

Food for thought from French scientists for a revised EU Common Fisheries Policy to protect marine ecosystems and enhance fisheries performance

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Abstract :

Since the 1980s, the Common Fisheries Policy (CFP) has shaped European fisheries. It has often been criticised for being too prescriptive and, above all, for failing to protect either fishermen or ecosystems. The last reform dates back to the early 2010 s and has led to a slight but slow improvement in the state of ecosystems. Given that the CFP is in the process of evaluation, a group of French fishery scientists set up an initiative to add to the debate on what should be retained, reinforced or added to a possible new reform. This initiative came 10 years after a previous manifesto that presented their vision for fisheries in Europe. Four major issues emerged from the current initiative: (1) a need for trans-Mots-clés parency and simplification in fisheries management, (2) a need for more consultation and dialogue between stakeholders, (3) the urgency of the situation in the Mediterranean Sea, and (4) the necessity of putting into practice all research developments for an ecosystem approach to fisheries. Compared to 10 years ago, the response of scientists shows that the focus is no longer on achieving the maximum sustainable

yield, but rather on the following steps to protect ecosystems and fisheries. An ecosystem approach to fisheries remains indispensable for both ecosystems and fishing activities. To this end, scientists put forward numerous proposals to improve the CFP, acknowledging that the final solutions should emerge from consultation with stakeholders. Climate change, an issue raised much more than in the manifest, reinforces the need to act.

Highlights

► 10 years after writing a manifesto, a group of French Fishery Scientists gathered proposals for the Future of the CFP. ► It resulted in an ordered list of proposed measures, highlighting measures considered a priority by the scientists. ► They ask for more simplicity, transparency and consultation, and for addressing the situation in the Mediterranean Sea. ► They also identify the need to move forward into the Ecosystem-Based Approach to Fisheries. ► Efforts are still needed to protect ecosystems and fisheries, especially in a context of climate and global change.

Keywords : Common Fisheries Policy, Consultation, Sustainable fisheries management, Best–worst scaling

Introduction

Initially developed in the 1970s, adopted in 1983, revised in 1992, 2002 and 2013, the Common Fisheries Policy (CFP), the European Union's (EU) legislative instrument for fisheries management, has undergone profound changes over the past five decades [1]. These developments have fundamentally shaped European fisheries and the entire fishery sector [2,3]. Considered one of the most integrated policies in Europe [1], the initial aims of the CFP were to exploit fish stocks sustainably, to ensure the economic viability of Member States' fleets and to provide consumers with quality food at reasonable prices (EEC Council Regulation No. 170/83). These primary objectives were then overlaid with ecosystem-based management goals aimed at minimising the impact of fishing on the marine environment (EU Regulation No. 1380/2013).

To date, the overall results of the CFP have been mixed [4,5]. Although the proportion of overexploited stocks has practically halved over the last 10 years (from 75% to 40% for stocks for which an assessment is available) and the biomass of assessed stocks has increased by around 35% in 20 years in EU waters [6,7], the stated objectives of exploiting 100% of stocks at Maximum Sustainable Yield (MSY) and achieving good environmental status in the marine environment by 2020 have not been met [5,8]. Worse, while the fishing pressure appears to decrease in the North-Eastern Atlantic, in the Mediterranean and Black Seas, fishing mortality in assessed stocks is still 2.1 times higher on average than that defined for MSY [5,9,10]. The socio-economic results of the CFP are also mixed. Although economic performance and fishermen's wages have improved in recent years, mainly for fleets exploiting stocks assessed as in good condition [11], the situation remains alarming in several Member States, particularly for small-scale fisheries, which are not profitable in several countries [11]. Based on figures from the EU's Scientific, Technical and Economic

Committee for Fisheries (STECF), the World Wide Fund for Nature (WWF) recently estimated that 43% of EU fishermen were paid less than the national minimum wage in 2018 (reaching 70% of fishermen operating on craft smaller than 12 metres [12]).

Since the formal implementation of the CFP, and despite the integration of major changes (e.g. MSY as a management target, the obligation to land species under quota, the regulation on technical measures, and the strengthening of controls), the policy has received intense criticism from stakeholders in the sector (fishermen, NGOs, fisheries managers and scientists) [13–19], and is still being questioned today (e.g. [20,21]). The slow and partial recovery of biomass [5] has not allowed a real return to profitability for a large number of fisheries [6]. Fisheries management still takes a single-species approach that largely ignores biological and technical interactions and the effects of global change [22–24], a far cry from a true ecosystem-based approach [19,25]. While single-stock approach can indirectly handle the side-effects of those interactions through yearly stock-assessment and recurrent update of reference points, it opens the door to side-effects such as increased discards in mixed-fisheries or to trophic cascades, especially on species that are not assessed, and poorly accounts for socio-economic consequences on fisheries. The CFP remains vertical, prescriptive and centralised, as illustrated by the introduction of the landing obligation in 2015, which is very poorly understood and negatively perceived by professionals [26–28]. The same applies to the Regional Advisory Councils (RACs). Created in 2004 to promote dialogue between stakeholders and initiate a process of regionalised co-management [16,29], then transformed into Advisory Councils (ACs) from 2013 onwards, these councils have since been regularly sidelined from debates in favour of political representatives from the Member States, to whom the European Commission turns in preference (e.g. [30]). This situation generates frustration among a certain number of Advisory Council stakeholders [31],

and is partly responsible for the fact that the regionalisation of the EU fisheries management system seems to be stalling (e.g. [32,33]).

Moreover, new environmental, economic and social challenges have been added to the original concerns of the CFP [4,34]. Brexit has also changed the situation, entailing that the management of the majority of stocks exploited by the EU will now be subject to international fisheries agreements between the UK and Europe [35,36], as is already the case with Norway, for example. Anthropogenic pressures on the marine environment are increasing, particularly with the development of tourism, marine renewable energy, aggregate extraction and coastal urbanisation [37,38]. Coastal development and the problems of eutrophication and pollution are sources of increased conflicts of use in coastal areas (e.g. [38]). The impacts of climate change are now being significantly felt and will inevitably increase in the coming decades [39–41]. This is leading to declines in abundance, and even the collapse of several large European stocks (e.g. cod in the Celtic Sea [42]), and to changes in the spatial distribution of stocks (e.g. [43]): for example, the increase in cod in the Barents Sea [44] or the arrival of boarfish (*Capros aper*) in the Bay of Biscay [45,46]. Total catches are decreasing, their species composition is changing, and they are becoming more unstable and less predictable overall [47–50]. Scientific recommendations and management procedures are also being questioned [51–53]. Furthermore, the multiplication of uses in the marine environment means that fisheries and marine ecosystems are at the centre of a patchwork of interacting policies, both conservation policies (e.g. CFP, Water Framework Directive, Marine Strategy Framework Directive) and spatial planning policies, without always being properly coordinated. There is little question that the CFP needs rethinking to ensure that future generations have sustainable and equitable access to fisheries resources.

In this context, and given that the European Commission must report to the European Parliament and Council on the performance of the CFP before 31 December 2022 with a view to its review (Article 49 of EU Regulation 1380/2013), there is a window for legislative action to adapt and modernise the CFP on the basis of current scientific knowledge. Fisheries stakeholders, in particular scientists, with their individual and collective expertise, therefore have a role to play in informing policymakers. Although the degree of involvement scientists should have in the public debate is sometimes the subject of controversy [54,55], it is unanimously recognised that they need to provide the objective knowledge necessary for decision-making [56], making it judicious to reduce the distance that can sometimes exist between researchers and other stakeholders [55,57,58]. As far as fisheries research is concerned, the challenge is to coordinate the voice of the scientific community, multidisciplinary and multi-institutional by nature, in order to elicit the most relevant and consensual areas of improvement for the CFP – based on individual scientific expertise – without dodging the uncertainties and controversies.

In 2011, the Association Française d'Halieutique (AFH), a non-profit organisation of more than 100 French-speaking fisheries scientists, published a manifesto for sustainable fishing [59]. This manifesto highlighted the deep crisis of fisheries in the European Union and proposed a set of reforms and a paradigm shift to improve the CFP. Ten years later, in light of new scientific knowledge and emerging international issues, the organisation decided to take advantage of the CFP review to solicit the views of all its members on concrete political, economic or environmental measures that could be integrated into a new CFP in order to achieve its objectives, or to set new ones, in a changing world.

This paper describes how the AFH used a participatory approach to identify and prioritise areas for improvement of the CFP by seeking proposals from scientists, and outlines the measures that seem most suitable to face the challenges ahead, taking stock of the evolution of the CFP over the last decade.

Materials and methods

The main mission of the AFH is to coordinate French-speaking fisheries scientists from different disciplines. Its members come from different institutions, mainly scientific (e.g. universities and research institutes such as Ifremer, IRD, INRAE, Institut Agro, etc.), and it is open to scientists from stakeholder organisations (environmental NGOs, producers' organisations, fisheries committees, etc.). Members do not represent their institutions. Those up to date with their membership fees (i.e. who have paid at least once since 2017) constituted the panel for this survey, i.e. 159 scientists. The directory of current members is available online (<https://www.association-francaise-halieuistique.fr/annuaire-des-adherents/>).

In order to identify, select and prioritise proposals for measures to be considered in the CFP reform, an approach similar to the MICESE (Multiphased, Iterative, and Consultative Elicitation of Scientific Expertise) method was used [56].

Between June and October 2020 (Figure 1), the 159 scientists were contacted by email and reminded once a month to propose measures they thought should be implemented in an updated CFP on a virtual bulletin board (<https://padlet.com/dashboard>). This allowed each participant to view all the measures proposed over time on the platform. As the aim was to obtain as wide a range of opinions as possible, the instructions made it clear that the proposals could be similar to, or contradictory to, other proposals. Participants were given the opportunity to comment on the proposals in order to improve, expand on, clarify or challenge

the content, and each contribution had to be signed. A total of 43 scientists participated in the call for proposals (submitting proposal(s) or comment(s) in response to them). An editorial committee made up of six scientists who are members of the AFH and themselves contributed to proposing measures, was then responsible for producing an initial summary of the proposals in order to merge those that appeared redundant, and to edit and standardise the content. From the 70 initial proposals, 50 distinct proposals emerged. Finally, in October 2020, the 43 participants were invited to verify the correct transcription of their original idea by the editorial committee (Figure 1).

A Best–Worst scaling (B-W scaling) survey [60,61] was then implemented to prioritise the 50 measures, using a methodology similar to that of Rudd and Lawton [62] and Rudd [58], which is well suited to ranking a large number of proposals. B-W scaling is used to rank proposals by assessing the preferences of respondents. It consists of subjecting the voter to several voting operations (called ‘tasks’), each of which concerns a reduced sub-group of proposals from which the voter must extract the most and least relevant (ranking). For each participant, the list of tasks was randomly constructed by selecting groups of proposals according to an experimental design (D-optimal design) that ensured the repeated random appearance of each proposal in the different tasks.

Each participant was assigned 36 tasks, each containing four proposals (exactly the number of tasks and proposals per task set by Rudd [58]). Thus, each proposal was evaluated three times on average by each participant. The experimental design was randomly generated for each participant so that the tasks, and thus the grouping of proposals, were different from one participant to another, ensuring an even greater mix of proposals. An invitation to vote was sent to the initial panel of 159 people (Figure 1). Each voter was given a unique voting opportunity to ensure a unique response. The survey was conducted between January and

March 2021. For each task, when choosing the most and least relevant proposal, the voter was given the title of the proposal and an explanatory text (see Supplementary Material). Of the 159 respondents, 83 complete votes were cast. Only these 83 votes were analysed.

To analyse the survey results, a multinomial generalised linear model was fitted (the model sought to predict the probability of a proposal being considered most or least relevant in a task). It was used to assess the score defined as the utility (quantifying the probability that a measure is selected as most relevant) of each proposal [63,64].

At the end of the voting process, voters were asked to provide demographic and professional information in order to better characterise the panel, including:

- their current main professional activity (e.g. scientist, manager, NGO)
- their geographical location (country)
- their age group (26–35, 36–45, 46–55, 56–65, >65)
- their main discipline based on the classifications of the National Universities Council: sciences, law/economics/management, humanities

Results

Summary of the CFP reform proposals

The proposals were varied and addressed a multitude of topics that were grouped into four CFP-related themes (Table 1):

- Governance: 19 proposals (P32 to P50) addressed issues such as decision-making methods (e.g. P34), the place of science in decision-making (e.g. P36), methods for controls (TACs/quota calculation key; 33, 41, 42, 49), and the organisation of

sectors (e.g. P35/P39). Most of the measures promoted greater consultation with stakeholders and greater regionalisation of the CFP (e.g. P34/P37/P39/P44/P47), as well as greater flexibility (e.g. P37/P38/P44) to deal with climate change and local contexts. Finally, better coordination of the CFP with other European directives and international initiatives (P32) was suggested, to prevent working in silos.

- Consumer information: four proposals (P28 to P31) concerned better consumer information on products available on the market, both in terms of the status of the marine population exploited and on the potentially negative impacts of fishing on the stock, in particular via environmental labelling. The ultimate aim is to encourage more responsible consumption, a theme also found in other proposals (P35).
- Improved scientific assessment: eight proposals (P20 to P27) aimed to better integrate and capitalise on recent developments in ecosystem modelling (P20), redefine the acquisition of data used for scientific assessment (P21/P24/P26), and better take into account scientific knowledge on stock assessment (P22/P25) as well as the associated uncertainty and variability caused by climate change (P25). Several proposals called for a revision of management targets, questioning the principle of MSY management as insufficient for an ecosystem approach to fisheries (P23/P27). Other proposals aimed to develop participatory and collaborative research (P26), often in interaction with the governance issues previously mentioned (P36, P38, P39).
- Ecological protection and conservation: 19 proposals (P1 to P19) included a wide range of resource and ecosystem conservation measures, including technical measures for fisheries (mesh sizes, e.g. P4/P11; fish sizes, e.g. P3/P11; TACs, e.g.

P10/P12), networks of marine protected areas, and individual financial incentives for taking into account environmental issues. They concerned a variety of biological scales (stocks, e.g. P5; communities, e.g. P15; ecosystems e.g. P8) and fleets (P6). Of these proposals and in line with the considerations on previously mentioned reference points, several proposals focused on the practical implementation of ecosystem-based fisheries management (e.g. P14/P15). The alarming situation in the Mediterranean was the subject of specific proposals (P5 and P10).

Ranking of proposals

Out of the 159 people contacted, 83 complete votes were cast. The characteristics of the panel showed a strong predominance of people working in France and on French and European fisheries (which was expected from AFH members), and a strong predominance of scientists in the life sciences compared to the humanities and social sciences (Figure 2). All age groups participated in the surveys, with a predominance of early-career scientists.

The 10 most relevant proposals (i.e. those with a significantly different score from reference proposal P2 according to the multinomial model) out of the 50 ranked by the panel (Figure 3) highlighted the need for a more holistic approach to the CFP and identified four main issues (presented here in no specific order) that can be summarized as follow:

- Issue 1: More transparency, less complexity: in response to the often-voiced criticism of the lack of transparency and the high complexity of the CFP, scientists put forward several proposals to improve the situation. Aligning all management units (i.e. the units on which TACs are set) with the functional units of biological populations (on

which scientific assessment is based) was considered a priority (P46). These functional units correspond to the best scientific knowledge currently available on population distribution, and management at any other scale could be inefficient. This realignment measure was also considered necessary to make political decisions more transparent and to be able to compare them with scientific recommendations.

Complexity also arises from directives and initiatives that are too 'siloed' (P32).

Conservation policies could be made more fluid by establishing an overall strategic framework. Finally, transparency and complexity were also often linked to a lack of consultation and dialogue. According to the survey, consultation on decisions with all the stakeholders in a sector is a prerequisite, particularly for implementing multiyear, multispecies management plans and for evaluating them afterwards (P34).

- Issue 2: More consultation with stakeholders to improve understanding and acceptability: the role of stakeholders was central to two of the first ten proposals. This was the case for the previously mentioned proposal on the concerted implementation of management plans (P34), but was also the focus of a proposal aiming to increase the practice of incentives for virtuous behaviour (in the form of allocation of fishing effort quotas or additional catch quotas, or real-time incentives, etc.) rather than the taxation/subsidy mechanisms currently practised (P39, P34). This mechanism could draw on Article 17 of the CFP, which has so far been little used. Here again, the types of behaviour to be promoted and the incentive methods should be developed jointly with stakeholders to ensure the system is effective.
- Issue 3: Fisheries resources in the Mediterranean: two of the proposals perceived as the most relevant concerned the Mediterranean (P5 and P10), underlining the extent to which the situation in this region is considered very concerning. In this respect, the panel members found it essential to improve knowledge on both the biology of the

species and on their exploitation in order to better assess the status of exploited populations and to improve the settings of technical measures (e.g. see the discussion about size-at-maturity and in minimum landing size in [65], or [66]). They also recommended the introduction of quotas for Mediterranean species, as management by fishing effort has shown its limits when not linked to other conditions. Finally, it was proposed that the CFP should gradually align its approach in the Mediterranean with that in force in the North-East Atlantic.

- Issue 4: Ecosystem-based management: from theory to practice. The panel members noted that (i) the first calls for an ecosystem approach to fisheries date back several decades, (ii) that little has yet been done in concrete terms to respond to this, while (iii) operational instruments are nevertheless available and could already be enlisted. As far as analysis tools are concerned, ecosystem models (end-to-end, trophic) have multiplied, but are still used in a disparate and ad hoc manner, which does not allow for long-term monitoring of the state of ecosystems, feedback on these tools by scientists, and even less their adoption by decision-makers. The use of ecosystem models and the knowledge they produce should therefore be made more routine and regular (P20), and the data collection systems needed to inform and update them set up (P21). Beyond tools and data, scientists gave even stronger support to two proposals for measures to better protect ecosystems. Scientific knowledge has highlighted the importance of protecting habitats and ‘forage species’ (P15). This knowledge should enable the implementation of measures that take better account of the seasonality, the heterogeneity of spatial distribution, and the trophic interactions of exploited species – the most popular proposal (P9), which echoes proposals in the top 10 (P15), or others that are slightly lower ranked (P8, P11, P22). Finally, particularly in relation to climate change, which is causing changes in the distribution

range of species, and the tendency to exploit lower and lower trophic levels, the scientists recommended that predefined rules, alongside clear criterion defining when they apply, should be rapidly put in place to limit the expansion of fisheries towards new species (either previously present but not yet exploited, or species that shift their distribution), pending the acquisition of sufficient knowledge for their proper management (P1 - see [67] for a review of international regulations on this question).

Discussion

An innovate consultation to collect opinions of French scientists on the CFP

This analysis proposes a rigorous survey of French scientists' opinions about fisheries management and concrete proposals for the future of the European Common fishery policy. The approach was collective, eliciting proposals and prioritising them based on proven methods [56,58,62]. For the time being, the survey was carried out only within the AFH membership to ensure a robust comparison with the 2011 manifesto [59]. This choice has certain limitations: only scientists, mainly French, were consulted for the study, with a predominance of researchers in the life sciences and an under-representation of researchers in the humanities and social sciences (Figure 2). This may explain the relatively small number of proposals concerning the organisation of the sector, marketing and consumer information, and the dominance of measures targeting environmental and species protection. Some cultural biases are also likely to occur. For example, the panel is composed mostly of French life scientists, this might explain the position about transferable fishing quota since the French quota allocation system is original [68].

The process was based on two steps: (i) the collection of proposals through an open online survey, (ii) then a ranking of these proposals through a statistically appropriate best-worst scaling procedure. It should be noted that care must be taken not to overinterpret the poorly ranked proposals, as this may also be explained by their proximity to other better ranked measures. For example, the measure aimed at giving the Advisory Councils a greater role (P47) is relatively low-ranked, but the panel unanimously recognised the need for a more regional approach and greater consultation, in which these councils have an important role to play (P34 and P39). Similarly, although no proposal on environmental labelling appears at the top of the ranking, this could be explained by the existence of three fairly similar proposals of this type (P29, P30 and P31), which tends to disperse their respective individual weight. The scope of the measure may also constitute a bias: in a choice between a precise technical measure (e.g. increasing mesh size) and a more conceptual proposal expressing an objective (wishful thinking) rather than a means (e.g. taking into account spatial and temporal variability), it is likely that the means would win more votes, even if the concrete aspects of this remain to be identified. That's why, while looking at the best ranked proposals is interesting to detect the most urgent challenges, it is also very interesting to explore the diversity of themes and measures addressed in other proposals (all the proposals are the results of the MICESE steps of the approach and can thus be found in supplementary material).

Four critical challenges that echo the most frequent criticisms against the CFP

The top 10 ranked proposals highlight 4 critical challenges that are closely related to the main criticisms of the CFP. First, the dramatic situation in the Black Sea and in the Mediterranean

Sea was highlighted in two proposals (P5, P10) and reminds that the CFP has failed to prevent the overexploitation for decades [14,69–71]. While progress has been observed in the North-eastern Atlantic since the last reforms of the CFP [6], this is not the case in some other regions [9,10,18,24,72]. Here, scientists have proposed to align the situation in the Mediterranean regions with the practices from North Eastern Atlantic. Since the implementation of adequate controls and management in Eastern Mediterranean region or Black Sea is likely to be challenging [73], those proposals are rather medium term objectives (P5 sets a 2030 objective). Nevertheless, it should be noted that recent efforts have been made to improve the data collection and stock assessments, especially in the context of the Mediterranean multiannual management plan [65,73]. This better monitoring of landings might in turn facilitate the implementation of controls in longer terms. For sure, that should not prevent immediate alternative actions in the meantime.

Among the top 10 proposals, there is a recurrent call for less complexity, enhanced transparency and consultation. It echoes the frequent and recurrent criticism of a too siloed, centralised and top-down policy [14,74–76]. To address those points, French scientists called for more involvement of stakeholders to design management plans (P34). Indeed, the example of the Scottish fishery showed that co-constructed transformations can yield significant outcomes [75] and has demonstrated that it is not incompatible with the CFP. The last CFP reform in 2013 promoted a regionalization of the management. However, at the same time, consultative regional bodies such as Regional Advisory Councils (RACs) / Advisory Councils (ACs) have since been regularly sidelined from debates in favour of political representatives from the Member States, to whom the European Commission turns in preference (e.g. [30]). As such, the benefits of regionalisation, as a step towards enhanced stakeholder involvement, have not always been perceived [77]. While P34 proposes an

objective, specific tools to reach this objective are proposed in other proposals. More specifically, shifting from a taxing, subsidies and bans approach, towards incentives approach is mentioned in two top-ranked proposals (P39, P34) . Such a solution, to be negotiated with stakeholders, has proved to be efficient in various countries [78,79]. Moreover, Article 17 of the CFP Regulation already provides for this possibility. More generally, enhanced consultation is likely to facilitate understanding of management measures (see [27,28] that illustrate how the poorly negotiated discard ban led to misunderstanding and its unacceptance by the industry), which is one of the main subjects emerging from the top-ranked proposals. While consultation is not a panacea and co-management of fisheries has not always delivered expected results [80], early consultation can help to detect issues early and to prevent latter blockages [81,82].

Finally, the last main theme was about upscaling the management towards an EAF that should account for all the threats due to the fishery [83]. The call for moving towards an EAF is old [84], and AFH scientists are not the only ones to criticise the slow pace of implementation [85,86]. While they note that tools exist to explore the impact of fisheries, management measures, and other pressures on food webs and socio-ecosystems (e.g. [83,87–93] and P20), their application in fisheries management or within other European environmental policies remains relatively limited (e.g. [94–96] and P9, P20). Scientific knowledge already exists to protect low trophic levels [97] and habitats through measures that take into account the seasonality and spatial distribution of species (P15, P9 and [98–100]). The recent framework developed by the STECF in the context of the Mediterranean Management Plan, to assess the relevance of closed areas to protect multiple key target species (but that can be extended to protect key habitats), that combines Vessel Monitoring System and scientific survey data, is an interesting example of how most recent scientific

data can be used to support spatial management measures implementation [101]. Marine protected areas can and should be a tool for EAF, (P9, and P8 though less well ranked) but for this to happen they must have a truly effective level of protection and management, contrary to what is currently observed in many cases [102]. Of course, moving towards the EAF will require the use of more complex models to support the scientific advice and constant discussion will be required with stakeholders [103]. P20 underlines that many ecosystem models are available to support the scientific advice of an EAF (this is also mentioned in P34 with the proposed generalised use of Management Strategy Evaluation). Such ecosystem models do not aim to set measures such as yearly single-stock TACs, nor to replace single-species models which are well suited to carry-out short term predictions, but rather as complementary tools to holistically assess the relevance of management approaches or to monitor ecosystems and anticipate changes over the long term. This is even more critical in a context of climate change which will drastically affect fisheries [41,50]. However, to do so, their use must be made more routine so that scientists and decision-makers gradually learn to make the best use of them. Indeed, demonstrating the usefulness and the reliability of complex models to stakeholders and managers is critical to increase trust and confidence [90,103]. As such, the work initiated by ICES Working Group on Multispecies Assessment Methods [94] and ICES Ecosystem Overviews, and concrete proposals and examples that can be found in the literature [23,86,90,94,104,105], will hopefully be important starting points. The diversity of impacts of fisheries on ecosystems [83], and the increase of others anthropogenic pressures on the marine environment [37,38] urges the development of such holistic approaches and a better integration of CFP with other international biodiversity protection initiatives such as MSFD, EMFD or WFD (P32) to promote synergies and prevent negative interactions among them [106–108]. In continental waters, Drouineau et al. [109] underlined how initiatives to restore some migratory fish populations have interfered with the

EU Renewable Energy Directive; these kinds of problems can only increase for marine fisheries.

A diversity of proposals that outline some progresses during the last 10 years but also many similarities

Ten years ago, the AFH made strong recommendations for fisheries management in Europe [59]. It is interesting to compare, a decade later, those earlier messages from 2011 with the diversity of themes addressed in the current analysis. The main messages in 2011 were (quoted and in italics):

- *“The sea is suffering from damage inflicted by humans, and fishermen are suffering too”*: since that time, scientists have recognised that the transition to MSY has been an important step forward (e.g. P27). Although progress has been slow [6,7] and the situation remains critical in some regions (P 32), fishing mortality has fallen and the biomass of some species is slowly rebuilding. A positive consequence of these changes is that the profitability of fisheries is generally increasing (excluding the Covid crisis) in the waters of the North-East Atlantic [11], although this recovery is slow [6]. However, many stocks are still overexploited and their biomass levels are low, making further efforts necessary. Our results indicate that all stakeholders (professionals and NGOs) should be put at the heart of the governance system (P34 is an iconic example, but also P47, P48), with the aim of improving the acceptability of decisions and implementing more effective and appropriate incentives for good exploitation practices to avoid blockages. Co-management and stakeholder involvement has indeed proved effective in many cases [75,79] and should be strengthened in European fisheries. Moreover, this must be done in consultation with

all stakeholders. The resources of the sea and marine ecosystems are common goods, which can only be managed sustainably if communities are formed that feel truly responsible for the sustainability of this common good. This is all the more important given that the behaviour of fishermen remains one of the greatest sources of uncertainty in fisheries management [110], and that the failure to take into account interactions between ecosystems and the behaviour of stakeholders is one of the main causes of the failure of the CFP [78]. Greater involvement of stakeholders will require progress in the regionalisation of fisheries management in order to adapt management measures to local situations and facilitate consultation between all parties.

- “*Reaching MSY requires considerable changes*”: this follows directly from the previous point. The level of overexploitation at the time was such that meeting the MSY objective seemed almost unattainable. This is no longer the case: while progress has been slow, it is significant. The recommendations of the AFH scientists have therefore gradually shifted to a post-MSY objective (e.g. P23, P27) , considering MSY as a necessary but insufficient step as a single-species target does not take into account trophic or technical interactions, impacts on ecosystems or income for fishermen [19,111]. Management targets that guarantee less impact on stocks, such as maximum economic yield (MEY [112,113]) or optimised mesh size management, are necessary, but, more generally, an ecosystem approach to fisheries was recommended in the recent survey. To achieve this, the scientists consulted consider that greater involvement and responsibility on the part of fishermen is essential.
- “*An ecosystem approach to fisheries (EAF) is a necessity*” This theme from the 2011 manifesto is still largely present in the top-ranked proposals, as mentioned earlier in the discussion, but also in many other proposals (see for example P6, P12, P14, P21).

- *“Overcapacity is not everything, access rights must be regulated”, “All management tools should be enlisted”*: this observation still seems valid according to our results, as a wide variety of measures were proposed to achieve sustainable exploitation objectives (e.g. P3, P4, P7, P8, P10,P42). These include individual quotas, recommended by other authors (e.g. [114]), that are non-transferable to avoid concentration of fishing rights [115,116], minimum fish sizes, mesh size changes, marine protected areas, and ecolabels. The management of mesh size and minimum fish size are also major tools for reducing impacts on exploited stocks. This set of measures should make it possible to take into account species ecology and the ecosystem impacts of exploitation.

Strong consensus emerged on several points in this study. The first is the need to continue efforts to restore and protect ecosystems: healthy ecosystems are essential for healthy fisheries. To achieve this, scientists consider that MSY should only be an intermediate step and that ecosystem-based fisheries management will necessarily involve going further. To this end, a wide range of measures were proposed. Some are already recognised (e.g. catch limits and mesh size changes, individual quotas, P3, P4, P42). Others are more innovative and original (e.g. modification of the landing obligation, restriction of subsidies, circular economy, real-time incentives, P7, P17, P19, P35) and could be tested, requiring a framework to facilitate such experimentation (P37). This diversity of measures reflects the fact that there is likely no single miracle recipe, but several possible paths. The most appropriate measures should be chosen according to context, in consultation with stakeholders.

This was the second strong consensus of the study: the success of the CFP will necessarily depend on greater consultation with and empowerment of stakeholders, particularly

fishermen, in order to develop appropriate regional management plans. Examples of the implementation of management and restoration plans in continental environments show that the involvement of stakeholders is one of the key factors for success: the process of implementing the plan being as important as the content of the plan itself [117,118].

The context of global change, in particular climate change, only adds to the urgency of reforming the CFP. The growing concern of scientists about these new challenges is the other salient fact that stands out in contrast to the 2011 manifesto [59]. Ten years ago, global change was mentioned only once, and climate change was only mentioned in passing [59]. In the recent survey, climate is the subject of a specific proposal (P43) and is reflected in several others (P13, P32 and even P19). More broadly, the proposals show that scientists consider that management cannot be considered ‘in a vacuum’, neglecting the interaction of fish and fisheries with their environment. This is the essence of the ecosystem approach to fisheries, which was widely put forward in the survey, but which must also be able to adapt continuously and rapidly to the consequences of the environmental changes to come.

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FIGURES

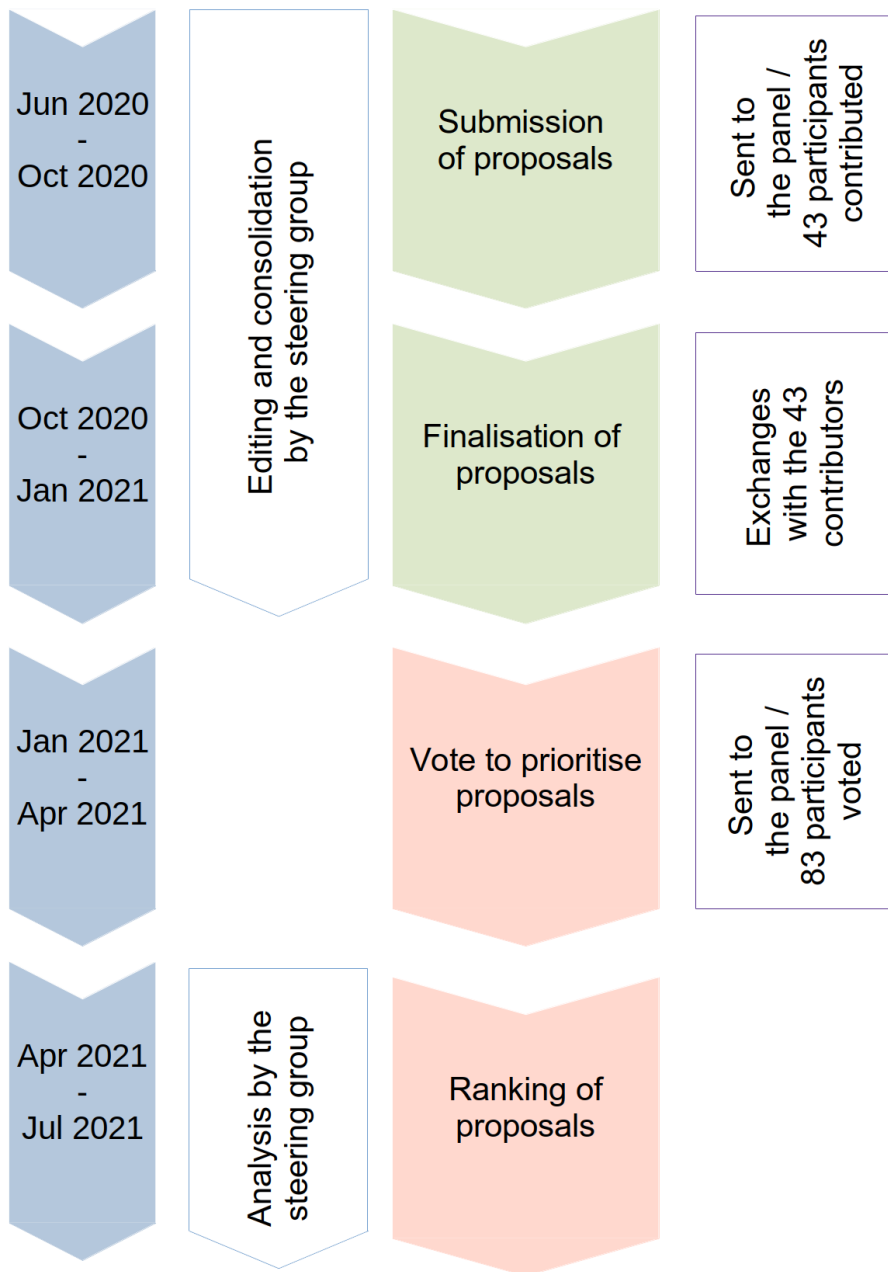


Figure 1: Diagram summarising the main stages of the process (3rd column), the timetable (1st column) as well as the work of the steering group at each stage (2nd column) and the interactions with the panel of scientists (4th column)

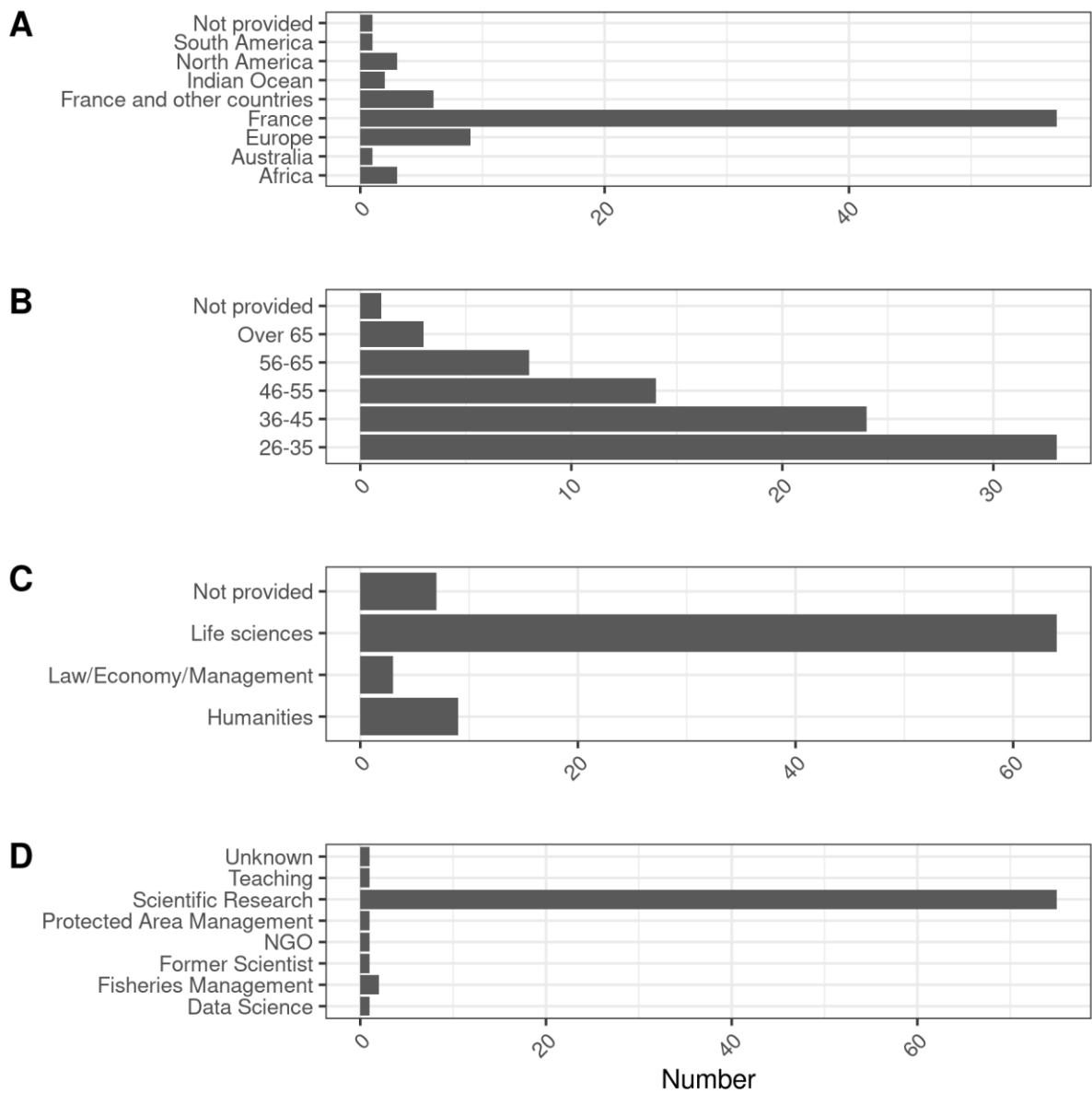


Figure 2: Characteristics of the panel responding to the survey allowing the ranking of the proposals: geographical area of work (A – France and other countries stands for scientists that work both on French fisheries and foreign fisheries), age group (B), main academic category (C) and type of occupation (D)

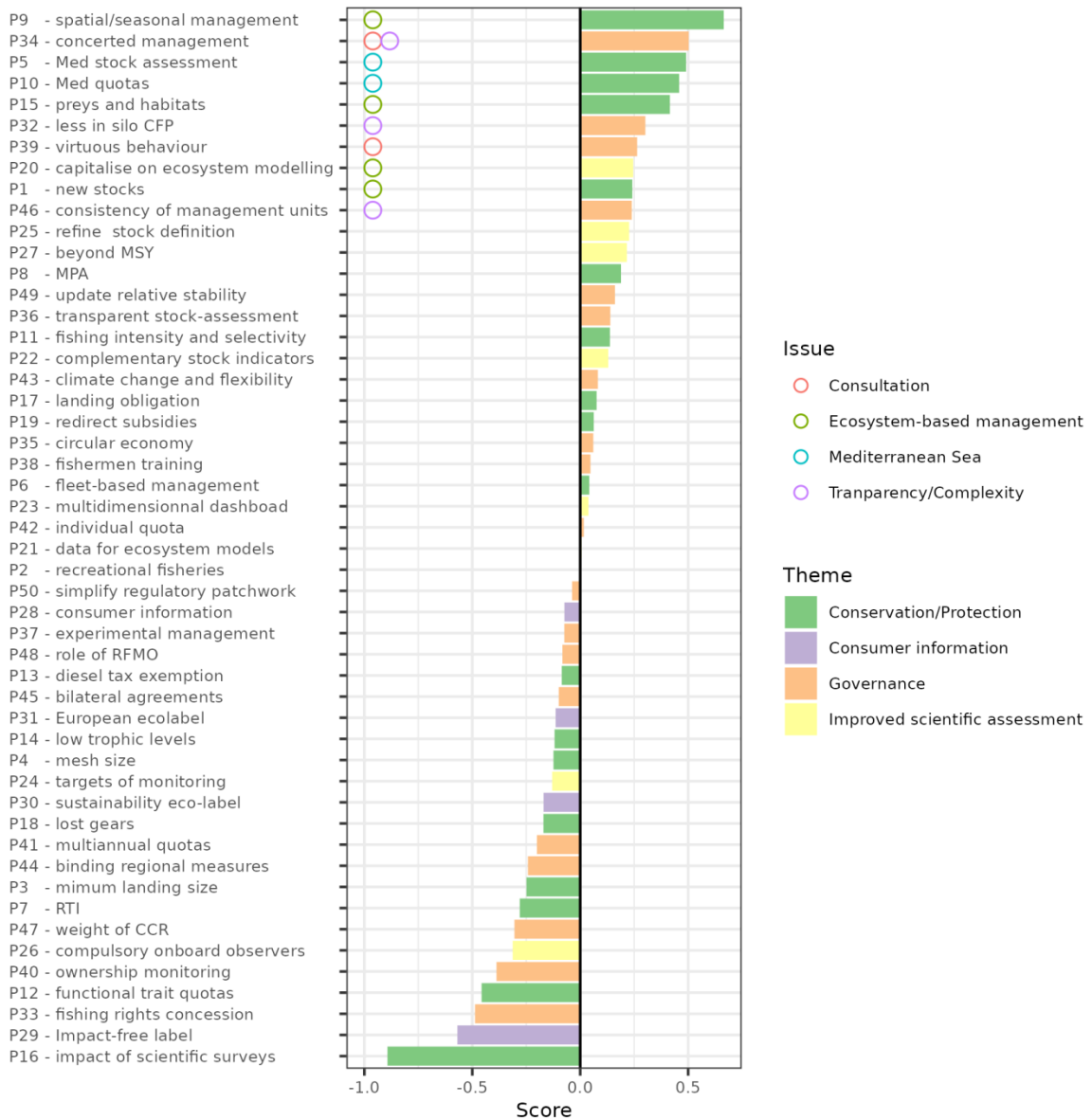


Figure 3: Ranking of proposals. The proposals are ranked from top to bottom by descending score. The colour indicates the main theme of the proposal. Issues refer to the issues described in the section “Ranking of proposals” that explore in detail the 10 first proposals. The score corresponds to the estimated value in the multinomial model, which is the deviation from the reference proposal P2 (scored zero), which was taken as the reference because of its central location in the ranking.

TABLE

Table 1: Title of individual proposals, associated main theme, proposal number and ranking following the Best-Worst scaling procedure (BW).

Theme	Number	Title of proposal	BW
Conservation/ Protection	P1 new stocks	Take a precautionary approach to ‘new’ stocks	9
	P2 recreational fisheries	Improve knowledge and management of recreational fisheries	27
	P3 mimum landing size	Increase fish size limits and create size limits for all species caught	42
	P4 mesh size	Increase regulatory mesh size	36
	P5 Med stock assessment	By 2030, assess all exploited stocks in the Mediterranean	3
	P6 fleet-based management	Develop a fleet-based approach	23
	P7 RTI	Develop real-time incentive approaches	43
	P8 MPA	Develop a network of marine protected areas with a sufficient level of protection	13
	P9 spatial/seasonal management	Develop management that takes into account the spatial and temporal variability of the marine populations caught	1
	P10 Med quotas	Establish quotas in the Mediterranean (EU areas) for the main species exploited	4
	P11 fishing intensity and selectivity	Implement management based on	16

		exploitation pattern and fishing intensity	
	P12 functional trait quotas	Establish quotas by functional traits	47
	P13 diesel tax exemption	End the tax exemption for marine diesel	32
	P14 low trophic levels	Protect low trophic levels through ecosystem-based management	35
	P15 preys and habitats	Protect prey and habitats through ecosystem-based management	5
	P16 impact of scientific surveys	Reduce the impact of scientific campaigns	50
	P17 landing obligation	Review the landing obligation	19
	P18 lost gears	Deal with lost gear at sea	39
	P19 redirect subsidies	Subsidise transitions to sustainability	20
Improved scientific assessment	P20 capitalise on ecosystem modelling	Capitalise on the ecosystem modelling efforts produced across Europe for integrated ecosystem assessment	8
	P21 data for ecosystem models	Collect the data needed to inform ecosystem models	26
	P22 complementary stock indicators	Consider indicators complementary to spawning biomass (e.g. size structure, condition) to assess the status of populations	17
	P23 multidimensionnal dashboard	Develop a socio-economic and ecological dashboard to analyse multidimensional trade-offs	24
	P24 targets of monitoring	Diversify/redirect the targets of monitoring programs	37
	P25 refine stock definition	Update the definition of stocks and	11

		populations for the assessment of certain species	
	P26 compulsory onboard observers	Make it compulsory to have observers on board	45
	P27 beyond MSY	Review the MSY management approach	12
Consumer information	P28 consumer information	Improve the display of the origin and species of fish for consumers	29
	P29 Impact-free label	Define impact-free labels	49
	P30 sustainability eco-label	Define a European sustainability label	38
	P31 European ecolabel	Define a public 'European sustainable fisheries' label for stocks managed according to EU objectives	34
Governance	P32 less in silo CFP	Align the objectives of the next CFP with international biodiversity conservation objectives; less siloed conservation/restoration policies	6
	P33 fishing rights concession	Define fishing rights in the form of concessions	48
	P34 concerted management	Develop management approaches in concertation with all stakeholders in the sector	2
	P35 circular economy	Develop circular economy approaches	21
	P36 transparent stock-assessment	Make assessment of resources and fisheries more transparent and accountable	15
	P37 experimental management	Facilitate experimentation with alternative	30

	management approaches	
P38 fishermen training	Standardise fishermen's training in Europe to improve safety at sea and raise awareness of respect for the environment and cooperation with scientists	22
P39 virtuous behaviour	Encourage virtuous behaviour	7
P40 ownership monitoring	Incorporate transparent monitoring of ownership of the means of production	46
P41 multiannual quotas	Establish multiannual rolling quotas	40
P42 individual quota	Progressively introduce individual non-transferable quotas	25
P43 climate change and flexibility	Implement more flexible management in the context of climate change	18
P44 binding regional measures	Enable the implementation of binding regional measures	41
P45 bilateral agreements	Take into account all existing forms of bilateral or private agreements in the context of fisheries agreements with non-EU countries	33
P46 consistency of management units	Realign management units with assessment units	10
P47 weight of AC	Reinforce the role of regional bodies (RACs)	44
P48 role of RFMO	Strengthen and review regional fisheries management organisations (RFMOs)	31

P49 update relative stability	Review catch records according to equity and sustainability criteria	14
P50 simplify regulatory patchwork	Build on existing regulations and simplify the regulatory patchwork	28
