Chapter 9
Trapped in the TAC Machine

Making a fisheries based indicator system for coastal cod in Steigen, Norway

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Abstract

The GAP project is concerned with the lack of stakeholder participation in providing knowledge for management. This creates a legitimacy problem as the fishermen do not get to share the knowledge basis for and justification of management decisions. In addition, fishermen's experience-based knowledge remains unused. GAP intends to bridge the legitimacy and knowledge gaps, finding practical ways for fishermen and scientists to co-create the knowledge basis for management. In this paper, we explore whether and how such co-creation can be achieved. We do that in the context of one of the GAP case studies, which set out to establish and test a fisheries-based indicator system for coastal cod in Steigen, Norway. The inspiration for the case study was the Norwegian Reference Fleet, in which commercial fishing vessels are used as platforms for data collection. In GAP, however, we did not simply aim for a replication of the reference fleet model. We were much more ambitious, dreaming of a project that would allow deeper engagement of fishermen. Our strategy was to break out of the strict framework of top-down management and create a cooperative platform that would also open up for fishermen's own insights and experiences. Inspired by collaborative research ideals, we sought equal

partnership and true collaboration, where science and experience-based knowledge together would pave the way to a sustainable future. Based on four years of work, the conclusion is that we failed. In a technical sense, we did what we promised, setting up a fisheries-based indicator system for coastal cod. We ended up exactly with the type of project we tried to transcend, a mini version of the reference fleet. In this paper, we tell the story about how and why we got trapped in the TAC machine.

Introduction

The GAP project is about the absence of cooperation among fishermen, scientists and managers. And about how this – which is acknowledged as a major barrier to sustainable fisheries – can be remedied. The days when fisheries scientists would explicitly reject fishermen's knowledge as useless for management purposes are gone. Instead, we have seen a marked turn in fisheries governance, by which stakeholder participation in general and fishermen's knowledge in particular are accepted as important and valuable. At least, this is how it appears. Whereas this turn no doubt is an improvement in itself, questions remain about what it means and how far it goes. While bridges may have been built, we know less about the traffic they carry and the extent to which they have contributed to closing the underlying gaps.

One important expression for the participatory turn in fisheries governance is the emergence of Fisheries Dependent Information (FDI). FDI is a relatively recent approach for providing knowledge for fisheries management purposes (Graham et al 2011, Hind 2014). As the label indicates, FDI stands in contrast to a previous approach, by which fisheries scientists would seek data involving fishermen as little as possible, for instance by relying mainly on scientific surveys for input in assessment models. FDI, then, involves research in which fishermen and commercial fishing vessels are involved some way or another. The emergence of FDI raises a number of interesting questions concerning its origin, purposes and variations. There is little doubt, of course, that FDI does include fishermen in research for management purposes. But does it allow the establishment of a common knowledge basis? The reason for asking this question, which perhaps suggests some skepticism, is that the degree of fishermen involvement in FDI is typically on the low side, doing basic data collection and sampling, and providing their vessels as research platforms. What fishermen are actually allowed to do here is very much under the

control of scientists. With Hoefnagel et al (2006) we can say that FDI is based on a deference model, in which scientists make the rules of engagement, and fishermen leave all important questions to be decided by scientists. As this indicates, FDI may work towards a common knowledge base, but primarily by allowing fishermen a peek into the world of science. This is not unimportant in itself. If fishermen learn to talk the talk of science, they may be able to express their insights and concerns in a way that could be more persuasive to scientists and managers (Hartley and Robertson 2009). This may be a step in the right direction, but remains quite far from the ideas of equal partnership usually promoted by the champions of collaborative research (NRC, 2004; Haggan, Neis and Baird, 2007; Johnson and van Densen 2007, Mackinson et al 2011).

These are the issues we want to explore in this paper. Would it be possible to go beyond the deference model, constructing a collaborative project that would allow deeper engagement of fishermen. Could we break out of the strict framework of top-down management and create a collaborative platform that would also open up for fishermen's own insights and experiences? Inspired by collaborative research ideals, we sought equal partnership and true collaboration, where science and experience-based knowledge together would pave the way to a sustainable future.

We did that in the context of one of the GAP case studies, aiming for the establishment of a fisheries-based indicator system for coastal cod in Steigen, Norway. The inspiration for the case study was a typical FDI project, namely the Norwegian Reference Fleet (NRF) (Bjørkan 2011). The NRF is a project run by the Institute of Marine Research (IMR), the Norwegian variety of the state-owned, marine research institutes in Europe, authorized to provide and certify knowledge for management purposes. In the NRF, commercial fishing vessels are used as platforms for data collection, and fishermen are engaged to collect data and samples under instruction from IMR.

As we designed the Steigen CS, the GAP team already knew the reference fleet quite well. IMR, the reference fleet owner, was included as a partner in the GAP project, represented by scientists who knew it intimately. In addition, one of the fishermen in the GAP project had previously owned and operated a vessel participating in the reference fleet. Finally, one of the researchers, working full time on the GAP project, had written her PhD thesis on the reference fleet (Bjørkan, 2011). Nevertheless, in GAP we did not simply intend to do a reference fleet type

project all over again. On the contrary, we were much more ambitious, aiming for a project that would allow more and deeper engagement from the fishermen. Inspired by the GAP ethos, we imagined a fully developed collaborative project. In the Steigen project, then, the fishermen themselves would be able to take an active part, not leaving all important decisions in the hands of the science partner. We did not want a project where fishers would collect data as prescribed by science, to feed into existing assessment models. Our strategy was to break out of the strict framework of top-down management – the TAC machine (Holm and Nielsen 2004; Schwach et al. 2017; see Chapter 2) – and create a cooperative platform that would also open up the fishermens' own insight and experiences. Inspired by the collaborative research ideals, we started out with the dream of equal partnership and true cooperation, where science and fishermen's experience-based knowledge together would pave the way to a sustainable future.

After four years of work, we conclude that we failed. It wasn't a spectacular failure. We have carried out what we promised, setting up a fisheries based indicator system for coastal cod. During the project period, fishermen collected data and samples on a regular basis, providing information that is useful for management purposes. If the project had been allowed to live on after the end of GAP, it could have produced an indicator series useful for assessing the status of coastal cod. In some ways, the fishermen were allowed more responsibility than in a typical FDI project. For instance, the fishermen succeeded in getting extra funding for the project, allowing us to extend the sampling program. All in all, however, the ambition to have the fishermen take control, to provide better access for and usage of fishermen's experience-based knowledge, to break the privileged position of science, did not succeed. On the contrary, we ended up exactly with the type of project we tried to transcend, a mini version of the reference fleet.

In this paper, we tell the story about how and why this happened. In the first section below, we describe the fisheries and management context for the project, focusing on the fascinating story of Norwegian coastal cod. In the following section, we describe the practical work of carrying out the project and how we ended up where we didn't intend to go. This leads to a final discussion, where we summarize our experiences and try to account for the reasons why we remained trapped in the TAC machine.

Norwegian Coastal Cod

In order to achieve our goal – a project that would give fishermen a strong hand in knowledge provision as well as a platform for integrating science and experience-based knowledge – the choice of research setting was crucial. The basic framing for the GAP case studies was participatory research for *management purposes*. Ideally, we wanted our project to come up with knowledge products with a potential to affect management decisions. This meant that we would have to start with some management problem, for instance a fish stock for which management measures were in place, but perhaps not working as intended. Nevertheless, it did not seem like a good idea to focus on the main commercial stocks, already caught up in the routine stock assessment procedures. For such stocks there is already a well-developed knowledge infrastructure in place, and it would be little hope that our tiny project could contribute anything useful. On the other hand, it wasn't tempting to go to the other extreme, focusing on marginal species like mussels or ling. Then there would be no demand for the knowledge products, and the project would not be able to prove anything one way or the other. What we needed was something in between the centre of things and the margins.

It was not really difficult to find our target: Norwegian coastal cod (NCC). NCC is a sub-category of Atlantic cod, *Gadus morhua*. In North Norwegian waters (above 62˚N), there are two main types of cod. In addition to the NCC, which mostly remain along the coast and in the fjords throughout the year, there is the North East Arctic cod (NEAC). The NEAC is a dominant natural resource in the Barents Sea. The stock is managed jointly by Norway and Russia through the Norwegian-Russian fisheries commission. In historical, economic and political terms, the NEAC is big and important, whereas the NCC is small and relatively insignificant. What is crucial, however, is that the NCC and the NEAC stocks are harvested in mixed fisheries. The two stocks have been (and still are) managed under a common quota regime for the whole area north of 62˚N. For the NEAC, this works great. There is a well sophisticated assessment system, a comprehensive management plan, and the stock status is well within precautionary approach criteria (ICES 2008:24-26). For the NCC, in contrast, the situation is different. While this stock is included in the management regime, the main focus remains with the NEAC. The minority status of the NCC means that it usually cannot sway the decisions in its favor. As a result, this stock has decreased considerably over the period 1997-2005 and has remained low since then. ICES has recommended zero catch for the years 2004-2011. These recommendations have not persuaded

management authorities, mainly because it would be difficult to implement without shutting down important parts of the NEAC fisheries. Instead, a less ambitious rebuilding plan (ICES 2008:38, ICES 013) has been adopted. The management of NCC north of 62˚N included several technical regulations, stricter inside fjords than outside. There were no regional differences in the regulations. Two important spawning areas, one close to Svolvær in Lofoten (68˚N) and one close to Ålesund (62˚30'N) are closed during the spawning season. While the rebuilding plan may have prevented a stock collapse, it was not immediately successful in rebuilding the NCC stock. The stock has been reasonably stable since 2005, but has remained at a very weak state and has not responded well to the management measures in place. In its 2014 advice, ICES' stated: "The survey indicates that the SSB is close to its lowest level" (ICES 2014).

The NCC assessment is widely considered – also among scientists – to be inaccurate. This is partly linked to the question of stock structure and the difficulties in differentiating between NCC and NEAC. In addition, the methodology in the standard coastal cod survey is to a large extent dependent on trawling (Aglen et al. 2008). This means that the bottom topography represents a challenge, since trawling is not possible over large areas of the Norwegian coastal zone. The way stock assessment is carried out is also an issue for debate due to the limited number of sample events over the course of the year. Such knowledge gaps have been recognized both by the management authorities and the fishermen. As part of an effort to improve the management of coastal cod resource, the Norwegian Ministry of fisheries and coastal affairs in 2005 established a task force to evaluate the existing knowledge base for the management of NCC. One of the recommendations was, besides indicating a need for more research, that models for geographically differentiated management regimes should be considered (Anon 2005).

From the perspective of the GAP project, the NCC provided an ideal context for a case study, with the absence of a solid and shared knowledge base for management. Although we can take note of the divergence views on stock development between the fishermen and the scientists, there was no deep and systematic polarization. The absence of a solid knowledge base naturally established a situation where different stakeholder, according to the interests at stake, could emphasize different viewpoints. Nevertheless, there was actually agreement among managers, scientists and fishermen that the knowledge base on NCC is weak and should be improved (Anon

2005). In this situation, a GAP case study on NCC could offer exactly what the situation demanded.

Furthermore, since the knowledge problem related to NCC was intimately tied to the unresolved question of stock structure, a relatively small and localized case study, as available funding suggested, would be appropriate. From an IMR perspective, such a case study was considered to be a good opportunity to learn what could be achieved by collecting more local information and local scientific data.

As the geographical location for our case study project, we quickly settled on Steigen, a fishing community and municipality in Nordland County. The reason for this had more to do with the early involvement of local fishermen from Steigen than with the strategic location of Steigen in relation to the research issue per se. Nevertheless, the rich natural environment together with a complex socio-economic setting makes Steigen a good location for the project. In Steigen, more than a thousand small islands are scattered in this large fjord area. Here we find spawning and feeding grounds for several important species of fish, of which cod is the most important. Steigen has known spawning grounds for NEAC as well as stationary and migratory stocks of NCC.

The Project in Practice

The aim of the project was to set up and run an information system sophisticated enough to produce data acceptable for management purposes, while robust enough to be operated as an integral part of on-going fishing operations. Since the project was intended to build a common knowledge base for fishermen and scientists, it was important to have active fisher participation in all phases of the project. Keeping with the guidelines on participatory processes (Johnson and van Densen 2007, Mackinson et al. 2011, 2017), fishermen should participate in the planning and method development, do data collection and contribute with local knowledge. That was the plan. Here we report how it worked out in practice.

Finding Common Ground

In contrast to many of the other Case Studies (CS) witin GAP, the Steigen CS was not anchored in collaborative networks established previous to GAP. In practical terms, the first time the would-be partners met in the context of GAP was in a meeting at the Fishermen's Association's offices in Trondheim in 2008. Initially, the UiT partner had started with an idea to work with the

model developed within IMR's "Coastal reference fleet", in which selected vessels are engaged in systematic collection of data for assessment purposes (Bjørkan 2011). However, this was just one possibility and a starting point for the discussion in Trondheim. The meeting here was one in which all ideas were welcomed. We discussed central notions such as fishermen's Experience Based Knowledge (EBK) and how it differs – or not – from scientific knowledge. Another issue was how EBK could be used for management purposes. The fisher representative, Jan Andersen, was very engaged and eager to test some of his experience-based knowledge. One of the issues he drew attention to, was that of moon phases and if they affect the catch rates of fish. The UiT scientists, Petter Holm and Maiken Bjørkan, talked about their research on knowledge production for fisheries management. At this meeting, agreement was reached that the reference fleet model would give a too restricted role for the fishermen. It was decided instead that we would develop a fisheries based model targeting coastal cod. A key point was to make sure that the project would allow the fishermen to take an active part in the design and implementation of the project.

During the second project meeting in 2009, also in Trondheim, it was decided to focus on the Steigen area. The partners had agreed that a regionally based project concerning the use of the coastal zone would be desirable. The home area of Jan Andersen, Steigen, has important spawning grounds for several ground fish stocks and there is known spawning sites for the Norwegian Coastal Cod. At the same time, this is also a crucial area for the coastal fisheries, occupational as well as recreational.

The third meeting was held in Steigen in 2009, and engaged with the practical design and planning of the project. At this meeting, the IMR was drawn in for the first time and presented their viewpoints on how the GAP project could be undertaken. Knut Sunnanå, the IMR scientist, emphasised the limitation of the existing knowledge on NCC, since the current surveys only cover areas where trawling is possible. These areas, however, only constitute a minor part of the coastal zone. In addition, the catch statistics are not accurate enough to give a precise measure of the fishing pressure in the fjords. Together this implies that getting a full overview of the stock situation is difficult under the current survey regime. A better resolution could be achieved if local fishermen were engaged in data collection, as intended by the GAP CS. The IMR also pointed out that there were no stock abundance indexes for gear types other than trawl.

Methodological development was therefore of great importance. There was a need to develop standardized gear for measurement purposes.

On the basis of the IMR perspectives on the possibilities, we went on to the key issues of developing a specific project idea for GAP. First, we identified possible issues and areas of concern. In Steigen there are several marine species that could become interesting subjects to further research, for instance redfish (*Sebastes marinus*), halibut (*Hippoglossus hippoglossus*) or common crab (*Cancer pagurus*). Still, it was agreed that the NCC would be of greater interest, particularly because of its relevance to ongoing matters in the Norwegian fisheries management sector.

Second, we discussed the relevant research question our project could engage with. This revolved around the many puzzles regarding the different types of cod in Steigen. What is the abundance and patterns of local cod resources in Steigen? Where do we find the stationary fjord cod, and where is the migrating coastal cod dominant. How does the NEAC mix with the NCC? How separate are the different stock components? What are the migration patterns for the different kinds of cod?

Third, we discussed the actual design of the project. It was agreed that we should select three areas in Steigen where the fishing activities are carried out in different ways. From each of these areas, at least two fishermen should participate in the research. The following methodological approaches were considered relevant for our study:

- Developing measures designed to improve the accuracy of catch statistics. Draw up a detailed code system for the different catch areas;
- Collecting samples. Otoliths. Genetic material. Measure length/weight, estimate degree of sexual maturity. In the winter season: State whether catch is believed to be NCC or NEAC;
- Using echo sounder and Olex[1]. These devices can be used to provide data to IMR concerning the abundance of cod on the spawning grounds;
- Tagging experiments to determine migration patterns;

[1] Olex is a technology that combines echosounder and GPS tracking, allowing the fishermen to record detailed information on fishing trips. It is also possible to combine data from several vessels.

- Methodological development: Calibrating the use of gear types like gillnets and/or fish pots as standard devices for assessing fish abundance.

At this meeting, it was agreed, both among scientists and stakeholders, that our planned study would be both relevant and interesting. We looked forward to its implementation and we agreed to work hard to get it funded! At the end of this process, the fishermen and scientists had finalized a collaborative project proposal entitled "Developing a fisheries-based resource monitoring system: The case of Norwegian coastal cod."

In the project description, it was made clear that the project would pursue two different objectives with different types of outcomes. On the one hand, the technical-scientific objective was to deliver, by way of a fisheries based project, "reliable and timely information" on the status of the cod resources in Steigen. On the other hand, the project emphasized that the development and testing of the cooperative research design in itself constituted and important objective. To fulfil this objective, the project description promised to deliver a range of indicators on the project performance:

- a detailed description of the monitoring system, including main objectives and functions, equipment, personnel, training, organization, information flow, cost, etc.
- an analysis of the performance of the monitoring system with regard to reliability, effectiveness, cost and legitimacy
- an evaluation of the institutional and political challenges such a monitoring system would need to meet if it were to function as part of the ordinary information infrastructure for marine resource management
- a handbook of cooperative research with particular emphasis on how to facilitate effective fishermen participation in research

In passing, we can note that the chapter you are now reading is what came out of these promises. Besides the tendency to be over-ambitions with regard to the level of detail in documenting the

project, we can note that the optimism with regard to the project was strong at the time. Nevertheless, the high hopes at the start, of creating a platform that would enable equal partnership between scientists and fisher had already been significantly toned down at the end of the project development phase. In the project description there was still a strong commitment to include fishermen in active and responsible positions in the project. The monitoring system "*will be built on cooperation between local fishermen and scientists.*" While the project was organized with a clear commitment to active fishermen participation, it is also obvious that the overall project design was attuned to scientific requirements. Under the section specifying what was in it for different stakeholders, the main benefit for the fishermen was to be educated in the ways of science:

- to participate actively in the development of information systems
- to gain hands-on experience in the processes of information generation
- to gain insights in the way science works
- to become skilled in working with and communicating with scientists

The list of benefits for science emphasizes the access to new systems and sources of knowledge, and new models to engage fishermen. This is all fine, of course. But we note the absence of fishermen's experience-based knowledge. While the project would allow fishermen to learn about science, there is no mention of the ways science may get to learn about and utilize what the fishermen know. In practical terms, the project had been redesigned, now aiming for a system collecting scientific information, operated by fishermen under scientific supervision, not for connecting to and collaborating with fishermen as knowledge agents.

Implementing the project

The implementation phase of GAP started in April 2011. In order to kick off our case study and get all the partners together, we met in Steigen in May 2011. Hector Peña, the scientists picked by IMR for GAP, came up from from Bergen. Maiken Bjørkan, who was engaged by UiT as a researcher working full time on GAP, came in from Tromsø. In Steigen, they met with Jan Andersen and Jon Erik Pettersen, who represented the local Fishermen's Association. Since it

was important to generate an environment where everybody felt that they could share ideas, views and questions, we started off by an informal chat during breakfast at the local hotel, where the entire meeting took place.

Making sure that everybody was on the same page about what GAP in Steigen should be, we talked about our expectations. For IMR, it was important to develop a monitoring system adapted to the local resource system. Steigen was a good place to make a pilot project. The local fishermen were happy to hear this, and underlined the project's importance of building up the fishermen' trust in the science.

The methodological issue was in focus at this meeting. Based on the previous discussions in GAP, the fishermen started out with a preference for a methodology on Catch Per Unit Effort (CPUE), using standardized gillnets in different areas. However, when Peña took out his laptop and presented several examples of how modern echo-sounders can be used to collect data, he immediately had their interest. With the particular equipment Penã demonstrated, it is possible to generate videos instead of still pictures, and Hector showed us a number of possibilities with the software. When he started the slideshow, the fishermen leaned in and understood immediately what information they contained (Figure 2). Fishermen and IMR scientists obviously have some experiences and knowledge in common that could serve as a platform for collaboration.

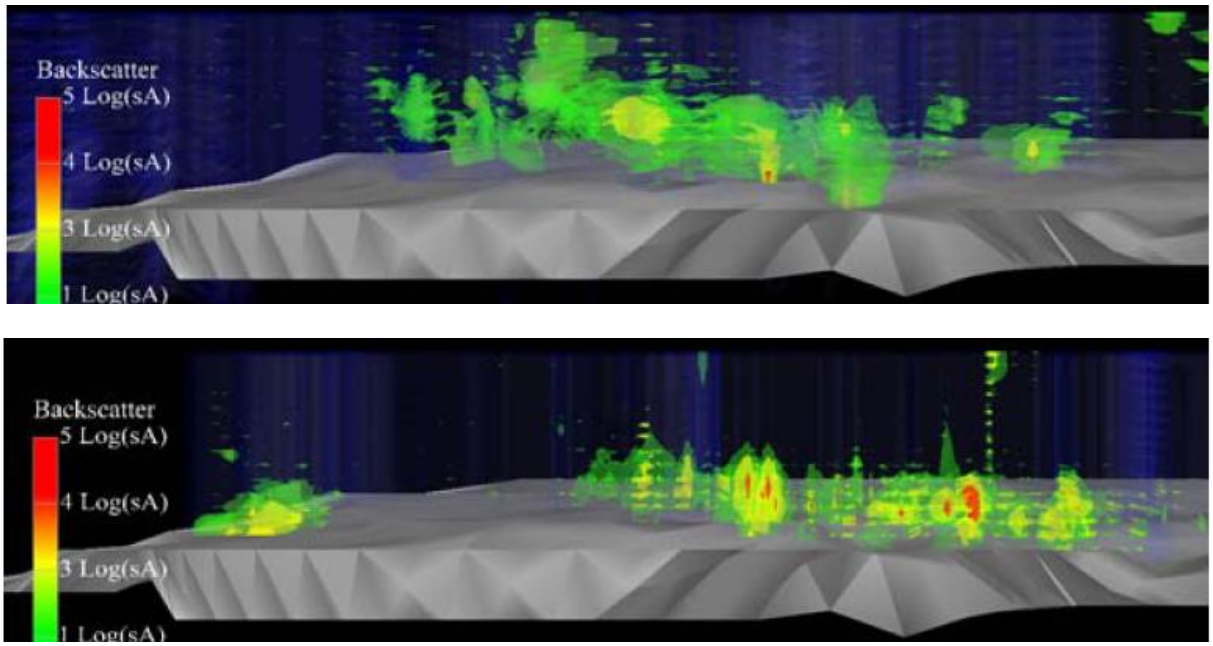

Figure 2. Two of the echograms Penã showed the fishermen at the kick off meeting.

After Penã's presentation, the fishermen were exited to follow this methodological idea, partly because it offered a way to collect necessary scientific information without compromising their fishing activities. One benefit would be that the echo-sounder could collect information of the same quality as that routinely used by IMR, and thus the data could be integrated with and complement the data series IMR is collecting themselves. Jan Andersen, himself a fisherman and the local coordinator of the GAP2 project, underlined several times how important it was that the data collected by the fishermen actually would be useful to the scientists.

The fishermen and scientists then discussed what problems could be generated for the fishermen with a different type of echo sounder. For instance, the acoustic gear suggested by Peña required some data skills and it was expensive. The IMR has already installed this gear in larger fishing vessels, but never in a small coastal vessel. Hence, we were entering unknown territory. A lot of the discussions focused on what had been done earlier, what was realistic and what it would take to implement this methodology in the Steigen project.

In short, the meeting agreed that the objectives was to assess the state of the local coastal cod resource in Steigen and this would be done using acoustic technology installed on 6 selected vessels, and also biological monitoring of the catch.

While fishermen and scientists were satisfied and confident with the new approach, several challenges and questions became evident soon after this meeting. First, the equipment was more expensive than we had planned for. With the available EU-funding, the project could only afford to buy one echo-sounder, and hence only engage one vessel in the project (MS Fix), instead of six as planned. Second, was that Penã did not speak Norwegian, and so the fishermen doing the sampling had to be able to speak English.

The Echo-sounder

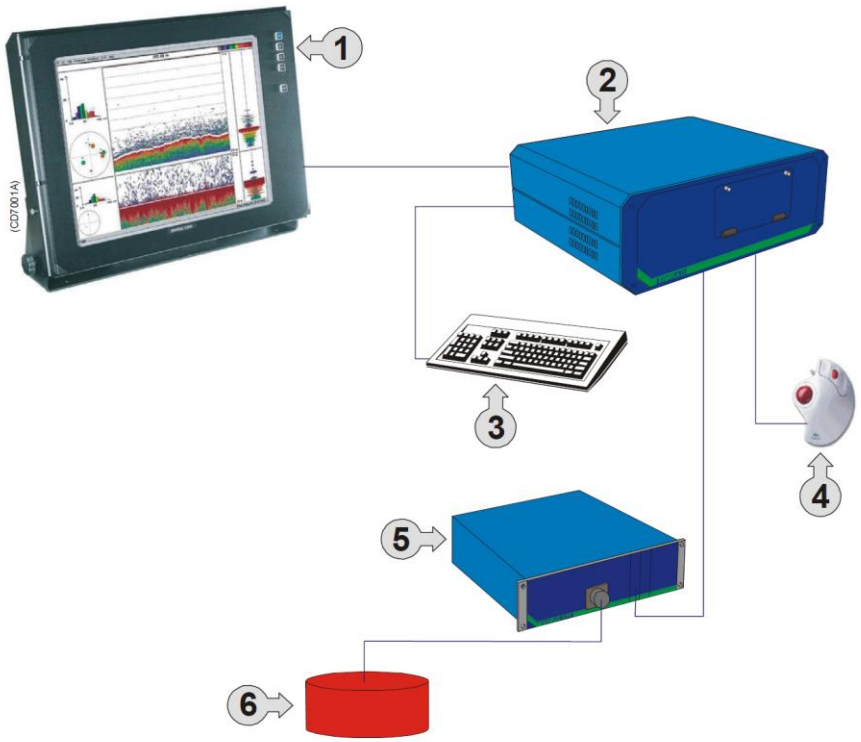

Figure 1 EK60 Basic system diagram

Legend: (1) = Colour LCD display, (2) = Processor Unit (computer), (3) = Keyboard, (4) = Mouse or pointing device, (5) = General Purpose Transceiver (GPT), (6) = Transducer.

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Figure 3. Schematics for the echo sounder Simrad EK60.

By the end of 2011, we ordered the echosounder. The installation was a three step process. One company (Simrad) delivered the equipment, the Simrad EK60 Scientific Echosounder (Figure 3). The price tag was NOK 500 000.

Following installation and calibration, the IMR partners went out to test the equipment and train the fisher in data collection and data storage. The following is an extract from an e-mail reporting how it went down. Figure 4 is a screen shot from the trial run mentioned in the e-mail.

> On Thursday we went for a fishing trip to record data and observe the performance of the echo sounder, using my notebook to avoid the problem previously mentioned. The fishing ground was ca. 1 hour from the port and several other vessels were in the area fishing. I attach one echograms of the conditions in the fishing ground, where cod and sei were together feeding on a large herring school. The echogram is very good, with no

interference, being able to identify the single targets of the larger fish in the surroundings of the large herring school in the center (e-mail from Aglen 26.01.2012).

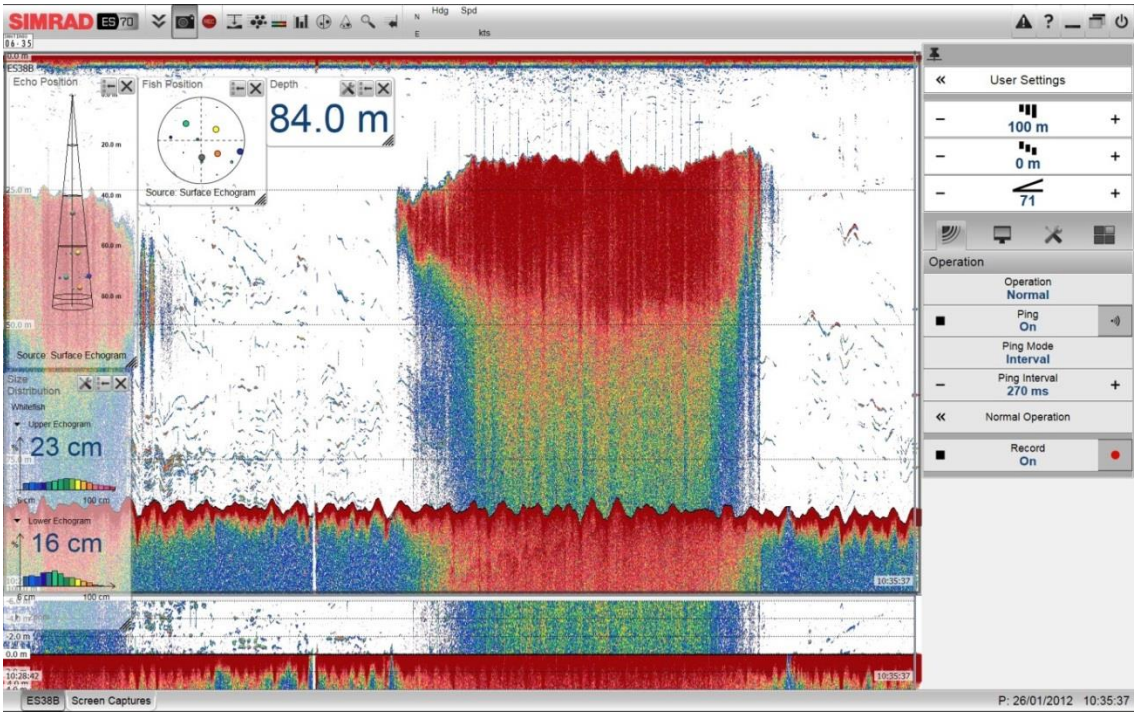

Figure 4. Ecogram taken from the test run.

Designing the data collection program

Having successfully installed and tested the echosounder, we needed to design a survey plan and a sampling program for the MS Fix. In order to do that, Asgeir Aglen from IMR traveled to Steigen. Here, he sat down with the fishermen, a map between them, to decide exactly the survey transects between the islands, making sure the important areas were covered. This is how Aglen described this step in the process:

> During the planning of the project the scientists got access to mapped data on fishing areas and spawning areas, developed by Steigen municipality based on information from fishermen. These maps were important as basis for the

> planning meetings with the fishermen and fisher's organization (e-mail from Aglen, 26.01.2012).

Due to the relatively high investment in project equipment, it was decided that surveys and sampling would be undertaken the whole year, not only in the traditional cod season from January to April. This would allow us to collect data on other fish resources in Steigen besides the NCC and NEAC stocks. We also had to agree on what and how to pay the fisher for doing the survey and sampling. The fisher partners underlined that it is important that fishermen are loyal to project. Committing to undertake the surveys and sampling represents a substantial cost for the fishermen involved. This does not only involve the time and effort involved in collecting samples. In addition, the pre-determined acoustic surveys ties the vessel up, taking time away from active fishing. In order for the fishermen to commit to such a project, there need to be some financial compensation. Also, in the Norwegian context, the Reference Fleet has set a precedent, indicating the level of payment the fisher can expect for this kind of work. For the Steigen project, the fisher partner suggested a model by which the participating vessels would get a fixed sum for every month of data collection. In addition, each sample collected should be paid according rates used by the Reference fleet. The other project partners agreed that this model made sense, and the fixed monthly payment was set to 17 000 NOK.

After several months of preparation, we were finally ready to begin the actual data collection. Trygve Skogheim and MK Fix started in March 2012, reporting the daily catches by species. Nevertheless, this was not based on an agreed sampling program. In March 2012 we go the following e-mail from Jan Andersen, insisting that such a program must be made:

> When it comes to getting the Steigen project started there is no lack of local quota, expertise or willingness. I have at an early stage, already in November 2011, proposed to make a written agreement with Trygve [the skipper on s Fix] about how data collection should be done: how long periods he should fish in Steigen and periods he would be able to fish elsewhere. This is so that he would be sure to be able to finish his quota. The remuneration he receives from the

> Steigen project [100.000 NOK + samples] will be little to live on. This got little response, and still Trygve does not know how sampling should be conducted. The IMR must as soon as possible to give us a plan of how the research will take place, so that Trygve can start fishing in Steigen with the quota he has left on the " Fix " (…) (e-mail from Jan Andersen, 23.03.2012).

As a response, Asgeir Aglen (IMR) and Maiken Bjørkan (UiT) went to Steigen in April to meet the fishermen and agree on a sampling program.

Money, Money, Money….

In trying to keep with the original plan, a key challenge throughout the project was to find extra funding. We looked into numerous possibilities to get extra funding during the first two years, which was time consuming and a source to frustration, especially since efforts were unfruitful.

The first attempt, made in the fall of 2012, was to get extra funding by the Norwegian Seafood Research Fund (FHF), the seafood industry's own instrument for industry-based research and development. Initially, we were quite confident that our project could get funding here, since the Steigen project, as we saw it, is innovative and extremely important to develop a new methodology for cooperative research (www.fhf.no), but turned out to be a huge disappointment. While the presentation from Jan Andersen went well, the feedback was entirely negative. As it turned out, the project we proposed did not fit into the FHF strategy, since they saw it as related to fisheries management, which FHF defined this as a government responsibility falling in the Ministry budget. Our argument of the importance of mobilizing the fishermen in knowledge provision, the need for finer resolution, the importance of collaboration and of developing methods for participatory research, did not find an interested audience in FHF.

The second attempt to find extra funding was initiated in the beginning of 2013, to Råfisklaget, one of the fish sales organizations. As such it is one of the truly important and powerful and in normal circumstances quite wealthy organizations in the industry. The team were invited to submit a concept note. Under the project title "Center for Experience Based Knowledge" we described a project that would collect and systematize the fishermen own

experiences and stories about the fisheries and the local resources (Andersen and Holm, 2013). We were careful to mention the ongoing data collection in cooperation with IMR. The point of the project we now applied funding for, was to add an extra layer of information. Using fishermen to undertake systematic acoustic and biological sampling and develop indicators that could be accepted and used by the science, was a good starting point, we claimed. Despite only applying for a small amount of money, there seemed to be little interest in the type of concern for which the project was set up to address.

In the core institutions of Norwegian fisheries, we gradually began to realize, there was no active discourse regarding a knowledge gap between fishermen and scientists. While the fishemen representatives would acknowledge, in principle at least, the importance of fishermen's knowledge, they were not ready to allocate their own hard-earned funds to collect and use it.

The third attempt finally met with some success. It started already in January 2012, when Jan Andersen arranged a meeting in Steigen:

> I had a meeting today with the political leaders in the Steigen Municipality, the head of the development section and the Steigen Seafood company regarding the fisheries in Steigen. Here, I informed them about GAP2 and asked for funds. They found it very interesting and were impressed that the research is focused on Steigen. I think there is a possibility here (e-mail from Jan I- Andersen, 27.01.2012)

As it turned out, Steigen municipality, which is very small and not at all wealthy, had little money available. However, as part of this process attention was directed towards the funding possibilities at the County level. Andersen and Bjørkan went to Bodø to present the project for the County administration for Nordland, and were well received and guided through the formal application procedure. While the whole process took well over a year to complete, we did in the end receive 250 000 NOK. Since the technical development of acoustic equipment apparently had been rapid, the price of an echosounder of acceptable quality now was only 220 000 NOK, including mounting and calibration. The extra money from the County thus allowed the project to include one more vessel in the sampling program. The equipment was installed in the vessel

Økssund – almost identical to Fix – owned and operated by Inge Wilhelmsen. With this vessel, data collection started from October 2013.

Results

As indicated in the project description formulated in eary phase of GAP, we aimed for two kinds of objectives. The first kind, which is the main focus of this chapter, is about the process of collaboration itself. The second type, to which we now briefly turn, concerns the actual data and knowledge generated by the project.

For both vessels, Fix and Økssund, the skippers collected, in addition to the echograms, weekly samples of cod and/or saithe, measuring length, weight and taking otoliths for age readings. They have also collected some genetic samples of cod. The otoliths are used to determine the age of the cod as well as the age at first spawning. In addition they are used for separating coastal cod from NEA cod. The genetic samples are used for verifying the stock separation by otoliths and for investigating the relationship to coastal cod in other areas. Both vessels have been fishing in other areas during the peak spawning fishery for NEAC, which is mid February to end of March. The observations from cod fishery in Steigen during the spawning season in 2012, 2013 and 2014 have confirmed reasonable concentrations of spawning cod in those spawning areas highlighted in the planning. The acoustic observations also showed good recordings of cod in those areas where catches were obtained. The exception was at Englevær where high catch rates were obtained (up to 90 kg per net), but very little fish was observed on the echo sounder. The fishermen claim that this is an area where the fish migrate through rather quickly (towards other spawning areas). Thus, the cod could already have moved away from the area when the nets were pulled in and the acoustic observations were made. When revisiting Englevær in the 2014 spawning season some patchy distributions of cod were observed on the echo sounder. Both in 2013 and 2014 the fish in this area had running gonads, indicating that some of the fish would have spawned there. Since the cod is spawning in batches at 1-2 day intervals these observations could indicate that some fish might choose to spawn in several spawning areas during the spawning season.

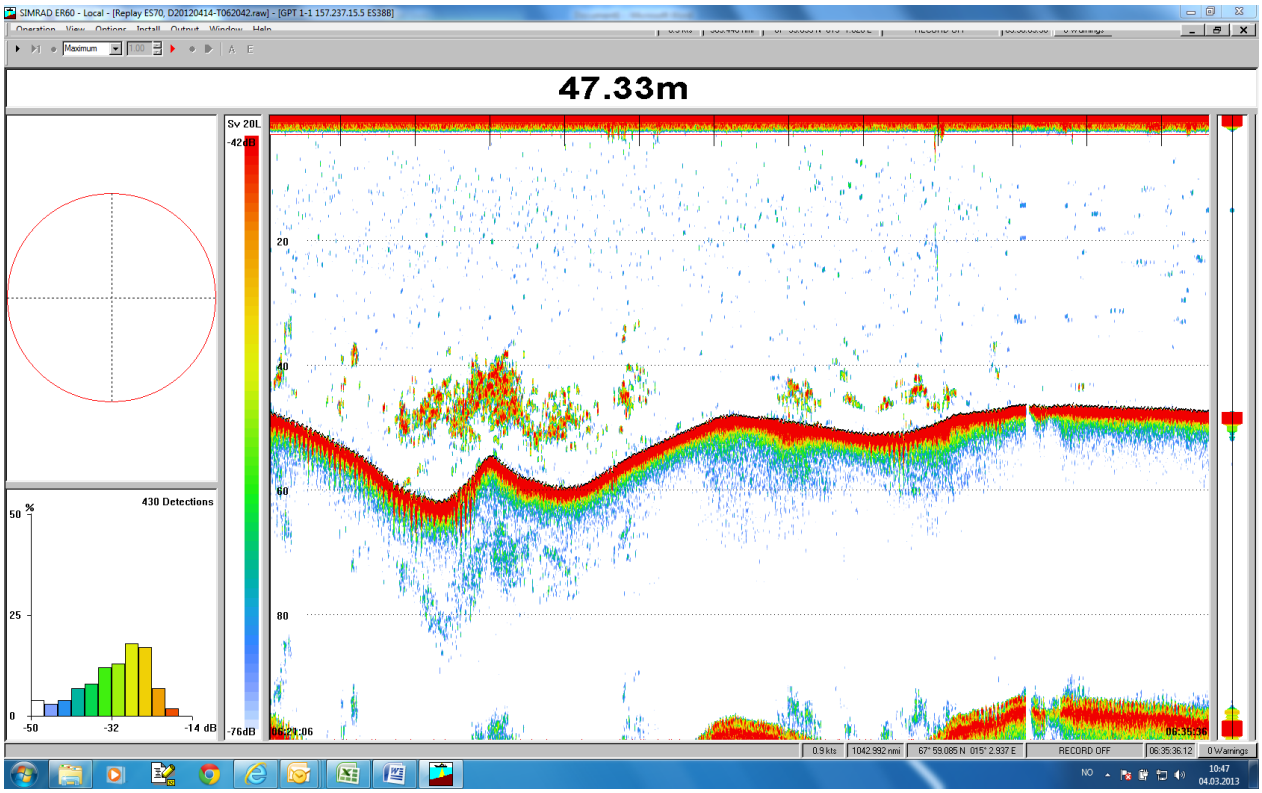

Figure 6. Echo sounder records of spawning concentrations of cod at Bøvika, Steigen, March 2013.

These observations represents glimpses of the collected data, and only serve to illustrate the kind of insights the work in Steigen could produce. The way the Steigen CS project was set up, the project only had resources to collect the data; putting them to use depended entirely on the interest and resources of our science partner. The otoliths sampled, together with length and wheight mesurements, has been included in the IMR data collection program. By the end of the GAP project, no systematic attempt at including the echo-sounder data was apparent, however.

Trapped in the TAC machine

When we started GAP, the premise was a project conducted on the fishermen's terms, rooted in the fishermen's experience-based knowledge. The result would be a method to bridge the gap between scientists and fishermen in the estimation of fish stock size and development . This

method was meant to be applicable anywhere. The project has not achieved this. Instead, the objective of the project changed along the way. Losing sight of the original ambition, we quickly moved on to become part of the established Norwegian marine research regime. Here, all important tasks are undertaken under instruction by scientists, and the fishermen use their experience based knowledge to catch fish.

We are, at the end of the day, not too disappointed. We are confident that new knowledge has been generated and that the collaborative model we have developed will work. Nevertheless, the type of knowledge produced through the project and the methods we have applied remain scientific. As for the gap between scientists and fishermen, it is surely reduced by the project simply because of the confidence built up through the practical collaboration and joint goal of sustainability. What the project has not achieved, however, is to develop a model for utilizing the fishermen's experience based knowledge.

There are several reasons why we were not able to realize our original intentions. One important factor is related to the limited funds relative to the high cost of the equipment. This effectively turned the GAP in Steigen into a mini-project. We may have underestimated the practical challenges this represented in developing the project. A project like ours, with limited funding and without precise, formal objectives for guidance, easily becomes vulnerable to external forces. In this case, we became very much dependent on the scientists from the IMR to guide us towards a methodology that could work. In practice, this meant that we were trapped in the TAC machine.

We do not mean to blame our science partner. Quite on the contrary. Without the valuable inputs from IMR, we would have achieved nothing. From the start of the project, all partners were in full agreement that we wanted the project to make a difference. This meant that we had to deliver knowledge products that would count in the existing management system. While we wanted to go beyond the Reference Fleet model, involving fishermen in more responsible roles, we did not want to do that in a way that would reduce the usefulness of the knowledge products. When we invited the IMR to take part, this was exactly to make sure the knowledge output from the project would stand up to the relevant requirements. In hindsight, it seems clear that we underestimated the degree to which this would reframe the project. Accepting the IMR as the authority on what would count as credible and salient knowledge, the GAP project in Steigen

turned into a mini-version of the Reference fleet. While the project group of course was still in command, the expertise of the IMR scientists in practice came to define the terms of the project. Through the careful guidance from the IMR science, we realized that the options they proposed actually were in our best interest. Or rather, given the premise that the knowledge generated in the project was going to fit into and be used by the existing management system, there simply was no alternative but to go with the IMR suggestions.

At the outset, we had aimed for a project where we wanted, as much as possible, to use relatively cheap and simple equipment and procedure. This would not only allow us to include more fishermen in the project, but was also important to be able to integrate data collection and fishing operations. Or so we had thought. In practice, however, we had to invest in a science-grade echo-sounder in order for the data to be useful for IMR. While this reduced the number of participating vessels to one, it did solve the problem of combining data collection and fishing. With the chosen methodology, however, the task left to the fishermen were not particularly interesting. All the fishermen had to do was to turn on the machine when they left the harbor and, from time to time, follow pre-defined survey transects. At the time, however, we did not see any alternatives but to go with this plan. Collecting data acceptable for IMR was an absolute requirement. The fact that the proud notion of active fishermen participation had transformed through the implementation process and that our project now began to resemble the reference fleet model that we originally had intended to transcend, somehow escaped our attention at the time.

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