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Smokescreen or groundwork? The paradox of ecological monitoring in the management of Marine Protected Areas

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ABSTRACT

At a time when ecological monitoring is crucial to implement efficient biodiversity conservation policies, we studied the perception of Marine Protected Areas (MPAs) agents on the place of ecological data in the functioning of MPAs. We interviewed agents working in eight of the main MPAs of the French Mediterranean Sea through qualitative surveys. We found that ecological monitoring encompasses multiple dimensions and fulfills several scientific, economic, psychological and political functions in the MPA while ultimately having limited effect on the implementation of biodiversity policies. The governance mode of some MPA and the chronic under-funding of marine conservation policies threatens both the quality of the ecological knowledge and its ability to affect decision-making. However, having ecological knowledge allows MPAs and their agents to establish themselves locally as essential institutions for marine biodiversity management. In this context, ecological monitoring not only justifies the existence of MPAs but can as a smokescreen, masking the absence of more stringent environmental regulations. Investigating how ecological monitoring is perceived within MPAs helps to unravel and describe the social and political processes underpinning ecological data and highlights its significance in contemporary marine conservation efforts.

1. Introduction

Over the last decades, technical and scientific progresses made biodiversity data more mobile and accessible [37]. The availability of quantitative biodiversity data flourished at international, national, and local scales [36,59]. Environmental decision-making is supposedly guided by rational understanding on ecosystems and should benefit from the increasing weight of quantitative data [23,57]. Monitoring, defined as any operation that collects information, emerged as a gold standard to collect ecological data in order to build reliable indicators to inform environmental decision-making [56]. Monitoring can take different forms including species counts along transects, expert judgements, or social surveys, and can cover different spatial and temporal scales. Yet, several studies stressed that massive investment in biodiversity monitoring failed to halt biodiversity losses [19,31]. While gathering ecological information is a powerful conceptual tool for alerting the public about the biodiversity loss, there is an apparent gap between ecological knowledge and political decisions [23]. Collecting data is not a goal in itself in biodiversity conservation and dedicating projects solely to ecological monitoring can create a disarticulation between data

collection and knowledge production. This disconnection can lead to misleading or incomplete knowledge, so called “data rich but information poor” [62]. In such cases, data becomes an end product in itself, failing to be translated into policies [14]. In this paper, we discussed the ambivalence of ecological data presented as a cornerstone of environmental management institutions while ultimately having little effect on the decision-making process.

The assumption that reality can be objectively measured through data leads to the perception that monitoring promotes transparent, quantifiable, and measurable information, which in turn is believed to enhance more objective decision-making (Alain Desrosi eres, cited by [45,52]). Within this realist ontology, data and monitoring are elevated as intermediaries between science and decision-making, effectively obscuring the roles of political actors and their divisions, and fostering the myth of a “non-politicized governance” that operates independently of socio-political processes [10]. However, constructivist approaches of science argued that data do not act as an independent agent of change [43], but emerged and are embedded in specific social contexts [11]. Consequently, the manipulation of monitoring programs and quantitative instruments can be strategically employed to guide political

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agendas, a perspective that led Foucault to describe monitoring programs as tools of governance [27,52]. In this way, monitoring, data, and quantification shape the social reality and frame decision-making processes [22,8]. Here, we advocated for a reflexive approach to knowledge construction that examines the social and political dimensions of ecological monitoring in environmental decision-making [52].

In the context of biodiversity conservation, the increased requirement for quantitative indicators established ecological science as a technoscience aiming at providing data for environmental decision-making and being directed by political agenda [23,34]. The construction of ecological knowledge can be embedded in a “management-oriented regime” to inform decision making for biodiversity policies [34]. However, Mathevet and Mauchamp (2005) pointed out the limited effect of evidence based on ecological data to influence conservation policies, which would rather be driven by social context and political influences. Then, social studies of the construction of ecological knowledge put emphasis on the social context of monitoring biodiversity that shapes the production of knowledge and aims at having a direct implication on environmental policies [3,48].

The constitution of data and quantitative indicators into operational tools for decision-making is partly due to the growing influence of neoliberal conservation policies [10]. Neoliberal policies also pushed for the downscaling of environmental management from national to local scales and for the development of deliberative approaches of decision-making [21,38,4]. Deliberative governance presented limitations to implement efficient environmental regulations [49,61], perceived as being only consultative instances rather than holding a true power of decision [12,13]. Besides, requirements of environmental quantitative indicators to assess and direct environmental management policies even may lead to deterioration of biodiversity protection [35], and the systematic measure performance through indicators affect workers’ motivation and can conduct to deterioration of public actions [15,20]. In this context, ecological monitoring encompasses multiple dimensions unrelated directly to decision-making [60]. Holding ecological knowledge obtained through monitoring serves to legitimate institutions that present themselves as credible actors of the decision-making process [33].

The culture of ecological monitoring flooding the world of biodiversity management worldwide [47] is logically impacting the marine environment. Marine Protected Areas (MPAs) constitute the institutional tool for the protection of the seas and oceans [1], in which most biodiversity policies are implemented. Worldwide ocean coverage by MPAs is undergoing rapid development and is likely to accelerate following the recent COP15 agreement. MPAs are administrative institutions that produce and use ecological data to set up indicators and local legislations [24]. As in many countries worldwide, the French maritime coastlines are mapped by a network of MPAs whose contribution to the production of ecological data on the marine environment is important. French environmental policies rely on consensual and deliberative governance [10,42], MPAs are not exempt from the influence of the “market of expertise” on which biodiversity workers are expected to compete to claim credibility [33]. Similar to what Guimont [35] described for terrestrial protected areas, MPAs are committed to fulfill ecological indicators to be reported at local, national, and European scales. Contrary to terrestrial protected areas, difficult accessibility to open waters induce ecological and political particularities for MPAs. The openness of the MPA boundary, specific legislations of the sea MPAs, and difficulties to apply active management in the sea lead MPAs to be regularly pointed out for a lack of legislation, poorly protected MPA being targeted as “paper parks” [17,50,54]. Since the recent *One Ocean Summit* in February 2022, 80 countries have agreed to classify 30 % of their waters as MPAs while Non-Governmental Organizations (NGOs) and scientists raised concerns about the level of protection and appropriate funding [44], including within the European Union [39]. While international agreements stressed countries to establish ambitious percentage of their territorial waters as MPAs, the lack of regulations

objectives often create purely administrative areas with few funding and little protection. Indeed, neoliberal policies of environmental management recurrently exhibited a contradiction between ambitious political announcements and chronic underfunding paired with low concretization of stated objectives [10,42]. Whatever the management of MPAs, ecological monitoring has a central role in the functioning of protected areas and structures the working life of their agents [29,53,60]. The French MPAs of the Mediterranean Sea being under active development to cope with international agreements, they provide a relevant illustration of the context of knowledge production in biodiversity policies in the Global North.

Here, we aimed at understanding how MPA agents perceived the role of ecological monitoring in the functioning of the MPA. We focused our study on the French Mediterranean MPAs although the same trends operate at a larger extent in European Seas with a global strengthening of the MPAs network. We performed semi-structured interviews with MPAs agents in the French Mediterranean Sea. We first presented how ecological monitoring structures the organization of MPAs through the production of quantitative knowledge to inform ecological indicators whereas MPA agents suffer from a significant burden in a context of limited funding. Second, we underlined the paradox between the multiplication of ecological monitoring protocols in the MPAs and the weak effect of ecological evidence on the implementation of environmental policies. Ecological monitoring materializes the MPAs and legitimates the implication of national agencies in marine policies. Contrary to terrestrial protected areas, MPAs have a limited effect on the decision-making process and overinvestment in monitoring programs not being followed by concrete regulation constitute a driving force of the paper park issue. Then, we discussed why monitoring programs are still the groundwork of MPA despite rarely informing regulations. MPA agents mobilized the ecological knowledge to interact with stakeholders and to ensure credibility in deliberative decision-making processes. Building our argument on similar observations of neoliberal biodiversity policies, we argued that quantitative indicators are not a tool of governmentality anymore in our context, and rather act as a smokescreen to justify the existence of MPA.

2. Methods

2.1. Study area

The institutional framework of French Mediterranean MPAs is complex and several governance models coexist. In France, the French Biodiversity Office (OFB) is the public institution that centralizes biodiversity management policies. National Parks are exclusively attached and managed the Ministry of the Environment (e.g. Port Cros National Park). Marine Natural Parks are funded by the OFB although being under the control of a management board of regional authorities and local stakeholders (e.g. Cap Corse and Agriate Marine Natural Park, Gulf of Lion Marine Natural Park). Some MPAs are managed by local authorities (e.g., Regional Natural Park - PNR - of the Camargue, Blue Coast Marine Park), or by municipalities (e.g. Cap d’Agde MPA), and local stakeholders participate in the MPA management. MPAs internal organization differs depending on if the MPA is managed by OFB, which provides recurrent funding allocated by the government, or if the MPA governance comes from local and regional authorities along with more precarious funding.

In this study, we targeted professional positions that are linked with monitoring within a MPA, whose classically include: i) a director in charge of managing the MPAs agents, ii) a team of scientific managers in charge of designing scientific surveys to monitor conservation status of species and ecosystems, iii) a field work technical team in charge of implementing ecological monitoring in the field and performing some police surveillance missions. In small MPAs, most tasks can be shared between agents and most agents do not have a police license to perform control.

2.2. Semi-structured interviews

During two years, we conducted qualitative interviews with agents of eight MPAs of the French Mediterranean Sea and OFB agents. We provided details about the eight MPAs in Table 1. We performed individual semi-directive interviews to explore the perceptions of marine biodiversity workers concerning ecological monitoring and their role in the marine protection policies. The interview guide included 31 questions structured in three sections (Appendix 1).

The first section dealt with the current and past professional activity of the MPAs agent. We discussed their current missions within the MPAs as well as their educational and professional background. The second part of the interview aimed at exploring how the ecological monitoring programs in which they take part are conducted. Questions focused on the different stages of the monitoring process, from the definition of the scientific question, to the reporting and the analysis of the results, including the data collection through field protocols. In the third section, we explored the role of ecological monitoring in the MPAs functioning, and in relation to national policies for the protection of the marine environment.

We targeted eight Mediterranean MPAs among the most important in terms of surface area and resources (see Fig. 1 describing the study area). A standard interview lasted about 45 minutes. In total, 22 people answered to the interview. Interviews took place directly in the MPAs offices, or in the field. Due to health restrictions related to the Covid-19 epidemic, we conducted 4 interviews via videoconference, two of them were performed with individuals already met in the field at their MPAs. Among the 22 MPAs agents we interviewed, 12 belonged to governmental civil service and work for Marine Natural Parks or National Parks, while 10 were employed by local authorities (municipalities, Regional Natural Park, Corsican community). Nine were field work agents, 9 scientific managers, and 3 MPAs directors. There were 7 women and 15 men.

Besides qualitative interviews, this study is also based on participatory observation along with MPA managers through the involvement of the lead author during his work on ecological monitoring by the French Mediterranean MPAs. Over the last three years, he assisted to meeting that aimed at designing protocols to monitor bottlenose dolphins (*Tursiops truncatus*) in five of the eight sampled MPAs and trained the agents to dolphin monitoring. For the purpose of this study, he attended several field missions jointly with MPAs agents to participate in ecological monitoring operations along with field work agents. MPA scientific managers explained the protocol, trained the lead author, and included

him as a member of the monitoring operation. He accompanied MPA agents during at-sea ecological monitoring protocols and was committed to collect data himself. Getting engaged in field missions and performing ecological monitoring do not constitute any of the interview results but nourished the discussions presented in this article. For example, it helped to measure the mutual understanding of field protocols between scientific managers and the field work team who collects data, or to assess the quality of the equipment of field work agents.

We proceeded to the exhaustive transcription of all interviews using oTranscribe website (<https://otranscribe.com/>). Then, we classified and coded the written transcription using NVivo 11.4 software (<https://lumivero.com/products/nvivo/>). We did not notice differences between the gender dimensions of the respondents. In the following lines, we numbered the quotes that refer to an individual anonymous number for each person interviewed specifying its position within the MPA to help contextualize the citation (e.g. #5 – scientific manager).

3. Results

3.1. Monitoring under pressure

All MPA are engaged in multiple monitoring programs to collect data about ecological features (species or habitat) and on human activities (fisheries, recreational activities). For example, every three years, agents from the Cap d'Agde MPA perform underwater diving census to map *Posidonia* seagrass beds and to assess their health. Twice a year, agents from the Gulf of Lion Marine Natural Park performed boat line transects monitoring over the entire MPA to collect counts of marine megafauna (seabirds, marine mammals, and large fishes) and human activities. In some case, the monitoring protocol involves advanced technologies that require external competences. Then, some ecological monitoring programs can be transferred to external organizations such as private company, universities, or NGOs. For example, the Port-Cros National Park performed acoustic monitoring using underwater recording devices and data is then analysed by acoustic scientific specialists from a local university.

Despite governance particularities, all MPAs follow a management planning strategy that specifies the priorities for the MPA, including quantitative ecological indicators to be fulfilled via monitoring. Thus, all MPAs were committed to collect data to report ecological indicators at local, national, and European scales. In the eight MPAs, monitoring programs span across many topics, either displaying an ecological focus on marine species and habitats, or targeting human activities or

Table 1

Description of the eight Marine Protected Areas (MPA) where we interviewed MPA agents. The overall staff number is given on an indicative basis as it might fluctuate yearly and seasonally. OFB stands for the French Biodiversity Office in charge of managing the national biodiversity strategies. 'Office de l'Environnement de Corse' is the Corsican community agency in charge of the environment.

Name of the MPA	Surface (in ha)	Governance mode	Date of creation	Number of interviewed people	Overall staff number
Gulf of Lion Marine Natural Park	401 904	OFB funded Management board with local stakeholders	2011	5	± 17
Cap Corse and Agriate Marine Natural Park	684 149	OFB funded Management board with local stakeholders	2016	5	± 15
Port-Cros National Park	123 000 (central zone 4622)	Ministry of Environment	1963	2	± 100
Bouches de Bonifacio Natural Reserve	79 460	Office de l'Environnement de Corse	1999	3	± 40
Scandola Natural Reserve	604	Regional Natural Park of Corsica Regional collectivities and local stakeholders	1975	1	±15
Camargue Regional Natural Park	38 572	Regional collectivities and local stakeholders	2006	2	± 40
Blue Coast Marine Park	9 873	Regional collectivities and local stakeholders	1983	2	± 10
Cap d'Agde MPA	6 152	Municipality of Agde	2017	2	± 9

Marine Protected Areas in the French Mediterranean Sea

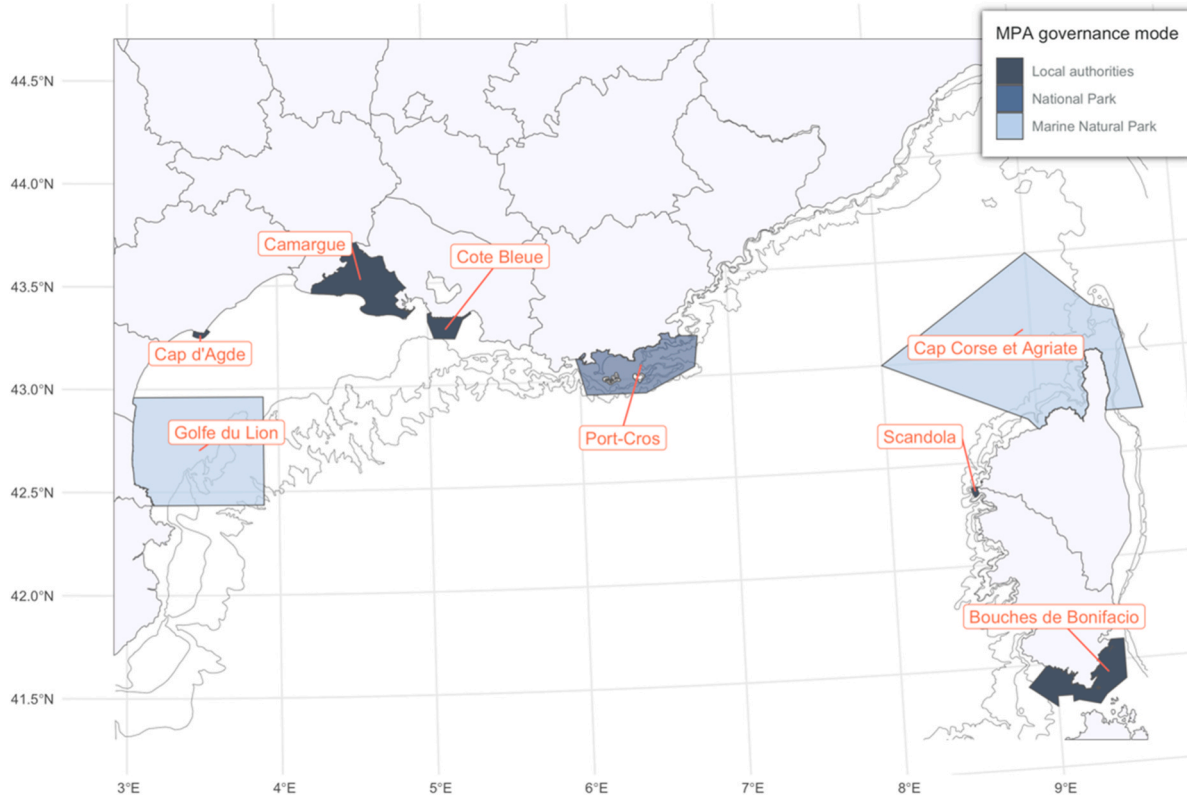


Fig. 1. Location of the Marine Protected Areas (MPAs) visited during the study. The MPAs are colored with respect to governance mode: Local authorities: Blue Coast Marine Park, Natura 2000 area of the Posidonia of Cap d'Agde, Camargue Regional Natural Park, Scandola and Bouches de Bonifacio Natural Reserves); National parks with public governance like the Port-Cros National Park; Marine natural parks with a mixed governance between the French Office for Biodiversity and a management council made up of local stakeholders, like the Marine Natural Parks of the Gulf of Lion, Cape Corse and the Agriate. Additional administrative details about the MPAs are given in Table 1.

pressures (e.g. fisheries, recreative sailing, plastic pollution) and can put a significant burden on MPAs agents.

“We performed halieutic, botanical, ornithological, climatic, and human activities monitoring. We are engaged in 85 scientific monitoring programs.” - #15 scientific manager

The scientific manager(s) designed the monitoring protocols, analysed the data, and reported the results to the MPA dashboard. In all MPAs, fieldwork agents are in charge of performing the monitoring protocols and share their time with other missions such as police surveillance or communication and raising environmental awareness. In MPAs managed by OFB, ecological monitoring programs take a predominant place in the agents' schedules compared to police oversights. *“Usually, it is 80 % of our time for knowledge and 20 % for police”* reports an agent of the Gulf of Lion Marine Natural Park. For MPAs managed on a smaller scale (e.g., Regional Natural Park, Blue Coast Marine Park), teams are usually smaller and, for these agents, police surveillance can take a more important role, even though they are not authorized to issue fines.

Yet, requirements to perform numerous ecological monitoring protocols is hampered by MPAs budgetary constraints. Widespread among biodiversity protection institutions, underfunding leads to scientific and operational dysfunction in protected areas [18,9]. Also described by Gardner et al. [31], underfunding can lead staff to rank MPAs missions in order to focus on the highest priority actions. When the planning of all protocols is impaired, and MPAs agents can be forced to choose between several ecological monitoring programs:

“In times of high attendance, it is too hard. Then in summer, it is too difficult to ensure monitoring, although this is a crucial period for the western Mediterranean” #19 – field work agent.

Monitoring burden can also lead agents to collect lower quality data, as excessive workload affects the communication between agents and deteriorates the quality of the monitoring.

“Scientific managers do not have enough time to go out on the field. Then, on some protocols we realize that there is a misunderstanding between data collection in the field and data processing afterwards” #10 – field work agent.

As a more direct effect of excessive monitoring objectives coupled with underfunding, MPAs agents may not have enough time to define the protocols:

“We have identified the ecological indicators but we haven't thought about the protocol. And we don't have the time to do that” #6 – scientific manager.

Underfunding of MPAs and the imperative to perform ecological monitoring lead to the risk of deterioration of ecological knowledge, and also compromises MPAs agents working conditions. However, MPAs agents commit their personality and their convictions in a sometimes-passionate relationship with their work as previously described for biodiversity workers [33].

“As I already said, we are pointed out as being very efficient but at the expense of the staff's working conditions. I'm happy with that and I'll continue, but we're among the worst off” #2 – field work agent.

Overall, the overestimation of the number of ecological monitoring programs to perform regarding capacities of the MPAs has scientific implications on both the quality of the collected data and the working conditions for the MPAs agents.

3.2. Monitoring for nothing?

MPAs agents recognized that holding robust ecological knowledge should be an indispensable prerequisite for environmental decision-making. One field work agent noted:

“The role of monitoring is to provide clues for setting up protection tools” #7 – field work agent.

Agreeing, a scientific manager emphasized the direct effect of collected data in environmental policies

“We set up a regulation to limit recreative fishing up to 5 kg per boat per day. We decided it based on existing data” #15 – scientific manager.

However, in 18 cases on 22, MPAs agents explicitly recognized the insufficiency of ecological evidence when trying to implement environmental policies.

“There are not enough regulations or legislation resulting from monitoring programs. At first glance, it is obvious. There is a lack of actions” #7 – field work agent.

Without necessarily pointing out monitoring as being detrimental to protection, MPA agents regretted the lack of regulations within their MPA.

“We have human resources, we are sworn police agent, but we do not have any regulation” #8 – field work agent.

MPAs agents referred to MPAs labelled as it while not exhibiting any funding nor protection (e.g. the Natura 2000, Fig. 1), which echoes the “paper parks” literature [54].

“Marine part of Natura 2000 areas is not funded and there is no protection. But it is completely nonsensical because the OFB is supposed to manage the sites but it can't because one person has to deal with 4 or 5 Natura 2000 areas” #13 – scientific manager.

As several agents testified, the recent Marine Natural Parks are very large MPAs and agents almost never go to the pelagic seas because the human and nautical resources are not available to go and work in these distant zones. Despite their MPAs label, these very large pelagic areas are not monitored, not regulated, and poorly studied.

To explain the limited regulation, MPAs agents highlighted the lack of political will to implement protection measures and the low value given to ecological evidence:

“For sea urchins, we keep the decree. But given the urchin report, it's not a critical argument to maintain the bylaw. It's just that no one asked to have the order removed” #8 – scientific manager.

Then, MPA agents underlined the paradox between intense monitoring burden and low effective regulations.

“We are a MPA, so yes, we perform monitoring, but for now there is no place more protected than Calvi where there is no MPA. Then, strict protection measures are good, they are necessary. And we need a little more in MPAs” #10 – field work agent.

One might see a paradox between oversized ecological monitoring requirements and environmental policies that are ultimately little affected by ecological evidence. In the context of limited funding, overemphasis on ecological monitoring could be detrimental to other MPAs actions such as police surveillance or conservation education, as illustrated in other protected areas [31,51]. Massive investment of MPA agents working time in monitoring regarding law enforcement also contribute to weaken environmental marine policies. While MPA agents

regretted a lack of regulations, they mostly pointed out the responsibility of the governance system of the MPA as a crucial shortcoming in the ability to implement policies. Except in national parks that are perceived to have the capacity to implement strict environmental policies, MPA agents depicted that the true regulation power remains between the hands of the local elected representatives of the management board that are more oriented towards economic stakeholders' interests than towards effective marine protection.

“In a National Park, they would shut down the fishery immediately. Here, we must bring ecological evidence and data, talk about that, etc. The coastline governmental service asked to the fisheries committee to choose their own policy. It was so soft that it turned out to be ineffective” - #7 field work agent.

In addition, Marine Natural Parks and locally managed MPAs are engaged in deliberative governance processes that reduce the power and agility to implement evidence-based policies. MPAs agents considered sociological mechanisms at work and socio-economic stakes to be determinant in the decision-making process, as highlighted by Vimal and Mathevet [61].

“With the deliberative management board, I do not understand why we are affiliated to the OFB. The power here is in the hands of the local stakeholders, not the OFB. If the management board is composed by good willing people, even if they have their own socio-professional interests, we would do some good stuff. But it is not at all the case, everyone tries to take all the credit, and see only its own interest. It is extremely apathetic” #18 – field work agent in an MPA funded by the OFB but partly managed by local stakeholders

Then, the same MPA agent adopted a negative discourse towards deliberative approaches and was akin to argue for more centralized management.

“The president of the MPA board thinks he pays us while it is the OFB. All local management is oriented to big him up. We always hear “Paris is bothering us”, however, the freshwater agency (ONEMA) worked like that and it worked fine!” #18 – field work agent.

We hypothesized that such deliberative governance is particularly inappropriate for MPAs management as marine policies and legislations are highly distinct to terrestrial protected areas, complex and poorly understood.

“Marine management is a mess; people don't know the rules, they have in their mind that the sea belongs to everyone and hence they can do what they want.” #8 Field-work agent.

The deliberative approach is perceived as being detrimental or ‘too soft’ to permit efficient marine biodiversity protection. Conflict of interests between elected representatives of the MPA management boards and socio-economic stakeholders (fisheries, recreative and touristic activities) limit the eagerness to push for unpopular environmental regulations. Then, locally managed MPA can be dependent on the elective representatives who even fund the MPA in some case.

“Here, if you're not on good terms with the mayor, it would not be the same. We are dependent on the local elections.” #3 – MPA director in an MPA funded partly by local authorities.

The lack of political willingness to implement effective protection also affect the law enforcement of existing regulations. Effective police surveillance is important for MPA agents and its weakness is regretted as the patrolling and fines system can suffer from conflict of interests.

“So, I do the report to the Maritime Affairs, instead of going directly and issue fine. The system does not work as the fisheries committee have conflicts of interests. We saw illegal fishing last week in front of us. We reported all the information. If they do not make him pay, it is because

they know each other.” #17 - scientific manager who is not sworn in to issue fine.

Besides, although several MPA agents are sworn, they do not issue fines to avoid facing the local stakeholders. “We can issue fine, but it has never been done in the MPA. If we start issue fines tomorrow, it will not be socially accepted.” #7 – field work agent. The decentralization of environmental governance seemed to affect the effectiveness of marine protection. Local stakeholders being in charge of the MPA management would be unlikely to support regulations that would face their own economic interests. Yet, the central government is also blamed as it settled the deliberative governance and organized the chronic underfunding of the MPAs. Overall, it is the consistency of MPA functioning that is questioned by the agents: “[A MPA is] a team, funding resources, and protected measures. If there isn't that, it doesn't work so well, it's paper parks.” #3 MPA director.

3.3. Monitoring to shine: justifying the existence of the MPA in its local context

MPA agents did not only pointed out a lack of willingness to engage in protection policies. MPA agents tackled monitoring for acting as a smokescreen covering the lack of protection measures. To justify the existence of the MPA without engaging in environmental regulations, MPAs are asked to perform monitoring, which is rewarding for the elected representatives in the area of the MPA while protection policies are less accepted.

“[monitoring] shed lights on the MPA and do not constrained the stakeholders. However, if we talk about Natural Reserve with protection measures, it is not accepted because it is restricting” #2 – MPA director.

Similarly, local elected representatives are proud of the conservation labels as Specially Protected Areas of Mediterranean Importance (SPAMI) of the IUCN Green List for communication purpose.

“SPAMI and IUCN Green List are nice label, but they do not bring anything concrete except communication” #2 – MPA director

On some specific topics regarding species of conservation concern (e. g. marine mammals, seabirds, sea turtles), MPAs agents underlined the impossibility of implementing protection measures because these are mobile species on which no regulation has any effect, hence questioning the relevance of getting engaged in intense monitoring for these species:

“Yes, we should not question knowledge acquisition, but today I have the feeling that we never know enough... we perform ambitious monitoring programs, monitoring strategies, but we still don't have any plan for action” #1 – MPA director

Overall, collecting data and producing ecological knowledge materialize the MPAs and justify their existence. Holding ecological knowledge in the public sphere counterbalances the lack of environmental regulations. Despite MPA agents identified that the primary motivations for holding ecological knowledge are operational (i.e. to inform the indicators of the MPAs planning dashboard and to be converted in marine policies), they acknowledged that this objective fails to be fulfilled. In reaction, MPAs agents adapt and value their ecological knowledge in an informal setting, notably by facilitating dialogue with stakeholders inside and outside the MPAs, e.g. about the size of fish stocks, or the presence of a local group of dolphins within the MPA.

“We are in an area of proximity with local people. We need to give them answers to their questions, and we talk to them. Even if it is pointless for marine management, to gain popular support is important.” - #3 MPA director.

MPAs legitimacy and acceptability in the eyes of local stakeholders benefit from a detailed knowledge of the territories, which echoes the “residential science” concept explained by Kohler [41]. Cooperation

between managers and local stakeholders has been identified as one of the main factors beneficial to the efficiency of MPAs [32]. Holding ecological knowledge allows to gain credibility in the eyes of local stakeholders, is socially rewarding for the agents, and constitutes a symbolic accomplishment of their work as they are able to provide important knowledge to other users. However, the subjective dimension of their job that includes interpersonal relations can be affected by work overload and underfunding [26].

Concerning relations with stakeholders, MPAs have departments and services that go beyond ecological monitoring and that aim, notably, to develop cultural heritage, or to support economic activities [49]. Because of their involvement in the local socio-economic world, MPAs build their actions and missions according to the social context of the territory.

“[the monitoring programs comes from] the manager's initiative because she/he is directly concerned by management issues. The field work expertise, history of monitoring design, are only known by the manager” #15 scientific manager

Hence, following Carolan's [16] classification of expertise, MPAs agents do not only hold *contributory expertise* via ecological knowledge, but they also know how to bring scientific and technical knowledge into dialogue with other actors, which is called *interactional expertise* [16,56].

“We present ecological data to local stakeholders, and to the management board to discuss with them, trying to make them change their practices. [...] We need to provide a diplomatic effort during meetings with stakeholders to have them engaged.” #7 field work agent

Having detailed knowledge of their territory, MPAs assume responsibility as a legitimate local actor in biodiversity management that justifies their existences and mask the lack of regulations. In other words, MPAs commitment to produce advanced ecological monitoring on their territory also has a symbolic utility ensuring a credibility in the arena of biodiversity policies.

4. Discussion

Our work depicted an ambiguous role of ecological monitoring in MPAs, in relation to national policies and global trends of marine conservation. We described antagonistic mechanisms of important requirements to perform ecological monitoring along with underfunding policies and few protection measures, a scene that is likely to be found in other biodiversity management institutions, associations, and NGOs [35,54]. While this study constitutes the first qualitative social research on ecological monitoring in French MPA, the requirements for ecological data presented for the French Mediterranean MPAs echoes the situation described in terrestrial environments in France ([2,40,7,6]) and spans many conservation contexts worldwide.

4.1. The limit of quantitative biodiversity regarding decision-making

While MPAs suffer from the lack of political willingness to implement environmental regulations, ecological monitoring constitutes one of the main actions of MPAs agents that structures the functioning of the institution [56,60]. Collecting data to fulfill quantitative ecological indicators materializes the MPAs when regulations are lacking. Paradoxically, although quantification of knowledge radiated through biodiversity institutions and requirements for ecological monitoring put a significant burden on MPA functioning, quantitative indicators have a limited impact in the decision-making. Acknowledging such paradox, ecological monitoring does not fulfill Foucault' description of tools of governmentality and endorse other background utilities [27,52]. National policies established quantitative indicators as apparent cornerstones of marine decision-making but did not performed the ultimate step of converting them into legitimate first-order tools of power and neither as intermediates between government and science as Desrosières

described for public statistics [22]. In fact, ecological data would be considered as a final product of the monitoring without any further outcome [14,23].

However, MPA agents adapted to the lack of operational outcomes of monitoring and mobilized the ecological knowledge produced as interactional expertise to facilitate their dialogue with stakeholders in a deliberative context [16]. The establishment of effective regulation based on quantitative indicators is also impaired by deliberative approaches supported national marine policies according to MPA agents. Although Berman and Hirschman [11] stated that governing through quantitative instruments may limit the democratic decision-making, quantitative indicators endorsed here a symbolic utility being a prerequisite to participate in deliberative approaches. Overall, MPA being created according to international objectives of marine protection, they rely on ecological monitoring to justify their existence and to cover the lack of political action to protect local ecosystems, also noted by Aro-nova [5].

Legitimizing the quantitative instruments as a criterion of decision-making would pledge for environmental regulations policies that face the socio-economic interests of the governing institutions, and ecological monitoring act as a smokescreen for the lack of protection. However, collecting data and producing ecological knowledge through monitoring 'disperses the smoke' and help to expose the lack of political will. Then, as more monitoring would bring argument to highlight the lack of biodiversity protection, governing institution are getting engaged in a vicious circle. Our argument supports Desrosières' discourse about *Statactivism* explaining how statistics and quantitative knowledge could be mobilized as tools to face dominant political system.

4.2. Insights on marine management

MPAs agents regretted the lack of protection measures and shared a common negative discourse about the chronic underfunding of marine biodiversity policies. Across French Mediterranean MPAs, we observed the public disinvestment from biodiversity management and protection operations, the rescaling of conservation policies towards local authorities and communities, the increase of public-private partnerships for biodiversity management, along with a rhetoric of deliberative and consensual approaches, whose formed well identified components of neoliberal conservation [10,38,4]. Marine Natural Parks, the most recent marine institutions created in 2010, illustrate the decentralization of biodiversity protection policies from national to local scales, giving decision-making power to a management board composed of local stakeholders along with the associated limits in terms of deliberative efficiency to implement environmental regulations [49,61]. In the context of Marine Natural Park creation, deliberative approach has been criticized for being only informative whereas sovereign power of national government had already decided how to create the MPA [49]. On the contrary, in our study, MPA agents pointed out the deliberative management of Marine Natural Parks regretting a lack of investment of the national government in MPAs management. We acknowledged that Mazurek et al., [49] and our study focused on stakeholders with distinct social representation and interests. However, we noted that stakeholders blamed the deliberative processes either for being an alibi for authoritarian marine policies, or for being a smokescreen that cover the lack of willingness to implement marine environmental policies. Then, deliberative approaches can be perceived as strategical tools for governmental institutions to legitimate environmental policies.

Besides, chronic underfunding put working conditions of MPA agents under pressure. Trends of decreasing budgets weigh on all biodiversity institutions at the national scale and is not specific to MPAs. Financial conditions of disinvestment come from the government and affect uniformly all biodiversity institutions in France but also spread to a large part of national public institutions [28,55]. Beyond our case study, underfunding biodiversity protection are an international concern [18]. Western governments, including the European Union, mobilize a series

of strategies to align conservation policies within a typically neoliberal framework of cost reduction [4]. State austerity measures of neoliberal policies particularly affecting biodiversity conservation [46] threatens the ability of conservation stakeholders to produce robust, stable, independent knowledge and increase the risk of "undone science" [30]. Underfunded biodiversity policies lead to a double risk on both the quality and quantity of ecological knowledge, and on the quality of MPAs agents' working conditions. We acknowledged that marine policies are embedded in multiple and complex socio-economic stakes constituting the "blue economy" that include fisheries, recreational activities, offshore windfarms or energy production planning; biodiversity management being one of them. Nevertheless, reframing the management of MPA to enhance decision-making based on ecological knowledge, along with a significant increase in MPAs funding would be likely to reduce the dysfunctions raised by MPA managers and to finally cope with international agreements on marine protection. Ultimately, we argue for a global rethinking of the social values and of the democratic process that should direct our marine planning strategy to implement efficient and socially accepted environmental policies while preserving sustainable human activities [25].

5. Conclusion

Overall, our study reinforces the idea that monitoring programs shape the actions of MPAs by mobilizing financial, logistical, and human resources [60]. We provided an in-depth understanding on how ecological monitoring can be used to justify the existence of MPAs and act as a smokescreen that mask the lack of protection of so-called 'paper parks'. Investigating the practices of protected area managers sheds light on how ecological monitoring takes place within the socio-economic context of today prevailing neoliberal model exposing its inherent contradictions [4]. We questioned the importance of quantified data in biodiversity conservation, given that marine policies appeared to be mainly shaped by the socio-economic interests of stakeholders and governmental institutions. Quantitative data rather endorse symbolic utilities and legitimize the existence of biodiversity institutions performing monitoring, thereby masking the lack of political action.

In contemporary data-rich societies, the legitimacy of quantitative indicators to inform decision-making is a result of social, political, and democratic processes [11]. However, specialized steps fragment the construction of ecological knowledge and involve multiple actors with their own perceptions, skills and values. The complex life cycle of ecological data can induce black boxes for many practitioners, obscuring the context of knowledge production [37,58], which subsequently affects the credibility and the legitimacy of the decision-making processes [22]. Further research should contribute to question and describe the social, democratic, and political processes behind the successive manipulations of ecological data and assess their significance within in the arena of biodiversity management.

CRediT authorship contribution statement

Nicolas Lescureux: Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Investigation, Conceptualization. **Valentin Lauret:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Olivier Gimenez:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Conceptualization. **Hélène Labach:** Writing – review & editing, Writing – original draft, Validation, Supervision, Funding acquisition.

Data Availability

No data was used for the research described in the article.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.marpol.2024.106383](https://doi.org/10.1016/j.marpol.2024.106383).

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