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Limits to fishing: the case for collective self-limitation illustrated with an example of small-scale fisheries in Catalonia

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Is there a limit to the amount of fish that can be taken from the sea? This question echoes the concern of the broader environmental movement in asking: are there 'limits to growth'? If the answer is 'yes', then what must be done to remain within sustainable limits? Fifty years after the publication of the landmark report *Limits to Growth*, new theories about limits highlight the importance of collective self-limitation, also in the context of fisheries management, in place of external, top-down determination and imposition of limits. This paper considers the shift in fisheries governance from regulating and establishing Maximum Sustainable Yields to collectively co-managing territories and ecosystems as symptomatic of a general turn from externally-imposed to self-imposed limitations. We show how perceptions and practices of limits are changing based on an ethnographic study of six small-scale fisheries co-management plans located off the Catalan coast in the Northwestern Mediterranean. The study evidences the challenges fishers face in attempting to define the limits of their agency to manage external forces that are often beyond their control. It concludes by arguing for the adoption of an ethos of collective self-limitation in fisheries governance to protect and benefit local communities and their environments.

KEYWORDS

fisheries management, small-scale fisheries, co-management, limits, MSY

1 Introduction

What is the limit to the amount of fish that can sustainably be taken from the sea? This question has been central to modern fisheries management since the industrialization of fishing activities (Smith, 1994), when pioneering works in fisheries science began theorizing about the sustainability and efficiency of exploitation rates (Graham, 1935). This paper explores the social and environmental consequences of changing the focus of fisheries management from an externally regulated "limit-centered" approach to a collective self-

limitation process. Engaging with debates about new fisheries management practices and the nature of limits in natural resource exploitation, our research sheds light on the challenges and possibilities of collective self-limitation in fisheries governance in the context of Catalan small-scale fisheries (SSF). The paper is based on an ethnographic study undertaken in six SSF co-management committees on the Catalan coast of the Western Mediterranean that incorporates a novel theoretical framework based on Cornelius Castoriadis (1997) thought on heteronomy and autonomy, new theories on limits (Kallis, 2019) and the understanding of the economy as a diverse field (Roelvink et al., 2015). We engage with these theoretical perspectives to understand how fishers perceive, re-think and enact limits on resource use to seek equity and sustainability through new institutions of co-management and how such different ideas of limits shape and are shaped by the everyday workings of the Catalan co-management committees.

This paper is structured in the following way: first, we introduce new theories of limits and explain the distinction between heteronomous limits and autonomous self-limitation based on recent interpretations of the work of political philosopher Cornelius Castoriadis. We then relate these theories with the process of shifting away from external, heteronomous limits evident in managerial fisheries governance models of Maximum Sustainable Yield (MSY) to the adaptive, ecosystem, and community-based co-management schemes, while framing the concept of collective self-limitation as a practice of economic difference. In section 2 we present the research question and describe the case study and the methodology of data collection and analysis. Finally, in section 3 we examine a case of community-based co-management, the Catalan SSF governance system, presenting examples of stakeholders' changing perceptions and practices of establishing limits, and identifying the new challenges faced as fishers attempt to redefine and enact such limits through participation in the scheme's co-management committees. We conclude in section 4 with the broader lessons taken from this study which point to the potential, but also the barriers, of SSF co-management initiatives in facilitating practices of economic difference –such as autonomous collective self-limitation— that can benefit resource-use communities and their environments.

1.1 Moving from limits to growth to collective self-limitation

Fifty years after the Limits to Growth report (Meadows et al., 1974), debates are ongoing about whether limits to growth exist (Nature, 2022). Pioneering detailed computer simulations of global development scenarios, the report was a landmark study on the unsustainability of industrial growth trajectories, and it kickstarted the modern debate on ecological limits to economic growth. Currently, sustainability scientists are still concerned about how to conciliate the existence of planetary boundaries with increasing human activity in the event of such limits growth (Steffen et al., 2015b; O'Neill et al., 2018; Brand et al., 2021). The prevailing climate crisis and the accelerating rates of biodiversity loss suggest a transgression of boundaries that, up until now, have offered a "safe operating space for humanity" (Rockström et al., 2009). Increasing anthropogenic pressures also affect the oceans (Halpern et al., 2019; Duarte et al., 2020). These stem from an unprecedented expansion and intensification of maritime and coastal industry (Brent et al., 2020; Jouffray et al., 2020) and the primarily land-based "great acceleration" of economic activity that began in the mid-twentieth century (Steffen et al., 2015a; McNeill and Engelke, 2016). Sustainability researchers argue that the cumulative effect of these anthropogenic impacts is pushing marine systems beyond their safe operating boundaries, thus risking their stability, functionality, and integrity (Nash et al., 2017).

New theories of limits, however, question their purported 'naturalness', pointing to the contested political processes through which limits come to be negotiated and practiced (Mehta, 2013; Kallis, 2019). The exclusive reliance on scientific expertise to define limits and related actions precludes a pluralist ontological, epistemological, and normative perspective on issues of sustainability. This theoretical foreclosure obscures alternative understandings and practices possibly better suited to address complex environmental problems in their specific socio-ecological contexts. Norgaard (1995), for example, argues that "the idea of limits does not convey what we must do to achieve sustainability. It is not simply a passive process of staying within limits, but an active one of assuring that future generations have the sufficient natural and human capital to live as well as we do" (pg. 130). In practice, it is difficult to maintain an ideal format whereby scientists establish an exact limit up to which a resource can be extracted or polluted, or an ecosystem disturbed, and policymakers then enforce a boundary up to which an activity is permitted in line with this 'natural' limit. Ecosystem complexity does not allow such simple determinations. Science, too, is bound by uncertainty, politics, and controversy when limits conflict with particular interests (Jasanoff et al., 1998; Miller, 2004; Turnhout et al., 2007; Wyborn et al., 2019) and when what may be a necessary and welcome limit for one resource-use stakeholder is not so for another[1]. Such factors make legislation and enforcement of limitations extremely difficult. Norgaard argues that if limits are to remain useful, they should not concern a property of the world 'out there' but should concern limiting our negative impacts on each other and on the environments with which we interact. In this, he shifts the importance from determining precise limits 'out there' to developing institutional mechanisms for limiting human activity.

This distinction between 'limits out there' and limits in our interactions can be further developed through the work of philosopher, psychoanalyst, and economist Cornelius Castoriadis (1922-1997). Castoriadis' thinking on limits was motivated by a concern for building emancipatory forms of social organization based on direct democracy (Castoriadis, 2010). He distinguishes autonomous and heteronomous forms of organization, that is, between societies that freely and consciously establish their own goals, rules, and limits and those that, although having themselves established their limits, attribute such limitations to an external

1 For a case study example of such controversies in fisheries governance see (García Lozano et al., 2019).

force, be it the Gods, the King, or 'the markets' (Kallis, 2019). In Castoriadis' view, theocracies, dictatorships, and capitalist societies epitomize heteronomous social orders. He saw growth-based development as the latest heteronomy: an unquestionable 'law' of the economy externally given (i.e., not a choice) that equates human progress with the compound growth of production and consumption and the unlimited development of the means of production (Castoriadis, 2010).

Autonomy, on the other hand, refers to the capacity of a group to consciously constitute a rule with its own norms, goals, and values. Castoriadis finds elements of such autonomy in Athenian democracy and the early Enlightenment. An autonomous society is truly democratic when it establishes its own limits on what is socially desirable and what is not, how much is desirable, and in what way it should be attained. Collective self-limitation is thus the ultimate form of autonomy and, perhaps paradoxically, of freedom of action. The tendency is to think of limits in reverse: as curtailing freedom of action because of the predominant understanding and experience of limits as an external, heteronomous force imposed upon the subject (Kallis, 2019). Limits are, nonetheless, relational: one is limited always in relation to something or someone. This limitation is necessary if true freedom of action is to be experienced–both of the 'self' and the 'other'. Without limits, there is little point in talking about freedom of action (think of a pianist trying to play piano on an infinite keyboard or a painter trying to paint a limitless canvas).

Kallis (2019) has reformulated the conception of limits and limitless growth under capitalism by integrating the ideas of Norgaard and Castoriadis. In the dominant model of economic thinking, traced from neo-classical economics back to Malthus, humans have limitless drives or needs that conflict with an environment that is, by its nature, limited in satisfying infinite needs. The pursuit of technological innovation and growth paradoxically emerges as the only viable response to such perceived limits, allowing more of this infinity to be satisfied, one notch at a time, but without ever overcoming the problem of scarcity inherent in unlimited ends and limited means. This is central to understanding how, under capitalism, limits are invoked to justify the pursuit of limitless growth. This idea is present in Malthus: his population model assumes a limitless propensity for humans to grow their numbers and advocates for agricultural and industrial growth as a response rather than redistribution. The same idea is central to neo-classical economics, premised on scarcity and growth. One can even find it in recent theories of planetary boundaries going hand-in-hand with claims in support of green growth (or blue growth for the oceans), geo-engineering, or colonization of other planets (Kallis, 2019). Castoriadis' work provides an alternative to this pairing of external limits and limitless growth: collective self-limitation or the deliberate control of supposedly unlimited needs that propel limitless expansion. Kallis (2019) identifies an ethos of self-limitation in ancient civilizations, spiritual movements, premodern egalitarian societies, and modern environmental and social movements, advocating for the readoption of such an ethos as the basis for environmental governance in the 21st century.

The discussion about environmental limits to human activity has parallels with the debate around the governance of the commons, which has long been central to fisheries social science (Berkes, 1985; Pontecorvo, 1988; McCay and Jentoft, 1998; Acheson, 2014; Armitage et al., 2017). In fact, the management of common-property resources was theorized in fisheries (Gordon, 1954; Scott, 1955) before the popularization of Garret Hardin's Malthusian parable of the "tragedy of the commons" (Hardin, 1968). The basic model of limitless drives in a limited environment underpins Hardin's story, where herders entering his imagined commons are assumed to have the drive to increase their herds at a compound rate, even knowing that such expansion will bring ´ruin to all.' Elinor Ostrom (1990), among others, demonstrates that there is nothing natural in such a tragedy. On the contrary, there are many historical and current examples of commoners communicating and devising rules to limit their herds (or their catch, in the case of fisheries) to sustain the commons over time while satisfying individual needs and providing collective wellbeing (Berkes et al., 1989; Feeny et al., 1990; McCay and Acheson, 1990; Ruddle et al., 1992; Ostrom et al., 1999; Agrawal, 2001; Dolšak and Ostrom, 2003; Cinner and Aswani, 2007; Burger et al., 2013). Moreover, critical analyses of the political economy of capture fisheries offer alternative and more comprehensive explanatory frameworks of overfishing that account for property relations, power inequities, and the systemic pressures toward privatization, competition, and accumulation as key drivers for resource exploitation and ecological decline (Campling et al., 2012; Longo et al., 2015; Longo and Clark, 2016; Barbesgaard, 2018; Campling and Havice, 2018).

Following Foley (2022), we build on previous research in marine social science, which argues that people who live permanently near resources and depend on them tend to have a long-standing concern about using those resources sustainably and are capable of "designing institutions that can limit access to adjacent fish resources equitably and effectively" (p.59). Similarly, Bavinck and Jentoft (2011) stress the relevance of subsidiarity as a guiding principle for a more democratic and sustainable fisheries governance system, where smaller (and usually politically weak and economically vulnerable) fishing communities should be given preference in managing their fishing grounds and meeting their needs. In this context, collective self-limitation practices can be a way to reinforce the autonomy local fishing communities in sustaining their livelihoods and environments. Hence, theories of self-limitation, such as those of Castoriadis or the commons literature, speak to works that problematize the ontological foundation dominant in natural resources and fisheries management, where fishers are assumed to be socially detached, value-free rational individuals seeking the maximum utility from their activity (Dyer and McGoodwin, 1994; Feeny et al., 1996; McCay and Jentoft, 1998; St. Martin, 2001; Mansfield, 2004; St. Martin, 2005a; Bresnihan, 2019a). Such

assumptions about human desires and behavior are formalized into many of the abstract models that mainstream natural resource management relies on, such as the Maximum Sustainable Yield (Bavington, 2002; St. Martin et al., 2007; Bavington, 2010a; Finley, 2011; Longo and Clark, 2016; Fressoz and Bonneuil, 2017).

1.2 Moving from maximum sustainable yield to sustainability through self-limitation

Since its origins in the first scientific observations of declining fish stocks in the late nineteenth century (Finley, 2011), modern fisheries science and management has posed the question of limits as its core challenge (Graham, 1935; Beverton and Holt, 1957; Schaefer, 1957; Mace, 1994; Smith, 1994). As a result, a concern around limits in the fisheries literature has centered on defining, quantifying, and setting adequate limits to fishing activity to achieve ecological sustainability or profit (Ludwig et al., 1993; Pauly, 1995; Schrank and Pontecorvo, 2007; Rindorf et al., 2017). This general approach relies on management models that assume that stock levels can be estimated accurately, recognize when a maximum level of sustainable harvest has been reached, and restrict fishing activity until stocks recover, and then fishing can resume at optimal levels (Pilkey and Pilkey-Jarvis, 2007; Finley and Oreskes, 2013). The epitome of this way of thinking is Maximum Sustainable Yield (MSY). Originating from the "gospel of efficiency" conservation ideals of German forestry science (Hubbard, 2014) and further developed through colonial forestry in India in the late nineteenth century (Ramesh and Namboothri, 2018; Scott, 2020), MSY moved from land to sea, becoming the governing concept of fisheries science from the 1930s onwards (Pilkey and Pilkey-Jarvis, 2007; Hubbard, 2014; Hubbard, 2018). The reasoning behind MSY owes much to the fundamental ideas of optimum and equilibrium in neoclassical economics, from which natural processes are conceived as linear and reversible (Finley, 2011; Fressoz and Bonneuil, 2017). The theoretical tenets of MSY became the cornerstone of fisheries management with the scientific establishment of fishery bio-economics in Canada, the United Kingdom, and the United States in the 1950s, which identified the problem of fisheries overexploitation in its open access character and the lack of clearly defined property rights (Gordon, 1954; Homans and Wilen, 1997; Scott, 1955). Fisheries bio-economics helped propel MSY as the guiding principle of sustainable fisheries in western countries in the following decades, coinciding with the industrialization of fishing fleets (Finley, 2011; Finley and Oreskes, 2013).

Since its popularization in fisheries science and management, the MSY model has faced several criticisms for its scientific shortcomings. On the one hand, researchers have pointed out how the model entails an oversimplification of ecological dynamics due to its single-species approach, as well as a disregard for broader ecosystem impacts, and have also problematized its reliance on difficult-to-obtain data and its lack of precautionary approach to uncertainty (Larkin, 1977; Murawski, 2000; Corkett, 2002; Mesnil, 2012; Pauly and Froese, 2021). On the other, mathematical models like the MSY were historically developed to meet the challenges of industrializing fisheries which required fish to be turned into 'stocks' that responded to fishing effort (Holm, 1996; Bavington, 2002; Bavington, 2010a), as Smith and Basurto (2019) summarize "scientific techniques of translation were needed in order to transform fish into natural resources—inputs suitable for capitalist production" (p.2). Therefore, these models do not account for most fishers' real-world socioeconomic status and wellbeing (Giron-Nava et al., 2019; 2021). Despite these criticisms and shortcomings, MSY, expressed in updated and more sophisticated forms, continues to be a pillar of fisheries policy and management globally, evident in its status as the ultimate and overarching goal in the European, national, and regional fisheries policies governing our case study (Common Fisheries Policy, 2013; Decret de governança, 2018; European Commission, 2021; Ley de pesca sostenible, 2023).

The social and political construction of limits discussed in the previous section is evident in the genesis and evolution of MSY, as is the paradox in the link between limits and growth. Finley and Oreskes (2013) depict MSY as a "policy disguised as science", given the crucial role of the U.S. State Department in its emergence. This policy model opposed more precautionary approaches focused on managing human activity to control fishing effort (Finley and Oreskes, 2013). The U.S., in the context of the Cold War and its consolidation as a global superpower, began extending its sovereignty claims over waters well beyond its traditional national boundaries. At the same time, other nations, such as Mexico and Peru, protested the U.S. trawling in their waters and sought to limit the incursion of foreign maritime powers into their areas of sovereignty (Finley, 2011). Significantly, the U.S. State Department anticipated that restricting entry to fishing boats would pave the way for restrictions on the freedom of passage for other vessels, such as the military (Finley and Oreskes, 2013). Fressoz and Bonneuil (2017) saw such imperialist dynamics as the reason for U.S. lobbying to adopt MSY as a principle in international fishery law, which stipulated that "fishing had to be authorized as long as the ratio of catch to effort had not yet reached a maximum" (p.12). Limits, in other words, became the basis for justifying growth and permitting expansion up to the supposed, but difficult to define, limit.

Similarly, fisheries policies and management plans in growth-driven industrialized western fisheries consistently use MSY as a goal to reach rather than a threshold to avoid (Worm et al., 2009; Mesnil, 2012; Pauly and Froese, 2021), a tendency that can lead to disastrous outcomes such as the infamous Newfoundland cod collapse of 1992 (McGuire, 1997; Schrank and Pontecorvo, 2007; Bavington, 2010a; Bavington, 2010b). Such stories support Norgaard's (1995) thesis, presented above, about the exhaustion of a scientific paradigm within which scientists are expected to know and define natural limits and policies and then confirm human activity according to those limits. The dependence of mainstream fisheries management on expert-defined limits risks advancing fragmented and partial understandings of complex

ecological conditions, thereby naturalizing the socially constructed character of environmental limits and excluding relevant stakeholders (e.g., the users/fishers) from knowledge building and decision-making. The shortcomings of such "managerial ecology" (Bavington, 2002; Bavington and Slocombe, 2003) that dominates fisheries governance indicate the need to shift from the traditional understanding of limits as external objective realities to a relational and normative perspective focusing on the praxis of self-limitation. We argue that the more recent shift towards adaptative community-based co-management schemes in natural resource management can under certain conditions open the space for an alternative understanding of limits that is more beneficial to the marine environment and the people who depend on it.

1.3 Moving from managerial ecologies to co-management

The concept of co-management in fisheries became prominent in the common property theory literature in the 1990s as a response to the observed shortcomings of top-down bureaucratic management systems for natural resources, on the one hand, and the structural push for the enclosure of the commons, on the other (Pinkerton, 1989; Berkes et al., 1991; Pomeroy and Berkes, 1997; Jentoft et al., 1998; McCay and Jentoft, 1998; Singleton, 1998; Mccay, 2011; Pinkerton and Davis, 2015). Although there is no universally used definition of the term, most authors coincide in defining co-management as a form of power-sharing between government and resource users (Olsson et al., 2004; Carlsson and Berkes, 2005; Berkes et al., 2007). Svein Jentoft, for instance, defines it as a "collaborative process of regulatory decision-making between representatives of user-groups, government agencies, research institutions and other stakeholders" in which power sharing and partnership are essential elements (Jentoft, 2019). Moreover, co-management is usually understood as a fisheries regulatory regime (Ojea et al., 2017) situated at a middle ground position in a governance continuum from centralized, command-and-control systems at one end to autonomous self-managed user-communities at the other (Pinkerton, 1992; Pomeroy, 1995). In addition, as Berkes et al. summarize (2007), different authors emphasize different aspects of co-management, such as stakeholder engagement, institutionalization, trust building, problem-solving, or governance issues. Most authors also concur that co-management requires, firstly, an institutionalized arrangement to ensure the participation of resource users in the decision-making process and, secondly, formalization of power and responsibility sharing to ensure that decisions taken are binding and are not seen merely as a form of public consultation or *ad hoc* participation (Pinkerton, 1989; Kearney et al., 2007; Berkes, 2009; Gutiérrez et al., 2011).

Co-management has recently gained renewed attention in fisheries research, policy-making, and environmental advocacy, due to its perceived advantage in social and ecological outcomes in contrast to centralized and yield-oriented managerial approaches (Worm et al., 2009; Gutiérrez et al., 2011; FAO, 2015; Cinner et al., 2019; Gelcich et al., 2019a; Westlund et al., 2019; Cavallé et al., 2020). We distinguish here two relevant and interconnected discursive arenas concerning the discussion on limits: one focused on the mechanisms through which resource users establish their own rules, boundaries, and restrictions and their effectiveness in achieving beneficial social and ecological outcomes (Adger et al., 2005; Cinner and Huchery, 2014; Rohe et al., 2017; d'Armengol et al., 2018; Cinner et al., 2019; Gelcich et al., 2019b; Pinkerton, 2019a; Viana et al., 2019). From this perspective, the concept of community-based co-management, a specific form of co-management that endows place-based communities organized through cooperatives, guilds, or fisher organizations with the right to access and control local resource use, is relevant to this study (Singleton, 1998; Kearney et al., 2007; Wiber et al., 2010; Pinkerton, 2011; McCay et al., 2014; Raicevich et al., 2018; García Lozano et al., 2019).

The other discursive arena understands co-management as a tool for developing new governance frameworks that extend beyond deterministic models focused on establishing limits to human action with regard to nature, as per MSY or carrying capacity. This perspective stems from a growing consensus in the fisheries management literature that complexity and uncertainty are inherent characteristics of marine socioecological systems that require the incorporation of adaptive and anticipatory governance systems to achieve resilient, sustainable fisheries (Olsson et al., 2004; Berkes et al., 2007; Armitage et al., 2009; Gelcich et al., 2010; Pecl et al., 2019). For instance, Berkes et al., (2007) argue that "non-linearity, feedback processes, and system self-organization challenge established assumptions of scientific certainty, stability paradigms in both the ecological and social sciences and the primacy of expert-driven solutions" (p.2). Indeed, researchers have become increasingly concerned with accounting for the complexity of marine and coastal socioecological systems to enable holistic and adaptive approaches (Oviedo and Bursztyn, 2016; Alexander et al., 2019; Ferro-Azcona et al., 2019; Herrón et al., 2019; Lindkvist et al., 2020; Woods et al., 2021; Lindkvist et al., 2022) which incorporate local ecological knowledge as well as user participation and perception in researching and managing natural resource systems (Beyerl et al., 2016; Fitzpatrick et al., 2020; Holm et al., 2020; Franco-Meléndez et al., 2021; Bastari et al., 2022; Puley and Charles, 2022). Ecosystem-Based Management (EBM) is one such approach (Pikitch et al., 2004; Alexander et al., 2019; O'Higgins et al., 2020) in that it aims to encompass social-ecological complexities and uncertainties while spanning multiple sectors of human activity (Long et al., 2015; Link et al., 2017; Link and Marshak, 2021). In theory, EBM is better suited to adapt to social and environmental change in fisheries, although researchers have pointed out that EBM has proven difficult and slow to implement in real settings and that ecosystem resilience does not necessarily translate into social well-being (Ogier et al., 2016; Stephenson et al., 2018; Alexander et al., 2019; Woods et al., 2021) while it risks overlooking fundamental issues regarding power relations, social conflict and epistemic injustice (Bavinck et al., 2018; Bennett, 2019; Campling et al., 2012; Dahlet et al., 2021; Fischer et al., 2022). Despite these shortcomings,

EBM is becoming increasingly prominent in the specialized literature and policy schemes, such as the European Marine Strategy Framework Directive and the Catalan Co-Management Decree itself.

1.4 Collective self-limitation as economic difference

Fisheries social scientists have had a long and critical engagement with management approaches that have led to the privatization and commodification of fishing rights and the enclosure of fishing commons (Pontecorvo, 1988; St. Martin, 2005a; Olson, 2011; Foley and McCay, 2014; Pinkerton and Davis, 2015)[2]. Some researchers extend this critique to community-based management systems, which they see as likely facilitators of enclosure, privatization, and neoliberal capture (Mansfield, 2004; Macinko, 2007; Mansfield, 2007; Bresnihan, 2019a; Bresnihan, 2019b). Macinko, (2007) indicates that "many policies that might ostensibly appear to be place-based are, upon closer inspection, revealed to be focused on the endowment of particular individuals, not places, significantly rights-based fishing" (p.73) therefore identifying placelessness as an entry point for private rights-based management and increased market dynamics. Similarly, in studying the transformation of contemporary Irish fisheries, Bresnihan (2019a) argues that implementation and development of co-management projects represent an extension of, rather than an alternative to neoliberal rationalities, in that they aim "to align the economic interests of individual fishers with the vagaries of a global seafood market and the unpredictable marine environments they work in", concluding that "over time this protracted process of 'improvement' (and) the tightening of economic and regulatory pressures will exclude more fishers from the fisheries than any one-off regulatory event (e.g., privatization)" (p. 169).

We concur with such criticisms in questioning the role that projects of power devolution from centralized state institutions play in the context of neoliberal restructuring of fisheries management (Pinkerton and Davis, 2015; Pinkerton, 2017; Pinkerton, 2019b) where processes of decentralization are at risk of market co-optation and privatization. Moreover, researchers have long pointed out how co-management schemes can function as a tool of regulatory capture by powerful actors, leading to an extension rather than a reduction of state and market rule resulting in the disenfranchisement and marginalization of resource-dependent communities (Agrawal and Gibson, 1999; Blaikie, 2006; Ribot et al., 2006; Nayak and Berkes, 2008; Ramenzoni, 2021). Although we recognize the wider power imbalances and structural constraints that economically vulnerable and politically weak communities are subject to, we also want to make space for seeing mechanisms of collective self-determination in the face of such constraints and imbalances (Foley et al., 2015; Pinkerton, 2015; Snyder and St Martin, 2015; Pinkerton, 2017; Gómez and Maynou, 2021). Based on the insights from our case study, we argue that under certain circumstances co-management schemes might facilitate commoning processes of collective self-limitation which can help place-based resource-use communities to resist or disrupt neoliberal and managerial rationalities in foregrounding livelihoods, wellbeing, and sufficiency against the systemic pressures of efficiency, competition, and accumulation (Davis, 1996; Pinkerton, 2017).

Our argument is premised on the ontological assertion of the economy not as a singularity but as a diverse field (Gibson-Graham, 2006; Roelvink et al., 2015; Gibson-Graham and Dombroski, 2020), where different forms of production, distribution, and consumption can exist. Furthermore, theorists of the diverse economy perspective argue that some of these forms might be mediated by an ethics of community and environmental wellbeing, instead of exploitation and competition (Gibson-Graham, 2008; Community Economies Collective, 2019). Indeed, in the following sections, we imbue our analysis with an anthropological perspective that treats fishers as subjects who do not necessarily pursue endless accumulation and private wealth but rather who can negotiate and decide on their own limits, individually and collectively, based on different ethics, priorities, and economic desires (Kallis, 2019). In this way, we engage with other researchers studying economic diversity in fisheries (St. Martin, 2005b; Snyder and St Martin, 2015; Foley and Mather, 2016; Arias Schreiber et al., 2020), emphasizing ethical negotiations and practices based on the values of interdependency, sufficiency, and self-limitation in the reproduction of more autonomous and sustainable commons. We understand collective negotiations and practices over what and how to limit as part of a 'commoning' process (De Angelis, 2014; Gibson-Graham et al., 2016), that is, the production and reproduction of the commons over time, the articulation of a collective commoner subject, and the situated and negotiated practices of sustaining life in common (Bresnihan, 2015; Karnad et al., 2021). Through our case study, we emphasize how commoning processes also include those actions that the collective decides not to take or chooses to limit, in contrast to the usual emphasis on doing and making as a sign of the expansion of the communal reach, or as determined by natural limits already 'out there'. Combining insights from new theories of limits with scholarship on fisheries management, the governance of the commons, and diverse economies, we frame collective self-limitation practices as active negotiations over what to limit based on different ethics, priorities, and economic desires than those often assumed in dominant fisheries management models.

From this conceptual basis, we formulate the driving question for our research: how are limits re-thought, negotiated, and enacted in the co-management schemes to ensure equity and sustainability in fisheries management? With an eye toward the challenges of implementing such limits, we wish to understand how fishers' engagement with the everyday workings of new institutions of co-management shapes and is shaped by different ideas of limits. Here, we advance three key insights from our case study research: First, the way that adaptative co-management works in practice marks a shift from limits as something out there (as in MSY) to practical decisions for collective (self-)limitations in the face of socio-environmental uncertainty, complexity, and high stakes. Second,

2 In the Mediterranean context, relevant work has been written on the commodification and privatization of the tuna fisheries (Longo et al., 2015; Longo and Clausen, 2011; Said et al., 2016).

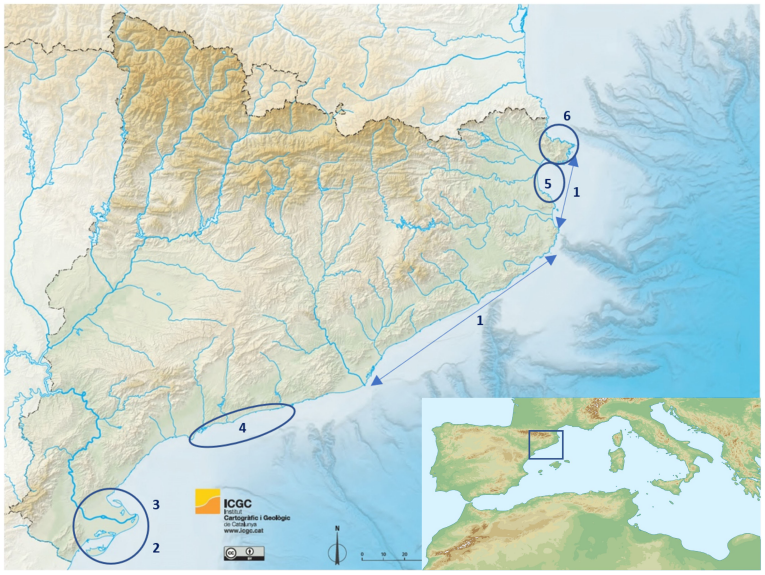
fishers perceive benefits in collectively limiting their activity because this might give them the freedom to work less and improve their quality of life, because they feel empowered to become creators of their own rules, and because they understand their actions as having a positive impact in their environments and communities. Third, commoning processes through collective self-limitation confer partial protection from external threats, although the inside/outside distinction within such processes can be problematic.

2 Materials and methods

2.1 Case study

Our case study concerns SSF in the Mediterranean Sea off the coast of Catalonia (Figure 1). The Mediterranean, together with the Black Sea, is one of the most overfished seas on the planet. (FAO, 2022a): 73% of the evaluated available commercial stocks are currently overfished. Although fishing pressure is lower than in the last decade, it is still double what is considered sustainable, with some stocks being fished eleven times over the estimated sustainable yield (General Fisheries Commission for the Mediterranean, 2022). Sustained overfishing since the 1990s (Colloca et al., 2013; Vasilakopoulos et al., 2014; Cardinale et al., 2017; Colloca et al., 2017; Piroddi et al., 2020) together with other anthropogenic pressures that are affecting the ocean globally such as climate change, habitat destruction, and pollution (Poe and Levin, 2017; Halpern et al., 2019; He and Silliman, 2019; Gissi et al., 2020), which have had a cumulative negative effect on Mediterranean ecosystems leading to their increased degradation (Coll et al., 2012; Micheli et al., 2013; Piroddi et al., 2017). A consequence of this ecological decline is a decrease in catch volumes throughout the Mediterranean over recent decades (Piroddi et al., 2020). Thus, Catalan fisheries, located in the northwestern Mediterranean, exemplify the relationship between the deteriorating ecological system and declining socio-economic activity. Over the past 15 years, Catalan fisheries have witnessed a 50 percent fall in catches and the loss of nearly half of the fishing fleet, with SSF facing the largest decline in boats. (Figure 2).

Catalan fisheries' most relevant fleet segments comprise SSF vessels (331 units), trawlers (211 units), purse seiners (61 units), and longliners (30), whose activity occurs mainly with daily trips and catches are commercialized in fresh markets (Gómez and Maynou, 2020; Gómez and Maynou, 2021). The term "small-scale fisheries" refers, in this case, to the part of the fishing fleet that is distinct both



Committee	Species	Constitution
1. Sand-eel fishery	Gymnammodytes cicerelus and semisquamatus	2012
2. Octopus fishery (southern coast)	Octopus vulgaris	2020
3. Blue crab fishery	Callinectes sapidus	2018
4. Octopus fishery (central coast)	Octopus vulgaris	2019
5. Cuttlefish fishery	Sepia officinalis	2018
6. Cap de Creus Natural Park Artisanal fisheries	Multispecies	2021

FIGURE 1
The Catalan region and its co-management system.

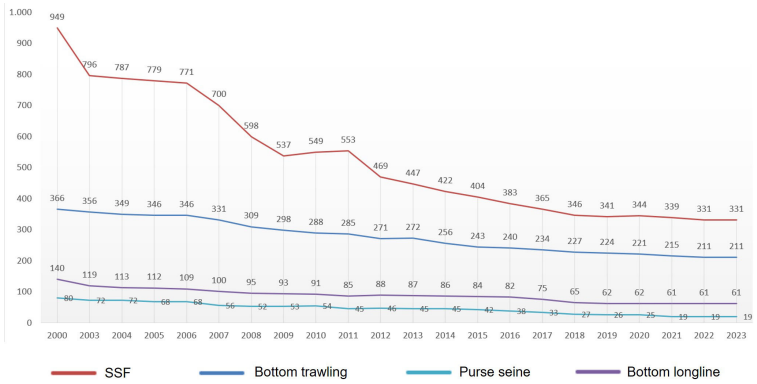


FIGURE 2
Number of vessels by gear type in the Catalan fishing fleet 2000-2023 (Source: Gencat, Department of Climate Action, Food and Rural Agenda).

by the scale of the vessels and fishing activity, as well as a range of shared (although not universal) characteristics such as labor intensity, low productivity, the use of artisanal gear, reliance on family labor, the diversity of the catch, or their location in near-shore waters (Pauly, 2018; Smith and Basurto, 2019; Boonstra et al., 2020; Smith et al., 2021). Approximately 90% of the world's fishers are considered small-scale (FAO, 2015) which provide close to 40% of the global catch, and sustain the livelihoods, well-being, and social fabric of coastal communities worldwide, particularly in the global South (Weeratunge et al., 2014; Teh and Pauly, 2018; Cohen et al., 2019; Jentoft et al., 2022). Despite this, coastal and marine resource governance has traditionally marginalized SSF concerns in favor of more productive and modernized fishing sectors that are considered of greater economic relevance and better suited to output-oriented management and assessment tools, such as MSY (Pauly, 2018; Cohen et al., 2019; Smith and Basurto, 2019; Said et al., 2020; Ayilu et al., 2022; Jentoft et al., 2022).

Catalan SSFs are characterized by the seasonality of their fishing activity, their small-volume but high-value catch, and the variety and selectivity of their fishing techniques and gear. Most Catalan SSF boats are owner-operated in a particular labor regime akin to self-employment and usually depend on the help of family labor, whether at sea or on land (Gómez and Maynou, 2020). Although Catalan SSFs represent most of the vessels, they are overshadowed by more intense extractive modalities in policy-making and public discourse, such as purse seiners and trawlers, which are more productive both in terms of captures and revenue (see Table 1). Patterns in Catalan fisheries are mirrored in regional estimates of the size and catch contributions of SSF as well as in their sociocultural dimensions (Battaglia et al., 2010; Leleu et al., 2014; Pascual-Fernández et al., 2020; Villasante et al., 2021). In the Mediterranean, most vessels belong to SSFs (82%), and despite comprising only 17% of the total catch, they represent more than half of all fishers and earn a third of total revenue (FAO, 2022b).

2.2 Governance system

The overarching policy framework for fisheries management in the Mediterranean is the European Union's Common Fisheries Policy, which combines technical restrictions, minimum conservation reference sizes for some stocks, area-based management measures, and effort-control regimes (mainly establishing limits on fishing days and spatial closures) for the stated aim of achieving the Maximum Sustainable Yield (MSY) for all Mediterranean fisheries. At the national level, fisheries in Catalonia are subject to state regulations of the Spanish Ministry of Food, Fishing, and Agriculture and regional regulations in inshore waters where the Catalan Government has jurisdiction. Locally, fishing communities throughout Spain are organized around fisher guilds or *cofradías* (meaning 'brotherhoods'). These

TABLE 1 Catalan fisheries catch by sector in 2022: weight, value, and average price of the catch (Source: Gencat, Department of Climate Action, Food and Rural Agenda).

	Catch (Tn)	Revenue (thousand €)	Average price (€/kg)
Trawling	7,096.68	55,397.21	7.81
Purse seine	11,485.83	19,239.39	1.68
SSF	1,843.73	16,180.55	8.78
Surface longline	365.74	2,883.84	7.89
Bottom longline	53.78	710.55	13.21
Shellfish gathering	284.17	2,007.26	7.06

are public law entities originating from traditional fishery self-governance institutions. *Cofradías* are rooted in the territory and have established legitimacy among most fishers (Herrera-Racionero et al., 2019; Gómez and Maynou, 2021; Herrera-Racionero et al., 2022).

The *cofradías* have a long history through which their organizational form and functions have changed, from devotional associations in medieval times to fisher guilds with the power to manage the commons in the modern period and to cooperatives, mutual-aid societies, and trade unions with the arrival of liberalism and capitalist development (Alegret, 1999). In the northern Mediterranean, other historical and contemporary analogues of collective self-governance institutions exist, such as the French *Prud'homies* and the Venetian *Fraglie* (Raicevich et al., 2018). Nowadays, the *cofradías'* function as representative bodies of the fishing sector (usually grouped into territorial federations), as mediators of internal sectoral conflicts (such as those that can arise between different sectors of the fleet or between boat-owners and workers), and as managers of some shared infrastructures (such as first-sell points or port facilities). Beyond their representative function, *cofradías* regulate and control access to specific resources within their territory of jurisdiction, establishing port entry and exit schedules, assigning zones of fishing activity specific to each type of fleet, determining closed seasons, organizing first-sell Dutch auctions, and stipulating specific norms of behavior based on local social and environmental characteristics (Raicevich et al., 2018; Gómez and Maynou, 2021; Herrera-Racionero et al., 2022).

Cofradías act in a regulatory constrained context, adapting and complementing the European, national, and regional legislations. In Catalonia, the regional government has endowed the *cofradías* with a key role in the structure and workings of the co-management plans. The Catalan SSF co-governance model was formally constituted with the approval of the Professional Fisheries Governance Decree in 2018 and has since then been presented as a flagship model for the Mediterranean in international policy and sustainability arenas (United Nations, 2023). The Decree established the legal architecture for developing a series of management plans based on a form of the territorial user rights for fisheries (TURF) system (Hilborn et al., 2005; Huppert, 2005; Mccay, 2011; Gelcich et al., 2019a; Villaseñor-Derbez et al., 2019) which limits access to specific inshore fisheries to license holders from adjacent *cofradías*. The Decree institutes co-management committees as the primary governance body, able to develop, implement and supervise the management plans for each specific region or target species to establish

> "the management framework that must guide the activity of extractive fishing in Catalonia, based and set on concepts such as co-management, ecosystem-based, adaptive and precautionary management, with the final objective of achieving the Maximum Sustainable Yield through the control of fishing effort and the increase of the selectivity of the gear, with the participation and implication of the government, the fishing sector, the scientific collective and civil society" (DECRET 118/2018, Gencat).

The Decree draws from previous experiences of co-management in the region, such as the red shrimp management plan in Costa Brava (Bjørkan et al., 2020), the sand-eel management plan (Lleonart et al., 2014), the management of marine reseves of fishing interest in Galicia (Perez de Oliveira, 2013; Fernández-Vidal and Muiño, 2014), and the "Plan Castellón" a pioneering management plan of the 1960s involving local trawling fleets from southern Catalonia and northern Valencia (Dahlet and Sánchez Lizaso, 2021). At the time of fieldwork for this study, the Catalan co-management system consisted of six SSF active management committees, managing only about 10% of the Catalan catch but involving around 60% of the SSF fleet.

Committees are constituted by representatives of the main stakeholder sectors: local fisher communities involved in the plan, the wider fishing sector, scientific bodies, government, and civil society, which have equal footing in decision-making. The committees are structured around the plenum, the principal decision-making body, and the technical committees, which are in charge of the elaboration, supervision, and execution of the management plans. Decisions are taken by majority vote, although consensus is preferred and sought. After approval, the General Directorate of Maritime Policy and Sustainable Fisheries ratifies the committees' decisions, which then become legally binding. One such decision is the endowment of fishing rights to local fishing communities. The licenses that give fishers rights to fish are contingent on the committee's yearly approval based on the collectively established entry criteria, such as historical catches, dependence on the resource, stock status, maximum length of the boat, gear restrictions, or overall compliance with regulations.

Although fishing rights are assigned to individual boats, these rights are not the property of the boat owners, nor are they tradable. Moreover, the boats with fishing rights need to be part of a *cofradía*, and their fishing activity is circumscribed to the territorial boundaries of the management plan, which encompasses the customary and traditional fishing grounds). In this way, the co-management committees seek to incorporate the "socioecological embeddedness" (Gómez Mestres and Lloret, 2017) of local fishing communities in the articulation of place-based community management schemes (St. Martin, 2001).

2.3 Methodology

For this research, the first author collected data during ten months of fieldwork (February – November 2021), including 60 hours of non-participatory observation at the monthly technical committee meetings (held in a hybrid format due to COVID restrictions), complemented with 35 semi-structured interviews, lasting two to three hours, with representatives from each sector (fifteen fishers, eight scientists, seven NGO and five government representatives). Interviewees were selected given their participation in the technical committees as representatives. At the time of fieldwork, most committees had been running for a short period, and their development was temporarily stalled due to the COVID emergency. The sand-eel committee, which was the first constituted and served as a role model for the rest of the

committees, was the most well-established and had been functioning for longer when fieldwork was carried out. More insights and data were therefore drawn from the workings and experience of this committee.

Interviews were conducted and recorded *in-situ* or online, with the previous informed consent of the participants. Transcriptions were coded with ATLAS.ti software and ethnographic data were triangulated with information from grey literature analysis of scientific and policy documentation from Catalan, Spanish, and European government and scientific bodies, as well as from other secondary sources. The primary data were analyzed from a critical realist perspective (Bhaskar, 2008), which refers to a body of work in political ecology that "seeks to understand ecological change through epistemological skepticism but ontological realism to underlying biophysical processes" (Forsyth, 2001). We find this approach relevant to our conceptual perspective and normative stance as our study coincides with the aims of critical realist political ecology which are, following Forsyth, to indicate "how supposedly apolitical scientific laws in fact reflect historic political and social relations" while also seeking "to reconstruct new and more effective science for environmental policy" that is ecologically more adequate and socially more just (ibid).

Similarly, we found grounded theory (Charmaz and Belgrave, 2015; Glaser and Strauss, 2017) a suitable methodological approach for gathering and analyzing the primary data. Grounded theory is a well-established qualitative research framework that aims to explore complex phenomena in depth from the participants' perspective (Glaser and Strauss, 1967). This approach attempts to minimize researcher assumptions and biases to uncover previously unconsidered topics (Creswell and Poth, 2016). Accordingly, we began data collection prior to making hypotheses to develop contextual understanding before articulating our research questions. We immediately analyzed our observations from the committee meetings to determine if recurrent themes should influence the direction of the research effort. We then developed our interview protocol by identifying recurrent themes and topics (such as motivations behind self-limitation, perspectives on environmental limits, or opinions on co-management). Finally, it should also be noted that smaller sample sizes are standard in grounded theory research because the emphasis is on quality and depth of findings over quantity and generalizability. The number of interviews is not defined by statistical significance but by the saturation of discursive concepts through theoretical coding and forming a narrative grounded on empirical observations (Charmaz and Belgrave, 2015; Creswell and Poth, 2016).

3 Results and discussion

3.1 Moving from limits as *'something out there' to limits based on human and natural-world interactions*

Our observations of committee meetings and discussions with participants pointed us to a core finding: the actors involved in the decision-making perceive that the high level of uncertainty involved in the management of the marine ecosystem precludes easy determination of external limits as per MSY and calls for a more pro-active and adaptive response, based on pragmatic and normative decisions on what and how to limit, for what purpose and to whose benefit. This situation conforms to Norgaard's (1995) critique of the external limits paradigm. It shows how practical and normative considerations drive novel fisheries governance models towards a 'self-limitation' approach, emphasizing the social and ecological implications of limiting human activity, independent of the predictive capacity of management expertise based on stock assessments and calculation of surplus yield. In fact, no co-management plan was based on stock assessments, the scientific method for establishing overfishing, because of a systematic lack of data for most of the fished stocks, which is a common characteristic in SSF (Salas et al., 2007; Smith and Basurto, 2019; Smith et al., 2021). Knowledge about the state of fisheries was primarily derived from reported catches, fishers' local ecological knowledge (LEK), and complementary indicators, such as average individual size or catches per unit of effort for some species.

Comments from scientific representatives indicate that they readily recognize the difficulty of establishing predictive certainties: "I often tell them [the fishers] that they shouldn't expect scientists to know everything about the fishery and that they themselves might know better what's going on, because of their daily direct experience and their shared knowledge" (interview #16). Given the localized, circumscribed, and small-scale nature of the Catalan management plans, it proved particularly challenging to assess the stock status, to know the reasons for environmental change, or to predict the evolution of marine ecosystems and their populations as a response to management actions. As another scientific representative warned: "we cannot leave everything to science to decide what to do. To have some scientific certainty, we would need years of systematic, reliable data collection and consistent application of a management measure to see its results. Even then, we wouldn't be sure because there's always uncertainty on how natural systems work, and it could very well be that one year you are fishing in the best way possible and catches fall nonetheless, and another year, you don't apply any of the approved measures and catches go up" (interview #18).

Fishers and scientists, in the technical committee meetings and during our conversations, showed a deep-seated familiarity with the unpredictability of the sea, which explains why limits were rarely negotiated in abstract or absolute terms. Discussions focused instead on concrete actions meant to limit fishing and its impact. These actions can take the form of technical restrictions (maximum meters of nets or quantity of fishing devices, the maximum length of boats, minimum mesh size, minimum fish size) or restrictions on the fishing activity itself (closed-off seasons, closed-off areas, fishing days reductions, tighter schedules). For instance, the self-managed quota system of the sand-eel committee signals the multidimensional effects of such a shift. In this case, both fishers and scientists recognized that it is difficult to assess if the sand-eel population has responded positively to management actions because it is a species of annual reproduction. Further, seasonal variations of the sand-eel population increase the difficulty of obtaining conclusive and updated data on stock status to inform

management action. Instead, fishers establish a conservative quota shared equally among themselves based on their observations and available scientific data. They adjust the quota weekly to allow for the maximum extension of the fishing season, according to the evolution of catches. It is customary to preventively close the fishing season when catches fall below a previously co-produced security threshold to allow the population to recover.

Concerning the uncertainty around the sand-eel population biology, a fisher representative explained that:

> "When scientists came and told us they wanted to study the *sonso* [popular name for sand-eel] ecology, I told them: good luck with that! Because I tried to understand it myself for many years, and really, there's no logic to it. I know it seems foolish, but I assure you that it is like this: the year when there's got to be *sonso*, there will be. And the year that's not, there won't be. It doesn't matter what you do. It could very well happen that now for two years in a row, there would be very little *sonso*, and people would freak out because they would think it's been exhausted. But then suddenly, there could be plenty of it in the third year. This type of thing has already happened."

Tellingly, when scientists studied the sand-eel ecology, they arrived at similar general conclusions, stating "that the fluctuating population dynamics of the Mediterranean sand-eel imply periods of 2-3 years of high abundance followed by similar periods of very low abundance when fishing mortality should be kept to a minimum" (Institut Català de Recerca per a la Governança del Mar (ICATMAR), 2020, p.41). This shift of focus from finding objective thresholds in nature to a praxis of adaptation and collective self-limitation of fishing activity represents a shift from an instrumental and means-end-oriented type of management to a more reflexive, deliberative, value-rational negotiation of the hermeneutics and the practices of fishing (Jentoft, 2006; Linke and Jentoft, 2014; Arias Schreiber et al., 2022). Fisher representatives, for example, do not seem to view environmental limits at sea as external impositions or a source of heteronomy. On the contrary, they appear to view their position within marine resource systems from a more relational standpoint in line with the latest theories of limits that emphasize the interaction between internal demands and external conditions: "the sea is what it is. It decides what and when to offer. If you ask too much of it and do not let it rest, you will destroy it" (interview #9).

Similarly, in the cuttlefish committee, the fishing communities involved decided to self-impose a restriction on net mesh-size, establishing a minimum size to allow young specimens to escape. This decision did not come from a detailed calculation of how such management action would increase surplus biomass population, neither was it motivated by the observation of an alarming decline in catches. Instead, it was taken from a collective desire to care for a commons that fishers appreciate, identify with, and understand as being in a relation of interdependency. As a fisher representative summarized:

> We took this decision mostly because of becoming self-conscious about what we were doing and how we were doing it. And from asking ourselves, what does work well for us? The cuttlefish is a nice fishery for us; we fish it close to home, we don't destroy the gear, and we fish it when it's good weather … Also, between three to five months a year, we know we can rely on this fishery. That's why it wasn't difficult for us to agree amongst ourselves that we wanted to take good care of it (interview #7).

Even in the cases where negotiations on self-limitation were fraught with disagreement and conflict, discussions in the technical committees did not center on how much fish was still out there or what was the optimal amount of fishing to be allowed, but rather what was the most ecologically adequate and socially fair way to limit fishing pressure and protect the fishery (i.e., which technical restrictions to apply or when to establish the closing season, under which criteria and for what aim).

These findings contradict the primary management goal of the Catalan co-management Decree, which intends user involvement in devising plans together for achieving MSY. Moreover, the case study of the Catalan co-management committees validates the claims of researchers regarding the difficulty of establishing cause-and-effect relationships between specific management actions and their outcomes or establishing objective thresholds prior to their transgression (Funtowicz, 1993; Ludwig et al., 1993; Schrank and Pontecorvo, 2007; Armitage et al., 2012). Our observations in the technical committees indicate that stakeholders' efforts were not devoted to finding out environmental limits at sea but to regulating and restricting human activity to control its environmental impact. Indeed, the workings of the committees' technical groups were based on a shared understanding, most prevalent in fisher and scientific representatives, of the marine environment as a complex system within which predictive certainty is difficult to establish. In this context, finding objective certainties about environmental limits to human activity becomes an impractical management approach. Therefore, instead of establishing outside limits to their extractive activity, fisher representatives tended to foreground collective self-limitation practices when trying to manage resources sustainably and equitably in contexts of socio-environmental uncertainty, complexity, and high stakes for their communities.

3.2 Self-limitation as freedom and autonomy

> "Now we have to fish more, work more hours, invest more on machinery, gear, and fuel to sustain ourselves. What we must do is fish less but better" (interview #23).

A common desire that we encountered in our conversations with fishers was that limiting their harvesting activity would confer benefits of wellbeing in terms of 'fishing less, but better', that is, reducing self-exploitation by decreasing work intensity and fishing pressure, leaving them more free time while maintaining their livelihoods, that they see being under threat. As a fisher representative and president of a local cofradia said: "maybe we will have to work less, but in exchange, we might get a better quality of life and similar economic output. This is the key: to manage things well so that there isn't as much fishing effort and hours of work while maintaining our livelihoods. But if you tell me that my income must go down 20%, I won't accept it, because I have to live from it! But I think we should try, and I believe that things can get better" (interview #8). Indeed, fishers often complained about how the decline of catches has entailed having to work harder and longer to sustain themselves: "if I could go back, maybe I wouldn't have gone to sea. The sea has changed a lot, each time is more difficult, you have to work much more, and it isn't like before. In these boats, you must work a lot, you must be on top of too many things, both on land and on the sea, just to get going. It takes so many hours out of your life, and in the end, you only live to work and don't have time to live your life" (interview #27).

Fisher representatives from the sand-eel co-management committee repeated positive perceptions of working less intensively. This committee managed to obtain higher prices for their catch by fishing less while reducing total working hours and achieving a better quality of life overall for its members. Fishers of the management plan, which includes all boats of the sand-eel modality, collectively define a seasonal quota to be approved by the committee. Fishers can lower their quota weekly either to avoid overfishing or to reduce landings and stabilize prices if fishmongers pay low prices for the catch as sand-eel is greatly appreciated in the region, and fishers have control over the supply. The management plan has made the sand-eel fishery more adaptive and resilient to socio-environmental change, thereby better securing the livelihoods of its participants. Moreover, according to sand-eel fishers, collective self-limitation helped reduce the competitive dynamics within them and fostered a more cooperative ethos based on equity and sufficiency. For instance, now fishers shared information about their catches more easily with their peers. Further, when a boat catch goes over its assigned quota, it is customary for the fisher to give the surplus to those who have not yet reached it. Echoing this shift, a fisher representative stated:

> "This thing that we do of self-regulating and self-imposing the quota and adjusting it as we see fit is something good. Today, I make less money because I used to be the one that caught more fish than anyone. But there were people who were not doing as well as me. Now we are regulating our fishery in a way that everyone can make a living, and that's better. I got used to not having to work as much, that's all. I work much less; to me, this is like going to play! It is like a hobby, as it was before, but with the difference that before I was always tired, and now I'm not" (interview #4).

Fishers often concur during our interviews that, assuming a decent living standard could be secured, they would prefer to fish less and improve their quality of life by reducing working time, having better schedules, and engaging in more comfortable and relaxed fishing practices. Such insights align with the findings of recent studies which do not see a strong positive correlation between fishers' subjective well-being and the amount of fish caught (Miñarro et al., 2022) and resonate with established critiques in fisheries social science on the ontological assumption in fisheries management of economic rationality as the primary driver of fishers' behavior and desires (Holm, 1996; Bavington, 2002; Mansfield, 2004; St. Martin, 2005a).

A second common opinion about the benefits of co-management concerned fishers taking matters into their own hands and not having to comply with unjust or *ad hoc* external limitations. Fisher representatives commonly described higher-level fisheries governance as inadequate, partial, and unadjusted to local conditions. As Herrera-Racionero et al. (2015) noticed, large governance institutions lack legitimacy among the Spanish Mediterranean *cofradías*. Fishers often complained of bureaucrats "sitting in offices in Barcelona, Madrid or Brussels telling us what we should do without ever coming here or going out to sea like we do every day" (interview #9). Instead, fisher representatives often invoked a closer relationship and dependence on the environment as rationales for claiming legitimacy in managing adjacent natural resources and the value of their local ecological knowledge. This observation supports Pinkerton's (1999) statement that parties with long-term relationships and dependence on local resources are the best suited to use them sustainably and to be more accountable for their conservation. As Herrera-Racionero et al. (2022) recently observed, some *cofradías* in the Spanish Mediterranean already self-impose restrictions to their harvesting activity (such as the delimitation of fishing zones, establishment of closures, shared quotas or minimum mesh sizes) further than their legal commitments as a way to protect their fishing grounds. Hence, Foleys' (2022) claim that proximity enhances the legitimacy and effectiveness resonates with fisher representatives' tendency to perceive rules and limits imposed by outside parties as illegitimate and arbitrary, whereas those deliberated on and decided upon *via* the committees' mechanisms as adequate and valid.

This perception of the adequacy of co-management was not without its detractors. In some committees, mainly the most recently established or those experiencing more difficulties in their development, fishers felt that the Catalan administration imposed the co-management system on them: "they [the government representatives] made it very clear to us: either we make a good management proposal (from their perspective, of course) or the *Generalitat* [Catalan administration] will impose theirs" (interview #9). Some fisher representatives from other co-management plans concurred, depicting fisher's position in the committees as vulnerable and in the minority. They complained about having only a quarter of the votes when the rest of the stakeholders often sided against their interests. Indeed, many of the fishers interviewed feared that the socioeconomic unsustainability

of the fishery was rapidly leading to its collapse making collective self-limitation a futile and unjust management strategy, due to the unequal distribution of benefits and burdens between the different actors using the marine space. As an interviewee stated: "why should we sacrifice when others keep damaging the sea and taking advantage of it?" (Interview #21).

However, in other technical committees, fisher representatives would give a different view claiming that fishers do not experience much resistance in the decision-making process, being able to push collective decisions closer to their interests. Despite any good intentions behind the co-management plans, it was evident that structural constraints and power imbalances were present in the Catalan co-management scheme. Indeed, the regional government fisheries directorate had a clear role as promoter and moderator in most committees and ultimately held the decision-making power as the management plans had to be approved by its general director. Although often functioning as a heteronomous source of limitations itself, the regional government representatives sometimes invoked the existence or the threat of externally imposed rules coming from higher-level governmental institutions at the State or European level: "either we set our own limits, or they will be forced upon us" (interview #11, government representative). In fact, the first co-management plan was constituted as a response to an EU ruling which banned the sand-eel fishery in 2012 due to its lack of compliance with European management measures for Mediterranean fisheries (Lleonart et al., 2014).

In that sense, an interesting dynamic played out between heteronomous limits, coming from the 'outside' the first co-management committees, and internal limits set by committee members autonomously. This is a fine balance. To the extent that fishers incorporate and control the process, the inside-outside distinction attenuates; but to the extent that there is little consensus on the implemented actions, perceptions of co-management as an externally imposed limitation can intensify, and the power imbalance and diverging interests become more apparent among stakeholders. In their study on *cofradías* development of self-management practices for sustainability, Herrera-Racionero et al. (2019, p.11) describe this process along similar lines:

> Moreover, they [the fishers] feel that public policies regarding this area are often inspired by measures previously tested by the guilds. Nevertheless, they denounce that, paradoxically, when their local rules are translated into general laws, self-control becomes hetero-control and loses effectiveness or even causes results opposite from those that were expected. Since those controls that fishers respected before, when "we controlled ourselves", are considered to be illegitimate ("they are imposed on us"), they now feel that circumventing and disobeying rules that were once accepted is justified.

A further problem in drawing clear boundaries between internal and external limits, or between autonomy and heteronomy, is that fishers do not regard all external limitations as negative or inadequate. For example, most fishers view state and regional bodies' surveillance and punitive functions as a necessary prerogative for the appropriate functioning of fisheries management. Notwithstanding this assessment, all fisher representatives in our interviews concurred that such functions were not always well implemented, frequently resulting in fishers being treated as 'criminals' while the actual offenders went unpunished (interview #6).

3.3 Limits as protection

SSF in Catalonia are facing major challenges in maintaining fishers' livelihoods (Gómez et al., 2006; Lloret et al., 2018; Gómez and Maynou, 2020; Pascual-Fernández et al., 2020), as signaled by the rapid disappearance of fishing vessels in the last decade. Beyond the drastic reduction of catches due to overfishing and the environmental impacts of economic growth (such as climate change, pollution or habitat destruction), Catalan SSF face competition of other fishing sectors (commercial and recreational), tourist development, increased bureaucratic control, and the pressures of corporate actors, mirroring the situation of SSF in other European and Mediterranean countries (Said et al., 2018; Cohen et al., 2019; Ertör-Akyazi, 2020; Said et al., 2020; Jentoft et al., 2022). In this context of adversity, the setting of collective self-limitations in the co-management committees is often articulated as a way to protect the fishing grounds, and hence fisher livelihoods and autonomy, from external pressures. Importantly, in interviews and committee discussions, fisher representatives did not express a desire for self-limitation as protection alone but also as a means to achieve better social and ecological outcomes for their communities and future generations in particular. As a fisher representative stated:

> "the crux of the issue is not only that you might make a living from it [fishing], but that the ones who come after you can also live from it. That's the thing. I have two children, and I hope that they don't go to sea because the situation is very bad. But if it turned out that they wanted to go to sea, they must be able to live from it. However, if we continue as we do now that won't even be possible" (interview #27).

References to intergenerational stewardship as part of the ethics of collective self-limitation were common in our conversations with fishers. Such statements reflect Norgaard's (1995) argument that the idea of limits "is not simply a passive process of staying within limits, but an active one of assuring that future generations have sufficient natural and human capital to live as well as we do" (pg. 130).

Indeed, there were instances where collective self-limitation was perceived or used as a tool for community resilience in the face of heteronomous pressures. In the cuttlefish committee, for example, fishers from neighboring *cofradías* came together through a common purpose to counter one such external pressure, the expansion of an economically powerful and technologically

advanced recreational fisheries sector (Said et al., 2018; Cooke et al., 2021; Gómez et al., 2021; Gómez, 2022), and established a closed-off season that was binding for all fishers, both professional and recreational. Hence, the self-imposed closed-off season functioned to limit the negative impact at a local level of an actor external to the committee. Similarly, the sand-eel committee's efforts to control supply to regulate prices to the fishers' benefit also worked to partially limit the power of market forces in shaping fishers' labor and livelihoods while also better adapting their harvesting activity to the sand-eel population dynamic. Notably, of the six co-management plans we studied the sand-eel achieved the best socioeconomic outcomes, to a great extent because it is based on a circumscribed fishery, in which there is no competition from recreational fishers nor other sectors of the commercial fishing fleet and neither is there high-volume imported produce entering the regional markets. This exceptional instance of protection and insulation from market pressures makes self-limitation and co-management easier and more effective, which is difficult for other fisheries where prices driven by globalized market dynamics dictate intense competition and resource exploitation in already declining fish stocks for fishers to stay afloat (Gómez and Maynou, 2021).

From this perspective, community-based co-management can act as a form of collective ownership of fishing rights which, although in some aspects mimics enclosure by excluding users external to the committees, can be used to protect the livelihoods and fishing grounds of economically vulnerable communities by building socioeconomic alternatives to ever-increasing resource exploitation, as documented in other studies (Johnson, 2000; Foley et al., 2015; Snyder and St Martin, 2015; Foley and Mather, 2016; Pinkerton, 2017; Foley and Mather, 2018; Pinkerton, 2019b; Ertör-Akyazi, 2020). In explaining that property can have multiple logics, Mansfield (2007) points at social relations (goals, values, and power) as structural elements in the establishment of particular property arrangements which in turn define a set of rights, obligations, interdependencies, and allocations. Based on that observation, Mansfield (2004) notes that "market rationality is not necessarily a dimension of property in general; property can involve multiple types of arrangements, with different goals and outcomes" hence arguing that "to the extent that control over access to resources and places can be about protecting traditional livelihoods, assigning property rights can actually challenge purely market-based approaches to resource use" (p. 314). Similarly, St. Martin (2020) notes that not all kinds of property arrangements become "an essential determinant of economic efficiency, rationality, and growth" (p.273) but rather that it is private property, as signaled by the European enclosures of the eighteenth century, which is attached to a vision of human nature defined by individual self-interest, a will for constant improvement (of the means of production and the self), and the satisfaction of infinite desires which calls for perpetual profit maximization and accumulation. In this context, collective self-limitation practices can be read as a search for autonomy and economic difference that actualizes aspects of traditional place-based self-management systems (Raicevich et al., 2018) that functioned for centuries in many Catalan's fisher communities under the customary principle "*que tothom visqui*" [so that everybody may live] (Garrido, 2012).

It should be noted, however, that such protections are only partial, as local fisheries are also affected by pressures other than the SSF's fishing activity that are not the purview of the co-management committees, such as the impact of other segments of the commercial fishing fleet, recreational fisheries, pollution, coastal development, or climate change. Market forces are a paradigmatic pressure for SSF communities which is beyond the committee's control (Pascual-Fernández et al., 2019). Fish is one of the most globalized food commodities; between 30-40% of all fish caught is traded internationally, while Spain is the 4th largest importer of seafood by value in the world (FAO, 2022a). In fact, the Catalan fishing fleet provides about just 20% of fresh fish consumed in Catalonia and only 12% of total fish products, including frozen and canned fish (Gencat, 2021); the rest is often imported as price-reduced commodities or extracted by industrial distant-water fleets from fisheries in global South. Hence, the limitation of user rights can partially secure a fishing community's catch since once the catch is landed, the price is defined through market mechanisms (Gómez and Maynou, 2021) in a context dominated by fish wholesalers and big retailers that buy seafood products from multiple and geographically disparate sources (Ortega-Cerdà and Coll, 2022). As an NGO representative stated: "We shouldn't only look to production (catching the fish) when thinking about social and environmental sustainability; we should also look at distribution and commercialization. The fish is 'abandoned' once it is fished and then it is the market that sets the price, and in the end, the fisher will only get a very small fraction of this price" (interview #13). We concur with Gómez and Maynou (2021) in seeing the potential for socio-economic transformation in alternative seafood marketing systems that are emerging in Catalonia, particularly in initiatives such as community-supported fisheries and fishers cooperatives (Snyder and St Martin, 2015; Ertör-Akyazi, 2020). However, when prices fall most fishers have little room to fish less and sell at a higher price: they are forced to fish as much and to sell as cheaply as the market dictates to stay afloat. Therefore, without a greater higher-level public control of market systems of provisioning, any co-managed system which focuses on the capture segment of the fishing activity will struggle to provide many benefits to most SSF communities, as most fishers will continue working under the structural pressures of increasing resource exploitation and of the self.

4 Conclusion

This paper has linked ongoing changes in fisheries governance and management to recent debates in environmental studies about the nature of limits. We show how the shift from determining and imposing external limits, as in MSY, towards shared and negotiated limits to fishing activity, as in adaptive co-management schemes, resonates with theory-informed calls to understand resource limits as projects of collective self-limitation rather than as boundaries inherent in the natural properties of the resources themselves. Based on the case study of SSF co-management schemes in Catalonia, we show how fishers can engage in collective practices of self-limitation which can lead to concrete measures to improve fisheries governance. Our results emphasize how, under certain conditions, place-based community co-management initiatives can

become spaces for economic difference in which values of sufficiency and practices of collective self-limitation can be articulated as part of a commoning process that benefits local fishing communities and their ecosystems. The results suggest, however, that the relationship between external and internal sources of limitation is complex, extending beyond single dimensions. Maintaining a certain degree of autonomy from a higher level of government, for instance, is crucial for experimentation with and developing self-limitation mechanisms through the co-management schemes, which in turn also risk becoming an unauthorized form of heteronomy when power inequities are not addressed, and fishers do not regard such limitations as just or sustainable. These processes of collective self-limitation are vulnerable to the extent that external forces can intrude, specifically those of the market that push relentless competition and intensification of resource exploitation and of the self, making such self-limitations irrelevant –a core finding of our research.

In the case of SSF in Catalonia, our results evidence how economic forces threaten to make the limitations imposed by the fishers themselves less stable or less relevant if the pressures driving fishery degradation are beyond their direct control. This raises the question of how lower-level limitations can act to force limitations at higher levels of governance. In the case of co-management, the challenge is for actors participating in the fisheries committees to become agents of structural change in coastal zone governance and in reforms of seafood markets and broader commodity chains. This research clarifies that the deliberation unleashed by co-management schemes' politicize fisheries management through the collective articulation of group boundaries, goals, and limits, making participants aware of the broader political and economic forces that constrain their choices. Finally, we see a potential in the Catalan co-management plans in protecting the livelihoods and environment of economically vulnerable and politically weak local fishing communities. Based on our observations, we argue that, under certain conditions, co-management schemes can give space to commoning actions that foreground collective prosperity, autonomy, and sufficiency, as a response to the pressures toward increased resource use, private enclosure, and individual profit maximization. In the context of the rapidly disappearing SSF sector in Catalonia, collective self-limitation can become a place-based mechanism to help resist and disrupt the encroachment of market imperatives, such as the need for privatization, competition, and relentless accumulation. Moreover, as instances of economic difference and commoning, collective self-limitation practices can also advance and inform alternative ways of relating to and living with the marine environment. Through our observations and interviews, we saw fishers that do not necessarily want to catch ever more fish, given secured and decent living conditions, and who are willing to self-limit their activity to the benefit of their community, environment, and of future generations. However, we also observed how fishers could perceive the institution of collective self-limitation as a heteronomous imposition that results in disagreement, conflict, and opposition amongst co-management stakeholders. Hence, how can fisheries governance further embrace and broaden a collective self-limitation ethos that uphold the autonomy, economic wellbeing, and environmental sustainability of fishing communities?

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by CEEAH - Comissió d'Ètica en l'Experimentació Animal i Humana, Universitat Autònoma de Barcelona. The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors developed the initial concept of the study. BN-A compiled the data, did the analysis and drafted the paper with inputs and feedback from GK and MO. GK and MO contributed to major revisions in structure and content. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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