could say "Well, they won't disappear this year, those cod". But it's very very difficult to do that today. [...] There are many organizations that are ... first of all, they have many more members. They have a lot of influence. So if a minister comes back from Brussels and says he is coming back with a good result, then not everybody here in Denmark will agree with him. If the fisheries minister comes back with a good result, and the fishermen and I believe also the minister believe it's a good result for the fishery, then there will immediately be some journalists who call WWF or Greenpeace and other organizations who may have reactions, and ask if they too think that it's a good result. And there they'll certainly get another reaction.

Thus, in this context, biological advice is given increasing importance by all parties involved, as the biologists are those who are believed to be most likely to be neutral, and thus believable. The fact that "politicians listen most to the biologists" was pointed out by all of the fishermen I spoke with. For this reason, collaborating with DIFRES is regarded as an important way in which fishermen can influence what is perceived as the single most important piece in the puzzle, namely the biological advice. For the fishermen, the important thing is that the biologists' stock assessment corresponds to reality and to the fishermen's experience of reality:

And the more focus and the more pressure is on various things, the more vital it becomes that the scientific advice is in agreement with, first, the stock. And second, fishermen's experience of the stock. [...] If we know that the advice is correct, then it will also be acceptable to decrease the fishing pressure. [...] But if the stock increases, and the biologists recommend a decrease in fishing, then we cannot find any ... then we have to tell the politicians "This here, this is incorrect (*forkert*)". And if we are good enough, we can also convince them that this is the case. But the way you really can change this, this is if you can change the biological advice through a

collaboration. That's by far the easiest way. Because that does not result in any trouble, neither for the politicians nor for the fishermen.

In the view of some of those I spoke to, such a collaboration between the fishery and biologists was also encouraged from the political side, in particular by the new minister responsible for fishery in Denmark.

4.3 Collaborative research in context

From the above, collaborative research in Denmark seems to be part of a new alignment of the actors involved in fishery management. Instead of facing each other as potential opponents, fishermen and biologists are increasingly perceived as working together as partners towards the common goal of providing accurate stock assessments and realistic biological advice. This is schematically represented in Figure 2.

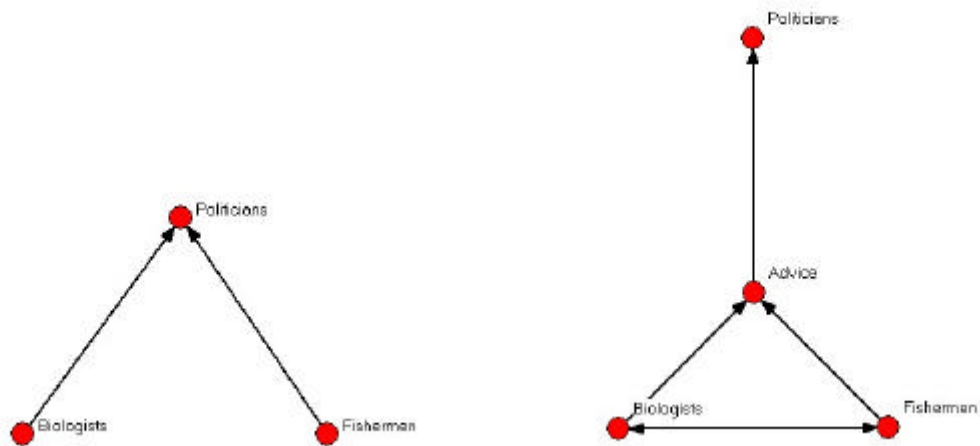


Fig. 2: Schematic representation of perceived relations of influence between biologists, fishermen and politicians. *Left*: Fishermen and biologists as potential opponents. *Right*: Fishermen and biologists in collaboration. Arrows indicate direction of influence. Created with Ucinet 6 (Borgatti et al. 2002).

While the relationship between fishermen and biologists is still described as troubled by "ups and downs", and dependent on individual goodwill and cooperativeness, it may eventually make the stock assessment process and the biological advice more open to fishermen. By contrast, it seems that politicians, and especially those Brussels, are increasingly regarded as a rather removed and almost inscrutable third party. Many of those I spoke with agreed that politicians in Denmark were difficult to reach, let alone influence:

It is difficult to get through. Because you can have a meeting with people from the Fishery Board (*Fiskeriudvalget*) and those people, but the second they go out of the door, they have forgotten we even had a meeting! We have been talking to several people from the Fishery Board and explained the situation to them, and have given them documents about it, but as soon as they go out of the door, they've forgotten all about it. Then it's no longer of interest to them. You can see for yourself how interested they were in the Danish fishery until the election XXX. And we put a lot of pressure on them everywhere we could, but it's no use if they forget us as soon as they walk out of the door.

As mentioned above, by some this was attributed to the presence of other interest groups such as environmental organizations, both in Denmark and at the EU level. Some of the fishermen I

talked to felt that Danish politicians were powerless compared to the EU. Others thought this was due to political negotiations, especially at EU level in Brussels. This was even more critical, as many pointed out that these negotiations could override even the biological advice:

Because the biologists are those who have to come with a TAC for the politicians. So you have to try to influence them from that end, rather than from that end. If the biologists come with a higher TAC to the politicians, then they have to ... But it's like horse-trading, the whole thing. It's not something you really know [?] what they are doing, it's like horse-trading, the whole political thing. [...] "You get some more quota here, and then we get some more agricultural subsidies." It's like the worst kind of horse-trading.

In spite of this, in the view of the fishermen I interviewed, biological advice still remained the most powerful influence on politicians that was accessible to the fishermen and their interest organizations.

Collaborative research has to be seen in relation to participants' perception of this social space. It is a means to an end, rather than an end in itself. For the biologists, it is a way to obtain data of high quality. For the fishermen, it is a strategy for influencing the regulations affecting the fishery. As evident from the above, this can be described as a two-step process. The first step is to influence the biological advice, in such a way that it corresponds as closely as possible to "the stock [and] fishermen's experience of the stock". In the second step, politicians decide on regulations on the basis of the biological advice.

Collaborative research plays a role in both steps. With regard to the first step, collaborative research was seen as the easiest way to ensure both the relevance of the research to the fishery's and the biologists' needs (by initiating relevant projects) and the accuracy of the findings (by allowing input from all involved). This was reflected in sound biological advice. In the second step, by aligning the position of the fishery with the biological advice, it was expected that this would make it more compelling to politicians.

Consequently, it seems that the fishermen evaluated collaborative research projects mainly in terms of their usefulness in this endeavour to influence biological advice and ultimately, the regulations affecting the fishery.

For instance, the Kattegat Sole Project was designed to provide information on stock size through private logbook data and the monitored commercial fishery, in order to affect the current TAC. The project was regarded as highly relevant, and was clearly evaluated primarily in terms of its outcome.

By contrast, the Sandeel Projects were by and large regarded in a more neutral way. Being more long-term and addressing more general questions of fish biology, these were not perceived as being of high immediate relevance for the fishery, although some of the fishermen were curious about the results. However, fishermen hoped this research might give biologists a better understanding of the resource and thus, in the long run, improve their assessments.

In both projects, biologists pointed to the high quality of the data.

In neither of them was the collaborative nature of the research an end in itself. Rather, what is crucial to those engaging in collaborative research are the relevance of the research topic, and the outcome of the project – its accuracy, and (for the fishing industry) its effects on regulations.

4 Conclusion

Collaborative research plays an increasingly important role in contemporary fishery management. As described above, this does not seem to be accidental. Rather, the Danish fishermen and biologists I talked to suggested that this might be part of a larger trend in Danish society, as environmental organizations and other new stakeholders become involved in fishery management. Faced with an increasing number of interest groups, politicians tend to use biological advice as their guideline. In addition, it seems that politicians attempt to pass on the arbiter role as far as possible to the institutions formulating the advice. Encouraged by political institutions, fishermen and biologists are increasingly perceived as working together as partners towards the common goal of providing accurate stock assessments and realistic biological advice. Being part of a new alignment of the actors involved in fishery management, for the fishermen collaborative research is a strategy for influencing the regulations affecting the fishery. While these statements are limited to Denmark, it appears nevertheless that this may be part of a larger trend, at least in a European context, and might be worth studying further.

Seeing collaborative research in relation to fishermen's perception of this social space helps to understand fishermen's perceptions and evaluations of collaborative research projects. In the two case studies described in detail, the Kattegat Sole Project and the Sandeel Projects, they were well aware of the strategical role of collaborative research. Indeed, for the fishermen, this was an important reason – and perhaps their most important reason – for participating. Although economic factors were certainly taken into account, they did not seem to be decisive in the decision to participate. Interestingly, in some cases, participating in joint fishery-independent surveys also provided a cost-free way to acquire new knowledge about fishing grounds and fish biology.

As noted above, the fishermen evaluated the projects largely in terms of their relevance, the accuracy of the results, and ultimately their effects on regulations. This clearly reflects the role of collaborative research as a means to an end, rather than an end in itself. What ultimately mattered to them was the effect on regulations, achieved through relevant research and accurate results.

Further, looking at the process of collaborative research itself, participants' descriptions and evaluations of the Kattegat Sole Project and the Sandeel Projects suggested that the perception of the process as successful largely depended on two things. First of all, on a feasible research design. Second, on direct and personal (rather than indirect or written) contact between participants in the project, which helped to include information and comments from project participants, and to identify and solve any potential problems as soon as they arose.

Both factors are crucial to the completion of the project – an obvious precondition for improving the quality of the assessment and exerting an influence on regulations. The accuracy of the results of these projects obviously depended on the methodological soundness and the feasibility of the research design. Adequate communication both ensured the relevance of the project to participants' purposes, and contributed to the inclusion of available pertinent information (and

thus to the accuracy of the results).

However, the effect of the results on the regulations was not immediate. For those involved in these projects, this caused not only disappointment, but also some resignation. Nevertheless, given the social and political context, collaborative research was still perceived as the best way to influence regulations that was available to the fishing industry.

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