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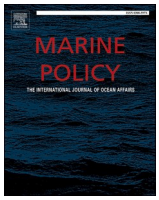

Full length article

Common Asset Trusts for blue commons stewardship

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ABSTRACT

There are critical direct and indirect, positive and negative links between the ocean and human wellbeing at multiple scales. Many of the ecosystem services the ocean provides to humans, including fisheries, are common pool resources that are non-excludable but rival or subtractive. Others, including climate regulation, are non-rival and non-excludable pure public goods. Resources without any restriction or condition for their use, are known as open-access resources. Unrestricted access generally leads to unsustainable use. Many ocean ecosystems are open access, blue commons. They range in spatial scale from national, such as mangroves and coral reefs, to the open seas within Exclusive Economic Zones (EEZs), to Areas Beyond National Jurisdiction (ABNJ). There are also many species that migrate between national jurisdictions or between national and global blue commons. The sustainable stewardship of these blue commons is one of the most important current global governance challenges. We describe in detail how to create a Common Asset Trust (CAT) for blue commons and how such a system would operate. Finally, we propose CATs to manage blue commons at different spatial scales, including coastal reefs, EEZs, and ABNJ.

1. Blue commons and human well-being

Our blue planet is the home of a wide range of ecosystems, with the global ocean covering 362 million km^2, a full 71% of the Earth's surface [30]. Marine ecosystems range from biodiversity-rich tropical and deep-water coral reefs to estuaries and the high seas, all interconnected in a myriad of ways we are only starting to understand. Indeed, the majority of animal life is marine [3]. At the same time, there is a critical connection between the ocean and human wellbeing that has existed for millennia. All these linkages are both direct and indirect, positive and negative, and exist at multiple scales [62,67].

Directly, the ocean provides food, education, livelihoods, medicine, transport, communication, recreation, treatments for disease, and many other goods and services [22]. Indirectly, the ocean provides cultural services that support mental and physical health, including reduced stress, active lifestyle, improved air quality, social interactions, artistic inspiration, among many others [23], as well as key regulating services such as producing half, or more, of the planet's oxygen, and absorbing 93% of world's anthropogenic heat [70]. The ocean has allowed cultures to communicate and spread around the world, and has contributed to the growth and evolution of civilizations into global powers [19]. Around 90% of international trade relies on oceanic shipping, and maritime trade volumes are expected to triple by 2050 [55]. Without oceanic transport, the global economy would collapse.

Much of the ocean-based economy is motivated by basic human needs for food, energy, transportation, and recreation [76]. In the formal economy, ocean-based industries make up around 3.5–7% of global GDP, providing at least 31 million direct full-time jobs [44]. This marine economy is growing rapidly and is predicted to approximately double by 2030. The informal economy is much harder to assess. It's been estimated that over 60% of the global adult labour force operates in the informal sector, at least part-time [41]. This is up to a third of a

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country's GDP [40], with women contributing a large proportion of the labour. In countries with large coasts, and especially in small island developing states, the majority of this informal economy is ocean-based. Communities are fully dependent on the ocean not only for the protein and nutrition that fish provide [6], but also for every other aspect of their lives.

In 2015, a report from WWF estimated the value of marketed ocean goods and services to be approximately $24 trillion. If this value is compared to the world's top 10 economies, the ocean would rank seventh globally, behind the United States, China, Japan, Germany, France, and the United Kingdom, and ahead of as Brazil, Russia, and India. Furthermore, this study found that more than two-thirds of the annual value of the ocean relies on healthy conditions to maintain its annual economic output [37].

One way to classify all these goods and services provided by the ocean is according to their "excludability and rivalness'' status. Table 1 arrays these two characteristics against each other in a matrix which leads to four categories. Goods and services are "excludable'' to the degree that individuals can be excluded from benefiting from them. Most privately owned, marketed goods and services are relatively easily excludable. However, it is difficult or impossible to exclude others from benefiting from many public goods, like a well-regulated climate, fish in the open seas, or the aesthetic benefits of a coral reef. Goods and services are "rival'' to the degree that one person's benefiting from them interferes with or is rival with other's benefiting from them. Excludability is largely a function of supply (to what extent can producers exclude users) and is related to the cultural and institutional mechanisms available to enforce exclusion, while rivalness is a function of demand (how do benefits depend on other users) and is more a characteristic of the good or service itself. Table 1 places ecosystem services into the four categories that this two-by-two matrix creates.

All goods harvested from the ocean are rival, and many are non-excludable. To assess the stewardship of resources, the term subtractability has been suggested as a substitute to rivalry, since the competition for these resources occurs to differing degrees, and therefore people using a resource decreases the resources available for other people to consume, but does not entirely eliminate their availability [56]. Some services, such as climate regulation, are inherently non-rival and non-excludable, while others, such as waste absorption capacity, could be made excludable through local, regional or international agreements limiting waste emissions into the ocean.

Extractive activities such as deep sea mining and offshore drilling are also examples of rival marine public goods that have been made excludable (with different degrees of success) to prevent the overexploitation of the stocks they depend on and the potential impacts on human well-being and the rest of nature [15,33,74]. In the case of deep sea mining, this has been done through international governance schemes such as the International Seabed Authority (ISA) and more indirectly by the new High Seas Treaty; and in the case of offshore drilling by national regulations on the EEZ since the great majority of oil rigs are in the country's jurisdiction [31,38].

Table 1
Ecosystem services classified according to their excludability and rivalness [12].

	Excludable	*Non-excludable*
Rival	Market goods and services (most provisioning services)	Open access resources (some provisioning services)
Non-rival	Club goods (some recreation services)	Public goods and services (most regulatory and cultural services)

At the global level, the ocean provides climate regulation, a benefit that is inherently non-excludable and non-rival, benefiting all of humanity. Currently, oceanic commercial transport is also non-excludable and effectively non-rival[1] outside of the busiest shipping lanes. But this common benefit conflicts with another: noise, pollution and boat collisions degrade oceanic habitat for many species, notably cetaceans, disrupting oceanic ecosystems and their myriad benefits, shared by innumerable species. Carefully considered access rules are needed to address this conflict. Universal benefit is also associated with some ecosystem services at the local scale, such as the storm protection provided by a mangrove forest [13,35,36].

In contrast, resources that are non-excludable (or very difficult to exclude) but rival or subtractive are referred as common-pool resources [56]. For example, in 1982, the United Nations Convention on the Law of the Sea created Economic Exclusion Zones (EEZ) that enable individual countries to regulate access to oceanic goods within 200 miles of their coast. Many countries have used these rights to restrict access to fish and other commodities [68]. Oceanic waste absorption capacity is also rival–one nation's use leaves less for others– and largely non-excludable, though most nations have some restrictions on ocean dumping.

Common-pool resources can be managed by different institutional arrangements, which can be categorized (in general terms) as governmental, private, or community ownership. Common-pool resources without any restriction or condition for their use, are known as open-access resources. Unrestricted access of such resources generally leads to unsustainable use [56]. In this sense, Harding's "tragedy of the commons", in which unfettered access leads to overexploitation, referred specifically only to open access-resources [29] not to resources that are managed as commons via community ownership.

In the case of the ocean, many common-pool resources, or blue commons, are open access, from national ecosystems such as mangroves, coral reefs, and the open seas within the EEZ, to global ecosystems such as Areas Beyond National Jurisdiction (ABNJ), as well as the species that migrate between national jurisdictions or between national and global blue commons. The blue commons are interconnected at multiple spatial and temporal scales, and along the water column, through ocean currents that transport nutrients and small organisms, as well as by migratory species, such as baleen whales, that travel thousands of kilometers between feeding and reproduction areas [72], and oceanic species that use coastal ecosystems as nursery grounds, as in the case of hammerhead sharks [8].

This interconnected system of blue commons is an essential mechanism to maintain the health of the ocean, which will determine the level of supply of ecosystem services [34]. Furthermore, the blue commons are also connected to the green commons, across land and seascapes, as it is across the system of catchment forests, agricultural fields, mangroves and coral reefs, as, for example, in the Great Barrier Reef in Australia [45,58,66,71].

The open access nature of most of the blue commons and its unsustainable use, plus its interconnection with the green commons, has caused the global degradation of the ocean (Fig. 1). Among the main drivers of change of the ocean health are climate change, unsustainable fishing, atmospheric pollution causing acidification, land-based pollution (e.g., plastics of all sizes, nutrients, agrochemicals, chemicals), habitat loss and degradation through coastal development and agriculture, among others [17,73]. The cumulative impact of these threats, mainly from climate change, unsustainable fishing, land-based pollutions, and shipping, is now affecting 59% of the ocean, with coral reefs, seagrasses and mangroves at most risk [28].

For all these reasons, the sustainable stewardship of the blue

[1] The space occupied by one boat cannot simultaneously be occupied by another, meaning that it is technically rival, but the ocean is so vast there is rarely competition for a specific space.

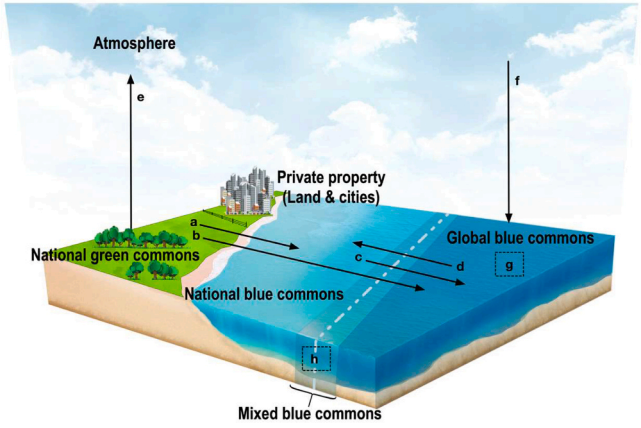

Fig. 1. Interconnection between the blue and green commons at different spatial scales. a) Coastal degradation from land-based drivers (e.g., agrochemicals, mangrove loss from agriculture, sewage from cities). b) Ocean degradation from land-based drivers (e.g., plastic, unsustainable diets). c) Ocean degradation from coastal-based drivers (e.g., housing development, tourism industry). d) Coastal degradation from ocean-based drivers. e) Greenhouse emissions from private property (e.g., farms, cities) and common property (e.g., deforestation of protected areas). f) Absorption of heat and carbon beyond ecological limits (e.g., ocean acidification, heat stress to species). g) Ocean degradation due to ocean-based drivers (e.g., fishing, mining, oil exploration, shipping). h) Impact on migratory species which spend a portion of time in both the EEZ and the open seas (e.g., humpback whales).

commons is one of the greatest current global governance challenges. Failing to successfully address a national and global transformation to restore and protect the blue commons could mean crossing tipping points that could flip the system (or parts of it) towards a new stable state, less biodiverse and less capable of providing vital benefits to the well-being of people around the planet [69].

In this paper, we propose Common Asset Trusts as a new element in governance and financial schemes that can help close the research and policy gap in the restoration and protection of our blue commons.

2. Creating Common Asset Trusts for better marine conservation and restoration across spatial scales

Private property rights and conventional economic markets are relatively efficient at managing simple (rival, scarce, and easily excludable, with no significant externalities) goods and services. On the other hand, common property such as coastal and marine resources (both rival and nonrival and not easily excludable), that should belong to everyone, including future generations, require significantly different institutions and management regimes [14].

Hardin's tragedy of the open-access ocean can potentially be solved by declaring it the common property of the members of the community with a stake, from local to global. For the open seas and the atmosphere, this means everyone on Earth. This would address the social dilemma in which members of a group can gain by cooperating, but cooperation is costly, and therefore each individual does better personally by not cooperating, no matter what the others do [26]. To achieve a win-win scenario on blue commons stewardship stakeholders need to have a clear understanding and agreement on a shared overarching goal, which broadly speaking should be a healthy and productive ocean for human well-being and the rest of nature. To achieve this shared goal, a legal entity or fiduciary association of citizen stakeholders which operates as a trust can manage the asset to maximize its shared value for all stakeholders – including natural ecosystems. For example, trustees could set a cap on the use of a resource according to metrics related to sustainability and well-being [61]. For renewable resources, caps that are lower than reproduction rates allow stocks to increase. Larger stocks generate more ecosystem services, reduce harvest costs, and allow for larger sustainable harvests in the future—an example of a win-win scenario. Furthermore, once the commons are protected for future generations, the trust can rent a portion of the ecosystem services provided by the blue natural capital under the cap to the private sector or to governmental institutions.

Thus, resources owned in common can be effectively managed through collective institutions that assure cooperative compliance with co-designed rules and agreements. Here we propose the creation of Common Asset Trusts (CATs) to sustainably manage the ocean. In essence a CAT is a collection of agreements and poly-centrically governed institutions in support of a shared purpose, sustainable management of public goods. To achieve this purpose, the design of these agreements and institutions can be guided by Ostrom's principles for sustainable commons management [14,56], which are functionally identical to core design principles for successful cooperation in the face of social dilemmas identified by evolutionary biologists [1,75]. These eight core design principles for effective and sustainable commons management are: (P1) clearly defined boundaries, (P2) proportional equivalence between benefits and costs, (P3) collective choice arrangements, (P4) monitoring, (P5) graduated sanctions, (P6) conflict resolution mechanisms, (P7) minimal recognition of rights to organize, and (P8) polycentric governance.

Different institutional and financial mechanisms for natural capital stewardship already exists which align with the core principles of the CATs. For example, in 1996 Costa Rica created a national Payment for Ecosystem Services (PES) program through the Forest Law, as well as the Nation Fund for Forest Finance (FONAFIFO) to manage this program. The Costa Rican PES scheme functions approximately as a common asset, with FONAFIFO playing the role of trustee using economic incentives to motivate protection and restoration of natural capital assets. It receives payments from activities that harm or utilize the asset (e.g., carbon emissions and water use), and rewards private parties that protect or restore the asset via payments for contracted activities (e.g., reforestation, agroforestry).

Furthermore, FONAFIFO and the PES scheme incorporate several elements of Ostrom's eight core design principles. FONAFIFO has a clear purpose of sustaining and enhancing forests in Costa Rica, and it enjoys strong support as an institution, suggesting a sense of shared identity and purpose (P1). It incorporates a relatively equitable distribution of contributions to the fund and benefits to landowners (P2), although this relationship is somewhat indirect. Decision-making is answerable to the government and ultimately to the citizens (P3), but this aspect could be strengthened with greater citizen consultation and participation. Monitoring of behaviors on funded properties is part of the system but could be improved particularly through enhancing mechanisms for peer monitoring among buyers (P4). There are financial sanctions for those who do not comply with their contracts and the rewards of continuing participation for those who do (P5), although monitoring to assess this is has proven to be difficult. The national legal system is used for fair conflict resolution (P6). Finally, FONAFIFO has the authority to self-govern to some extent (P7) and collaborate with the national government.

Any stewardship and legal system based on the commons should derive its governance and functionality from the ecosystem model, where individuals and their networks are horizontally linked and therefore power is dispersed, contrary to a hierarchy of power concentration common in State and market systems [52]. Furthermore, a key principle to natural capital stewardship through a CAT is to engage resource users directly in the protection, restoration and access to the blue commons and recognition of the rest of nature as a key stakeholder. For example, a CAT's foundations should be built around the inherent rights of nature, which will require humans to reconnect with the rest of nature in a democratic relationship with the community of life.

To design a CAT for the ocean, following Hernández-Blanco [32] we propose a 7-step process (Fig. 2), which is in close relation with Ostrom's

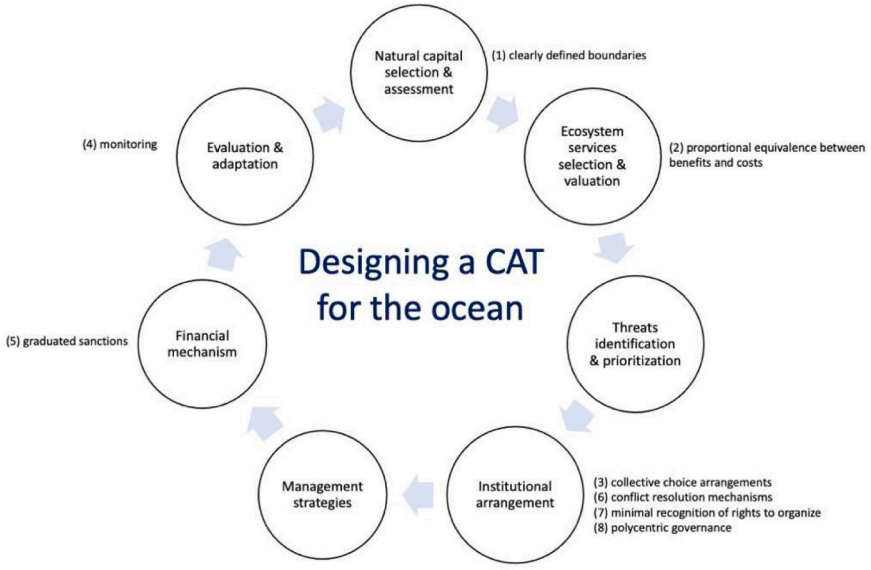

Fig. 2. Process to design a CAT for the ocean, indicating how each step is related to Ostrom's principles.

principles for managing the commons. The first step is to identify the marine and coastal ecosystems that are going to be the subject of the CAT, taking into consideration properties such as location, extension and health of the ecosystem. The second step is to agree on the benefits (i.e., ecosystem services), and their value, that the CAT will focus on to ensure its sustainable use by the beneficiaries. Next, stakeholders of the CAT should have a clear understanding of the main threats the ecosystem faces, in order to address them efficiently. The institutional arrangement is the fourth step of this process, and it's the heart of the CAT, in which the rules of stewardship will be agreed among the stakeholders under a polycentric governance system.

The stewardship rules of the trust will produce the agreed management strategies to protect and restore the ecosystem and the benefits it provides to the trustees. These management strategies will consist of a wide arrangement of management actions, the exact identity of which will depend on the ecosystem (due to system specificity of function), the level of threats it faces, and the agreed division of benefits among the trustees. The sixth step is the creation of the financial mechanism of the CAT (i.e., how funds are going to be collected and used to finance the management strategies). We propose that these funds should come from the main externalities to the trust, both positive (i.e., benefits to specific beneficiaries, which can translate into instruments such as fees, ecosystem services markets), and negative (i.e., those who degrade the natural capital should be charged a fee or sanctioned). Finally, the process needs to be iterative, through monitoring and evaluation, allowing the CAT to adapt and evolve to new social and environmental conditions.

3. A global CAT for the ocean

A systems approach is key to effectively address the challenges of protecting, restoring and sustainably using the ocean. The majority of current approaches focus on the stewardship of a couple of elements of the socio-ecological marine system, mostly in an uncoordinated way. We need to first define a shared and common purpose or goal of this system in order to orchestrate the institutional arrangements and financial mechanisms at multiple levels towards its achievement.

In the case of ocean governance, the purpose in theory should be to create social well-being while maintaining a healthy ocean. However, by looking at how the current system behaves, it is evident that the economic element has a far greater role in guiding current global and national development decisions. The current purpose is arguably biased towards resource extraction and economic growth.

Recent global agreements provide some hope for creating this shared goal of protecting and restoring the global and national blue commons. For example, the Kunming-Montreal Global biodiversity framework, adopted by all parties of the Convention on Biological Diversity during the last Conference of the Parties in December 2022, has the vision of valuing, conserving, and restoring biodiversity by 2050, maintaining the delivery of benefits that nature provides to people. This vision is embedded in the GBF's targets, especially in target 2 on restoring ecosystems (including coastal and marine) by 2030, and target 3 on protecting 30% of terrestrial, inland water, and of coastal and marine areas by 2030.

Six months later, in June 2023, governments meeting at the United Nations in New York formally adopted the new High Seas Treaty to protect the ocean. The objective of the agreement is "*to ensure the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction*". The high seas or areas beyond national jurisdiction are the waters beyond 200 nautical miles (322 km) of the coast where a nation has jurisdiction over both living and nonliving resources, also known as the exclusive economic zone (EEZ). Although they cover 45% of Earth's surface [77], less than 1% of the high seas are protected, meaning that no nation owns or manages the majority of the open seas, leaving it vulnerable to exploitation and abuse [50]. The treaty will also be key in achieving GBF's target 3 by setting a legal framework to establish marine protected areas in ABNJ, introducing environmental impact assessments, ensuring the fair and equitable sharing of genetic resources and building the capacities to help countries to implement the agreement.

Nevertheless, stakeholders at all governance scales, are struggling to design a stewardship framework to reach these goals and agreements. For example, fishing on the high seas has led to a decline in many open seas species, with an estimated three-quarters of these species considered depleted or overfished [60]. The trend of fishing lower on the food chain has also reduced the abundance of certain functional groups, leading to an imbalance within the ocean's ecosystem, and significantly reducing its resilience to shocks [65].

To address this cross-scale governance challenge, we propose the creation of a Global Ocean CAT (GOCAT) for ABNJ, since these areas comprise the entire global blue commons, co-owned by all stakeholders of the planet. The GOCAT would ensure that no single nation or interest had control or exclusive access to the open seas. However, it would allow nations and other interests to utilize the open seas sustainably and

responsibly. Moreover, the GOCAT would allow for fragile, vulnerable, and valuable ocean ecosystems to be protected increasing the resilience of the entire ocean system. It would put these and other ocean ecosystems under the protection of a trust with trustees from existing regional, national, and sectorial bodies, as well as the scientific community as representatives of the ecosystems [2].

The creation of a CAT of this kind would need to be co-produced with global stakeholders. Social scientists, ecologists, legal scholars, and other experts would provide pragmatic opinions on the design, structure, and implementation of GOCAT. Stakeholders would have to come from all sectors and nations to ensure buy-in and adherence to the CAT. This would also allow trustees of the GOCAT to hold nations and industries accountable for damages done to the ocean's ecosystems. To do this, the CAT trustees will require the authority and oversight to enforce restrictions and penalties on global entities. All decisions made by the trustees should be open and transparent.

For decisions to be open and transparent, the knowledge upon which they are based must be as well. Knowledge is not only non-rival but actually anti-rival, in that it improves through use. In the age of the Internet, there are almost no costs to sharing knowledge, while creating and enforcing intellectual property rights (IPRs) is expensive. The value of knowledge is maximized when it is freely available to all, especially because the most important input into new scientific knowledge is existing knowledge [20,46]. The GOCAT should therefore include a non-profit, free to publish, open access Oceanic Commons Press that includes a repository for Author Accepted Manuscripts and pre-prints, thereby creating an Oceanic Knowledge Commons. This knowledge commons could eventually be expanded to include all scientific literature that contributes to a socially just sustainability transition.

Current technology and knowledge allow for global monitoring and assessment of ecosystem health (e.g., UNESCO IOC's GOOS, NOAA's GOMO). It also enables cumulative impacts and long-term impacts to be assessed and valued. Such understanding allows the ocean to be monitored globally to not only ensure further degradation is prevented but also to track and monitor areas of improvement. This will allow trustees to reward, as well as penalize, entities impacting the ocean positively or negatively.

Because of the interconnected nature of the ocean, and the global political and operational structure of the GOCAT, protecting the whole system of global blue commons, will require the governance of other subsystems. This is true of both capital and flows and could even extend to the management of particular species (e.g., keystone species and species of commercial interest), which will depend on goals set at the national and transnational scale. For example, national governments will need to decide, (taking in consideration a wide set of criteria, including culture, social needs, state of the health of the national blue commons, and financial sustainability, among others) the set of rules and activities that would be the most appropriate for countries and other

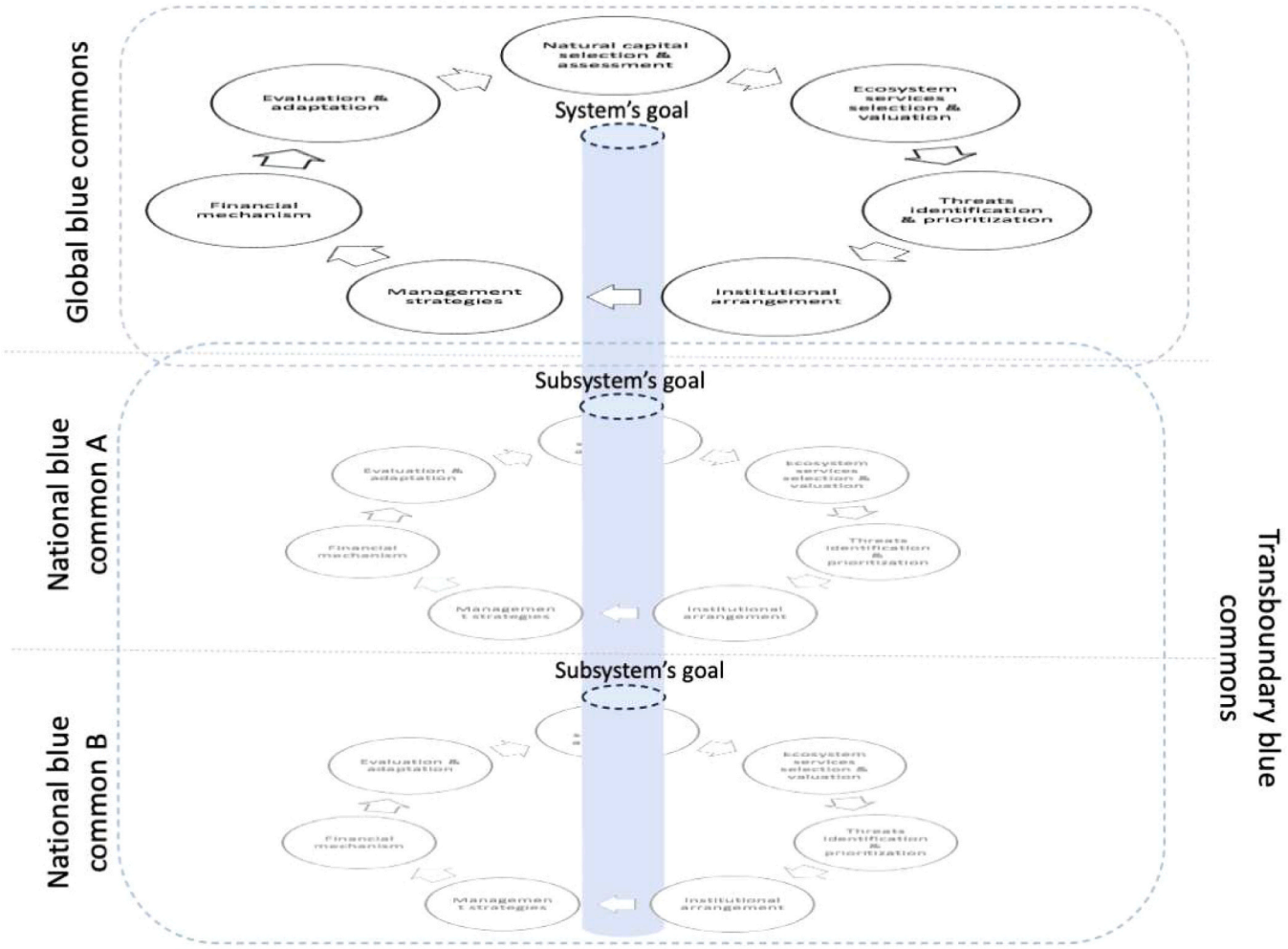

Fig. 3. A nested approach to the design and implementation of CATs for ocean stewardship, in which the global blue commons, and its CAT, will interact with other subsystems at the national level, which at the same time interact to produce transboundary blue commons. CATs can be designed in a coordinated way to address the particular characteristics of blue commons at the different scales, maintaining across scales the overall system's goal, which will be supported by the goal of each CAT from each subsystem.

stakeholders to respond to their role in protecting the global blue commons, as well as to address the interconnection between the global and national blue commons.

This will require a set of downscaled goals, which will then require downscaled versions of the GOCAT, operating in synchronicity and coevolving with it in an interconnected and dynamic hierarchy of governance schemes. Fig. 3 illustrates how the design process for CATs presented on Fig. 1 can be downscaled for other subsystems, maintaining scientific and political coherence with the GOCAT and its global goal. This nested approach of systems will of course depend on the stewardship and/research boundaries defined by the trustees and other stakeholders.

Obviously, we are creating artificial boundaries between these geographical scales of the social-ecological marine system, and it is expected that both "positive" and/or "negative" behaviors will emerge from crossing these boundaries. These behaviors relate to the ecosystems we want to protect, as well as to the governance structures that will be implemented as part of the CAT. Therefore, to operate effectively and efficiently, this nested approach should balance the freedoms and responsibilities of the whole system and its subsystems, with enough central control to ensure the coordination toward the larger system, and enough autonomy to keep all the subsystems working. In other words, this operationalizes the polycentric governance as described in Ostrom's principle 8.

A key principle of our nested approach of CATs for ocean protection the ability to self-organize in a coordinated way along its nested levels of governance. This will allow novel stewardship schemes to evolve out of the particular local conditions of people and the rest of nature. Moreover, the governance structures need to be able to adapt organically depending on how the whole system (and its subsystems) is behaving in relation to achieving the general goal, which will increase the resilience of the GOCAT and its subsystems to ecological and socio-economic pressures.

In the case of the subsystems (i.e., coastal and marine ecosystems), a CAT for national blue commons could be created for ocean habitats such as expansive seagrass meadows, oyster, coral or rocky reefs, among others. In terms of coral reefs, The Great Barrier Reef (GBR) could be a model system for implementing a CAT as it has a clearly defined boundary, it has had iterations of planning and extensive knowledge collation in support of maintaining its structure, function and health [10] and it has coordinated institutional arrangements to enact or oversee these activities (via the federal Great Barrier Reef Marine Park Authority and the State government level body, the Office of the Great Barrier Reef). However, in most instances things will not be so clean. The Great Southern Reef (GSR) of Australia is perhaps a better example of the true complexity, but also potential benefits, of the multi-dimensional complexity faced in stewardship of marine ecosystems.

Networks of coral reefs – such as those that make up the GBR or its equivalent along the Ningaloo coast of Western Australia, or the Meso-American reef systems – are considered as a single broad scale system of 100–1000 s of biophysically interconnected reefs [16,53]. Similarly, the GSR consists of an extensive temperate rocky (kelp dominated) reef system that stretched for more than 8000 km along the southern half of Australia – from Kalbarri in Western Australia, across the Great Australian Bight, around Tasmania and up the eastern seaboard to northern New South Wales [4]. This system is as biophysically integrated as the GBR, a hotspot for global biodiversity, generates an extensive list of ecosystem services (Bennet et al., 2015; [21,59]. In fact, more than 70% of all Australians live within 50 km of the GSR and often work or recreate on at least some part of it (Australian census data available from https://www.abs.gov.au/), contributing at least $10 billion AUD per annum to Australia's economy (Bennett et al., 2016).

In contrast to the GBR, however, the GSR reef system is not overseen by a single entity. Instead, the GSR straddles five Australia State jurisdictions meaning its management is split between those states, with local government also making related decisions at specific points along its length. The lack of a coherent concept of the GSR as a system has meant that awareness (public, private and political) of its existence and contribution to the functioning of the ecosystems of southern Australia is very low, which is reflected in the disjointed management (with inconsistency in management approaches and policies along its length) and low research investments (Bennett et al., 2016). This geographic region is under heavy human use or modification, growing populations (https://www.abs.gov.au/) and rapid climate change driven shifts in the physical systems [64] and ecological components [25,42].

The current fragmentation of oversight in conjunction with these cumulative pressures puts in question the capacity to achieve long term sustainable and equitable use of the GSR, especially in the context of restoration and nature positive outcomes [47,54] and climate resilience. What is required is management that spans jurisdictions, recognises the contribution the system makes to its many beneficiaries (who hold multiple potentially competing objectives), accounts for its interconnected multi-component make-up ([24,48]; Bennet et al., 2015) and is sufficiently flexible to acknowledge the regional variation inherent in the system [11]. By considering the GSR as a system that is national in geographic scale and reach into the Australian population, this system becomes a natural candidate for a CAT for national blue commons.

Again, ocean biotic and abiotic elements and functions are interconnected by subsystems beyond national boundaries. These transboundary blue commons will require a set of very specific measures, that although they should be part of the GOCAT, in reality political viability could dictate the implementation of measures that are specially aligned with the current goals of the governments, as well as with the idiosyncrasy and development history of the countries involved [39].

For example, in 2004, the San José Declaration established the Eastern Tropical Pacific Marine Corridor (CMAR by its Spanish acronym), created by the governments of Costa Rica, Panama, Colombia and Ecuador, in order to make a protected corridor comprised by a series of Marine Protected Areas from each country (Cocos, Coiba, Malpelo and Gorgona) [9,18]. This agreement was launched again in 2021 during the 26th Conference of the Parties from the United Nations Framework Convention on Climate Change (UNFCCC), where the founding countries pledged to carry out different national and regional efforts on these islands and the corridors that connect them, including carrying out a process that would conclude with the creation of a Marine Biosphere Reserve between the islands, which would be one of the largest in the planet.

The marine systems between these islands function as biological corridors for species such as sharks, tuna, turtles, rays, whales and many other migratory marine species. Humpback whales (*Megaptera novaeangliae*), for example, move constantly between national jurisdictions, as well as between the EEZ and ABNJ (including the Antarctic Peninsula) using consistent migratory paths or blue corridors [43]. This makes these whales a transboundary common-pool resource with significant challenges to their protection, since the responsibility for their stewardship is divided between countries with different worldviews, political contexts, cultures, environmental awareness, and funding capabilities. Furthermore, the Eastern Tropical Pacific Ocean (ETPO) is seen as extending across an even wider area: down the coast of the Americas from southern Mexico to northern Peru [78]; some geographical definitions of the area go even further south to include Chile [43]. This vast area represents quite a complex marine system, which could legitimately be extended to include significant portions of the Southern Ocean as well [63].

To address this complex conservation need, governance systems must be designed with an authoritative reach equal to the geographical scale of the ecosystems and the life history dynamics of its biodiversity, which requires cross-scale networks of resource management [51]. We propose to design a CAT for this transboundary system, a multisectoral and transboundary trust catalysed by public-private partnerships with the goal of protecting its ecosystems and species in the CMAR and later in the entire ETPO. The trust will be polycentric [7,27,49,57],

compromised by all governments (national and local) that benefit from these habitats and its species, as well as by those industries who pose a threat to the blue commons, such as fisheries, shipping and tourism.

The CAT will define its rules and governance in relation with the common goal of providing the multigovernmental and multisectoral protection of these transboundary areas. The CAT will also decide the management strategies needed to achieve this goal. These strategies could be focused on 1) key areas such as feeding and reproduction areas of migratory species such as whales, and on 2) reducing the negative impact from the industries mentioned before. In terms of key areas, recent efforts such as the identification of blue corridors and Important Marine Mammal Areas (IMMAs) (Tetley et al., 2022) can be used as part of the selection and prioritization criteria of areas throughout the ETPO.

These strategies could be funded using funding sources related to externalities. Financial instruments to internalize negative externalities can include high penalties for polluting the transboundary blue commons. For positive externalities, the CAT can develop instruments such as user fees (e.g., for whale watching), carbon and biodiversity markets related to the role of the blue commons of the system in climate regulation and ecosystem services. Payment for Ecosystem Services (PES) schemes in which some of the actors involved in the trust, such as fishermen and tourist operators, can play a role in the conservation of these habitats through citizen science for example.

The evaluation and monitoring activities of the CAT will need to be across countries, acknowledging the impacts (both positive and negative) through the connectivity nature of the blue corridors. To address this, and to make these activities cost-effective, initiatives such as citizen science and Artificial Intelligence (A.I.) for conservation [5] can prove to be highly cost-effective.

Finally, one of Ostrom's 8 principles is "polycentric governance". In our case this implies collaborative and coordinated governance among the CAT's at different scales. We can envision a nested hierarchy of CATs (Fig. 3) and it is key that their institutional arrangements have effective and inclusive governance processes to coordinate the management and funding strategies necessary across scales to support themselves and the GOCAT. This could be done, for example, by setting clear indicators of the global stocks (i.e., fish and marine mammal species, mangrove and coral reef cover, and plastic and other pollutants concentrations, among others) that the GOCAT wants to manage and ensuring that these goals are effectively communicated to the regional/national/transnational CATs via their existing and evolving institutions in a truly polycentric governance arrangement.

4. Conclusion

The future of our common ocean will depend on the agreement on a global shared goal to protect it and restore it, prioritizing ecological sustainability and ethical obligations to future generations and other species over economic efficiency. This shared goal can be achieved through the design and implementation of novel governance structures able to steward the blue commons at different time and special scales. To do this, we proposed the design of Common Asset Trusts based on Ostrom's 8 governance principles. These require co-production of rules and norms by all stakeholders related to the blue commons, directly and indirectly, and considering both positive and negative impacts.

The case of transboundary resources such as marine corridors requires the highest level of coordination for the stewardship of these blue commons. Analysis of CAT opportunities provide a good research and policy case study for other global challenges, such as reducing society's carbon emissions to limit global temperatures without increasing more than 1.5ºC, and the newly agreed target from the Convention on Biological Diversity to protect 30% of the planet by 2030.

Each of the three case studies proposed show how the design of CATs for the blue commons at multiple geographical scales provide important opportunities. Such CATs also present challenges in their implementation, mainly the political feasibility related to the effective and efficient coordination among governmental institutions and other key actors from society, as well as the coordination between national governments in the case of managing transboundary blue commons. Nevertheless, the polycentric nature of CATs can overcome some of these issues, empowering actors from society that have both a direct benefit and a potential threat to their livelihoods from the change in the health of blue commons. Furthermore, these polycentric structures will increase the scope of participation of different actors, and therefore potentially provide new livelihood opportunities to communities based on blue jobs related to the protection and conservation of the blue commons.

CRediT authorship contribution statement

Marcello Hernández-Blanco: Conceptualization, Writing – original draft, Visualization. **Robert Costanza:** Conceptualization, Writing – original draft. **Tundi Agardy:** Writing – original draft. **Joshua Farley:** Writing – original draft. **Elizabeth Fulton:** Writing – original draft, Visualization. **Ida Kubiszewski:** Writing – original draft. **Rifaee Rasheed:** Writing – original draft.

Declaration of Competing Interest

The authors declare no competing financial interests.

Data availability

No data was used for the research described in the article.

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References

[1] Atkins, P.W., Wilson, D.S., & Hayes, S.C. (2019). Prosocial: Using evolutionary science to build productive, equitable, and collaborative groups. New Harbinger Publications.
[2] N.C. Ban, N.J. Bax, K.M. Gjerde, R. Devillers, D.C. Dunn, P.K. Dunstan, A. J. Hobday, S.M. Maxwell, D.M. Kaplan, R.L. Pressey, Systematic conservation planning: A better recipe for managing the high seas for biodiversity conservation and sustainable use, Conserv. Lett. 7 (1) (2014) 41–54.
[3] Y.M. Bar-On, R. Phillips, R. Milo, The biomass distribution on Earth, *Proc. Natl. Acad. Sci.* 115 (25) (2018) 6506–6511.
[4] S. Bennett, T. Wernberg, S.D. Connell, A.J. Hobday, C.R. Johnson, E. S. Poloczanska, The 'Great Southern Reef': Social, ecological and economic value of Australia's neglected kelp forests, Mar. Freshw. Res. 67 (1) (2015) 47–56.
[5] D. Blount, S. Gero, J. Van Oast, J. Parham, C. Kingen, B. Scheiner, T. Stere, M. Fisher, G. Minton, C. Khan, Flukebook: An open-source AI platform for cetacean photo identification, Mamm. Biol. (2022) 1–19.
[6] Blue Food Assessment, 2021, Building Blue Food Futures for People and the Planet -The Report of the Blue Food Assessment. https://bluefood.earth/policy/.
[7] K. Carlisle, R.L. Gruby, Polycentric systems of governance: A theoretical model for the commons, Policy Stud. J. 47 (4) (2019) 927–952.
[8] Y. Chiriboga-Paredes, Á. Palomino, L. Goodman, F. Córdova, V. Páez, M. Yépez, S. Jorgensen, D. Armijos, D. Pazmiño, A. Hearn, Discovery of a putative scalloped hammerhead shark Sphyrna lewini (Carcharhiniformes: Sphyrnidae) nursery site at the Galapagos Islands, Eastern Tropical Pacific, Environ. Biol. Fishes (2022) 1–12.
[9] CMAR. (2004). Corredor marino de conservación y desarrollo sostenible del pacifico este tropical entre las islas Coco – Galápagos –Malpelo – Coiba – Gorgona. Antecedentes y consideraciones técnicas para su definición.
[10] Commonwealth of Australia, Reef 2050 Long-Term Sustainability, Plan (2021) *2021–2025*.
[11] S.D. Connell, Water quality and the loss of coral reefs and kelp forests: Alternative states and the influence of fishing. Marine Ecology, Oxford University Press,, *Melbourne*, 2007, pp. 556–568.
[12] R. Costanza, Ecosystem services: Multiple classification systems are needed, Biol. Conserv. 141 (2) (2008) 350–352.
[13] R. Costanza, S.J. Anderson, P. Sutton, K. Mulder, O. Mulder, I. Kubiszewski, X. Wang, X. Liu, O. Pérez-Maqueo, M.L. Martinez, The global value of coastal wetlands for storm protection, Glob. Environ. Change 70 (2021), 102328.
[14] R. Costanza, P.W. Atkins, M. Hernandez-Blanco, I. Kubiszewski, Common asset trusts to effectively steward natural capital and ecosystem services at multiple scales, J. Environ. Manag. 280 (2020), 111801.

[15] Daly, H.E., & Farley, J. (2004). Ecological economics: Principles and applications. Island press. https://books-google-com-au.virtual.anu.edu.au/books?hl=en&lr=&id=20R9_6rC-LoC&oi=fnd&pg=PR5&dq=ecological+economics+principles+and+applications+2004&ots=ylSDF9HQTV&sig=l0fSFvDK60s5LLjJc0IVXZIr2RM.

[16] J.C. Day, Zoning—Lessons from the Great Barrier Reef marine park, Ocean Coast. Manag. 45 (2–3) (2002) 139–156.

[17] C.M. Duarte, S. Agusti, E. Barbier, G.L. Britten, J.C. Castilla, J.-P. Gattuso, R. W. Fulweiler, T.P. Hughes, N. Knowlton, C.E. Lovelock, Rebuilding marine life, Nature 580 (7801) (2020) 39–51.

[18] S.R. Enright, R. Meneses-Orellana, I. Keith, The Eastern Tropical Pacific Marine Corridor (CMAR): The Emergence of a Voluntary Regional Cooperation Mechanism for the Conservation and Sustainable Use of Marine Biodiversity Within a Fragmented Regional Ocean Governance Landscape, Front. Mar. Sci. (2021) 569.

[19] J.M. Erlandson, S.M. Fitzpatrick, Oceans, islands, and coasts: Current perspectives on the role of the sea in human prehistory, J. Isl. Coast. Archaeol. 1 (1) (2006) 5–32.

[20] J. Farley, I. Kubiszewski, The economics of information in a post-carbon economy, Patricia W. EllioTt (2015) 199.

[21] K. Filbee-Dexter, T. Wernberg, Substantial blue carbon in overlooked Australian kelp forests, Sci. Rep. 10 (1) (2020) 1–6.

[22] L. Fleming, H. Depledge, N. McDonough, M. White, S. Pahl, M. Austen, A. Goksoyr, H. Solo-Gabriele, J. Stegeman, The Oceans and Human Health, Oxford University Press,, 2015.

[23] L.E. Fleming, B. Maycock, M.P. White, M.H. Depledge, Fostering human health through ocean sustainability in the 21st century, People Nat. 1 (3) (2019) 276–283.

[24] E.A. Fulton, R. Gorton, Adaptive Futures for SE Australian Fisheries & Aquaculture: Climate Adaptation Simulations, CSIRO,, *Canberra*, 2014, p. *309*.

[25] J. García Molinos, H.L. Hunt, M.E. Green, C. Champion, J.R. Hartog, G.T. Pecl, Climate, currents and species traits contribute to early stages of marine species redistribution, Commun. Biol. 5 (1) (2022) 1329.

[26] H. Gintis, Gene–culture coevolution and the nature of human sociality, Philos. Trans. R. Soc. B: Biol. Sci. 366 (1566) (2011) 878–888.

[27] K.M. Gjerde, S.S. Yadav, Polycentricity and Regional Ocean governance: Implications for the emerging UN agreement on marine biodiversity beyond National Jurisdiction, Front. Mar. Sci. (2021) 1205.

[28] B.S. Halpern, M. Frazier, J. Afflerbach, J.S. Lowndes, F. Micheli, C. O'Hara, C. Scarborough, K.A. Selkoe, Recent pace of change in human impact on the world's ocean, Sci. Rep. 9 (1) (2019) 1–8.

[29] G. Hardin, The tragedy of the commons, Science 162 (3859) (1968) 1243–1248.

[30] P.T. Harris, M. Macmillan-Lawler, J. Rupp, E.K. Baker, Geomorphology of the oceans, Mar. Geol. 352 (2014) 4–24.

[31] Henderson, J., & Loe, J. (2014). The Prospects and Challenges for Arctic Oil Development. The Oxford Institute for Energy Studies.

[32] Hernández-Blanco, M. (2019). The Treasure of the Commons: Valuing and Managing Natural Capital in Costa Rica [PhD Thesis]. The Australian National University (Australia).

[33] M. Hernández-Blanco, R. Costanza, Natural capital and ecosystem services. *The Routledge Handbook of Agricultural Economics* (1st ed.), Routdledge,, 2019.

[34] Hernández-Blanco, M., Costanza, R., Chen, H., deGroot, D., Jarvis, D., Kubiszewski, I., Montoya, J., Sangha, K., Stoeckl, N., Turner, K., & Hoff, V. van 't (2022). Ecosystem health, ecosystem services, and the well-being of humans and the rest of nature. Global Change Biology.

[35] M. Hernández-Blanco, R. Costanza, M. Cifuentes-Jara, Economic valuation of the ecosystem services provided by the mangroves of the Gulf of Nicoya using a hybrid methodology, Ecosyst. Serv. 49 (2021), 101258.

[36] M. Hernández-Blanco, M. Moritsch, M. Manrow, L. Raes, Coastal ecosystem services modelling in Latin America to guide conservation and restoration strategies: The case of mangroves in Guatemala and El Salvador, Front. Ecol. Evol. 167 (2022), https://doi.org/10.3389/fevo.2022.843145.

[37] Hoegh-Guldberg, O. (2015). Reviving the Ocean Economy: The case for action—2015 (p. 60). WWF International.

[38] Hughes, W.E. (2016). Fundamentals of International Oil & Gas Law.

[39] A. Hurrell, A crisis of ecological viability? Global environmental change and the nation state, Political Stud. 42 (1_suppl) (1994) 146–165.

[40] Igin, C., Kose, M.A., Ohnsorge, F., & Yu, S. (2021). Understanding Informality (CERP Discussion Paper 16497). Centre for Economic Policy Research.

[41] ILO, 2018, Women and men in the informal economy: A statistical picture. International Labour Off.

[42] C.R. Johnson, S.C. Banks, N.S. Barrett, F. Cazassus, P.K. Dunstan, G.J. Edgar, S. D. Frusher, C. Gardner, M. Haddon, F. Helidoniotis, Climate change cascades: Shifts in oceanography, species' ranges and subtidal marine community dynamics in eastern Tasmania, J. Exp. Mar. Biol. Ecol. 400 (1–2) (2011) 17–32.

[43] Johnson, C., Reisinger, R., Palacios, D., Friedlaender, A., Zerbini, A., Willson, A., Lancaster, M., Battle, J., Graham, J., Cosandey-Godin, A., Jacob, T., Felix, F., Grilly, E., Shahid, U., Houtman, N., Alberini, A., Montecinos, Y., Najera, E., & Kelez, S. (2022). Protecting Blue Corridors, Challenges and Solutions for Migratory Whales Navigating International and National Seas. WWF.

[44] Konar, M., & Ding, H. (2020). A sustainable ocean economy for 2050. Approximating its benefits and costs. World Resources Institute. https://www.oceanpanel.org/Economicanalysis.

[45] F.J. Kroon, P. Thorburn, B. Schaffelke, S. Whitten, Towards protecting the Great Barrier Reef from land-based pollution, Glob. Change Biol. 22 (6) (2016) 1985–2002, https://doi.org/10.1111/gcb.13262.

[46] I. Kubiszewski, J. Farley, R. Costanza, The production and allocation of information as a good that is enhanced with increased use, Ecol. Econ. 69 (6) (2010) 1344–1354.

[47] Locke, H., Rockström, J., Bakker, P., Bapna, M., Gough, M., Hilty, J., Lambertini, M., Morris, J., Polman, P., & Rodriguez, C.M. (2021). *A nature-positive world: The global goal for nature*.

[48] R.A. Magris, R.L. Pressey, R. Weeks, N.C. Ban, Integrating connectivity and climate change into marine conservation planning, Biol. Conserv. 170 (2014) 207–221.

[49] R. Mahon, L. Fanning, Regional ocean governance: Integrating and coordinating mechanisms for polycentric systems, Mar. Policy 107 (2019), 103589.

[50] Marine Conservation Institute, 2021, Marine Protection Atlas. https://mpatlas.org/countries/HS.

[51] Markelova, H., & Mwangi, E. (2012). Multilevel governance and cross-scale coordination for natural resource management: Lessons from current research. In The wealth of the commons—A world beyond market and state. Leverllers Press.

[52] Mattei, U. (2012). First thoughts for a phenomenology of the commons. In The wealth of the commons—A world beyond market and state. Leverllers Press.

[53] J. Melbourne-Thomas, C.R. Johnson, E.A. Fulton, Regional-scale scenario analysis for the Meso-American Reef system: Modelling coral reef futures under multiple stressors, Ecol. Model. 222 (10) (2011) 1756–1770.

[54] E.J. Milner-Gulland, P. Addison, W.N. Arlidge, J. Baker, H. Booth, T. Brooks, J. W. Bull, M.J. Burgass, J. Ekstrom, S.O. zu Ermgassen, Four steps for the Earth: Mainstreaming the post-2020 global biodiversity framework, One Earth 4 (1) (2021) 75–87.

[55] OECD. (2022). Ocean shipping and shipbuilding. https://www.oecd.org/ocean/topics/ocean-shipping/.

[56] E. Ostrom, The challenge of common-pool resources, Environ.: Sci. Policy Sustain. Dev. 50 (4) (2008) 8–21.

[57] V. Ostrom, C.M. Tiebout, R. Warren, The organization of government in metropolitan areas: A theoretical inquiry, Am. Political Sci. Rev. 55 (4) (1961) 831–842.

[58] R. Packett, C. Dougall, K. Rohde, R. Noble, Agricultural lands are hot-spots for annual runoff polluting the southern Great Barrier Reef lagoon, Mar. Pollut. Bull. 58 (7) (2009) 976–986, https://doi.org/10.1016/j.marpolbul.2009.02.017.

[59] H. Patterson, D. Bromhead, D. Galeano, J. Larcombe, R. Curlotti, Fishery status reports 2022, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra, CC 4 (2022) *0*, https://doi.org/10.25814/gx9r-3n90.

[60] D. Pauly, D. Zeller, Global Atlas of Marine Fisheries: A Critical Appraisal of Catches and Ecosystem Impacts, Island Press,, 2016.

[61] Quilligan, J.B. (2012). Why distinguish common goods from public goods? In The wealth of the commons—A world beyond market and state. Leverllers Press.

[62] A.R. Rasheed, Marine protected areas and human well-being – A systematic review and recommendations, Ecosyst. Serv. 41 (2020).

[63] K. Rasmussen, D.M. Palacios, J. Calambokidis, M.T. Saborío, L. Dalla Rosa, E. R. Secchi, G.H. Steiger, J.M. Allen, G.S. Stone, Southern Hemisphere humpback whales wintering off Central America: Insights from water temperature into the longest mammalian migration, Biol. Lett. 3 (3) (2007) 302–305.

[64] K.R. Ridgway, Long-term trend and decadal variability of the southward penetration of the East Australian Current, Geophys. Res. Lett. 34 (13) (2007).

[65] E. Sala, J. Mayorga, C. Costello, D. Kroodsma, M.L. Palomares, D. Pauly, U. R. Sumaila, D. Zeller, The economics of fishing the high seas, Sci. Adv. 4 (6) (2018) eaat2504.

[66] B. Schaffelke, J. Mellors, N.C. Duke, Water quality in the Great Barrier Reef region: Responses of mangrove, seagrass and macroalgal communities, Mar. Pollut. Bull. 51 (1) (2005) 279–296, https://doi.org/10.1016/j.marpolbul.2004.10.025.

[67] R.E. Short, D.T.C. Cox, Y. Ling Tan, A. Bethel, J.F. Eales, R. Garside, Review of the evidence for oceans and human health relationships in Europe: A systematic map, Environ. Int. (2021) *146*.

[68] U.T. Srinivasan, R. Watson, U.R. Sumaila, Global fisheries losses at the exclusive economic zone level, 1950 to present, Mar. Policy 36 (2) (2012) 544–549.

[69] W. Steffen, J. Rockström, K. Richardson, T.M. Lenton, C. Folke, D. Liverman, C. P. Summerhayes, A.D. Barnosky, S.E. Cornell, M. Crucifix, Trajectories of the Earth System in the Anthropocene, Proc. Natl. Acad. Sci. 115 (33) (2018) 8252–8259.

[70] Stuchtey, M., Vincent, A., Merkl, A., & Bucher, M. (2020). Ocean solutions that benefit people, nature and the economy. High Level Panel for a Sustainable Ocean Economy. oceanpanel.org.

[71] P.J. Thorburn, S.N. Wilkinson, D.M. Silburn, Water quality in agricultural lands draining to the Great Barrier Reef: A review of causes, management and priorities, Agric., Ecosyst. Environ. 180 (2013) 4–20, https://doi.org/10.1016/j.agee.2013.07.006.

[72] UNEP-WCMC, 2019, Connectivity: A critical consideration in global ocean governance. https://www2.unep-wcmc.org//system/comfy/cms/files/files/000/001/498/original/3207_Technical_Brief_Edited_Web.pdf.

[73] United Nations. (2021). World Ocean Assessment II. Vol I.

[74] J.R. Wakefield, K. Myers, Social cost benefit analysis for deep sea minerals mining, Mar. Policy 95 (2018) 346–355.

[75] D.S. Wilson, E. Ostrom, M.E. Cox, Generalizing the core design principles for the efficacy of groups, J. Econ. Behav. Organ. 90 (2013) S21–S32.

[76] J.-G. Winther, M. Dai, T. Rist, A.H. Hoel, Y. Li, A. Trice, K. Morrissey, M.A. Juinio-Meñez, L. Fernandes, S. Unger, Integrated ocean management for a sustainable ocean economy, Nat. Ecol. Evol. 4 (11) (2020) 1451–1458.

[77] G. Wright, J. Rochette, K.M. Gjerde, L.A. Levin, Protect the neglected half of our blue planet, Nature 554 (7691) (2018) 163–165.

[78] WWF, 2020, The Eastern Tropical Pacific Ocean. WWF. https://www.wwfca.org/en/the_eastern_tropical_pacific_ocean_/.