



HAL
open science

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

Hilaire Drouineau, Fabien Moullec, Didier Gascuel, Francis Laloë, Sterenn Lucas, Nicolas Bez, Patrice Guillotreau, Jérôme Guitton, Pierre-Yves Hervann, Martin Huret, et al.

► To cite this version:

Hilaire Drouineau, Fabien Moullec, Didier Gascuel, Francis Laloë, Sterenn Lucas, et al.. Food for thought from French scientists for a revised EU Common Fisheries Policy to protect marine ecosystems and enhance fisheries performance. *Marine Policy*, 2023, 148, pp.105460. 10.1016/j.marpol.2022.105460 . hal-03903499

HAL Id: hal-03903499

<https://institut-agro-rennes-angers.hal.science/hal-03903499>

Submitted on 17 Oct 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Royal Netherlands Institute for Sea Research

This is a pre-copyedited, author-produced version of an article accepted for publication, following peer review.

Drouineau, H.; Moullec, F.; Gascuel, D.; Laloë, F.; Lucas, S.; Bez, N.; Guillotreau, P.; Guitton, J.; Hervann, P.-Y.; Huret, M.; Lehuta, S.; Léopold, M.; Mahévas, S.; Robert, M.; Woillez, M.; Vermard, Y. (2023). Food for thought from French scientists for a revised EU Common Fisheries Policy to protect marine ecosystems and enhance fisheries performance. *Mar. Policy* 148: 105460. DOI: 10.1016/j.marpol.2022.105460

Published version: <https://dx.doi.org/10.1016/j.marpol.2022.105460>

NIOZ Repository: <http://imis.nioz.nl/imis.php?module=ref&refid=361052>

[Article begins on next page]

The NIOZ Repository gives free access to the digital collection of the work of the Royal Netherlands Institute for Sea Research. This archive is managed according to the principles of the [Open Access Movement](#), and the [Open Archive Initiative](#). Each publication should be cited to its original source - please use the reference as presented.

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

4
5 Keywords: Common Fisheries Policy, Consultation, Sustainable fisheries management, Best–
6 worst scaling

7
8 **Highlights :**

- 9 • 10 years after writing a manifesto, a group of French Fishery Scientists gathered
10 proposals for the Future of the Common Fishery Policy
- 11 • The study resulted in an ordered list of proposed measures, highlighting measures
12 considered relevant and a priority by the scientists
- 13 • It highlights the need for more simplicity and transparency, for increased consultation,
14 for moving forward into the Ecosystem-Based Approach to Fisheries, and for
15 addressing the situation in the Mediterranean Sea
- 16 • Efforts are still needed to protect ecosystems and fisheries, especially in a context of
17 climate and global change

18
19
20 **Abstract**

21 Since the 1980s, the Common Fisheries Policy (CFP) has shaped European fisheries. It has
22 often been criticised for being too prescriptive and, above all, for failing to protect either
23 fishermen or ecosystems. The last reform dates back to the early 2010s and has led to a slight
24 but slow improvement in the state of ecosystems. Given that the CFP is in the process of

25 evaluation, a group of French fishery scientists set up an initiative to add to the debate on
26 what should be retained, reinforced or added to a possible new reform. This initiative came
27 10 years after a previous manifesto that presented their vision for fisheries in Europe. Four
28 major issues emerged from the current initiative: (1) a need for transparency and
29 simplification in fisheries management, (2) a need for more consultation and dialogue
30 between stakeholders, (3) the urgency of the situation in the Mediterranean Sea, and (4) the
31 necessity of putting into practice all research developments for an ecosystem approach to
32 fisheries. Compared to 10 years ago, the response of scientists shows that the focus is no
33 longer on achieving the maximum sustainable yield, but rather on the following steps to
34 protect ecosystems and fisheries. An ecosystem approach to fisheries remains indispensable
35 for both ecosystems and fishing activities. To this end, scientists put forward numerous
36 proposals to improve the CFP, acknowledging that the final solutions should emerge from
37 consultation with stakeholders. Climate change, an issue raised much more than in the
38 manifest, reinforces the need to act.

39

40 **Introduction**

41 Initially developed in the 1970s, adopted in 1983, revised in 1992, 2002 and 2013, the
42 Common Fisheries Policy (CFP), the European Union's (EU) legislative instrument for
43 fisheries management, has undergone profound changes over the past five decades [1]. These
44 developments have fundamentally shaped European fisheries and the entire fishery sector
45 [2,3]. Considered one of the most integrated policies in Europe [1], the initial aims of the CFP
46 were to exploit fish stocks sustainably, to ensure the economic viability of Member States'
47 fleets and to provide consumers with quality food at reasonable prices (EEC Council
48 Regulation No. 170/83). These primary objectives were then overlaid with ecosystem-based

49 management goals aimed at minimising the impact of fishing on the marine environment (EU
50 Regulation No. 1380/2013).

51

52 To date, the overall results of the CFP have been mixed [4,5]. Although the proportion of
53 overexploited stocks has practically halved over the last 10 years (from 75% to 40% for
54 stocks for which an assessment is available) and the biomass of assessed stocks has increased
55 by around 35% in 20 years in EU waters [6,7], the stated objectives of exploiting 100% of
56 stocks at Maximum Sustainable Yield (MSY) and achieving good environmental status in the
57 marine environment by 2020 have not been met [5,8]. Worse, while the fishing pressure
58 appears to decrease in the North-Eastern Atlantic, in the Mediterranean and Black Seas,
59 fishing mortality in assessed stocks is still 2.1 times higher on average than that defined for
60 MSY [5,9,10]. The socio-economic results of the CFP are also mixed. Although economic
61 performance and fishermen's wages have improved in recent years, mainly for fleets
62 exploiting stocks assessed as in good condition [11], the situation remains alarming in several
63 Member States, particularly for small-scale fisheries, which are not profitable in several
64 countries [11]. Based on figures from the EU's Scientific, Technical and Economic
65 Committee for Fisheries (STECF), the World Wide Fund for Nature (WWF) recently
66 estimated that 43% of EU fishermen were paid less than the national minimum wage in 2018
67 (reaching 70% of fishermen operating on craft smaller than 12 metres [12]).

68

69 Since the formal implementation of the CFP, and despite the integration of major changes
70 (e.g. MSY as a management target, the obligation to land species under quota, the regulation
71 on technical measures, and the strengthening of controls), the policy has received intense
72 criticism from stakeholders in the sector (fishermen, NGOs, fisheries managers and
73 scientists) [13–19], and is still being questioned today (e.g. [20,21]). The slow and partial

74 recovery of biomass [5] has not allowed a real return to profitability for a large number of
75 fisheries [6]. Fisheries management still takes a single-species approach that largely ignores
76 biological and technical interactions and the effects of global change [22–24], a far cry from a
77 true ecosystem-based approach [19,25]. While single-stock approach can indirectly handle the
78 side-effects of those interactions through yearly stock-assessment and recurrent update of
79 reference points, it opens the door to side-effects such as increased discards in mixed-
80 fisheries or to trophic cascades, especially on species that are not assessed, and poorly
81 accounts for socio-economic consequences on fisheries. The CFP remains vertical,
82 prescriptive and centralised, as illustrated by the introduction of the landing obligation in
83 2015, which is very poorly understood and negatively perceived by professionals [26–28].
84 The same applies to the Regional Advisory Councils (RACs). Created in 2004 to promote
85 dialogue between stakeholders and initiate a process of regionalised co-management [16,29],
86 then transformed into Advisory Councils (ACs) from 2013 onwards, these councils have
87 since been regularly sidelined from debates in favour of political representatives from the
88 Member States, to whom the European Commission turns in preference (e.g. [30]). This
89 situation generates frustration among a certain number of Advisory Council stakeholders [31],
90 and is partly responsible for the fact that the regionalisation of the EU fisheries management
91 system seems to be stalling (e.g. [32,33]).

92

93 Moreover, new environmental, economic and social challenges have been added to the
94 original concerns of the CFP [4,34]. Brexit has also changed the situation, entailing that the
95 management of the majority of stocks exploited by the EU will now be subject to
96 international fisheries agreements between the UK and Europe [35,36], as is already the case
97 with Norway, for example. Anthropogenic pressures on the marine environment are
98 increasing, particularly with the development of tourism, marine renewable energy, aggregate

99 extraction and coastal urbanisation [37,38]. Coastal development and the problems of
100 eutrophication and pollution are sources of increased conflicts of use in coastal areas (e.g.
101 [38]). The impacts of climate change are now being significantly felt and will inevitably
102 increase in the coming decades [39–41]. This is leading to declines in abundance, and even
103 the collapse of several large European stocks (e.g. cod in the Celtic Sea [42]), and to changes
104 in the spatial distribution of stocks (e.g. [43]): for example, the increase in cod in the Barents
105 Sea [44] or the arrival of boarfish (*Capros aper*) in the Bay of Biscay [45,46]. Total catches
106 are decreasing, their species composition is changing, and they are becoming more unstable
107 and less predictable overall [47–50]. Scientific recommendations and management procedures
108 are also being questioned [51–53]. Furthermore, the multiplication of uses in the marine
109 environment means that fisheries and marine ecosystems are at the centre of a patchwork of
110 interacting policies, both conservation policies (e.g. CFP, Water Framework Directive,
111 Marine Strategy Framework Directive) and spatial planning policies, without always being
112 properly coordinated. There is little question that the CFP needs rethinking to ensure that
113 future generations have sustainable and equitable access to fisheries resources.

114

115 In this context, and given that the European Commission must report to the European
116 Parliament and Council on the performance of the CFP before 31 December 2022 with a
117 view to its review (Article 49 of EU Regulation 1380/2013), there is a window for legislative
118 action to adapt and modernise the CFP on the basis of current scientific knowledge. Fisheries
119 stakeholders, in particular scientists, with their individual and collective expertise, therefore
120 have a role to play in informing policymakers. Although the degree of involvement scientists
121 should have in the public debate is sometimes the subject of controversy [54,55], it is
122 unanimously recognised that they need to provide the objective knowledge necessary for
123 decision-making [56], making it judicious to reduce the distance that can sometimes exist

124 between researchers and other stakeholders [55,57,58]. As far as fisheries research is
125 concerned, the challenge is to coordinate the voice of the scientific community,
126 multidisciplinary and multi-institutional by nature, in order to elicit the most relevant and
127 consensual areas of improvement for the CFP – based on individual scientific expertise –
128 without dodging the uncertainties and controversies.

129

130 In 2011, the Association Française d’Halieutique (AFH), a non-profit organisation of more
131 than 100 French-speaking fisheries scientists, published a manifesto for sustainable fishing
132 [59]. This manifesto highlighted the deep crisis of fisheries in the European Union and
133 proposed a set of reforms and a paradigm shift to improve the CFP. Ten years later, in light of
134 new scientific knowledge and emerging international issues, the organisation decided to take
135 advantage of the CFP review to solicit the views of all its members on concrete political,
136 economic or environmental measures that could be integrated into a new CFP in order to
137 achieve its objectives, or to set new ones, in a changing world.

138

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

143

144 **Materials and methods**

145 The main mission of the AFH is to coordinate French-speaking fisheries scientists from
146 different disciplines. Its members come from different institutions, mainly scientific (e.g.
147 universities and research institutes such as Ifremer, IRD, INRAE, Institut Agro, etc.), and it is
148 open to scientists from stakeholder organisations (environmental NGOs, producers’

149 organisations, fisheries committees, etc.). Members do not represent their institutions. Those
150 up to date with their membership fees (i.e. who have paid at least once since 2017)
151 constituted the panel for this survey, i.e. 159 scientists. The directory of current members is
152 available online (<https://www.association-francaise-halieuistique.fr/annuaire-des-adherents/>).

153

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

157 Between June and October 2020 (Figure 1), the 159 scientists were contacted by email and
158 reminded once a month to propose measures they thought should be implemented in an
159 updated CFP on a virtual bulletin board (<https://padlet.com/dashboard>). This allowed each
160 participant to view all the measures proposed over time on the platform. As the aim was to
161 obtain as wide a range of opinions as possible, the instructions made it clear that the
162 proposals could be similar to, or contradictory to, other proposals. Participants were given the
163 opportunity to comment on the proposals in order to improve, expand on, clarify or challenge
164 the content, and each contribution had to be signed. A total of 43 scientists participated in the
165 call for proposals (submitting proposal(s) or comment(s) in response to them). An editorial
166 committee made up of six scientists who are members of the AFH and themselves
167 contributed to proposing measures, was then responsible for producing an initial summary of
168 the proposals in order to merge those that appeared redundant, and to edit and standardise the
169 content. From the 70 initial proposals, 50 distinct proposals emerged. Finally, in October
170 2020, the 43 participants were invited to verify the correct transcription of their original idea
171 by the editorial committee (Figure 1).

172 A Best–Worst scaling (B-W scaling) survey [60,61] was then implemented to prioritise the 50
173 measures, using a methodology similar to that of Rudd and Lawton [62] and Rudd [58], which

174 is well suited to ranking a large number of proposals. B-W scaling is used to rank proposals
175 by assessing the preferences of respondents. It consists of subjecting the voter to several
176 voting operations (called ‘tasks’), each of which concerns a reduced sub-group of proposals
177 from which the voter must extract the most and least relevant (ranking). For each participant,
178 the list of tasks was randomly constructed by selecting groups of proposals according to an
179 experimental design (D-optimal design) that ensured the repeated random appearance of each
180 proposal in the different tasks.

181

182 Each participant was assigned 36 tasks, each containing four proposals (exactly the number
183 of tasks and proposals per task set by Rudd [58]). Thus, each proposal was evaluated three
184 times on average by each participant. The experimental design was randomly generated for
185 each participant so that the tasks, and thus the grouping of proposals, were different from one
186 participant to another, ensuring an even greater mix of proposals. An invitation to vote was
187 sent to the initial panel of 159 people (Figure 1). Each voter was given a unique voting
188 opportunity to ensure a unique response. The survey was conducted between January and
189 March 2021. For each task, when choosing the most and least relevant proposal, the voter
190 was given the title of the proposal and an explanatory text (see Supplementary Material). Of
191 the 159 respondents, 83 complete votes were cast. Only these 83 votes were analysed.

192

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

197

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

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

205

206 **Results**

207 **Summary of the CFP reform proposals**

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

- 210 • Governance: 19 proposals (P32 to P50) addressed issues such as decision-making
211 methods (e.g. P34), the place of science in decision-making (e.g. P36), methods
212 for controls (TACs/quota calculation key; 33, 41, 42, 49), and the organisation of
213 sectors (e.g. P35/P39). Most of the measures promoted greater consultation with
214 stakeholders and greater regionalisation of the CFP (e.g. P34/P37/P39/P44/P47),
215 as well as greater flexibility (e.g. P37/P38/P44) to deal with climate change and
216 local contexts. Finally, better coordination of the CFP with other European
217 directives and international initiatives (P32) was suggested, to prevent working in
218 silos.
- 219 • Consumer information: four proposals (P28 to P31) concerned better consumer
220 information on products available on the market, both in terms of the status of the
221 marine population exploited and on the potentially negative impacts of fishing on

222 the stock, in particular via environmental labelling. The ultimate aim is to
223 encourage more responsible consumption, a theme also found in other proposals
224 (P35).

225 • Improved scientific assessment: eight proposals (P20 to P27) aimed to better
226 integrate and capitalise on recent developments in ecosystem modelling (P20),
227 redefine the acquisition of data used for scientific assessment (P21/P24/P26), and
228 better take into account scientific knowledge on stock assessment (P22/P25) as
229 well as the associated uncertainty and variability caused by climate change (P25).
230 Several proposals called for a revision of management targets, questioning the
231 principle of MSY management as insufficient for an ecosystem approach to
232 fisheries (P23/P27). Other proposals aimed to develop participatory and
233 collaborative research (P26), often in interaction with the governance issues
234 previously mentioned (P36, P38, P39).

235 • Ecological protection and conservation: 19 proposals (P1 to P19) included a wide
236 range of resource and ecosystem conservation measures, including technical
237 measures for fisheries (mesh sizes, e.g. P4/P11; fish sizes, e.g. P3/P11; TACs, e.g.
238 P10/P12), networks of marine protected areas, and individual financial incentives
239 for taking into account environmental issues. They concerned a variety of
240 biological scales (stocks, e.g. P5; communities, e.g. P15; ecosystems e.g. P8) and
241 fleets (P6). Of these proposals and in line with the considerations on previously
242 mentioned reference points, several proposals focused on the practical
243 implementation of ecosystem-based fisheries management (e.g. P14/P15). The
244 alarming situation in the Mediterranean was the subject of specific proposals (P5
245 and P10).

246

247 **Ranking of proposals**

248

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

254

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

259 ● Issue 1: More transparency, less complexity: in response to the often-voiced criticism
260 of the lack of transparency and the high complexity of the CFP, scientists put forward
261 several proposals to improve the situation. Aligning all management units (i.e. the
262 units on which TACs are set) with the functional units of biological populations (on
263 which scientific assessment is based) was considered a priority (P46). These
264 functional units correspond to the best scientific knowledge currently available on
265 population distribution, and management at any other scale could be inefficient. This
266 realignment measure was also considered necessary to make political decisions more
267 transparent and to be able to compare them with scientific recommendations.

268 Complexity also arises from directives and initiatives that are too ‘siloed’ (P32).

269 Conservation policies could be made more fluid by establishing an overall strategic
270 framework. Finally, transparency and complexity were also often linked to a lack of
271 consultation and dialogue. According to the survey, consultation on decisions with all

272 the stakeholders in a sector is a prerequisite, particularly for implementing multiyear,
273 multispecies management plans and for evaluating them afterwards (P34).

274 ● Issue 2: More consultation with stakeholders to improve understanding and
275 acceptability: the role of stakeholders was central to two of the first ten proposals.

276 This was the case for the previously mentioned proposal on the concerted
277 implementation of management plans (P34), but was also the focus of a proposal
278 aiming to increase the practice of incentives for virtuous behaviour (in the form of
279 allocation of fishing effort quotas or additional catch quotas, or real-time incentives,
280 etc.) rather than the taxation/subsidy mechanisms currently practised (P39, P34). This
281 mechanism could draw on Article 17 of the CFP, which has so far been little used.
282 Here again, the types of behaviour to be promoted and the incentive methods should
283 be developed jointly with stakeholders to ensure the system is effective.

284 ● Issue 3: Fisheries resources in the Mediterranean: two of the proposals perceived as
285 the most relevant concerned the Mediterranean (P5 and P10), underlining the extent to
286 which the situation in this region is considered very concerning. In this respect, the
287 panel members found it essential to improve knowledge on both the biology of the
288 species and on their exploitation in order to better assess the status of exploited
289 populations and to improve the settings of technical measures (e.g. see the discussion
290 about size-at-maturity and in minimum landing size in [65], or [66]). They also
291 recommended the introduction of quotas for Mediterranean species, as management
292 by fishing effort has shown its limits when not linked to other conditions. Finally, it
293 was proposed that the CFP should gradually align its approach in the Mediterranean
294 with that in force in the North-East Atlantic.

295 ● Issue 4: Ecosystem-based management: from theory to practice. The panel members
296 noted that (i) the first calls for an ecosystem approach to fisheries date back several

297 decades, (ii) that little has yet been done in concrete terms to respond to this, while
298 (iii) operational instruments are nevertheless available and could already be enlisted.
299 As far as analysis tools are concerned, ecosystem models (end-to-end, trophic) have
300 multiplied, but are still used in a disparate and ad hoc manner, which does not allow
301 for long-term monitoring of the state of ecosystems, feedback on these tools by
302 scientists, and even less their adoption by decision-makers. The use of ecosystem
303 models and the knowledge they produce should therefore be made more routine and
304 regular (P20), and the data collection systems needed to inform and update them set
305 up (P21). Beyond tools and data, scientists gave even stronger support to two
306 proposals for measures to better protect ecosystems. Scientific knowledge has
307 highlighted the importance of protecting habitats and ‘forage species’ (P15). This
308 knowledge should enable the implementation of measures that take better account of
309 the seasonality, the heterogeneity of spatial distribution, and the trophic interactions
310 of exploited species – the most popular proposal (P9), which echoes proposals in the
311 top 10 (P15), or others that are slightly lower ranked (P8, P11, P22). Finally,
312 particularly in relation to climate change, which is causing changes in the distribution
313 range of species, and the tendency to exploit lower and lower trophic levels, the
314 scientists recommended that predefined rules, alongside clear criterion defining when
315 they apply, should be rapidly put in place to limit the expansion of fisheries towards
316 new species (either previously present but not yet exploited, or species that shift their
317 distribution), pending the acquisition of sufficient knowledge for their proper
318 management (P1 - see [67] for a review of international regulations on this question).
319
320

321 **Discussion**

322 **An innovate consultation to collect opinions of French scientists on the** 323 **CFP**

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

337 The process was based on two steps: (i) the collection of proposals through an open online
338 survey, (ii) then a ranking of these proposals through a statistically appropriate best-worst
339 scaling procedure. It should be noted that care must be taken not to overinterpret the poorly
340 ranked proposals, as this may also be explained by their proximity to other better ranked
341 measures. For example, the measure aimed at giving the Advisory Councils a greater role
342 (P47) is relatively low-ranked, but the panel unanimously recognised the need for a more
343 regional approach and greater consultation, in which these councils have an important role to
344 play (P34 and P39). Similarly, although no proposal on environmental labelling appears at

345 the top of the ranking, this could be explained by the existence of three fairly similar
346 proposals of this type (P29, P30 and P31), which tends to disperse their respective individual
347 weight. The scope of the measure may also constitute a bias: in a choice between a precise
348 technical measure (e.g. increasing mesh size) and a more conceptual proposal expressing an
349 objective (wishful thinking) rather than a means (e.g. taking into account spatial and temporal
350 variability), it is likely that the means would win more votes, even if the concrete aspects of
351 this remain to be identified. That's why, while looking at the best ranked proposals is
352 interesting to detect the most urgent challenges, it is also very interesting to explore the
353 diversity of themes and measures addressed in other proposals (all the proposals are the
354 results of the MICESE steps of the approach and can thus be found in supplementary
355 material).

356

357 **Four critical challenges that echo the most frequent criticisms against the** 358 **CFP**

359 The top 10 ranked proposals highlight 4 critical challenges that are closely related to the main
360 criticisms of the CFP. First, the dramatic situation in the Black Sea and in the Mediterranean
361 Sea was highlighted in two proposals (P5, P10) and reminds that the CFP has failed to
362 prevent the overexploitation for decades [14,69–71]. While progress has been observed in the
363 North-eastern Atlantic since the last reforms of the CFP [6], this is not the case in some other
364 regions [9,10,18,24,72]. Here, scientists have proposed to align the situation in the
365 Mediterranean regions with the practices from North Eastern Atlantic. Since the
366 implementation of adequate controls and management in Eastern Mediterranean region or
367 Black Sea is likely to be challenging [73], those proposals are rather medium term objectives
368 (P5 sets a 2030 objective). Nevertheless, it should be noted that recent efforts have been

369 made to improve the data collection and stock assessments, especially in the context of the
370 Mediterranean multiannual management plan [65,73]. This better monitoring of landings
371 might in turn facilitate the implementation of controls in longer terms. For sure, that should
372 not prevent immediate alternative actions in the meantime.

373

374 Among the top 10 proposals, there is a recurrent call for less complexity, enhanced
375 transparency and consultation. It echoes the frequent and recurrent criticism of a too siloed,
376 centralised and top-down policy [14,74–76]. To address those points, French scientists called
377 for more involvement of stakeholders to design management plans (P34). Indeed, the
378 example of the Scottish fishery showed that co-constructed transformations can yield
379 significant outcomes [75] and has demonstrated that it is not incompatible with the CFP. The
380 last CFP reform in 2013 promoted a regionalization of the management. However, at the
381 same time, consultative regional bodies such as Regional Advisory Councils (RACs) /
382 Advisory Councils (ACs) have since been regularly sidelined from debates in favour of
383 political representatives from the Member States, to whom the European Commission turns
384 in preference (e.g. [30]). As such, the benefits of regionalisation, as a step towards enhanced
385 stakeholder involvement, have not always been perceived [77]. While P34 proposes an
386 objective, specific tools to reach this objective are proposed in other proposals. More
387 specifically, shifting from a taxing, subsidies and bans approach, towards incentives approach
388 is mentioned in two top-ranked proposals (P39, P34) . Such a solution, to be negotiated with
389 stakeholders, has proved to be efficient in various countries [78,79]. Moreover, Article 17 of
390 the CFP Regulation already provides for this possibility. More generally, enhanced
391 consultation is likely to facilitate understanding of management measures (see [27,28] that
392 illustrate how the poorly negotiated discard ban led to misunderstanding and its unacceptance
393 by the industry), which is one of the main subjects emerging from the top-ranked proposals.

394 While consultation is not a panacea and co-management of fisheries has not always delivered
395 expected results [80], early consultation can help to detect issues early and to prevent latter
396 blockages [81,82].

397

398 Finally, the last main theme was about upscaling the management towards an EAF that
399 should account for all the threats due to the fishery [83]. The call for moving towards an EAF
400 is old [84], and AFH scientists are not the only ones to criticise the slow pace of
401 implementation [85,86]. While they note that tools exist to explore the impact of fisheries,
402 management measures, and other pressures on food webs and socio-ecosystems (e.g. [83,87–
403 93] and P20), their application in fisheries management or within other European
404 environmental policies remains relatively limited (e.g. [94–96] and P9, P20). Scientific
405 knowledge already exists to protect low trophic levels [97] and habitats through measures that
406 take into account the seasonality and spatial distribution of species (P15, P9 and [98–100]).
407 The recent framework developed by the STECF in the context of the Mediterranean
408 Management Plan, to assess the relevance of closed areas to protect multiple key target
409 species (but that can be extended to protect key habitats), that combines Vessel Monitoring
410 System and scientific survey data, is an interesting example of how most recent scientific
411 data can be used to support spatial management measures implementation [101]. Marine
412 protected areas can and should be a tool for EAF, (P9, and P8 though less well ranked) but
413 for this to happen they must have a truly effective level of protection and management,
414 contrary to what is currently observed in many cases [102]. Of course, moving towards the
415 EAF will require the use of more complex models to support the scientific advice and
416 constant discussion will be required with stakeholders [103]. P20 underlines that many
417 ecosystem models are available to support the scientific advice of an EAF (this is also
418 mentioned in P34 with the proposed generalised use of Management Strategy Evaluation).

419 Such ecosystem models do not aim to set measures such as yearly single-stock TACs, nor to
420 replace single-species models which are well suited to carry-out short term predictions, but
421 rather as complementary tools to holistically assess the relevance of management approaches
422 or to monitor ecosystems and anticipate changes over the long term. This is even more
423 critical in a context of climate change which will drastically affect fisheries [41,50]. However,
424 to do so, their use must be made more routine so that scientists and decision-makers gradually
425 learn to make the best use of them. Indeed, demonstrating the usefulness and the reliability of
426 complex models to stakeholders and managers is critical to increase trust and confidence
427 [90,103]. As such, the work initiated by ICES Working Group on Multispecies Assessment
428 Methods [94] and ICES Ecosystem Overviews, and concrete proposals and examples that can
429 be found in the literature [23,86,90,94,104,105], will hopefully be important starting points.
430 The diversity of impacts of fisheries on ecosystems [83], and the increase of others
431 anthropogenic pressures on the marine environment [37,38] urges the development of such
432 holistic approaches and a better integration of CFP with other international biodiversity
433 protection initiatives such as MSFD, EMFD or WFD (P32) to promote synergies and prevent
434 negative interactions among them [106–108]. In continental waters, Drouineau et al. [109]
435 underlined how initiatives to restore some migratory fish populations have interfered with the
436 EU Renewable Energy Directive; these kinds of problems can only increase for marine
437 fisheries.

438

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

441 Ten years ago, the AFH made strong recommendations for fisheries management in Europe
442 [59]. It is interesting to compare, a decade later, those earlier messages from 2011 with the

443 diversity of themes addressed in the current analysis. The main messages in 2011 were
444 (quoted and in italics):

445 ● *“The sea is suffering from damage inflicted by humans, and fishermen are suffering*
446 *too”*: since that time, scientists have recognised that the transition to MSY has been an
447 important step forward (e.g. P27). Although progress has been slow [6,7] and the
448 situation remains critical in some regions (P 32), fishing mortality has fallen and the
449 biomass of some species is slowly rebuilding. A positive consequence of these
450 changes is that the profitability of fisheries is generally increasing (excluding the
451 Covid crisis) in the waters of the North-East Atlantic [11], although this recovery is
452 slow [6]. However, many stocks are still overexploited and their biomass levels are
453 low, making further efforts necessary. Our results indicate that all stakeholders
454 (professionals and NGOs) should be put at the heart of the governance system (P34 is
455 an iconic example, but also P47, P48), with the aim of improving the acceptability of
456 decisions and implementing more effective and appropriate incentives for good
457 exploitation practices to avoid blockages. Co-management and stakeholder
458 involvement has indeed proved effective in many cases [75,79] and should be
459 strengthened in European fisheries. Moreover, this must be done in consultation with
460 all stakeholders. The resources of the sea and marine ecosystems are common goods,
461 which can only be managed sustainably if communities are formed that feel truly
462 responsible for the sustainability of this common good. This is all the more important
463 given that the behaviour of fishermen remains one of the greatest sources of
464 uncertainty in fisheries management [110], and that the failure to take into account
465 interactions between ecosystems and the behaviour of stakeholders is one of the main
466 causes of the failure of the CFP [78]. Greater involvement of stakeholders will require

467 progress in the regionalisation of fisheries management in order to adapt management
468 measures to local situations and facilitate consultation between all parties.

469 ● *“Reaching MSY requires considerable changes”*: this follows directly from the
470 previous point. The level of overexploitation at the time was such that meeting the
471 MSY objective seemed almost unattainable. This is no longer the case: while progress
472 has been slow, it is significant. The recommendations of the AFH scientists have
473 therefore gradually shifted to a post-MSY objective (e.g. P23, P27) , considering
474 MSY as a necessary but insufficient step as a single-species target does not take into
475 account trophic or technical interactions, impacts on ecosystems or income for
476 fishermen [19,111]. Management targets that guarantee less impact on stocks, such as
477 maximum economic yield (MEY [112,113]) or optimised mesh size management, are
478 necessary, but, more generally, an ecosystem approach to fisheries was recommended
479 in the recent survey. To achieve this, the scientists consulted consider that greater
480 involvement and responsibility on the part of fishermen is essential.

481 ● *“An ecosystem approach to fisheries (EAF) is a necessity”* This theme from the 2011
482 manifesto is still largely present in the top-ranked proposals, as mentioned earlier in
483 the discussion, but also in many other proposals (see for example P6, P12, P14, P21).

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

492 measures should make it possible to take into account species ecology and the
493 ecosystem impacts of exploitation.

494

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

506

507 This was the second strong consensus of the study: the success of the CFP will necessarily
508 depend on greater consultation with and empowerment of stakeholders, particularly
509 fishermen, in order to develop appropriate regional management plans. Examples of the
510 implementation of management and restoration plans in continental environments show that
511 the involvement of stakeholders is one of the key factors for success: the process of
512 implementing the plan being as important as the content of the plan itself [117,118].

513

514 The context of global change, in particular climate change, only adds to the urgency of
515 reforming the CFP. The growing concern of scientists about these new challenges is the other
516 salient fact that stands out in contrast to the 2011 manifesto [59]. Ten years ago, global

517 change was mentioned only once, and climate change was only mentioned in passing [59]. In
518 the recent survey, climate is the subject of a specific proposal (P43) and is reflected in several
519 others (P13, P32 and even P19). More broadly, the proposals show that scientists consider
520 that management cannot be considered ‘in a vacuum’, neglecting the interaction of fish and
521 fisheries with their environment. This is the essence of the ecosystem approach to fisheries,
522 which was widely put forward in the survey, but which must also be able to adapt
523 continuously and rapidly to the consequences of the environmental changes to come.

524

525

526

527

528

529 **Author contributions :**

530 Hilaire Drouineau: Conceptualization, Methodology, Software, Validation, Formal analysis,
531 Data Curation, Writing - Original Draft, Visualization, Supervision

532 Youen Vermard: Conceptualization, Methodology, Software, Validation, Formal analysis,
533 Data Curation, Writing - Original Draft, Visualization, Supervision

534 Francis Laloe: Conceptualization, Methodology, Validation, Data Curation, Writing - Review
535 & Editing, Supervision

536 Didier Gascuel: Conceptualization, Methodology, Validation, Data Curation, Writing -
537 Review & Editing, Supervision

538 Sterenn Lucas: Conceptualization, Methodology, Validation, Data Curation, Writing -
539 Review & Editing, Supervision

540 Fabien Moullec: Conceptualization, Methodology, Software, Validation, Data Curation,
541 Writing - Original Draft, Visualization, Supervision

542 Sigrid Lehuta: Data Curation, Validation, Writing - Review & Editing
543 Marc Léopold: Data Curation, Validation, Writing - Review & Editing
544 Patrice Guillaudeau: Data Curation, Validation, Writing - Review & Editing
545 Pierre-Yves Hervann: Data Curation, Validation, Writing - Review & Editing
546 Stéphanie Mahévas: Data Curation, Validation, Writing - Review & Editing
547 Nicolas Bez: Data Curation, Validation, Writing - Review & Editing
548 Marianne Robert: Data Curation, Validation, Writing - Review & Editing
549 Jérôme Guitton: Data Curation, Methodology, Software

550 **Acknowledgments**

551 We would like to thank the 83 contributors that participated in this initiative. We also thank
552 Frédéric Gosselin for his help and support with the MICESE Methodology, and two
553 anonymous referees for their constructive remarks that enhanced the paper. Finally, we are
554 grateful to Elise Bradbury for her revision of this manuscript.

- 557 [1] E.P. Lado, *The Common Fisheries Policy: The Quest for Sustainability*, John Wiley &
558 Sons, 2016.
- 559 [2] S. Jennings, N.K. Dulvy, Reference points and reference directions for size-based
560 indicators of community structure, *ICES Journal of Marine Science*. 62 (2005) 397–
561 404.
- 562 [3] L. Borges, E.P. Lado, Discards in the common fisheries policy: The evolution of the
563 policy, in: S.S. Uhlmann, C. Ulrich, Y. Kennelly (Eds.), *The European Landing
564 Obligation: : Reducing Discards in Complex, Multi-Species and Multi-Jurisdictional
565 Fisheries*, Springer International Publishing, Cham, 2019: pp. 27–47.
- 566 [4] M. Aranda, R. Prellezo, S. Marina, C. Ulrich, B. Le Gallic, L. Borges, S. Metz,
567 Research for PECH Committee-EU Fisheries Policy-Latest Developments and Future
568 Challenges, European Parliament, 2019.
- 569 [5] STECF, *Monitoring the performance of the Common Fisheries Policy*, Luxembourg,
570 2021. <https://data.europa.eu/doi/10.2760/26195>.
- 571 [6] R. Froese, A.C. Tsikliras, G. Scarcella, D. Gascuel, Progress towards ending
572 overfishing in the Northeast Atlantic, *Marine Policy*. 125 (2021) 104282.
573 <https://doi.org/10.1016/j.marpol.2020.104282>.
- 574 [7] D. Gascuel, M. Coll, C. Fox, S. Guénette, J. Guitton, A. Kenny, L. Knittweis, J.R.
575 Nielsen, G. Piet, T. Raid, M. Travers-Trolet, S. Shephard, Fishing impact and
576 environmental status in European seas: a diagnosis from stock assessments and
577 ecosystem indicators, *Fish and Fisheries*. 17 (2016) 31–55.
578 <https://doi.org/10.1111/faf.12090>.
- 579 [8] European Commission, Report from the Commission to the European Parliament and
580 the Council on the implementation of the Marine Strategy Framework Directive
581 (Directive 2008/56/EC), 2020. [https://eur-lex.europa.eu/legal-
582 content/EN/TXT/PDF/?uri=CELEX:52020DC0259&from=EN](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0259&from=EN).
- 583 [9] FAO, *The State of Mediterranean and Black Sea Fisheries*, FAO, Rome, 2020.
- 584 [10] P.G. Fernandes, G.M. Ralph, A. Nieto, M. García Criado, P. Vasilakopoulos, C.D.
585 Maravelias, R.M. Cook, R.A. Pollom, M. Kovačić, D. Pollard, E.D. Farrell, A.-B. Florin,
586 B.A. Polidoro, J.M. Lawson, P. Lorange, F. Uiblein, M. Craig, D.J. Allen, S.L. Fowler,
587 R.H.L. Walls, M.T. Comeros-Raynal, M.S. Harvey, M. Dureuil, M. Biscoito, C. Pollock,
588 S.R. McCully Phillips, J.R. Ellis, C. Papaconstantinou, A. Soldo, Ç. Keskin, S.W.
589 Knudsen, L. Gil de Sola, F. Serena, B.B. Collette, K. Nedreaas, E. Stump, B.C.
590 Russell, S. Garcia, P. Afonso, A.B.J. Jung, H. Alvarez, J. Delgado, N.K. Dulvy, K.E.
591 Carpenter, Coherent assessments of Europe's marine fishes show regional
592 divergence and megafauna loss, *Nat Ecol Evol*. 1 (2017) 1–9.
593 <https://doi.org/10.1038/s41559-017-0170>.
- 594 [11] STECF, *The 2021 Annual Economic Report on the EU Fishing Fleet (STECF 21-08)*,
595 EUR 28359 EN, Publications Office of the European Union, Luxembourg, 2021.
- 596 [12] WWF, *Socio-economic impacts of the EU Common Fisheries Policy. An evaluation of
597 the European Union fishing fleet and options for the future.*, 2021.
598 [https://wwfeu.awsassets.panda.org/downloads/wwf_cfp_socio_economic_impact_stud
599 y_2021.pdf](https://wwfeu.awsassets.panda.org/downloads/wwf_cfp_socio_economic_impact_study_2021.pdf).
- 600 [13] T. Daw, T. Gray, Fisheries science and sustainability in international policy: a study of
601 failure in the European Union's Common Fisheries Policy, *Marine Policy*. 29 (2005)
602 189–197. <https://doi.org/10.1016/j.marpol.2004.03.003>.
- 603 [14] S. Khalilian, R. Froese, A. Proelss, T. Requate, Designed for failure: A critique of the
604 Common Fisheries Policy of the European Union, *Marine Policy*. 34 (2010) 1178–
605 1182. <https://doi.org/10.1016/j.marpol.2010.04.001>.
- 606 [15] R.H. Thurstan, S. Brockington, C.M. Roberts, The effects of 118 years of industrial

- 607 fishing on UK bottom trawl fisheries, *Nat Commun.* 1 (2010) 15.
608 <https://doi.org/10.1038/ncomms1013>.
- 609 [16] J.L. Hatchard, T.S. Gray, From RACs to Advisory Councils: Lessons from North Sea
610 discourse for the 2014 reform of the European Common Fisheries Policy, *Marine*
611 *Policy.* 47 (2014) 87–93. <https://doi.org/10.1016/j.marpol.2014.02.015>.
- 612 [17] R. Prelezo, R. Curtin, Confronting the implementation of marine ecosystem-based
613 management within the Common Fisheries Policy reform, *Ocean & Coastal*
614 *Management.* 117 (2015) 43–51. <https://doi.org/10.1016/j.ocecoaman.2015.03.005>.
- 615 [18] M. Cardinale, G.C. Osio, G. Scarcella, Mediterranean Sea: A Failure of the European
616 Fisheries Management System, *Frontiers in Marine Science.* 4 (2017).
617 <https://www.frontiersin.org/article/10.3389/fmars.2017.00072> (accessed January 21,
618 2022).
- 619 [19] D. Gascuel, *Pour une révolution dans la mer: de la surpêche à la résilience*, Éditions
620 Actes Sud, 2019.
- 621 [20] A. Said, J. Tzanopoulos, D. MacMillan, The Contested Commons: The Failure of EU
622 Fisheries Policy and Governance in the Mediterranean and the Crisis Enveloping the
623 Small-Scale Fisheries of Malta, *Frontiers in Marine Science.* 5 (2018).
624 <https://www.frontiersin.org/article/10.3389/fmars.2018.00300> (accessed January 21,
625 2022).
- 626 [21] J. Wakefield, European Protection of Fisheries in the North East Atlantic, in: C.
627 Sheppard (Ed.), *World Seas: An Environmental Evaluation*, Elsevier, 2019: pp. 173–
628 182.
- 629 [22] R. Arnason, Global warming: New challenges for the common fisheries policy?,
630 *Ocean & Coastal Management.* 70 (2012) 4–9.
631 <https://doi.org/10.1016/j.ocecoaman.2012.04.003>.
- 632 [23] C. Ulrich, D.C.K. Wilson, J.R. Nielsen, F. Bastardie, S.A. Reeves, B.S. Andersen,
633 O.R. Eigaard, Challenges and opportunities for fleet- and métier-based approaches
634 for fisheries management under the European Common Fishery Policy, *Ocean &*
635 *Coastal Management.* 70 (2012) 38–47.
636 <https://doi.org/10.1016/j.ocecoaman.2012.06.002>.
- 637 [24] S. Libralato, F. Colloca, A.C. Gücü, C.D. Maravelias, C. Solidoro, S. Villasante, M.
638 Cardinale, Editorial: Challenges and Opportunities for the EU Common Fisheries
639 Policy Application in the Mediterranean and Black Sea, *Frontiers in Marine Science.* 5
640 (2018). <https://www.frontiersin.org/article/10.3389/fmars.2018.00299> (accessed
641 January 21, 2022).
- 642 [25] F. Bastardie, E.J. Brown, Reverse the declining course: A risk assessment for marine
643 and fisheries policy strategies in Europe from current knowledge synthesis, *Marine*
644 *Policy.* 126 (2021) 104409. <https://doi.org/10.1016/j.marpol.2021.104409>.
- 645 [26] S. Villasante, C. Pita, G.J. Pierce, C.P. Guimeráns, J.G. Rodrigues, M. Antelo, J.M.D.
646 Rocha, J.G. Cutrín, L. Hastie, U.R. Sumaila, M. Coll, To land or not to land: How do
647 stakeholders perceive the zero discard policy in European small-scale fisheries?,
648 *Marine Policy.* 71 (2016) 166–174. <https://doi.org/10.1016/j.marpol.2016.05.004>.
- 649 [27] F. Maynou, M. del M. Gil, S. Vitale, G.B. Giusto, A. Foutsis, M. Rangel, R. Rainha, K.
650 Erzini, J.M.S. Gonçalves, L. Bentes, C. Viva, P. Sartor, F. De Carlo, I. Rossetti, M.
651 Christou, K. Stergiou, C.D. Maravelias, D. Damalas, Fishers' perceptions of the
652 European Union discards ban: perspective from south European fisheries, *Marine*
653 *Policy.* 89 (2018) 147–153. <https://doi.org/10.1016/j.marpol.2017.12.019>.
- 654 [28] L. Borges, The unintended impact of the European discard ban, *ICES Journal of*
655 *Marine Science.* 78 (2021) 134–141. <https://doi.org/10.1093/icesjms/fsaa200>.
- 656 [29] R. Long, The Role of Regional Advisory Councils in the European Common Fisheries
657 Policy: Legal Constraints and Future Options, *The International Journal of Marine and*
658 *Coastal Law.* 25 (2010) 289–346. <https://doi.org/10.1163/157180810X516980>.
- 659 [30] S.Q. Eliassen, T.J. Hegland, J. Raakjær, Decentralising: The implementation of
660 regionalisation and co-management under the post-2013 Common Fisheries Policy,
661 *Marine Policy.* 62 (2015) 224–232. <https://doi.org/10.1016/j.marpol.2015.09.022>.

- 662 [31] K. Ounanian, T.J. Hegland, The Regional Advisory Councils' current capacities and
663 unforeseen benefits, *Maritime Studies*. 11 (2012) 10. <https://doi.org/10.1186/2212-9790-11-10>.
- 665 [32] C. Pita, G.J. Pierce, I. Theodossiou, Stakeholders' participation in the fisheries
666 management decision-making process: Fishers' perceptions of participation, *Marine*
667 *Policy*. 34 (2010) 1093–1102. <https://doi.org/10.1016/j.marpol.2010.03.009>.
- 668 [33] PEW, Lessons From Implementation of the EU's Common Fisheries Policy, 2021.
669 <https://pew.org/3vBSb7H>.
- 670 [34] E. Ojea, E. Fontán, I. Fuentes-Santos, J. Bueno-Pardo, Assessing countries' social-
671 ecological resilience to shifting marine commercial species, *Sci Rep*. 11 (2021) 22926.
672 <https://doi.org/10.1038/s41598-021-02328-6>.
- 673 [35] J. Phillipson, D. Symes, "A sea of troubles": Brexit and the fisheries question, *Marine*
674 *Policy*. 90 (2018) 168–173. <https://doi.org/10.1016/j.marpol.2017.12.016>.
- 675 [36] T. Bjørndal, G.R. Munro, A game theoretic perspective on the management of shared
676 North Sea fishery resources: Pre and post Brexit, *Marine Policy*. 132 (2021) 104669.
677 <https://doi.org/10.1016/j.marpol.2021.104669>.
- 678 [37] IPBES, Global assessment report on biodiversity and ecosystem services of the
679 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services,
680 IPBES secretariat, Bonn, Germany, 2019.
- 681 [38] S. Jentoft, M. Knol, Marine spatial planning: risk or opportunity for fisheries in the
682 North Sea?, *Maritime Studies*. 12 (2014) 13. <https://doi.org/10.1186/2212-9790-12-13>.
- 683 [39] M. Barange, T. Bahri, M.C.M. Beveridge, K.L. Cochrane, S. Funge-Smith, F. Poulain,
684 Impacts of climate change on fisheries and aquaculture: synthesis of current
685 knowledge, adaptation and mitigation options, *FAO Fisheries and Aquaculture*
686 *Technical Paper (FAO) Eng No. 627*. (2018).
687 <http://www.fao.org/3/i9705en/i9705en.pdf> (accessed December 16, 2021).
- 688 [40] H.K. Lotze, D.P. Tittensor, A. Bryndum-Buchholz, T.D. Eddy, W.W.L. Cheung, E.D.
689 Galbraith, M. Barange, N. Barrier, D. Bianchi, J.L. Blanchard, L. Bopp, M. Büchner,
690 C.M. Bulman, D.A. Carozza, V. Christensen, M. Coll, J.P. Dunne, E.A. Fulton, S.
691 Jennings, M.C. Jones, S. Mackinson, O. Maury, S. Niiranen, R. Oliveros-Ramos, T.
692 Roy, J.A. Fernandes, J. Schewe, Y.-J. Shin, T.A.M. Silva, J. Steenbeek, C.A. Stock,
693 P. Verley, J. Volkholz, N.D. Walker, B. Worm, Global ensemble projections reveal
694 trophic amplification of ocean biomass declines with climate change, *PNAS*. 116
695 (2019) 12907–12912. <https://doi.org/10.1073/pnas.1900194116>.
- 696 [41] D.P. Tittensor, C. Novaglio, C.S. Harrison, R.F. Heneghan, N. Barrier, D. Bianchi, L.
697 Bopp, A. Bryndum-Buchholz, G.L. Britten, M. Büchner, W.W.L. Cheung, V.
698 Christensen, M. Coll, J.P. Dunne, T.D. Eddy, J.D. Everett, J.A. Fernandes-Salvador,
699 E.A. Fulton, E.D. Galbraith, D. Gascuel, J. Guiet, J.G. John, J.S. Link, H.K. Lotze, O.
700 Maury, K. Ortega-Cisneros, J. Palacios-Abrantes, C.M. Petrik, H. du Pontavice, J.
701 Rault, A.J. Richardson, L. Shannon, Y.-J. Shin, J. Steenbeek, C.A. Stock, J.L.
702 Blanchard, Next-generation ensemble projections reveal higher climate risks for
703 marine ecosystems, *Nat. Clim. Chang*. 11 (2021) 973–981.
704 <https://doi.org/10.1038/s41558-021-01173-9>.
- 705 [42] P.-Y. Hervann, D. Gascuel, Exploring the impacts of fishing and environment on the
706 Celtic Sea ecosystem since 1950, *Fisheries Research*. 225 (2020) 105472.
707 <https://doi.org/10.1016/j.fishres.2019.105472>.
- 708 [43] A.R. Baudron, T. Brunel, M.-A. Blanchet, M. Hidalgo, G. Chust, E.J. Brown, K.M.
709 Kleisner, C. Millar, B.R. MacKenzie, N. Nikolioudakis, J.A. Fernandes, P.G.
710 Fernandes, Changing fish distributions challenge the effective management of
711 European fisheries, *Ecography*. 43 (2020) 494–505.
712 <https://doi.org/10.1111/ecog.04864>.
- 713 [44] A.B. Sandø, G.O. Johansen, A. Aglen, J.E. Stiansen, A.H.H. Renner, Climate Change
714 and New Potential Spawning Sites for Northeast Arctic cod, *Frontiers in Marine*
715 *Science*. 7 (2020). <https://www.frontiersin.org/article/10.3389/fmars.2020.00028>
716 (accessed January 21, 2022).

- 717 [45] F. Blanchard, F. Vandermeirsch, Warming and exponential abundance increase of the
718 subtropical fish *Capros aper* in the Bay of Biscay (1973–2002), *Comptes Rendus*
719 *Biologies*. 328 (2005) 505–509. <https://doi.org/10.1016/j.crvi.2004.12.006>.
- 720 [46] S.M.M. Fässler, C. O'Donnell, J.M. Jech, Boarfish (*Capros aper*) target strength
721 modelled from magnetic resonance imaging (MRI) scans of its swimbladder, *ICES*
722 *Journal of Marine Science*. 70 (2013) 1451–1459.
723 <https://doi.org/10.1093/icesjms/fst095>.
- 724 [47] W.W.L. Cheung, J. Pinnegar, G. Merino, M.C. Jones, M. Barange, Review of climate
725 change impacts on marine fisheries in the UK and Ireland, *Aquatic Conservation:*
726 *Marine and Freshwater Ecosystems*. 22 (2012) 368–388.
727 <https://doi.org/10.1002/aqc.2248>.
- 728 [48] M.A. Peck, I.A. Catalán, D. Damalas, M. Elliot, J.G. Ferreira, K.G. Hamon, P.
729 Kamermans, S. Kay, C.M. Kreiss, J.K. Pinnegar, *Climate Change and European*
730 *Fisheries and Aquaculture: CERES Project Synthesis Report*, University of Hamburg,
731 2020.
- 732 [49] O.S. Kjesbu, S. Sundby, A.B. Sandø, M. Alix, S.S. Hjøllø, M. Tiedemann, M. Skern-
733 Mauritzen, C. Junge, M. Fossheim, C. Thorsen Broms, G. Søvik, F. Zimmermann, K.
734 Nedreaas, E. Eriksen, H. Höffle, A.M. Hjelset, C. Kvamme, Y. Reecht, H. Knutsen, A.
735 Aglen, O.T. Albert, E. Berg, B. Bogstad, C. Durif, K.T. Halvorsen, Å. Høines, C.
736 Hvingel, E. Johannesen, E. Johnsen, E. Moland, M. Skuggedal Myksvoll, L.
737 Nøttestad, E. Olsen, G. Skaret, J.E. Skjæraasen, A. Slotte, A. Staby, E.K. Stenevik,
738 J.E. Stiansen, M. Stiasny, J.H. Sundet, F. Vikebø, G. Huse, Highly mixed impacts of
739 near-future climate change on stock productivity proxies in the North East Atlantic,
740 *Fish and Fisheries*. n/a (n.d.). <https://doi.org/10.1111/faf.12635>.
- 741 [50] M.R. Payne, M. Kudahl, G.H. Engelhard, M.A. Peck, J.K. Pinnegar, Climate risk to
742 European fisheries and coastal communities, *PNAS*. 118 (2021).
743 <https://doi.org/10.1073/pnas.2018086118>.
- 744 [51] M. Travers-Trolet, P. Bourdaud, M. Genu, L. Velez, Y. Vermard, The Risky Decrease
745 of Fishing Reference Points Under Climate Change, *Frontiers in Marine Science*. 7
746 (2020). <https://www.frontiersin.org/article/10.3389/fmars.2020.568232> (accessed
747 January 21, 2022).
- 748 [52] A.-M. Winter, A. Richter, A.M. Eikeset, Implications of Allee effects for fisheries
749 management in a changing climate: evidence from Atlantic cod, *Ecological*
750 *Applications*. 30 (2020) e01994. <https://doi.org/10.1002/eap.1994>.
- 751 [53] E. Schuch, S. Gabbert, A.P. Richter, Institutional inertia in European fisheries –
752 Insights from the Atlantic horse mackerel case, *Marine Policy*. 128 (2021) 104464.
753 <https://doi.org/10.1016/j.marpol.2021.104464>.
- 754 [54] R. Hoppe, Scientific advice and public policy: expert advisers' and policymakers'
755 discourses on boundary work, *Poiesis Prax*. 6 (2009) 235–263.
756 <https://doi.org/10.1007/s10202-008-0053-3>.
- 757 [55] S. van der Hel, Science for change: A survey on the normative and political
758 dimensions of global sustainability research, *Global Environmental Change*. 52 (2018)
759 248–258. <https://doi.org/10.1016/j.gloenvcha.2018.07.005>.
- 760 [56] F. Gosselin, A. Galanaki, M. Vandewalle, J. Van Dijk, L. Varumo, J. Ventocilla, A.
761 Watt, J. Young, MICESE: A New Method Used for the Formulation of Key Messages
762 from the Scientific Community for the EU Post 2020 Biodiversity Strategy,
763 *Sustainability*. 12 (2020) 2385. <https://doi.org/10.3390/su12062385>.
- 764 [57] D. von Winterfeldt, Bridging the gap between science and decision making, *PNAS*.
765 110 (2013) 14055–14061. <https://doi.org/10.1073/pnas.1213532110>.
- 766 [58] M.A. Rudd, Scientists' perspectives on global ocean research priorities, *Front. Mar.*
767 *Sci*. 1 (2014) 36. <https://doi.org/10.3389/fmars.2014.00036>.
- 768 [59] D. Gascuel, N. Bez, A. Forest, P. Guillotreau, F. Laloë, J. Lobry, S. Mahévas, B.
769 Mesnil, E. Rivot, S. Rochette, V. Trenkel, A future for marine fisheries in Europe
770 (Manifesto of the Association Française d'Halieumétrie), *Fisheries Research*. 109
771 (2011) 1–6. <https://doi.org/10.1016/j.fishres.2011.02.002>.

- 772 [60] H. Aizaki, T. Nakatani, K. Sato, Stated preference methods using r, CRC Press, 2014.
773 <https://doi.org/10.1201/b17292>.
- 774 [61] T.N. Flynn, A. a. J. Marley, Best-worst scaling: theory and methods, Handbook of
775 Choice Modelling. (2014).
776 <https://www.elgaronline.com/view/edcoll/9781781003145/9781781003145.00014.xml>
777 (accessed October 14, 2021).
- 778 [62] M.A. Rudd, R.N. Lawton, Scientists' prioritization of global coastal research questions,
779 Marine Policy. 39 (2013) 101–111. <https://doi.org/10.1016/j.marpol.2012.09.004>.
- 780 [63] J.J. Louviere, T.N. Flynn, A.A.J. Marley, Best-worst scaling: Theory, methods and
781 applications, Cambridge University Press, 2015.
- 782 [64] Y. Croissant, Estimation of Random Utility Models in R: The mlogit Package, Journal
783 of Statistical Software. 95 (2020) 1–41. <https://doi.org/10.18637/jss.v095.i11>.
- 784 [65] STECF, Scientific, Technical and Economic Committee for fisheries - 70th plenary
785 report (PLEN-22-02), Publications Office of the European Union, Bruxelles, 2022.
- 786 [66] D. Dimarchopoulou, K.I. Stergiou, A.C. Tsikliras, Gap analysis on the biology of
787 Mediterranean marine fishes, PLOS ONE. 12 (2017) e0175949.
788 <https://doi.org/10.1371/journal.pone.0175949>.
- 789 [67] R. Caddell, Precautionary Management and the Development of Future Fishing
790 Opportunities: The International Regulation of New and Exploratory Fisheries, The
791 International Journal of Marine and Coastal Law. 33 (2018) 199–260.
792 <https://doi.org/10.1163/15718085-13310013>.
- 793 [68] Z. Larabi, O. Guyader, C. Macher, F. Daurès, Quota management in a context of non-
794 transferability of fishing rights: The French case study, Ocean & Coastal Management.
795 84 (2013) 13–22. <https://doi.org/10.1016/j.ocecoaman.2013.07.001>.
- 796 [69] J.-M. Da Rocha, S. Cerviño, S. Villasante, The Common Fisheries Policy: An
797 enforcement problem, Marine Policy. 36 (2012) 1309–1314.
798 <https://doi.org/10.1016/j.marpol.2012.02.025>.
- 799 [70] D.C. Payne, Policy-making in Nested Institutions: Explaining the Conservation Failure
800 of the EU's Common Fisheries Policy, JCMS: Journal of Common Market Studies. 38
801 (2000) 303–324. <https://doi.org/10.1111/1468-5965.00221>.
- 802 [71] S. Villasante, M. do Carme García-Negro, F. González-Laxe, G.R. Rodríguez,
803 Overfishing and the Common Fisheries Policy: (un)successful results from TAC
804 regulation?, Fish and Fisheries. 12 (2011) 34–50. <https://doi.org/10.1111/j.1467-2979.2010.00373.x>.
- 806 [72] B. Salihoglu, S.S. Arkin, E. Akoglu, B.A. Fach, Evolution of Future Black Sea Fish
807 Stocks under Changing Environmental and Climatic Conditions, Frontiers in Marine
808 Science. 4 (2017). <https://www.frontiersin.org/articles/10.3389/fmars.2017.00339>
809 (accessed December 8, 2022).
- 810 [73] J.L. Sánchez Lizaso, I. Sola, E. Guijarro-García, J.M. Bellido, R. Franquesa, A new
811 management framework for western Mediterranean demersal fisheries, Marine Policy.
812 112 (2020) 103772. <https://doi.org/10.1016/j.marpol.2019.103772>.
- 813 [74] T.J. Hegland, K. Ounanian, J. Raakjær, Why and how to regionalise the Common
814 Fisheries Policy, Maritime Studies. 11 (2012) 7. <https://doi.org/10.1186/2212-9790-11-7>.
- 816 [75] C. Carter, The transformation of Scottish fisheries: Sustainable interdependence from
817 'net to plate,' Marine Policy. 44 (2014) 131–138.
- 818 [76] T. Gray, J. Hatchard, The 2002 reform of the Common Fisheries Policy's system of
819 governance—rhetoric or reality?, Marine Policy. 27 (2003) 545–554.
820 [https://doi.org/10.1016/S0308-597X\(03\)00066-6](https://doi.org/10.1016/S0308-597X(03)00066-6).
- 821 [77] N. van Bogaert, L. Lemey, S. De Peuter, M. Kraan, E. Giesbers, J. Sanderse, N.A.
822 Steins, D. Ustup, M. Plikshs, V. Bartolino, M. Hansson, D. Valentinsson, K. Ringdhal,
823 M. Rakowski, A. Mytlewski, M. Panayotova, M. Galatchi, G. Tiganov, S. Mangi Chai,
824 S. Abreu, S. Metz, M. Aranda, C. Perales, G. Triantaphyllidis, A. Strbenac, D.B.
825 Hayes, R. Alhaija, A. Gugnali, E. Mravlje, S. Vandamme, CFP Regionalisation - Final
826 Report, European Commission, 2021. <https://www.ccrup.eu/wp->

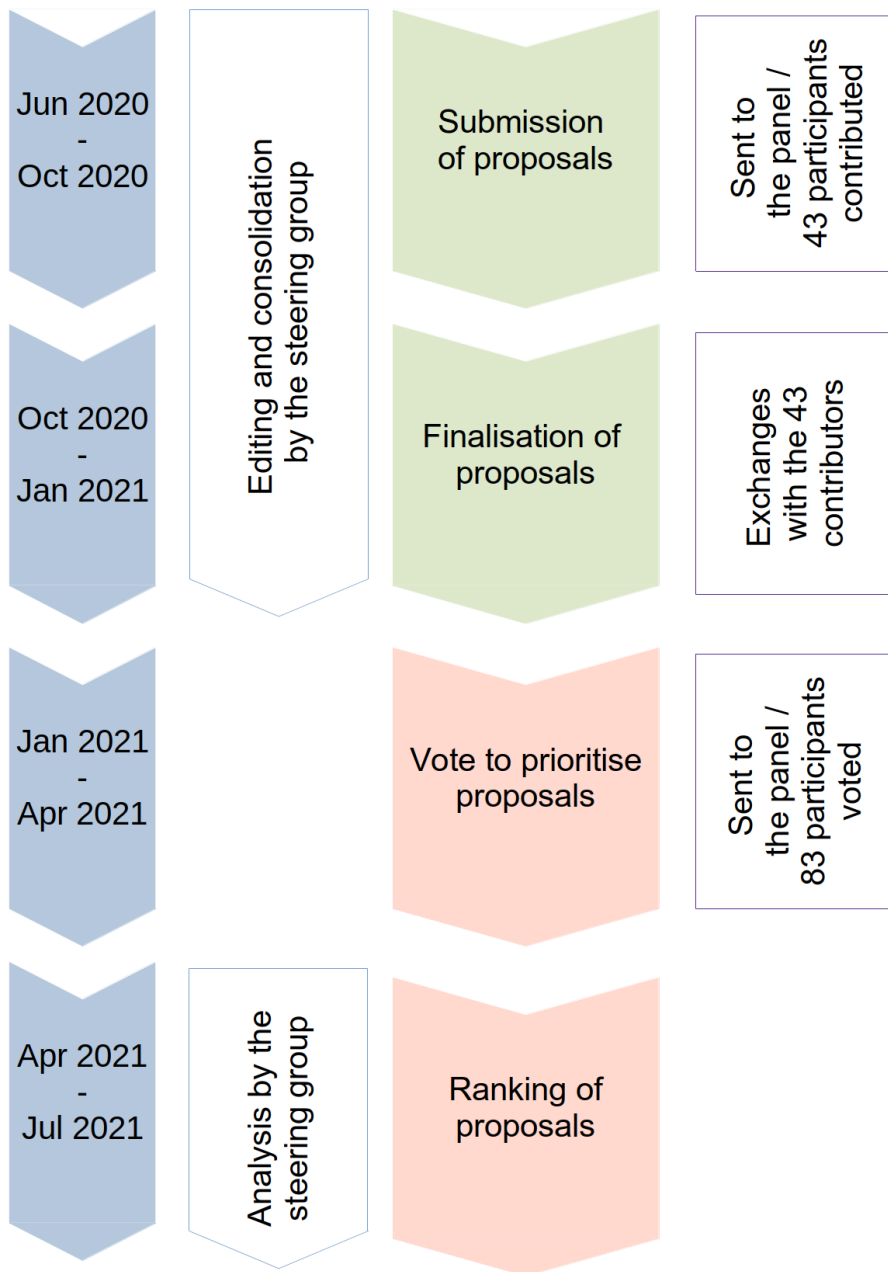
- 827 content/uploads/2021/07/CFP-Final-Report.pdf.
- 828 [78] H. Österblom, M. Sissenwine, D. Symes, M. Kadin, T. Daw, C. Folke, Incentives,
829 social–ecological feedbacks and European fisheries, *Marine Policy*. 35 (2011) 568–
830 574. <https://doi.org/10.1016/j.marpol.2011.01.018>.
- 831 [79] N.L. Gutiérrez, R. Hilborn, O. Defeo, Leadership, social capital and incentives promote
832 successful fisheries, *Nature*. 470 (2011) 386–389.
833 <https://doi.org/10.1038/nature09689>.
- 834 [80] Y. Stratoudakis, Legitimacy objects, agents, and evaluators: A framing to strengthen
835 planning and performance of fisheries co-management, *Environmental Science &*
836 *Policy*. 116 (2021) 230–238. <https://doi.org/10.1016/j.envsci.2020.11.001>.
- 837 [81] D. Pedreschi, A. Vigier, H. Höffle, S.B.M. Kraak, D.G. Reid, Innovation through
838 consultation: Stakeholder perceptions of a novel fisheries management system reveal
839 flexible approach to solving fisheries challenges, *Marine Policy*. 124 (2021) 104337.
840 <https://doi.org/10.1016/j.marpol.2020.104337>.
- 841 [82] C. Carter, Constructing sustainability in EU fisheries: Re-drawing the boundary
842 between science and politics?, *Environmental Science & Policy*. 30 (2013) 26–35.
843 <https://doi.org/10.1016/j.envsci.2012.11.015>.
- 844 [83] F. Bastardie, E.J. Brown, E. Andonegi, R. Arthur, E. Beukhof, J. Depestele, R. Döring,
845 O.R. Eigaard, I. García-Barón, M. Llope, H. Mendes, G. Piet, D. Reid, A Review
846 Characterizing 25 Ecosystem Challenges to Be Addressed by an Ecosystem
847 Approach to Fisheries Management in Europe, *Frontiers in Marine Science*. 7 (2021).
848 <https://www.frontiersin.org/article/10.3389/fmars.2020.629186> (accessed January 21,
849 2022).
- 850 [84] M. Sinclair, R. Arnason, J. Csirke, Z. Karnicki, J. Sigurjonsson, H. Rune Skjoldal, G.
851 Valdimarsson, Responsible fisheries in the marine ecosystem, *Fisheries Research*. 58
852 (2002) 255–265. [https://doi.org/10.1016/S0165-7836\(02\)00168-6](https://doi.org/10.1016/S0165-7836(02)00168-6).
- 853 [85] D. Howell, A.M. Schueller, J.W. Bentley, A. Buchheister, D. Chagaris, M. Cieri, K.
854 Drew, M.G. Lundy, D. Pedreschi, D.G. Reid, H. Townsend, Combining Ecosystem and
855 Single-Species Modeling to Provide Ecosystem-Based Fisheries Management Advice
856 Within Current Management Systems, *Frontiers in Marine Science*. 7 (2021) 1163.
857 <https://doi.org/10.3389/fmars.2020.607831>.
- 858 [86] V.M. Trenkel, How to provide scientific advice for ecosystem-based management
859 now, *Fish and Fisheries*. 19 (2018) 390–398. <https://doi.org/10.1111/faf.12263>.
- 860 [87] D. Pauly, V. Christensen, C. Walters, Ecopath, Ecosim, and Ecospace as tools for
861 evaluating ecosystem impact of fisheries, *ICES Journal of Marine Science*. 57 (2000)
862 697–706.
- 863 [88] D. Gascuel, D. Pauly, EcoTroph: modelling marine ecosystem functioning and impact
864 of fishing, *Ecological Modelling*. 220 (2009) 2885–2898.
- 865 [89] D. Pelletier, S. Mahévas, H. Drouineau, Y. Vermard, O. Thébaud, O. Guyader, B.
866 Poussin, Evaluation of the bioeconomic sustainability of complex fisheries under a
867 wide range of policy options using ISIS-Fish, *Ecol Modell*. 220 (2009) 1013–1033.
868 <https://doi.org/10.1016/j.ecolmodel.2009.01.007>.
- 869 [90] S. Lehuta, R. Girardin, S. Mahévas, M. Travers-Trolet, Y. Vermard, Reconciling
870 complex system models and fisheries advice: Practical examples and leads, *Aquat.*
871 *Living Resour*. 29 (2016) 208. <https://doi.org/10.1051/alr/2016022>.
- 872 [91] A. Audzijonyte, H. Pethybridge, J. Porobic, R. Gorton, I. Kaplan, E.A. Fulton, Atlantis:
873 A spatially explicit end-to-end marine ecosystem model with dynamically integrated
874 physics, ecology and socio-economic modules, *Methods in Ecology and Evolution*. 10
875 (2019) 1814–1819. <https://doi.org/10.1111/2041-210X.13272>.
- 876 [92] B. Planque, C. Mullan, Modelling chance and necessity in natural systems, *ICES*
877 *Journal of Marine Science*. 77 (2020) 1573–1588.
878 <https://doi.org/10.1093/icesjms/fsz173>.
- 879 [93] Yunne-Jai Shin, Philippe Cury, Using an individual-based model of fish assemblages
880 to study the response of size spectra to changes in fishing, *Canadian Journal of*
881 *Fisheries and Aquatic Sciences*. 61 (2004) 414–431.

- 882 [94] ICES, Working Group on Multispecies Assessment Methods (WGSAM), 2021.
883 <https://doi.org/10.17895/ices.pub.9562>.
- 884 [95] C. Piroddi, E. Akoglu, E. Andonegi, J.W. Bentley, I. Celić, M. Coll, D. Dimarchopoulou,
885 R. Friedland, K. de Mutsert, R. Girardin, E. Garcia-Gorriz, B. Grizzetti, P.-Y.
886 Hernvann, J.J. Heymans, B. Müller-Karulis, S. Libralato, C.P. Lynam, D. Macias, S.
887 Miladinova, F. Moullec, A. Palialexis, O. Parn, N. Serpetti, C. Solidoro, J. Steenbeek,
888 A. Stips, M.T. Tomczak, M. Travers-Trolet, A.C. Tsikliras, Effects of Nutrient
889 Management Scenarios on Marine Food Webs: A Pan-European Assessment in
890 Support of the Marine Strategy Framework Directive, *Frontiers in Marine Science*. 8
891 (2021). <https://www.frontiersin.org/article/10.3389/fmars.2021.596797> (accessed
892 January 21, 2022).
- 893 [96] M. Skern-Mauritzen, G. Ottersen, N.O. Handegard, G. Huse, G.E. Dingsør, N.C.
894 Stenseth, O.S. Kjesbu, Ecosystem processes are rarely included in tactical fisheries
895 management, *Fish and Fisheries*. 17 (2016) 165–175.
896 <https://doi.org/10.1111/faf.12111>.
- 897 [97] P.M. Cury, I.L. Boyd, S. Bonhommeau, T. Anker-Nilssen, R.J.M. Crawford, R.W.
898 Furness, J.A. Mills, E.J. Murphy, H. Österblom, M. Paleczny, J.F. Piatt, J.-P. Roux, L.
899 Shannon, W.J. Sydeman, Global Seabird Response to Forage Fish Depletion—One-
900 Third for the Birds, *Science*. 334 (2011) 1703–1706.
901 <https://doi.org/10.1126/science.1212928>.
- 902 [98] O. Le Pape, J. Delavenne, S. Vaz, Quantitative mapping of fish habitat: A useful tool
903 to design spatialised management measures and marine protected area with fishery
904 objectives, *Ocean & Coastal Management*. 87 (2014) 8–19.
905 <https://doi.org/10.1016/j.ocecoaman.2013.10.018>.
- 906 [99] C. Dambrine, M. Woillez, M. Huret, H. de Pontual, Characterising Essential Fish
907 Habitat using spatio-temporal analysis of fishery data: A case study of the European
908 seabass spawning areas, *Fisheries Oceanography*. 30 (2021) 413–428.
909 <https://doi.org/10.1111/fog.12527>.
- 910 [100] S. Mahévas, D. Pelletier, ISIS-Fish, a generic and spatially explicit simulation tool for
911 evaluating the impact of management measures on fisheries dynamics, *Ecol Modell*.
912 171 (2004) 65–84.
- 913 [101] Scientific, Technical and Economic Committee for Fisheries, Evaluation of maximum
914 catch limits and closure areas in the Western Mediterranean (STECF-22-01),
915 Publications Office of the European Union, Luxembourg, 2021.
- 916 [102] J. Claudet, C. Loiseau, M. Sostres, M. Zupan, Underprotected Marine Protected Areas
917 in a Global Biodiversity Hotspot, *One Earth*. 2 (2020) 380–384.
918 <https://doi.org/10.1016/j.oneear.2020.03.008>.
- 919 [103] J.S. Link, H.I. Browman, Operationalizing and implementing ecosystem-based
920 management, *ICES Journal of Marine Science*. 74 (2017) 379–381.
921 <https://doi.org/10.1093/icesjms/fsw247>.
- 922 [104] J.W. Bentley, M.G. Lundy, D. Howell, S.E. Beggs, A. Bundy, F. de Castro, C.J. Fox,
923 J.J. Heymans, C.P. Lynam, D. Pedreschi, P. Schuchert, N. Serpetti, J. Woodlock,
924 D.G. Reid, Refining Fisheries Advice With Stock-Specific Ecosystem Information,
925 *Frontiers in Marine Science*. 8 (2021).
926 <https://www.frontiersin.org/articles/10.3389/fmars.2021.602072> (accessed October 13,
927 2022).
- 928 [105] D. Gascuel, G. Merino, R. Döring, J.N. Druon, L. Goti, S. Guénette, C. Macher, K.
929 Soma, M. Travers-Trolet, S. Mackinson, Towards the implementation of an integrated
930 ecosystem fleet-based management of European fisheries, *Marine Policy*. 36 (2012)
931 1022–1032. <https://doi.org/10.1016/j.marpol.2012.02.008>.
- 932 [106] S. Raicevich, P. Battaglia, T. Fortibuoni, T. Romeo, O. Giovanardi, F. Andaloro,
933 Critical Inconsistencies in Early Implementations of the Marine Strategy Framework
934 Directive and Common Fisheries Policy Objectives Hamper Policy Synergies in
935 Fostering the Sustainable Exploitation of Mediterranean Fisheries Resources,
936 *Frontiers in Marine Science*. 4 (2017).

- 937 <https://www.frontiersin.org/articles/10.3389/fmars.2017.00316> (accessed October 18,
938 2022).
- 939 [107] H.O. Fock, *Natura 2000 and the European Common Fisheries Policy*, *Marine Policy*.
940 35 (2011) 181–188. <https://doi.org/10.1016/j.marpol.2010.09.003>.
- 941 [108] H.-J. Rätz, H. Dörner, R. Scott, T. Barbas, *Complementary roles of European and*
942 *national institutions under the Common Fisheries Policy and the Marine Strategy*
943 *Framework Directive*, *Marine Policy*. 34 (2010) 1028–1035.
944 <https://doi.org/10.1016/j.marpol.2010.03.001>.
- 945 [109] H. Drouineau, C. Carter, M. Rambonilaza, G. Beaufaron, G. Bouleau, A. Gassiat, P.
946 Lambert, S. Le Floch, S. Tétard, E. De Oliveira, *River Continuity Restoration and*
947 *diadromous fishes: much more than an ecological issue*, *Environmental Management*.
948 61 (2018) 671–686. <https://doi.org/10.1007/s00267-017-0992-3>.
- 949 [110] E.A. Fulton, A.D.M. Smith, D.C. Smith, I.E. van Putten, *Human behaviour: the key*
950 *source of uncertainty in fisheries management*, *Fish and Fisheries*. 12 (2011) 2–17.
951 <https://doi.org/10.1111/j.1467-2979.2010.00371.x>.
- 952 [111] A. Rindorf, J. Mumford, P. Baranowski, L.W. Clausen, D. García, N.T. Hintzen, A.
953 Kempf, A. Leach, P. Levontin, P. Mace, S. Mackinson, C. Maravelias, R. Prelezo, A.
954 Quetglas, G. Tserpes, R. Voss, D. Reid, *Moving beyond the MSY concept to reflect*
955 *multidimensional fisheries management objectives*, *Marine Policy*. 85 (2017) 33–41.
956 <https://doi.org/10.1016/j.marpol.2017.08.012>.
- 957 [112] H.S. Gordon, *The economic theory of a common-property resource: the fishery*,
958 *Journal of Political Economy*. 62 (1954).
959 [https://scholar.google.com/scholar_lookup?title=The%20economic%20theory%20of%20a%20common-](https://scholar.google.com/scholar_lookup?title=The%20economic%20theory%20of%20a%20common-property%20resource%3A%20the%20fishery&author=H.%20S.%20Gordon&publication_year=1954&journal=Journal%20of%20Political%20Economy&volume=62&pages=124-142)
960 [property%20resource%3A%20the%20fishery&author=H.%20S.%20Gordon&publicati](https://scholar.google.com/scholar_lookup?title=The%20economic%20theory%20of%20a%20common-property%20resource%3A%20the%20fishery&author=H.%20S.%20Gordon&publication_year=1954&journal=Journal%20of%20Political%20Economy&volume=62&pages=124-142)
961 [on_year=1954&journal=Journal%20of%20Political%20Economy&volume=62&pages=](https://scholar.google.com/scholar_lookup?title=The%20economic%20theory%20of%20a%20common-property%20resource%3A%20the%20fishery&author=H.%20S.%20Gordon&publication_year=1954&journal=Journal%20of%20Political%20Economy&volume=62&pages=124-142)
962 [124-142](https://scholar.google.com/scholar_lookup?title=The%20economic%20theory%20of%20a%20common-property%20resource%3A%20the%20fishery&author=H.%20S.%20Gordon&publication_year=1954&journal=Journal%20of%20Political%20Economy&volume=62&pages=124-142) (accessed October 14, 2021).
- 963 [113] Q.R. Grafton, T. Kompas, T.N. Che, L. Chu, R. Hilborn, *BMEY as a fisheries*
964 *management target*, *Fish and Fisheries*. 13 (2012) 303–312.
965 <https://doi.org/10.1111/j.1467-2979.2011.00444.x>.
- 966 [114] M.C. Melnychuk, T.E. Essington, T.A. Branch, S.S. Heppell, O.P. Jensen, J.S. Link,
967 S.J.D. Martell, A.M. Parma, A.D.M. Smith, *Which design elements of individual quota*
968 *fisheries help to achieve management objectives?*, *Fish and Fisheries*. 17 (2016) 126–
969 142. <https://doi.org/10.1111/faf.12094>.
- 970 [115] E. Pinkerton, D.N. Edwards, *The elephant in the room: The hidden costs of leasing*
971 *individual transferable fishing quotas*, *Marine Policy*. 33 (2009) 707–713.
972 <https://doi.org/10.1016/j.marpol.2009.02.004>.
- 973 [116] U.R. Sumaila, *A Cautionary Note on Individual Transferable Quotas*, *Ecology and*
974 *Society*. 15 (2010). <https://www.jstor.org/stable/26268177> (accessed October 14,
975 2021).
- 976 [117] K.L. Blackstock, K.A. Waylen, J. Dunglinson, K.M. Marshall, *Linking process to*
977 *outcomes — Internal and external criteria for a stakeholder involvement in River Basin*
978 *Management Planning*, *Ecological Economics*. 77 (2012) 113–122.
979 <https://doi.org/10.1016/j.ecolecon.2012.02.015>.
- 980 [118] K.L. Blackstock, C. Richards, *Evaluating stakeholder involvement in river basin*
981 *planning: a Scottish case study*, *Water Policy*. 9 (2007) 493.
- 982
- 983
- 984
- 985

986 FIGURES

987

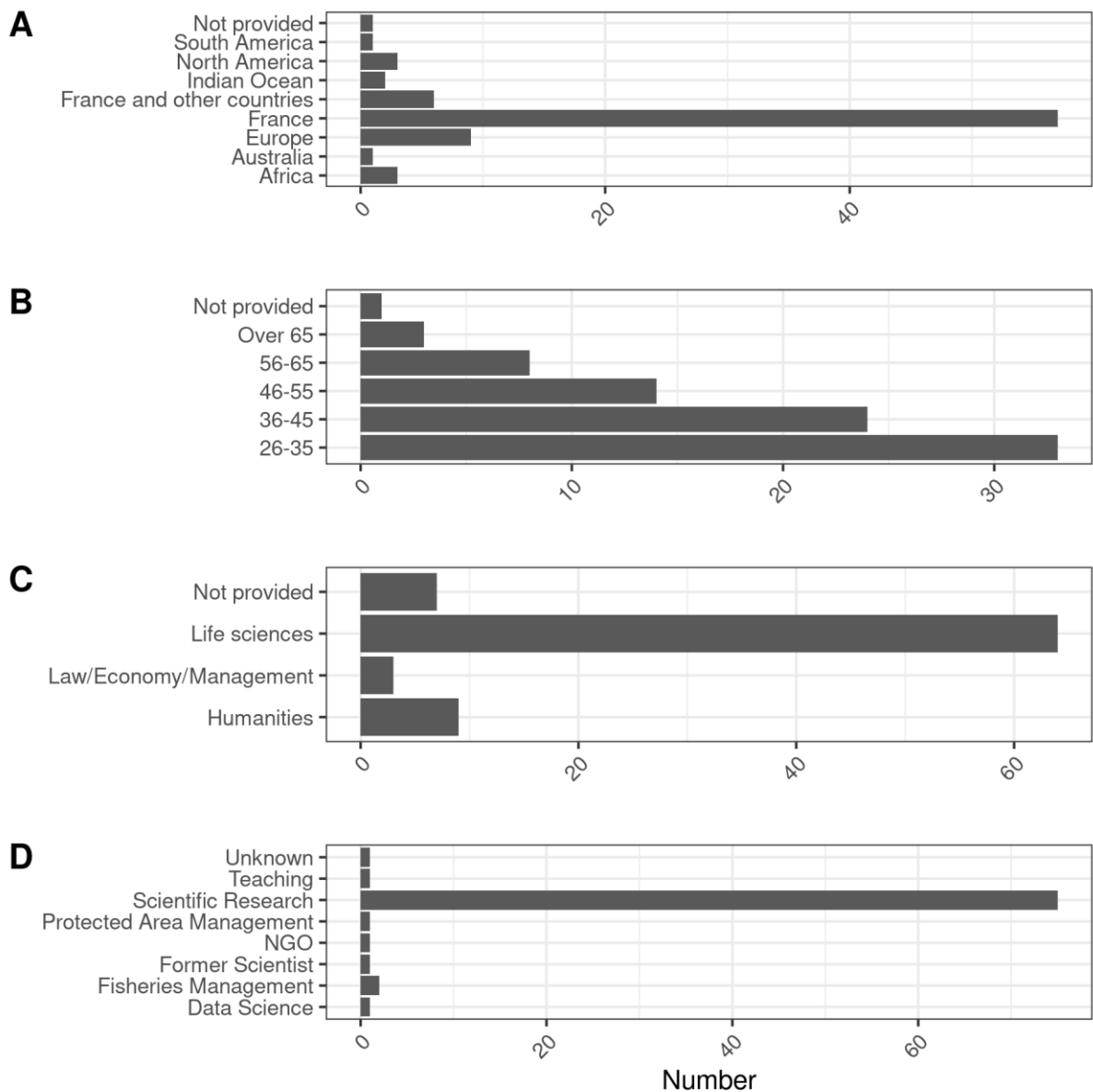


988

989 Figure 1: Diagram summarising the main stages of the process (3rd column), the timetable

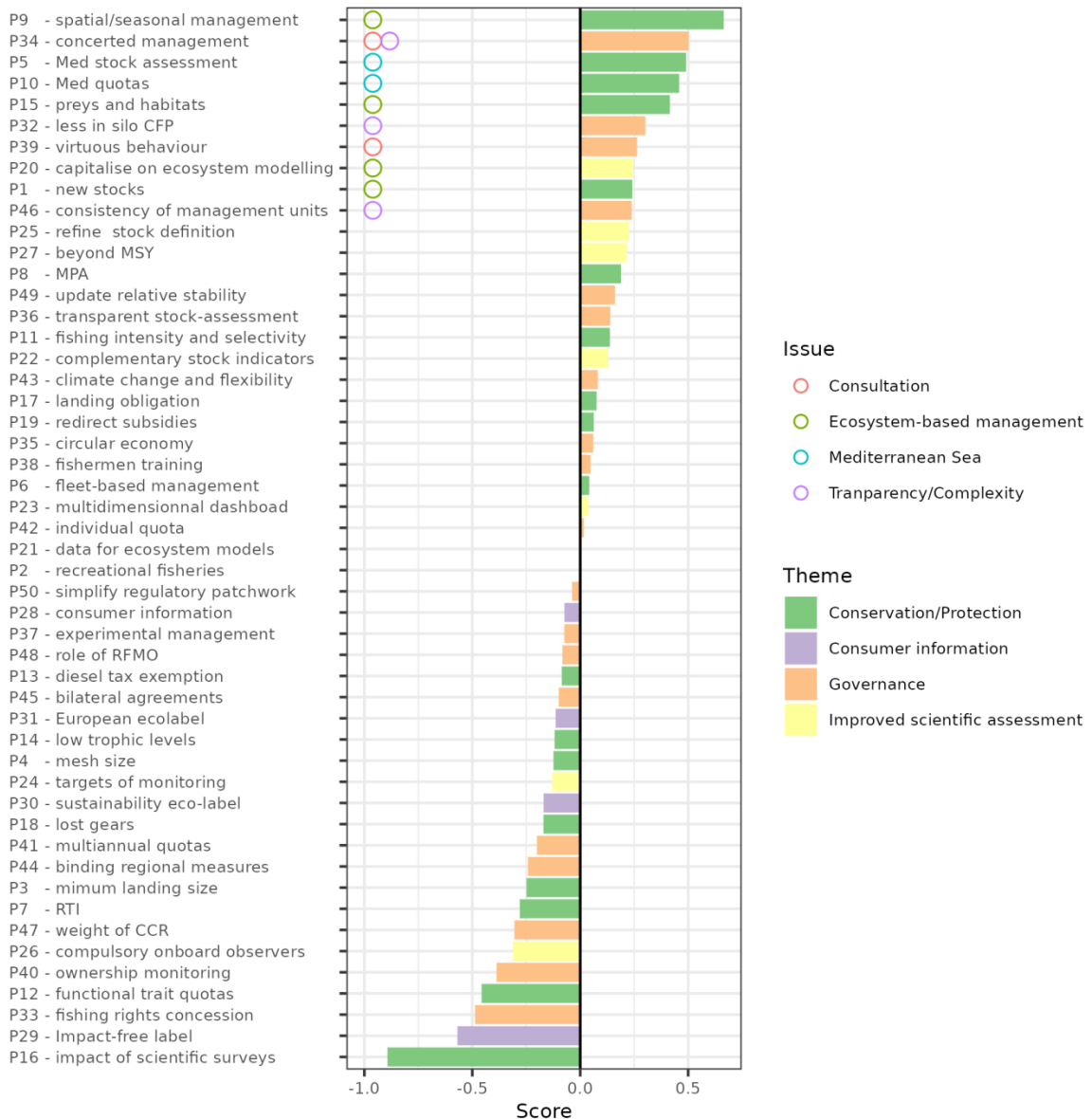
990 (1st column) as well as the work of the steering group at each stage (2nd column) and the

991 interactions with the panel of scientists (4th column)



992

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



997

998

999 Figure 3: Ranking of proposals. The proposals are ranked from top to bottom by descending

1000 score. The colour indicates the main theme of the proposal. Issues refer to the issues

1001 described in the section “Ranking of proposals” that explore in detail the 10 first proposals.

1002 The score corresponds to the estimated value in the multinomial model, which is the

1003 deviation from the reference proposal P2 (scored zero), which was taken as the reference

1004 because of its central location in the ranking.

1005

1006 TABLE

1007 Table 1: Title of individual proposals, associated main theme, proposal number and ranking

1008 following the Best-Worst scaling procedure (BW).

1009

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

SUPPLEMENTARY MATERIAL

Theme	Number	Best-Worst scaling ranking	Title of proposal	Development	Refs
Protection/Conservation	P1	9	Take a precautionary approach to 'new' stocks	<p>In 1995, United Nations Article 6(6) on stock definition stated: "For new and exploratory fisheries, States shall adopt as soon as possible cautious conservation and management measures, including, inter alia, catch and effort limits. Such measures shall remain in force until there is sufficient data to allow assessment of the impact of the fishery on the long-term sustainability of the stocks, whereupon conservation and management measures based on that assessment shall be implemented. The latter measures shall, if appropriate, allow for the gradual development of the fisheries."</p> <p>Clear rules should therefore be defined within the CFP to apply these general principles to new stocks (mesopelagic fish, copepods or others). The aim is to avoid a windfall effect due to a legal vacuum (see e.g. consequences of deep-sea fishing) and to allow time for the acquisition of the necessary data for the promulgation of scientific recommendations. These rules could, for example, be inspired by the rules laid down by the Convention for the Conservation of Antarctic Marine Living Resources, the South Pacific Regional Fisheries Management Organisation and the South-East Atlantic Fisheries Organisation, which have clearly defined the concepts of new and exploratory fisheries. Access to these fisheries should be limited to data acquisition until they can be properly assessed and reference points defined.</p> <p>See Caddell 2018 for more examples. (https://doi.org/10.1163/15718085-13310013)</p>	[1]
	P2	27	Improve knowledge and management of recreational fisheries	It is recognised that recreational fisheries have significant impacts on certain stocks, which it is important to quantify in order to provide relevant and reliable scientific recommendations. When these stocks are subject to TACs and quotas, it is crucial to be able to regulate recreational fishing as well.	[2–5]
	P3	42	Increase fish size limits and create size limits for all species caught	Size limits for fish caught are one of the measures used to influence the exploitation pattern of a species. Increased size limits would increase the spawning biomass. Although the size threshold at maturity is often used as an example (although this is debatable depending on the lifecycle of the species), size limits only make sense if they are consistent with regulatory mesh sizes (for many species, the survival rate of discards is limited) and, above all, if they are used as a tool for optimal management combining fishing effort and exploitation pat-	[6–9]

				terns. These changes in size limits must be considered in conjunction with the landing obligation.	
	P4	36	Increase regulatory mesh size	Increased mesh size is among the measures that can improve the selectivity of fisheries and ultimately the productivity of the stock. While such measures have been implemented in some fisheries, no multispecies reviews of the effect of different mesh size scenarios have been conducted at the scale of eco-regions, in terms of landings/discards, biomass, income, etc. This should be one of the first objectives set for STECF, in collaboration with the RACs, in the framework of the next CFP.	[10]
	P5	3	By 2030, assess all exploited stocks in the Mediterranean	Many stocks in the Mediterranean are currently not assessed. Reference points should be defined and population status indicators established for all exploited stocks. The methods used to define these reference points (data limited to analytical assessment) may depend on the data available. This should be implemented as a priority in European waters of the Mediterranean, with Europe subsequently advocating its application to all GFCM waters.	[11–14]
	P6	23	Develop a fleet-based approach	The ecological impacts and economic and social performance of each European fleet should be evaluated, based on an evolving dashboard set up in consultation with stakeholders (professionals, NGOs, scientists, under the arbitration of policymakers), and these evaluations made public. Currently, this assessment is only carried out at stock level and no indicators are used at fleet level. The dashboard could be based on the work carried out by the STECF (SG-MOS 10-03: Ecosystem Approach in Fisheries Management). This fleet-based management should in particular better assess the impact of various types of fishing gear.	[15–17]
	P7	43	Develop real-time incentive approaches	Management by RTI consists of allocating fishermen a quota of points that they can use to fish in an area. The point maps are regularly updated and several criteria can be taken into account: ecological criteria (oversize, TACs reached, by-catch, etc.), socio-economic criteria (market conditions, technical interactions). This system makes it possible to optimise exploitation according to different criteria, encouraging fishermen to adapt their fishing strategy. The cost maps can be co-constructed within the framework of the regionalisation of fisheries to reflect the interests of the various stakeholders, and thus contribute to greater acceptability. Kraak, S. B. M., Reid, D. G., Gerritsen, H. D., Kelly, C. J., Fitzpatrick, M., Codling, E. A., and Rogan, E. 2012. 21st century fisheries management: a spatio-temporally explicit tariff-based approach combining multiple drivers and incentivising responsible fishing. <i>ICES Journal of Marine Science</i> , 69: 590–601.	[18–22]
	P8	13	Develop a network of marine protected areas with a sufficient level of protection	The creation of MPAs is a measure (perhaps the only measure?) that can preserve the whole ecosystem and benefit adjacent ecosystems (spillover), as well as serve as a tool for marine spatial planning. The Aichi Biodiversity Targets set a goal of 10% of MPAs worldwide. A French working group even set the bar at	[23–27]

			<p>20%. It is clear that this objective will not be reached globally (only 6% of the Mediterranean is currently protected, for example). Worse still, even in countries where the theoretical objective has been met, the level of protection put in place in MPAs is too low to make them effective. In 95% of MPAs, regulations are no more restrictive than outside their limits (Claudet et al. 2020). Less than 1% of the European EEZ would be classified as level 1 according to IUCN criteria (i.e. marine sanctuary, the highest level of protection) and only 1.8% (in 2019) of the EEZ was covered by MPAs with a real management plan in place (in France, this is currently around 5%). There is also a need for real experimentation with one or more MPAs with a high level of protection in order to be able to observe the ecological and fisheries consequences in European waters, particularly in the North-East Atlantic (this exists in small areas in the Mediterranean).</p> <p>It is thus necessary to continue to develop the network of MPAs in Europe, while backing them up with clear management plans that guarantee real protection of biodiversity. In addition to MPAs, it is necessary to integrate the protection of functional zones, and therefore to set up conservation areas within fisheries.</p>		
	P9	1	<p>Develop management that takes into account the spatial and temporal variability of the marine populations caught</p>	<p>Few measures yet take into account the spatial and seasonal ecology of species and their exploitation methods. However, many solutions can be envisaged (e.g. gear adapted to the area, seasonal moratoriums) to better adapt exploitation to the lifecycle, habitats and environment of the species. These measures should be developed to better protect essential habitats and species in their most vulnerable phases or in phases of high concentration in functional zones (nursery areas, spawning grounds; e.g. debate on the vulnerability of sea bass at the time of reproduction).</p>	[28–32]
	P10	4	<p>Establish quotas in the Mediterranean for the main species exploited</p>	<p>In the western Mediterranean, the management plan is currently based on fishing effort. As things stand, there is no clear link between this and fishing mortality (this has been tested by the STECF, for example) so this does not allow for sustainable management. As a first step, it is necessary to improve the quality of the effort data (change to fishing hours rather than days and cross-check this with VMS data). The example of the cod plan in the North Sea shows that a drastic regulation of effort can provide results if it is indexed on the F/F_{msy} ratio. However, the mixed fishery context in the Mediterranean further complicates this type of management, so it would be necessary to introduce a system of restrictive catch quotas, based on a scientific assessment of the stocks (even in a data-limited situation), although Member States are currently reluctant to accept controls given the number of landing points.</p>	[33,34]
	P11	16	<p>Implement management based on exploitation pattern</p>	<p>Currently, TAC calculations are based on the MSY for a given exploitation pattern. However, reaching MSY can have very different effects on the spawning</p>	[8,35]

			and fishing intensity	biomass of stock depending on the dynamics of the species and the exploitation pattern considered. A sustainability criterion linked to impact on biomass should therefore be introduced into the calculation of quotas, which would guarantee a 'sufficient' level of biomass and encourage the joint optimisation of effort and exploitation pattern. For example, as a first step, it could be required that the TACs set should not result in a reduction of more than 50% of the biomass in the pristine state. This could be done either by lowering fishing mortality F under F_{msd} , or by increasing minimum fish size (and mesh size), or a combination of both. A transitional phase could be envisaged (as we are far from this target), which could be defined in the management plans. In the longer term, we could perhaps move towards 40%.	
	P12	47	Establish quotas by functional traits	At present, quotas are mainly set at species level and take little or no account of ecosystem functioning. Along the lines of the model that exists for technical interactions (Fcube) or certain trophic interactions (MSVPA), tools need to be designed to explore and discuss the impact of quotas on functional groups, and then to set quotas that (1) ensure a certain threshold of diversity of functional traits in a community or ecosystem and (2) ensure a certain threshold of functional diversity.	[36,37]
	P13	32	End the tax exemption for marine diesel	The increase in the capacity of fishing fleets during the second half of the 20th century has made it possible to amplify their efficiency and dramatically extend both fishing grounds and the range of species exploited. This has been achieved at the expense of rising fuel consumption (40 billion litres in 2011), increasing greenhouse gas emissions (179 million tonnes of CO ₂ -equivalent GHG, 4% of combined agriculture, fishery and livestock emissions Parker et al. 2018), and the sector's dependence on oil prices (between 30 and 50% of production costs are linked to fuel on average). This increase has been partly enabled by the tax exemption allowed for fishing vessels by Article 14 of the EU Directive 2003/96/EC (in France, marine diesel is zero-rated under Article 262 of the General Tax Code), limiting the cost of fuel. In the context of climate change and the urgency of reducing all greenhouse gas emissions, this exemption should be reversed. By re-taxing fuel, the increase in production costs would force a reduction in the distances travelled, thus reducing greenhouse gas emissions. This would also have the indirect benefit of limiting fishing effort in areas further from the coast. In the longer term, it would also reduce the dependence of fishermen on oil price fluctuations. For greater acceptability, this measure should be implemented gradually, and the revenue from taxation reinvested in the sector through subsidies to support sustainable development, the fight against climate change and technological research to reduce consumption. Co-constructed transitional compensation measures could be envisaged.	[38]
	P14	35	Protect low trophic levels through ecosystem-based	Low and intermediate trophic levels contain many species that are not or only marginally exploited, and which benefit from the exploitation of their competitors	[29,30,39–41]

			management	and predators. This leads to a modification of species assemblages to the advantage of these uninteresting species (a terrestrial analogy could be made with 'weeds' as opposed to desirable plants). This sometimes leads to serious dysfunctions (e.g. jellyfish blooms). It is thus important (1) to limit the impact on species exploited at these low species-rich trophic levels: for example, by setting a high minimum biomass threshold (e.g. 2/3? of the pristine state); and (2) to avoid extending fishing to currently unexploited trophic levels (zooplankton, in particular), by adopting a precautionary principle: no fishing of trophic levels (or components of species assemblages) for which we are unable to estimate the fishing pressure on the productivity of each species.	
	P15	5	Protect prey and habitats through ecosystem-based management	The capture of forage species (and more generally of all prey species) has direct repercussions on their predators, which are generally not taken into account in the definition of management objectives and in the calculation of TACs. Conversely, minimum biomass constraints must be introduced that take into account this specific role of prey species, either by setting a precautionary threshold (e.g. 50%? of the biomass in the pristine state, or 60%? or more if the predators are themselves sensitive or threatened species), or by subtracting from the TAC a volume reserved for feeding predators. The definition of these thresholds should be systematically evaluated in the context of the implementation of multiannual management plans. The classification of a species on the IUCN Red List or the list of species protected by the CFP (Annex 1 of the technical measures regulation) should lead to a systematic scientific assessment of the state of the populations that serve as their prey and of the possible need to protect them beyond the usual rules of good management. The same principle of enhanced protection should also apply to the habitats of these threatened and/or protected species.	[40,41]
	P16	50	Reduce the impact of scientific campaigns	The collection of scientific data to assess the state of an ecosystem may disturb or impact it depending on the means of collection. It is important to consider and use collection methods that limit these disturbances and impacts by developing non-intrusive sampling methods and equipment.	[42,43]
	P17	19	Review the landing obligation	While the discard ban was a virtuous initiative, the way it is implemented often makes it counterproductive. The current regulation is too complex to be understood, the controls are insufficiently enforced, the level of effort reduction is ultimately lower than it was over the 2008–2018 period, and it is a source of food waste. Without calling into question the initial objective of drastically reducing waste, which is an absolute necessity, technological development aimed at reducing unwanted catches should be pursued (work on gear, fishing seasons and areas), prioritising incentives rather than top-down coercive measures (particularly for virtuous fleets) to obtain information on the total catch, to ensure that all catches (whether landed or not) are taken into account in the calculation of quota consumption, to provide adequate means of verification, and to avoid food	[44–46]

				waste generated by the measure.	
	P18	39	Deal with lost gear at sea	Currently, the United Nations Environment Programme estimates that 10% of the plastic in the oceans comes from fishing gear that has been lost at sea, and an estimated 46% of the Pacific garbage patch comes from fishing gear. In addition to the well-known problem of ghost fishing, pollution from lost gear is a major source of microplastics in the food chain. The CFP must take the necessary measures to encourage gear with a limited risk of loss, require gear recovery (e.g. recovery of gear by ROV in Corsica), and develop new materials that limit this source of pollution (bio-degradable gear).	[47–50]
	P19	20	Subsidise transition to sustainability	The perverse effects of certain subsidies on fisheries have been widely demonstrated and have led, in particular, to the structural overcapacity of the European fleet. Sustainable fisheries should not exist through subsidies. Financial aid should therefore be restricted or have the objective of achieving sustainability or improving safety onboard vessels. If subsidies are granted to encourage the transition to more sustainable practices, which is currently very limited, this should be done through a multicriteria evaluation by a group of stakeholders. These subsidies should not be intended to be long-term but to accelerate the transition at a given time.	[51–53]
Improved scientific assessment	P20	8	Capitalise on the ecosystem modelling efforts produced across Europe for integrated ecosystem assessment	<p>Despite the existence of a steering group on integrated ecosystem assessment within the ICES, few of the recommendations issued are truly integrated. Two examples of efforts in this direction include:</p> <ul style="list-style-type: none"> - Ecosystem overviews [https://www.ices.dk/advice/advisory-process/Pages/Ecosystem-overviews.aspx] which aim to integrate existing scientific knowledge on an ecosystem into a summary document - the WGSAM working group (Working Group on Multispecies Assessment Methods [https://www.ices.dk/community/groups/Pages/WGSAM.aspx]) which has built a standard procedure for the validation of multispecies and end-to-end models and, after validation, requests the annual production of key-runs based on updated data. This group produces natural mortality rates taking into account trophic interactions and used for the assessments of a number of North Sea stocks. <p>However, these examples represent only a fraction of the knowledge and models produced in national or European projects to answer specific ecological or management questions. The establishment of regularly updated 'benchmark models' for various ecosystems that could be used to answer questions requiring ecosystem expertise seems essential and would also encourage the greater integration of ecosystem considerations into stock assessment models.</p>	[54–56]

	P21	26	Collect the data needed to inform ecosystem models	While the EU Data Collection Framework has enabled the routine acquisition of data on long-exploited stocks, it focuses on the data needed to apply conventional single-species stock assessment models. This has resulted in a lack of information on biological data such as diets, juvenile ecology, and planktonic and benthic production. Efforts need to be stepped up to acquire this biological data, which is key for the trophic and ecosystem models used in an ecosystem approach to fisheries. Data assimilation procedures should be encouraged in a similar way to those used for meteorological and oceanographic models.	[49,57]
	P22	17	Consider indicators complementary to spawning biomass (e.g. size structure, condition) to assess the status of populations	At present, fisheries management is based primarily on monitoring fishing pressure and spawning biomass according to MSY. However, these composite measures can conceal very different population structures. The size/age structure of the population is little taken into account, nor the energetic state of the individuals. Yet it has been observed that changes in demographic structure due to fishing or environmental conditions can have long-term effects and be the source of genetic selection if maintained over the long term. Other indicators of population status such as average size or condition factors should therefore be additionally considered. This would allow the implementation of specific measures (e.g. dynamic protection of size classes by spatial management/selectivity), and would be complementary to the principle of optimising the exploitation pattern to minimise its impact on the population.	[58–60]
	P23	24	Develop a socio-economic and ecological dashboard to analyse multidimensional trade-offs	To date, scientific assessment and management objectives have been based mainly on MSY, neglecting ecosystemic, social and economic aspects. Rather than using a single-species ecological indicator, a global indicator should be used and a dashboard established that could be used to monitor stocks, fleets, regions and Member States. This indicator should include ecological indicators (fishing mortality, SSB, etc.), economic indicators (turnover, prices, etc.) and social indicators (number of jobs, income, etc.), as well as corresponding targets (e.g. MSY, MEY, etc.). By strengthening the use of integrated trade-off analysis methods (combining quantitative and qualitative indicators) and standardising the indicators provided, this tool would allow a more holistic view when evaluating alternative management plan scenarios by illustrating potential trade-offs between the different aspects of the problem, and thus better inform decision-making.	[61]
	P24	37	Diversify/redirect the targets of monitoring programmes	Monitoring programmes are defined at a national level and evaluated annually by the European Commission via the STECF. However, this evaluation mainly focuses on the capacity of these programmes to provide data on the assessment of commercial species, with a particular focus on species subject to TACs and quotas. It is important to develop these programmes for species/stocks that are not or little monitored, yet represent a strong economic interest, as well as for key species in the ecosystem (sentinel species), even if these are little exploited.	[62–64]

	P25	11	Update the definition of stocks and populations for the assessment of certain species	The notion of stock is defined as functional biological units. Their boundaries evolve as knowledge advances, and the delimitation of stock is still uncertain in many situations (e.g. sole in the eastern Channel or cod in the North Sea). This lack of knowledge can lead to bias in the assessment process and thus have consequences in terms of management, potentially leading to unsustainable exploitation. Efforts must be made to continue to acquire data in order to refine and validate the delimitation (e.g. multi-marker approaches including genetic methods).	[65,66]
	P26	45	Make it compulsory to accept observers on board	In many countries, observers are accepted on a voluntary basis. Although the DCF now collects statistics on refusals, this can lead to bias in the data, with only 'virtuous fishermen' tending to take observers on board, which is even more the case in the context of landing obligations. To prevent this, the acceptance of observers could be made conditional on the granting of fishing licences, as is the case in some countries.	[67,68]
	P27	12	Review the MSY management approach	MSY management, which is a step forward from the precautionary approach, is a single-species criterion for maximising catches for a given exploitation scenario. It does not take into account ecosystem impacts or socio-economic effects. The North American practice of using buffers around TACs to reflect uncertainty linked to trophic relationships (particularly on the basis of the results of trophic models and when a significant change is detected in the ecosystem – abundance of a predator, decline in prey, risk of carryover from a fishery whose main species is less accessible) could be used as a model. This practice could also help to approximate the MEY, which is generally reached at fishing pressure levels below the MSY.	[69,70]
Consumer information	P28	29	Improve the display of the origin and species of fish for consumers	The display of the origin of fishery and aquaculture products (FAP) must be systematised for all FAP, whatever their level of processing. The origin should be indicated at a more detailed level than the FAO's division into major fishing areas. The scientific name of the species must also be mentioned systematically, whatever the level of processing of the product.	[71–74]
	P29	49	Define impact-free labels	Some species are emblematic for the general public, and the impacts of fishing on these species are therefore critical and are sometimes the focus of shock campaigns by NGOs. While research efforts are needed to limit these impacts, Europe could introduce 'impact-free' labels guaranteeing the absence of impacts of a fishery/gear on these emblematic species. This notion of impact should be clearly explained and defined in consultation. One example is the case of marine mammals, which recently made the headlines.	[75–77]
	P30	38	Define a European sustainability label	All fishery and aquaculture products (FAP), whether from Europe or elsewhere but sold on the European market, should be given a sustainability score, according to a simple and transparent scoring system. This label would be intended to guide consumers by allowing them to compare FAPs in terms of sustainability. The creation of this label should take into account indicators common to all	[71–74]

				foodstuffs (e.g. carbon cost) but also specific to FAP (state of stocks, fishing area and technique, etc.).	
	P31	34	Define a public 'European sustainable fisheries' label for stocks managed according to EU objectives	A label should be created to identify fish caught in European waters according to EU sustainability criteria. This would have the double virtue of allowing consumers to know whether the sustainability criteria for exploitation were respected, and to be able to differentiate fish from those from more distant areas in order to encourage local consumption.	[73,74]
Governance	P32	6	Align the objectives of the next CFP with international biodiversity conservation objectives; less siloed conservation/restoration policies	The aim is to apply the same policy framework to the fishery and aquaculture sectors as for biodiversity. Clear targets (around 20) should be set and achieved by 2030 with the overall objective of 'living in harmony with nature' by 2050. These targets would be evaluated and monitored over time (annually) and space (at local, regional, national and European levels). In general, these targets (very similar to those for biodiversity conservation and restoration) should contribute to achieving (among others) the Paris climate agreements, UN Sustainable Development Goals (SDGs), and the revised Aichi Biodiversity Targets as part of the new Strategic Plan for Biodiversity renamed 'Post-2020 Global Biodiversity Framework'. It must also align with and make every effort to achieve the targets/ambitions announced under the United Nations Decade of Ocean Science for Sustainable Development (2021–2030). It must go further in addressing threatened species, bycatch and protected areas and promote nature-based solutions.	[78,79]
	P33	48	Define fishing rights in the form of a concession	The current fisheries system suffers from an inherent flaw: it pushes fishermen to catch as much as possible before the overall quota is reached. This race is exacerbated by fluctuating prices and, in some cases, by the lack of rules on the price of fish. One way to reverse the problem, to mitigate market price fluctuations, and to ensure a 'minimum'/fair income for fishermen would be to allocate quotas in the form of a concession allocating a certain amount of catch. As in an individual quota system, the fisherman's total catch would thus be known in advance. In such a concession system, mechanisms could be put in place to mitigate price fluctuations, with a basic buy-back price for fish that could be fixed in advance in the concession contract. This contract could be concluded, for example, between the fishermen and the government, which would thus act as an intermediary between fishermen and buyers. The conditions of the concession contract (basic price, etc.) could possibly be used as a lever for incentive measures (e.g. retrocession of a certain percentage of the surplus value subject to the acceptance of onboard monitoring observers).	[80,81]
	P34	2	Develop management approaches in concertation with all stakeholders in the sector	Several recent crises have shown that the acceptability of fishing practices on the part of those in the fisheries sector, other stakeholders and the general public can be strongly questioned (the so-called 'social licence to operate'). Prior consultation is one of the means of avoiding these crises and blockages and should be widely promoted, particularly in the context of the regionalisation of	[20,82–84]

				fisheries. Within the framework of multiannual management plans, the implementation of gear, type of vessel, species, exploitation area, as well as measures (incentives, bans, access rules, etc.), should be co-constructed. It is recommended that the relevance of all of these modalities be evaluated through Management Strategy Evaluation (MSE), and that reviews of previous plans are also jointly constructed.	
	P35	21	Develop circular economy approaches	Developing circular economy approaches in fisheries and aquaculture markets would optimise the exploitation of marine bioresources, enhancing the use of the resource at all stages of the product lifecycle. This would reduce the environmental impact of the sector, while supporting the economy of areas dependent on marine resources.	[85,86]
	P36	15	Make assessment of resources and fisheries more transparent and accountable	In Canada, some assessments are carried out jointly by scientists, fishermen and managers (e.g. https://waves-vagues.dfo-mpo.gc.ca/Library/40708196.pdf). If scientists carry out the analyses, they present the results to all the participants and a joint recommendation is drafted. In this way, everyone has access to the scientific information used to make the decision. This way of working could be envisaged in Europe to facilitate a triangular dialogue between fishermen/managers/scientists, avoiding the distortion of information and allowing exchanges to take place upstream in the decision-making process rather than downstream. The transparency in the process would be aided by providing data in the greatest possible detail.	[83,84]
	P37	30	Facilitate experimentation with alternative management approaches	Historically, the CFP has appeared too prescriptive and restrictive of local initiatives; this has made the system sclerotic, making collaboration between stakeholders seem futile. However, several examples, such as in Scotland and Norway, have shown that local initiatives co-constructed by stakeholders have led to a virtuous reform of the entire sector. The regionalisation of fisheries could be a step towards making the CFP more flexible. To further stimulate these local initiatives, the CFP could promote local experimentation with alternative management approaches through an official framework. This should be based on specifications that clearly spell out the objectives, the methods of measurement and the means put in place to monitor effectiveness, all of which should be validated by an independent scientific body and subject to regular reporting. A rigorous framework would make it easier to share feedback.	[87]
	P38	22	Standardise fishermen's training in Europe to improve safety at sea and raise awareness of respect for the environment and cooperation with scientists	There is no standard in Europe for the training and certification of fishermen. Although since 2019 the European Commission has encouraged Member States to sign the International Convention on Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel (STCW-F Convention), not all have yet done so. (France has just signed and is consequently updating its training courses.) This results in highly heterogeneous training and qualifications of fishing professionals, raising questions about safety at sea. Fishing remains one of	[88–90]

				<p>the most dangerous occupations in Europe, and inconsistency in safety training poses a problem in the context of free movement within the EU. The second aspect is the need to raise awareness among fishermen, particularly fishing captains, of ecological issues and the sustainability of fisheries. To achieve this, it seems essential that European fishermen have basic knowledge of the functioning of exploited marine populations, the effects and risks of overfishing, and more generally the ecology of species and the functioning of ecosystems. In this respect, the current requirements in France would seem to be a minimum. These include 20 hours of training on the environment and resource management (ranging from physical oceanography to population dynamics, including the biology and ecology of all the components of the ecosystem) in the 'Fishing Management' module for a fishing captain's diploma, or knowledge of the environment and resource management in the vocational baccalaureate 'Conducting and managing maritime businesses, fishing option'. The training requirements should also enlist scientists in the aim of encouraging exchange between fishermen and researchers.</p>	
	P39	7	Encourage virtuous behaviour	<p>At present, fisheries management is mainly based on taxation, subsidies and bans. In recent years, incentive-based management has proved successful in various countries (e.g. Scotland, Norway). These incentives should help fishermen to make a living from their profession, promote virtuous behaviour for the ecosystem or the industry, and encourage data acquisition. Incentives could take the form of compensation: additional effort (days at sea, real-time incentive credits or rate cards with reduced rates), more access to a region (in time or space), higher quotas, eco-certification, etc. In terms of quotas, the EU could, for example, use Article 17 of the CFP to set aside 10% of each TAC as an incentive reward (this regulation already allows this possibility). The choice of the best type of incentive, from the point of view of relevance and effectiveness, should be co-constructed with all the stakeholders.</p>	[83,91,92]
	P40	46	Incorporate transparent monitoring of ownership of the means of production	<p>At European level, the question of ownership of the means of production (vessels and fishing rights) in the fisheries sector is becoming an important issue. It is important to be able to assess the economic and social implications (concentration of capacity and production, impacts on the distribution of wealth) of fisheries policies and the methods of allocating fishing rights (quotas, licences, etc.).* Ownership of the means of production cannot be assessed solely at the level of vessels but needs to take place at the level of companies. In the European vessel fleet register, which is publicly available online, there is no information on the ownership of vessels by companies. However, in each country, companies are referenced by a unique identification number. Each Member State should provide the European Commission with the company registration data for each of the vessels in the fleet register so that the situation in the sector can be analysed in terms of ownership and concentration of production means</p>	[93]

				and fishing rights. * This is not a new issue: it was discussed at the last STECF Social Group [https://stecf.jrc.ec.europa.eu/web/stecf/ewg2014]	
	P41	40	Establish multiannual rolling quotas	More and more fishing stocks are subject to multiannual plans. To guarantee greater stability of fishermen's incomes, a further step would be to introduce multiannual rolling quotas. This would require being able to define the rules for interannual variations, as well as to formulate clear rules for reconsideration in the event of an exceptional situation.	[94]
	P42	25	Progressively introduce individual non-transferable quotas	Management based on individual quotas has shown positive results in many situations. It allows fishermen to take responsibility and gives them visibility over management. Yet transferability has led, in countries where this has been allowed, to a concentration of fishing rights in the hands of a few actors. Individual quotas should therefore remain public and verifiable in order to avoid inflation, speculation and concentration. Quotas could be allocated for 5 to 10 years, either directly to fishermen or to representative bodies such as producer organizations (POs). Inter- and intra-PO exchanges could be authorised, but the rules must be clear, public and transparent to avoid speculation.	[95–97]
	P43	18	Implement more flexible management in the context of climate change	In the current environmental context, the distribution of stocks and the biological productivity of species is bound to change, so management must be able to adapt quickly to these developments. This means that the definition of stocks and the allocation key between and within countries must be capable of evolving more rapidly than when the CFP was established. The same applies to reference points, the data collection system and technical management measures. This is important for the sake of future equity between stakeholders and to ensure the sustainability of species. Tracking allocation keys between countries as species distribution gradually shifts would ensure that stocks are fished by vessels that are close to each other, thus limiting a carbon-intensive import/export process.	[98,99]
	P44	41	Enable the implementation of binding regional measures	In the decentralisation of fisheries, if specific local regulations are implemented that are more restrictive than EU regulations, they should apply to all vessels fishing in the area concerned. While unilateral decisions cannot be taken by one country, the CFP should establish rules allowing more restrictive regional regulations (e.g. voting in RACs? 12-mile band for each country?), and then work to ensure that the more restrictive measures are applied by all (e.g. scallops in Normandy or seasonal closures in shared waters).	[100]
	P45	33	Take into account all existing forms of bilateral or private agreements in the context of fisheries agreements with non-EU countries	Fisheries agreements should not be based on the unfair concept of surplus, but on a principle of compensation (by the fleet owners and under EU control) for all social and economic impacts, direct or indirect, and subject to the establishment of a management plan for the fisheries concerned. The agreements should be fully transparent. The impact on EU fisheries should be assessed on the basis of all the activities of fisheries under the jurisdiction of the Member States, includ-	[101–103]

				ing those under bilateral or private agreements, as well as the activities of 'national' fishing companies that are de facto financed by European companies. All these actions should be undertaken by the EU, which must have the means to sanction Member States and companies that violate this general principle.	
	P46	10	Realign management units with assessment units	The management units on which TACs are set were defined at the time of the first CFP and have never been redefined since. They have gradually diverged from stocks as defined by scientists for assessment purposes, which have themselves evolved over time with advances in knowledge about fish populations. This leads to unnecessary complexity, opacity, the impossibility for managers to follow scientific recommendations as closely as possible and, in some cases, risks for the sustainability of species.	[104–107]
	P47	44	Reinforce the role of regional bodies (RACs)	When they were created in the mid-2000s, the Regional Advisory Committees (RACs) were supposed to be the consultation body at the heart of the regionalisation of fisheries, able to provide recommendations to the EU or respond to requests for measures to be implemented. Bringing together all stakeholders, they allowed for dialogue between industry, NGOs, fisheries managers, etc. However, their role has been limited in recent years, and they have had little influence on decisions taken at the EU level. Moreover, dialogue in these bodies has progressively stalled, and the EU now tends to bypass the RACs through the Member States. Yet the need for consultation and dialogue between stakeholders makes such structures essential. The RACs thus need to be revitalised, and to this end they should be involved earlier in the decision-making process (at the moment, consultations take place at a late stage, once the directives are almost ready), or given more responsibility for implementing local management measures. Their internal governance needs to be reviewed to remove the bottlenecks that have led to the current situation.	[108–110]
	P48	31	Strengthen and review regional fisheries management organisations (RFMOs)	The governance of RFMOs should be reformed with five objectives: (1) to make scientific recommendations more binding; (2) to revise quota allocation based on historical rights in favour of developing countries: e.g. 10% of TACs defined on the basis of development criteria (to be defined) and a gradual increase in this rate; (3) to give developing countries greater political weight; (4) to ensure NGOs are represented; (5) to provide financial support to developing countries that are members of an RFMO in order to strengthen fisheries research capacity, as well as the verification and enforcement of fisheries regulations.	[111,112]
	P49	14	Review catch records according to equity and sustainability criteria	While the allocation key for fishing rights between countries is managed at the EU level and has remained unchanged since 1983, intranational allocations are the responsibility of the Member States, which often delegate to producer organisations for a more detailed allocation. At all levels, allocation keys are based on past catches, which are sometimes out of date and therefore unfair. In the interests of equity (e.g. between small-scale and industrial fishing) and sustainability, the EU should regularly update its allocation key and make it explicit, and re-	[97,113]

				quire Member States to do the same at their level. Rather than relying solely on historical data, all stakeholders in the fisheries sector (producers, NGOs, policymakers, scientists, managers) should be involved. The key could also take into account local consumption to avoid a high import/export carbon footprint. These reforms could limit situations where discards are produced because of quota limits.	
	P50	28	Build on existing regulations and simplify the regulatory patchwork	A multitude of regulations exist at European (CFP, MSFD, WFD), national and even regional level, resulting in a complex system and a negative perception of regulatory red tape. Rather than proposing new rules, the reform of the CFP should be based on what already exists (CFP, MSFD, WFD), while identifying and removing bottlenecks. The aim should be less complex regulation that is accessible, understandable and less 'siloed' between directives. The CFP–MSFD dichotomy is largely obsolete and should be merged with spatial planning issues, both regulatory and financial. Better understanding and acceptance requires broad stakeholder consultation in this reform process, to ensure that regulation addresses a consistent number of performance objectives. Furthermore, regulations would benefit from taking into account the behaviour of stakeholders, drawing on the effects of behavioural sciences (social norms, peer effects, nudge, etc.: see Ingrid Van Putten's work) to improve their effectiveness.	[78]

Table MS1: The proposals grouped by theme, with the explanatory text provided to voters to help them rank their priority. The columns “title of proposals” and “Development” display the proposal exactly as they were presented during the online survey (except the translation from French to English). The column Ref lists some additional background literature that were added a posteriori.

- [1] R. Caddell, Precautionary Management and the Development of Future Fishing Opportunities: The International Regulation of New and Exploratory Fisheries, *The International Journal of Marine and Coastal Law*. 33 (2018) 199–260. <https://doi.org/10.1163/15718085-13310013>.
- [2] K. Hyder, M.S. Weltersbach, M. Armstrong, K. Ferter, B. Townhill, A. Ahvonen, R. Arlinghaus, A. Baikov, M. Bellanger, J. Birzaks, T. Borch, G. Cambie, M. de Graaf, H.M.C. Diogo, Ł. Dziemian, A. Gordo, R. Grzebielec, B. Hartill, A. Kagervall, K. Kapiris, M. Karlsson, A.R. Kleiven, A.M. Lejk, H. Levrel, S. Lovell, J. Lyle, P. Moilanen, G. Monkman, B. Morales-Nin, E. Mugerza, R. Martinez, P. O'Reilly, H.J. Olesen, A. Papadopoulos, P. Pita, Z. Radford, K. Radtke, W. Roche, D. Rocklin, J. Ruiz, C. Scougal, R. Silvestri, C. Skov, S. Steinback, A. Sundelöf, A. Svagzdys, D. Turnbull, T. van der Hammen, D. van Voorhees, F. van Winsen, T. Verleye, P. Veiga, J.-H. Vølstad, L. Zarauz, T. Zolubas, H.V. Strehlow, Recreational sea fishing in Europe in a global context—Participation rates, fishing effort, expenditure, and implications for monitoring and assessment, *Fish and Fisheries*. 19 (2018) 225–243. <https://doi.org/10.1111/faf.12251>.
- [3] S.J. Cooke, I.G. Cowx, The Role of Recreational Fishing in Global Fish Crises, *BioScience*. 54 (2004) 857–859. <https://doi.org/10.1641/0006->

- 3568(2004)054[0857:TRORFI]2.0.CO;2.
- [4] P. Pita, S. Villasante, The building of a management system for marine recreational fisheries in Galicia (NW Spain), *Ocean & Coastal Management*. 169 (2019) 191–200. <https://doi.org/10.1016/j.ocecoaman.2018.12.027>.
 - [5] P. Pita, I. Artetxe, H. Diogo, P. Gomes, A. Gordo, K. Hyder, J. Pereira, C. Pita, M. Rangel, J. Garcia-Rodrigues, O. Sagué, P. Veiga, J. Vingada, S. Villasante, Research and management priorities for Atlantic marine recreational fisheries in Southern Europe, *Marine Policy*. 86 (2017) 1–8. <https://doi.org/10.1016/j.marpol.2017.08.030>.
 - [6] R.J. Beverton, S.J. Holt, *On The Dynamics Of Exploited Fish Populations Vol-19*, (1957). <http://krishikosh.egranth.ac.in/handle/1/2034488> (accessed September 30, 2016).
 - [7] R. Froese, A. Stern-Pirlot, H. Winker, D. Gascuel, Size matters: How single-species management can contribute to ecosystem-based fisheries management, *Fisheries Research*. 92 (2008) 231–241. <https://doi.org/10.1016/j.fishres.2008.01.005>.
 - [8] R. Froese, H. Winker, D. Gascuel, U.R. Sumaila, D. Pauly, Minimizing the impact of fishing, *Fish and Fisheries*. 17 (2016) 785–802. <https://doi.org/10.1111/faf.12146>.
 - [9] F. Colloca, M. Cardinale, F. Maynou, M. Giannoulaki, G. Scarcella, K. Jenko, J.M. Bellido, F. Fiorentino, Rebuilding Mediterranean fisheries: a new paradigm for ecological sustainability, *Fish and Fisheries*. 14 (2013) 89–109. <https://doi.org/10.1111/j.1467-2979.2011.00453.x>.
 - [10] Scientific, Technical and Economic Committee for Fisheries (STECF), Review of the Technical Measures Regulation (STECF-21-07), Publications Office of the European Union, Luxembourg, 2021. <https://policycommons.net/artifacts/2089794/scientific-technical-and-economic-committee-for-fisheries-stecf/2845092/> (accessed December 9, 2022).
 - [11] Scientific, Technical and Economic Committee for Fisheries (STECF), Stock Assessments: demersal stocks in the western Mediterranean Sea (STECF-EWG-22-09), Publications Office of the European Union, Luxembourg, 2022. <https://policycommons.net/artifacts/2089794/scientific-technical-and-economic-committee-for-fisheries-stecf/2845092/> (accessed December 9, 2022).
 - [12] Scientific, Technical and Economic Committee for Fisheries (STECF), Stock Assessment in the Adriatic, Ionian and Aegean Sea 2022 (STECF-EWG-22-16), Publications Office of the European Union, Luxembourg, 2022. <https://policycommons.net/artifacts/2089794/scientific-technical-and-economic-committee-for-fisheries-stecf/2845092/> (accessed December 9, 2022).
 - [13] A.C. Tsikliras, A. Dinouli, V.-Z. Tsiros, E. Tsalkou, The Mediterranean and Black Sea Fisheries at Risk from Overexploitation, *PLOS ONE*. 10 (2015) e0121188. <https://doi.org/10.1371/journal.pone.0121188>.
 - [14] FAO, *The State of Mediterranean and Black Sea Fisheries*, FAO, Rome, 2022. <https://doi.org/10.4060/cc3370en>.
 - [15] C. Ulrich, D.C.K. Wilson, J.R. Nielsen, F. Bastardie, S.A. Reeves, B.S. Andersen, O.R. Eigaard, Challenges and opportunities for fleet- and métier-based approaches for fisheries management under the European Common Fishery Policy, *Ocean & Coastal Management*. 70 (2012) 38–47. <https://doi.org/10.1016/j.ocecoaman.2012.06.002>.
 - [16] D. Gascuel, G. Merino, R. Döring, J.N. Druon, L. Goti, S. Guénette, C. Macher, K. Soma, M. Travers-Trolet, S. Mackinson, Towards the implementation of an integrated ecosystem fleet-based management of European fisheries, *Marine Policy*. 36 (2012) 1022–1032. <https://doi.org/10.1016/j.marpol.2012.02.008>.
 - [17] D. Gascuel, M. Coll, C. Fox, S. Guénette, J. Guitton, A. Kenny, L. Knittweis, J.R. Nielsen, G. Piet, T. Raid, M. Travers-Trolet, S. Shephard, Fishing impact and environmental status in European seas: a diagnosis from stock assessments and ecosystem indicators, *Fish and Fisheries*. 17 (2016) 31–55. <https://doi.org/10.1111/faf.12090>.
 - [18] S.B.M. Kraak, D.G. Reid, G. Bal, A. Barkai, E.A. Codling, C.J. Kelly, E. Rogan, RTI (“Real-Time Incentives”) outperforms traditional management in a simulated mixed fishery and cases incorporating protection of vulnerable species and areas, *Fisheries Research*. 172 (2015) 209–224. <https://doi.org/10.1016/j.fishres.2015.07.014>.

- [19] S.B.M. Kraak, D.G. Reid, E.A. Codling, Exploring the RTI (real-time incentive) tariff-based approach to single-species fisheries management, *Fisheries Research*. 155 (2014) 90–102. <https://doi.org/10.1016/j.fishres.2014.02.014>.
- [20] D. Pedreschi, A. Vigier, H. Höffle, S.B.M. Kraak, D.G. Reid, Innovation through consultation: Stakeholder perceptions of a novel fisheries management system reveal flexible approach to solving fisheries challenges, *Marine Policy*. 124 (2021) 104337. <https://doi.org/10.1016/j.marpol.2020.104337>.
- [21] S.B.M. Kraak, D.G. Reid, H.D. Gerritsen, C.J. Kelly, M. Fitzpatrick, E.A. Codling, E. Rogan, 21st century fisheries management: a spatio-temporally explicit tariff-based approach combining multiple drivers and incentivising responsible fishing, *ICES Journal of Marine Science*. 69 (2012) 590–601. <https://doi.org/10.1093/icesjms/fss033>.
- [22] A.S. Little, C.L. Needle, R. Hilborn, D.S. Holland, C.T. Marshall, Real-time spatial management approaches to reduce bycatch and discards: experiences from Europe and the United States, *Fish and Fisheries*. 16 (2015) 576–602. <https://doi.org/10.1111/faf.12080>.
- [23] J. Claudet, C. Loiseau, M. Sostres, M. Zupan, Underprotected Marine Protected Areas in a Global Biodiversity Hotspot, *One Earth*. 2 (2020) 380–384. <https://doi.org/10.1016/j.oneear.2020.03.008>.
- [24] J. Humphreys, R.W.E. Clark, Chapter 1 - A critical history of marine protected areas, in: J. Humphreys, R.W.E. Clark (Eds.), *Marine Protected Areas*, Elsevier, 2020: pp. 1–12. <https://doi.org/10.1016/B978-0-08-102698-4.00001-0>.
- [25] D. Laffoley, J.M. Baxter, J.C. Day, L. Wenzel, P. Bueno, K. Zischka, Chapter 29 - Marine Protected Areas, in: C. Sheppard (Ed.), *World Seas: An Environmental Evaluation (Second Edition)*, Academic Press, 2019: pp. 549–569. <https://doi.org/10.1016/B978-0-12-805052-1.00027-9>.
- [26] J. Roessger, J. Claudet, B. Horta e Costa, Turning the tide on protection illusions: The underprotected MPAs of the 'OSPAR Regional Sea Convention,' *Marine Policy*. 142 (2022) 105109. <https://doi.org/10.1016/j.marpol.2022.105109>.
- [27] L. Mesnildrey, D. Gascuel, O.L. Pape, Integrating Marine Protected Areas in fisheries management systems: some criteria for ecological efficiency, *Aquatic Living Resources*. 26 (2013) 159–170. <https://doi.org/10.1051/alr/2013056>.
- [28] C. Dambrine, M. Woillez, M. Huret, H. de Pontual, Characterising Essential Fish Habitat using spatio-temporal analysis of fishery data: A case study of the European seabass spawning areas, *Fisheries Oceanography*. 30 (2021) 413–428. <https://doi.org/10.1111/fog.12527>.
- [29] O. Le Pape, J. Delavenne, S. Vaz, Quantitative mapping of fish habitat: A useful tool to design spatialised management measures and marine protected area with fishery objectives, *Ocean & Coastal Management*. 87 (2014) 8–19. <https://doi.org/10.1016/j.ocecoaman.2013.10.018>.
- [30] F. Colloca, G. Garofalo, I. Bitetto, M.T. Facchini, F. Grati, A. Martiradonna, G. Mastrantonio, N. Nikolioudakis, F. Ordinas, G. Scarcella, G. Tserpes, M.P. Tugores, V. Valavanis, R. Carlucci, F. Fiorentino, M.C. Follesa, M. Iglesias, L. Knittweis, E. Lefkaditou, G. Lembo, C. Manfredi, E. Massutí, M.L. Pace, N. Papadopoulou, P. Sartor, C.J. Smith, M.T. Spedicato, The Seascape of Demersal Fish Nursery Areas in the North Mediterranean Sea, a First Step Towards the Implementation of Spatial Planning for Trawl Fisheries, *PLOS ONE*. 10 (2015) e0119590. <https://doi.org/10.1371/journal.pone.0119590>.
- [31] M. Giannoulaki, A. Belluscio, F. Colloca, S. Fraschetti, M. Scardi, C. Smith, M. Spedicato, *Mediterranean Sensitive Habitats: DG MARE Specific Contract SI2*, Hellenic Centre for Marine Research: Heraklion, Greece. (2013).
- [32] B. Alglave, E. Rivot, M.-P. Etienne, M. Woillez, J.T. Thorson, Y. Vermard, Combining scientific survey and commercial catch data to map fish distribution, *ICES Journal of Marine Science*. 79 (2022) 1133–1149. <https://doi.org/10.1093/icesjms/fsac032>.
- [33] Scientific, Technical and Economic Committee for Fisheries (STECF), Evaluation of the fishing effort and catch regime for demersal fisheries in the western Mediterranean Sea – PART IX (STECF-22-11), Publications Office of the European Union, Luxembourg, 2022. <https://policycommons.net/artifacts/2089794/scientific-technical-and-economic-committee-for-fisheries-stecf/2845092/> (accessed December 9, 2022).
- [34] P. Carpi, G. Scarcella, M. Cardinale, *The Saga of the Management of Fisheries in the Adriatic Sea: History, Flaws, Difficulties, and Successes*

- toward the Application of the Common Fisheries Policy in the Mediterranean, *Frontiers in Marine Science*. 4 (2017). <https://www.frontiersin.org/articles/10.3389/fmars.2017.00423> (accessed November 30, 2022).
- [35] Scientific, Technical and Economic Committee for Fisheries (STECF), Impact of exploitation pattern on MSY yields (STECF-PLen-18-01), Publications Office of the European Union, Luxembourg, 2018. <https://policycommons.net/artifacts/2089794/scientific-technical-and-economic-committee-for-fisheries-stecf/2845092/> (accessed December 9, 2022).
- [36] I. Trindade-Santos, F. Moyes, A.E. Magurran, Global change in the functional diversity of marine fisheries exploitation over the past 65 years, *Proceedings of the Royal Society B: Biological Sciences*. 287 (2020) 20200889. <https://doi.org/10.1098/rspb.2020.0889>.
- [37] K. Zhao, S.D. Gaines, J. García Molinos, M. Zhang, J. Xu, Climate change and fishing are pulling the functional diversity of the world's largest marine fisheries to opposite extremes, *Global Ecology and Biogeography*. 31 (2022) 1616–1629. <https://doi.org/10.1111/geb.13534>.
- [38] R.W.R. Parker, J.L. Blanchard, C. Gardner, B.S. Green, K. Hartmann, P.H. Tyedmers, R.A. Watson, Fuel use and greenhouse gas emissions of world fisheries, *Nature Clim Change*. 8 (2018) 333–337. <https://doi.org/10.1038/s41558-018-0117-x>.
- [39] P.M. Cury, I.L. Boyd, S. Bonhommeau, T. Anker-Nilssen, R.J.M. Crawford, R.W. Furness, J.A. Mills, E.J. Murphy, H. Österblom, M. Paleczny, J.F. Piatt, J.-P. Roux, L. Shannon, W.J. Sydeman, Global Seabird Response to Forage Fish Depletion—One-Third for the Birds, *Science*. 334 (2011) 1703–1706. <https://doi.org/10.1126/science.1212928>.
- [40] A.D.M. Smith, C.J. Brown, C.M. Bulman, E.A. Fulton, P. Johnson, I.C. Kaplan, H. Lozano-Montes, S. Mackinson, M. Marzloff, L.J. Shannon, Y.-J. Shin, J. Tam, Impacts of Fishing Low-Trophic Level Species on Marine Ecosystems, *Science*. 333 (2011) 1147–1150. <https://doi.org/10.1126/science.1209395>.
- [41] E.K. Pikitch, K.J. Rountos, T.E. Essington, C. Santora, D. Pauly, R. Watson, U.R. Sumaila, P.D. Boersma, I.L. Boyd, D.O. Conover, P. Cury, S.S. Heppell, E.D. Houde, M. Mangel, É. Plagányi, K. Sainsbury, R.S. Steneck, T.M. Geers, N. Gownaris, S.B. Munch, The global contribution of forage fish to marine fisheries and ecosystems, *Fish and Fisheries*. 15 (2014) 43–64. <https://doi.org/10.1111/faf.12004>.
- [42] V.M. Trenkel, S. Vaz, C. Albouy, A. Brind'Amour, E. Duhamel, P. Laffargue, J.B. Romagnan, J. Simon, P. Lorance, We can reduce the impact of scientific trawling on marine ecosystems, *Marine Ecology Progress Series*. 609 (2019) 277–282. <https://doi.org/10.3354/meps12834>.
- [43] M.J. Costello, K.H. Beard, R.T. Corlett, G.S. Cumming, V. Devictor, R. Loyola, B. Maas, A.J. Miller-Rushing, R. Pakeman, R.B. Primack, Field work ethics in biological research, *Biological Conservation*. 203 (2016) 268–271. <https://doi.org/10.1016/j.biocon.2016.10.008>.
- [44] L. Borges, The unintended impact of the European discard ban, *ICES Journal of Marine Science*. 78 (2021) 134–141. <https://doi.org/10.1093/icesjms/fsaa200>.
- [45] L. Borges, E.P. Lado, Discards in the common fisheries policy: The evolution of the policy, in: S.S. Uhlmann, C. Ulrich, Y. Kennelly (Eds.), *The European Landing Obligation: Reducing Discards in Complex, Multi-Species and Multi-Jurisdictional Fisheries*, Springer International Publishing, Cham, 2019: pp. 27–47.
- [46] F. Maynou, M. del M. Gil, S. Vitale, G.B. Giusto, A. Foutsis, M. Rangel, R. Rainha, K. Erzini, J.M.S. Gonçalves, L. Bentes, C. Viva, P. Sartor, F. De Carlo, I. Rossetti, M. Christou, K. Stergiou, C.D. Maravelias, D. Damalas, Fishers' perceptions of the European Union discards ban: perspective from south European fisheries, *Marine Policy*. 89 (2018) 147–153. <https://doi.org/10.1016/j.marpol.2017.12.019>.
- [47] J.A. Lively, T.P. Good, Chapter 10 - Ghost Fishing, in: C. Sheppard (Ed.), *World Seas: An Environmental Evaluation (Second Edition)*, Academic Press, 2019: pp. 183–196. <https://doi.org/10.1016/B978-0-12-805052-1.00010-3>.
- [48] J. Brown, G. Macfadyen, Ghost fishing in European waters: Impacts and management responses, *Marine Policy*. 31 (2007) 488–504. <https://doi.org/10.1016/j.marpol.2006.10.007>.
- [49] E. Gilman, Status of international monitoring and management of abandoned, lost and discarded fishing gear and ghost fishing, *Marine Policy*. 60 (2015) 225–239. <https://doi.org/10.1016/j.marpol.2015.06.016>.

- [50] H. Vitorino, R. Ferrazi, G. Correia-Silva, F. Tinti, A.C. Belizário, F.A. Amaral, F.P. Ottoni, C.V. Silva, T. Giarrizzo, M.S. Arcifa, V.M. Azevedo-Santos, New treaty must address ghost fishing gear, *Science*. 376 (2022) 1169–1169. <https://doi.org/10.1126/science.adc9254>.
- [51] U.R. Sumaila, V. Lam, F. Le Manach, W. Swartz, D. Pauly, Global fisheries subsidies: An updated estimate, *Marine Policy*. 69 (2016) 189–193. <https://doi.org/10.1016/j.marpol.2015.12.026>.
- [52] B. Mesnil, Public-aided crises in the French fishing sector, *Ocean & Coastal Management*. 51 (2008) 689–700. <https://doi.org/10.1016/j.ocecoaman.2008.07.009>.
- [53] A.M. Cisneros-Montemayor, E. Sanjurjo, G.R. Munro, V. Hernández-Trejo, U. Rashid Sumaila, Strategies and rationale for fishery subsidy reform, *Marine Policy*. 69 (2016) 229–236. <https://doi.org/10.1016/j.marpol.2015.10.001>.
- [54] ICES, Working Group on Multispecies Assessment Methods (WGSAM), 2021. <https://doi.org/10.17895/ices.pub.9562>.
- [55] D. Howell, A.M. Schueller, J.W. Bentley, A. Buchheister, D. Chagaris, M. Cieri, K. Drew, M.G. Lundy, D. Pedreschi, D.G. Reid, H. Townsend, Combining Ecosystem and Single-Species Modeling to Provide Ecosystem-Based Fisheries Management Advice Within Current Management Systems, *Frontiers in Marine Science*. 7 (2021) 1163. <https://doi.org/10.3389/fmars.2020.607831>.
- [56] V.M. Trenkel, How to provide scientific advice for ecosystem-based management now, *Fish and Fisheries*. 19 (2018) 390–398. <https://doi.org/10.1111/faf.12263>.
- [57] R.J. Latour, M.J. Brush, C.F. Bonzek, Toward Ecosystem-Based Fisheries Management, *Fisheries*. 28 (2003) 10–22. [https://doi.org/10.1577/1548-8446\(2003\)28\[10:TEFM\]2.0.CO;2](https://doi.org/10.1577/1548-8446(2003)28[10:TEFM]2.0.CO;2).
- [58] J. Lloret, E. Faliex, G.E. Shulman, J.-A. Raga, P. Sasal, M. Muñoz, M. Casadevall, A.E. Ahuir-Baraja, F.E. Montero, A. Repullés-Albelda, M. Cardinale, H.-J. Rätz, S. Vila, D. Ferrer, Fish Health and Fisheries, Implications for Stock Assessment and Management: The Mediterranean Example, *Reviews in Fisheries Science*. 20 (2012) 165–180. <https://doi.org/10.1080/10641262.2012.695817>.
- [59] M. Véron, E. Duhamel, M. Bertignac, L. Pawlowski, M. Huret, Major changes in sardine growth and body condition in the Bay of Biscay between 2003 and 2016: Temporal trends and drivers, *Progress in Oceanography*. 182 (2020) 102274. <https://doi.org/10.1016/j.pocean.2020.102274>.
- [60] F. Ordines, J. Lloret, P. Tugores, C. Manfredi, B. Guijarro, A. Jadaud, C. Porcu, L. Gil De Sola, R. Carlucci, M. Sartini, I. Isajlovic, E. Massutti, A new approach to recruitment overfishing diagnosis based on fish condition from survey data, *Scientia Marina*. 83 (2019) 223–233. <https://doi.org/10.3989/scimar.04950.03A>.
- [61] J.-F. Dewals, D. Gascuel, Les dimensions, critères et indicateurs de durabilité des pêches françaises, Pré-étude – Rapport final, 2020.
- [62] H. Dörner, J. Casey, N. Carvalho, D. Damalas, N. Graham, J. Guillen, S.J. Holmes, F. Natale, G.C. Osio, H.-J. Rätz, C. Ribeiro, P. Vasilakopoulos, Collection and dissemination of fisheries data in support of the EU Common Fisheries Policy, *Ethics in Science and Environmental Politics*. 18 (2018) 15–25. <https://doi.org/10.3354/esep00183>.
- [63] M. Louzao, J. Ruiz, I. Oyarzabal, M. Basterretxea, A. Pedrajas, A. Mugerza, I. Krug, U. Cotano, E. Mugerza, L. Zarauz, M. Santurtún, Including ecosystem descriptors in current fishery data collection programmes to advance towards a holistic monitoring: Seabird abundance attending demersal trawlers, *Marine Environmental Research*. 160 (2020) 105043. <https://doi.org/10.1016/j.marenvres.2020.105043>.
- [64] A.I. Arkhipkin, L.C. Hendrickson, I. Payá, G.J. Pierce, R.H. Roa-Ureta, J.-P. Robin, A. Winter, Stock assessment and management of cephalopods: advances and challenges for short-lived fishery resources, *ICES Journal of Marine Science*. 78 (2021) 714–730. <https://doi.org/10.1093/icesjms/fsaa038>.
- [65] G.A. Begg, K.D. Friedland, J.B. Pearce, Stock identification and its role in stock assessment and fisheries management: an overview, *Fisheries Research*. 43 (1999) 1–8. [https://doi.org/10.1016/S0165-7836\(99\)00062-4](https://doi.org/10.1016/S0165-7836(99)00062-4).
- [66] S.X. Cadrin, Defining spatial structure for fishery stock assessment, *Fisheries Research*. 221 (2020) 105397.

- <https://doi.org/10.1016/j.fishres.2019.105397>.
- [67] S.C. Mangi, P.J. Dolder, T.L. Catchpole, D. Rodmell, N. de Rozarieux, Approaches to fully documented fisheries: practical issues and stakeholder perceptions, *Fish and Fisheries*. 16 (2015) 426–452. <https://doi.org/10.1111/faf.12065>.
- [68] A. Jones, S.J. Slade, A.J. Williams, B.D. Mapstone, K.J. Kane, Pitfalls and benefits of involving industry in fisheries research: A case study of the live reef fish industry in Queensland, Australia, *Ocean & Coastal Management*. 50 (2007) 428–442. <https://doi.org/10.1016/j.ocecoaman.2006.09.002>.
- [69] A. Rindorf, J. Mumford, P. Baranowski, L.W. Clausen, D. García, N.T. Hintzen, A. Kempf, A. Leach, P. Levontin, P. Mace, S. Mackinson, C. Maravelias, R. Prelezo, A. Quetglas, G. Tserpes, R. Voss, D. Reid, Moving beyond the MSY concept to reflect multidimensional fisheries management objectives, *Marine Policy*. 85 (2017) 33–41. <https://doi.org/10.1016/j.marpol.2017.08.012>.
- [70] B. Worm, R. Hilborn, J.K. Baum, T.A. Branch, J.S. Collie, C. Costello, M.J. Fogarty, E.A. Fulton, J.A. Hutchings, S. Jennings, O.P. Jensen, H.K. Lotze, P.M. Mace, T.R. McClanahan, C. Minto, S.R. Palumbi, A.M. Parma, D. Ricard, A.A. Rosenberg, R. Watson, D. Zeller, Rebuilding Global Fisheries, *Science*. 325 (2009) 578–585. <https://doi.org/10.1126/science.1173146>.
- [71] Scientific, Technical and Economic Committee for Fisheries (STECF), Marketing standards: review of fishery criterias and underlying methodologies (STECF-EWG-22-12), Publications Office of the European Union, Luxembourg, 2022. <https://policycommons.net/artifacts/2089794/scientific-technical-and-economic-committee-for-fisheries-stecf/2845092/> (accessed December 9, 2022).
- [72] Scientific, Technical and Economic Committee for Fisheries (STECF), Marketing standards: review of proposed sustainability criteria / indicators for aquaculture (STECF-EWG-22-13), Publications Office of the European Union, Luxembourg, 2022. <https://policycommons.net/artifacts/2089794/scientific-technical-and-economic-committee-for-fisheries-stecf/2845092/> (accessed December 9, 2022).
- [73] F. Salladarré, P. Guillotreau, Y. Perraudeau, M.-C. Monfort, The Demand for Seafood Eco-Labels in France, *Journal of Agricultural & Food Industrial Organization*. 8 (2010). <https://doi.org/10.2202/1542-0485.1308>.
- [74] D. Brécard, B. Hlaimi, S. Lucas, Y. Perraudeau, F. Salladarré, Determinants of demand for green products: An application to eco-label demand for fish in Europe, *Ecological Economics*. 69 (2009) 115–125. <https://doi.org/10.1016/j.ecolecon.2009.07.017>.
- [75] L. Mulazzani, L. Piredda, M. Cerjak, L. Camanzi, Consumer appreciation of a shark-free eco-label for small pelagics, *British Food Journal*. 123 (2021) 88–104. <https://doi.org/10.1108/BFJ-10-2020-0899>.
- [76] R. Lent, D. Squires, Reducing marine mammal bycatch in global fisheries: An economics approach, *Deep Sea Research Part II: Topical Studies in Oceanography*. 140 (2017) 268–277. <https://doi.org/10.1016/j.dsr2.2017.03.005>.
- [77] A. Treves, S.M. Jones, Strategic tradeoffs for wildlife-friendly eco-labels, *Frontiers in Ecology and the Environment*. 8 (2010) 491–498. <https://doi.org/10.1890/080173>.
- [78] J.A. Nilsson, E.A. Fulton, C.R. Johnson, M. Haward, How to Sustain Fisheries: Expert Knowledge from 34 Nations, *Water*. 11 (2019) 213. <https://doi.org/10.3390/w11020213>.
- [79] A. Said, R. Chuenpagdee, Aligning the sustainable development goals to the small-scale fisheries guidelines: A case for EU fisheries governance, *Marine Policy*. 107 (2019) 103599. <https://doi.org/10.1016/j.marpol.2019.103599>.
- [80] R.E. Dahl, A. Oglend, Fish price volatility, *Marine Resource Economics*. 29 (2014) 305–322.
- [81] S.A. Sethi, Risk management for fisheries, *Fish and Fisheries*. 11 (2010) 341–365. <https://doi.org/10.1111/j.1467-2979.2010.00363.x>.
- [82] C. Carter, The transformation of Scottish fisheries: Sustainable interdependence from ‘net to plate,’ *Marine Policy*. 44 (2014) 131–138.
- [83] S. Mackinson, D.C.K. Wilson, Building bridges among scientists and fishermen with participatory action research, in: *Social Issues in*

- Sustainable Fisheries Management, Springer, 2014: pp. 121–139.
- [84] M. Ballesteros, M. Dickey-Collas, Managing participation across boundaries: A typology for stakeholder engagement in the International Council for the Exploration of the Sea, *Marine Policy*. 147 (2023) 105389. <https://doi.org/10.1016/j.marpol.2022.105389>.
- [85] I. Ruiz-Salmón, M. Margallo, J. Laso, P. Villanueva-Rey, D. Mariño, P. Quinteiro, A.C. Dias, M.L. Nunes, A. Marques, G. Feijoo, M.T. Moreira, P. Loubet, G. Sonnemann, A. Morse, R. Cooney, E. Clifford, N. Rowan, D. Méndez-Paz, X. Iglesias-Parga, C. Anglada, J.-C. Martin, Á. Irabien, R. Aldaco, Addressing challenges and opportunities of the European seafood sector under a circular economy framework, *Current Opinion in Environmental Science & Health*. 13 (2020) 101–106. <https://doi.org/10.1016/j.coesh.2020.01.004>.
- [86] European Commission, Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of the Circular Economy Action Planimplementation of the Circular Economy Action Plan, 2019. https://commission.europa.eu/document/download/2ea77dac-ba61-4032-ae3c-820a6d6f837e_en?filename=report_implementation_circular_economy_action_plan.pdf (accessed December 9, 2022).
- [87] L. d'Armengol, M. Prieto Castillo, I. Ruiz-Mallén, E. Corbera, A systematic review of co-managed small-scale fisheries: Social diversity and adaptive management improve outcomes, *Global Environmental Change*. 52 (2018) 212–225. <https://doi.org/10.1016/j.gloenvcha.2018.07.009>.
- [88] J. Urquhart, T.G. Acott, D. Symes, M. Zhao, Introduction: Social Issues in Sustainable Fisheries Management, in: J. Urquhart, T.G. Acott, D. Symes, M. Zhao (Eds.), *Social Issues in Sustainable Fisheries Management*, Springer Netherlands, Dordrecht, 2014: pp. 1–20. https://doi.org/10.1007/978-94-007-7911-2_1.
- [89] K. Martin, M.C. James, The need for altruism, *Mast*. 3 (2005) 105–118.
- [90] U. Budzich-Tabor, Area-based Local Development—A New Opportunity for European Fisheries Areas, in: J. Urquhart, T.G. Acott, D. Symes, M. Zhao (Eds.), *Social Issues in Sustainable Fisheries Management*, Springer Netherlands, Dordrecht, 2014: pp. 183–197. https://doi.org/10.1007/978-94-007-7911-2_10.
- [91] R. Hilborn, Managing fisheries is managing people: what has been learned?, *Fish and Fisheries*. 8 (2007) 285–296. https://doi.org/10.1111/j.1467-2979.2007.00263_2.x.
- [92] N.L. Gutiérrez, R. Hilborn, O. Defeo, Leadership, social capital and incentives promote successful fisheries, *Nature*. 470 (2011) 386–389. <https://doi.org/10.1038/nature09689>.
- [93] European Commission, Executive Agency for Small and Medium-sized Enterprises, Study on ownership and exclusive rights of fisheries means of production : final report, 2019.
- [94] D. van Dijk, R. Haijema, E.M.T. Hendrix, R.A. Groeneveld, E.C. van Ierland, Fluctuating quota and management costs under multiannual adjustment of fish quota, *Ecological Modelling*. 265 (2013) 230–238. <https://doi.org/10.1016/j.ecolmodel.2013.06.019>.
- [95] M.C. Melnychuk, T.E. Essington, T.A. Branch, S.S. Heppell, O.P. Jensen, J.S. Link, S.J.D. Martell, A.M. Parma, A.D.M. Smith, Which design elements of individual quota fisheries help to achieve management objectives?, *Fish and Fisheries*. 17 (2016) 126–142. <https://doi.org/10.1111/faf.12094>.
- [96] Z. Larabi, O. Guyader, C. Macher, F. Daurès, Quota management in a context of non-transferability of fishing rights: The French case study, *Ocean & Coastal Management*. 84 (2013) 13–22. <https://doi.org/10.1016/j.ocecoaman.2013.07.001>.
- [97] E. Hoefnagel, B. de Vos, E. Buisman, Quota swapping, relative stability, and transparency, *Marine Policy*. 57 (2015) 111–119. <https://doi.org/10.1016/j.marpol.2015.03.012>.
- [98] M. Harte, R. Tiller, G. Kailis, M. Burden, Countering a climate of instability: the future of relative stability under the Common Fisheries Policy, *ICES Journal of Marine Science*. 76 (2019) 1951–1958. <https://doi.org/10.1093/icesjms/fsz109>.
- [99] F. Bastardie, D.A. Feary, T. Brunel, L.T. Kell, R. Döring, S. Metz, O.R. Eigaard, O.C. Basurko, V. Bartolino, J. Bentley, B. Berges, S. Bossier,

- M.E. Brooks, A. Caballero, L. Citores, G. Daskalov, J. Depestele, G. Gabiña, M. Aranda, K.G. Hamon, M. Hidalgo, S. Katsanevakis, A. Kempf, B. Kühn, J.R. Nielsen, M. Püts, M. Taylor, G. Triantaphyllidis, K. Tsagarakis, A. Urtizberea, L. van Hoof, J. van Vlasselaer, Ten lessons on the resilience of the EU common fisheries policy towards climate change and fuel efficiency - A call for adaptive, flexible and well-informed fisheries management, *Frontiers in Marine Science*. 9 (2022). <https://www.frontiersin.org/articles/10.3389/fmars.2022.947150> (accessed November 30, 2022).
- [100] B. Stewart, M. Johnson, “Scallop wars” between Britain and France are just a pre-Brexit skirmish, *The Conversation*. (2018). <http://theconversation.com/scallop-wars-between-britain-and-france-are-just-a-pre-brexit-skirmish-102588> (accessed December 2, 2022).
- [101] A.S. Antonova, The rhetoric of “responsible fishing”: Notions of human rights and sustainability in the European Union’s bilateral fishing agreements with developing states, *Marine Policy*. 70 (2016) 77–84. <https://doi.org/10.1016/j.marpol.2016.04.008>.
- [102] A. Kadfak, A. Antonova, Sustainable Networks: Modes of governance in the EU’s external fisheries policy relations under the IUU Regulation in Thailand and the SFPA with Senegal, *Marine Policy*. 132 (2021) 104656. <https://doi.org/10.1016/j.marpol.2021.104656>.
- [103] I. Okafor-Yarwood, D. Belhabib, The duplicity of the European Union Common Fisheries Policy in third countries: Evidence from the Gulf of Guinea, *Ocean & Coastal Management*. 184 (2020) 104953.
- [104] ICES, *Whiting (Merlangius merlangus) in Division 6.a (West of Scotland)*, Copenhagen, Denmark, 2021. <https://doi.org/10.17895/ices.advice.8220>.
- [105] ICES, *Norway lobster (Nephrops norvegicus) in divisions 7.a, 7.g, and 7.j, Functional Unit 19 (Irish Sea, Celtic Sea, eastern part of southwest of Ireland)*, Copenhagen, Denmark, 2022. <https://doi.org/10.17895/ices.advice.19772416.v1>.
- [106] Association Française d’Halieutique, *L’AFH communique : Fixation des quotas de pêche 2017*, Association française d’halieutique. (2016). <https://www.association-francaise-halieutique.fr/presse/l-afh-communique-fixation-des-quotas-de-peche-2017/> (accessed November 30, 2022).
- [107] Scientific, Technical and Economic Committee for Fisheries (STECF), *Monitoring the performance of the Common Fisheries Policy (STECF-Adhoc-19-01)*, Publications Office of the European Union, Luxembourg, 2019. <https://policycommons.net/artifacts/2089794/scientific-technical-and-economic-committee-for-fisheries-stecf/2845092/> (accessed December 9, 2022).
- [108] J.L. Hatchard, T.S. Gray, From RACs to Advisory Councils: Lessons from North Sea discourse for the 2014 reform of the European Common Fisheries Policy, *Marine Policy*. 47 (2014) 87–93. <https://doi.org/10.1016/j.marpol.2014.02.015>.
- [109] R. Long, The Role of Regional Advisory Councils in the European Common Fisheries Policy: Legal Constraints and Future Options, *The International Journal of Marine and Coastal Law*. 25 (2010) 289–346. <https://doi.org/10.1163/157180810X516980>.
- [110] K. Ounanian, T.J. Hegland, The Regional Advisory Councils’ current capacities and unforeseen benefits, *Maritime Studies*. 11 (2012) 10. <https://doi.org/10.1186/2212-9790-11-10>.
- [111] B. Pentz, N. Klenk, S. Ogle, J.A.D. Fisher, Can regional fisheries management organizations (RFMOs) manage resources effectively during climate change?, *Marine Policy*. 92 (2018) 13–20. <https://doi.org/10.1016/j.marpol.2018.01.011>.
- [112] S. Cullis-Suzuki, D. Pauly, Failing the high seas: A global evaluation of regional fisheries management organizations, *Marine Policy*. 34 (2010) 1036–1042. <https://doi.org/10.1016/j.marpol.2010.03.002>.
- [113] A.R. Baudron, T. Brunel, M.-A. Blanchet, M. Hidalgo, G. Chust, E.J. Brown, K.M. Kleisner, C. Millar, B.R. MacKenzie, N. Nikolioudakis, J.A. Fernandes, P.G. Fernandes, Changing fish distributions challenge the effective management of European fisheries, *Ecography*. 43 (2020) 494–505. <https://doi.org/10.1111/ecog.04864>.