Geoprospective as a support to marine spatial planning: some French experience-based assumptions and findings

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10.1 Introduction

With around 60 initiatives worldwide (IOC-UNESCO, EC-DGMARE, 2017), marine spatial planning (MSP) is asserting itself on a global scale in a context of rapid change due to a

combination of two phenomena which are cited in the preamble of European Directive 2014/89 on establishing a framework for MSP. First, the need for ocean space is intensifying because of the development of "new" uses, such as marine renewable energies to meet the challenge of climate change. Second, tools for protecting marine ecosystems and biodiversity—marine protected areas (MPAs) currently being the most developed of these—are multiplying with the aim of incorporating 10% of the world's ocean surface area by 2020 (i.e., about 36 million km^2) compared with just under 4% currently.[1]

The expressions "marine spatial planning," "maritime spatial planning," and "maritime space planning" are often used analogously to signify a *planned* approach to developing maritime space, in other words, an interventionist approach. However, the first two terms put an emphasis on *spatial planning* (Smith et al., 2011), an approach that has actually evolved over time and changed in essence by being applied to the maritime domain (Kidd and Ellis, 2012), whereas the third term (used by the French authorities and translated as such in the French version of European Directive 2014/89) comes from wanting to highlight the strategic character of the planning process at the expense of the spatial aspect. This position adopted by the French authorities at the end of the 2000s and until the start of the 2010s can be explained by the experience of planning initiatives mainly based on *zoning* (Trouillet et al., 2011), notably the *Schémas de Mise en Valeur de la Mer* initiatives. In a certain way, this reluctance shown by the French authorities echoed Mintzberg's (1994) view: "The goal of those who promote planning is to reduce managers' power over strategy making." Besides, European institutions also prefer the adjective "maritime" as opposed to "marine" when employing this expression, the aim being to encompass everything to do with the ocean and not just refer to what is produced by the sea.

However, implementing MSP is a complex and even controversial process. In the European Union, for example, at least two opposing points of view show themselves to be in favor of either planning based on an ecosystemic approach (hard sustainability), in keeping with its original spirit (Douvere, 2008; Degnbol and Wilson, 2008), or planning as a support to "blue growth" (soft sustainability) (Frazão Santos et al., 2014; Qiu and Jones, 2013). This opposition gives rise to an ambiguity, particularly when it comes to coordinating MSP and PMAs. It also brings the "spatial" aspect into question, which is viewed differently depending on the dominant logic and on the "temporal" aspect, as conservation takes place over the long term whereas economic rationales require flexibility over the short term. Another problem arising when implementing MSP is the uncertainty surrounding possible changes in maritime uses and how these evolving uses can cohabit. Uncertainty may well be inherent to planning and development; however, the problem becomes more acute with regard to sea uses for which knowledge gaps often exist, especially in terms of their spatiotemporal dimension and the speed at which changes take place (St. Martin and Hall-Arber, 2008).

Fishing is a prime example of this problem, both due to the highly variable spatiotemporal nature of the activity (Le Tixerant et al., 2010; Le Guyader et al., 2017; Tissière et al., 2016) and its strong dependency on external factors that often lead to conflicts (Trouillet, 2015), falling in line with the observation made by the UK government in one of its first plans: "The lack of uniformity and stakeholder consensus regarding fisheries data combined with the difficulties in predicting the future of fisheries, makes formulating prescriptive marine plan policies for this sector a challenge" (HM Government, 2014). Lastly, the ocean remains "unfinished territory" as, without mentioning the number of maritime borders that have not yet been agreed upon as to their demarcation, these nascent sea territories still lack a component (Trouillet, 2004) as they hover somewhere between the institutional territory of planning [e.g., *façades maritimes* (coastal regions) in France] and the territories of activity and use. In short, speaking of MSP here raises the question of what a "territory" is and consequently of what "makes" a territory (actors, projects, etc.).

These three main challenges faced when implementing MSP, especially in a context of rapid spatial changes and the need to adapt to long-term climate changes, bring three geoprospective elements to mind: "space" as a support and agent, "participation" as a performance-related device and, situated at interface of these two aspects, "models" as complements or supports for scenario setting (Emsellem et al., 2012; Houet and Gourmelon, 2014; Voiron-Canicio, 2012). These three elements are inseparable because geoprospective implies that actors participate in discussions about assumptions based on knowledge and models used to describe and represent current trends. These models and knowledge are in turn based on data, notably spatial data, which refers to questions of availability and quality that condition the use of other types of model (GIS, simulators, etc.) (Le Tixerant et al., 2018; Pinarbasi et al., 2017).

We posit that MSP is a pertinent framework for testing the heuristic potential of geoprospective, which we view as an aid to social learning, or in this particular case, to "socio-spatial learning." However, beyond the interest of social learning as a means of generating new knowledge, of acquiring technical and social competencies, or of developing relations that may contribute to a common understanding of the system and thereby lead to agreements and collective action (Muro and Jeffrey, 2012), in this chapter, we focus more specifically on the characteristics of geoprospective processes themselves, as well as the contextual factors that contribute or are an obstacle to their implementation and the results obtained. In fact, although participation has gradually become a key principle for MSP, it can be confronted not only with differently appropriated types of model used in geoprospective—from the more traditional (map) to the more sophisticated (numerical simulation model), and from the more abstract to the more realistic (Le Page, 2017)[2]—but

also with various ways of using space as a support or agent (data, types of space, relations to space, etc.). The variety of possible links between the questions of space, participation, and models suggests that there is a potential for thinking about and using geoprospective in different ways, each way liable to offer advantages and challenges depending on the implementation context and methods.

In order to test this general hypothesis (i.e., the diversity of viable geoprospective approaches and tools vs the diversity of publics along with the variety of implementation contexts and methods), we developed an analysis based on experiments performed over several scales of time and space, with a variety of publics and using different objects (Fig. 10.1).

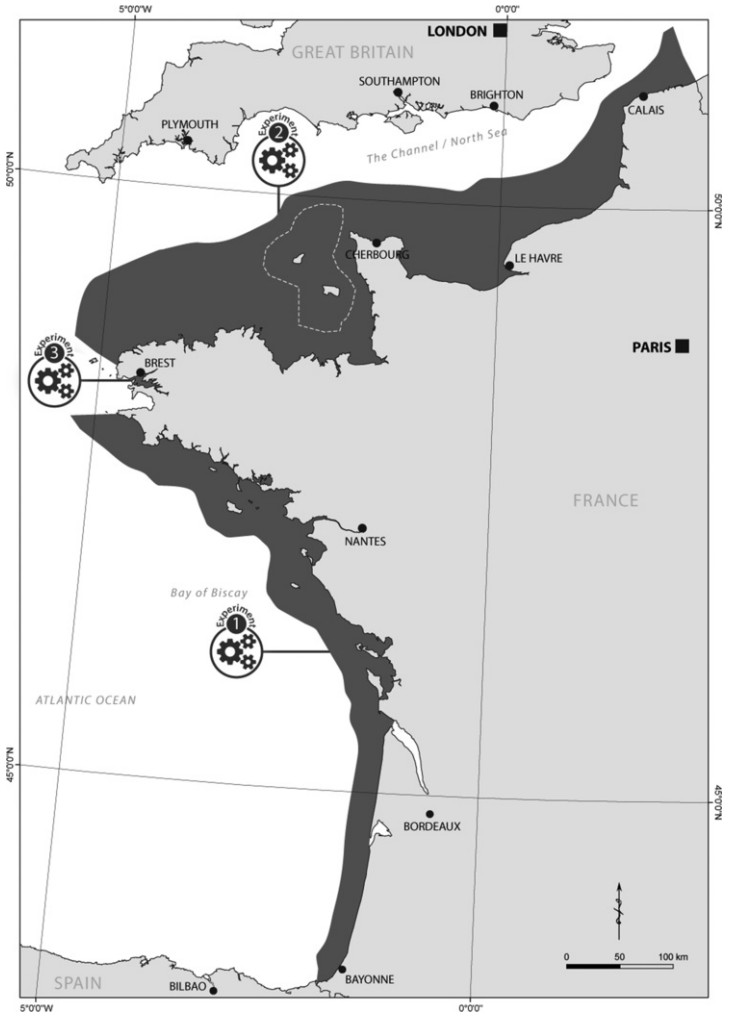

Figure 10.1 Location of the three case studies.

We think that the implementation of MSP in France provides a pertinent application framework as it was rolled out as a national strategy first, before becoming a basis for producing regional MSP documents with a strong strategic quality and ultimately, enabling the coordination of spatial planning tools and efforts at a local level (Trouillet et al., 2011). Based on this logic, we chose three experiments which enabled us to approach the space-participation-modeling trio from different angles: a first case combines one use and regional scale (Section 10.2), a second links multiple uses and regional scale (Section 10.3), and a third focuses on multiple uses and local scale (Section 10.4). Following on from this, we analyzed the benefits and limits of geoprospective using a discussion grid based on this trio (Section 10.5).

10.2 A geoprospective experiment concerning one activity on a regional scale

10.2.1 Implementation context and objectives

The aim of this first experiment was to test a geoprospective approach on a case focusing on fishing activities, which are often at the heart of MSP stakes (variability of production factors, large spatial distribution, resource conservation challenges, activities confronted with the development of new uses, and the implementation of MPAs). Although this in itself is an interesting observation, at least three other reasons inherent to the fishing sector bolster

this interest: the question of data, and thus of models, is particularly sensitive in this domain; participation is considered a key element in the management of fisheries; and the area at stake rarely matches the management area.

For the main fisheries off the French Atlantic coast, the Bay of Biscay (Fig. 10.1) is the most appropriate management area with regard to fishing resources. The conservation of resources, the good environmental status, the distribution of access to the area, or the renewal of fleets are all important goals for fishery management policies and more broadly,

policies on the development of maritime space in the Bay of Biscay. Whereas public administrative and scientific institutions have always been involved in management policies, the regionalization of the Common Fisheries Policy now justifies the increasing participation of new public and private actors, namely, fishers, local, or regional authorities and nongovernmental organizations (Van Hoof et al., 2012). The involvement of stakeholders—with fishers being at the forefront—in the decision-making process is increasingly encouraged to guarantee the success of the measures adopted. Given that these management measures are evaluated with the help of simulation models, the issue of adapting this type of tool to the actors becomes primordial. The decentralization of fishery management as defined by Pomeroy and Berkes (1997) thus brings into question the tools used to assist in decision-making, particularly models, which have gradually become more complex to account for the different elements of fishery systems (Thébaud et al., 2014).

The ISIS-Fish model, which spatially and temporally charts fishery dynamics, was designed to measure the effects of different management scenarios on the dynamics of both exploited fish populations and fishing activities (Mahévas and Pelletier, 2004). This feature makes it usable for geoprospective in terms of fishery management and support for MSP. More globally, it makes it capable of shedding light on model-participation interactions (Kieken, 2005; Houet and Gourmelon, op. cit.). From a technical point of view, as its precision is determined by the level of knowledge and the availability of input data, ISIS-Fish simulations are mostly generated on the statistical scale of the International Council for the Exploration of the Sea (i.e., a surface area of between 4169 and 4474 km² around the latitudes of the Bay of Biscay) and on a monthly basis. It produces a cartographic interface, making it user-friendly and encouraging discussion between actors.

In this context, this first experiment had three targets: (1) to contribute to reflection on the future of marine fisheries in the Bay of Biscay, given the changes taking place there in terms of occupancy dynamics and the implementation of MSP tools, (2) to accompany the participation of several types of actor, and (3) to analyze the use of tools in a participatory context.

10.2.2 Methods

The geoprospective exercise consisted of cowriting several scenarios for 2050 by spatializing the narrative to enable interaction with several scientific methods, including modeling. Using ISIS-Fish in this context required us to establish a procedure involving about 20 actors from the maritime fishery sector in the Bay of Biscay, including government department representatives, fishers, community activists, other users of maritime space, and researchers from different disciplines. Three rounds of surveys were led by a foresighter and a geographer, with modelers sometimes brought in to work with them (Fig. 10.2).

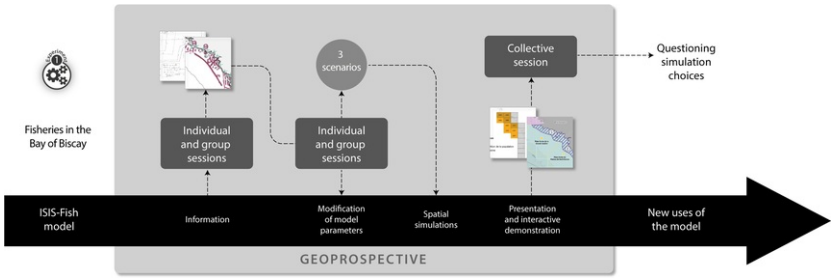

Figure 10.2 Fisheries in the Bay of Biscay: methodology.

From the outset, the participants were informed that the ISIS-Fish model was going to be used. The model was then presented in detail during the third round of surveys via a short film explaining parameters in layman terms[3] and an interactive demonstration of the different forms of simulation, such as the spatial distribution of populations and of fleet fishing efforts, or the evolution of biomasses, catches, and fishing mortality. The model was also accompanied by different qualitative support materials to enable discussion about its parameters and to cobuild hypotheses to be tested.

10.2.3 Results

The first round of surveys consisted of individual and group sessions with the aim of identifying actors' concerns for the future. Three topics came to the fore, around which the rest of the geoprospective experiment was organized: (1) management of fisheries in terms of the organization of decision-making processes and the measures adopted; (2) cohabiting with other uses from the point of view of dialogue between activity sectors and the distribution of spatial resource; and (3) the state of the environment, which was a secondary topic perceived through global changes. These concerns were represented on mental maps[4] (Fig. 10.2). During the second round of surveys, also consisting of individual and group sessions, these three concerns were used to establish change hypotheses (Fig. 10.2). The latter were then brought together into three contrasting scenarios whose respective narratives were progressively adjusted through to the end of the experiment. At first, the scenarios took on a narrative, written, and illustrated form before being transposed numerically into the ISIS-Fish model. They continued to be developed during the third

round of surveys. This round drew on different types of support material (Fig. 10.2), which were valued by the actors present to varying degrees. Some of the support materials were rejected whereas others were created by the participants in the same vein as an influence graph, which enabled the chain of causal links for one of the scenarios to be highlighted (Tissière et al., 2018).

The quantification of the effects of the scenarios on the Bay of Biscay fishery shows the real pertinence of using the ISIS-Fish model, which was at the heart of the third round of surveys. The modeling demonstration was based on one of the scenarios called "Jaws in the Bay," or more specifically, on two of its hypotheses—(1) the standardization of the fishing fleet and (2) the appropriation of the coastal band by new uses—which required further interviews to be quantitatively transposed. The discussions that ensued once the simulation results had been presented in a plenary meeting showed that all the participants had a good understanding of how the model worked. The criticisms expressed were not aimed at the parameters but at the choices made in transposing the hypotheses (faithfulness to the original narrative, probability of orders of magnitude selected, etc.) (Provost et al.,)
Similar comments were made regarding the representation of scenarios in the shape of maps. In the end, these criticisms equated to a questioning of the decision taken in transposing the narratives of the actors interviewed, given that the more strategic aspects of their participation had been formalized.

10.3 A geoprospective experiment concerning multiple uses on a regional scale

The goal of this second experiment was to test a geoprospective approach in the context of a French regional scale initiative prefiguring the production of the strategic document for the Channel/North Sea French coastal region.

10.3.1 Implementation context and objectives

MSP needs to respond to an increasing number of challenges at sea, especially with regard to the Channel/North Sea coastal region due to the creation of an MPA, the development of marine renewable energies, an increase in maritime traffic, and a high level of fishing activity. Given the context, the general aim of this second experiment was to prepare and provide support for the new decision-making processes concerning the sea for this coastal region (Fig. 10.1).

Throughout the different stages, it brought together about 20 actors representing public government departments and agencies, as well as professionals and users involved in a variety of activities. Our main hypothesis was first that participation in a geoprospective experiment would encourage the convergence of perceptions held by actors with different

points of view, leading to the implementation of shared strategic visions, and second that these visions could not be constructed based on spatial representations that were worlds apart.

In practice, the approach primarily aimed to use participatory mapping methods (Moore et al., 2017) as suitable tools for understanding and clarifying the perceptions of actors and monitoring the way these developed throughout the geoprospective process. This would then confirm whether these approaches encourage or not both the emergence of converging perceptions of maritime space among the actors and the drafting of strategic visions.

10.3.2 Methods

To meet these objectives, the project was split into two main stages (Fig. 10.3). The first stage consisted of gathering the perceptions of participants during semistructured interviews using participatory mapping methods. We thus interviewed 28 actors from the Channel/North Sea French coastal region to identify their perceptions of the current state-of-play and their visions for the future. The method relied on using mental maps and stake maps. This is understood as being a free representation of the stakes on a map, based exclusively on individual perceptions which are meant to embody social perceptions. The second stage involved organizing two 2-day seminars to create the conditions for cobuilding contrasting and spatialized scenarios based on a combination of hypotheses and to observe the process itself. These seminars unfolded following the usual three-step approach: phase-in, scenario building, and discussion (Mermet, 2005). The first seminar drew 11 participants out of the 26 actors met beforehand. This made it easier to gather qualitative data while keeping a broad range of the profiles identified during the individual interviews. Three months later, the second seminar counted 10 participants, all of which had been present at the first

seminar, ensuring continuity in our experiment. The aim was not so much representativeness as to check our main hypothesis.

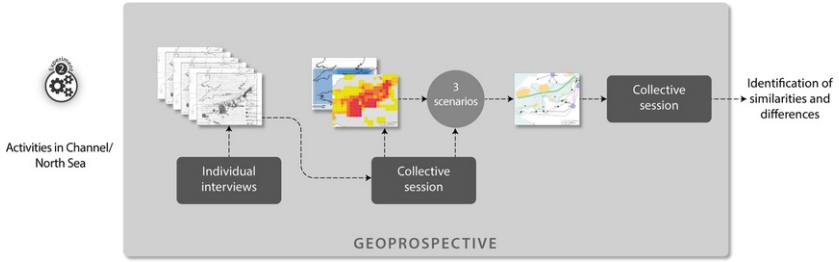

Figure 10.3 Activities in the Channel/North Sea: methodology.

During these seminars, we favored the use of qualitative tools given that planners generally only have access to data which is scattered across several institutions and organisms has information gaps (St. Martin and Hall-Arber, 2008) and is nonstandardized (Abramic et al., 2018). Therefore gathering qualitative data from actors was quicker than collecting quantitative data, which involves fieldwork over a relatively long period. The qualitative approach, which is more adapted to the frequently very tight public policy-making time schedule, was our preferred approach. It was based on mapping aids that were deliberately schematic and adapted to research on the unpredictable future of vast entities.

10.3.3 Results

The preparatory phase of the geoprospective experiment provided us with two types of maps for each actor (Fig. 10.3). A mental map enabled us to gather information concerning activity locations, whereas a stake map encouraged a first step toward identifying perceptions by asking actors to spatialize and qualify these stakes (i.e., activities and actors concerned, major changes to be anticipated, trends, etc.).

During the first seminar, the phasing-in stage enabled us to establish a shared perception based on a collectively produced regional scale map. This map enabled us to group together activities, uses, and zoning (Fig. 10.3). To

build spatialized scenarios (second part of the seminar), we started by identifying possible future changes, distinguishing between strong trends, whose evolution can be anticipated over time, and critical uncertainties, whose pathways are less predictable. Different hypotheses arose on how the main critical uncertainties could evolve. The group spontaneously chose three hypothesis combinations as a basis for three contrasting scenarios characterized by a narrative and a graphical spatial modeling for the year 2050 (Fig. 10.3). Scenario 1, “channeling together,” was founded on strong dynamics of cooperation between the United Kingdom and France to centrally manage ecosystems despite serious economic crises. Scenario 2, “the company as guarantor and fostering blue growth in the Channel,” described a weakening of public policies and the rise to power of an ultraliberal model leading to the depletion of resources following a period of strong growth. Scenario 3 presented the Channel as the “blue gate to Europe,” boosted by ever stronger European policies. The general leanings of the scenarios show that environmental stakes were all but absent in all three, despite the participation of representatives from this sector (the French Agency for Marine Protected Areas, the French Water Agency, etc.). They are in fact a lower priority than governance stakes, probably due to the political context in which the exercise took place, that is, the reorganization of government departments coupled with the rise of MSP. The link between current events and

the “game” proposed by the workshop seemed obvious, both in the opinions held by the actors and the scenarios themselves.

These three spatialized scenarios were discussed in a second seminar (Fig. 10.3), enabling their similarities and differences to be identified. Although the diagnosis and analysis of stakes led to a consensus, the discussions on the solutions to be adopted to meet these challenges did not result in a shared strategic vision common to all the participants.

10.4 A geoprospective experiment concerning multiple uses on a local scale

This third experiment consisted of testing a geoprospective approach from the point of view of challenges linked to the multiple uses of maritime space, and on a local scale potentially corresponding to that of the spatial planning tools (e.g., marine natural parks) which need to be coordinated in the local strategic documents.

10.4.1 Implementation context and objectives

The geoprospective workshop dealt with the maritime activities which take place in the Bay of Brest, located on the western-most tip of Brittany (France) (Fig. 10.1). This maritime basin faces (1) potential space conflicts between commercial fishing, maritime transportation, and supervised nautical activities (windsurfing, sailing, kayaking, rowing, and scuba-diving) and (2) ever-growing regulations and coastal conservation policies. This new situation is handled through an Integrated Coastal Zone Management (ICZM) process, which aims to promote cooperation among stakeholders. The geoprospective workshop exploited a GIS-driven Spatio-Temporal Database (STDB), which had gathered heterogeneous data describing the spatial and temporal scope of supervised activities on a daily basis over a year (Le Guyader, 2012). This STDB was developed to (1) model the spatial and temporal dynamics of the activities and (2) produce different kinds of artifacts (spatial or not: maps, geovisualization, statistics, networks, etc.) for local stakeholders (Gourmelon et al., 2014). In short, the geoprospective workshop aimed to evaluate the usability of the STDB in a professional context as a support for debates as well as a way to optimize the simulation based on the collective scenario process, while providing different types of representations.

10.4.2 Methods

The geoprospective workshop was organized by three researchers and took place within an applied research process (Fig. 10.4). During two successive sessions, one representative from local commercial fisheries and five representatives from local agencies involved in the management of the Bay of Brest were brought together. Government departments and

representatives from nautical activity centers and from maritime transportation declined the invitation. During the workshop, a moderator and an observer from the scientific team were appointed to manage and record the reactions and debates between the participants.

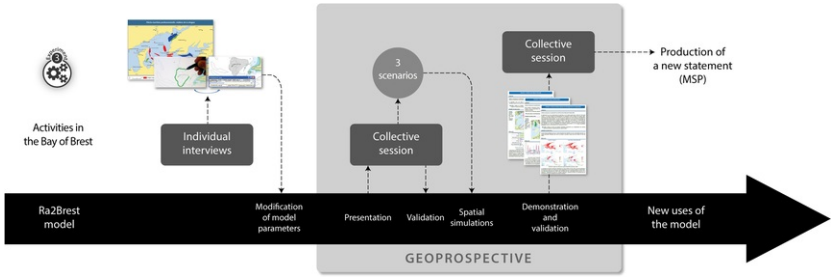

Figure 10.4 Activities in the Bay of Brest: methodology.

During the first 3-hour session, one of the researchers presented the different phases of knowledge production concerning the supervised human activities that simultaneously occur in the Bay of Brest: data gathering, notably from what actors have said, the creation and analysis of a spatiotemporal database, and the generation of results in different graphical formats highlighting potential conflicts between activities (Fig. 10.4). A back drop was then created for applying the geoprospective tool, using a scenario proposed by the researcher, which simulated the siting of a wind farm in the Bay of Brest and the consequences it would have on the current activities. The participants were then invited to propose future scenarios for maritime activities in the Bay of Brest.

The second workshop session was programmed to take place a month later (Fig. 10.4). It lasted 3 hours and featured the same participants. A researcher presented the simulations resulting from the scenarios proposed by the stakeholders during the first session. The debriefing was structured by an evaluation form concerning the approach and the output, filled in individually each by each actor. It gave rise to a collective discussion on the advantages of the geoprospective approach in this kind of application context and notably, the benefits of the spatiotemporal aspect of representations.

10.4.3 Results

During the first workshop session, the spatiotemporal modeling of human activity in the Bay of Brest was interactive. Participants reacted positively to the approach in general and to the value added by the spatiotemporal aspect. Spatiotemporal interactions between

activities were presented in different formats: summary maps (e.g., density of entities over a year), dynamic geovisualization (e.g., the spatial footprint of activities as it unfolds on a daily basis over a year), interaction matrix and network (e.g., the number of times two activities share the same space at the same time over a year) (Fig. 10.4). Several questions were raised by participants during the course of the presentation. They concerned among other things the inclusion of physical parameters in the model (bathymetry, currents, tide, weather forecast), the possibility of obtaining an even more precise temporal granularity (a half-day) and of ranking the spatiotemporal interactions highlighted, and the inclusion of benthic habitats to evaluate the pressure put by some activities on the resource. With regard to the scenario-setting phase, once the participants had overcome their initial surprise at the scenario proposed by the researcher, they all took part seemingly unreservedly, except for the fisher representative who took a back seat. After an hour of spontaneous discussions often held in pairs between representatives from local authorities, without any research intervention, three simulation leads came to the fore: the creation of a new passenger maritime transport route (scenario 1), ulva harvesting via trawler offshore from the urban beach (scenario 2), and reintroduction of marine aquaculture (scenario 3). These three scenarios were essentially proposed by three local authority representatives.

During the second workshop session, the context, data used, and results for the three simulations made using the STDB were presented for each scenario, despite the difficulties encountered in collecting complementary data and in remotivating the local actors between sessions, even though they had been very motivated during the first session. These presentations were made using statistics and maps and highlighted the activities impacted (scenarios 1 and 3) and the days with minimum restrictions (scenario 2). The debriefing provided an opportunity for coming back to the advantages of the approach and usefulness of the output for managers in the ICZM process. All the participants thought that the interaction matrices for the activities were very useful for the diagnosis phase. Equally, for the ICZM prospective and planning phase, they all generally appreciated the dynamic geovisualization depicting the occurrence of activities and the prospective simulations. During the presentation, the issues surrounding MSP were evoked by two participants as a future challenge for the Bay of Brest. With regard to this, they asserted that the approach could be of interest for two stakes: (1) showing the spatiotemporal interactions between activities to anticipate potential conflicts and (2) the collective development of planning scenarios to help with decision-making. The

other participants agreed with this and a discussion ensued between participants and researchers on the transferability of the method to another maritime space.

10.5 Discussion—Conclusion

The common objective of these three geoprospective experiments was to test the advantages and limits of this approach in terms of social learning, with a focus on the role of the

different types of spatial representation and whether they aided or hindered the participatory process. As with all empirical approaches, these three exercises only serve as illustrations and are intrinsically characterized by the conditions in which they were conducted (type of participants, current issues, etc.). In addition, the aim was not necessarily to compare them but rather to multiply the analysis angles with the aim of adding to the discussion. In this context, it seems logical that these three cases involved publics that were more or less homogeneous (managers of territories, user representatives, etc.) and maritime territories of varying size (regional or local scale) confronted with MSP stakes in different ways. Although not a perfect approach, due to the numerous gaps between the three terms of the space-participation-modeling trio, it can still serve as a guide for transversal analysis, aimed at gaining knowledge on applying geoprospective to the maritime area in terms of planning.

First, in terms of participation, the assiduity and involvement of the participants throughout the three experiments show both their interest in the exploratory geoprospective approach and their willingness to participate, on this occasion, in an unprecedented discussion proposed by the researchers. Geoprospective thus comes to the fore as a social learning aid for better understanding interdependency. Although meetings to initiate dialogue on fishery management are often a place for expressing power relations between different groups of actors, with one group predominantly taking the floor (Tissiere et al., in press), the first case shows that as long as dialogue between participants is constant and does not lead to a deadlock, debates in the context of a geoprospective exercise can be more constructive and balanced than in the more traditional participatory exercises. This can clearly be explained by the fact that projecting oneself into the relatively long-term future (50 years in this case) makes it easier to cooperate and even adhere to the principle of participation. The second case shows us that if a diversity of actors is involved, geoprospective improves the understanding of each other’s goals and perspectives and sheds light on the underlying values and visions of the future. Furthermore, using spatial scenario setting on the scale of a coastal region encourages consideration for the different system compartments (geographical, socioeconomic, ecological) and the links between them. However, such a vast territory can also actually hinder collective actions, which rely on mutual agreement between actors who do not share the same areas of interest and/or issues. At a local level, the third case shows that with a relatively homogeneous public made up of local stakeholders, the creation of collective scenarios raises questions of legitimacy, of active involvement, and of access to additional information which is not always readily provided by the actors, as has already been shown in other participatory experiments (Becu et al., 2008; Dupont et al., 2016). Some participants tend to remain on the sidelines and at a group level, the geoprospective workshop raises questions about the risk this could pose to policies and actors who are not represented (Steyaert et al., 2007). Nevertheless, in this local experiment, the geoprospective approach taken as a whole helped not only to encourage actors to cooperate at certain times, but also to produce a new statement to

which they all adhered. This substantiates what Ritschard et al. (2018) have already shown: spatiotemporal representations and other forms derived from their analysis serve not only to spark the interest of and enroll stakeholders in a participatory process, but also to smooth the way for the emergence of a collective statement of new stakes for the territory.

Second, where spatial and modeling issues are concerned, although the various categories of public involved may have appropriated the multifarious geographical information in different ways, they all showed an interest in the spatial representations based on qualitative data, that is, data gathered from what actors have said. This supports the current trend and the interest in geographical content and knowledge as produced by the general public (Haklay, 2013). For users of maritime territory, it would appear that when their knowledge is recognized by the other stakeholders, all the actors are brought onto the same footing, which is essential for a collaborative approach based not only on an exchange of knowledge and proposals but also on the individual power to influence the process (Barreteau et al., 2010). For the researchers, by using the information gathered from actors interviewed prior to the scenario-setting phase, they were able to acquire new data and better understand the perceptions and visions of the stakeholders, which is often

restricted at first to the space in which they practice their activity and their field of activity. In fact, collecting data from interviews probably makes the notion of cobuilding more concrete for managers and policy-makers and additionally contributes somewhat to stakeholder enrollment in the management process (Ritschard et al., 2018). The first case supports this idea by showing that the participants' understanding of the model was improved by cobuilding input variables and combining participation support material prior to the simulations. The second case also illustrates that using mental maps based on interviews with the actors and schematic graphical models enables participants to move on from the technical questions linked to data and representations and concentrate on the strategic questions involved in policy decisions, especially where access to space and marine resources is concerned. On a local scale, the third case shows us that realistic or hyperrealistic representations using data from geographical databases can be successful and therefore prove to be interesting in certain contexts. The same applies for the temporal dimension of geographical data on a daily scale, which played a major role in the diagnosis, planning, and environmental foresight phases according to the participants taking part in the third experiment. This result, which confirms the relevance of realist models as a support for management approaches, is probably linked to the homogeneity of the group in terms of spatial competencies (Noucher, 2009). With other types of actor, using spatial representations—particularly those based on realist models—in whatever form they may come in, can prove to be more complex or even controversial, depending on the contexts in which and the subjects for which they are used (Ritschard, 2017). The experiment undertaken with fishers from the Bay of Biscay in case 1 illustrates this situation. The spatial dimension became a mediator when it gave rise to stakes shared by the different categories of participants, both in terms of the fishing

components (e.g., identifying key zones) and in terms of the representation of these components (e.g., choosing the appropriate scale). The spatial dimension also played a mediation role when it enabled the narratives to be viewed in all the graphical presentations as well as in the ISIS-Fish model display interface. However, conversely, it not only created a deadlock when it embodied much debated management modes (especially MSP and PMAs) but also when obstacles relating to methods (e.g., the difficulty of mapping a piece of information) or strategy (e.g., not wanting to map a piece of information) were met.

Lastly, from a more global point of view, among the numerous issues to be resolved in geoprospective projects, the question of an individual's appropriation of the reality of a given territory, including a reality expressed by others, is clearly raised. In our three cases, we have considered that all types of spatial representation that a priori enable individual understanding and the expression of different viewpoints are worth using. Therefore we have drawn on a broad range of spatial representations based on qualitative and quantitative data. They are used both as intermediary objects (Vinck, 2009) to provide local actors with a dynamic and integrated vision of the territory, facilitating cooperation between them, and as inscriptions used by certain actors to argue and convince their colleagues of a certain statement (Latour, 1985). The results drawn from our three case studies illustrate the nuanced appropriation of the different forms of spatial representations and somewhat evoke the MORE reference framework (Modeling for resilience thinking and ecosystem stewardship) proposed by Schlüter et al. (2013) in socioecological system models (Fig. 10.5).

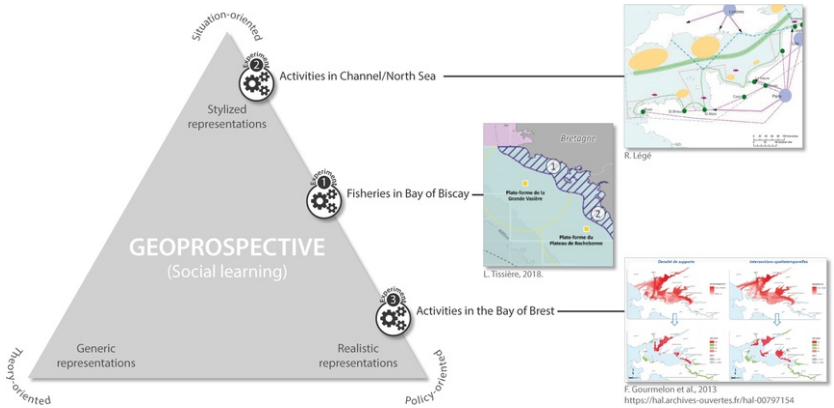

Figure 10.5 The different forms of spatial representations produced by the three geoprospective experiments versus MORE reference framework (Schlüter et al., 2013).

According to the authors, schematic models support inter- and transdisciplinary communication and integration for the development of societal strategies (adaptation and transformation) as shown by the experiment conducted in the Channel/North Sea coastal region (case 1), whereas approaches based on structurally realistic models and case-specific models are policy-oriented as shown by the two other experiments (cases 2 and 3), with varying degrees of possible actions and appropriation. The question of implicit choices that guide the debate is particularly meaningful for fishery models (case 1) as management measures are prerequisites and debates can only set certain parameterizable elements such as thresholds (e.g., quotas) and limits (e.g., fishing areas). In case 3, the participants adopted the realist model without any difficulty and "played along" during the scenario-setting phase. Their level of innovation with regard to possible futures was nevertheless limited by their feeling of illegitimacy in taking decisions.

To conclude, the challenges and some of the different stages of the MSP process can benefit from a geoprospective approach as shown by Pinarbasi et al. (2017). Our study highlights the interest in having a plurality of model types and tools adapted to different application contexts and to different stages of the MSP process. The various forms of spatial representation, based on qualitative and/or quantitative data, and the different modeling techniques used must be inscribed in these contexts and carefully introduced to ensure that they facilitate rather than hinder an often-fragile collaborative process (Barreteau et al., 2010). In any case, further evidence of the beneficial outcomes is now required, which justifies the increasing number of new experiments.

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Footnotes

1 http://www.mpatlas.org/map/mpas/ (viewed in January 2018).

2 According to Le Page (2017), an empirical model is a means of representing observations with the aim of sharing them. He distinguishes between realistic empirical models built by integrating georeferenced data (e.g. from a Geographic Information System) and stylized empirical models that represent space schematically.

3 The short film and the results generated by the model can be viewed at this address: www.isis-fish.org.

4 "Mental maps are understood here as physical, hand-drawn maps on a blank sheet of paper where the subject expresses, graphically, a subjective reality of space using individual and social memory" (Dernat et al., 2016).

Abstract

Marine spatial planning (MSP) is becoming established on a global scale in a context of rapid change. It was first introduced as a national strategy before being used as a basis for producing regional MSI documents with a strong strategic quality and ultimately enabling the coordination of tools and efforts at a local level. Based on this logic, we present three experiments which enable us to approach the contribution o geoprospective: one case combines one use and regional scale, another links multiple uses and regional scale, and the third focuses on multiple uses and local scale. We conclude that a broad approach t geoprospective should be taken, enabling it to adapt to the different application contexts and targets. The various forms of spatial representation and the different modeling techniques must be inscribed in thes contexts and carefully introduced to ensure that they facilitate rather than hinder an often-fragile collaborative process.

Keywords: Geoprospective process; marine spatial planning; modeling; participation; space; spatial representation