The Ocean Transition: What to Learn from System Transitions

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Highlights

- The ocean is a global commons on which the prosperity and well-being of humanity rests. Business as usual will result in the collapse of key biophysical ocean functions, which will have significant implications for the global economy, societies and people.
- Science has demonstrated that ecosystems on land, rivers, deltas, estuaries and the ocean are intrinsically linked. Therefore, to transition to a sustainable ocean economy that protects the ocean and provides for humanity, a more holistic approach to ocean governance is needed. In short, humanity needs to redefine its relationship with the ocean.
- Ocean governance currently consists of different forms of plural and multilevel institutions responsible for designing solutions for common resources in the ocean. However, the nature of these institutions limits their ability to consider outcomes at different scales, and the ability of resource users to devise livelihood strategies within integrated systems. These weaknesses in the current system generate significant problems for the conservation, sustainable use and equitable sharing of the ocean.
- Major efforts to better manage the ocean as a common resource are needed. These efforts will require greater willingness and cooperation, from local communities to national and international action. Stronger accountability, transparency and participation mechanisms will be required to resolve conflicts and enable equitable sharing among different users, particularly in areas beyond national jurisdiction.
- This paper considers what governance configurations would facilitate the better management of the ocean as a global commons. To do so, it considers the conditions that have facilitated societal transitions in the past, from the information and communications technology revolution in the 1970s to the more recent Paris Agreement of the UN Framework Convention on Climate Change, and the governance arrangements that have enabled them. The paper's authors are optimistic about these shifts, pointing to system transitions that are already occurring at the local level through 'niche innovations' that communities, governments and business are implementing, to governments negotiating new agreements at the global level.
- This paper proposes four key opportunities for action to strengthen ocean governance: support current UN ocean processes (e.g. ratification of UNCLOS); reconfigure nation-state authority as it relates to the ocean (e.g., establish a global 'ocean agency' that supports polycentric, 'bottom up' governance innovations); support civil society's ability to play a more significant role (e.g. by recognising access to a healthy environment as a human right and establishing a new 'wiki-type' interactive ocean knowledge commons for co-creating solutions); and integrate property rights with stewardship responsibilities (e.g. establish local user rights programs).
- A balance of civil society rights and stronger government leadership from the state is crucial to avoid overburdening citizens with securing their future in the ocean system, or with inequitable access opportunities and benefit distribution resulting from policy interventions that fail to consider their implications.

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1 Introduction

The ocean is the ultimate commons. Sustainability narratives now recognise what science continues to demonstrate—that ecosystems on land, rivers, deltas, estuaries and the ocean are intrinsically linked (Mathews et al. 2019). There is a growing consensus that the prosperity and well-being of

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humanity depends on the health of the ocean environment, including the ocean-climate nexus (OECD 2016; IPCC 2019). Critical indicators reveal that business as usual is going to result in the collapse of key biophysical ocean functions, with major implications for the global economy and societies (IPCC 2019). Science has demonstrated that these close systemic interlinkages in and among ecological, economic and social systems require solutions which are responsive and flexible, robust yet elastic (SDG 2019).

It is also evident that time is of the essence (Steffen et al. 2018; IPCC 2019). A new relationship between humanity and the ocean is thus required. It follows that the transition to a new and effective governance system for the ocean should ensure that it 'does justice to humanity's obligations to itself, and to the planet which is its home' (International Court of Justice judge C.G. Weeramantry in Gabčíkovo-Nagymaros Project (Hungary v Slovakia) 1997).

This paper proceeds from the assumption that the ocean is a commons. The problem this paper seeks to address is the complex challenge of governing the ocean as a commons. Governance systems since the dawn of modernity have evolved to govern city-states, nation-states and international relations. But the transformations to sustainability require governing interlinkages and interactions that have not previously existed across sectors, and scales with multiple actors. Sustainable development is not only a laboratory for governance innovation (How will goals be achieved?) but also for policy innovation (Which concrete goals need to be set in a specific situation?) (Meuleman 2019). Governance configurations to craft the required policies that are appropriate for a global commons like the ocean are nascent at best. It follows, therefore, that this paper must address this key question: In response to the threats to the ocean's biophysical functions and life-support services, what transition dynamics are emerging at different levels (local, regional and global) that suggest appropriate governance configurations for the future?

What governance configurations could be established to govern the ocean as a commons?

The scale of the contemporary transition that is required now can be compared to that of the transition from hunter-gatherers to agrarian societies, and from agrarian societies to industrial societies (Haberl et al. 2011). Over the past 500 years, societal transitions of this scale have typically resulted in a change in governance with respect to socio-political arrangements, territorial authority, representation, rights, regulatory authority and accountability (Jessop 2016). In addition, since the beginning of human civilisation, people have collaborated to secure and protect common natural resources they have depended on for their survival (Ostrom 1990). During the modern industrial era, the commons has gradually been replaced by private ownership, on the one hand, and the public goods owned or controlled by states, on the other. The sustainability- oriented transitions that characterise the twenty-first century have once again brought into focus the crucial importance of the commons (Dasgupta et al. 2019). This has been made most clear with respect to the global scientific consensus about climate change, which is, arguably, about protecting the most important commons of all.

Societal transitions are not random events. Following the well-known 'multilevel perspective' on sustainability transitions, they emerge from a specific constellation of conditions that interact in complex ways (Geels and Schot 2007; Geels 2010; Grin 2010; Geels et al. 2017; Schot and Kanger 2018). Transitions come about when landscape pressures (e.g. population growth, technological change, climate change) result in a realisation that existing socio-technical regimes (e.g. fossil fuel-based energy systems, mobility systems based on the private car, industrial fishing) are inappropriate to address potentially destructive pressures or achieve a set of broader goals that previously did not exist (e.g. mitigating climate change, degradation of the ocean). For example, overfishing may be allowed by a legalised fishing regime, incentivised by an economic system and promoted by a political system. Yet in too many cases, the governance system as a whole does not resolve the problem of the ultimate collapse of the fish stocks as predicted by scientific research on wider landscape-level system dynamics (Cullinan 2014). At the same time, 'niche innovations' can open up as key networks of innovators respond to changing conditions by designing systems that aim to respond to the emerging landscape pressures (e.g. sustainable fishing regimes in the ocean context, or renewable energy in the context of climate change). Sometimes existing governance regimes engage with and absorb the niche innovations as their way of responding to the landscape pressures (e.g. the decision of large coal-based energy companies like Italy's Enel to become major renewable energy providers; Swilling 2019). At other times, regimes resist change, thus creating space for niches to coalesce and emerge as an alternative regime (e.g. the emergence of the organic food movement in response to the persistent dominance of the conventional global food system) (Smith et al. 2005). Sometimes niches are too weak and alternative regimes refuse to reform, resulting in landscape pressures causing social-ecological system breakdowns (as is emerging in water systems in many city-regions; Smith et al. 2005).

If, however, the dynamics of change are such that a societal transition becomes possible (e.g. the commitment by 57 countries to meet 100% of their energy needs with renewables, led by countries like Costa Rica and Uruguay; REN21 2018), much will depend on the emergence of governance configurations that are fit for purpose.

Incumbent governance arrangements can often prevent the implementation of known solutions (e.g. despite the

rapid growth in renewables worldwide, there is no significant decline in the use of fossil fuels, largely because of path dependencies that existing tax and subsidy regimes reinforce; Geels 2014). Given the focus on a new set of global environmental goods such as the climate, the ocean and water, new governance arrangements appropriate for managing a commons will better enable the necessary transitions to occur in these sectors.

The approach to sustainability transitions used in this paper draws on complex adaptive systems theory (Levin 1998; Norberg et al. 2008; Preiser et al. 2018), many aspects of which are relevant to ocean systems (Lubchenco et al. 2016). The ocean system, from this perspective, is portrayed not as deterministic, predictable and mechanistic but as a diverse range of complex processes underway at multiple scales (global, regional, local). These processes catalyse self-organising dynamics that produce a new set of emergent and adaptive patterns. Ex post facto, data- intensive modelling may track past patterns, but future predictions cannot capture many critical drivers and responses. Scenario analysis and other forms of modelling may be useful for certain purposes, such as exploring global pathways to mitigate coastal risk through nature-based solutions (Chaplin-Kramer et al. 2019) or quantifying a subset of interacting ecosystem components for coordinated sectoral management, such as coastal habitat-fishery and disaster reduction linkages (Mumby et al. 2004; Arkema et al. 2015; Guannel et al. 2017; Rogers and Mumby 2019), but such approaches are unlikely to help us fully understand the highly complex dynamics of the ocean transition (Levin et al. 2012).

By identifying landscape, regime and niche dynamics, sustainability transition theory instead uses narrative analyses to help create useful categories for describing different kinds of transition dynamics, how they intersect and probable future pathways.

In order to describe what a transition to a more sustainable ocean system might look like, we first characterise the system through a brief outline of the current governance regime (Sect. 2) for the ocean. Establishing a governance baseline is required in order to build a narrative which can be used to understand ocean dynamics, and assist in identifying the nature of the changes that are needed for the transition to a sustainable ocean economy. Next, we define the stakeholders for several key sectors and describe the dynamics at play at multiple scales in the various sectors comprising the ocean economy (Sect. 3). We then demonstrate how regimes can respond to landscape pressures by diagnosing the principal drivers of change, including global and local scales (Sect. 4). Thereafter we demonstrate how the ocean system has evolved as a result of these drivers of change.

Hundreds of niche innovations have emerged, some of which we detail for illustrative purposes (Sect. 5). We propose theories of change which are suggestive of future trajectories, which in turn highlight the benefits of protecting and regenerating the ocean commons (Sect. 6). We offer paths forward, with examples of actions taken at local, national, regional and global levels which demonstrate successful transitions (Sect. 7). We conclude with opportunities for nation-states and other stakeholders in the ocean economy to contribute to a purposive transition to a thriving and vibrant relationship between humans and the ocean founded on a clear vision of the changes required, and an agreed future pathway for bringing about those changes (Sect. 8).

2 Current Governance Baseline

Governance is recognised as one of the key enablers of sustainable transformation (SDG 2019; TWI2050 2018; Pretlove and Blasiak 2018). The United Nations' 2030 Agenda represents a new mode of governance, one defined not through binding legal agreements but through the Sustainable Development Goals (SDG 2019). Current governance models and arrangements, whether global, regional, national or institutional, are ill-suited to develop, oversee or implement truly integrated, multidimensional sustainable development agendas such as the SDGs (Vidas 2011; Kotzé 2017, 2019; TWI2050 2018). Ocean governance is currently too fragmented across administrative boundaries and sectors to provide integrated responses (IPCC 2019; IPBES 2019).

An analysis of ocean governance includes institutions with mandates related to land use (urban, rural, coastal), freshwater management (surface and groundwater; quantity and quality), natural resource use (agriculture, horticulture, silviculture, mining, fisheries), environmental protection (including protected areas in terrestrial, freshwater and marine environments), development policies (e.g. economic, energy, transportation), human-environment interactions and the policies, procedures and regulations within and across segments of the source-to-sea ocean continuum (Mathews et al. 2019).

2.1 Ocean Governance

The current regime for ocean governance is complex (WCED 1987). As with international environmental law in general, governance internationally is comprised of two branches: customary law (judicial precedent, government policy and practice) and conventional law (international conventions).

The UN Convention on the Law of the Sea (UNCLOS) is at the centre of ocean governance. A key provision in UNCLOS is the distinction between various maritime zones of coastal states in contradistinction with the high seas (UNCLOS 1982). Maritime zones endow coastal states with either full sovereign jurisdiction or more limited sovereign

rights (depending on the zone), in contradistinction to the principles of freedom of navigation and freedom of fishing which operate in the high seas, otherwise known as areas beyond national jurisdiction (ABNJs).

ABNJs generally are subject to weaker governance and poorer management. These waters are home to some of the rarest and most charismatic species on the planet—but all countries have the right to navigate, fly over, carry out scientific research and fish on the high seas with limited restriction (High Seas Alliance Treaty Tracker 2019). This, by definition, is why the high seas are a global commons. However, unlike the natural commons that is the focus of extensive work on commons governance today (influenced by Ostrom's research), the high seas as commons lack integrated commons governance.

In ABNJs, no nation-state is vested with jurisdiction, nor is any single international body vested with a strong mandate or effective means to secure a holistic, sustainable approach to managing the high seas (Pretlove and Blasiak 2018). In addition, human activities, water conditions and migratory species in nations' exclusive economic zones (EEZs) and territorial waters affect, and are affected by, activities in ABNJs. Ocean currents and species do not heed governance boundaries; and economic sectors commonly overlap in ocean spaces and share inputs to production (Klinger et al. 2018). Even the significant bodies such as the International Seabed Authority (ISA) or the various regional fisheries management organisations (RFMOs) are not mandated to implement the holistic comprehensive approach that is required to secure sustainable management of humankind's most important global commons. Peggy Kalas from the High Seas Alliance argues, 'The current high seas governance system is weak, fragmented and unfit to address the threats we now face in the twenty-first century from climate change, illegal and overfishing, plastic pollution and habitat loss' (High Seas Alliance Treaty Tracker 2019).

A promising development is the new agreement being negotiated under the provisions of UNCLOS, known as the internationally legally binding instrument for conservation and sustainable use of biological diversity in areas beyond national jurisdiction (the BBNJ).

A working draft of the BBNJ, released in September 2019, addresses a package of four topics, namely, the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction; marine genetic resources, including benefit-sharing; area- based management tools, including marine protected areas, environmental impact assessments and capacity building; and the transfer of marine technology (A/CONF.232/2019/6). During the first Marine Regions Forum, held in October 2019, participants emphasised the potential of universal participation in the BBNJ (Tsioumani et al. 2019). Proposals included listed mandatory environmental impact assessments; innovative options for the management of high seas biodiversity; improved coordination and cooperation among key stakeholders; and ongoing inter-regional exchange (Tsioumani et al. 2019). Concerns remain, however, as to whether the final agreement will be sufficiently robust to overcome the tension in a process characterised by individuated state and (institutional) interests. It will need to do so in order to solve a collective problem—the protection of ocean biodiversity in ABNJs. Several challenges may compromise a meaningful agreement. First, the agreement will require some inherent flexibility in its design in order to provide a useful framework for regulating decision- making in circumstances characterised by uncertainty; second, in an already crowded ocean governance space, existing institutions need to be rationalised in ways that increase coherence and effectiveness; and, finally, the new agreement needs to respond to the complex set of multiple, multilevel and systemic threats to marine biodiversity in areas beyond national jurisdiction (including, among other things, overfishing, plastic pollution and climate change) (De Santo et al. 2019) (see Appendix A1 for a more detailed discussion of the BBNJ).

2.2 Coastal Governance

Coastal regions naturally fall within the sovereign jurisdiction of coastal states. The interface between humans and the ocean is keenly experienced at the coast. More than 1.9 billion people lived in coastal areas in 2010, mostly in developing countries (Kummu et al. 2016). Coastal ecosystems provide services to humanity which are not easily included in monetary-based decisions, such as coastal stabilisation, regulation of coastal water quality, biodiversity, spawning habitats, carbon sinks, buffering and livelihood resources (Baker et al. 2019). The ocean is also an integral part of the global climate system (IPCC (Intergovernmental Panel on Climate Change) 2013; IPCC 2019).

From a governance perspective, integrated coastal management (ICM) is an approach developed to manage, in an integrated way, the complex and dynamic system encompassing the many interactions between people and ecosystems (Bremer and Glavovic 2013). The underlying key principle in ICM is the recognition that the traditional sectoral approach to managing human activities in the coastal zone, characterised by competing needs and overlapping mandates, has significant negative impacts on the environment. The aim of ICM is then to provide integrated governance for guiding coastal area development in an ecologically sustainable fashion (FAO 2019a). ICM has been applied in regional applications with marine ecosystem programs and regional seas programs, for example the EU Integrated Maritime Policy, and in a growing number of nations (see Winther et al. 2020).

However, regulatory challenges for effective ICM arise as a result of institutional and sectoral inertia, lack of flexible decision frameworks to manage the complexity, uncertainty and difficulties managing the trade-offs inherent in ICM (Vierros and Buonomo 2017).

Figure 12.1 illustrates the complexity of overlapping and competing interests and mandates which exist in the ocean economy.

Ngeta (2014, p. 28) confirms this by stating that 'the complexity of the actor constellation tends to increase as one moves up the governance ladder from the local to the global'. Complexity of this nature in coastal governance has implications for resource and livelihood sustainability (Agrawal and Perrin 2009). For this reason, implementing ICM has proven to be a challenge in different parts of the world (Ngoran et al. 2016; Cantasano et al. 2017; Warnken and Mosadeghi 2018).

Figure 12.1 demonstrates that, from a national perspective, overlapping mandates in the ocean economy arise primarily within coastal states' exclusive economic zones, but they can also occur on the high seas. An integrated ocean management (IOM) approach to policymaking is designed to address challenges for ocean management in EEZs that can include conflicts between sectors (e.g. tourism versus hydrocarbon extraction), across different scales of organisations (such as local, municipal, regional) and biophysical features (local water bodies, shared watercourses, regional seas, global ocean) and across time (current and future uses) (Klinger et al. 2018; Winther et al. 2020). Another obstacle to integrated management is a lack of information on how sectors interact, and how changes in one affect incentives and actions in others (Klinger et al. 2018). Anticipated economic growth from the blue economy is likely to lead to additional cross-sector conflicts and could bring environmental degradation, inefficient natural resource use and other socially undesirable outcomes (McCauley et al. 2015; Winther et al. 2020). A FAO study on the application of IOM in a number of countries including Norway, Indonesia and Angola found that multi-sectoral coordination, created through a grouping of marine ministries, was very effective in Indonesia (Torrie 2016). Information- gathering through a decentralised power structure and incorporating stakeholder engagement through a network approach (see Sect. 7.1.2)

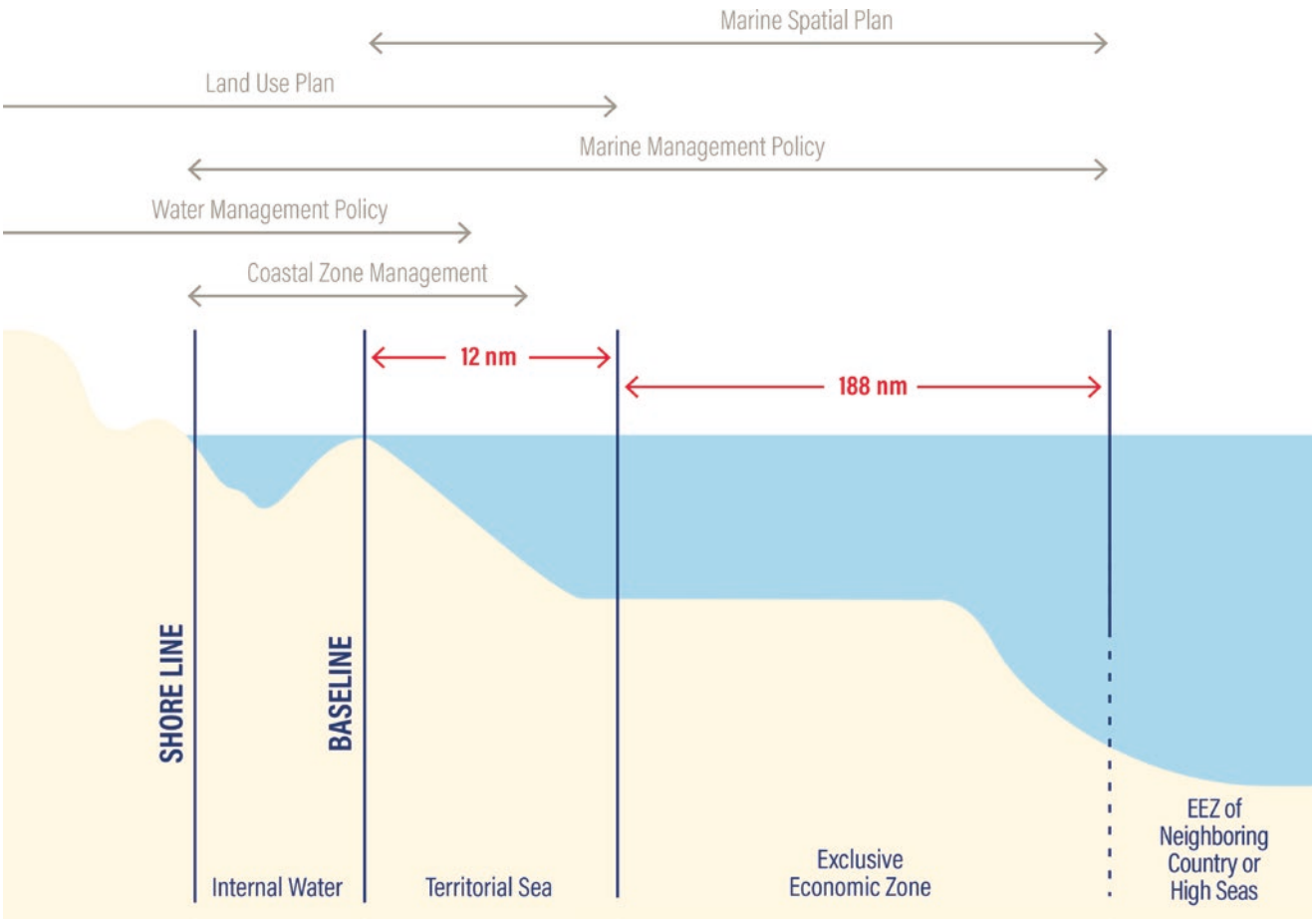

Fig. 12.1 Independent and overlapping management frameworks in the source-to-sea system in Sweden

provided highly valuable information (Torrie 2016). An advantage in Norway has been the relative speed and flexibility with which the government is able to draft, pass and enforce laws, which has contributed to effective ocean governance focused on the health of fish stocks and ecosystems (Torrie 2016).

Many of these principles will be echoed throughout this paper. In addition, the knowledge commons for sharing information and establishing transparency (discussed in Sect. 7.2.2) will facilitate policy development in the national context. Polycentric governance processes within the boundaries of national laws and policies will facilitate coordination, the sharing of knowledge and information and the identification of possible solutions for trade-offs.

Enhancing understanding about the governance interactions, as well as the manner in which governance outcomes may influence resource and livelihood sustainability, is needed in order to elucidate understanding about how different forms of commons governance produce different outcomes for livelihoods and well-being of marginalised communities (Brockington and Wilkie 2015). South Africa's first UN Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site, Simangaliso, provides an example of the governance challenges which arise as a result of the co-existence of plural and multilevel governance systems and institutions governing the coast (see Appendix A2 for this case study).

Sectoral institutions still dominate in national governments and in the UN system. This gap presents one important opportunity for future policy development—a UN or another version of a supranational body could, through access to a knowledge commons platform (discussed later in this paper), analyse the functioning of existing laws and institutions, articulate a flexible framework (which can provide for diverse region-specific conditions) on agreed ICM principles, as well as provide monitoring and oversight to achieve greater coherence. To that end, sectorally focused management regimes would benefit from greater integration, such as integrating marine spatial planning with efforts aimed at regulating land-based activities such as food production and the resulting nutrient runoff, tourism-based livelihoods and small-scale fisheries (Sale et al. 2014; Lubchenco et al. 2016). The functions of ICM are more fully developed in the Blue Papers "*Coastal Development* and *Integrated Ocean Management*".

2.3 Shared Resource Governance

Governance of shared resources has matured over the past several decades. The lucrative global fisheries for migratory and straddling fish stocks in the high seas, such as tuna, are managed through several measures. Regional fisheries management organisations (RFMOs) were set up under the UN Fish Stocks Agreement (UNFSA), and sector-specific measures were taken by the UN Food and Agriculture Organization (FAO), including the FAO Code of Conduct for Responsible Fisheries, the International Plan of Action to combat illegal, unreported and unregulated (IUU) fishing, and the Agreement on Port State Measures to Prevent, Deter and Eliminate IUU Fishing. While some RFMOs have been effective, severe challenges result from a lack of cooperation among states, conflicting interests in resource utilisation and conservation, fragmented responsibilities, lack of political will, lack of effective monitoring and enforcement and perverse economic incentives for 'free riders' to cheat the system (Figueres et al. 2014).

River-basin management of shared transboundary waterbasins provides useful lessons for joint stewardship of the ocean. In circumstances of shared international watercourses, states have been required to share sovereignty in a kind of 'joint ownership' of the water body (Rieu-Clarke and Spray 2013). For example, the Mekong River Basin, a 4909 km river system which flows through six countries, is collaboratively managed by the Mekong River Commission. The UN Watercourse Convention 1997 (UNWC), is widely recognised as a pivotal document in international water law (Litke and Rieu-Clarke 2014). It codifies and clarifies existing norms and develops emerging principles of customary international water law. It constitutes a model that can guide the interpretation of other treaties and the negotiation and drafting of future ones; and it has informed the judgements of international and regional courts (Litke and Rieu-Clarke 2014). Some of the unique procedural provisions in the UNWC offer lessons for future regulatory frameworks for regional or international management of shared estuaries or seas. In addition, the principles of shared water management through regional organisations set up under the UNWC could be adapted for regional fisheries management by adapting or expanding RFMOs into regional ocean management organisations (ROMOs). ROMOs would be responsible for the preservation and productivity of the entire ecosystem, rather than only shared fish resources or specific species (Figueres et al. 2014).

3 Sectoral Regime Dynamics and Stakeholders

Having briefly outlined a high-level overview of current ocean governance, the next step in determining potential pathways to a purposive ocean transition requires understanding some of the regime dynamics at play in the ocean and identifying the key stakeholders in those dynamics. Regimes are understood in the sustainability transitions literature to be a tightly knit combination of regulations; key

operators that produce products or services; consumers who depend on those products or services; the revenues that governments, agencies and regulators extract in the form of levies or taxes and so on; the financial institutions that have provided debt or equity; plus a substantial infrastructure operated by people who have been trained over decades to understand and operate the system in certain ways.

This combination of interlocking interests creates an alignment of purpose that reproduces path dependency.

Path dependency can be described as a constraint on decisions or processes due to a combination of interlocking interests that creates an alignment of purpose and resistance to change. The tightly interdependent set of interests limits possible decisions for any given circumstance due to past decisions or because of inexperience with new conditions, even when past circumstances may no longer be relevant or appropriate (e.g. reliance on fossil fuel energy). Generally, path dependencies arise because of the tendency of institutions to act (and react) as a result of their historical structural properties or beliefs. For changes in a regime to occur, the reprogramming of a vast array of system components will be necessary. This is why regime change is challenging, and why often regimes resist change. Regimes will change in response to landscape pressures if they have the internal capacity to manage change and access to new external knowledge about alternatives. Without these conditions, niche innovations will emerge outside the regimes and can eventually coalesce into alternative regimes that are more responsive to landscape pressures than are the incumbent regimes (Smith et al. 2005).

In order to propose a theory of change, it is necessary to view the ocean system in its full complexity. The key ocean-relevant regimes that directly and indirectly affect the future resilience of the world's ocean are summarised in Appendix B. The regimes we outline are shipping, ocean-based food extraction, offshore oil and gas, ports, marine and coastal tourism, marine and seabed mining, marine biotechnology, cabling and maritime equipment, and offshore and renewable energy. The regimes we sketch in Appendix B are sectoral in nature, with distinct governance and operational dimensions. Regimes often interact at multiple scales, and shifts that seem unimportant at the local or regional scale, when aggregated, could actually precipitate major changes in other regimes (e.g. aquaculture and coastal development; Rocha 2010).

Several regime responses illustrate shifts in existing ocean systems towards sustainability. For example, institutions such as the International Maritime Organization (IMO) and some industries have contributed to significant regime responses in the shipping sector.

Green ship recycling is one example. This involves environmentally friendly ways of managing end-of-life ships (OECD (Organisation for Economic Co-operation and Development) 2010; IMO Guidelines for Shipbreaking; the Hong Kong Convention; NatCap (Natural Capital Project) 2019; EU Directive on Ship Breaking). Also in the shipping sector, the GloFouling Partnership project was formed under the auspices of the IMO to support anti-fouling measures. These measures are designed to guard against the significant risks to marine biodiversity created by ship's discharges contaminated with alien invasive species. The move towards the decarbonisation of the shipping industry, initiated by the *Initial IMO Strategy on the Reduction of GHG Emissions from Ships* (IMO 2018), is underway. A target has been set to decarbonise the shipping industry by 2035, which would equate to a reduction in shipping's carbon dioxide (CO_2) emissions of between 82 and 95% below the current level (OECD International Transport Forum 2018). Some ports around the world (Los Angeles, Auckland, Valencia, Guayaquil, Baku and Rotterdam) are working towards becoming carbon-neutral. Several transparency initiatives are also unfolding across numerous regimes. For example, in the maritime transport sector, the Open Simulation Platform, founded by industry in 2018, facilitates collaborative open platforms for the design, operation and building of ships. Fisheries certification schemes such as the Marine Stewardship Council (MSC) are supported by new information products such as Global Fishing Watch. These information products track and analyse global fishing activity using publicly available automatic identification system transmissions from boats and satellite images. Traceability programs of this nature allow full tracking of harvested species along the entire production chain (Costello et al. 2019). Such monitoring information is critical to building trust that fishery management interventions are having the desired effects, or if not, to encouraging action and adaptation throughout the seafood value chain, and enabling monitoring and compliance through these systems. The suite of sustainable fishery management approaches that have been implemented in the ocean and food extraction regime, such as rights-based fisheries management (RBFM), marine protected areas (MPAs) and integrated coastal management regulations, indicate that fish stocks, marine habitats, fisher communities and ocean food–based supply chains can recover if management objectives are clear and monitoring and scientifically based assessments inform open discussion of trade-offs and adaptation over time (Costello et al. 2019). New synergies are being investigated in the cabling and maritime equipment sector, which could lead to the use of private sector submarine telecommunications infrastructure for climate monitoring and disaster warning (Submarine Telecoms Industry Report 2019). Other responses are emerging; for example, a submarine cable in the Olympic Coast National Marine Sanctuary in the U.S. Pacific Northwest was re-buried and then systematically monitored to reduce concerns about entanglement of fishing gear and species disruptions (Antrim et al. 2018).

3.1 Inter-regime Dynamics

Although the regimes described above and in Appendix B are conceptually distinct, in practice they overlap in highly complex ways that are both mutually reinforcing and potentially contradictory. A growing global consensus and plethora of scientific reports are contributing to an awareness that these regime and inter-regime dynamics have unintended consequences that could irrevocably harm the ocean's biophysical systems in ways that subvert ocean-dependent regimes (Winther et al. 2020).

4 Drivers of Change

Now that we have outlined the existing framework of ocean governance, and identified the dynamics of the ocean system, we turn to a diagnosis of the landscape-level pressures or 'drivers of change' which are destabilising the system. Establishing an understanding of the issues and practises which have led to the landscape pressures now facing the ocean will help identify pathways that will allow change to occur. Landscape pressures are broad, long-term emergent cumulative shifts that are not caused by single current actions in present time.

4.1 Greenhouse Gas Emissions

Anthropogenic greenhouse gas emissions, and CO_2 specifically, are widely recognised as the biggest long- term threat to a functional ocean (Rogers and Laffoley 2013; Gaines et al. 2019). Climate change is altering the ocean's impact on climate, its chemistry, temperature, circulation, sea level and ice distribution. Collectively, these system changes are affecting the habitats, biological productivities and species assemblages that support ocean-based economies and cultures. Ocean circulation changes also are predicted to lead to increased intensity and frequency of tropical cyclones and extreme sea level events, including storm surges and flooding and precipitation (Gaines et al. 2019).

Increasing ocean acidity is influencing large swathes of ocean ecosystems in a range of ways (Suggett et al. 2012; Kroeker et al. 2013) and is most acutely felt in shallow water systems such as the subarctic Pacific and western Arctic Ocean (IPBES 2019). The ocean has absorbed over 90% of the excess heat from global warming, with consequences for organisms that are adapted to specific temperature ranges in terms of both latitude and depth (IPCC (Intergovernmental Panel on Climate Change) 2013). Oxygen content is in decline, dramatically observed in increasingly extreme hypoxic events (Stramma et al. 2010). Other primary stressors on ocean systems include habitat destruction, overfishing and pollution from land and coastal sources (Bailey and van der Grient 2020). Impacts of climate change on biodiversity and ecosystems are well documented, including shifts in species ranges and the socio-ecological ramifications of this (Cheung et al. 2010; Pecl et al. 2017; Costello et al. 2019; Gaines et al. 2019).

4.2 Overfishing

Direct exploitation of fish and seafood has the largest relative near-term impact among drivers of ocean status (IPBES 2019). Currently, 33% of fish stocks are classified as overexploited and greater than 55% of the ocean area is subject to industrial fishing (IPBES 2019). Since 1950 the percentage of fish stocks that are 'developing' (i.e. still increasing in output) has declined dramatically, while stocks that are exploited, over-exploited or collapsed has escalated dramatically since the 1980s (FAO 2018; Costello et al. 2019; Widjaja et al. 2020). Severe impacts on ocean ecosystems can occur through direct harvest of target and bycatch species, and, indirectly, through degradation or destruction of benthic habitats (e.g. through dredging in soft-bottom regions or dynamite fishing in coral reef areas) or through the ramifications of predator-prey and other food web dynamics (Costello et al. 2019).

Small-scale fisheries catches have been increasing, from about 8 MT per year in the early 1950s to 22 MT per year in 2010, and continue to grow at the global scale, while industrial catches at larger scales decline (Pauly and Zeller 2016). Small-scale fisheries suffer from highly variable regulation and enforcement, even where catch, area or gear limits do occur. Such fisheries are characterised by very limited information on stock status and fisher behaviour, exacerbating socioeconomic pressures on vulnerable fishing communities dependent on local seafood for nutrition and livelihood support (FAO 2015). Additional detail on drivers in the current fishing regime is provided in Sect. 3 and Appendix C.

4.3 Seabed and Land Use

Another direct driver with a high relative impact on the ocean is the many changes in the uses of the sea and coastal land (IPBES 2019; Addo et al. forthcoming). Nearshore regions of the world are straining to support exploding demand from oil and gas development, shipping and port activities, fisheries and aquaculture, tourism and the protection of people, property and infrastructure from increasing storm intensity and sea level rise (Fig. 12.2). Much of the planet's population growth over the next decades will occur along coastlines, where development pressures already are destroying nearshore marine ecosystems (e.g. mangroves,

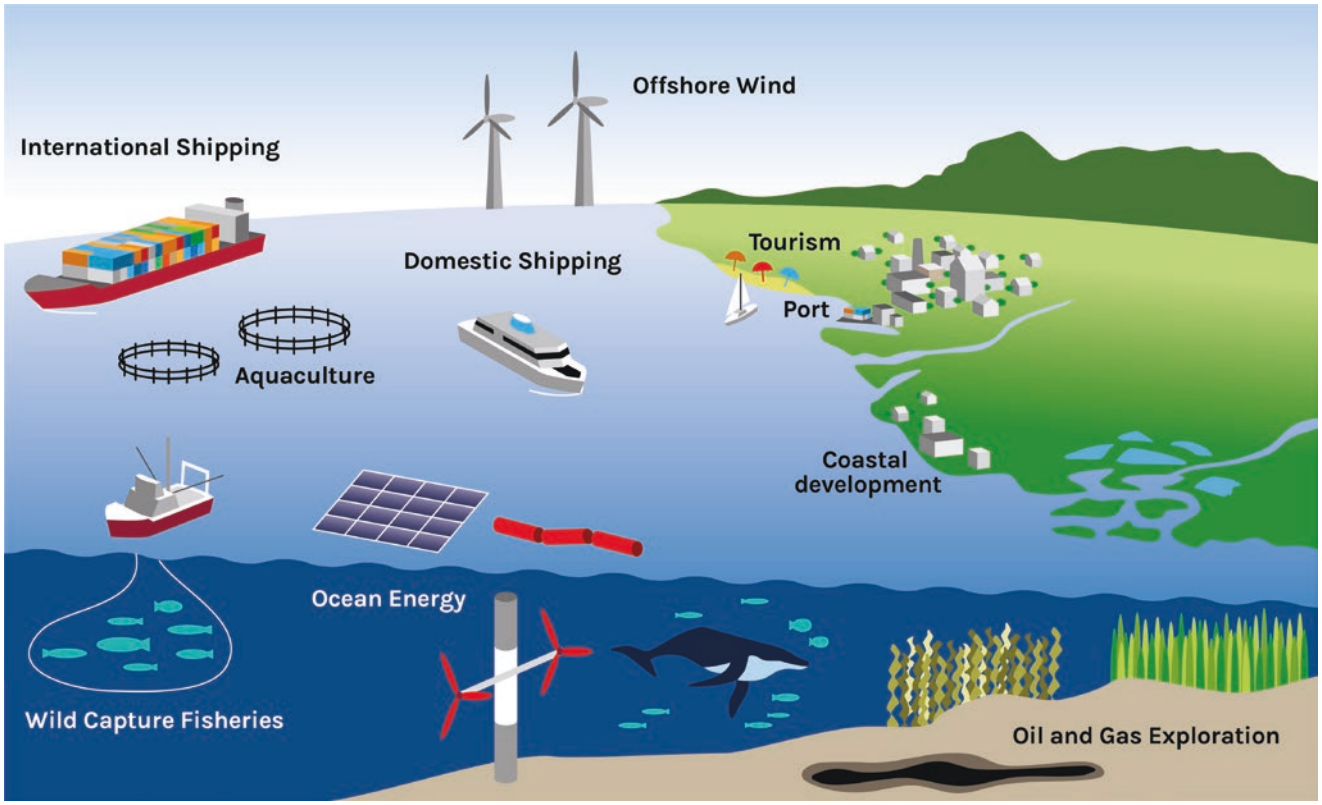

Fig. 12.2 A sampling of human activities in the coastal ocean

coral reefs, wetlands, seagrasses, kelp forests) that provide many of the benefits on which people rely (Costello et al. 2019; Aburto-Oropeza et al. 2020). Coastal habitats, including estuaries and deltas critical for marine biota and regional economies, have been severely affected by sea-use changes (coastal development, offshore aquaculture, mariculture and bottom trawling) and land-use changes (land clearance, urban development along coastlines, pollution of rivers). Ocean drilling, while relatively small in scope, has expanded since 1981 to roughly 6500 offshore oil and gas installations worldwide in 53 countries (60% in the Gulf of Mexico by 2003) and likely will expand into the Arctic and Antarctic regions as the ice melts. Plastic microparticles and nanoparticles are entering food webs in poorly understood ways (Jambeck et al. 2020). High levels of metals, nutrients and persistent organic pollutants from industrial discharges and agricultural runoff damage fish species and seabed biota. The dynamics of ocean and airborne transport of pollutants mean that the harm from inputs of plastics, persistent organic pollutants, heavy metals and ocean acidification is felt worldwide, including with consequences for human health (IPBES 2019).

4.4 Fragmented Governance

As we have already indicated, governance arrangements are too fragmented across administrative boundaries and sectors to provide the integrated responses that are required to meet the increasing and cascading risks of negative environmental impacts on the ocean (IPCC 2019). Existing governance is inadequate to stem unsustainable ocean uses in some coastal regions, where often a full constellation of resource demands and human activities are degrading ecosystems, and where regulatory contexts lack mechanisms to integrate management across sectors (IPCC 2019). Bigagli (2016) argues that more resilient ocean management systems incorporate learning-based management strategies that are supported by science-based advice to policy. He reviewed over 500 existing international agreements for environmental protection and regulation of human activities in the world's ocean and found them woefully inadequate. At global scales, agreements largely focus on single-sector objectives—fisheries, pollution, nature protection and transportation primarily—governing human use and management of the ocean. Regional agreements tend to include multiple sectors, but

inclusion of ecological resilience considerations is mixed at best (see Winther et al. 2020). Integration and coordination of ocean governance is required to address these issues. In the absence of this, a very real risk arises: if a governing system becomes too complex, diverse or dynamic, it may become ungovernable in itself (Jentoft 2007; see also Winther et al. 2020).

It is clear from this and previous sections that a wide range of increasingly significant landscape pressures are already starting to harm the functional effectiveness and resilience of the ocean's complex social-ecological systems. Although pre-existing governance regimes are no longer adequate, as indicated earlier, significant shifts are already underway. These shifts are reflected in the ways regimes are responding to landscape pressures, and how niche innovations (instigated often at the local level by new actor networks) are emerging with a focus on the protection and regeneration of the commons.

5 Niche Innovations

In order for transitions to occur in response to landscape-level drivers of change, two dynamics must be at play: either existing regime actors (i.e. key individuals located within a particular regime, which could include decision-makers, consumers, regulators or funders) respond to these drivers, and/or networks of innovators come together to instigate so-called niche-level innovations. When path dependencies persist because regime actors resist change, niche innovations can emerge that demonstrate through trial and error that alternatives are possible. Niche innovations tend to be geographical and/or sectoral spaces where coalitions of innovators coalesce in response to perceived landscape pressures. Often, these niche innovations are protected from market dynamics (via subsidies or soft money) or political interference (via regulation or location in the non-profit sector).

For example, groups of anti-nuclear activists initiated wind-power experiments in Denmark in the 1980s and 1990s. Government policy banned businesses from owning windmills located within communities, thus protecting these niches from competitive pressures, and regulations resulted in rewards for—and subsidies of—innovations. Denmark has subsequently become a world leader in wind-power generation through its global company Vestas (Mey and Diesendorf 2018). The same applies to organic food production. In the United States, for example, the Whole Foods supermarket chain has transformed previously limited-impact organic food niches (farming and retail) into a mainstream food retail regime. In this case, niches were 'protected' by the evolution of a particular set of consumer values and organic certification schemes. Niches can coalesce into an alternative regime (e.g. wind power), or existing regimes can change course and absorb niche innovations (e.g. the way Italy's energy utility Enel has decided to close down half of its coal-fired power business and enter the renewable energy market as a mainstream global player).

These niche innovations reveal how regulatory interventions (if any), stakeholder engagement/organisation, institution-building, and ongoing monitoring and evaluation have worked in ways that counteract the negative landscape pressures. We offer four examples here to illustrate the diversity of niche innovations emerging in the ocean: coastal zone development planning in Belize (Box 12.1); the Chilean territorial user rights fisheries (TURFs) as an example of rights-based fishery management (Box 12.2); shared stewardship in business in SeaBOS fishery companies (Box 12.3) and responses to plastic pollution in the ocean (Box 12.4). There are literally hundreds of niche innovations, some disconnected, others are starting to coalesce into potential alternatives. To illustrate the breadth of niche innovations in the ocean system, we highlight four additional examples in Appendix C to reveal their breadth and dynamics: integrated coastal development, fisheries and disaster risk planning in Belize; rights-based fishery management; illegal, unreported and unregulated (IUU) fisheries monitoring innovations; and justice in marine sustainability, including the Pacific Islands' Parties to the Nauru Agreement (PNA Tuna 2010).

Box 12.1. Coastal Zone Development Planning in Belize

The Government of Belize's Coastal Zone Act of 2000 recognises the value of multi-sectoral, integrated spatial planning to guide policy and investment for more sustainable use of the coastal zone. The government approved a national Integrated Coastal Zone Management Plan (ICZMP) in 2016, led by a new ministry inspired by integrated development planning, connecting in one department Agriculture, Fisheries, Forestry, the Environment and Sustainable Development (CZMAI (Coastal Zone Management Authority and Institute) 2016). The government led an interactive stakeholder engagement process to co-develop the plan, beginning with identifying shared objectives for artisanal and commercial lobster and conch fisheries; reducing the risk to coastal infrastructure, property and people from sea level rise and storms; and sustainable tourism benefits, the largest sector of the Belizean economy. The iterative science-policy process engaged all relevant stakeholders from government ministries, non-governmental organisations, business, and community leaders (Arkema and Ruckelshaus 2017). The final plan is projected to improve coastal protection from storms and sea level rise, and increase revenue from fisheries and tourism, more than alternative plans emphasis-

ing either conservation or development alone (Arkema et al. 2015, 2019; CZMAI (Coastal Zone Management Authority and Institute) 2016). At the same time, the plan improves protection for mangroves, coral reefs and seagrass beds—the natural capital upon which coastal populations' safety and livelihoods depend.

The final ICZMP highlights the importance of coordinating the management of, and investment in, a diverse set of activities and actors implicated in sustainable outcomes for the nation, ranging from those engaging in or affecting coastal pollution, dredging, fisheries, aquaculture and tourism development, to education, social resilience to climate change, and preservation of cultural heritage. The plan led the Belizean government to enact a permanent ban on all oil exploitation within the second-largest coral reef in the world. The ICZMP actions and new zoning-based management are being implemented with funding from the government, the Inter-American Development Bank and other sources. The Belize plan has been hailed by UNESCO as 'one of the most forward-thinking ocean management plans in the world' (Douvere 2016). In 2017, the Belize Barrier Reef was removed from the UNESCO List of World Heritage in Danger because of the protections provided in the government ICZMP.

The key innovations in the Belize ICZMP process include a legal government mandate, in the Coastal Zone Management Act of 2000, requiring a cross-sectoral, multi-objective and spatial planning process. In and of themselves, such laws do not necessarily lead to transformation of ocean management. An important institution in Belize, the Coastal Zone Management Authority and Institute (CZMAI), played a key role in designing the co-development process for the ICZMP, and continues to lead its ongoing implementation and adaptation. The science-policy process to envision, debate, and select the final ICZMP approved by the government also included training of Belizeans on the scientific and policy aspects of ecosystem-based management, increasing the chances that the process will be internalised in government and civil society activities (Arkema and Ruckelshaus 2017). Appendix C details efforts in fisheries and disaster risk sectors to integrate more fully with coastal zone development planning in Belize.

Box 12.2. Chilean Territorial Use Rights Fisheries

In 1991, after an overfishing crisis led to critical closures of the Chilean abalone ('Loco') fishery in the late 1980s, Chile enacted the first step in a governance transformation—a Territorial Use Rights in Fisheries (TURF) policy (Gelcich et al. 2010). As of 2013, there are over 450 TURFs in full operation, making up more than 1100 km^2 of subtidal habitat decreed to fisher organisations throughout the Chilean coast (Gelcich et al. 2017). This network of TURF areas has been established by numerous associations of fishers, along a wide geographic range, under one policy instrument, Chile's National Fisheries and Aquaculture Law (Marín et al. 2012). As a result of the TURFs, Chile's artisanal sector has increased in importance, with landings consistently surpassing the industrial catch since 2008. Artisanal fisheries are a significant source of employment for coastal communities in Chile, and their harvests represent a key source of nutritional food for many rural communities. Increases in biomass and size of individuals from species within properly managed TURFs also are demonstrating the potential of this rights-based management approach to sustain ecosystems and fishery benefits (Gelcich et al. 2019a, b).

The national enabling legislation, combined with the presence of scientific knowledge signalling alternative ways to manage stocks, and the capacity and political leverage of fisher associations that facilitated the cross-scale and the cross-organisational interactions for change, each were key in institutionalising the new governance regime.

Any registered fishing association in Chile can register as a TURF under the national law, thus encouraging volitional participation in the program, a key component of adaptive governance for a more resilient system. The TURF network has improved the knowledge of fishers and their access to learning, especially as it relates to harvest management practices, biological aspects of the resource and the interactions of the target species with other elements of the ecosystem. This increased understanding has served to develop a sense of resource stewardship on the part of fishers.

While the 25-year-old Chilean TURF model has proven its potential to improve the sustainability of fisher communities and fisheries, its governance must continue to evolve as information on social and ecological barriers to further scaling emerges (Gelcich et al. 2010). TURFs convey rights to fishers and allow them a greater, collective voice in the long-term management of the resource, a key component of their adaptability and responsiveness to changing social-ecological conditions. Currently there is room for improvement with respect to enforcement, profitability, socioeconomic impacts on resource users and the adaptability of the policy to local realities. Science, both social and natural, is key to informing ways to maintain the policy, enabling adaptation of TURFs and identifying new conditions that must be improved to build the resilience of TURFs or enable further transformations.

Box 12.3. Seafood Business for Ocean Stewardship

The Seafood Business for Ocean Stewardship (SeaBOS) initiative is an innovative collaboration among 10 of the largest global seafood companies that is transforming business operations for more sustainable wild capture fisheries and aquaculture production. Collectively, the companies in the SeaBOS initiative influence the strategic direction of more than 639 subsidiaries along the seafood value chain, with operations in at least 93 different countries, and participation in fisheries and aquaculture decision-making institutions such as regional fisheries management organisations. Under the SeaBOS platform, the world's leading seafood businesses are managing seafood cooperatively, monitoring their practices and impacts, and charting a new path for their sector. They have pledged to address illegal, unreported and unregulated fishing; work towards full traceability and transparency throughout their supply chains; make efficient use of aquaculture feeds and use fish feed resources from sustainably harvested stocks; apply existing certification standards; eradicate labour abuses and human rights violations from their supply chains; reduce the use of plastics in seafood operations; work towards reducing the use of antibiotics in aquaculture; and prevent harmful discharges and habitat destruction. The participating businesses also have pledged to work with governments to improve existing regulations concerning aquaculture and fisheries (Österblom et al. 2017). The scope of the undertaking spans every continent and all segments of seafood production. The collaborative nature of the SeaBOS project also helps companies share information to develop best practices, which in turn has helped to build trust and common purpose. An on-deck species-detecting camera and facial-image recognition software pilot is aimed at identifying illegal catch and undocumented fishermen onboard vessels. SeaBOS has recognised the crucial role of scientists in framing the urgency of problems and potential solutions. The initiative is an ongoing experiment that is being closely monitored to understand the significance of the changes over time. Such initiatives engaging with the private sector are best considered a complementary approach to existing processes, such as government regulations. This initiative is improving the prospects for transformative change by providing novel links between science and business, between wild-capture fisheries and aquaculture industries, and across geographical space (Österblom et al. 2015). SeaBOS is best described as a co-production initiative between science and business, in which companies can develop their agency (Westley et al. 2013) and ability to influence change across subsystems, thereby contributing to amplifying new norms of ocean stewardship.

Box 12.4. Global Response to Plastic Pollution in the Ocean

Over the past several years, awareness of marine plastic pollution has skyrocketed around the world. Stories of marine turtles and mammals dying from ingested plastic and plastic pollution washing up on beaches have inspired hundreds of commitments from government, businesses and non-governmental organisations, dozens of innovation challenges, hundreds of start-up companies seeking to create solutions and millions of citizens eager to take action (Jambeck et al. 2020). Global plastic production has indeed exploded, from 1.7 million metric tonnes/year in 1950 to 422 million metric tonnes/year in 2018 (Geyer et al. 2017; Plastics Europe 2019), with a concomitant increase in plastic in the waste stream (in the United States, plastic was 0.4% of the waste stream by mass in 1960 and 13.2% in 2017 (U.S. EPA 2014, 2019)). Both micro- and macro-plastics can enter the ocean through direct discharge, discharge into rivers that then flow into the ocean, runoff from land or deposit from air into waterways. Impacts of this increased load on biodiversity include negative effects on growth, reproduction and survival of marine species (Jambeck et al. 2020).

Strategies to address ocean plastics include enhancements to wastewater, stormwater and coastal zone management, development of alternative materials, greater resource efficiency, recovery and recycling (Jambeck et al. 2020). The plastic challenge is systemic, spanning product-specialised value chains and geographic heterogeneity in plastic generation, use and recycling capabilities (Jambeck et al. 2020). The specific solutions to plastic pollution in the ocean are likely to be many, crossing sectors and spatial scales, from changing individual choices to company sourcing decisions to enforcement of existing and new regulation. Efforts to address the ocean plastic challenge are acknowledging the need both for a systems approach and for understanding the ocean as a commons. For example,

ocean plastic is a growing problem in Africa, where waste volumes within coastal countries are relatively low but waste streams from other nations are overwhelming limited environmental regulation (Jambeck et al. 2018, 2020).

Leaders from governments, businesses and civil society are focusing on changing perceptions and behaviour along the entire supply chain, from design, production and use through to disposal and further use. Heightened public concern about plastic in the ocean is currently an effective catalyst for action on solutions; and this urgent attention is beginning to activate broader strategies to reduce the flow of other pollutants into the ocean. For example, a number of social innovations emerging in Africa are aimed at waste problems generally, such as community-driven collection systems and financial reward for recyclables, such as Wecyclers in Nigeria and Packa-ching in South Africa (Jambeck et al. 2020). At the regional scale, the Lower Mekong Initiative, a multinational partnership to integrate the policies of Cambodia, Laos, Myanmar, Thailand, Vietnam and the United States, is now addressing plastic contamination upstream before it gets to the ocean (Jambeck et al. 2020). The system-level collaboration emerging to address plastic pollution is a promising start to what needs to be a worldwide response. Collaborative efforts such as the Ellen MacArthur Foundation's New Plastics Economy Global Commitment, which requires signatories to align on a shared vision and targets, and the World Economic Forum's Global Plastic Action Partnership, which is a public-private collaboration platform helping to translate commitments into action, are also providing forums where many stakeholders can work together at the system level.

The system-level collaboration emerging to address plastic pollution is a promising start to what will most effectively be a worldwide response.

6 Transition Dynamics: Theories of Change

To transform socio-ecological systems, the elements below are needed to enable articulation of future aspirations, as well as a generative dialogue so that learning and adaptation can occur.

6.1 Knowledge for Transitions

Up until this point we have described the key regime dynamics (with overviews in Appendix B of shipping, ocean-based food extraction, offshore oil and gas, ports, marine and coastal tourism, marine and seabed mining, marine biotechnology, cabling and maritime equipment and offshore renewable energy), the various relevant landscape pressures and a sample of niche innovations (see Sect. 5 and Appendix C). In summary, it is clear that there are a set of landscape pressures that could result in the collapse of the ocean's key ecosystem functions, with negative implications for humanity and, specifically, the global economy. Despite the strong governance framework provided by the UNCLOS system, the existing regimes are institutionally misconfigured for this challenge. They are locked into path dependencies at odds with what is required to face the landscape pressures. However, some regime dynamics respond positively to these landscape pressures.

These sustainability-oriented regime dynamics are suggestive of future trajectories. Similarly, there is a mushrooming of niche innovations as constellations of actors (primarily, but not exclusively, at the local level) respond to landscape pressures and the inadequacy of current regimes. What is distinctive about these niche innovations is that they entail forms of stakeholder collaboration that are driven by an overriding concern to protect and regenerate the commons. As Nobel Prize winner Eleanor Ostrom (1990, 2000) has argued, humans have collaborated for millennia to protect the commons that they recognise they are dependent on. The niche innovations, therefore, suggest future trajectories that valorise the commons. They also provide signposts for the 'anticipatory thinking' (Poli 2018) that is needed in order to chart a course for the future. Transdisciplinary research methodologies will be required to conduct research on the constantly changing interactions between landscape pressures, regime dynamics and niche innovations in order to grasp the emergent properties of the sustainability-oriented ocean transition (van Breda and Swilling 2018; van Breda 2019).

6.2 Capacity and Incentives for Transitions

Transition dynamics are dependent on three key factors: whether or not existing regimes access new knowledge from external sources; whether or not they have the capacity to integrate new knowledge in order to facilitate substantive change processes; and whether or not there are incentives, initiatives or other enabling conditions that activate change. In simple terms, if within a given regime (e.g. a car-based fossil fuel–dependent transport system in a given country) there is sufficient capacity to manage change (among, in this transport case, the policymakers, regulators, transport company managers, etc.) coupled to rapid learning about alternatives (derived from experimental examples), the chances are high that a transition will occur over time (in this example, to a decarbonised transport system). However, actual changes will only take place if some catalytic event instigates the need to activate the capacity for managing change. This could be anything from price hikes to protest movements to an electoral shift that brings a new party to power with an anti-car agenda.

Following Smith et al. (2005), there are four possible transition pathways, depending on how these knowledge, capacity and catalytic factors combine. When a particular regime can access new external knowledge, when it has the capacity to manage change and when enabling conditions are present, a 'purposive transition' can occur. Such transitions can be quite radical, including the transcendence of the mainstream regime itself in the process (e.g. the renewable energy transition in Germany). A purposive transition, however, is not inevitable. If the capacity to manage change exists but only 'internal knowledge' is relied on to envision alternatives, the result will be a reform of the regime rather than its replacement (i.e. an 'endogenous renewal'). Conversely, if there is limited capacity to manage change and external knowledge is sourced, the result will be an 'emergent transformation', that is, the internal breakdown of the regime followed by the mushrooming of alternatives with limited capacity for implementation. Where there is both limited capacity for change and a reliance on internalised knowledge sources, the result will be a 're-orientation of trajectories' as the old regime becomes dysfunctional but viable alternatives fail to emerge.

The above analysis is more appropriate for understanding transitions in particular sectors, such as the transition to renewable energy or to organic food. Ocean governance is an amalgam of sectoral and spatial regimes, loosely assembled within—and beyond—the UNCLOS framework. However, as revealed in the sections above (and in Appendix C), as our understanding of regime dynamics and niche innovations improves, emergent change is unfolding. In brief, there is evidence in the ocean system that all four of these transitions are underway. A system-wide 'purposive transition' that builds on emergent regime responses to landscape pressures and transformative niche innovations is the most effective pathway to ocean sustainability. These Blue Papers have instigated the process of sourcing external knowledge that helps stakeholders to reimagine the future of the ocean. Key governments, business and civil society can now lead the way in developing the coordination capacity to manage a 'purposive transition' based on the accelerated learning emerging from the Blue Papers.

What follows is a framework for how a 'purposive transition' to a global ocean governance system can be imagined. A purposive transition suggests there is clear vision of the changes required and an agreed future pathway for bringing about these changes. It draws from the principles emerging from the above selected regime responses and niche innovations. Together, they provide the framework for ensuring that the key elements of a successful transition are put in place. A combination of a new legal framework, an 'ocean agency' and an ocean knowledge commons would bring into focus (1) the need to remove perverse incentives and promote incentives that reinforce the regime shifts and niche innovations that can catalyse a purposive transition; (2) knowledge-sharing that will be a precondition for nudging along the transition dynamics; (3) dialogues that inspire a new vision and compelling narrative; (4) the importance of a clear set of guiding principles that become the basis for new institutional configurations; and (5) the need to reinforce and empower early adopters and amplify best practices and niche innovations that reveal the alternative pathways towards a purposive transition.

7 Framing Transitions: Regulatory Lessons

The sustainable development of the ocean's economic potential will require a balance between, on the one hand, sufficient flexibility to meet constantly changing conditions and, on the other, regulatory structures that are sufficiently vigorous, strong and transparent to protect the planet for current and future generations (Pretlove and Blasiak 2018). Effective responses require international coordination and cooperation at unprecedented levels (TWI2050 2019). Multifaceted, integrated solutions can lead to new modes of stewardship (protecting, caring or responsibly using the environment) and social practices for managing the ocean as a commons. The World in 2050 report (TWI2050 2019) states that 'it is even more important now to integrate social and economic goals with climate, water, oceans, biodiversity and other Earth-systems so that sustainable development is not threatened in the long term'. Drawing on our understanding of the landscape pressures, regime dynamics and niche innovations, we propose a way of thinking about such a fundamental shift. In

particular, we imagine a global governance transition that is more faithful to commons-oriented niche innovations.

Jessop (2002) argues that governing complexity means breaking away from linear modes of policymaking whereby problem analysis leads to policy solutions.

Instead, as our world becomes more complex, it helps to accept that 'governance failure is routine'. An adaptive, iterative process (i.e. learning and evolving through repetition) which reimagines a transition from the current, top-down nation-state structure towards a law for the commons will be more adaptable and sustainable (Bollier 2016). There is no one-size-fits-all solution.

Governance approaches that are diverse, tailored, innovative and adaptive, using science to support decision-making and develop early warning systems, are likely to be more sustainable (SDG 2019). Global collaboration is therefore essential, but on what terms?

Jessop (2011) recommends that governance reflect the context and align with stakeholders' concerns.

Social learning is crucial in order to understand drivers, attribute responsibility appropriately, understand the capacity for action and coordination in a changing, turbulent environment, and to activate change in decisions and activities. Finally, a common worldview is best for guiding action, and a system of meta-governance will help establish rules of conduct, as well as stakeholder orientations and expectations (Jessop 2011).

Meta-governance can be described as the governance of governance among interacting groups (Jessop 2011). These mechanisms could coalesce into a commons governance system which is based neither solely on the incremental logic of market forces, nor on top-down planning, but builds on these existing processes and interactive learning among a plurality of operationally autonomous but interacting agencies (Jessop 2011).

Bollier (2016) proposes that such a new sustainable system encompass three radical shifts in the current established system: (1) reconfiguring nation-state authority (along the lines suggested by Jessop)—as multiple governing bodies at different scales interact within a system of *networked governance*, they voluntarily learn and adapt followed by repetition (*adaptive voluntary governance*) in ways that that can eventually consolidate into new modes of *meta- governance*; (2) making communities sovereign by empowering the commons through rights and institutional capabilities for collectively managing knowledge and material resources; and (3) making ownership generative by integrating property rights (ownership or use) with stewardship responsibilities to ensure that the exercise of such rights incorporates environmental responsibility (Fig. 12.3). We have elected to use Bollier's conceptualisation for the purposes of this paper, although these shifts also are echoed in slightly different terms as necessary governance reforms in The World in 2050 report (TWI2050 2019).

While these shifts may seem far-fetched, in reality all three of these transitions are already underway in the ocean system. A closer look at an example of each in global governance will demonstrate the viability of these pathways to achieving sustainability in ocean governance, and illuminate the possible pathways into the future.

7.1 Reconfiguring Governance and Authority

7.1.1 Governance as Voluntary and Adaptive Learning

The traditional concept of governing through nation-state authority has begun to shift in several ways. One pathway is through voluntary commitments aimed at delivering outcome-oriented activities. Voluntary commitments have become a well-recognised mechanism in international sustainability policy (Neumann and Unger 2019). The UNFCCC Paris Agreement (UNFCCC 1992, 2015) demonstrates the possibility of a new model of international governance through a shift to a *volitional reflexive* approach (Box 12.5). This type of governance involves two aspects: (1) volitional or voluntary commitments aimed at delivering outcome-oriented activities and (2) reflexive governance where governance (the concepts, practices and institutions by which societal development is overseen) has the flexibility to adapt and adjust to include more appropriate alternatives over time, as a result of social learning. The Paris Agreement reflects this shift through two complementary mechanisms. First, state parties are legally obliged to comply with procedural commitments such as transparency reporting, but these commitments are combined with an element of volitional, non-binding obligations, allowing state parties to determine their own goals (or 'nationally determined contributions' [NDCs]) for measuring progress on meeting global climate targets (Pickering et al. 2018).

The obligations create a long-term framework for cooperation that aims to add momentum to the global response to climate change. At the same time, the volitional, softer layer underneath (the substance of NDCs) provides the flexibility needed to minimise barriers to universal participation (ones that would arise through rigid requirements) and to adjust contributions in the light of changes in scientific knowledge and shifts in complex social-ecological systems (i.e. in a reflexive manner as a result of learning over time) (Pickering et al. 2018). This style of governance therefore allows for dynamic real-time adjustments and flexible ecosystem-based responses. See also the example of the voluntary national review process under the UN SDGs (Appendix A3).

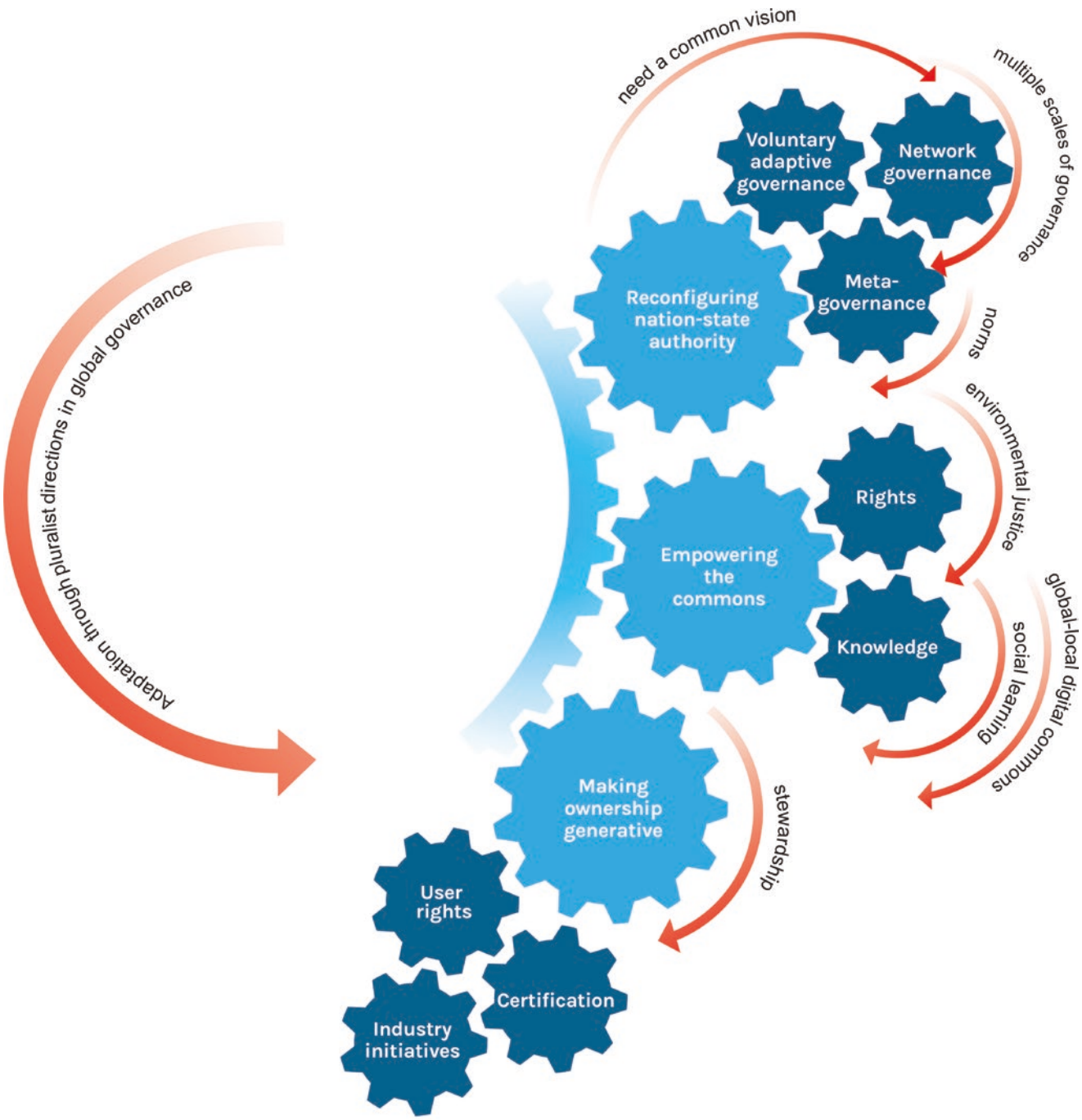

Fig. 12.3 Elements informing a transition to effective global ocean governance. Source: Authors. Conceptual elements drawn from Bollier (2016)

In ocean governance, two major international processes presently harness voluntary contributions. Voluntary commitments made under the banner of the Our Ocean Conference (OOC) series and the UN Ocean Conference provide opportunities to raise awareness, promote engagement and catalyse political will for action by states as well as the public and private sectors (Neumann and Unger 2019). In evaluating verifiable outcomes of voluntary commitments made at the OOC from 2014 to 2017, Grorud-Colvert et al. (2019) found that one-third of the announcements focused on marine protected areas (MPAs), and that almost half of the promised MPA actions were completed at the time of publication.

These voluntary commitments cumulatively amounted to over 5 million km^2 of protected area, encompassing 1.4% of the ocean, almost doubling the quantity of implemented MPAs worldwide (Grorud-Colvert et al. 2019).

During October 2019 at the sixth Our Ocean Conference, 370 commitments worth $63 billion were made to marine health and productivity (Evans 2019). The research conducted by Grorud-Colvert et al. (2019) has demonstrated the potency of these voluntary commitments. However, a uniform global process is still required to register and assess commitments, including consistent reporting and monitoring systems with clear targets, baselines and review systems (Neumann and Unger 2019).

7.1.2 Interacting, Multiple Centres of Governance at Different Scales

Another pathway to reconfiguring nation-state authority is through polycentric or network governance models (Ostrom 2010). Network-based modes of governance rely on the involvement of public, private and societal actors, and thus change the traditional top-down structure of political leadership (Sørensen 2006). This type of governance occurs across multiple scales, from transnational agreements, regional and national agreements and policies, down through individual municipalities, to the operations of public and private institutions and individuals (TWI2050 2018). Multiple centres of authority and distributions of power, which operate in complementary combinations, can address complexity more effectively than a single mode of governance (Pahl-Wostl 2017; Ostrom 1990; Dietz et al. 2003). The presence of these various forms of interacting decision-making bodies in a network governance structure is a core characteristic and requirement for sustainability transitions (Ottens and Edelenbos 2019). This type of network governance of the commons enables adaptation and mitigation through open, inclusive, pluralist directions in global governance (SDG 2019).

Box 12.5 Lessons from the Paris Agreement

Several innovative aspects of the Paris Agreement offer signposts for a new direction for global governance of the ocean, even though the resources and complex ecosystem services offered by the ocean commons are not as easily quantifiable as the carbon budget:

- The recognition that governments are only one set of the players in solving global commons problems. The Paris Agreement is a cooperative effort across sectors, including civil society, the private sector, financial institutions, cities and other sub-national authorities, local communities and indigenous peoples (Macy 2017).
- Instead of a top-down or bottom-up focus on narrow issue-based objectives, global goals inform policy directions. (This is also reflected in the UN 2030 Agenda.)
- Effective transparency mechanisms for reporting and verifying performance can replace or complement the need for compliance mechanisms and sanctions.
- Volitional reflexive commitments can provide the flexibility for evolution, for 'ratcheting up' commitments to reflect more ambitious targets, without requiring extensive time-consuming negotiations and trade-offs between state parties.
- Legal instruments for coordination of global action for commons problems need not be limited to treaties between states defining rights and obligations but can provide frameworks to facilitate and support action between governments and non-state actors (Macy 2017).

Network models, where multiple governing bodies interact to make and enforce rules within a specific policy arena or location, allow decision-makers to 'experiment with different governance solutions tailored to particular scales and socio-ecological contexts' (SDG 2019). They allow social learning, and importantly often include the involvement of directly affected local communities. Network governance may reinforce a system's ability to adapt structural elements and alter processes in response to current or anticipated changes in the social or natural environment (Pahl-Wostl 2017; Dietz et al. 2003; TWI2050 2019). Network governance structures have proliferated, the Chilean TURFs being a well-documented development in ocean governance (Box 12.2; see also description of U.S. Fishery Management

Councils in Hanna 1995). Many existing network arrangements for the ocean include elements of the second shift (i.e. making communities sovereign by empowering the commons) and third shift (i.e. making ownership generative by integrating property rights with stewardship commitment) underway as discussed below.

7.1.3 Meta-governance

The final piece of the transition in reconfiguring nation-state authority is the concept of meta-governance, or supranational governance. The Arctic Council and the Antarctic Treaty System are demonstrably important examples of supranational management (IPCC 2019). In some instances, multilateral agreements between states have successfully addressed commons issues.

The Montreal Protocol has, for example, successfully protected the ozone layer (the hole in Earth's ozone layer is the smallest in recorded history (Helfenstein et al. 2019) and is widely recognised as an example of effective protection of the global commons (Dietz et al. 2003). Regional cooperative agreements, implemented between states (such as the UN Shared Watercourse Agreement of 1997), have successfully created effective new modes of governance of shared water resources. Despite some successes, however, the nation-state political system is too fragmented, slow and rigid to manage the profound normative, societal, political and institutional changes that are required to implement integrated, multidimensional sustainable development agendas (TWI2050 2019).

A culture of global cooperation is required to develop multiple sustainable development pathways across scales (TWI2050 2019). A common worldview coupled with supranational standards could provide framework conditions for addressing issues at different scales, in response to changing needs, capacity and context (Jessop 2011; TWI2050 2019). Governing the trade-offs between different policy objectives which arise in multi-scalar, polycentric, adaptive governance models will be easier if meta-governance principles, such as transparency, accountability and inclusiveness, are in place (Weitz et al. 2017; UN ECOSOC 2018; TWI2050 2019). Some examples of ocean-related meta- governance instruments include the FAO 'Step-wise Guide for the Implementation of International Legal and Policy Instruments Related to Deep-Sea Fisheries and Biodiversity Conservation in Areas beyond National Jurisdiction' (FAO 2019b); the *Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication* (FAO 2015); UNESCO's Man and the Biosphere programme (Bridgewater 2016); and several IMO guidelines, for example, the *Post-2015 Development Agenda* (IMO 2015) for the maritime transport sector, the *Guidelines for Safe and Environmentally Sound Ship Recycling* (IMO 2012), and the *Guidelines on Places of Refuge for Ships in Need of Assistance* (IMO (International Maritime Association) 2003).

7.2 Empowering the Commons

The second shift suggested by Bollier (2016) and the TWI report (and implicit in our assessment of the niche innovations) towards a new ecological order is making communities sovereign by empowering the commons. It is important to remember that the commons is both the resource of a defined community and the protocols, values and norms devised by the community to manage its resources (Bollier and Burns 2011). A commons in this sense is characterised by bottom-up participation, subjective responsibility, transparency and self-policing accountability (Bollier and Burns 2011). One way to achieve this is through the creation and protection of rights to the commons.

7.2.1 Rights to the Commons

Environmental obligations generally are resolved at an inter-state level (Boyle 2012), but if one considers the ocean as a global commons that is part of the global ecological system (IPCC 2019), then in legal terminology, the obligations inherent in concepts such as the sustainable use of natural resources, intergenerational equity and the common concern of humankind can be considered obligations owed to the international community as a whole (Boyle 2012; Weston and Bollier 2013a, b; Kotzé 2019). While commons have traditionally been held in trust by sovereign nations, or collaboratively managed through inter-state relationships, this has proved insufficient to protect the ocean commons (Dietz et al. 2003). A third way is now needed.

A human rights perspective provides a useful basis to ensure transnational environmental fairness and justice, because human rights are understood to permeate traditional sovereign boundaries (Robinson 2016; Weston and Bollier 2013b). The development of the human right to a decent or sound environment is a basis from which to empower the commons. Risks posed to human rights by climate change are significant (Robinson and Shine 2018). Global warming of 2 °C would, for example, impact the right to food and the right to an adequate standard of living. This raises a question of ethics (Robinson and Shine 2018): 'If the international community accepts that climate change is happening, understands its causes and knows what needs to be done to change course—how can it justify its continued delays to act on the scale, and with the urgency required?' Robinson and Shine (2018) suggest in response that rights-informed climate action can maximise benefits for people and the planet (Box 12.6).

The link between the environment and human rights has long been recognised (UN General Assembly 1972; OHCHR (Office of the High Commissioner for Human Rights) 1994;

OHCHR 1995, 1996; IUCN (International Union for the Conservation of Nature) 1995). Although the International Union for Conservation of Nature (IUCN) covenant was presented as a means of strengthening momentum for global action to implement the 2030 Agenda for Sustainable Development, it has not gained universal support or momentum. Despite this, in the 50 years which have passed since the Stockholm Declaration (UN General Assembly 1972), the human right to a healthy environment has been refined to include procedural rights (such as in the Convention on Access to Information, Participation in Decision-Making and Access to Justice (UNECE 1998)). Substantive elements have also been clarified in some constitutions (e.g. the right to clean air, safe water, adequate sanitation, healthy and sustainably produced food, healthy biodiversity and ecosystems, and a safe climate; see Boyd 2019, by the UN special rapporteur on human rights). In 2019, 130 states were party to regional treaties which incorporate a right to a healthy environment, and in over 110 states this right is constitutionally protected. In total at least 155 states recognise, in law, the right to a healthy environment (Boyd 2019).

The human right to a sound environment was once again brought to the fore by an initiative of the French legal think tank Club des Juristes, which in 2017 called for a Global Pact for the Environment; in May 2018, the UN General Assembly adopted a resolution opening negotiations to create the treaty (Club des Juristes 2018). The Global Pact codifies a human right to an ecologically sound environment and is designed to consolidate and integrate generally accepted but fragmented environmental norms and principles into one overarching, binding text. This way of thinking informs the work of the Ad Hoc Open-Ended UN Working Group towards a Global Pact for the Environment, which held its third session in May 2019.

Box 12.6 South African West Coast Rock Lobster

An example of rights-based environmental action demonstrates the utility of a human rights perspective for ocean resources. In terms of Section 24 of the Bill of Rights in the South African constitution, the environmental right comprises two parts: first, 'everyone has the right to an environment that is not harmful to their health or well-being' and, second, everyone has the right 'to have the environment protected, for present and future generations, through reasonable legislative and other measures that … secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development' (Republic of South Africa 1996, Chap. 2, Sec. 24). This right is mirrored in the South African environmental legislative framework.

On the basis of the foundation provided by this constitutional right, a landmark decision was handed down by the Western Cape High Court in 2018 in *WWF South Africa v. Minister of Agriculture, Forestry and Fisheries and Others* [2018], 4 All SA 889 (WCC). The West Coast rock lobster fishery is one of South Africa's oldest formal commercial fisheries, dating back to the late nineteenth century. It has also been a mainstay of poorer subsistence fisher communities. Catch peaked in the 1950s at around 18,000 tonnes but has declined sharply over the past few decades to an all-time low of 1500 tonnes in the 1995–1996 season. A scientific working group convened by the Department of Agriculture, Forestry and Fisheries called in 2016 for a total suspension of lobster fishing until a sustainable path for the resource was established (with compensation for stakeholders). The same working group recommended a total allowable catch (TAC) of less than 800 tonnes for the 2017–2018 season. Instead, the TAC for the 2017–2018 season was set at 1934 tonnes. The WWF sought to have this decision set aside, arguing that, given the depleted state of the resource, its harvest above prudent levels posed a threat of serious or irreversible environmental damage. The court set the TAC determination aside on the basis that it was unlawful, in contravention of the constitutional right, the subordinate legislation and South Africa's obligations in international law under UNCLOS. (Other principles were also relevant, including the precautionary principle and critical role of scientific analysis in the determination of the sustainability of a marine resource (Glazewski 2018)).

The constitutional environmental right in this matter made it possible for civil society (in this case, WWF) to ensure that the government department upheld the principles of sustainable development.

Despite some criticisms (Biniaz 2017), the reintroduction of the groundbreaking universal, justiciable individual human right to the environment opens the possibility of using the existing legal human rights framework for enforcement of the right to a decent environment. The Global Pact (or another similar agreement) could, if adopted, generate a shift in the collective understanding of legal norms and environmental rights in a similar fashion to what occurred in the human rights body of law as a result of the Universal Declaration of Human Rights (1948). This type of agreement provides a possible paradigm shift away from the conventional justification of social and economic development at the cost of the environment and embodies the potential for a new holistic environmental stewardship for the planet, based on human rights.

The relevance of adopting a human rights approach in the context of the environment was affirmed by the explicit recognition of human rights in the Paris Agreement (Robinson and Shine 2018). In 2015 the Dutch court in the Urgenda case[1] was prepared to venture into the uncertain territory of separation of powers in order to enforce a duty of care to meet greenhouse gas emission targets by the Dutch government. In June 2019 the Danish Institute for Human Rights launched strategic web-based tools it developed to operationalise the synergies between SDGs and human rights, namely, the Human Rights Guide to the SDGs and the SDG Human Rights Explorer (2020). The younger generation has been particularly vocal in asserting the right to intergenerational equity (UN News 2019; *La Rose et al. v. Her Majesty the Queen*, T-1750-19, Federal Court of Canada).

These developments illustrate that the nature of human rights is not fixed or static—human rights are changeable and relate to particular historical moments and social contexts. The right to a healthy environment could form a baseline 'net' for governance of the commons to address and redress the grave inequities suffered by individuals and communities exposed to environmental degradation and the unsustainable extraction of natural resources.[2] Human Rights Watch, in its World Report (Orellana 2018), stated that global recognition of the right to a sustainable environment is long overdue, as has Boyd (2019), the UN special rapporteur for human rights.

7.2.2 Knowledge Commons

Traditional economics was premised on the assumption that resources were unlimited and information scarce—the reverse is now true. The digital revolution has resulted in open information platforms otherwise known as the 'digital knowledge commons' or 'platform co-operativism'. This is a rapidly unfolding phenomenon that could be harnessed for the benefit of the ocean. A growing body of literature proposes that these new technologies provide the most powerful way to accelerate the empowerment of the commons by creating a new generation of trans- sovereign institutions that facilitate 'many-to-many' communications, including the reconfiguration of nation-state authority over shared commons that transcend national boundaries (see Bauwens et al. 2019). (The term *digital revolution* includes virtual and augmented reality, additive manufacturing (e.g. 3D printing), artificial intelligence, deep learning through open platforms, robotics, big data, the Internet of Things, and automated decision-making systems including crowd-sourced tracking and monitoring (TWI2050 2019; Leape et al. 2020)). Digitalisation hardly featured in the Paris Agreement or UN Agenda 2030, but it is increasingly clear that digital changes are becoming a key enabler of societal transformation (Domingos 2015; Schwab 2016; Tegmark 2017; Craglia et al. 2018; TWI2050 2019). It is predicted that by 2020 data generation will increase annually by 4300% (Sunderji 2016).

Bollier (2016) argues that there is enormous practical potential in developing a digital knowledge commons sector as a quasi-independent source of production and governance—a kind of 'fifth estate'. The World in 2050 (TWI2050 2019) states that 'digitalization is not only an "instrument" for resolving sustainability challenges, it is also a fundamental driver of disruptive, multiscalar change'.

The information and communication technology (ICT) revolution that emerged in the 1970s introduced the 'network' as an alternative to market- and hierarchical modes of organisation. Vast swathes of contemporary organisational and economic life are now organised in networks that have been hardwired into massive global 'many-to-many' platforms. ICTs made possible 'self-managed mass communication' as a new mode of sharing knowledge that was never before technically feasible (Castells 2009). Over the past two decades, these two modes of organisation and communication—networks and self-managed mass communication—have fused, resulting in increasingly complex, global interactive networks. Using the new ICTs for direct 'many-to-many' communications without transacting through a regulator or a market operator, a new 'peer-to-peer' (P2P) economy has emerged that can be configured in a wide variety of ways. The result is the rapid expansion of an information and knowledge commons, whether this is for private profit, as with Facebook, Uber and Airbnb, or for the public good, as with Wikipedia, GNU and Mozilla Firefox.

For Bauwens et al. (2019), the peer-to-peer mode of production becomes the basis for what they call a 'commons-centric society' or what others have called 'platform economies'. Bauwens et al. (2019) connect three aspects of this emergent alternative: (1) it creates conditions for a new mode of social relationships for learning, innovating and producing on a global scale; (2) it develops a technological infrastructure that makes scaling up possible through mutual coordination; and (3) it creates new property relations that mix shared ownership of the commons with private use for commercial gain.

The core of numerous types of for-profit and non-profit platform economies is clear: designs/data are loaded up in real time for collaborative co-production and optimisation, while users download applications from the knowledge com-

[1] Urgenda Foundation v. The State of the Netherlands. 2015 HAZA C/09/00456689 (June 24, 2015); aff'd (Oct. 9, 2018) (District Court of the Hague, and The Hague Court of Appeal (on appeal).

[2] The Oganiland case (Social and Economic Rights Action Centre v. Nigeria, 2001, AHRLR 60) demonstrates this point. The applicant would have had the additional armory of founding liability in a duty of care owed by the multinational corporations involved in the despoliation of the Niger delta. This extended duty of care would have been owed to the people of the region in addition to the state's duty to ensure its citizens' right to a satisfactory environment.

mons for use in their local or sectoral environments. Until now, this has never been possible before at scale (Bauwens et al. 2019; Leape et al. 2020).

Bauwens et al. (2019) show that each of these major global initiatives have three exemplary features (that are relevant for the purpose of imagining an ocean commons): (1) a 'productive community' of people who voluntarily create new and improve existing understanding in the commons; (2) an 'entrepreneurial coalition' that is licensed to exploit the understanding in the commons in the wider market, but with controls over the distribution of surplus; and (3) a 'for-benefit association' supported from the revenues generated to reinvest in the capabilities of the productive community and wider environment. These three become the potential organisational template for building up from below the ocean commons–based peer production.

Components of such a knowledge commons for the ocean exist, but there is much more work to do (Box 12.7; Leape et al. 2020).

An 'Ocean Knowledge Commons' would comprise its own 'productive community' (including scientists and a wide variety of other people who share a common interest in the future of the ocean); an 'entrepreneurial coalition' to manage the distribution of and access to knowledge—perhaps a Global Ocean Commons Institute (GOCI); and a 'for-benefit foundation' that raises funds to actively support and develop the 'productive community' and GOCI. To make it happen, 'transvestments' from the traditional grant-making, for-profit and public sectors will be required until the Ocean Commons Community (the ocean 'commoners', GOCI and for-benefit foundation) has its own autonomous capital base.

The most appropriate architecture for an Ocean Knowledge Commons could be a fusion of a global commons (e.g. Wikipedia) and a localised commons (e.g. the decentralised slow-food movement) in what Jose Ramos calls 'cosmo localism' (Fig. 12.4; Ramos 2019). In this model as adapted to the ocean, a 'wiki-type' global commons would be created for pooling (at least) two types of information: (1) crowd-sourced data (from, e.g., sensors on ships of various types) plus satellite data; and (2) alternative processes and arrangements (e.g. locally relevant approaches for restoring damaged mangroves or building sustainable fishing systems) that 'commoners' can collaboratively work on together, drawing from a range of local case experiences.

However, the localised commons would also be created as decentralised platforms for commoners from particular subregions to collaborate, both using designs downloaded from the global commons and generating new designs and monitoring data fed upwards into the global commons. The result would be an 'ocean cosmo localism' supported by the relevant generic institutional forms that have emerged at the global commons level, that is, what we referred to above as the GOCI and the for-benefit foundation, plus equivalents where necessary at the local level (that could be either local partners or local branches of the GOCI and the for-benefit foundation).

Box 12.7 Open-Source Data and Analytical Platforms for Ocean Decision-Making

Open-source data and analytical platforms envisioned under a knowledge commons already exist for components of the ocean system. These platforms are being used to design and improve content in a peer-to-peer sense, and also at multiple scales by decision-making communities such as those for small-scale fisheries and integrated coastal management (Costello et al. 2019). They also help collect global satellite remote-sensing data from the U.S. National Oceanic and Atmospheric Administration and the U.S. Geological Service (Leape et al. 2020). At the global scale, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) harnessed an open-source global data and software platform (InVEST; see Sharp et al. 2020) and a networked community of scientists to model for the first time global changes in biodiversity, ecosystem services and the values to people under UN future scenarios, including in the ocean realm (Chaplin-Kramer et al. 2019). Open source data, models and interactive viewers for the IPBES global modelling platform (NatCap (Natural Capital Project) 2019) are catalysing discussions with multilateral institutions, governments and civil society leaders about how to standardise and improve data, analytics, and communication to diverse audiences such as those tracking SDG progress and impacts of nationally determined contributions under the UNFCCC. The same InVEST data and analytical platform are being used to drive integrated, multi-sectoral coastal development and disaster risk planning at national (e.g. see Box 12.1) and regional scales around the world (e.g. Arkema et al. 2015, 2019; Mandle et al. 2017; Silver et al. 2019; Wyatt et al. 2017) and China's national zoning for development (Ouyang et al. 2016). Progress towards integrative frameworks to connect these existing open data platforms is ongoing, mostly from the producer communities (e.g. Selig et al. 2018). Clear signals for priority policy needs, and engagement between global- and local-scale actors, can accelerate these nascent efforts.

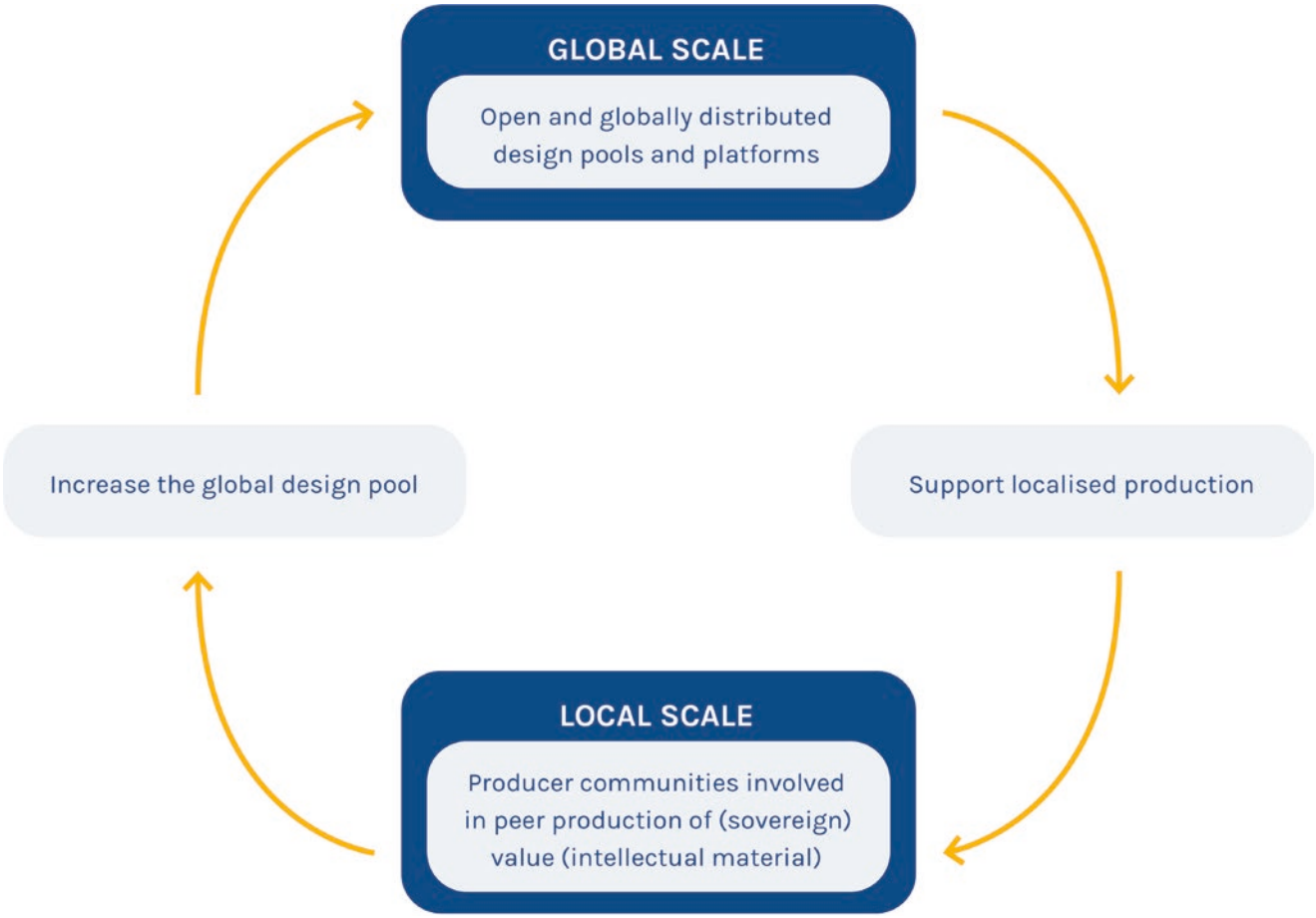

Fig. 12.4 Cosmo localism. Source: Derived from Ramos (2019)

7.3 Making Ownership Generative (Integrating Property Rights with Stewardship Commitment)

The third and final building block of a new ecological order as suggested by Bollier (2016) is to make ownership generative by integrating property rights with stewardship commitment. Bennett et al. (2018) see an urgent need and propose a framework to promote improved human-environment interactions through stewardship, defined as 'the suite of approaches, activities, behaviours, and technologies that are applied to protect, restore or sustainably use the environment'. The concept of integrating property rights with stewardship, embedded in this transition pathway, is already evident in the ocean economy. Fisheries management, for example, has seen a growing emphasis on the role, rights and responsibilities of small-scale fishers in stewarding local resources (Bennett et al. 2018). As discussed in Sect. 5, the integration of property rights with stewardship is happening currently, as exemplified in the case of SeaBOS (Box 12.3) and Chilean TURFs (Box 12.2; Appendix C).

In summary, the current governance regime, structured around nation-states and international treaty systems, is facing serious new pressures. The internet and digital technology have increased the velocity of transborder flows, not only in commerce but also in the exchange of ideas, values, projects, policy initiatives and visions for humanity, and these are catalysing revolutionary pressures from below (Bollier 2019). A new global polity activated and adapted by 'commoners' can light a pathway to transformational change (Bollier 2019).

The elemental components of the commons pathway (reconfiguring nation-state authority, empowering the commons, making ownership generative) are not talismans to preserve us from the pressures we are facing, but they do provide a means for us to rediscover the ancient wisdom that sovereignty ultimately resides not in the state or market but within ourselves, together (Bollier 2019).

8 The Ocean in a Transformed World: Towards a Governance Framework

Sustainability transitions are inherently political (Ottens and Edelenbos 2019). 'Precisely because politics plays a potentially powerful role (defining the landscape, propping up or destabilizing regimes, protecting or exposing niches), it requires explicit attention from those interested in understanding sustainability transitions' (Meadowcroft 2011). There is broad consensus that governmental steering solely through top-down decision-making or markets is not sufficient to address sustainability transitions (Meuleman 2020; Ottens and Edelenbos 2019; Meadowcroft 2011; Loorbach 2010).

The next step, therefore, is for the international community to recognise how a purposive transition can encompass a shared vision for a future pathway. As we have already argued, the transition to a thriving, vibrant and reciprocally rewarding relationship between humanity and ocean requires three fundamental elements that characterise any successful transition: (1) new knowledge drawn from beyond the current regimes; (2) the capacity to manage change in the context of rapid, unpredictable circumstances; and (3) incentives or other enabling conditions that activate the change. With regard to the first element, we have proposed a knowledge commons (a 'cosmo local digital commons', as discussed in Sect. 7.2.2). For the second, we propose the consolidation of a system of polycentric governance anchored by a new supranational ocean agency of some kind. The third element represents the Ocean Panel's catalytic role in the face of increasingly serious landscape pressures.

A key challenge woven into the substrate of ocean governance is that commons 'are either situated outside national jurisdiction or their conservation and sustainable use conflicts with national sovereignty and regulation' (Dasgupta et al. 2019). One of the methods which has evolved in the international arena to achieve this is the adaptive, flexible approach adopted in the Paris Agreement (Rajamani 2016). This approach provided a means to successfully negotiate a path through the sovereignty maze and secure broad agreement on comprehensive rules to address climate change. The BBNJ will, in a similar fashion, rely on volitional state responsibility for commitments, for example in relation to funding and transfer of technology. However, on its own, this is not likely to be sufficient.

We have also shown that in the ocean, local and regional realms are functionally connected with global and transnational scales (Bollier 2016). Thus, cross-sector coordination and multilevel network governance will facilitate a sustainable transition (Pahl-Wostl 2017; Tosun and Leininger 2017; Weitz et al. 2017; Leck et al. 2015; TWI2050 2019; SDG 2019). A purposive transition in ocean governance requires an evolving system of polycentric governance, including supranational policy and normative guidelines, flexible, adaptive governance and bottom-up stewardship.

To facilitate the workings of this system of top-down and bottom-up polycentric governance, we recommend two new institutional architectures that remain autonomous from one another. The first we have already proposed: a 'cosmo local ocean commons' to facilitate information-sharing and accelerated learning. Initiated by a coalition of knowledge institutions, this 'cosmo local commons' will require its own well-funded and dedicated set of autonomous institutions. The second is an ocean agency that will establish the norms, principles, 'rules of the game' and arbitration mechanisms for conflict resolution. What follows is a more detailed discussion of the latter.

Despite some successes in the international arena (e.g. the Montreal Protocol, the 1997 UN Shared Watercourse Agreement), the nation-state political system has not been able to manage the profound societal, political and institutional changes required for implementing an integrated ocean governance system to support the SDGs and other shared goals at the scale and with the urgency required. Building on some of the precedents and examples of experiments and regime shifts underway in many regions, it is clear that a polycentric system of governance for the ocean will be required that is neither centralised and top- down nor purely about the flourishing of bottom-up initiatives. Without a shared set of norms, values and operating rules, the bottom-up flourishing of commons initiatives will not lead to systemic impact. In order to create common future narratives, provide normative guardrails and negotiate the maze of trade-offs that will be required between different policy objectives, a supranational ocean agency of some kind (a form of meta-governance or transnational structure) could be considered. Similar to the way UNESCO's Man and the Biosphere programme works (but also learning the lessons from this experiment; Bridgewater 2016), this meta-governance institution could be mandated to establish 'rules of the game' for a polycentric system that empowers local actors to collaborate, with the goal of protecting and regenerating ocean commons at regional levels. This ocean agency could provide frameworks for addressing ocean-related challenges at different scales, in response to changing needs, capacity and context.

Furthermore, governing the trade-offs between different policy objectives which will arise in polycentric, adaptive governance models will be easier if meta-governance principles and structures, such as transparency, accountability and inclusivity, are in place.

The ocean agency could be created by UN resolution, or it could be created by a founding group of nations that invite others to participate. Its establishment should ensure legitimacy and safeguards against capture by special interests.

The ocean agency on its own will not be adequate. Its effectiveness will depend on the viability and vibrancy of the 'cosmo local' knowledge commons. Open and free entry into an ocean-oriented knowledge system would result in continuous, real-time information flows within a public space that cannot be controlled by a few dominant actors. Using satellite and other remotely observed metadata, crowd-sourced micro-data from ship-based sensors and uploaded modelling and design information, it will be possible to create wiki-type open databases that give regulatory watchdogs, research institutes, civil society organisations and industry bodies access to unprecedented levels of quality data that can be used to ensure and maintain maximum transparency (Leape et al. 2020). This, in turn, will encourage an entirely new generation of (potentially interlinked) observatories motivated by a desire to protect and regenerate the ocean commons. Given that most states lack the resources to build traditional closed information agencies to back up their regulatory functions, an open- source wiki-type global knowledge commons for the ocean would be the cheapest and most effective way of accessing design solutions that could catalyse local action.

9 Conclusion and Opportunities for Action

> *On the one hand, I believe it is vital to accept uncertainty, not-knowing, and unpredictability fully to the point of deep humility. On the other hand, I also believe that we need to choose to act from the conviction that we can design for positive emergence in complex systems even if it is not an exact science and we cannot know with certainty how our efforts will turn out to affect transformative change.*
> —Daniel Wahl, *A Brief History of Systems Science, Chaos and Complexity* (2019)

SDG 14 provides the global community with an opportunity to consider how to strengthen governance of the ocean. We have demonstrated that a range of transition dynamics are underway as existing regimes (fisheries, shipping, etc.) and niche innovations (mainly local level initiatives) respond to changing landscape pressures (climate change, depletion of fish stocks, pollution, etc.). Transition dynamics can be messy, and their legitimacy requires well-functioning science-policy engagement processes built on diverse stakeholder participation, trust and open discourse at multiple, interacting scales.

New insights into the complex interconnections among different ecosystems—on land and in rivers, deltas, estuaries, nearshore and in the ocean—have contributed to a growing realisation that a more holistic approach is needed to inform the design of policies and institutions across sectors and nations (Mathews et al. 2019).

Governance solutions for common pool resources such as the ocean that prioritise resource users' ability to devise livelihood strategies that restore rather than deplete ocean ecosystems (Ostrom 1990; Bavinck and Gupta 2014) can enable transition to a sustainable system.

Our conclusion is clear: national governments, the private sector and civil society have an opportunity to collaborate at the regional and international level to harness and give direction to the emergent regime shifts and niche innovations already contributing to a 'purposive transition'. Such a transition requires access to shared transdisciplinary knowledge, the build-up of capacity to implement changes and initiatives that activate change. This anticipatory perspective is supported by the evidence we have presented regarding regime and niche responses to increasingly serious land- and seascape pressures. Ours is neither a predictive approach based on a model nor a narrative approach that constructs scenarios. We have interpreted transitional dynamics at regime and niche levels as discerned from particular directions. Our approach is similar to one articulated eloquently in 1987 by the World Commission on Environment and Development, which in the conclusion of its Our Common Future report states, 'We have tried to point out some pathways to the future. But there is no substitute for the journey itself, and there is no alternative to the process by which we retain a capacity to respond to the experience it provides' (WCED 1987).

Leaders in public and private sectors can catalyse a transition to a more sustainable ocean system by harnessing and directing emerging niche innovations and regime shifts. Governance approaches that facilitate transformation and guide societal change in the face of uncertainty, and that are legitimate and fair, can lead to a transition in the ocean system when the overarching principles below are followed:

- Guide governance decisions by the ocean sustainability imperative.
- Integrate policies across sectors and spatial zones (addressing complexity).
  - Increase regulatory coordination across sectors and mandates.
  - Increase regulatory coordination among governing bodies.
- Use science to support decisions.

  - Adopt a precautionary approach in light of uncertainty, thereby shifting the burden of proof to the person or party who wishes to carry out the activity (rather than the person alleging damage to the environment).
  - Include explicit mechanisms and processes to base decisions on science and expert knowledge.
  - Consistently monitor and evaluate policies, actions and system responses.
- Create flexible frameworks for policymaking and governance decisions to facilitate responsiveness (including efficiency and reflexivity).
  - Include the expectation of change and surprise by building in provisions for periodic review and adaptive management.
  - Incorporate climate change adaptation exemptions into existing standards to avoid inefficient inflexibility.
- Establish a network approach to governance.
  - Widen the scope of participation (ensure transparent and authentic inclusivity of local and all stakeholder participation.
  - Establish networks of leadership and governance at different scales which allow for a distribution of power and decision-making capacity across scales of governance (legitimacy, inclusivity).
- Share information through an accessible knowledge commons available to everyone (transparency, accountability, social learning).
- Reinforce stringent monitoring and evaluation mechanisms, including transparency through compliance requirements (accountability).
- Foster equality and equity.
  - Incorporate environmental responsibility with property rights.
  - Protect human rights.
  - Examine the incentives that might help drive sustainable behaviours, and stop perverse incentives for maladaptive behaviours.
  - Balance long-term goals with short-term perspectives.

Based on these principles, we propose the following set of opportunities for action:

National governments, businesses and civil society have opportunities to support current UN ocean transition processes.

Examples of such opportunities include the following:

- Advocate for the ratification by non-party states of the UNCLOS agreement (especially the United States).
- Encourage the ratification, implementation and operationalisation, at the national level, of the BBNJ as soon as possible but by no later than 2025.
- Lobby for the ratification, implementation and localisation of the Global Pact for the Environment (or similar UN convention) as soon as possible, but no later than 2025.
- Support other UN initiatives such as the UN Environment Programme, Communities of Ocean Action, Ocean Conference Voluntary Commitments and so on.

Should there be agreement that a more sustainable ocean system is required, then national governments, businesses and civil society can consider the following opportunities for action to encourage the reconfiguration of nation- state authority vis-à-vis the ocean:

- Establish a new supranational ‘ocean agency’ of some kind to support polycentric governance, including transition processes and dynamics, the development of norms to guide the transition process and the design of flexible and adaptive frameworks which take account of local contextual issues. (Working task forces could provide pro forma frameworks for the different elements of a transition which draw from successful local niche innovations and regime responses, and all the lessons learnt from the Ocean Panel process; see Appendix D.)
- Strengthen voluntary learning and adaptation by improving coordination, monitoring and reporting on national voluntary commitments.
- Encourage nation-states to facilitate new modes of inclusive governance that are framed by an agreed- upon, general set of top-down principles but powered by bottom-up decision-making on resource use. This could include supporting multilateral, local area– based and regional governance innovations through legislative frameworks and negotiated agreements which establish shared rules of engagement but are flexible and can accommodate rapid change.

If there is agreement that civil society and communities should play a more significant role in promoting the restoration and sustainability of the ocean commons, then we propose the following opportunities for action:

- Promote the global recognition of a human right to a sound environment (as per the global pact for the environment or similar instrument mentioned above).
- Invest in various capacity-building initiatives and incentives that help increase the involvement of a diversity of leaders in niche innovations at the local, regional and global scales, so they learn to develop and hold their visions and aspirations, and also develop the ability for generative dialogue.
- Use the advances in informational technologies now available to encourage creation of an ocean knowledge commons through mobilising the funds required to build a new open-source, 'wiki-type' ocean knowledge commons that collates crowd-sourced and satellite data, and creates a clearing house for shared strategies that amplify best practices and viable working alternatives;
  - ensuring that a global network emerges of research institutes, universities and knowledge organisations across the world's regions, all actively participating in the open-source knowledge commons; and
  - ensuring that the transparent open data-sharing platform consolidates all relevant knowledge and research as a basis for creating a system which pools and transmits information, and can facilitate the design of solutions capable of responding to changing landscape pressures and new transitional dynamics through diverse scales and institutions.

Should there be a shared commitment to a new form of ocean stewardship that explicitly prioritises the restoration and sustainability of the ocean ecosystem, then a key opportunity for action would be the integration of property rights with stewardship responsibilities through initiatives such as local user rights programs, certification of exemplary practices, and recognition of industry initiatives.

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Appendix A. Governance

UNCLOS Implementation Agreement: Biodiversity Beyond National Jurisdiction—Challenges and Opportunities

One of the risks facing the international instrument on biodiversity in areas beyond national jurisdiction (the BBNJ) is that the 'best' credible science may fail to foster ambitious progress because major stakeholders may question whether the science reflects their interests and concerns (legitimacy) and is presented at a time and in ways compatible with their policymaking context and constraints (salience) (de Santo et al. 2019). This problem could be addressed by ensuring that the scientific and technical body created by Article 49 of the draft BBNJ (A/CONF.232/2019/6) is an independent autonomous body, informed by a diversity of perspectives, including transnational science and citizen networks, with sufficient resources and an effective mandate.

There is some debate that a risk of fragmentation arises as a result of Article 4, according to which the BBNJ 'should not undermine the existing regime' (Mendenhall et al. 2019). Some states (and institutions) may have vested interests in maintaining the status quo fragmentation of governance in areas beyond national jurisdiction (ABNJs). However, institutional fragmentation could be reduced through harmonisation processes such as the Kobe Process, which was used to harmonise and increase efficiencies between five tuna-related regional fisheries agreements (de Santo et al. 2019). The nesting of the BBNJ within the architecture of the UN Convention on the Law of the Sea (UNCLOS) provides opportunities for harmonisation and synergy without increasing fragmentation and competition through wide participation and shared norms.

Given the high levels of attention to systemic issues, a shift in the framing of the BBNJ could better reflect UNCLOS's obligations on coastal states to prevent, reduce and control pollution, moving the focus from resource allocation to an agreement which expands the existing law of the sea framework to better ensure conservation and sustainable management of biodiversity beyond national jurisdiction.

This may be difficult to achieve, but it would overcome the fact that the suite of management measures currently on the table (e.g. marine protected areas, environmental impact assessments, benefit-sharing and technology transfer) do not integrate systemic issues (Mendenhall et al. 2019). Leary et al. (2019) state that even though this may prove difficult, reframing the agreement to include threats to biodiversity like climate change and marine plastics could increase the potential for issue linkages and help to counteract vested interests in fisheries, mining and commercial use of marine genetic resources (de Santo et al. 2019).

Case Study of Coastal Governance: Kosi Bay, South Africa

The sustainability of livelihood strategies that marginalised peoples have developed over the years largely depends on the nature of governance systems, institutions and policies that exist to govern land and resources (Agrawal and Perrin 2009). The same holds true for the governance of marine resources and coastal zones. South Africa's first UN Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site, Simangaliso, was declared in 1999, within a context of coastal communities' historically marginalised access to the coast during apartheid. The site's planners had hoped for a more inclusive decision-making processes with respect to marine and coastal governance following apartheid. However, the injection of multilevel coastal conservation through the creation of the world heritage site in 1999 entrenched a plural system of governance embedded at international, national, provincial and local scales. In addition, Kosi Bay people have a long-standing customary fisheries governance system that predates colonial times. Although it is largely overlooked by statutory structures, this customary system plays a significant role in regulating small-scale fisheries governance at the local level.

Despite this, governance processes in Simangaliso were and still are driven by UNESCO and by the state at the national level, and these are communicated poorly to actors at the local level, including wider communities (Mbatha 2018). A gap exists between stated policy objectives of sustainability, good governance and inclusiveness, on the one hand, and the lived realities of the people on the ground, on the other. This gap is widened by the fact that the institutional design that drives coastal conservation within

Simangaliso from the international to the local level allows little room for livelihood considerations to be a focus of governance practices within the Simangaliso site. Mechanisms to ensure effective interaction between higher-level governance actors and communities are not in place because of the lack of representation of communities in decision-making platforms.

It is unclear whether UNESCO was aware of the socio-economic and political challenges created by establishment of the site, and the negative livelihood impacts that ensued. Ongoing debates in Kosi Bay have centred on whether the community was effectively consulted about the declaration of the Simangaliso World Heritage Site; 95% of communities have stated that they were not consulted in the process for establishing the site (Mbatha 2018). The design of plural and multilevel institutions governing common pool resources (e.g. coastal and marine) influences the ability of resource users to devise livelihood strategies, as well as governance outcomes (Ostrom 1990; Ostrom and Janssen 2004; Cinner et al. 2012). This is because pluralism tends to exacerbate uncertainty, and 'in many countries, state laws are largely unknown in villages, and sometimes when new laws are promulgated, not only villagers but also government officials at the district or village levels are ignorant of the new laws' (Meinzen-Dick and Pradhan 2002, p. 13).

Governance Examples

Another form of volitional reflexive governance is the voluntary national review process (VNR), which lies at the heart of the global SDGs' follow-up and review mechanism set by the UN 2030 Agenda. Since 2016, 142 VNRs have been submitted to the UN High-Level Political Forum on Sustainable Development (HLPF), and 50 new reports are expected to be presented at its 2020 session (SDG Knowledge Hub, https://sdg.iisd.org/). The reports have given the international community a broad perspective on the status of the advance towards the SDGs at the national level. A Latin American think tank, Cepei (which provides analysis of global development agendas), has shown in recent research that current reporting is too static. Second-round VNRs should answer more reflexive questions like, 'How have we progressed since our previous report?' 'What worked well and what failed since then?' 'What have we learned on our way towards the SDGs at the national level?' and 'Where do we predict we will be in the short- and medium-term?' (SDG Knowledge Hub).

Cepei also suggested that second-round VNRs focus on integrating ministerial and sectoral silos, share successes and failures to facilitate learning, be democratised to encourage input from local voices and be more rigorously verified through the review process (SDG Knowledge Hub).

Appendix B. Regimes

	Shipping
Description	By 2017, 11.7 billion tonnes of cargo shipped across the ocean (UNCTAD 2018) More than 80% of global trade (IMO 2019) transported via this industry An increase of almost 40% in most trade segments (apart from crude oil and oil products) expected between 2016 and 2030, with a 2% annual rise for the period 2030–2050 (Gjølberg et al. 2017)
Stakeholders	Private sector governments Non-governmental organisations
Applicable governance/ institutions/mechanisms	UN Convention on the Law of the Sea (UNCLOS) and all supporting conventions and institutions (Pretlove and Blasiak 2018) including (but not limited to) • International Maritime Organization (IMO) • Agreement on Port State Measures, 1982 • International Convention for the Prevention of Pollution from Ships (MARPOL) • Liability conventions • Certification and classification schemes
Challenges	Energy consumption and emissions Recycling end-of-life ships Biofouling Pollution and discharges Flags of convenience Ports of convenience Accidents and damage to ecosystems
	Ocean-based food extraction
Description	Pillar of global nutrition (Pretlove and Blasiak 2018; Costello et al. 2019; FAO 2018) Capture fisheries and plant and animal mariculture provide nearly 80 mmt of edible food, people with 20% of their animal protein and critical micronutrients not found in land-based foods (long-chain omega-3 fatty acids) (Costello et al. 2019; FAO 2018) Global mariculture production expanded significantly; marine production now around 30 million tonnes annually (Pretlove and Blasiak 2018) Significant further expansion in aquaculture and mariculture is expected
Stakeholders	Food security for humanity Parties to UNCLOS and subordinate conventions regional fisheries management organisations (RFMOs) private sector Small fisheries Coastal communities
Applicable governance/ institutions/mechanisms	Both sovereign and commons space (in areas beyond national jurisdiction [ABNJs]) from a spatial/zonal perspective, and a species perspective, given the nature of fish stock UNCLOS and all supporting conventions and institutions (see Pretlove and Blasiak 2018) including (but not limited to) the following: • UN Fish Stocks Agreement 2001 • National legislation • FAO (Codes of Conduct, Guidelines for Small-Scale Fisheries, Guidelines for Fisheries in ABNJs) • Mariculture regulation is complex; involves interlinking regulatory bodies (e.g. spatial planning, regional planning, environmental agencies, food safety)
Challenges	A sustainable and efficient system is required to maintain food security (given the anticipated population increase by 2050) Over-harvesting Indirect impacts from bycatch Illegal, unreported and unregulated (IUU) fishing: $23.5 billion each year; up to 30% of total catch, and for one in five fish transacted in markets (FAO 2018; Global Fishing Watch 2018; Widjaja et al. 2020) Monitoring and enforcement (Costello et al. 2019; Aburto-Oropeza et al. 2020; Widjaja et al. 2020) conservation of biodiversity and ecosystem services while increasing production Social justice: uneven distribution of the fishing enterprise impacts on small-scale fisheries (Costello et al. 2019; Österblom et al. 2020) Management and monitoring of RFMOs Appropriate regulatory frameworks needed to address competing interests and overlapping man-dates in mariculture
	Offshore oil and gas
Description	Extraction of fossil fuels increasingly moving to deeper waters of exclusive economic zones (EEZs); under state authority Beginning to see exploration in ABNJs
Stakeholders	Private sector governments Financial system investors

	Offshore oil and gas
Applicable governance/ institutions/mechanisms	Activities take place on the continental shelves of coastal states under domestic legislation If exploration and production moves into the area, activities would be regulated by the International Seabed Authority (ISA) Private sector regulations and best practices (e.g. global oil and gas industry association IPIECA (http://www.ipieca.org/))
Challenges	Cross-border jurisdictional issues such as baseline data collection and monitoring, transboundary oil spill response/planning Weak ISA regulation and authority in ABNJs High ecological and climate risks in deeper, pristine ocean habitats (OECD 2016) Global disinvestment campaign targeting the $5 trillion subsidy to oil industry Decarbonisation commitments by financial investors could increase risk of stranded assets (McGlade and Ekins 2015)
	Ports
Description	Port expansion is increasing globally (number and size of ships) Increasingly crowded ocean makes shipping lane designations critical
Stakeholders	Private sector governments regions Consumers
Applicable governance/ institutions/mechanisms	UNCLOS and supporting conventions, including (but not limited to) the following: • Agreement on port state measures, 1982 • MARPOL • Merchant shipping (minimum standards) convention, 1976 (ILO Convention No. 147) • Regional efforts such as European Commission (2007, 2011) • Regional port state memoranda of agreement • IMO code of good practice for port state control (for more detail, see Addo et al. forthcoming)
Challenges	Pollution of environment by ships, port activities Shipping lanes stress species, habitats Ports of convenience give rise to compliance and enforcement issues in IUU fishing and other illegal activities
	Marine and coastal tourism
Description	Second-fastest growing sector of ocean economy (OECD 2016) relies on ocean resources which it often depletes or impacts
Stakeholders	Private sector governments consumers
Applicable governance/ institutions/mechanisms	Emerging financial instruments (see Sumaila et al. forthcoming) to address vulnerabilities integrated ocean management (IOM) approaches (Widjaja et al. 2020; Winther et al. 2020) civil society advocacy
Challenges	Balancing need for tourism infrastructure and risk to species and ecosystem services Generally not monitored or regulated via internationally accepted certifications
	Marine and seabed mining
Description	Retrieval of mineral resources, either on continental shelves or on the deep sea bed, e.g. polymetallic nodules, polymetallic sulphides or seafloor massive sulphides (Aldred 2019) Exploration zones comprising 1.5 million km^2 are mainly in the Pacific, mid-Atlantic and Indian Oceans, in the ABNJs Rich deposits of rare earth minerals in deep ocean being discovered (e.g. samples extracted 500 km from the Canary Islands revealed deposits of the scarce substance tellurium—used in solar panels—in concentrations 50,000 times higher than in deposits on land)
Stakeholders	Private sector governments civil society
Applicable governance/ institutions/mechanisms	In ABNJs governed by the ISA (under UNCLOS) ISA Council in 2019 addressed regulations for financial models for mining of polymetallic nodules ISA regulations adding an additional scoping stage to the environmental assessment process and providing financial incentives for companies to participate in environment assessment and reporting
Challenges	Depleting terrestrial deposits of rare earth metals, coupled with rising demand for metals for smartphones and green technologies, has resulted in a surge of interest in deep sea mining (Cuyvers et al. 2018) Biophysical impacts of deep sea mining can be significant (IUCN (International Union for the Conservation of Nature) 1995) Many countries lack regulations or capacity to enforce regulations in their EEZs (Pretlove and Blasiak 2018) United States have not ratified UNCLOS
	Maritime biotechnology
Description	The creation of products and processes from marine organisms in these ecosystems, through the application of tools in biotechnology, molecular and cell biology, and bioinformatics Potential for new pharmaceutical drugs, chemical products, enzymes, advancement of aquaculture and seafood safety, bioremediation, biofuels, etc.
Stakeholders	Private sector governments civil society
Applicable governance/ institutions/mechanisms	Developments in governance underway to address some of the legal challenges which arise (see Blasiak et al. 2020; Sect. 3.1 and Appendix A1 above in relation to the international instrument on biodiversity in areas beyond national jurisdiction [BBNJ])
Challenges	Legal challenges for ownership of material derived from ABNJs (see notes on BBNJ) Technological, ecological and other knowledge barriers

	Cabling and maritime equipment
Description	Submarine cable network provides over 95% of international telecommunications and is the 'backbone' of the internet (Davenport 2015) Numbers and extent of submarine cables will increase drastically in coming decades as more islands and archipelagos are connected and renewable energy projects such as offshore wind farms, tidal and wave turbines are developed
Stakeholders	Private sector governments civil society
Applicable governance/ institutions/mechanisms	UNCLOS (rights and obligations of states for protection of submarine cables and the freedom to lay, repair and maintain such cables)
Challenges	Current gaps in legal regime around cybersecurity, counterintelligence and environmental impacts Environmental impacts include noise, pollution, physical disturbance, electromagnetic fields, heat, entanglement risk, pollution and threats to benthic reefs and reserves (Taormina et al. 2018)
	Offshore renewable energy (ORE)
Description	Wave, tidal and offshore wind energy generation—stationary installations in EEZs New technologies in development produce ORE through other processes, including by salinity gradients and thermal gradients
Stakeholders	Private sector governments intergovernmental bodies civil society Institutions (e.g. International Renewable Energy Agency, International Energy Agency, WindEurope, Ocean Energy Europe)
Applicable governance/ institutions/mechanisms	Domestic legislation Private sector standards, certification schemes, guidelines
Challenges	Growing scale and deployment expansion will push the technology into areas of both scientific and engineering uncertainty Environmental impacts Need for data and information streamlining to meet demand (Veers et al. 2019)

Appendix C. Case Studies of Niche Innovations

Integrated Ocean Management for Development Planning, Fisheries Management and Disaster Risk Management in Belize

Sustainability transformations call for cross-sectoral thinking and approaches. Sectoral policies and measures can be effective in particular contexts but often fail to account for indirect, distant and cumulative impacts, which can have adverse effects, including exacerbating inequalities. Cross-sectoral approaches, including ecosystem-based management approaches, integrated watershed and coastal zone management, and area- based and marine spatial planning, offer opportunities to reconcile multiple interests, values and forms of resource use, provided that these cross-sectoral approaches recognise trade-offs and uneven power relations among stakeholders (from IPBES 2019; Winther et al. 2020).

The final Integrated Coastal Zone Management Plan (ICZMP) approved by the Belizean government (Box 12.1) coordinates the management of, and investment in, a diverse set of activities and actors implicated in sustainable outcomes for the nation, ranging from those engaging in or affecting coastal pollution, dredging, fisheries, aquaculture and tourism development, to education, social resilience to climate change and preservation of cultural heritage.

The fishery sector in Belize has in parallel adopted a combination of secure fishing rights and a locally controlled 'managed access' approach through which small-scale fishers are given licenses to fish in and manage specific geographic areas through a territorial use right for fishing (TURF). The managed access fishery approach in Belize transitioned from a few pilots with positive fishery returns to a national scale in 2016 (Fujita et al. 2017), so the full economic and ecological impacts are not yet clear (Fujita et al. 2018). Surveys of fishers participating in the new Belizean managed access program emphasise the importance of government enforcement and response, which will encourage fishers to comply with required surveillance, which comes at a cost with as yet unproven economic returns (Wade et al. 2019). Furthermore, integrating fishery TURF locations with the coastal development planning zones and protected areas identified through the Integrated Coastal Zone Management Authority and Institute (CZMAI) could improve fishery returns and thus livelihood security, providing positive feedbacks to small-scale fishing communities (Arkema et al. 2019).

The institutional, legal and science-policy engagement innovations exemplified in the Belize case are transferable to anywhere in the world. Promoting co-existence and syner-

gies among ocean uses is a key issue for spatial management. Area-based and 'ridge-to-reef' management approaches for managing social- ecological systems in an integrated way have shown the value and broad relevance of cross-sectoral spatial planning in marine coastal zones, ranging from the Great Barrier Reef Marine Park in Australia (e.g. Day 2002; Fernandes et al. 2005; Olsson et al. 2008; Day 2017) to the *ahupua'a* (ridge-to-reef) system in Hawai'i and the concept of *vanua* in Fiji (Minerbi 1999; Johannes 2002; McGregor et al. 2003; IPBES 2019), to spatial planning under the European Union's Maritime Spatial Planning Directive (e.g. EU (European Union) 2014; de Grunt et al. 2018). Sale et al. (2014) suggest that expanded use of marine spatial planning could provide a framework for 'more effective, pragmatic management based on ocean zones to accommodate conflicting uses'. Establishing boundaries for resources and those allowed to use them could enable the separation of incompatible uses and give rise to governance systems that effectively address the commons dilemma (Sale et al. 2014).

Aware of the rising costs of disaster risk management and recovery under changing climate regimes, governments, multilateral development banks and businesses are beginning to turn their attention to nature-based solutions that provide greater resilience to impacts from sea level rise and increasingly intense coastal storms. The UN Global Assessment on Disaster Risk Reduction (UNDRR 2019) is tracking country commitments to integrate DRR in development planning and budgeting. Encouraging examples are emerging in Indonesia, Vietnam, Fiji and the Philippines, where DRR is being actively integrated with development planning policies, programs, capacity building and financial resources. More broadly, as in Belize, the growing number of ministries of marine affairs (e.g. Indonesia) or of the 'blue economy' (Barbados, Kenya, Seychelles) points to cross-sectoral integration.

Food production sectors, through fisheries and aquaculture, put major demands on marine and coastal regions. Although aquaculture could address the gap between aquatic food demand and supply, realising this potential will depend in part on the availability of suitable space. Integrated spatial planning for aquaculture and other uses is fundamental to the sustainable development of aquaculture in a way that accommodates the needs of competing economic sectors, minimises conflict and integrates social, economic and environmental objectives (FAO 2018).

Similarly, for fishery management, global guidance is available to ensure that area-based management, including the consideration of marine protected areas, is integrated within broader fisheries management frameworks and follows good practices with regard to participatory approaches, especially for small-scale fisheries. Both the *Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication* (FAO 2015) and the *Voluntary Guidelines on Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security* (FAO (Food and Agriculture Organization of the United Nations) 2012) describe such practices and outline, among other things, the need to respect customary and informal tenure rights.

Rights-Based Fisheries Management

Rights-based fisheries management (RBFM) can represent a significant regime shift as institutions, regulations and community engagement adapt over time (see Costello et al. 2019 for a more detailed treatment). The territorial user rights fisheries (TURFs) of Chile, described in Box 12.2, are a well-studied example of RBFM that has been able to adapt over time. Successful local governance supported by recognition of local rights has often incorporated knowledge of how nature contributes to human well-being to motivate such behaviours (IPBES 2019). Recent studies have shown a positive relationship between leadership, social capital and sustainable fisheries outcomes (Gutiérrez et al. 2012). Results demonstrate the critical importance of prominent community leaders and robust social capital, combined with clear incentives through catch shares or other rights-based mechanisms, and conservation benefits derived from protected areas, to successfully managing aquatic resources and securing the livelihoods of communities depending on them (Gutiérrez et al. 2012). The Belize TURF/CZMAI example (discussed above), U.S. fishery reforms (Lubchenco et al. 2016) and a number of other cases provide compelling examples of how RBFM, in combination with other management and social capital elements, can lead to improved ecosystem conditions and livelihood support. Modelled fisheries using data from nearly 5000 stocks worldwide indicate that RBFM can lead to catch, biomass and profit increases for diverse fisheries (Costello et al. 2016). Co-management is considered by Gutiérrez et al. (2012) to be the only realistic solution for the majority of the world's fisheries, one that can solve many of the problems they face. Yet in some cases, RBFM interventions alone will not be sufficient.

For example, economic incentives for stewardship and asking fishers to join participatory processes are unlikely to work if economic insecurity is high and government or community capacity to enforce or respond is low. If more fundamental social and political development interventions are implemented first, based on key incentives that will motivate fishing people, then RBFM approaches are more likely to succeed (Allison et al. 2012; Wade et al. 2019).

In order to enhance governability to benefit small-scale fisheries, governance designs and interactions must be sensitive to the needs and contexts of small-scale fishing people. In a review of alternative governing modes for small-scale

fisheries, Jentoft and Chuenpagdee (2015) find that small-scale fisheries globally will benefit from more constructive interaction, collective action, policy and market innovation, and empowerment but that generalised governance principles are not likely. The transition of governing modes observed in many cases illustrates how governance actors try to cope with system dynamics. Often, the combination of different modes into one coherent but hybrid approach is warranted.

To support these commitments to sustainable small- scale fisheries development, it is crucial to better develop the understanding and knowledge base about small-scale fishing enterprises. Several initiatives are underway to improve and expand existing empirical information and to quantify the importance of the marine and inland small-scale fisheries sector (e.g. World Bank 2012). Bennett et al. (2018) identify additional fisheries examples, such as the rise of community supported fisheries programs globally (Brinson et al. 2011; McClenachan et al. 2014), the release of the global *Voluntary Guidelines for Securing Sustainable Small- Scale Fisheries* (FAO 2015) and increased funding of non-governmental organisation programs that focus on small-scale fisheries (e.g. the Fish Forever Program (Barner et al. 2015; Bennett et al. 2018)).

Monitoring Innovations for Illegal, Unreported and Unregulated Fisheries

One of the key challenges in countering illegal, unreported and unregulated (IUU) fishing historically has been the limited capacity of coastal states to monitor the vast swathes of ocean comprising their EEZs, as well as areas of the high seas. The modus operandi of IUU fishing has been to fish inside or hover at the edge of EEZs (where the majority of fish stocks are found) with smaller vessels, which then drop their catches into larger 'mother ship' refrigeration vessels waiting in the high seas, beyond the reach of national jurisdiction. The rapid development of vessel monitoring systems and automatic identification systems over the past several years provides new possibilities for the reduction of IUU fishing given that many open platforms now exist which provide real-time tracking of vessels (Widjaja et al. 2020). The ability to identify locations allows enforcement responses to be accurately and effectively focused.

Justice in Marine Sustainability

Several developments indicate a move towards social justice in marine sustainability thinking. Eco-labelling, certification schemes and supply chain transparency have, for example, given rise to the concept of socially responsible seafood, evident in the common use of mobile apps which show the full supply chain (such as Monterey Bay Aquarium's Seafood Watch app).

Cooperative fishing arrangements such as the Parties to the Nauru Agreement (PNA) in the Pacific islands are being developed to equitably share fishing benefits.

The PNA governs the annual fishing effort of skip-jack tuna. This highly migratory species moves between the EEZs of the island countries and also in response to climate (Lehodey et al. 1997). The PNA's 'vessel day scheme' facilitates cooperative management of these species within the combined EEZs of the PNA members (Aqorau et al. 2018). A capped fishing effort of vessel days is shared among members, allowing a trading scheme which enables responses to extreme weather events and migratory patterns. As a result, all members receive revenue regardless of where fish are caught, and stock has remained robust under this cooperative management arrangement (Aqorau et al. 2018). An example of this in the South African context is Abalobi—an innovative information and communication technology tool (mobile app) that is playing a significant role in improving small-scale fisheries governance in South Africa. It does this by addressing social justice and access issues faced by small-scale fishers within the sector, while assisting the government in improving catch data monitoring by accessing catch data of small- scale fishermen. Abalobi (2019) promotes traceable and 'storied' seafood that encourages ecological sustainability as well as social justice.

Appendix D. Potential Governance Functions of a Supranational Ocean Agency

1. Draft the flexible frameworks for policymakers and lawmakers, animated by commons norms discussed above and building on existing mandates and initiatives (UNESCO, UNEP, FAO, ILO, UNFCCC, etc.). Frameworks could be designed in such a way that law and policy can be applied at local levels and adapted according to rapidly changing needs, capacity and context, as well as guide the negotiation of trade-offs and realisation of co-benefits. This could result in appropriate combinations of decision analysis, land and ocean use planning, public participation and a science- policy process, diverse knowledge systems and conflict resolution approaches (IPCC 2019, C3.3). In turn, this would help reduce short-term risks, build long-term resilience and sustainability, and facilitate capacity building. Framework policy guidelines could be crafted with temporal awareness. Many coastal and ocean decisions now being made have time horizons of decades to over a century, far longer than the lifespan of the governance arrangements facilitating them (IPCC 2019, C3.4).

2.	Coordinate measurable volitional commitments by stakeholders, such as commitments to marine protected areas and biodiversity targets in the international instrument on biodiversity in areas beyond national jurisdiction (BBNJ), aspects of the voluntary national review process related to Sustainable Development Goal 14, voluntary commitments under the Our Ocean Conference series and the UN Ocean Conference
3.	Provide a monitoring function to ensure transparency, compliance and accountability of ocean commitments made in international processes. Without some form of agreed transnational accountability, voluntary governance based on volitional commitments lacks gravity and certainty (SDG 16: Develop effective, accountable and transparent institutions at all levels). A shared knowledge commons (see Sect. 7.2.2) will facilitate this accountability
4.	Facilitate social learning, social innovation and reflexive, adaptive governance responses through the creation of an overarching legal architecture for the ocean transition sufficiently flexible to allow it to respond to rapid change but sufficiently robust to provide a cohesive framework for the implementation of selected transition pathways. This is the type of governance that can create conditions for mutual learning and coordination
5.	Provide a venue for co-construction of sustainable ocean narratives that includes existing agencies and institutions (SDG Target 16.7: Ensure responsive, inclusive, participatory and representative decision-making at all levels; SDG 17: Strengthen the means of implementation and revitalise the global partnership for sustainable development)

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