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8 **More than maps: providing an alternative for fisheries and fishers in marine** 9 **spatial planning.**

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20 Abstract: Although a necessary approach in many cases, implementing Marine Spatial Planning (MSP)
21 reveals discrepancies between theory and practice. These discrepancies include the major importance
22 given to technical issues along with the role and meaning ascribed to the “spatial” dimension at the
23 expense of the “strategic” one. This gives rise to questions especially from the point of view of fisheries
24 that invite to develop a more in-depth critical analysis of MSP. Far from considering the technical and
25 political dimensions in opposition, the goal is to find out whether the reasoning used can be turned
26 around, or in other words, whether the potential of a mapping instrument can be used to give greater
27 importance and more visibility to strategic questions in MSP processes. Our reflection is based on
28 methods used to map fisheries. It is also enhanced by notions such as empowerment and asserting the
29 value of non-scientific knowledge *in-situ*. To test the strengths and shortcomings of this idea, it was
30 applied in the context of an ongoing 2010 experiment between scientists (geographers and statisticians),
31 fishers and fishers’ representatives in metropolitan France. They have been working together for several
32 years and have gradually expanded their scope to now include almost three-quarters of French
33 metropolitan fleets (around 3,250 vessels). This experiment shows that fishers and their representatives are
34 not only able to generate spatial data using robust methods (almost 6,000 surveys have already been
35 conducted), but more importantly that they are also able to draw on this knowledge and participate in
36 debates in a more effective manner, taking on the role of “real actors”. This has enabled a more political
37 alternative to take shape, full of promise and giving rise to new questions.
38

39 Keywords: Marine Spatial Planning, Fishers’ knowledge, Mapping, Power, Critical approach
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41 Highlights:

- 42 ▪ A summary of methods used to map fisheries was established,
 - 43 ▪ A method that enables fishers to assert their knowledge themselves was developed,
 - 44 ▪ Data (6000 surveys) on fishing areas was collected using this method,
 - 45 ▪ This data allowed fishers to participate in the discussions concerning sharing maritime space,
 - 46 ▪ This experiment proved the existence of possible alternatives for rethinking MSP.
- 47

48 1. Introduction

49 Although the overall idea of (integrated) sea use management is no longer very new (e.g., Fricke, 1975;
50 Eisma et al., 1979; Smith, 1991; Smith et al., 2011), putting it into practice through Marine Spatial
51 Planning (MSP) is a more recent development (Douve, 2008). Today, there are around 60 plans
52 implemented worldwide (IOC-UNESCO and EC-DG Mare, 2017). In theory, MSP is a much-needed
53 approach that takes into consideration global social and economical requirements, as well as the protection
54 of the marine environment. It enables an overall strategy to be defined all while avoiding “patchy and
55 uncoordinated decisions” (Kannen, 2014). Beyond these commendable principles, it seems obvious that
56 there are several discrepancies between the theory and practice of MSP. Fisheries are often at the meeting
57 point of some of them.

58 Firstly, MSP debates have mainly revolved around the “technical” aspect of implementing an MSP (data,
59 geotechnologies, etc.) at the expense of the “political” dimension. In fact, the latter, far from being at the
60 heart of MSP processes, is still side-lined for the most part (Kidd and Ellis, 2012). This situation is not
61 specific to MSP since technical devices and other technological artefacts have appeared more broadly in
62 the field of democracy (e.g., Akrich, 1987; Akrich, 1989; Latour, 1999, 2005; Law, 1999; Callon et al.,
63 2001; Callon and Ferrary, 2006). While technical work in MSP often leads to mapping and zoning, it is
64 important to remember that technical choices (e.g., the role given to the “spatial” aspect in MSP, data,
65 metrics and analysis tools used, the map-making choices, etc.) are inevitably somewhat political in nature,
66 as they guide decision-making and influence the end result. Furthermore, fisheries are highly sensitive to
67 data and maps by their intrinsic characteristics (scattered, temporary, variable in time and space, etc.), as
68 well as sensitive to any change in the distribution patterns of species, notably due to climate change
69 (Janßen et al., 2018). One should pay attention to the risk of fisheries being “pushed off” the map, or at
70 least to be incorrectly or partially taken into account. This is particularly true for small-scale fisheries for
71 which lack of data is patent.

72 Secondly, the pre-existence of national or supranational strategies in the domain of marine conservation as
73 well as “blue growth” (marine energy, mining, shipping, offshore aquaculture, etc.) questions the capacity
74 of MSP to incorporate the different stakes *a posteriori*, and consequently, its ability to actively carry
75 strategies rather than simply act as a receptacle for multiple strategies (Qiu and Jones, 2013; Jones et al,
76 2016). Also, despite an apparent paradox, the two coexistent approaches of sustainability in MSP, soft and
77 hard (Qiu and Jones, 2013; Frazão Santos et al., 2014), mainly converge on the important role assigned to
78 spatial matters, especially zoning: zones for protecting nature and zones for developing uses. By its very
79 nature, fisheries are resistant to zoning (Jentoft and Knol, 2014). The zoning option is therefore not just a
80 technical choice with no political stakes; one should be wary of any cartographic determinism that would
81 make a shortcut between mapping and zoning.

82 Thirdly, initiatives leaning either towards economic growth or towards conservation also limit the extent
83 to which social stakes are taken into consideration. This is particularly critical for fisheries because they
84 are spread out over a wide spatial area and have been present in seas and oceans for longer than other
85 activities currently under development, although they do not have any property or use rights on space. As
86 a result, the question of sharing maritime space and its practicalities from a fisheries point of view is
87 raised differently than for other users. Because fisheries are mostly viewed from an essentially
88 bioeconomic angle (Urquhart et al., 2011), the weak consideration given to social and cultural aspects in
89 classical fisheries approaches (cultural dimension, identity, heritage, contact to nature, food provision,
90 lifestyles, etc.) raises particular questions. In this context, providing that a rationalism that favours
91 prevailing interests takes precedence (Flannery and Ellis, 2016; Tafon, 2017), questions of social justice
92 can come to the fore (Qiu and Jones, 2013), along with questions of spatial justice in the sense suggested
93 by Young (1990), which may lead to the processes of ocean-grabbing (Bennett et al., 2015) or sea-sparing
94 (Wolff, 2015).

95 Of course, this is without considering the variety of situations in which the fisheries find themselves,
96 depending on their type (vessel size, gear, targeted species, small or large scales, etc.), the historical and
97 geographical context in which they work (the more or less strong presence of competing activities, the
98 level of internal competition, etc.), the level of structuring in the sector, their capacity to adapt, or even the
99 environmental, social, cultural and food related stakes in their situation.. Within fishing activities on a
100 general basis, small-scale fisheries are even more vulnerable when it comes to an overly-spatial approach
101 dominated by technical considerations. Their case is all the more conspicuous for four reasons: (i) a high
102 dependency on the coastal zone, where competition for space is potentially stronger, (ii) a weaker capacity
103 to spatially adapt, (iii) an almost non-existent availability of data enabling them to be taken into account
104 (e.g., in most cases, Vessel Monitoring System (VMS) or Automatic Information System (AIS) data only
105 exists for vessels more than 12 or 15 metres long, depending on the system), and (iv) a characterisation of
106 their importance that is hard to measure against economic metrics solely (Agapito et al., 2018).

107 Accordingly, a more in-depth critical analysis of MSP is needed, especially in regard to data collection
108 and mapping processes which constitute the basements of the MSP technical frame. Far from considering
109 the technical and political dimensions, and relying on the example of fisheries, we see that the idea
110 examined in this paper proves to us that mapping as a technical instrument can play a role in transforming
111 MSP as a political and technical “device” (in reference to Foucault French word “dispositif” (1980)). In
112 other words, by adopting the idea of Flyvberg (1998) that “power defines what counts as rationality and
113 knowledge and thereby what counts as reality”, our aim is to examine the potential of geotechnologies
114 (i.e., mapping instrument) when it comes to strategy. The idea is to enhance or even de-construct the
115 “reality” on which the sharing of space between different uses is based – a “reality” that stems from a
116 balance of power which takes place in mapping design. Thus, the question would no longer be of knowing
117 what data to use and how to map it, but rather of how to turn these issues into an opportunity to promote
118 other “realities” that are not captured by techno-managerial instruments and more globally, science and
119 technology (Whatmore, 2009), thus enabling MSP to be more firmly anchored in the political field. In
120 other words, a matter of testing if fishers could be empowered through mapping in MSP processes.
121 Therefore, we question the interest to move from a view where spatial data have primacy to another where
122 fishers’ empowerment in spatial data and map production is just as much as central to engage political
123 debates in MSP. To tackle this, we begin by looking at the literature of mapping fisheries in the context of
124 MSP. That would allow us to develop and strengthen the theoretical frame about the potential of mapping
125 as an empowerment lever for reinforcing the political dimension of MSP (2). On this basis, we present an
126 experiment in progress in France since 2010. The goal of this experiment is to help fishers to be fully able
127 to collect their data and to spatialize their activity. The experiment relies on collaborations with several
128 researchers in geography and mathematics fields making the whole procedure of data collection and
129 treatment scientifically well founded. . Since it is strongly context-related, the French situation of fisheries
130 and of MSP is presented. Additionally, it is at the heart of the empowerment process, thus we precisely
131 describe data collection and mapping features (3). Then, we expose the results produced by this
132 experiment, both in terms of data produced and in terms of potential of the mapping exercise to place
133 political considerations at the heart of MSP (4). Finally, we discuss the many questions raised by this
134 experiment, while hoping it can contribute to further critical thought on the sharing of marine space, the
135 integration of scientific and non-scientific knowledge, and participatory mechanisms (5).

136 **2. Mapping fisheries for MSP**

137 **2.1. From the primacy of data...**

138 Since the mid-2000s, an increasing number of research works are dealt with the mapping of human
139 activities. In fact there has been a growing need for spatial data fostered by the development of MSP in the
140 past years. Additionally, technological progresses allowed the improvement of spatial data supply. Such
141 circumstances explain this increasing number of research work during the recent period. Where the
142 mapping of fishing grounds is concerned, several studies based on a wide range of methods have emerged
143 and several attempts at providing a synthesis have been made (e.g., Ben Rais Lasram and Cruz Folch,
144 2007; ERG, 2010; Daw et al., 2011; MMO, 2014; Janßen et al., 2018). Protocols for acquiring spatial data
145 on fishing activities around the world fall into two broad categories. Firstly, there are those which rely on
146 data collected on a continuous or regular basis, often through automated methods primarily linked to
147 regulatory systems for monitoring fishing vessels:

- 148 - logbooks and Vessel Trip Reports (VTR) (e.g., Breeze and Horsman, 2005; St Martin, 2005;
149 Simms et al., 2007; St Martin and Hall-Arber, 2008a; Jin et al., 2013),
- 150 - sometimes combined with automatic monitoring systems such as VMS (e.g., Fock, 2008;
151 Stelzenmüller et al., 2008; Pedersen et al., 2009a; Pedersen et al., 2009b; Bastardie et al., 2014;
152 Bastardie et al., 2010; Jennings and Lee, 2012; Campbell et al., 2014) or AIS (e.g., Natale et al.,
153 2015).

154 Secondly, there are those which rely on data collected on a one-off basis using different means:

- 155 - GPS (e.g., Valdés-Pizzini et al., 1997; Sidi Cheikh et al., 2009; Daw et al., 2011),

- 156 - observations and counts made from a fixed point on land or through overhead flights (e.g., Léauté,
157 1998; Dalton et al., 2010),
- 158 - individual or collective interviews, sometimes supported by participatory GIS (e.g., Close and
159 Hall, 2006; Hall and Close, 2007; des Clers et al., 2008; St Martin and Hall-Arber, 2008b; De
160 Freitas and Tagliani, 2009; Hall et al., 2009; Lieberknecht et al., 2011; Maes et al., 2012; Moreno-
161 Báez, 2010; Pascual et al., 2013; Leite and Gasalla, 2013; Yates and Schoeman, 2013; Kafas et
162 al., 2014a; Purroy et al., 2014; Léopold et al., 2014; Sullivan et al., 2015; Kafas et al., 2017)
- 163 - feasible combinations which are sometimes tested, namely by Daw et al. (2011).

164 The instances where these two broad data categories are brought together are few, but the authors who
165 explored this possibility agree that the triangulation of several methods would certainly bring added value
166 (e.g., St Martin and Hall-Arber, 2009; Woolmer, 2009; Scottie et al., 2012; Kafas et al., 2014b; Turner et
167 al., 2015). Furthermore, approaches to spatialising functional fisheries zones and habitats of certain
168 species on the one hand (e.g., O’Sullivan et al., 2013; Lelièvre et al., 2014; Le Pape et al., 2014; Orio et
169 al., 2017), and regulatory approaches on the other (e.g., Norwegian Ministry of the Environment, 2014)
170 are also sometimes mobilized together when considering the stakes involving fisheries in MSP.

171 All this data inevitably reveals benefits and limitations, which need to be viewed in relation to initial
172 objectives (evaluation of stocks, maritime security, fisheries inspection, etc.) and in our case, in relation to
173 MSP requirements – here we are essentially referring to:

- 174 - spatial VMS or AIS data, which is highly precise but gathered from an overly reduced portion of
175 fleets (e.g., according to the Fleet register system [1], only 11,5% ships in Europe in January 2018
176 are followed by the VMS) and raising post-processing issues (e.g., how to select the speed
177 thresholds to identify when fishing is underway) or issues linked to the lack of data-related
178 information (e.g., gear used);
- 179 - pertinent attribute data from logbooks (e.g., gear used) and a good coverage of fleets, but a spatial
180 granularity which is too broad (e.g., International Council for the Exploration of the Sea (ICES)
181 statistical rectangles);
- 182 - data acquired on a one-off basis, which is often more adapted but provides restricted geographic
183 and/or temporal coverage (data from one-off surveys, counts or observations).

184 Therefore, although this data is ever more readily used today, it does not seem altogether adapted in its
185 current state to get a spatial overview of fishing practices for the needs of MSP. Nevertheless, as there is
186 no better alternative, it continues to be increasingly used. To remedy this, several MSP experiments (e.g.,
187 in the UK, Scotland, Massachusetts, Oregon, etc.) have highlighted both the relevance and difficulty of
188 combining standard monitoring data with data acquired through fishers’ interviewees. Additionally,
189 Woolmer (2009) illustrated that data collected from fisher surveys could be as precise as that obtained
190 through automated monitoring. It is also worth noting that the choice of metrics used is rarely discussed.
191 For instance, when dealing with metrics, the implications of the observation period and scale are
192 ultimately hardly questioned (e.g., a zone may have a weak or moderate economic value on the scale of
193 the plan but could be very crucial for a small fishing community). In addition, it is striking to see that
194 ethical questions are rarely discussed, even if they concern an individual-based data. The use of this data
195 should have been limited to the context in which it was collected (e.g., maritime surveillance, management
196 of fisheries resources, etc.). If we step back a little, it becomes glaringly obvious that reflection on the
197 advantages and shortcomings of different data sets revolves again mainly around technical questions (i.e.,
198 access to data, cost of acquiring data, processing time and costs, data quality and type, pre- and post-
199 processing, etc.). These reflections may well be necessary but are probably not sufficient.

200 In contrast to numerous fisheries science studies on mobilising fishers’ knowledge for management
201 purposes (e.g., Hind, 2015), there is little literature on the mapping of fisheries for marine spatial
202 planning. Aside from generating data, this mapping also examines the role that fishers’ knowledge could
203 play in contributing to MSP (e.g., Olson, 2010; Strickland-Munro et al., 2016). This is doubly surprising.
204 On the one hand, this type of data collected for fisheries management purposes is sometimes used for

205 MSP, as is the case for routine (e.g., logbooks, VTR) or one-off (i.e., surveys) data. On the other hand,
206 “the commitment of stakeholders” is presented as being a key aspect in the “success” of MSP approaches
207 (Pomeroy and Douvere, 2008). In any event, even if we suppose that this data is pertinent in this context,
208 standard spatial data does not enable fishers to exist in the same way as other maritime actors to the extent
209 that they are excluded from nonetheless important technical choices (Jentoft and Knol, 2014). We need to
210 turn our attention to the relevance of an approach to mapping fisheries which would enable fishers to
211 contribute or even generate data themselves, in addition to existing instruments. In other words, their
212 contribution would give them the means to become fully-integrated marine *actors*.

213 This overall idea falls into the scope of asserting the value of non-scientific knowledge *in-situ* (Agrawal,
214 2012). That is to say knowledge can be asserted by the holders themselves. In doing so, it would mean
215 going beyond the standard *ex-situ* approaches which have evolved anyway, as revealed by the four waves
216 described by Hind (2015) by reducing the gap between scientific and non-scientific knowledge to
217 integrate fishers more effectively into a co-management approach (e.g., Armitage et al., 2009; Berkes et
218 al., 2000; Olsson et al., 2004). In other words, we could posit that mobilising and formalising “non-
219 scientific knowledge” (geospatial in this case) *in-situ* could contribute to a “repositioning” of fishing
220 actors, thus enabling socio-technical controversies to exist, to quote Callon et al. (2011). In any case, this
221 idea is worth developing.

222 **2.2. ...to the primacy of fishers’ empowerment**

223 This aforementioned idea can be associated with that of empowerment. Nevertheless, this notion needs to
224 be handled with care, given its many meanings which are inextricably linked to contextual use (discipline,
225 field of application, etc.), and whose use needs to be “historically situated, depending on the relationship
226 between the government and civil society” (Jouve, 2006). It is clear that the different attempts at defining
227 this term cast far and wide. Finally, the notion of empowerment is easier to define by its absence than its
228 presence (Rappaport, 1984). Without going into too much detail, different authors generally agree a
229 minimum common basis: it provides a given entity (a person, group or community) with the sufficient
230 strength and autonomy to acquire the power to act, enabling them to control their destiny (Torre, 1986;
231 Rappaport, 1987; Breton, 1989; Le Bossé, 2003). At this stage, it is worth noting that empowerment does
232 not only stand for “the power over”, but also for “the power within”, “the power with” and the “power to”
233 (Parpart et al., 2002).

234 Beyond the fuzzy boundaries of this somewhat “catch-all” notion, its popularity as well as the distrust it
235 triggers (especially when misappropriated as a “liberating empowerment” or a “liberal empowerment”,
236 endowing it with an instrumental vision more interested in “how the poor can contribute to development,
237 rather than how development can contribute to giving more power to the poor” (Calvès, 2009)) point to
238 three different possible interpretations of it: optimistic, sceptical and critical (Jouve, 2006). These
239 respectively refer to issues of overthrowing power relations and the transfer of power, the effect of social
240 dynamics calling to question relations between civil society and the state, and the government’s self-
241 organised disempowerment; three interpretations that inevitably relate to changes in political order (forms
242 of participation, types of democratic process, new public management, etc.). From our point of view, this
243 is an additional reason for using this notion, as it refers to the demand for “a commitment from
244 stakeholders” in the management of public affairs, with different possible levels of involvement that have
245 been theorised since Arnstein (1969).

246 The fact that social sciences have had a weak role to play in fisheries sciences (Urquhart et al., 2011) is
247 probably partly why the notion of empowerment has not been very present in the fisheries sector (Jentoft,
248 2005). When it has been explicitly used, the optimistic interpretation of the notion has largely taken
249 precedence, pushing towards the idea of participation or even co-management (see for example, Pomeroy
250 et al., 2003; Béné and Neiland, 2004; Nunan, 2006; Wiber et al., 2009; Jacobsen et al., 2012; Constantino
251 et al., 2012; Tsai et al., 2013; Johnsen and Hersoug, 2014). The empowerment of fishers has subsequently
252 been viewed as a pre-condition for co-managing fisheries (Jentoft, 2005). Even when it is not explicit, the
253 notion of empowerment in the fisheries sector comes to the fore via issues of knowledge and how fishers

254 can participate. In our case, the field of application is a little different because the subject is no longer the
255 management of fisheries resources but MSP. In this very specific context, the notion of power is
256 understood as a relational one (Hinchliffe, 2000). That is to say as the ability to contribute to shape the
257 relational environment here based on mapping's discourses. In other words, power is seen as the capacity
258 to contribute to shape the technical frame (data and maps) in which MSP will be done; then, within this
259 frame, as the capacity to express its own interests. Basically, MSP does not disempower fishers, but the
260 technical conditions could disadvantage fisheries if fishers if fishers were not part of what constituted
261 technical conditions. However, these two topics (fisheries management, spatial planning) should converge
262 as the development of marine spaces is likely to have more and more implications for fisheries resource
263 management. In any case, it would seem that the question is taking shape at the interfaces between fishers'
264 knowledge, empowerment and participation. This will prove useful for making a critical reevaluation of
265 MSP.

266 Under this triple entry, we rather consider empowerment as a kind of positive sum game at a certain level
267 and a zero-sum game at an infra-level. That is to say a game in which the collective as a whole gains
268 knowledge and capacity to act, but also in which some ones win more than others or more at the expense
269 of the others. We thus go back to the original concept of empowerment as simultaneously politicised,
270 collective and centred on "horizontal" relationships. Through this, we turn more towards the idea of a
271 weak or strong actor as described by P. Bourdieu, i.e., relatively independent concepts as opposed to the
272 dominant/dominated relationship structure (Payet and Laforgue, 2008). In our case, the fishers' increased
273 power to act within the scope of MSP does not consist of climbing up a rung in Arnstein's participation
274 ladder (1969) to share in the decision-making process. Instead, the aim is rather to contribute to enable the
275 expression of naturally diverse interests (including those of fishers) in the construction of a strategy that
276 promotes the public interest. Thus, the issue is more about knowledge and power that *complement* each
277 other to improve collective knowledge and, consequently, the quality of the decision taken and the
278 reasoning, which is what is at stake. In more linear terms, increased knowledge provides empowerment,
279 which in turn enables real participation beyond pretexts or tokenism.

280 This triple approach forms an interesting prism for understanding the relationships between knowledge
281 and power – relationships that often underpin critical approaches (Peet, 2000; Harvey, 2001), in a manner
282 Foucault (1980) considered inextricable. Formalising the geographical knowledge of fishers is thus
283 regarded as a *strategic lever*, or even a precondition that enables them to acquire the power to act on the
284 political scene: "It appears the old adage 'knowledge is power' gains plausibility if knowledge is
285 conceived strategically, one might say 'pragmatically', and power is understood as the ability to control."
286 (Flynn, 2007). We therefore suggest that an increase in the fishers' power to act by better asserting the
287 true value of their knowledge and better handling it would contribute to reintroducing some political
288 content into debates on MSP. To be more precise, it would help bring the political dimension of debates to
289 the fore, given that this dimension has always existed just below the surface – as is already the case with
290 Marine Protected Areas (MPAs) (see Caveen et al., 2013). Furthermore, as far as fishing is concerned, this
291 may also provide the means for being more mindful about the missing layer (St Martin and Hall-Arber,
292 2008b), with the goal of reinstating not only the areas occupied by fisheries, but more importantly, a set of
293 currently-absent values linked to fishing.

294 The fact that fishers can be empowered by formalising their geospatial knowledge *in-situ* (themselves) is
295 likely to become a priority as a study subject inasmuch as, the power relations between fishers, scientists
296 and managers usually "shifts dramatically once the data have been collected" (Jacobsen et al., 2012).
297 Although mapping and being mapped are not the same things, as Jentoft and Knol (2014) remind us, the
298 capacity to formalise this geospatial knowledge through maps can be viewed as an expression of the
299 power/knowledge relationship (Kitchin and Dodge, 2007).

300 **3. Method**

301 An experiment being conducted in (metropolitan) France provided food for thought on the potential of a
302 fisheries mapping instrument for bringing out the political dimension in MSP. The experiment is being

303 conducted in the framework of collaborative research bringing together professional fishers’
304 representatives and scientists (mainly geographers and statisticians).

305 3.1. Case-study

306 3.1.1. The situation of French fisheries in MSP

307 It is important to properly understand the context in which this experiment was conducted. We will first
308 discuss the elements that are an intrinsic part of the fishery system and then look at the system’s
309 environment.

310 Concerning the elements inherent to the fishery system, official statistics (i.e., FranceAgriMer, 2017;
311 European Commission, 2018) show first and foremost that:

- 312 - France is a small fishing country (with only 0.5% of the world’s capture fisheries),
- 313 - it has fleets mainly comprised of small vessels (two-thirds of the 4,400 vessels in metropolitan
314 France measure less than 10 m, and 80% of them less than 12 m, whereas only 1% of vessels
315 measure more than 40 m),
- 316 - fleets have primarily adopted an “artisan model” (e.g., almost three-quarters of vessels are part of
317 “small-scale fisheries”, which means vessels are out at sea for less than 24 hours),
- 318 - their activity revolves around exploiting a wide variety of species, using a broad range of
319 techniques (even if trawling is the predominant practice),
- 320 - and the sector provides 13,400 full-time sea-based fisher jobs (not including in overseas
321 territories), two-thirds of which are in “small-scale fisheries”.

322 Subsequently, in keeping with the situation at a European level, French fisheries are in a transition phase,
323 as demonstrated by the dip in several indicators according to the same sources: overall production has
324 decreased by 20% over 20 years (and by as much as a third in volume where fish market sales are
325 concerned), a third of vessel crews have disappeared over 20 years, and a quarter of jobs over 15 years.
326 However, after years of effort, marked by several fleet reduction plans to reduce fishing capacity and the
327 ensuing above-mentioned losses, the state of exploited stocks seems to be improving in the North-East
328 Atlantic (STECF, 2017; Jayasinghe et al., 2017; see also [2]). On a national level, the most recent
329 assessments indicate that almost two-thirds of stock landed in France and fished in the North-East Atlantic
330 now come from stocks considered as “sustainably exploited” in terms of volume and value (Biseau, 2017).
331 In contrast, the situation is much less encouraging in the Mediterranean (Vasilakopoulos et al., 2014;
332 STECF, 2017; Piroddi et al., 2017), despite a reduction in European catches (Colloca et al., 2017).
333 However, it is also more difficult to evaluate for French fisheries due to the small space it occupies in
334 French national fishery statistics. As a result, the aforementioned improvement remains fragile, but it is
335 also more striking than it seems given the tightening of the objective over the last few years (F_{msy}).

336 Concerning the consumption of seafood products, the trend is on the increase in France while the
337 consumption is already higher than the European average. In other words, if we look at France, the
338 contribution of fishing to domestic supply is modest and falling regularly in favour of fishery and
339 aquaculture produce imports (the trade balance deficit for seafood products was -3.7 billion Euro in 2016),
340 40% of the value of which comes from countries outside of the European continent (Ecuador, China,
341 Vietnam, India, Morocco, etc.) (FranceAgriMer, 2017). This means that other than resorting to
342 aquaculture (despite it seeming a limited option), the pressure placed on fish stocks by French consumers
343 (and more widely, European consumers) has simply extended to other countries’ waters.

344 Lastly, when it comes to the representation of fishers in France, two main structures emerge. On the one
345 hand, we find EU-recognised Producer Organisations (POs), generally set up as associations and whose
346 main role is to manage the quotas attributed to France as well as any issues concerning the marketing of
347 products. On a national scale, although fisher's membership of these 16 POs (European Commission,
348 2018) is optional, the majority of fishers are members. On the other hand, there are Fishery Committees
349 (at national and regional levels, and sometimes on a *département* level) to which fishers belong as a rule.
350 These private-sector bodies, which are financially and legally autonomous, have public-service missions:

351 representing the interests of fishers; participating in developing regulations (resource management, gear
352 use, cohabiting); partaking in economic and social actions; participating in regional public policies on
353 protecting and promoting the environment; and providing their members with scientific and technical
354 support. They also have the human resources to fulfil their role: just over 160 employees spread across 27
355 committees at national, regional and *département* levels (de Menthière et al., 2015). These committees are
356 managed by elected boards, with seats reserved for employees and company managers, the composition of
357 which is decided by the administrative authority in charge of fisheries.

358 As for the elements concerning the environment of the fishery system, two drastic shifts occurring almost
359 simultaneously have profoundly changed fishing conditions over recent years. Firstly, in the wake of the
360 commitments made by France at the 2010 Nagoya conference (Aichi Target 11), a network of MPAs has
361 been developed in under ten years, covering 23.6% of the surface area of French metropolitan waters at
362 the end of 2016 (or a surface area of about 88,000 km²) (AAMP, 2016). Most MPAs have taken the form
363 of Natura 2000 sites and marine natural parks, mainly spread along the coastal band. Other large sites off
364 the coast recently appeared at the start of 2018, bringing the surface area of MPAs to about half that of
365 French metropolitan waters. At the time being, these MPAs still have only a limited effect on fishing
366 (especially in the interim period while management plans are established and the resources for
367 implementing them made available). However, fishers are worried that the conditions placed on exercising
368 their activity will gradually become more restrictive, despite their strong involvement in the creation of
369 MPAs and sometimes active work on behalf of the government within Natura 2000 sites at sea. Around
370 the same period, fishers were also confronted with the creation of conservation areas in the waters of
371 neighbouring countries (e.g., analysis and creation of Marine Conservation Zones in the UK in 2011-
372 2012).

373 On top of this, following the EU's Climate and Energy Package and the COP 21 held in Paris, France set
374 out ambitious goals for marine renewable energy production (especially from wind farms), initially set at
375 6,000mW by 2020 (MEEDAT, 2009) and revised by France's 2015 Energy Transition Act to 500-
376 6,000mW by 2023. As a result, in 2011, 2013 and 2016, calls for tenders were launched covering seven
377 zones identified at the planning stage for offshore wind farms and spread over 700 km² of coastal fringe.
378 Four other smaller zones were also identified for testing floating wind turbines. Other economic sectors
379 have also benefited from reflection on their future and on marine development possibilities (e.g., regional
380 schemes for developing aquaculture required by France's 2010 Act on modernising fishing and
381 aquaculture). In just a few years, on top of the management measures – in the strict sense – applied to the
382 fisheries sector, fishers have seen several fronts open up that may have a strong impact on their activity,
383 especially in the coastal band, home to small-scale fisheries.

384 Finally, France's national strategy for the sea and coastal areas (MTES, 2017) has added the final touches
385 to these two drastic shifts, which is to say this was only done very recently, despite its preamble stating
386 that the “movement towards a national maritime target” was to begin in 2009. In compliance with the
387 MSP (2014/89) and Marine (2008/56) Directives, this national strategy is built around four priorities
388 (ecological transition; the blue economy; good environmental status; and the reputation and influence of
389 France) and is supposed to be set out for metropolitan France via four marine planning documents
390 (*Documents Stratégiques de Façade*) (Trouillet et al., 2011). The first two comprise the strategic
391 component and are planned for 2019 (report on the current situation and definition of strategic objectives),
392 and the last two set out the operational component and are planned for 2021 (methods for assessing the
393 implementation of the strategic component and an action plan for Framework Directive 2008/56). Since
394 2016, several guides on the content and methods for drawing up plans in France have been issued to the
395 government's technical experts in charge of steering MSP development. These guides take a very “spatial”
396 approach to MSP, with the aim of defining zones with priorities for the coming years.

397 3.1.2. Launching of the experiment

398 In 2010, at a time when the presence of MSP was just beginning to be felt, the Fishery Committees
399 (hereafter referred to as fishers' representatives) realised that they would have to defend the interests of

400 fishers both in the moribund context surrounding fishing activities and in the face of an increasing number
401 of sea areas initially earmarked for conservation, then very rapidly for developing new uses (see 3.1.1.).
402 Given that the first marine spatial plans in France will not appear until 2019, this experiment actually
403 began outside of an official MSP framework. Furthermore, in this study, MSP also refers to all the
404 deliberations that contribute to the sharing of maritime space and not only the official process in response
405 to the MSP Directive. Beyond the French case, it appears crucial to take a broad view of MSP because,
406 firstly, it seems linked to sector-based strategies and planning and, secondly, no planning process operates
407 within a vacuum or as though nothing preceded it.

408 At this moment, fishers' representatives in different regions understood well that if their role is simply to
409 account for all the fleets they represent, without possessing any data, they will not have any reliable
410 elements to back up their case on the nature of the interests at stake. Although the stakes are common for
411 all kind of fisheries, they are even more vital for small-scale fishing fleets and "artisan-based" fishing
412 more generally, as no data exists for these and they do not have the direct political lobbying power that
413 some of the big industrial ship owners have. Consequently, with no other real alternative, fishers'
414 representatives quickly realised that they had to build up a geodatabase relating to fishing practices. If
415 some regional fishing committees engaged in a work to spatialize fishing activity in order to face the
416 increasing challenge of MSP, fishers' representatives from the Pays de la Loire region decided to ask
417 geographers to define an appropriate method for spatializing fishing activities. This has been the starting
418 point of the experiment.

419 In 2010, the Pays de la Loire Fishery committee represented a little over 460 vessels at the time (compared
420 with about 380 in 2018). From the outset, after reviewing the literature on all existing mapping tools, it
421 was clear that it would be much more interesting and possible to design a method that fishers'
422 representatives could make their own and turn into "a tool for fishers by fishers". With technology in
423 crescendo mode, the underlying idea was that firstly, by understanding and controlling the way in which
424 data was produced and mapped, they would benefit fully from the knowledge it generated; and secondly, a
425 tool created and used by the fishers themselves would give them independence from third-party data to
426 which access was not guaranteed (at this time, fishers' representatives tried without success to gain access
427 to official data). So, from the beginning, this was a key element that has conditioned the whole experiment
428 (Figure 1). In this logic, the role of scientists is only to design some methods and tools that are made
429 available for fishers. Thus, fishers engage in a process that empowers them with their own valorisation of
430 their geospatial knowledge, while benefiting from a scientific framework. This may potentially lead to
431 reinforcing their position to seat at the table in MSP debates; and test this assumption is the reason to be of
432 this experiment.

433 Figure 1 Here

434 **3.2. Data collection and mapping features**

435 3.2.1. Data format

436 By comparing the different data collection methods against human, technical and financial resources of
437 fishers' representatives, the protocol quickly focused on using reporting to acquire mapping data. The
438 basic principles are as follows.

439 Every year, the fishers' representatives use their own human resources to conduct surveys on fishing
440 vessel skippers to reconstruct activity over last year's activity. The surveys developed consist of semi-
441 structured, individual, face-to-face interviews of varying length (between 15 minutes and about two
442 hours). To help with the interview, the interviewer and the responding skipper can use different aids to
443 reconstruct fishing areas as precisely as possible (logbook data, data from on-board navigation systems,
444 fishing logs, etc.). For each year, the collected data is always displayed in the format
445 "vessel*month*gear*targeted species" (Table 1). Thus:

446 - for the same grid square, a vessel fishing for a given month (one or more days/fishing trips), with
447 the same gear and targeting the same species gives rise to one occurrence only in the data table,

448 - for the same grid square, a vessel fishing for a given month (one or more days/fishing trips), with
449 either another gear, or another targeted species gives rise to a number of occurrences in the data
450 table equivalent to the number of gear/species combinations.

451 Table 1 Here

452 In other words, this table actually shows absence/presence data recorded for a vessel, a month (even for
453 one day), a type of gear (even if it is used just once) and a species (even if targeted just once, out of the
454 three main species fished; see hereafter). On this basis, it is evident that the data cannot be used to
455 precisely describe fishing effort; they were not intended for this use. The individual data is collected for
456 one grid square (representing about three nautical miles per side) based on the subdivision of ICES [3]
457 statistical rectangles. The size of the grid square was determined empirically during a series of test surveys
458 conducted in 2010 in a geographical sub-sector (47 vessels were surveyed), and was the result of three
459 combined elements: (i) ensuring a certain level of confidentiality was maintained concerning fishing areas
460 (especially for passive gear), (ii) finding a compromise between precision/accuracy linked to the memory
461 of the responder and the aids s/he used to help reconstruct his/her activity, (iii) accounting for the time it
462 took to conduct the survey and aiming for the financial sustainability of the experiment. To further allow
463 for interoperability, gear typology was based on the EU's Data Collection Framework (DCF) [4] and the
464 nomenclature for names of species came from the Aquatic Sciences and Fisheries Information System
465 (ASFIS) database of the Food and Agriculture Organization (FAO) [5]. The established protocol enables
466 an unlimited number of gear types to be entered, but only a maximum of three targeted species were
467 selected in the surveys. The data characteristics enable fishing areas to be mapped for a vessel or a group
468 of vessels, depending on different parameters that offer several combinations: the gear used, the targeted
469 species, the month and other vessel-related parameters (home port, length, etc.). As a result, both fleets
470 (defined in several ways) working in a given area and spatial-temporal dynamics can be identified. To
471 attain the study's original objective, it is agreed that the data produced belongs both to the fishers
472 (respondents) and their representatives.

473 As with any data from reported surveys, this data has limitations that are difficult to quantify due to the
474 context of the survey (current relevance, tiredness of respondents, etc.) or inaccurate reports (intentional or
475 not). To reduce the impact of such factors, the protocol planned for data to be double-validated by the
476 respondents: on an individual basis by sending the maps summarising individual reports to each
477 respondent; and on a collective basis through meetings where maps combining individual reports from
478 each port (or group of ports in some cases) are presented and discussed. Although not a failproof
479 guarantee, an important awareness-raising effort is made before conducting the surveys to explain that an
480 inaccurate report can have a real impact on a respondent (e.g., a vessel could be excluded from a group of
481 vessels affected by this or that project, or the impact could be underestimated if a fishing area was
482 reported as being broader than it was in reality).

483 3.2.2. Options to reduce risks

484 From a data collection viewpoint, three main risks were identified:

- 485 - the uncertainty that fishers' representatives would have the resources over time to survey all the
486 vessels every year;
- 487 - the possibility of fishers growing tired of being surveyed every year, especially as numerous
488 surveys are already conducted on them;
- 489 - a human error committed by the interviewers during an interview and/or when recording data.

490 To minimise the first two risks, in 2012, it was decided that surveys would be conducted according to a
491 sampling design. After revising the sampling strategy several times, and with the support of statisticians
492 who joined the other scientists in this experiment, surveying activities are now implemented as follows:

- 493 - To begin with, two years of "exhaustive" surveying (i.e., conducting surveys with the aim of
494 surveying all fleets, although in reality this thoroughness goal is obviously never reached),
495 principally to establish the most solid baseline possible;

- 496 - Then, two years of surveying following a sampling plan designed after performing several
497 statistical tests – based on re-sampling without replacement (Monte-Carlo method) – on the
498 exhaustively-collected data. The chosen sampling design is a stratified random sampling one with
499 proportional allocation. It is based on three principles:
- 500 ○ Stratification: this is one of the most powerful tools in sampling design. Here we stratified
501 our population on the primary gear (category and type), a geographical criterion (port or
502 group of ports) and the length segment,
 - 503 ○ Simple random sampling (without replacement) from the sample of vessels per stratum:
504 each vessel has the same probability of being surveyed,
 - 505 ○ Proportional allocation: the number of vessels to be allocated per stratum is proportional
506 to the sample size of vessels in the fleet. This is determined using sampling survey theory
507 (Tillé, 200; Ardilly, 2006; Lumley, 2010), depending on the rate of precision chosen in
508 the sampling design – between 5 and 10%. For instance, for an estimation of 20% of the
509 proportion of vessels operating in a grid square (e.g., density indicator, see further on) and
510 a precision of 5% in the sampling design (a 95% confident interval for the whole
511 population might be 15% to 25%).
- 512 - Then, a year of exhaustive data collection is again done, and so on.

513 For exhaustive surveys, the interviewer takes an opportunistic strategy, whereas for surveys based on a
514 sampling strategy, they have to conduct interviews for a specific list of randomly selected vessels (except
515 for the first sampling plan, where the population to be surveyed has been divided into three sub-
516 populations, each having to be surveyed in one of the three years) and can fall back on an additional list if
517 necessary.

518 Where the first and third above-mentioned risks are concerned, although the survey data was initially
519 entered manually into spreadsheets, entry is now performed via an online application specially designed
520 for the purpose (in addition to an off-line version with less functions, which is only used if the application
521 is not available online). It enables automated data collection via a map-based data entry interface
522 (Figure 2), thus limiting the risk of error during this operation. Available and in use since 2014, the
523 application has two logic components:

- 524 - a server divided into:
 - 525 ○ a map-based server application (geoServer);
 - 526 ○ a database server (PostgreSQL);
 - 527 ○ a back-end application offering REST API for storing data (Java technology and the Spring
528 software suite).
- 529 - a client: a front-end HTML/JavaScript application based on Ext JS, GeoExt and OpenLayers
530 components.

531 Figure 2 Here

532 During the survey, using the relevant cartographic background(s) and by displaying the grid developed for
533 this experiment, the interviewer selects one or more grid squares for a given month and enters the gear and
534 target species using drop-down menus. For the same month and grid square (or group of grid squares), the
535 entry operation is repeated as many times as required for entering all gear/species combinations. The
536 procedure is the same for each of the other months. Functionalities have been developed to indicate when
537 any incompatible gear/species combinations are selected. At the end of the survey, the application enables
538 one or more maps selected by the interviewer to be generated – to show the responder the results
539 immediately – along with a “.csv” file containing all the survey data. The data remains editable, along
540 with the procedures defined for compiling results, for as long as the surveying period is still underway for
541 a given year.

542 Now that this application provides all the functions for collecting data, managing surveys and archiving,
543 work is about to start. It will cover developing a new version which will integrate the data processing

544 functionalities currently handled by external GIS software. A series of seven indicators has been
545 developed to harmonise and standardise the data processing handled by fishers' representatives (Table 2).
546 They have already been made available to fishers' representatives in the form of Structured Query
547 Language (SQL) queries. These queries will soon be available in the application so that processing can be
548 performed directly without any specific GIS knowledge being required. The plan is also to develop other
549 indicators, firstly to study potential intra-and inter-annual variabilities (differences between indicators
550 calculated each year, variability in concentration of activities, etc.), and secondly to summarise and
551 compile the variabilities (multi-year indicators: means, totals, etc.).

552 Table 2 Here

553 All the scientific and technical aspects of the protocol for collecting and processing data are described in
554 technical documents in the form of information sheets (how to conduct a survey, conditions for and limits
555 of using indicators, sampling plan, etc.) for fishers' representatives in charge of implementing the
556 protocol.

557 **4. Results**

558 Firstly, the results had a positive outcome in terms of the experiment generating new knowledge.
559 Launched in 2010 by scientists and fishers' representatives from the Pays de la Loire, this experiment has
560 grown following the successive widening of its geographical scope: Brittany in 2012, Hauts-de-France in
561 2013, Normandy in 2014, Provence-Alpes-Côte d'Azur in 2015, Charente-Maritime in 2016. This means
562 that the fishing practices of vessels represented by these six Fishery Committees can now potentially be
563 mapped, i.e., about 3,250 vessels or three-quarters of French metropolitan fleets or more than 90% of the
564 landed value at fish auctions. At the start of 2017, a little over 4,800 surveys had been conducted and since
565 then, around 6,000 surveys have been conducted in total (Table 3). It is difficult to estimate the exact
566 number for at least four reasons: (i) the surveys conducted in 2017 (on activity during 2016) have not yet
567 been compiled; (ii) given that the different Fishery Committees did not all become part of the experiment
568 at the same time, the surveys for all the Committees are not yet synchronised in terms of years for
569 exhaustive data collection and years for collection based on successive sampling plans; (iii) exhaustive
570 surveys are never actually exhaustive (the survey response rate has reached 65% in total), and neither are
571 the surveys based on sampling designs (88% response rate); (iv) a falling trend in the number of fleets
572 requires baselines to be revised each year. The data produced and the maps they create (e.g., Figures 3 and
573 4) break new ground in terms of the type and scale of the experiment (both geographically and
574 temporally).

575 Table 3 Here

576 Secondly, another positive outcome of the results is that they suggest that this type of a experiment could
577 introduce politics into MSP. A rundown based on a survey by questionnaires filled-in by the different
578 regional Fishery Committees (winter 2017) indicated that the data had already been used in more than 60
579 instances when fishers and other actors worked together, especially on issues concerning offshore wind
580 farm projects, new concessions for extracting marine aggregates, and MPAs. In real terms, by ensuring
581 that the stakes for fisheries were better taken into consideration by mobilising knowledge produced by
582 fishers, certain layouts for placing wind turbines within farms and corridors for carrying electricity
583 between the farms and the mainland were modified; socio-economic diagnostics were improved for
584 MPAs; and the interests of fleets were put forward during discussions in the aftermath of the Brexit vote.
585 In relation to the above, the discussions underway between government agencies and fishers'
586 representatives on launching an analysis of the risk that fishing poses to Natura 2000 sites are an
587 interesting case in point. Thanks to the data at their disposal, fishers were able to participate in technical
588 discussions. In other words, they were able to take part at an earlier stage and gain access to what until
589 then had been a "black box" conditioning the later-stage decision-making process. In fact, given the
590 method chosen to describe this fishing risk on a national level, fishers' representatives heeded the advice
591 of scientists and decided not to comply with a general request for use of the data they had acquired.

592 Instead, they opted to lay down conditions for a case by case analysis (depending on the size of sites, the
593 shape and scope of habitats, etc.). As a result, we can see that this experiment provides a variety of
594 advantages: for fishers – of course – who have data and maps to promote their interests; for other actors,
595 who can take fishers’ interests into account; and for MSP.

596 Figures 3 and 4 Here

597 **5. Discussion**

598 Looking at the first result, despite the positive outcome, it should be noted that not all French fleets
599 participated in this initiative. This is the case in the following regions: Nouvelle-Aquitaine (in part),
600 Occitanie and Corsica. Although this is difficult to explain inasmuch as no steps have been taken to
601 encourage the relevant Fishery Committees to join in this initiative (and consequently, they have not been
602 able to express any form of refusal), the most probable reasons are that these three committees have not
603 felt the need or not wished to take part. The first of these reasons is easy to understand, particularly as one
604 of the committees will soon be participating in the experiment due to the arrival of the very first wind farm
605 projects in the geographical area where their fleets operate. In contrast, the second possible reason is a
606 more sensitive one, potentially suggesting political tensions between committees. It is worth highlighting
607 that this experiment is not limited to regional committees because for many years now, the National
608 Fisheries Committee and five POs have been associated with it and participate in collaborative work to
609 varying degrees.

610 As for the second result, which is a logical outcome of the study’s original idea, the issue of access to
611 produced knowledge can be both an advantage and a constraint. The interest of this kind of approach is
612 namely that the fishers and their representatives keep a hold on the raw data (in other words, the data
613 belongs to them). It not only helps them to be invited to the discussion table, but also enables them to take
614 part in debates, with arguments backed by data. The advantage is that fishers are placed in an *empowered*
615 position as opposed to a powerful one: they are able to partake in bilateral or multilateral discussions with
616 other maritime actors. However, it is also a constraint because inevitably the data produced is not openly
617 available to the public and cannot automatically be accessed by third parties, even though information
618 based on the data is shared in an MSP context. At the same time, official data used in most MSP processes
619 is not available anymore (e.g., VMS data); an issue we came up against in the context of this experiment
620 (see below). More generally, this accessibility issue fundamentally questions the role of public authorities
621 in the production of data against the backdrop of the withdrawal of funding for a certain number of
622 missions. This can actually lead to an ambiguous situation where on the one hand, public authorities off-
623 load onto actors, who have to compensate for this lack of funding, and on the other hand, they reproach
624 these same actors for organising themselves in response. The “neutrality” card is often played when it
625 comes to the production of data. With regards to this, the status of the data acquired through an
626 experiment such as the one described in this paper raises questions similar to the ones on using data
627 generated by citizen sciences (as opposed to “sovereign data”, which is naturally considered as “neutral”
628 by the sovereign authority) and the possibility of bypassing opposition via a hybrid alternative (Goodchild,
629 2009). This experiment has not always been held in high esteem, especially by certain government
630 agencies or subcontractors (who may have felt that they were being robbed either of some of their
631 prerogatives or some of their contracts). But its aim has always been to develop a complementary system,
632 specifically dedicated to MSP, and not to replace existing systems that have their own place and
633 legitimacy. It would seem, however, that the attitudes of government agencies are somewhat changing..
634 This is due in part to the fact that in developing marine plans, they are not only faced with a lack of
635 standard data to describe fishing activities, but they also need to take all interests into account, including
636 those of the fishing sector.

637 Important scientific work has been carried out through this experiment over the last few years in terms of
638 building and improving the tools and methods used: survey protocol, software application, sampling
639 strategies, indicators and mapping, etc. This said, there is still much to be done to improve this
640 experiment.

641 Firstly, from a quantitative point of view, a certain number of organisational choices were made
642 concerning surveys as the experiment developed, and these were sometimes hampered by material
643 circumstances (e.g., a certain type of survey was not conducted by one of the committees for one year due
644 to a shortfall in resources, or simply because they refused to do so). Work is still needed to be able to
645 jointly use data acquired on different bases (e.g., exhaustive surveys or using several sampling plans) or to
646 evaluate the usability of data sets in relation to years and regions which produced weaker scores.
647 Similarly, the issue of missing data is also relevant for data acquired according to the more recent
648 sampling plans based on stratified sampling with proportional allocation. If we step back a little, the work
649 to be done leads us to another central element of this experiment: the fact that the intermediary assumption
650 on the empowerment of fishers and their representatives (by mastering a technical mapping instrument
651 that enables them to benefit fully from the knowledge it produces) has only been partially proven. In fact,
652 from a purely simplistic and perilously naïve point of view, the empowerment process will only end when
653 collaborating with scientists is no longer worthwhile for fishers; in other words, when all their scientific
654 questions have been answered. However, the numerous discussions and even disagreements witnessed
655 over the last few years between scientists and fishers' representatives reveal that representatives
656 sometimes refuse to follow the recommendations of scientists due to a lack of thorough understanding
657 (e.g., the refusal mentioned above concerning a survey based on a sampling plan). The above clearly
658 shows the commitment of fishers' representatives (and fishers themselves, on another level) to gradually
659 come to grips with how data is produced and represented. This said, we must not presume that this
660 experiment is based on a one-way relationship where scientists have the authority and knowledge every
661 which way. The relationship is actually two-way because fishers not only take possession of scientific
662 know-how, but also contribute to it – they are co-developing it.

663 As for the quality of collected data (which refers back to the previously-raised issue of neutrality), there is
664 still important work to be done here too. For apparently confidential reasons, it has not been possible until
665 recently to begin work on comparing data acquired through this experiment with data from official
666 sources, which has unfortunately remained inaccessible (e.g., VMS). In addition, we cannot naturally
667 assume that official data have no limitations, especially as they were only collected from a small portion
668 of the fleets. We can see that more research is also required here, even though this issue is more complex
669 than it first seemed when viewed from another angle. It is complex because first of all, as the data is used
670 to defend the interest of fishers in discussions on the sharing of maritime space, fishers would make their
671 case worse if the data was of bad quality. As a result, it is for many a question of knowledge
672 transmission/acquisition as well as of the legitimacy of the body conducting the surveys (and of those
673 responding to them, from a fisher's perspective). It is probably also worth envisaging quality over the long
674 term by considering the whole experiment as a process, rather than just regarding the data as a finished
675 product. Two main lessons can be learnt from this experiment: (i) the fact that surveys are conducted by
676 fishers' representatives is a prerequisite in terms of feasibility, but also quality (e.g., few errors or
677 approximations spotted in individual reports during collective validation); (ii) the duration of the
678 experiment obviously favours quality data because it gradually limits or mitigates any biased reporting
679 (e.g., the longer the experiment goes on for, the less important the context in which the survey is
680 conducted becomes). The issue is also complex because, secondly, given the ultimate hypothesis of this
681 experiment (i.e., that the empowerment of fishers will enable them to become "real actors" with a
682 minimum power due to their possession of their own data the issue of the quality of geographical
683 information needs to be viewed not only in terms of "internal" quality, but also of "external" quality (see
684 Devillers and Jeansoulin, 2006), and probably by additionally integrating the capacity of producing it. In
685 this regard, the experiment relates to works on citizen sciences, which encourage notions of data quality,
686 legitimacy of sources and levels of uncertainty to be reviewed (Mericksay and Roche, 2011).

687 **6. Conclusion**

688 The case of fisheries is an interesting one because it invites us to take a more critical look at MSP as it is
689 implemented today, i.e., as a process that is both implicitly dominated by "technical" aspects and heavily

690 conditioned by strategies developed “outside” of the MSP context, namely in sector-based policies and
691 planning. These predominant influences are encouraged by the supposedly paradoxical convergence of
692 two opposing concepts of sustainability, one favouring economic growth (namely by developing marine
693 renewable energies) and the other, marine conservation. The place given to the “spatial” aspect is one of
694 the points in common, which is a particularly critical facet for fisheries, and consequently for MSP,
695 because its capacity for integration has levelled out. It is of utmost importance that all kinds of viewpoints
696 and interests be expressed in MSP, and it seems equally crucial to be able to do this explicitly, i.e., without
697 technical issues being used as a screen for expressing dominant interests. This is why it seems vital to
698 (re)position technical issues within the scope of democratic debate, rather than cutting loose from the
699 “technical” aspect or considering it as a tool for steering democratic debate. In this respect, the outcomes
700 of this experiment, which is still in progress, are already positive, offering one option among others for
701 further exploration that is both highly promising and which raises new questions. These efforts will help in
702 the rebalancing of the “technical” and the “political” dimensions of MSP, and maybe towards a more
703 strategic than spatial process, mainly more participatory and democratic.

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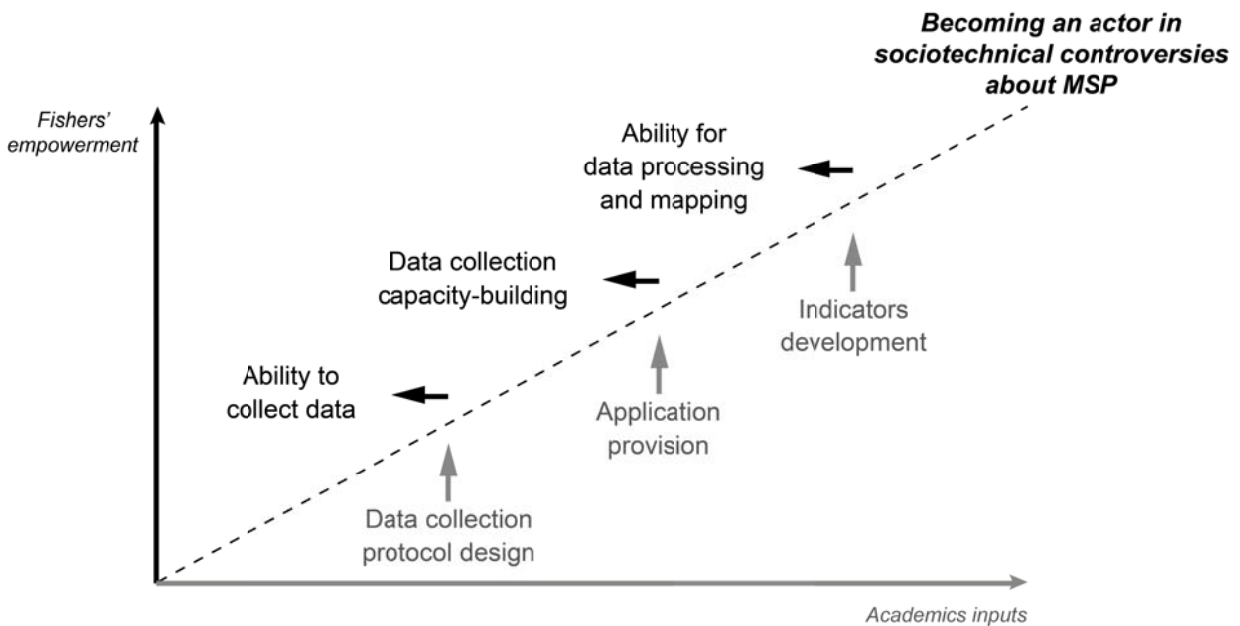
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1015 Figure 1: Fishers' empowerment through map-making: an experiment



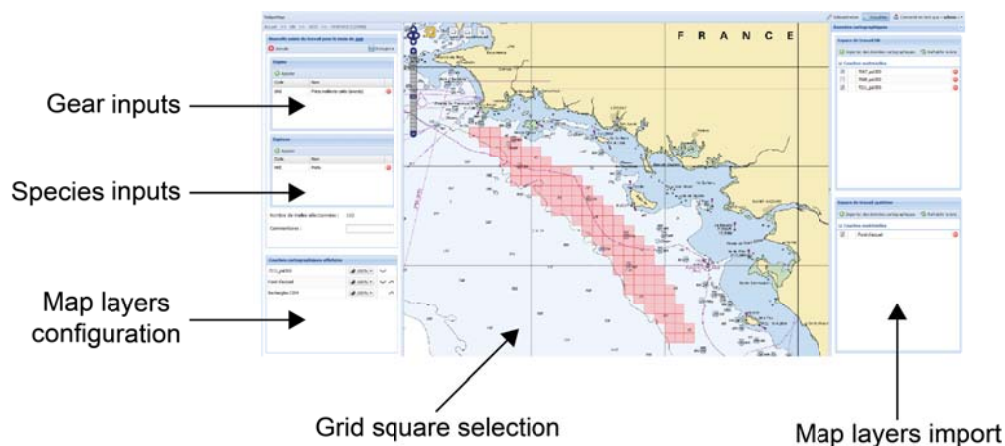
1016

1017 Table 1: Example of the data collected

Vessel ID	Month	Year	Grid ID	Gear	Species
xxxxxx	4	2010	2722E7K8	OTB	SOL
xxxxxx	4	2010	2722E7K9	OTB	SOL
xxxxxx	4	2010	2722E7L5	OTB	SOL
xxxxxx	4	2010	2722E7L6	OTB	SOL
xxxxxx	4	2010	2722E7L6	OTM	SOL

1018

1019 Figure 2: Application used to collect data



1020

1021 Table 2: Indicators used for processing

Indicator	Brief description
Density	Number of different vessels in a given grid square (number of vessels)
Frequency	Number of months during which vessels work in a given grid square (number of months)
Intensity	Total number of months a fleet works within a given grid square (number of vessel*months)
Spatial dependency	For one fleet, the share of a grid square (or zone under study) compared to all the grid squares where vessels work (percentage)
Temporal dependency	For one fleet, the share of a grid square (or zone under study) compared to all of the months vessels worked (percentage)
Intensity dependency	For one fleet, the share of a grid square (or zone under study) compared to all of the vessel*months (percentage)
Economic dependency	For one fleet, by combining with sales data (other sources), the share of the turnover generated within a grid square (or zone under study) compared to overall turnover (percentage)

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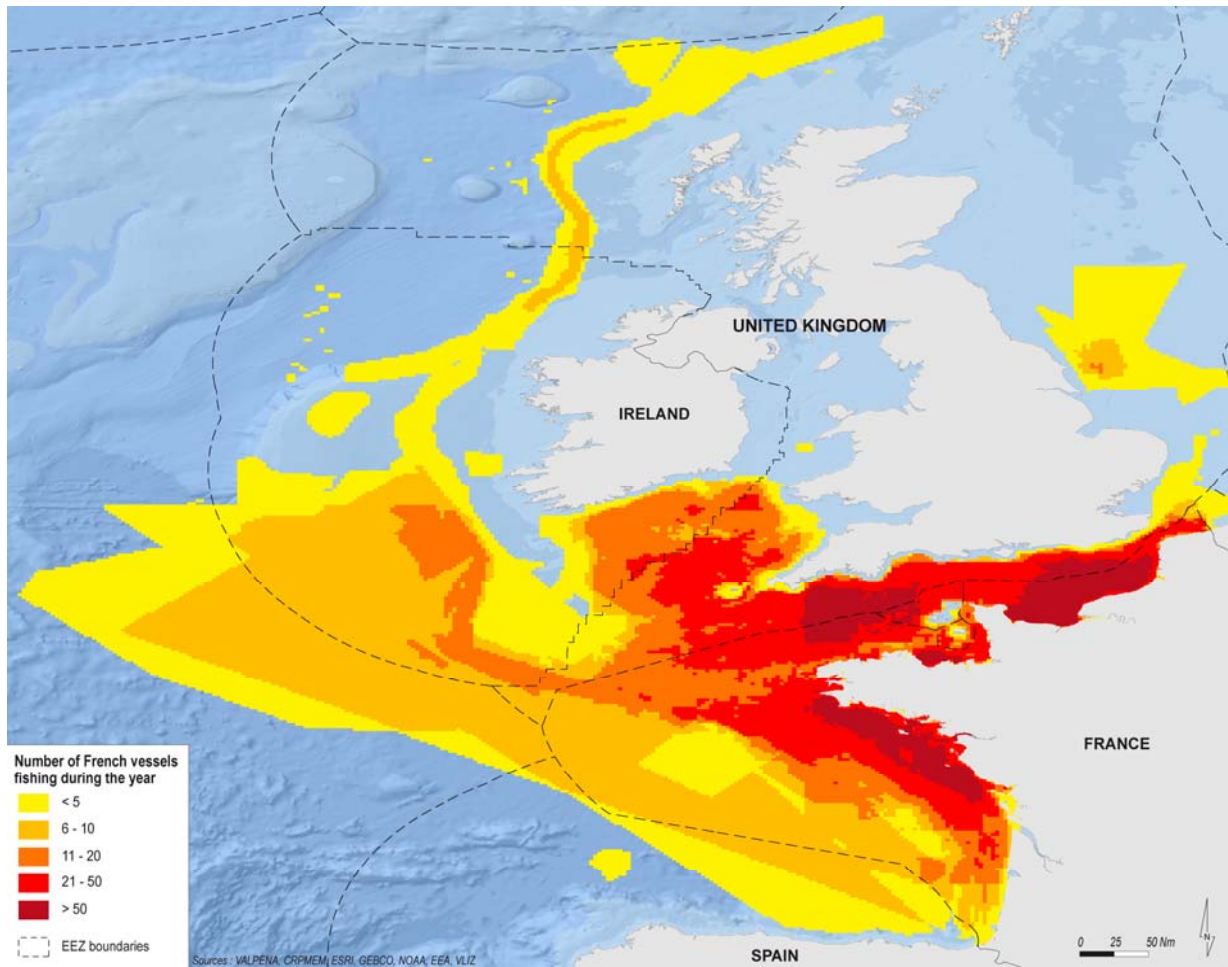
1023 Table 3: Results of the conducted surveys

		2010	2011	2012	2013	2014	2015	2016
Pays de la Loire	Surveys	359	280	90	97	96	102	90
	Score	77,7%	64,8%	69,8%	75,2%	74,4%	97%	79,6%
Bretagne	Surveys		391	611	1,035		343	245
	Score		30,9%	77,7%	78,5%		97,2%	71,0%
Hauts-de-France	Surveys			139	137	61	61	86
	Score			83,2%	85,6%	98,4%	100%	65,6%
Normandie	Surveys				307	476	213	108
	Score				52,8%	82,8%	89,1%	57,4%
Provence-Alpes-Côte d'Azur	Surveys							433
	Score							73,0%
Charente-Maritime	Surveys							210
	Score							88,2%
	TOTAL	359	671	840	1,576	633	722	1,172

NB: The years correspond to activity data (the surveys were conducted at $n+1$). The grey squares represent years during which no survey was conducted: either because the committee had not yet joined this initiative, or due to lack of resources (in only one case). The indicated targets correspond to vessels to be surveyed and consequently, do not correspond to the total number of vessels in fleets for the years when a sampling plan was followed. The surveys conducted appear in italics: either conducted according to a sampling plan, or as a "mixed" version (i.e., following a fusion between two committees, one conducting an exhaustive survey and the other using a sampling plan: Normandy in 2015). In any case, the sampling strategy changed over time (there have been three different sampling plans) before becoming more established in 2016.

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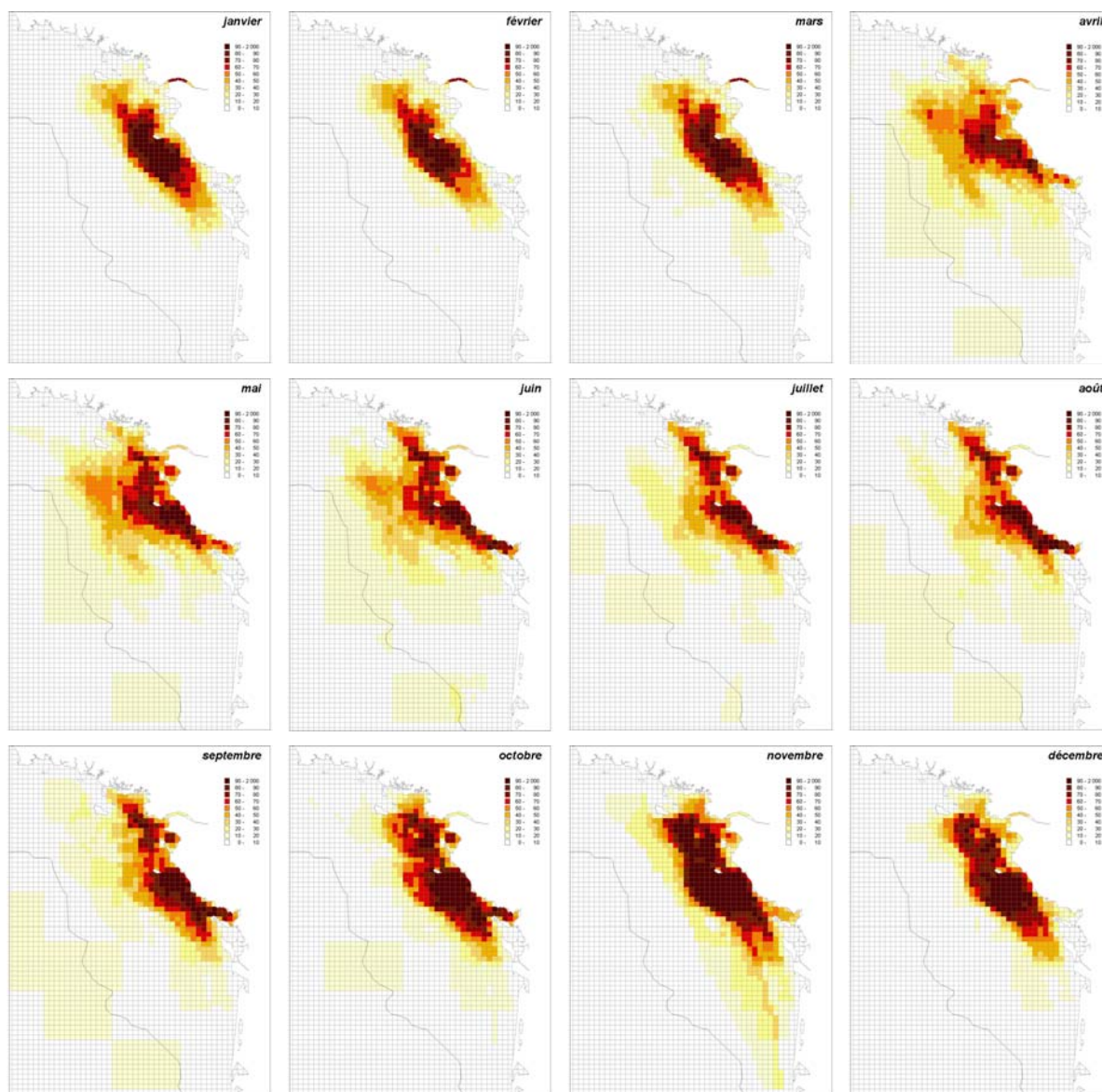
1025 Figure 3: First example of a map created using data from the experiment



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1028 Figure 4: Second example of a map created using data from the experiment



1029