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The Relation between Fisheries–Science Partnerships and Co-Management: A Case Study of EU Discards Survival Work

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Abstract: This paper is an analysis of the relationship between the concepts of fisheries–science partnership (FSP) and fisheries co-management (FCM), using a case study of recent EU work on discard survival. Are FSP and FCM entirely different forms of joint activity, or is FSP a form of FCM or a means of preparing the ground for FCM? And is the recent EU work on discard survival a form of FSP, or of FCM, or both? A questionnaire was sent out by email in 2015 to 13 people who were involved in the discard survival work, and eight responses were received that covered eight projects in seven countries (Belgium, England, Denmark, France, Norway, Sweden, and the Netherlands). Our main findings are fourfold. First, while FSP and FCM are different forms of joint activity, they are both partnerships. Second, FSP may serve as a precursor or preparation for FCM. Third, the EU discard survival assessment work contains elements of both FSP and FCM, but is mainly a FSP exercise and falls far short of FCM. Nevertheless, fourth, this joint work alongside many other FSP initiatives undertaken under the auspices of the Common Fisheries Policy (CFP) (e.g., the GAP projects) has improved relations between fishers, scientists, and managers, and this may contribute to a modification of the CFP's largely top-down decision-making system.

Keywords: collaborative research; fisheries–science partnership; fisheries co-management; Common Fisheries Policy (CFP) discard survival research work

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1. Introduction

The relationship between fisheries-science partnership (FSP) and fisheries co-management (FCM) is complex. In some respects, FSP is itself a form of FCM, in that it entails joint research undertaken by fishers and scientists together that is often initiated, funded, and monitored by government, and feeds directly into fisheries management decision-making [1]. However, in other respects, FSP and FCM are entirely different concepts: FSP is about research, whereas FCM is about management, and there is no necessary connection between them. This paper examines the concepts of FSP and FCM to determine the theoretical relationship between them, and applies those concepts to a case study of EU work on assessing discard survival rates. The importance of this issue is partly conceptual—to clarify the meaning of the concepts of FSP and FCM—and partly practical—to contribute to policy debates about whether the hierarchical structure of the EU's Common Fisheries Policy (CFP) might be moving towards a more participative form of management.

On 1 January 2014, the reformed CFP came into force with a ban on discarding (known as the "landing obligation") for regulated species. The landing obligation originated in public pressure following a campaign to end discards launched by Hugh Fearnley-Whittingstall in 2012, whose Channel 4 TV series, *Hugh's Fish Fight*, received over 700,000 signatures. The landing obligation was strongly opposed by the fishing industry and its implementation has been fraught with problems, most notably that of "choke" species (fish whose catch exceeds a vessel's quota but which cannot be discarded so the vessel must stop fishing and

return to port). However, if a species of unwanted fish could survive being discarded at sea, it would be foolish to insist that it is landed, dead, at ports. Accordingly, an exemption from the landing obligation was granted for "species for which scientific evidence demonstrates high survival rates, taking into account the characteristics of the gear, of the fishing practices and of the ecosystem" [2]. But such "scientific evidence" was very limited in 2013: there were some published data on discard survival rates, but the results were highly variable and only available for a few species. Hence there was an urgent demand for systematic scientific evidence on discard survival rates of many species. This demand was not easy to meet, because many factors, including biological attributes, environmental conditions, and technical elements of the capture process, can affect the survival probability of discarded species. Nevertheless, as we shall see in Section 3, the EU's demand for discard data was met with an unprecedented response from member state fisheries departments, marine science institutes, the International Council for the Exploration of the Sea (ICES), the fishing community, and the European Commission. In a relatively short period of time, new scientific data were obtained and incorporated into fisheries management (Figure 1). This remarkable development of a joint effort to assess discard survival rates in EU waters raises the question of whether it is another example of FSP or a new form of FCM.

The paper is divided into four sections. Section 2 sets out the conceptual framework by explaining what the notions of fisheries–science partnership (FSP) and fisheries co-management (FCM) mean and how they relate to one another. Section 3 outlines the case study of the EU rapid research assessment on discard survival. Section 4 explains the methods used in the rapid research assessment. Section 5 reports the findings of the questionnaire. Section 6 discusses why the case study exemplifies FSP but not FCM, and whether the elements of FSP in the rapid research assessment constitute small steps in the direction of modifying the top-down system of EU fisheries management. Section 7 concludes with a summary of the argument of the paper and a note on its wider implications.

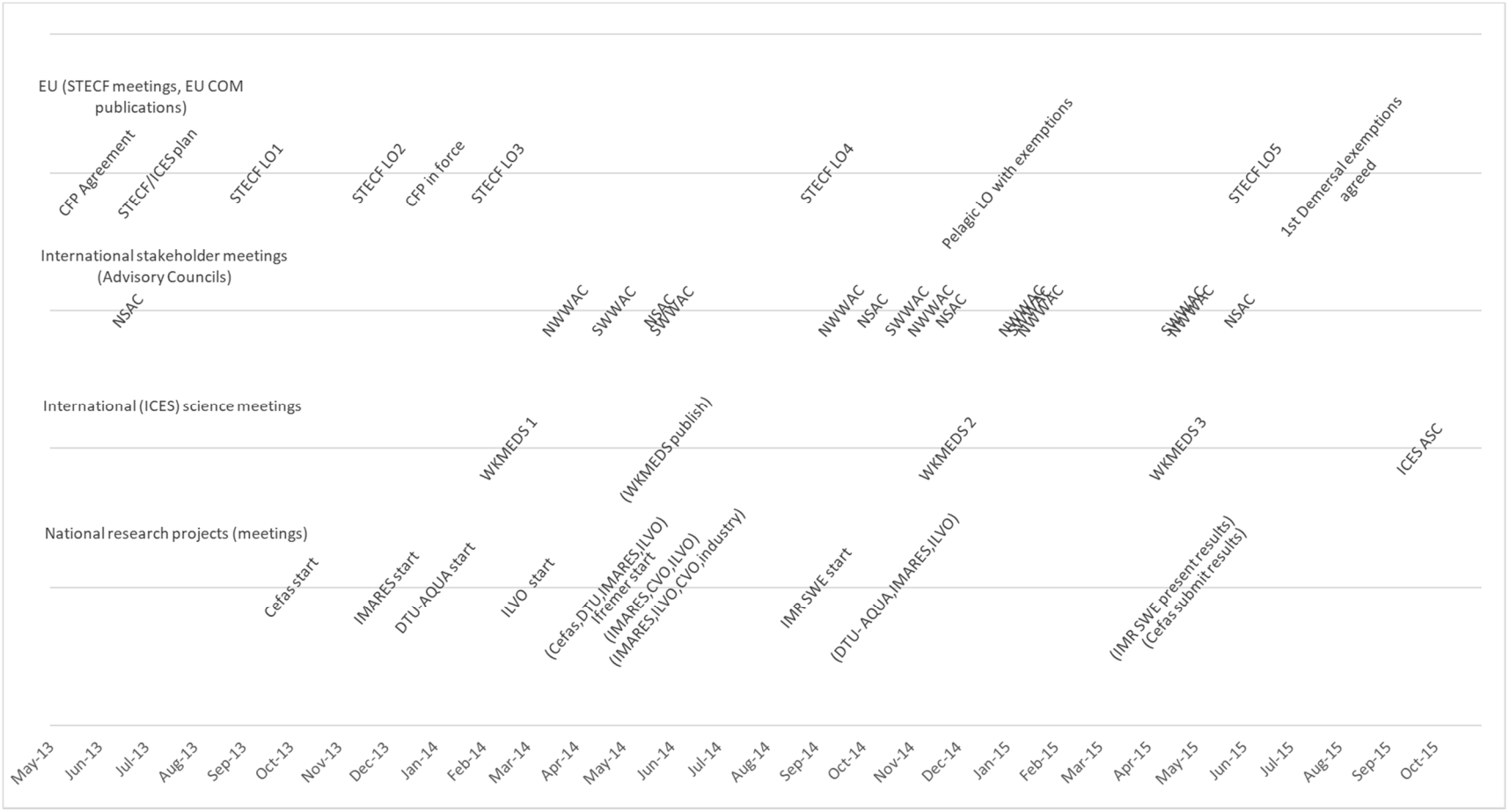


Figure 1. Timeline of key events from the Common Fisheries Policy (CFP) reform agreement to the first of the exemptions for demersal fish given for the EU; Advisory Council meetings; relevant international science meetings; and the start point for national collaborative research projects by each scientific institute. (Source STECF and EU Commission publications. "Pelagic LO with exemptions", "pelagic purse seine fisheries"—existing evidence. "IMR SWE present results; Cefas present results", "1st Demersal exemptions agreed"–derived from new data).

2. Conceptual Framework: FSP and FCM

2.1. The Concept of Fisheries–Science Partnership (FSP)

At its root, FSP is about research partnerships between fishers and scientists, though some writers (including Harte, Stange et al. and Hartley and Robertson [3–5] widen its definition to include other stakeholders such as managers and fishing communities. Advocates of FSP claim that FSPs provide more accurate data on fish stocks because fishers' experiential knowledge is added to scientists' ecological knowledge, and this improves the knowledge base required for effective fisheries management [6]. Also, agreement between fishers and scientists on stock data is deemed essential if management policies are to be accepted and complied with [7]. In addition, according to Hartley and Robertson [5,8,9], FSP breaks down barriers between fishers and scientists, replacing distrust and misperception with mutual understanding and respect [10]. Mutual mistrust arose from the hostile relationship between fishers and scientists as fishing stocks were deemed by scientists to be in decline but fishers held them to be healthy, and fishers challenged the methods used by scientists to estimate stock levels [11–13] report that FSP deepens the capacity of both fishers and scientists to understand the ways in which the other side works. Johnson and Van Densen [14] refer to the cost-effectiveness of FSP and its provision of additional income for fishers.

FSP is not a new phenomenon, but originated in the late 19th/early20th century [8,10,15,16]. Major initiatives have been launched during the last 20 years throughout the world to encourage joint research between fishers and scientists to improve the quality of stock data [8,11,15]. In the case of the EU's CFP, funding for FSP projects began in 2007 with programmes such as GAP1, GAP2, and MYFISH [16,17]. FSPs take a variety of forms. Mangi et al. [18] divide FSPs into two types: passive participation, which uses routine fishing operations to collect data, normally by an observer or electronic instruments such as CCTV (closed-circuit television) or VMS (vessel monitoring system); and active participation, which entails fishers adapting their normal activity to collect data by, for example, sampling, measuring, tagging, monitoring survival rates, and identifying spawning and nursery areas (see also [19]).

Other writers distinguish between four forms of FSP: informative, consultative, cooperative, and collaborative, in ascending degrees of engagement [6,9,20]. Informative FSP entails a two-way process of scientists informing fishers about scientific survey data, and fishers informing scientists about their experiential data [21–24]. Consultative FSP entails scientists interacting with senior members of the fishing industry in order that each side listens to the other side's perceptions of the state of the stocks and additional issues of concern to them [15,22]. Cooperative FSP entails involving fishers in scientific research to carry out ancillary roles short of making a "significant intellectual contribution" [10]. Here, typically, skippers take scientists on board their vessels to conduct surveys of fish stocks or measure discard practices or investigate habitat conditions, and fishing crews follow instructions from scientists in carrying out, for instance, sampling activities, but do not take part in the design of a project or analysis of the data generated [22]. Collaborative FSP, according to Wendt and Starr [10], entails an "intellectual partnership" between fishers and scientists, which involves the incorporation of fishers' knowledge into the scientific process. Here, FSP is a "joint intellectual endeavour" [25] in which fishers participate in every phase of the research process, including formulation of the research questions and hypotheses, location of funding, design of the methodology, generation, and analysis of the data, and dissemination of the findings [9,11] (p. 67) report that in Canada, a fisheries science website stated that through this participation, "the fishermen have in many ways themselves become scientists on the water". Dubois et al. [26] refer to the "rise of the scientific fisherman", transitioning from data collector to "knowledge agent" and the "fusion or blurring of 'expert' and 'lay' knowledge". Feeney et al. [20] describe collaborative FSP as fishers and scientists working together as "equal partners". Collaborative FSP is defined by Wilson [24] as "the community science model", and the "democratization" of science, which involves fishers and scientists transcending the divide between them and working

together on scientific research issues as a team or community. Hartley, Jacobsen et al. [5,27] claim the community science model is increasingly emerging in Europe. Collaborative FSP is closely related to the concept of "citizen science" in that it entails non-scientists' voluntary involvement in the collection and analysis of data, and at similar levels of engagement to scientists [28]. The more FSP moves to the collaborative mode the closer it comes to FCM, in that it develops structural rather than simply functional characteristics [13,29].

In our view, FSP is generally an arrangement whereby fishers work with scientists on joint projects to co-produce knowledge that is of mutual interest, and each party treats the other with equal respect, but the leading role is normally taken by scientists. Over the last 20 years, there has been a considerable amount of FSP conducted in EU member states, especially under the auspices of the EU-funded GAP project [16]. But at the EU level, it has been confined to a mainly one-sided relationship between a dominant expert-led scientific advisory body, the Scientific, Technical and Economic Committee for Fisheries (STECF), and weak regional advisory bodies (ACs) that are populated by a majority of fishers' representatives but whose recommendations are rarely implemented by the Commission [30]. These fishers are invited to attend STECF meetings not as industry representatives but as members of ACs; they are designated as "observers" by contrast to the scientists who are designated as "experts"; and they do not contribute to drafting the reports, which are reviewed in STECF plenary meetings from which observers are excluded.

2.2. The Concept of Fisheries Co-Management (FCM)

Jentoft is credited with inventing the term "fisheries co-management" in 1989, defining it as government agencies sharing management functions with fishers' organisations [31,32], though Hoefnagel et al. [33] point out that FCM was in operation long before the term was coined. At its root, FCM is about the sharing of fisheries management decision-making between government and other players, particularly resource users [34–38]. However, as [39] say, FCM is not easy to define (see also [40,41]) notes there is "no single universally accepted definition" of FCM. Metzner et al. [42] say that FCM "can mean just about anything" (see also [43,44]) argues there is no "blueprint formula" that can be applied everywhere because FCM reflects national styles of governance and local ecological, social, and cultural contexts (see also [45]). The wide range of meanings attributed to FCM include partnership [33,41,46–51]; power-sharing [40,52–54]; empowerment [37,55–57]; democracy [49,58]; user participation [59]; decentralisation [60]; accountability [5]; transparency [48]; epistemic community [61]; self-governed common pool resources [62]; and co-governance [63]. Many writers assert that FCM is less a formal structure than an on-going process [45,63–65].

Since the 1980s, there has been a rapid growth in acceptance of the concept of FCM. In 1980, FCM would not even have been considered a viable form of fisheries management [66], because the prevailing wisdom was that fisheries were a tragedy of the commons problem, the solution to which was either top-down command and control or privatisation [67]. But with the widespread failure of top-down management systems and the ideological controversy over private property in natural resources, FCM is now frequently proposed as the only realistic solution for fisheries problems [68,69] and scores of other writers have attested to its extensive use around the world [36,37,39,59,70–72]. Carlsson and Berkes [51] claim FCM has probably become the rule rather than the exception. Hoefnagel et al. [33] say that the rationale for FCM has three main elements: to benefit from fishers' expertise; to improve fishers' compliance with regulations; and to give fishers their democratic right to have their say in what affects them.

However, there are many different types of FCM. Symes [73] distinguishes between micro-FCM and macro-FCM. Micro-FCM is where specific technical fisheries issues such as gear restrictions and discard regulations are cooperatively grappled with by groups made up of fishers, scientists, and administrators. This form of FCM is close to FSP. Macro-FCM is where the whole range of national fisheries decision-making is in the joint hands of government and stakeholders (as in Norway). Nielsen et al. [39] distinguish between

"instrumental" FCM and "empowering" FCM: instrumental FCM is where management makes use of stakeholder participation to smooth the process of implementation of its measures rather than to give fishers a real say in what those measures should be, which is what empowering FCM entails. Another useful distinction can be drawn between structural and functional typologies of FCM [74]. Structural typologies include Sen and Nielsen's [75] distinction between five kinds of fisheries co-management listed in order of most top-down to most bottom-up. Functional typologies focus on the type of work or activity the FCM engages in, concentrating on its role or purpose rather than its form [41].

In our view, strictly speaking, FCM means shared responsibility for decision-making between fishers and managers in an institutional arrangement that is formally and legally established. On this interpretation, while there are structural elements of FCM in the domestic fisheries management systems of some EU member states, including the Netherlands and the small-scale sector in England, much of it is functionally driven by the EU to serve its own goals [74]. Moreover, there is little FCM in the way the CFP is managed at the EU level [76]: the co-decision arrangement shares legislative responsibility between the EU Fisheries Council and the European Parliament, but does not include the fishing industry, and while the fisheries Advisory Councils have a majority of fishers' representatives, they do not share any executive decision-making authority with the European Commission; their role is purely advisory.

2.3. The Relationship between FSP and FCM

What is the relationship between FSP and FCM? For example, (1) are they entirely separate and independent phenomena, or are they interrelated? (2) If the latter, does FSP lead naturally to FCM, and does FCM necessarily imply FSP? In answer to the first question, FSP is distinct from FCM in several respects. It is restricted to fisheries research, whereas FCM potentially covers the whole range of fisheries management. FSP is an epistemic community, sharing the process of knowledge co-production, whereas FCM is a decision-making framework, sharing the exercise of power. However, FSP and FCM have some features in common, including their partnership status. Dubois et al. [26] claim that in the FSP they studied in the Devon inshore brown crab fishery, the role of knowledge is more about influencing decisions in fisheries management than it is about proving truth claims over stock levels, so fishers' knowledge is less truth-finding than a "political commodity" to be used to effect entry into management decision-making: the new fisher scientists are political actors. Here, FSP may be seen as a form or aspect of FCM. Lodi and Tardin [77] point out that citizen science projects may contribute not only to data collection but also to species management and policy-making. Karr et al. [78] seem to regard FSP and FCM as inseparable. Hipwell [1] sees a reciprocal connection between FSP and FCM, since each needs the other. FCM is unlikely to be successful without FSP because FCM depends on integrating fishers' knowledge with scientific knowledge (see also [11,79]), while FSP is unlikely to be successful without FCM because joint research needs the framework of power-sharing that co-management provides (fishers are unwilling to engage in joint research unless arrangements are in place to ensure they will have control over how the research is conducted and how their data are used). On this view, FSP and FCM are symbiotically linked, and wherever the one is found, the other will also be found. For Hipwell [1], the very definition of FCM incorporates FSP within it, while for Quimby and Levine [80], FCM often includes FSP. In our view, notwithstanding these links between them, FSP and FCM are distinct and different kinds of arrangement: FSP is about collaborative knowledge decisions, and FCM is about collaborative governmental decisions.

In answer to the first part of the second question, many commentators argue that FSP naturally leads or morphs into FCM. For example, according to Wilson [24], FSP is the "ideal model" for developing the necessary knowledge base for FCM. Stephenson et al. [29] say FSP is a "major pathway" to FCM. Wendt and Starr [10] claim that FSP serves as a model for FCM: by undertaking joint fisheries research, stakeholders in coastal

communities learn how to work together (see also [79]). Indeed, Wendt and Starr [10] say that FSP is a "potent mechanism" for, and "critical step" towards, democratic fisheries management (see also [81]). Likewise, Kittinger [82] sees FSP as a stepping stone to FCM, explaining that joint fisheries research builds capacity for working together that is readily transferred to management decision-making, and he reports how this has happened in Hawaiian communities. Mackinson et al. [83] (p. 1, 6, 7) say "the basic idea of collaboration in research and innovation is deeply connected with the principles of inclusive governance", referring to co-management as "an outcome of participatory research", and observing "how multi-actor collaboration in research and innovation can provide a vehicle for inclusive governance". Holm et al. [84] (p. 22) describe the GAP project as "part of a more general movement towards more inclusive governance approaches". In a review of fishery-dependent information, Dörner et al. [85] (p. 1133) say a "paradigm shift towards full engagement of key stakeholders started to take place" between 2010 and 2014. Mackinson and Wilson [7] describe FCM as being "catalysed" by successful FSP. Hartley and Robertson [5] report that experience of FSP encourages both fishers and scientists to take part in FCM. However, Kittinger [82] cautions that FSP is unlikely to be sufficient in itself for the development of FCM. Other factors are also necessary, including equitable power relations and robust institutional capacity. We agree with Kittinger—there is nothing inevitable about a transition from FSP to FCM.

In answer to the second part of the second question—does FCM necessarily imply FSP?—we say "No", because FCM can and does exist without FSP. For example, in England, the management of small-scale fisheries lies in the hands of Inshore Fisheries Conservation Authorities' (IFCAs') committees, which are co-management bodies composed of fisheries officers, fishers, and local authority councillors, but very few of these IFCAs have set up FSPs. Similarly, in the Netherlands, FCM existed a long time before FSP was introduced [14,76].

There is one final point of clarification to be made about the concepts of FSP and FCM. Although most of the literature is broadly in favour of FSP and FCM, each of them has its critics. For example, FSPs are criticised for being used by each side to promote their own agendas [86], while FCMs are criticised for their unequal power relations [48,87]. Our view is that FSP and FCM are not panaceas, but work well only under certain conditions.

3. Case Study: EU Rapid Research Work on Discard Survival

In this section, we describe the case study of the EU rapid research work on discard survival. On 1 January 2014, a ban on discarding known as the landing obligation for regulated species came into place in the CFP [2]. This discard ban was phased in. It began with pelagic fisheries in January 2015 and covered all quota stocks in EU waters by January 2019. The dual purpose of the landing obligation is to make the "best use" of unwanted catches and to incentivise fishers to avoid catching unwanted fish ("selectivity") [88]. There are, however, a number of exemptions to help the landing obligation work in practice. One exemption can be granted for species for which scientific evidence demonstrates high survival rates [2]. But such exemptions must be based on rigorous scientific studies independently verified by the European Commission's Scientific, Technical and Economic Committee for Fisheries (STECF) before being accepted by the European Commission. This case study is an account of the way that one group of experts cooperated quickly to conduct an assessment of discard survival rates. The machinery put in place by the EU Commission included the creation of High Level Groups to receive the reports of such groups of experts. The most prominent High Level Group authorised by the EU to take on the role of monitoring the discard survival assessments is the Scheveningen High Level Group, which is composed of representatives of seven EU member states bordering the North Sea (Belgium, Denmark, France, Germany, the Netherlands, Sweden, and the UK), and since 2014 has been working with the NSAC (North Sea Advisory Council) on the implications of the landing obligation.

The assessment began with a scoping meeting involving STECF and the ICES Secretariat, held in July 2013, when a draft work plan was agreed between STECF and ICES on how to proceed. A STECF Expert Working Group (EWG 13-16) meeting took place in September 2013 to establish guidelines for best practices in undertaking discard survival studies, and to define high survivability. This meeting was attended by 38 participants, including 8 from STECF, 3 from the EU Joint Research Centre, 3 from the European Commission, 14 scientific experts, and 10 observers affiliated with the fishing industry. STECF concluded from this meeting that the selection of a value that constitutes a high level of survival is subjective and likely to be species- and fishery-specific, and it proposed that the value should be based on trade-offs between the benefits to the stock of continued discarding and the potential removal of incentives to change exploitation patterns [89].

Three methodologies for conducting survival experiments were identified: (1) captive observations; (2) vitality/reflex assessments; and (3) tagging/biotelemetry experiments [90]. ICES set up a workshop on methods for estimating discard survival (WKMEDS) in January 2014 to review current estimates of discard mortality; improve understanding of the explanatory variables associated with discard mortality; and establish approaches for measuring and reducing the uncertainty associated with mortality estimates. The first WKMEDS meeting of experts from around the world was held in February 2014 and was attended by 23 people from 13 countries, with 27 people engaged through correspondence. At this meeting, WKMEDS drafted a set of guidelines on how to estimate discard survival rates, identifying potential pitfalls and highlighting best practice. Many WKMEDS members were already conducting research in discard survival while the guidance was being developed, because the timeframe for the implementation of the landing obligation was very tight. For example, in the case of demersal species, which were to come under the landing obligation in January 2016, for exemptions to be in place, proposed exemptions evidenced by scientific research needed to be drafted by May 2015. Pressure also came from the industry, which had high expectations that the WKMEDS group would provide definitive proof of high survival rates for many fisheries. Several new studies were conducted by members of WKMEDS from different member states on the discard survival rates of plaice (*Pleuronectes platessa)*, sole (*Solea solea)* and Norway lobster (*Nephrops norvegicus)* in trawl fisheries, and the WKMEDS meetings enabled them to share experiences whilst conducting research, thereby avoiding duplicating effort, harmonising their survival assessments, and ensuring comparability [91].

4. Methods

Information for this paper on how the survivability research was carried out was based largely on questionnaire responses from researchers. The written questionnaire was directed at the researchers and science practitioners who were all members of WKMEDS and had leading roles in national research projects with first-hand experience in managing the projects from inception to completion. For each project, or from each institute, there was one respondent who provided and collated the feedback. The questions in the questionnaire were a mixture of structured and semi-structured questions, and covered the following issues: **Initiation** (How were the projects initiated? Was the fishing industry involved in project initiation and commissioning?); **Objectives** (What were the objectives of the projects? Were these agreed with the industry?); **Expectations** (What were the expectations of the different participants?); **Funding** (How were the projects funded and how much funding was involved?); **Structure** (How were the projects organised?); **Methods** (How were the research methods developed? Did the industry contribute to methodology?); **Timeframe** (What was the timeframe for delivery of the projects?); **Vessel selection** (How were the vessels selected? was it difficult to find vessels to participate?); **Challenges** (what were the main technical challenges of the work?); **Completion** (Have the projects been completed?); **Results** (What were the results from the projects? How have they been received by the industry and managers?); **Partnership working** (Did the partners work well together?).

Potential bias in the framing of the questions was avoided by running the questions past three groups of stakeholders (managers, fishers, and scientists). The second author's role in managing the questionnaire exercise was to write the questions; have them checked by stakeholders; distribute them to respondents; collect them for analysis; and conduct the data analysis process. The idea of using the data to explore the relation between FSP and FDC came later, and the first author was recruited to review the literature on FSP and FCM, and interpret the data obtained from the discard survival project fieldwork in light of this review.

The questionnaire was sent out by email to 13 individuals in July 2015, and by September 2015, 8 responses were received that covered all the known national projects being undertaken in Europe. Data were obtained from eight projects in seven countries (Belgium, England, Denmark, France, Norway, Sweden, and the Netherlands), six of which commenced after the landing obligation was introduced. The projects covered the North Sea and the Celtic Sea ecoregions. Three projects were initiated by science institutes alone; one project by a science institute and a government; one project by the fishing industry together with a science institute; one by a government alone; one by the fishing industry alone; and one by a combination of a government, the fishing industry, and a science institute (see Table 1). The projects were at different timescales, from 3 months to 24 months, with budgets ranging from €30k to €870k. All the projects were financed by newly acquired funds from national governments, and in three cases, also from EU sources (Interreg and the European Marine and Fisheries Fund).

Table 1. Summary of source data and project information (* each national scientific team completed a questionnaire, ** not in EU but involved in development of scientific methods and evidence from Norway was utilised to support exemptions in EU pelagic fisheries).

1. Response to Questionnaire by Country (Project Science Lead)	2. Research Project Start Date	3. Initiated by	4. Industry Role	5. Species of Interest and Fishery	6. Published Scientific Outputs
Belgium (ILVO)	March 2014	Industry (Rederscentrale CV), scientists (ILVO)	Commissioning, steering committee, communication, chartered vessels	Flatfish (plaice and common sole) in beam trawl	[92]
Denmark (DTU-AQUA)	January 2014	Scientists (DTU-AQUA)	Steering committee, chartered vessels	Plaice and Nephrops in 3 fisheries	[93]
England (Cefas)	October 2013	UK Government managers	Steering committee, fishery selection, chartered vessels	Plaice in 4 fisheries	[94]
France (Ifremer) project 1	Relevant research in 2009	Scientists (Ifremer)	Steering committee, chartered vessels	Nephrops in trawl fishery	[95]
France (Ifremer) project 2	May 2014	Scientists (Ifremer)	Steering committee, chartered vessels	Nephrops in trawl fishery	[96]
Netherlands (IMARES; now Wageningen University)	December 2013	Industry (Coöperatieve Visserij Organisatie)	Formal project leader, steering committee	Plaice, sole, dab in pulse trawl	[97]
Sweden (IMR-Sweden; now Swedish University of Agricultural Science)	September 2014	Industry, scientists and Swedish Government managers	Steering committee, chartered vessels	Nephrops in creel and selective trawl	[98]
Norway (IMR-Norway) **—series of projects	Series of projects 2004-2012	Scientists (IMR-Norway)	Some proposals, steering committee, chartered vessels, input from fishing gear manufacturers	Herring and mackerel in purse seine	[99,100]

5. Results

The results of the questionnaires revealed that the fishing industry was involved closely in most stages of projects, from conceptual origins to delivery. Indeed, one respondent said that the "Fishing industry is more involved than policymakers". Another respondent said "Fishermen, through the open tender charters, were invited to collaborate on these projects where they were included in the planning and delivery of the project". Some initiatives originated from the fishers, and they were often members of steering groups ("There was a commitment to include industry members in steering group meetings in the original proposal in order for them to influence and contribute"). The industry organized commissioning processes, assisted in the selection of case studies ("Industry fed into case study prioritisation process through a series of meetings at port roadshows"), helped find commercial vessels, advised on practical elements of experimental work ("All experiments were performed using, and in collaboration with, commercial fishing vessels. This gave confidence that the practices adopted ... were representative of commercial practices"; "For all practical challenges, the fishing industry together with other partners, do find solutions jointly"; "The crew also helped a lot with the operations"; "The fishing industry is involved in designing monitoring units which are subject to discussion by fishermen themselves"), proposed technical solutions to problems ("Industry was included from the beginning with the development of new solutions"), and agreed the setting of objectives (including quantifying discard mortality of commercial species; discovering reasons for mortality; identifying species with the potential for survival after discarding; determining optimal conditions of survival; describing the condition of discarded individuals; and developing the technology to reduce mortality). In some projects, skippers were consulted about the methodology ("The methodology was first presented and agreed with the industry"), though in other projects they were not (the industry "did not contribute to method development outside setting up of tanks onboard the vessels"). In some projects, the industry was involved in joint evaluation of monitoring programs, though a respondent said "Participation/involvement of the fishing industry in data analysis and interpretation can be improved". Recruitment of skippers and their vessels was sometimes difficult: in one project, only 6 out of a potential 80 agreed to participate, and in another project "handsome remuneration" had to be provided. One respondent said that co-knowledge production occurred between scientists and fishers but not with other stakeholders: "There was little co-learning, co-creation or co-ownership of the work outside of those individuals (scientists and fishers) who were directly involved in the fieldwork".

The expectation of industry members was that survival rates would be sufficiently high to warrant recommendations for exemption from the landing obligation, but they were dismayed that in many cases the survival rates were low. However, a respondent said the industry was more positive about the search for solutions:

> "The industry was initially surprised/skeptical at the high level of mortality but all experiments had very good survival control which is difficult to argue against. This proved challenging at first with regard to relations between industry, scientists and managers. But with the development of the technical solutions project, all persons are now engaged, and it is beginning to generate real and practical solutions for the industry".

Another respondent said "We have received mostly positive feedback from members of the fisheries representative organizations, most participatory skippers and crew", though he added "negative comments have also been made ... by colleagues and crew members ... in Facebook posts and face-to-face conversations". A respondent said "The wish to continue the work in 2016–2018 has been expressed by the fishing industry".

For their part, the expectation of fisheries managers was to obtain "robust and objective data" on survival rates in order to serve EU discard plans, but they were "disappointed with the uncertainty of final estimates" of survival rates. A respondent said that initially there was tension with the industry about the stringency of regulations. However, "the

relation with industry improved and enabled more pragmatic regulations to be developed. The managers are now actively involved in dialogue with industry and scientists".

The main challenges faced by these projects were technical problems of conducting the captive holding experiments, staff shortages, and time constraints. However, pressure on the projects was reduced both by the flexibility afforded by the phasing "in of the discard ban", (which meant there was more time for researchers to complete their planned survival assessments), and by the fact that the Discard Plans, the regulations that define the exemptions, could be revised to include additional exemptions [101]. The final proposed exemptions for the first implementation phase in 2016 were submitted to STECF in June 2015 by the regional management bodies as part of the Joint Recommendations for Discard Plans for the North Sea, the North Western Waters, and the South Western Waters, after consultations with the relevant Advisory Councils. STECF assessed the proposals immediately, for example, judging the Nephrops pot fishery in NW Waters and the North Sea to be at the upper end of the survivability range, and the EU Commission agreed its exemption status. But the Nephrops trawl fisheries' bids for exemption in several areas of the North Sea were judged to need further evidence [89], and the Nephrops trawl fishery in SW Waters was judged to have overestimated survivability, and was granted only a 12-month exemption, after which new data would be required. Rihan et al. [90] say that STECF has found it very difficult to provide conclusive advice on some of the exemption claims because of a lack of detailed information.

6. Discussion

6.1. Elements of FSP in the Discard Survival Assessment Case Study

There are many elements of FSP in the EU discard survival assessment case study. Most obviously, FSPs are designed to bring fishers and scientists together to carry out fisheries research [11], and this is exactly what the case study projects illustrated. Moreover, many FSPs are established to focus on a particular topic of fisheries research such as discard reduction, which is what the projects were about. FSPs are partnerships [15], and there are strong partnership elements in the discard survival projects: the fishing industry influenced what research was funded; contributed to the development and execution of scientific methods; took part in research design; and assisted in the creation of new scientific evidence that could be of direct economic benefit to fishers. FSPs are designed to improve the level of trust between scientists and fishers [20] and this was an aim of the case study projects that seems to have been achieved in some cases. In relation to the four modes of FSP—informative; consultative; cooperative; and collaborative [6,9]—elements of all of them were found in the case study's project assessment process. For example, STECF meetings, at which interpretations of the discard survival policy were drafted, received contributions from scientists, managers, industry, and other interested groups (informative); the process of drafting guidelines on scientific methods to generate discard survival estimates incorporated contributions from the fishing industry; the selection of fisheries to study was agreed between industry, scientists, and managers (consultative); the commissioning and generation of the new evidence was achieved by scientists, managers, and industry working in partnership (cooperative); and through the ICES group, there was considerable collaboration between the parties in meeting and exchanging information.

However, although much collaboration took place, the result could not be described as the creation of an intellectual partnership or a community science model. For example, some commentators report that FSP resolves disputes between scientific knowledge and fishers' knowledge [8], but we found no evidence of this in the case study projects. Other claims are that FSP engenders a deeper understanding of sustainability in the minds of fishers [9], and that FSPs improve fishers' commitment to management decision-making, but neither occurred in the case study projects. Indeed, there remained divergences of approach between scientists and fishers: scientists were focused on obtaining robust estimates of discard survival that could be used to assess whether an exemption was warranted, whereas fishers were looking for confirmation that survival rates were high. Also, the industry

wanted further exemptions to be proposed, but these were rejected by High Level Groups because they did not meet the main criterion of being supported by scientific evidence. Some recommendations made by the High Level Groups themselves were challenged by the European Commission for the same reason [89], though no exemption request in a joint recommendation was turned down on the basis that the evidence did not demonstrate that the survival rates were high.

6.2. Elements of FCM in the Discard Survival Case Study

There were some elements of FCM in the discard survival projects. For example, in the initiation stages of some projects, there was evidence of sharing in decision-making. Article 18.2 of Regulation (EU) No 1380/2013 states that "Member States having a direct management interest affected by the measures referred to ... shall cooperate with one another in formulating joint recommendations. They shall also consult the relevant Advisory Councils" [2]. Each regional Advisory Council presented its recommendations to the relevant High Level Groups. For instance, the North West Waters Group undertook regular and detailed engagement with the North Western Waters Advisory Council, and its recommendations were taken on board where possible; while the NSAC was invited to cooperate closely with the Scheveningen High Level Group, which stated it had been in regular touch throughout the generation of the joint recommendations [101]. Also, industry representatives attended as observers in WKMEDS. Moreover, at the completion stages of the discard survival projects, FCM elements included collaboration between the regional High Level Groups and the European Commission. However, not all the High Level Groups' recommendations were accepted by the European Commission following an evaluation by STECF, so in the co-management conceptual framework, this mechanism is best defined as consultative because the decision-making process is not one based on an equal partnership. Therefore, this case study is less an example of an empowering FCM where stakeholders democratically share in determining policy outcomes, than an example of an instrumental FCM where government uses FCM as a means of implementing its plans. Other elements of FCM in the case study projects included transparency and accountability: the supporting scientific evidence of discard survival and the evaluation reports are published and the activities and outcomes of the working groups are open to scrutiny by resource users (via Advisory Councils) and subject to validation by administrators (via the European Commission), though the reasoning behind the final decisions by the European Commission to award exemptions is not published.

From Sections 6.1 and 6.2, it is clear that the discard survival research case study contained some elements of both FSP and FCM. Two questions arise for discussion. First, how were these two elements combined? Second, were the FSP elements a stepping stone to FCM?

6.3. How Did the Discard Survival Case Study Combine FSP and FCM?

The short answer to this question is that the FSP elements were in the middle of the discard survival project, while the FCM elements were at the beginning and the end of it. In our view, the FSP elements were the pre-eminent elements in that they formed the operational core at the heart of the project, while the FCM elements constituted the framework that housed the project, initiating it and concluding it. So the FSP and FCM elements complemented each other in that FSP related to the function and purpose of the project, while FCM related to its structure and modalities. At its root, the discard survival project was an FSP exercise, but sandwiched between two FCM elements. It was brought into being directly out of a formal and major policy shift in one of the most powerful and extensive fisheries management systems in the world—the EU's CFP. This initiation process involved intensive and unusually speedy negotiations between the EU Commission, member states, regional Advisory Councils, the fishing industry, and scientists—a process that was highly cooperative. Once the FCM elements ensured that the initiative project was up and running, the exercise slipped into FSP mode, manifesting the familiar characteristics

of partnerships between fishers and scientists to obtain and process fisheries data. This fieldwork was the guts of the work, because it created the primary data on which the whole endeavour depended. After this FSP stage, the exercise reverted once more to FCM mode in the way the data were interpreted and policy recommendations were made. This is not to say that either the FSP or the FCM processes were egalitarian. On the contrary, the FSP process was dominated by scientists, while the FCM processes were dominated by administrators. So both sets of processes were still top-down.

6.4. Were the FSP Elements in the Case Study a Step towards FCM?

The second question for discussion is whether the discard survival case study can be seen as a prototype for power-sharing FCM. Our view is that during the FSP process, joint research between fishers and scientists improved their levels of mutual understanding, respect, and trust. It also afforded the fishing industry the opportunity to develop new-found skills in working with scientists and to become more familiar with scientific methods. All this is good preparation for potential participation of fishers in FCM in line with a finding by Holm et al. [84] from similar case studies. However, on the question of whether this FSP case actually moved forward the prospect of establishing FCM, the answer is no. This negative conclusion replicates the findings of Hartley and Robertson [5] (p. 168): "Cooperative research may have increased inclusiveness and openness in fisheries science but has not challenged the existing power structure or led to more shared authority and accountability".

It could be argued that in the case study projects, FSP was itself a form of FCM, a micro-form, incorporating elements of FCM such as shared decision-making within a restricted area of operation (fisheries research) [73]. But even within this restricted domain, the FSP in the case study projects did not constitute FCM because they were essentially research exercises, not management exercises, since they did not make management decisions but only offered recommendations to management. It is conceivable that the FSP provided fishers with political leverage in future fisheries management decision-making [84]. NSAC [102] saw the FSP activity within the case work as an opportunity for Advisory Councils to deepen the relationship between fishers and scientists from consultation to equal partnership. Time will tell whether such equal partnership arrangements materialise. However, a recent study by Overgard and Sunde [103] of an FSP conducted into the discarding of saithe in the herring fishery in Sweden casts doubt on the seriousness with which the EU takes landing obligation research and does not encourage confidence that FSP will promote FCM.

7. Conclusions

7.1. Summary of Findings

This paper set out to examine whether the EU rapid research exercise on discard survival is an example of fisheries–science partnership (FSP) or fisheries co-management (FCM), or both. In doing so, we first analysed the concepts of FSP and FCM and their relationship to one another, and then applied this analysis to the case of the discard survival exercise. The two main findings of the paper are that in the case of the discard survival project (1) FSP and FCM are distinct kinds of organization—the first is essentially functional (i.e., designed to perform joint fisheries research); and the second is essentially structural (i.e., designed to democratise fisheries management decision-making), although they do share some common aspirations such as empowerment, partnership, and good governance. (2) The EU discard survival case study manifested elements of both FSP (in the working operations or "fieldwork" conducted by fishers and scientists together) and FCM (in the exercise's organization, including joint membership of the steering committee, joint participation in project design and management, and involvement of member states, Advisory Councils, and the EU Commission). However, it was mainly an FSP exercise, and although it contained elements of potential political leverage, it fell short of power-sharing FCM. This finding is in line with the judgement of Linke et al. [104] on the GAP project.

7.2. Wider Implications

The issues raised in the paper are not only of conceptual interest (to clarify the distinction between FSP and FCM), but also of practical importance, for two reasons. First, many social science researchers assert that a solution to numerous fisheries management problems is co-management [71] and some claim that FSP is an exemplification of FCM. But a fisheries–science partnership in itself does not constitute FCM: co-management requires more than FSP. Second, this paper is in part an enquiry into whether fisheries management in the CFP is moving away from its traditional top-down structure towards a more substantive partnership with fisheries resource users. It may be that the burgeoning forms of FSP sponsored by the CFP and supported by Advisory Councils may withstand the EU's instinctive top-down tendencies and contribute to a stronger culture of stakeholder partnership in CFP decision-making. On the other hand, if Borges [105] is right to claim that the implementation of the landing obligation has so far failed to reduce discards and has increased total allowable catches (TACs) of EU stocks since 2015 by an average of 36%, and that the only way to redeem the discard ban it is to ramp up monitoring and enforcement at sea, this might reduce enthusiasm for both FSP and FCM on the part of the European Commission.

7.3. Postscript

Although the UK officially left the EU on 31 January 2020, the UK Government has stated in the 2020 *Fisheries Act* its commitment to minimise unwanted catches and discarding, and the Landing Obligation regulations were transposed into UK regulations as retained EU law. The UK can now develop discard policies independent of the EU, but the current regulations will continue to be in force until they are changed.

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