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Limits to Blue Growth
Linking Marine Sustainability and Degrowth in the North-Western Mediterranean

Borja Nogué Algueró

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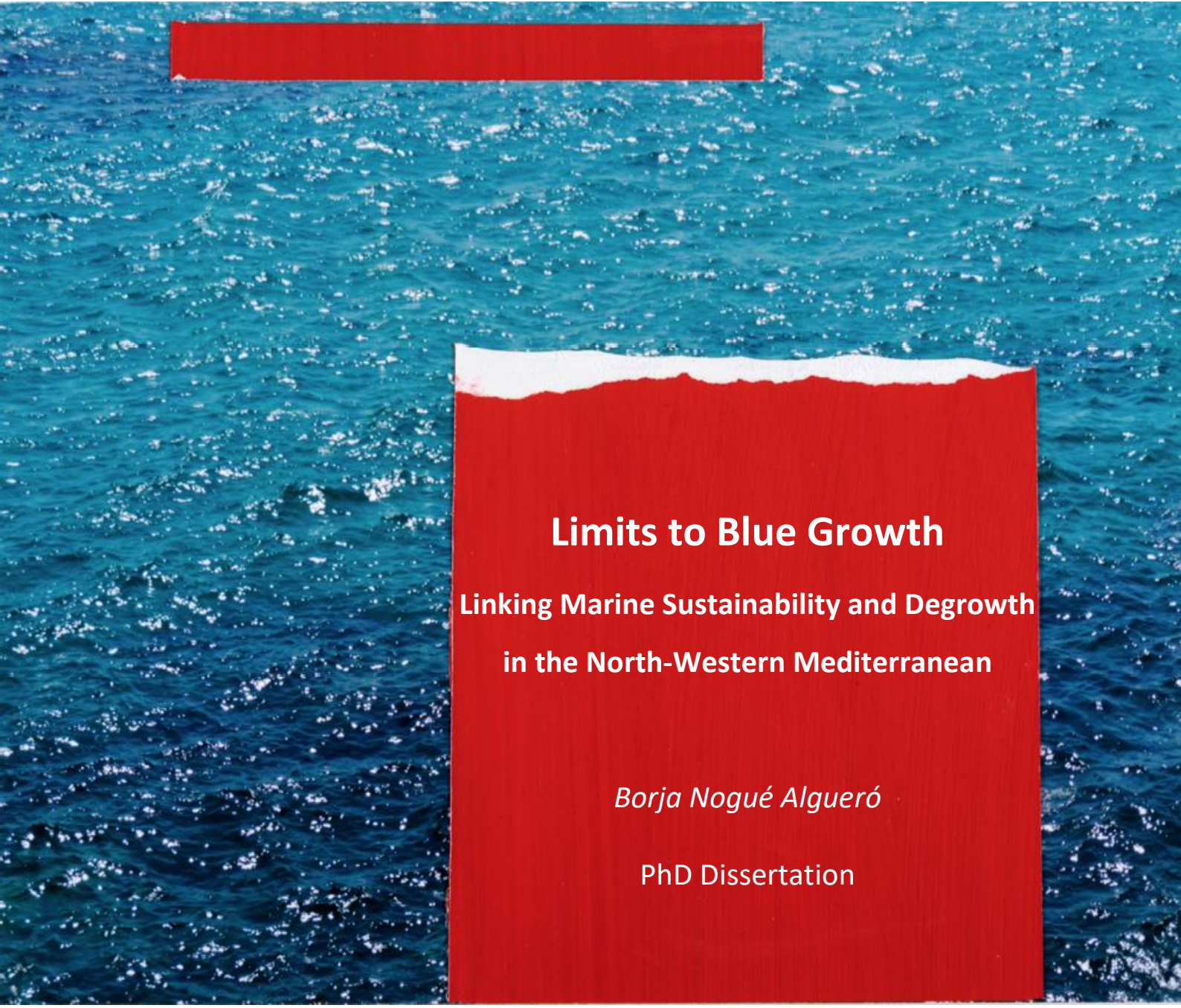

Limits to Blue Growth

Linking Marine Sustainability and Degrowth in the North-Western Mediterranean

Borja Nogué Algueró

PhD Dissertation

December 2023, ICTA-UAB

Ph.D. Program in Environmental Science and Technology

Supervised by Dr. Giorgos Kallis, Dr. Santiago Gorostiza and Dr. Miquel Ortega

ICTA Institut de Ciència i Tecnologia Ambientals - UAB

UAB Universitat Autònoma de Barcelona

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Doctoral Program in Environmental Science and Technology
Institut de Ciència i Tecnologia Ambientals,
Universitat Autònoma de Barcelona (ICTA-UAB)

Barcelona, December 2023

ICTA Institut de Ciència i Tecnologia Ambientals - UAB

UAB Universitat Autònoma de Barcelona

"Car la Mar és gran vida de la terra"

Francesc Eiximenis, *Dotzè del Crestià* (1385-1392)

Ὅταν πιστεύω θάλασσα μονάχα καὶ βυθὸ
καὶ προσκυνάω γιὰ κόνισμα ἕναν παλιὸ ἀστρολάβο,
πές μου, στὴν ἅγια πίστη σου, πῶς νὰ προσευχηθῶ;
σὲ ποιὸν νὰ ξομολογηθῶ καὶ ποῦ νὰ μεταλάβω;

Νίκος Καββαδίας, s/s Apollonia (1967)

It is a curious situation that the sea, from which life first arose, should now be threatened by the activities of one form of that life. But the sea, though changed in a sinister way, will continue to exist; the threat is rather to life itself.

Rachel Carson, "The Sea Around Us" (1961)

This Ph.D. research was supported by the is supported by the Spanish Ministry of Science and Innovation through the FPU fellowship program (FPU17/05908) and by the Universitat Autònoma de Barcelona. Views represented in this work are those of the author. They do not purport to reflect the views of the Spanish Ministry of Science and Innovation or of the Universitat Autònoma de Barcelona.

Borja Nogué Algueró [borja.nogue@mailbox.org], Universitat Autònoma de Barcelona, 2023

Suggested citation: Nogué-Algueró, B. 2023, Limits to Blue Growth: Linking Marine Sustainability and Degrowth in the North-Western Mediterranean. Ph.D. dissertation. Universitat Autònoma de Barcelona.

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Cover credit: **Alexandre Nogué i Font**

Title**: No exit_exit/19-9-13**

Published in Àlex Nogué, Jordi Puig, Victor Sunyol (2022). NO EXIT: La Costa Brava de nord a sud en creuers turístics. Úrsula llibres, Girona

Summary

In the last decade, degrowth has emerged as a useful framework for understanding the role of growth-based economies in the destabilization of the planet's life-support systems as well as a conceptual toolkit to imagine and plan sustainable and desirable socio-ecological futures. However, little engagement between marine sustainability and degrowth research represents a significant gap in the literature, foreclosing the exploration of promising theoretical and empirical avenues. In a situation where the social sciences and humanities are slowly taking a "oceanic turn" and the blue economy is becoming the dominant sustainability paradigm in international Ocean governance circles, degrowth research must turn "blue" and tackle key marine sustainability problems. To this end, in this dissertation, I return to the old sustainability question of the limits to growth from a marine perspective using a situated critical lens. I ask, how does the Ocean work both as a conduit and a barrier for notions and projects of growth? Unlike the modelling approach of the original Limits to Growth report, my objective is to provide an in-depth analysis of the social, economic, and cultural conditions that give rise to or limit ocean-based growth imaginaries and projects. Focusing on the northwestern Mediterranean, a place with a historically high concentration of maritime and coastal industries that is becoming a leading region in the promotion and development of the blue economy, I attempt to answer this question by looking at i) how the ocean has been a stage for the great acceleration, ii) how it has fueled the imperative to grow, and iii) how it has established limits to growth. Based on a historical overview of the notions and projects of growth behind the development of maritime industries in the Spanish Mediterranean, together with ethnographic work carried out on two case studies on the contemporary shipping and fishing industries, I show how both the materiality and the social construction of the Ocean have generated growth imaginaries, as well as collective self-limitation projects that are distinct from those on land. Drawing on insights and methodologies from political ecology, ecological economics, and environmental history, this thesis links marine sustainability concerns with debates on emerging degrowth scholarship. The results of this dissertation point to the need to abandon terra-centric perspectives in degrowth research and promote a blue degrowth counterhegemonic sustainability paradigm in Ocean governance.

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Preface

For most of my life, I did not think of the sea as an intellectual conundrum. Growing up next to the Mediterranean, I assumed its presence with pleasant familiarity. Like many people, I would naturally associate the sea with leisure time and holidays on the beach. However, as I grew up, I became increasingly alienated from it. I was turned off by the highly urbanized and commodified landscapes that permeated the coast of my region. I would rather gravitate towards the mountains when seeking to spend time in nature, as most of my friends would do. For many years, I relegated the sea to the background of my terrestrial life. This began to change during my postgraduate studies, when my curiosity towards the forgotten spaces of the global economy made me rediscover and appreciate the sea under a new light. Since then, curiosity has morphed into research interest and, in parallel, into deepened love and awe for the marine world. Coming from the traditionally land-centered social sciences and humanities, my research entry into the marine realm has been both exciting and challenging. The natural vs. social sciences is a persisting divide, despite all calls in favor of interdisciplinarity. Moreover, in addition to the common difficulties of conducting research in highly competitive and precarious academia, my doctoral journey has been conditioned by the COVID-19 pandemic. In the early days of March 2020, during my second year of PhD studies, I was preparing to attend the Eastern Mediterranean Offshore Conference in Cyprus. This was supposed to be the first stop in my initially planned fieldwork, aimed at a critical analysis of offshore hydrocarbon exploration in the Eastern Mediterranean region. The emergency measures that followed made it impossible to continue the research plan that we had originally designed. Instead, I had to find an alternative case study that was closer to home and could be accessed under pandemic restrictions. At that point, the incorporation of Miquel Ortega into the supervision team made possible a swift transition to a new case study in Catalan fisheries. Amidst the hardship of the first months of the

pandemic, I was lucky enough that could adapt comfortably to the situation and continue working under safe conditions. Now, the lockdowns and social restrictions might seem like long-gone nightmares. However, they remain a painful lesson of the risks and vulnerabilities that the current organization of the global social metabolism entails. We are immersed into a path of environmental destruction and the present dissertation is part of my humble contribution to redress it. I am convinced that the sea will be crucial in constructing better socioecological futures. What follows is a testimony to that conviction.

Acknowledgments

Although the process of writing my doctoral dissertation often felt like a lonely journey, in truth it was a collective enterprise for the most part. During these years I had the enormous luck to count on a multitude of mentors, comrades, supporters and even cheerleaders. I wish to acknowledge them here, so that their essential contribution to the work I did leading to this thesis does not remain hidden by academic authorship conventions. I apologize in advance to those whom I might forget to include here: my gratitude goes to all of you who one way or another helped me keep going during the past years.

To my supervisors: Giorgos, thank you for offering me so much trust, support, and freedom since the very beginning. I always knew that you had my back and that you believed in my capacities. You have also taught me how to aspire to be a good researcher while not taking oneself too seriously. I think this is a very rare and valuable teaching, which will continue to guide me through this or other professional paths. If it weren't for all this, I'm not sure that I would have embarked into PhD and navigate it until the end (apologies for the cheap marine language). So, thank you. Santi, gràcies per ser-hi des d'abans dels inicis. Des d'aquell TFG premonitori (jo diria que prehistòric ja!) he tingut la sort de comptar amb tu com a mentor i amic durant els alts i baixos d'aquest llarg procés. T'agraeixo especialment la teva dedicació,

motivació, i interès sincer que has aportat al projecte i també la confiança que sempre has mostrat vers les meves capacitats com a investigador. De tu he après que el rigor i la passió intel·lectuals no han d'estar pas necessàriament renyides. Sempre he estat convençut que qualsevol bona recerca social s'ha de pensar històricament i em sento molt afortunat d'haver pogut comptar amb la teva ajuda per aplicar aquest principi a la tesis. I finalment, Miquel, gràcies especialment per la teva generositat. Et vas afegir en un moment que la tesis anava força a la deriva i no vas dubtar en oferir-nos tota la teva ajuda. Gàcies a tu la recerca s'ha pogut mantenir amb els peus a terra (o a l'aigua, més aviat) i jo he pogut endinsar-me encara més en el món marí i de la pesca. Por último, gracias a los tres por haberme guiado conjuntamente en un delicado equilibrio entre estimularme las ideas y conseguir que las acabe realizando adecuadamente y a tiempo. Para nada tarea facil!

Chrysanthi, seguramente eres la persona que más ha sufrido este doctorado y que más ha contribuido a que finalmente se pudiera terminar, aunque tu nombre no aparezca en ningún lado. Gracias por enseñarme tanto durante todo este tiempo. Y sobretodo, gracias por ayudarme a salir cuando me hundía en la oscuridad. Ha sido enormemente inspirador ver como seguías adelante pese a las dificultades, desarrollabas apasionadamente tu multitud de intereses (devorando libros como nadie) y a la vez disfrutabas de las cosas buenas de la vida. Desde mi más profunda admiración, gracias.

A la meva familia més propera: Adela, Joan, Irene, David (i el llarg llistat de membres no-humans) em sento enormement privilegiat d'haver pogut passar tot aquest temps aprop vostre. Sou la meva base, la meva llar i les meves arrels en aquesta vida. Mai us podré agraïr prou tanta estima i suport. Gràcies infinites.

Στην θετή μου οικογένεια στην Αθήνα: Μαρίκα, Ηλία, Μπέμπα, Τάμι. Ευχαριστώ παρά πολυ για ολα. Μου δώσατε ένα μέρος να αποκαλώ σπίτι και με φροντίσατε τις πιο δυσκολες ώρες. Υπάρχουν ελάχιστα μέρη σε αυτόν τον κόσμο όπου νιώθω τόσο άνετα και ήρεμα όσο όταν είμαι μαζί σας. Δεν μπορώ να σας ευχαριστήσω αρκετά που με υποδεχτήκατε με τόση γενναιοδωρία και αγάπη.

To my fellow travelers, friends and comrades in academia and beyond. Without you, working in this industry would be completely pointless. Thank you Nikolas for welcoming into the FLOATS crew and for introducing me to the world of thalassopolitics and maritime solidarity. To Irmak Ertör and Maria Hadjimichael thank you for being my blue degrowth comrades, confidants, and co-conspirators. Thank you to Kevin St. Martin for your valuable mentorship for warmly welcoming me at Rutgers, the Community Economies collective, the Indicators Research Group and the Blue Economy reading group. Gracias a Leonardo Calzada por el compadreo, por ser un anfitrión fantástico en New Brunswick y por compartir tus increíbles dotes estadísticas y de GIS conmigo. Thank you for the graduate students at Rutgers for the readings and discussions together: Jeffrey Immanuel, Dhruv Gangadharan, Sahithya Venkatesan, Tyler Young, and Arianna Lindberg. Thanks to Giacomo Parrinello for hosting me at the Centre for History of Sciences Po. Thank you to the fellow ICTA graduate students for having built a beautiful and supportive community together: Riccardo Mastini, Aljoša Slameršak, Finn Mempel, Alejandro Marcos Valls, Soledad Castro Vargas, Amalia Calderón Argelich, Ana Terra Amorim-Maia, Fulvia Calcagni, Austin Matheney, Annie James, Laura Pérez-Sanchez, Lucía Muñoz Sueiro, Lukas Barrero, Gemma Simón i Mas and the rest! Thank you to Federico Demaria for inspiring me to study ecological economics from a maritime perspective.

Gràcies a Marina Requena-i-Mora i Liliana Solé per la camaradería, la solidaritat i el suport entre investigadores joves precàries. Mil gracias Sole y Ale por ser mi Grupo de Soporte y de Emergencias Doctorales Varias. Moltes gràcies Amàlia per ajudar-me a passar les pantalles de l'ovodeposició doctoral. Gràcies a Sergio Ruiz Cayuela per introduïr-me a l'ecologia política i el decreixement fet a casa nostra. Un agraïment a Silvia Gómez Mestre pel companyerisme social marí i gironí. Gràcies a l'Ivan Murray pel suport i els ànims al llarg dels anys. Moltes gràcies a la gent del Departament de Geografia de la UAB que m'ha acollit, m'ha companyat o m'ha ajudat als inicis d'aquesta etapa de formació: Antonio Miguel Solana, Àngel Cebollada Frontera, Abel Albet i Mas, Asun Blanco, Carme Miralles, Antonia Casellas, Eduard Ariza i Oriol Nel·lo. Un agraïment a la gent de la Direcció General de Política Marítima i Pesca Sostenible

per la bona acollida i disposició vers la meva participació en els comités de cogestió pesquera. Gràcies Remy per acollir-me a casa teva durant la meva visita parisenca. Thank you to all the Research & Degrowth International comrades i a la gent de l'Ateneu Popular Sol Ixent de Banyoles per la ilusió de military junts. Gracias a Estrella y Antonio por enseñarme a cuidar de mi mismo. Agraïments i mil disculpes als amics que més he atabalat i més m'han ajudat en aquesta etapa doctoral: Álvaro, Anna, Ale, Albert, Aljosa, Annie, Ben, Brototi, Daniel, Enric, Eva, Finn, Gio, Hooman, Julia, Maya, Marc, Noam, Ossi, Pau, Pablo, Rubén, Sandra, Sole, Sergio, Nina, Yeray, Zeynep. I a tots els que m'he deixat però que hi haurieu de ser: moltes gràcies!

Àlex, aquest treball te'l dedico a tu. Espero poder aprendre de la teva perseverança, valentía, sensibilitat i saviesa.

Main acronyms and abbreviations

BE – Blue Economy
BG – Blue Growth
BDG – Blue Degrowth
CO2 – Carbon Dioxide
EBM – Ecosystem-Based Management
EE – Ecological Economics
EEZ – Exclusive Economic Zone
FAO – Food and Agriculture Organization
GDP – Gross Domestic Product
GENCAT – Generalitat de Catalunya
GHG – Greenhouse Gas
GWP – Global Warming Potential
IMO – International Maritime Organization
ISA – International Seabed Authority
IOC – Intergovernmental Oceanographic Commission
IPCC – Intergovernmental Panel on Climate Change
IPBES – Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPOS – International Panel for Ocean Sustainability
ITQ – Individual Tradeable Quotas
LNG – Liquified Natural Gas
NOx – Nitrogen Oxides
MSY – Maximum Sustainable Yield
OECD – Organization for Economic Co-operation and Development
PE – Political Ecology
PoB – Port of Barcelona
SCM – Supply Chain Management
SDGs – Sustainable Development Goals
SOx – Sulphur Oxides
SSF – Small Scale Fisheries
TEU – Twenty-foot Equivalent Unit
TURF – Territorial User Rights for Fisheries
UNCLOS – United Nations Convention on the Law of the Sea
UNCTAD – United Nations Conference on Trade and Development
WWF – World Wide Fund for Nature

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Chapter I: Introduction

1.1. Research objectives and background

Throughout history, the Ocean has enabled the flourishing and sustenance of human societies. The rise of capitalism and its global expansion during the last centuries have also relied on the increased use of ocean space and resources. The exponential growth in global economic activity since the 1950s has extended and intensified the exploitation and degradation of marine and coastal environments. Triggered by an alarming rate of ecological decline, the United Nations recently declared the Decade of Ocean Science for Sustainable Development (2021 – 2030) an attempt to reconcile economic development with environmental sustainability at sea through scientific knowledge and management. In this context, the blue economy has emerged as a dominant sustainability paradigm in ocean governance. Stemming from the sustainable development framework, the most usual conceptualizations of blue economy discourse assumes that economic growth is a necessary and desirable outcome for the well-being of marine ecosystems and coastal communities. Blue economy proponents foreground technological innovations, market incentives, marine spatial planning, techno-scientific management, and stakeholders dialogue, as enablers of ocean-based sustainable economic growth or 'blue growth.' A growing number of studies in the social environmental sciences are raising concerns and critiques of the contradictions and risks that the blue economy paradigm entails for generating socio-ecological well-being in marine and coastal environments. Despite the long tradition of critical engagement with the sustainable development paradigm and mounting evidence that current growth patterns are incompatible with ocean health, ecological economics scholarship has only partially addressed the emergence of the blue economy.

The overarching goal of this thesis is to investigate how the ocean acts as a conduit and barrier for notions and projects of growth. To this end, I offer theoretical and empirical insights into how and why the sea has both enabled and limited the expansion of social metabolism and the construction of growthist imaginaries and discourses. In the context of an increased interest in governance and sustainability

arenas for the Ocean, this question has become ever more pertinent. My doctoral research can be inserted into a wider context of renewed interest in the sea, both as a space for environmental conservation and as a frontier for economic expansion. I ask, how does the Ocean work both as a conduit and a barrier for notions and projects of growth? Unlike the modelling approach of the original Limits to Growth report, my objective is to provide an in-depth analysis of the social, economic, and cultural conditions that give rise to or limit ocean-based growth imaginaries and projects.

Focusing on the northwestern Mediterranean, a biodiversity rich region with a historically high concentration of maritime and coastal activities that is becoming a leading region in the promotion and development of the blue economy, I attempt to answer this question by looking at the relation between the sea and the a) the Great Acceleration, b) the growth imperative, and c), and the limits to growth. Based on a historical overview of the notions and projects of growth behind the development of maritime industries in the Spanish Mediterranean, together with ethnographic work carried out on two case studies on the contemporary shipping and fishing industries, I show how both the materiality and the social construction of the Ocean have generated growth imaginaries, as well as collective self-limitation projects that are distinct from those on land. Drawing on insights and methodologies from political ecology, ecological economics, and environmental history, this thesis links marine sustainability concerns with debates in emerging degrowth studies. The results of this dissertation highlight the need to move beyond terra-centric perspectives in degrowth research and promote a blue degrowth sustainability paradigm in Ocean governance.

In the subsequent sections, I articulate the thesis' research questions as part of a recent shift in the social sciences and humanities towards adopting ocean-centered perspectives in the study of environmental change. Building on the epistemic approach characteristic of the Barcelona School of Ecological Economics and Political Ecology (Villamayor-Tomas et al., 2023), I engage with questions of marine sustainability by paying special attention to their political and historical dimensions while framing them within the wider social-metabolic processes that drive environmental change. Following this framework, I address the limits to growth debate, a seminal topic in degrowth scholarship (Kallis et al., 2018), by critically examining the historical, cultural, social, and political forces that have made economic growth a dominant objective for ocean

governance and marine sustainability. On the one hand, I mobilize theories of degrowth as a critical tool for examining the construction of imaginaries and projects of ocean-based economic growth and exploring their social and environmental limits. On the other hand, I engage with degrowth scholarship's attentiveness to existing knowledges and practices that foreground social and environmental well-being beyond or despite the growth imperative. In this sense, I draw from the literature on diverse economies in my reading for difference in the everyday workings of blue economy actors. As explained further in the theoretical section, I use the concept of limits as a hermeneutical device both for the critical analysis of the sustainable ocean economy and for a generative exploration of alternative ways of relating to the sea that foreground community well-being and environmental sustainability.

Prior to describing the thesis' theoretical and methodological basis in more detail, I situate the relevance of the research questions in the context of recent developments in the marine sustainability and ocean governance arenas. As scientific evidence on the rapidly declining health of the Ocean has been increasing in the last decade, intergovernmental bodies and international environmental organizations have tried to raise awareness of the centrality of marine systems in sustaining life on the planet, including human societies and their economies, and warn of the dangers of their destabilization or destruction. Simultaneously, different institutional actors from the governance, business, finance, and sustainability spheres have been promoting interest in the untapped economic potential of the Ocean, reinvigorating the well-established oceanic frontier paradigm, and actualizing it under the sustainable development framework. In the following section, I trace how both developments–the rise of environmental concerns and the push for economic expansion–have coalesced into the emergence of the blue economy narrative, which is rapidly becoming the predominant economic policy framework for marine sustainability and ocean governance.

1.1.1. The Planet Ocean

The view of Earth from outer space makes evident a reality that often goes unnoticed: We live on a blue planet. The ocean occupies 70% of its surface area, and accounts for 90% of the habitable volume of the biosphere. Since 2009, the United

Nations has celebrated June 8 as World Ocean Day to educate the public about the crucial role it plays in life support systems on the planet and to raise awareness of the need to protect it. It is difficult to overstate the importance of the sea for the functioning of the biosphere, which regulates the global climate and contains 97% of the planet's water, enormous biodiversity, much of which is still unknown to science, as well as practically all the living mass and metabolic activity of the biosphere. Therefore, it is not surprising that from scientific knowledge, through different worldviews, ancestral cultures, and popular knowledge, the sea is recognized as a primordial source of life and the heart of the planetary organism. In one way or another, most human societies have historically relied on the ocean for the production and reproduction of their material conditions of life as well as their imaginaries and worldviews (Abulafia, 2020; Gillis, 2012; McPherson, 1997; Paine, 2014). They have done so through intricate socio-metabolic relationships that have, in turn, generated a multiplicity of social formations, collective identities, cultural expressions, epistemologies, and worldviews (Cohen, 2021; Demuth, 2019; Malinowski, 2014; Reid, 2015). More specifically, the Ocean is fundamental to the economic reproduction of human societies, and millions of people depend on it for adequate nutrition. Globally, coastal communities around the world base their livelihoods on marine and coastal ecosystems, and almost half of the world's population lives less than 100 km from the coast. Approximately 90% of international trade by volume circulates through shipping, and more than a quarter of all hydrocarbons consumed by the fossil economy are extracted from the seabed. On the other hand, the sea has become a global landfill for industrialized societies, and apart from the enormous amounts of waste (especially plastics) and polluted water that end up there daily, the Ocean waters capture a third of carbon dioxide emissions, and it is estimated that in the last 50 years, they have stored 90% of the excess heat produced by greenhouse gas emissions (drastically mitigating its destabilizing effects on the weather).

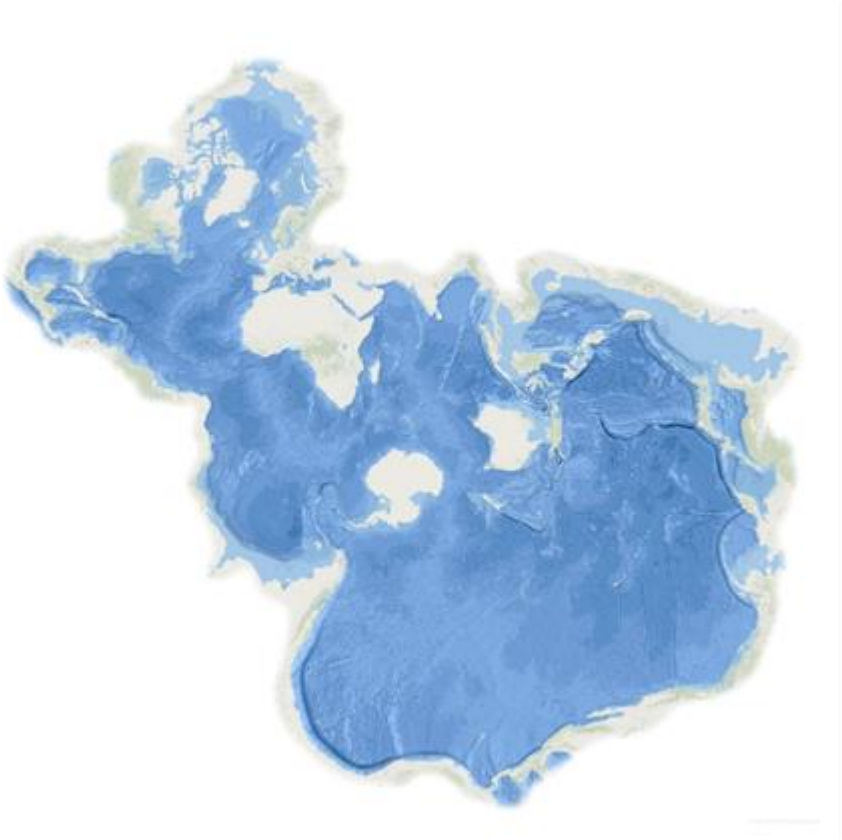

Figure 1. Spilhaus map

Source: https://nation.maps.arcgis.com/home/item.html?id=9b2ce7c8179b4744af7bf3ddb86b7804

According to the United Nations Environment Programme's Global Environment Outlook 6, the Ocean faces numerous challenges such as overfishing, pollution, habitat destruction, and climate change (UN Environment, 2019). These factors have led to a decline in the marine biodiversity and ecosystem health. The Intergovernmental Panel on Climate Change's Special Report on the Ocean and Cryosphere in a Changing Climate highlights the impacts of climate change on marine systems, including rising sea levels, ocean acidification, and changes in ocean currents (IPCC, 2019). The intensification and accumulation of multiple anthropogenic pressures have pushed the ocean towards a deep and multidimensional ecological crisis. According to Halpern et al. (2019), cumulative impacts have increased significantly in 60% of the global ocean over ten years, resulting in widespread and accentuated degradation of marine ecosystems and their collapse in some cases. Research has shown that global economic growth is behind the expansion and intensification of environmental impacts, both on land and at sea, of which affluent

countries are disproportionally responsible (Fanning et al., 2022; Haberl et al., 2020; Hickel, 2020; Hickel et al., 2022; Krausmann et al., 2009; Otero et al., 2020; T. Wiedmann et al., 2020; Wiedmann et al., 2015). Central to this discussion is the concept of economic growth, commonly measured by gross domestic product (GDP). Growth charts a yearly increase in monetized activities, often sidelining accompanying social and environmental costs. The inherent design of capitalist economies demands consistent 2-3% annual GDP growth to stave off political and economic instability (Kallis, 2018; Piketty, 2017). This relentless pursuit of yearly economic growth, although seemingly modest, compounds exponentially and exacerbates the negative social and environmental consequences of the capitalist accumulation process. During the second half of the 20th century, such impacts raised exponentially as the "Great Acceleration" took off —a monumental surge in socio-environmental change which significantly impacted the Earth systems (McNeill & Engelke, 2014; Steffen et al., 2015, 2018). Consequently, the Ocean grapples with rising temperatures, acidification, and habitat destruction, driving sustainability scientists to caution that the rapid growth of economic activity threatens the health of ecosystems and the well-being of the people that depend on them (Lenton, 2013; Nash et al., 2017; Otero et al., 2020; Richardson et al., 2023; Wiedmann et al., 2020).

The escalating degradation of ocean systems and emerging concerns regarding future environmental threats have increased public awareness of the importance of marine sustainability (Gelcich et al., 2014; McKinley et al., 2023; Pecl et al., 2022). In response to this awareness, leading ocean governance institutions have recognized that the interactions between marine processes and human activities are not sufficiently understood to achieve sustainable outcomes (Gaill et al., 2022; Mieszkowska et al., 2014; Pittman et al., 2021). Faced with growing challenges throughout the world's seas and coasts, ocean research and governance bodies are seeking new approaches to marine sustainability that can account for and address the deepening and complexity of the unfolding socio-ecological crises at sea (Brodie Rudolph et al., 2020; Cavaleri Gerhardinger et al., 2023; Pecl et al., 2022). This heightened awareness has catalyzed collaborative endeavors among various institutions to advance interdisciplinary and ground-breaking research and policies on marine sustainability. For example, in 2017, the United Nations General Assembly

declared the period from 2021 to 2030 to be the Decade of Ocean Science for Sustainable Development. The main objectives of the Ocean Decade, as outlined by UNESCO's Intergovernmental Oceanographic Commission (IOC), include creating a shared understanding of the state, potential, and future challenges of the Ocean for sustainable development (UNESCO, 2023). The Decade aims to improve the connection between ocean science and society while underscoring the importance of an interdisciplinary and inclusive approach (Claudet et al., 2020; Guan et al., 2023; Ryabinin et al., 2019). To that end, the incorporation of the social sciences is considered key to providing a more nuanced understanding of the human-ocean relationship, bridging the gap between science and policy, and helping to inform the design of sustainable and equitable ocean governance (McKinley et al., 2022; Popova et al., 2023; van Putten et al., 2021). In alignment with the Sustainable Development Goals (SDGs), the Decade for Ocean Science promotes marine conservation, sustainable growth, and a greater societal respect for and understanding of the Ocean (UNESCO, 2023).

Although the Ocean Decade is a relatively new development, the UN system has had a longstanding commitment to governance and protection of the marine environment. For instance, the IOC already declared 1998 the International Year of the Ocean, whose main rationale stated that "The oceans and all seas and adjacent coastal areas form an integral whole that is an essential component of the global life-support system and a positive asset presenting opportunities for sustainable development, if adequately managed on the basis of scientific knowledge, and the respect of the laws of nature and taking into account the legitimate interests of the human societies concerned" (UNESCO, 1993). Most importantly, the establishment of the 1982 United Nations Convention on the Law of the Sea (UNCLOS) laid the foundation for contemporary global ocean governance. As an international treaty, UNCLOS is considered a significant milestone in the development of the modern international law of the sea and the sustainable oceanic development paradigm (Joyner & Martell, 1996; Spalding & Ycaza, 2020; Stephens, 2022). The treaty provides a comprehensive legal framework that sets out the rights and obligations of states in relation to Ocean use and management, covering various aspects, such as territorial waters, exclusive economic zones (EEZs), the continental shelf, navigation rights,

marine scientific research, and the protection of the marine environment. Diplomatic efforts leading up to UNCLOS sought to balance the rights and interests of coastal states over marine resources and space with the freedom of navigation and the interests of powerful economic and geopolitical actors (Finley, 2011; Hannigan, 2016; Zalik, 2015). The intellectual and geopolitical history of UNCLOS is too large and complex to be analyzed here in detail.[1] For the purpose of this thesis, UNCLOS is relevant to the two main oceanic imaginaries it articulates: the Ocean as a global commons and the Ocean as an economic frontier. These are the most salient imaginaries in oceanic sustainability development rhetoric, prevalent from its earliest articulations in the mid-twentieth century to the latest ones, such as the Blue Economy.

1.1.2. From global commons to economic frontier

The production and reproduction of dominant oceanic imaginaries is a historically contingent socially constructed phenomenon (Steinberg, 2001). People's relationships with the sea have been understood, imagined, and represented differently across time and space as well as throughout the intellectual history of Western societies (Cohen, 2021; Gee, 2019; Rock et al., 2019). However, in specific contexts such as ocean governance and marine sustainability arenas, some imaginaries tend to predominate. Here, I draw on Appadurai's (1990) understanding of the imagination as an organized field of social practices and Castoriadis' definition of imaginaries as collective and socially constructed frameworks that function as shared understandings and interpretations shaping and guiding human behavior and social organization (Castoriadis, 1994; Castoriadis & Arnason, 2015). Following recent work on social and environmental imaginaries (Adams et al., 2015; Davoudi & Machen, 2022; S. Jasanoff & Kim, 2015; Kaşdoğan, 2020), I argue that ocean imaginaries are key elements shaping the understanding and interaction between people and the sea. The 'ocean as a global commons' and of the 'ocean as an economic frontier' although seemingly contradictory

[1] For further reference, check (Campling & Colás, 2021; Hannigan, 2016; Peters et al., 2022; Steinberg, 2001)

imaginaries, often appear together in ocean governance and marine sustainability mainstream policy frameworks and discourses, such as the UNCLOS and the SDGs. Owing to the connectivity of its biogeochemical systems, its fluid nature, and the difficulty of territorializing and controlling it, the Ocean has widely been referred to as the great global commons, particularly the areas beyond national jurisdiction, also known as the high seas, which encompass the majority of the Ocean space, both in surface and volume (Feichtner & Ranganathan, 2019; Joyner & Martell, 1996; «The Ocean Transition», 2020; Wijkman, 1982). In international law, most of the ocean is thought to be a shared resource that belongs to all of humanity and should be managed collectively for the benefit of the present and future generations (Constantinou & Hadjimichael, 2020; Pontecorvo, 1974; Schrijver, 2016). The intellectual history of the Ocean as a global commons idea in international law has a long trajectory, going back at least to Hugo Grotius' Mare Liberum (Free Seas) doctrine. The early modern Dutch philosopher and jurist established the seas to be international territory; henceforth, all nations were free to use it for seafaring trade.[2] A similar perspective is reflected in the UNCLOS designation of the seabed beyond the EEZ the "common heritage of mankind," a concept that has been revived in recent negotiations on developing the treaty on the biodiversity conservation of areas beyond national jurisdiction (*UN News*, 2023; Blasiak et al., 2017; Gjerde et al., 2016; Santos et al., 2022).

The 'Ocean as global commons' imaginary found in contemporary marine sustainability and governance discourses goes beyond the jurisdictional aspect in including an ecological conception about the key role that ocean systems play in supporting life on Earth and providing human societies with a myriad of ecosystem services (Halpern et al., 2012; IPCC, 2022; Malone et al., 2014; Sandifer & Sutton-Grier, 2014). Additionally, this ecological perspective is linked to the warning that ocean systems are in trouble and require management (Claudet et al., 2020; Duarte et al., 2018; Guan et al., 2023; Halpern et al., 2019; Nash et al., 2017; Ryabinin et al., 2019). However, as Steinberg points out (1999), such an imaginary is not particularly novel and

[2] *The sea is common to all, because it is so limitless that it cannot become a possession of anyone, and because it is adapted for use by all, whether we consider it from the point of view of navigation or fisheries.* (Grotius, 1609)

can already be found in the oceanic concerns expressed in the beginnings of the sustainable development discourse of the 1990s. For instance, the 1992 Earth Summit's Agenda 21 emphasized the conservation and sustainable use of marine resources and, according to Steinberg, the International Year of the Ocean was designed to place the world ocean within the discourse of sustainable development. Hence, the sustainable development discourse advances the imaginary of the Ocean as an ecological global commons in crisis that requires comprehensive techno-scientific management and planning. Even if there is compelling evidence that economic growth drives global environmental damage, the sustainable development paradigm encourages economic frontier imaginaries by exploring the growth potential of sociotechnical breakthroughs and the integration of natural capital into the market economy (Banerjee, 2003; Buller, 2022; Fletcher, 2023). Researchers have long pointed out several contradictions and inconsistencies in the sustainable development idea arising from its conceptual vagueness and instrumental use by powerful political and economic actors due to the expediency of the term in governmental and scientific institutions (Caradonna, 2017; Mebratu, 1998; Ruggerio, 2021). One such contradiction is the usual incorporation of economic rationality as the guiding principle of natural resource management and environmental protection in sustainable development frameworks, which legitimizes and promotes the growth imperative and its entrenched expansionary and extractive tendencies (Banerjee, 2003; Demaria et al., 2023; Kaul et al., 2022; Luke, 2005). Indeed, the degrowth scholarship is based upon a critique of the sustainable development paradigm as a colonial enterprise for universalizing capitalist modernity as the ultimate benchmark of progress (Demaria & Kothari, 2017; Escobar, 2015; Kothari et al., 2019; Latouche, 2009).

In the context of mainstream marine sustainability and ocean governance discourse, the uncritical assumption of the sustainable development paradigm has resulted in the incorporation of widespread imaginaries about the Ocean as an economic frontier. Although they are currently experiencing a resurgence, such imaginaries proliferated back in the 1950s and the 1960s, coinciding with the takeoff of the Great Acceleration and golden age of capitalist growth (McNeill & Engelke, 2016; Rozwadowski, 2019; Schmelzer, 2016). Partly the result of the geopolitical tensions of the Cold War era, and the economic competition and technological innovation it

entailed, the sea became fertile ground for the opening of new scientific and economic frontiers (Camprubí, 2020; Doel et al., 2006; Martínez-Rius, 2020). The development of technologies such as sonar and scuba, as well as the popularization of the first underwater films, pushed oceanic frontier imaginaries even to the point of visions of human colonization and urbanization of the sea[3] (Rozwadowski, 2019). Ocean historian Helen Rozwadowski shows how the popularization of the cornucopian visions around the expansion of the US western frontier[4] in the early twentieth century also inspired post-war oceanic frontier imaginaries, subsequently influencing the articulation of the UN's Law of the Sea (Rozwadowski, 2023). In her words, "The ocean frontier metaphor contributed to the formation of an international legal regime for the sea predicated on the anticipation of virtually limitless wealth, enabled by novel science and technology to flow from the depths' (p.3). Notably, Malthusian fears of overpopulation and natural resource scarcity stimulated most post-war frontier imaginaries of the Ocean: humanity's expansive enterprise could overcome the constraints of terrestrial environmental limits by going to sea and taking hold of the marine cornucopia.[5]

As will be further discussed in Chapter II, the Blue Economy paradigm leverages this ingrained frontier metaphor by linking it with the previously mentioned Ocean as ecological commons imaginary. Henceforth, the blue economy as a marine actualization of the sustainable development paradigm positions the ocean as a new economic horizon in a particular way—a realm in which economic expansion and environmental conservation coexist harmoniously. The naturalization of the linkage between the two visions is clearly summarized in the OECD's report on The Ocean Economy in 2030:

"For many, the ocean is the new economic frontier. It holds the promise of immense resource wealth and great potential for boosting economic growth,

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3 Popular fascination with the sea in modern western cultures precedes the development of these technologies, as in the case of the popularization of Jules Vernes' novels. However, the hyped vision of a fully colonized and industrialized Ocean is arguably a mid-twentieth cultural phenomenon.

4 In reference to the work of historian Frederick Jackson Turner and his famous 'Western Frontier' thesis

5 "Obviously man must enter the sea. There is no choice in the matter. The human population is increasing so rapidly, and land resources are being depleted at such a rate, that we must take sustenance from the great cornucopia" [Jacques Cousteau, The Silent World (1953), quoted in Rozwadowski (2019)].

employment, and innovation. And it is increasingly recognized as indispensable for addressing many of the global challenges facing the planet in the decades to come, from world food security and climate change to the provision of energy, natural resources, and improved medical care. While the potential of the ocean to help meet these challenges is huge, it is already under stress from over exploitation, pollution, declining biodiversity, and climate change. Realizing the full potential of the ocean will therefore demand responsible, sustainable approaches to its economic development."

(OECD, 2016)

1.1.3. The emergence of the Blue Economy paradigm

In the context of secular stagnation, ecological breakdown, and resource depletion, the Ocean's vast imagined untapped wealth is becoming increasingly central to the various strategies of capitalist economies aimed at realizing its potential for sustainable economic growth. By merging the oceanic ecological commons and the oceanic frontier imaginaries, the blue economy advances a new vision of the sea, in which it plays a crucial role in resolving humanity's most pressing social and environmental issues. A number of international organizations, financial institutions, think tanks, and environmental non-governmental organizations (eNGOs) have promoted the concept of "blue economy" and "blue growth" in recent years to illustrate how ocean resources and maritime industries currently play a key economic role and can be used to its full potential in the future (Louey, 2022; Morrissey et al., 2022; Voyer et al., 2018; Winder & Le Heron, 2017). The term blue economy appeared internationally in 2012 at the United Nations Conference on Sustainable Development Rio+20, where it was articulated as a marine version of the already more established terms of green economy or green growth. As with the sustainable development paradigm from which it derives, the blue economy is characterized by being conceptually vague but highly expedient in governmental, scientific, and business circles (Silver et al., 2015; Voyer et al., 2018). According to its proponents, sustainable and increased use of the ocean's vast natural assets and ecosystem services can be achieved by utilizing new technologies, market forces, and technocratic regulation, resulting in an increase in global economic growth (FAO, 2018; OECD, 2016, 2019; The Economist, 2015; World Bank, 2019; WWF, 2015). Although there is no consensus regarding which sectors of the ocean economy are

deemed to have sustainable growth potential[6], generally speaking, blue economy proponents call for the sustainable development of established and emergent maritime and coastal industries such as shipping, aquaculture, renewable energy, tourism, and biotechnology (Hadjimichael, 2018; Morrissey et al., 2022). Overall, the aim of blue growth is to bring "win-win-win" solutions beneficial to the main stakeholders in the ocean's future: coastal communities, businesses, and the environment (Barbesgaard, 2018).

In this context, marine sustainability and ocean governance bodies seek new ways of approaching socio-ecological issues at sea, which are growing in frequency, seriousness, and complexity; all-encompassing and solution-oriented paradigms, such as the blue economy, become highly attractive. This explains why the blue economy has gained significant traction in governance, business, NGOs, and scientific arenas, where it is commonly framed as the maritime implementation of the UN's Sustainable Development Goals (SDGs) through a combination of Goal 14 (life below water) and Goal 8 (decent work and economic growth). As the growth of the ocean economy is increasingly acknowledged by governments as a strategic priority, as evidenced by national plans and policies, the blue economy has become the dominant sustainable development framework in marine space.

However, emerging research has warned of the danger of adopting a development paradigm that could exacerbate the present unsustainable tendencies of the ocean economy (Barbesgaard, 2018; Bennett et al., 2021; Childs & Hicks, 2019; Ertör & Hadjimichael, 2020). For instance, social scientists have analyzed how the vague definition of the blue economy lends itself to varying interpretations, depending on the particular interests and epistemes of actors using the term (Voyer et al., 2018). In a context in which the global ocean governance regime tends to emphasize economic growth over any other socioecological objective (Jacques & Lobo, 2018), mainstream blue economy discourses are more likely to prioritize growth and extraction over environmental or equity concerns (Louey, 2022). In addition, scholars have noted that the uncritical assumption of the growth imperative in hegemonic blue economy visions

[6] capture fisheries, seabed mining, or offshore hydrocarbon extraction are contentious candidates.

contradicts the purported aims of ecological sustainability and social well-being (Brent et al., 2020; Ertör & Hadjimichael, 2020; Hadjimichael, 2018; Nogué-Algueró, 2020). These arguments are based on empirical evidence demonstrating that the acceleration of economic activity has socio-ecological impacts that cannot be solved solely through efficiency gains and technological improvements (Haberl et al., 2020; Hickel & Kallis, 2019; Moranta et al., 2022; Otero et al., 2020; Sorman, 2023; Wiedmann et al., 2015).

1.2. Theoretical Framework

In this dissertation, I conceptualize the sea as a key space in the reproduction of global social metabolism. On the one hand, the Ocean has facilitated the transgression of social and environmental limits to the unfettered development of capitalist productive forces, both as a surface for trade flows and a site for the appropriation of marine nature and exploitation of labor (Barbesgaard, 2023; Longo et al., 2015; Wallerstein, 2011). On the other hand, the sea has defined processes of territorialization and enclosure, difficulting management and control, and limiting the capacity of the growth imperative to take hold (Campling & Colás, 2021; Rozwadowski, 2019; Steinberg, 2001). In framing the Ocean as the paradigmatic liminal space of social metabolism, I intend to mobilize the idea of limits as an analytical device for the critique of the blue economy paradigm and as a generative concept for exploring alternative ways of relating to the sea that foreground community well-being and environmental sustainability without growth. I do not consider liminality as an inherent condition or property located in the biophysical characteristics of the sea but rather as arising from the co-constitutive interaction of human action and agency with the marine environment (Kallis, 2019; Mehta, 2013; Norgaard, 1995). The sea is boundless, mighty, limited, and fragile, depending on what it is expected from it and how it is treated. As a small-scale fisher stated, commenting on how the richness and vastness of the sea was relative to human desire: “the sea is what it is. It decides what and when to offer it. If you ask too much of it and do not let it rest, you will destroy it’ (Chapter IV, page 115). The materiality of the sea and the limits co-evolved through human activity have produced specific forms of political and legal frameworks and imaginaries (Hannigan, 2016; Rozwadowski, 2023; Zalik, 2018) solidarity politics (Kosmatopoulos, 2019; Rediker, 1989), community economies (Martin,

2005; St. Martin et al., 2007) and ontologies (Pannell, 1996; Peters et al., 2018; Reid, 2015; Steinberg & Peters, 2015) among many other socioeconomic and cultural phenomena.

Additionally, I theorize about recent developments in marine sustainability and ocean governance within the larger political economy of the social metabolic processes behind the reproduction of human societies. In recent decades, the impact of economic activities on the entire biosphere has increased at an unprecedented speed and scale (McNeill & Engelke, 2014; Richardson et al., 2023; Steffen et al., 2015). This acceleration of social metabolism – the exchange of energy and materials between human societies and their environment – responds to the logic of capital accumulation, which in its constant search for profit needs to increase and accelerate economic activity (Krausmann, 2017; Martinez-Alier et al., 2010; Molina & Toledo, 2014). As the social and environmental costs of the acceleration of global social metabolism become more apparent and as the capitalist systemic imperative to grow remains a societal goal, the need to find solutions that conciliate economic growth and socio-ecological sustainability becomes increasingly urgent. To this end, leading intergovernmental bodies, financial institutions, industrial lobbies, economic think-tanks, and some environmental organizations have been promoting new iterations of the sustainable development paradigm, such as the twin concepts of a 'green economy' and 'green growth,' which argue that technological innovation, market incentives, and techno-scientific management can reconcile economic growth with environmental conservation and community well-being (Barbier & Markandya, 2013, 2013; Hickel & Kallis, 2019).

Critical social scientists have pointed out how hegemonic blue economy projects and discourses tend to reflect the preeminence of capitalist dynamics and goals, such as the imperative of economic growth and increased commodification of nature (Louey, 2022; Mallin & Barbesgaard, 2020; Midlen, 2021). Researchers have analyzed how the blue economy works as a 'fix' to capitalism's internal contradictions (Brent et al., 2020), leading to processes of Ocean grabbing and dispossession (Barbesgaard, 2018; Bennett et al., 2015; Ertör, 2021). Moreover, in the context of the increasing financialization of the ocean economy, researchers have noted how the blue economy and blue growth

also work as attractive investment-institutional projects (Christiansen, 2021; Winder & Le Heron, 2017). According to these researchers, oceanic imaginaries of the global commons keep being reconfigured into visions of the vast economic frontier in ocean sustainability and governance discourses, transforming marine spaces into new opportunities for economic capital accumulation and economic expansion (Barbesgaard, 2023; Knott & Mather, 2021; Louey, 2022; Zalik, 2018). In addition, the blue economy can also be understood as an emergent socio-technical imaginary, defined by Jasanoff & Kim (2015) as "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology"(p. 4). Similar to Beckert's understanding of capitalist "fictional expectations" (2016), sociotechnical imaginaries play a significant role in influencing the direction of technological development and shaping public policies and practices. However, these imaginaries are not static, but rather dynamic and subject to negotiation and contestation (Jasanoff, 1987), which opens the space for intervening towards alternative and emancipatory socioecological imaginaries.

In the following section I situate the theorization of the human relationship with the Ocean and the dominant sustainability and governance paradigms within different bodies of literature and schools of thought in which I engage throughout the dissertation. Although each empirical chapter has its own theory section and review of the literature, here I will synthesize the main theoretical approaches used in the research and address how they relate to each other, to the research questions posed, and the research methods used. As explained further, I engage with questions of marine sustainability by paying special attention to their political and historical dimensions while framing them as components of the wider social-metabolic processes of reproduction in human societies. I revisit the limits to growth debate, a seminal topic in the degrowth scholarship, from a marine perspective and by critically examining the cultural, social, and political forces that have made economic growth a dominant objective for marine sustainability and ocean governance. Moreover, I mobilize key degrowth theories both as a critical tool for examining the construction of imaginaries and projects of ocean-based economic growth and for exploring their social and

environmental limits. Finally, I draw from degrowth scholarship's attentiveness to already existing knowledges and practices that foreground social and environmental wellbeing alternatives beyond or despite the growth imperative and I put them in dialogue with the diverse economies literature in my reading for difference in the everyday workings of blue economy sectors.

1.2.1. Thalassology, the Barcelona School and Degrowth

The thesis is situated within a recent shift in the social sciences and humanities towards adopting ocean-centered perspectives in the study of environmental change, sometimes referred as the 'oceanic turn.' This turn signifies a transition toward integrating social scientific research into the study of marine and coastal environments (McKinley et al., 2022; Meo et al., 2021; Popova et al., 2023; van Putten et al., 2021). Such multidisciplinary approach acknowledges the significance of understanding the human elements of these ecosystems and emphasizes the necessity of incorporating a plurality of knowledge systems and perspectives to develop effective analyses and governance of marine and coastal environments (Brodie Rudolph et al., 2020; Cavaleri Gerhardinger et al., 2023; Gaill et al., 2022; Winther et al., 2020). Much of this research is motivated by the calls of the UN Ocean Decade, which aims to improve the connection between ocean science and society in which the incorporation of social sciences is considered key to providing a more nuanced understanding of the human-ocean relationship, bridging the gap between science and policy, and helping to inform the design of sustainable and equitable ocean governance (Claudet et al., 2020; Guan et al., 2023; Ryabinin et al., 2019).

Although many researchers in the social sciences and humanities have previously engaged with the Ocean as a site of inquiry and analytical standpoint, their work has generally been less voluminous and prominent compared to their land-based counterparts. This explains why the current surge in interest in the Ocean in social sciences and humanities is understood as a recent phenomenon. However, an established field of scholarship has long privileged the marine from a terrestrial perspective in the study of social and environmental change within the social sciences and humanities. In chapter IV, I engage with an important segment of this literature,

such as fisheries social science work (Arbo et al., 2018; St. Martin, 2001, 2005; St. Martin & Olson, 2017) and research on the governance of marine commons[7] (Berkes, 1985; Pontecorvo, 1988; McCay and Jentoft, 1998; Acheson, 2014; Armitage et al., 2017). I include such Ocean-centric perspectives within the 'thalassology' tradition. Although its origins are mostly situated in the historiographical scholarship (Horden & Purcell, 2006),[8] here I use the term of 'thalassology' more broadly in defining the intellectual approach that casts aside traditional land-centric narratives and puts the ocean center-stage in explaining socio-ecological phenomena. Derived from the Greek word "thalassa," meaning sea or ocean, thalassology's main thrust is advancing a comprehensive understanding of the pivotal role oceans have played in shaping human societies, economies, cultures, and environments. I position my primary theoretical orientation towards the sea within the ambit of this transdisciplinary corpus of work, which I conceptualize as extending beyond the exclusive emphasis on maritime concerns, but rather prioritizing the oceanic perspective in the understanding of social and environmental change (Anderson & Peters, 2014; Campling & Colás, 2021; Gillis, 2015; Kosmatopoulos, 2019, 2023; Reid, 2015; Rozwadowski, 2019; Steinberg, 2001).

My research is also rooted in the epistemic tradition of the Barcelona School of Ecological Economics (EE) and Political Ecology (PE) (Villamayor-Tomas et al., 2023), an interdisciplinary approach developed by researchers at the Institute of Environmental Science and Technology, Universitat Autònoma de Barcelona (ICTA-UAB). Villamayor-Tomas et al. (2023) identify three main aspects that work as bonding elements of the Barcelona School: (i) a special attention to the biophysical dimension of the economic system (ii), an interest in the political and historical aspects underlying the environmental performance of contemporary capitalism (iii), and an emphasis on the study of alternative ways of knowing, valuing, and organizing social life (p.17). As will be shown throughout this dissertation, the theoretical approach of the research is

[7] 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).

[8] with classic works such as Fernand Braudel's work on the Mediterranean, K.N. Chaudhuri's work on the Indian Ocean and Marcus Rediker and Paul Gilroy's work on the Atlantic

articulated around these three aspects. First, special attention is given to the Ocean and its materiality in the reproduction of global social metabolism; second, the political and historical aspects of ocean-based capitalist growth are analyzed; and finally, alternative ways of relating and living in the sea are explored. This dissertation is a significant addition to the work of Barcelona School, as its contributors have rarely addressed marine issues.[9]

Indeed, both EE and PE have had limited engagement with the marine realm, although this is a truer statement for the former than the latter, which has in recent years seen a remarkable increase in publications on marine and coastal issues (Bennett, 2019). Indeed, despite the few pioneering works of Robert Costanza in the 90s (Costanza, 1999; Costanza et al., 1997, 1999), EE-oriented works on the Ocean have been rare[10] and most relevant work has been in the field of environmental economics (Lillebø et al., 2017; Sumaila, 2021; Sumaila et al., 2011). Although EE is supposed to challenge the mainstream economic paradigm by incorporating heterodox features such as the open systems perspective, value pluralism, transdisciplinarity, and radical criticism of the conventional representation of economic processes (Carpintero, 2013; Martinez-Alier, 2013; Spash, 2017), much of the EE works on the ocean focuses on monetary valuation and natural capital analysis.

PE, on the other hand, has had a richer engagement with various aspects of marine sustainability issues, such as the power dynamics involved in ocean management and governance; the use of narratives, knowledge, and scale to legitimize and shape policies and management efforts; the impact of historical events on present-day circumstances, options, and practices; and the existence of inequities and environmental injustices in the marine environment are all important considerations (Bennett, 2019). As an analytical approach that considers the sociopolitical processes structured within hierarchical political economies and discourses, and emphasizes the

[9] An important exception is the work of Irmak Ertör (Ertör, 2021; Ertör & Ortega-Cerdà, 2017; Ertör & Ortega-Cerdà, 2018; Ertör-Akyazi & Ertör, 2022; Scheidel et al., 2021)

[10] Some notable exceptions exist such as (Bailey et al., 2022; Patterson & Glavovic, 2013; Sabau, 2019) and the edited book "Ecological Economics of the Oceans and Coasts" edited by Patterson & Glavovic in 2008

study of power relations in the distribution of environmental goods and bads (Perreault et al., 2015; Robbins, 2012), ocean-centered PE research has touched upon property relations, power inequities, and systemic pressures toward privatization, competition, and accumulation as key drivers of resource exploitation, environmental transportation, and ecological decline at sea (Andriamahefazafy & Kull, 2019; Boucquey, 2019; Campling et al., 2012; Carse & Lewis, 2017; Childs & Hicks, 2019; Longo et al., 2015).

Finally, this thesis is strongly influenced by the Barcelona School's challenge to the economic growth paradigm, challenging the prevalent ideas that growth is necessary and desirable for societal and environmental well-being, and highlighting the need for alternative models that prioritize ecological sustainability, economic democracy, and social justice (Villamayor-Tomas et al., 2023). Degrowth is one such alternative that directly challenges the hegemony of economic growth as a social objective and argues for radical societal change that limits economic expansion and redistributes wealth as a way to achieve sustainability and well-being (D'Alisa et al., 2015; Demaria et al., 2013; Kallis & March, 2015). In capitalist societies, the growth paradigm is so deeply ingrained that it is viewed as a natural, inevitable, and desirable process (Kallis et al., 2018; Koch & Buch-Hansen, 2021; Schmelzer, 2015). As the growth ideology also pervades marine sustainability and ocean governance circles, a few researchers have advanced the idea of articulating a "blue degrowth" (BDG) counter-paradigm (Ertör & Hadjimichael, 2020; Hadjimichael, 2018). The emergent BDG scholarship, to which this thesis belongs, aims to scrutinize the dominant, growth-oriented blue economy paradigms to expose the challenges, contradictions, and risks in their uncritical assumptions by marine sustainability and ocean governance bodies (Brent et al., 2020; Carver, 2020; Ertör & Hadjimichael, 2020). Research on BDG draws inspiration from ocean-based environmental justice movements, community economies, and emancipatory socioecological imaginaries in an effort to build alternatives to dominant growth-oriented paradigms (Bogadóttir, 2020; J. Childs, 2020; Kosmatopoulos, 2019; Said & MacMillan, 2020). Moreover, this thesis engages more in depth with two specific questions of the degrowth discussion: on the one hand, the nature of the concept limits and its relevance for environmental politics and research (Benjaminsen, 2021; Brand et al., 2021; Kallis, 2019); and on the other, the ontological diversity of the economy and

its potential for the production of fairer and more sustainable socio-ecological futures (Chertkovskaya et al., 2019; Gibson-Graham, 2006; Roelvink et al., 2015).

1.3. Methodology & Structure

The aim of this dissertation is to respond to the question of how the sea acts as a conduit and barrier for notions and projects of growth. The brief literature review just presented, which is to be explored in more detail in each empirical chapter, evidences a research gap regarding the main question guiding the thesis. To answer this question, I address three different sub-questions that will be explored in subsequent empirical chapters.

First, what role did the ocean play in the context of the great acceleration of the second half of the twentieth century?

Second, how has the growth imperative been articulated and realized in the development of the ocean economy?

Third, how has the limits to growth debate shaped marine sustainability?

Using the historical evolution of the Spanish Mediterranean ocean economy as an empirical basis, this dissertation focuses on two case studies that provide opposing answers to such questions: on one hand the exponential increase in shipping (fig.1) and the decrease of fisheries activity (fig.2). My discussion around the limits to blue growth is based upon a critical realist epistemology (Collier, 1977; Gorski, 2013) which posits that there exists an objectively, mind-independent reality whose knowledge of it is possible, although partial and limited, and upon which a social construction of meaning is articulated and enacted (O'Mahoney, 2016; Pearce & Frauley, 2007). Following Forsyth (2001) the adoption of critical realism in political ecology and environmental studies generally "seeks to understand ecological change through epistemological skepticism but ontological realism to underlying biophysical processes" with the aim to show "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" (p.2) that is ecologically more adequate and socially more just.

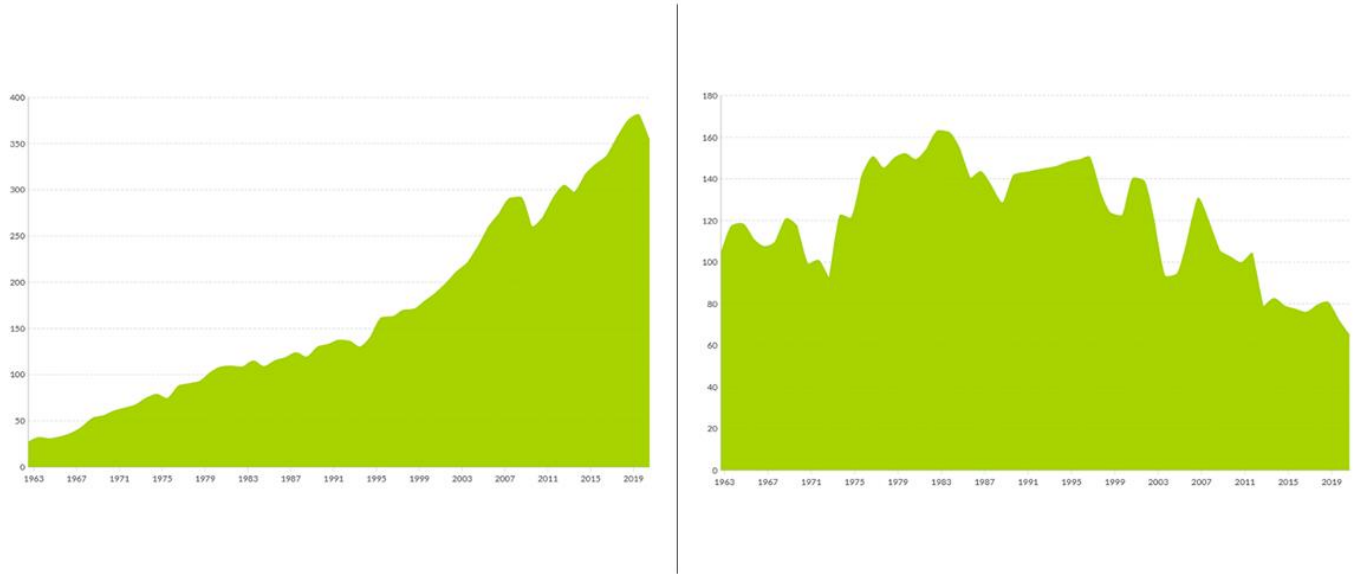


Figure 2. Shipping vs fishing in the Spanish Med 1963-2019 (in thousand tons)

Source: Ortega, M., Coll, M., Gorostiza, S., & Murray, I. (2021). *La aceleración azul del Mediterráneo español* (2; Informes exploratorios). Fundació ENT.

Following the case study methodology (Easton, 2010; Helmcke, 2022; Yin, 2018), I argue that insights drawn from more circumscribed observations can be useful for understanding broader questions, and hence, the utility of using sub-questions with their respective case studies. The case study is a methodological approach that aims to gain insight and develop a comprehensive understanding of phenomena by exploring real-life situations in their natural environments (Gerring, 2016). The rationale behind this approach is to provide analytical depth and richness by focusing on significant elements representing the tendencies of a broader dialectic, whose dimensions and complexity make it impossible to address in full detail in this dissertation. Case studies contribute to theory development, identification of practices, and formulation of recommendations (Gerring, 2009). Qualitative and quantitative methods are often used to collect and analyze data, allowing for an exploration of the research topic with depth and nuance, which facilitates comprehension of the research question, while also enabling exploration of context-specific factors and dynamics (Creswell & Clark, 2017; Yin, 2016, 2018). The specific methods used in each chapter are described in the methods section. Each empirical chapter contains a method section that describes the

approach used in more detail. The research methodologies were selected according to their adequacy in addressing specific research goals. As I aimed to explore the social, cultural, political, and economic aspects of growth at sea in the northwestern Mediterranean, I relied primarily on qualitative methods of inquiry, as these can provide nuanced and contextualized insights into the questions researched. I also engaged with descriptive quantitative approaches to trace and analyze the environmental status and tendencies of socioeconomic activities at sea. Most of the primary data were collected during two periods of fieldwork in 2019 and 2021 at different sites within Barcelona and along the Catalan coast, as well as throughout the periods of deskwork conducted during 2020 and 2022.

This dissertation is organized into five chapters (fig.4). The first chapter introduces the thesis' aims, background, theoretical framework, research questions, and methodology. Chapter 2 explores the role of the Ocean in the Great Acceleration by examining the historical development of maritime and coastal industries in the Spanish Mediterranean region. In this chapter, I argue that the ocean was a key liminal space facilitating and motivating the expansion of social metabolism during the second half of the twentieth century and producing distinct oceanic frontier imaginaries that pervade the contemporary blue economy paradigm. In Chapter 3, I address a particular aspect of blue acceleration, that is, the growth imperative. In this chapter, I trace the exponential expansion of the global shipping industry by focusing on the Port of Barcelona. In this chapter, I mobilize Daly's "uneconomic growth" concept to explain the underlying socioecological effects of growth in maritime traffic and port operations. Chapter 4 examines the socioecological crisis of Catalan fisheries and asks how the materiality of the sea has articulated distinct limits on human activity. This chapter shows how the marine environment has helped produce an alternative understanding of limits, as exemplified by the practice of collective self-limitation in co-managed fisheries. Finally, Chapter V concludes by discussing the empirical findings and addressing the limitations of this research before providing a list of future research avenues.

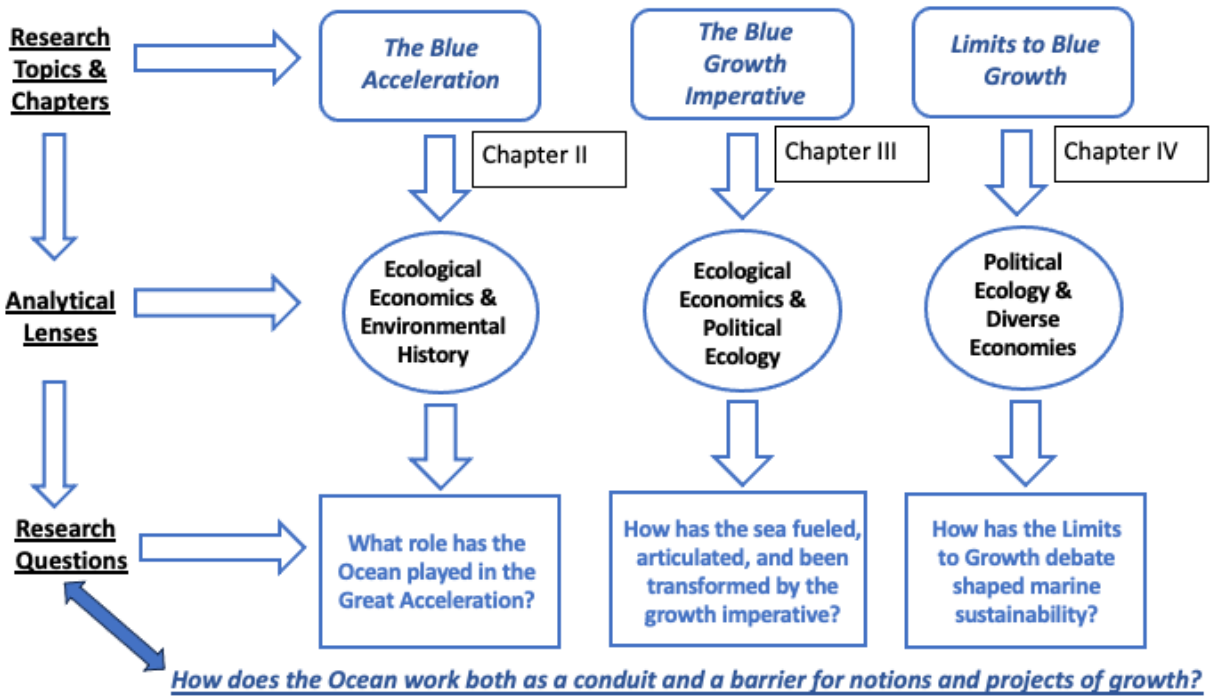


Figure 3. Conceptual framework of the thesis research question

Chapter II: The Blue Acceleration

Article – A Sea of Limitless Wants: The Blue Acceleration as Early Warning for the Sustainability of the Ocean Economy in the Spanish Mediterranean

Over the past few decades, human activity has expanded into the ocean at an unprecedented speed and scale, resulting in the transformation of marine ecosystems globally and affecting communities that rely on them. Sustainability researchers call this increase in ocean-based economic activity the "blue acceleration." This study examines the trajectory of blue acceleration in Spain, a peninsular country in which maritime activities significantly contribute to economic growth. We focus on the Spanish Mediterranean region, where there has been a historically high concentration of maritime and coastal industries, such as fishing, offshore oil extraction, tourism, and desalination. Using a decades-long dataset, we show how these industries' activities experienced significant expansion, which, in the case of fishing and offshore oil extraction, led to natural resource depletion and environmental degradation. Additionally, our historical analysis of policy and public discourse reveals that the Spanish blue acceleration reproduced and relied on long-standing imaginaries of the sea as a place of limitless resources and economic growth potential. Furthermore, we found that institutional actors systematically invoked scarcity to justify the continued expansion of economic activity at sea. Based on these findings, we contend that there are significant similarities between the ideological underpinnings of past ocean-based economic growth projects and the contemporary calls for the sustainable expansion of maritime industries framed under the ‘blue economy’ paradigm. Given the negative social and environmental impacts associated with the blue acceleration in the Spanish Mediterranean and elsewhere, we caution against the institutionalization of development paradigms that frame the ocean as scarce on the one hand, and an economic frontier of growth potential on the other. Instead, we argue for a shift in

marine sustainability and governance towards embracing limits to growth at sea as a basis for more socially just and environmentally sustainable ocean futures.

Keywords: Blue Economy, Great acceleration, Ocean sustainability, Mediterranean, Spain

2.1. Introduction

Since the second half of the twentieth century, global economic activity and its associated environmental impacts have grown dramatically, which scholars have termed “the great acceleration’ (McNeill & Engelke, 2016; Steffen et al., 2015). The exponential increase in the last few decades of a multiplicity of indicators of global environmental change, such as material and energy consumption, land-use change, and greenhouse gas emissions, has contributed to the reemergence of the debate on the existence of limits to economic growth and the setting of safe and just planetary boundaries for human activity (Nature, 2022; Brand et al., 2021; O’Neill et al., 2018; Rockström et al., 2023; Steffen et al., 2018). In recent years, studies have begun to trace the pace and scope of human impacts on marine systems; these debates have encompassed ocean space (Duarte et al., 2020; Halpern et al., 2019; Nash et al., 2017). Jouffray et al. (2020) trace the exponential increase of human activity at sea and the interests for the use of ocean resources and space during the last decades claiming that “the extent, intensity, and diversity of today's aspirations are unprecedented (p.43).” In this context, the United Nations' Proclamation of the Decade of Ocean Science for Sustainable Development (2021-2030) signals widespread concern in marine governance and sustainability spheres regarding how to combine ocean-based economic development with the conservation and protection of marine ecosystems. As the centrality of marine systems to the functioning of the biosphere and the well-being of human societies becomes clearer (Selig et al., 2019), the relationship between accelerated social metabolism (the exchange of energy and materials between human societies and their environments) and the declining health of ecosystems, including those in the sea (Duarte et al., 2020; Halpern et al., 2019), has become increasingly relevant. Indeed, in their analysis of the global blue acceleration, Jouffray et al. (2020) warn that as the ocean space becomes progressively saturated by different economic claims “interactions and conflicts among them intensify, paving the way for new risks to emerge and regime shifts to occur,” potentially leading to unknown socio-ecological consequences and cascading effects (p. 48).

As the social and environmental costs of the acceleration of global social metabolism become more apparent, the need for governance spheres to find discursive solutions that address both economic growth and socio-ecological sustainability has become increasingly urgent. To that end, leading intergovernmental bodies, financial institutions, industrial lobbies, economic think-tanks, and some environmental organizations are promoting the twin concepts of a 'green economy' and 'green growth,' arguing that technological innovation, market incentives, and techno-scientific management can reconcile economic growth with environmental conservation and community well-being (FAO, 2018; OECD, 2016; The Economist, 2020; World Bank, s.d.). Under the rubric of the 'blue economy' and 'blue growth,' these discourses have grown ocean-centric over the past decade (Silver et al., 2015). Generally speaking, blue economy proponents call for the sustainable development of established and emergent maritime and coastal industries such as shipping, aquaculture, renewable energy, tourism, and biotechnology (Morrissey et al., 2022). However, the tensions between economic growth and marine sustainability are apparent in some of the blue economy proposals themselves. For instance, in the context of the European blue economy, the challenge of finding a new direction is explicit in the new EU sustainable blue economy strategy "Transforming the EU's Blue Economy for a Sustainable Future" (European Commission, 2021) which states: We need to shift the focus from "blue growth" to a "sustainable blue economy."

Although the term lacks a specific and universal definition, particularly regarding which sectors of the ocean economy are deemed to have sustainable growth potential (capture fisheries, seabed mining, defense, or offshore hydrocarbon extraction are contentious sectors), the emergent blue economy paradigm has gained significant traction in ocean governance, business, NGOs, and scientific arenas. It is commonly framed as the maritime implementation of the UN's Sustainable Development Goals through the combination of Goal 14 (life below water) and Goal 8 (decent work and economic growth), and their associated positive effects relating to additional SDGs. Global actors such as the UNEP, the FAO, and the World Bank have institutionalized the blue economy in interregional governance spheres such as the European Union or the

Union for the Mediterranean, which in turn shape national maritime strategies, as in the case of Spain and its regional governments along the Mediterranean coast.

While mainstream ocean governance schemes and discourses increasingly embrace the blue economy framework, emerging research warns of the danger of adopting a development paradigm that could exacerbate the present unsustainable tendencies of the ocean economy (Barbesgaard, 2018; Bennett et al., 2021; J. R. Childs & Hicks, 2019; Ertör & Hadjimichael, 2020). For instance, social scientists have shown how the vague definition of the blue economy lends itself to varying interpretations, depending on the particular interests and epistemes of actors using the term (Voyer et al., 2018). In a context in which the global ocean governance regime tends to emphasize economic growth over any other socioecological objective (Jacques & Lobo, 2018), mainstream blue economy discourses are more likely to prioritize growth over environmental or equity concerns (Louey, 2022). Therefore, an emerging body of literature takes a skeptical view of the alleged social and ecological benefits of the blue economy and warns of the dangers that further entrenchment of growth-based development paradigms in maritime and coastal industries can lead to marine ecosystems and their dependent communities (Andriamahefazafy et al., 2020; Bennett et al., 2019, 2022; Ertör & Hadjimichael, 2020; Satizábal et al., 2020). For instance, researchers have shown that most blue economy projects and discourses tend to reflect the preeminence of capitalist dynamics and goals (Barbesgaard, 2018; Brent et al., 2020; Mallin & Barbesgaard, 2020; Midlen, 2021; Winder & Le Heron, 2017). In addition, scholars have noted that the uncritical assumption of the growth imperative in hegemonic blue economy visions contradicts the purported aims of ecological sustainability and social well-being (Brent et al., 2020; Ertör & Hadjimichael, 2020; Hadjimichael, 2018; Nogué-Algueró, 2020). These arguments are based on empirical evidence that demonstrates that at a global scale the acceleration of economic activity has socio-ecological impacts that cannot be solved solely through efficiency gains and technological improvements (Haberl et al., 2020; Hickel & Kallis, 2019; Moranta et al., 2022; Otero et al., 2020; Sorman, 2023; T. O. Wiedmann et al., 2015).

As the blue economy paradigm becomes the dominant institutionalized response to the great acceleration of coastal and maritime activities, ocean governance and marine sustainability research needs to be more attentive to historical contingencies giving rise to such socioecological phenomena, as past experiences can provide better approaches for both scientific analysis and policymaking. By examining the origins of the blue acceleration in the Spanish Mediterranean, this study makes the case that the blue economy paradigm reproduces and reinforces the same disruptive patterns of prior ocean-based growth trajectories by invoking environmental limits to promote unlimited economic expansion at sea to circumvent them. Indeed, the fundamental idea behind the blue economy, that of the sea as a space of endless economic opportunity, in contrast to land, which requires comprehensive techno-scientific management and planning for sustainable exploitation, is not new. This cornucopian but environmentally seemingly sensitive vision was already present in ocean imaginaries during the emergence of sustainable development discourse in the 1990s (P. E. Steinberg, 1999) and can be traced back to the Cold War's ocean boosterism of the 1950s and the 1960s (Rozwadowski, 2019, 2023), coinciding with the takeoff of the Great Acceleration (McNeill & Engelke, 2016). A common thread in these past imaginaries and discourses is the preoccupation with terrestrial environmental limits and ecological constraints on human activity, against which the sustainable use of marine cornucopia is presented as a solution. The same argumentative logic underpins mainstream contemporary discourses of the blue economy, where the sustainable exploitation of ocean space and resources –facilitated through improved scientific knowledge and technological development— is framed as the solution to the effects of land-based scarcity and other problems such as overpopulation, resource depletion, geopolitical conflict, and global health issues.

Drawing upon critical theoretical perspectives that highlight how in capitalism limits are systematically invoked to naturalize scarcity, legitimize capital's accumulation imperative, and promote perpetual economic growth (Jonsson & Wennerlind, 2023; Kallis, 2019; Mehta, 2013). This research seeks to empirically substantiate how the sea has been, and continues to be, a conduit for capitalist notions and projects of limitless growth. Our argument is that such path dependencies not only pose obvious social and

ecological risks for people and the ocean but also foreclose alternative readings for solutions that question the centrality of growth in marine governance and sustainability.

The remainder of this paper is organized as follows: Section 2 articulates the conceptual framework of limits, capitalist development, and frontier thinking underlying our analytical approach. Sections 3 and 4 trace the trajectory of the blue acceleration in the Spanish Mediterranean by focusing on four emblematic economic sectors: fishing and aquaculture, energy, tourism, and desalination. Section 5 draws parallels between Spanish blue acceleration and the contemporary blue economy discourse and projects. Finally, Section 6 concludes by warning of the potential risks and negative socioecological outcomes of following a growth-centric path dependency and calls for a degrowth paradigm shift in ocean governance and marine sustainability.

2.2. Capitalist development, the blue acceleration, and the ocean frontier paradigm

Capitalism has a strong maritime pedigree (Campling & Colás, 2021; P. E. Steinberg, 2001). European maritime trade was key to the development and expansion of the capitalist mode of production and constitution of capitalism as a world system (Braudel, 1992; Wallerstein, 2011). Moreover, slavery, colonial plunder, imperial domination, and globalization of production all depend on the scientific and military mastery of ocean space (Cowen, 2014; Hugill, 1993; Paine, 2014; Rediker, 2007; Rozwadowski, 2009). The ocean has facilitated economic growth since the origins of the capitalist mode of production, both as a surface for trade flows and a site for the appropriation of marine nature and the exploitation of labor (Barbesgaard, 2023; Campling & Colás, 2021; Longo et al., 2015; Rozwadowski, 2019). From a socio-metabolic perspective (Fischer-Kowalski & Haberl, 2015; Haberl et al., 2019; Krausmann, 2017; Martinez-Alier et al., 2010), the ocean serves as a site for the extraction and circulation of energy and materials consumed in land-based industrial economic processes, as well as a sink for their derived waste, such as carbon emissions, excess heat, noise, and other forms of pollution that

lead to mounting environmental pressures (Duarte et al., 2020; Halpern et al., 2019; Longo & Clark, 2016; Nash et al., 2017). Covering 70% of the planet's surface, 90% of the habitable space of the biosphere, and holding 97% of water in the hydrosphere, the ocean constitutes a key component of Earth systems, transcending the land/sea divide.

During the mostly land-based 'great acceleration' of the second half of the 20th century, ocean space increasingly became occupied by economic activity and pressured by anthropogenic environmental impacts (Jouffray et al., 2020; Steffen et al., 2015), which have had a significant cumulative impact on 60% of the global ocean (Halpern et al., 2019). The late Earth system scientist Will Steffen coined the term 'great acceleration' to describe the unprecedented rise in global human activity and its associated environmental pressures at the planetary scale (Steffen et al., 2015). The concept gained traction in scientific and public spheres as it encapsulated seemingly disparate socioeconomic and earth-system trends such as energy consumption, population and GDP growth, greenhouse gas emissions, international tourism, water usage, tropical forest loss, transportation, fertilizer consumption, ocean acidification, and foreign direct investment into a simple and coherent narrative of historically sudden and escalating transformation of global social metabolism. McNeill and Engelke (2016) examined the environmental history of the great acceleration since 1945, which they characterized as the genesis of the Anthropocene epoch. As evidence of the unsustainable nature of the documented acceleration trends, the authors point to indicators that are already showing signs of slowdown, such as population growth and marine fish capture. Some scholars have recently interpreted these signs of deceleration as portending a beneficial global slowdown for people and the planet (Dorling, 2020). However, from an oceanic perspective most indicators of human activity and environmental pressure continue to increase at an accelerating rate (Duarte et al., 2020; Halpern et al., 2019; Nash et al., 2017). Notably, the global Great Acceleration of socioeconomic activity at sea, as traced by Jouffray et al. (2020), began some decades later than on land, with the steepest portions of their exponential curves occurring from the 1980s-1990s to today. Such a lag in economic development can be partly explained by the ocean's particular materiality, which makes it inhospitable to human habitation and more difficult for capital to

enclose, control, and exploit ocean space and resources than in most terrestrial environments (Campling & Colás, 2021).

The ocean's biophysical characteristics mold the development and establishment of the social metabolic processes of extraction, circulation, and disposal at sea. In some respects, the materiality of the sea has facilitated the growth of global social metabolism, and its fluidity and buoyancy have helped the unhampered circulation of shipping flows, diffusion of pollution (absorption of waste from industrial and agricultural processes), and oceanic capture of excess atmospheric heat and carbon dioxide from anthropogenic (and mostly terrestrial) sources. However, the same material characteristics make ocean space also less amenable to being settled, controlled, and fixed than on terrestrial environments. As a result, most land-based economic activities, such hydrocarbon extraction or renewable energy production, become either infeasible or require significant investment in resources and technological capacity when transferred to the marine environment. The physicality of the ocean also hinders standard processes of territorialization –the re-ordering of space through the establishment of property systems, political jurisdictions, rights, and social contracts (Rasmussen & Lund, 2018)– a territorialization that is necessary for capitalist accumulation. In this respect, the ocean becomes a barrier to the notions and projects of growth. As Campling and Colás (2021) note, the materiality of the ocean poses both risks and opportunities for capitalist reproduction, turning the sea into a "source of competitive innovation and experimentation in finance, technology, insurance, labor regimes and spatial governance" (p. 2). Reflecting this dual character, Steinberg (2018) argues that the ocean has historically acted as a fluctuating frontier, at times opening and closing up to the expansion of capitalist social relations and accumulation strategies.

Indeed, the concept of the frontier is key to understanding the relationship between the sea, capitalist development, and economic growth. For instance, Campling and Colás (2021) draw from Moore's (2000) theorization of the commodity frontier in arguing how such economic opportunity stems from the non-existent or minimal presence of previous enclosure or commodification, which allows capital to appropriate higher ecological surpluses from the exploitation of labor at sea. Once the frontier has matured

and the productivity gains of its commodification decline, capital typically attempts to maintain the rate of relative surplus capture by searching for new frontiers or intensifying appropriation through enhanced socio-technical innovation (Campling and Colás, 2021). Banoub et al. note how the commodity frontier is produced "by the historical dialectic of capitalism's interior and exterior relations" in which the frontier serves as capitalism's 'constitutive outside' (p. 1536). This perspective aligns with the distributional approach of the Barcelona School of ecological economics and political ecology, which posits that the growth of the social metabolism occurs through the expansion and intensification of global commodity frontiers at the peripheries of centers of power (Martinez-Alier et al., 2010; Muradian et al., 2012; Scheidel, 2023). Additionally, ecological Marxists emphasize how a capitalist accumulation imperative driving the growth of social metabolism at the expense of the planet's ecology (Clark & York, 2005; Foster, 1999; Schneider & McMichael, 2010) produces rifts in the metabolic relationships between human societies and their marine environments (Clausen & Clark, 2005; Longo & Clark, 2016), as exemplified in the case of the demise of Mediterranean tuna fisheries (Longo et al., 2015; Longo & Clausen, 2011).

Beyond its socio-metabolic aspect, the frontier metaphor has had a long-standing symbolic power and sustained cultural hegemony in governance and development discourse. Distinct from a border (a clear line separating two entities), Steinberg (2018) notes how dominant discourses around the ocean economy tend to articulate the concept of frontier as a space of opportunity. Such imaginaries promote "the notion of an ocean expanse ripe for exploration and exploitation" (J. Anderson et al., 2022, p. 6). Environmental historian Helen Rozwadowski traces the explosion of the oceanic frontier imaginary to the Great Acceleration in the post-war era, coinciding with the height of capitalist expansion and economic growth in the Western countries, and spurred by the military interests of developing technoscientific knowledge about the Ocean, which lead to the development of oceanography and the invention of technologies such as the sonar or the scuba, which opened the realm of possibility for the exploration and exploitation of the ocean (Rozwadowski, 2019). Similarly, the development of oceanography during the Francoist period was spurred by geopolitical interests and cornucopian imaginaries of the Ocean as an economic frontier. Fawcett et al. (2022)

show how oceanic frontiers are also epistemological and analyze scientific-technical attempts to turn the ocean into a knowable object for control and exploitation. Steinberg (1999), for instance, traces how the social construction of ocean space has historically relied on and produced idealized visions of the ocean as the 'ultimate outside,' a realm beyond civilization that contrasts with terrestrial rationality and control. Two of the most common instances of capitalist ocean imaginaries portray the sea as an empty surface to be transcended by speeding up circulation, and the sea as a reservoir of infinite wealth to be untapped. Although seemingly contradictory, these visions share a common characterization of the sea as a frontier space, an 'outside' that needs to be overcome by the entrepreneurial spirit of capital and expansionary forces of the economy.

Our interpretation of the oceanic frontier as an external or nature-imposed limit to the human enterprise that simultaneously calls for its transcendence through growth is based on theories that the naturalization of limits under capitalism is a mechanism to legitimize scarcity, undermine redistribution efforts, and justify the growth imperative (Kallis, 2019). The naturalization of scarcity and growth originates in the emergence of neoclassical economics as the dominant school of thought. According to this perspective, which has its roots in Malthusian theory, humans have unlimited needs that clash with a limited environment. The logical solution under this paradigm is to promote technological innovation and growth. This approach depoliticizes the issue of scarcity by shifting the focus from how the social metabolism is organized to meet specific needs to the technical question of how to overcome environmental limits through continuous growth. Capitalism creates scarcity, not only by imposing unlimited accumulation on a biophysically limited planet but also by enclosing the commons and concentrating wealth produced by the metabolic exchange between workers and nature into the hands of the few (Longo et al., 2015). This study builds upon research such as that of Steinberg and Rozwadowski, which show how frontier thinking was incorporated into the sustainable development paradigm as well as into the legal codification of the contemporary ocean regime, the UN's Law of the Sea. Drawing on theories of capitalist naturalization of limits (Jonsson & Wennerlind, 2023; Kallis, 2019; Mehta, 2013), we argue that it is possible to trace a similar genealogy of frontier thinking from the blue

acceleration to contemporary calls for the blue economy. A key component of oceanic frontier thinking is scarcity, which serves as a rationale for perpetual growth at sea, as demonstrated in our study.

2.3. Case study & methodology

The Mediterranean Sea is a semi-enclosed sea located in a densely populated region that is also a climate change hotspot and contains the highest rate of endemic species worldwide. A historically significant and strategically located sea, the Mediterranean Sea has long been a hub of human activity and geopolitical strife. Although there is evidence of long-standing anthropogenic pressures, it has been during the course of the global Great Acceleration of the second half of the twentieth century that the expansion and intensification of economic activities such as fishing, coastal development, industrial production, transportation, intensive agriculture, and tourism increased anthropogenic pressures on the region's marine ecosystems (Coll et al., 2012; Colloca et al., 2017; Micheli et al., 2013). The Mediterranean supports a large and dynamic marine economy, which, due to the region's geographic and historical specificity, developed distinct growth trajectories and characteristics, particularly between the northern and southern shores, among which there is geopolitical arrangement with a strong neocolonial character. One of the leading intergovernmental actors promoting the blue economy globally, the European Commission, approved a Blue Growth Strategy in 2015[11] and has since then produced reports annually which track the development of the Union's blue economy sectors.

In the Spanish Mediterranean, our focus area, the acceleration of maritime and coastal activities during the last decades, followed a similar path to the rest of the region,

[11] However, Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 already established a framework for maritime spatial Planning that required the coordination of maritime economic activities to promote growth.

particularly on its northern side. Successive Spanish governments have aspired to establish themselves as leaders in the blue economy since the appearance of the EU's blue economy program. The Ministry of Agriculture, Fisheries, and Food played a pivotal role in this pursuit. A blue economy has a substantial presence in this region. Algeciras, Barcelona, and Valencia serve as the primary transport ports, whereas Barcelona, Palma, and Valencia are hotspots for cruise and maritime tourism and the development of blue economy initiatives and networks.

Although the promotion of the sustainable development of Spanish maritime and coastal sectors under the banner of the blue economy is a relatively recent phenomenon, historically speaking the vision of the sea as an untapped source of economic growth is not a novelty. Given Spain's colonial and imperial history, the sea has long been central to nation-building narratives, geopolitical interests, and developmentalist visions. Traditionally, the ocean has been depicted as a vehicle for conquest, expansion, and growth in institutional nationalist imaginaries (Carrero Blanco, 1962; Davis, 2000; Núñez Seixas, 2015; Schmidt-Nowara, 2006). Spain's twentieth century history was marked by the forty-year-long far-right nationalist dictatorship of Francisco Franco (1939-1975) which continued the tradition of maritime glorification and turned it into a key component of its political economy. Franco's victory at the Spanish Civil War (1936-1939) cemented the sea's status as a symbol of nationalist power tied intrinsically to the patriotic mission of reclaiming Spain's glorious maritime past. The Francoist dictatorship crafted grandiose oceanic imaginaries, built on a nostalgic yearning for the lost empire and transatlantic colonial dominance (del Arco Blanco & Gorostiza, 2021; Gorostiza & Ortega Cerdà, 2016).

Inspired in the economic and social policies of its Axis allies, during the postwar years the nascent Francoist dictatorship implemented an autarkic political economy which aimed at promoting national industries and the exploitation of natural resources within Spain and its colonial territories. During the 1940s, in a context of hunger and agricultural crisis, regime officials framed the sea as an unclaimed productive space that could provide an inexhaustible source of food and supported the expansion of the fishing fleet (del Arco Blanco & Gorostiza, 2021; Gorostiza & Ortega Cerdà, 2016).

However, the overall impact of the autarkic policies slowed down Spanish economic recovery and contributed to an emerging social unrest (Catalán, 2002; Viñas, 1999). By the end of the 1950s, the deteriorating situation contributed to the abandonment of the autarkic project. In 1959, the Francoist government approved several reforms aiming at liberalizing the economy and opening it up to foreign markets. The approval of the so-called Stabilization Pact in 1959 signaled a shift in economic policy, which primarily focused on correcting the trade balance and was followed by the approval of three Development Plans ("Planes de Desarrollo") between 1964 and 1972, aimed at fostering high and sustained economic growth (Alsina Oliva, 1987). Key to our research, these plans reflect the dictatorship's vision of the sea as a source of wealth, first primarily through its coasts and fish resources but also through other untapped economic activities such as aquaculture, offshore oil extraction, and desalination planning and development. In addition, the interest of the Francoist regime in the country's coasts and sea waters also manifested in its support for the scientific development of oceanography, which was boosted by the Development Plans (Rubio, 1972a; Jefatura del Estado, 1972; CSIC - Instituto de Investigaciones Pesqueras, 1974).

In the following section, we examine the evolution of several ocean-based economic activities in the Spanish Mediterranean region. In accordance with the approval of Francoist Development Plans, we established the baseline of our data series in 1963. Our study is anchored on multiple sources. First, we utilize publicly available statistical data to trace the progress of five different ocean-based activities: fishing, aquaculture, offshore oil extraction, tourism and desalination. For each sector, we devised a proxy indicator to quantify growth trajectories over recent decades (see table 1).

Concept	Category	Indicator
Fishing	Extraction of marine resources	Tons caught on the Spanish Mediterranean coast
Aquaculture (food production)	Coastal use and transformation	Tons of marine aquaculture fish production (fattening phase)
Offshore oil extraction	Extraction of marine resources	Tons extracted on the Spanish Mediterranean coast

Coastal tourism	Maritime and coastal tourism	Number of beds in the Mediterranean coastal provinces
Desalination	Extraction of marine resources	Hm3 of desalinized water produced in the Mediterranean coastal provinces

Figure 4. Indicators for the ocean-based economic activities analyzed.

Our work builds on the data collection carried out by Ortega et al. (2021) for the technical report *La aceleración azul del Mediterráneo español*, which we have updated and expanded. Most importantly, we use multiple historical documents —from official state reports to historical press— to contextualize discursively and politically the analysis of the datasets. On this basis, we examine how preoccupations with terrestrial environmental limits and ecological constraints on human activity were set against the celebration of marine cornucopia, portrayed as the solution to overcome them.

2.4. Five Instances of the Spanish Blue Acceleration

2.4.1. Fishing

During the Francoist dictatorship, the promotion of fish consumption and the expansion and modernization of the fishing fleet were top priorities. After the war the sea was portrayed as an endless source of resources, in stark contrast to the famine and food scarcity experienced in most of the country. The autarkic legal reforms supported the reconstruction of the merchant and fishing fleets and pushed a significant expansion of the fishing fleet and activities during the 1940s. However, the main beneficiaries of these reforms were the high-sea fishing fleet, while coastal fisheries, like the Mediterranean fleet, evolved much slowly and remained largely outside the scope of these mechanisms (Giráldez et al., 2011).

This situation started to change during the 1960s, with the approval of the Fleet Protection and Renewal Act (1961), which contributed to vessel modernization and motorization in the Mediterranean (Jefatura del Estado, 1961). The 1961 law justified the need of modernisation pointing out that most of the fishing resources were “beyond

the territorial limits" of Spain and the need to increase fish catches to contribute to food security, fish use in industrial processes and fish exports (Jefatura del Estado, 1961, p. 18345). Interestingly, the 1961 law already established the possibility to implement management measures if necessary to ensure that stocks remained at a level that guaranteed a Maximum Sustainable Yield. However, environmental management measures at a large scale were not implemented (Sinde Cantorna et al., 2007), and the focus on modernization led to increased fishing mortality. In certain areas of the Mediterranean limited co-management schemes were adopted, such as the one in the Castellón region (Dahlet & Sánchez Lizaso, 2021).

The impact of the 1961 law in the modernisation of the Mediterranean fleet began to be noticeable in the mid-1960s and gained momentum in the 1970s. A consequence of this increase was a clear pattern of biological overfishing and overcapacity that became evident in the 1970s. Even the legal text of the Third Development Plan highlighted the declining trend in fishing catches and emphasized that both the catch per fisher and its associated -monetary efficiency (income per fisher) were far from optimal (Jefatura del Estado, 1972). Along the same lines, a press piece lauding the Development Plan pointed out that "before, the sea offered more than what was asked to it, but now many of its resources are in danger of extinction or, at least, in dangerous decrease" (Rubio, 1972a). Both in the press narratives and the legal texts, the development of oceanographic sciences was portrayed as a way out of scarcity by learning more about the "mysterious" and "unknown" seas. From correcting the "irrational exploitation" of the seas to understanding the multiple resources that it "offered" and that remained "unexploited", oceanographic sciences offered "immense possibilities". More specifically, the text of the Third Development Plan gave oceanographic research a privileged position and pointed it in two directions: first, marine aquaculture, and second, the search for mining resources, particularly offshore fossil fuels — both discussed in the following sections (Jefatura del Estado, 1972; Rubio, 1972a, 1972b).

As a result of the overfishing pattern during the 1970s, official figures of catches of many species started declining during the 1980s. After the accession of Spain to the EU in 1986, subsidies for vessel scraping were introduced, but its impact in fishing capacity was more than offset by the construction of new vessels with larger catch capacity and

the modernization of existing vessels (European Court of Auditors, 2011; Lagares & Ordaz, 2014). Since 2006, subsidies have increasingly focused on avoiding the increase of fishing mortality and overcapacity, attempting to align fishing capacities with ecosystem limits, and encouraging diversification. However, success has been limited, as overfishing remains a major problem along the Spanish Mediterranean coast (European Court of Auditors, 2020; Lagares & Ordaz, 2014).

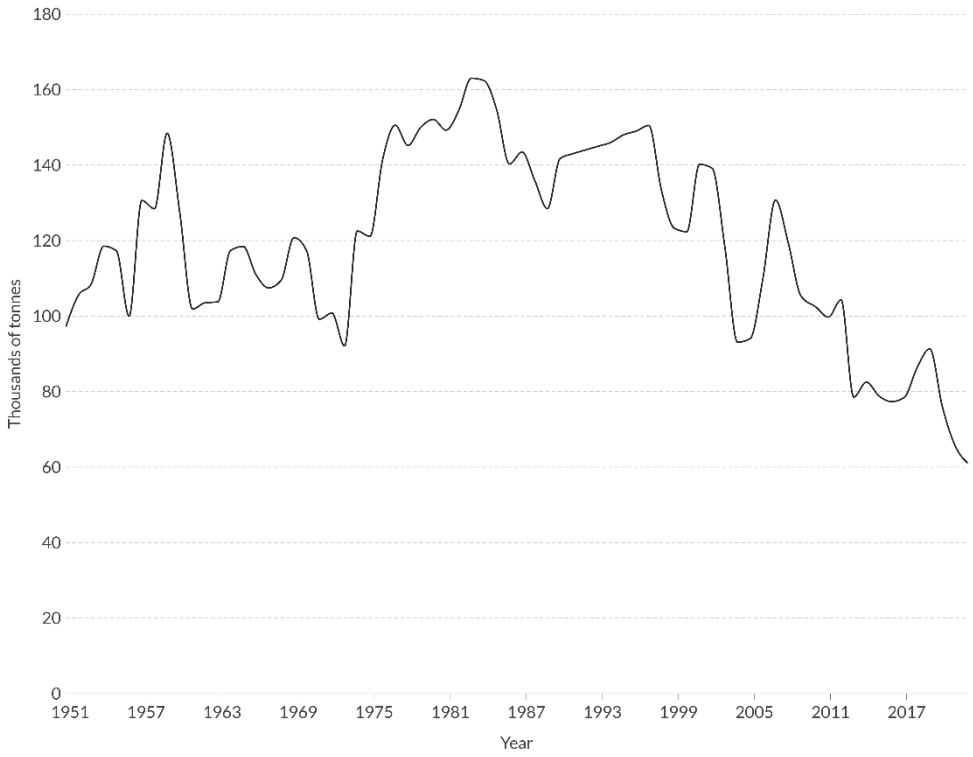


Figure 5. Fishing landings in the Spanish Med coast (total live weight).

Source: FAO. 2023. Fishery and Aquaculture Statistics. Global capture production 1950-2021 (FishStatJ). In: FAO Fisheries and Aquaculture Division [online]. Rome. Updated 202

2.4.2. Aquaculture

While the origins of mussel farming in Spain go back to the early decades of the 20th century, by the early 1970s fish aquaculture in the Spanish seas remained unexplored. The alarming signs of decreasing fishing catches throughout the 1950s and 1960s attracted attention to the potential and diverse forms of aquaculture (Fernández González, 2008). As presented above, in 1972 the 3rd Development Plan presented "marine farming" as a way to circumvent the environmental limits of fishing. The plan stated that research about "marine farming" should be developed "to the fullest" throughout the action of public institutes of fishing research ("Institutos Científico-Pesqueros") and directed towards "species of interest". In the narratives of the Spanish press, "the cultivation of the oceans" was presented as a "vital need" to face the growing world's population and the required food supplies (Rubio, 1972a).

During the 1970s, while the first private companies were established in Spain, scientists belonging to the Instituto de Investigaciones Pesqueras participated in several international meetings on aquaculture and organized them in Spain. The facilities of the Institute in Cádiz, devoted to aquaculture, were expanded to experiment with fish (Andreu, 1974; CSIC - Instituto de Investigaciones Pesqueras, 1974). The potential of the Mediterranean coast for aquaculture was emphasized in the reports at the time (San Feliu, 1973). While these first years of research were key for the sector's development, private activities grew slowly. It was not until 1984 when the Spanish Government approved a law on marine farming ("Ley de Cultivos Marinos") that production started taking off with the help of public subsidies (Fernández González, 2008). Throughout the 1970s and 1980s, news about the decreasing fishing catches, as well as the reduction of the fishing fleet imposed by the access to the European Union in 1986, came often accompanied by calls to resort aquaculture as a way to bypass the limitations of fishing.

In the last years of the 20th century, aquaculture production surged dramatically in the Spanish Mediterranean region, promoted by large European subsidies. This upsurge contrasted with a sharp decrease in wild fish catches, largely because of persistent overfishing and other environmental factors. On a global scale, the swift growth of aquaculture has become essential for addressing the challenges created by the depletion of marine resources and the falling rate of profit in fisheries (Banoub et al., 2021; Béné et al., 2016; Blanchard et al., 2017; Ertör & Ortega-Cerdà, 2018; Troell et al.,

2014). Thanks to technological innovations, proactive government strategies, and its prime geographic position, Spain's aquaculture sector has emerged as a frontrunner in the European Union, primarily thanks to the Galician mussels industry in the Atlantic. In the Mediterranean governmental incentives have paved the way for upgraded fish farms by introducing superior feeds, enhanced breeding methods, and advanced health management protocols.

Nonetheless, the accelerated growth of aquaculture in this region has brought about several issues. Concerns such as nutrient pollution, the emergence of diseases, and interactions with wild fish populations have grown alongside production boosts. Additionally, the Spanish aquaculture sector has faced challenges from shifting market demand and global economic dynamics. While establishing export markets, especially within the European Union, was pivotal for the sector's expansion, it also exposed it to the volatility of consumer perceptions and trade regulations.

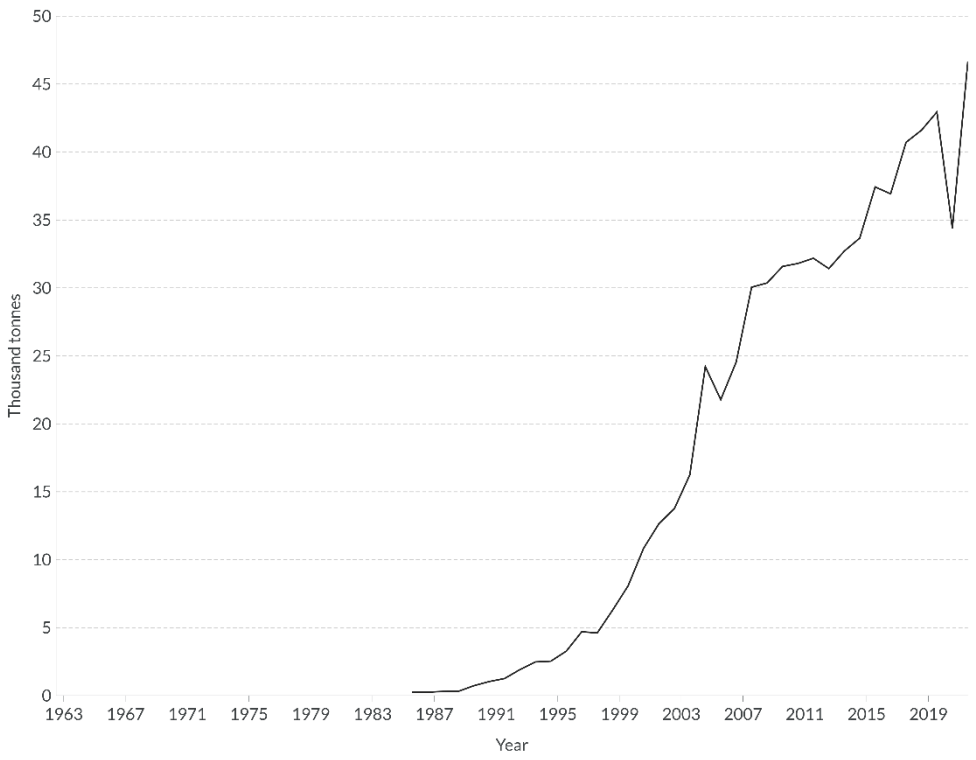


Figure 6. Fish aquaculture production in the Spanish Med (total live weight)

Source: FAO. 2023. Fishery and Aquaculture Statistics. Global aquaculture production 1950-2021 (FishStatJ). In: FAO Fisheries and Aquaculture Division [online]. Rome. Updated 2023. www.fao.org/fishery/en/statistics/software/fishstatj Note: oysters and mussel's are only included since 2008.

2.4.3. Offshore oil extraction

The 3rd Development Plan in 1972 underlined the importance of the scientific development of oceanography to study the wealth potential of the seas, emphasizing two different fields: marine aquaculture and mineral reserves (Jefatura del Estado, 1972). Oceanographic research was to focus on "achieving the maximum performance and utilization of the littoral platform and continental slope" (Rubio, 1972b). As discussed in the national press, the geographical focus was on the region of Cantabria (in the Atlantic) and, most of all, in the Mediterranean.

Hydrocarbon exploration in Spain had begun at the end of the 19th century and continued at low levels during the early 20th century. During Franco's autarkic period, the quest for domestically produced fuel was seen as a means of achieving independence and sovereignty in the context of geopolitical animosity and an energy shortage that impeded industrial development. However, it was not until 1958 that oil exploration was regulated independently from mining resources. The regulatory decree that followed the 1958 law was approved in the midst of the economic turn taken by the dictatorship in 1959, marked by liberalization measures. Accordingly, oil exploration and production were opened to foreign capital, rapidly attracting the interest of multinational firms such as Chevron, Texaco or Shell, among other. Exploration activities intensified and, in 1965, started in the continental platform of the Mediterranean (Puche Riart & Navarro Comet, 2019; Quiroga, 2022)

The early success of these offshore explorations in the Mediterranean explains the enthusiasm that followed. In 1970, offshore oil was discovered near the Ebro delta coast with a potential production of 10.000 barrels of oil per day. This represented the largest sources of oil exploited in Spanish history and sparked a substantial increase in marine exploration in the Mediterranean (Puche Riart & Navarro Comet, 2019). In addition, the project of expanding oil production in Spain thanks to the offshore reserves turned into a critical need as the first oil crisis unfolded in late 1973, producing recession and stagflation problems. The ocean was considered a potential solution. In 1974, the

Spanish government approved a new hydrocarbon law that further promoted exploration. Its emphasis on offshore exploration was one the main innovations in relation to 1958. The law established a new zone in the divisions of the national territory, which included the continental platform and the deposits of the territorial seas, and stated clearly that these resources were “"inalienable and imprescriptible heritage of the [Spanish] Nation" (Jefatura del Estado, 1974).

The faith placed in the oceans soon bore fruit, but promises were not fulfilled. Texaco, Chevron and Shell located new reserves in the Mediterranean in 1975 and 1976, but these were far from enough to make up for the impact of the oil crisis in Spain. The extraction facilities peaked during the 1980s, but no more reserves were identified. Oil extraction in the Mediterranean decreased fast during the second half of the 1980s and throughout the 1990s and has not recovered ever since. The last exploitation area (Casablanca unit) was closed in 2021.

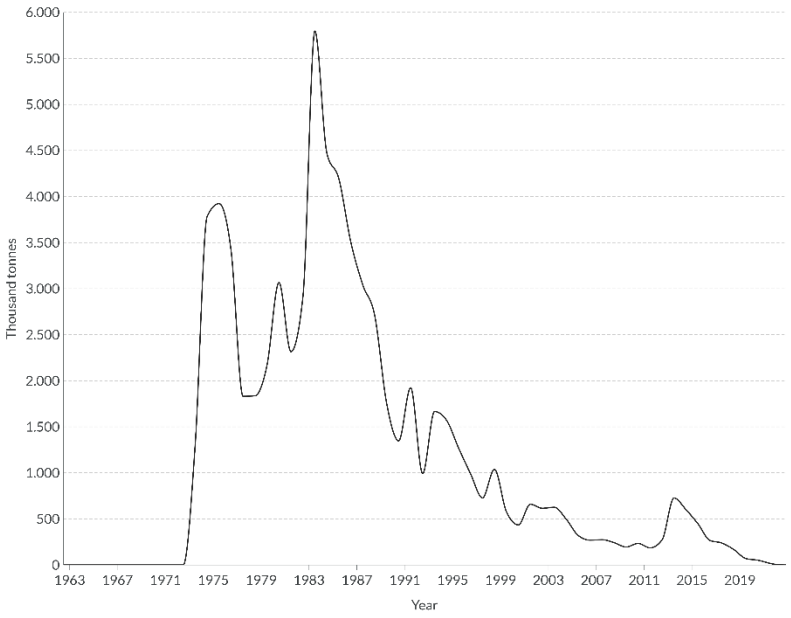


Figure 7. Offshore oil extraction per year in the Mediterranean coast of Spain

Source: CORES Producción interior de crudo.

2.4.4. Coastal tourism

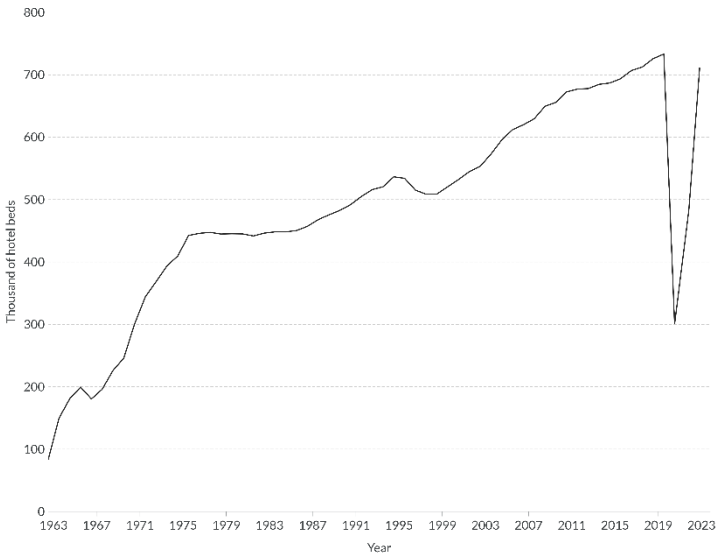


Figure 8. Hotel beds per year in the Mediterranean coast of Spain

Source: INE. Yearly average volumes obtained from the survey "Datos de encuesta de ocupación hotelera" for the period 2009-2020. Previous yearly data have been balanced to ensure the series continuation in 2009.

In the wake of a decade-long unsuccessful experiment with autarky, Spain found itself in an unfavorable economic situation that stirred social unrest. In this context, the emergence of international tourism as a major economic activity spurred interest in the regime in promoting the tourism industry in coastal regions as an easy way to obtain foreign currency and spark the industrialization of other sectors of the economy. The expansion of tourism in Spain started in the mid-1950s but boomed after the liberalization of the Spanish economy approved in the 1959 Stabilization Plan. The regime attempted to legitimize itself by associating social progress with economic growth, aiming to pacify internal conflicts under this banner. The burgeoning mass tourism industry became instrumental in achieving these objectives. Francoist authorities promoted coastal tourism development in the 60s and 70s to transcend the economic limitations of an autarkic system, grappling with isolation from advanced capitalist countries and exclusion from global capital circuits (Murray Mas, 2015). International tourism became one of the pillars of the "Spanish Miracle," a period of accelerated and sustained economic growth, between 1959 and 1973.

Researchers have characterized as "coastalization" (Lagarias & Stratigea, 2022) and "littoralization" (de Andrés et al., 2017) the massive transformation of the Spanish economic geography and its concentration along the coastline, which was driven in great part by the tourist boom. This tourist explosion is seen in countries such as Italy, Portugal, and Greece, but is comparatively more significant in Spain (Vallejo Pousada, 2015).

From the early 1960s, the Spanish coastal tourist industry blossomed with a planned model of mass tourism development made possible by investments in transportation infrastructure such as airports, ports, and highways, which facilitated easier access to vacation destinations. Regime officials and bureaucrats identified the tourist industry's "natural resources" as the privileged ecology and landscapes of Spain, particularly its coastal regions. Manuel Fraga Iribarne, the Minister of Tourism, talked of the coastal landscapes as God-given natural capital: “We have, by the grace of God, a continental and insular territory attractive in its variety, in great contrast to the rest of the countries, and endowed in most of the year with a mild climate and an envied luminosity. An extensive repertoire of natural landscape attractions, a long coastline with abundant beaches and, in general, a geography of intense character, serve as the basis for a human panorama, an urban and monumental environment, which powerfully captivate the interest of those who visit us” (Fraga Iribarne, 1964)

Based on the 1963 law of “Centres and Zones of Tourist National Interest”, the Francois government approved a plan of development that identified dozens of “underdeveloped” coastal zones and assigned them hotel bed capacities by the thousands. In a matter of years, these virtually virgin zones —such as the Manga del Mar Menor, among many other— experienced a massive urban development (Jefatura del Estado, 1963; Galiana Martín & Barrado Timón, 2006; Asensio & Cárceles, 2019). Particular emphasis was given to the attractiveness of coastal environments for international tourists coming from across the Pyrenes: “On the map of today's Europe, our country has become a particularly sought-after target. The nations of the North and the Center, with their strong currency and more and more perfected means of transportation, have made our Spanish land, especially our extensive coasts and

beaches, their circumstantial home of recreation and vacation, of rest and recuperation"[12]

After a decade of spectacular tourism growth —tourists visiting Spain increased from 6 to 24 million between 1960 and 1970— the 3rd Development Plan discussed tourism as "the first exporting industry of our country" (Jefatura del Estado, 1972, p. 8250). Fraga Iribarne, the Minister of Tourism, presented tourism in similar terms: as a source of foreign exchange, akin to exports, necessary for the country's industrialization. The legal text approved by the Francoist government in 1972 underlined the importance of developing infrastructure —from airports and roads to ensuring water and energy supply— and modernizing accommodations to ensure continued growth and prevent "choking of tourist flows". As stated in the 3rd Plan, "it would be a mistake to take for granted that tourist expansion will continue spontaneously". The growth of tourists visits —it stated— would depend more and more on investments, and not in the "beauty of the Spanish land its mild climate" (Jefatura del Estado, 1972). In the years that followed, despite the impact of the 1973 oil crisis, the tourist sector remained a key industry for Spain (Vallejo Pousada, 2015).

2.4.5. Desalination

As of the early 2020s, Spain is one of the world's leaders in desalination technology. The Spanish Mediterranean region benefits from a substantial desalination infrastructure that plays a vital role in the water supply, particularly in periods of drought. The great acceleration of the desalination sector in the Spanish Mediterranean did not take off until the 2000s. The approval of the AGUA program in 2004 marked a massive increase in water production capacity, at the same time that desalination was presented as the alternative for water supply that dams and inter-basin water transfers could not

[12] Fraga Iribarne, Cortes Españolas, 27 december 1963

accomplish (March et al., 2014). However, the potential of desalination as a "new cornucopia" for Spain began to be recognized decades earlier.

The first steps of desalination technology in Spain built on the scientific collaboration with the US, during the 1950s (Muro et al., 1979). Hand in hand with the developments of nuclear energy, desalination was portrayed as the door to cornucopia by President J.F. Kennedy, who in 1961 declared that "no water resources program is of greater long-range importance than our efforts to convert water from the world's greatest and cheapest natural resources – our oceans – into water fit for our homes and industry. Such a break-through would end bitter struggles between neighbors, states and nations" (cited in March et al., 2014). The Francoist dictatorship participated of this vision and, in collaboration with the US, launched a program on water desalination during the 1960s. In 1968, Madrid hosted the celebration of an international congress on the applications of nuclear energy for desalination (Saurí et al., 2018).

Building on the scientific collaboration with the US, the 2nd Development Plan (1968-1971) of the Francoist dictatorship referred to the potential of "potabilization of sea water", particularly for tourist resorts. At a time when the high costs of desalination limited its possible application, the plan considered it an experimental alternative for islands, which could later be spread to other territories (Presidencia del Gobierno, 1969). With the support of the US, Spain had built its first desalination plants in Lanzarote in 1965, and by the early 1970s two more larger plants had been completed in the Canary Islands, which at the time were undergoing a transformation into destinations for mass tourism (Oltra Oltra & Troyano Lobatón, 1972; Saurí et al., 2018).

Despite the interest of the dictatorship in desalination, the 1960s and 1970s were undoubtedly the golden age of Spanish water policy based on dams, reservoirs and inter-basin transfers (Saurí et al., 2018; Swyngedouw, 2015). The high cost of desalination precluded further applications at the time, but the vision of desalination as the key to a world of abundance did not falter. Facing a future when freshwater would become increasingly scarce, the sea appeared as the obvious solution. As put by the former vice-president of the Consejo de Obras Públicas of the Spanish Government in the journal of Spanish engineers, "We should not see the future with pessimism, certainly not from Spain's perspective (…), because, after all, the great alternative will be the sea (…) From

the sea we can expect great support of all kinds, which are now barely glimpsed." (Valdés Díaz-Caneja, 1973, p. 409-410).

During the 1970s and 1980s the projects for desalination plants in the Mediterranean were shelved, while only in the Canary Islands did desalination play a significant role to sustain tourist development (Saurí et al., 2018). Building in the know-how and experience accumulated, in the 1990s Spain became a global leader in desalination technology in infrastructural capacity, driven by increased investment in research and implementation of cutting-edge technologies, such as reverse osmosis. These advancements reduced the energy consumption and costs, making desalination more feasible. Desalination capacity increased steadily, even if most of the water was produced in the Balearic and Canary Islands (March et al., 2014). Around the early 2000s, urbanization boomed in the coastal areas and took a sprawling trend, generating growing demands for water. The coastalisation of economic activity, mainly led by the touristification of coastal regions, prompted the development of desalination after the approval of the AGUA program in 2004. However, the 2007-2008 crisis forced a deep restructuring of the program. Many of the plants planned were not built, while other have been working at low capacity. However, recurrent droughts have also proved the benefits of having desalinated water available.

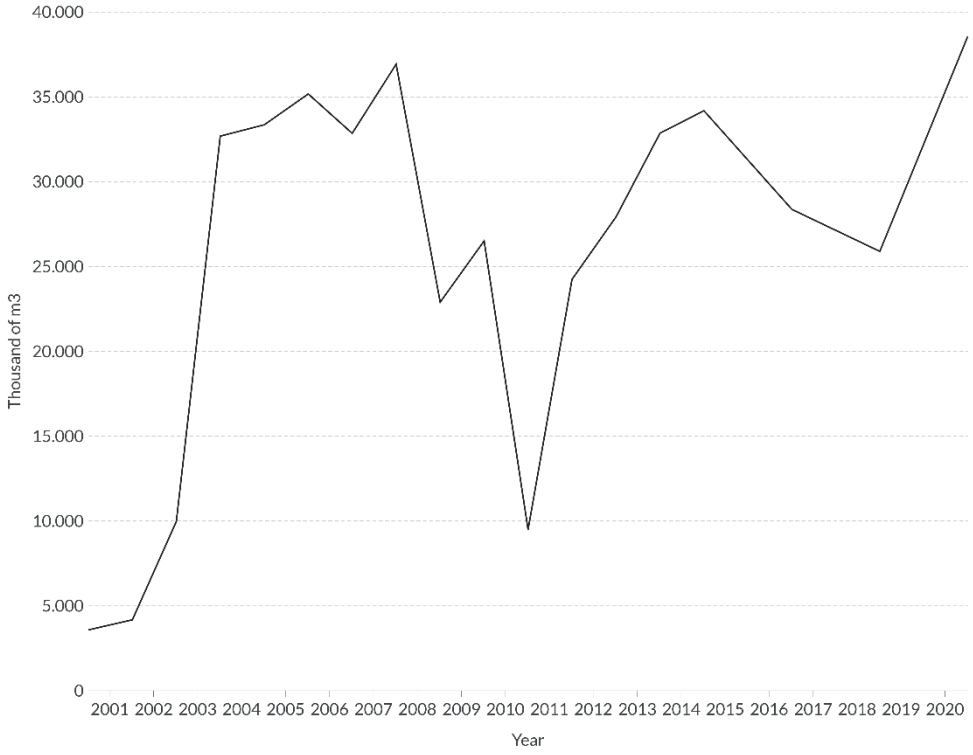


Figure 9. Water capture for desalination in the Spanish Med

(Andalucía, Illes Balears, Catalunya, Comunitat Valenciana)

Source: Instituto Nacional de Estadística.

2.5. Shades of the same blue acceleration?

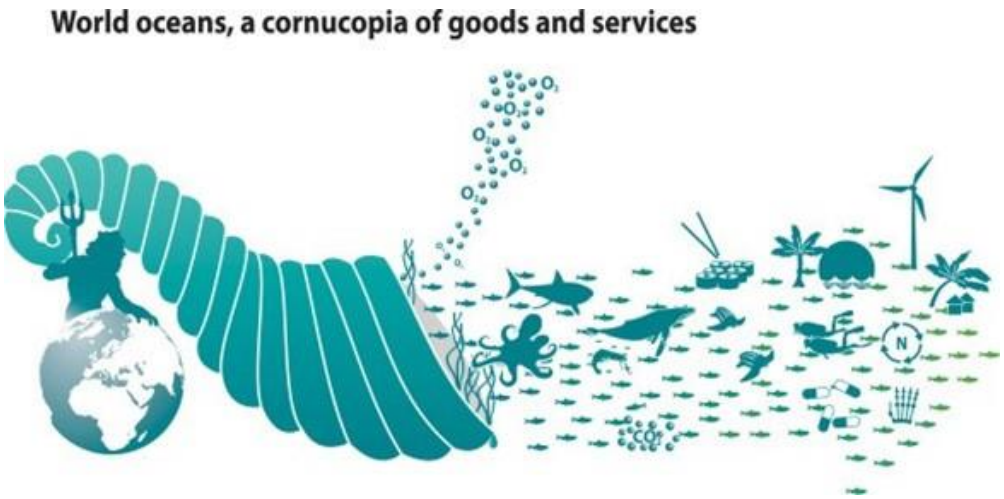


Figure 10. The marine cornucopia

Source: Green Economy in a Blue World (UNEP, 2015)

"Obviously man must enter the sea. There is no choice in the matter. The human population is increasing so rapidly, and land resources are being depleted at such a rate, that we must take sustenance from the great cornucopia"
[Jacques Cousteau, *The Silent World* (1953), quoted in Rozwadowski (2019)].

[o]ceans are the home of an under-recognized and under-appreciated "blue economy." At a time when the world is looking for sources of growth, there is huge potential for "blue growth"—wisely preserving and investing in the value of ocean ecosystems to fight poverty and improve lives.
(Robert Zoellick, President of the World Bank in 2012, quoted in Silver et al., 2015)

As exemplified by the quotes above, cornucopian and frontier imaginaries are easily found in past ocean accelerationist imaginaries and contemporary calls for a sustainable ocean economy. Such visions align with the centrality of growth present in hegemonic blue economy discourses and wider articulations of the global ocean regime (Brent et al., 2020; Jacques & Lobo, 2018; Louey, 2022; Mallin & Barbesgaard, 2020). Although the blue economy was initially framed as a strategy to protect the social welfare of coastal communities and the health of marine ecosystems, particularly those of Small

Island Developing States (SIDS) researchers increasingly recognized the real risk that those tenets “are being sidelined in policy and practice in the push for aggregate economic growth through ocean development” (Bennett et al., 2019, p.1). Early on, social scientists observed multiple and competing interpretations of the term, as this was increasingly being adopted in the ocean governance spheres (Silver et al., 2015), with Voyer et al. (2018) characterizing the blue economy as a 'buzzword' by arguing that it seeks abstract consensus but often fails to achieve concrete agreement. This failure stems from the fact that different actors favor interpretations that serve their own interests, which is facilitated by the unprecise definition of the term.

Indeed, researchers have concluded that the label hardly provides an advancement in practice beyond the sustainable development framework (Keen et al., 2018). However, ecological economists and political ecologists have long pointed out that the sustainable development paradigm assumes that economic growth is imperative to drive the constant expansion of social metabolism (Demaria et al., 2023; Kaul et al., 2022). Scholars have argued that under capitalism, scarcity is regularly invoked as a justification for increasing economic output, as opposed to redistribution, which drives infinite expansion. This mechanism often obscures the fact that continued expansion is a political choice. We argue that the same ideological mechanism is at play in the blue economy's paradoxical depiction of the sea as a fragile, yet rich reservoir of wealth, which calls for the development of productive forces to exploit it sustainably.

The evolution of Spain's relationship with its marine and coastal resources over the past few decades has illustrated a broader global trend. This transition spans from traditional fisheries to aquaculture, and from passive water collection to active desalination, from land-based to offshore oil exploration and drilling. As capitalist economies exhaust terrestrial resources and grapple with the impacts of climate change, the sea increasingly appears as a realm of untapped potential. However, what appears as a shift towards a new vision of sustainability might be the reedition of past trajectories and visions. The 'blue acceleration' in Spain, although developing in a unique historical and geographical context, shares key similarities with today's discourses on the development of the blue economy. These similarities can be identified along the

following three axes: environmental limits, the growth imperative, and technological fixes.

Valdés Díaz-Caneja's (1973) text on the desalination potential previously quoted, read on its entirety pictures perfectly how these three discursive axes come together into a coherent socio-technical imaginary (S. Jasanoff & Kim, 2015) of the cornucopian Ocean as the next economic frontier:

We should not see the future with pessimism, certainly not from Spain's perspective, so abundant in coasts, because, after all, the great alternative will be the sea. The sea will be our greatest reserve resource and we have it in abundance; . . . its exploitation is still rudimentary; . . . for us, it is the great unknown. If the means and the enormous human and economic efforts dedicated to the exploration of the stars . . . had been used in learning about the sea and obtain its benefits, we believe the results would have been far more productive. . . From the sea we can expect great support of all kinds, which are now barely glimpsed." (Valdés Díaz-Caneja, 1973, p. 409-410)

2.5.1. Environmental limits

"Compared to the 150 million square kilometers that represent the emerged lands on which man can develop his agriculture and extractive processes, we have the approximately 371 million square kilometers that constitute the surface of the oceans. Thus, humans are presented with a challenge that is also a vital necessity, because the increasing population density of the planet brings with it the consumption of food in a geometric progression. This challenge is the cultivation of the ocean." (Rubio, 1972a)

In both the Blue Economy and Spanish Blue Acceleration, environmental limits are routinely expressed in terms of resource scarcity, to which the sea can provide a solution. In the early years of the Francoist dictatorship, regime propagandists promoted an imaginary form of widespread scarcity and celebrated the seas as an "unclaimed latifundium," with fish ready to be taken (Gorostiza & Ortega Cerdà, 2016). When the extension and intensity of fishing compromised ecosystems, aquaculture substituted for the expansion of fisheries as a means of assisting the contribution of the ocean to the Spanish economy. Although the surge in aquaculture production was particularly noticeable in the 1990s, the conceptual groundwork for this industry had been laid long

before, as calls for the “cultivation of the sea” were part and parcel of the Francoist strategy for growth, as laid out in the 3rd Development Plan and became a guideline for oceanographic research (Jefatura del Estado, 1972). The naturalization of scarcity and environmental limits continues to be present in dominant blue economy discourses, where issues of systemic inequality and global imperial arrangements are not addressed. Similarly, regarding energy consumption, it is assumed that production must continually increase, with the ocean appearing as the perfect site for the unlimited expansion of renewable energy capacity or carbon sink function (also known as blue carbon).

The discovery of underwater oil fields in the Spanish Mediterranean region marked a significant turning point in energy exploration. This discovery, and the subsequent peak in exploitation, occurred during a time when energy security was exceptionally low, a situation that echoes the challenges we face today. At that time, the urgent need for energy led to intensified calls for the exploration and utilization of energy resources, much like the current demand. This urgency has also ignited keen interest in scientific research and technological innovation that fed off the same prospect of untapped energy resources waiting to be utilized, which sparked the entrepreneurial spirit of the post-war era of ocean discovery. In many ways, the sentiments and discourses surrounding energy exploitation from that period are strikingly like those found under the rubric of the "Blue Economy" which often symbolizes this desire to unlock the potential of the seas through technological progress. Within this framework, the sea is viewed as a vast reservoir of untapped wealth where human innovation can create economic value while preserving the environment.

Reflecting the belief that technology holds the key to unlocking the ocean's mysteries and treasures, the Blue Economy is surrounded by ecomodernist hopes and growth fantasies. Although it is true that the blue economy discourse is coupled with an ecological concern for the condition of marine ecosystems, this is not a particularly novel phenomenon.

“Unlike the sea, land has always been the object of care and planning, which has allowed humanity to harvest after harvest at the same site. The oceans, always mysterious and little-known entities, did not

invite us to consider planning their exploitation. They resembled a huge bottomless pit that offered an endless source of food. However, with the development of oceanography, the sea has begun to be known and has allowed scientists to realize the immense possibilities it offers and that today are, in many aspects, unexploited. At the same time, it has made it possible to realize that in others, subjected to irrational exploitation, the clear danger of imbalance that lies ahead can be corrected if their exploitation persists as before […] Before, the sea offered more than was requested, while today there are many of its resources that have turned on the red light warning of its early extinction or, at least, dangerous diminution." (Rubio, 1972a)

The previous statements constitute examples of a well-known ecological cautionary tale that is commonly encountered in the discourse surrounding the blue economy/blue growth. As environmental and social constraints have become more pronounced in the tourism and fishing sectors, the rhetoric surrounding sustainability has become increasingly prevalent. Despite the incorporation of sustainability rhetoric, the systemic invocation of growth restrictions in the Spanish environment continues to justify the expansion of marine enterprises despite mounting evidence that marine ecosystems are imperiled. For instance, the Minister of Tourism during the height of Francoist development projects advocated for the reproduction and careful use of the nation's tourist capital (eminently, the coastal landscape) to prevent misuse and collapse:

"In many cases, tourist land needs to be created, or at least "recreated, "and its conditioning and management involves innumerable issues, from its own acquisition to its total urbanization, issues that, given the febrile nature of the tourist "boom, "can be distorted by the identity of exacerbated speculation... Demands for the protection of the landscape and the safeguarding of the historic, artistic and monumental sites for which there is an acute concern throughout the world today in the face of the egalitarian and anodyne threat of urbanization"

(Fraga Iribarne, Cortes Españolas, 27 december 1963).

However, celebrations of such natural resources are paired with a perceived lack of hotel beds and infrastructure, resulting in calls for additional roads, motorways, and ocean transit. Initially, any reference to the environment in tourist promotions referred to it in terms of natural resources. However, as the tourist industry expanded and encountered its first social and environmental effects, discourse on tourism promotion gradually incorporated sustainability considerations.

2.5.2. The growth imperative

"The scant interest that has long been devoted to the sea is one of the most obvious symptoms of our political decadence. The Government having resolved that Spain should recover its rank as soon as possible in all lineages of maritime activities, it must stimulate by all means at its disposal the awakening of the country's concern in this regard, beginning with those coastal population centers most immediately and directly affected by the possibilities of all kinds that the sea - repeated and recent witness of national heroism - offers to the peoples who know how to know and dominate it."

(Blanco, p. 564, in relation to the Decree approved on August 8, 1939, establishing the national prizes "The Virgin of Carmen" to develop interest for the seas and their problems

***"Blue Growth** is a long-term strategy to support the sustainable growth of the marine and maritime sectors; it recognizes the importance of seas and oceans as drivers of the European economy due to their great potential for innovation and growth. It is based on the Europe 2020 Strategy that is based on smart, sustainable, and inclusive growth as a way to overcome the structural deficiencies of the European economy, to improve its competitiveness and productivity and sustain a sustainable social market economy, one of its objectives being the promotion of research and technological development."*

(Blue Growth website of the Spanish Ministry of Agriculture, Fishing and Food, which publishes monthly Blue Growth bulletins (*Crecimiento azul*, s.d.)

Facing naturalized scarcity imposed by environmental limits, economic growth is systematically invoked. As researchers have shown, such argumentative logic is pervasive in hegemonic capitalist ideologies and governance. By framing the sea as a frontier, past and present growth strategies situate the ocean space as a place of opportunity to overcome terrestrial environmental limits through growth at sea. In Spain, regime officials framed the sea as a productive territory and a potential inexhaustible protein source that needed to be claimed by the nation to provide for the Spanish population. This vision, combined with a fascist ideology that envisioned a new imperial Spain being constructed through sea routes, led to a self-sufficiency strategy that transformed into an ambitious ecological endeavor to conquer the sea. The project

reflected the ideology of Spanish Fascism that embraced geographical expansion, despite the apparent contradiction with autarkic ideals. The regime promoted the expansion of fishing and merchant fleets as a new navy that would venture into Spain's untapped ocean territories (Gorostiza & Ortega Cerdà, 2016). The dictatorship imposed a regime of scarcity that impoverished the masses but benefited the regime's economic and political elites, while blaming for people's economic hardships external forces such as the losing Republican side, international isolation, the absence of national industry, or the country's lack of natural resources. Franco's response was to call for patriotic sacrifice in rebuilding the country, and to extol the unexploited riches in Spanish soil, colonies, and seas that could be harvested through collective effort and technological advancement.

In this discourse, the ocean was prominently featured as a significant source of untapped wealth, such as national territory reserves of gold, shale oil, and lignite that the dictator fantasized about (Fontana, 2004). During the 1960s, the regime replaced the autarkist economic model with a more open and liberalized approach. As a result, the causes of scarcity shifted to factors such as a lack of hydrocarbons, limited industrialization, inadequate foreign trade, and subpar economic growth, among other culprits. Within this framework, the ocean arises again as a necessary resource or platform to overcome outside-imposed limitations to growth, first through the promotion of fisheries and merchant shipping, followed by tourism and offshore energy production. In that sense, Spain followed global development strategies in promoting the sea as a "commodity for tourist consumption" (Steinberg, 1999, p. 199), followed by the expansion of social metabolism through commodities frontiers and producing new metabolic rifts in the process.

2.5.3. The technological fix

"Our country, due to the great extension of its coasts, has always had a great seafaring tradition, although the scientific approach has been significantly delayed. Sailors and fishermen constantly sailed all the

waters of the planet in search of their end. But today the approach has changed and is no longer the traditional one under which the marine environment is contemplated: scientific research in its different branches, and even the military, are giving way to a real revolution in this field." (Rubio, 1972a)

In both blue economy discourse and Spanish blue accelerationism, the apparent contradiction between environmental limits or scarcity and the growth imperative is systematically resolved through scientific-technological development. Examples of this logical pattern can be found in all four cases examined; for instance, in the 70s technological development and scientific knowledge were expounded as a solution to fish stock decline through aquaculture, or water scarcity through desalination. Regarding the latter, Sywngedouw showed how hydrological technologies advanced the modernization ideology in Spain and were part of the perspective of war against nature, a nature which imposed limits on the Spanish economy and people, but the wealth of the sea presented the opportunity for its resolution. In his chapter “Mobilizing the Seas: Reassembling Hydro-Modernities,” Swyngedouw (2015) outlined how since the 1970s the sea has been systematically depicted as a space of infinite potential to address Spain's perennial water scarcity.

From this perspective, large-scale desalination serves a dual purpose. It was not only a discursive and material tool through which tension and conflict could be mediated and managed but also a means to perpetuate a modernization-based growth trajectory centered around the expanding incorporation of nature within the circuits of capital accumulation. Similarly, March et al. (2014) posited that water desalination was presented as a "new cornucopia" for Mediterranean Spain's persistent water scarcity at the beginning of the 21st century. Despite this, most desalination plants remained idle after their construction. The issue was not with the technology or availability of seawater, but rather with the broader economic and political circumstances surrounding their operations. Swyngedouw (2015) further argued that Spain's 'perennial drought,' used as a recurring discursive device, allowed the blame to be shifted onto nature. This narrative served as a powerful tool that not only justified Spain’s hydraulic mission but also facilitated its expansion to incorporate urban-industrial development and the provision of homegrown energy. The framing of nature as a hostile and

uncooperative entity provides a rationale for aggressive interventions to harness its resources in the form of both water and energy (p. 114).

Important parallels can be drawn here in regard to the debates surrounding the energy transition and the Ocean's potential and capacity to become a main source of renewable energy.

2.6. Conclusions

Marine cornucopian discourses are neither a recent phenomenon nor confined to sustainability platforms, such as the blue economy. The concept of blue growth is more than just an oceanic version of sustainable development or green growth. This is a discursive tool that recasts the sea as a new global frontier for accumulation. This study aims to contribute to empirical investigations of the conceptual grounding and material effects of frontier thinking on ocean-based economic development. It engages with criticism of the capitalist tendency to naturalize limits. Spain's "blue acceleration" in the Mediterranean is the outcome of a historical process that frames social and environmental limits as hurdles to be surpassed through further growth. This discursive reasoning around limits often portrayed the sea as the ultimate frontier for the expansion of Spain's economic forces. This expansion was seen to 'emancipate' the country from its resource constraints, economic difficulties, and political conflicts. In this study, we demonstrate how the growth of sectors such as large-scale desalination, coastal tourism, fishing and aquaculture, offshore hydrocarbon extraction, and shipping was promoted as a necessary response to the perceived scarcity created by external limitations.

The central assertion of this chapter is that the blue economy, despite being presented as a novel concept and a departure from the past, actually shares numerous similarities with past blue acceleration discourses and narratives. Despite the apparent differences, the commonalities found between such visions continue to be reproduced on ocean

development visions and imaginaries. The lineage we explored should serve as an alert regarding the impacts of approaching human interactions with the marine environment with a frontier mentality. We can see clear parallels between the naturalization of limits and scarcity, the call for economic growth to overcome them, and the default reliance on techno-scientific development to achieve this. Fisheries decline and offshore hydrocarbon depletion exemplify the destruction wrought by an economy with an insatiable appetite for resources and a constant need for expansion. Aquaculture and renewable energy represent attempts to correct the unsustainable growth trajectory, which when first presented, supposedly do not have significant negative social or ecological consequences –as other fixes before them— but whose real repercussions remain unknown or obscured. Similarly, the social and ecological conflicts arising from tourism highlight the limitations of this model, while desalination underscores the pitfalls of techno-utopianism.

The conflict between the endless expansion of human activity at sea and the ecology of marine systems necessitates a new relationship with limits on the ocean economy. In capitalist societies, casting limits as external to society, as part of nature, is a mechanism for invoking limits to overcome them through further growth. Instead of assuming endless growth of desire and demands to satisfy such desires and then using technological and social advancements to meet them, a sustainable ocean economy should start by questioning such desires and uses by making the space for democratically deciding which ones are worth pursuing. Therefore, we need a post-growth model for the ocean economy that respects limits to achieve ecological sustainability and social equity.

Chapter III: The Blue Growth Imperative

Article - Growth in the Docks: Ports, Metabolic Flows, and Socio-environmental Impacts[13]

3. Abstract

Shipping carries virtually all internationally traded goods. Major commercial ports are fully integrated into the transnational production and distribution systems, enabling the circulation of massive flows of energy and materials in the global economy. Port activity and development are usually associated with positive socioeconomic effects, such as increased GDP and employment, but the industry's continuous expansion produces adverse outcomes such as air and water pollution, the destruction of marine and coastal environments, waterfront congestion, health risks, and labor issues. In its quest to marry economic growth and environmental sustainability in the maritime industries, proponents of the newly coined *blue growth* paradigm assume the negative impacts of ports and shipping to be fixable mostly through technological innovation. This paper questions the validity of the premise that the unlimited growth of the port and shipping activity is compatible with environmental sustainability and analyses the feasibility of technological improvements to offset the sector's associated negative impacts. Based on insights from ecological economics and political ecology, ports can be described as power-laden assemblages of spaces, flows, and actors, which produce unequally distributed socioecological benefits and burdens at multiple scales. Focusing on the case of the Port of Barcelona, this study argues that the continuous expansion of port activity increases seldom accounted-for negative socioenvironmental impacts, acquiring an uneconomic character at port cities and regions. In contrast, degrowth is presented as a radical sustainability alternative to ocean-based growth paradigms. The paper concludes

13 This article was published in Sustainability Science in 2020

by discussing its prospective ‘blue’ articulation in the context of maritime transportation while offering some avenues for future research and policymaking.

Keywords: Ports; Shipping; Blue Economy; Blue Growth; Environmental Impacts; Degrowth

3.1. Introduction

The seas have long been sites of capital accumulation and economic growth. As maritime trade routes, resource frontiers, or waste sinks, they have become the "forgotten" but critical spaces of industrialized societies (Story, 2012). While shipping is responsible for the movement of up to 90 percent of trade goods in volume (UNCTAD, 2019), its crucial role in providing the material basis of current socioeconomic systems remains obscure. In recent years, a series of international organizations, financial institutions, think tanks and environmental NGOs have been promoting the twin concepts of ‘blue economy’ and ‘blue growth’ in order to visibilize the present economic importance and the future potential of ocean resources and maritime industries (FAO, 2018; OECD, 2019; The Economist, 2015; World Bank, 2019; WWF, 2015). Although lacking a unified definition (Boonstra et al., 2018; Silver et al., 2015), these concepts are rooted in a cornucopian vision of the Ocean as the great but delicate container of unexploited wealth, an image also present in the United Nations’ sustainable development discourse (Steinberg, 1999). *Blue growth* proponents position the sea as pivotal in the resolution of humanity's most pressing social and environmental problems –such as secular economic stagnation, resource depletion, and ecological crisis—, promoting the idea that an expanded and intensified use of the ocean’s vast natural assets and ecosystem services can be realized sustainably based on new technologies, market forces and technocratic regulation, which will boost global economic growth (OECD, 2016). This highly optimistic vision about the ocean’s economic potential has a precedent in the futuristic imaginaries of post-war “ocean boosters,” such as Arthur C. Clarke and

Jacques Cousteau, who popularized the cornucopian imagination about the marine world in the 1950s and 60s (Rozwadowski, 2019).

The *blue growth* paradigm purports to bring "win-win-win" solutions beneficial to the main stakeholders of the ocean's future: coastal communities, businesses, and the environment (Barbesgaard, 2018). Following this framework, the OECD (2016) and the European Commission (2017a) promote shipping as an established ocean-based industry which – together with emerging industries such as seabed mining and marine biotechnology– offers a high potential for sustainable development. This paper questions the validity of the *blue growth* premise that the unlimited growth of the port and shipping industries is compatible with environmental sustainability and analyses the feasibility of technological improvements to offset the sector's associated negative socioecological impacts. To that end, the article offers a critical and comprehensive account of port activity and development, while exploring alternative paths to a more sustainable maritime transportation sector. This research seeks to contribute to the development of sea-oriented emancipatory politics (Kosmatopoulos, 2019) and a socio-ecological sustainability research agenda (Asara et al., 2015; Longo et al., 2016) by articulating the "degrowth hypothesis" (Kallis et al., 2018) in the context of the maritime transportation industry.

Degrowth is a subversive proposal for a radical political and economic transformation of society (Kallis & March, 2015), which is often described as a 'challenge' and 'critique' to the growth hegemony in economic thinking and social imaginaries (D'Alisa et al. 2015). Degrowth proponents aim to initiate a "democratically-led redistributive downscaling of production and consumption" by drastically reducing resource and energy throughput in the rich countries to achieve environmental sustainability, social justice, and well-being (Demaria et al., 2013, p.209). The degrowth scholarship addresses the contradiction between

environmental sustainability and the pursuit of continuous capital accumulation, repoliticizing the debates on the science and practice of sustainability.[14]

Even amidst a global ecological collapse and climate breakdown, the idea that infinite economic growth and environmental goals might contradict each other (Steinberger et al., 2012) remains anathema to blue economy proponents and mainstream sustainability discourse (see Editorial in this issue). The vagueness and plasticity of the concept of 'sustainability' have generated contrasted discourses and meanings over time (Mebratu, 1998; Caradonna, 2018). As noted by Muraca and Döring (2018), the sustainability discourse is often articulated under the guise of the 'sustainable development' idea, which naturalizes capitalist social relations and corollaries such as the growth imperative (Longo et al., 2017). In industrialized societies, the ideological hegemony of the growth "fetish" (Schmelzer, 2015) **sits** behind the formation of an uncontested common sense concerning the natural, necessary and desirable character of economic growth (Kallis, 2018). The blue economy discourse taps into the socially established growth paradigm to construct an ocean-based "economentality" (Mitchell, 2014), whose central vision is the ocean as the new economic frontier; the source for an imagined future or "fictional expectation" (Beckert, 2016) in which economic growth and environmental sustainability can be married (Arbo et al., 2018).

In the context of a global destabilization of Earth's life support systems, degrowth proponents defend the radical idea of setting social and ecological limits to the expansion of economic activity as a means to achieve human flourishing and planetary wellbeing (Kallis, 2019; Schneider et al., 2010). Hadjimichael (2018) recently coined the term *sustainable blue degrowth* as an alternative to the mainstreaming of the *blue growth* paradigm both in ocean research and governance circles. Building upon other critical analyses on the ocean expansion of capital accumulation (Campling 2012; Clausen & Clark, 2005; Ertör & Ortega-Cerdà, 2018; Murray, 2015; Saguin, 2016), the following text joins other contributions to this

[14] See the Special Feature "Socially Sustainable Degrowth as a Social-Ecological Transformation" edited by Asara, V., Otero, I., Demaria, F., & Corbera, E. (2015) in this same journal.

Special Feature aiming at deconstructing and counteracting the ideological staging of what has become capitalism's latest assault on the seas.

3.2. Theoretical framework & Methodology

This research builds upon insights from the fields of ecological economics (EE) and political ecology (PE), which have proven to be a fruitful analytical combination for the study of complex socio-ecological realities (Martinez-Alier et al. 2010; Spash 2017; Gerber et al. 2009). EE adopts a biophysical view of the economy and conceptualizes it as a system embedded in the environment (Martinez-Alier 2015). The central concept of social metabolism refers to the processes in which biophysical inflows and outflows are organized to sustain social systems through the extraction, transformation, consumption, and disposal of energy and materials (Martinez-Alier et al. 2010; Molina and Toledo 2014). PE brings a critical approach to the study of socio-ecological dynamics, with a particular interest in the conflicts they generate and in the constitutive role of power relations (Billon 2015; Svarstad et al. 2018). PE's epistemological departure point is that differential power relations unequally distribute socio-ecological benefits and burdens, resulting in environmental injustices, and conflicts (Robbins 2012). Some researchers have promoted PE as a critical complement to EE's biophysical perspective, which often lacks a strong socio-political and historical content (Burkett 2009; Murray 2015; M'Gonigle 1999). A combined EE and PE approach allows for a more nuanced understanding of the processes of production, reproduction, and social mediation of the materiality of life (Heynen et al. 2006; Spash 2011). Previous works linking the metabolic and (urban) PE perspectives have mostly analyzed the extraction (Arboleda 2016), production (Huber 2017), consumption (Delgado-Ramos 2015), and disposal (Demaria and Schindler 2016) aspects of social metabolic expansion.

This research addresses the existing gap in the literature on the means and processes of metabolic circulation by looking at the role of contemporary global transportation and logistics systems. The paper is based upon a literature review combined with qualitative research and fieldwork carried at the Port of Barcelona. Ports are complex assemblages of spaces, flows, and actors whose activity and

development produce socio-ecological benefits and burdens at multiple scales. Due to space constraints and for the sake of simplicity, this paper will focus on just some key analytical elements mapped during the fieldwork (Fig. 1). Research was conducted following the case study methodology, combining data from primary sources—grey literature from the port, governmental bodies and environmental agencies—and 11 semi-structured and in-depth interviews with port researchers, workers, public officials, journalists, grassroots activists and environmental NGOs conducted between March and June 2019. Interviewees were selected through purposive expert sampling to represent a broad spectrum of interests and knowledge regarding port activity and development.

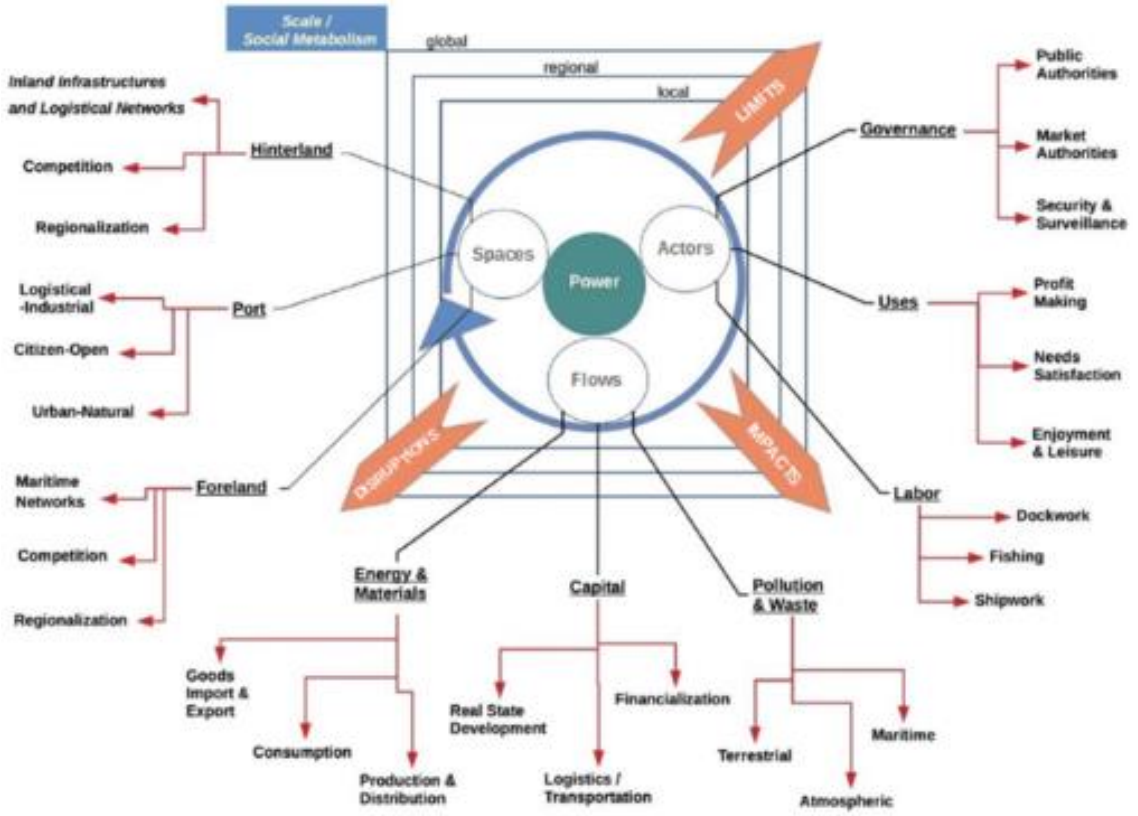


Figure 11. Conceptual diagram for a PE and EE analysis of port activity

Source: Own author

3.3. The port research literature

Human geography was among the first disciplines to consistently engage with port research, starting in the 1950s, with pioneering works on port development and the port-city relationship (Bird 1963; Gottmann 1951). As Ng observes (2013), geographical research progressively dropped its humanistic content and adopted more functionalist approaches that highlighted profit-making and efficiency oriented meanings (Ng et al. 2014), increasingly collaborating with the fields of applied (port) economics, logistics and supply chain management (SCM) (Pallis et al. 2010, p. 201). The approaches within these fields adopt a positivist methodological paradigm, combining mathematical modeling and advanced statistical analysis (Woo et al. 2011).

The other relevant body of literature dedicated to seaports has its origins in emerging preoccupations with the ecological impacts of port activity during the 1980s. This research comes from a diverse disciplinary background, spanning across marine ecology (Katsanevakis et al. 2014), oceanography (Tournadre 2014), environmental planning and coastal management (Nebot et al. 2017; Pearson et al. 2016), maritime policy (Acciaro et al. 2014; Poulsen et al. 2018), environmental and coastal engineering (Grifoll et al. 2011), environmental and ecological economics (Carić 2016; SazSalazar et al. 2012) and industrial and urban ecology (Cerceau et al. 2014; Darbra et al. 2005; Mat et al. 2016; Puig et al. 2014). Most of this scholarship focuses on the negative impacts of the shipping industry on human and non-human communities, proposing technical or policy solutions, but rarely addressing questions of power relations, environmental injustices, or social conflict.

Despite a recent upsurge of interest in oceans,2 and the publication of notable works in geography and sociology dealing with maritime transportation (Anim-Addo et al. 2017; Chua et al. 2018; Cowen 2014; Birtchnell et al. 2015; Wilmsmeier and Monios 2015), PE and EE researchers have brought limited contributions to the subject. Some relevant works dealing with ports and shipping from a broader PE perspective have studied the production of socio-natures on urban waterfronts (Bunce and Desfor 2007; Desfor and Vesalon 2008; Laidley 2007), the ecologically destabilizing practices of standardizing global transportation

infrastructures (Carse and Lewis 2017), the expanding scale of shipbreaking as a result of the sector's growth and contraction periods (Sibilia 2019) that generate ecological distribution conflicts in coastal areas of the Global South (Demaria 2010), the impact of freight throughput on the health of communities adjacent to ports (Houston et al. 2008) or the role of the flag of convenience system of open registries as a particular form of capitalist sovereignty at sea (Campling and Colás 2018).

3.4. Three aspects of port growth

3.4.1. The growth imperative

Economic competition underlies the activity and development of commercial ports. The sector follows a capitalist grow-or-die logic in which the investment of surplus is the goal and precondition for greater surplus creation and further investment. Port operators struggle to acquire a bigger market share, ports compete against each other to capture more traffic flows, and port regions vie to become the main gateways to entire national markets (Ducruet and Lee 2007; Merkel 2017; Notteboom et al. 2017). Port management models differ in the ratio of public-to-private participation, but virtually all assume a market-centric perspective on the goals of port functions and development (Brooks and Cullinane 2007). In the landlord port management model, dominant in large and medium-size ports, the port grounds are state-owned but leased to private operators who offer their services to incoming ships (World Bank 2006). Following this model, a public body manages the port (usually the Port Authority) and must ensure the development of competitive infrastructure for its private operators and customers, while also contributing to regional and national economic growth (Bergqvist and Monios 2019; van der Lugt et al. 2014).

Until the mid-twentieth century, commercial ports in most capitalist countries were public assets managed under a centralized regulatory framework, with minimal competition within and between them (Brooks and Cullinane 2007; World Bank 2006). In general, traditional bureaucratic port management schemes did not prioritize efficiency but focused instead on providing positive economic benefits

for the local and regional economies by assuring a high level of employment and stimulating industrial production (Ferrari et al. 2015). This model began to change in the 1980s when port systems in most Western countries went through a devolution reform process based on three principal instruments: decentralization, privatization, and greater competition (Brooks and Cullinane 2007). The goal of these reforms was to improve the efficiency of port services and their responsiveness to global market dynamics (Coto-Millán et al. 2016). International financial institutions engaged in the neoliberal restructuring of global production such as the World Bank widely promoted these policy changes (Debrie et al. 2013; World Bank 2006), enabling the creation of globally integrated just-in-time production schemes and demand-driven commodity chains (Bonacich and Wilson 2008; Gereffi and Korzeniewicz 1994). However, even after several rounds of reform, most commercial ports in advanced capitalist economies remain in part publicly managed and funded[15] (Bergqvist and Monios 2019). Currently, the high capital costs of port activity and development encourage the maximum utilization of fixed assets, leading to a process of spatial sorting that marginalizes some ports by driving the "spatial concentration of freight flows at one or two big ports by region" (Guerrero 2014, p.84). In this development phase, known as regionalization, a port acts as the main load center in a regional network of multimodal logistical platforms, concentrating greater quantities of flows and operating at higher geographical scales through the externalization of port operations to its hinterland (Notteboom and Rodrigue 2005; Rodrigue et al. 2016). This process turns major commercial ports into outsized consumers of physical space onshore and inland, promoting the development of coastal and hinterland transportation infrastructures and requiring constant capacity upgrades to handle ever-growing freight throughput.

3.4.2. Socio-environmental impacts

Port activity and development produce a series of negative social and environmental impacts, such as air and water pollution, seafloor erosion, wave and

15 With the exception of countries like the United Kingdom, where much of the port system has been fully privatized since the onset of Thatcher's neoliberal reforms.

current regimes alteration, introduction of invasive species, underwater noise pollution, land-use change, waterfront congestion, and health and labor issues (Bonacich and Wilson 2008; Darbra et al. 2005; Dinwoodie et al. 2012; Gupta et al. 2005; Merk 2013; Puig et al. 2014; Walker et al. 2019; Wooldridge et al. 1999). Although shipping is the most significant source of these problems (Cullinane and Cullinane 2013; Merk 2014; Micheli et al. 2013) land-based operations, such as cargo handling, maintenance, and construction works, dredging, and other logistical operations produce additional atmospheric emissions, sewage, solid waste, leakages of harmful materials and accidents (Cowen 2014; Gupta et al. 2005; Lam and Notteboom 2014; Peris-Mora et al. 2005). To satisfy the need for spatial expansion, ports often relocate from city centers to specially designed areas at the urban periphery (Birtchnell et al. 2015), or they overcome constraining natural barriers by expanding into adjacent locations or out into the sea (World Bank 2006). The construction of port infrastructure has a direct bearing on the structure and configuration of the coast, as it replaces natural sandy or rocky seabeds with artificial blocks and landfill, changing the direction and intensity of coastal dynamics (Alemany 2006). The maintenance and expansion of port facilities also affect marine and coastal ecosystems, mainly through the dredging of large volumes of sediment required to maintain the water depths adequate for berthing the ever-bigger ships, a practice that is expensive and ecologically destabilizing (Carse and Lewis 2017). The proliferation of mega-ships represents another growth-driven socio-ecological disruption of the sector. On the one hand, their carrying capacity is so large that it is rarely fully used; and on the other, it often becomes a logistical bottleneck as most ports cannot handle it efficiently (Wan et al. 2016; International Transport Forum 2015). Mega-ships' oversized dimensions pose navigation difficulties in traditional shipping routes without enough water depth, canals lacking width or ports with no maneuvering room (Grammenos 2013). The gigantism of vessels decreases cost savings and requires constant infrastructure expansion and upgrades, often leading to port infrastructure overcapacity and redundancy (European Court of Auditors 2016; Haralambides 2019; Núñez-Sánchez and Coto-Millán 2010) while creating greater socio-ecological pressures for marine and coastal environments (Wan et al. 2016) such as the constant dredging of canals and harbors required to be

accommodated (Carse and Lewis 2017). Moreover, crew sizes are about 60% smaller than in 1970 while ships are about three times larger (Walters and Bailey 2013) which has resulted in an intensification of labor: seafarers work longer shifts, have flexible tasks and are rarely given free days or shore leave (Alderton et al. 2004). These developments, coupled with the poor labor regulations facilitated under the system of open registries or 'flags of convenience,' partially explain why contemporary seafaring stands as one of the most precarious and dangerous professions globally (Walters and Bailey 2013; Roberts et al. 2014). Shipping is the most energy-efficient transportation mode for large volumes of cargo (Wan et al. 2016): it uses only 7% of all energy consumed by global transportation activities while carrying about 90% of global trade goods (Rodrigue et al. 2016), and has a much lower ratio of CO2 emissions per ton-kilometer compared to road transportation (Song and Panayides 2012). Nonetheless, the maritime transportation industry is powered by massive consumption of fossil fuels, amounting to 300 Mtonne (fuel oil equivalents) in 2012 (Fridell 2019), with resulting aggregate GHG emissions making up 2–3% of the global total emissions (IMO 2015). Ships use cheap, unrefined, and highly polluting fuels known as heavy fuel oils, which emit higher levels of CO2 and much higher levels of nitrogen oxides (NOx), sulfur oxides (SOx), and particulate matter than diesel burned on land. These emissions have all been shown to be harmful to the environment and human health (Cullinane and Cullinane 2013; Fridell 2019; Tian et al. 2013), causing around 50,000 premature deaths in Europe in the year 2000, according to Brandt et al. (2011). Shipping is one of the least regulated anthropogenic emission sources (EEA 2013) and, along with aviation, it has been omitted from all international agreements on climate change since the Kyoto Protocol. Projections show that in a business-as-usual scenario the industry could account for 17% of global CO2 emissions by 2050, as demand for shipped goods is expected to increase (European Parliament 2015; IMO 2015).

Facing the prospect of a fourfold rise in emissions from global shipping by mid-century (Merk 2014), the International Maritime Organization signed a landmark agreement in April 2018 to halve carbon emissions by 2050, in addition to introducing a strict global sulfur cap to be implemented in 2020. To meet these reduction targets, industry experts have developed the concepts of "green shipping" and "green ports,"

favoring decarbonization strategies that strike a balance between environmental sustainability and economic growth (Acciaro et al. 2014; Lam and Notteboom 2014; Lam and Van de Voorde 2012; Psaraftis 2016). Most of these strategies rely on the substitution of bunker fuels with liquefied natural gas (LNG), together with the use of filtering techniques, more energy-efficient vessel designs and the deployment of renewable energy use in ports and on ships (Davarzani et al. 2016; Wan et al. 2018, 2016). However, researchers have pointed out that LNG can only provide a marginal reduction in greenhouse gas (GHG) emissions, as the methane leakage during the extraction, transportation, and bunkering of LNG can render its purported benefits insignificant (Baresic et al. 2018; Speirs et al. 2019). Methane has a global warming potential (GWP) 86 times higher than CO2 over a 20-year time horizon, which is why, according to some estimations, LNG substitution could increase shipping's current carbon footprint (Kollamthodi 2016). Big shipping companies like NYK and Wallenius have recently promoted hydrogen as an alternative non-fossil fuel with minimal environmental impacts, although its practical deployment is currently anecdotical and limited to short distance travel. However, Cullinane and Cullinane (2013) list a series of complications in using hydrogen as a "clean" alternative. First, hydrogen is not an energy source but an energy carrier, which means that energy has to be produced from other sources, making it only as clean as these sources are (Euractiv 2012). Second, it acts as an indirect greenhouse gas with potential global warming effect (Collins et al. 2002). Third, its usage would require building whole refueling infrastructure networks; and the fuel-cell batteries require expensive materials like platinum, whose extraction and refinement produce additional negative socio-environmental impacts (Cullinane and Cullinane 2013).

In addition to a transition from heavy fuel oils to LNG or hydrogen, researchers have also promoted slow steaming for intentionally decreasing speed to curb fuel consumption—as an emissions abatement strategy that increases efficiency without added resource consumption and coupled environmental impacts (Chang and Wang 2014). But as Wan et al. conclude (2018, p. 430), slow steaming may at best offer a partial solution, and is unlikely to be applied at the scale necessary to achieve a significant emissions reduction, as it will "inevitably increase transit time and other operating costs (e.g., on-board labor costs) and reduce on-time

performance possibly interrupting logistics reliability." Overall, the combination of LNG and slow-steaming strategies with highly ambitious energy efficiency improvements are likely to fall short of the IMO's 50% carbon emissions reduction target (Bergqvist and Monios 2019; Speirs et al. 2019). Given the aforementioned contradictions and shortcomings it can be argued that, in regards to atmospheric pollution and GHG emissions from shipping, blue growth theory resembles its land-based green growth precursor in lacking an empirical basis for the argument that increased economic activity can decouple from associated negative socio-environmental effects (Hickel and Kallis 2019; Parrique et al. 2019).

3.4.3. The production of uneconomic growth

Port activity and development are commonly associated with beneficial socio-economic impacts in their host localities, as they advance and facilitate international trade, and therefore economic growth. This assumption echoes the widely held view behind the 'growth idea,' which is that growth is always economic, i.e., that it makes people richer, not poorer (Daly 1999a). But according to ecological economist Herman Daly growth also has an "uneconomic nature", expressed when the optimal scale of the economy within its hosting ecosystem is exceeded, increasing "environmental and social costs faster than production benefits" (Daly 2014). Since usually only production benefits are measured and not their attached socio-environmental costs, economists typically fail to recognize the uneconomic character of growth. "Illth" refers to the often-obscured socio-ecological cost incurred by economic growth: when illth increases faster than wealth, people get poorer rather than richer, producing uneconomic instead of economic growth (Daly 2014). Maritime transportation has facilitated and sustained the expansion of social metabolisms throughout history (Armitage et al. 2017; Bevan 2014; McPherson 1997). Historical economist Douglass North (1958) famously argued that the eighteenth century's fall in freight costs, combined with the expansion of international trade and technological improvements in shipping, had a positive effect on capitalist development as it widened the resource base of Western countries and provided the raw materials for industrialization. Indeed, shipping was fundamental to the expansion of European colonialism, by allowing the forced transportation of

millions of enslaved humans across the Atlantic (Rediker 2007), facilitating exctractivism and the advancement of commodity frontiers (Moore 2000) while also exporting the jurisdictional, legal and socio-technical structures required for the deployment of the colonial enterprise (Mawani 2016). In fact, and as Campling and Colás point out (2018, p. 3), historians of large-scale socio-economic processes such as Fernand Braudel see capitalism as "a world-system emerging out of maritime trade during the long 16th century and premised on the accumulation of mercantile wealth in seaports like Venice, Genoa, Amsterdam, and London." Indeed, ports have historically acted as catalysts of capital accumulation and urban development, exemplified by the fact that most major cities have developed originally as port cities. According to Fujita and Mori (1996), in 1920 the ten largest US cities all developed as port cities, most of which remain major cities today.

During the post-war capitalist restructuring of global production, the introduction and standardization of the Twenty-foot Equivalent Unit container (TEU) exponentially sped up cargo shipping and handling, affecting the entire structure of supply chains (Levinson 2016). Containerized freight became the physical expression of international trade, with traffic levels growing at a faster rate than both the value of exports and global GDP due to the shipping industry's economies of scale, which continually reduce transportation's economic costs (Dean and Sebastia-Barriel 2004; Stopford 2009). Since the 1970, global seaborne trade has quadrupled in tonnage (UNCTAD 2019) mirroring cyclical fluctuations in the rate of global economic growth, as industrial production drives most of the demand for sea-traded goods (Stopford 2009). This relationship is most apparent in the decline in shipping traffic that occurs during economic recessions: in 2009 seaborne trade dropped by 20% compared to the previous year as a result of the global financial crisis (Pallis and de Langen 2010). Besides, transshipment traffic has also been growing at a faster rate than regular container traffic (Stopford 2009), signaling a shift in port activity towards more purely logistical functions such as the handling of cargo bound to third destinations as opposed to catering industrial production in the host regions.

A well-established common sense among industry stakeholders and expertise is that ports function as "springboards for economic development" enabling higher levels of output, income, and employment in their host cities and

regions (Wang 2007). Indeed, some empirical research appears to support the hypothesis that port activity and development have positive effects on trade and productivity (Bottasso et al. 2018; Clark et al. 2004) local and regional employment (Bottasso et al. 2013; Fageda and Gonzalez-Aregall 2017), and regional development (Bottasso et al. 2014). However, this body of literature is limited, and as Ferrari et al. (2019, p. 236) have recently noted, most of it "struggles to go beyond robust correlations in the data given the difficulty of constructing convincing instruments or finding credible quasi-natural experiments." Port economic impact studies (PIS) represent another stream of research that looks at the relation between port activity and economic benefits (Chang 1978). Port Authorities and economic stakeholders usually rely on these publications to "maintain and strengthen the societal acceptance of seaport activities" (Dooms et al. 2015, p. 2). Many academics consider this type of research to have significant epistemological and methodological shortcomings and to lack scientific interest (Coto-Millán et al. 2010; Ferrari et al. 2001; Hall 2004; Merk and Hesse 2012).

Since the onset of neoliberal globalization, researchers have found it increasingly difficult to directly correlate port activity and development to positive economic impacts in host cities and regions (Bottasso et al. 2013; Ducruet et al. 2016; Ferrari et al. 2019; Haralambides 2002). The deployment of capital-intensive cargo handling systems decreases labor-intensive port operations, leading to reduced employment (Musso et al. 2000). In fact, studies have found a weak (Ferrari et al. 2001; Heijman et al. 2017) or even negative relation (Grobar 2008) between port throughput and local and regional employment. The presence of transport infrastructures facilitates the import of cheaper goods which can reduce the demand for less competitive local products, decreasing regional growth and employment levels or even wiping out local industries (Bottasso et al. 2013; Fujita and Mori 1996). Moreover, waterfront congestion in urban cores has pushed both cargo handling activities and related productive industries away from port cities into specialized industrial-logistical spaces in the hinterland such as inland intermodal terminals, container depots and distribution centers (Haralambides 2017; Musso et al. 2000).

The "de-maritimization" process of port activity (Ferrari et al. 2006; Lee et al. 2008) allows for increased efficiency in handling ever-higher freight throughput

but it does not create much additional economic activity, employment, or added value for port regions (Musso et al. 2000). In fact, as port functions become interlocked with globalized economic processes, they progressively delink from the economic development of their host localities (Ducruet et al. 2016; Zhao et al. 2017), because a greater share of the economic value produced by port activities is dispersed away from port regions into the entire economic area of port customers and operators, while the negative social and environmental burdens remain concentrated at the local and regional levels (Ferrari et al. 2001; Grobar 2008; Haralambides 2002). These developments seem to confirm Daly's (1999b) claim that globalization acts as a stimulus for uneconomic growth as trade liberalization and free capital mobility accelerate illth-production processes such as increased income inequality (Cornia 2004; Hickel 2017) and environmental impacts (Wiedmann et al. 2015; Steinberger et al. 2012). Indeed, researchers have linked trade liberalization with rising carbon emissions from shipping as the reduction of tariffs raises the demand for imported goods, increases the profitability of practices such as redundant trade or re-importation, and promotes the geographical dispersion of global production in facilitating capital's access to cheap pools of labor and resources (Islam et al. 2019; Liu 2013).

3.5. The Port of Barcelona: wealth and illth

The case study is situated on the northeastern corner of the Iberian Peninsula. Covering an area of over 10 km2, the Port of Barcelona (PoB) (Fig. 2) is among the busiest commercial ports in the Western Mediterranean and the top cruise port destination in Europe (Barcelona City Council 2012). Barcelona is representative of what Ducruet and Lee (2007) call a maritime city: cities such as Marseille, Cape Town, or Buenos Aires where port functions are efficient despite their proximity to large urban environments.

Figure 12. Aerial view of the Port of Barcelona

Source: Port of Barcelona

3.5.1. Wealth

The PoB handles 71% of regional and 22% of national foreign trade, ranking first among Spanish ports in turnover and goods value (PoB 2017) and it acts as a primary gateway for Europe–East Asia international trade routes, with China as its major trading partner. The PoB's position near the traditional Mediterranean trunk route has recently helped to attract a share of the traffic growth resulting from Chinese strategic investments in the region as part of the 21st Century Maritime Silk Road Initiative (Chaziza 2018; Wang 2007). The Port is a fundamental infrastructure of Barcelona's urban metabolism as it plays a vital role in the metropolitan energy production and distribution systems. Moreover, the PoB is a leading regional distribution hub for hydrocarbons in the Western Mediterranean and North Africa (PoB 2017). The energy wharf contains Spain's biggest natural gas storage and regasification plant which periodically receives liquified natural gas (LNG) shipments from its three main suppliers (Qatar, Algeria, Nigeria) which then is injected into the gas supply network or re-exported to faraway places like Brazil, Japan, South Korea and India (Nualart and Pérez 2017). The PoB is managed according to the landlord port model, the mixed public–private management model most commonly adopted in Europe. The Port grounds are publicly owned and managed by the Port Authority

of Barcelona (PAB), but they are leased to private operators to carry out their business. Despite being a public entity dependent on the Ministry of Industry, the PAB is fully market-oriented: its main aim is to provide a competitive infrastructure for the benefit of the private enterprise. Although the PAB nominally includes political and labor representatives, they lack authority in front of powerful economic actors, such as the big shipping companies and terminal operators, real estate developers and energy companies, for which the institution works as a business facilitator (Solé-Figueras 2019). Containerized cargo represents the largest share of the Port's freight throughput (PoB 2018). The container terminals at the PoB are operated by two giants of the sector: APM Terminals and Hutchinson Ports, which together operate more than 200 port and inland terminals worldwide. The three biggest shipping line companies in the world, Maersk (owner of APM Terminals), Mediterranean Shipping Company (MSC) and China Ocean Shipping Company (COSCO), which together control almost half of the global share of containerized traffic (Alphaliner 2019), have regular shipping lines at the PoB. The world leaders of the cruise ship industry also have a permanent presence at the port: Carnival Corporation, Royal Caribbean, Norwegian Cruise Line, and MSC Cruisers, which together dominate almost 90% of the cruise market. The Spanish national port administration (Puertos del Estado) and the PAB have given cruise companies a series of tax reductions, fiscal benefits, and concession extensions to attract and consolidate the sector's growth (Solé-Figueras 2019).

Global and national economic developments, coupled with the PoB's consolidation as a regional hub, resulted in a 26% traffic increase in 2017 compared to the previous year, making the PoB the fastest growing port in Europe that year and registering a 50% increase in profits, a record-breaking result touted as a "qualitative leap" by the then Ministry of Industry and President of the Port. In 2018, the Port also achieved the highest record of 3 million cruise passengers, consolidating its position as the leading European port in cruise ship traffic. That same year freight traffic grew by 10%, registering the highest record again in the Port's history in terms of traffic and profits (67.7 million tons of general cargo and 57.3 million euros). Much of this traffic growth was due to transshipment, i.e., cargo that is received and re-exported to another location, a process weakly related to local and regional economic activity

(Fig. 3). As pointed by Murray (2012), the PoB presents itself as the major logistical hub in Southern Europe while generating an effect on the Western Mediterranean similar to the 'Rotterdam effect' on the North Sea in which the redistribution of massive quantities of commodities to and from other locations often leads to inflated trade figures and over-accounting.

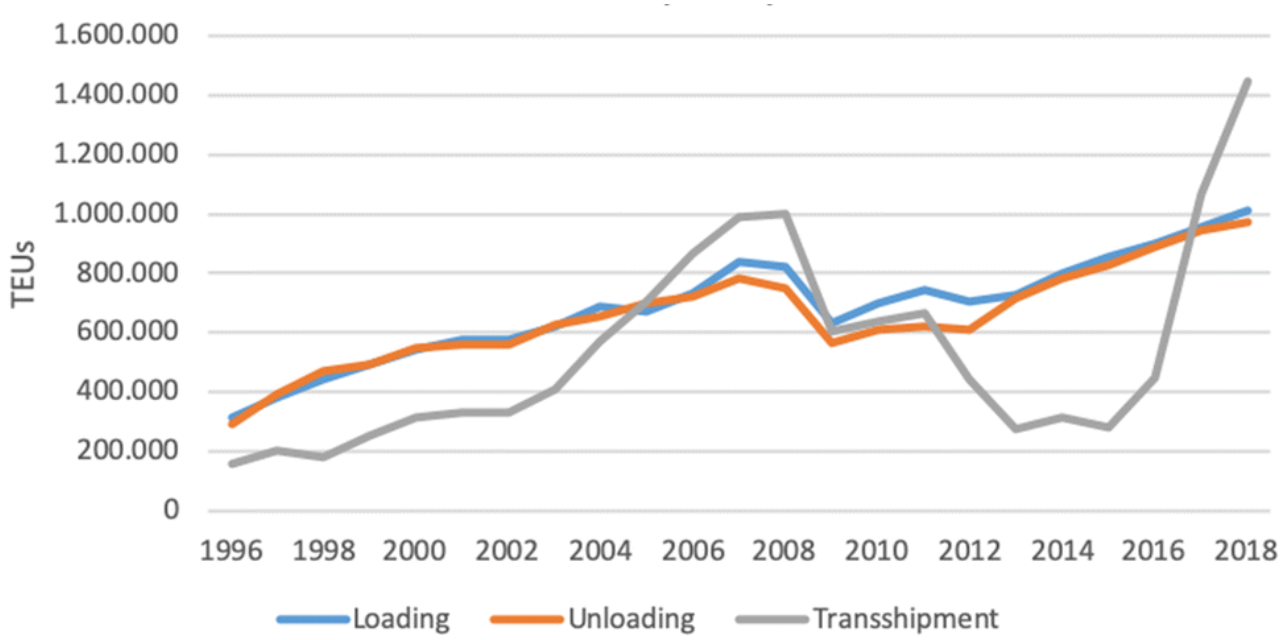


Figure 13. Containerized traffic per operation at the PoB

(Recent record-high traffic levels at the PB are due mostly to an increase in transshipment)

Source: Port de Barcelona. Own elaboration

To achieve these results, the PoB is in constant competition with neighboring ports to attract and maintain traffic flows from overlapping hinterlands and maritime trade routes. The Port of Valencia is the other major Spanish port for deep-sea cargo and Barcelona's main gateway competitor in the Western Mediterranean, in contrast to Algeciras which is almost wholly dedicated to transshipment, with other regional competitors being Genoa, Naples, and Marseille (Monios 2011; Moura et al. 2017). Improving hinterland accessibility is one of the main strategies pursued by port authorities to capture higher market shares and become more competitive (Garcia-Alonso et al. 2017). To that end, the APB invested

over 50 M euros in expanding and upgrading port infrastructure such as the railway system in 2017, doubling investments from the previous year (Port of Barcelona 2018).

The most recent figures on the PoB's economic impact stem from a 2010 internal PIS study commissioned by the Port to a consulting firm, of which only the results have been published. Based on 2006 data, this study estimated a direct and indirect contribution of 1.6% regional and 0.3% national total taxed income and numbered the Port's employment figures at 13,365 direct and 32,101 indirect jobs. In addition to these, in the PoB's corporate website it is claimed that the port has a customer base of 3000 companies, which it is estimated to generate over 1 million jobs and a turnover of 300,000 million euros related to the PoB's activity (Port de Barcelona 2019). As noted by Dooms et al. (2019), PIS studies commonly account for the complete supply chain, leading to inflated figures of this sort. The Spanish branch of the Cruise Lines International Association (CLIA) has also commissioned similar studies on the positive economic impact of cruise tourism through AQR-Lab, an applied economics research group at the University of Barcelona (Suriñach and Vayá 2017). The latest study from this group estimated a contribution to regional GDP of € 413.2 M and the creation of a total of 6759 jobs, while ship emissions and excessive congestion at the waterfront are briefly mentioned as negative externalities (Vayá et al. 2018). Despite the lack of scientific consensus on the validity of the methodologies used, PIS results typically enjoy widespread media coverage and public credibility. This positive media coverage tends to overlook any socio-environmental costs attached as well as the heavily subsidized and debt-financed character of port development, which in the case of Barcelona adds up to €272 M in public subsidies and €281.1 M in long-term debts, mostly with the European Investment Bank (PoB 2018).

The financialized nature of the PoB's economic activity increases the need for ever-higher levels of liquidity to operate and pay off its debts. To find more profitable avenues of investment, the Port Authority accelerates the elimination of less productive activities from its grounds, such as the small-scale fishing wharf and shipyards remaining at the margins of the Old Port. This process of reconversion started in the 1970s with the arrival of containerization, modern intermodal cargo

systems, and bigger ships which turned many port facilities obsolete, prompting the relocation of industrial port activity away from urban cores. Old port areas underwent a process of decay, conflict, and ultimately redevelopment that followed a familiar pattern across different cities (Hoyle 1989; Ng et al. 2014). In Barcelona, the redevelopment of the urban waterfront followed a way analogous to the pioneering cases of Baltimore or Boston (Desfor et al. 2010; Alemany 2015), opening excellent investment opportunities and offering an attractive "spatial fix" for overaccumulated capital seeking investment outlets globally (Harvey 2001). The massive urban transformations that took place prior to the 1992 Olympic Games adapted derelict port infrastructure to large-scale cruise tourism traffic, transforming Barcelona's marginal situation in the market to the global leadership position it enjoys today (Tamajón and Valiente 2012). The transformation of the old port was an immediate financial success, and today, the old port grounds play host to a massive influx of visitors (17 million people in 2016), as well as dozens of luxury, real estate and entertainment businesses.

3.5.2. Illth

Barcelona's waterfront redevelopment can also be understood as a process of accumulation by dispossession (Harvey 2004) intrinsic to neoliberal urban development (Castro 2015), in which capital encloses the urban commons, commodifying ever more aspects of social life for the purpose of expanded accumulation (De Angelis 2004). In Barcelona, the enclosure of the seashore (Hadjimichael 2018) has mobilized neighborhood organizations and social movements in the defense of the waterfront as an urban commons (Castro 2015; Tapia and Tatjer 2013). Many of these movements' protests have centered on the negative effects that mass tourism has on the city, such as congestion, gentrification or heritage loss. Recently, some have focused on the impacts of the cruise ship industry, such as air pollution (Fig. 4). Indeed, the record levels of cruise ships berthing at the port have increased the level of harmful emissions: a report by the eNGO "Transport and Environment" recently ranked the PoB the worst in cruise ship air pollution from a list of 50 European ports in terms of NOx, SOx and PM emissions (Faig 2019).

Figure 14. Poster of a 2017 campaign against cruise activity expansion

(Launched by neighborhood organizations and environmental NGOs against the construction of a new cruise terminal at the PoB, it reads "No to the new terminal. We oppose the new cruise terminal because of the widespread growth of tourism and pollution that cruise activity generates for the neighborhoods closest to the PoB".

Source: Plataforma per la Qualitat de l'Aire

The PoB significantly contributes to the atmospheric pollution of Barcelona's urban area, of which road traffic is the primary source (Pérez et al. 2016). According to an air quality report from Barcelona City Council (2015), based on the data from the metropolitan network of air quality monitoring stations, the Port was the primary source of NOx (5.548,8 t) and PM10 (505,6 t) in 2013, accounting for 46% and 52% of total emissions, respectively, while Pérez et al. (2016) found the PoB to be the only major source of SO2 in the city. Virtually all of these emissions originate from ships berthing at the harbor, and estimations on their contribution to the urban

area's pollution are much lower and vary depending on the proximity to the harbor. On average, the PoB's contribution to urban NOx pollution is estimated at 7.5% while at he neighborhoods closest to the Port it has been estimated up to 14% (PoB 2016). Regarding particulate matter, Pérez et al. (2016) estimated the Port's contribution to the urban area of Barcelona at between 9 and 12% and 11 and 15% for PM10 and PM2.5, respectively. Finally, the PoB also has a significant carbon footprint: Villalba and Gemechu (2011) estimated a generation of 331,390 tonnes of GHG emissions (CO_2 equivalents) in 2008, half of which were attributed to vessel movement and the other half to land-based activities.

Port-based air pollution aggravates a chronic atmospheric pollution problem in Barcelona which has long become a serious public health issue (Forns et al. 2016; Nieuwenhuijsen et al. 2018; Sunyer et al. 1996). Data from the Spanish Ministry for the Ecological Transition (2018) show that Barcelona's average concentration of NO_2 in 2017 was 59 µg/m3, exceeding by 47.5% the limit of 40 µg/m3 set by the World Health Organization and adopted by the European Union (European Commission 2019b; WHO 2006). According to a report by the European Environmental Agency, exposure to high levels of NO_2 and PM2.5 in Spain caused over 28,000 premature deaths in 2013 (Guerreiro et al. 2016). The Public Health Agency of Barcelona has estimated a yearly average of 424 premature deaths due to air pollution in the city during the period of 2010–2018 (ASPB 2019). The European Commission (2017b, 2019a) has given repeated warnings and finally referred Spain to the European Court of Justice for systematically breaching EU's pollution limits in the urban areas of Madrid and Barcelona since their implementation in 2010. In response to air pollution, the PoB has developed an ambitious Air Quality Improvement Plan (2016) whose key abatement strategy centers around the promotion of LNG as an alternative fuel for shipping and the electrification of harbor operations. The Port has committed itself to become the leader of LNG usage in the Mediterranean, partnering with the Spanish natural gas industry in a series of R&D projects with EU funding (Cleanport, Core LNGas hive). In 2018, the Port opened the first liquified and compressed (LNG/CNG) natural gas supply station in the Spanish port system, following the EU's directive on Alternative Fuels which requires the

building of refueling points on all maritime and inland waterway ports of the Trans-European Transport (TEN-T) Core Network.

Barcelona's coastal ecosystems have experienced significant impacts throughout the history of the Port's activity and development. In the 1960s, the construction of the new industrial port away from the city's waterfront resulted in the disappearance of the beaches of the nearby Llobregat river delta, as well as the agricultural area of neighboring towns. The construction of inland docks in the delta led to the salinization of the river waters, which had a profound impact on local ecosystems (Margenet 2009). The relentless expansion of port grounds finally reached the physical limit of the Llobregat river estuary by the mid-1990s, which was resolved by diverting the river 2 km southward. This diversion allowed the Port to double its operational space, at the expense of destabilizing coastal ecosystem dynamics and affecting sediment regimes (Rosa Martinez 2013). The Llobregat's diversion was a clear instance of the large-scale remaking of socionatures at the service of economic expansion (Desfor and Vesalon 2008), driven by the growth of ship sizes and an increased need for larger logistical spaces (Notteboom and Rodrigue 2005).

Stevedoring is the main work carried at Barcelona's commercial harbor, along with tugging and mooring the vessels, and driving the cargo on trucks. Dockworkers manage very heavy and voluminous cargo, handle hazardous goods, move around big machinery and work at dangerous heights; all of which is done at a very fast pace, which explains why there is a high risk of occupational illness and injury in the sector, including major and fatal accidents4 (Greenberg 2003; O'Neill 2012). Since the neoliberal industrial restructuring of the 1970–80s (Turnbull 1992), successive pushes to de-regulate and liberalize the sector have managed to increase the capital-labor ratio in many ports worldwide, weakening unions and generating a "race to the bottom" in working conditions and job security (Bonacich and Wilson 2008; Turnbull and Wass 2007). Spanish dockworkers have been mobilizing against each wave of reforms with relative success; since the period of high conflict and major strikes of the 80s, to the most recent episode in 2017, in which 5 months of nation-wide struggle forced the Spanish Congress to revoke an executive order meant to liberalize dockworking's recruitment model (AFP 2017). Currently, major

sections of the port labor force in Spain and beyond perceive automation to be an additional threat to workplaces, with unions fearing massive job loss as big companies like Maersk and APM are pushing to automate terminals, sparking labor conflicts and strikes in major ports around the world (Mongelluzzo 2019; Roosevelt 2019; Tabak 2019; Witschge 2019). However, at the moment only 9.1% of all main container terminals around the world are partially or fully automated (Rodrigue 2019) and according to business reports (Chu et al. 2018), automation at ports is advancing at a slower pace compared to other industries with similar complexity—such as warehousing or mining—due to its high up-front deployment expenditures, the risks of labor conflict and the low productivity of existing fully automated terminals. Barcelona's longshore work is a highly unionized and internationally organized sector, with a rich history of labor militancy, and internationalist and solidarity activism (Atleson 2004; Cole 2013, 2015; Kosmatopoulos 2019). In contrast to seafarers, dockworkers have retained greater bargaining power and better working conditions partly due to their strategic position within the production and distribution networks, which allows them to easily disrupt metabolic circulation (Bonacich 2003; Cowen 2014). Moreover, dockworkers, by definition, cannot be offshored and, as highly skilled workers, they are not easily substitutable by eventual labor. Capital has historically attempted to overcome militant work forces at docks mainly through processes of liberalization, de-regulation, and technological change. In Barcelona, the combined effect of different levels of each of these processes have resulted in a progressive delinkage between port throughput and employment levels, which in the last decades have been decreasing or remaining stagnant (Fig. 5).

3.5.3. Discussion: a call for blue de-growth at ports?

Figure 15. Evolution of stevedoring workforce at the PoB

Dockworkers employment data at the PoB for the last decade shows a slow but steady decline, which does not correlate with traffic levels.

Source: Organización Estibadores Portuarios de BarcelonaOEPB (Data obtained by Barcelona Port Dockworkers Organization—OEPB from Estibarna, Barcelona's management company of port workers (SAGEP))

The invisible circulation of the massive volumes of energy and materials that sustain industrialized countries is, following Birtchnell et al. (2015, p.6), a characteristic of contemporary commodity fetishism by which, "not only are the labor and other processes that produce commodities hidden from consumers, but also the processes that distribute and dispose of consumer objects." Already noted by urban political ecologists (Kaika and Swyngedouw 2000), circulatory networks become themselves fetishized in the commodification process, attaining a "phantom-like character, being usually hidden from view and relegated to the underbelly of the city" (Arboleda 2016, p. 236). Commercial ports function as the 'phantom-like' metabolic gateways at the sea-land interface of capitalist terraqueousness: they are "fixed logistical and social infrastructures" (Campling and Colás 2018) facilitating value circulation through the "smooth space" of global port operations (Wilmsmeier and Monios 2015), and help reconcile capital's tendencies toward mobility and fixity at sea (Steinberg 1999). Modern maritime transportation systems are paradigmatic of large scale and highly complex sociotechnical assemblages, reminiscent of

Mumford's megamachine (1967), whose structure and functions are wholly geared towards the logistical goals of maximized efficiency and reliability in moving the goods. Logistics originated in the military knowledge acquired by reliably supplying armies across long distances and was transformed during the post-war period into a managerial science aimed at increasing the flexibility and synchronization of global production and distribution systems, which heavily depend on maritime transportation (Chua et al. 2018; Cowen 2010).

Commercial ports are instances of what Virilio (2006) calls "metabolic vehicles," i.e., those objects that help speed up the social metabolism, as they channel and mediate the throughput of energy and materials consumed in the system, allowing higher production and consumption in less time, and hence speeding up metabolic exchange. Swyngedouw introduced Virilio's concept into urban political ecology in reference to the city itself and also to the sociotechnical and material assemblages such as "pipes, ducts, cables, canals, (rail)roads [...] infrastructures of all kinds, the technical conditions that permit the flow and metabolization of energy, food, information, bodies and things—as well as their socioecological characteristics", which allow the production and reproduction of the urban environment (Swyngedouw and Kaika 2014, p. 471). As key nodes in the global supply chain networks, ports facilitate the intensification of global capitalist dynamics such as time-space compression (Harvey 1992) while also creating more distance than they reduce by fostering the consumption of foreign products that have traveled thousands of kilometers instead of locally produced goods (Illich 1979). Contrastingly, de-growth proponents contemplate a "relocalization" of economic activity by "slowing down long-distance trade, producing in proximity to consumption, and circulating and reinvesting surpluses locally" (Kallis 2018) as a means to slow down the social metabolism, while reducing and redistributing the aggregate energy and material throughput in the pursuit of socio-ecological wellbeing. Latouche (2009) thinks of economic relocalization as a way for communities and regions to become more self-sufficient although not isolated or autarchic, therefore envisaging the maintenance of some level of international surplus trade in the post-growth metabolisms.

Shipping is poised to play a crucial role in sustaining international trade and travelling in post-growth socioeconomic systems, as it remains the most energy-efficient mode of freight transport. Moreover, all of IPCC (2018) decarbonization pathways to stay below 1.5 C before preindustrial levels envisage a large-scale transition to renewable energy systems, whose construction and maintenance require large amounts of materials—mostly minerals—that need to be shipped around the world as they are unevenly distributed across the earth's surface (Capellán-Pérez et al. 2019; Valero and Valero 2010). In fact, the de-growth literature does not advocate for the annihilation of industrial activity, such as modern commercial shipping and logistics, but calls instead for the subversion of its societal monopoly (Illich 1979; Gorz 1989). A de-growth transition can thus open opportunities for the rehabilitative appropriation of previously destructive technologies (Likavčan and Scholz-Wäckerle 2018). Although the size and complexity of modern maritime transportation throws into question the feasibility and desirability of repurposing its productive technologies and infrastructure towards the emancipatory ends of the de-growth transition. Researchers unrelated to de-growth have already suggested a downscaling of traffic levels as a reasoned response to maritime transportation's negative environmental impacts. Bergqvist and Monios (2019) argue that the decarbonization of the maritime transportation industry remains "impossible under present conditions without a considerable reduction in the volume of shipping." Bailey and Solomon (2004, p.14), on the other hand, encourage the "local production of goods to reduce marine traffic" as a precautionary approach to port-related air pollution, which could be complemented with emission reduction instruments such as caps or levies (Winnes et al. 2016). Other researchers have looked at port cooperation as a means for reducing the hegemonic "maritime competitive dynamics" of the sector, which is a main driver of port growth (Fraunhofer 2016; Mclaughlin and Fearon 2013). To deal with infrastructure expansion, Nebot et al. (2017) recommend a strategy for the sector's qualitative development, based on the establishment of an efficient port networking system and the development of already existing infrastructures instead of constructing new ones.

Building on the de-growth literature on transitions (Schneider et al. 2010), blue de-growth research should explore paths for a radical transformation of

maritime transportation based on the core principles of ecological sustainability and social justice. Following Barca (2017), future studies should engage with the centrality of work as a mediator of the social metabolism in the maritime realm and examine the role of organized labor as a critical agent of systemic change. In a context of climate breakdown and ecological collapse, it becomes urgent to link environmental and labor demands to bring about effective change: promoting, for instance, the downscaling of shipping to sustainable levels together with relocalization of production and job guarantee schemes (Alcott 2013). Furthermore, socio-ecological and labor struggles could find a common rallying ground in demanding a democratic control over critical infrastructures and metabolic vehicles. Indeed, ports can easily be turned into chokepoints through political action, a strategic condition that researchers and activists increasingly recognize as important leverage in social struggles (Bernes 2013; Chua et al. 2018; Toscano 2011; Transnational Social Strike Platform 2017). There are historical precedents of workers' takeover of metabolic vehicles in the class struggle, which were then used as political leverage for broader emancipatory movements. As Mitchell (2009) argues, miners' strikes, sabotages and disruptions of the energy channels during the coal-powered phase of industrial capitalism were crucial in bringing about mass democracy. Furthermore, during Catalunya's social revolution of 1936 and the following Spanish Civil War, workers collectivized the Port of Barcelona itself and put it to use in the war against fascist forces (Ibarz 1997). Histories such as these can offer valuable insights into thinking about socio-ecological emancipatory politics at sea.

3.5.4. Conclusions

This paper has offered a comprehensive view of port activity and development by factoring in the production of 'illth' alongside wealth resulting from the growth of maritime transportation. The case of the Port of Barcelona shows that the maritime circulatory processes driving the expansion of the social metabolism are coupled with seldom accounted for negative socio-environmental impacts at port cities and regions, which contrasted to the limited data on their positive outcomes, suggests that modern commercial ports are becoming bearers of uneconomic growth for their host localities. Proponents of the blue growth paradigm treat these impacts

as negative “externalities” rectifiable mostly through efficiency improvements and the use of alternative fuels. However, in the context of rising demand for internationally traded goods and the need to rapidly decarbonize the global economy, the evidence suggests that technological change will not be enough to offset the socio-ecological illth produced by ever-increasing marine traffic and port throughput. In contrast, a blue de-growth counter-paradigm should advocate for a sustainably planned cooperative port system, the downscaling and control of traffic levels, and the relocalization of production as a reasoned response to maritime transportation’s increasing pressures on society and the biosphere.

Ports are complex assemblages of spaces, flows, and actors that function as “metabolic vehicles” in allowing the social mediation and acceleration of global flows of commodified energy and materials. Economic power and market rationality dictate the structure, workings, and rhythm of port activity and development, producing ample socio-environmental benefits and burdens while distributing them unequally. A transition to a more environmentally sustainable and socially just post-growth economy will require a joint articulation of ecological and labor struggles, which can find a common rallying ground in demanding a democratic control over critical metabolic vehicles such as commercial ports. Further research on the sustainability of maritime transportation should aim to engage researchers from the marine social sciences and the broader field of sustainability sciences, as well as coastal communities, labor unions, and social movements, to address more practically-oriented questions and explore potential alliances and synergies for a radical socio-ecological transformation of the peopled seas.

Chapter IV: Limits to Blue Growth

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

4. Abstract

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.

4.1. 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 comanagement initiatives in facilitating

practices of economic difference –such as autonomous collective self-limitation— that can benefit resource-use communities and their environments.

4.1.1. 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[16]. 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 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

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

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).

4.1.2. 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 bioeconomics 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.

4.1.3. 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; Jentoftetal.,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, comanagement 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 "nonlinearity, 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 wellbeing (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.

4.1.4. 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)[17]. 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 comanagement 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

[17] 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).

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

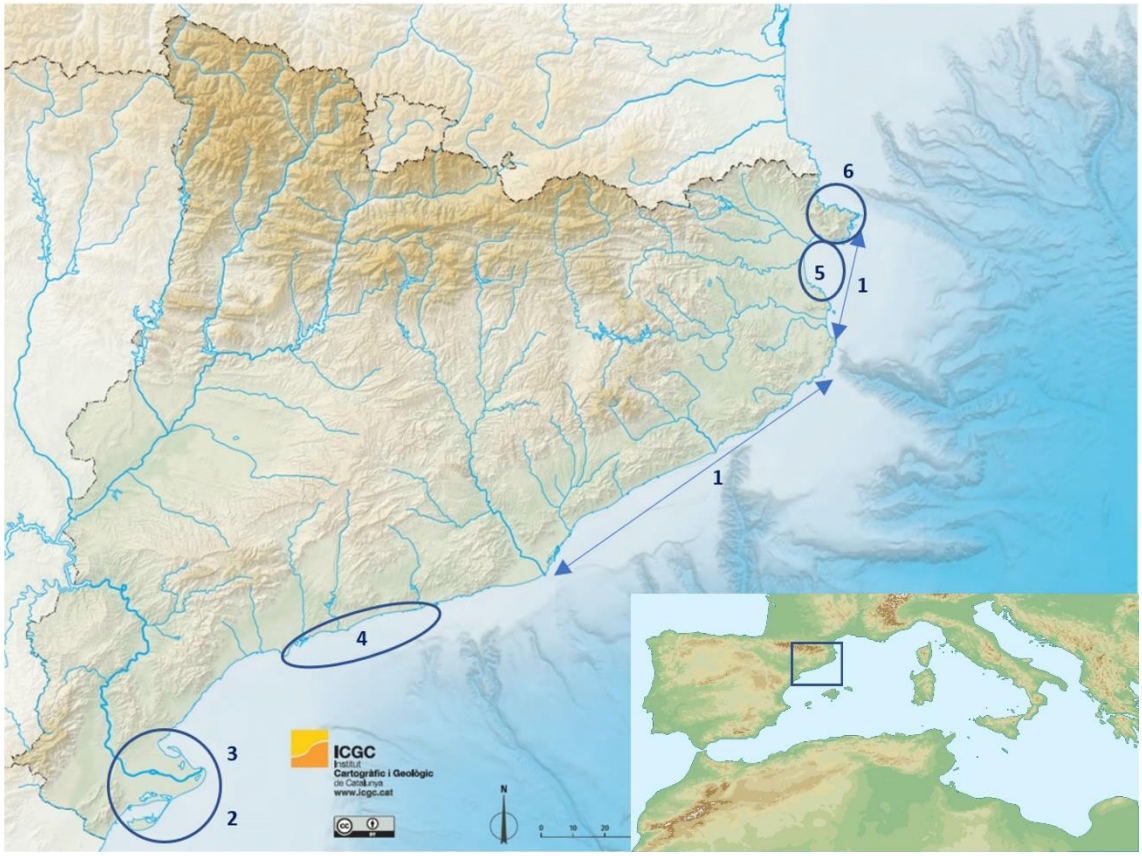
life in common (Bresnihan, 2015; Karnad et al., 2021). Through our case study, we emphasize how commoning processes also include those actions that the collective decides not to take or chooses to limit, in contrast to the usual emphasis on doing and making as a sign of the expansion of the communal 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 comanagement 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 socioenvironmental uncertainty, complexity, and high stakes. Second, 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.

4.2. Materials & Methods

4.2.1. Case study

Our case study concerns SSF in the Mediterranean Sea off the coast of Catalonia (Figure 16). 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).



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 16. The Catalan region and its co-management system

Source: Own elaboration

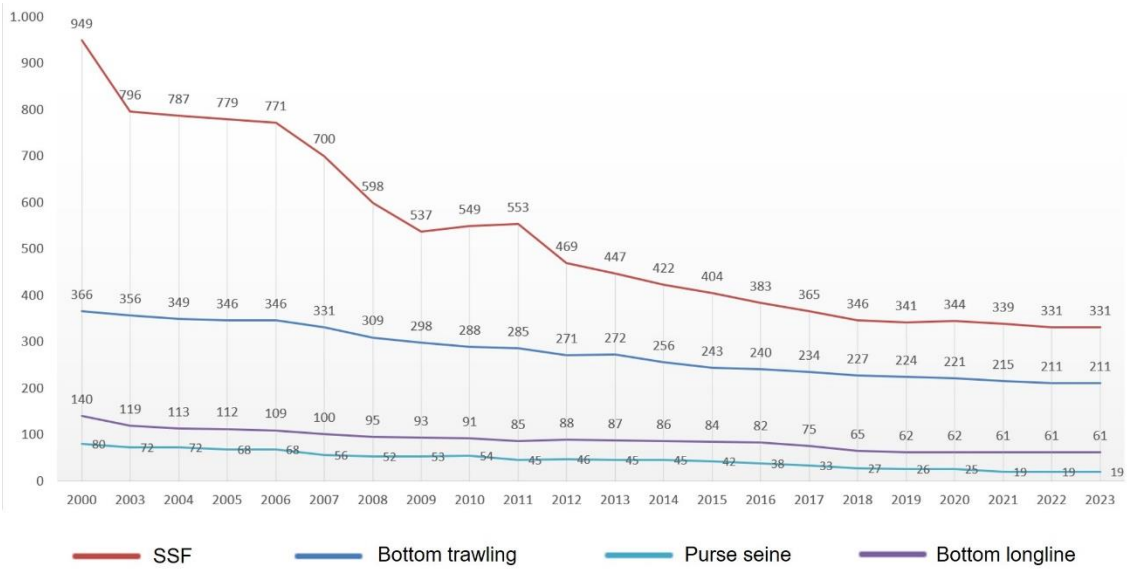


Figure 17. Number of vessels by gear type in the Catalan fishing fleet 2000-2023

Source: Gencat, Department of Climate Action, Food and Rural Agenda

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 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 nearshore 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 figure 18). 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).

4.2.2. 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 cofradias (meaning 'brotherhoods'). These are public law entities originating from traditional fishery selfgovernance institutions. Cofradias 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).

	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

Figure 18. Catalan fisheries catch by sector in 2022

(Source: Gencat, Department of Climate Action, Food and Rural Agenda).

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 cofradias' 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, cofradias 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).

Cofradias act in a regulatory constrained context, adapting and complementing the European, national, and regional legislations. In Catalonia, the regional government has endowed the cofradias 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 cofradias. 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 comanagement 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).

4.2.3. 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).

4.3. Results & Discussion

4.3.1. 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 comanagement 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 socioenvironmental uncertainty, complexity, and high stakes for their communities.

4.3.2. 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 comanagement 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 cofradias. 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 cofradias 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 comanagement 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 comanagement 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 comanagement 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 comanagement as an externally imposed limitation can intensify, and the power imbalance and diverging interests become more apparent among stakeholders. In their study on cofradias 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).

4.3.3. 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 cofradias 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 comanagement 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 comanagement 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.

4.4. 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, comanagement 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?

Chapter V: Concluding Remarks in Navigating Towards Blue Degrowth

This dissertation is the result of four years of research on the relationship between growth and the sea. During this time, I inquired about this question from the perspective of fisherfolks, dockworkers, scientists, environmentalists, activists, politicians, public officials, union members, and businesspeople. I further researched this issue by delving into digital archives, public datasets, technical reports, policy documents, and the vast scientific and scholarly literature. My aim was to understand, from a historically sensitive standpoint, how the Ocean acts as a conduit as well as a barrier to notions and projects of growth. The relevance of such research goes beyond scholarly inquiry or the production of scientific knowledge, as it addresses the remarkable surge of interest in the sustainable development of the ocean economy in marine sustainability and governance arenas. Hopefully, the chapters constituting this thesis can contribute to a variety of disciplinary approaches researching human relations with the marine environment, while also informing current discussions on the blue economy and its limits. Following, I summarize the general contributions, conclusions, and the potential research threads that derive from this research.

5.1. Overview of empirical findings and arguments

Drawing on insights and methodologies from political ecology, ecological economics, and environmental history, this thesis linked marine sustainability concerns with debates on emerging degrowth scholarship. Based on a historical overview of the notions and projects of growth behind the development of maritime industries in the Spanish Mediterranean, together with ethnographic work carried out on two case studies on the contemporary shipping and fishing industries, I showed how both the materiality and the social construction of the Ocean have generated distinct growth imaginaries, as well as collective self-limitation projects. The results of this research,

which will be further explored below, point to the need to question the growth hegemony in contemporary marine sustainability and ocean governance, together with the articulation of a degrowth counter paradigm in order to achieve greater environmental and social well-being. As the sea has historically been a space of possibility for growth imaginaries and projects, it can also become a platform for the fruition of alternative visions and ways of relating to the marine environment that foreground values and practices of sufficiency, equity, and care. Moreover, the dissertation argued for questioning the primacy of land-based perspectives in the social environmental sciences and promoted instead a sea-centered approach to the study of social and environmental change, particularly in the degrowth scholarship. With regard to the main research question about the relationship between growth and the sea, this dissertation has made several contributions that help to better understand the linkages between marine sustainability and key degrowth questions such as the nature of the Great Acceleration, the workings of the growth imperative, and the limits to growth debate.

Regarding the question of the ocean-based Great Acceleration, or Blue Acceleration, Chapter II explores the historical role of frontier imaginaries in economic development at sea. Following ground-breaking work on the naturalization of limits in capitalism (Jonsson & Wennerlind, 2023; Kallis, 2019; Mehta, 2013), this chapter shows how the Blue Acceleration is the outcome of a historical process that frames social and environmental limits as hurdles to surpass by further growth. As explained through the example of MSY in Chapter IV, casting limits as external to society and as part of nature is a common mechanism for invoking the need for their transgression through economic expansion. Chapter II shows how this reasoning tends to portray economic expansion as the way to overcome the apparent contradiction between Ocean's supposedly unlimited wealth potential and its fragile nature in need of management. Moreover, past and current oceanic frontier imaginaries present such expansion as a way to emancipate societies from resource constraints, economic hardships, and socio-ecological conflicts. In fact, the research results show striking parallels between past marine cornucopian imaginaries and projects, and current calls for developing and expanding the blue economy. The naturalization of limits and scarcity, the call for

economic growth to overcome them, and the default reliance on techno-scientific development to achieve it appears as a common discoursive pattern behind the promotion of the blue acceleration in different historical moments. As evidenced in chapter II, the origins of the blue acceleration in the Spanish Mediterranean were predicated upon a prevailing scientific and policy discourse that highlighted land-based scarcity as a justification for expanding economic activity into the marine realm. The emergence of the sustainable development paradigm in the 1980s shifted the focus from terrestrial scarcity to environmental limits at sea, invoking the fragility of marine ecosystems as a rationale for further management and sustainable development of the Ocean frontier. In truth, the delineations between these narratives are not as distinct as they may seem and in fact reflect a variation in emphasis and perspective rather than a divergence in substance. For instance, and as shown in Chapter II, various influential political, scientific, and cultural figures that promoted the emergence of the blue acceleration in the Spanish Mediterranean also expressed concern about the existence of environmental limits to the expansion of human activity at sea. On the other hand, references to the scarcity of terrestrial resources as a reason for developing the oceanic frontier can also be found on contemporary blue economy discourses. In summary, the findings of this thesis suggest that there is a logical progression underlying the apparent variations in the articulation of the discourses and imaginaries promoting the blue acceleration across different time periods, which has translated into public funding in research and subsidies in production of different maritime industries. This realization highlights the potential socioecological setbacks of unquestioningly embracing such a developmentalist approach as a policy cornerstone for marine sustainability and ocean governance.

With respect to the question of the growth imperative at sea, Chapter III explores how the Ocean plays a crucial role as the main circulatory platform for the energy and material flows that sustain the reproduction and expansion of the global social metabolism. As virtually all international trade volume is shipped, there is a strong correlation between global GDP and shipping traffic (Stopford, 2009). Hence, an increase in port and shipping activities is commonly associated with a more vibrant economy

(Grammenos, 2013)[18], while the negative social and environmental impacts remain largely obscured. Proponents of the blue growth paradigm treat these impacts as negative "externalities" rectifiable mostly through efficiency improvements and the use of alternative fuels. But in the context of rising demand for internationally traded goods and the need to rapidly decarbonize the global economy, the evidence suggests that technological change will not be enough to offset the socio-ecological illth produced by ever-increasing marine traffic and port throughput. Hence, the systemic imperative of increasing the rate of capital accumulation, implies a need for an ever larger and faster circulation of commodity flows, which in turn results in an expansion and acceleration of the social metabolism. As the backbone of the global trade and production system, maritime transportation is key in realizing such growth imperative. Hence, as shown in Chapter III, most of the measures advanced in blue economy policy documents are meant to not interfere with the efficient, seamless, and fast circulation commodity flows at sea, which inevitably results in an ever-increasing maritime traffic throughput, as has been witnessed thus far.

Therefore, the results of Chapter III question the dominant assumption within the blue economy discourse of the desirability or feasibility of ever-increasing traffic flows as a reasoned approach to sustainability by looking at the seldom accounted for negative socio-environmental impacts in port cities and regions. The findings of this chapter represent a significant maritime contribution to a key aspect of the degrowth literature, namely, the critique of GDP as a measure of progress and the hegemony of growth as a social objective (Kallis et al., 2018). Chapter III draws upon the previous chapter's exploration of oceanic frontier imaginaries and engages degrowth perspectives with works on the 'thalassology' tradition that emphasize the pivotal function of shipping in shaping the global economy and the contradictions it embodies (Beukelaer, 2023; Campling & Colás, 2021; Kosmatopoulos, 2023; Steinberg, 1999). Chapter III advances relevant theoretical insights for the articulation of a blue degrowth (BDG) counter paradigm. First and foremost, the fundamental role of shipping in

[18] Typically, when newsreels depict the economy, they portray a bustling scene of activity at ports, such as cranes moving cargo containers from docked ships. This imagery is commonly used to convey a healthy growth rate of the economy.

allowing the contemporary expansion of the social metabolism –unprecedented in human history— makes the case for arguing that the corollary of the sustainable development of the ocean economy is in fact land-based economic growth. Such a materialist socio-metabolic perspective diverges radically from mystified vision of the ocean as a space detached from terrestrial environments. Indeed, conceptual separation between land and sea as two discrete entities, works as an ontological premise for the social construction of the ocean as economic frontier imaginary pervasive in blue economy discourses.

Regarding the limits to growth debate, Chapters II and IV make an ocean-centered contribution to ongoing discussions on establishing the existence of such limits (Brand et al., 2021; Meadows et al., 1974; Nature, 2022) and how to reconcile them with increasing human activity (Richardson et al., 2023; Steffen et al., 2015b; O'Neill et al., 2018). These chapters analyze the political implications of the naturalization of limits with regard to the production of notions and projects of ocean-based economic growth. While Chapter II traces the broad history of the blue acceleration in the Spanish Mediterranean, Chapter IV offers a detailed case study on Small Scale Fisheries community co-management throughout the Catalan coast. Both chapters concur in discerning a socio-political trend wherein the invocation of environmental constraints and naturalized scarcity serves as a pretext for transgressing these limits through economic expansion at sea, a logic that has been observed in the development of capitalism since its origin (Benjaminsen, 2021; Brand et al., 2021; Kallis, 2019). More specifically, Chapter IV shows how the Ocean can play a transformative role in the shift from understanding limits as externally imposed properties of nature to socially negotiated restrictions or transgressions of human action (Brand et al., 2021; Kallis, 2019; Norgaard, 1995). The case study of the Catalan co-management committees displays how the governance of marine ecosystems presents a high degree of uncertainty, which renders the straightforward determination of external limits exceedingly challenging. Moreover, the results demonstrate that engaging resource users in the collective deliberation of group boundaries, goals, and limits raises

awareness of the socially constructed nature of the broader political and economic dimensions constraining their decisions.

Chapter IV makes the case that if limits are to remain useful, there must be a shift from trying to precisely determine them as a property of the world 'out there' to developing institutional mechanisms for limiting human activity. The results of the chapter underscore the complexity and uncertainty of Ocean management and cautions against theoretical foreclosure resulting from an exclusive reliance on scientific expertise, which might preclude a pluralist perspective on marine sustainability. Such insight resonates with the critical realist approach to social environmental science, which, following Forsyth (2001), scrutinizes ecological change by adopting epistemological skepticism together with ontological realism towards fundamental biophysical processes, with the objective of unveiling the inherent political and social dynamics embedded within seemingly neutral scientific laws. The objective of this approach is to establish a more comprehensive science for environmental governance, which is attuned to the issues of power inequalities and justice, particularly in light of the growing recognition of the Ocean as the next global frontier for economic development and scientific discovery.

Beyond the stated research questions, this dissertation can make valuable contributions to the different fields of inquiry and bodies of scholarship addressed throughout the chapters. With regard to Thalassology and the Oceanic Turn, this dissertation highlights the relevance of focusing on crucial degrowth discussions in relation to the recent upsurge in marine sustainability and ocean governance concerns. The findings of this thesis emphasize the significance of oceanic frontier imaginaries in advancing the growth of ocean-based economic activities (Chapter II), as well as the materiality of the sea as a catalyst for the acceleration and intensification of global social metabolism through shipping (Chapter III), and the role of marine ecosystems' uncertainty and complexity in producing alternative practices and understandings of human relations with the sea (Chapter IV).

Despite cornerstone works within the thalassology tradition have already pioneered oceanic perspectives on capitalist development and its contradictions (Braudel, 1992; Campling & Colás, 2021; Rozwadowski, 2019; Steinberg, 2001), they have not addressed growth as a distinct capitalist material and ideological phenomena and its relation to the sea. The results of this dissertation clarify the Ocean's fundamental role in shaping the growth dynamics of contemporary capitalism. In bringing a marine perspective to the workings of global social metabolism, this dissertation speaks directly to the scholarly interests of the Barcelona School of Political Ecology and Ecological Economics, whose contributors have rarely engaged with Ocean issues. Following Villamayor-Tomas et al's (2023) description of the Barcelona School, this dissertation incorporates three of its main bonding characteristics.

First, chapters II and III give special attention to the ocean and its materiality in the reproduction of global social metabolism. These chapters advance our understanding of how oceanic frontier imaginaries and maritime circulatory processes have been key in facilitating the unprecedented expansion of the global social metabolism over the last half century. Specifically, these chapters incorporate a special attention to the biophysical dimension of the economic system in their analysis of how the materiality of economic growth bears a direct relationship to current issues in marine sustainability, such as the Blue Acceleration (Jouffray et al., 2020).

Second, chapters I and II examine the political and historical dimensions of ocean-based capitalist growth. By engaging with past and current debates within ocean governance, this dissertation seeks to reconcile the Barcelona School's theoretical and analytical approach with the recent oceanic turn in the social sciences and humanities (McKinley et al., 2022; Meo et al., 2021; Popova et al., 2023; van Putten et al., 2021).

Finally, Chapters III and IV focus on the production of alternative ways of knowing, valuing, and relating to the sea. The research presented in these chapters on the reappropriation and democratic control over socio-metabolic devices or collective self-limitation practices in the management of natural resources advance key discussions within the Barcelona School around the different possibilities of organizing social life and its relation to environmental change. In this regard, this thesis contributes

to the Barcelona School's challenge to the economic growth paradigm, which posits that growth is both necessary and desirable for societal and environmental well-being and highlights the need for alternative models that prioritize ecological sustainability, economic democracy, and social justice (Villamayor-Tomas et al., 2023). In this regard, degrowth scholarship directly challenges the hegemony of economic growth as a social objective and argues for radical societal changes that limit economic expansion and redistribute wealth to achieve socio-ecological well-being (D'Alisa et al., 2015; Demaria et al., 2013; Kallis & March, 2015).

Indeed, degrowth is the third major field of inquiry and body of literature that the thesis engages with and aims to contribute to. A marine perspective on topics such as the growth hegemony or the limits to growth offers relevant theoretical and empirical insights that have remained largely unexplored owing to a strong terrestrial bias in the social environmental sciences and humanities. Chapters II and IV advance a marine-centered perspective on the limits to growth debate, which was seminal in the field of degrowth, while Chapters I and II trace how the growth paradigm is articulated through discourse and projects on marine sustainability and ocean governance. These chapters explore how oceanic perceived vastness, and the seemingly inexhaustible character of its resources, facilitated the development of frontier and cornucopian imaginaries to promote the development of the growth imperative at sea. These insights contribute to ongoing discussions around the sociopolitical, economic, and cultural dynamics behind the development of the blue economy paradigm (Bennett et al., 2022; Bond, 2019; Choi, 2017; Louey, 2022; Silver et al., 2015) by analyzing how the growth imperative is socially constructed as a natural, inevitable, and desirable process in capitalist societies (Kallis et al. 2018; Koch and Buch-Hansen 2021; Schmelzer 2015). Chapter III delves into certain aspects of Ivan Illich's pioneering thought –a leading figure in degrowth theory— and puts it into dialogue with key concepts and debates in ecological economics. Using the Port of Barcelona as a case study, this chapter contends that the fundamental role played by maritime transportation in sustaining and expanding the global social metabolism is often overlooked regarding its socio-ecological negative consequences, or "illth," as per Illich's definition. The chapter argues that the growth of the global shipping industry's illth in recent decades can be considered "uneconomic," in accordance with Daly's description of uneconomic growth patterns. This observation

adds to ongoing discussions within degrowth scholarship, particularly those originating from the Barcelona School, which place a strong emphasis on the unequal distribution of environmental goods and bads at the stages of extraction, production, and consumption but often fail to consider them during the circulation phase of the social metabolic process. Moreover, Chapter III situates Illich's thoughts on convivial technologies within a discussion on the rehabilitative appropriation of maritime transportation for a degrowth transition towards a fairer and more sustainable organization of social metabolism. Similarly, in the context of fisheries management, Chapter IV delves into degrowth's interest in the diverse ontology of the economy and its capacity to produce more equitable and sustainable socio-ecological futures (Chertkovskaya et al., 2019; Gibson-Graham, 2006; Roelvink et al., 2015). Such insights resonate with degrowth's attentiveness to nurturing and developing alternative approaches to socioeconomic organization that result in better socioecological outcomes for all.

5.2. Policy implications

The empirical findings and arguments summarized thus far point to the need to articulate a BDG counter-paradigm that transcends scholarly inquiry and considers policy implications for marine sustainability and ocean governance. The current unfolding of the UN's Ocean Decade, with its stated openness towards value and knowledge plurality, presents an important opportunity to rethink human relations to the sea in ways that go beyond the growth paradigm hegemonizing environmental governance. The contradiction between the endless expansion of human activity at sea and the protection of marine systems necessitates a new approach to marine sustainability and ocean governance that embraces the establishment of limits to growth as a desirable collective endeavor to attain socioecological well-being. The present thesis adds to the work of a burgeoning body of research that advances a critique to the prevalent growth-oriented blue economy frameworks embraced by marine sustainability and ocean governance communities (Ertör & Hadjimichael, 2020; Hadjimichael, 2018, 2022; Jacques & Lobo, 2018; Louey, 2022). Beyond critically

examining and challenging the prevailing notions and projects of oceanic sustainable development (Barbesgaard, 2023; Brent et al., 2020; Carver, 2020; Mallin & Barbesgaard, 2020), research on BDG has been inspired by environmental justice concerns, community economies, and emancipatory socioecological imaginaries to create alternatives to dominant growth-oriented paradigms (Bogadóttir, 2020; Childs, 2020; Said & MacMillan, 2020). The articulation of a BDG counter-paradigm involves a reinterpretation of human–ocean relations, grounded in the premise that the biophysical characteristics of the Ocean that have facilitated socially constructed economic frontier thinking and growth-oriented visions –such as its vastness, depth, fluidity, complexity, and uncertainty– can also serve as a basis for alternative imaginaries and endeavors that transcend growth imaginaries.

In what follows, I briefly address the implications of a BDG framework in the realm of marine governance and policy. It should be noted that these policy implications originate and are framed within the socioecological, legal, and economic context of the North-Western Mediterranean, which is the region where I conducted the case study research for this dissertation[19]. The European Commission has recently introduced a revised approach to the promotion of the blue economy in the European Union in response to the growing criticism of its original "Blue Growth" strategy, which emphasized the imperative for economic growth above any other social or ecological consideration (Hadjimichael, 2018). In this context, the Commission established in 2023 the European Blue Forum, a multi-stakeholder group created to facilitate discussions on shared challenges and priorities regarding the sustainable development of the ocean economy. At the official launch of the European Blue Forum in May 2023, degrowth elicited significant interest[20], consistent with other signals of upward interest in degrowth found in ocean governance and marine sustainability literature (Bennett et al., 2021; Howson, 2020; Standing, 2022). The heightened focus on the term is a result

[19] However, I believe that some of the insights gained from this research can be adapted and applied to various other realities, as the blue economy paradigm is rapidly becoming a global phenomenon.

[20] leading to a special session being dedicated to the concept during a stakeholder workshop several months later, of which I was a participant.

of increasing concerns about the degradation of the Ocean and the limitations of conventional sustainable development models in tackling escalating social and environmental issues at sea (Bennett et al., 2021; Cohen et al., 2019; Jouffray et al., 2020). The articulation of a BDG policy framework can contribute to the development of effective and innovative strategies for ocean governance aimed at addressing key marine sustainability issues. I now outline the fundamental features of such a framework based on this thesis's theoretical and empirical contributions while exemplifying it with insights from the two case studies.

In consonance with this dissertation's main arguments, I contend that BDG policy frameworks should be based on four basic premises: first, that environmental issues are ultimately political; second, that the corollary of blue growth is land-based economic expansion; third, that infinite economic growth is incompatible with environmental sustainability; and fourth, that the collective establishment of limits to human activity at sea can be just desirable and necessary to achieve and sustain socioecological well-being in marine and coastal environments. These conceptual cornerstones provide a radically different approach to current mainstream oceanic sustainable development paradigms in marine sustainability and ocean governance. In the case of maritime transportation, a BDG policy framework should begin by framing the environmental impacts of shipping and port activities within the political economy of international trade, transnational value chains, and the global distribution of production. Such framing situates the answer to maritime transportation's problematic environmental performance beyond the conventional focus on technological solutions and into the political negotiation on how to organize the social metabolic processes of extraction, circulation, transformation, consumption, and deposition, to what purpose, and to whose benefit. For instance, virtually all discussions on the reduction of the sector's GHG emissions in leading marine sustainability and ocean governance forums rely on decarbonization strategies that focus on fuel substitution and efficiency improvements to strike a balance between environmental sustainability and economic growth. However, such discussions disregard the underlying socioeconomic dynamics of an

accelerating and growing global social metabolism, which has resulted in a quadrupled increase in international traded volume in recent decades and a subsequent ever-increasing shipping traffic and port activity.

Moreover, the profit-seeking and competitive dynamics of capitalist markets drive socially and environmentally harmful tendencies in maritime transportation, such as ever-larger economies of scale, resulting in a 'gigantism' problem in the industry, as well as an unsustainable increase in traffic throughput that is affected by systematic logistical disturbances, redundancies, and bottlenecks. In this context, BDG policies would be based on the acknowledgment that decarbonization of the maritime transportation industry is not feasible under current conditions without a significant reduction in the volume of shipping. Such an approach could therefore promote a shift away from unsustainable growth-oriented policy frameworks and towards a planned reduction of traffic levels aimed at better satisfying social needs within ecological constraints. Key policy objectives would promote the relocation of production and the development of cooperative port systems. The increase in the production of goods near the point of consumption could help reduce and slow down long-distance trade, mitigating its negative environmental impacts, which could be supported by emission reduction instruments such as caps or levies, as part of a broader approach that aims to reduce the pace and size of social metabolism and redistribute and reduce aggregate energy and material throughput in pursuit of socio-ecological well-being. Furthermore, the BDG policy platform highlights the importance of interdisciplinary collaboration and democratic participation in planning an environmentally sustainable and socially beneficial maritime transportation sector.

Similarly, a BDG policy framework should promote the democratization of the governance of fishing activities as a main strategy to achieve social, economic, and environmental sustainability. By addressing power imbalances, BDG-oriented policies can support small-scale and marginalized fishers in having access to resources and

decision-making processes. In that respect, policy proposals should be attentive to the ways in which different narratives are mobilized to support the interests of specific groups in fisheries management. This includes examining perspectives on fishery practices, the valuation of public resource use, and the thinking behind marine spatial planning, as to promote policies that advance sustainable and fair socioecological outcomes. Overall, the policy implications of this research highlight the importance of community-based approaches, inclusive decision-making, and being attentive to unequal power relations when devising and implementing fishery policies. Undoubtedly, promoting the democratization of decision making in fisheries management involves more than just establishing inclusive governance systems. It also entails advancing redistribution and protection of access rights to resources. Doing so can help ensure that all stakeholders, including marginalized communities, have a say in the management of fisheries resources and that these resources are allocated and utilized in a fair and sustainable manner.

BDG policies aligned with these objectives could focus on supporting community-supported fisheries, co-management, fishing cooperatives, and basic conservation income, among others. Such a policy approach aims to address the unequal power relations within the fisheries industry that often result in Small-Scale Fisheries lacking representation of fisheries' specific concerns at various levels of governance. This, in turn, can contribute to more equitable and effective fishery management outcomes. Additionally, the democratization of fisheries governance would entail a pluralist approach to fisheries science and management that is open to alternative understandings and practices that are possibly better suited to addressing complex environmental problems in their specific socio-ecological contexts. Among other things, this implies a shift from an instrumental and means-end-oriented type of management to a more reflexive, deliberative, value-rational negotiation of hermeneutics and fishing practices. In essence, BDG-aligned fishery policies would prioritize community-based organizations and promote sustainable fishing practices by changing the focus from finding objective thresholds in nature to a praxis of autonomous adaptation and democratic collective self-limitation of fishing activities that benefits both people and the sea.

To conclude, any BDG policy framework must begin by incorporating fishing and shipping sectors, as these are maritime activities with the largest socioeconomic and environmental reverberations. However, BDG must also account for the current acceleration of ocean claims and the proliferation of ocean-based economic activities, such as renewable energy production, sea-bed mining, aquaculture, tourism, biotechnology, finance, market-based conservation, and others. Although each of these sectors requires specific consideration, BDG-oriented policies are characterized by a common focus on ecological resilience, social equity, and community empowerment over the relentless pursuit of economic expansion as a condition of possibility for sustainable development of the ocean economy.

As explained throughout this thesis, such an approach would necessitate a radical shift in perspective, moving away from the current dominant narratives of the sea as an economic frontier, towards a more holistic understanding of the ocean as a complex and interconnected system that is susceptible to the environmental impacts of human activity. In doing so, policymakers and researchers can work towards creating a more comprehensive and integrated approach to sustainable ocean development. It is also essential to consider the social and cultural implications of a BDG shift, as this will play a pivotal role in shaping relationships between communities and the marine environment. Furthermore, bringing the discussion around the blue economy beyond the more established stakeholders (industry, public officials, scientists, and coastal communities) into a broader democratic deliberation on human relations to the sea might be necessary to achieve a consensus that prioritizes ecological resilience and community well-being.

5.3. Future research avenues

In this dissertation, I aimed to contribute to the synergy between marine sustainability and degrowth by advancing relevant empirical and theoretical insights into the issue of blue growth and its limits. Inevitably, my research has left many aspects unaddressed,

raising additional questions that require further investigation. In what follows, I outline six interrelated research avenues that have emerged during my doctoral journey, ranging from more concrete and practical questions to more general and philosophical considerations.

5.3.1. Enacting and widening Blue Degrowth

This thesis has contributed to an emerging effort to articulate a BDG counter paradigm in ocean governance and marine sustainability (Ertör & Hadjimichael, 2020), while exploring some of its policy implications. However, the crucial question of agency remains to be empirically theorized and explored. Which actors can become agents of change towards a BDG transformation? What initiatives, social movements, organizations, projects, and imaginaries already exist that can be thought of as part of, representing, or contributing to a BDG counter paradigm? Should BDG advocates aim to build alliances and linkages among a disparate array of actors, visions, and spaces? If so, under what common basis? These questions are critical for advancing a more grounded BDG theory and praxis of change. If BDG is to become and remain relevant as a transformative framework both in research and policymaking, it needs to be attentive to the plurality of experiences and visions of real-existing actors, while seeking the connections among them.

5.3.2. Planning for Blue Degrowth

Despite being explicitly or implicitly a key element in most standard definitions of degrowth, the issue of economic planning remains largely unexplored in the literature. In the context of a coupled rise in market fundamentalism and authoritarianism worldwide, the democratic planning of economic activity is often recognized as an urgent research and political endeavor among degrowth advocates. Symptomatic of this trend is the increased exploration of large-scale, top-down, and structural socioecological transformations and their complementarity or tensions with the focus

on local, bottom-up, small-scale prefigurative experiences that have traditionally been more commonly explored in degrowth research. In contrast to the dominant blue economy policy frameworks that establish market mechanisms and technocratic regulation as their basic pillars, a BDG counter paradigm should advance a democratic alternative in the form of a planned sustainable blue economy. Research on blue planning could delve into various theoretical aspects and apply different methodologies in the study of how to better organize human-ocean interactions, such as the development of innovative socio-economic and ecological indicators, participatory governance systems, and coordinated self-management schemes for organizing sustainable ocean-based production and consumption.

5.3.3. A sea of emancipation

A key argument of this thesis is that, as the sea has historically been a space for growth imaginaries and projects, it can also become a platform for alternative visions and ways of organizing the social metabolism that foreground values and practices of sufficiency, equity, and care. For instance, solidarity activists participating in sea rescue missions in the Mediterranean often happen to be also active environmentalists and committed to other social justice struggles. Throughout history and to the present day, the sea has helped people escape oppression, build collective autonomy and spaces of resistance, and develop solidarity and mutual aid networks. This thesis' reading of the Ocean as a space of possibility for the development of degrowth theories and praxis is largely based on the recognition of already existing spaces and practices of economic difference (Arias Schreiber et al., 2020; Foley & Mather, 2016; St. Martin, 2005a; 2005b), solidarity politics and emancipatory struggles (Campling & Colás, 2021; Ertör, 2021; Kosmatopoulos, 2019; Linebaugh & Rediker, 2012). However, more effort needs to be devoted to exploring what other past, contemporary, and even future sea-based movements have the potential to contribute to broader struggles for emancipation. What can a BDG approach

learn from these struggles? What would an ocean-based politics of emancipation through collective self-limitation look like?

5.3.4. A colonial Ocean

Inequalities in the global ocean economy are drawn along the established colonial and imperial legacies (Kosmatopoulos, 2023; Mawani, 2016). Countries in the center of the capitalist world system drain marine resources from those at the periphery (Chen-Zion, 2023; Hickel et al., 2021; Hicks et al., 2019). Such inequalities pervade the dominant blue economy articulations, which is evidenced by the fact that those countries that depend the most on maritime activities, such as Small Island Developing States (SIDS) and Global South coastal nations, have the least benefit from the sustainable development of the ocean economy (Bond, 2019; Childs & Hicks, 2019; Louey, 2022b, 2022a). The oceanic frontier imaginary can also be read as a product of the intellectual history of colonialism[21], particularly in its moral quest to subsume marine life and space to the imperative development of modern civilization through economic growth. Arguably, there is a parallelism between the hegemonic vision of the seas as unpeopled and unproductive places awaiting to be developed with the metropolitan gaze over its colonized territories. Considering this context, what other colonial legacies might pervade in the dominant visions, discourses, and projects within marine sustainability and ocean governance? But also, what would a decolonial perspective of the blue economy look like? Moreover, are there anti-colonial legacies to recover in the plurality of ways that people relate to the sea?

5.3.5. The pluriversal Ocean

21 Particularly in this case, the north-american settler-colonialism as articulated in Turner's Frontier Thesis

In light of the preceding inquiry, it should be noted that the coloniality inherent in dominant ocean governance and marine sustainability paradigms is also reflected in the methods by which knowledge is generated and legitimized. Although this thesis largely focuses on Western perspectives when examining imaginaries, values, and practices associated with the sea, it acknowledges the existence of a plurality of ways in which people relate to the ocean. This plurality remains to be explored further. Some interesting research avenues include the role of marine identities and ocean literacy in shaping people's relation with the sea. Moreover, future research should explore and incorporate non-Western perspectives, cosmologies, and histories of human-ocean interactions. In doing so, future research can contribute to a more pluriversal understanding of the sea as a complex and diverse cultural and ecological space. Additionally, further research should examine the epistemological implications of articulating environmentalist values, discourse, and praxis from an ocean-centered perspective. This could involve exploring how the ocean, as a physical and metaphorical space, influences our ways of understanding the world. Exploring these research avenues can help challenge the dominant Western-centric gaze and contribute to a more inclusive and holistic understanding of the ocean.

5.3.6. The terraqueous predicament

Borrowed from Campling and Colás (2021), the Latin term 'terraqueous' simply means "made of land and water." The 'terraqueous predicament' is, following these authors, the amphibious form that capitalist valorization processes take in appropriating nature and exploiting labor across land and sea. In this context, the land-sea divide becomes a predicament for capital accumulation, as the territorialization and settlement of aquatic environments is much harder to accomplish than in terrestrial spaces. This is the biophysical basis of the socially constructed divide between land and sea in capitalist societies. This ontological dichotomy is foundational for the blue economy, as it starkly demarcates what are the "blue" environmental and socioeconomic issues from the rest.

However, in reality, such a division is not so clear: not only are marine ecosystems directly connected with terrestrial and atmospheric processes –think of the hydrological cycle— but socioeconomic activities are as well. For instance, most marine pollution sources are land-based, and as previously mentioned, the corollary of blue growth is land-based growth. From a social-metabolic perspective, such a stark separation between land and sea is ultimately detrimental to the development of comprehensive and effective sustainability frameworks. Moreover, as already explained in Chapters I and II, the social construction of the sea as a space distant and detached from human realities has been the conceptual precondition for the development of oceanic frontier imaginaries, in which the sea easily becomes an external limitation to human enterprise that must be challenged and overcome. An ocean-centered or blue degrowth emphasizes the intimate connection, rather than separation, of humans with the sea.

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