2020 OCEAN PATHWAYS WEEK

11-15 November 2019

Background briefs for 2020 Ocean Pathways Week

Montreal, 11-15 November 2019

Contents

Introduction

The global community will have a critical opportunity in 2020 to set the world on a path to a sustainable future for the global ocean. The year 2020 will host a number of major global policy events for the oceans, in particular the 2020 UN Ocean Conference and the 2020 UN Biodiversity Conference. As 2020 marks the deadline for the Aichi Biodiversity Targets, the fifteenth meeting of the Conference of the Parties (COP 15) to the Convention on Biological Diversity (CBD) in 2020, is expected to adopt a new post-2020 global biodiversity framework. Another key 2020 milestone for the ocean is the 2020 UN Ocean Conference. The first Conference, held in 2017, was a historic event, catalysing major commitments and generating momentum for the achievement of Sustainable Development Goal (SDG) 14, as well as forming Communities of Ocean Action (COA) to maintain momentum on the many ambitious commitments announced in the context of the Conference. As the 2020 UN Ocean Conference nears, these Communities provide a key platform for synthesizing valuable input to the SDG 14 and CBD processes, including the global biodiversity framework.

2020 Ocean Pathways Week (11-15 November 2019 in Montreal, Canada) is a key opportunity to host focused discussions on key priorities for marine and coastal biodiversity to inform the post-2020 global biodiversity framework and the 2020 UN Ocean Conference. 2020 Ocean Pathways Week is composed of:

- Advancing Ocean Action Towards SDG 14: Leveraging Synergies for Marine and Coastal Ecosystems, Mangroves and Coral Reefs, 11-13 November 2019
- Thematic workshop on marine and coastal biodiversity for the post-2020 global biodiversity framework, 13-15 November 2019

This compilation of background briefs was prepared to inform the discussions of the above-noted meetings.

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Synthesis of Findings on the State of the Ocean

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Background and role in achieving global targets

The ocean provides more than 97% of the living space on Earth[1] and covers more than 70% of the planet's surface[2]. The ocean is an integral part of the global climate system[3] and plays a major role in keeping the planet habitable by absorbing heat and carbon dioxide[4,5,6], producing half of the world's oxygen[7], and influencing temperature and rainfall. Seafood provides at least 20% of the animal protein supply for 3.1 billion people globally[8] and is particularly important for economically disadvantaged coastal areas and communities. More than 1.9 billion people lived in coastal areas in 2010, and this number is expected to reach 2.4 billion by 2050[9]. Coastal ecosystems provide numerous benefits including coastal stabilization, regulation of coastal water quality and quantity, biodiversity and spawning habitats for many important species[2]. Coastal and shelf ecosystems are of great significance to Indigenous Peoples and Local Communities (IPLCs). Many coastal cultures have centuries- and even millennia-old practices and customs demonstrating intimate adaptation[10]. However, commercial over-exploitation of local marine resources and the decline of many coastal shelf ecosystems contribute to the loss of these traditions.

Status and trends

Assessments leading up to 2010 showed that global biodiversity was generally in decline with no substantial reduction in the rate of decline, while pressures on biodiversity were generally increasing[11]. These trends were also shown for marine and coastal ecosystems with no part of the ocean thought to be unaffected by human influence[12]. Areas of the ocean that are still devoid of intense human impacts (marine wilderness areas) can provide important refugia for marine biodiversity[13]. A recent analysis of nineteen global stressors on the ocean and the cumulative impact of these stressors revealed that only 13% of the ocean can be defined as marine wilderness[13].

The ocean is becoming warmer, more acidic and less oxygenated[1], with knock-on effects on the global climate. These changes to ocean chemistry are having impacts on marine biodiversity from the organismal to the ecosystem level. Moreover, severe impacts on key marine ecosystems and ecosystem services are predicted in response to the future increase in global mean temperature and concurrent ocean acidification, deoxygenation, and sea-level rise[14,15,16]. As these impacts are directly related to CO_2 emissions, they will be considerably worse with a high-emissions scenario than with one that restricts the global temperature increase to less than 2ºC[17]. Current pledges under the 2015 Paris Agreement are insufficient to keep global temperature from exceeding a 2ºC increase by 2100[18] and to reach targets for the United Nations Sustainable Development Goals[17].

There can be no doubt that human actions have radically changed, and are continuing to change, ecosystem structure (extent and physical condition), especially in sensitive ecosystems, across much of the world[19]. The IPBES Global Assessment on Biodiversity and Ecosystem Services found that all five ecosystem structure indicators[a] used for marine and coastal systems showed a decreasing trend in terms of the average per-decade rate of change of between 1.7 and 10.9%, all greater than the global average of 1.1% decrease[19]. Coastal protection and coastal carbon-rich habitats, that include mangroves and seagrass meadows, are declining by 3.6 and 5.6% per decade respectively. The current status of ecosystems relative to a pristine or largely pre-industrial baseline (equivalent to 100%) also included indicators for the whole ocean such as the fraction of the ocean not fished per year (45%). Indicators for coastal ecosystems status are already at low levels and are continuing to decline particularly rapidly[19], especially for warm-water coral reefs (53%), mangroves (24%) and seagrass meadows (53%). Global spatial coverage of mangroves has declined by 37.8% up to 2010[20] while seagrass meadows declined by 10.9% per decade[19]. Warm-water coral reefs have also shown long-term decline[21] and are losing live coral cover at a rate of 4% per decade[19]. Unsuitable environmental conditions for the persistence of shallow coral reefs are predicted to occur within the next 10-50 years at almost all reef locations globally[22,23]. In the deep sea, most organisms are adapted to living in a stable environment and therefore likely to be highly sensitive to environmental changes, especially to climate-induced shifts in energy supply, alteration of biogeochemical cycles including ocean acidification and prey-predator interactions[19].

Marine ecosystem functions are also changing at the global level; for example, oceanic carbon sequestration has recently been rising by 29% per decade[24]. The ocean surface is sensitive to climate change, experiencing a globally averaged 0.44°C warming between 1971 and 2010[25]. Environmental changes have been documented in ocean circulation and chemistry, thermal stratification, composition and growth of phytoplankton[26,27], biogeochemical cycling[28,29], and the distribution of ecologically key species with effects on food webs[30,31].

The relative impact of six direct drivers[b] on the state of nature at the global level has been estimated for the oceans both as an overall marine value and in terms of six essential biodiversity variables[c] (EBVs). For marine ecosystems, direct exploitation is the strongest driver of change (29%), followed by land/sea use change (22%), with pollution and climate change at 15% and 16% respectively. For marine ecosystems, the highest impact of direct exploitation is on species populations (31.5%). Interactions between drivers can also be complex and lead to additive, synergistic, or antagonistic effects[32].

Direct extraction of living marine resources has had a substantial effect on the ocean. Predatory fish biomass has been falling by 14% per decade[33], and the proportion of fish stocks within biologically sustainable levels by 6% per decade[34]. The proportion of global fish biomass that is made up of predatory fish has declined by a factor of around 10 since 1880[35] while the Marine Trophic Index has fallen from around 4.0 to 3.6 in the last 60 years[35]. A meta-analysis reported that populations of fish species that have been overfished in the last 50 years had significantly lower genetic diversity than populations of closely related species[36]. The declines in range size, numbers of populations, and population sizes of many species will all tend to reduce their genetic diversity[37]. Reduced genetic

[a] Five indicators: Mangrove forest area, coastal protection habitats, percentage of live coral cover, coastal carbon-rich habitat, seagrass meadow area.

[b] Six drivers: Climate change, direct exploitation, land/sea use change, pollution, invasive alien species and ‘other’.

[c] Six EBVs: Genetic Composition, Species Populations, Species Traits, Community Composition, Ecosystem Function and Ecosystem Structure [http://geobon.org/essential-biodiversity-variables/classes/].

diversity reduces a species' resilience to changes in environmental conditions and increases its risk of extinction[38].

There are indications that marine habitat modification is accelerating and may be posing a growing threat to marine fauna[39]. Initially restricted to coastal and inshore areas, marine habitat modification is increasing in all ocean biomes as technology improves and marine industries extend into offshore and deeper waters[40,41]. A global assessment of bottom trawling of continental shelves to a depth of 1000 m found that on average 14% of the areas studied were trawled with a large range (1-80%) between regions[42]. Bottom trawling can result in rapid declines in populations of slow growing fish species and extensive damage to unique benthic habitats[43], especially on seamounts. Deep-sea mining is expected to be a major threat in the near future[44].

Gaps and challenges / areas in need of further work

There are many gaps in the basic information necessary to build a reliable, world-wide, comprehensive, quantified survey of the state of the ocean[45]. An estimated 91% of oceanic species are undescribed[46] with invertebrates and deep-sea ecosystems, particularly lacking species descriptions. Techniques using genetic information to identify species, such as DNA barcoding, are increasingly being used[47], but more traditional taxonomy is still needed to describe morphological traits[2]. Indirect information gathering techniques, such as remote sensing, are able to provide data for surface and shallow waters but cannot penetrate to deeper areas. Most oceanic data are collected by direct measurement or modelling, making it difficult to obtain good coverage for such a vast environment[2]. The low abundance of organisms in the deep sea coupled with low scientific sampling and an assumed high proportion of range-restricted species make species numbers hard to assess, but it is thought to rival other global biodiversity hotspots[19].

The First Global Integrated Marine Assessment[48] identified four main categories of knowledge gaps for the oceans: (1) the physical structure of the ocean; (2) the composition and movement of the ocean's waters; (3) the biotas of the ocean; and (4) the ways in which humans interact with the ocean[49]. In terms of oceanic regions, the assessment concluded that we know least about the Arctic and Indian Oceans. In general, the North Atlantic Ocean and its adjacent seas are probably the most thoroughly studied but even there, major gaps remain.

At the ecosystem level, gaps in data for ecological processes and ecosystem and community structure are even greater than those for species information[2]. Examples include ecosystem function and services, which are understood conceptually but are often difficult to measure[49]. There are few indicators for the structure of marine ecosystems, especially in the deep sea. Overall, ecosystem condition is less well represented than ecosystem extent, meaning that important degradation of ecosystem structure may be missed[19].

In terms of direct extraction of living marine resources, commercial fishing catches are well monitored in developed countries, but are almost certainly underestimated, as illegal fishing can make up as much as 40% of all catch in some areas[50]. In countries with fewer resources to devote to reporting, fishing estimates are often based on a small number of samples and are less reliable[2]. Research costs are a major impediment to obtaining fisheries-independent data, particularly in developing countries where even catch monitoring is logistically and economically challenging, especially for multi-species fisheries.

Marine ecosystems that are highly productive, contain biodiversity hotspots and/or are particularly sensitive to change (e.g. coral reefs, mangroves, seagrass beds, polar systems and the deep sea) could be prioritised to fill key knowledge gaps. For example, the current and potential exploitation of sensitive deep-sea habitats for resource extraction (e.g. through mining or fishing) highlights the need for better biological and ecological information. Scientific surveys conducted in prospective mining regions have confirmed hundreds of new species as well as high diversity in both species and habitats[1]. There are also gaps for assessing cumulative effects of multiple pressures in coastal and shelf waters, with the sources and interactive effects of nutrient pollution particularly requiring attention.

There have been recent calls to significantly scale up scientific research efforts on the ocean[1]. A much greater expansion of long-term, in-depth studies across a variety of areas to obtain more clarity on the spatio-temporal heterogeneity of the ocean will provide evidence to better contribute to future ocean policy needs[1].

Better coordination at the global level regarding data storage and sharing will help to improve ocean knowledge. For example, both warm-water coral reefs and marine litter lack global databases[2] while addressing emerging pressures such as underwater noise and seabed mining would also benefit from improved coordination. International cooperation between scientists, governments and industry for data transparency and accessibility is also critical[1]. Ocean data gateways operating with globally agreed standards could provide a system where data applications can be developed to allow access to appropriate data by specific user groups from science, government, industry and the public[1].

As well as the logistical challenge of collecting information on the status of the oceans and its biodiversity, there are concerns regarding the accelerated rate of change, and not only for climate effects. Once detrimental and negative changes have occurred they may lock in place and may not be reversible, especially at gross ecological and ocean process scales[1]. Concerning trends are being reported by multiple scientific research groups as a result of climate change effects[1].

Overall, the incompleteness of our knowledge of marine biodiversity and the factors that affect it means that decision-making about potential impacts can be subject to high uncertainty, and the application of precaution is appropriate[45]. Nevertheless, based on existing knowledge, detrimental trends in biodiversity on many scales can be at least mitigated, and sometimes eliminated, even when knowledge is incomplete, if the available knowledge is enough to use in choosing appropriate measures and the capacity for implementation of the measures is available[45]. Considering the current and projected changes for the oceans[51], it is also clear that concerted action should be taken without delay to mitigate impacts on biodiversity in the marine and coastal environment.

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Coral Reefs

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Background and role in achieving global targets

Coral reefs occupy less than one-quarter of 1% of the marine environment[1], yet they are among the most valuable ecosystems on earth with a total net benefit of US$29.8 billion per year[2]. Reefs host about a quarter of all known marine species and are a key source of food, livelihoods and economic opportunities to hundreds of millions of people in more than 100 countries[3]. A study by UN Environment in collaboration with the International Coral Reef Initiative (ICRI) shows that proactive policies to protect and restore the health of the world's coral reefs could generate a substantial economic gain (e.g. by 2030 healthy reefs could unlock US$35 billion in Mesoamerica and US$37 billion in Indonesia) in addition to providing societal benefits[3]. Ecosystem services of coral reefs and associated ecosystems provide and help deliver UN Sustainable Development Goals (SDGs) and Aichi Biodiversity Targets[4]:

- Human health and wellbeing: 70% of the protein in the diets of Pacific Islanders comes from reef-associated fisheries5 (SDGs 2, 3, 6, 9 & 14; Aichi Biodiversity Targets 13, 14, 16).
- Shoreline protection: a healthy reef can reduce coastal wave energy by up to 97%[6]. Globally, US$6 billion of built capital is protected from flooding by coral reefs (SDGs 1, 8, 11, 13, 14).
- Food security and livelihoods: coral reef fisheries support some six million people[6] and are worth US$6.8 billion a year providing an average annual seafood yield of 1.42 million tonnes[7] (SDGs 2, 4, 5, 8, 12, 13, 14, 16).
- Tourism: coral reef tourism contributes US$36 billion to the global tourism industry annually[8] (SDGs 2, 4, 5, 6, 8, 9, 12, 14; Aichi Biodiversity Targets 6, 13, 14).
- Biodiversity: coral reefs support approximately 4,000 species of fish and 800 types of corals[9], Globally, about 830,000 species of multi-cellular plants and animals are estimated to occur on coral reefs, of which c. 13% are unnamed and c. 74% of species are undiscovered[10], most are cryptic, small and relatively rare.
- Medicines: coral reefs are the medicine chests of the 21st century, with more than half of all new cancer drug research focusing on marine organisms[9].

Maintaining and improving the health and function of coral reefs is key to achieving many SDGs. As a response to the unprecedented changes observed and projected in coral reef ecosystems, the international community, including *inter alia* governments, non-governmental organizations, scientists, companies and research institutions, has undertaken coordinated actions to protect coral reef ecosystems. Such actions include adoption of a coral reef resolution by the United Nations

Environment Assembly (UNEA resolution 2/12[11] and 4/13[12]), awareness and knowledge dissemination (for instance, 2018 was designated the International Year of the Reef by ICRI) and the strengthening of partnerships (ICRI) and scientific knowledge (Global Coral Reef Monitoring Network - GCRMN).

Status and trends

It is estimated that 75% of the world's coral reefs are rated as threatened, with more than 60% under immediate and direct threat from local stressors, (i.e. coastal development, over/destructive fishing, marine-based pollution)[13]. The IPCC special report in 2018, projected the world's coral reefs to decline by 70-90% with 1.5ºC and by 99% with a 2ºC increase in global mean temperature from pre-industrial levels[14].

Considering that the deadline of the Aichi Biodiversity Targets is 2020, and that 2020 also provides the first interim reporting for Agenda 2030 and the SDGs, it is the opportune time for the GCRMN to produce another *Status of Coral Reefs of the World* report in mid-2020 to contribute to these processes and help set targets and assessment for the post-2020 biodiversity agenda. This will be the first report produced since 2008, before which the GCRMN (an operational network of ICRI) had been reporting on this topic every 4 years since 1998.

The Status and Trends of Caribbean Coral Reefs (1970-2012) showed that the average coral cover throughout the wider Caribbean, Gulf of Mexico and Bermuda had declined by 49%. Most (88%) of this total decline occurred between 1984 and 1998. This decline in coral cover led to a reversal in coral reef and macroalgal abundance, which occurred over a decade and is evidence of a phase shift in the coral reef community structure. These findings led to the following three, key overarching results: (1) the majority of the degradation of Caribbean reefs occurred between the 1970s and early 1990s before most ecological surveys began, (2) the phase shifts from greater coral cover to greater macroalgal abundance happened early and are geographically pervasive and (3) there is a stark geographic disparity in the fates of reefs at different locations[15].

A regional framework was set up in the Western Indian Ocean to monitor the status of coral reefs, with the aim of illustrating broad patterns to explain the differing health status of reefs, and the prospects for reef management in relation to this. It also aims to present regional drivers of change and how they may evolve in coming years, to help countries in planning for impacts and for recovery of coral reefs.

In the Western Indian Ocean, it was reported that coral reefs crossed a threshold after the impacts of the first global bleaching event in 1998. This resulted in an average coral cover decline of 25% (from 40% before 1998 to 30% after 1998), a 2.5 times increase in algal cover after 1998 (from 15% before to about 35% after) and the fish community structure is now dominated (about 80% of biomass) by small-bodied herbivores and detritivores.

Unlike the results from the Caribbean and the Western Indian Ocean, in general, across the Pacific the average coral cover was consistently greater than average macroalgal cover (throughout the study period of the 2018 report on the Status and Trends of coral reefs of the Pacific). The data from the study period (1989-2016) showed the live coral cover across all islands and all years monitored was 25.6%, and although this varied from year to year it remained stable across the Pacific[16].

Positive experiences / approaches

Coral reef health is declining worldwide, but this is not going unnoticed, there are a number of ongoing activities and initiatives targeted at improving the status of coral reefs; these include:

- The small grants program: In 2017, ICRI and the UN Environment launched a small grants program. This program assisted in the implementation of the ICRI Plan of Action 2016-2018[17] and the United Nations Environment Assembly (UNEA) resolution 2/12[18] on sustainable coral reef management. With funding from the government of France and Monaco, five projects were funded[19]. The volume of interest and proposals received speaks to how strong the sense of passion, innovation and ingenuity is within the coral reef community. There is a stark disparity between the amount of available funding and the number of projects currently awaiting funding and support. Over 200 applications were received and, in the end, only five were funded.
- The coral reef Community of Ocean Action: ICRI and the UN Environment are co-chairs of the coral reef Community of Ocean Action. This Community of Ocean Action aims to support its members in implementing their coral reef-related voluntary commitments (VCs) by exchanging progress reports, experiences, lessons learned and good practices. Over 130 VCs relate to coral reefs[20], including activities aimed at their protection, management and restoration, as well as maintaining tangible benefits to coastal communities from coral reef fisheries and tourism, on both local and global levels. As of December 2018, a total of US$444 million had been committed, with commitments coming from all coral reef regions. When examining the VCs, it was clear that everyone, from individuals to NGOs and Governments had a passion to improve the prospects of the world's coral reefs.
- The Reef 2050 Long-Term Sustainability Plan (Australia): Like other coral reefs globally, the Great Barrier Reef (GBR) is under pressure from climate change and other threats. However, it remains a vibrant, beautiful ecosystem of immense value to Australians and the world. The Great Barrier Reef Marine Park Authority is committed to building the resilience of the GBR for future generations and promoting strong and effective management of local and regional pressures (such as pollution and pest outbreaks). These measures build the resilience of the system in the face of the externally driven risks posed by climate change. The Reef 2050 Long-Term Sustainability Plan provides an overarching framework for protecting and managing the GBR. The plan sets clear actions, targets, objectives and outcomes to drive and guide the short, medium and long-term management of the reef. The plan firmly responds to the pressures facing the GBR and will address cumulative impacts and increase the reef's resilience to longer-term threats such as climate change.

Gaps and challenges / areas in need of further work

Despite coordinated responses by the international community, climate change and other anthropogenic drivers continue to simultaneously affect coral reefs. Such responses include international policy instruments targeting coral reef conservation (Agenda 21, Aichi Biodiversity Targets adopted in 2010 by the Convention on Biological Diversity, United Nations SDGs in Agenda 2030 and UN Environment Assembly Resolutions 2/12 and 4/13 of 2016 and 2019, respectively), and coral reef campaigns (International Year of the Reef – ICRI). The following gaps and challenges can be attributed to the alarming loss of coral reefs.

Policy instruments and other challenges

- The breadth of international coral reef-related instruments is vast, with at least 232 international policy instruments and 591 commitments supporting conservation and sustainable management of coral reef ecosystems, yet coral reef ecosystems continue to decline. This can be attributed to the lack of 'depth' in the instruments since the nature of the commitments, 75% of which are implemented primarily by states, is largely voluntary and thus considered weak[21].

- There are relatively few governance mechanisms established by the instruments to support states in delivering these commitments. For example, guidance and tools to support the implementation of actions related to Aichi Biodiversity Target 10 "By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning" (now expired) came late in the process. Indicators were established after the 2015 deadline, and it was not a Specific, Measurable, Achievable, Responsive, Time-bound (SMART) target[22].

- Human and financial resource constraints – a lack of consistent, sustainable funding for coral reef conservation especially for small island states, and both low and lower-middle income economies. Most instruments are also not linked to financial mechanisms to help fund for associated costs.

- Significant pressures relevant to coral reefs are not localized and thus require global action (reducing atmospheric CO_2). To address this problem, cross-sectoral and cross-jurisdictional implementation is necessary, and this requires making partnerships which is another challenge.

- It is also a challenge for countries to reduce multiple stressors on coral reefs in the face of rapidly growing populations and economic growth and development.

Data limitation, monitoring and limited capacity

- There is under-sampling of coral reefs for long term monitoring, bias in available data and gaps in data especially in remote reef areas. A lack of baseline evidence or accounts to support actions relating to removing pressure on coral reefs, and a lack of data sharing within and between countries has been a hindrance[22].

- Saving the world's coral reefs would require a multi-pronged approach that includes restoration (repopulating target reefs with resilient, genetically diverse and reproductively-viable populations)[23]. Although a lot of knowledge and hands-on practice has been developed, actual coral restoration is still in a fledgling state in terms of practice and scientific research[24].

Management tools and approaches for effective coral reef conservation

Globally there are a large range of tools and approaches that are employed for effective coral reef conservation, including but not limited to (1) resilience-based management approaches[25], (2) multi-sectoral marine spatial planning addressing a range of stressors in an integrated approach[26], (3) identifying and protecting of coral reef climate refugia[27], (4) establishment of networks of marine protected areas or other effective area-based conservation measures such as locally managed marine areas[28], (5) traditional approaches to coral reef protection based on indigenous knowledge and cultures, (6) innovative financing mechanisms such as payments for ecosystem services or insurance schemes,

(7) coral reef restoration techniques and even (8) assisted evolution of coral species. Active participation in decision-making, local leadership, recognition and acknowledgement of knowledge and rights of local stakeholders is critical for of effective coral reef conservation and management, as well educational activities and accountable and transparent governance.

The post-2020 global biodiversity framework

The current Aichi Biodiversity Targets will expire in 2020 and the discussions to develop and agree on a post-2020 global biodiversity framework are beginning. Parties to the CBD have decided[29] that the development of a post-2020 global biodiversity framework should be a participatory process. The International Coral Reef Initiative (ICRI) at its General Meeting in December 2018 concluded that there is a clear and urgent need to continue to address the decline of coral reef ecosystems within the CBD processes and formed an *ad hoc* committee who has been tasked to work towards the appropriate inclusion of coral reef ecosystems within the post-2020 global biodiversity framework. The *ad hoc* committee is engaging in the post-2020 process and will present a draft recommendation to ICRI in December 2019 (at the 34th General Meeting).

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Mangroves and Coastal Ecosystems

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Background and role in achieving global targets

Mangrove ecosystems are made up of 70 species of salt tolerant plants[1] covering more than 14 million hectares of tropical and subtropical coastal areas worldwide, in 123 countries and territories[2]. Although making up only 0.1% of the global landmass[3], mangrove forests are some of the most productive and biologically diverse ecosystems on the planet. Occupying the intertidal zone between marine and terrestrial ecosystems, mangroves support a high diversity of flora and fauna of marine, estuarine, freshwater, and terrestrial species. Mangroves also deliver substantial ecosystem services that play a critical role in supporting human well-being through climate regulation, disaster risk reduction, food security, and poverty reduction. However, despite the benefits mangroves provide, they are being degraded and deforested at an alarming rate. In the past century, two-thirds of mangrove forests globally have been lost due to drivers including coastal development, aquaculture, agriculture, and climate change. The critical need to conserve, manage, and restore functioning mangrove forests and related coastal ecosystems is recognized in multiple international cross-cutting conventions and policy agreements including the Ramsar Convention on Wetlands, the Sendai Framework for Disaster Risk Reduction, the Convention on Biological Diversity (CBD), the UN Framework Convention on Climate Change (UNFCCC), and the Sustainable Development Goals (SDGs).

Healthy mangrove ecosystems provide numerous services and benefits including:

- Biodiversity: Mangroves support a large number of wildlife species as nursery and spawning areas for fish and invertebrates, rookeries for birds, as well as through habitat associations with an estimated 13% of all marine megafauna species at some point in their life cycles. This includes 80% of manatees and dugongs, 57% of sea turtles, 28% of dolphins, as well as crocodiles, alligators, sharks, rays, otters, and other taxa[4]. More than 3000 species of fish are found in mangroves at some part of their life cycle[5]. Mangroves are also closely interlinked with other coastal ecosystems, such as coral reefs and seagrass beds. Their dense root systems filter and retain sediments and excess nutrients that would otherwise wash into the ocean.

- Human well-being and sustainable development: Mangroves support both local livelihoods and national economies by providing subsistence and commercial fisheries, food security, timber, tourism, and coastal protection. Globally, mangroves support livelihoods for over 120 million people, with economic values of up to US$33,000-57,000 per hectare per year[6], amounting to a global value of up to US$800 billion total per year. Mangroves are also widely used for travel and tourism, a multi-billion dollar industry[7].

- Climate adaptation and disaster risk reduction: Mangrove ecosystems provide protection from the impacts of climate change by attenuating wave energy and storm surges, adapting to rising sea levels, and stabilizing shorelines from erosion. Studies have shown that the natural infrastructure of mangrove belts only 100 m in width reduce wave heights by up to 66%, protecting shorelines and reducing the vulnerability of local communities. In some cases, restoring mangroves for coastal defense can be up to five times more cost-effective than grey infrastructure such as seawalls[8]. In areas where mangroves have been cleared, coastal damage from hurricanes and typhoons is much more severe.

Climate mitigation: Of all the biological carbon captured in the world, over half (55%) is captured by mangroves and associated coastal ecosystems such as seagrasses and salt marshes. These ecosystems sequester carbon far more effectively (up to 100 times faster) and more permanently than terrestrial forests. Studies have shown that per hectare, mangrove forests store up to five times more carbon than other tropical forests around the world, resulting in an average of 1,023 metric tons of carbon sequestered per hectare[9]. Greenhouse gas emissions from the conversion of mangroves are amongst the highest from all land uses in the tropics and make up as much as 20% of global emissions from deforestation, despite accounting for just 0.7% of tropical forest area, resulting in economic damages of US$6-42 billion annually[6,10].

Conserving, managing, and restoring mangrove forests are ecosystem-based approaches that governments and communities can take to mitigate and adapt to climate change and disasters, reduce poverty, and help realize sustainable development, climate, and biodiversity targets.

- The CBD and the post-2020 global biodiversity framework: The invaluable biodiversity benefits mangroves provide contribute to numerous Aichi Biodiversity Targets including Targets 5 (habitat loss halved or reduced), 6 (sustainable management of marine resources), 7 (sustainable agriculture, aquaculture, and forestry), 10 (pressures on vulnerable ecosystems reduced), 11 (protected areas increased and improved), 12 (extinction prevented), 14 (ecosystems and essential services safeguarded), and 15 (ecosystems restored and resilience enhanced). The conservation, restoration, and sustainable management of coastal wetlands offers an important opportunity to capitalize on the extensive co-benefits to biodiversity, climate, and human well-being thus aligning the post-2020 biodiversity framework with both the UNFCCC and the SDGs.

- UNFCCC and nationally determined contributions (NDCs) under the Paris Agreement: The conservation and restoration of mangroves and associated coastal ecosystems offer opportunities for countries to contribute to their emissions reduction targets. The protection and restoration of coastal blue carbon ecosystems is recognized as a priority for both climate change mitigation and adaptation, and many countries have identified measures that harness these benefits in their NDCs, including at least 28 countries in terms of mitigation strategies, and at least 59 countries in adaptation strategies[11]. There is a significant opportunity to integrate and expand blue carbon ecosystems clearly into the mitigation section of future revised NDCs, by both detailing the inclusion of mangroves, seagrasses, and saltmarshes as mitigation and adaptation solutions, and for specific countries to accounting for coastal wetlands management in national greenhouse gas inventories.

- Sustainable Development Goals: The economic, climate, and social benefits of mangroves have been identified as a key contributor to reaching the targets of the 2030 Agenda for Sustainable Development, notably SDG 14 (ocean action) and SDG 13 (climate action). The

UN Community of Ocean Action for Mangroves, jointly led by IUCN and the Ramsar Convention on Wetlands, has demonstrated that SDG 14 voluntary commitments related to mangroves to date primarily contribute to Aichi Biodiversity Target 14.2 (sustainable management and protection of marine and coastal ecosystems) at 72% of the registered voluntary commitments, Target 14.5 (conservation of at least 10% of coastal and marine areas by 2020) at 46% of commitments, and Target 14.7 (increasing economic benefits to SIDS and least developed countries by 2030) at 38% of commitments. Mangrove commitments are also closely interlinked with contributions to SDG 13 (climate action), SDGs 1 and 2 (eliminating poverty and hunger), SDG 15 (sustainable use of terrestrial ecosystems), and SDG 8 (ensuring livelihoods and economic growth).

Status and trends

To date, it is estimated that over 67% of mangrove historical habitat has been lost, deforested, and degraded worldwide, with 20% of that loss occurring since 1980, at global rates of 3-5 times greater than overall forest loss. If this trend continues, mangrove ecosystems may functionally disappear in as little as the next 100 years[12]. Drivers of deforestation vary geographically but conversion of mangroves to rice paddies and aquaculture has resulted in the largest mangrove losses globally, particularly in Southeast Asia. Between 1980 and 1990 alone, about 38% of the global mangrove area was degraded or lost through shrimp farming. Other significant drivers of mangrove loss include agriculture, urban and industrial development, coastal development, pollution, and extraction of mangrove wood for building materials, charcoal, and other products. Changes in water and sediment supply – such as resulting from dams and other upstream water diversion projects – can also have major impacts on mangrove ecosystems. Shifting climate, rising temperatures, and habitat degradation including through pollution, biodiversity loss, and unsustainable fishing around mangroves further threaten the integrity of mangrove ecosystems. Threats to mangroves are further exacerbated by weak institutional arrangements, policies, and management of mangroves, as well as poverty and inequity issues within the communities who depend on these forests.

Positive experiences / approaches

To halt further net loss of mangrove cover and to begin to restore and expand global coverage by 2030 requires an integrated and multi-pronged approach that combines both protection and restoration. Solutions and approaches towards this goal should prioritize the conservation of existing healthy mangroves including through participatory sustainable use schemes, complemented by recovery through natural regeneration and appropriate restoration measures. Examples of such measures include:

- International and national protection: The designation of certain sites as protected areas under international conventions offers one means of strengthening national protection. The designation of sites under the Ramsar Convention on Wetlands and the UNESCO World Heritage Convention offers countries recognition and support for effective protected areas management.
- Nature-based solutions, including restoring and conserving mangroves and coastal ecosystems, are increasingly recognized across international frameworks such the Paris Agreement to address societal challenges such as climate adaptation, climate mitigation, and human well-being. Coastal ecosystems protect people, infrastructure, and economic activities from

flooding, erosion, and sea level rise. As part of an integrated planning approach for coastal zones, utilizing the ecosystem services that healthy mangrove ecosystems provide can improve livelihoods, help to mitigate the humanitarian impacts of disasters, enhance climate resilience, and accelerate sustainable development.

- Mangrove habitat regeneration and ecological restoration are a key aspect of a national approach for achieving a net increase of mangrove habitat. Recent evidence highlights the importance of an integrated conservation and restoration approach prioritizing natural regeneration to ensure ecosystem functionality. The most effective approach for successful mangrove restoration is to restore or create the right topographic and hydrological conditions for mangroves to grow back naturally, especially in a changing climate. Mangroves restored in this way generally survive and function better than large-scale planting on its own. Evaluation of the success of mangrove restoration should include indicators that demonstrate the establishment of a diverse, functional and self-sustaining mangrove forest that offers multiple ecosystems services and benefits, and not by the number of seedlings planted.
- Community involvement: The involvement of local communities is critical for any management interventions for mangroves and all natural resources, as they are generally the most important beneficiaries from mangrove goods and services and are directly impacted by loss and degradation of mangroves. Community-based mangrove management models can vary from securing community stewardship rights for implementing local management plans, to incentive based mechanisms for restoring degraded mangrove areas.

Other initiatives that support and promote the preservation and restoration of mangroves include:

- The Mangrove Restoration Potential Map [a]: This interactive global map of mangrove restoration potential provides global as well as national overview figures on mangrove restoration potential for climate mitigation and adaptation, based on mangrove typologies, regional and national boundaries, biogeographic ecoregions, and protected area status. The map also offers identification of national and local priority areas for mangrove restoration based on both potential ecosystem services gains and/or other socioeconomic benefits.
- The Global Mangrove Alliance: Taking Action to Expand Global Mangrove Habitat by 20% by 2030: To accelerate a comprehensive global approach to mangrove conservation, restoration, and sustainable use, IUCN, World Wildlife Fund, The Nature Conservancy, Conservation International, and Wetlands International formed the Global Mangrove Alliance (GMA). The GMA brings together NGOs, governments, industry, local communities and funders towards a common goal of halting mangrove degradation and expanding mangrove habitat by 20% by 2030. GMA members connect and coordinate isolated initiatives into a global portfolio that leverages and amplifies best practices, and capitalizes on collective strengths and partnerships to accelerate science-based conservation and the restoration of mangroves at unprecedented scale.
- Save Our Mangroves Now! (SOMN): SOMN is a joint initiative of the German Federal Ministry of Economic Cooperation and Development (BMZ), IUCN, and WWF to intensify, upscale, and focus global efforts to halt and reverse the decrease of mangrove habitat globally. SOMN mobilizes political decision makers towards embedding ambitious objectives on mangrove conservation in international and national policy agendas, and with a focus on the

[a] See: http://maps.oceanwealth.org/mangrove-restoration/

Western Indian Ocean Region, facilitates and supports regional networks and national key stakeholders to promote and mainstream mangrove conservation into national development strategies.

Gaps and challenges / areas in need of further work

Despite mangroves providing cost effective and sustainable approaches to provide climate, food security, and biodiversity benefits, many countries are still slow to include mangroves in their national climate change, biodiversity, and sustainable development plans. This can be attributed to the relatively small geographic area of mangroves, as well as lack of information, complicated jurisdictional issues, lack of capacity, and insufficient funding. Climate alteration, coastal migration and high population growth also present additional risks. Yet much of what can be achieved to safeguard coastal habitat and mangroves is paced against a ticking clock. Halting and reversing the loss of mangroves requires consideration of the social, economic, ecological, and political factors affecting mangrove management, and shifting opinion of governments, the private sector, coastal managers and the general public. Some of the challenges looking forward include:

- Financing mechanisms: Economic and financial barriers impede the effective conservation, sustainable management, and restoration of mangroves. Longer-term and additional sources of finance are needed for mangrove management, particularly through the engagement of the private sector and the development of both sustainable use schemes and longer-term business models[13]. Models for blended conservation finance that increase available donor funds alongside a joint increase in private sector involvement are being modelled through initiatives such as the Blue Natural Capital Financing Facility (BNCFF) and the Coalition for Private Investment in Conservation (CPIC).
- Conservation, regeneration, and ecological mangrove restoration: the need for better restoration approaches and principles: Restoration historically through large-scale mangrove planting has largely been unsuccessful in achieving net increase of mangrove habitat. Recent evidence highlights the importance of an integrated conservation and restoration approach prioritizing natural regeneration and sustainable use schemes to ensure ecosystem functionality. There is need for both capacity building and improved technical best practices in site and species selection, integrated coastal planning, long-term monitoring and maintenance, and sound policies coupled with better protection and governance of mature mangrove forests[14]. This would include policies regulating and limiting mangrove loss due to land use changes for aquaculture, agriculture, and coastal development.
- Governance and legal barriers: Addressing the continued loss of mangroves requires designing and implementing appropriate management and governance approaches tailored to the national and ecosystem context and informed by understanding of the main threats to mangroves in the target site as well as the needs, interests, and capacities of stakeholders and users[15]. Drivers of mangrove loss and degradation vary geographically; while the primary threat to mangroves globally comes from conversion for aquaculture or agriculture, local pressures can include pollution, diversion of upstream water sources, offshore mining, and land reclamation for development. Failure to address systematic causes of vulnerability such as land access and tenure also limits successful governance of mangrove ecosystems.

Despite these challenges, effective mangrove action would lead to positive impacts across SDGs, Aichi Biodiversity Targets, Sendai Framework targets, the Ramsar Convention and the UNFCCC. In order to accelerate the restoration and recovery of mangroves and coastal wetlands worldwide, for their benefits to biodiversity, climate, and human well-being, implementation needs to be significantly scaled up at national and regional levels. In this regard the post-2020 global biodiversity framework can accelerate progress through including a clear target halting the further net loss of mangroves and associated coastal wetlands and turning the tide towards a net increase by 2030, accomplished through the conservation of existing healthy mangroves, the introduction of sustainable use schemes, restoration and natural regeneration. To avoid duplication and leverage existing work, the post-2020 global biodiversity framework should also seek synergies and align with both the UNFCCC processes and relevant SDG indicators to ensure that the framework provides a common scheme to enhance effectiveness towards a comprehensive global approach to mangrove conservation, restoration, and sustainable use.

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Migratory Species

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Background and role in achieving global targets

Animal migration is a patterned phenomenon. It differs from usual animal movement because it is being predictable and cyclical. In the marine realm, many mammals, seabirds, sea turtles, fish (including eels, sharks and rays, tuna-like species and salmon) are typically migratory species. Under the Convention on Migratory Species (CMS), migratory species means "*the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries and areas beyond national jurisdiction (ABNJ*)". Distances travelled by marine migrants can vary from short to complete circumpolar cycle or extreme pole-to-pole migrations with round-trip travel reaching up to 70,000 km (e.g. Arctic tern, *Sterna paradisea*). In a political context, movements span multiple jurisdictions, moving between areas within and beyond national jurisdiction. Migratory species require favourable habitats at critical junctures along their entire route, particularly for stop-over, feeding and resting sites, and an absence of anthropogenic causes of additional mortality (such as bycatch by fishers).

Different governance structures apply in different jurisdictions, making conservation of migratory species a greater challenge. The Convention on Biological Diversity (CBD) includes provisions relevant to migratory species, including provisions regarding international cooperation. Migratory populations should be managed as single units across their migratory cycle, requiring extensive international coordination, cooperation sand in the case of threatened species, concerted action.

The CBD Strategic Plan for Biodiversity 2011-2020 addresses the need to prevent the extinction of threatened species (Aichi Biodiversity Target 12) and reduce pressures on biodiversity (e.g. Target 6: unsustainable fisheries, and Target 9: pollution, etc.). Aichi Biodiversity Target 11 calls for the development of a "*well-connected systems of protected areas and other effective area-based conservation measures*", which are also meant to be integrated into the wider landscape and seascape, thereby recognizing the role of connectivity as an ecological function. However, connectivity corridors essential for migratory species (also defined as 'areas of connectivity conservation') generally fall outside of the current suite of coastal and marine protected areas. Connectivity as a concept is implicit within several other Aichi Biodiversity Targets, such as Targets 5 (to reduce loss, degradation and fragmentation of natural habitats), Target 7 (to sustainably manage areas under agriculture, aquaculture and forestry), and Target 15 (to restore degraded ecosystems).

Status and trends

The 2019 IPBES Global Assessment highlights a continued decline in conservation status of biodiversity. In many cases, migratory species are at enhanced risk due to the cumulative threats they experience across their migration routes, uncoordinated conservation across jurisdictions and dependence on disparate habitats. Data from the IUCN Red List of Threatened Species shows that 21% of migratory marine species are classified as threatened: sea turtles (85%), seabirds (27%), cartilaginous fishes (26%), marine mammals (15%) and bony fishes (11%)[1]. However, in some of these groups (e.g. marine mammals) large numbers of species are listed as Data Deficient, adding significantly to uncertainty.

Ten common drivers for marine migratory species decline include: fishing and harvesting, invasive and other problematic species, genes and diseases, pollution (oil, debris, including fishing nets, plastic, chemicals such as persistent organic pollutants), climate change and severe weather, residential and commercial development, human intrusions and disturbances, natural system modifications, energy production and mining, transportation and service corridors, agriculture and aquaculture[1,2,3].

Seabird species are affected by a combination of threats, both to the colonies in their terrestrial habitats, with invasive alien species and hunting/trapping the major stressors, and in their foraging areas at sea, where accidental capture in fisheries (bycatch) and overfishing (which reduces their prey base) are the most significant. Climate change affects more than 25% of seabird species. It is also important to highlight that nearly three quarters of species are affected by at least two threats, and nearly half of them by at least three threats. Therefore, a combination of conservation actions need to be implemented in order to effectively reduce the loss of seabird species[2].

Many migratory aquatic mammals are threatened, with many species listed in Appendix I of CMS[a]. Some are recovering (e.g. gray, humpback, and southern right whales). However, others are increasingly endangered (e.g. Arabian humpback whales, North Atlantic and North Pacific right whales). Climate change may significantly disrupt their migration patterns, and there are of signs that this is happening already[4,5,6].

Marine turtles have historically suffered population declines, and populations of some species remain Critically Endangered (e.g. leatherbacks). Recent assessments, however, have shown encouraging population trends for some species. Bycatch from fishing is an important stressor. Harvesting adults for meat, shells and eggs, and entanglement in fishing gear are increasingly being reported. Entanglement in anthropogenic debris, primarily lost or discarded fishing materials, known as ‘ghost gear’, is an issue at the global scale, impacting all migratory species throughout their geographic range. Stranded turtles are found in the thousands per year, 5.5% of which are entangled, 90.6% of these dead. Debris effects from land-based sources are in the distinct minority[7].

Large proportions of pelagic shark and ray populations are under significant threat, primarily from overfishing: 32% threatened globally[8]. As for sharks alone, 46% of the 95 migratory species reported are Threatened, 21% are Near Threatened, and only 9% are Least Concern, leading these migratory species at a higher overall risk when compared to non-migratory ones (14% threatened)[9]. Tens of millions are taken each year on commercial fisheries, many of these caught incidentally (bycatch) in

[a] The CMS has two appendices listing migratory species to which the Convention applies. Appendix I comprises migratory species that have been assessed as being in danger of extinction throughout all or a significant portion of their range. Appendix II covers migratory species that have an unfavourable conservation status and that require international agreements.

other fisheries. A particular problem is the fin trade, with habitat loss and climate change also considered important stressors[3].

Anadromous species like salmon cross international and intra-national jurisdictions, making management particularly complex. Increased and uncoordinated production from salmon hatcheries has intensified ocean competition in ABNJ for common prey resources[10].

Tuna and billfish are the most commercially targeted migratory fish, with various species overexploited and threatened: 7% Near Threatened and 11% met the threshold for a Threatened category, 20% was data deficient (study with 61 species). Experts argue for caution on the use of maximum sustainable yield as reference for sustainable fisheries, as this population level would be placed in the Vulnerable category on the IUCN Red List[11].

Positive experiences / approaches

Migratory species benefit from being the only group of organisms with a dedicated international legal instrument addressing their conservation needs. The CMS strives to foster cooperation among member States to conserve and sustainably manage species, their habitats and their migration routes. Agreements and Memoranda of Understanding under this Convention also provide specific measures for certain regions (e.g. Agreement for the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area (ACCOBAMS) or certain groups of species (e.g. Agreement for the Conservation of Albatross and Petrels (ACAP)). Nonetheless, compliance and enforcement of these instruments remain a challenge. In addition, not all migratory species are under their scope.

Other international (global or regional) legal instruments, binding or non-binding, also offer mechanisms for addressing migratory species protection, though these are not especially designed to address migratory species. In many cases, these instruments have lists of species under threat and in need of protection and/or have specific management measures under their auspices. Examples include the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), Conservation of Arctic Flora and Fauna (CAFF) under the Arctic Council, the Convention on International Trade in Endangered Species of Fauna and Flora (CITES), and Regional Seas Conventions and Action Plans.

At least 23 of the Voluntary Commitments registered in the context of the 2017 UN Ocean Conference include specific deliverables addressing marine migratory species conservation[b]. Other Voluntary Commitments may also direct or indirectly benefit marine migratory species (e.g. those related to marine protected areas and sustainable fisheries). Pledges that explicitly mention “migration” and “migratory” (in the title) include: creating protected areas, capacity building for marine species watching tourism, developing and committing to international instruments for the protection of species, and eradicating invasive alien species. Of these 23 commitments, less than 20% have declared positive progress: three scored ‘green’, one had a ‘yellow’ score, progress for two had not been reported. For all the others (16 commitments) the progress report scored ‘red’[c]. Lack of delivering commitments may be attributed to non-action, but equally to inadequate/ineffective reporting.

[b] Based on a preliminary and non-exhaustive search for the terms ‘migration’ and ‘migratory’. Some commitments may address groups of migratory species without having explicitly mentioned their migratory characteristics. Also, MPAs and other management measures (e.g. reducing bycatch of seabirds) positively impact these migratory organisms. Commitments specific to those targets related to fisheries were not considered as it is outside the mandate of the CBD.

[c] Progress reports are to be submitted once a year until completion of the initiative. Green = submitted within the last 12 months; Yellow = due for submission; Red = two years due.

Some examples of positive initiatives are in the area of technological innovation to support research and conservation efforts. Developments in tracking technology, including increased reliability and reduced size and cost of tags, have enabled an increased number of species to be the focus of tracking studies. Tagging animals with trackers that monitor their movement via satellite is a powerful research tool. Data generated with such tags can provide insights into the habitat preferences, behaviour, the timing of migration, and factors that shape the abundance and distribution of species.

New datasets and databanks are also being established, providing conservation practitioners with increasing data to elaborate on new findings and strengthen the science to policy efforts. Of particular note is a move to aggregate ‘usable knowledge’ rather than raw data. Ongoing efforts to describe Important Bird and Biodiversity Areas (IBAs[12]) have been complemented by an analogous effort to describe Important Marine Mammal Areas (IMMAs[13]) and the development of a system to describe Migratory Connectivity in the Ocean (MiCO[14]). These efforts are geared toward bridging the science-policy gap by synthesizing data into products that are more easily ingested by management and policy processes. Studies that assess overlaps between the use of space by migratory species and activities that pose threats to those have been instrumental, as they can be the basis for coordinated decisions on spatial use and prioritization[15,16].

Generally, a combination of policy decisions, conservation actions, market incentives, awareness raising with involvement of local communities and mainstreaming of biodiversity into sectoral activities renders positive results. The growth in abundance of some sea turtle populations is a good example where a multi-level approach has been applied with success. Combined efforts on reducing illegal harvesting and caging or relocating nests to hatcheries to maximize protection; reducing bycatch in fishing gear (e.g. through the use of turtle excluder devices (TEDs)) along with the modification of hook types in long-line fisheries as well as prohibiting trade of sea turtle products through the international conservation agreements including CITES, have all contributed to improving the population status of this group in many areas[7,17].

Gaps and challenges / areas in need of further work

The protection of migratory organisms relies on a suite of conservation options, including site-based (e.g. protection for aggregation sites and migration corridors) and non-site-based measures (including removing barriers to migration) in order for connectivity to be maintained. However, the space-use patterns of the species and the type of threat can support decisions on complementary approaches. Species with large foraging ranges and little aggregation may require a more diverse array of measures as compared to those with high aggregation and small foraging ranges[18,19]. Measures should account for the coverage of habitats used across a migratory species’ range. In order to accomplish this, a consolidated ocean governance framework is necessary. Instruments and provisions applied within the various national jurisdictional waters used by migratory species, as well as those applied to ABNJ need to be consistent with the needs of these organisms and coherent among themselves. Strengthened cooperation and coordination among CBD and other regional and international bodies at all levels will be fundamental.

Key challenges to the development of a holistic ocean governance framework remain, nevertheless. There are both geographic and taxonomic gaps in governance in ABNJ[20]. These are furtherer hampered by marked differences in governance capacity within national jurisdictions and limited integration of policies across sectors both within and beyond national jurisdictions. These challenges result in limited implementation of ecosystem-based approaches to management, and conservation strategies that focus on individual stages of a species migratory cycle with little consideration of population connectivity[21]. A coordinated cross-sectoral and multilateral approach is also key. The relevance of mainstreaming biodiversity is fully recognized within the CBD as well as the SDGs and other international and regional frameworks.

The development and application of dynamic conservation measures that are actionable in near-real time may provide a means to assess risks in the overlap between marine migratory species, marine industries and the marine environment. Interaction, and consequent negative impact on migratory species by vessels occurs in a number of ways and includes oil spills, artificial light pollution, ship strikes, underwater noise, and as bycatch of non-target species associated with fishing activities.

Unsustainable fisheries practices are a significant stressor to most migratory organisms, with financial tools such as subsidies acting as an additional layer of pressure[22]. There remains limited enforcement and compliance with international decisions and guidance on sustainable practices. For instance, few countries have developed National Plans of Actions (NPOAs) for sharks or for seabirds which are instruments agreed by FAO member-countries to reduce bycatch of these migratory groups[23,24]. Regulating activities from other industries is also required. Underwater noise from industry activities adds to the package of risks to marine organisms as it may have acute, cumulative, and chronic effects. Shipping and seismic surveys, which use loud sound pulses fired from compressed air guns to explore the seafloor cause hearing damage, alters migratory species communication and navigation signals and potentially impacts reproductive behaviour. Possible approaches to mitigate negative effects of underwater noise include restrictions on activities in biologically sensitive habitats based on monitoring that counts cumulative contributions to noise or techniques that use steady streams of energy at lower levels than air guns[25].

Climate change can drive shifting distribution patterns as species react to changing environmental conditions and changes in food availability. These impacts are likely to be felt particularly hard by migratory species who expend incredible amounts of energy to move to areas previously known to be bountiful with food or free of predators. Changes in environmental conditions will lead to changes in food availability and invasion by new predators and diseases. Changes in the timing of migrations (e.g. due to changes in the timing of environmental cues) will lead to mismatches in when migratory species arrive at foraging or nesting grounds, and the conditions that are conducive to their survival in those regions (e.g. food)[26]. More standardized monitoring programs (e.g. as coordinated by the Global Ocean Observing System) and better structural funding of that monitoring will be necessary to understand the full scope of these climate impacts and to develop adaptation measures.

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Island Biodiversity

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Global Island Partnership (GLISPA)

Background and role in achieving global targets

Islands vary from large oceanic entities with vast EEZs to small islands connected to continental countries and host very diverse marine and coastal ecosystems. The 52 Small Island Developing States (SIDS) are found in the Caribbean, the Pacific and Indian Oceans, the South China Sea and around Africa. The remaining Parties to the Convention on Biological Diversity (CBD) include 10 island nations and 82 other countries that have islands. The total global population on islands is around 730 million people.

Responding to the specific issues facing islands, a programme of work on island biodiversity (PoWIB) was adopted by the Conference of the Parties to the CBD in 2006 (Decision VIII/1). It applies to island Parties and Parties with islands, and its goal is to significantly reduce the rate of island biodiversity loss and contribute to poverty alleviation and the sustainable development of islands, particularly SIDS. The Programme of Work recognises the interconnectivity of island ecosystems, the need to manage from ridge to reef and that islands would progress best by working together. It recognizes that island biodiversity is of global significance and, as such, merits increased attention at the global scale.

Biodiversity-based industries such as tourism and fisheries account for more than half the gross domestic product of SIDS. Coral reefs alone provide an estimated US$375 billion annual return in goods and services[1]. Islands also play key roles in larger marine ecosystem dynamics (e.g. for coral reefs) and global nutrient cycling. They also provide the primary breeding habitat for many seabirds and seals with dual marine-terrestrial life history.

Status and trends

A disproportionate amount of global biodiversity is found on islands, which cover 5% of the earth's surface, but contain approximately 20% of biodiversity. Islands harbour more than half of the world's known marine biodiversity including seven of the world's 10 coral reef hotspots, and 10 of 34 conservation hotspots[2]. Islands have also hosted 75% of known bird, mammal, amphibian and reptile extinctions since 1500, and currently support 36% of species in these groups that are classified as Critically Endangered on the IUCN Red List of Threatened Species[3].

Reflecting a global pattern, island biodiversity is being lost at an unprecedented rate in the face of growing threats. Rising sea levels, ocean acidification, invasive alien species, overfishing, pollution and ill-considered development are taking a heavy toll.

Invasive Alien Species (IAS), particularly non-native terrestrial mammals, have been the major driver of island species extinctions, and remain a serious threat to extant island species and human communities. For example, rats and mice have been introduced to at least 80% of the world's island groups, and implicated in about 50% of all bird and reptile extinctions.

Pacific region

Pacific Islanders consume some of the highest levels of fish per capita per year (an estimated average of 35 kg/year if Papua New Guinea is excluded[4]). According to FAO forecasts, by 2030, coastal fisheries will be able to meet demand in only 6 of 22 Pacific Island countries. Climate change has unleashed the threats of coral bleaching, droughts, extreme weather, and rising sea levels. High water temperatures during a 36-month period from 2014-2019 resulted in a global coral bleaching event of unprecedented proportions, with many reefs in the Pacific experiencing the most extensive bleaching ever documented[5]. The 2013 State of Conservation in Oceania assessment showed that invasive species are the most important driver of species loss in the region.

Caribbean region

Like in the Pacific, increasing population, industrial and urban development, agricultural production, commercial forestry and fishing, natural disasters, particularly hurricanes, have increased pressure on biodiversity in the Caribbean. Declines in marine fishery production in some parts of the region are a result of overfishing and habitat degradation including coral reef loss. The average coral cover for the wider Caribbean has declined by about 50% since 1970. Invasive species continue to appear in terrestrial, freshwater and marine habitats. Habitat loss through wildfires, hurricanes, pollution, development and unsustainable consumption habits are largely responsible for the steady decline in many species.

European Union (Overseas Countries and Territories and Outermost Regions)

From the poles to the tropics, European Overseas Territories represent 34 political entities that span the five oceans. With an exclusive economic zone (EEZ) of more than 19 million km^2 (5%) of the global ocean, they constitute the world's largest maritime area. With more than 150 islands, they are home to over 20% of the world's atolls with extensive lagoons and coral reefs. Seven of the 10 largest marine protected areas in the world are in the EU Overseas Territories – 10.5 million km^2.

The EU Overseas Territories also host half of the current world's shark sanctuaries covering over 6 million km^2 in the Pacific and Caribbean.

Positive experiences / approaches

Islands are taking significant action to effectively conserve biodiversity and promote sustainable livelihoods across a diverse range of capacities and circumstances. Positive examples include:

- Island Political Leadership: Including the Micronesia Challenge, the Caribbean Challenge Initiative, the BEST Challenge, the Coral Triangle Initiative and the more mainstreaming focused Aloha+ Challenge among others, together with island-led cooperation platforms such as the Global Island Partnership, previous multi-country commitments up to 2020 are now being re-energized. Micronesian leaders endorsed a new, bolder and more comprehensive conservation commitment called the Micronesia Challenge 2030, with a goal of effectively managing at least 50% of marine resources and 30% of terrestrial resources across Micronesia by 2030. The Caribbean Challenge Initiative has a 20-by-20 goal (effectively conserving and managing 20% of the Caribbean's marine and coastal environment by 2020) supported by sustainable finance architecture. The connected Caribbean Biodiversity Fund now works with newly developed national trust funds in eight Caribbean countries and is also delivering resources through an Ecosystem Based Adaptation facility which is effectively using existing architecture to support work in the region.

- Financing Mechanisms: Including leveraging financial resources based on political commitments and delivering these resources to local communities. These include the Micronesia Conservation Trust, Seychelles Climate Change Adaptation Trust, the Caribbean Biodiversity Fund and new national trust funds in eight Caribbean countries. Other tools being used include Debt Swaps, Blue and Green Bonds and new risk and insurance tools. The importance of the EU Overseas Territories and the significance of their biodiversity has led European Institutions to pilot a grant scheme, the BEST initiative, to support further tangible actions on the ground. The initiative has already supported 90 projects (an investment of €18 million) and was the first interregional GLISPA Brightspot in 2016.
- Island collaboration: The new Small Island Organisation (SMILO) is labelling small sustainable islands across the world including for biodiversity values. NGOs and local communities are critical for the conservation of threatened species and habitats on islands. Examples include public awareness, protection of endangered species and their habitats, establishment of coral nurseries, constructed reefs (biorock), the establishment of Reef Guardians (voluntary citizen action), locally managed marine areas, mangrove replanting and restoration, tree planting and re-afforestation in watersheds and community tour guiding/ecotourism initiatives.
- Addressing Invasive Species: The eradication of IAS is a proven conservation tool, with demonstrable positive outcomes measured for hundreds of species and populations. Globally, more than 1,200 non-native mammal eradications have been implemented, with an average success rate exceeding 85%. In the Caribbean, control of the invasive lion fish in many islands has worked well, especially the 'catch and eat' approach, with recipe books and support from popular chefs.

Gaps and challenges / areas in need of further work

Major constraints to successful implementation on most islands, particularly SIDS, include: (1) limited institutional, technical and economic capacity in governments, communities and the private sector, (2) susceptibility to invasive species, (3) isolation and remoteness, (4) vulnerability to global shocks, trends and climate change. Some islands have been able to connect conservation and sustainable use through the blue economy or blue/green growth initiatives, including in the Seychelles (Blue Economy Roadmap), Hawaii (Aloha+ Challenge), Grenada, and Barbados (new Ministry of the Blue Economy) among others.

Many islands face a range of institutional challenges, including a lack of awareness of the values of their biodiversity, weak environmental legislation, shifting jurisdiction of environmental portfolios, overlaps and/or gaps in jurisdiction, limited technical information, inadequate human and technical capacity, and insufficient funding for biodiversity or to address the drivers of biodiversity loss.

With small population sizes in many islands, maintaining a pipeline of champions and practitioners to implement conservation actions remains a challenge. Together with the maintenance of high level political buy-in as administrations change, community action and on-the-ground support is critical.

Despite the demonstrated and replicated success of invasive species eradications, they are a relatively underutilized conservation action. A dramatic increase in the scope, scale and pace of IAS eradications from islands is needed to match the conservation opportunities and local demands to prevent extinctions and protect island communities.

Historically, marine protected areas (MPAs) have been established on an individual and *ad hoc* basis. The representativeness and connectivity of protected marine ecosystems needs sensible improvement in order to support the effectiveness and resilience of existing MPAs and MPA networks. Taking into account the diversity of marine ecosystems of islands, MPA networks needs to be further improved, not only for ecological and biodiversity purposes but also for supporting sustainable development and economic resilience. Some islands are also exploring marine spatial planning as a tool for improving their knowledge and management of their EEZs along with competing uses.

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Impacts of Climate Change and Ocean Acidification on Marine Biodiversity

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Background and role in achieving global targets

At the forefront of various threats to the ocean and its organisms, habitats and ecosystems is climate change, which interacts with other human-induced pressures such as pollution, eutrophication and over-exploitation of marine resources.

Climate-related drivers impacting the ocean include so-called 'slow-onset events' such as ocean warming, acidification, deoxygenation, sea level rise and glacial retreat, alongside extreme weather events such as marine heat waves and increased frequency of storms. These are all likely to drive biodiversity shifts in different ways, particularly in biodiversity hotspots such as coral reefs and other ecosystems that provide important services for coastal communities. The overall impact of climate change and ocean acidification on marine biodiversity is difficult to predict, as it involves complex interactions between organisms. Different species may either struggle or thrive in response to changing ocean conditions, depending on their specific tolerance limits or indirectly due to changes in species interactions and habitat loss. While precise predictions are currently not possible, it is certain that marine ecosystems will change and marine biodiversity will decrease, at least in the short term.

Marine biodiversity and a stable climate, a healthy ocean and a healthy people go hand in hand. Limiting climate change is essential to preserving marine biodiversity. In turn, actions to protect or restore marine biodiversity will enhance the resilience of ecosystems to better withstand climate change impacts and maintain key processes involved in climate regulation. Due to its global and broad spectrum of impacts, climate change and ocean acidification will affect the efforts to attain many, if not all, of the Sustainable Development Goals (SDGs). Similarly, climate change and ocean acidification will affect the progress towards many of the Aichi Biodiversity Targets, even if they are only specifically mentioned in two of them (Targets 10 and 15). While this will limit the success of many measures taken to address the Aichi Biodiversity Targets and the SDGs, it also highlights that any positive climate change and ocean acidification action is likely to lead to positive impacts on other SDGs (e.g. Goal 1 on poverty and Goal 2 on food security) and Aichi Biodiversity Targets (e.g. Target 6 on overfishing).

This brief will focus on ocean warming, acidification and deoxygenation in the context of Aichi Biodiversity Target 10: "*By 2015, the multiple anthropogenic pressures on coral reefs, and other* *vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.*"

Status and trends

The ocean has absorbed more than 90% of the excess heat resulting from anthropogenic greenhouse gas emissions since 1970, resulting in an average global sea-surface temperature increase of 0.63°C over the past hundred years[1]. With today's emissions rates, global mean sea-surface temperature is expected to increase by 3.2-5.4°C by the end of the century[1]. Warmer water holds less oxygen and leads to increased stratification, which reduces gas exchange and oxygen replenishment of the ocean interior and estuaries. Projections estimate an overall decline in dissolved oxygen concentration of 2 to 4% in the 2090s compared to the 1990s, with an expansion of oxygen depleted zones in the deep ocean[2]. In coastal areas, the combined effects of climate change and eutrophication (excess nitrogen and phosphorus from sources such as agricultural and urban runoff) can lead to severe oxygen loss and so-called 'dead zones' – areas where deep waters have insufficient levels of oxygen to sustain life. Global and regional models project that the oxygen content of marine waters will continue to decline as atmospheric and ocean temperatures rise and human population size increases[1].

Anthropogenic carbon dioxide (CO_2) emissions also lead to ocean acidification. Between 20-30% of CO_2 released into the atmosphere since the 1980s has been taken up by the ocean, limiting atmospheric CO_2 and heat build-up[1]. However, when CO_2 enters the ocean it changes seawater chemistry, resulting, among other changes, in increased seawater acidity (decreased pH). Since the industrial revolution, mean surface ocean pH has dropped by 0.1 units, corresponding to an increase in acidity of 26%. Open ocean surface pH is projected to decrease by around 0.3 pH units (equivalent to a 100% increase in acidity) by 2081-2100, relative to 2006-2015, if emissions continue at the current rate[1].

Whilst these changes in temperature, acidity and oxygen content may seem small, they could cause large perturbations to physiological processes and ecological performance of key marine species, habitats and ecosystems. This dangerous trio of ocean change can act on marine biodiversity directly, on a physiological level (e.g. when conditions exceed species' tolerance levels), or indirectly through changes to habitat availability, species interactions or productivity[3]. Temperature seems to be the single most important environmental predictor of the distribution and diversity of marine life, due to species' thermal tolerance limits[3,4].

Effects of warming on marine biodiversity are already observable on both local and global scales[1,3,4]. Even if impacts are complex to evaluate, especially given that these stressors do not occur in isolation of each other or of other pressures on the ocean, some overall trends have been shown, mostly for fish and plankton communities. Ocean warming tends to provoke a loss in species abundance and diversity in tropical regions, as maximal thermal tolerance levels are exceeded (e.g. in coral reefs), while diversity tends to increase in temperate and polar regions, as species distributions shift toward the poles in response to warming waters[3]. In some cases, the changing conditions could favour invasive alien species, with considerable impacts on habitat and species diversity.

An increasing body of literature investigates the effects of ocean deoxygenation on marine organisms. Oxygen structures aquatic ecosystems, plays a role in the biogeochemical cycling of carbon, nitrogen and other key elements, and is a fundamental requirement for marine life from the intertidal zone to the greatest depths of the ocean. Nearly all ocean organisms require oxygen for survival. A reduction in oxygen below required levels causes physiological stress, behavioural changes and ultimately death of key marine species[5,6,7].

The effects of ocean acidification on marine organisms and ecosystems has been an increasingly active research topic in the past 15 years, showing varying impacts between different groups of organisms[8]. Calcifying organisms such as hard corals, pteropods, bivalve molluscs and some species of calcifying phytoplankton seem to be particularly sensitive to changes in seawater chemistry, but impacts are not limited to calcification. Each species has its optimal range of carbonate chemistry and the energy needed to counteract changing ocean chemistry can reduce the energy available for other physiological processes. The more that conditions deviate from the ecological niche of a given species, the more negatively an organism is impacted[9]. Impacts range from enhanced growth and primary production in seagrasses and some phytoplankton, to decreased calcification rates in corals, coralline algae, and some molluscs[10]. Field studies around CO_2 seeps in several locations around the world have shown declining species diversity closer to the seeps, with communities dominated by non-calcifiers.

Most experimental studies to date have considered only one of these stressors. Experiments manipulating two stressors in concert have increased, but there are very limited studies looking at the combined effects of all three stressors. While multi-stressor experiments are challenging to design and assess[11], such studies are critical to provide a more holistic picture of the changes to come, as a mechanistic understanding of complex interactions between stressors are needed to predict impacts on marine organisms[12]. From a biodiversity perspective, several past mass extinction events have been shown to correlate with changes in ocean temperature, circulation, chemistry and/or productivity[3].

Ocean warming, acidification and deoxygenation are superimposed on other stressors to marine ecosystems, which have already decreased marine biodiversity in many places, for example, destructive and unsustainable fishing practices, heavy metals and organic pollutants, eutrophication and habitat degradation or loss. Climate change and ocean acidification are expected to further reduce the resilience of ecosystems by increasing the sensitivity of species to such stressors.

Positive experiences / approaches

In order to help biodiversity cope with climate change and ocean acidification, several types of synergistic action need to be pursued: (1) mitigation of greenhouse gas emissions; (2) resilience and protection measures and (3) reduction of other human induced stressors.

Drastically reducing CO_2 emissions and other greenhouse gases must be at the centre of climate action. Only the significant reduction of emissions can help prevent considerable changes in ecosystem function and composition in the future. Some coastal ecosystems already play a role in helping to sequester carbon long-term, primarily in their sediment. Saltmarshes, mangroves and seagrasses are being protected and restored to take carbon out of the atmosphere; yet even at scale, they will not prevent further drastic change. However, their role in climate adaptation, including their role in helping to reduce the impacts from storm events, has long been recognized, although often still underutilized.

Measures such as Marine Protected Areas (MPAs), can support the creation of more resilient ecosystems. Well managed, conserved and protected areas have a better chance of adapting to the inherent changes that climate change still has in store, even if future emissions are curbed. MPAs, as well as other area-based management approaches, must be embedded in appropriate spatial planning exercises and implementation. Such planning processes need to be inherently linked and implemented in conjunction with natural resource management, primarily fisheries.

Other examples of potential adaptation measures include the restoration of damaged coral reefs and other coastal ecosystems through farming and/or ‘assisted evolution’ – the active intervention to accelerate the rate of naturally occurring evolutionary processes in organisms, with the goal to enhance temperature tolerance, for example. Some industries have already shown how adaptation measures to ocean acidification conditions can be implemented successfully. Along the west coast of the Unites States of America, where oyster aquaculture has suffered from increasingly corrosive upwelling events in recent years, farmers monitor seawater conditions and adjust pH levels by adding alkaline material when needed to sustain oyster larval growth and survival. Pilot projects are also testing the potential benefits of planting kelp adjacent to oyster hatcheries, to lower pH levels through CO_2 uptake by the kelp. Comprehensive reviews exist[13] of the potential and the limitations associated with these and other ocean-based solutions to address climate change and ocean acidification.

The ocean acidification research field benefits from strong international coordination and collaboration, as reflected for example by the Ocean Acidification International Coordination Centre (OAICC; Voluntary Commitment (VC) #31368) and the Global Ocean Acidification Observing Network (GOA-ON; VC #16542). GOA-ON is driven by scientists and supported by a range of national and international organizations, such as the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO) and the International Atomic Energy Agency (IAEA), with the goal to work together internationally to provide a global understanding of ocean acidification conditions and ecosystem response, inform modelling efforts and ultimately policy development. GOA-ON has grown tremendously and now counts more than 655 members from 96 countries. Since its launch in 2012 GOA-ON has significantly contributed to advancing ocean acidification monitoring worldwide, through defining acceptable uncertainties for ocean acidification measurements, best practices, and building capacity in many countries through training courses and a mentorship program.

In an effort to obtain baseline data and document ocean acidification conditions, The Western Indian Ocean Marine Science Association (WIOMSA) launched a project with involvement of six countries in the region (Kenya, Mauritius, Mozambique, Tanzania, Seychelles and South Africa; VC #15788). Its objectives are to establish ocean acidification observation and research in the region, to help countries achieve SDG target 14.3, and to create a community of practice in the region for ocean acidification and other stressors on the marine environment, and relate ocean acidification observations to species of socioeconomic importance.

Gaps and challenges / areas in need of further work

There is an urgent need to better understand how ocean change is affecting marine biodiversity, which individual stressors are most influential, how they interact, and how responses to multiple stressors vary between organisms and/or communities. It is expected that programs and projects under the umbrella of the upcoming UN Decade of Ocean Science for Sustainable Development (2021-2030) will embrace a participative and transformative process so that scientists, policy makers, managers, and service users can work together to ensure that ocean science delivers greater benefits for both the ocean ecosystem and for society, protecting marine biodiversity.

Despite positive examples and the fact that climate change and ocean acidification impacts on biodiversity are covered by several global frameworks, the main challenge is that CO_2 mitigation remains insufficient to meet the Paris Agreement and to stem the direct and indirect drivers of marine biodiversity deterioration, particularly for highly vulnerable marine ecosystems such as warm-water coral reefs. It is therefore likely that most of the Aichi Biodiversity Targets for 2020 will be missed, including Aichi Biodiversity Target 10[14]. Similarly, half of the targets of SDG 14, contributing to the sustained resilience of marine ecosystems, with deadlines of 2020 and 2025 (SDGs 14.1, 14.2, 14.4, 14.5, 14.6) are unlikely to be achieved.

Expanding the development and implementation of successful adaptation measures to sustain and improve marine species resilience to anthropogenic change at local and regional levels will be an important part of the puzzle, although a major challenge for any adaptation action is the inherent difficulty to scale up these efforts and have an impact at larger geographical scales. Ultimately, increased political will to enforce the mitigation of greenhouse gases will continue to be the main challenge of the next decade. New technologies as well as newly gained knowledge and developed scientific capacities are expected to support these actions, in addition to recent increased public concern such as the Youth Climate Movement, which can hopefully inspire the political will required to support the action needed.

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Marine Capture Fisheries and the Post-2020 Global Framework on Biodiversity Conservation

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Background and role in achieving global targets

The current CBD vision of "*Living in harmony with nature*" where "*by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people*" captures the core challenges of fisheries managers to maintain sustainable fisheries, stop overfishing, and avoid or reduce collateral impact of fishing on biodiversity. The following sections describe briefly: (1) the expected role of fisheries, (2) the status and trends of fisheries and the biodiversity they impact, (3) examples of positive approaches to fisheries management and their outcomes, and (4) key gaps, challenges and needs for future work.

Fisheries contribute to food security, generate economic returns, and support safe and dignified livelihoods, including for vulnerable small-scale communities. Fulfilling this role requires understanding and recognition of the: (1) interdependence of healthy ecosystems and sustainable fisheries, (2) essential contributions of all fisheries, particularly small-scale fisheries (SSFs), (3) need for cross-sectoral planning and management, (4) impact of external drivers like climate change and global economic development and trade, and (5) uncertainty about ocean ecosystems functioning and resilience and their links to human well-being. Correspondingly, the role of fisheries policy and adaptive management is to: (1) keep fishing pressure aligned with natural productivity (e.g. at F_{MSY} or below) and stock biomasses at levels capable of producing maximum sustainable yield (MSY), (2) mainstream biodiversity conservation into fishery policies and practices to maintain ecosystem structure and function, and (3) promote equity in access to fishing opportunities and distribution of costs and benefits.

Although, in many regions of the world, fisheries are not yet delivering these expected outcomes, they already have the strong legal and policy foundation needed to meet the challenges (e.g. UNCLOS, UN Fish Stock Agreement (UNFSA), Port States Measures Agreement (PSMA), Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem, the CBD and the related Strategic Plans, and five decades of commitments at UN summits). Implementation is guided by the FAO Code of Conduct for Responsible Fisheries (CCRF), its numerous guidelines (e.g. on the precautionary and ecosystem approaches, MPAs, vulnerable marine ecosystems, and small-scale fisheries) and Plans of Action, particularly to protect vulnerable species and fight against illegal, unreported and unregulated (IUU) fishing. Effective implementation should deliver the relevant Sustainable Development Goals for 2016-2030 (particularly SDG 14) and the successors to CBD Aichi Biodiversity Targets, particularly Targets 6 and 11 on sustainable fisheries and area-based conservation measures.

Status and Trends

Following the features identified in Aichi Biodiversity Target 6, and consistent with CBD Technical Series Report N° 87[1] where further details and references for each point can be found, the status and trends in the key elements of biodiversity used and impacted by fisheries and on management measures are:

- Sustainably fished stocks – about 70% of assessed target-stocks are sustainably fished (i.e. are capable of producing MSY) and about 30% are overfished (including depleted or collapsed). Overall, overfishing has been growing since 1974, more slowly since the 1990s, is decreasing in some places, but still raising concern overall. High-value species are the more heavily exploited. Numerous stocks are still not regularly monitored and assessed, particularly but not only in small-scale fisheries. Successful management in many nations demonstrate the feasibility of sustainable fisheries when appropriate measures are taken.

- Depleted target species require reduced fishing pressure are part of rebuilding plans. The proportion of overfished stocks that are depleted is not consistently assessed. Rebuilding strategies have been successful for a range of stocks, demonstrating feasibility when targeted and stringent measures are taken, but greater uncertainty about rebuilding times and rebuilding of species assemblages. There is great scope for more explicit identification of depleted stocks and generalization of formal rebuilding strategies and plans.

- Threatened species – their number, identified in IUCN (Red List), CITES appendices, or at the national level, is increasing. Collapsed target species may also meet standards for 'threatened'. Non-target species taken as bycatch are often discarded and rarely monitored and assessed. Their trends may follow that of jointly exploited target species but could be worse or better, depending of degree of co-occurrence. Global trends are not systematically assessed. Some nations and Regional Fishery Management Organizations (RFMOs) are expanding efforts to reduce bycatch, selectively prioritizing avoidance of depleted, collapsed and threatened species. More systematic efforts are needed.

- Vulnerable ecosystems need protection against Significant Adverse Impacts (SAIs). Adoption of UNGA Resolution 61/105 in 2006 provided an effective incentive to identify habitats and species vulnerable to damage by various types of fishing gear in the deep-sea bottom fisheries in the High Seas and to avoid or adopt protective measures. Most RFMOs have already provided evidence that, since 2006, gear impact assessment, habitat evaluations and protective measures have increased[2]. Similar actions have been reported in EEZs but their extent and the overall change in the footprint and impact of fisheries on vulnerable seabed habitats will only be better known at the global level when reports of CBD Parties on Aichi Biodiversity Targets 6 and 11 will be submitted and analyzed.

- All harvested ecosystems should be maintained within Safe Ecological Limits (SEL). The adoption of an ecosystem approach to fisheries (EAF) is now widespread among nations and RFMOs, and maintaining the aggregate impact of all fisheries in an area within SEL is an expected outcome. However, although the concept of ecosystem overfishing has been addressed in various ways, there is no general scientific consensus yet on how to quantify SELs and whether the aggregate impact of all fisheries in an area is within such limits. Moreover, activities other than fishing may move ecosystems outside SEL, and integrated assessments of impacts of all uses are rare. Hence reliable global reporting on status on this aspect of sustainable fishing relative to sustainability benchmarks is not possible at this point.

In conclusion, Aichi Biodiversity Target 6 will be met for some stocks and habitats in some nations, but not globally. The post-2020 framework will need to consider the unsatisfactory situation and ways to correct it. The EAF should more effectively operationalize the concepts of SAIs and SELs. Secondly, the measures known to be effective in increasing fishery sustainability and reducing collateral impact should be generalized. Future target development should be better supported by economic and social analyses, including the equity of fishery and conservation outcomes.

Positive approaches and outcomes

Progress is being made as the global legal and policy framework is translated into legislation, policies, plans and management action in many countries and regions. Responsible fisheries give prominence to social, economic and ecological sustainability, mainstreaming biodiversity, covering target and non-target resources and essential or critical habitats, as well as ecosystem structure, function and related services. Governance is also evolving to be more adaptive and stakeholders' empowerment is increasing in local communities, EEZs, seascapes or large marine ecosystems. Collaboration between national, regional and global institutions in charge of fisheries and biodiversity, particularly RFMOs and Regional Seas Organizations (RSOs), is improving in a few regions (e.g. between the Northeast Atlantic Fisheries Commission (NEAFC) and the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) and between the General Fisheries Commission for the Mediterranean (GFCM) and the Barcelona Convention), and expanded coherence is being promoted by the CBD Sustainable Ocean Initiative Global Dialogue with Regional Seas Organizations and Regional Fishery Bodies[3]. Globally, consistent evidence of improvements of stock status where appropriate measures have implemented is not available. However, an example at the regional level is the EU where stocks are assessed regularly. Here, the number of assessed stocks with biomasses above their Precautionary Reference Points, and therefore being fished sustainably, increased from 27% to 77% in under a decade – 2002-2011[4].

A range of instruments for fisheries management are used, and their nature and effectiveness depend on the types of resources, habitats, ecosystems, fisheries, and political and socio-economic systems. These are examined briefly below.

Certification of over 350 fisheries by the Marine Stewardship Council relate to over nine million metric tonnes of catch or 16% of global commercial fisheries landings. Their management systems have significantly improved in the process.

Long-term management plans with pre-agreed Harvest Control Rules (HCRs) based on long-term objectives, are an effective way of ensuring that fishing opportunities are sustainable. Capacity control to stabilize and reduce fishing pressure is key to sustainable fisheries, stock rebuilding, reduction of biodiversity impact, increased economic viability and, possibly, of food security. User-rights, whether traditional or modern, communal or individual, have been successful in cost-effectively reducing fishing capacity and improving stewardship under a wide range of circumstances.

Co-management with empowered fisheries stakeholders is another effective way to increase sustainability. Together with economic incentives, user rights and good enforcement, it has provided an effective way to maintain fleet viability, compliance, livelihoods and social and political stability at acceptable costs.

The FAO global review and case studies on rebuilding[4,5] show that: (1) rebuilding is possible, (2) the outcome depends on the species, level of depletion, and the match of measures taken to causes of depletion, (3) fast rebuilding requires drastic cuts in fishing pressure, and (4) there are clear trade-offs between rebuilding speed and socio-economic costs. Weak governance, conflicting priorities for stock recovery, and IUU are serious sources of failure.

The perception of the bycatch problem is changing rapidly, from a waste issue to a biodiversity externality as ecosystem and economic approaches to fisheries management are increasingly adopted. It may change further if there is uptake of size-based approaches to management, or if food security becomes a more dominant consideration in the use of catches. Measures to reduce unwanted bycatch include technological standards (e.g. gear regulations, closed areas and seasons) and performance standards (e.g. economic incentives, bycatch quotas and credits, real-time incentives, and conservatory offsets) and the latter may facilitate effective cost-effective bycatch reduction. Vessel monitoring systems (VMS) and the use of on-board observers is increasing, improving information in bycatch levels and fates. Harnessing the innovation capacity of the fishers themselves is key. Total bans on discards have sometimes met resistance as unworkable and may alter fishing practices in unexpected ways that pose new challenges to overall sustainability. Complete analyses of economic as well as biological consequences of full discard bans are not yet available to evaluate their effectiveness.

Other effective area-based conservation measures (OECMs) acknowledged under Aichi Biodiversity Target 1[1] may contribute significantly to improved fisheries management and biodiversity conservation. In Decision 14/8, the CBD COP provided criteria for the identification of OECMs as well as guiding principles and common characteristics of OECMs. There are various examples of measures in the fisheries sector that may qualify as OECMs. For example, consistent with UNGA Resolution 61/105, more than 100 Vulnerable Marine Ecosystems – covering from 10 to over 200,000 km^2 – have been identified (data 2016) by RFMOs, with corresponding measures to protect the seafloor habitats.

New strategies for prosecuting and managing such as ‘balanced harvesting’[6] are being explored. These aim to lessen and more sustainably distribute the footprint of fisheries on species assemblages and marine ecosystems while maximizing sustainable contributions to food security.

Inter-regional cooperation is improving. The Regional Fishery Bodies (RFBs) Secretariat is facilitating inter-regional coordination of fisheries management actions. Under the CBD Sustainable Ocean Initiative (SOI), RFBs and RSOs and sometimes other sectoral management agencies discuss how to better coordinate ocean conservation efforts at regional scales across fishing-related and other pressures on marine ecosystems.

Gaps and challenges / areas in need of further work

The Voluntary Commitments submitted in support of SDG 14 have not yet be assessed in terms of effective implementation and outcomes. However, their overview[7] reflect actions to address concerns of direct relevance to fisheries: (1) EAF, harmful practices and gear, MCS and compliance, science-based management plans, by-catch, IUU fishing, cooperation, protection of marine habitats (SDG 14.4), (2) removal of, and information on, harmful subsidies (SDG 14.6), (3) small-scale fisheries access to coastal grounds and resources and to markets, empowerment, institutional capacity, technology transfer (SDG 14b), community-managed areas (SDG 14.5), (4) market-based management instruments, trade measures, traceability, certification, eco-labelling (SDG 14b). Other commitments relate to the environment within which fisheries operate (e.g. Blue Growth and the transition to a blue economy (SDG 14.7) and marine spatial planning (SDG 14.5)). Many entities pledged to substantially increase MPA coverage, the contributions of which to sustainability of fisheries will depend on ecosystems and local social and economic conditions, including population density and vulnerability, and on equity of governance systems.

A major effort is needed to improve fishery statistics and public access to them for all levels (regional, national, local). The impacts of IUU fishing need to be reassessed. Efforts are needed in small-scale fisheries, particularly inland and coastal fisheries, on total catch composition by species and size, and discards. Monitoring and assessment of inland fisheries stocks needs to improve[8]. More generally, assessment of the state of populations of non-commercial species and of vulnerable or essential habitats is needed in cases where bycatch and other impacts still occur, in order, to evaluate the impact of the corresponding fisheries.

The mobilization of financial resources and capacity building are continuous challenges when pursuing existing commitments and to implement existing effective tools, particularly in many Small Island Developing States (SIDS[a]) and Low-Income Food Deficit Countries (LIFDCs).

There is a need for better documentation of the performance of existing tools under the broad range of ecosystem and socio-economic conditions in which fisheries occur. Performance evaluations of most RFMOs have been undertaken but have been resource-demanding and need to be regularly updated. It is particularly urgent to better document and share lessons learned regarding the ability of SSF to keep stocks and ecosystems healthy while supporting indigenous and local communities, as well as external factors that can impede or negate the efforts of these communities.

International cooperation is needed at all scales, and particularly in transboundary areas and Areas Beyond National Jurisdiction (ABNJ), for effective fisheries regulation, to further combat IUU fishing and to ensure a more equitable sharing of living marine resources benefits between developed and developing States. RFMOs may need to upgrade their constituting act (convention or agreement) to refine and improve the mandate in relation to biodiversity conservation.

Cross-sectoral cooperation between fisheries authorities and authorities of other sectors is essential for the effective conservation of biodiversity, including the use of area-based measures as conservation tools. The need is being increasingly recognized in various processes, including the Sustainable Ocean Initiative Global Dialogue with Regional Seas Organizations and Regional Fishery Bodies and the ongoing deliberations of the Intergovernmental Conference on an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, and is amplified by the global economic reform and the Blue Economy perspective.

Other considerations include:

- Knowledge gaps: There are still many gaps in knowledge about stocks (e.g. structure or factors influencing stock productivity) and ecosystems (status and resilience; fisheries and other impacts) that are challenging management at all scales. Delivering on existing and future commitments requires improved understanding of ecosystem structures, properties and processes, their complex dynamics and how they are affected by pressures, including fisheries. Benchmarks comparable to single stock MSY need to be identified for ecosystem properties. Spatial scales of ocean processes and connectivity of ecosystem properties need to be improved. In some rural areas, deruralization and drift to urban centers may cause loss of community skills and knowledge. Immigration may increase local fishery pressure faster than

[a] Sometimes now referred to also as Large Ocean States [https://www.undp.org/content/undp/en/home/blog/2018/Large-ocean-states-pave-the-way-to-the-2030Agenda.html]

integration in local community culture and management practices. Notwithstanding how much knowledge may be improved, fisheries projections and decisions will often be made under high uncertainty and robust assessment and adaptive management methods need to be generalized.

- Human dimensions: connecting fisheries to the broader social, economic and governance environment, within a systems perspective. Addressing human rights, labor issues, health and community development, among other considerations, leads to a greater likelihood of meeting the SDGs[b].
- External drivers: Other pressures including global pollution, modification of hydrology, and socio-ecological feedback loops, are still incompletely understood, but may greatly affect the performance and value of fixed outcome-based targets. In an uncertain and changing environment, appropriate targets intend to increase resilience and adaptability in fish populations, ecosystems and socio-economic contexts. However, challenged by scarce knowledge, inadequate institutions, economic drivers, social relationships, and the multiplicity of values, and perceptions of equitable outcomes, setting fixed, knowledge-based targets will be complex and demanding.
- Climate change: Future fisheries management will have to adapt to climate change, for example, to the poleward displacement of fish biomass and related redistribution of fishing opportunities, and the changing productivity of ecosystems for resident and migrating stocks. The changes will affect ecosystem composition and resilience, population parameters, stock assessment, as well as fishing and consumption patterns. It may increase misalignments between fishing capacity and changing productivity and hence the impact of fishing on biodiversity. It will also require regular updating of targets and other management benchmarks, to appropriately reflect sustainable boundaries for populations under the changing environmental conditions. Considering the likely high negative impact of climate change on sources of land-based animal protein[9] any decrease in seafood contribution to protein availability is likely to have significant adverse impacts on land-based conservation (e.g. though increased use of bush-meat and deforestation for land-based feeds production. The role of fisheries in local and global food security needs to be re-assessed in that context.

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Area-based Conservation Measures

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Introduction

Explanations on "What is meant by Area-Based Conservation Measures (ABCMs)?

Area-based conservation measures (ABCM) are an important means for achieving the CBD's 2050 Vision[a]. These include Protected Areas (PAs) and other-effective area-based conservation measures (OECMs) as spelled out in Aichi Biodiversity Target 11, which calls for an increase in both quantity and quality of PAs OECMs. Both are considered Area-Based Conservation Measures and have been defined under the Convention (Article 2 definitions of the Convention text and decision 14/8 of the Conference of Parties). Other ABCMs could include, inter alia, ecological corridors, conservancies, the buffer zones and transitional areas of some Biosphere Reserves, some high value conservation areas or fishery closures, and could include various governance arrangements as found in territories and areas conserved by indigenous peoples and local communities (ICCAs) and locally Managed Marine Areas (LMMAs).

What are marine ABCMs?

Marine ABCMs include Marine Protected Areas (MPAs) and marine OECMs, and other marine ABCMs which could include inter alia Locally Managed Marine Areas (LMMAs), Fishery refugees /closures, etc.

Updated status of Aichi Biodiversity Target 11 in the marine realm

Target 11 refers to both protected areas and other effective area-based conservation as means of conserving biodiversity in situ. A definition of other effective area-based conservation measures (OECMs) was recently adopted at the 14th meeting of Parties to the Convention, while the same decision welcomed the scientific and technical advice on OECMs (see Decision 14/8, Annex III). As the definition was only recently adopted, there is limited information on the global extent of OECMs or the impact they could have for elements of Target 11. As such, analysis presented herein is based primarily on protected areas reported in the World Database on Protected Areas (WDPA). It is likely

[a] By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people.

that the status of several elements of Target 11 will improve substantially as reporting on OECMs advances.

Quantitative elements

(i) Coverage of Marine Protected Areas

As of October 2019, marine protected area coverage for the global ocean has reached 7.8% (coverage is 18.1% for national waters and 1.2% for areas beyond national jurisdiction [ABNJ]). This represents a significant—almost three-fold—increase from the coverage of 2.9% in 2011, at the start of the current Strategic Plan (7.3% for national waters and 0.2% ABNJ[b]). For marine areas under national jurisdiction, the 10% global target has already been surpassed (Fig. 1).

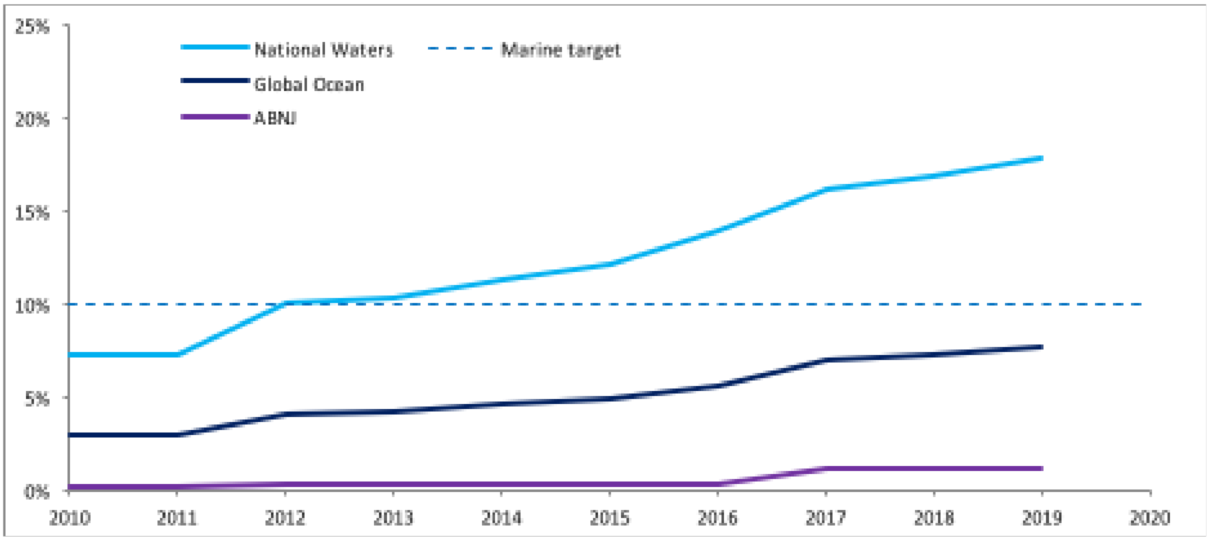

Figure 1. Growth in global protected area coverage over the time period of the Strategic Plan for Biodiversity 2011-2020. Data for the years 2010 to 2018 based on information in the July 2018 WDPA release; data for 2019 from the June 2019 WDPA release. Analyses performed by UNEP-WCMC.

Much of this growth in marine protected area coverage has come from the recent designation of very large marine protected areas, for example in Cook Islands (~2 million km^2 in 2017), Antarctica's Ross Sea (1.5 million km^2 in 2017), France's Southern and Antarctic Lands (~1 million km^2 in 2017), Pitcairn (0.8 million km^2 in 2016), and Easter Island (570,000 km^2 in 2018). In total, there are 14 marine protected areas larger than a half million square kilometres, and all but one was designated or expanded in the last ten years. These sites together account for more than half of the ocean area protected. There is some concern that recent designations have poor ecological representation[c] and have only minimally addressed stoppable threats[d].

(ii) National commitments

Commitments addressing expanded protected area cover have been made by Parties to the Convention through various fora, including National Biodiversity Strategies and Action Plans (NBSAPs), national priority actions identified through a series of regional capacity-building workshops, the 2017 UN

[b] UNEP-WCMC (2019a).

[c] Jantke et al. (2018). Poor ecological representation by an expensive reserve system: Evaluating 35 years of marine protected area expansion. *Conservation Letters*, *11*(6), e12584.

[d] Kuempel et al. (2019). Quantifying biases in marine-protected-area placement relative to abatable threats. *Conservation Biology*.

Oceans Conference, and various regional initiatives (e.g. the Micronesia Challenge). If completed as proposed by 2020, and avoiding double counting of actions from different sources, these would increase protected area coverage of the global ocean by almost 10 million km^2. This would bring marine coverage to 10.5% of the global ocean (Fig. 2), surpassing the global quantitative target. However, further efforts will still be needed to ensure that the qualitative elements of Target 11 are being addressed.

To date, 64 Parties have provided NBSAPs with quantitative targets for marine protected area coverage, of which 46 have a target date of 2020 or earlier. Of these 46 Parties, 12 have reached or surpassed their national coverage targets as of October 2019, as per data in the WDPA. Of the 18 NBSAPs with post-2020 end-dates for marine protected area targets, one Party has already surpassed their national coverage target.

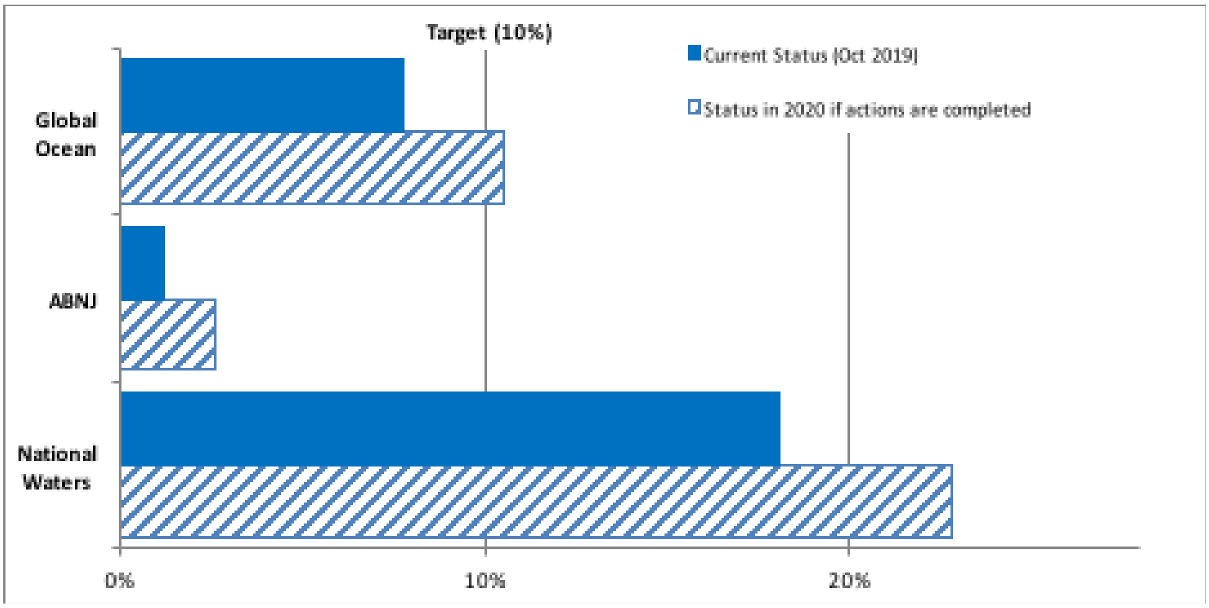

Figure 2. Increase in global protected area coverage if national commitments are completed as proposed by 2020.

Qualitative Elements

Though it is likely that the 10% marine quantitative target will be met globally by 2020, there is a need for increased efforts to address the qualitative elements of Target 11.

(i) Ecological representation

Protected area coverage of broad-scale biogeographic units (like ecoregions) is often used to assess the ecological representation element of Target 11[e]. Globally, ecoregions have been defined and mapped for both terrestrial and marine areas. These include 232 marine ecoregions covering shallow coastal waters (<200m in depth) and 37 pelagic provinces[f]. As reported in the Digital Observatory for Protected Areas (DOPA) of the Joint Research Centre of the European Commission (EC-JRC)[g] using data from the WDPA for January 2019, protected area coverage for marine ecological representation,

[e] E.g. UNEP-WCMC, IUCN and NGS (2018). *Protected Planet Report 2018.* Cambridge UK; Gland, Switzerland; and Washington, D.C., USA: UNEP-WCMC, IUCN and NGS.
[f] Spalding et al. (2007), Marine ecoregions of the world: a bioregionalization of coastal and shelf areas, *BioScience*, *57*(7), 573-583; Spalding et al. (2012), Pelagic provinces of the world: a biogeographic classification of the world's surface pelagic waters, *Ocean & Coastal Management*, *60*, 19-30.
[g] European Commission – Joint Research Centre (EC-JRC) (2019), The Digital Observatory for Protected Areas (DOPA), http://dopa.jrc.ec.europa.eu/ (see section on maps and datasets).

109 out of 232 marine ecoregions, and 4 out of 37 pelagic provinces have reached 10% coverage, while 66 marine ecoregions and 13 pelagic provinces have less than 2% cover (Fig. 3 and Table 1). Eight marine ecoregions and four pelagic provinces have no protected areas, including Central Somali Coast, Weddell Sea, South eastern Madagascar, and others. For larger biogeographic units, just over half of the 62 marine provinces, and eight of 12 marine realms have reached at least 10% coverage. All marine realms and all terrestrial biomes have at least 2% cover, while five of the 62 marine provinces have less than 2% cover.

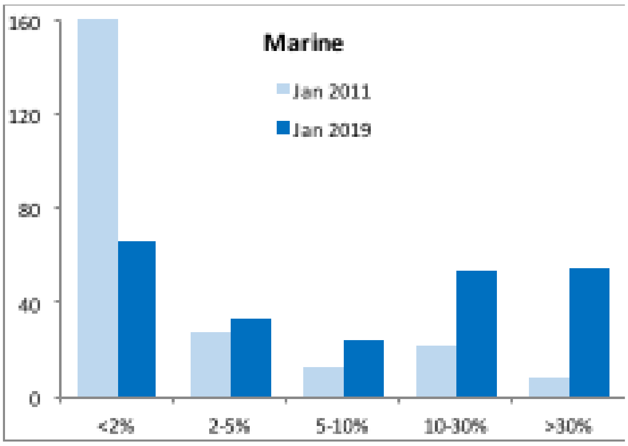

Figure 3. Protected area coverage of marine ecoregions in January 2011 and January 2019; showing the number of ecoregions at varying levels of protection[h].

Mean target achievement (MTA)[i] represents the average degree of conservation target achievement across biodiversity features. For assessing ecological representation under Target 11, it would represent the degree to which targets are being achieved within ecoregions, where a score of 100% would indicate that all ecoregions have met a specific benchmark (whether the 10% target for ecoregions from the current Strategic Plan, or considering at least partial coverage—at least 2%—for all ecoregions). Table 1 presents MTA for marine ecoregions, and pelagic provinces, as of January 2019 for a range of possible conservation targets. MTA ranges from 62% to 82% for marine ecoregions, and from 41% to 73% for pelagic provinces, depending on the benchmark used. Ecological representation has improved for marine areas since 2011(Fig. 3; Table 1). This follows the significant increase in MPA cover over the same period (Fig. 1).

[h] Data from EC-JRC (2019).
[i] Jantke et al. (2018), Metrics for evaluating representation target achievement in protected area networks, *Diversity and Distributions*, *25*(2), 170-175.

Table 1. Global status of ecological representation based on different conservation targets.

Realm and Year	**At least partial coverage (>2%)**		**10% coverage (per COP Decision VII/30)**	
	# meeting target	MTA	# meeting target	MTA
Marine ecoregions				
2011	69 (30%)	44.3%	30 (13%)	23.2%
2019	166 (72%)	82.4%	109 (47%)	62.1%
Pelagic provinces				
2014[j]	16 (43%)	50.0%	2 (5%)	19.7%
2019	24 (65%)	73.0%	4 (11%)	40.6%

(ii) Areas important for biodiversity

Protected area coverage of Key Biodiversity Areas (KBAs) provides one proxy for assessing the conservation of areas important for biodiversity. KBAs are "sites that contribute significantly to the global persistence of biodiversity", with globally agreed criteria for their identification provided in the IUCN's Global Standard[k]. As of December 2018, out of 3,990 marine KBAs, 945 (24%) were fully covered, while 1,456 (36%) had no coverage (Fig. 4a). Mean percent coverage for marine KBAs is 45.7%, which shows a modest increase from the 41.1% mean coverage in 2010 (Fig. 4b)[l]. It is expected that recognition and reporting of OECMs would further increase this figure.

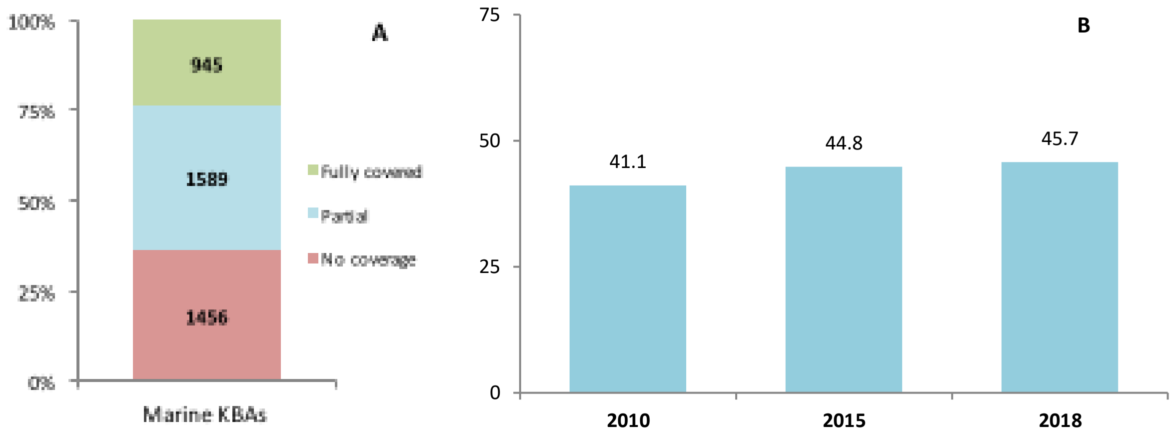

Figure 4. Proportion of KBAs fully, partially, and not covered by protected areas (A); and change in mean percentage area of each KBA covered by protected areas from 2010 to 2018 (B). Both are based on the spatial overlap between polygons from the World database on KBAs and the WDPA (December 2018 release), as reported in the 2019 SDG report (analysed by UNEP-WCMC in collaboration with BirdLife International and IUCN).

[j] The map of pelagic provinces was only developed in 2012, so coverage from 2011 is currently unavailable.
[k] IUCN (2016) *A Global Standard for the Identification of Key Biodiversity Areas*, v. 1.0. Gland, Switzerland: IUCN.
[l] UNEP-WCMC, in collaboration with BirdLife International and IUCN, Indicator 14.5.1 and Indicator 15.1.2 from SDG Report 2019: Statistical Annex: Global and regional data for Sustainable Development Goal indicators.

Areas of importance for biodiversity could also include more than just identified KBAs, which are currently both geographically and taxonomically incomplete. For example, these could include Vulnerable Marine Ecosystems (VMEs) or Particularly Sensitive Sea Areas (PSSAs). One recent study noted that 55% of the ocean has been identified as important by one or more initiative, with 15% covered by at least 2 initiatives[m]. MPA coverage is 7.75% of areas identified by one initiative; 11.7% of moderate-consensus areas (with 2-4 overlapping initiatives); and 94.7% of high-consensus areas (with 5-7 overlapping initiatives). Other approaches could consider the coverage of species richness hotspots, other hotspot measures, centres of endemism, centres of origin, or measures of intact wilderness. Remaining wilderness areas, based on measures of human impact, cover only 13% of the ocean[n]. In 2017, marine protected areas covered only 5% of remaining marine wilderness[o]. For reporting on the final status of Target 11 in 2020, it could be useful to explore a range of measures for the coverage of areas important for biodiversity.

(iii) Connectivity

To date, there is no global assessment of connectivity for marine protected areas, though there are examples of assessments at the regional[p] and national level. It is possible that the Prot Conn indicator[q], developed to assess the connectivity of terrestrial protected areas, could be applied in the marine realm, possibly incorporating the effects of ocean circulation.

(iv) Effectively managed

In 2010, per COP Decision X/31, Parties were invited to implement management effectiveness evaluations in at least 60% of their total protected areas. In 2016, the COP encouraged Parties to expand, institutionalize, and undertake more systematic assessments of management effectiveness within their protected areas system, as well as to update and share the relevant information on management effectiveness in the global database on protected area management effectiveness (GD-PAME). By June 2019, as per information reported in the GD-PAME, only 15% of countries have evaluated management effectiveness for at least 60% of their total marine protected areas. Currently, 48 CBD Parties have no completed assessments for marine protected areas reported in the GD-PAME, and nearly three-quarters have less than 30% of their protected area network assessed (Fig. 5).

[m] Gownaris, N. J., Santora, C. M., Davis, J. B., & Pikitch, E. K. (2019). Gaps in Protection of Important Ocean Areas: A Spatial Meta-Analysis of Ten Global Mapping Initiatives. *Frontiers in Marine Science*, *6*, 650.
[n] Watson et al. (2018). Protect the last of the wild, *Nature* 563, 27-30.
[o] Jones et al. (2018). The location and protection status of Earth's diminishing marine wilderness. *Current Biology*, *28*(15), 2506-2512.
[p] Pittman, S. J., Monaco, M. E., Friedlander, A. M., Legare, B., Nemeth, R. S., Kendall, M. S., ... & Caldow, C. (2014). Fish with chips: tracking reef fish movements to evaluate size and connectivity of Caribbean marine protected areas. *PLoS One*, *9*(5), e96028.
[q] Saura et al. (2017). Protected areas in the world's ecoregions: How well connected are they? *Ecological Indicators*, *76*, 144–158; Saura et al. (2018). Protected area connectivity: Shortfalls in global targets and country-level priorities. *Biological Conservation*, *219*, 53–67.

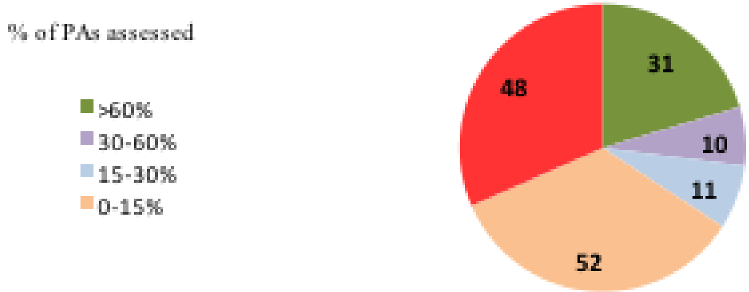

Figure 5. Number of CBD Parties with completed PAME evaluations for MPAs, as of June 2019 per the GD-PAME[r].

To date, reporting of progress on the 'effectively managed' element of Target 11 has focused on the completion of management effectiveness evaluations (measured against the 60% target). However, simply reporting on the completion of evaluations is not adequate. Results of these management effectiveness evaluations need to be examined to determine whether sites are reporting sound management. One difficulty arises from the fact that over 60 different assessment methodologies are in use, according to data reported in the GD-PAME. Future targets relating to protected area management effectiveness should require that some benchmark of quality is being met. For example, a 2010 study[s] applied a benchmark of two-thirds indicating "effective" management across a suite of indicators and based on the sample of protected areas included at the time (~6,000 sites[t]) less than one-quarter were deemed to have 'sound management'. Without this information on the adequacy of aspects of management, it will not be possible to properly assess progress for this element of Target 11.

Recent studies have shown that staff and budget capacity are some of the aspects of management most related to conservation outcomes in marine protected areas[u]. Most of the 433 marine protected areas in a recent review reported inadequate budgets (65%) and inadequate or below optimum staff capacity (91%)[v]. There is a need for more information on conservation outcomes in protected areas, and a better understanding of their relation to specific management inputs[w]; aspects which should receive greater focus in a post-2020 biodiversity framework. There is also a need for a simple set of indicators that can be used to properly report on management effectiveness[x].

(v) Equitably managed

Target 11 also calls for protected areas to be 'equitably managed'. Equity, which is one element of good governance[y], is generally described with respect to three dimensions: recognition, procedure and distribution[z]. Enhancing the diversity, quality, effectiveness and equity of protected area governance is important for the achievement of Target 11. Given the lack of comprehensive global assessments of governance and equity in protected areas, to date, reporting on this element has focused on governance diversity. In general, four broad governance types are described: governance by governments; governance by private individuals or organizations; governance by indigenous peoples and/or local

[r] UNEP-WCMC (2019b).
[s] Leverington et al. (2010), *Management effectiveness evaluation in protected areas – a global study*. Second edition. Brisbane, Australia: The University of Queensland
[t] This accounts for only 6% of the >100,000 sites in the WDPA at the time (Leverington et al., 2010).
[u] Gill et al. (2017), Capacity shortfalls hinder the performance of marine protected areas globally, *Nature*, *543* (7647)
[v] Gill et al. (2017).
[w] Geldmann et al. (2018).
[x] Coad et al. (2019).
[y] Franks, P et al. (2018) *Understanding and assessing equity in protected area conservation: a matter of governance, rights, social impacts and human wellbeing*. IIED Issue Paper. IIED, London.
[z] Schreckenberg et al. (2016) Unpacking equity for protected area conservation, *Parks*, *22*(2), 11–26.

communities (IPLC); and shared governance (e.g. between IPLC and Governments or between private individuals and Governments). In 2018, sites reported in the WDPA were primarily governed by governments (>80%), with less than 4% under shared or IPLC governance[aa]. But comprehensive information on the quality, effectiveness and equity of protected area governance is still not available globally.

In Decision XIII/2, the COP invited Parties to use the IUCN Green List of Protected and Conserved Areas as a voluntary standard to promote and encourage protected area management effectiveness. The IUCN Green List is a voluntary global standard, with the goal of increasing "the number of Protected and Conserved Areas (PAs) that are effectively and equitably managed and deliver conservation outcomes,"[bb] and currently contains 46 areas in 14 countries[cc]. It could provide one benchmark for effective and equitable management, with contributions to successful conservation outcomes. The four components of the Green List Standard (Good Governance, Sound Design and Planning, Effective Management, and Successful Outcomes) are underpinned by 17 criteria[dd]. Existing approaches for management effectiveness[ee], governance[ff], and social assessment[gg] in protected and conserved areas could be used to compile information to address these 17 criteria. This would allow for better estimates of progress in the quality of protected areas.

(vi) Integration

Protected area integration involves linking sites within wider networks of protected, conserved and managed lands/waters, but also incorporating protected area design and management into a broader framework of land-use plans, other relevant laws and policies, and related sectoral plans, strategies and programmes[hh]. This will ensure the maintenance of ecological processes and functions, and help to maximize benefits from, and mitigate threats to, biodiversity[ii]. Although not explicit in the Target's language, integration of biodiversity within and across sectors is also vital, and was included in PoWPA, as well as guidance on Target 11[jj]. Contradictory policy objectives across different sectors could jeopardise biodiversity conservation and limit the efficacy of protected areas.

Voluntary guidance on this element has been developed (see COP Decision 14/8, Annex I), and offers a range of suggested steps for the integration of protected areas into wider landscapes and seascapes as well as important sectors. However, there is still a lack of indicators and global assessments available for this element of Target 11.

Marine spatial planning "is an area-based management framework that addresses multiple management objectives" and represents a "framework to provide a means for improving decision-

[aa] UNEP-WCMC, IUCN and NGS (2019). *Protected Planet Live Report 2019*. UNEP-WCMC, IUCN and NGS: Cambridge UK; Gland, Switzerland; and Washington, D.C., USA

[bb] IUCN and World Commission on Protected Areas (WCPA) (2017). *IUCN Green List of Protected and Conserved Areas: Standard,* Version 1.1. Gland, Switzerland: IUCN.

[cc] https://www.iucn.org/theme/protected-areas/our-work/iucn-green-list-protected-and-conserved-areas

[dd] IUCN & WCPA (2017).

[ee] Hockings et al. (2006). *Evaluating effectiveness: a framework for assessing the management of protected areas*, 2nd edition. Gland, Switzerland and Cambridge, UK: IUCN.

[ff] Franks & Booker (2018).

[gg] Franks et al (2018) *Social Assessment for Protected and Conserved Areas (SAPA). Methodology manual for SAPA facilitators.* Second edition. IIED, London.

[hh] Ervin et al. (2010).

[ii] Ervin et al. (2010).

[jj] Ervin et al. (2010).

making as it relates to the use of marine resources and space."[kk] It represents an important means for ensuring the integration of marine protected areas with the wider seascape, and with relevant sectors, and coordinating the distribution of human impacts in the ocean. Globally, marine spatial planning is under development in more than 66 countries[ll].

(vii) Remaining elements

For other element of the Aichi target11 – namely coverage of areas of important for ecosystem services, there is no agreed global indicator. As global patterns of biodiversity, ecosystem services and human impacts in the ocean are poorly correlated[mm], there will need to be attention paid to both areas important for biodiversity, as well as important areas for ecosystem services, which are vital for human well-being.

Opportunities for further progress

Commitments made by Parties to the Convention, as noted above (Fig. 2), will have significant impacts for global protected area coverage if implemented as proposed by 2020. Further opportunities exist through the completion of Global Environment Facility (GEF-5 and GEF-6) projects, the recognition and reporting of locally managed marine areas (LMMAs), and especially through better recording of data and recognition of marine OECMs. These additions will improve ecological representation and may also have benefits for connectivity and the coverage of areas important for biodiversity, as well as other elements of the Target. However, to assess the impacts for these elements, spatial information on these areas is needed. Work is underway to collect some of this information and assess the impact on these elements of Target 11.

Additionally, properly updating information in the WDPA to better reflect conditions on the ground, which may be higher than presently recorded, will improve our knowledge of the global status of protected area coverage. Information on protected area coverage from Sixth National Reports submitted by June 2019 has been analysed and includes information submitted by 90 Parties. Of these, for marine areas: 11 report values lower than the WDPA, 26 report values higher than the WDPA, 10 report values that are similar, 3 provided information that was unclear, 17 did not provide marine coverage, and the remaining 23 National Reports are from landlocked countries. This means that the remaining gaps for global protected area coverage (~2.2% of the global ocean) are lower than currently assessed based on coverage in the WDPA. Based on this preliminary analysis, global coverage could be almost 8% for the global ocean. Work is ongoing to facilitate updating records in the WDPA to better reflect the situation on the ground, or to clarify some of the discrepancy.

Opportunities from GEF-5 and GEF-6 protected area projects

There are 33 approved projects from the fifth and sixth replenishment of the Global Environment Facility (GEF-5/6) with clear plans for increasing marine protected area coverage—through either the creation of new sites, or expansion of existing sites. However, one of these projects did not include the

[kk] Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel —GEF (2012). *Marine Spatial Planning in the Context of the Convention on Biological Diversity: A study carried out in response to CBD COP 10 decision X/29,* Montreal, Technical Series No. 68, 44 pages.

[ll] Santos et al. (2019). Chapter 30: Marine spatial planning, In *World Seas: An Environmental Evaluation* (p. 571-592). Academic Press.

[mm] Lindegren, M., Holt, B. G., MacKenzie, B. R., & Rahbek, C. (2018). A global mismatch in the protection of multiple marine biodiversity components and ecosystem services. *Scientific reports, 8*(1), 4099.

area to be added. Overall, completion of these projects before 2020 would add about 500,000 km^2 in marine protected areas (0.36% of national waters; 0.14% of the global ocean).

While these projects address the quantitative aspect of Target 11 by increasing the coverage of marine protected areas, there are over 120 approved GEF-5/6 biodiversity projects in coastal, marine or mangrove areas that address one or more qualitative element of Target 11. While all qualitative elements are addressed in at least 14 projects, the elements addressed most often (in over 100 projects) are: effective management, integration, and more equitable governance

Opportunities from LMMAs

The overall contribution of LMMAs to biodiversity conservation has yet to be fully assessed globally, although some studies are available on their contribution to fisheries. The Programme of Work on Protected Areas and successive decisions of the COP (e.g. Decisions IX/18 and X/31) have accorded recognition to LMMAs, though they are currently underreported in the WDPA[nn] (see below).

Opportunities from Other Effective Area-based conservation measures (OECMs)

OECMs may contribute to all elements of Target 11, inter alia, through the conservation of important habitats, retaining and connecting fragmented ecosystems, and contributing to ecologically representative and well-connected conservation systems, integrated within wider seascape approaches. As noted above, the status of many elements of Target 11 is expected to improve significantly as reporting on OECMs advances, though there is no clear indication of potential global coverage at this time. Work will be needed to develop an understanding of OECMs within different national contexts.

Recognising and reporting on OECMs will result in substantial improvements in global coverage, with implications for other elements of Target 11. It will also provide better understanding of the range of available approaches providing effective in situ conservation of biodiversity. This will help to better recognise de facto conservation occurring outside formally designated protected areas, being carried out by a diverse set of actors.

Case studies of areas potentially meeting the definition for OECM have been described in a number of countries[oo], and in some countries OECMs are making a significant contribution to progress on Target 11. For example, in Canada there has been a five-fold increase in marine coverage since 2015, and a large portion of this has come from the designation of marine OECMs[pp] (see below).

Available information on other ABCMs in the marine realm

Locally Managed Marine Areas

Locally Managed Marine Areas (LMMA's) are protected or conserved areas that are largely or wholly managed by coastal communities and/or land-owning groups, with the support of government and partner representatives. The communities impose restrictions on areas such as 'no-take zones' and on

[nn] Bingham et al (2019). Sixty years of tracking conservation progress using the World Database on Protected Areas. *Nature ecology & evolution*, 1.

[oo] See examples in *Parks* Journal 24, Special Issue on OECMs (June 2018), https://parksjournal.com/list-of-papers/; as well as the collation of case studies submitted to the IUCN-WCPA Task Force on OECMs, https://www.iucn.org/commissions/world-commission-protected-areas/our-work/oecms/oecm-reports

[pp] Environment and Climate Change Canada (2018), Canada's conserved areas, https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/conserved-areas.html

certain equipment, practices, species or sizes of catches. These zones or restrictions allow resource and habitat recovery in over exploited areas, enabling a return to more sustainable harvest of marine resources for the community.

First recognized in Fiji, LMMA's are being replicated across coastal communities world-wide. More than 420 Indo-Pacific sites in the LMMA network involve around 600 villages and LMMAs cover more than 12,000 km^2 in 15 Pacific Island States. LMMAs are now in Madagascar and Indian Ocean. The LMMA Network is a global initiative founded in 2000 to advance LMMA practices around the world. It consists of communities, dedicated practitioners and government officials all focused on community-based marine resource management projects, providing capacity building, awareness and monitoring support. The Network is about sharing ideas and experiences to improve the performance of LMMAs while empowering greater numbers of communities to manage their marine resources in a sustainable way.

MPAs and LMMAs both contribute substantially to social, economic and environmental benefits including through food security, livelihood security, poverty alleviation, disaster risk reduction and climate change mitigation and adaptation. LMMAs may provide a significant contribution to achieving Aichi Biodiversity Target 11 and several targets of SDG 14, but LMMAs are currently under-represented in the global protected area database that is used for assessing progress towards these tar-gets (i.e. the World Database on Protected Areas). Recent studies have recorded nearly 1,000 LMMAs in the Pacific Islands which could amount to 8% of island communities. Their coverage of inshore waters has not yet been estimated but these local management approaches have encouraged many islands to adopt these as national policy approaches to coastal fisheries management and conservation.

	Fiji	**Papua New Guinea**	**Samoa**	**Solomon Islands**	**Tonga**	**Tuvalu**	**Vanuatu**	**Totals**
Marine Managed Areas (all records)	246	166	84	127	18	10	55	**745**
Marine Managed Areas "Active" (est.)	217	80	54	113	6	4	20	**518**
Locally managed marine areas	217	86	59	113	6	10	44	**558**
Community Conserved Areas	217	79	82	109	0	10	44	**564**
No-take Zones	222	94	82	115	9	3	44	**593**
MMA coverage, all records (Km^2)	10,880	3,764	209.1	1,381	10,009	75.6	89.4	**26,427**
LMMA coverage (Km^2)	10,816	59.4	119.5	941	92.9	75.6	58.1	**12,180**
No-take Zones (Km^2)	593.0	18.0	15.8	310.5	10.1	50.2	89.4	**1,107**

Marine OECMs

To date, there is no data for the global coverage of marine OECMs. However, some countries have already begun to consider marine OECMs within their own national conservation frameworks. One example of such a country is Canada.

Marine refuges in Canada

Fisheries management measures in Canadian waters that qualify as other effective area-based conservation measures are considered as “marine refuges”. These measures are designated to help protect important species and their habitats, including unique and significant aggregations of corals and sponges. Canada intends to keep these measures in place for the long-term, creating a lasting contribution to marine conservation. As of April 25, 2019, these marine OECMs cover 283,365 km^2 (4.93% of Canada’s marine territory). Marine refuges make a significant contribution to the achievement of Canada’s marine conservation targets (protecting 10% by 2020). In consultation with affected stakeholders, Canada’s Department of Fisheries and Oceans (DFO) is also exploring additional opportunities to identify or establish new measures that have biodiversity conservation benefits, so that their contributions to the marine conservation targets can be recognized[qq].

Progress in SDG 14.5

The 2030 Agenda for Sustainable Development adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries in a global partnership. They recognize that ending poverty and other deprivations must go together with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests. SDG 14 aims to conserve and sustainably use the oceans, seas and marine resources for sustainable development. SDG 14 has 10 individual targets, including Target 14.5 which states: By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information. The indicator adopted for this target includes the coverage of protected areas in relation to marine areas (14.5.1).

Progress towards the 10% target, which mirrors Aichi Target 11, was presented in section 2. Table 2, below, presents the global status MPA coverage (as well as the coverage of marine areas under national jurisdiction) at several points in time following the UN Ocean Conference in June 2017. Figure 6 shows the increase in coverage that would occur from implementation of national commitments (see above) that have been communicated through various fora. Based on these commitments, the 10% global target may be achieved by 2020, though this will require the completion of three proposed MPAs in Antarctica, being negotiation through the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR).

[qq] http://www.dfo-mpo.gc.ca/oceans/oeabcm-amcepz/refuges/index-eng.htm

Table 2. Global coverage of MPAs, and cover in areas under national jurisdiction, at several points in time since the UN Ocean Conference in June 2017.

	MPA Coverage in National Waters (%)	MPA Coverage in Global Ocean (%)
June 2017	14.45	5.68
May 2018	16.77	7.26
January 2019	17.31	7.47
October 2019	18.11	7.78

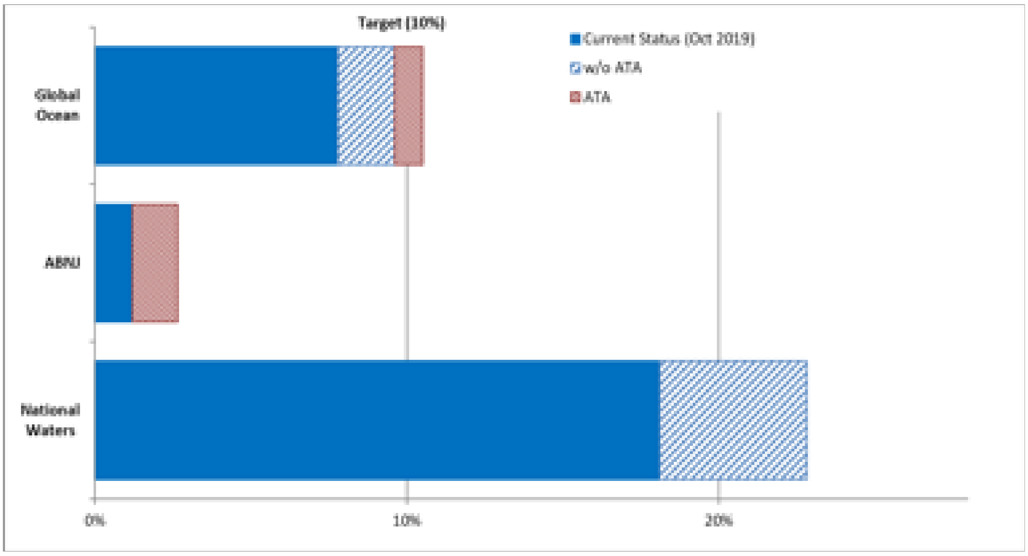

Figure 6. Increase in MPA coverage if national commitments are completed as proposed, including the difference in global coverage with and without three proposed MPAs in Antarctica (ATA).

Local and Community-based Approaches for Marine Biodiversity Conservation and Sustainable Resource Use

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Background and role in achieving global targets

Coastal indigenous peoples, local communities and small-scale fishers in both the developing and developed world have historically played a crucial role in the collective governance, management, sustainable use and conservation of coastal, island and marine environments. Despite multifaceted threats, the men and women of these communities remain beacons of hope and inspiration for the whole planet; illuminating ways to chart new courses for sustainability and navigate challenging waters in times of change. They are working hard to govern and manage their territories and areas in ways that are environmentally, socially, culturally and economically sustainable. Indigenous peoples and local communities are doing this through a diversity of approaches, cultural and livelihood practices and activities that contribute to conservation.

In the coastal, marine and island context, these mechanisms are at times also described as Locally Managed Marine Areas (LMMAs), Marine Responsible Fishing Areas (MRFAs) or ICCAs – territories of life (Territories and Areas Conserved by Indigenous Peoples and Local Communities), notwithstanding the huge variety of local names. These marine ICCAs – territories of life and the associated small-scale fisheries are collectively governed and managed to achieve benefits to both biodiversity and livelihoods by applying indigenous and local knowledge, skills and rules developed and enforced via local institutions or in a shared governance system with the State.

The Convention on Biological Diversity (CBD) and the International Union for Conservation of Nature (IUCN) strongly recognise the rights and roles of indigenous peoples and local communities. In the CBD, this recognition is enshrined in Articles 8(j) and 10(c) and a wide range of decisions of the Conference of the Parties (COP). Marine ICCAs – territories of life are recognized in several decisions since 2004, including in relation to protected areas, financial mechanisms and resource mobilisation, traditional knowledge and customary sustainable use, sustainable development, ecosystem conservation and restoration, climate change, agricultural biodiversity and taxonomy.

The UN Food and Agriculture Organization's (FAO's) Voluntary Guidelines for Securing Sustainable Small-scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines) were adopted by member countries of the FAO and were officially approved as an international instrument in June 2014. These guidelines were developed through a unique, participatory and consultative process. They are consistent with, and promote, international human-rights standards[1].

Marine ICCAs - territories of life and small-scale fisheries contribute to many of the global targets of the Strategic Plan for Biodiversity 2011-2020[2]. Specifically, SDG 14 can be achieved, in part, through the implementation of the SSF Guidelines. All over the world there are examples of community fisheries that have resisted the industrialization of fisheries, helped to combat illegal fishing, and advocated for policies that support community-based conservation and management. In some cases, indigenous peoples and local communities may wish to have their ICCAs – territories of life or parts thereof recognised and reported as protected or conserved areas. Doing so must always recognise their customary and local governance systems, rights and responsibilities to the fullness of their collective territories and be subject to free, prior and informed consent. Such appropriate recognition can help contribute to international commitments such as SDG 14 and CBD Aichi Biodiversity Target 11, among others.

Status and trends

The UN Environment World Conservation Monitoring Centre (UNEP-WCMC) offers an opportunity for indigenous peoples and local communities to register in and contribute information on their ICCAs – territories of life to the international ICCA Registry[3] and/or World Database on Protected Areas (WDPA)[4]. The WDPA currently has 1,498 protected areas listed under the governance of indigenous peoples and local communities, but of these only 29 are marine or coastal sites. Global figures from such international processes cannot be used to accurately reflect reality, as the Indigenous peoples and local community custodians of these numerous but remote areas would not usually engage with such international processes or databases, and others may avoid such designations as historical protection processes have not considered their rights[5]. Some global analyses estimate 13%[6] to more than 25%[7] of the terrestrial surface of the planet is managed for conservation by indigenous peoples and local communities, but there are no systematic surveys of how much of this is marine or coastal.

We know that an estimated 10% of the world's population directly depends on marine, coastal and island ecosystems for their livelihoods, food security, cultures and wellbeing. Small-scale fisheries currently employ over 90% of the world's fishers and fish-workers engaged in catching, processing, trading and marketing fish. About half of these fishers are women, who comprise up to 90% of the workforce in upstream 'secondary activities', such as buying and selling, processing, and related marketing activities[1]. This emphasizes the diversity of revenues and benefits generated from the local ecosystems that are conserved as the livelihood security of these communities.

Unfortunately, these social collectives and small-scale producers have historically suffered from strong marginalization, extreme poverty conditions and, in some cases, a lack of compliance of their human rights. The main threats to these initiatives usually relate to irresponsible fishing practices, industrial aquaculture, coastal infrastructure development including tourism, oil and gas extraction and intensive agriculture among others. In addition, imposed governance models and political and legal systems, disruption of small-scale and subsistence economies and multiple patterns of acculturation are eroding indigenous and local institutions, and the knowledge, practices, cultural connections and values on which they are based. The impacts are exacerbated by climate change, sea level rise, water temperature changes and ocean acidification, which impact the ecosystems upon which biodiversity and ultimately their food security depends.

Positive experiences / approaches

Throughout out the world, indigenous peoples and local communities have had very positive experiences when they govern their own marine and coastal areas for sustainable livelihoods and biodiversity, including (1) restoration of depleted fisheries and coastal ecosystems[a], (2) expanding local management[8] (see inset box), (3) advocating for legislative reforms towards local governance[b,c], (4) implementation of the SSF Guidelines [d], and (5) the mobilization of networks of fishing communities that work together on ecosystem restoration[e]. In some instances, communities advocate to protect areas they consider highly sensitive from all human uses and activities[f]. Many of these communities play the dual role of custodians and defenders of their marine and coastal areas in the face of undesired industrial developments. They are equipped to take wise, adaptable and resilient decisions in response to a changing environment based on historical experiences and local knowledge of the marine, coastal and adjacent terrestrial environments. Some communities are starting to monitor and develop information based on their traditional knowledge and management experience and others are using this in combination with external knowledge and experience.

The LMMA Network

A Locally Managed Marine Area is an "*area of nearshore waters and coastal resources that is largely or wholly managed at a local level by the coastal communities, land-owning groups, partner organizations, and/or collaborative government representatives who reside or are based in the immediate area*". The LMMA Network International, formed in 2001 around the common vision of "*Vibrant, resilient and empowered communities who inherit and maintain healthy, well-managed and sustainable marine resources and ecosystems*". Participants in the network are bound only by a common vision and commitment to respect communities as enshrined in a Social Contract. By 2018 LMMA International had played varying roles in support of a global proliferation of more than 1,000 LMMAs or similar local management practices; over 900 are recorded in the Pacific Island Countries and Territories alone with numbers in excess of 100 reported for East Africa and Western Indian Ocean (Madagascar, Kenya, Tanzania, Myanmar, Mozambique, Comoros) and Southeast Asia.

Gaps and challenges / areas in need of further work

Despite increasing support in national and international policy, most conservation paradigms are still blind to the institutions of ICCAs – territories of life and community-based fisheries, with important capacities to govern and manage marine and coastal environments[9,10]. An increase is needed in the appropriate recognition of ICCAs – territories of life and their conservation contributions as a distinct governance type for protected and conserved areas, applicable to all management categories[11,12].

In some cases, provisions are needed for the restitution of rights, access and capacity of coastal indigenous peoples and local communities, including small-scale fishers, to take responsibility for the

[a] Example from Kawawana, Senegal [https://news.mongabay.com/2018/10/senegal-after-reviving-fish-and-forests-jola-villages-tackle-new-threats/]

[b] National and local recognition often follows international recognition [https://www.cbd.int/doc/publications/cbd-ts-64-en.pdf]

[c] Example from Haítzaqv Nation, Canada [https://www.wcel.org/blog/respecting-and-taking-care-our-ocean-relatives-creation-hailzaqv-nation-oceans-act]

[d] Example from Costa Rica [https://igssf.icsf.net/en/samudra/detail/EN/4194-Sailing-from-a-.html]

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[https://ffi.maps.arcgis.com/apps/Cascade/index.html?appid=70448e12ec3c45139beca33dfc990b7a]

conservation of their ICCAs – territories of life. These communities also need to be protected from unwanted external threats by ensuring they have the opportunity to give or withhold free prior and informed consent (FPIC) for proposed activities[13]. Local, regional, and national governments and other civil society players can all play a role in respecting, upholding and strengthening this human rights-based approach to conservation. Governments can also ensure capacity and financial resources are available to support local management, as appropriate. There are many supportive international instruments (e.g., FAO, SSF Guidelines, CBD, IUCN) and all players including governments and civil society should effectively implement these and other relevant agreements and decisions.

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Marine Spatial Planning

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Background and role in achieving global targets

Marine spatial planning[1] (MSP) is a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process. It is a decision-making process that supports the conservation and sustainable use of marine biodiversity. The goals of MSP are derived from policy decisions are about the desired outcomes for marine environment.

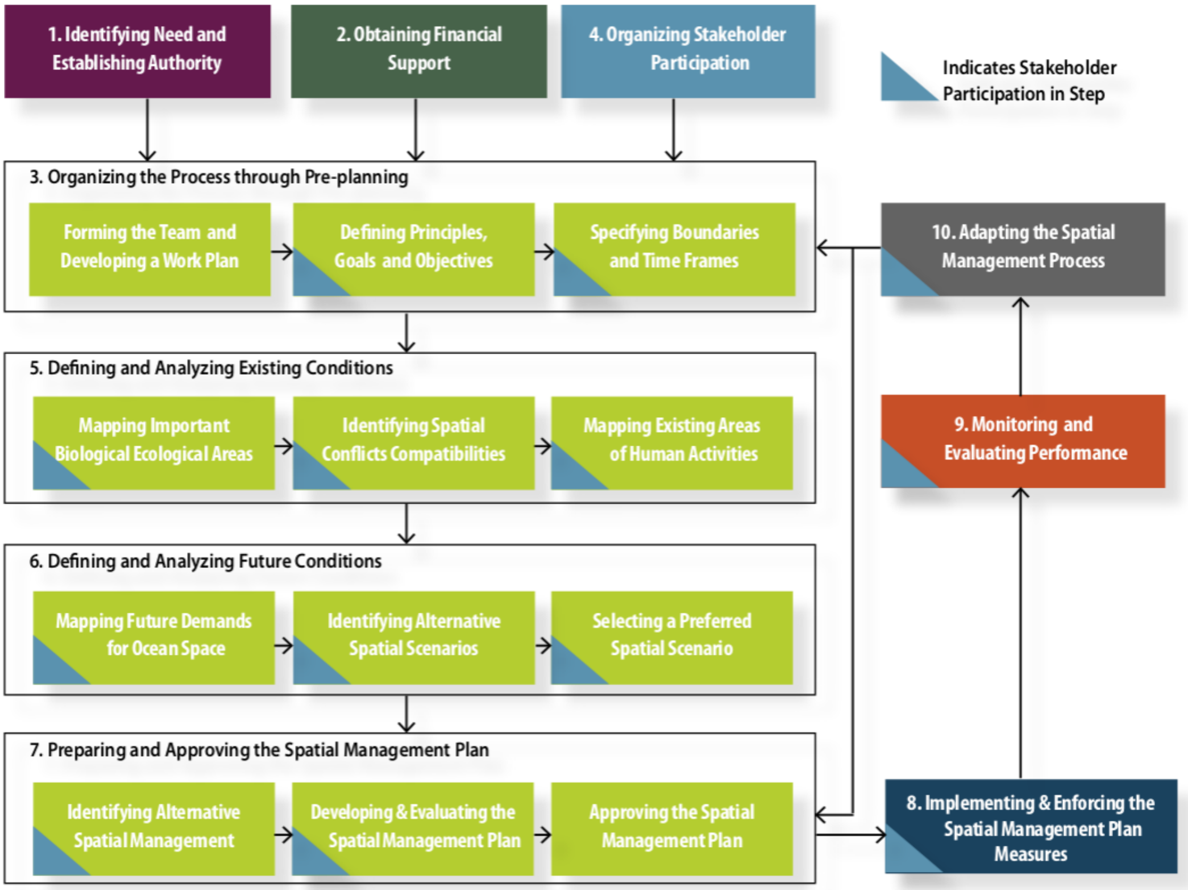
Global goals can provide the framework that these developments can be assessed against. These include the Aichi Biodiversity Targets and Sustainable Development Goals. Marine Spatial Planning can support the sustainable use and conservation of marine biodiversity by:

- Addressing the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society and across sectors, in line with Aichi Biodiversity Targets 2, 3 and 4.
- Reducing the direct pressures on biodiversity and promoting sustainable use, in line with Aichi Biodiversity Targets 5, 6, 7, 8, 9 and 10.
- Improving the status of biodiversity by safeguarding ecosystems, species and genetic diversity in line with Aichi Biodiversity Targets 11, 12 and 12.
- Enhancing the benefits to all from biodiversity and ecosystem services in line with Aichi Biodiversity Targets 14 and 15.
- Enhancing implementation through participatory planning, knowledge management and capacity building in line with Aichi Biodiversity Targets 18 and 19.

Marine spatial planning can also be directly used to implement managed to achieve SDG 14, with additional benefits to SDGs 2, 8, 9, 12, 13 and 17 through the potential economic and social benefits of sustainable use and conservation.

Decisions made through MSP are at the interface between science and policy and where the actions needed to implement policy outcomes are decided. Decisions made at this level will define what needs to change to achieve the desired policy outcomes. These decisions are implemented through the application of spatial (and sometimes non-spatial) management tools such as zoning for particular uses such as Particularly Sensitive Seas Areas[2], areas to be avoided, vessel lanes, cable exclusions, lease areas for specific purposes, area closures and marine protected areas. However, non-spatial tools can also be applied to achieve particular outcomes. The exact tool applied depends on the desired outcomes for conservation and sustainable use that have been specified for that area.

IOC-UNESCO's step-by-step approach for marine spatial planning[1] provides an excellent basis for a marine spatial planning program. It is a comprehensive way to move through the policy and decision cycles. However, as noted, experience suggests that the decision process implemented in national jurisdictions can take a number of different forms that may add to or remove from the steps identified in the IOC-UNESCO guidance.



A step-by-step approach to marine spatial planning[1].

Status and trends

Marine spatial planning is being used in a number of countries, with more programs being initiated each year, including extensive programs in EU countries[3]. Previous surveys indicate that there are significant MSP programs in East Asia, the European Union, South West Pacific and North West Pacific, including experiences from Australia, Canada, Cook Islands, EU, Seychelles and USA. The majority of these programs were initiated after 2000. IOC-UNESCO maintains a summary of global MSP activities[4] and report that approximately 70 countries have implemented MSP in some form. Many of these activities are still developing management plans[5] and relatively few have moved to implementation or revision of plans.

The overall objectives of these programs are varied and generally include: (1) conserve or restore the health of marine ecosystems, (2) maximise the overall economic values of the marine ecosystem in a sustainable way, (3) maintain or develop local, small-scale or traditional uses, and (4) facilitate the development of marine infrastructure or other economic initiatives.

The objectives of the MSP process are identified at the outset and determine what is considered and how[6]. Experiences from Europe suggest that processes that begin with an emphasis on blue growth objectives tends to optimise for economic development, while those that start from an environmental basis will tend to have an ecosystem approach focus. This is consistent with broader analysis of multiple decision processes[7], which suggested that many decision processes share a conceptual background based on adaptive management, but that the exact approach used was dictated by the objectives stated at the beginning of the process – that is, the decisions made in the policy process determine how the decision process is framed and implemented.

Positive experiences / approaches

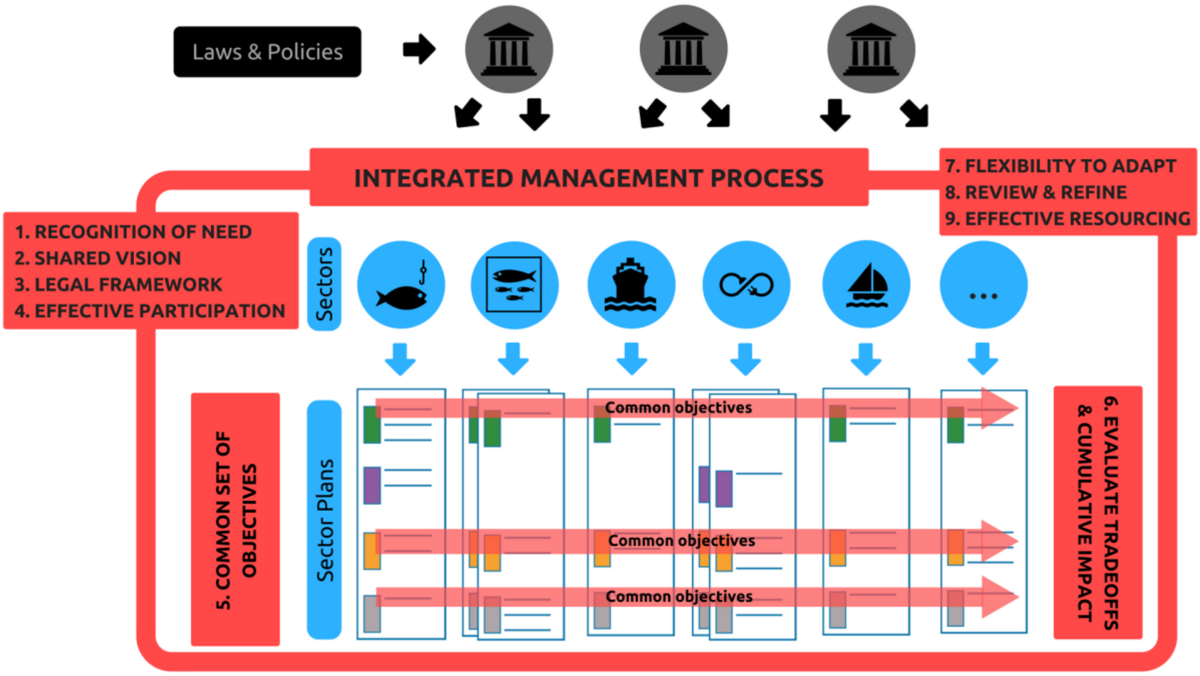
The relatively new status of MSP as a formal process means that experience is still developing in many locations. However, jurisdictions that have implemented marine spatial planning for some time (i.e. those listed with implemented plans[5]) are maintaining and reviewing their current plans, ensuring continued implementation. Experience from Europe suggests that the current use of MSP has been focused on achieving sectorial outcomes[6] and that the desired outcomes specified at the beginning of the MSP process will largely drive the participation across and within sectors. Many of the existing MSP processes are based on top-down centralised decision making, with sometimes limited levels of stakeholder participation[8]. This contrasts with many of the more recent applications of MSP (e.g. in Cook Islands[9] and Seychelles[10]) where stakeholder participation began early within the process and was extensive.

Gaps and challenges / areas in need of further work

A number of countries have implemented MSP programs, but few have reached the point of review and revision. Experience shows that there are a number of different challenges that limit the planning and implementation phases of MSP programs. These include, but are not limited to: (1) governance issues, (2) insufficient funds, (3) data and knowledge gaps, (4) human capacity, (5) poorly established goals, and (6) compliance and enforcement[3].

A real challenge for all these programs is moving from planning to implementation. Key gaps in the development of plans are often broad support for common objectives, the ability to evaluate trade-off and cumulative impacts and cost-effective monitoring programs.

As noted above, the extent that common objectives are articulated will directly determine the type of process and the sectors that are involved. Setting broad objectives that cross-sectoral boundaries will necessarily involve those sectors in decision making. Likewise, setting objectives for only one sector (e.g. shipping or environment) could limit the scope and extent of consultations.



Conceptual representation of a practical framework for Integrated Management.

Tools to estimate cumulative impacts and trade-offs are important to facilitate multi-sector decisions. Assessing cumulative impacts will allow attribution of impacts to particular sectors and facilitate an ecosystem approach. This allows the identification of which activities (or combination of activities) are responsible for which impacts. Finally, cost effective and practical monitoring will allow the assessment of the management effectiveness of the management plan. Monitoring, Control and Surveillance (MSC) needs to be tailored to the circumstances of individual jurisdictions in a way that uses available capacity. This means that MCS will look difference in different jurisdictions and highlights the need for development of MCS tools where capacity is low.

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Regional Ocean Governance in the Post-2020 Biodiversity Framework

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Background and role in achieving global targets

Many elements of international law reflect the importance of regional collaboration. The United Nations Convention on the Law of the Seas (UNCLOS) provides the legal framework for the ocean, emphasizing the duty of States to cooperate globally and regionally through competent international organizations for its implementation[1]. Parties to the Convention on Biological Diversity (CBD) are required to "*cooperate with other Contracting Parties, directly or, where appropriate, through competent international organizations, in respect of areas beyond national jurisdiction and on other matters of mutual interest, for the conservation and sustainable use of biological diversity*" (Art. 5).

A recent global assessment of national SDG implementation[2] suggests that on average, significant progress is required to achieve SDG 14 targets (as well as SDG 13 (climate action) and SDG 15 (life on land)). The assessment also indicates that, so far, no country has achieved SDG 14 targets. The recent reports from IPBES[3] and IPCC[4] confirm continuing degradation trends of marine and coastal ecosystems, which would require accelerated efforts from States to sustainably manage these ecosystems. As many SDG 14 targets are set for 2020, or 2025, it is now questionable whether they will be achieved in time.

While progress has been made towards these goals, efforts are falling short of the needed conservation of marine biodiversity to stop dangerous trends and ensure a healthy and productive ocean. The regional level offers a potential opportunity to coordinate efforts and link action towards global targets. For example, the regional level, potentially through the regional seas organizations, could be used as a regional follow-up and review mechanism to monitor and track down the achievement of the ocean related SDGs including SDG 14[5]. Many of the regional seas programs already set regional targets or objectives, which are well aligned with the ocean related SDGs.

The CBD highlights the need to integrate biodiversity conservation "*into relevant sectoral or cross-sectoral plans, programmes and policies*"[6]. The 2030 Agenda for Sustainable Development calls on the international community to address sustainability issues as a whole. This requires States and organizations to go beyond traditional single-sector and State-centric approaches to governing sustainability issues, including the ocean and coasts, and strengthen cooperation and coordination. With SDG 14 focusing on the ocean, some States have recognized the need for integrated approaches to ocean governance and have highlighted the importance of regional ocean governance in their implementation strategies[5,7]. As marine ecosystems and resources (e.g. fish stocks) do not respect national borders, and threats to biodiversity are often transboundary in nature (e.g. marine pollution), States cannot effectively manage these working in isolation. Thus, enhanced cooperation, particularly at the regional level and across sectors, has been highlighted as a key requirement for improving the conservation and sustainable use of marine and coastal biodiversity.

The regional scale is an appropriate scale for assessment and management of ecosystems and their services and can provide a platform for coordination, cooperation, and exchange across territorial and sectoral boundaries, fostering shared understanding of common and interdependent challenges to ocean ecosystem sustainability and enabling the alignment of policies[8]. Working regionally also allows for political consensus among limited numbers of States that share similar interests and challenges in the region[7,8,9,10,11]. In other cases, regional initiatives facilitate fundraising and streamlining of available financial resources to provide targeted and tailor made support for policy implementation and capacity building to address shared and common policy and capacity needs[7].

The regional level offers an efficient means to implement global marine biodiversity conservation goals by enabling the effective targeting of the specific challenges of marine regions while building on existing initiatives and strengthening cooperation amongst stakeholders and across sectors. The Marine Regions Forum 2019 made the case for regionally agreed targets and indicators that are in line with globally agreed goals and reflect regional priorities and needs. Nevertheless, ocean governance, including at the regional scale, is continuously evolving and requires coordination and cooperation across a diverse range of contexts, interests, and capacities. Effective coordination and concrete action across governance levels can be costly impeding tangible benefits for ocean sustainability in such contexts. Indeed, limited human and financial resources are a common problem for many organizations including their contracting parties and securing adequate capacities and strategic and long-term funding for global process is also a challenge. In some cases, unclear or weak legal frameworks or the lack of a comprehensive knowledge base is another challenge for common positioning or decision-making[7].

Status and trends

The current institutional and legal framework for ocean governance is fragmented and lacks mechanisms and institutions for coordination, cooperation and coherence among existing organizations to achieve global goals[11]. As a result, not all actors may be adequately equipped or aware of global sustainability goals, coordinate to actively achieve and co-implement measures (e.g. through data and knowledge exchange), or operate by modern sustainability principles, such as the precautionary principle, ecosystem approach, or transparent and inclusive decision-making processes.

The regional level is particularly important for conservation and sustainable management of marine biodiversity as these areas should be ecologically connected and regionally representative from an ecological perspective. Furthermore, the regional and sectoral levels can underpin global goals and targets by developing, implementing and enforcing regionally or sectoral-based agreements[10,11]. Regional level implementation of global goals can ensure that the specifics of each region, such as the challenges and needs are considered, but also leave flexibility to adopt new initiatives to strengthen or complement existing policies and measures, and even adopt more stringent measures going beyond global targets. One example was the effort under the Helsinki Commission to align their regional activities and targets with global targets and goals, namely Aichi Biodiversity Targets and SDG 14[12]. Similarly, the General Fisheries Commission for the Mediterranean (GFCM) developed its own strategy to implement the SDG 14[13]. International sectoral organizations also have a long-standing history bringing together States to collaborate on marine issues, including through undertaking scientific assessments, creating working groups, establishing protocols and ensuring compliance to global targets[10,11].

Some regional sea programs and regional fisheries organizations have sought to overcome longstanding sectoral divisions to enhance cooperation through developing collaborative arrangements and Memoranda of Understanding (MOUs) in a number of regions. Recognition of the role of regional cooperation and coordination for achieving global biodiversity targets could therefore be strengthened in the post-2020 global biodiversity framework pursuant to achieve coherent, effective and well-managed MPA networks with regionally coordinated robust management plans for implementation.

Positive experiences / approaches

Opportunities for improving regional ocean governance include:

- Identify regional gaps and challenges in ocean governance within the context of the post-2020 global biodiversity framework to be addressed and specifically targeted. Include regional stakeholders and funders in discussions to ensure efforts are aligned with funding mechanisms, where appropriate.
- Strengthen existing efforts and focus on the implementation of actionable solutions through regionally coordinated efforts and seeking coherence across sectors. Support regular review and monitoring of regional level governance initiatives, and consider creating indicators for good governance to be monitored at the regional level. Ensure that the value of biodiversity is adequately and appropriately integrated into cross-sectoral efforts.
- Stimulate, through the post-2020 global biodiversity framework and relevant regional processes, the development and implementation of actionable regional biodiversity targets *inter alia* through a better alignment of implementation activities and stronger coherence between governance levels.
- Focus on building capacity and strengthening institutions through regional initiatives to spur stakeholder engagement, facilitate common and comprehensive capacity development, and support coordinated action that links capacity and technology needs and funding opportunities. For example, such an initiative is underway through the 'STRONG High Seas – Strengthening Regional Ocean Governance for the High Seas' project[a] funded by the German Government's International Climate Initiative (IKI) and is initially focusing on the Abidjan Convention covering the Southeast Atlantic and the Comisión Permanente del Pacífico Sur (CPPS) covering the Southeast Pacific.
- Boost regional cooperation and exchange of science and research, and promote the development of shared knowledge on ecosystem dynamics and their response to human activities.
- Strengthen 'intra-regional', 'inter-regional' and 'region-to-global' cooperation and dialogues such as the Marine Regions Forum[b] and Sustainable Ocean Initiative Global Dialogue with Regional Seas Organizations and Regional Fishery Bodies[c] to facilitate learning processes,

[a] See: https://www.prog-ocean.org/our-work/strong-high-seas/

[b] See: https://www.prog-ocean.org/marine-regions-forum/

[c] See: https://www.cbd.int/soi/

broaden the scope of existing approaches, gather regional organizations and mechanisms from different regions, and further involve actors in the development of new solutions. This could provide the opportunity to meet informally to share experiences and good practices, discuss common initiatives, highlight options to tackle key challenges, and identify pathways toward improved cooperation for ocean sustainability.

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Monitoring and Indicators

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Background and role in achieving global targets

Monitoring and indicators [a] inform adaptive management and aid reporting under multiple environmental agreements, international commitments and intergovernmental processes such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES[1]) and the 'regular process'. In addition, monitoring is vital to inform the development of the post-2020 global biodiversity framework and related targets and indicators.

The following sections provide an overview of current status, trends and advances in ocean monitoring and indicator development. Key knowledge gaps and recommendations are also highlighted.

Status and trends

Recent reports have documented negative trends in ocean state, for example in regards to cumulative impacts[1], losses in coral and sea-grass coverage[2], ocean acidification[3] and marine debris[4]. Whilst progress has been made in regards to protected area coverage (Sustainable Development Goal (SDG) target 14.2; Aichi Biodiversity Target 11) and coastal water quality (SDG target 14.1), more effort is needed to safeguard key biodiversity areas, establish new marine protected areas and strengthen the management of existing ones[5].

To date, only 22 of the 93 environment-related SDG indicators have demonstrated good progress, while the remaining indicators either have insufficient data to assess progress, or are linked to targets which are unlikely to be met unless action is scaled up[6]. Indicators without enough data to assess global trends include those related to coastal eutrophication, marine litter and ocean acidification (SDG targets 14.1 and 14.3) and SDG indicator 14.4.1, the proportion of fish stocks within biologically sustainable levels. The deep sea remains under-sampled and under-observed[7]. Limited systematic reporting and repeat assessments for management effectiveness in protected areas[8] makes Aichi Biodiversity Target 11 difficult to assess.

Inadequate collaboration, resources and capacity need to be addressed in order to fill these gaps and support better management of marine resources and ecosystems.

Positive experiences / approaches

Several positive advances have been made in relation to ocean monitoring and indicators. Notable examples include:

[a] An indicator is defined as "*a measure or metric based on verifiable data that conveys information about more than itself*".

- The development of biodiversity indicators to measure progress towards the Aichi Biodiversity Targets through the Biodiversity Indicators Partnership (BIP). The partnership supports the integration of knowledge products into global and national-level reporting, policy making and environmental management[b] [9] and will be a key source of information for developing documentation related to the post-2020 process[10].
- Progress made by the UN Inter-Agency and Expert Group on the SDG indicators in reaching agreement on measurement methodologies for several ocean-related SDG indicators, including indicator 14.3.1 – Average marine acidity (pH)[11]. The 2020 Comprehensive Review process provides an opportunity for the global community to submit new marine-related SDG indicators and review the global indicator framework[c].
- Efforts to support countries in tracking progress toward the delivery of SDG 14, such as the step-by-step guide provided by the Global Manual on Ocean Statistics[12] for SDG targets 14.1, 14.2 and 14.5.
- Voluntary Commitments to advance SDG 14 during the UN Ocean Conference[13]. These commitments represent a multi-stakeholder pledge to address a range of ocean-related issues and challenges, including efforts to streamline ocean data.
- Efforts to draw together existing datasets to make them more accessible and user-friendly, such as Ocean+[d] and Marine Protected Planet[e]. Such initiatives provide access to data to inform decision making, policy development, and business and conservation planning.
- Recognition of the need to form partnerships and streamline ocean data observation systems, as evidenced within the roadmap[14] for implementing the UN Decade of Ocean Science for Sustainable Development (i.e. A/RES/72/73). Examples include IOC-UNESCO's Global Ocean Observing System (GOOS) and the definition of Essential Ocean Variables[f] (EOVs). Global communities of practice such as the Global Coral Reef Monitoring Network (GCRMN) provide a framework for contributing high quality data to this global system. IOC-UNESCO's Ocean Biogeographic Information System (OBIS) and the World Meteorological Organization's Global Climate Observing System (GCOS) also collate and standardise ocean-related datasets[9].
- Calls to streamline the marine data landscape by establishing a global digital ecosystem for the environment[g] [15], led by the UN Environment Programme and the UN Science Policy Business Forum. This underscores the importance of improving links between policy needs, data streams, technological solutions and technical expertise.
- Progress towards establishing global biodiversity data standards (e.g. DarwinCore[16]) and strengthening capacity necessary to mobilize data across scales, particularly in data-poor regions.

[b] For example, the World Database on Protected Areas, IUCN Red List and Global Biodiversity Information Facility contribute indicators to the BIP related to Aichi Biodiversity Target 11 and 19.

[c] The 2020 Comprehensive Review consultation will run through 8 September 2019 [http://bit.ly/2020Review_Consult]

[d] See https://oceanplus.org/

[e] See https://www.protectedplanet.net/marine

[f] Essential Ocean Variables are characterized by their relevance, feasibility and cost-effectiveness [http://www.goosocean.org/index.php?option=com_content&view=article&id=14&Itemid=114]

[g] Defined as "*a complex distributed network* or interconnected socio-technological system".

- Technological advances in satellite and in situ ocean monitoring. This includes the use of drones to patrol remote areas, assess fish stocks and support fisheries management[17]. Automatic Identification System can be used to track fishing vessels (as demonstrated by Global Fishing Watch [h] and other technologies such as Remotely Operated Underwater Vehicles, underwater hydrophones, buoy systems and SeaGliders provide data for a range of oceanographic parameters.
- Use of citizen science to support policy-making and management, such as Seasearch, SeagrassSpotter, Reef Check and Reef Life Survey[18]. Initiatives such as the International Coastal Cleanup also play a critical role in catalyzing on-the-ground action to tackle threats to marine ecosystems, such as marine debris.
- Inclusion of indigenous and local knowledge (and diverse knowledge systems) within the IPBES assessment on biodiversity and ecosystem services, recognizing the contributions of indigenous peoples and local communities to sustainability[19].

Gaps and challenges / areas in need of further work

A number of gaps and challenges remain that need to be addressed in order to improve management of ocean resources and ecosystems and support the post-2020 global biodiversity framework and related processes.

- Development of effective indicators to track progress.
  - — Fill indicator gaps for coastal eutrophication, marine litter and ocean acidification (SDG targets 14.1 and 14.3).
  - — Address gaps linked to issues such as gender to acknowledge the different needs, vulnerabilities and contributions to sustainable use of men and women.
  - — Consider how progress in achieving post-2020 goals and targets will be measured at the same time as developing the post-2020 global biodiversity framework.
  - — Adopt the ‘collect once, use many times’ approach by building on existing indicators, and promoting synergies with related conventions and intergovernmental processes, including the 2030 Agenda for Sustainable Development. Examples include the Marine Trophic Index (related to Aichi Biodiversity Target 6; SDGs 2 12 and 14 as well as CITES), the Living Planet Index (providing trends in targets and bycatch species related to Aichi Biodiversity Target 6; SDG 14), and the Ocean Health Index (Aichi Biodiversity Target 10; SDGs 2, 8, 12, 14, 15 and Ramsar)[20]. Many of these align with the indicator set of IPBES[21]. Datasets, such as those related to the conservation or restoration of seagrass and mangrove ecosystems. also support reporting on Nationally Determined Contributions under the Paris Agreement of the United Nations Framework Convention on Climate Change, while also aligning with SDG target 13.2 and indicator 13.2.1. There are further opportunities for synergies at regional scales (e.g. the EU Habitats Directive, Regional Seas Conventions).
  - — Ensure that global indicators are scalable to the local/national level and build on existing tools such as the Biodiversity Indicators Partnership (BIP) Dashboard to communicate indicator trends at different spatial scales.

[h] See https://globalfishingwatch.org/about-us/

- Supporting the uptake of ocean data to inform adaptive management.
  - Ensure that ocean data is made accessible to managers and decision-makers, and is used to inform adaptive management (i.e. by supporting sustainable management of marine protected areas and fish stocks) and providing insights into the effectiveness of management regimes.
- Resources and capacity.
  - Ensure post-2020 biodiversity targets are supported by adequate capacity and resourcing to establish baselines and monitor progress.
  - Review and prioritize investment in data necessary for delivering on the objectives of post-2020 biodiversity framework and objectives such as the UN Decade on Ecosystem Restoration and the UN Decade of Ocean Science for Sustainable Development.
  - Mobilize data in data-poor regions by encouraging the use of existing data standards and investing in capacity development, focusing on actions with multiple benefits across conventions.
  - Invest in developing flexible approaches to data collation and management that are responsive to spatial scale and levels of national capacity, combining *in situ* and remote sensing approaches.
- Streamlining data and increasing global coordination.
  - Promote global coordination and streamline protocols to establish consolidated global datasets for habitats such as coral reefs, seagrasses and mangroves, drawing on initiatives such as GCRMN and related habitat networks associated with GOOS.
  - Develop an interconnected, global network of data (i.e. a 'digital ecosystem of data'[g]) to underpin effective indicators. Capitalize on the expertise harnessed through membership of the BIP to deliver this data network.
  - Encourage systematic reporting of data within national reports, and encourage coordination where data and indicators have relevance to multiple multilateral environmental agreements.
- Consideration of land-sea interactions.
  - Focus on monitoring the state and condition of ecosystems, including the impacts of land-based activities on marine and coastal ecosystems, and their relevance for achieving sustainable blue economies.

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Ocean Science for Sustainable Development and Conservation of Marine Biodiversity

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Background and role in achieving global targets

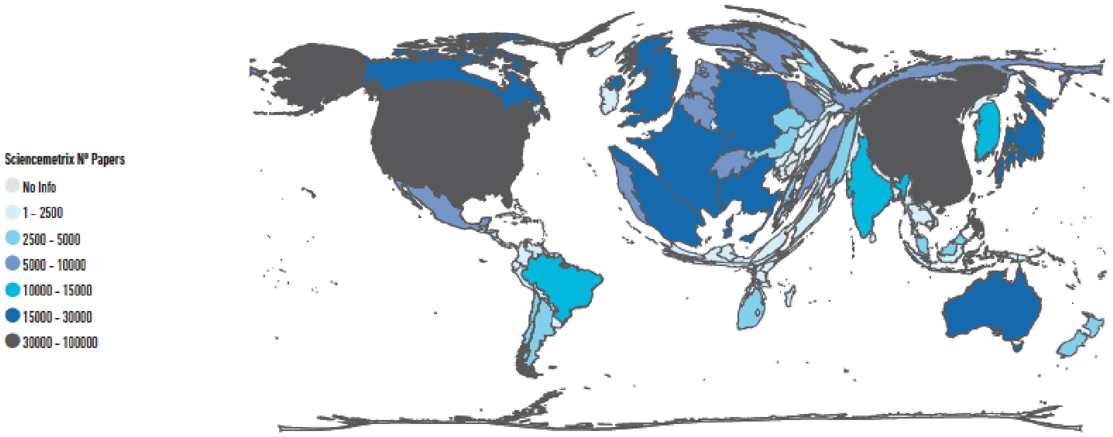
Ocean Science, as defined in the Global Ocean Science Report in 2017[1], encompasses: (1) human resources (natural, social and humanities scientists), (2) the observation and data infrastructures that support ocean science, (3) the application of knowledge generated through science for societal benefits, including capacity development through the transfer of marine knowledge, and (4) the science-policy-society interface. The ocean's significant contribution to the 2030 Agenda and the dependence of many Sustainable Development Goals (SDGs) and their targets on ocean science may not be obvious for some stakeholders. Setting ocean health on a path to sustainability is existential to achieve societal objectives as equity, sustainable economic development, food security, gender equality, mitigation of climate change, among many. Naturally, targets of the SDG 14 are especially science-intensive. Marine biodiversity assessments are critical for conservation and management, and relevant to multiple targets under SDG 14. Science has an important role in understanding and managing human pressures on the marine environment, including local impacts such as marine pollution, coastal development and resource extraction that superimpose the global impacts of climate change. However, attainment of all SDG 14 targets means a direct or indirect contribution to conservation of marine biodiversity. There is one common feature of Goals of the 2030 Agenda, the CBD, and the emerging legally-binding instrument on the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction: they are all dependent on relevant scientific knowledge.

This short note briefly and non-exhaustively reviews how ocean science is measured and organized to support such goals and provisions, and suggests what can be done to maximize the science contribution to the conservation and sustainable and equitable use of marine biodiversity in the future.

Status and trends

Tracking change in ocean science capacity and its impacts on sustainable development is still in the early stages. The first edition of Global Ocean Science Report of 2017[1] analyses the state of ocean science by reviewing human resources (natural, social and humanities scientists), availability of supporting observation and data infrastructures, the process of converting scientific knowledge into societal benefits, and efficiency of the science-policy-society interface. Ocean science includes research on multiple drivers affecting the state of the ocean and trends in ocean health and sustainability. Some of these drivers have been studied in detail, while others are emerging topics. The interaction between multiple drivers, whether it be synergistic, antagonistic or simply cumulative, is an important aspect that requires further investigation.

Nations around the world are increasing investment in ocean science, which manifests in the number of ocean scientists, research and education institutions and growing infrastructure for ocean observations[1]. There has been considerable progress in observations, data and information flows, understanding the processes in and state of the ocean, and the various services provided, especially the provision of food, support to transport, weather and climate predictions, disaster risk reduction, and some other areas. However, as indicated in the map below, gaps in human and institutional capacities or inadequate governance of ocean science, often resulting in insufficient financial support, still hamper a large number of countries, including many developing nations, from participating in ocean science and even from using the existing knowledge to act on factors that degrade ocean health and affect marine biodiversity.



Map of scientific publications of the world[1]*. The area of each country is scaled and deformed according to the number of ocean science publications. Different colours indicate a different number of publications.*

The non-proportional ocean science output is even more alarming when considering that countries in tropical areas with low ocean science output may also be highly dependent on ocean services, highly vulnerable to CO_2-related threats and to future change[2].

Development of research capacity

SDG 14 target 14.a specifically calls for "*increasing scientific knowledge, developing research capacities and transferring marine technology taking into account the IOC Guidelines and Criteria for the Transfer of Marine Technology (TMT), in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries*".

Several United Nations organizations, such as the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO), the Convention of Biological Diversity (CBD), the International Maritime Organization (IMO), the Food and Agriculture Organization (FAO) and the International Seabed Authority (ISA), conduct TMT. However, presently there is no overarching clearing-house mechanism that would facilitate accessing information on the different types of TMTs. There is a call to support capacity development in relation to the emerging legally-binding instrument on the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction. The IOC Expert Group on Capacity Development is elaborating a concept for a global clearing-house mechanism on TMT with the potential to inform several communities and ocean policy processes (e.g. such as the 2030 Agenda and CBD).

The UN Decade of Ocean Science for Sustainable Development

Recognizing the need of to boost investment in ocean science, the UN General Assembly proclaimed in 2017 the United Nations Decade of Ocean Sciences for Sustainable Development (2021-2030). This decade is anticipated to:

- Address knowledge gaps through integrated research.
- Enable action at all levels by catalyzing major investments in ocean science and stimulating the research agenda at the national level, by aligning science priorities with national commitments towards the sustainable development agenda.
- Provide a global coordinated framework responding to regionally-driven priorities to improve the scientific knowledge base through capacity development, especially SIDS and LDCs.

The second edition of the Global Ocean Science Report, to be launched at the second UN Ocean Conference in Lisbon, Portugal, in June 2020, will provide baseline information for the UN Decade in terms of by whom, where and how ocean science is conducted, connecting these findings with science outputs in terms of scientific articles and patents.

Some ocean science networks contributing to sustainability and conservation of marine biodiversity

The IOC Ocean Biogeographic Information System (OBIS) is a distributed global marine biodiversity data system and a community of data contributors and users. It develops standards, protocols and best practices, applies innovative technologies, strengthens human capacity through training, and establishes new partnerships. OBIS data collection, analysis and resulting data products are fit for ocean management, such as the description of Ecologically or Biologically Significant Marine Areas (EBSAs) or for the establishment of marine protected areas by competent authorities, for example.

Close alignment with the IOC training system 'OceanTeacher Global Academy' has helped OBIS to develop and deliver a number of training courses including on data management, data analysis, and decision support. Innovative data synthesis routines offer new types of products and applications for scientific research and decision-making. The future of OBIS is associated with co-development of a global open-source data system, enabling the scientific community to organize, document, and contribute analytical codes that interface directly with the data system, provide analyses, and share results. OBIS has provided leadership in this area through enhancements to the Darwin Core Standard allowing to document, qualitatively or quantitatively, a sampling event and the species observation within that sampling event. This standard integrates information from a variety of sampling methods and instruments, enabling OBIS to leverage external datasets containing rich environmental observations. Further challenges ahead are to mobilize the scientific community to publish more comprehensive and high-quality data more rapidly. Essential Ocean Variables[3] describing marine biodiversity will be further coordinated by the Global Ocean Observing System (GOOS) with the support of the Marine Biodiversity Observation Network of the Group on Earth Observations.

The Global Ocean Oxygen Network (GO_2NE) is an expert group established in 2016 under IOC-UNESCO. The group aims to provide a global and multidisciplinary view of the ocean deoxygenation, with a focus on understanding its multiple aspects and impacts. GO_2NE offers scientific advice to policy makers to counter this concerning trend and to preserve marine resources in presence of deoxygenation. The network's scientific work, outreach, and capacity building efforts include facilitating communication with other established networks and working groups (e.g. IOCCP, GOOS, IGMETS, GOA-ON, GlobalHAB, and WESTPAC O_2NE), improving observations systems, identifying and filling knowledge gaps, as well as developing related capacity development activities with respect to deoxygenation and impact on marine ecosystems.

In 2011, Conservation International, IUCN and IOC started the Blue Carbon Initiative, a global program to mitigate climate change through the conservation and restoration of coastal and marine ecosystems. By synthesizing knowledge of blue carbon, it provides a scientific basis for coastal carbon conservation, management and assessments, including relevant biodiversity aspects. The specific objectives are to: (1) describe the global relevance of coastal carbon, (2) establish internationally applicable standards for quantifying and monitoring coastal carbon, for data collection and quality control, (3) identify and support priority research on carbon dynamics in coastal ecosystems, (4) develop coastal conservation, planning and management guidelines for coastal carbon activities, and (5) support the development of pilot projects for carbon in coastal ecosystems.

The IOC HAB Programme is governed by the IOC Intergovernmental Panel on Harmful Algal Blooms (HABs). HABs are widespread now. They negatively affect marine life and require local and regional solutions. Continued progress in research, management, mitigation, and prediction of HABs strongly benefits from international coordination under the programmes sponsored by IOC and the Scientific Committee on Oceanic Research.

IOC is a part of the Global Ocean Acidification Observing Network (GOA-ON). The network aims to improve understanding and measurements of global ocean acidification and its impacts on marine life. It coordinates regional and national research efforts, reviews data quality and comparability, organizes targeted workshops, and provides data visualization tools. Under the 2030 Agenda for Sustainable Development, IOC-UNESCO acts as the custodian agency for the SDG indicator 14.3.1, calling for the "*average marine acidity (pH) measured at agreed suite of representative sampling stations*". The methodology provides detailed guidance to scientists and countries on how to carry out measurements following the best practices established by experts in the ocean acidification community. It explains how to report the collected information. The indicator serves as a proxy to measure reduction of the impacts of ocean acidification through scientific cooperation.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is an intergovernmental platform established by governments in 2012. The objective of the Platform is to strengthen the science-policy interface for biodiversity, including marine biodiversity, and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development. The work of IPBES can be broadly grouped into four complementary areas: (1) assessments, focusing on specific scientific issues, guidance, regions, (2) policy support: development, identification and dissemination of policy-relevant tools and methodologies, (3) development capacity and knowledge, including through fostering dialogues between science and indigenous and local knowledge, and (4) communications and outreach.

Gaps and challenges / areas in need of further work

Our knowledge of how and how much humans benefit from the ocean is still insufficient. It is not yet even possible to place an explicit value on the ecosystem services derived from the ocean[4]. Full-scope earth system science is critical to determining management options and strengthening our capacity to adapt to changes in marine. In many regions and countries, ocean research policies as well as scientific advisory mechanisms are still missing. Acquisition of credible scientific data and information requires yet major investments at the regional and national level. Enhanced international and interdisciplinary scientific collaboration paired with technology transfer and an international framework to fill technological and knowledge gaps need to be strengthened.

Traditional knowledge, based on generations of close interaction with the ocean environment, can provide a similarly important foundation for ocean ecosystem management. Therefore, systematic dialogues between ocean science and relevant indigenous communities and local knowledge holders are necessary. Education and public awareness are equally important priorities for producing an informed and engaged population and for raising the next generation of ocean citizens.

The development of the post-2020 global biodiversity framework should incorporate elements related to the capacity of marine biodiversity science. We still need to better understand the causes and consequences of marine biodiversity loss and to develop evidence-based best practices of conservation and restoration of marine ecosystem health. The UN Decade of Ocean Science for Sustainable Development (2021-2030) offers an excellent opportunity to deliver, by 2030, the science we need for the ocean we want.

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