Repenser les systèmes alimentaires marins en Méditerranée

Berkowitz, Héloïse

CNRS UMR5303 TSM-Research et IBEI

Heloise.berkowitz@gmail.com

Longoni Annachiara

ESADE

annachiara.longoni@esade.edu

Luzzini Davide

EADA

davide.luzzini@eada.edu

Guérineau Mathias I3-CRG Ecole polytechnique

mathias.guerineau@polytechnique.edu

Résumé :

La Méditerranée est un écosystème gravement menacé par une combinaison de pressions anthropiques, dont la surpêche. Dans cet espace morcelé et instable, 90% des stocks de poissons évalués sont en surexploitation. D'autres problèmes viennent se rajouter –comme le plastique, la pollution acoustique ou les espèces invasives– et rendent d'autant plus complexe la gestion des ressources communes. L'enjeu majeur consiste à trouver des solutions de gestion pérennes des ressources alimentaires marines dans cette région, tout en respectant les objectifs de développement durable des Nations Unies. Cet article cherche à améliorer notre compréhension des systèmes alimentaires marins locaux ainsi que des conditions pour les rendre plus durables. L'étude porte sur trois grands facteurs interdépendants : pratiques durables de pêches et des systèmes d'approvisionnement ; normes et institutions influençant ces systèmes ; engagement des parties prenantes.

Mots-clés : Approvisionnement alimentaire, pêche, système alimentaire local, méditerranée

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INTRODUCTION:

In a context of unprecedented threats on the environment and growing population, oceans will be key to secure future sustainable food for humanity. Yet scholarly and policy efforts have largely been on agriculture and lands, leaving oceans as the great forgotten, even though they represent 70% of the earth. Mediterranean, especially, is considered an ecosystem "under siege", due to overfishing and unsustainable fishing practices, a situation expected to worsen with climate change (Guiot & Cramer, 2016; Piroddi et al., 2017; Thiébault et al., 2016). In this geopolitically tense and multifaceted maritime interface, 90% of assessed-stocks are overfished (STECF, 2016). Other ocean management problems such as plastic, underwater noise pollution, invasive species threaten ecosystems, making it even more complex to govern common resources (Ostrom, 1990a). The question of how to sustainably manage the marine Mediterranean resources while meeting United Nations Sustainable Goals (boosting employment, protecting environment, providing safe and healthy food) remains largely unanswered (Tsikliras, Dinouli, Tsiros, & Tsalkou, 2015).

Hot spots of biodiversity and global change, Mediterranean has an old history of fishing activity, dominated by small-scale, diversified fisheries (Farrugio, Oliver, & Biagi, 1993). Existing works on sustainability are fragmented and treat different factors in isolation from each other. Some scholars have started to examine performance and sustainability of fishing techniques (Furesi et al., 2016; Lucchetti & Sala, 2012). Other works have made progress in refining our understanding of communities' self-governance of fisheries resources (Dietz, Ostrom, & Stern, 2003; Hardy, Béné, Doyen, Pereau, & Mills, 2016a).

Yet, most scholarly or policy works still underestimate the combined importance of technologies and innovation, governance instruments, and resource demand on overfishing (Finkbeiner et al., 2017). Addressing sustainability of Mediterranean ecosystems requires a more systemic approach (Fu et al., 2018), integrating multiple stressors that interact: business practices in the supply system (e.g. fishermen, distributors, retailers), institutional factors, and stakeholders' engagement, such as local communities. In a time of climate change, high environmental pressures and threats on marine ecosystems (Tsikliras et al., 2015), there is a need for integrated, interdisciplinary research to tackle ocean policy (Petes, Howard, Helmuth, & Fly, 2014; Thiébault et al., 2016).

This paper seeks to develop a comprehensive socio-economic approach of sustainable seafood systems in the Mediterranean. By sustainable seafood systems, we mean providing safe, local and seasoned food supply while restoring and preserving marine ecosystems and resources, and responsibly developing coastal communities in Mediterranean. To develop this approach, we first describe the Mediterranean as an endangered ecosystem and briefly review existing models of fisheries management. Next, we present our conceptual framework, which integrates business practices, institutions and stakeholder engagements as major impacts on ecosystems' sustainability. Finally, we discuss the contributions of this framework to ongoing works on sustainability and transition.

1. THE MEDITERRANEAN: AN ENDANGERED ECOSYSTEM

In this section, we briefly describe overfishing in the Mediterranean as a grand challenge we aim to tackle, answering recent calls in the management literature (Eisenhardt, Graebner, & Sonenshein, 2016; Etzion, Gehman, Ferraro, & Avidan, 2015; Ferraro, Etzion, & Gehman, 2015; George, Howard-Grenville, Joshi, & Tihanyi, 2016). We review two main branches of the literature on sustainable fisheries management (bioeconomics modeling and governance approach).

1.1. OCEANS: A STATE OF EMERGENCY

Oceans represent 71% of the earth's surface and as such constitute one major driver of our climatic and ecological systems. Global fish production has steadily increased as Table 1 shows. Fish food supply has increased by 3.2% per year between 2007 and 2012, thus overcoming the population growth (1.8%) (Food and agriculture organization of the United Nations, 2014, p. 3). Worldwide fish consumption per capita a more than double in 50 years: it went from 9.9 kg by individual in the '60s, to 19.2 kg in 2012.

Fish is the second most consumed source of protein in the world, just behind pork: in 2010, fish accounted for 16.7% of international animal protein consumption. With population forecast reaching more than 8 billion in 2030, a report of the National Intelligency Council (2012) calculates that the world will need 50% more energy production, 40% more water and 35% more food supply.

	2007	2008	2009	2010	2011	2012
			(Million tonnes)			
PRODUCTION						
Capture						
Inland	10.1	10.3	10.5	11.3	11.1	11.6
Marine	80.7	79.9	79.6	77.8	82.6	79.7
Total capture	**90.8**	**90.1**	**90.1**	**89.1**	**93.7**	**91.3**
Aquaculture						
Inland	29.9	32.4	34.3	36.8	38.7	41.9
Marine	20.0	20.5	21.4	22.3	23.3	24.7
Total aquaculture	**49.9**	**52.9**	**55.7**	**59.0**	**62.0**	**66.6**
TOTAL WORLD FISHERIES	**140.7**	**143.1**	**145.8**	**148.1**	**155.7**	**158.0**
UTILIZATION[1]						
Human consumption	117.3	120.9	123.7	128.2	131.2	136.2
Non-food uses	23.4	22.2	22.1	19.9	24.5	21.7
Population (*billions*)	6.7	6.8	6.8	6.9	7.0	7.1
Per capita food fish supply (*kg*)	17.6	17.9	18.1	18.5	18.7	19.2

Note: Excluding aquatic plants. Totals may not match due to rounding.
[1] Data in this section for 2012 are provisional estimates.

Table 1: Global fish production and consumption 2007–2012 (Food and agriculture organization of the United Nations, 2014, p. 4)

World fish stocks are decreasing everywhere, but Mediterranean is especially concerned with overfishing and habitat loss.

1.2. MEDITERRANEAN AS AN ENDANGERED BIODIVERSITY HOTSPOT

In 2017, MedFish4Ever Mediterranean alliances among countries achieved a unique and broad consensus on the urgency of saving the region's fish stocks, while ensuring sustainable development of coastal communities and conserving natural ecosystems. 90% of fish stocks are overfished (Colloca et al., 2013). Mediterranean therefore is considered a biodiversity hotspot, largely threatened by human pressures, such as overfishing or unsustainable fishing practices, a situation expected to worsen with climate change (Guiot & Cramer, 2016; Piroddi et al., 2017; Thiébault et al., 2016).

Mediterranean ecosystems present a great variety of geological settings. With continental shelf seldom extended, Mediterranean coasts are characterized by steep cliffs, a varied hydrographic landscape with lakes, canals, lagoons, and other deltas. The Mediterranean basin also hosts several islands and peninsulas, with either sandy or rocky areas. Underwater, the Mediterranean habitats are often grown with seagrass. This diversity of geology calls for different and specific operating methodologies and fishery management (Decugis, 2015).

1.3. SUSTAINABLY MANAGING FISHERIES: A LITERATURE REVIEW

Bio-economics modeling constitutes a relatively recent branch of economics aiming to reconcile biological resources with their exploitation (Gordon, 1953; Schaefer, 1957). It relies on applied mathematics, economic science and biology. Bio-economics literature underlines the interrelation between biological and economic systems. Overfishing, water pollution, or social problems related to fisheries qualify as market failures which human regulators have to deal with (Hardin, 1968). In bio-economics, scholars use mathematical modeling to find optimal trade-offs among economic, social and ecological objectives. Finally, these models help to

determine a maximum exploitation threshold of the resource (Clark, 1990). Such models combine biological variables such as resource stock, extinction speed, reproduction rates with economic variables for examples the number of active users of the resource, demand and supply, resource extraction technology.

Bio-economic models have been developed in many ways and used since 1950s as a tool for policy making such as determining fish quota or specific regulations (Raúl Prellezo et al., 2012). Despite several critics (Cury, 2013), bio-economics has been mentioned and used in many reports and policy programs led by OECD, the European commission, especially at national or regional levels (Raul Prellezo et al., 2009). Though such models may fail to understand the complexity of reality (Cury & Pauly, 2013), e.g. evaluation of initial stock or the relations between the resource and its ecosystem, this field of research has evolved to try and integrate new variables such as cooperation or its lack among resources' users (Gourguet et al., 2013; Hardy, Béné, Doyen, Pereau, & Mills, 2016b). This economic approach, however, calls for a better understanding of biological variability and human behavioral aspects (Ommer, Perry, Cochrane, & Cury, 2011). It also largely neglects governance aspects.

Bio-economic models follow the path that Hardin's seminal work on the tragedy of commons mapped out. Indeed, when there is no barrier to a good's consumption (non-excludability), then actors' rational behavior will be to exploit this good to get the most out of it. If all actors embrace this reasoning, then they will over-exploit the good. This results in the tragedy of the commons. And if Hardin invites us to think of privatization as a solution in order to empower everyone, others see the Leviathan State (Hobbes, 2006) as the optimal but coercive solution which is emphasized in regulation systems.

Conversely, Ostrom defines a third way beyond privatization or Leviathan state. Based on empirical work in the 1960s California's water industry, Ostrom places institutional arrangements at the center of common-pool resources (CPRs) management (Ostrom, 2010; Ostrom, Gardner, & Walker, 1994). Institutions result in humanly designed constraints that

structure political, economic and social interactions. As such, Ostrom argues that they allow the management of common resources involving a wide variety of actors.

Unlike the market, or a coercive state, this institution building goes beyond traditional models because it presupposes a case-by-case construction. It challenges Hardin's rationalist vision and shows that under certain conditions CPRs survive. The main initial conditions explaining the commitment to a collective organization are the information and control agents can have over the management object (Ostrom, 1990b). According to Ostrom, if the agents are rational, they will only engage in a cooperative process leading to the emergence of an institution if the information on the state of the resource is good enough to enable them to carry out a cost-benefit calculation as accurately as possible. To have this information therefore presupposes the commitment of certain individuals to the service of the collective, and this can only be done gradually, because an institution does not appear ex-nihilo but is the fruit of a long-term process aimed at solving problems by "small steps" (Ostrom, 1990b). The institution's sustainability depends on numerous rules relating to the roles, positions, choices, information, goals, conflict resolution, contributions and fees of the various actors in the system that must be respected (Ostrom, 2010)

Ostrom formalizes this approach by proposing a general analytical framework for understanding CPR management situations. This is the Institutional Analysis and Development (IAD) framework. This inductively constructed operational framework (see figure 1) explains why interactions around the CPRs are affected by the characteristics of this common resource, the attributes of the actors, and the rules in force. It brings a better understanding of governance and institutions issues in a social-ecological system (McGinnis & Ostrom, 2014).

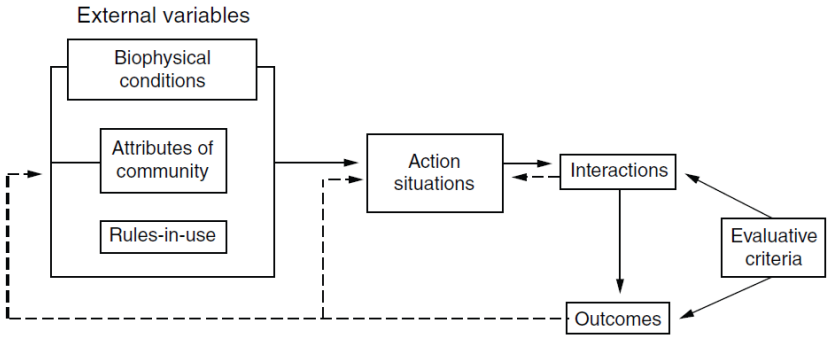

Figure 1: IAD Framework (Ostrom, 2010, p. 646)

In this broad literature, however, scholarship has largely neglected the impact of consumption on seafood systems (Richter, Thøgersen, & Klöckner, 2017). A more recent trend in research on sustainable fisheries seeks to integrate broader factors of business practices (innovation, supply chain management) or human behaviors (consumption). Richter et al. (2017) investigate consumer behaviors types that can result in sustainable seafood consumption. Kittinger et al. (2017) further invite scholars to integrate ocean science and social sciences in an attempt to rethink sustainable seafood supply chain. Finkbeiner et al. (2017) also challenge the traditional view on the causes of overfishing. The dominant explanation for overfishing relies on a Malthusian narrative where overpopulation of the planet is the main reason for resource depletion. The paper reconstructs an alternative narrative that relies on multiple drivers of overfishing: technologies and innovations, resource demand and distribution, marginalization and equity, management and governance aspects. Our paper seeks to reconcile these various aspects in a comprehensive framework.

2. SUSTAINABLE LOCAL SEAFOOD SYSTEMS: A CONCEPTUAL FRAMEWORK

Addressing sustainability of Mediterranean ecosystems requires a more systemic approach, integrating multiple factors that interact: business practices in the supply system (e.g. fishermen, distributors, retailers), institutional factors, and stakeholders' engagement, such as local

communities. In a time of climate change, high environmental pressures and threats on marine ecosystems (Tsikliras et al., 2015), there is a need for integrated, interdisciplinary research to tackle ocean policy (Petes et al., 2014; Thiébault et al., 2016).

We propose a conceptual framework that integrates three main types factors affecting marine ecosystems:

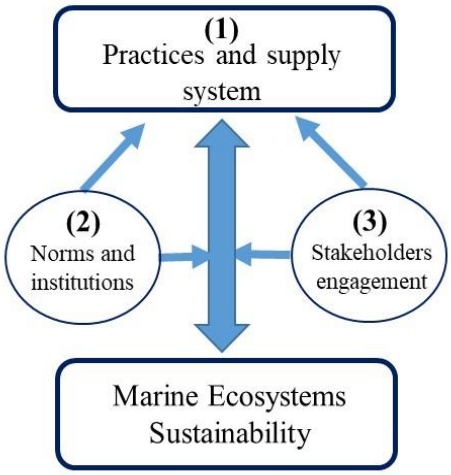

Figure 2: developing sustainable seafood systems to achieve ecosystems' sustainability

2.2 ASSESSING THE ENVIRONMENTAL IMPACTS OF BUSINESS PRACTICES IN THE SEAFOOD SYSTEM

The first pillar of our framework consists in evaluating and integrating business practices' impacts on ecosystems at the level of seafood supply systems. We analyze this separately: first we focus solely on fishing practices (exploitation) then on seafood supply (distribution).

2.1.1. Assessing sustainability of fishing activities and techniques in Mediterranean

Roheim (2009) defines sustainable seafood as products that have high stock abundance, low levels of fishing pressure, nominal bycatch levels, minimal adverse gear effects, negligible habitat damage, or effective management.

Few studies have focused on the specificities of Mediterranean small-scale fisheries and their impact on the environment. Falautano et al. (2018) study artisanal fishing in Sciacca, assessing both levels of professional and illegal artisanal fishing. A recent study has looked at the development of sustainable small scale fisheries in Turkey (Göktürk & Deniz, 2017). Fishing a broader diversity of fish species may mean more stable revenues for fishermen while it may reduce impact on fish stocks and habitat (Anderson et al., 2017). Gee, Pinello and Polymeros (2017) focus on the labor aspects (employment, remuneration) of Mediterranean fisheries.

Finkbeiner et al. (2017) highlight the role of technology and innovation in overfishing. A motley literature has looked at the impacts of fishing techniques over marine ecosystems. This also raises the question of whether traditional fishing techniques are more sustainable than innovative or industrial ones. Literature has shown that traditional fishing techniques, such as urchin fishing (Furesi et al., 2016) or traditional tuna trap fishing (Longo & Clausen, 2011) in Mediterranean may be more sustainable than industrial ones. Longo and Clausen (2011) argue that traditional tuna trap fishing techniques has allowed for centuries to sustainably fish tuna in Sardinia from an ecological point of view. Through interviews with fishermen, the authors find that *tonnaroti*, tuna fishers, are deeply aware of tuna reproductive processes and needs and of overfishing risks. However, innovation and industrialization of fisheries led to a dramatic overfishing of blue fish tuna, first by long-lines and then by purse-seines. Modern technology such as radars, spotter planes, as well as vessels' increase in size and power, reduced demand for labor contributed to increase production and value. Commodification of Bluefin tuna for

sushi/sashimi global markets resulted in yet more global demand and therefore overfishing. Meanwhile, tuna trap labor-intensive traditional method, declined or even collapsed in some places, the authors describe.

Regarding fishing gear itself, McClenachan et al. (2014) identify certain lower impact gear such as targeted hook and line fishery (sand dabs in California), vessel changes to reduce fuel usage while trolling (coho salmon in British Columbia), use of trawl nets with reduced roller gear (Mixed species trawl fishery in California). It would be important to identify best practices for each type of fisheries in the Mediterranean.

2.1.2. Sustainability performance for seafood supply

Roheim (2009)'s definition largely focuses on fishing practices. What does sustainable seafood means at the broadest level of analysis of the supply system? It could mean several things, from distribution distance (McClenachan et al., 2014), to sustainable waste management, secondary use market (e.g. for old fishing gear), or respecting human rights in procurement (Kittinger et al., 2017). To develop a system-based approach, it is necessary to therefore analyze not only fishing practices but also local seafood supply networks in the basin. Specifically, this calls for studying, at the level of the supply system, all economic actors involved in the seafood supply, their structure (e.g., agglomeration in cooperative or other organizational forms or individual actors), functioning mechanisms, strategies and geographical specificities. These actors include fishermen associations, cooperatives, producer organizations, auctions, harbors, retailers, restaurants.

2.2 IMPACTS OF NORMS AND INSTITUTIONS AND THE QUESTION OF IMPLEMENTATION

Second, we seek to understand the influence of institutional factors, such as regulation or governance, on seafood systems, as called for by Bennet et al. (2015) and Geijzendorffer et al.

(2017). Developing a multi-level governance approach, we propose to review the institutional logics at play, paving the way for a finer understanding of regional specificities and existing challenges for commons' governance.

2.1.3. The complexity of Mediterranean fisheries' governance

Mediterranean fisheries' formal and informal governance relies on an intertwining of actors, instruments and norms at the local, national, European, Mediterranean and international levels.

At the local level, one actor of the regulation of coastal fishing areas are fishermen corporations. Their role and importance vary across countries and depending on the strength of the government's decentralization (Hogg, Noguera-Méndez, Semitiel-García, & Giménez-Casalduero, 2013). In French, these are called prud'homies, in Spanish cofradias, or in Italian fraglie. Decugis (2015) studies these associations or corporations of fishermen on the French Mediterranean coasts, named "prud'homies". These organizations can take on several governance tasks, such as managing coastal fishing areas, act as arbitrary to settle disputes, participate to the definition of coastal regulation by setting rules that all member-fishermen accept. Decugis' conclusion is that prud'homies constitute an important, albeit undervalued, device for governing fisheries, allowing fishermen to participate in a collective effort of regulation that ought to integrate all actors of the sector, from economic to institutional and territorial development actors. Cofradias in Spain also play similar roles of organizing fishermen at the local level (Alegret, 1999; Astorkiza, del Valle Erkiaga, & Ikazuriaga, 1998). While Italian fishermen Fraglie have tended to disappear, a recent study argues it could constitute a tool to ensure sustainable use of resources (Fortibuoni, Gertwagen, Giovanardi, & Raicevich, 2014). The paper studies the case of the Venetian Lagoon, following the progressive deregulation of fishery management after the fall of the Repubblica Serenissima. According to the authors, fraglie may facilitate exclusive use of fishing space and restricting lagoon resource use and management.

At the national level, central governments and state agencies develop policies and regulation. European member states' regulation also must meet regulatory requirement at the European level (Common Fisheries Policy). However, non-member states, such as those of the South or West banks of the Mediterranean. This may lead to discrepancies at the regional (Mediterranean) level. In France, at the national level, fishermen fall under the power of general laws such as license Commissioning Operation and Reduction Plans fleets, under pluri-annual programs of the European Union Common Fisheries Policy. Decugis (2015) argues that those are heavy instruments that put too much pressure on fishermen and thus impede the profession's renewal. Furthermore, many additional laws, e.g. in employment conditions or safety at sea, also hinder the development and renewal of fishermen. The author, a fisherman himself, also criticizes these measures for ill-adapted to the requirements of such professions.

At the Mediterranean level, common governance efforts take place in Regional Fisheries Management Organizations (RFMOs). RFMOS are "intergovernmental regional fishery bodies or arrangements with the competence to establish binding conservation and management measures" (Gilman, Passfield, & Nakamura, 2014, p. 328). RFMOs are a collective device allowing States to meet their international obligation to collaborate in order to sustainably govern marine resources. Legal instruments that enable such international responsibility and collective governance around the issue of species' protection only dates back to 1982, with the Law of the Sea Convention (Gilman et al., 2014). Mediterranean is concerned with two RFMOs: International Commission for the Conservation of Atlantic Tunas (ICCAT) and General Fisheries Commission for the Mediterranean (GFCM).

Lastly, at the international level, another aspect of a more informal governance logics resides in certification. Iles (2007) studies the Marine Stewardship Council certification in fisheries. In 1997, the NGO WWF and the multinational company Unilever decided to create the Marine Steward Council (MSC), which then became independent. The certification aims to

provide consumers with certified fish that are sustainably produced. The process is voluntary since fisheries must apply for the certification process.

2.1.4. The failure of existing institutions

The state of overfished stocks in Mediterranean constitutes a tragic piece of evidence that existing governance and institutional frameworks have failed. This can be explained by several reasons. This includes a failure of governance, as a study shows in a cofradias in the Catalan region (Alegret, 1999). Already then, Alegret acknowledges the need to involve fishermen in marketing strategies and in adjusting captures to demand. Back then, cofradias were unable to agree upon maximum catch quotas. This resulted in a situation where cofradias lost bargaining power with retailers, who then dominated the pricing process and public administration did not see cofradias as a device for co-management. Similarly, Astorkiza, del Valle Erkiaga and Ikazuriaga (1998) show that while a cofradias decides upon self-imposed restrictions, those are not sufficient to be sustainable as they do not prevent pressure on stocks, overcapacity of the fleet or replacement of stocks and upkeep of economic revenues. As such, this is a case of a cofradias defining restrictions that do not guarantee a sustainable fisheries self-governance. The authors therefore conclude that self-organization, in such cases of common pool resource management, does not prevent resource overexploitation and irreversible depletion. Despite this empirical failure of the cofradias in anchovy fishing governance, the authors argue cofradias may be a potentially powerful device for sustainable management, especially in applying regulations.

According to Iles (2007), MSC certification constitute a promising way to govern fishing practices and enhance industries' capabilities. However, the certification is extremely costly for individual, small-scale fisheries, which constitute the vast majority of Mediterranean fleet. Therefore, MSC certification is difficult to achieve there.

Further, the cost of implementing national and European policies, as well as regional or international agreements is also very high. In terms of control and sanction, monitoring the seas, even in a closed region like Mediterranean, is close to impossible.

2.1.5. Innovative tools

Alegret (1999) has shown that the consequences of the collective action model's failure include loss of bargaining power and increase of transaction costs for fishermen. This has led to the growing bargaining power taken by other organizations of the sector, such as Boat Owners or Fish retailers' associations. These associations increasingly occupy bargaining space that initially belonged to fishermen. This is what led, according to Alegret, fishermen to call for more public intervention and therefore the development of a co-management, instead of the self-regulation that existed before.

Under the fisheries co-management systems existing in some countries like Japan, local fishermen play important roles in deciding on and implementing local management measures (Makino et al., 2017). Few co-management regimes have been implemented in Mediterranean. Pioneers in the matter, Catalonia has experimented with such co-management systems, developing innovative governance tools. A recent study describes co-management committees as an instrument for sustainable local governance (Lleonart et al., 2014). The authors present a case study of the co-management committee of sand eels in Catalonia. The committee consists of fishermen associations, research centers, NGOs and public administrations. This committee seeks to enhance fisheries' sustainability in the North West Mediterranean region. The study followed two phases: first a comprehensive analysis of the fishery (sand eel) with the definition of a management plan to increase fish stocks while enhancing value creation for fishermen; second the implementation and monitoring of the management plan.

Future research could first systemically review governance instruments and actors, as well as their underlying management methodologies and philosophies in order to develop a

more comprehensive understanding of governance in Mediterranean. The objective would also be to explore ways of efficiently harmonizing these devices. Future studies could also empirically investigate different cases of governance devices in Mediterranean. Literature on fisheries governance may build from works on nested governance, i.e. "where decision-making is distributed among a hierarchy of institutions" (Wyborn & Bixler, 2013, p. 59).

3. MULTI-STAKEHOLDER ENGAGEMENT MODEL

Lastly, Finkbeiner et al. (2017) have shown that another major group of factors that may impact sustainability of seafood system is resource demand and social behaviors. The sharing economy provides a useful framework to understand how stakeholders such as consumers or local communities may engage in seafood systems to increase their sustainability.

3.1 THE GROWING IMPORTANCE OF SHARING ECONOMY

Muñoz and Cohen (2017) broadly define the sharing economy as a "socio-economic system enabling an intermediated set of exchanges of goods and services between individuals and organizations which aim to increase efficiency and optimization of sub-utilized resources in society" (n.p.). The "sharing economy" covers increasingly important phenomena in contemporary societies, which is why several scholars have deemed it an "umbrella concept" (Acquier, Daudigeos, & Pinkse, 2017; Hamari, Sjöklint, & Ukkonen, 2015). Acquier et al. (2017) identify three building cores of business models belonging to the sharing economy. First, it implies an access economy, i.e. the sharing of underused assets such as financial savings in the case of crowdfunding, or rooms in the case of peer-to-peer housing. Second, it is based on a platform economy, i.e. it uses a platform to decentralize and intermediate transactions among actors. Finally, it consists of a community-based economy, which is to say interactions among actors are nonhierarchical whether they are monetized or non-monetized.

3.1.1. Relevance of sharing economy for sustainable seafood supply

More specifically, we see two fruitful domains of the sharing economy that could be relevant for sustainable fisheries: community supported systems and crowdfunding. Literature has particularly analyzed community-supported systems in agricultural economics, as a system of sourcing local food products (Brown & Miller, 2008). Community-supported agriculture "Community Supported Agriculture (CSA) is a marketing strategy where consumers buy 'shares' in the farm before planting begins and receive a portion of whatever is available each week of the growing season. These shares generally cost several hundred dollars and provide enough fresh produce for a family; some shares include other products, such as eggs, honey, flowers, and/or meat." (Brown & Miller, 2008, p. 1296) Literature has started to apply the concept of community-supported agriculture to fisheries (Community-supported fisheries) in the United States (Campbell, Boucquey, Stoll, Coppola, & Smith, 2014). The authors (2014) compare community-supported fisheries and community-supported agriculture. They show that motivation of members consists mostly of finding high quality, fresh and local fish, while encouraging the development of local employment.

Brinson, Lee and Rountree (2011) further identify several market and non-market benefits to this type of direct-to-consumer-marketing strategy. Fishermen gain a higher value for their fish. The program guarantees them a stable income. In addition, they benefit from direct political and regulatory support from consumers. On the side of consumers, the advantages include access to high-quality new types of fish, as well as enriching interactions with fishermen. The authors argue that the model cannot replace traditional markets but may act as a valuable complement. They also show that this type of fishing is more sustainable first because of seasonal, diversified fishing, rather than intensive mono-species fishing. As CSF reduce food miles, it also minimizes the environmental impact of food production.

McClenachan et al (2014) have conducted one of the most comprehensive study of CSF's sustainability. The authors test the hypothesis that CSF are more sustainable than industrial

fisheries. To do so, they compare both systems across several metrics such as sustainability of target fish stock, carbon footprint, and other environmental impacts. The authors find that CSFs drastically reduce the average seafood carbon footprint thanks to reduced distribution distance (average of 65 km for CSF and of 8812 km for industrial in the United States). They find no significant difference in the sustainability of target fish stock using different measures such as trophic level, or current stock biomass status. But they find that CSFs diversified distribution of fish may increase local fisheries sustainability. The study identifies five ways to reduce CSF environmental impact: developing a market for bycatch and waste products (e.g. Jonah and rock crabs in New England), creating markets for lesser-known, more abundant species (e.g. Atlantic herring in New England or sand dabs in California), creating local demand for otherwise exported products, using lower impact gear (e.g. targeted hook and line fishery), and educating and collaborating (e.g. walking Fish CSF, a business model developed with input from Duke University, local Catch Monterey Bay: sustainability plans developed with Stanford's Center for Ocean Solution, Port Clyde Fresh Catch marketing and promotional assistance from the Island Institute). Little literature has focused on identifying and studying CSF in Mediterranean. For instance, Paniers de Thau was recently created in Marseille, in the South of France but there is no structured knowledge regarding the functioning of such CSF, their potential differences with North-American systems, their number and scope in Mediterranean.

The second domain of the sharing economy relevant for sustainable fisheries is crowdfunding. Crowdfunding is a growing financing system among individuals and organizations, often referred to as peer-to-peer funding or lending, with highly disruptive potential (Philippon, 2016). Hildebrand, Puri and Rocholl (2016) define such financing model as a process by which "individuals can directly finance other individuals or companies without financial intermediation" (p. 587). As such, they argue, crowdfunding may be considered a way to encourage SME's development and economic growth. Crowdfunded fisheries may consist of peer-to-peer financing the buying of a boat or more sustainable fishing gear. To date, no work

has been conducted to assess the potential role of crowdfunding in increasing fisheries' sustainability.

3.1.2. Challenges to scaling-up sustainable community-supported fisheries (CSF) in Mediterranean

Community-supported fisheries (CSF) and crowdfunded-fisheries (CFF) constitutes two main ways by which models of the sharing economy could improve sustainability of fisheries in Mediterranean while meeting SDGs. Indeed, CSF and CFF could boost small-scale fisheries and local employment. Other initiatives may also increase sustainability of Mediterranean fisheries thanks to synergies with other sectors, such as pescatourism, natural tourism (i.e. diversifying activities into landscape and or marine fauna boat tours). The European Parliament has recently encouraged such diversification of fisheries thanks to fisheries-related tourism (European Parliament, 2017). This report highlights that small-scale fisheries are largely declining and coastal and island regions undergo a severe economic downturn. Developing fisheries business models that include pescatourism or natural tourism builds on the sharing economy core principles (access economy, platform economy and community-based economy) but call for further research.

While the literature has begun to compare CSF and CSA, it has done so largely focusing on North America. Future research should seek to compare CSF with existing in-land community-supported agricultural associations in Mediterranean. Geographical, biological, cultural, and political specificities exist that may call for different models for CSF than those developed in North America. Building on existing research on CSA would be a fruitful venue to explore these specificities. This would also help to assess the potential for scalability and diffusion at the scale of the basin of initiatives existing in certain regions, as the CSF Panier de Thau in the South East of France.

Mediterranean, and other regions of the world, may also face an issue of "ocean literacy" (Guest, Lotze, & Wallace, 2015), or more precisely of seafood literacy. Indeed, consumers have lost the knowledge of fish species, geography or seasonality. They are also largely unaware of the broad impacts of their consumption modes of marine habitats and oceans in general. Future research seeking to contribute to literature on sustainable seafood could assess sustainable seafood literacy in Mediterranean. Quantitative surveys at level of the Mediterranean basin could assess seafood literacy as well as consumers' willingness to support fisheries. and pedagogical efforts

4. DISCUSSION

With this paper we sought to answer recent calls in the management literature to tackle grand challenges (Eisenhardt, Graebner, & Sonenshein, 2016; Etzion, Gehman, Ferraro, & Avidan, 2015; Ferraro, Etzion, & Gehman, 2015; George, Howard-Grenville, Joshi, & Tihanyi, 2016). Our objective was to develop a comprehensive approach of sustainable seafood systems in the Mediterranean. We define sustainable seafood systems as providing safe, local and seasoned food supply while restoring and preserving marine ecosystems and resources, and responsibly developing coastal communities in Mediterranean.

We have shown that addressing sustainability of Mediterranean ecosystems requires a more systemic approach, integrating multiple factors that interact: business practices in the supply system (e.g. fishermen, distributors, retailers), institutional factors, and stakeholders' engagement, such as local communities. Our work aims to establish a roadmap to sustainable and responsible seafood supply in Mediterranean. We thus seek to contribute to ongoing public debates on the development of sustainable seafood production and supply, and to scientific debates on the interaction between multiple socio-economic factors in ecosystems' sustainability. Ultimately, better ocean management can have broader social impacts. It can

provide better economic alternatives to poor coastal communities and consequently ensure more political stability in an unstable region.

Encouraging the development of a sustainable local seafood system may benefit the environment for several reasons. It can reduce the impact on fish stocks and their habitat by reducing volumes and diversifying target species for higher quality, fresh, local supply. It can also increase awareness of communities involved regarding the need for ocean and cultural conservation (for traditional fishing techniques for instance). Further, local seafood systems may reduce distribution distance and as such help reduce the environmental impact of food distribution.

Moreover, small-scale fisheries and fisheries-related tourism may help create jobs and stability in a region otherwise suffering from severe economic decline and geopolitical instability. Fisheries areas are indeed generally parallel or close to tourist destinations and could therefore benefit from tourism but also help diversify tourism itself. Developing such a model raises several issues, from infrastructure to seasonality, legal status to safety measures, but transforming and harmonizing tourism and fishing constitutes a promising way to make the blue economy more sustainable in the basin. Mediterranean already attracts millions of visitors every year. Tourism in the region may benefit from a shift from mass monospecific tourism brought by big tour operators, to diversify, distributed tourism towards traditional fishing villages for instance, thanks to fishing related activities.

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