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7 **Aligning with dominant interests: the role played by geotechnologies in the** 8 **place given to fisheries in marine spatial planning**

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12 Abstract: This study explores how geographic information technologies – or geotechnologies – are used in spatial
13 planning processes, and more specifically, marine spatial planning (MSP) processes. MSP has the double advantage
14 of being both fertile ground for a lively epistemological debate on positivism and associated with a unique space
15 (maritime space) that is frequently reduced to a simple planar space. We investigate the role of geotechnologies in
16 MSP processes and in particular, their capacity to reinforce power relationships by aligning spatial representation
17 norms with dominant interests, which are then expressed through zoning. To do this, we have decided to look at the
18 different cases involving fishing activities, given that they are resistant to zoning and infrequently regarded as a
19 priority in MSP. This has required us to propose a method which draws on the actor-network theory and the field of
20 critical cartography. On this basis, we perform an initial analysis of the fishery “inscriptions” produced by
21 geotechnologies, by examining the content of 43 current marine spatial plans from around the globe. We conclude
22 that fisheries are generally not inscribed, or incorrectly inscribed (i.e., data and representation methods are
23 unsuitable), and as a result, fisheries align themselves more often than not “by default”. We go on to discuss the
24 results and suggest a few ways in which dominated interests, including fisheries, can be taken into account more
25 effectively. Aside from fisheries, dominated interests more generally include interests that are either not inscribed or
26 incorrectly inscribed, such as non-commercial “uses” of maritime space, non-use, itinerant activities, or elements not
27 considered as a priority for conservation objectives.

28 Keywords: Marine spatial planning, Fisheries, Geo-technologies, Actor-network theory, Critical cartography

29 Highlights:

- 30 ▪ Geotechnologies produce “inscriptions”
- 31 ▪ “Inscriptions” enable representation norms to be aligned with dominant interests
- 32 ▪ This study focuses on fishery inscriptions in marine spatial planning
- 33 ▪ This study draws on both actor-network theory and critical cartography
- 34 ▪ Fisheries get aligned by default in MSP as they are mis-inscribed or not inscribed

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36

37

1. Introduction

38 In view of the technological leaps and bounds made over the last few decades, as well as the
39 spatial turn (Cosgrove, 1999), it is hardly surprising that geographical information technologies
40 (e.g., spatial database management systems, mapping tools, geovisualization tools, geographic
41 information systems (GIS), models, geoportals, spatial data infrastructures) – hereafter referred to
42 as “geotechnologies” – are ubiquitous in territorial planning processes. Ever since the influence
43 that cartography has on society was highlighted (Harley, 1988, 1989; Monmonier, 1991; Wood,
44 1992), studies have gradually turned their attention to their role. Studies have notably looked at
45 the relationships between territorial planning and spatial data (e.g., Dühr & Müller, 2012;
46 Zaucha, 2012), cartography (e.g., Carton, 2007; Dühr, 2007; Jensen & Richardson, 2003;
47 Söderström, 1996; Zonneweld, 2011), GISs (e.g., Aitken & Michel, 1995; Wegener, 1998),
48 geovisualization (e.g., Jiang et al., 2003; Slocum et al., 2001; van den Brinck et al., 2007),
49 geoweb (e.g., Li et al., 2013; Mericskay, 2013) and, more recently, geodesign (e.g., Li &

50 Milburn, 2016; Lenferink et al., 2016). Links with planning would probably appear to be even
51 stronger in geodesign (whose connection with decision-making systems or tools¹ has been
52 established – see Wilson, 2015) if we look at the definition given by Goodchild (2010): “(...) *geodesign is planning informed by scientific knowledge of how the world works, expressed in*
53 *GIS-based simulations.*”
54

55 At the crossroads between the science-technology continuum and governance, geodesign is part
56 of a positivist “renewal” around an evidence-based approach which on the one hand, raises the
57 issue of the link between scientific knowledge and decision-making, and on the other hand –
58 specifically where planning is concerned (evidence-based planning) – evokes two opposed
59 concepts of space: absolute or relational (Davoudi, 2006; Davoudi, 2012; Davoudi & Strange,
60 2009; Dühr, 2007; Faludi & Waterhout, 2006; Krizek et al., 2010). This return to favor of
61 positivism in the field of planning tends to highlight its *false disappearance*, hence it being
62 viewed as “*an apparent countermove*” (Faludi & Waterhout, 2006). In addition, beyond a
63 probably less than constructive opposition between technophiles and technophobes (Douay,
64 2016), these reservations actually invite us to step back from “(...) *the over-emphasis on*
65 *rationality and objectivity, and the over-confidence in the power of reason to control time and*
66 *space*” (Davoudi, 2012).

67 Ignoring these reservations would inversely amount to substantiating two things. First, that
68 scientific facts *alone* (and indirectly, scientists or “experts”) are qualified to determine and
69 legitimize the “best solution”, thus relieving the decision-maker of all responsibilities and
70 depoliticizing the decision – at least in appearance – much like techno-managerialism (Luke,
71 1990)², and leading in certain ways to a governance by numbers (Rose, 1991). Second, that space
72 can be reduced to its role as a mere container, thus neglecting the importance of social aspects
73 when considering spatial issues (see Dühr, 2007). At the heart of all this is the nagging question
74 of the relationship between knowledge and power and, notably, the place occupied by space in
75 this knowledge/power relationship.

76 These reflections mixing science-technology, planning and power are particularly worth
77 developing in the case of marine spatial planning (MSP), defined as “(...) *a public process of*
78 *analyzing and allocating the spatial and temporal distribution of human activities in marine*
79 *areas to achieve ecological, economic, and social objectives that usually have been specified*
80 *through a political process*” (Ehler & Douvère, 2009). It has emerged on the international scene
81 at the start of the 2000s (Douvère, 2008; Gilliland & Laffoley, 2008; Douvère & Ehler, 2009).
82 Since, it has been introduced into an ever-increasing number of national planning initiatives in
83 relation for a growing demand for space at sea (marine energy, mineral extraction, offshore
84 aquaculture, conservation, etc.). Its newness has not yet enabled it to experience the same
85 developments as land planning and, given that its roots delve into different scientific fields, it
86 clearly leans towards the modernist planning model or, in other words, a quantitative and
87 rationalist model (Kidd & Ellis, 2012; Kidd & Shaw, 2014).

88 There are two main reasons for looking more closely at the case of MSP. First, MSP can be
89 fertile ground for lively epistemological debate on the issue of positivism, accentuated by the

¹ i.e., decision support systems/tools, planning support systems/tools.

² Luke (1999) refers to eco-managerialism, namely the management of natural resources by combining technologies and managerial approaches.

90 broad range of scientific disciplines concerned. MSP seems to be often reduced to a technical
91 protocol, largely dominated by natural scientists using tools, models and approaches of
92 conservation planning (see Caldow et al., 2015; Pınarbaşı et al., 2017). Second, maritime space,
93 by its very nature, tends to be reduced to a simple Euclidean planar space (uses are mostly non-
94 permanent, there is no materialized borders and limits, etc.), sidelining a post-modern approach
95 that recognizes the “triplicity of space” (Lefebvre, 1974) and its relational character (Murdoch,
96 2006), despite all the advantages it brings. Maritime space equally appears less “equipped” (in
97 the sense provided by Vinck, 2009) than terrestrial space. Tensions between these two
98 conceptions of space can have important consequences for certain activities or issues at sea that
99 are more difficult to characterize and to map. These last years, more critical research has been
100 developed and points henceforth to a number of tricky elements revealed by the implementation
101 of the MSP, such as its instrumental scope (Kidd & Shaw, 2014), its conception of space (Jay,
102 2012; Jay, 2018) and politics and power that play in such processes (Boucquey et al., 2016;
103 Fairbanks et al., 2018; Flannery & Ellis, 2016; Flannery et al., 2019; Tafon, 2017). These
104 elements lead to making MSP a fertile ground for studying the role of geotechnologies in
105 planning.

106 Considering the different modes of planning and the diversity of epistemological foundations on
107 which they rest, exploring the contribution of geotechnologies to MSP processes offers a novel
108 insight into the field of planning studies in general. Being thus incorporated into the field of
109 Science and Technology Studies (STS), the challenge is now to identify how geotechnologies
110 operate *within* and *on* MSP processes through the “inscriptions” they produce, which in turn set a
111 socio-technical network in motion. In this context, an “inscription” refers to an artefact produced
112 by geotechnologies (mainly geographic information, maps and other types of visualization in this
113 particular case), then formatted, interpreted and exploited in “translation”³ centers: “*Inscriptions*
114 *are information that can be combined and evaluated, enabling these centres to decide on and*
115 *launch strategic actions that activate the [socio-technical] network*” (Callon, 2006a).

116 There are multiple ways of exploring this question. In this paper, we focus more specifically on
117 the form inscriptions take and their meaning in the context of MSP processes. To do this, we also
118 draw on critical cartography approaches. We propose to test the hypothesis that geotechnologies
119 reinforce the power relationships in the context of MSP through the inscriptions they produce or
120 use. In other words, they are carriers of one of the forms of injustice identified by Young (1990),
121 namely cultural imperialism defined as “[the] *establishment* [of its experience and culture] *as the*
122 *norm*. (...). *The dominant group reinforces its position by bringing the other groups under the*
123 *measure of its dominant norms*.” Additionally, as we are dealing with the spatial aspect of this
124 particularly sensitive form of injustice (Harvey, 1992), the idea is to investigate how
125 geotechnologies enable spatial representation norms to be aligned with dominant interests in
126 terms of MSP as they converge through zoning. To test our hypothesis, we chose to look more
127 specifically at inscriptions relating to fisheries in the different MSP initiatives, through the lens of
128 data, metrics or different types of cartographic representation used or produced to characterize
129 fisheries in MSP. Similarly, for this research, instead of conducting an in-depth study of one or a
130 few MSP processes and drawing some general conclusions, we have knowingly decided to adopt

³ In keeping with the actor-network theory, “translation” is a negotiation process between parties, leading to situations where they align themselves (or not) around a statement and the associated solutions.

131 a method based on a comparative approach, focusing on identifying regularities or specificities
132 within all MSP initiatives from around the globe.

133 This decision to concentrate specifically on fisheries is justified by the fact that fisheries currently
134 find themselves in a critical situation in several ways (Jentoft & Knol, 2014). First from a spatial
135 perspective – given that fisheries are scattered, variable in time and space, and only occupy a
136 space for the time it takes to fish – being inscribed by geotechnologies is as complicated as it is
137 meaningful, even in a simple planar space. Second from a social perspective, fisheries are not
138 only imbued with values other than economic values (e.g., identity-related, cultural), which evoke
139 the way in which fisheries are problematized, but are also marked by a diversity that makes it
140 seemingly impossible to federate these multiple interests around common priorities (HM
141 Government, 2014; Symes, 2005). Third and last, from a political perspective, fisheries are not
142 regarded as one of the stakes acting as a driving force for MSP, but are nevertheless often in
143 competition with these stakes (e.g., offshore wind energy). They are thus forced to suffer
144 negative impacts (Jones et al., 2016), in a way that resembles agriculture in outer urban areas:
145 “(...) *like agriculture on the urban fringes which frequently found even its best farmland*
146 *sacrificed to urban, industrial and transport developments under the argument of overriding*
147 *national need, so too the fishing industry - a small, contracting economic sector - is conscious of*
148 *the weakness of its arguments in terms of greater economic gain should the allocation process*
149 *involve a bidding war with other economic competitors.” (Symes, 2005). In other words,*
150 *fisheries, and notably small-scale fisheries, are in a tricky situation when it comes to MSP*
151 *(Jentoft, 2017) because they are often difficult to map and are considered as relatively small*
152 *players when compared to large-scale fisheries or other maritime industries. This exposes small-*
153 *scale fisheries to ocean grabbing (Bennett et al., 2015) issues and rise social and spatial justice*
154 *questions (Bavinck et al., 2018; Cohen, 2019).*

155 In this paper, we start by reviewing the concepts and approaches borrowed from actor-network
156 theory and the approaches of critical cartography. This will structure our analysis, which centers
157 on the role played by geotechnologies in MSP processes (section 2). We then present the results
158 of this analysis applied to the case of fisheries, based on the “inscriptions” produced by
159 geotechnologies in MSP initiatives from around the world (section 3). Lastly, we discuss these
160 findings (section 4) and draw more general conclusions from this research, notably concerning
161 the different fields that intersect within our study: geotechnologies, planning and marine fisheries
162 (5).

163 **2. Proposed methods**

164 Carton (2002, 2007) has shown that cartography can take on different roles during a planning
165 process: as a science, an art and a policy. Using this multiplicity of roles activated during the
166 planning process as a starting point, our aim is to analyze the inscriptions produced by different
167 geotechnologies concerning fisheries and through this, study the role(s) geotechnologies
168 themselves play in terms of MSP. To do this, we built an analytical framework by putting
169 contributions from actor-network theory (2.1) into perspective along with critical cartography
170 approaches (2.2). After having identified the elements to be analyzed, we present the framework
171 used to structure them and the corpus to which the framework is applied (2.3).

172 **2.1.The actor-network theory**

173 By positioning our reflection in the field of STSs and notably within the actor-network theory
174 (ANT) (Akrich, 1989; Callon, 1986; Latour, 1987; Latour, 2005; Law, 1999), an MSP process
175 may be considered as a group of heterogeneous elements clustered around a problem, i.e., a
176 “device” (Foucault, 1980), or better still, a socio-technical “network” or “agencement” (Callon,
177 2006b; Callon & Ferrary, 2006). Whatever the term used, MSP is the outcome of a “translation”,
178 which is to say a process that “*intelligibly [establishes] communication between [separate*
179 *worlds]*” and which, if it succeeds, enables “*positions to be brought into alignment*” (Callon
180 1986). In some ways, a territorial planning process follows the same logic, as its aim is to bring
181 together a heterogeneous group of stakes and actors with a common territory around positions
182 and objectives that need to be “aligned” (we often talk of a “common” or “shared” vision in the
183 context of planning). During the translation, everything is important, and individuals (or groups)
184 and technical objects operate at the same level. The objects mediate and in doing so, impact and
185 even transform relationships between individuals and groups. In ANT, objects are thus
186 considered as “non-human” actors (Latour, 1999).

187 The term “technical objects” refers to all real or virtual objects that are socially constructed but
188 also have an impact on social relations: theories, discourses, techniques, knowledge, norms and
189 regulations, living things, natural habitats, etc. To be more precise, a technical object is defined
190 by the relationship between the object itself and all its uses or functions (Akrich, 1987). As a
191 result, these technical objects are very politically loaded: they organize, standardize and
192 “depoliticize” the relationships between individuals and their environment (Akrich, 1987). In a
193 territorial planning process, and especially MSP, geotechnologies (in this case, mainly database
194 management tools, spatial analysis tools, GIS and geoportals) occupy a distinct place amongst the
195 technical objects, as they are intermediary objects or in some cases even, boundary objects –
196 objects whose “*structural elements are partially shared by several social worlds*” (Vinck, 2009)
197 (i.e., a set of data can be used as a repository partially shared by different actors) – which are at
198 the very heart of planning issues themselves.

199 A first analytical objective would thus be to identify the different objects, in our case the
200 geotechnologies that serve to “inscribe” fisheries in MSP.

201 Although one of the original interests of ANT is to recognize the role of objects, Callon (1986)
202 has chiefly formalized four translation process stages. They are the core components of a method
203 for analyzing the way in which socio-technical networks are created:

- 204 (i) problematization, which consists of both defining a problem and problematizing
205 actors around an “obligatory passage point”. This is the stage for constructing and
206 defending the idea that within a certain set-up, a “shared” problem needs to be
207 resolved prior to solving individual problems (i.e., establishing a zoning plan):
- 208 (ii) interressement, which refers to “*all the actions through which an entity strives to*
209 *impose and stabilize the identity of the other actors it has defined via its*
210 *problematization. All these actions are embodied in devices*”. This is the stage where
211 solutions are examined for resolving the shared “problem” (i.e., how to enter into a
212 zoning rationale);
- 213 (iii) enrolment, which is “*the mechanism used to define a role and attribute it to an actor*
214 *who accepts it. Enrolment is a successfully-implemented interressement.*” This is the
215 stage that aims to get all actors to accept the measures found to resolve the shared
216 “problem” (i.e., the measures found for entering into a zoning rationale);

217 (iv) and mobilization, which consists of mobilizing allies to stabilize the network. The
218 solutions selected to solve the shared “problem” are implemented at this stage.

219 Although Callon (1986) developed this approach to offer a framework for clarifying scientific
220 controversies, we thought it could also help us interpret an MSP process, which is nonetheless
221 related to a controversy. A large part of this controversy is the form of spatial representations
222 used or produced to resolve a shared “problem”, as these representations are frameworks for
223 reflection, debate and decision-making. However, it did not appear *a priori* to be totally adapted
224 to our study given that we were not going to analyze MSP processes directly “in action” (in
225 reference to Latour, 1987), but indirectly through inscriptions produced and used by these
226 processes in planning documents. This led us to reveal a subtle difference between “occasional
227 inscriptions”, made during the planning process and transformed, and “long inscriptions”, made
228 during or resulting from the process and stabilized by being incorporated into planning
229 documents. We were more interested in the second type of inscription because on top of being
230 practical for analysis purposes, the fact that these inscriptions became stabilized can in turn
231 stabilize the network by aligning the positions of actors with the objectives of the planning
232 document. By taking another step back, we realized that these “long inscriptions” could also
233 serve again at later date, during the next planning cycle or in another planning initiative.
234 Therefore, “long inscriptions” actually extended the socio-technical network by transcending
235 planning processes, whereas “occasional inscriptions” were simply instants in the process. *A*
236 *posteriori*, taking an interest in “long inscriptions” can be useful in a comparative context,
237 whereas analyzing “occasional inscriptions” is probably more pertinent in an explicative context.

238 To extend this idea further, we compared the four translation stages with both those of a planning
239 process in general and of MSP in particular. Until now, ANT has mainly been used as a more or
240 less explicit analytical reference framework to stimulate critical thought in the field of planning:
241 on the different planning structures and practices (e.g., Albrechts, 2004; Albrechts et al., 2003;
242 Allmendinger & Haughton, 2009), on the meaning given to the notion of space (e.g., Healey,
243 2004), on power relations (e.g., Allmendinger & Haughton, 2012; Dabinett & Richardson, 1999;
244 Olesen, 2004), on the role of knowledge in the planning process (e.g., Healey, 2008; Rydin,
245 2007) and also on the assessment of practices (e.g., Faludi, 2000). However, studies having
246 sought to apply the analytical framework of ANT in this field are actually relatively few: Boelens
247 (2010), Boelens & de Roo (2016), Doak & Karadimitriou (2007), Rydin (2012) and Webb
248 (2011). These authors have also pointed out a certain number of limits and imperfections when
249 ANT is applied to a planning context.

250 For example, Boelens (2010) makes three main criticisms, one of which consists of questioning
251 the role of objects as primary actors, and preferably assigning them (simple) mediation roles,
252 whereas Doak & Karadimitriou (2007) and Rydin (2010) contrastingly view the same attention
253 given to objects as to human actors as one of ANT’s major advantages: “*These actants can enroll*
254 *(human) actors and other actants (other aspects of socio-technical systems) and influence their*
255 *contribution to planning practice.*” (Rydin, 2010). Rydin’s (2012) study is thus based on
256 recognizing the mediatory role of objects (i.e., planning documents); the consent of actors as
257 being an “obligatory point of passage” (Callon, 1986); and the process of creating a “black box”
258 (Latour, 1987). For their part, Boelens (2010) and Boelens & de Roo (2016) offer an Actor-
259 Relational-Approach to Planning consisting of seven steps that correspond to Callon’s (1986)
260 translation model (Fig. 1). As for us, we feel that the processes of planning and translation fit

261 together rather inadequately. In practice, it would seem that the interessement and enrolment
262 phases occur several times during a planning process, particularly when reviewing the current
263 situation and identifying alternatives.

264 Figure 1 here

265 Inspired by these research works, our second analytical objective was to examine the role played
266 by the inscriptions (e.g., maps, geovisualizations) relating to fisheries during the
267 problematization, interessement, enrolment and ally-mobilization stages that successively unfold
268 within a planning process. In our case, we used the “long inscriptions” concerning fisheries to
269 retrace the solutions that were implemented (mobilization of allies), their impacts on the
270 problems faced by fisheries (problematization), and the elements on which these solutions were
271 based and justified (interessement and enrolment). To do this, we first had to take into account
272 the elements that provided us with the “long inscriptions”.

273 **2.2. Critical cartography**

274 In a guide published by UNESCO, Ehler & Douvère (2009) proposed a general framework for
275 establishing marine planning documents comprising ten main stages (Fig. 2). Although the type
276 of planning used leads to specificities in the process (Albrechts, 2004), these stages correspond to
277 those generally found in spatial planning approaches and can be summarized from a technical
278 point of view as a succession of operations forming a planning cycle: definition of objectives,
279 review of the current situation (identifying problems), identification and testing of alternatives
280 and other problem-solving measures, and implementing spatial measures, notably through
281 zoning. Apart from the first stage, the others draw on the standard functionalities of
282 geotechnologies that overall enable spatial data to be collected, brought together, processed and
283 analyzed with results generated as maps or other forms of visualization if necessary (Center for
284 Ocean Solutions, 2011). These functionalities thus produce inscriptions that we can also interpret
285 as being standard, as shown by Dühr (2007) for planning in general, i.e., 2D static map
286 representations⁴. The fact that advances in technology (e.g., dynamic maps, 3D visualization) are
287 not exploited could in this case be explained by the fact that work is still needed to improve user-
288 friendliness (Center for Ocean Solutions, 2011) in contexts as formalized as those of planning.

289 In any event, a third analytical objective emerged concerning the type of inscriptions produced, if
290 applicable, and used where fisheries were concerned (e.g., static or dynamic), along with their
291 capacity to align (or not) with the positions of the different MSP actors. It must be added here
292 that in certain cases, where interactive technologies are concerned (e.g., map viewers), the objects
293 – geotechnologies our case – can be confused with their inscriptions. This is also the case for
294 “long inscriptions” as increasingly, map viewers and other geoportals used to support or
295 supplement planning documents can exist above and beyond a planning cycle.

296 Figure 2 here

⁴ At the same time, it is worth noting that John Law, quoted by Murdoch (1998), concluded that by bringing together heterogeneous elements, ANT advocates a relational and non-absolute approach: “[ANT] is ‘a machine for waging war on Euclideanism’”.

297 Therefore, *a priori*, one of the main forms of inscription in planning approaches is static 2D
298 maps. As a result, we examined this type of inscription more closely, but without leaving out the
299 other types of inscription that our analysis could possibly reveal. In this area, research on critical
300 cartography shows that where cartography is concerned, everything is important, from the
301 creation of the map itself (centering, colors, legend structure, symbols, etc.) to its interpretation
302 and use (e.g., Crampton, 2001; Crampton & Krygier, 2006; Harley, 1988, 1989; Kitchin &
303 Dodge, 2007; Monmonier, 1991; Wood, 1992). However, in addition to what is featured on a
304 map and how this can be used, whatever is not featured on the map is also significant, as noted by
305 Harley (1988): “*The notion of 'silences' on maps is central to any argument about the influence of*
306 *their hidden political messages. It is asserted here that maps (...) exert a social influence through*
307 *their omissions as much as by the features they depict and emphasize.*” The fact that
308 geotechnologies use the Euclidean space as a basic reference largely pre-determines what can or
309 cannot be represented: “*Cartesian space and its co-ordinate system are thus seen as defining the*
310 *conditions of im/possibility within which Euclidean objects can exist.*” Harley (1988) went even
311 further by arguing that “*Maps as an impersonal type of knowledge tend to ‘desocialise’ the*
312 *territory they represent. They foster the notion of a socially empty space*” which can constitute a
313 hidden political objective as Kitchin et al. (2009) remind us: “*Mapping in this view always has a*
314 *political purpose, and this 'interest' often leads to people being pushed 'off the map'.*” Thus, we
315 needed to incorporate the existence or inexistence of inscriptions relating to fisheries into our first
316 two analytical objectives as well as the type of fishing concerned, if applicable.

317 Figure 3 here

318 Geotechnologies can potentially fulfil other roles than the more traditional ones mentioned above.
319 They can for instance encourage the participation of different actors and incorporate their
320 knowledge, as is the case with participatory GISs⁵ (Abott et al., 1998; Chambers, 2006; Dunn,
321 2007; McCall & Dunn, 2012; Sieber, 2006). The latter were developed in reaction to a positivist
322 ideology (Joliveau et al., 2013) and to the fact that spatial data, along with the type of processing
323 performed with it, are actually rarely accessible to the actors in a planning process, thus creating
324 a “black box” whose contents avoid being subjected to critical analyses. Schuurmann (2000) used
325 the image of the iceberg, the majority of which is submerged, to suggest that we need to dig
326 deeper below the surface of maps to explore the analysis processes and the data used in these
327 processes. In doing this, she contributed to the emergence of critical GIS. In fact, although it is
328 widely accepted that maps are not neutral and not only describe “reality” but also serve to create
329 it (e.g., Aitken & Michel, 1995; Kitchin et al. 2009), Dühr (2007), for instance, has stated that the
330 analyses performed are not neutral either: “*Planning practice also needs to represent places as*
331 *multiple layers of relational assets and resources, which generate a distinctive power geometry*
332 *of places. This emphasizes the need to recognize that privileging one experience of space and*
333 *time (for example [speed train] stations, optic fiber grids, mega airports etc.) may necessarily*
334 *undermine other, equally important, but less powerful interests. The multiple layering is thus*
335 *neither neutral nor value-free (Graham and Healey, 1999: 642).*” The submerged part of the
336 iceberg thus corresponds to the “black box” (Latour, 1987) of ANT, and the visible part relates to
337 the inscriptions (Fig. 3).

⁵ There are variety of terms used, but they do not necessarily refer to the same things (*Participatory GIS, Public Participation GIS, Community-integrated GIS, GIS-2, GIS for participation, Participatory 3-Dimensional Modelling, Bottom-Up GIS, collaborative GIS/geocollaboration*; see Dunn, 2007). For our paper, we decided to use the term Participatory GIS in the more generic sense.

338 Consequently, our fourth analytical objective was to trace back the processes for producing
339 inscriptions, starting from the inscriptions themselves and looking at the spatial analyses and data
340 (types, collection methods) which enabled their production.

341 **2.3.Establishing an analysis framework**

342 The proposed methods whose basis we have just elucidated can be applied beyond the framework
343 of our current study and rolled out in different ways. In our case, it has been used as a general
344 framework for organizing our analysis based on “long inscriptions”. Furthermore, given that the
345 four main objectives described above overlap in part and, in order to make them more operational
346 for our analysis, they were reorganized around the three following questions and applied more
347 specifically to the case of fisheries (Fig. 4):

- 348 - Question 1 (Q1) in reference to objective 3: are there any inscriptions for fisheries and if
349 so, which ones?
- 350 - Question 2 (Q2) in reference to objectives 1 and 4: how are these fishery inscriptions
351 produced (collection protocol and data processing tools, metrics used, etc.)?
- 352 - Question 3 (Q3) in reference to objectives 2 and 3: how do these types of inscriptions
353 enable fisheries to be aligned with dominant interests?

354 Thus, we observed (i) the long inscriptions produced by geotechnologies (Q1), i.e., mainly the
355 maps found in planning documents; (ii) how they were produced (Q2), by notably focusing on
356 the data and processing that enabled their inscription; and (iii) their role in aligning fishery
357 representations with the modes defined by dominant interests (Q3), i.e., how through these
358 inscriptions, fisheries were able to be included at the zoning stage, which is often the end result of
359 MSP initiatives. The idea behind this was to try to understand the functioning of translation
360 centers during the different stages involved in establishing a plan (Fig. 4).

361 Figure 4 here

362 We hence decided to approach this study from a comparative angle and look at all the planning
363 documents resulting from MSP initiatives undertaken to this day all around the world. MSPs
364 were identified based on the research done by UNESCO⁶, and the cases finally selected were
365 initiatives having reached “Phase 4” (finalized plans that have not yet been approved). Given that
366 some documents were inaccessible, the corpus of documents was finally made up of 43 plans and
367 their appendices, if available (see Supplementary materials 1 and 2). The chosen body of
368 documents is obviously not free from debate, as far as it is not trivial to distinguish what is MSP
369 and what is not. The main interest of this source is that it is supposed to be fairly uniform and
370 open to everyone's scrutiny. That said, it will be necessary to keep this aspect in mind when
371 interpreting the results. To this corpus of documents, we applied a group of five indicators
372 (Table 1) to enable us to record the answers to our three main questions as factually as possible,
373 thus enabling us to draw general conclusions. To collect the data, MSP documents for each
374 initiative have been read and examined one by one as precisely as possible, notably cartographic
375 contents. The indicators were empirically identified and coded following several successive
376 adjustments made when we analyzed our corpus.

377 Table 1 here

⁶ http://msp.ioc-unesco.org/world-applications/status_of_msp/; information consulted in April 2018.

378 **3. Results**

379 The raw results (Table 2 and Supplementary material 3) show that:

- 380 - Indicator I1: Fisheries are not inscribed in 21 out of 43 cases and only partly inscribed in
381 eight cases. They are thus only inscribed in 14 cases.
- 382 - Indicator I2: Out of the 22 cases where inscriptions are at least partial, only 12 enable the
383 variability and/or diversity of fishery activities to be taken at least partially into account
384 whereas nine are limited inscriptions in the sense that the diversity and/or variability of
385 fisheries are not included in the inscription. In one specific case (Nunavut, Canada), the
386 inscription is produced via a single map but in a particular way: by identifying socio-
387 economic values recognized by coastal communities for certain geographical zones.
- 388 - Indicator I3: Out of the 22 cases where fisheries are inscribed, five show indirect
389 inscriptions, that is to say inscriptions are done through data that refer indirectly to
390 fisheries such as the distribution of resources or due to regulations. In other cases,
391 inscriptions are produced (on an additional or one-off basis) by drawing on data collected
392 using protocols established to monitor and/or manage fisheries (i.e., data from a Vessel
393 Monitoring System (VMS), logbooks or an Automatic Information System (AIS)). Most
394 of the time, the format of this data limits the possibility of performing an analysis that
395 encompasses the variety in types of fisheries (e.g., based on the fishing gear used) and
396 establishes links with the social and territorial dimensions (e.g., the link between fishing
397 areas and territories).
- 398 - Indicator I4: In 19 of the 22 cases, the metrics used evoke a purely bioeconomic
399 characterization of fisheries (e.g., fishing effort, catches) expressed in a variety of units
400 (e.g., kg/km²/year; tonnes caught, number of vessels or number of fishing operations each
401 time per geographical grid square). Conversely, only three MSP initiatives tried to include
402 other elements: socio-economic values (Nunavut, Canada, see above); the weighting of
403 fishing effort against fishers' expertise to take account of, for example, the different fleets
404 and/or coastal communities (Oregon, United States); and the relationship between fisher
405 communities and the area in which they undertake their activity ("communities at sea")
406 (Mid-Atlantic region, United States).
- 407 - Indicator I5: As fisheries were not integrated into zoning in 28 of the 37 cases (probably
408 more given that some of the documents did not explicitly refer to other zoning that was
409 already in effect, even when it existed), they ended up being aligned "by default". In the
410 nine other cases, this "by default" method was combined with attempts to identify high-
411 density, high-value or high-interest zones for fisheries (the vocabulary used varies from
412 one case to another), logically defined according to the same bioeconomic metrics.

413 Table 2 here

414 The analysis of these 43 documents from MSP initiatives, conducted all over the world, clearly
415 indicates that the alignment of fisheries takes place through a combination of three elements,
416 which we observed: (i) paradoxically, by not being inscribed (indicator I1); (ii) through
417 inscription methods that reproduce the functional characteristics of fisheries (notably their
418 variability) incorrectly or not at all, and do not account for their diversity (indicator I2); or (iii)
419 through inscriptions produced using data that does not allow for the triplicity of space or its
420 relational character, e.g. links with "communities of fishers", social or cultural values (indicators
421 I3 and I4). Given that, technically speaking, geotechnologies currently offer functionalities that

422 would enable fisheries to be better inscribed, not exploiting these technologies leads to a *de facto*
423 “by default” alignment of fisheries with the functional model of zoning, or possibly even an
424 alignment based on minimal inclusion, i.e., by identifying reserved or priority zones for fisheries
425 (indicator I5). None of the initiatives evoked the possibility of adapting the zoning model to
426 fisheries (e.g., mobile zoning) and only a few cases explicitly emphasized the inappropriateness
427 of this model for fisheries (e.g., East Inshore and East Offshore Marine Plans in the UK). It
428 would appear that zoning, in its current form at least, tends more towards catering for dominant
429 interests than for interests related to the inherent characteristics of fisheries: it enables activities
430 to be organized within a static plan produced by taking account of metrics that they themselves
431 refer to dominant interests (i.e., the development of marine renewable energies for their
432 apparently high economic growth potential, and the protection of ecosystems for the value of the
433 services they would offer). By choosing these inscription methods and data/metrics, fisheries are
434 viewed solely as economic activities, which leads to a biased comparison of their value in
435 relation to other activities. Consequently, in answer to the initial question of how geotechnologies
436 act within and on MSP processes, we confirm that through the inscriptions they produce, they
437 work towards stabilizing power relations by aligning spatial representation norms for fisheries.

438 **4. Discussion**

439 The analysis method and results obtained can be discussed from two different perspectives.

440 Firstly, the method is limited in certain ways. We made several decisions that also have a
441 downside. To start with, by approaching this study from a global and comparative angle to draw
442 general conclusions and focus on “long inscriptions”, inevitably, we probably overlooked a
443 certain number of “occasional inscriptions”. Next, by concentrating on one activity or stake, such
444 as fisheries in this study, other inscriptions were not taken into account, although these could
445 probably provide some insight into how other activities or stakes are inscribed. Principally for
446 these two reasons, it would be worthwhile expanding on this global and fishery-centered initial
447 analysis by undertaking further, more detailed, research on all the inscriptions produced by or
448 used in an MSP process.

449 Concerning our analysis method, although the indicators proposed were obviously not free from
450 interpretation to some extent, they could nonetheless have been strengthened by other more
451 comprehensive means of analysis, such as a study of the symbols, colors, features, legend, etc.
452 and not just the content of inscriptions. The methods proposed and developed within this study
453 actually invited us to do just this. However, once again, we chose to focus on the main elements,
454 notably the content, to enable us to study all MSP initiatives from around the globe. Here again,
455 further research could provide additional insight on this point.

456 Secondly, turning to the results, the non-inscription of fisheries in almost half of the analyzed
457 MSP initiatives (even if the activity exists within the scope of a marine plan) leads to fisheries
458 being “*pushed off the map*”, in the words of Kitchin et al. (2009), and consequently pushed out of
459 plans. Although this cartographic silence can notably be explained by the unavailability of data, it
460 undeniably has a consequence. In cases where fisheries are partially inscribed, the partial
461 inscription is more often than not linked to the fact that small fisheries are not accounted for and
462 often continue to be less documented. However, they are paradoxically more vulnerable in that
463 their capacity to spatially adapt is more limited, or sometimes non-existent, and they equally face

464 more competition for space in coastal sea areas. To further investigate this aspect, research could
465 first try to understand and characterize the reasons for inscriptions not being made, along with the
466 subsequent impacts of this non-inscription, and then conversely, pinpoint any other types of
467 inscription not produced by geotechnologies – if there are any. To do this, a study conducted for
468 throughout the lifespan of an MSP initiative would of course enable these elements to be
469 analyzed in more detail.

470 As for the cases where fisheries are inscribed, the question revolves around the manner in which
471 they are inscribed. As noted by Dühr (2007) for terrestrial planning, it is hardly surprising to note
472 that these inscriptions take the shape of static 2D maps often aggregating all types of fisheries,
473 even when using geotechnologies that enable the spatio-temporal dynamics of fisheries to be
474 reproduced. In fact, if we refer more specifically to the question of variability, the
475 geovisualization tools created to support certain MSP initiatives only actually reproduce the maps
476 featured in documents, or at best, offer different versions (i.e., aggregated data from different
477 time periods). However, what may come as more of a surprise is the minimal or complete lack of
478 possible methods for representing the intra- and inter-annual variability of fisheries. Reflection is
479 also required on the temporal aspect of the data itself, as data is gathered over different time
480 periods (a year or several years, with various configurations) without this actually leading to any
481 argumentation in most cases. This issue of not considering spatio-temporal variability is probably
482 linked to the fact that when traditional zoning is established, this information is actually of little
483 interest: what is the point of describing the dynamics of activities and switching from 2D to 4D
484 representations if the aim is to share maritime space by implementing zoning, and thus presuming
485 from the outset that uses are completely incompatible? Equally, the current inability to create a
486 link between fishing areas and the territories to which fisheries belong is of little interest for this
487 rationale and could inversely even crystallize tensions. Thus, there could be an indirect advantage
488 to “dissocializing maritime space”, i.e., representing fishing areas by varying the intensity of the
489 fishing activity at a given location without ever correlating these fishing areas with the
490 territory(ies) and/or “communities” at stake. In any case, from this angle, it may seem logical that
491 the issue of the scale of analysis is rarely dealt with or reproduced through inscriptions (however,
492 see the example of Massachusetts in the United States, which evokes the critical role played by
493 geographical scales in interpreting maps), insofar as variations in scale can reveal the stakes for
494 different territorial scales more clearly (e.g., a maritime zone may be considered as rather
495 unimportant on the scale of territory corresponding to the planning scope, but could conversely
496 be important for a small-scale territory).

497 Concerning the inscription methods for fisheries, the issue of the metrics used (which are
498 essentially standard metrics from the fisheries domain, used to manage fisheries) is never
499 discussed in the documents analyzed. However, there is nothing that “naturally” predisposes
500 them to be used in an MSP context, especially as they come in extremely variable forms, which
501 in themselves are unsubstantiated. Yet the choice of descriptors is not insignificant in terms of
502 planning (Rydin, 2007). In this respect, an interesting study from the Marine Management
503 Organization (MMO) (2014) actually shows that metrics, such as the vocabulary used to
504 contribute to the interpretation of results, are particularly pivotal elements in characterizing
505 fisheries. Not all forms of knowledge were recognized and used in the majority of MSP
506 initiatives analyzed, especially so-called “non-scientific” knowledge, which probably explains in
507 part the use of metrics describing fisheries from a mainly bio-economic angle. Once again, to
508 expand on this study, further analysis is needed to explore how the metrics are actually

509 determined and justified, how other more suitable metrics for taking all aspects of fisheries into
510 account (not just the economic aspect) could be proposed, and what the impacts would be of
511 choosing one metric over another for mapping fisheries in terms of MSP.

512 Ultimately, we are endeavoring to open up thinking around the fact that geotechnologies have
513 both a decisive and ancillary role to play in affirming the place of fisheries within MSP. Their
514 role is decisive in the sense that geotechnologies are actually a crucial part of the interestment,
515 enrolment and ally-mobilization stages. A controversy concerning the black box can effectively
516 arise at any one of these stages. However, their role is also ancillary as it appears that the
517 decisions influencing the way in which geotechnologies are used (e.g., the final methodological
518 objective of an MSP, that is whether to undertake zoning or use an existing zoning plan) are
519 taken at the problematization stage, where geotechnologies still play a minor role. Although the
520 black box needs to be opened, it is probably more important to seek to understand how it came to
521 be; therein lies the interest of exploring the issue by looking at MSP initiatives as “hybrid
522 forums” (Callon et al., 2001) and studying the role that geotechnologies play within them.

523 **5. Conclusion**

524 The answer to the question “*marine spatial planning; cui bono?*” (who benefits?) (Flannery &
525 Ellis, 2016) appears to be that the non- or badly-inscribed “stakes” or “interests” (thus using
526 neutral terms that can be applied both to tangible things, such as activities, as well as more
527 dispersed – yet equally valid – expectations) lose out: in addition to fisheries, this probably also
528 concerns cases where maritime space is non-commercially used or not used at all, or simply
529 where certain elements are not considered as a priority in terms of conservation objectives. As it
530 is, in MSP, fisheries (along with other non-inscribed elements) are condemned to have the left-
531 over space or in some cases maybe, the space we are willing to give them. This observation is
532 finally quite logical, at least inasmuch as MSP contributes to a new approach to maritime space
533 which appears to be clearly oriented. This approach is new in that ultimately, it is an abrupt
534 change that re-explores the future of fisheries in-depth, given the relationship between fisheries
535 and space (i.e., a resource for adapting themselves). By progressively eating away at the capacity
536 of fisheries to adapt, the future of fisheries itself is brought into question, or should at least be
537 brought onto the table. The role of zoning in the MSP model probably needs to be rethought as
538 does the place occupied by “spatial” aspects, the type of space in MSP and the way in which
539 space is taken into account in geotechnologies.

540 This lack of inscription should not be considered as inevitable or as the result of a process, but as
541 the expression of domination that manifests itself through upstream technical orientation (i.e.,
542 zoning) and subsequently conditions the whole planning process. In truth, the technical decision
543 to undertake zoning places non-inscribed (or non-inscribable) interests in a subordinate position
544 in relation to a process that is designed for dominant interests and thus excludes other non-
545 dominant interests. Unless the model is changed, two main avenues schematically open up to
546 enable dominated interests to be expressed and consequently, a greater socio-spatial justice to be
547 attained in MSP processes.

548 Firstly, an avenue stemming from the questioning of technical aspects, with the aim of improving
549 inscriptions by working on the functionalities of geotechnologies and/or the integration of data
550 relating to other types of values (e.g., social, cultural, emotional). Research on geovisualization

551 (see MacEachren & Kraak, 2001 for example) offers interesting perspectives in this respect, even
552 if at the planning application stage, much effort is still required for this type of technical solution
553 to be effectively used in a formal framework such as planning. Other research aiming to provide
554 information for the “*missing layer*” (St. Martin & Hall-Arber, 2008) or “*that which we know little*
555 *about*” (Antoni & al., 2004) also follow this line of approach, as is the case for research in the
556 field of organizational sociology and certain approaches developed in the case of serious games
557 (e.g., Mayer et al., 2014; Poplin, 2012) or “geoprospectives” (see Voiron-Canicio, 2012).
558 Secondly, another avenue opens up that, conversely, stems from questions of a more political
559 nature, which aim to build tools to improve participation and enable various interests – not
560 necessarily expressed in economic terms and sometimes expressed differently – to be taken into
561 account more effectively. This is notably the case for research on counter-mapping, which
562 explores the political dimensions and implications of cartography (e.g., Peluso, 1995), or certain
563 studies with a more qualitative “geoprospective” approach.

564 Intermediate pathways have already appeared between the two main avenues; the examples of
565 research given above actually illustrate this porosity between the two. Developments around
566 participative GISs are a prime example of this phenomenon. Following Young’s (1991) logic
567 indicating that “*Double consciousness⁷ arises when the oppressed subject refuses to coincide*
568 *with these devalued, objectified, stereotyped visions of herself or himself*”, we have now to
569 explore every other intermediate pathways between technology and politics; pathways that may
570 be part of a reflection wherein geotechnologies can be something other than the “eyes of others”
571 through which fisheries observe themselves.

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⁷ “ (...) this sense of always looking at one’s self through the eyes of others, of measuring one’s soul by the tape of a world that looks on in amused contempt and pity.” (Young, 1991).

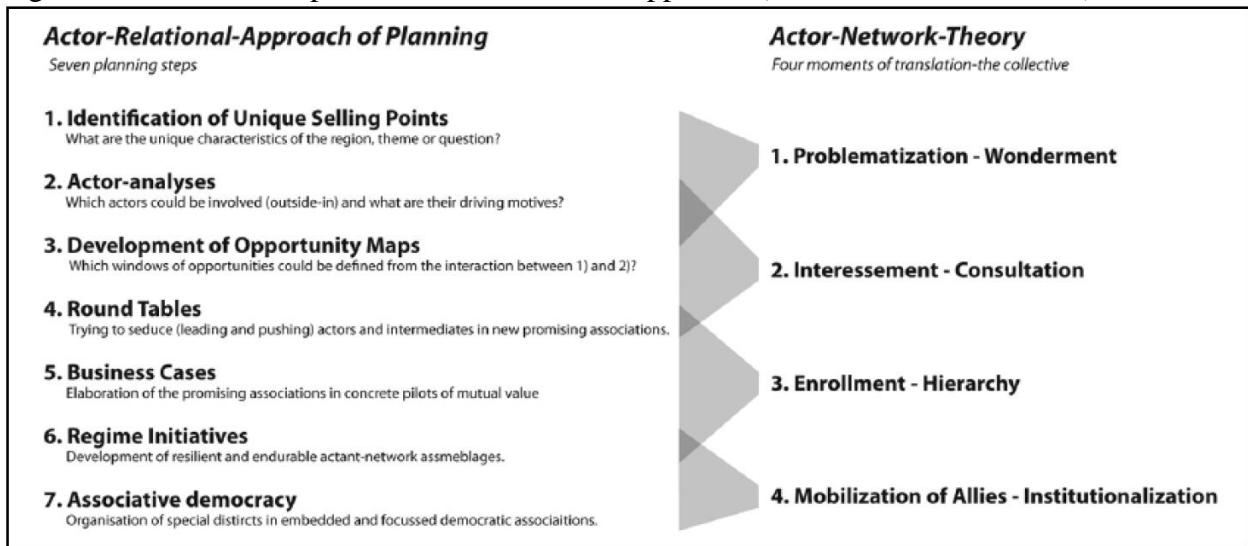
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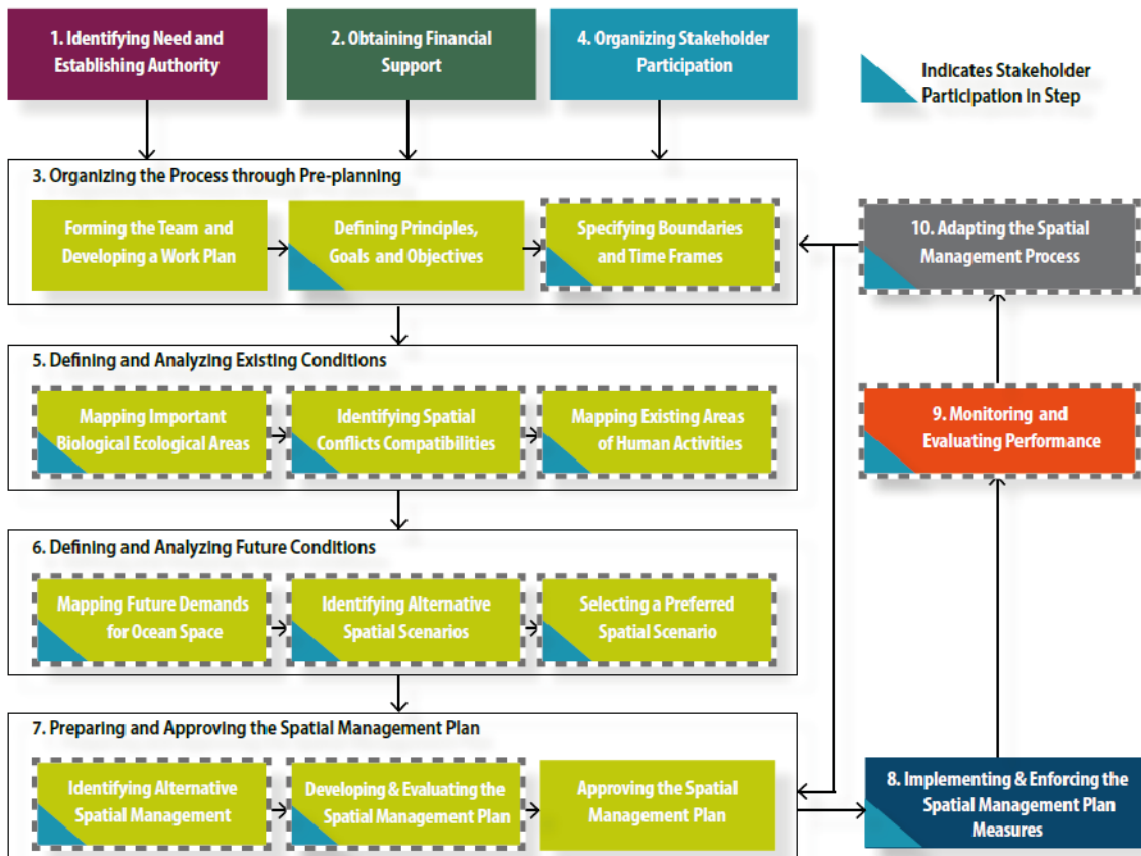
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806 Figure 1 - The seven steps of the actor-relational approach (Boelens & de Roo, 2016)



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Figure 2 - The role played by geotechnologies throughout MSP processes

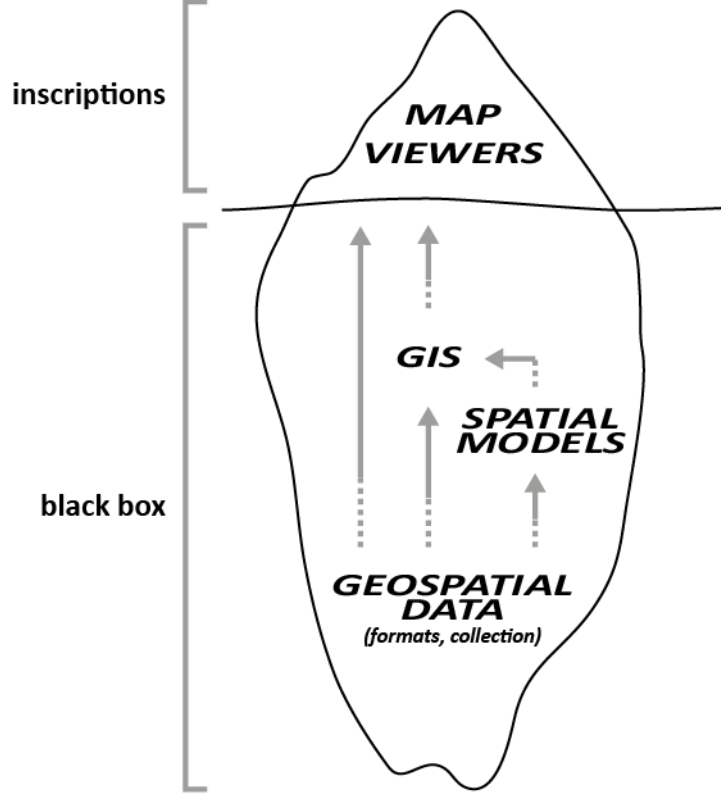


--- Substeps supported by geo-technologies

Source: Ehler & Douvere, 2009

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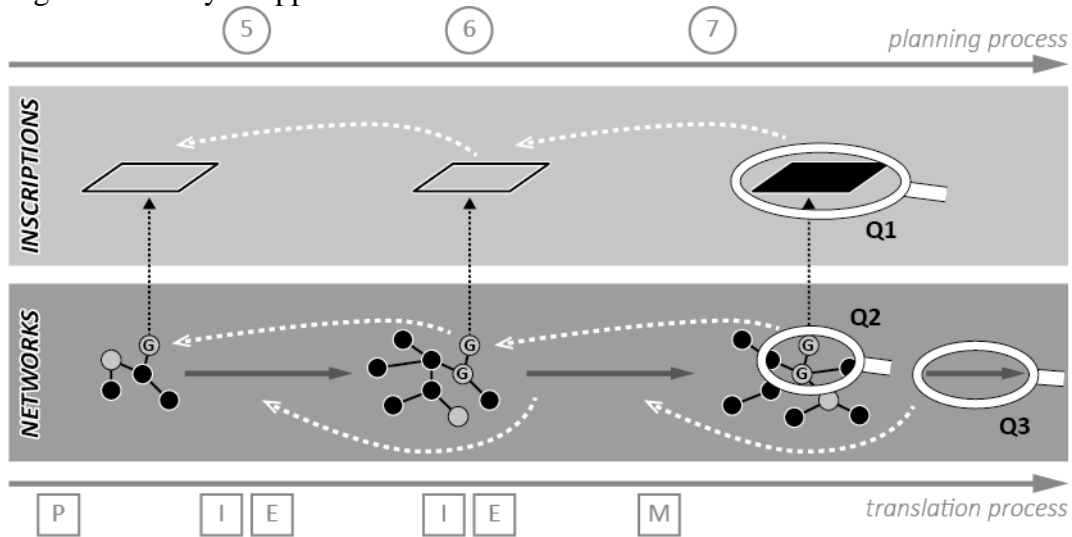
813 Figure 3 - The inscriptions: both N. Schuurmann's visible part of the iceberg and B. Latour's
814 black box "outputs"



Based on Schuurmann, 2000

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818 Figure 4 - Analysis approach



Ehler & Douvere (2009):

- 5. Defining and analyzing existing conditions
- 6. Defining and analyzing future conditions
- 7. Preparing and approving the spatial management plan

Callon (1986):

- P. Problematization
- I. Interressement
- E. Enrollment
- M. Mobilization of the allies

- Human actor
- ⊗ Geo-technology (non-human actor)
- Other objects (non-human actor)
- ▭ Occasional inscription
- ▨ Long inscription (planning document)

Main questions:

- Q1: Which inscriptions for fisheries?*
- Q2: How these inscriptions have been done?*
- Q3: Abilities of these inscriptions to align fisheries?*

Based on Callon, 1986; Ehler & Douvere, 2009

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822 Table 1 - Indicators applied to MSP initiatives

Questions	Indicators	Descriptions (<i>and comments</i>)
Q1	I1	- Fishery inscription <i>This consisted of factually establishing whether mapping of fisheries activity actually takes place (or maybe another type of inscription).</i>
	I2	- Inscription methods (if applicable) <i>Given that the analyzed material was made up of planning documents (see associated geoportals), long inscription can only logically occur in the form of a static map. Consequently, the idea was to factually ascertain whether, despite the constraints of inscription in a planning document, the inscription methods still enabled the dynamic character of the activity and/or its diversity to be taken into account.</i>
Q2	I3	- Types of data for inscription (if applicable) <i>This consisted of factually establishing the type of data enabling inscription.</i>
	I4	- Metric used for inscription <i>This consisted of factually ascertaining which metric(s) were used to inscribe fishery activities and, consequently, the way in which the solution to the shared “problem” was produced.</i>
Q3	I5	- Alignment of fisheries with the zoning rationale <i>This consisted of factually establishing how fisheries are considered with regards to the zoning found in the planning documents, whether this zoning was produced using an MSP or other process (e.g., MPA).</i>

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826 Table 2 - Raw results following the analysis of 43 MSP initiatives

I1	Code	Are fisheries inscribed?	Remarks	Number
	2	Yes	<i>A priori, all types of fisheries are inscribed.</i>	14
	1	Partially	<i>Some fishery activities are not inscribed.</i>	8
	0	No	<i>Not inscribed.</i>	21
I2		Fisheries are inscribed:		
	2	With the aim of showing the spatio-temporal dynamics of activities and/or the diversity of activities (through several maps)	<i>The inscription enables the variability and/or diversity of fishery activities to be taken into account. The inscription is based on a set of maps that highlight the variability or diversity.</i>	12
	1	Through one map only (a single method)	<i>The inscription does not enable the variability and/or diversity of fishery activities to be differentiated. The inscription is based on one map, generally only giving an overview.</i>	9
	0	Other	<i>Fisheries are inscribed in another way (see Appendix 2).</i>	1
I3		The data used describes:		
	2	Both aspects below		9
	1	Fishery activities themselves		8
	0	The elements linked to fisheries (distribution of resources, regulations, etc.)		5
I4		The metric used for inscription enables fisheries to be characterized:		
	1	By incorporating all the components of these activities (bioeconomic as well as social, cultural, identity-related, territorial, etc.)		3
	0	From a strictly bioeconomic perspective (fishing effort, production levels, distribution of the resource, management measures, etc.)		19
I5		By being or not being inscribed, fisheries are aligned:		
	2	Directly	<i>Fisheries are an integral part of the zoning rationale: zones are reserved or prioritized for fishing.</i>	0
	1	Both directly and indirectly		9
	0	Indirectly	<i>Fisheries are "at the mercy" of the other zoning in the plan or from other plans (e.g. sectorial)</i>	28

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