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External Geophysics, Climate and Environment

Knowledge and power in integrated coastal management. For a political anthropology of the sea combined with the sciences of the marine environment



Camille Mazé^a, Tarik Dahou^b, Olivier Ragueneau^{a,*}, Anatole Danto^a,
Emilie Mariat-Roy^c, Mélanie Raimonet^d, Julien Weisbein^e

^a UMR LEMAR, Laboratoire des sciences de l'environnement marin, Institut universitaire européen de la mer, Technopôle Brest-Iroise, 29280 Plouzané, France

^b UMR PALOC, Patrimoines locaux, Institut de recherche pour le développement/Museum national d'histoire naturelle, 57, rue Cuvier CP51, 75005 Paris cedex 05, France

^c CETMA, Museum national d'histoire naturelle, 43, rue Cuvier, 75005 Paris, France

^d UMR METIS, Milieux environnementaux, transferts et interactions dans les hydrosystèmes et les sols, case courrier 105, université Pierre-et-Marie-Curie, 4, place Jussieu, 75252 Paris cedex 05, France

^e LASSP, Laboratoire des sciences sociales du politique, IEP de Toulouse, 2ter, rue des Puits-Creusés, 31685 Toulouse cedex 6, France

ARTICLE INFO

Article history:

Received 1st August 2017

Accepted after revision 27 September 2017

Handled by Isabelle Manighetti,
Rutger De Wit, Stéphanie Duvail,
and Patrick Seyler

Keywords:

Governance of the sea

Power

Political sciences

Anthropology

Natural sciences

Systemic management

ABSTRACT

This article presents an innovative collaborative approach, which aims to reinforce and institutionalize the field of the political anthropology of the sea combined with the natural sciences. It begins by relating the evolution in coastal areas, from integrated coastal zone management to the notion of adaptive co-management. It then sets out what contribution the social sciences of politics may bring to our understanding of the government/governance of the sea in terms of sustainable development, starting with political science and then highlighting the importance of a deep anthropological and socio-historical approach. Finally, it gives us a glimpse of the benefits of combining the human and social sciences with the natural sciences to produce a critical analysis of the categories of thought and action associated with the systemic management of the environment, especially the coastal areas.

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1. Introduction

Anthropogenic environmental changes are especially intense along the coastal zones where human populations

are concentrated and growing fast (Small and Nicholls, 2003). Disturbance is driven by a diversity of activities in the immediate area (fishing, aquaculture, introduction of invasive species, waste disposal, habitat modifications) but also by upstream activities inland (agriculture, urbanization, industry). The coastal zone is uniquely influenced by human activities plus climate-driven variability over local watersheds and across ocean basins (Cloern et al., 2015). Coastal ecosystems and estuaries in particular, provide ecosystem services such as food production, nutrient cycling and waste assimilation, valued highest among the

* Corresponding author.

E-mail addresses: camille.maze@univ-brest.fr (C. Mazé),
tarik.dahou@ird.fr (T. Dahou), olivier.ragueneau@univ-brest.fr (O. Ragueneau),
emilie.mariat-roy@mnhn.fr (E. Mariat-Roy),
melanie.raimonet@upmc.fr (M. Raimonet),
julien.weisbein@sciencespo-toulouse.fr (J. Weisbein).

world biomes (Costanza et al., 1997). But because this zone is subject to several aspects of global change (climate change, biodiversity loss, pollutions...), which continue to take place at a breath-taking pace (Rockström et al., 2009), they are zones where risks to human and ecosystem health (Jackson et al., 2001) and loss of ecosystem services (Barbier et al., 2011) are particularly high.

Hence, to move towards “sustainability” of the coastal zone, for 20 years, a paradigm shift was made in its management, going from science-based management that involved primarily the consideration of scientific knowledge, warnings and advice, to the integration of local and autochthonous knowledge and the most successful forms of “participation”. Indeed, as noted by Bremer and Glavovic (2013), the actors of the so-called Integrated Coastal Management (ICM) have long sought to create political settings within which coastal communities can arrive at collective decisions and support these decisions with the best quality knowledge available. Traditionally, this has been through the integration of natural sciences and social sciences with the political processes of decision- and policymaking and management, across the science/policy interface (Mazé and Ragueneau, 2017). These authors argued that in the future, this interface should be framed as a “governance setting”. It is this governance setting in the coastal zone that we explore in this paper.

There have been many studies carried out on these tools of governance of the sea at global, regional, and local scales (Rey-Valette and Antona, 2009). They have focused in particular on the effects of institutions (such as those like the creation of Marine Protected Areas (MPAs) and national parks) on communities and on the role of local communities in decision-making processes (Crespi et al., 2014; Ostrom and Dolsak, 2003), sometimes in a support perspective (Chlous-Ducharme and Gourmelon, 2011). But “despite many years of intervention of scientists, governments, local communities and other actors, the health of coastal ecosystems continues to decline” (Benham and Daniell, 2016). This inadequacy or inefficiency of public action towards environment preservation is attested by social sciences and environmental management studies (Jordan and Russell, 2014; Laurans et al., 2013; Rochette, 2013). This gap between intentions and achievements has so far been mostly explained by the complexity of the social world and political and institutional system (“Implementation Gap”) but also by the complexity of science and of the science/policy interface themselves (“Knowledge Gap”).

This paper examines to what extent these difficulties result from knowledge/power issues at the core of interactions among multiscale networks and actors. It investigates how a research at the frontier of anthropology and politics could nurture this analysis. By exploring the problems confronted by Integrated coastal zones management (ICZM) in its implementation, it sheds light on the governance issue. The relevance of the notion of governance in terms of tackling inequity issues linked to sustainable development will be assessed and the added value of the analysis of government of coastal zone considered.

2. From Integrated coastal management (ICZM) towards an adaptive co-management?

The concept of integrated coastal zone management (ICZM) has been proposed to link more closely the conservation of littoral ecosystems with the sustainable development of coastal activities. In this perspective ICZM rests on an integration of natural resources preservation and human development goals, an integration of the coastal ecosystems and their related economic activities, and an integration of value chains and networks of actors. The core principle is to unify the different visions of the territory to define coherent policies which limit competitions between different segments of local authorities or vested interests. In addition, it combines scales of regulation from the local problems to the global changes. With such an ambition ICZM projects face difficulties to achieve all these goals, notably given the specific characteristics of each coastal zone which demand high adaptability to social and ecological contexts.

Generally, ICZM programs spur the formulation of indicators dedicated to mingling very diverse social and natural criteria. The set of indicators is mainly oriented towards an assessment process to redefine segmented public policies through shared goals. However little is known about who is involved in the definition of indicators and for what purpose/interests. ICZM often generates a new agency to coordinate state agencies and local authorities, but it generally lacks institutional and legal power to mediate disputes among preexisting institutions and actors (Dahou et al., 2011). Besides, as it is rarely complemented by shifts in terms of decentralization progress (Mazé and Meur-Férec, 2017), it tends to reinforce state authorities (Wiber and Recchia, 2010). ICZM process establishes parallel institutions, whose action should be negotiated in the hierarchy of state authorities and government priorities. This situation limits the capacity for change and innovation, for example in earth-sea interface management, as maritime government could be under the responsibility of specific central state bodies or military organizations.

It has also been demonstrated that ICZM is well anchored in four deep-rooted illusions (Billé, 2008): the illusion that round table discussions can solve any problem, the coastal manager myth, the community illusion and the positivist illusion. The concept of ICZM is highly indebted to the notion of governance that idealizes cooperation among institutions and actors. Instead of facilitating compromises, this kind of arena of coordination masks the power of expert knowledge that may strengthen the defense of stakeholder’s interests. This depolitization of management impedes to tackle broader issues of social and environmental accountability. ICZM aims to disseminate environmental and social data to improve cooperation between actors in decision-making albeit without considering the hindrances to this circulation due to power relationships. The ICZM process designed to attain common goals or at least to find ways to overcome conflicts tends to mask the exclusion of actors from cooperation arenas.

More recently, the notion of adaptive co-management (Armitage et al., 2007; Plummer et al., 2012) has been developed to designate one ideal mode of social-ecological

(Collins et al., 2010; Liu et al., 2007) governance, based on collaboration, learning and multi-level governance (Kofinas, 2009). Compared to “adaptive management”, it also involves collaboration between scientists and different stakeholders at various scales and promotes social learning, dynamic interactions between diverse knowledge to address the challenges of rapid change affecting social-ecological systems that are already complex and heterogeneous. Hence, adaptive co-management is conceived as a means to increase resilience in social-ecological systems (Olsson et al., 2004).

In this context, there is a critical need to understand the decision-making process concerning the governance of resource (Berkes, 2008; Dietz et al., 2003) and social-ecological system (Anderies et al., 2013). As noted by Kofinas (2009), “to realize the ideals of adaptive co-management, there is a need to reevaluate the conditions, assumptions and human values associated with management decisions... Power studies are necessary, as power relations can either build or undermine social-ecological resilience”. Interestingly, five years later, resilience scholars continue to call for more studies of power structure, dynamics, and relations (Foucault, 1969; Weber, 1963) to better understand the social-ecological governance and more specifically, the capacity of a social-ecological system (SES) to transform towards sustainability (Epstein et al., 2014; Kofinas et al., 2013; Olsson et al., 2014).

Social sciences of politics (Politix, 2013) have this capacity to unravel power balance, extending studies of SES governance (Hess and Ostrom, 2007), exploring a blind-spot of this topic. They are crucially useful, as they could help to understand better the role of actors, groups, and networks, with their diverse values and interests.

3. Social sciences of politics, a way to enrich our knowledge on the various forms to govern the sea and coastal areas

3.1. From “governance” to “public action”

By social sciences of politics, we mean the sciences that understand, within an interdisciplinary development perspective in the human and social sciences (Offerlé and Rousso, 2008), political reality with no disciplinary exception (anthropology, law, economy, geography, management, history, philosophy, political science, and sociology), either in principle or in practice. Within this interdisciplinary landscape, the sociological, socio-historical, and anthropological approaches in particular seem to be a determining factor in terms of enriching our knowledge on the various ways to govern the sea and its interfaces.

Laden with implicit meaning, the term “governance” refers to the idea of new modes of government, which would be based on a variable number of public and private actors located as much at local and supranational levels, as well as nationally (Lascoumes and Le Galès, 2012; Le Galès, 1995). It has become the symbol of a new modernity in modes of public action, from the point of view not only of analytical categories but of categories of action. It is used in

various ways, which are sometimes contradictory and is often overused, such that it has become somewhat of a blanket term (Pasquier et al., 2013; Theys, 2002). This contributes to a blurring of the meaning and leads to controversy or misuse of standards: the concept of “governance” is not far from that of “good government” (good practice). Hence, the idea of “governance” can refer to so-called new modes of direction that are more flexible, ethical, participatory, or democratic (Kofinas, 2009). While “governance” as a concept has many strong points and the actors themselves trust in it, it appears to be less suitable than “public action” for restoring the full complexity to the contemporary social construction of modes of government and regulation of Nature by Human.

“Public action” (Laborier and Trom, 2003) precisely allows the concept of “governance” to be questioned in terms of its uses and the underlying representations, without a priori or preconceptions. It is a concept that is characterized by “tinkering”, overlapping networks, randomness, a proliferation of actors, multiple purposes, heterogeneity, transversality of problems and changes in the scale of reference territories (Jordan and Lenschow, 2010). Such complexification of “public action” is particularly true in the case of the environment and of development in the face of global change, especially global warming.

The study of the political phenomenon and “government”, as space of power exercise, in the meaning of Max Weber until Michel Foucault (i.e. legitimization vs. domination), is a good way to explore the “governance” of the sea. The endless scientific discussion on the benefit from using the term “governance” or “government”, especially in French and European studies tends to become unproductive, but there is an advantage to understand the “government” as the set of activities socially constructed to maintain or change the social order (Weber, 1963) and to put it at the core of the investigation of “public action”. The interest of this concept is precisely to allow the concept of the “Government” to be applied to Nature (Larrère and Larrère, 2015) or the most used concept of “governance” to be questioned in their social uses and underlying representations: “public action” allows restoring full complexity to the contemporary social construction of modes of government and regulation, from the State level to new forms of politics, in scale interactions, from the local to the international level and it aims at improving our understanding of how we create order in complex society.

3.2. The contribution of historical and political sociology

Examining public action on the sea from political sociology and historical perspective consists in examining the sea as just one of many possible public intervention categories. The sea is the object of a public issue construct thanks to certain actors and processes and the power relations between these are worth studying. In finding out about the producers and actors involved in public action, we would like to go beyond the categorizations, typologies, and analyses in terms of the protagonists, to restore the complete sociological dimension to the construction of the governance of the sea. In other words, we believe it is

essential to consider the positions of both the individuals and the interest groups (Offerlé, 1998) that govern the sea today by studying their tendencies and trajectories, the resources representational and action strategies that they deploy in their collective and individual interests and, finally, their reasons for action and the relationships between them.

Some political sociology studies within the European constructivist tradition have already been conducted on the government of the sea (Saliou, 2012). Applied to the context of the European nation states and Europeanisation, they essentially talk in terms of “sector” and “integrated policy” by interpreting the public policies that create the different forms of regulation, which are often differentiated (e.g. the case of fishing) from the marine element (Lequesne, 2001a,b). These studies have most notably shown that up until the 1970s in Europe, maritime spaces were a matter of national sovereignty, whether through direct prerogatives or delegated to supranational institutions. They were administered by various sectors through a multitude of policies (transport, fishing, environment, planning and development, etc.). States were, for a long time, considered the only institutions adequately equipped and entitled to intervene in the management and regulation of maritime affairs. Nevertheless, the open seas were not considered to be coherent spaces requiring public investment and, in practice, these spaces were often neglected by State authorities, who authorized sub-national or supranational authorities to invest in them and to develop competence in the matter (Carter, 2015; DeSombre, 2006). Sometimes, simply because of their physical proximity to the marine element in question, some mainly sub-national authorities were steered into managing their own local maritime affairs, whether or not they had any legal competence in the matter (e.g. Brittany). Expanding maritime activities and the absence of a coherent legal framework has led to conflicts of uses and conflicts between actors. This has reinforced the need for a Law of the Sea and for the political management of maritime issues.

International, sub-national and EU institutions were the first to attempt to regulate the sea and mobilize maritime competence by proposing the introduction of integrated maritime policies that extended beyond coastal issues to tackle deep-sea challenges. This desectorisation, or integration, is visible through an integrated management of the coast, integrated maritime policies or through an event like the “Grenelle de la mer” strategy in France. It is defined as intersectoral public action, aimed at coordinating all activities at sea and along the coast. It considers maritime spaces as coherent entities for which *ad hoc* public policies should be drawn up. It also encourages participation from all the stakeholders, private as well as public, in the decision-making process and in the search for new policy instruments, allowing a greater coordination of maritime activities. Through these objectives, the European maritime policies have therefore had an impact on the distribution of competences between the actors as well as on the territories concerned and the traditional ways of managing maritime activities. Environmental crises, particularly the oil spills such as that of

the Prestige (Itçaina and Weisbein, 2011; Weisbein, 2015a), have provided opportunities to put these new forms of governing the seas to the test and to stabilize them.

Some political sociology studies have also focused on the socio-professional mobilizations that have a stake in the sea and often deploy very practical forms of expertise, which can be integrated into public regulatory measures. The expertise drawn from these studies has come from surfers (Terral and Weisbein, 2010; Weisbein, 2015b), coastal residents (Lafaye, 1994; Weisbein, 2016) and even from sea fishers (Itçaina and Weisbein, 2011).

In view of the political issues it encompasses and the tensions and power relations it centers on, and considering the many cognitive and technical interventions carried out today in relation to the governance of the sea, understanding the sea through the lens of political sociology will likely shed new complementary light on existing studies.

Our aim is to propose a political sociology of the government of the sea as the very mode of production and legitimization of the frameworks that regulate this environment and the relationships that we as humans have with it by situating it in an anthropological dimension (Le Meur, 2011).

4. Anthropology and the socio-historical dynamics of government of coastal areas

Political anthropology allows thinking about politics outside of just the modern western State frameworks by integrating the growing influence of the new political actors – whether non-State, supranational/post-national (European Union, UN) or community (cultural and epistemic communities, professional groups, community activists and NGO's) – into institutional as well as symbolic analyses. This perspective is particularly made possible by contemporary political anthropology (Shore, 2000). Political anthropology offers the benefit of understanding the transnationalization of a globalized world subject to many rearrangements of political space. Using observations that are local but also situated within their dynamic range of scales, this approach gives us access to a more detailed, more nuanced understanding of contemporary political phenomena, owing to: (1) the diversity of interlinking analytical dimensions that anthropology focuses on (historic, cultural, social, ecological, economic, technical, symbolic); (2) its intrinsic universal, comparative principle; and (3) the fact that it places the human being at the heart of its approach. It has been shown to be particularly well suited to studying problems linked to the environment, and environmental governance (Jul-Larsen et al., 2011).

It is in this sense that we have been able to apply it to the governance of the sea and coastal areas. The impact of socio-historical trajectories of state rule and local power is to be considered to understand how coastal zone resources are exploited and how they could be managed in a sustainable way. This approach allows to grasp path dependency (Pierson, 2000) in environmental policy and thus the capacity of a system to change or resist change towards sustainability.

The state making issue (Berman and Lonsdale, 1992) – the way state rule is shaped by social hierarchies and their transactions with historical powers – is at the origin of public policies capture by a series of intermediaries inside and outside the state until the local level (Dahou, 2017). This is an important factor that influences the circulation of knowledge and power inside human societies (power distribution and knowledge dissemination). The longevity of local elites not only depends on the historical evolution of state/society relationships but also on the market dynamics that reproduce power through the uneven process of accumulation. The rent seeking strategies around resources exploitation often stem from a long belonging to multilayered political and economic networks (Kusumawati and Visser, 2014).

The question of elite capture in development and conservation policies has primarily focused on free rider strategies and individualist rationale. However, it is a broader issue of patronage networks and relationships, on which institutions are built or emerge. The fact that they are often sidelined by global policies strengthens the strategies to act outside the public policy framework. The power relations can thus hinder the dissemination of knowledge and euphemize the equity problems of sustainable policies (Dahou et al., 2004). By contrast, the mobilization of elites endowed with knowledge in the definition of resources management rules could involve larger power networks and lead to greater transparency in value chains (Kusumawati and Visser, 2016). The idea of institutional bricolage (De Certeau, 1990) leads to study power across formal and informal institutions; a research action approach is able to rearticulate horizontal and vertical powers and to spur trade-offs that combine conservation and equity in coastal zones management (Warren, 2016).

A political anthropology, anchored to historical trajectories of state making and long-term access rights (sometimes linked to long-distance relationship related to history of natural resources commodification), is able to take account of the cultural-historical norms that are beyond the scope of the organizations emanating from external intervention but influence them. We then illustrate these problems with the specific case of co-management in coastal resources conservation and fisheries through the framework of social-ecological systems.

5. Coastal communities and social-ecological systems

The notion of adaptive co-management is a way to improve the principle of co-management, broadly disseminated in fishery management, as it fits with the concept of socio-ecological system (SES). The collective analysis of the dialectics between nature and society by scientists, users, and decision-makers that supposes SES is deemed to guarantee an equilibrium between social and ecological criteria in policy implementation to attain social and environmental resilience. As every conceptual elaboration, the SES approach is characterized by different biases of analysis that could impact adaptive co-management tools: people's knowledge, values and livelihoods are mainly

concerned with the environment; an inclination to homogenize social complexity; and a value-laden use of resilience in the social arena (Fabinyi et al., 2014, 2015). They lead to a functional approach of adaptation for institutions and organizations subjected to environmental changes, which is embodied in the Traditional ecological knowledge (TEK) issue. Indigenous norms are often considered as strict product of community-based institutions concerned by resources management (Dahou and Ould Cheikh, 2007).

Following the trend of co-management in fisheries, many coastal management programs developed an approach that rests on scientific data sharing with fishers' organizations to enforce management rules for coastal resources. Adaptation is generally conceived as a way to respond to climate and ecosystem variations. Policy makers presume that dynamic methods of co-management could improve the answers to instability in the availability of resources. They assume that strong identification with territory and indigenous claims are warranties to sustainable use (Dahou, 2011) and that the local rationales just have to be strengthened through further information based on scientific data. Even though co-management could be a way to address the issue of hierarchy in the production of knowledge (between scientific knowledge and traditional ecological knowledge) and management rules, it is rarely the case.

The SES approach is highly indebted to the common pool resources (CPR) theory. The institutional paradigm of the CPR school puts the emphasis on formal organizations and neglects the cultural and political dimension of institutions. That is perhaps why the difficulties in transposing theory of commons to community-based management are underestimated. Formulating the problem of institution in terms of rules and compliance erases the question of power and inequity. In many projects, the process of devolution of power concerns essentially the monitoring of access to spaces and resources. Generally local groups do not have enough power to define the management rules and when they accede to this power they are not necessarily concerned by the balance of power and inequities.

Should the SES approach consider the strict adaptation to ecological changes or encompass the instability of State rule and markets? Co-management is now carried out as a standard tool that does not aim either to change the decision-making power centered on state authorities, or to tackle the hurdles for local organizations that stem from the impact of global markets (Wiber et al., 2010). Its implementation is similar to classical public policy tools designed to foster capacity (Boonstra, 2016) instead of being considered as an opportunity to guide trade-offs about the diverse impacts of this adaptive co-management on livelihoods. It is rarely centered on a conciliation process that is focused on access recognition, an important factor of performance and resilience of any SES.

As a matter of fact, the resources management rules of coastal societies are impacted by the lack of trust among stakeholder's groups and weak devolution of management power, as well as the uncontrolled economical dynamics, such as the increase of demand and price. Besides, the

collusion between economic actors and public agents are at the core of disaffection for common organizations when people face unequal accumulation, notwithstanding their concerns for environment. That is the reason why time has come to change the analysis of power and reconsider classical dichotomies, from scrutinizing the opposition between state and societies to tracking networks of power across private and public delimitations, multiple scales, and formal and informal boundaries. This conversion supposes to put the emphasis on the power trajectories that encompass global power flows and local power evolutions. An historical perspective of coastal zone will contribute to improve a procedural approach to better understand the path dependencies in the answers to global changes.

6. The case of fisheries and marine resource management policies

The case of fishing activities and fisheries provides a good example to illustrate our approach by considering globalized issues (ecological, commercial, environmental) through a dynamic empirical method (Mariat-Roy, 2017) gathering both intensive and extensive field-works. Since the introduction of regional and national institutions, charged with restructuring fishing activity to implement streamline operations and ensure the continued existence of marine resources, the fishery system – fishing, processing, and selling – has become more complex (Geistdoerfer and Mariat-Roy, 2011). This complexity deserves and needs to be studied through an ethnographic approach. Fishermen groups and producers in both fields of industrial and artisanal sectors have become more and more dependent on the institutions that regulate their activities (Mariat-Roy, 2011): the comparative studies of seven harbors in the wake of the implementation of Individual Transferable Quotas in Iceland in these matters is a relevant case study (Mariat-Roy, 2011). Fishers have encountered new kinds of problems with these changes. They have had to develop new competences, strategies of adaptations and partnerships as a result. However, the impact of their participation in designing policies is in question as they are subject to power structure and networks, even in projects based on sustainable tools.

In Algeria the prohibition of coral exploitation for the stock renewal faces networks of power beyond usual categories of analysis, of state, fishers, and market operators. With the establishment of the conservation norm, a lucrative traffic deployed in the National Park of El Kala to harvest coral and export it to Italy. A lot of local fishers are involved in this illegal sector, in the meantime maintaining their legal activity of fish capture. However coral exploitation in this zone involves diverse actors, including civil servants, who finance and arm the boats and hire a labor force, which is exposed to the inherent risks of this activity. There are even boats that are funded by staff of the Chamber of Fisheries, which is made up of fishermen's representatives and is responsible for regulating the fisheries sector. The involvement of members of the local and central administration (the armed forces, which directly include the coastguards, attached to the Presiden-

cy, benefit of smuggle through bribes) perpetuates of this traffic.

Illegal fishing overlaps parts of fishing community, segments of local and central authorities in charge of fishing regulation, maritime police, and sometimes global criminal organizations. Those networks of power hinder sustainability strategies inside and outside the state. The lack of consideration for these dense and informal relationships masks the abilities of particular actors to capture policies. The difficulty to consider the power of various interests does not favor the overcome of sustainability problems at the local level.

In Saloum Delta in Senegal, a Marine Protected Area and biosphere reserve of UNESCO, we observe confrontations about conservation areas and fishing norms. These conflicts oppose migrant fisheries claims favored by state regulation vs. local fisher's claims supported by local authorities and NGO's. The difficulties to reach collective action in terms of allocation of resources and access to territories among this diversity of actors and interests impede conservation initiatives. Conflicts of knowledge between central and local authorities tend to emerge in alignment with territorial claims from migrant and local fishers. The blurring of oppositions inside the broad community of fishers, between migrant and local, between capitalized and non-capitalized fishers, does not foster practical solutions to go beyond the hindrances to sustainable fishing policies in this territory.

The assimilation of methods of exploiting the environment with cultural and communitarian characteristics based on a closed local space and norms shared by all persists in local management of resources projects. Nonetheless, this idea that a territory corresponds to a community, derived from the paradigm of common pool resources, cannot be easily transferred to this context and more broadly to African contexts (Watts, 2000). The assumption of homogeneity that generally guides the management of protected areas, loses its credibility as it faces power dynamics across different scales and institutions.

Maritime anthropological (Geistdoerfer, 1983) research today is therefore focused on the comparative, dynamic study of the consequences of these major changes in the governance of marine resources in terms of the practices of those who, in different environments and social, cultural, and economic contexts, make their living from the sea (Mariat-Roy, 2014). This research, able to vividly contribute to the adaptive co-management debate, thus responds to the call from prominent researchers in the field of French maritime anthropology for more field researches into political issues (Geistdoerfer, 2007), in contact with the actors and opened to interdisciplinarity.

7. Interdisciplinarity between social sciences of politics (SSP) and natural sciences

Interdisciplinarity is crucial if we are to better understand the complexity of social-ecological systems (Blanchard and Vanderlinden, 2012; Holling, 2001). The emergence of sustainability science (Kates et al., 2001), and its associated journals, in the early 2000s, and the

launching of the international initiative “Future Earth” in 2012, provide a proof of the necessity to bring together natural and human and social sciences to address major societal challenges and a general framework within which this interdisciplinary research can be constructed, conducted and communicated. Mooney et al. (2003) provided a nice history of how this interdisciplinarity has been built within major international programs. However, despite such claims at the international level, often relayed by national research funding agencies, genuine interdisciplinarity is difficult to achieve in practice, in particular in a context where training and recruitment of young scholars is still very disciplinary and the evaluation of scientific production still dominated by the process of peer-reviewing in disciplinary journals (Hart et al., 2015 for a discussion of the numerous barriers that prevent, within academia, the development of interdisciplinary research and training).

To overcome these difficulties, new boundary settings (Mattor et al., 2014) emerge which aim at favoring such interdisciplinarity on the long-term, beyond the “project mode”. The research structure ApoliMer (“Anthropologie politique de la mer”)¹ intends to become one such setting by immersing the social sciences of politics within a scientific environment mostly dedicated to the sciences of the marine environment. The aim is to bring the social sciences of politics (SSP) at the core of a marine research environment where some disciplines of the social sciences were already present (law, economics, geography), but where SSP were crucially missing (Mazé et al., 2015). The idea is to develop an interdisciplinary platform to explore the governance of the sea, by (i) introducing the tools, methods, and concepts of the social sciences of politics into the field of marine environmental sciences and (ii) forging a daily dialogue with these disciplines including law, economics, geography, and the many branches of marine natural sciences, in particular biogeochemistry, biology, and ecology.

The idea of immersion of SSP in such a scientific environment, over the long-term and not only through collaborations during projects, is crucial in this perspective of better understanding the complexity of social-ecological systems. On the one hand, SSP bring the tools, methods, and concepts to explore governance, which is a concept that was dealt with mostly by geographers, economists, or management sciences. They also provide very important help for natural scientists involved in participatory processes, expertise, help for decision-making, by enlightening the socio-political context within which this scientific expertise is being asked. Indeed, they help researchers in the natural sciences to understand better the complexity of the decision-making process and the power relations which are very tense in the coastal zone

because of the tensions between exploitation and conservation. Simply, through daily informal discussions and participation in seminars, they bring the field of human and social sciences with their research questions, concepts, and tools, and raise awareness of natural scientists to the social and human dimension of their studies. On the other hand, natural scientists help SSP understand better the functioning of ecosystems; identify major threats to these ecosystems and to the societies which depend upon them, through the alteration of ecosystem services. This implies a true collective effort to assist in the identification of problems and the understanding of natural phenomena in order to understand the complexity of the functioning of ecosystems: interactions of scales/“tipping points”/threshold effects/surprises/uncertainty/modeling and scenarios, etc. In this context, interdisciplinarity goes from the co-construction of research questions to the joint collection and analysis of field data, through collective ethnographic surveys that involve natural scientists or the confrontation of the indicators that are being used (or not) by decision-makers as compared to the descriptors of the complexity of social-ecological systems.

7.1. Stimulating a return to collective field surveys

Experience shows that, when faced with the complexity of ecosystem functioning, models, scenarios, and a diversity of other data, in addition to deal with technical vocabulary and highly specialized questions, human and social researchers rapidly experience difficulties, risking misinterpretation and preventing going into more details during interviews. Beyond their role as translators, the presence of natural scientists during interviews allows the human and social scientists to explore the public problem in a more profound manner. We have experienced such advantages when conducting interviews with scientists and stakeholders (but are not scientists, stakeholders?) in the Bay of Brest or in the San Francisco Bay area. In the Bay of Brest, whether the physical (macrotidal aspect of the estuary/bay, Le Pape and Menesguen, 1997) or the biological (proliferation of a benthic suspension feeder, Chauvaud et al., 2000) component of the estuarine filter plays a major role in controlling water quality has different implications for the management of the Great scallop fishery. In San Francisco Bay, the debate is very important concerning the factors controlling water quality, and whether nutrients play a major role (Dugdale et al., 2007) or not (Cloern, 1982) has major implications for the management of waste water treatment plants and associated investments. In both cases, the resulting uncertainties and their implications in the decision-making process would have remained totally obscure for the human scientist; the presence of biogeochemists or ecologists during the interviews allowed exploring more deeply the origin of these uncertainties and their implications at the science-policy interface.

7.2. Constructing interdisciplinary indicators

Interdisciplinarity will also predominate when building environmental and social indicators of the vulnerability

¹ ApoliMER is a French research structure with strong internationalization, based at IUEM in Brest. Initially a cooperative research structure within the University of Western Brittany (UBO), founded in June 2014, ApoliMer became in January 2018 a multidisciplinary thematic network from the French National Center for Scientific Research (CNRS), supported by the National Institute for Ecology and Environment (INEE). ApoliMer belongs to the Marine Environmental Science Laboratory (LEMAR).

and the resilience of the studied social-ecological system. The idea is to create a common analytical framework gathering the battery of existing indicators on environmental vulnerability in a reorganized format, making it possible to assess risk exposure, sensitivity, and ecosystem resilience with indicators of the human activities that take place there (their economic weight, evolution over time, nature, and interdependencies). This will enable the development of an interdisciplinary vulnerability analysis framework, not only of ecosystems, but of social-ecological systems. These indicators could then be included, for example as variables in Social Network Analysis (SNA), not only to understand the power relations between actors in the decision-making process but also to discover how this knowledge is being used in the process, if at all. As such, the concept of network, as used by natural sciences (e.g. trophic network) and by social sciences in SNA, may reveal itself as a boundary-object that will facilitate the concrete joint development of SES modeling between natural and human and social scientists.

7.3. Better accounting for regulation services in social-ecological system management

Finally, it is very important that not only biological resources be considered in SES modeling and ecosystem management, but also biogeochemical, hydrological, geomorphological, and other natural cycles that play a major role in the control of primary and secondary growth and production (Smith et al., 2015). Several SES frameworks are very “resource-oriented”, because “final ecosystem services (ES)”, those that can be directly enjoyed, consumed, and used, such as provisioning services, are the one to which ecosystem managers are the most sensitive, especially because they can be subject to monetary evaluation. However, these final ES often lead to overexploitation or disruption of “intermediate ES” that are crucial to nature functioning and human health and well-being, such as nitrogen regulation, carbon sequestration or silicon recycling (Watanabe and Ortega, 2011). Therefore, there is a crucial need for joint work between biogeochemists, earth scientists, economists and SSP, so as to focus more on the relationship between biogeochemical and other natural cycles, regulating ES and decision-making; this has been shown for soil science (Smith et al., 2011) and it also is very important in the marine realm. Actually, it is even essential that a more holistic approach is being taken, (i) not only on land or in the coastal zone and the open ocean, but along the land-ocean continuum, and (ii) not only working on the cycle of a particular element, but on coupled biogeochemical and other natural cycles and the role of their coupling/uncoupling in the functioning of ecosystems and the production of ES. How natural cycles and these intermediate ES are being considered in the decision-making process represents a major challenge at the interface between science and policy.

8. Conclusion and perspectives

This article, co-written at the interface of the humanities and social sciences and natural sciences,

sought to present an innovative collaborative approach whose aim is to reinforce and institutionalize the field of the political anthropology of the sea combined with the natural sciences to better explore the systemic management of coastal social-ecological systems. It brings a contribution to the debate on the analysis of coastal governance by showing what the combination of sociology and political anthropology, in strong interaction with the sciences that deal with the health status of coastal and marine ecosystems, has to bring to grasp the dynamics of power over time. Its main contribution is to show that beyond the concepts of science-based or community-based management applied to Integrated Coastal Zone Management, we must seriously question the weight of interests and study power relations that play such a crucial role in determining the conditions of possibility or impossibility of implementing a sustainable management of coastal areas. Co-management, commons theory and community organizations approach have strong links, but their relationships should be disentangled in local situations to stress the historical conditions that lead to success in co-management. The common pool resources paradigm is too functionalist to transpose its specific case studies conclusions from one place and period to others. Recent historical researches on its famous case studies and reevaluation of political key factors question more and more this framework of analysis. These problems and the limits of a homogeneous perception of the social world that hide behind the notion of community require focusing on networks of powers at various scales (Dahou, 2009, 2010; Dahou et al., 2013).

This observation is based on literature review and field surveys partly described in this contribution. It calls for the multiplication of combined theoretical and empirical studies, using the concepts and methods of the social sciences of politics, as they allow to explore theoretically and practically the implementation of ICZM in particular case studies, to shed light on several illusions hidden behind the ICZM concept and to evaluate the relative weight of diverse interest in the decision-making process relative to the transformation to sustainability, as well as possible inequities in power distribution. Applied to the sustainable management of coastal and marine socio-ecosystems, we show that this can only be completed through a deep, long-term collaboration between human and social sciences and natural sciences.

Such interdisciplinary approaches are increasingly called upon in sustainability science (Mooney et al., 2013). However, it should be kept in mind that the barriers against the practical implementation of interdisciplinarity are numerous, including semantics, strong cultural differences, the organization of academic research and training in disciplinary silos or the evaluation of scientific careers, still based on the publication of scientific articles in disciplinary journals (Hart et al., 2015; Ragueneau et al., under review). Developing such interdisciplinarity implies to rethink the way we organize research and training, to better explore complex problems and challenges ahead of us.

Acknowledgements

The authors wish to thank the French CNRS for constant support in the development of ApoliMer, coordinated by CM, and its transformation into a RTPi, “Réseau thématique pluridisciplinaire international”, CNRS, France. The authors also thank the French LTER Network, so-called “Réseau des zones ateliers” (CNRS–INEE), for the funding of a series of workshops (2016–2018), coordinated by CM and OR and dedicated to the governance of social-ecological systems. This is a contribution to the SPA project, funded by the “Mission for Interdisciplinarity” of the French CNRS (2017–2018). They finally thank IRD for its supports for MPA’s and ICZM researches in North and West Africa (TD).

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