Chapter 17
Bridging gaps, reforming fisheries

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Abstract

Scientific debates often revolve around the issues of 'unbiased science' with the majority of scientists keeping themselves at arm's length from policy-making to ensure their credibility. Participatory research has been shifting these dynamics and has led to the emergence of research practices and advice frameworks that allow co-creation of common knowledge bases for management. This chapter, following the description of 14 cases of participatory research, places these cases alongside each other, compares and examines them as pieces in a larger puzzle to let us identify emergent patterns. In doing that, we draw on the analytical basis developed in Chapter 2. To understand what goes on in the transition zone between top-down management and participatory governance, we focus on i) participation, ii) knowledge inclusion and iii) institutional reform. What we are seeing is that the case studies, instead of becoming arenas for negotiating knowledge gaps and removing false preconceptions, worked much more pragmatically, allowing fishermen access to the resources of science. With the ongoing institutional reform, emphasizing stakeholder participation and the need for broader sharing of responsibility for management processes, fisheries governance is changing. We explore this change process through the concept of the "scientific fisherman" introduced in Chapter 2, a character who is actively involved in management decision making and a competent and acknowledged participant in the processes of mobilizing knowledge for management purposes.

1. Introduction

The GAP project was set up to explore ongoing transitions in fisheries governance. A key premise for the overall project (see section 1.3) was that existing gaps in knowledge, communication and trust between fishermen and scientists can be bridged through collaborative research (Mackinson and Wilson 2014). Joint knowledge production practices are expected to improve transparency, trust and social robustness in fisheries governance, and thereby contribute to the sustainability of fisheries practices (Holm and Soma 2016). The case studies presented in this volume have investigated how collaborative research works out and performs in practice. Collectively, they address fundamental questions (see section 2.2): *What are the knowledge gaps that the GAP case studies are constructed to fill? Why are they not addressed by conventional designs? Can they be bridged through collaborative research? What characterizes the relationship between scientists and stakeholders within the collaborative research projects? To what extent can collaborative research remedy the legitimacy deficits created by unresponsive management practices? Do the GAP case studies represent new modes of science-society relations, or do they reproduce a conventional and deferential relationship between science and lay clients? Are the case studies sites where scientists get access to new platforms for pursuing scientific research? Or are they arenas where fishers get access to the resources of science for their own purposes?* To address these questions, we bring together a set of theoretical perspectives and debates introduced in Chapter 2, and the practical experiences of the individual case studies (CS) projects, presented in the previous 14 chapters.

In Chapter 2, we introduced three interrelated strands of research that have investigated knowledge issues and the prospects for co-creating knowledge between scientists and stakeholders under new modes of governance. These research strands, or pillars as we call them (see Chapter 2, Fig. 2.1) focus on participation, knowledge inclusion and institutional reform. In order to make these arguments directly relevant to the GAP experience, however, we must consider what type of insights the different CS projects can contribute. At the outset, of course, it is reasonable to expect that all the 14 GAP CS projects are relevant to all the three issues. This is also confirmed by the CS chapters. Given the great variety represented by the CS projects, however, the issues are framed in different ways across CS projects. In the following section, we therefore examine the main categories of the CS projects, and discuss the specific take they offer on the main governance issues at stake. In the final section, we summarize the main results and discuss their implications.

2. Sorting out the CS projects

As indicated by the GAP CS projects, the variation among fisheries across Europe is staggering. What fisheries are – their resource basis, technology, structure, economic importance and place in society – varies, and so do the principles and procedures by which they are governed. In order to understand what the CS projects specifically can teach us, we first need to consider the range of lessons they may provide.

Since the CS projects were not explicitly designed to explore issues of theoretical interests, connecting theory and practice is not straightforward. While the design and development of each CS certainly were constructed as part of the overall GAP project, their specific identities and thrusts were in important ways framed by the specific conditions of their local context. The three pillars (participation, knowledge inclusion and institutional reform) remain at the heart of a changing fisheries governance (see Chapter 2). The CS projects, however, are the sites where we can examine how that change actually happens. How are the issues of participation, knowledge inclusion and institutional reform articulated given the nature of the particular case in question? To address this question, we need to sort out the CS projects.

As a start, we note that some of the CSs fall under the *Common Fisheries Policy* (CFP) while others do not. For example, the CS project reported in Chapter 9, fishery monitoring for coastal cod, located in Steigen, Norway, engages with fisheries that remain squarely outside the CFP. Moreover, a number of the case studies within the EU work with fisheries that are not managed under the CFP, at least not directly. For instance, the CS on selectivity in Lake Vättern (Chapter 4) focuses on white fish fisheries in a freshwater lake managed by the Swedish authorities. In addition, the CS projects within the EU that feature coastal fisheries remain within Member State jurisdiction, as in the CS on sustainability of brown crab in the UK (Chapter 3), the CS on rare Wadden Sea species (Chapter 7) and the CS on mapping habitat and fishing in Galicia, Spain (Chapter 5). In the Estonian CS, featuring marine spatial planning in the Baltic Sea (Chapter 13), the fisheries involved may be covered by the CFP. Nevertheless, the focus of this case study is spatial planning conducted under national jurisdiction. For practical purposes, we can therefore count the Baltic CS as non-CFP.

At the outset, it makes sense to distinguish between CS projects on the basis of whether they fall under the CFP or not. As pointed out by Doug C. Wilson, the CFP stands out as unique in its geographical scope:

> No other fisheries management system in the world seriously attempts to manage fisheries through such a huge, top-down system. On a continental scale, the complexity of the information needed simply cannot be handled (Wilson 2009: 267).

The discourse on the three pillars of transformation – participation, knowledge inclusion and institutional reform – are particularly relevant to the CFP and have to some extent been developed explicitly to address concerns arising in the context of the CFP and the CFP reform. This is confirmed by the CS projects on fisheries governed under CFP, for instance in the CS projects on mixed fisheries in the North Sea (Chapter 11), on French and Spanish tuna fisheries (Chapter 12) and on discard sampling in Dutch flatfish fisheries (Chapter 14). As it is apparent from these chapters, the rigidities imposed by the CFP are framing the CS projects in different ways.

Nevertheless, the relevant object of analysis here is not the CFP as such, but the governance framework in operation at the level of the CS fishery in question. For instance, even though the Norwegian case, reported in Chapter 9, is outside the CFP, the fishery in question is managed under the centralized Norwegian governance system for fisheries. This makes the Norwegian case more similar to the CS projects within the EU that are governed under the CFP than those which are not. On the other hand, some of the CS projects feature fisheries that in principle fall under the CFP, but are strongly influenced by the specific local governance practices in operation. This is the case in the CS project on management of NW Mediterranean red shrimp (Chapter 10) and on the Maltese fisheries management zone (Chapter 15). It is hardly a coincidence that both these CS projects are located in the Mediterranean, where important features of the CFP have not been implemented in the same way as in the northern EU regions (Hadjimichael et al. 2010; Smith and Garcia 2014).

As this suggests, an important factor affecting the governance framing of the CS projects is whether the fisheries in question are managed under a centralized TAC machine system or not. As introduced in Chapter 2 (section 2.1), the TAC machine concept captures the highly specialized and institutionalized system dedicated to the production, authorization and deployment of TACs as the key management instrument (Holm and Nielsen 2004; Schwach et al. 2007; Nielsen and Holm, 2008). It is on the basis of the institutionalization of the TAC machine as the standardized management regime that the possibility of fisheries management on a “continental scale” comes within reach, although, as Wilson (2009) has noted, the complexity of the task suggests that the success of such an accomplishment will be limited. Since the TAC machine requires standardization and centralization, it comes with strong restriction on participation in knowledge provision and management decision making.

	TAC Machine		**Non-TAC Machine**	
CFP	Chapter 6	Management of herring	Chapter 8	Fishing and habitat in northern Adriatic Sea
	Chapter 11	Multispecies and mixed fisheries in the North Sea	Chapter 10	Management of NW Mediterranean red shrimp
	Chapter 12	FADs in tuna fisheries	Chapter 15	The Maltese fisheries management zone
	Chapter 14	Discard sampling for flatfish fisheries		
	Chapter 16	Bycatch and discards of elasmobranchs		
Non-CFP	Chapter 9	Fishery monitoring for coastal cod	Chapter 3	Sustainability of brown crab fishery
			Chapter 4	Selectivity in Lake Vättern
			Chapter 5	Mapping habitat and fishing
			Chapter 7	Rare Wadden Sea species
			Chapter 13	Baltic fisheries and Marine Spatial Planning

Table 17.1 The CS projects sorted according to two dimensions of the governance framework of the fisheries they engage with; first, whether they are managed under the EU *Common Fisheries Policy* (CFP) or not; second, whether the management system has TAC machine features or not.

In table 17.1, we have sorted the CS projects along the two dimensions discussed above. In the following, we discuss how the issues of participation, knowledge production and reform get articulated for each main type of CS, i.e. whether it involves a TAC-machine structure or not.

At the outset, CS projects tied to TAC-machine structures will provide lessons that are directly relevant to the key problems taken up by the GAP project. If things like weak participatory mechanisms, low legitimacy and gaps in understanding and communication are typical for fisheries, it is because of the dominance of the TAC-machine regime, and not an inherent trait of fisheries as such. In the same way, the thrust of the reform is about issues that primarily relate to limitations and rigidities of TAC-machine structures. While this is important to keep in mind in order to draw inferences from the GAP project, it does not mean that the CS projects that somehow have escaped from the TAC-machine are less relevant. As we shall see, the more open and sometimes more benign governance settings outside the

TAC-machine provide better opportunities for exploring the capacities and limitations of collaborative models. Also, they open up for an exploration of the possibilities of a nested design, as suggested in Chapter 2 (section 2.3). We return to this topic below (section 17.3).

CS projects under the TAC machine

Six of the CS projects are closely tied to TAC-machine structures, within the EU and in Norway. While the variation among these projects may be more striking than their commonalities, they all focus on issues that can be expected to arise within TAC machine settings. TAC-machine frameworks are centralized structures characterized by limited direct access and influence for those affected (Nielsen and Holm, 2008; Schwach et al. 2007). Since they tend to be large-scale and standardized, with decisions taken through pre-programmed procedures, they will often produce decisions that are insensitive to regional and local complexities (Degnbol 2003; Wilson 2009; Symes 2012). This trait does not affect all fisheries the same way, of course. While TAC-machine frameworks are rigid, they are not immune to political and social pressures. The capacity for mobilizing such pressures vary greatly among fisheries, depending on factors like the size and economic importance of the fishery; the social and cultural and political standing of the fisheries in the society in question; the organizational and economic organization of the sector, and so on (Hallenstvedt 1982). This means, in short, that well organized, economically important fisheries, like the Norwegian fishery for North East Arctic cod (Kolle et al. 2017), the North Sea pelagic fisheries (Coers et al. 2012) or the Icelandic cod fisheries (Pálsson 1991) usually will be able to bend the TAC machine to serve their respective purposes. For marginal fisheries and nonstandard issues, however, the regulations imposed will sometimes be disruptive, with interventions perceived as uninformed and counterproductive at the local level (Wilson and Degnbol 2002; Symes, Phillipson and Salmi 2015).

This is a well-known and necessary consequence of large-scale systems, which must be constructed with a standardized set of problems in mind (Wilson 2009; Hadjimichael et al. 2010). The efficiency of the TAC-machine in dealing with the standard problems as seen from the perspective of the economically and politically dominant fishing interests, is of course a strong justification of its existence and support. Nevertheless, this justification is challenged under the present transition of fisheries governance, as we argue in Chapter 2. With the acceptance of governance principles related to participation and knowledge inclusion, combined with the insights related to ecosystem interactions and increasing competition among interests in marine space, relevant management and knowledge objects are becoming more complex (Wilson 2009). This development is an important driver behind the efforts to make TAC-machine structures more dynamic, flexible and participatory. Nevertheless, participatory approaches may also be more vulnerable to the influence of well-organized and wealthy interest groups. An important argument in support of a centralized system is that it lends itself to democratic control and, hence, the will and values of the majority of civil society. While making fisheries management more dynamic and participatory is important in order to meet increasing complexity and local variation, this may come with greater exposition to the power play of well-organized interest groups.

The CS projects on FADs in tuna fisheries (Chapter 12) and discard sampling for flatfish fisheries (Chapter 14) are cases that illustrate, albeit in different ways, the types of strain generated by this transition. In the tuna FAD case, the CS project was initiated by scientists, building on the assumption that the industry stakeholders would be interested in and had the capacity for collaborative approaches to management and knowledge issues. The project focused on use of Fishing Aggregation Devices (FADs), a fishing technique that improved catch rates, but at the same time introduced bycatch and discard problems. The CS project was organized as a common arena where fishermen, scientists and managers could collaborate on defining research goals and approaches. Instead of fertile interaction, however, the project became a site where distrust and frustration spilled out in the open. Opening up a Pandora's Box of mutual suspicion, the project had to take a big step back, focusing on basic trust building activities. In a dramatic fashion, Chapter 12 demonstrates some of the consequences in terms of lost trust and legitimacy imposed by TAC machine structures (though not necessarily only because of that). Moreover, it indicates the enormous investment required in order to repair this problem. Trust and collaborative spirit are not simply capacities that are available on demand, ready for action when a strategic deliberation suggests that it would be useful.

In the Dutch discard case (Chapter 14), in contrast, the new governance norms of participation and mutual interest already had resulted in a collaborative arrangement and growing trust between scientists, fishermen and managers. In particular, this materialized in a series of industry-government self-sampling projects, whereby fishermen collected data on by-catch and discards in the flatfish fisheries. The Dutch CS project was set up to explore this emerging practice, with a particular interest in improving collaborative research design. As reported in Chapter 14, however, this exploration, as well as the practices under examination, was disrupted by the implementation of the landing obligation, by which hard targets for discard reduction were introduced in the form of a directive thrust down from the EU Council. This case, of course, is a striking demonstration of the logic and limitation of standardized solutions implemented across a field of great complexity and variation (Wilson 2009; de Vos et al. 2016).

In the CS on tuna FADs and flatfish discards, the GAP projects were neither prepared for nor geared up to deal effectively with the anger and distrust that were revealed by the CS. In these instances, the GAP project could not really help building solid bridges, but had to retreat into the more modest task of charting the gaps in question. Nevertheless, the GAP portfolio also contains cases where the project's capabilities were more appropriate for the task at hand. The CS project on bycatch and discards of elasmobranches, reported in Chapter 16, is a case in point. As in the Dutch discard case, the landing obligation played an important role here. The case features the Cornish cod and hake fishery, where elasmobranches – sharks, skates and rays – are occasional but regular bycatch. The bycatch rates had not been recorded in a systematic way, however. In the combination of the new landing obligation, the red-listing of elasmobranches, and standard precautionary procedures for dealing with data-poor situations, the fishermen were hit by regulations that effectively would exclude them from some of their most productive fishing grounds. Since the CS project, involving fishermen collecting bycatch data, could supply the missing information and deliver it in an appropriate format at the right place, the crisis was averted. The regulation was changed and the fishery remained open. Collaborative research made a difference! In this case, we argue, the complexities of the Cornish fisheries were too local and specific to attract attention within the centralized management system. Nevertheless, the problem was framed in such a way that a solution primarily hinged on the provision of the missing data, which could be done through fishermen's participation in this CS project.

In the case on the Western Baltic Spring Spawning herring (WBSS), reported in Chapter 6, the CS project also made a difference. The purpose of the project was to develop an assessment model and harvest control rules that could improve the prediction and management of the WBSS herring fisheries. While this fishery clearly is subject to a TAC-machine framework, it did not fit in easily, due to a combination of the stock's migration pattern and a complex pattern of fisheries. As the spawning ground is located in the Baltic, it falls under the Baltic management framework, where the EU is in charge. Since its feeding migration brings it to the North Sea, it is also affected by the joint Norway/EU fisheries agreements. Due to such complications, the WBSS stock remained both misunderstood and mismanaged. The CS project sought to repair this, allowing the development of an appropriate Multi Annual Management Plan for the stock. In order to accomplish that, the stock behavior needed to be modelled. This was challenging in part because of the lack of understanding of the stock structure and its migration pattern and in part by imprecise catch statistics and misreporting.

Initiated and led by a scientist holding key positions in the herring assessment system, the project also included stakeholder representatives from the industry and relevant Advisory Councils (ACs). While it perhaps can be characterized as "science driven", the project was deeply committed to industry collaboration, both in the reconstruction of faulty catch statistics and during the modelling stage. By establishing a common knowledge platform, the project built a foundation for a better management plan that was worked out in the CS.

Similar to the CS on elasmobranches (Chapter 16), a critical challenge for the project on WBSS fisheries was to make project results count in management decisions. In both cases, the projects were able to identify the problems, collect and clean up data, and establish a common knowledge basis. Solving the modelling problem, though challenging, proved to be a success. Nevertheless, this was not sufficient for getting agreement on new management decisions. The WBSS CS collided with a "management wall", although there were indications that this eventually could be climbed. In the elasmobranchs CS, the positive outcome was only achieved after several years of systematic effort.

In the CS project on coastal cod in Steigen, Norway (Chapter 9), the outcome was less encouraging. The original objective of the coastal cod project was to develop and test a model for monitoring coastal cod resources organized by fishermen themselves. The Norwegian coastal cod stock had been at a reasonably stable albeit poor state for the last 10 years, and it did not seem to respond well to the management measures. There was agreement among managers, scientists and fishers that the knowledge basis for coastal cod is weak. The way stock assessment is carried out is an issue of debate due to the limited number of sample events over the course of the year, the surveys only covering areas where trawling is possible, and because the surveyed areas 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. Such knowledge gaps have been recognized both by the fisheries authorities and the stakeholder groups including the fishermen.

In much the same way as the elasmobranchs and WBSS cases, the Steigen CS sought to fill recognized knowledge gaps through collaborative research. The idea for the Steigen project was to develop the prototype for a local, fishermen-operated data collection mechanism that could improve the data basis for coastal cod management. In its attempt to achieve this objective, an important requirement for the CS was that the data collected would be acceptable as input in the existing data collection regime in Norwegian fisheries. On the advice of the science partner in the project, the CS invested in a state-of-the art scientific data collection device (echo-sounders). While this solved the data quality problem, it trapped the Steigen project into a marginal position of a large data collection machinery. While most of the funds and effort in the project was spent in making the method work (producing quality data), less attention was paid to the utilization of the data and what difference they made. Although not a spectacular failure, perhaps, the disappointing outcome of this CS demonstrates some of the difficulties involved in trying to establish an independent role for fishermen in knowledge provision in the face of a well-established system. The CS was hence "trapped in the TAC machine", unable to realize its objective.

All of the CSs tied to TAC-machine structures were in one way or another affected by institutional reform. In several cases, as in the projects on tuna FADs (Chapter 12), Dutch discards (Chapter 14), and elasmobranch bycatch (Chapter 16), the stronger emphasis on biodiversity issues, an important reform issue, is obvious. In the projects on WBSS herring and Norwegian coastal cod, the strategy of active stakeholder participation was tested out as a way to fill knowledge gaps. In the CS on multispecies and mixed fisheries in the North Sea (Chapter 11) moreover, the project was explicitly motivated to inform an ongoing fisheries reform in a more direct way. This project was designed to develop methodologies and tools adapted to the complex, recursive dynamic of an ecosystem-based approach. Set up as a collaboration between the scientists and fisheries stakeholders, the project aimed to build a decision support tool that would facilitate stakeholder interaction in long term management planning. The idea was not specifically to find what would be the best management option for North Sea mixed fisheries, but to find the language, approach and knowledge required for identifying and evaluating management options. The ultimate knowledge product was a software decision support tool that would help focus the thinking when making an evaluation of the options, and improve the ability to make better-reasoned choices. The project utilized the North Sea Advisory Council (NSAC) as a platform, mobilizing the participants' knowledge and insights on the problems of mixed fisheries and multi-species interactions and on that basis developed options plausible for the industry. Originally, the Advisory Council was also intended as the main user of such a tool for framing and informing discussion when developing its advice. However, after the reform of the CFP, and the proposed regionalisation structure, it was realized that other end-users of the tool (such as the Member States) are relevant and could have been considered. In practical terms, the project struggled with the day-to-day demand of the NSAC to give advice on plausible management options, compounded by the requirements generated by the ongoing reform process. Under the high strain from ongoing activities, it was hard for the project to mobilize NSAC partners' attention to project activities. While a "slow-burn" process was the inevitable outcome, delays in CFP reform meant that the tool was ready in time and applied to evaluate the EC's proposed North Sea multiannual plan (Mackinson et al. 2018; see Chapter 11).

A common feature of the six TAC-machine CS projects was their strong framing by "a management wall" (cf. Chapter 6) and the existence of a centralized arena for management decisions on which specific fisheries depend but from which they remained excluded. Exactly how the management wall problem defined the CS project varied. In some cases, the absence of meaningful ways of participation had left fishermen distraught, with huge gaps in understanding and trust revealed by the GAP project (cf. Chapter 12 and 14). In other cases, the top-down features of the system had fewer devastating effects, allowing the possibility of mobilization of better information from the local fisheries to lead to improved management decisions. While "scaling the management wall" in this way appears highly difficult, and sometimes beyond the scope of the GAP CS projects (Chapter 9), it sometimes proved possible, as in the cases of WBSS herring and elasmobranch bycatch (Chapters 6 and 16).

CS projects outside the TAC Machine

While the CS projects under the TAC-machine formed a reasonably homogeneous category, this was not so for the remaining cases. Despite their differences, however, their escape from the constraints of the TAC machine sometimes allowed for easier and more direct access of stakeholders and their knowledge to the management and decision-making processes. In the absence of a management wall as a strong framing, these projects developed under a different logic than those reviewed above. Nevertheless, the variability of the governance conditions for these projects makes it challenging to understand how these projects speak to our overarching research questions. In pragmatic terms, we can distinguish between two different groups of CS projects in this category, depending on the type of management and knowledge issues they focus on. The first group was united by their focus on issues related to access and management of marine space rather than classical fisheries management issues like fishing mortality, quotas, bycatch and discards. The second group comprised projects that remain with classical fisheries management issues, but where the absence of TAC machine structures has opened up for local and participatory (co-)management.

One of the CS projects, Mapping habitats and fishing in Galicia, Spain (Chapter 5), exemplifies both issues. It started out with research goals in support of a specific local management arrangement under fishermen control, but ended up demonstrating how collaborative research can mobilize local knowledge as a political commodity for coastal people in the fight for their position within marine space. From the start, the Galician CS project was clearly management oriented, focusing on the documentation and local involvement required in order to get Galician authorities to establish an exclusive fishing zone controlled by local fishermen in the area of Aguiño. At the time, this was a recognized, albeit not much used, area-based management instrument under Galician authorities (de Oliveira 2013). As the economic crisis made this instrument politically unavailable, however, the CS transformed, focusing instead on demonstrating the practical feasibility of participatory mapping as a method. This highlighted the trust and legitimacy gap, which exists in Galicia. Fishermen consider management regulations to have low legitimacy due to lack of participation. At the same time, the management does not trust the fishermen because their arguments are usually not supported by data. Thus, after the initial plan failed, the Galician CS project refocused on the development of a methodology for collaborative management. Through knowledge cartography and vessel monitoring, segments of the small-scale fisheries have been mapped, creating 'knowledge-based *metiérs*'. This empowered fishermen, providing research-based evidence using their knowledge of fishing grounds. Fishermen from different *metiérs* and of different ages participated in the project. In addition, scientists and students participated as well as technical assistants (as intermediaries between fishermen and scientists). Neither the official representatives of the fishermen nor administrative bodies participated in the project, since it was expected that this would make it more difficult for fishermen to participate. Knowledge produced in this CS has created a potential political commodity that may allow the fishermen more leverage in their negotiation with management authorities and other stakeholders in the struggle for marine space.

The CS projects on sustainability of brown crab fishery in Devon, UK (Chapter 3) and on rare Wadden Sea species, Germany (Chapter 7), although different in many ways, focus squarely on the struggle for marine space. An important contender in this struggle, sometimes in direct conflict with traditional small-scale fishing, is that of conservation and the establishment of Marine Protected Areas (MPAs) (Jentoft, van Son and Bjørkan, 2007).

The Devon brown crab CS (Chapter 3), was organized in collaboration between scientists from the University of Leicester and eight fishers from the South Devon and Channel Shell Fishermen's Association and focused on the fisheries within an area managed under the Inshore Potting Agreement (IPA). This agreement is a voluntary management system, in place since 1978 to reduce conflict between static gear (trap and net) and towed gear (trawl and dredge) fishers. The aim of the CS was to produce locality-specific stock assessments as official data on the status of the crab stock were unsatisfactory. This was not an immediate management problem, since the crab stock assessment indicated that it was fished sustainably and no new restrictions were on the agenda. In the light of the re-opening of the discussion around the management of the British waters and the setting up of a network of MPAs, however, an area specific stock assessment was deemed vital for the protection of the existing IPA and the right of the inshore crabbers to continue with their activities. Thus, the collaboration between the inshore crabbers and the scientists produced an Individual Based Model (IBM) of the South Devon crab fishery. This model was based on data collected at sea with the fishers as well as with interviews collecting fishermen's ecological knowledge. Though it is early days to identify if and how the model will be used, it seems that this collaboration has strengthened the political stature of the fishermen, lending them more leverage in their struggle to preserve the IPA. In addition, the collaboration also helped generate new ideas of how the data could be used such as for example to attain an 'environmental license', a sort of environmental accreditation, which would distinguish the small-scale fishermen from large-scale operators.

In Devon, the GAP project contributed to a reconfiguration of the societal standing and political effectiveness of fishermen as a group, making them able to stand up for themselves in the battle over priorities in the marine domain. In much the same way, the CS project on the Wadden Sea (Chapter 7) was motivated by the vulnerability of the brown shrimp fishermen in a political setting where the environmental discourse was predominant. The whole Wadden Sea area, including the traditional fishing grounds of the German brown shrimp fishermen, is protected, under the EU's Birds and Habitats Directive. While the fishery itself is not considered to be unsustainable by management authorities, it has a negative reputation as it is often claimed – without evidence – to have high by-catch rates. Collaborative research was seen as an opportunity to document actual by-catch rates, end hence disprove such notions. In practical terms, the project collected data on the occurrence of rare and migratory species in the shrimp catches. Project outputs included a species inventory of rare and migrant species for the area, valuable for monitoring Good Environmental Status. Nevertheless, since the project was not based on an organizational platform that could refine and bring this information to the relevant audiences, the CS struggled to realize its objectives.

The GAP CS projects in Galicia, Devon and the Wadden Sea focused on governance issues and frameworks that are relatively new in fisheries, reflecting emerging demands of the Blue Economy (COM 2012) and the new realities at sea this agenda has created for traditional fishermen and fishing communities (Johnsen and Hersoug 2014; Arbo et al. 2018; Hadjimichael forthcoming). In the larger picture, activities and interests like marine aquaculture, shipping, oil and gas extraction, seabed mining, renewable energy production, tourism and environmental protection are posed to expand their claims in marine space. While these activities continue to be governed under sectoral frameworks, with underdeveloped capacities for cross-sectoral dependencies (Raakjær et al. 2014), the need for greater integration and holistic planning is recognized. For instance, the adoption of the Marine Spatial Planning Directive by the EU in 2014 made zoning and planning at sea a requirement, building on important developments in many coastal states and regions before that (Flannery and Ó Cinnéide 2012; Knol 2011; Smith and Brennan 2012). While such development surely recognizes the fact that fisheries increasingly must compete with other interests at sea, the planning instruments also provide new mechanisms for documenting, utilizing and authorizing fishing practices and fishermen's knowledge (Johnsen, Hersoug and Solås 2014). Whereas the projects in Galicia, Devon and Wadden Sea illustrate this in general, the CS project on Baltic fisheries ties this explicitly to an MSP process (Chapter 13).

The Baltic GAP CS was primarily a collaboration between scientists from the Estonian Marine Institute at University of Tartu and small-scale fishing interests in the Estonian Pärnu county. Following an MSP process, this CS was established to improve the ability of small-scale fishers to put their knowledge forward, formulate their views and impact on the MSP process. The aim was not to produce new knowledge but rather to find a way to make their knowledge available to the instruments used in the MSP process. During this process, the identification and the mapping of the actual or planned competing sea uses took place, as well as an assessment of the possible impact on the spatial and temporal allocation of fishing possibilities. This was done in two phases: first by putting fishermen's knowledge on maps, and second, by including other stakeholders, trying to understand how the different activities could co-exist. Although the general requirements for an MSP plan are set out in the EU MSP directive, the specific governance process as to how the plan could be created is to a large extent up to the respective EU Member States. With the aid of the GAP project, Estonian small-scale fisheries interests were included in the MSP process.

Together, the CS projects from Galicia, Devon, Wadden Sea and Estonia forcefully demonstrate the new reality of marine space, with growing competition for space and societal recognition of worth. Fishermen cannot hide from public view, expecting to be carried through by the force of tradition. In order to be recognized as important and worthy of support, fishermen must struggle to make themselves visible. In doing that, knowledge is an important resource, particularly if it is collected, refined and disseminated in collaboration with scientists.

In the CS project in Galicia (Chapter 3), the initial plan was to establish a fisheries reserve, within which the fishermen themselves could take on management responsibilities. In the CS project on brown crab fisheries in Devon, the idea was to establish data collection procedures by which the fishermen could assess the sustainability of their fishery. Both these projects, as turned out, must be understood in terms of building societal capital useful in the power struggle over marine space as well as competencies and knowledge in support of fisheries management responsibilities. Indeed, the co-creation of policy-relevant knowledge is what unites the last group of the CS projects.

The CS project on selectivity in Vättern, Sweden (Chapter 4) is a case in point. As a part of a broader national initiative, a fisheries co-management group for Lake Vättern had been formed in 2004-2005, with membership of fishermen, regional authorities and scientists under leadership of the Lake Vättern Water Conservation Society. The co-management group works as an arena for management advice, conflict resolution, general discussions and information exchange between different groups. The co-management group has no formal authority for regulating the fisheries but has an advisory function. Nonetheless, its advice is in most cases taken seriously and implemented by the national authority. The purpose of the GAP project was to undertake research in support of the advisory work of the co-management group. This happened in the context of a crisis, in which a new set of fisheries restrictions were implemented in the lake, including large areas closed for all fishing, increased minimum landing sizes for Arctic charr and a substantial increase in the minimum mesh size of gill nets. These management efforts appeared to have the desired effect. At the same time, however, they also made it very difficult for commercial fishermen to target whitefish, traditionally a very important fishery in terms of economic benefits. Since Arctic charr and whitefish were exploited in a mixed gill net fishery, the strong protection of the weak stock (the charr) made it difficult to pursue the abundant and underexploited species (the whitefish).

With striking similarity to the case study on elasmobranches (Chapter 16), the Vättern CS was confronted with the problem were the measures taken to protect one type of fish threatened the economic viability of an entire fishery. Nevertheless, the existence of a co-management framework for Vättern allowed for a more orderly process for trying to sort out the problem. In keeping with the collaborative ideals of GAP as well as the Vättern management framework, the research goals of the CS project were developed in a collaborative process, anchored in and approved by the co-management group. The project focused on solving the selectivity problem of the whitefish fishery, exploring methods and fishing practices that would reduce the bycatch of Arctic charr. On the basis of this research, carried out with strong involvement of the fishermen, a set of recommendations were provided to the co-management group and, with the expectation that the regulations will be updated accordingly.

However, the account of the Vättern CS project in Chapter 4 does not tell the story to the end, leaving out whether the collaborative research made a difference on the regulations or not. What we do know is that the existence of a co-management framework has consequences for the existence of a "management wall", as discussed previously. Since the collaborative research was anchored in, if not commissioned by, the co-management group, the salience and legitimacy of the research were already secured. Where the GAP CS projects under top-down TAC-machine frameworks have struggled mightily in order for their findings to be acknowledged and put to use by managers, as documented in the WBSS herring (Chapter 6) and elasmobranches (Chapter 16) cases, access to the decision-making arena is less restrictive under co-management conditions. Co-management is a governance arrangement, in which user groups are directly involved in and co-responsible for management decision making (Symes 2006; Linke and Bruckmeier 2015; see Chapter 2, section 2.3).

In the CS project on the Maltese fisheries management zone, reported in Chapter 15, there were also close linkages between the research undertaken within GAP and the management arena. In Malta the management authority resides with government authorities, and there is no formal co-management arrangement in place. In practical terms, however, the smaller scale and close ties among stakeholders allowed for collaboration between scientists, managers and fishermen. This CS was a collaboration between fishers from the Maltese trawling fleet and scientists from the Maltese fisheries department aiming for a better understanding of the demersal resources of the Maltese Fisheries Management Zone (which extends to 25 nm from the coast). The study was originally proposed by the fishermen themselves and the methodology was determined through continuous discussions between fishermen and scientists from the Maltese Department of Fisheries and Aquaculture so that fisher's knowledge would be used to determine sampling locations while at the same time obtaining sound results. The research included mapping the nursery and spawning grounds targeted by the trawlers with a sharper seasonal and spatial analysis of how fish in Maltese waters change according to season throughout the year; where they spawn, and mature, and where is the greatest concentration of young fish throughout the year. Although fisheries management in Malta works through a top-down decision-making system, the CS allowed for the establishment of a collaborative platform, where fishermen, scientists and managers worked together collecting data relevant for management. The chapter does not report on the extent to which the new data actually influenced management decisions. Since the study was designed with direct involvement of management authorities, however, there seems to be no principled reasons why it will not do so, as demonstrated by similar projects elsewhere (Bjørkan 2011; Kraan et al. 2013; see also Chapter 14).

The CS project on fishing and habitat in the northern Adriatic Sea (Chapter 8) was designed to fill a gap in understanding of the sustainability status of the fishery. While the responsible managers and affiliated scientists, with support from some fishermen, argued that the health of the stocks was not in danger, other fishermen and scientists described the fisheries as in crisis, with stock collapse and ruination on the way. These groups saw the GAP project as an opportunity to establish new research that could help establish a common understanding and lead to more appropriate regulations. The CS included marine scientists from ISPRA (Istituto Superiore per la Ricerca e la Protezione Ambientale) and fishers from the trawling fleet in Chioggia, Northern Adriatic. A main thread in the account in the chapter is the struggle to overcome division and distrust. This was apparent not only in the limited success in getting important stakeholder groups onboard, but also on the reluctance of the fishermen who were actually included. In this respect, the Italian CS project confronted the same type of problems reported in the tuna FAD CS (Chapter 12). In spite of these challenges, however, the project was reasonably successful in the collection of new data, both on the ecology and the state of commercially important stocks and on the viewpoints of the fishermen regarding the management interventions. In particular, the project results indicated that the summer fishing ban, the main management measure in place, should be extended and that this would be supported by fishermen. Whether such a proposal will be successful is far from clear, as a number of obstacles still remain. While the proposal, as reported in Chapter 12, was well received in some quarters, it does not seem to be well aligned with the perspectives and mandate of the relevant management authorities. In particular, the effective implementation of the proposal seems to be outside the scope of the regional management authority, requiring agreement and coordination between all the relevant coastal states in the Northern Adriatic. As such frameworks are still not in place, the prospect of improved management seems remote.

An illuminating contrast to the Italian case, the CS project on management of NW Mediterranean red shrimp was more successful in terms of influencing management decisions. The purpose of the project, a collaboration between local red shrimp fishers in Palamós and marine scientists in Barcelona was to undertake research in support of a Long Term Management Plan (LTMP) for the local fishery. Twenty-four vessels, provided daily data on catches and haul positions. This information was used to record the fishing grounds visited over a two year period, and identify the recruitment areas and juvenile capture season for the red shrimp. On this basis, the fishermen and scientists developed a management plan proposal, which included an extended period of no fishing during winter months. The CS team cooperated with regional fisheries managers who strongly supported the initiative. In the end the implementation of the management plan hinged on the approval from central Spanish authorities. After the two years of negotiation, an agreement with the Spanish Government was reached and the LTMP was approved in May 2013.

Unfolding like a text-book case on the conditions for successful resource governance (Ostrom 1990), the Mediterranean red shrimp case is truly unique. Here, the fishing grounds were clearly delimited, with recognized territorial user rights already secured for the Palamós fishermen. The red-shrimp fishery has virtually no bycatch, the presence of which easily could have introduced tricky boundary issues. There were well-established organizations of fishermen and crew, which allowed for an effective arena for coordination and agreement among stakeholders. There was the happy escape from centralized TAC machine structures, allowing national authorities to recognize a local management plan without infringing on established management systems. There was the presence of interested managers at the regional level, who saw the advantage in having the fishermen take the lead. And to kick it off from the start, there was the successful explanation by marine scientists of a stock collapse in the early 2000, completed with an accurate prediction of its recovery. This made the fishermen trust the scientists to the extent that they were willing to engage in a collaborative project within GAP, resulting in the development of a local management plan.

The red shrimp case is interesting not least because it illustrates how many different resources and conditions must be aligned in order for local fishermen to take control and manage their own fishery. In this respect, the red-shrimp case stands in contrast, as already suggested, to the CS on the northern Adriatic fisheries. While most of the key institutional conditions for successful resource management were already in place in Palamós, even before the GAP team started its work, the fishermen in Chioggia could not even agree whether their fisheries were in crisis or not. This points to the pivotal importance of a "step zero" of joint problem framing, on which successful collaboration always depends upon. While the (successful) collaboration on the red shrimp management was based on such a solid basis of trust between scientists and fishermen, the main challenge in Chioggia was to establish and consolidate such trust.

3. GAP and the pillars of transformation

An important premise for the GAP project, as indicated by its title, was the persistence of gaps in understanding, participation and influence in the fisheries, and that such gaps affect the legitimacy and effectiveness of fisheries governance. The CS in this volume confirm and qualify this. Some fisheries are infested with mutual suspicion and legitimacy problems, requiring substantial investment in trust-building activities in preparation for collaborative work. In the FAD tuna case (Chapter 12), the GAP project became an arena for venting frustration that seems to have been building up in a system without appropriate participatory mechanisms. In Chioggia (Chapter 8), fishermen worried that the research would be used against their interests. In the Galician case (Chapter 5), the CS project retreated into basic trust-building activities through mapping of fishing practices and knowledge, with no immediate plans for using such maps for management purposes. As these examples indicate, the availability of mechanisms for meaningful stakeholder participation and influence remain a problem in many fisheries across Europe (cf. Chapter 2, section 2.1). How this may affect issues of legitimacy and trust becomes evidently clear in comparison with the CS projects were more appropriate participatory mechanisms are in place, be it under co-management frameworks as in Vättern (Chapter 4) or under conventional government direction as in Malta (Chapter 15).

As we pointed out in the beginning of this chapter (section 17.1), the governance framework – including participatory arrangements – for the fishery in questions must be taken as given from the perspective of a specific GAP CS project, with only limited prospects of contributing to its change. Accepting such limitations, what can we reasonably expect a GAP CS project to accomplish in terms of improved participation? The general answer, of course, is that the GAP CS aim to improve conditions for participation and influence through participatory research. With access to solid, agreed and certified knowledge, and better capacities to produce and promote such knowledge, fishermen will be in a better position to improve the knowledge basis for management, and to yield influence and protect their interests. In Galicia (Chapter 5), the CS team accepted this as the primary task, bringing scientists and fishermen together as a first step to establish trust. In Chioggia (Chapter 8) the project went one step further, and using that hard-won trust and the shared knowledge basis, it allowed to promote an improved management solution, even though no appropriate management authority seems to exist for acting on the proposal. In Palamós (Chapter 10), like a dream come true, the construction of the management plan and the knowledge to justify it went hand in hand, allowing fishermen to take charge of the management of the fishery.

In these cases, the CS projects were surely informed, but not strongly framed, by existing management structures. Collaborative research served as a stepping stone towards more appropriate and participatory management practices, rather than aiming at changing specific management measures. In the Vättern case (Chapter 4) this was different. Here, a co-management framework was already in place, allowing fishermen and other stakeholders access to and real influence over management decisions. While the collaborative approach towards project identification and data collection was emphasized in support of co-management ideals, the focus of the research was to solve a typical fishery problem relating to selectivity in a mixed fishery. In a similar way, although within a very different management setting, the WBSS herring (Chapter 6) and the elasmobranches (Chapter 16) cases maintained a strong focus on the technical issue at hand. In all these cases, the GAP projects were able to carry out research that could justify different and more sustainable management measures. In contrast to the relatively small-scale Vättern case, where the road from advice to implementation is rather short, the CS projects on WBSS herring and elasmobranches encountered the "management wall" problem, typical for larger-scale management systems.

The "management wall" problem, we argue, is a specific version of a participation problem, where a relevant and effective management arena exists, but where access to and influence on decisions are highly restricted. Large and centralized TAC-machine structures will by their nature include restrictive management walls, since they work by deploying a limited set of standardized solutions, fit to cover a set of standardized problems. In some cases, the solutions available in the existing TAC machine repertoire does not fit, for some reason or other, the local situation in the fisheries. The repertoire of interventions available from the center does not allow the fine-grained resolution required to capture the local issue. Or if it does, the intervention tools at hand do not have the required precision to fix the problem. To the extent fisheries governance comprises a range of specific and dynamic local problems, in addition to the brief catalogue of standard issues serviced by the TAC machine, the management wall problem will be re-occurring as a regular feature.

Following Stange (2016), we can apply the concept of a "boundary object" to come to grips with the "management wall" problem. This concept was introduced by Star and Griesemer (1989) in order to understand how collaboration is possible among actors that come from different social worlds. Boundary objects, according to Star and Griesemer (1989: 393) are "both plastic enough to adapt to local needs and the constraints of several parties employing them, yet robust enough to maintain a common identity across sites." In a fisheries management context, this concept is useful in order to understand collaborative efforts across the divides among fishermen, scientists and managers.

Depending on the context, boundary objects can take a variety of forms, and may be abstract or concrete (Star 2010). In Stange's (2016) analysis of the collaborative approach to management of boarfish, both an acoustic survey and a management plan served as boundary objects for different collaborative purposes. This can be confirmed and qualified in light of the GAP CS projects. We notice that specific knowledge pursuits, like acoustic or trawl surveys, GIS mapping, discard sampling or any other relevant research method, can be found at the heart of the CS project. Usually, this is a boundary object bounced back and forth between fishermen and scientists, with management concerns in the background. Typically, the management implications of these activities come up towards the end of the project. Here, the boundary object is no longer the primary knowledge item in itself or the research method, but becomes part of the management decisions towards which it speaks, which sometimes are embedded in a management plan, as Stange suggests. The management wall problem as formulated above may indicate that it is easier to organize collaborative research than to make it count. This makes sense since the boundary issue involved becomes more complex when it involves managers as well as fishermen and scientists.

In Stange's formulation, the management plan itself is designated as a boundary object. We suggest a slightly different usage, indicating that the management plan proposal becomes the boundary object. It is not the plan itself, but the process of working out submitting, reviewing, rejecting, revising and resubmitting the plan proposal that should be in focus here. It is in this back-and-forth process of "boundary work" that the boundaries between the different social worlds are negotiated and sometimes transformed. An important factor in deciding how this work can proceed is the boundary infrastructure facilitating such exchanges (Bowker and Star 1999: 313). As pointed out by Stange (2016), a common vocabulary among the actors is important for transferring experiences and shared meaning, and that takes time and practical collaboration to establish. Such a vocabulary, together with the standards and shared meanings that support it, is part of the boundary infrastructure. In addition, we argue, the framework defining what a management plan is and what it can do constitutes an important part of the boundary infrastructure in a fisheries management context.

Now, the focus of the GAP CS projects has been to organize local processes of co-creating common knowledge and management proposals as boundary objects, flexible enough to contain local needs and viewpoints, yet robust enough to survive the passage across the management wall and to make a difference on management decisions. In this way, the GAP CS method is a prototype for improved local participation in knowledge mobilization and management decision making. As we have seen, the success of this approach is highly variable, depending on a number of factors within and outside the respective CS project. One important dimension here concerns the state of the boundary infrastructure facilitating the development and utilization of the co-created local boundary objects.

As already noted, the "GAP method", common across all the case studies, was collaborative research. If the major problem to be addressed was connected to weak participatory mechanisms, as discussed above, the approach to fix that relied on the promises of collaborative research and co-creation of knowledge. The CS chapters confirm that this was the common approach, although its modes of deployment and effectiveness depend on the particularities of the case study setting. Some of the cases were motivated by specific management problems, conducting research that could justify retraction or modification of punitive regulations, as in the CS projects on Lake Vättern (Chapter 4) and on elasmobranches (Chapter 16) or allow better management plans, as in the CS projects on WBSS herring (Chapter 6); red shrimp (Chapter 10), or in Chioggia (Chapter 8). In other cases, the focus was broader, involving the assessment of key stocks in a fisheries zone in Malta (Chapter 15) or mapping the fishing practices and resources of a local area in Galicia (Chapter 5). Some of the case studies focused on method development, like the use echo-sounders for monitoring coastal resources, as in Steigen (Chapter 9) or developing decision tools to help stakeholders make sense of complex management options as for the North Sea mixed fisheries (Chapter 11). Some of the cases started out with a management related focus, but were overwhelmed by legitimacy issues, as in the case of FAD tuna (Chapter 12) and Dutch discard (Chapter 14). Some cases were not primarily motivated to provide a new type of knowledge-based advice relevant for fisheries management decisions. Instead, they worked to strengthen the fishermen's capacity for knowledge mobilization, improving their status and effectiveness in the tightening struggle for space in the coastal zone, as in the CS projects of Devon brown crab (Chapter 3), Wadden Sea brown shrimp (Chapter 7) and Baltic MSP (Chapter 13).

The CS projects in this volume seem to comprise the same range of variation in themes and approaches that is generally observed in collaborative fisheries research, be it covered under the heading of Fisheries Dependent Information (FDI) (Graham & al, 2011; Dörner et al. 2015; Mangi et al. 2018) or Fishers' Knowledge (FK) (Hind 2015; Stephenson et al. 2016). Nevertheless, FDI and FK include approaches where the participation of fishermen and other stakeholders are limited to practical tasks, usually data collection, but where strategically important issues like project design and data analysis remain the prerogative of the science partner. In line with recent shifts towards more complete engagement of stakeholders (Dörner et al. 2015; Mangi et al. 2018), the GAP CS projects stand out by a commitment to active stakeholder participation beyond that (Johnson and van Densen 2007) with particular emphasis on joint problem definition. In functional terms, we want to argue, an important feature of the GAP approach was on how the project allowed systematic research efforts to be dedicated to knowledge gaps and problems as defined by the particular context and complexities of the local situation. In the design of the specific research approach to such problems, i.e. the choice of appropriate methods and the analysis and packaging of the results, the stakeholders in general have been happy to stand back and let the science partner take the lead (see also Stange 2016).

An important practical reason for this, of course, is the realization of the key role of fisheries scientists as gate-keepers for knowledge and advice for management purposes. In order to penetrate the management wall, then, you need fisheries scientists firmly in charge of formatting and pushing the message, as demonstrated most clearly in CS projects on WBSS herring (Chapter 6) and elasmobranches (Chapter16). In cases like Vättern (Chapter 4) and Palamós (Chapter 10), where strong fishermen participation in management functions was already secured, the collaborative organization of the research itself (i.e. the legitimacy issue) seems to be less important than the credibility and management relevance (saliency) of the knowledge it produces.

The GAP CS projects indicate that a range of different configurations are possible in the relationship between stakeholders, scientists and managers. We have previously suggested the term "scientific fisherman" as a handle for the new agency afforded by this configuration (Dubois et al. 2016; see Chapter 2 section 1). The scientific fisherman is constituted by a network of scientists, fishermen and managers, aligned in a common effort to maintain the social, economic and environmental sustainability of the fisheries. In that struggle, the involved actors certainly have different roles and responsibilities. Nevertheless, as indicated by the qualifier "scientific", the fishermen can no longer afford to leave knowledge and management issues in the hands of other actors. In the information age, fishermen must have ready access to the language and resources of science. In order for that to be possible, however, fishermen and other stakeholders must engage actively in knowledge and management work, and not leave this to the outside experts. This is important in order for fishermen to explain and defend their own interests. As noted in Chapter 2, this new actor constellation comes about from the transformation of fisheries management discussed as a "communicative turnaround" resulting from sharing the burden of proof (Linke and Jentoft 2013). The GAP CS projects not only demonstrate how this is possible, but also how useful such projects can be in order to identify and contain the overflows arising from the transition taking place in the governance of fisheries, whether the case studies explored are from within the CFP or not.

It is worth noting that the knowledge and competencies of the scientific fisherman in this sense is of a different order than that imputed to fishermen in classical work on Fishermen's Ecological Knowledge (FEK; cf. Holm 2003; see also Hind 2015). In the FEK discourse, the knowledge and skills of fishermen are portrayed as existing unrelated and prior to their interaction with scientists and managers. FEK could complement scientific knowledge because it existed as a separate knowledge formation, independent of scientific knowledge. The scientific fisherman, in contrast, becomes knowledgeable through interaction with scientists and managers. The most useful aspect of such knowledge, moreover, is not about fish stocks or marine ecology, since these are the home domains of scientific experts. Instead, it is knowledge about the dynamic interaction between ecology, exploitation and management intervention, mediated by technology, economic motives and social responsibilities. For such inter- and trans-disciplinary knowledge, the scientific fisherman is clearly at home in a new political domain.

In this perspective, then, the GAP CS projects can be seen as sites for forging the networks among fishermen, scientists and managers out of which the scientific fisherman emerges. In this sense, the scientific fisherman is characterized by its command of a common vocabulary across social worlds (cf. Stange 2016). While the GAP project in itself has contributed to the creation and stabilization of such networks and infrastructure, its realization is part of a more general movement towards more inclusive governance approaches, as noted in Chapter 2. The scientific fisherman, then, is the result of a broad acceptance of active stakeholder participation in fisheries management and marine research (see Stevenson et al. 2016; Holm and Soma 2016).

As already noted, the GAP project was conceived as a research program and a reform agenda, set up to explore and contribute to the development towards more participatory and inclusive fisheries science and management. The individual CS projects, as we have seen, were informed by institutional reform issues in different ways. Some of the projects became exemplary models for stakeholder-driven research and co-management (Chapter 10 Mediterranean red shrimp; Chapter 4 Selectivity in Lake Vättern). Some of the projects demonstrated the potentials and pitfalls of collaborative solutions for collecting fisheries dependent information (Chapter 15 Maltese Fisheries Management Zone; Chapter 5 Mapping habitats and fishing in Galicia; Chapter 9 Fishery monitoring for coastal cod). Some of the projects brought out the challenges of making a collaborative knowledge count, of making a difference in management (Chapter 16 Bycatch and discards of elasmobranchs; Chapter 6 on Management of herring). Some of the projects became entangled in ongoing reform processes in Europe (Chapter 14 Discard sampling for flatfish fisheries; Chapter 11 Multispecies and mixed fisheries in the North Sea), while others were swamped by distrust and legitimacy issues generated by weak mechanisms for participation and influence (Chapter 12 Tuna FADs; Chapter 8 Fishing and habitat in the northern Adriatic Sea). Some of the projects pointed towards the growing importance of broader processes of marine management, in which the fisheries are challenged by other interests in the coastal zone (Chapter 3 Sustainability of brown crab fisheries; Chapter 7 Rare Wadden Sea species; Chapter 13 Baltic fisheries and Marine Spatial Planning).

One of the CS projects, on Multispecies and mixed fisheries in the North Sea (chapter 11), engaged with the ongoing CFP reform in a more direct way than any of the others. Using the North Sea Advisory Council as a platform, its objective was to develop a decision tool needed to support effective collaboration among fishers, scientists and managers in the development of a multi-annual management plan for North Sea mixed fisheries. Sticking to the terminology introduced above we could say that such decision tools, together with the shared vocabulary they require and disseminate, form part of the boundary infrastructure that facilitates collaboration across different social worlds.

In the same way, an important output of the GAP project as a whole was a set of guidelines for participatory research between fishermen and scientists (Mackinson et al. 2008; Mackinson et al. 2015). It is of course difficult to assess the extent to which such guidelines are picked up and put to use. Nevertheless, we can note that their impact is strengthened by an alignment with the discourse on Fisheries Dependent Information (Graham et al. 2011; Dörner et al. 2015; Hind 2015; Stephenson et al. 2016), suggesting that it is approaching an accepted normative model for involving stakeholders in research. Based on the emerging practices in the UK, consistent with international trends, Mangi et al. (2018: 622) conclude: “There is considerable evidence of a paradigm shift from the conventional practice of asking fishers to provide data for scientific analysis towards full engagement of key stakeholders in data collection.”

The work to establish a common framework and vocabulary for research collaboration forms an important part of the process of creating a boundary infrastructure that facilitates co-creation of knowledge. The GAP project has contributed to the development and institutionalization of such an infrastructure, building a foundation for reform. In addition, however, the GAP CS projects also explored the prospects of more specific reform approaches. In particular, the GAP project speaks to the possibilities and challenges of effective local participation in making co-created knowledge count in management decisions, as in Chapter 4 on selectivity in Lake Vättern and Chapter 10 on Management of Mediterranean red shrimp.

In both of these CS project, the fisheries in questions are managed under co-management frameworks. As pointed out in Chapter 2, co-management comes with strong participatory ideals, and is as such an important model in the context of fisheries reform. Nevertheless, the co-management model cannot be a complete alternative to top-down management, replacing it altogether. While management issues sometimes can be contained locally, as in the red shrimp case, this is often not the case, as demonstrated in Chapter 8 on fishing and habitat in the Northern Adriatic Sea. With the increasing complexity and interconnectivity acknowledged in the ecosystem approach to fisheries management, any functional governance format must include strong elements of centralization. The GAP experience indicates the possibility of a nested design, by which the structures and processes of top-down systems can be adjusted in order to allow co-management modules to operate within the larger framework. This in itself is of course not a new idea. One of Ostrom's design principles for successful local resource management is nested design, highlighting that the local management institutions must be supported, or at least not undermined, by higher authorities (Ostrom 1990). The GAP project indicates the potential of one specific format of nested design, namely one where the management plan proposal serves as boundary object for communication and coordination between local co-management units and the higher decision-making levels. It is in the process of bouncing the proposal back and forth among different stakeholders that the possibility of alignment and mutual adjustment occur, as we have seen in some of the CS projects (Chapters 6; 10 and 16). This is also consistent with research in EcoFishMan project, where a model for management planning along these lines was developed and tested (Nielsen, Holm and Aschan 2015; Nielsen et al. 2017).

While the GAP project was not specifically designed to explore a nested design, it clearly demonstrates the feasibility of a nested model for knowledge construction. Whereas the GAP experience surely indicates that this may work, it has also made clear the need for developing an appropriate boundary infrastructure in support of such a model. We already see the traces of such an infrastructure, in constructions of a shared vocabulary, best practice guidelines for collaborative research and decision support tools. Needless to say, realizing a complete governance model for fisheries based on a nested design as indicated here would require a more systematic process to establish an appropriate management plan framework, with the appropriate legal, organizational and economic standards for a division of responsibilities and the streamlining of processes. While this seems to be far off at the moment, we note that the recent CFP reform includes a legal definition of a management plan process that may open up for stronger regional involvement in management plan processes (Nielsen et al. 2017), within a system where the key values and principles remain under democratic control in a centralized system.

The power of a nested systems model along these lines lies in its capacity for opening-up for more active stakeholder participation at the same time as it can handle the problem of increasing complexity that follows from the ecosystem approach. To realize such a model would require considerable investment in appropriate boundary infrastructure. Nevertheless, the GAP experience also indicates that modest approaches towards such a model is possible and do not have to wait for such infrastructure to be put in place. In several of the GAP CS projects, stakeholder led management was realized within the established structures, as demonstrated in Chapter 6 on WBSS herring; in Chapter 10 on Mediterranean red shrimp, and in Chapter 16 on bycatch of elasmobranchs. Management plan proposals, it hence seems, can function effectively as boundary objects even in the absence of a clear boundary structure to streamline the process.

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