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Item 4 of the provisional agenda*

MARINE INPUT TO HEADLINE INDICATORS OF THE DRAFT POST-2020 GLOBAL BIODIVERSITY FRAMEWORK

Note by the Executive Secretary

1. The Executive Secretary is pleased to circulate herewith, for the information of participants in the third meeting and by the Open-ended Working Group on the Post-2020 Global Biodiversity Framework, an information document on available monitoring frameworks and information to support monitoring of progress towards goals and targets of the post-2020 global biodiversity framework with respect to marine and coastal biodiversity, prepared by Mr. Nic Bax in collaboration with the Secretariat, with the financial support of the European Union.

2. The document is an updated version of document CBD/WG2020/3/INF/4/4 and is intended to provide information to supplement CBD/WG2020/3/3/Add.1, which provides information on available indicators for the post-2020 global biodiversity framework.

3. The attached information document has not been formally edited or formatted. It is being circulated in the form in which it was received.

* CBD/WG2020/3/1.

INTRODUCTION

This document provides information on the existing monitoring frameworks and expertise available to support monitoring of progress towards goals and targets of the post-2020 global biodiversity framework of relevance to marine and coastal environments. The document complements CBD/SBSTTA/24/INF/16[1] prepared by UNEP-WCMC in collaboration with the Biodiversity Indicators Partnership which provides information on available indicators for the post-2020 global biodiversity framework.

The document focusses on the primary data and monitoring frameworks needed to address headline indicators for coastal and marine environments, although these primary data will also provide the input information for many additional indicators. Monitoring frameworks are needed to produce and make accessible the data, including field and remote observations, that can support the measurable criterion of SMART goals[1]. SMART goals and targets were identified as important for monitoring progress towards the post-2020 global biodiversity framework at the second meeting of the Open-ended Working Group (OEWG)[2] in February 2020.

This document focusses on the proposed "Headline indicators" in the updated version of the draft monitoring framework as presented in the annex to document CBD/WG2020/3/3/Add. 1, released in July 2021[3]. Headline indicators in that document are described as:

> "Headline indicators should constitute a limited set of high-level indicators which capture the overall scope of the goals and targets of the post-2020 global biodiversity framework. Headline indicators, by definition, cannot capture all elements of each goal or a target and, therefore, for analytical purposes, will need to be complemented, as appropriate, with component and complementary indicators….. Priority has been given to indicators that have been agreed through an established scientific or intergovernmental process and where there is an existing body that will continue to review the indicator, as is the case, for example, for the indicators identified for monitoring implementation of the 2030 Agenda for Sustainable Development." (CBD/WG2020/3/3/Add.1, paragraph 7).

Headline indicators were not chosen to be specific to the terrestrial, freshwater or marine environment, but to be generally applicable to all environments. Because the development of appropriate marine and coastal data and metadata often lag compared to terrestrial areas[4], this document identifies the monitoring frameworks and data sources available to monitor and report progress against proposed headline indicators for marine and coastal areas. The lack of a sufficient monitoring capacity, including through national biodiversity monitoring systems, creates barriers to effective reporting against goals and targets[1]. This document aims to support Parties in accessing existing national monitoring capability and products and in identifying priority capacity needs for improved monitoring of progress towards the post-2020 global biodiversity framework of relevance to marine and coast environments. It also intends to encourage those scientific communities who lead monitoring frameworks and collect monitoring data to make their existing data more accessible and relevant for national reporting.

OTHER INTERNATIONAL PROCESSES REQUIRING SIMILAR INFORMATION FOR MONITORING PROGRESS AGAINST AGREED GOALS

The post-2020 global biodiversity framework does not stand alone in its need for improved information on status and trends in marine and coastal biodiversity and its management. There are clear links to the 2030 Agenda for Sustainable Development and its Sustainable Development Goals, the United Nations System

[1] CBD/SBSTTA/24/INF/16

[2] CBD/WG2020/2/4

[3] CBD/WG2020/3/3/Add.1

[4] Miloslavich et al. 2018. Essential ocean variables for global sustained observations of biodiversity and ecosystem changes. Global Change Biology 105(6332):10456–18.

for Environmental Economic Accounting, the United Nations Framework Convention on Climate Change (UNFCCC), and other international conventions and agreements.

There are currently more than 500 global environmental conventions or multilateral environmental agreements (MEAs), which address transboundary global environmental issues including biodiversity loss, climate change, and pollution[5]. MEAs raise awareness, gather information and promote coordinated action. While membership is often high, and the Convention on Biological Diversity is one of the highest, their implementation and effectiveness varies[6].

Improving the consistency between the data and products produced and used by these different conventions would improve the efficiency of global marine and coastal monitoring and the impact of the collected information. An assessment of 23 MEAs that address marine and coastal biodiversity, resources and the environment, identified many areas of overlap in subject matter (Table 1).

In addition to regular reporting of progress towards the goals of the MEAs, more general reviews of the status of coastal marine biodiversity take place through other processes, including the United Nations Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects ("Regular Process"), now in its second cycle of reporting[7], the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)[8], and the High Level Panel for a Sustainable Ocean Economy (HLP)[9].

Over 600 experts contributed to the first World Ocean Assessment, rising to almost 800 for the second World Ocean Assessment. The IPBES assessment was carried out by about 150 experts and about 350 contributing authors. Sixteen teams of experts contributed to the assessments of the HLP.

[5] Escobar-Pemberthy, et al.2020. Implementation of multilateral environmental agreements: rationale and design of the Environmental Conventions Index. Sustainability 12:7098. Fig. 1 redrawn with permission of author.

[6] Xu et. al. 2021. Ensuring effective implementation of the post-2020 global biodiversity targets. Nature Ecology & Evolution. https://doi.org/10.1038

[7] The United Nations Regular Process develops assessments of the world ocean and supports other ocean-related intergovernmental processes. The first World Ocean Assessment released in 2015 provided a baseline of the state of the world ocean; the second World Ocean Assessment will extend this to include an evaluation of trends and identification of gaps. https://www.un.org/regularprocess/content/second-cycle-regular-process

[8] IPBES (2019) Global Assessment Report on Biodiversity and Ecosystem Services, was delivered in 2019 following an invitation from the CBD and included an assessment of effectiveness of the Strategic Plan and Aichi Biodiversity Targets. www.ipbes.net/global_assessment_ipbes7

[9] HLP was established in 2018 by 14 serving heads of government, co-chaired by Norway and Palau to identify bold pragmatic solutions for ocean health and wealth. 16 'Blue Papers" were produced including one on critical habitats and biodiversity. See citation for Table 1.

Table 1. Examples of shared interests of 23 MEAs that also include the protection of marine and coastal biodiversity, resources and the environment[10]

Marine-relevant focus area	Number out of 23 surveyed MEAs that specify an interest in the focus area
Sustainable management of living resources	11
Sustainable management of unexploited resources	8
Habitat management or protection	6
Protected area implementation	5
Monitoring of species, habitats or environment	14
Environmental impact assessment	8
Prevention of environmental pollution	10
Biosecurity	4
International cooperation	22
Capacity development	15

Improved consistency and agreed reporting priorities would reduce the current redundancy of the existing overlapping global reporting efforts, freeing scientific experts to improve the data underlying the assessments and reducing the over-reporting burden experienced especially by developing countries. The United Nations Decade of Ocean Science for Sustainable Development provides one opportunity to further integrate marine observations in support of societal needs. Increased harmonization of reporting to international conventions and agreements would be an equally powerful driver of increased efficiency and impact for marine and coastal monitoring.

MAJOR INTERNATIONAL ACTIVITIES THAT COLLECT INFORMATION ON MARINE AND COASTAL BIODIVERSITY RELEVANT TO MONITORING PROGRESS TOWARDS THE POST-2020 GLOBAL BIODIVERSITY FRAMEWORK

Marine and coastal monitoring is supported by many international organizations. But ultimately their success is based on national reporting through government reporting to MEAs and scientific monitoring supported by a variety of organizations and made available through international collaborations. Some major international organizations supporting the sustained flow of information on the status and trends in marine and coastal biodiversity and resources are listed in Table 2. A short description of each listed organization is available in annex II.

There are also many specialist groups that support the collection and analysis of data for specific areas of marine and coastal biodiversity and resources. Those specialist groups collecting information relevant to reporting progress against the headline goals and targets of the post-2020 global biodiversity framework are listed against the relevant goal or target in Annex 1.

The need for capacity development to "facilitate the use of Headline indicators at the national level" is clearly identified[11]. This may be the case especially for least developed and small island developing States where the ocean environment may be of high importance but resources for its monitoring are few.

[10] Data summarized from Table 4 of Rogers, et al. 2020. Critical Habitats and Biodiversity: Inventory, Thresholds and Governance. Washington, DC: World Resources Institute. Available online at www.oceanpanel.org/blue-papers/critical-habitats-and-biodiversity-inventory-thresholds-and-governance. The 23 MEAs are listed in that report. It is not an exhaustive list; regional and sub-regional conventions and voluntary agreements are not included. See for example, Friedman, et al. 2018. Mainstreaming biodiversity in fisheries. Marine Policy 95:209-220.

[11] CBD/WG2020/3/3, para. 10.

Table 2. Major international groups supporting the flow of information to support global reporting on marine biodiversity and resources

International Group	Supported Data
Food and Agriculture Organization of the United Nations (FAO)	State of the World Fisheries and Aquaculture; State of the World's Aquatic Genetic Resources for Food and Agriculture; Global Forest Resources Assessment (includes mangroves); IUU Fishing governance indicator; Code of Conduct for Responsible Fisheries;
United Nations Environment Programme (UNEP), Regional Seas Programme	Core set of 22 indicators developed linked to SDGs. Detailed advice prepared for four indicators
UNEP World Conservation Monitoring Centre (UNEP-WCMC)	World Database on Protected Areas; Global Database on Protected Area Management Effectiveness; Ocean Data Viewer; Ocean+ Library; Biodiversity Indicators Partnership
International Oceanographic Commission of UNESCO (IOC)	Ocean Biodiversity Information System; Global Ocean Science Report; Global Ocean Observing System set of 10 biological Essential Ocean Variables (EOVs) supported by expert groups; Ocean Best Practices Repository; Global Climate Observing System* with six relevant Essential Climate Variables.
Marine Biodiversity Observing Network (MBON)	Marine thematic group under GEOBON helps coordinate individual monitoring programs through Essential Biodiversity Variables (EBVs)**
International Union for Conservation of Nature (IUCN)	Red List Index includes marine mammals (e.g. cetaceans), birds, and reef building corals. Sharks and rays have been recently reviewed and are ready for inclusion in index. Reef building corals are being reviewed.

* Marine areas of GCOS sit within IOC; **MBON, GOOS and OBIS have a memorandum of understanding to jointly support development of EOVs and EBVs.

The United Nations Decade of Ocean Science for Sustainable Development (2021-2030) ('the Ocean Decade')[12] provides a common framework to ensure that ocean science can fully support countries' actions to sustainably manage the oceans and, more particularly, to achieve the 2030 Agenda for Sustainable Development. One aim of the Ocean Decade is to expand systematic and sustained observations to all ocean basins and depths and promote free and open data sharing. This will have direct benefits to monitoring progress towards the goals and targets of the post-2020 global biodiversity framework relevant to marine and coastal biodiversity. A formal request from the Convention on Biological Diversity for support from the scientific community to meet the monitoring requirements of the post-2020 global biodiversity framework would help focus science conducted under the Ocean Decade and help ensure support is coordinated and aligned with existing initiatives supporting information flow for the oceans as identified in Table 2 and with the newly approved UN SEEA-Ocean[13].

[12] The United Nations Decade of Ocean Science for Sustainable Development was proclaimed in 2017 by the United Nations General Assembly and seeks to stimulate ocean science and knowledge generation to reverse the decline of the state of the ocean system and catalyse new opportunities for sustainable development. https://www.oceandecade.org

[13] https://sdg.iisd.org/news/statistical-commissions-52nd-session-advances-beyond-gdp-approach/

INDIGENOUS, LOCAL AND CULTURAL KNOWLEDGE SYSTEMS

Indigenous local, and cultural knowledge systems provide an important source of information while indigenous peoples and local communities are essential partners in ocean research, monitoring and management, perhaps especially in more remote areas, rarely visited by academic scientists.

The importance of appropriate engagement with indigenous peoples and local communities to ensure respect for the cultural and intellectual heritage of indigenous peoples and local communities and other local communities is recognized in several international agreements, including the Tkarihwaié:ri; Code of Ethical Conduct, developed under the Convention on Biological Diversity[14]. But more actions to implement these agreements is required especially at higher levels of power sharing including Indigenous co-governance[15] where Indigenous people participate in setting priorities, resource allocation, maintaining ownership of their cultural knowledge and establishing legal agreements to protect and manage Indigenous knowledge[16]. For example, while the majority of Australian marine scientists surveyed in 2019 recognized the mutual benefits of engaging with Indigenous people and expected engagement to increase, most marine research projects in Australia currently do not engage Indigenous people and are too short to develop sustained collaboration[17]. The potential of increased Indigenous people participation in research, monitoring and management is evidenced by achievements on Indigenous-led collaboratively governed marine areas through Indigenous Protected Areas, Sea Country Planning, negotiated agreements (such as the Traditional Use of Marine Resources Agreements within the Great Barrier Reef Marine Park) and other forms of MPAs in Australia[18]. Locally Managed Marine Areas (LMMA) are community-based initiatives to support marine conservation and sustainable use especially in the Indo-Pacific region. The awarded LMMA Network shares best practices, lessons learned and helps represent many communities[19].

Indigenous participation in monitoring sea country in Australia continues to grow with Indigenous Rangers engaged in tagging, tracking and aerial surveys of endangered marine animals, mapping coastal habitat, surveying for marine plastic debris and monitoring restoration activities to name just a few. The combination of new technologies and communication pathways that link remote communities to national monitoring and facilitate a two-way exchange of information hold great promise for improved monitoring of some of the most remote coastal areas.

Approach taken in this document

This document focuses on information to support the monitoring of progress towards the headline indicators of the first draft monitoring framework as presented in the annex to document CBD/WG2020/3/3 Add. 1, released in July November 2021[3]. Indicators in the proposed framework were developed to meet the following criteria:

(a) The data and metadata related to the indicator are (or will be) publicly available;

(b) The methodology for the data product is either published in a peer reviewed academic journal or has gone through a scientific peer review process;

(c) There is evidence that the indicators will be regularly updated with a time lag of less than five years between updates;

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[14] Convention on Biological Diversity. 2011. The Tkarihwaieé:ri: Code of Ethical Conduct Ensure Respect for the Cultural and Intellectual Heritage of Indigenous and Local Communities. Montreal: Secretariat of the Convention on Biological Diversity

[15] Hill, et al. 2012. A typology of indigenous engagement in Australian environmental management: implications for knowledge integration and social-ecological system sustainability. Ecol. Soc. 17:123. doi: 10.5751/ES-04587-170123.

[16] Janke, et al. 2018. Indigenous Knowledge: Issues for Protection and Management, IP Australia, Commonwealth of Australia. Available online at: https://www.ipaustralia.gov.au/sites/default/files/ipaust_ikdiscussionpaper_28march2018.pdf

[17] Hedge, et al. 2020. Perceptions, Motivations and Practices for Indigenous Engagement in Marine Science in Australia. Front. Mar. Sci.7. https://doi.org/10.3389/fmars.2020.00522

[18] Rist, P., W. Rassip, D. Yunupingu, J. Wearne, J. Gould, M. Dulfer-Hyams, E. Bock, and D. Smyth. 2019. Indigenous protected areas in Sea Country: Indigenous-driven collaborative marine protected areas in Australia. 29:138-151.

[19] https://lmmanetwork.org/

(d) There is an existing mechanism for maintaining the indicators, including, for example, by a member of the Biodiversity Indicators Partnership, an intergovernmental organization or a well-established scientific or research institution.

Information here denotes both established indicators, including some of those found in the analysis of the Biodiversity Indicators Partnership[11], and monitoring frameworks that have or are developing indicators that meet the above four criteria. Monitoring frameworks provide the primary data that support development and reporting of most indicators. Given suitable direction and support, monitoring frameworks have the capacity to develop indicators targeted at monitoring progress towards headline indicators of the post-2020 global biodiversity framework.

Primary data in marine and coastal areas are most frequently collected by local jurisdictions either through government, academic or joint ventures. Even remotely sensed data require local on-ground verification and calibration. Identifying and building priority collaborations will increase the likelihood that suitable indicators are developed and the necessary data collected at the national level for national reporting. The draft conceptual framework identified to improve coordination of reporting of progress towards Aichi Target 6 by the Convention on Biological Diversity, FAO and Regional Fisheries Bodies[20] is one such example.

Preparation of this document included inputs from many experts in marine and coastal biodiversity and resources and their monitoring. There are undoubtedly additional marine and coastal indicators and monitoring frameworks relevant to reporting progress towards headline indicators of the post-2020 global biodiversity framework that could be included. The potential indicators and frameworks in this document represent a knowledge base that can be built upon as familiarity with the headline indicators develops.

IDENTIFIED GAPS IN INDICATORS AND MONITORING FRAMEWORKS

There are suitable indicators and monitoring frameworks to measure marine and coastal progress against most of the proposed headline goals and targets, although there are still data gaps compared to terrestrial areas. This is due to a number of factors: the vastness and remoteness of ocean which covers almost 71 per cent of the planet surface makes data collection expensive; almost two-thirds of oceans are beyond national governance complicating their management and measurement; the ocean is on average almost 3.7km deep (maximum >11km) and remote sensing cannot be used to measure beneath the surface of the water, and; the ocean is highly interconnected so that much biodiversity is transboundary.

These difficulties in ocean observing have resulted in a lack of investment in ocean science. On average only 1.7 per cent of national research budgets are allocated for ocean science, despite the facts that 3 billion people depend on it for their livelihoods, and it contributed an estimated US$1.5 trillion to GDP in 2010[21]. Increasing this investment and increasing global collaboration are key goals of the United Nations Decade on Ocean Science for Sustainable Development and will be necessary to support the post-2020 global biodiversity framework. Increased attention needs to be given to extending available information globally to developing countries including least developed countries and small island developing States, and to areas managed or used by indigenous peoples and local communities.

There are clear gaps in indicators that cross all environmental domains. In addition, there are indicators specific to marine and coastal areas would benefit from a more rapid development, for example:

- Extend measurements of extent of selected marine and coastal natural ecosystems to all regions and identify ongoing development of a saltmarsh monitoring expert group (**A0.1**);
- Update Red list assessments for marine and coastal species groups not currently included in Red list indices, especially under-represented invertebrate groups (**A0.3**);
- Develop a species habitat index for marine and coastal areas (**A0.4**) based primarily on existing data and indicators.

[20] UNEP/CBD/SBSTTA/20/INF/27

[21] IOC 2020. Global Ocean Science Report 2020. https://en.unesco.org/gosr

- Improve monitoring of the effectiveness of Marine Protected Areas from implementation of management measures to outcomes (**T3.0.1**)
- Improve information on the management and control of marine invasive species (**T5.0.1** and **T5.0.2**)
- Improve in situ measurement of marine and coastal pollution (**T6.0.1** and **T6.0.2**)
- Include marine and coastal values in UN SEEA monitoring (**T13.0.2**)
- Continue development of agreed systems to monitor reduction in harmful fishing subsidies (**T17.0.2**)

FINAL REMARKS AND CONCLUSIONS

Existing marine and coastal monitoring frameworks and indicators are available to monitor progress against the majority of headline indicators of the proposed post-2020 global biodiversity framework. Although marine and coastal information underpins the logic of many of the headline indicators, the monitoring of marine and coastal species and ecosystems for these indicators is often underrepresented in comparison to terrestrial monitoring. Thus, there is a need to increase support to increase geographic or taxonomic coverage.

There is a disconnect between much of current marine research and monitoring and the support of indicators to monitor progress towards the goals and targets of many MEAs, including the proposed post-2020 global biodiversity framework. Improved coordination between MEAs to use and reuse indicators and data would encourage researchers and monitoring frameworks to collect and distribute data relevant to assessing progress towards the goal and targets of multiple MEAs. Building on existing regional initiatives such as the UNEP Regional Seas Programme or on established training through the regional IOC Regional Sub-Commissions would support existing frameworks and reduce complicating and already cluttered landscape.

Composite indicators that include data on many species or systems can be difficult to interpret and global trends can be driven by a minority of species. Caution needs to be exercised in using highly aggregated composite indices to monitor progress. The sensitivity and specificity of composite indices against change in headline indicators should be evaluated before their use and the underlying disaggregated data for the composite indicators should be publicly available to support more detailed analysis.

Mobile marine species and systems, especially pelagic and mesopelagic species and systems, may extend through several jurisdictions. Regional assessments may be more appropriate for highly migratory species and highly connected habitats.

Coverage of marine and coastal research, data and indicators is biased towards more developed countries. Improving the accuracy of assessing global progress on issues related to marine and coastal biodiversity under the proposed post-2020 global biodiversity framework will require increased efforts to support developing countries, including least developed countries and small island developing States.

Engaging indigenous peoples and local communities (indigenous peoples and local communities) in marine and coastal monitoring will increase coverage of some of the more remote marine and coastal areas and provide an opportunity to increase inclusion of indigenous local, and cultural knowledge systems in indicator and monitoring frameworks.

The United Nations Decade of Ocean Science for Sustainable Development provides a mechanism to improve monitoring of the marine and coastal biodiversity. Early engagement by the Convention on Biological Diversity in the Ocean Decade would assist in prioritizing those aspects relevant to the proposed post-2020 global biodiversity framework.

Annex I

MONITORING FRAMEWORKS OR PROGRAMMES AVAILABLE TO SUPPORT MONITORING OF PROGRESS TOWARDS PROPOSED HEADLINE INDICATORS OF THE DRAFT POST-2020 GLOBAL BIODIVERSITY FRAMEWORK RELEVANT TO MARINE AND COASTAL BIODIVERSITY

(*Details on each framework/ program and current status are provided in annex III)*

Proposed goal or target[22]	Proposed indicators[23],[24]	Potential marine and coastal monitoring frameworks/programmes to inform progress[25]
Goal A: The integrity of all ecosystems is enhanced, with an increase of at least 15 per cent in the area, connectivity and integrity of natural ecosystems, supporting healthy and resilient populations of all species, the rate of extinctions has been reduced at least tenfold, and the risk of species extinctions across all taxonomic and functional groups, is halved, and genetic diversity of wild and domesticated species is safeguarded, with at least	A.0.1 Extent of selected natural and modified ecosystems (i.e. forest, savannahs and grasslands, wetlands, mangroves, saltmarshes, coral reef, seagrass, macroalgae and intertidal habitats)	*Mangroves*: FAO Global Forest Resources Assessment; UNEP-WCMC's Ocean Data Viewer; Global Mangrove Watch, Global Mangrove Alliance *Saltmarshes*: UNEP-WCMC's Ocean Data Viewer *Coral reef*: Global Coral Reef Monitoring Network (GCMRN); Allen Coral Atlas; UNEP-WCMC's Ocean Data Viewer *Seagrass*: C-GRASS; UNEP-WCMC's Ocean Data Viewer *Macroalgae:* Global Ocean Macroalgal Observing Network (GOMON) *Intertidal Habitats*: UNEP-WCMC's Ocean Data Viewer *Wetlands*: Ramsar Site Management Effectiveness Tracking Tool (R-METT)
	A.0.2 Species Habitat Index	IPCC Report reports changes in distribution and habitats of marine organisms Marine metabolic habitat maps ratio of oxygen supply to resting metabolic oxygen demand Marine Heatwave Tracker has daily records for all oceans starting in 1982
	A.0.3 Red list index	Global Coral Reef Monitoring Network (GCMRN) preparing update to 2008 assessment IUCN Cetacean Specialist Group – most species and subspecies updated in last 3 years IUCN Shark Specialist Group – in process of developing Red list index from 1200 recent species assessments

[22] The 2050 goals and 2030 milestones and targets are as proposed in document CBD/WG2020/3/3.

[23] The headlines indicators are the same as in document CBD/WG2020/3/3/Add.1.

[24] Indicators marked with an asterisk "*" are not yet developed

[25] Two asterisks (**) indicate that additional information will be provided for the third meeting of the Working Group on the Post-2020 Global Biodiversity Framework in an information document.

Proposed goal or target[22]	Proposed indicators[23,24]	Potential marine and coastal monitoring frameworks/programmes to inform progress[25]
90 per cent of genetic diversity within all species maintained. *Milestone A.1* Net gain in the area, connectivity and integrity of natural systems of at least 5 per cent. *Milestone A.2* The increase in the extinction rate is halted or reversed, and the extinction risk is reduced by at least 10 per cent, with a decrease in the proportion of species that are threatened, and the abundance and distribution of populations of species is enhanced or at least maintained. *Milestone A.3* Genetic diversity of wild and domesticated species is safeguarded, with an increase in the proportion of species that have at least 90 per cent of their genetic diversity maintained.		*Additional information* FAO Fisheries Resources Monitoring System (FIRM) provides assessments for 539 fished stocks, updated every two years.
	A.0.4 The proportion of populations within species with a genetically effective population size>500	GEOBON, see: https://www.sciencedirect.com/science/article/pii/S0006320720307126 *Additional Information* Estimating genetically effective population size for large marine populations is problematic. Other more reliable census methods are available but all require high sampling intensity.

Proposed goal or target[22]	Proposed indicators[23,24]	Potential marine and coastal monitoring frameworks/programmes to inform progress[25]
Goal B: Nature's contributions to people have been valued, maintained or enhanced through conservation and sustainable use, supporting the global development agenda for the benefit of all. *Milestone B.1* Nature and its contributions to people are fully accounted and inform all relevant public and private decisions. *Milestone B.2* The long-term sustainability of all categories of nature's contributions to people is ensured, with those currently in decline restored, contributing to each of the relevant Sustainable Development Goals.	B.0.1 National environmental economic accounts of ecosystem services*	UN System of Environmental Economic Accounting: https://seea.un.org/ecosystem-accounting includes reference to marine environment which is to be enhanced through SEEA-Ocean *Additional Information* Ocean Accounts Framework being developed and tested by the Global Ocean Accounts Partnership
Goal C: The benefits, from the utilization of genetic resources are shared fairly and equitably, with a substantial increase in	C.0.1 Monetary benefits from utilization of genetic resources as a result of an ABS agreement, including traditional knowledge*	Convention on Biological Diversity: An estimate of monetary benefits would fill a key knowledge gap; however, additional coordination would be required** *Additional Information* Marine genetic resources included under BBNJ negotiations

Proposed goal or target[22]	Proposed indicators[23,24]	Potential marine and coastal monitoring frameworks/programmes to inform progress[25]
both monetary and non-monetary benefits shared, including for conservation and sustainable use of biodiversity. *Milestone C.1* The share of monetary benefits received by providers, including holders of traditional knowledge, has increased. *Milestone C.2* Non-monetary benefits, such as the participation of providers, including holders of traditional knowledge, in research and development, has increased.	C.0.2 Number of research and development results or publications shared as a result of an ABS agreement*	See above
Goal D: The gap between available financial and other means of implementation, and those necessary to achieve the 2050 Vision, is closed.	D.0.1. Funding for implementation of the global biodiversity framework*	Convention on Biological Diversity: To be collected through National Biodiversity Finance Plans *Additional Information* Allocation of funding for ocean science collated in Global Ocean Science Report 2020 https://en.unesco.org/gosr
	D.0.2. Indicator on national biodiversity planning processes and means of implementation*	See above
Target 1. Ensure that all land and sea areas globally are under integrated biodiversity-	1.0.1 Percentage of land and seas covered by	Convention on Biological Diversity: Collected through national reporting and would link with SDG 6.5.1, 14.2.1 and 15.2.1.

Proposed goal or target[22]	Proposed indicators[23,24]	Potential marine and coastal monitoring frameworks/programmes to inform progress[25]
inclusive spatial planning addressing land- and sea-use change, retaining existing intact and wilderness areas.	spatial plans that integrate biodiversity*	UNEP SDG Indicator 14.2.1 Proportion of national exclusive economic zones managed using ecosystem-based approaches *Additional Information* Marine Spatial Planning initiatives http://msp.ioc-unesco.org/world-applications/overview/ Integrated Coastal Zone Management
Target 2. Ensure that at least 20 per cent of degraded freshwater, marine and terrestrial ecosystems are under restoration, ensuring connectivity among them and focusing on priority ecosystems.	2.0.1 Percentage of degraded or converted ecosystems that are under restoration	Task Force on Monitoring in support of the United Nations Decade on Ecosystem Restoration: 2021-2030 http://www.fao.org/in-action/forest-landscape-restoration-mechanism/resources/detail/es/c/1315004/ *Additional Information* Task Force encompasses all ecosystems (natural, semi-natural, production, cultural and urban) including the marine realm.
Target 3. Ensure that at least 30 per cent globally of land areas and of sea areas, especially areas of particular importance for biodiversity and its contributions to people, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based	3.0.1 Coverage of Protected areas and OECMs (by effectiveness)	World Database on Protected Areas UNEP-WCMC Ocean+ Habitats High Level Panel - Critical Habitats and Biodiversity assessed coverage of 12 marine ecosystems. Global Database on Protected Area Management Effectiveness (GD-PAME) *Additional information* Reef Life Survey https://reeflifesurvey.com/ Maxwell et al. (2020) assessed coverage of marine ecoregions and KBAs using publicly available online data, although marine KBAs are currently incomplete.

Proposed goal or target[22]	Proposed indicators[23,24]	Potential marine and coastal monitoring frameworks/programmes to inform progress[25]
conservation measures, and integrated into the wider landscapes and seascapes.		Areas meeting EBSA criteria provide another measure of effectiveness https://www.cbd.int/ebsa/
Target 4. Ensure active management actions to enable the recovery and conservation of species and the genetic diversity of wild and domesticated species, including through ex situ conservation, and effectively manage human-wildlife interactions to avoid or reduce human-wildlife conflict.	4.0.1 Proportion of species populations that are affected by human wildlife conflict	IUCN SSC Human-Wildlife Conflict Task Force: https://www.hwctf.org/ IWC-CC Ship Strike database: https://iwc.int/ship-strikes *Additional Information* Task Force includes aquatic species and marine events including vessel collisions and the culling of marine predators.
	4.0.2 Number of plant genetic resources for food and agriculture secured in medium or long-term conservation facilities	
Target 5. By 2030, ensure that the harvesting, trade and use of wild species of fauna and flora is legal, at sustainable levels and safe.	5.0.1 Proportion of wildlife that is harvested legally and safely*	FAO SDG Indicator 14.6.1 Progress in implementing instruments to combat IUU fishing under development
	5.0.2 Proportion of fish stocks within biologically sustainable level	FAO SDG Indicator 14.4.1 Proportion of fish stocks within biologically sustainable levels
Target 6. Manage pathways for the introduction of invasive alien species, preventing, or reducing their rate of introduction and establishment	6.0.1 Rate of invasive alien species spread	International Convention for the Control and Management of Ships' Ballast Water and Sediments, (2004) (86 Contracting Parties)

Proposed goal or target[22]	Proposed indicators[23,24]	Potential marine and coastal monitoring frameworks/programmes to inform progress[25]
by at least 50 per cent, and control or eradicate invasive alien species to eliminate or reduce their impacts, focusing on priority species and priority sites.		
Target 7. Reduce pollution from all sources to levels that are not harmful to biodiversity, ecosystem functions or human health, including by reducing nutrients lost to the environment by at least half, and pesticides by at least two thirds and eliminating the discharge of plastic waste.	7.0.1 Index of coastal eutrophication potential (excess nitrogen and phosphate loading, exported from national boundaries)	SDG Indicator 14.1.1a UNEP GEO Blue Planet Chlorophyll Global Analysis *Additional Information* OBIS Harmful Algal Bloom (HAB OBIS) MARPOL (1973/1978) (159 Contracting Parties)
	7.0.2 Plastic debris density	SDG Indicator 14.1.1b
	7.0.3 Pesticide use per area of cropland	
Target 8. Minimize the impact of climate change on biodiversity, contribute to mitigation and adaptation through ecosystem-based approaches, contributing at least 10 GtCO2e per year to global mitigation efforts, and ensure that all mitigation and adaptation efforts avoid	8.0.1 National green-house gas inventories from land use and land use change	IPCC: https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html Mangrove forests, tidal marshes and seagrass meadows are included as Chapter 4 ‘Coastal Wetlands” in the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. https://www.ipcc-nggip.iges.or.jp/public/wetlands/pdf/Wetlands_separate_files/WS_Chp4_Coastal_Wetlands.pdf Globally, 20–90 per cent of current coastal wetlands are projected to be lost by 2100. https://www.ipcc.ch/srocc/chapter/summary-for-policymakers/

Proposed goal or target[22]	Proposed indicators[23,24]	Potential marine and coastal monitoring frameworks/programmes to inform progress[25]
negative impacts on biodiversity.		
Target 9. Ensure benefits, including nutrition, food security, medicines, and livelihoods for people especially for the most vulnerable through sustainable management of wild terrestrial, freshwater and marine species and protecting customary sustainable use by indigenous peoples and local communities.	9.0.1 National environmental-economic accounts of benefits from the use of wild species	SEEA: https://seea.un.org/ecosystem-accounting (disaggregation of accounting information from Goal B) *Additional Information* FAO Code of Conduct for Responsible Fisheries (biannual survey) including Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication. SDG Indicator 14.b.1 Progress by countries in the degree of application of a legal/regulatory/policy/institutional framework which recognizes and protects access rights for small-scale fisheries.
Target 10. Ensure all areas under agriculture, aquaculture and forestry are managed sustainably, in particular through the conservation and sustainable use of biodiversity, increasing the productivity and resilience of these production systems.	10.0.1 Proportion of agricultural area under productive and sustainable agriculture	FAO State of the World Fisheries and Aquaculture (SOFIA) The State of the World's Aquatic Genetic Resources for Food and Agriculture (SoWaqGR)
	10.0.2 Progress towards sustainable forest management (Proportion of forest area under a long-term forest management plan)	

Proposed goal or target[22]	Proposed indicators[23,24]	Potential marine and coastal monitoring frameworks/programmes to inform progress[25]
Target 11. Maintain and enhance nature's contributions to regulation of air quality, quality and quantity of water, and protection from hazards and extreme events for all people	11.0.1 National environmental-economic accounts of regulation of air quality, quality and quantity of water, and protection from hazards and extreme events for all people, from ecosystems	SEEA: https://seea.un.org/ecosystem-accounting (disaggregation of accounting information from Goal B) *Additional Information* Church, et al. 2013: Sea Level Change. In the Fifth Assessment Report of the Intergovernmental Panel on Climate Change
Target 12. Increase the area of, access to, and benefits from green and blue spaces, for human health and well-being in urban areas and other densely populated areas.	12.0.1 Average share of the built-up area of cities that is green/blue space for public use for all	SDG 11.7.1: UN-Habitat: https://urban-data-guo-un-habitat.hub.arcgis.com/documents/metadata-on-sdg-indicator-11-7-1/explore *Additional Information* About 40 per cent of world population lives within 100km of coast. Indicators for Goal A may be relevant here.
Target 13. Implement measures at global level and in all countries to facilitate access to genetic resources and to ensure the fair and equitable sharing of benefits arising from the use of genetic resources and, as relevant, of associated traditional knowledge, including through mutually agreed terms and prior and informed consent.	13.0.1 Indicators of operational legislative, administrative or policy frameworks which ensure fair and equitable sharing of benefits, including those based on PIC and MAT*	Convention on Biological Diversity: This index would need to be developed to capture all ABS mechanisms in a coherent way.** *Additional Information* Marine genetic resources included under BBNJ negotiations

Proposed goal or target[22]	Proposed indicators[23,24]	Potential marine and coastal monitoring frameworks/programmes to inform progress[25]
Target 14. Fully integrate biodiversity values into policies, regulations, planning, development processes, poverty reduction strategies, accounts, and assessments of environmental impacts at all levels of government and across all sectors of the economy, ensuring that all activities and financial flows are aligned with biodiversity values.	14.0.1 Extent to which national targets for integrating biodiversity values into policies, regulations, planning, development processes, poverty reduction strategies and accounts at all levels, ensuring that biodiversity values are mainstreamed across all sectors and integrated into assessments of environmental impacts	SDG 15.9.1a: Convention on Biological Diversity: https://unstats.un.org/sdgs/metadata/?Text=&Goal=15&Target=15.9
	14.0.2 Integration of biodiversity into national accounting and reporting systems, defined as implementation of the System of Environmental-Economic Accounting	SDG 15.9.1b: UNSD: https://unstats.un.org/sdgs/metadata/?Text=&Goal=15&Target=15.9 *Additional Information* Marine environmental assets proposed to include marine ecosystems under Goal A Ocean Accounts link SNA, SEEA CF and SEEA EA

Proposed goal or target[22]	Proposed indicators[23,24]	Potential marine and coastal monitoring frameworks/programmes to inform progress[25]
Target 15. All businesses (public and private, large, medium and small) assess and report on their dependencies and impacts on biodiversity, from local to global, and progressively reduce negative impacts, by at least half and increase positive impacts, reducing biodiversity-related risks to businesses and moving towards the full sustainability of extraction and production practices, sourcing and supply chains, and use and disposal.	15.0.1 Dependencies and impacts of businesses on biodiversity	Convention on Biological Diversity: Would need to be developed, but could be based on corporate sustainability reporting under SDG 12.6.1 and methodological work by TFND, IPBES, etc. https://unstats.un.org/sdgs/metadata/?Text=&Goal=12&Target=12.6 *Additional Information* Marine Stewardship Council Certification 239 certified fisheries based on the sustainability of the stock, minimising environmental impacts, and effective fisheries management. May not account for all factors relevant to this Target.
Target 16. Ensure that people are encouraged and enabled to make responsible choices and have access to relevant	16.0.1 Food waste index	

Proposed goal or target[22]	Proposed indicators[23,24]	Potential marine and coastal monitoring frameworks/programmes to inform progress[25]
information and alternatives, taking into account cultural preferences, to reduce by at least half the waste and, where relevant the overconsumption, of food and other materials.	16.0.2 Material footprint per capita	
Target 17. Establish, strengthen capacity for, and implement measures in all countries to prevent, manage or control potential adverse impacts of biotechnology on biodiversity and human health, reducing the risk of these impacts.	17.0.1 Indicator of measures in place to prevent, manage and control potential adverse impacts of biotechnology on biodiversity taking into account human health*	.
Target 18. By 2030, redirect, repurpose, reform or eliminate incentives harmful for biodiversity, including [X] reduction in the most harmful subsidies, ensuring that incentives, including public and private economic and regulatory incentives, are either positive or neutral for biodiversity.	18.0.1 Value of subsidies and other incentives harmful to biodiversity, that are redirected, repurposed or eliminated.	Based on OECD methodology https://www.oecd.org/fr/tad/environmentallyharmfulsubsidieschallengesforreform.htm *Additional Information* UNCTAD-FAO-UNEP Joint Statement on Fisheries Subsidies. Signed by 90 countries.
Target 19. Increase financial resources from all sources to at least 200 billion per year, including new, additional and effective financial resources, increasing by at least 10 billion per year international financial	19.0.1 Official development assistance for biodiversity	SDG 15.a.1: OECD: https://unstats.un.org/sdgs/metadata/?Text=&Goal=15&Target=15.a ODA statistics include marine activities but may need to be disaggregated for reporting against this target.

Proposed goal or target[22]	Proposed indicators[23,24]	Potential marine and coastal monitoring frameworks/programmes to inform progress[25]
flows to developing countries, leveraging private finance, and increasing domestic resource mobilization, taking into account national biodiversity finance planning, and strengthen capacity-building and technology transfer and scientific cooperation, to meet the needs for implementing the post-2020 global biodiversity framework.		
	19.0.2 Public expenditure and private expenditure on conservation and sustainable use of biodiversity and ecosystems	Existing methodologies and research by the Convention on Biological Diversity, BIOFIN and SEEA. Data can be collected through national biodiversity finance plans. Statistics include marine activities but may need to be disaggregated for reporting against this target.
Target 20. Ensure that relevant knowledge, including the traditional knowledge, innovations and practices of indigenous and local communities with their free, prior, and informed consent, guides decision making for the effective management of biodiversity, enabling monitoring, and by promoting awareness, education and research.	20.0.1 Indicator on biodiversity information and monitoring, including traditional knowledge, for management*	To be developed with GEOBON, IIFB and others to capture biodiversity observation systems and traditional knowledge. This indicator would aim to capture different elements of data and knowledge availability and access.** *Additional Information* IOC Global Ocean Observing System reports on status of monitoring the physical ocean annually and plans to extend this to the biological ocean. IOC Global Ocean Science Report (GOSR 2020), based on reports from 150 member states. Times Higher Education Impact Rankings identify universities offering courses relevant to SDG 14 (201 in 2021).

Proposed goal or target[22]	Proposed indicators[23,24]	Potential marine and coastal monitoring frameworks/programmes to inform progress[25]
Target 21. Ensure equitable and effective participation in decision-making related to biodiversity by indigenous peoples and local communities, and respect their rights over lands, territories and resources, as well as by women and girls, and youth.	21.0.1 Land tenure in the traditional territories of indigenous peoples and local communities	SDG 1.4.2, 5.a.1: World Bank and UN-Habitat: https://www.worldbank.org/en/programs/lsms/land-tenure FAO CCRF includes The Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries (SSF) in the Context of Food Security and Poverty Eradication Tenure rights to land in the coastal/waterfront area are critical for ensuring and facilitating access to the fishery, for accessory activities …. and for housing and other livelihood support[153]
	21.0.2 Degree to which indigenous peoples and local communities, women and girls as well as youth participate in decision-making related to biodiversity	Data on engagement of stakeholders is already included in NBSAPs and national reports. This would be based on self-reporting. See comments for 21.0.1

Annex II

This annex provides a brief description of some major international organizations supporting the sustained flow of information on marine and coastal biodiversity and resources.

Food and Agriculture Organization of the United Nations

The Food and Agriculture Organization of the United Nations (FAO)[26] is the only intergovernmental organization formally mandated to collect, compile and analyse global information on fisheries and aquaculture. Its statistical databases populated with data provided by FAO members are publicly accessible.

FAO's Fisheries Resources Monitoring System (FIRM)[27] provides assessments for 539 fished stocks leading to the biennial State of the World Fisheries and Aquaculture (SOFIA) which provides policy-makers, civil society and those whose livelihoods depend on the sector a comprehensive, objective and global view of capture fisheries and aquaculture, including associated policy issues[28]. The 2020 edition has a particular focus on sustainability. The State of the World's Aquatic Genetic Resources for Food and Agriculture[29] focusses on farmed species and their wild relatives under national jurisdiction.

The FAO Code of Conduct for Responsible Fisheries (CCRF)[30], adopted in 1995, directly addresses fisheries sustainability including equity through development of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries (SSF) in the Context of Food Security and Poverty Eradication[31]. The FAO is developing the Indicator for SDG 14.6.1 – "Progress by countries in the degree of implementation of international instruments aiming to combat illegal, unreported and unregulated fishing".

The status of mangroves forests is reported in the FAO Global Forest Resources Assessment (FRA)[32].

United Nations Environment Programme (UNEP)

UNEP Regional Seas Programme

There are 18 Regional Seas Conventions and Action Plans (RSCAPs) covering more than 143 countries. Seven RSCAPs are hosted by the United Nations Environment Programme (UNEP). The UNEP Regional Seas Programme has identified a core set of 22 indicators that they encourage members to monitor[33]. Each indicator is linked to a specific target of SDG Goal 14. Detailed advice has been prepared for four of these indicators, which is essential for developing standard or complementary reporting between areas. There is a potential role for RSCAPs to help coordinate relevant data and undertake regional assessments. In their submission, UNEP indicates that the RSP has particular capability in aspects related to monitoring trends in coastal water quality (including chlorophyll-a and marine/beach litter), provision of food and feed from biodiversity, integrated coastal zone management and marine protected areas.

A recent review of opportunities for closer collaboration between RSCAPs and the post-2020 global biodiversity framework[34] highlights the "unique position" of Regional Seas Conventions and Action Plans to provide regional-scale coordination for improved monitoring and reporting that links with and supports

[26] www.fao.org

[27] http://firms.fao.org/firms/summaries/en accessed 22/12/2020

[28] http://www.fao.org/publications/sofia/2020/en/

[29] FAO. 2019. The State of the World's Aquatic Genetic Resources for Food and Agriculture. FAO Commission on Genetic Resources for Food and Agriculture assessments. Rome. 290 pp. (also available at www.fao.org/3/CA5256EN/CA5256EN.pdf).

[30] FAO. 2011. Code of Conduct for Responsible Fisheries. Rome, 91 p. http://www.fao.org/3/i1900e/i1900e00.htm

[31] FAO. 2015. Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication. Rome: FAO.

[32] FAO. 2020. Global Forest Resources Assessment 2020. Main report. Rome. https://doi.org/10.4060/ca9825en

[33] https://www.unenvironment.org/resources/report/regional-seas-core-indicators-set

[34] United Nations Environment Programme. 2021. Regional Seas Biodiversity under the post-2020 Global Biodiversity Framework.

reporting to other MEAs. This would have the potential to support eco-regional assessments that may better match the commitments of ecosystem-based management, and by linking many assessment and reporting processes reduce the reporting over-burden experienced especially strongly by developing countries and small island developing States. UNEP proposes that the COP consider a regional mechanism (linked to NBSAPs) under the global biodiversity framework to achieve these benefits[20].

UNEP World Conservation Monitoring Centre

The UNEP World Conservation Monitoring Centre (UNEP-WCMC) works with scientists, policymakers and businesses worldwide to deliver biodiversity knowledge, including through reports, books, journal papers and online databases. Among the databases of most relevance here are: the World Database on Protected Areas (WDPA)[35], Global Database on Protected Area Management Effectiveness (GD-PAME)[36], Ocean Data Viewer (ODV)[37] that provides data sets of ocean ecosystems, and Ocean+ Library that provides synthesis products and summary information from data sets in ODV and elsewhere. UNEP-WCMC is the official Secretariat of the Biodiversity Indicators Partnership (BIP), which promotes and coordinates the development of indicators of biodiversity change.

International Oceanographic Commission of UNESCO (IOC)

The Intergovernmental Oceanographic Commission of UNESCO (IOC)[38] is the United Nations body responsible for supporting global ocean science and services. The 150 Member States of IOC coordinate activities in ocean observations, tsunami warnings and marine spatial planning. The IOC has long-term activities in capacity development through the Ocean Teacher Global Academy (OTGA)[39], and hosts the pre-eminent global data base on marine biodiversity, the Ocean Biodiversity Information System (OBIS)[40] Several products are particularly relevant to post-2020 global biodiversity framework reporting.

Global Ocean Science Report

The Global Ocean Science Report 2020 (GOSR2020)[41] is the second global report of ocean science. GOSR2020 extends the 2017 report to include: contribution of science to sustainable development, blue patent applications, extended gender analysis, and capacity development in ocean science, relevant to proposed Targets 18 and 19. The next GOSR is due to be published in 2025.

"On average, States devote only 1.7 per cent of their research budgets to sciences of the ocean (0.03 per cent to 11.8 per cent, depending on the country), much less than they spend on other major scientific fields…between 2013 and 2017, 14 countries increased their average budget…while nine countries reduced expenditure, in some cases significantly…"[42]

Global Ocean Observing System (GOOS)

The Global Ocean Observing System (GOOS)[43] is a sustained collaborative system of ocean observations, encompassing in situ networks, satellite systems, governments, United Nations agencies and individual scientists operating under the Framework for Ocean Observations (FOO) developed by the global ocean

[35] UNEP-WCMC and IUCN (2021), Protected Planet: The World Database on Protected Areas (WDPA) [On-line], Cambridge, United Kingdom: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net.

[36] UNEP-WCMC and IUCN (2021), Protected Planet: The Global Database on Protected Areas Management Effectiveness (GD-PAME)] [On-line], Cambridge, United Kingdom: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net.

[37] UNEP-WCMC (2021). The Ocean Data Viewer (ODV) [On-line], Cambridge, United Kingdom: UNEP-WCMC. Available at http://data.unep-wcmc.org.

[38] https://ioc.unesco.org/

[39] https://classroom.oceanteacher.org/

[40] https://obis.org/

[41] https://en.unesco.org/gosr

[42] https://ioc.unesco.org/news/new-global-ocean-science-report-voices-concern-over-inadequacy-funding-ocean-research

[43] https://www.goosocean.org/

observing community in 2009[44]. The GOOS works by fostering and facilitating international collaboration, building expert teams and developing ocean observing capacity.

Three expert panels – physics, biogeochemistry, and biology & ecosystems – facilitate development and consistency of monitoring for Essential Ocean Variables (EOVs)[45]. Biological EOVs were developed to reflect reporting requirements for international conventions and agreements that shape policy responses to global change[46]. Four of the ten biological EOVs measure the marine natural ecosystems identified for Goal A and indicators being considered for the UN SEEA, while the remaining six provide information relevant to the health of these and other important marine ecosystems and the species they support. EOV data are often delivered through expert groups.

Ocean Biodiversity Information System (OBIS)

The Ocean Biodiversity Information System (OBIS)[47] is a global open-access data and information clearing-house on marine biodiversity for science, conservation and sustainable development, holding over 64 million presence records for more than 147,000 marine species. OBIS includes 20 OBIS nodes around the world that connect 500 institutions from 56 countries. OBIS is working with GOOS to ensure that all relevant information on the biological EOVs are available through OBIS.

Ocean Best Practices Repository

The Ocean Best Practices Repository has been developed to collate and archive the best practices in ocean research, observation, and data and information management[48]

Global Climate Observing System (GCOS)

The Global Climate Observing System (GCOS)[49] is co-sponsored by the World Meteorological Organization (WMO), IOC-UNESCO, the United Nations Environment Programme, and the International Science Council (ISC). It assesses the status of global climate observations of the atmosphere, land and ocean.

GCOS expert panels support Essential Climate Variables (ECVs)[50] which are required to systematically observe Earth`s changing climate. The marine ECVs are developed in parallel with the GOOS EOVs.

Marine Biodiversity Observing Network (MBON)

The Marine Biodiversity Observation Network of the Group on Earth Observations Biodiversity Observation Network (GEOBON MBON)[51] is a thematic BON that evolved from GEOBON's Working Group on "Marine Ecosystem Change" and is envisioned as the key biodiversity pillar of GEO and GEOBON for the marine realm. The MBON aims to help coordinate individual monitoring programs and existing networks focused on local, regional and thematic aspects of marine biology and biodiversity and facilitate the sharing of data, experiences, and protocols to understand species and the status and trends of ecosystems and their services. MBON, OBIS and GOOS signed a memorandum of understanding in 2016 to support a common framework to develop EOVs and Essential Biodiversity Variables (EBVs).

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[44] http://www.oceanobs09.net/foo/

[45] https://www.goosocean.org/eov

[46] Miloslavich et al. 2018. Essential ocean variables for global sustained observations of biodiversity and ecosystem changes. Global Change Biology 105(6332):10456–18.

[47] https://obis.org/

[48] www.oceanbestpractices.net

[49] https://gcos.wmo.int/en/home

[50] https://gcos.wmo.int/en/essential-climate-variables

[51] https://geobon.org/bons/thematic-bon/mbon/

Annex III

This annex identifies some of the most readily available data sources to report progress towards the goals and targets of the post-2020 global biodiversity framework that are most relevant to marine and coastal biodiversity.

Identified data sources are in a varied state of readiness. Some data sources have already been collated and can be accessed directly by each Party from global websites to meet reporting needs; this is especially true for data derived from satellites (e.g. extent of mangroves) or model-based products that integrate and interpret many types of information (e.g. frequency of marine heatwaves). On the other hand, products that require *in situ* observation (e.g. extent of macroalgae, or species-level data) are more challenging to measure globally; however identified indicators have global processes in place to make information available over the next five years to the agreed standard. Parties would be able to access this information directly from domestic research providers working to an agreed set of standards, or indirectly from global repositories of these standardized data.

There is also a gradual improvement in the coverage and quality of these data products based on new technologies and processes. For example, the extent and integrity of coral reefs is being rapidly improved by the Allen Coral Atlas[52], while the quality of remotely sensed mangrove extent is being steadily validated with improved interpretation from *in situ* observations[53].

Identifying agreed indicators and data sources for the goals and targets of the post-2020 global biodiversity framework will facilitate the development of the national and global data products, where necessary, to assist national and global decision makers. Linking these indicators to those identified by other conventions and initiatives, including the UN SEEA, will ease the current over-reporting burden[54], which impacts small island developing States and least developed countries, especially, by providing one agreed set of information products to inform many environmental decisions.

[52] https://allencoralatlas.org/

[53] http://www.mangrovealliance.org/global-mangrove-watch/

[54] "Concern at the increasing number of national reports that countries are required to submit has been growing and expressed in various forums. Member States have noted that they must prepare reports not only for the Commission but also to comply with the requirements of conventions, agreements reached at major conferences and global programmes of action. For all countries, the requests constitute a burden; but for countries with limited capacity, the burden has become overwhelming. It has also become apparent that some of the information being requested is duplicative and redundant" (E/CN.17/1997/6).

Goal A

The integrity of all ecosystems is enhanced, with an increase of at least 15 per cent in the area, connectivity and integrity of natural ecosystems, supporting healthy and resilient populations of all species, the rate of extinctions has been reduced at least tenfold, and the risk of species extinctions across all taxonomic and functional groups, is halved, and genetic diversity of wild and domesticated species is safeguarded, with at least 90 per cent of genetic diversity within all species maintained.

Headline Indicator A.0.1 Extent of selected natural and modified ecosystems (i.e. forest, savannahs and grasslands, wetlands, mangroves, saltmarshes, coral reef, seagrass, macroalgae and intertidal habitats).

The extent and changes in extent of ecosystems are fundamental attributes of biodiversity that affect many species and ecosystem services. While all ecosystems are impacted directly and/or indirectly by human activities, many still provide essential habitat and services.

The mapping of ocean ecosystems has typically lagged that of terrestrial ecosystems as coastal ecosystems are often smaller and less distinct while offshore ecosystems are submerged. All are hard to detect with standard unvalidated remote sensing. The advent of new technologies including satellites with smaller footprints and new sensors, drones, passive and active acoustics, autonomous underwater vehicles, water-column profiling robots, improved imagery and automated image analysis, advanced molecular technologies, and improved (cloud) computing capacity all contribute to a major increase in science's ability to detect and monitor changes in ecosystem extent, that will only increase over the next decade.

Harnessing this increasing capacity to meet the needs of policy and decision makers will be an important consideration over the next few years.

Mangroves

Mangroves are classified as MFT1.2 "Intertidal forests and shrublands" under the IUCN Global Ecosystem Typology 2.0[55] and as the "Mangrove – cover and composition" Essential Ocean Variable by the IOC/UNESCO Global Ocean Observing System (GOOS)[56] and GCOS[50].

Global cover of mangroves has been estimated to decline by ~40 per cent, with 20 per cent since 1980. This is estimated to be 3-5 times the rate of loss of terrestrial forests.

(i) FAO Global Forest Resources Assessment

Mangroves are characterized as primary forests -- where there has been minimal human activity and disturbance – and are reported separately in the FAO Global Forest Resources Assessment (FRA)[57]. FRA 2020 received information from 223 countries and territories of which 113 reported areas of mangrove. Forest area as reported is considered insufficient, on its own, for identifying important trends in forests and their management, however many countries were unable to report growing-stock composition and relatively few reported full time series for growing stock composition. Few data were available on disturbances (insects, diseases, severe weather events) in the period 2000-2017. FRAs use a three-class tier system to assess data quality of submitted reports.

(ii) UNEP-WCMC's Ocean Data Viewer

Data on mangroves are available from the World Atlas of Mangroves (2010)[58] and from Global Mangrove Watch (1996-2016). Additional data available from some RSCAPs.

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[55] Keith et al. 2020. IUCN Global Ecosystem Typology 2.0. https://doi.org/10.2305/IUCN.CH.2020.13.en

[56] GOOS Biology and Ecosystems Panel. https://www.goosocean.org/bioeco

[57] FAO. 2020. Global Forest Resources Assessment 2020. Main report. Rome. https://doi.org/10.4060/ca9825en

[58] Spalding M, Kainuma M, Collins L (2010). World Atlas of Mangroves (version 3). A collaborative project of ITTO, ISME, FAO, UNEP-WCMC, UNESCO-MAB, UNU-INWEH and TNC. London (United Kingdom): Earthscan, London. 319 pp. URL: data.unep-wcmc.org/datasets/5

(iii) Global Mangrove Watch

Global Mangrove Watch (1996-2016) data are available through WCMC ODV[59] and the World Resources Institute[60]. It was initiated as part of the 2011 Kyoto & Carbon and is led by Aberystwyth University (U.K.) and solo Earth Observation (Japan), in collaboration with Wetlands International, the International Water Management Institute (Sri Lanka) and the UNEP World Conservation Monitoring Centre (U.K.). The primary objective of the GMW has been to provide countries lacking a national mangrove monitoring system with first cut mangrove extent and change maps, to help safeguard against further mangrove forest loss and degradation.

The GMW has generated a global baseline map of mangroves for 2010 using ALOS PALSAR and Landsat (optical) data, and changes from this baseline for six epochs between 1996 and 2016 derived from JERS-1 SAR, ALOS PALSAR and ALOS-2 PALSAR-2. Annual maps are planned from 2018 and onwards. GMW has documented a nearly 6 per cent decline in global mangrove extent since 1996.

In situ sampling efforts are essential for validating maps derived from satellite data and for assessing species composition, but at present these efforts are very limited (primarily to the Caribbean and Australia and more recently Africa) and uncoordinated[61]. Improving coordination of *in-situ* observations is a priority for the GOOS Biology and Ecosystems Panel.

(iv) Global Mangrove Alliance

The Global Mangrove Alliance[62] provides a clearinghouse for information on mangroves, including the recent State of the World's Mangroves 2021 report that presents and interprets the most recent (2016) maps from World Mangrove Watch[63]. It provides access to the WCMC ODV for mangrove extent by country and access to global mangrove canopy and height data[64]. The GMA has a goal of expanding global mangrove habitat by 20 per cent by 2030.

Saltmarshes

Saltmarshes are classified as MFT1.3 "Coastal saltmarshes" under the IUCN Ecosystem Typology. A saltmarsh EOV, under GOOS, is being discussed.

Saltmarshes are estimated to have lost between 25 per cent and 50 per cent of their global historical coverage[65].

(v) UNEP-WCMC's Ocean Data Viewer

The global map of saltmarshes[66] is based on data from 99 countries with 5,495,089 hectares mapped in 43 countries and territories; data from the other 56 countries is maintained as point data but lacks geographical extent. Data were collected from 1973 through to 2015, with most occurring after 2005.

The compiled data includes remote sensing and field-based survey data, although not all data records have been validated through *in situ* observations. There is likely to be some overlap with mangroves as these

[59] https://data.unep-wcmc.org/datasets/45

[60] Global Forest Watch portal (http://www.globalforestwatch.org)

[61] Duffy, et. al. 2019. Integrating global seagrass and mangrove ecosystem observations. EOS, 100. https://doi.org/10.1029/2019EO136791.

[62] http://www.mangrovealliance.org/mangrove-knowledge/

[63] Spalding, et al. 2021. The State of the World's Mangroves 2021. Global Mangrove Alliance. URL: https://www.mangrovealliance.org/mangrove-forests/

[64] Global mangrove canopy height and biomass results from Simard et al. 2018. https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=1665

[65] Mcowen, et. al. 2017. A global map of saltmarshes. Biodiversity Data Journal 5: e11764. Paper DOI: https://doi.org/10.3897/BDJ.5.e11764

[66] https://data.unep-wcmc.org/datasets/43

ecosystem types overlap. Additional spatial data is required especially for Canada, the northern Russian Federation, South America and Africa, where saltmarshes are known to occur but have not been spatially mapped.

Coral Reef

Coral Reefs are classified as M1.3 "Photic coral reefs" under the IUCN Global Ecosystem Typology and is coordinated as the "Hard Coral – Cover and composition" EOV under GOOS and GCOS.

Live coral cover has declined by about 50 per cent since the 1870s, or about 4 per cent/decade[67]. Corals could be reduced to 10-30 per cent of their former abundance at warming of 1.5ºC and to only 1 per cent at 2ºC[68].

(vi) Global Coral Reef Monitoring Network (GCRMN)

GCRMN works through a global network of researchers to provide information on status and trends of warm water coral reefs[69]. Regional guidelines have been developed to improve consistency in monitoring and reporting within large regions, with regional workshops helping to gather data including through the RSCAPs and their member States.

The latest report on the global status of warm water coral reefs of the world will be released in 2021 at the IUCN World Conservation Congress. This will be the first global report for 12 years and incorporates 195 data sets from 75 countries. These data sets contain more than 2 million observations from more than 100,000 transects. The report will analyse percentage cover of hard corals (total) and fleshy algae with long-term time series (>15 yrs) from 700 sites. Data on coral reef fish (abundance and biomass) could not be analysed globally due the high variability in data collection methodologies.

(vii) Allen Coral Atlas

The Allen Coral Atlas[70] is based on newly available 3.7m resolution satellite imagery from the commercial Planet Dove satellite constellation. A map of coral reef extent has been provided to GCRMN for their global report based on 554,663 individual scenes collected in 2017 and 2018[71], although it may require additional calibration before its reliability is understood for all areas.

(viii) UNEP-WCMC's Ocean Data Viewer

This data set shows the global distribution of coral reefs in tropical and subtropical regions. It was the most comprehensive global data set of warm-water coral reefs in 2018, acting as a foundation baseline map for future, more detailed, work and has been the global standard for GCMRN and the IUCN Red listing process (species and ecosystems)[72]. Approximately 85 per cent of the data set comes from the Millennium Coral Reef Mapping Project, at 30m resolution, only 35 per cent of which was validated. Additional data available from some RSCAPs.

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[67] IPCC. 2019. IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. Edited by H.O. Pörtner, et al. Geneva: IPCC.

[68] IPCC (Intergovernmental Panel on Climate Change). 2018. Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty. Edited by V. Masson-Delmotte, et al. Geneva: IPCC.

[69] https://gcrmn.net/

[70] https://allencoralatlas.org/

[71] Li, et al. A global coral reef probability map generated using convolutional neural networks. Coral Reefs. 2020. https://doi.org/10.1007/s00338-020-02005-6

[72] UNEP-WCMC, WorldFish Centre, WRI, TNC (2018). Global distribution of warm-water coral reefs, compiled from multiple sources including the Millennium Coral Reef Mapping Project. Version 4.0. Includes contributions from IMaRS-USF and IRD (2005), IMaRS-USF (2005) and Spalding et al. (2001). Cambridge (United Kingdom): United Nations Environment Programme-World Conservation Monitoring Centre. URL: http://data.unep-wcmc.org/datasets/1

Seagrass

Seagrass is classified as M1.1 "Seagrass meadows" under the IUCN Global Ecosystem Typology and is coordinated as the "Seagrass – Cover and composition" EOV under GOOS and GCOS.

It is estimated that almost 30 per cent of seagrass global cover has been lost over the last century[73] and 22 of the world's 72 seagrass species (31 per cent) are in decline[74]. The most recent census estimates that 7 per cent of this habitat is being lost worldwide per year[75]. More than 45 programs worldwide conduct repeated observations of submerged vegetation at regional to global scales[76]. The global area of seagrass is estimated at 160,387km^2 across 103 countries/territories with moderate to high confidence and an additional 106,175km^2 across another 33 countries with low confidence[77].

(ix) Coordinated Global Research Assessment of Seagrass Systems (C-GRASS)

The C-GRASS project seeks to complete a scientific synthesis of the drivers and trajectories of seagrass ecosystems under global change, and to provide a framework for expanded international coordination of observation, research and knowledge product development on seagrass systems and their integration into international open-access portals.

The C-GRASS project received partial funding by the Scientific Committee on Oceanic Research (SCOR) and partners with the World Seagrass Association.

(x) UNEP-WCMC's Ocean Data Viewer

The 2020 data set was compiled by UNEP WCMC with many collaborators and is composed of two subsets of point and polygon occurrence data[78]. It comprises data from multiple sources in 128 countries and territories and is the seventh update of the original 2003 data set. Additional data available from some RSCAPs. Those for the Mediterranean and Caribbean are particularly data rich.

Macroalgae

Macroalgae are classified as M1.2 "Kelp forests" under the IUCN Global Ecosystem Typology and is coordinated as the "Macroalgae cover and composition" EOV under GOOS and GCOS. There are several thousand species of macroalgae (or seaweed) and three main types – red, brown and green. Of most concern here are the canopy-forming macroalgae, or macroalgae forests, that provide structural habitat for many marine species. Large green and red macroalgae can form marine forests, in addition to brown algae (including kelps and fucoids).

Macroalgal forests dominate at least 25 per cent of the world coastlines[79]. Available time series >20 years show declines in 61 per cent and increases in only 5 per cent. However, data are lacking for two-thirds of the bioregions with kelp forests.

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[73] Waycott M, et al. (2009) Accelerating loss of seagrasses across the globe threatens coastal ecosystems. Proceedings of the National Academy of Sciences 106(30):12377–12381.

[74] West JA, Calumpong HP, Martin G, Gaever S van (2016) Kelp Forests and Seagrass Meadows. United Nations World Ocean Assessment, eds Inniss L, Simcock A, pp 1–13.

[75] United Nations Environment Programme. 2020. Out of the blue: The value of seagrasses to the environment and to people. UNEP, Nairobi. https://www.grida.no/publications/479

[76] Duffy, et al. 2019. Toward a Coordinated Global Observing System for Seagrasses and Marine Macroalgae. Frontiers in Marine Science 6 (317). https://doi.org/10.3389/fmars.2019.00317.

[77] McKenzie, et al. 2020. The global distribution of seagrass meadows. Environmental Research Letters 15:074041.

[78] UNEP-WCMC, Short FT (2020). Global distribution of seagrasses (version 7.0). Seventh update to the data layer used in Green and Short (2003). Cambridge (United Kingdom): United Nations Environment Programme-World Conservation Monitoring Centre. URL: http://data.unep-wcmc.org/datasets/7

[79] Krumhansl, et al. 2016. Global patterns of kelp forest change over the past half-century. Proceedings of the National Academy of Sciences 113:13785–13790.

Pelagic macroalgae are of increasing interest because of recent extensive accumulations of two pelagic brown species (*Sargassum fluitans* and *S. natans*) on shorelines of the Caribbean Sea[76].

(xi) Global Ocean Macroalgal Observing Network (GOMON)

The Global Ocean Macroalgal Observing Network (GOMON) was established recently following a POGO workshop[80] focused on establishing monitoring and reporting infrastructure for this EOV and broadening the community of practice. GOMON includes representatives of communities of practice, the major observing networks and data management.

Intertidal Habitats

Intertidal habitats are classified as the MT1 "Shorelines" biome under the IUCN Global Ecosystem Typology, comprising MT1.1 "Rocky shorelines", MT1.2 "Muddy shorelines", MT1.3 "Sandy shorelines", and MT1.4 "Boulder and cobble shorelines". They may overlap M1.1 "Seagrass meadows" and MT1.4 "Shellfish beds and reefs". There is no equivalent EOV under GOOS.

At least 127,921 km^2 of the Earth's surface consists of tidal flat ecosystems. Consistent multidecadal time series indicate ~16 per cent of tidal flats were lost between 1984 and 2016[81].

(xii) UNEP-WCMC's Ocean Data Viewer

The data set on "Tidal flat ecosystems" was developed in 2019 from a supervised classification of 707,528 Landsat Archive images to identify the non-vegetated areas of coastline (sand, rock or mud flats) subject to regular tidal inundation[81]. Data are available for 3-yr time periods between from 1984-1986 and 2014-2016 from the intertidal URL. Additional data available from some RSCAPs.

Wetlands

Wetlands include at least four of the marine ecosystem types identified for Headline Indicator A.0.1 and possibly all six. Many wetlands are listed under the Convention on Wetlands (Ramsar, Iran, 1971) by its 171 Contracting Parties[82], and 41 per cent of the total number and 30 per cent of the total area of wetlands listed include coastal and marine areas (990 listed covering 75 million ha). Some of these may be human-made wetlands. Management plans are available for 508 of these wetlands with a further 183 in preparation. The Ramsar Sites Information Service (RIS)[82] includes a listing of major threats, the ecosystem serviced provided by the wetland and the number of sites listed on the Montreux record (22), which is "a record of Ramsar sites where changes in ecological character have occurred, are occurring or are likely to occur."

Ramsar COP12 Resolution XII.15 emphasized the importance of evaluating the management effectiveness of Ramsar sites, encouraged Ramsar site management authorities to evaluate the effectiveness of the management of each of their Ramsar sites and approved the Ramsar Site Management Effectiveness Tracking Tool (R-METT), a voluntary self-assessment tool. The resolution further invited parties to update the RIS and report results to UNEP World Conservation Monitoring Centre (WCMC). It was noted that this recommendation does not create an additional reporting obligation for Parties.

Headline Indicator A0.2 Species Habitat Index

The GEOBON Species Habitat Index uses remotely sensed environmental and species data addressing all terrestrial areas of the world at 1 km spatial resolution[83] and are available at various levels of aggregation including country-level. They can be aggregated at spatial levels ranging from 1 km to small regions, countries, biomes, and the whole planet. Indices are updated annually and include ten data points from 2011 to 2020. The information is available to develop complementary indices for the ocean.

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[80] https://www.goosocean.org/index.php?option=com_oe&task=viewEventDocs&eventID=2327

[81] Murray N. J., et al. (2019) The global distribution and trajectory of tidal flats. Nature. 565:222-225. http://dx.doi.org/10.1038/s41586-018-0805-8. Data URL: https://www.intertidal.app/download or http://data.unep-wcmc.org/datasets/47

[82] Ramsar Sites Information Service, https://rsis.ramsar.org/ris-search/, accessed 20 January 2021.

[83] https://geobon.org/ebvs/indicators/

IPCC Special Report on the Ocean and Cryosphere in a Changing Climate

Ocean warming has contributed to changes in distribution and habitats of marine organisms (51.5 ± 33.3 km per decade for epipelagic and 29.0 ± 15.5 km for the decade for seafloor organisms since the 1950s)[67]. There is high confidence that warming related movements have occurred in habitat extent of coastal ecosystems, including mangroves, seagrass and kelp forests[67].

Marine Metabolic Habitat

Marine metabolic habitat integrates physiological, climatic and biogeographic data to map the ratio of oxygen supply to resting metabolic oxygen demand for several marine ectotherms across their geographic ranges and depths[84]. The combined effects of warming and oxygen loss are projected to reduce this metabolic habitat by ~20 per cent globally this century and ~50 per cent in northern high latitude regions, forcing poleward and vertical contraction of species' habitats.

Marine Heatwaves

The oceans are warming at an unprecedented rate which increases the likelihood of marine heatwaves occurring[85]. Marine heatwaves affect ecosystem structure, can change species ranges leading to losses to biodiversity, fisheries and aquaculture, including through increased incidence of disease and bleaching. A marine heatwave is defined as when water temperature in a given location is in the top 10 per cent of temperatures ever recorded at that time of year for at least 5 successive days. Data for all oceans are available on the Marine Heatwave Tracker[86] starting in 1982 and for current periods with a one-two day delay.

Headline Indicator A.0.3 Red list index

The IUCN Red List Index is derived from species groups that have been comprehensively reviewed at least twice, including mammals, amphibians, birds, reef building corals and conifers. Sharks and rays have recently been comprehensively reviewed and could be included in the index. The first complete assessment of reef building corals was completed in 2008. The latest GCMRN report on the global status of warm water reefs (see above) will allow an updated Red List assessment.

Approximately 50 per cent of marine fishes (~9,500) have now been assessed in IUCN Red List assessments [87]. Assessments for other groups including tuna and billfishes, and groupers are under development. Assessments of 35 per cent of marine fish species are currently more than 10 years old and flagged as in need of assessment, although the most recent assessment remains on the Red List[87].

Assessments of invertebrates are typically very low with an average of 2.6 per cent of species listed in four phyla on the World Register of Marine Species (WoRMS) assessed[88]. The assessed species are also biased towards relatively well-described taxa (e.g. hard corals and cephalopods). Data is available by species group and geography. Information on major perceived threats is also available.

IUCN Cetacean Specialist Group

IUCN Cetacean Specialist Group [89] provides regular (5-10 year) updates to the Cetacean Species Assessments under the IUCN Red List of Threatened Species. The indicator runs from 1991 to the present with most species, subspecies and a number of populations having been (re-) assessed in the last three years. The assessments include an examination of the threats affecting each species, subspecies or population.

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[84] Deutsch, et al. 2015. Climate change tightens a metabolic constraint on marine habitats. Science 348:1132-1135.

[85] Hobday, et. al. 2018. Categorizing and Naming Marine heatwaves. Oceanography **31**:162-173.

[86] http://www.marineheatwaves.org/tracker.html

[87] http://www.fao.org/3/cb1489en/cb1489en.pdf

[88] Rogers, et al. 2020. Critical Habitats and Biodiversity: Inventory, Thresholds and Governance. Washington, DC: World Resources Institute. Available online at www.oceanpanel.org/blue-papers/critical-habitats-and-biodiversity-inventory-thresholds-and-governance.

[89] IUCN Cetacean Specialist Group https://iucn-csg.org/

IUCN Shark Specialist Group

IUCN Shark Specialist Group[90] is in the process of developing a Red List index for Sharks and Rays worldwide based on Global Shark trends project[91], including 1200 species assessments over the time horizons of 1980, 2005 and 2020. The current IUCN Red List of Threatened Species includes assessments of 422 species of sharks and rays, 33 per cent of which were classified as threatened.

FAO Fisheries Resources Monitoring System

FAO's Fisheries Resources Monitoring System (FIRM)[92] provides assessments for 539 fished stocks with a further 148 stocks remaining uncertain or not assessed. Fifty-four stocks were assessed as depleted, 121 at low abundance, 227 at intermediate abundance and 137 at pre-exploitation or high abundance. Assessments are updated every 2 years and the state of world marine fishery resources reviewed approximately every five years, most recently in 2018[93]. Assessments are at the level of fished stock rather than species to account for regional differences in status of individual species.

Headline Indicator A.0.4 The proportion of populations within species with a genetically effective population size>500*

Effective population size is defined as the size of an ideal population that is experiencing the same rate of change in allele frequencies or heterozygosity as the observed population, where ideal in this instance means diploid organisms with sexual reproduction, non-overlapping generations, random mating, no migration, no mutation, but also no natural selection[94]. Theoretically, reduced effective population size is positively correlated with reductions in population viability.

While the number of studies estimating effective population size in marine species has increased rapidly, a meta-analysis found no significant linear relationship between effective population size and census sample size for large marine populations and estimates were biased to the point of becoming meaningless[94]. Studies suggest that effective population size may only be reliably estimated for medium-sized populations (effective population > 1,000,000) when life history is accounted for and at least 1 per cent of the population has been sampled. Given this high sampling intensity, more advanced methods such as close-kin mark-recapture[95] based on the identification of pairs of close relatives (parents–offspring or half sibling pairs) are likely to be more informative and can be used to directly estimate population size and connectivity.

Effective population size may be relevant for smaller threatened marine populations, although again given the likely sampling effort required, more informative approaches with potentially less bias are available.

Goal B

Nature's contributions to people have been valued, maintained or enhanced through conservation and sustainable use, supporting the global development agenda for the benefit of all peoples

*Headline Indicator B.0.1 National environmental accounts of ecosystem services**

UN System of Environmental Economic Accounting (UN SEEA) Ecosystem Accounts

[90] IUCN Shark Specialist Group https://www.iucnssg.org/

[91] https://www.iucnssg.org/global-shark-trends-project.html

[92] http://firms.fao.org/firms/summaries/en

[93] http://www.fao.org/3/i2389e/i2389e.pdf.

[94] Marandel, et al. 2019. Estimating effective population size of large marine populations, is it feasible? Fish and Fisheries, 20:189-198. DOI: 10.1111/faf.12338

[95] Bravington, et. al. 2016. Close-Kin Mark-Recapture. Statistical Science259-274. DOI: 10.1214/16-sts552

The System of Environmental Economic Accounting (SEEA)[96] provides a framework that integrates physical environmental data with monetary data from the System of National Accounts (SNA)[97] , to provide a more comprehensive and multipurpose view of interrelationships between the economy and the environment, and the stocks and changes in stocks of environmental assets, as they bring benefits to humanity. The SEEA contains internationally agreed concepts, definitions, classifications accounting rules and tables for producing internationally comparable statistics and accounts, which are interoperable with the SNA. Following the adoption of the SEEA Ecosystem Accounting at the 52nd Session of the UNSC in March 2021[98], the SEEA can be applied to non-transferable assets such as land-based pollutants and the value of ecosystem services such as coastal protection and recreation in addition to transferable assets such fish stocks that were already included under the Central Framework. Statistical indicators as used by the UN SEEA are summary measures derived from a series of observed facts (aka variables) but indexed according to a reference condition, e.g. a previous or ideal state. The pathway between these statistical indicators and observations is to be defined.

Global Ocean Accounts Partnership

The Global Ocean Accounts Partnership (GOAP)[99] brings together diverse member institutions who have a common interest to ensure that the values and benefits of oceans are recognized and accounted for in decision-making about social and economic development.

The Ocean Accounts Framework[100] adapts two international statistical standards: the System of National Accounts (SNA)97 and the System of Environmental Economic Accounting (SEEA)96. The SNA provides a set of recommendations on how to compile monetary measures of economic activity, including a set of coherent, consistent and integrated macroeconomic accounts. SNA accounts form a basis for economic analysis and policy formulation. The SEEA provides a framework that integrates physical environmental data with monetary data from the SNA, to provide a more comprehensive and multipurpose view of interrelationships between the economy and the environment, and the stocks and changes in stocks of environmental assets, as they bring benefits to humanity. The Ocean Accounts Framework is based on the principles, components, and classifications of the SEEA and extends them, where necessary, to better apply to the ocean.

The Ocean Accounts Framework is currently designed to support compilation of spatially detailed national-level accounts for internal waters, the territorial sea and contiguous zone, archipelagic waters, the exclusive economic zone (EEZ)and/or the continental shelf, and would be applicable to the global accounting.

Goal C

The benefits, from utilization of genetic resources are shared fairly and equitably with a substantial increase in both monetary and non-monetary benefits shared, including for conservation and sustainable use of biodiversity

No marine-specific indicators have been identified for this goal; however, the headline and component indicators should include products from marine resources.

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[96] https://seea.un.org

[97] https://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf

[98] Decision 8c of the Report of the United Nations Statistical Commission on its 52th session https://unstats.un.org/unsd/statcom/52nd-session/documents/decisions/Draft-Decisions-Final-5March2021.pdf.

[99] The Global Ocean Accounts Partnership was launched by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) on behalf of the United Nations in response to international commitments in the 2030 Agenda for Sustainable Development (particularly SDG14, SDG 15.9, SDG 17.9), UNGA Resolution 71/312, United Nations Statistical Commission Decision 49/110, and ESCAP Resolutions 72/6 , 72/9 and 73/5.

[100] Dated 1 October 2020, Global Ocean Accounts Partnership. Technical Guidance on Ocean Accounting for Sustainable Development See https://www.oceanaccounts.org/technical-guidance-on-ocean-accounting-2/.

The international community is currently in the process of negotiating a new international legally binding instrument on Biodiversity Beyond Natural Jurisdiction (BBNJ) under the United Nations Convention on Laws of the Sea in accordance with United Nations General Assembly resolution 72/249[101]. The four main components under negotiation are: marine genetic resources, area-based management tools, capacity building and technology transfer, and environmental impact assessments. Results or products of these negotiations may be relevant to Goal C.

Goal D

The gap between available financial and other means of implementation, and those necessary to achieve the 2050 Vision, is closed

Headline Indicator D.0.1 Funding for implementation of the global biodiversity framework*

No marine-specific indicators have been identified for this goal; however, the headline and component indicators should include products from marine resources. Indicators for this goal are to be collected through National Biodiversity Finance Plans.

Additional information on funding for ocean science for States members of IOC are collated periodically in the Global Ocean Science Report[41].

Headline Indicator D.0.2. Indicator on national biodiversity planning processes and means of implementation*

See above.

Target 1

Ensure that all land and sea areas globally are under integrated biodiversity-inclusive spatial planning addressing land- and sea-use change, retaining existing intact and wilderness areas

Headline Indicator 1.01. Percentage of land and seas covered by spatial plans that integrate biodiversity*

No marine-specific indicators identified for this target however the headline and component indicators should include products from marine resources. Indicators for this goal are to be collected through national reporting and would link with SDG 6.5.1, 14.2.1 and 15.2.1. UNEP SDG Indicator 14.2.1[102] includes data from both Marine Spatial Planning and Integrated Coastal Zone Management and where not reported through the Regional Seas Programme will be sought directly[103].

Marine Spatial Planning

Marine Spatial Planning is a practical way to understand and organize the human use of ocean space by different industries and the public, their interactions with each other and the environment. Initiated as way to support marine protected area planning, it is now clearly established as representing the needs and value of multiple sectors and is a key tool for implementing marine components of Ecosystem Based Management and Integrated Coastal Zone Management. Over 70 countries engage in marine spatial planning from initial

[101] Rabone, et al. 2019. Access to Marine Genetic Resources (MGR): Raising Awareness of Best-Practice Through a New Agreement for Biodiversity Beyond National Jurisdiction (BBNJ). Front. Mar. Sci., https://doi.org/10.3389/fmars.2019.00520

[102] Proportion of national exclusive economic zones managed using ecosystem-based approaches

[103] https://unstats.un.org/sdgs/metadata/?Text=&Goal=14&Target=14.2

planning to continuing adaptation of established plans[104]. The European Union maintains a community of practice database to support knowledge exchange and learning between different partners[105].

Integrated Coastal Zone Management

Integrated coastal zone management (ICZM) provides a cooperative, inclusive framework integrated across biota and habitats, time and space, and levels of government. ICZM is a dynamic, multidisciplinary and iterative process to promote sustainable management of coastal zones, while achieving the best possible outcomes for both large-scale and local-scale issues concerning society, the environment and the economy.

Target 2

Ensure that at least 20 per cent of degraded freshwater, marine and terrestrial ecosystems are under restoration, ensuring connectivity among them and focusing on priority ecosystems

Headline Indicator 2.0.1 Percentage of degraded or converted ecosystems that are under restoration

Mangroves and characterised as primary forests and thus currently included in The Task Force on Monitoring in support of the United Nations Decade on Ecosystem Restoration: 2021-2030[106]. The work of this task force encompasses all ecosystems (natural, semi-natural, production, cultural, and urban) and therefore, additional aspects of the marine realm, in addition to mangroves will be included.

Marine restoration in addition to mangroves occurs to a lesser extent, or is at an earlier level of development, for all marine 'selected natural and modified ecosystems' for Goal A – saltmarshes, coral reef, seagrass, macroalgae and intertidal habitat. Restoration activities could therefore also be collected as a component of indicators used for Goal A.

Target 3

Ensure that at least 30 per cent globally of land areas and of sea areas, especially areas of particular importance for biodiversity and its contributions to people, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes

Headline Indicator 3.0.1 Coverage of protected areas and OECMs (by effectiveness).

There are several ways in which marine areas are assessed for their biogeographic importance, at varying levels of completeness. Two of the more complete classifications are given below. Coverage of other classifications including areas meeting the criteria for Ecologically or Biologically Significant Marine Area (EBSA) under the Convention on Biological Diversity[107], Ramsar sites[108], World Heritage Sites[109], Important Bird and Biodiversity Areas[110] would be relatively straightforward to derive. Important Marine Mammal Areas[111] and Key Biodiversity Areas (marine) are also being progressed[112]. Effectiveness can be estimated by the proportion of IUCN Red List species covered, through a specific management effectiveness database (although coverage is low) and through dedicated global surveys.

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[104] http://msp.ioc-unesco.org/world-applications/overview/

[105] https://www.msp-platform.eu/msp-practice/database

[106] http://www.fao.org/in-action/forest-landscape-restoration-mechanism/resources/detail/es/c/1315004/

[107] https://www.cbd.int/ebsa/

[108] https://www.ramsar.org/

[109] https://whc.unesco.org/en/list/?search=marine&order=country

[110] https://www.birdlife.org/worldwide/programme-additional-info/important-bird-and-biodiversity-areas-ibas

[111] https://www.marinemammalhabitat.org/imma-eatlas/

[112] http://www.keybiodiversityareas.org/kba-data

UNEP-WCMC World Database on Protected Areas

The World Database on Protected Areas (WDPA)[113] is considered to be the most comprehensive global database of marine and terrestrial protected areas. It is supported by UNEP and IUCN, managed by UNEP-WCMC), and updated monthly.

UNEP-WCMC Ocean+ Habitats

Ocean+ Habitats[114] provides summary information and mapped products from the extensive UNEP-WCMC data holdings and partnerships with other research providers. Extension to national and UNEP Regional Seas products is planned with agreements to exchange data with some RSCAPs completed. Between 26 and 43 per cent of the areas of warm-water corals, saltmarshes, mangroves, seagrasses and cold-water corals currently occur within a marine protected area[10].

UNEP-WCMC also maintain Protected Planet-Marine, which provides the most recent official statistics for marine protected areas[115].

High Level Panel - Critical Habitats and Biodiversity

Critical Habitats and Biodiversity[10] is one of a series of Blue Papers produced under the auspices of The High Level Panel for a Sustainable Ocean Economy[9]. Of the habitats considered (estuaries, mangroves, saltmarshes, seagrasses, coral reefs, kelp, shelf valley and canyons, cold corals, seamounts and guyots, trenches, hydrothermal vents, and ridges), 12 per cent was estimated to lie within an MPAs, 6 per cent within MPAs with management plans, and 3 per cent within fully protected MPAs. These habitats match 5 of 6 marine natural ecosystems identified for monitoring in Goal A.

These analyses are scheduled to be updated annually and maintained by the Data and Modelling Centre at Senckenberg, Frankfurt, Germany. Data are sourced primarily from UNEP-WCMC and a geomorphological classification of the world ocean[116].

An analysis of protected area coverage in 2019 using publicly available online data found 47.5 per cent of marine ecoregions to have adequate coverage, an increase from 31.8 per cent in 2010[117]. Only 10.8 per cent of pelagic regions had adequate coverage in 2019.

IUCN Red List

An analysis of protected area coverage of species listed as "Vulnerable', 'Endangered', or 'Critically Endangered' on the IUCN Red List, including marine species, for 2019, found 44.0 per cent species of reef-forming corals to have adequate representation in marine protected areas, 50.0 per cent of mangrove species, 50.0 per cent of seagrass species, 43.2 per cent of marine mammal species, 42.1 per cent of marine bony fish species and 32.4 per cent of cartilaginous fish species[117]. No species of marine reptiles had adequate representation in 2019. All data are publicly available online.

https://www.protectedplanet.net/en/thematic-areas/wdpa?tab=WDPA

[114] https://habitats.oceanplus.org/

[115] https://www.protectedplanet.net/en/thematic-areas/marine-protected-areas

[116] Harris, et al. 2014. "Geomorphology of the Oceans." Marine Geology 352 (1): 4–24. https://doi.org/10.1016/j.margeo.2014.01.011.

[117] Maxwell, et. al. 2020. Area-based conservation in the twenty-first century. Nature 586:217-227.

Global Database on Protected Area Management Effectiveness (GD-PAME)

The Global Database on Protected Area Management Effectiveness (GD-PAME)[118] is a searchable database that includes assessments submitted by a wide range of governmental and non-governmental organizations. Assessments mostly follow the IUCN World Commission on Protected Areas framework for protected area management effectiveness (PAME), which covers: design/planning, adequacy/appropriateness and delivery. GD-PAME includes information on 8 per cent of the 258,725 protected areas listed in the WDPA and 10 per cent of the 18,416 listed marine MPAs. It is updated on a monthly basis and includes marine protected areas.

Reef Life Survey

Reef Life Survey is a non-profit citizen science program where trained divers undertake standardized underwater visual assessments of reef biodiversity on rock and coral reefs. Data derive from ~29,000 underwater surveys from 4,065 sites in 53 countries and include data from 176 MPAs. Properties of MPAs that were effective in conserving biodiversity relative to adjacent areas was described in 2014 [119]. Repeat surveys are planned with development of a global Management Effectiveness Management Tool scoped.

Marine World Heritage Areas

The 50 UNESCO marine World Heritage sites make up just 1 per cent of the world's oceans but host 21 per cent of the world's blue carbon ecosystems and 15 per cent of the world's stored blue carbon—equal to 10 per cent of annual global greenhouse gas emissions[120].

Convention on Biological Diversity Ecologically or Biologically Significant Areas (EBSAs)

EBSAs are special areas in the ocean that serve important purposes, in one way or another, to support the healthy functioning of oceans and the many services that it provides[121]. Criteria for identifying EBSAs were adopted in 2008 by the ninth meeting of the Conference of the Parties to the Convention on Biological Diversity (decision IX/20). Potential EBSAs are identified by States and competent intergovernmental organizations, in accordance with international law, including the United Nations Convention on the Law of the Sea and subsequently referred by COP to other United Nations organizations.

Target 4

Ensure active management actions to enable the recovery and conservation of species and the genetic diversity of wild and domesticated species, including through ex situ conservation, and effectively manage human-wildlife interactions to avoid or reduce human-wildlife conflict.

Headline Indicator 4.0.1 Proportion of species populations that are affected by human wildlife conflict

As human activities in the marine environment increase (e.g. a doubling of the world shipping fleet in the last 12 years) and some marine megafauna populations increase from low population numbers at the cessation of hunting and/or the beginning of protection, human wildlife conflicts in the ocean can be expected to increase. Types of conflict include animals taken as bycatch, animals becoming entangled in active or lost fishing and other gear, ship strikes, underwater noise, harassment and purposeful culling. For example, at

[118] UNEP-WCMC and IUCN (2021), Protected Planet: The Global Database on Protected Areas Management Effectiveness (GD-PAME)] [On-line], January 2021, Cambridge, United Kingdom: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net.

[119] Edgar, et. al., 2014. Global conservation outcomes depend on marine protected areas with five key features. Nature 506:216-220.

[120] Douvere, F.2021. Science. https://science.sciencemag.org/content/373/6555/601?utm_campaign=toc_sci-mag_2021-08-05&et_rid=17775780&et_cid=3872853

[121] https://www.cbd.int/ebsa/about

least 75 marine species are affected by collisions with large vessels, with smaller species most likely to be undetected[122] and under-reporting likely[123].

The IUCN SSC Human-Wildlife Conflict Task Force[124] includes aquatic species and marine events including vessel collisions and the culling of marine predators in its deliberations. Sharks are one of Task Force's focus taxa.

The International Whaling Commission Conservation Committee (IWC-CC) established the Ship Strike Working Group with the main aim to understand and reduce the threat of vessel strikes to cetaceans, especially whales. An international centralized database (ship strike database) that contains validated information on cetacean (i.e., whales, dolphins, and porpoises) ship strikes worldwide has been established[125].

Target 5

By 2030, ensure that the harvesting, trade and use of wild species of fauna and flora, is legal, at sustainable levels and safe.

Headline Indicator 5.0.1 Proportion of wildlife that is harvested legally and safely

One in five of every fish caught is thought to originate from illegal, unreported and unregulated (IUU) fishing valued at $10-23 billion annually[126]. IUU fishing is targeted by The Agreement on Port State Measures (PSMA) which entered into force in 2016 with the intent preventing vessels engaged in IUU fishing from using ports and landing their catches. There are 67 participating Parties to the agreement[127].

More recently, the Global Record of Fishing Vessels, Refrigerated Transport Vessels and Supply Vessels (Global Record) is compiling an online comprehensive repository of vessels involved in fishing operations, with each vessel assigned a Unique Vessel Identifier (UVI) which remains constant throughout the vessels life regardless of change of name, ownership or flag. There are 65 participating Parties[128].

There are many different methods used to estimate IUU catch but methods are inconsistent, and many estimates are not robust[129]. A recent structured approach to fisheries officers builds on FAO recommendations to improve estimates of IUU fishing and has the capacity to be extended globally[130]. Nine different indicators of governance actions are being tested for their power in tracking sustainability of fisheries and might provide information to all Parties on which indicators might be most informative to report[131].

FAO SDG Indicator 14.6.1

The FAO Indicator for SDG 14.6.1 – "Progress by countries in the degree of implementation of international instruments aiming to combat illegal, unreported and unregulated fishing" is under development. The indicator assesses levels of compliance on surveillance, enforcement and prosecutions. Currently, 11 States

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[122] Schoeman, et. al. 2020. A Global review of vessel collisions with marine animals. Front. Mar. Sci 7. https://doi.org/10.3389/fmars.2020.00292

[123] Peel, et. al. 2018. Vessel strike of whales in Australia: the challenges of analysis of historical incident data. Front. Mar. Sci. 5:69. doi: 10.3389/fmars.2018.00069

[124] https://www.hwctf.org/

[125] https://iwc.int/ship-strikes

[126] http://www.fao.org/port-state-measures/en/

[127] http://www.fao.org/port-state-measures/background/parties-psma/en/ Accessed 22/12/2020

[128] http://www.fao.org/global-record/background/about/en/ Accessed 22/12/2020

[129] Macfadyen et al. 2016. Review of studies estimating levels of IUU fishing and the methodologies utilized. Poseidon Aquatic Resource Management Ltd. Report to FAO, June 2016. http://www.fao.org/3/a-bl765e.pdf

[130] Donlan, et al. 2020. Estimating illegal fishing from enforcement officers. Scientific Reports 10:12478.

[131] Chris Wilcox, CSIRO Australia, personal communication. 11/2/2021

for which there are data are at the lowest level of implementation, 16 at level 2, 28 at level 3, 34 at level 4 and 93 at level 5[132].

Headline Indicator 5.0.2 Proportion of fish stocks within biologically sustainable level

FAO SDG Indicator 14.4.1 Proportion of fish stocks within biologically sustainable levels.

FAO Fisheries Resources Monitoring System

FAO's Fisheries Resources Monitoring System (FIRM)[92] provides assessments for 539 fished stocks with a further 148 stocks remaining uncertain or not assessed. Fifty-four stocks were assessed as depleted, 121 at low abundance, 227 at intermediate abundance and 137 at pre-exploitation or high abundance. Assessments are updated every 2 years and the state of world marine fishery resources reviewed approximately every five years, most recently in 2018[93].

FIRM also evaluates whether fished stocks are fished at zero (182), moderate (235) or high intensity (122)[92]. Of particular concern are those stocks that are both depleted and subject to high fishing intensity (20). The combination of stock status and fishing pressure provide greater information on which fisheries are failing and likely to continue to do so, or conversely which fisheries are likely to recover to medium or high abundance.

Target 6

Manage pathways for the introduction of invasive alien species, preventing, or reducing their rate of introduction and establishment by at least 50 per cent, and control or eradicate invasive alien species to eliminate or reduce their impacts, focusing on priority species and priority sites.

Headline Indicator 6.0.1 Rate of invasive alien species spread

Global coordination on monitoring the spread of marine invasive species suffered a setback in 2010 with the loss of funding to the Global Invasive Species Program (GISP)[133]. Other databases available online appear to be unsupported and not up to date for marine species. A new database the Global Register of Introduced and Invasive Species (GRIIS) being developed and run by the IUCN Invasive Species Specialist Group (ISSG), supported by the SCBD[134]. GRIIS's principal focus is on naturalised taxa within countries, for which there is evidence of environmental impact there or elsewhere.

International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004

This convention, the goal of which is to reduce the probability of marine invasive species entering a State's national waters, entered into force in 2017 and currently has 86 contracting States representing 91 per cent of the world shipping tonnage[135].

Target 7

Reduce pollution from all sources to levels that are not harmful to biodiversity, ecosystem functions or human health, including by reducing nutrients lost to the environment by at least half, and pesticides by at least two thirds and eliminating the discharge of plastic waste

Headline Indicator 7.0.1 Index of coastal eutrophication potential (excess nitrogen and phosphate loading, exported from national boundaries)

[132] http://www.fao.org/iuu-fishing/international-framework/en/

[133] https://www.gisp.org/

[134] Pagad, et al. 2018. Introducing the Global Register of Introduced and Invasive Species. Scientific Data 5:170202. https://www.nature.com/articles/sdata2017202#MOESM78

[135] https://gisis.imo.org/Public/ST/Treaties.aspx.

There is a lack of information on ocean water quality even close to the coast. A total of 12 persistent organic pollutants ("legacy" POPs) that have been globally banned or restricted since 2004 were initially listed under the Stockholm Convention on Persistent Organic Pollutants[136]. Nine more substances were listed in 2009, two more in 2011 and in 2013. Long-time series of legacy POPs in the air and human matrices are available for many areas of the world (excluding Africa, Latin America and the Caribbean). Information on newly listed POPs is limited. Trend information for PFOS in water is currently very limited and differences in sampling and detection limits preclude any robust assessment of trends of PFOS in water.

Another set of chemical pollutants in ocean waters are those derived from anti-fouling products. Bans on the use Tributyl Tin (TBT) on boats less than 25m long started in 1980s. In 2008 organotin compounds acting as a biocide (like TBT) were banned as an anti-fouling agent on ship hulls by the International Maritime Organisation[137]. However, TBT anti-fouling paints are still being used in countries with poor regulation enforcement and even better regulated countries and over 6 per cent of the global tonnage of shipping is operated under non-signatories to the anti-fouling convention[138].

Monitoring the implementation of activities designed to reduce the passage of PFOS and banned anti-fouling products and developing and using standard sampling protocols for PFOS are two actions that could improve coastal water quality.

Another pollutant of coastal waters is excess nutrients that can lead to increased primary production manifesting as algal blooms, including harmful algal blooms. One option identified to respond to SDG indicator 14.1.1 is the use of remote sensing colour products to identify changes in chlorophyll-a concentrations in coastal waters that may indicate local algal bloom events contributed to by eutrophication.

SDG Indicator 14.1.1a UNEP GEO Blue Planet Chlorophyll Global Analysis and Metrics

The GEOPlanet Chlorophyll Global Analysis and Metrics utility[139] developed with UNEP and ESRI provides global chlorophyll-a deviations and anomalies derived from satellite data. Chlorophyll-a data come from a merged set prepared for the GCOS[49] ECV encompassing SeaWiFS, MODE, MERIS and VIIRS sensors spanning the years 1997 to 2019[140]. Preliminary sub-indicator results are monthly averages from 2005 and daily anomalies from 2018 based on a 4 km spatial resolution monthly mean product[141]. These global low-resolution products form Level I of a progressive monitoring approach. Level 2 incorporates higher resolution regional and national data, including in situ measurements and model-based synthesis.

While Level 1 products have global coverage, Level 2 products are verified with *in situ* measurements. Water properties of the world ocean are changing and algorithm parameterizations converting remote-sensed colour products to chlorophyll-a concentrations developed over past decades or in locations distant from the area of interest will become increasingly susceptible to changes in the coloured dissolved organic matter (CDOM) and total suspended matter (TSM) in coastal waters[142]. Shorter term anomaly detection would be less affected by these changes.

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[136] UNEP 2017. Second Global Monitoring Report of the Stockholm Convention on Persistent Organic Pollutants. UNEP/POPS/COP.8/INF/38

[137] Anon, 2001. International Convention on the Control of Harmful Anti-fouling Systems on Ships. IMO, London. 5 October 2001.

[138] de Oliveira, et al. 2019. Monitoring vessel traffic in Rio de Janeiro port area: Control of marine antifouling regulations. Ocean & Coastal Management 182:104997.

[139] https://chlorophyll-esrioceans.hub.arcgis.com/

[140] Sathyendranath, et al. 2019. An Ocean-Colour Time Series for Use in Climate Studies: The Experience of the Ocean-Colour Climate Change Initiative (OC-CCI). Sensors (Basel, Switzerland) 19:4285. URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6806290/

[141] The merged multi-sensor product will be regularly updated including data from additional sensors (e.g., OLCI) as part of the Copernicus Climate Change Service (C3S) and the Copernicus Marine Service (CMEMS).

[142] Blondeau-Patissieret al. 2014. A review of ocean color remote sensing methods and statistical techniques for the detection, mapping and analysis of phytoplankton blooms in coastal and open oceans. Progress in Oceanography 123:123-144.

Increased focus of the ocean observing community on coastal waters, especially in situ measurements, would lead to improvement of this analysis and metrics.

HAB OBIS

The OBIS Harmful Algal Bloom (HAB OBIS)[143] is a thematic node compiling occurrence data for toxin producing micro-algae species and their impacts. Initial compilation will lead to the first Global Harmful Algal Bloom Status Report as approved by the IOC Assembly (IOC-XXVII/Dec.5.4.2). The node currently contains 8,444 occurrence records for 131 species spanning the period 1596-2018 (1974 is the first year containing more than 100 data records).

MARPOL (1973/1978)

The protocol of 1978 relating to the International Convention for Prevention of Pollution from Ships, 1973, as amended, has 159 contracting states, representing 98.95 per cent of world shipping tonnage.

Headline Indicator 7.0.2 Plastic debris density

A marine litter monitoring framework is being developed[144] to harmonize sampling protocols and reporting and upgrade monitoring for SDG 14.1.1 from Tier 1 to Tier 2[145]. The UNEP Regional Seas Programme is actively involved. Marine debris is an emerging GOOS EOV. A key priority is to ensure interoperability of different databases. Level 1 data can detect plastic patches greater than 10 meters and is a remote-sensing product. Level 2 data are field surveys including beach litter, floating, water column and seafloor plastic litter following the GESAMP Guidelines[146].

Target 8

Minimize the impact of climate change on biodiversity, contribute to mitigation and adaptation through ecosystem-based approaches, contributing at least 10 GtCO2e per year to global mitigation efforts, and ensure that all mitigation and adaptation efforts avoid negative impacts on biodiversity

Headline Indicator 8.0.1 National green-house gas inventories from land use and land use change

Coastal wetlands hold large carbon reservoirs, especially in soil carbon. Both the rate and capacity of coastal wetlands to hold carbon can be significantly higher than for terrestrial forests and grasslands. Globally, 20–90 per cent of current coastal wetlands are projected to be lost by 2100[147].

Mangrove forests, tidal marshes and seagrass meadows are included as Chapter 4 ‘Coastal Wetlands” in the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories[148]. Specific management activities recognized for coastal wetlands include: forest management for mangroves; extraction for ports, marinas, dredging, land reclamation, aquaculture and salt production; drainage for agriculture, forestry and mosquito control, and; rewetting, revegetation and creation.

[143] http://hab.ioc-unesco.org

[144] SDG Metadata: https://unstats.un.org/sdgs/metadata/files/Metadata-14-01-01.pdf

[145] Indicator is conceptually clear, has an internationally established methodology and standards are available, but data are not regularly produced by countries.

[146] http://www.gesamp.org/publications/guidelines-for-the-monitoring-and-assessment-of-plastic-litter-in-the-ocean

[147] https://www.ipcc.ch/srocc/chapter/summary-for-policymakers/

[148] https://www.ipcc-nggip.iges.or.jp/public/wetlands/pdf/Wetlands_separate_files/WS_Chp4_Coastal_Wetlands.pdf

Semi-natural treatment wetlands which receive wastewater but are otherwise left in their natural condition are covered in Chapter 6 of the same 2013 Supplement[149]. Adequacy and extent of time-series data are addressed in Chapter 7[150].

Target 9

Ensure benefits, including nutrition, food security, medicines, and livelihoods for people especially for the most vulnerable through sustainable management of wild terrestrial, freshwater and marine species and protecting customary sustainable use by indigenous peoples and local communities.

Headline Indicator 9.0.1 National environmental-economic accounts of benefits from the use of wild species

The majority of the world's fisherfolk (47 million women and men in developing countries alone) engage in small-scale fisheries[151]. Small-scale fishing communities often have limited political power relative to large-scale commercial fisheries. This is especially the case for indigenous and women subgroups even within the community and can lead to barriers to access, an inability to obtain fair value for catch, increased vulnerability to resource degradation, and lack to access to governance and fisheries management.

Disaggregation of accounting information from Goal B (SEEA: https://seea.un.org/ecosystem-accounting) is anticipated to provide this information.

FAO Code of Conduct for Responsible Fisheries (CCRF)

The FAO Code of Conduct for Responsible Fisheries (CCRF)[152], adopted in 1995, directly addresses fisheries sustainability including equity through development of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries (SSF) in the Context of Food Security and Poverty Eradication[153]. These documents establish guidelines on how to value the lives and livelihoods of small-scale food producers and so are fundamental to food sovereignty[154].

There are clear links to SDG 14.b[155] and its Proposed Indicator 14.b.1. The proposed method for reporting on SDG 14.b and its indicator 14.b.1 is based on the small-scale fisheries section of the biannual CCRF questionnaire, in particular:1) existence of laws, regulations, policies, plans or strategies that specifically target or address the small-scale fisheries sector; 2) ongoing specific initiatives to implement the SSF Guidelines; and 3) existence of mechanisms through which small-scale fishers and fish workers contribute to decision-making processes[156]. Capacity development is required to raise awareness of this target and develop a participatory inclusive process that can establish an initial baseline against which future progress can be monitored.

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[149] https://www.ipcc-nggip.iges.or.jp/public/wetlands/pdf/Wetlands_separate_files/WS_Chp6_Constructed_Wetlands.pdf

[150] https://www.ipcc-nggip.iges.or.jp/public/wetlands/pdf/Wetlands_separate_files/WS_Chp7_Cross-Cutting_Issues_and_Reporting.pdf

[151] Österblom, et al. 2020. Towards Ocean Equity. Washington, DC: World Resources Institute. Available online at www.oceanpanel.org/how-distribute-benefits-ocean-equitably.

[152] FAO. 2011. Code of Conduct for Responsible Fisheries. Rome, 91 p. http://www.fao.org/3/i1900e/i1900e00.htm

[153] FAO. 2015. Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication. Rome: FAO.

[154] Ertör, et al. Situating small-scale fisheries in the global struggle for agroecology and food sovereignty. 2020. Transnational Institute, Amsterdam, November 2020. https://www.tni.org/files/publication-downloads/web_english_foodfish_final.pdf

[155] SDG 14.b.1 – Progress by countries in the degree of application of a legal/regulatory/policy/institutional framework which recognizes and protects access rights for small-scale fisheries.

[156] FAO. 2018. Workshop on Exploring Sustainable Development Goal 14.b and its Proposed Indicator 14.b.1. Workshop proceedings, 28–29 November 2017, Gaeta, Italy. FAO Fisheries and Aquaculture Proceedings No. 59. Rome, Italy.

Target 10

Ensure all areas under agriculture, aquaculture and forestry are managed sustainably, in particular through the conservation and sustainable use of biodiversity, increasing the productivity and resilience of these production systems

Headline Indicator 10.0.1 Proportion of agricultural area under productive and sustainable agriculture

Managed ecosystems have been defined as complex, dynamic systems with spatially varying inputs and outputs that are the result of interrelated physical, biological, and human decision-making processes[157]. While all marine ecosystems technically meet this definition, as even the lack of active management is the result of a human decision, the term 'managed ecosystems' usually applies to agricultural ecosystems. Aquaculture operations and their sustaining environment are the ocean equivalent.

Aquaculture currently accounts for only 17 per cent of the current production of edible meat, but could be increased though policy reforms, technological advancements (especially in alternative non fish-based feeds) and increased demand. It is estimated that aquaculture could provide most of the potential economically and environmentally sustainable 36-74 per cent increase in marine food production by 2050, representing 12-25 per cent of the estimated increase in all meat needed to feed 9.8 billion by 2050[158]. Under these scenarios, 44 per cent of edible production could come from mariculture by 2050. These estimates are more optimistic than the 14 per cent growth in food from the sea over the next decade predicted by OECD and FAO[159].

FAO State of the World Fisheries and Aquaculture (SOFIA)

FAO publishes annual statistical data on aquaculture production from all known producing countries and territories. The FAO State of the World Fisheries and Aquaculture (SOFIA)[160] report includes summary results from the aquaculture questionnaire. The rapid growth in aquaculture from only a few members including aquaculture as an economic sector in the 2007 report to 98 per cent of members reporting that aquaculture occurred in their countries by 2012 outpaced the development of legislative and institutional framework. Only 40 per cent members reported having legislative and institutional frameworks in place in 2012; by 2018 this had risen to just over half.

The State of the World's Aquatic Genetic Resources for Food and Agriculture (SoWaqGR)

FAO also produces The State of the World's Aquatic Genetic Resources for Food and Agriculture[161] focussed on farmed species and their wild relatives under national jurisdiction. The report's principal sources of information were country reports from 92 countries, representing 96 per cent of global aquaculture production. FAO is preparing a global plan of action on aquatic genetic resources "for the promotion of enhanced and effective conservation, sustainable use and development of these resources" for approval in 2021[161].

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[157] Antle, et al. 2002. Agriculture as a Managed Ecosystem: Implications for Econometric Analysis of Production Risk. Pages 243-263 in R. E. Just and R. D. Pope, editors. A Comprehensive Assessment of the Role of Risk in U.S. Agriculture. Springer US, Boston, MA.

[158] Costello, et al. 2020. The future of food from the sea. Nature 588:95-100.

[159] OECD-FAO Agricultural Outlook 2020-2029. https://www.oecd-ilibrary.org/sites/1112c23b-en/1/3/8/index.html?itemId=/content/publication/1112c23b-en&_csp_=b0996d88e18a7bcce47bdc65ebeeff2c&itemIGO=oecd&itemContentType=book#section-d1e19713

[160] http://www.fao.org/3/ca9229en/online/ca9229en.html#chapter-2_1

[161] FAO. 2019. The State of the World's Aquatic Genetic Resources for Food and Agriculture. FAO Commission on Genetic Resources for Food and Agriculture assessments. Rome. 290 pp. (also available at www.fao.org/3/CA5256EN/CA5256EN.pdf).

Target 11

Maintain and enhance nature's contributions to regulation of air quality, quality and quantity of water, and protection from hazards and extreme events for all people

Headline Indicator 11.0.1 National environmental-economic accounts of regulation of air quality, quality and quantity of water, and protection from hazards and extreme events for all people, from ecosystems

Disaggregation of accounting information from Goal B (SEEA: https://seea.un.org/ecosystem-accounting) is anticipated to provide this information.

It is considered "very likely" that sea level extremes will increase in frequency by up to an order of magnitude in some regions by 2100, with a "likely" increase in the early 21st century[162]. This increase will result primarily from increasing mean sea level ("high confidence").

Target 12

Increase the area of, access to, and benefits from green and blue spaces, for human health and well-being in urban areas and other densely populated areas

Headline Indicator 12.0.1 Average share of the built-up area of cities that is green/blue space for public use for all

About 40 per cent of the world population lives within 100km of the coast[163] and coastal green/blue spaces are valued for many aspects of human health and wellbeing including physical protection, food security, culture and recreation. The most relevant coastal ecosystems are included as indicators for Goal A.

SDG Indicator 11.7.1[164] defines public space, open public space and potential open public space. Open public space includes riparian reserves and waterfronts. However, inclusion of waterfronts may be limited by the computation method that: a) limits the area under consideration to the city/urban area, and b) focusses on areas that are within a 400m (walking distance). Additional consideration may be required to fully account for waterfronts, estuaries and associated shallow waters.

Target 13

Implement measures at global level and in all countries to facilitate access to genetic resources and to ensure the fair and equitable sharing of benefits arising from the use of genetic resources and, as relevant, of associated traditional knowledge, including through mutually agreed terms and prior and informed consent

Headline Indicator 13.0.1 Indicators of operational legislative, administrative or policy frameworks which ensure fair and equitable sharing of benefits, including those based on PIC and MAT*,**

Marine Genetic Resources (MGR) lack a legal definition but can be described as 'material from marine plants, algae, animals and microbial or other organisms, and parts thereof containing functional units of heredity or actual or potential value' (Convention on Biological Diversity, Article 2). There are 44 phyla in

[162] Church et al. 2018. Sea Level Change. https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter13_FINAL.pdf

[163] http://sedac.ciesin.columbia.edu/es/csdcoastal.html

[164] SDG Indicator 11.7.1: Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities.

the ocean compared to only 28 on land and of the 32/33 major animal phyla found in the ocean, only 12 are found on land[165].

Approximately 34,000 marine natural products have been reported, eight of which have resulted in clinically approved drugs, with a further 28 in clinical trials and 250 under preclinical investigation, a much higher success rate compared with drug development from terrestrial natural products[166].

Nutraceuticals, cosmeceuticals, genetically enhanced food products and bulk products including emulsifiers, stabilizers and bioplastics are just some of the commercial products from MGR, while red seaweeds are being grown to reduce methane emissions from ruminants.

However, marine biodiscovery is typically extremely costly and as a result most exploration has been undertaken by high-income countries. Barriers to entry for low- and middle-income countries include research capacity, technology, finances and intellectual property rights[166].

MGR within national jurisdiction would be an important component of headline indicators under Target 13. Ownership of the potential benefits from MGR in Areas Beyond National Jurisdiction (ABNJ) is part of ongoing discussions, including whether their regulation is inherently different from the regulation of MGR within national jurisdiction[166,167].

Target 14

Fully integrate biodiversity values into policies, regulations, planning, development processes, poverty reduction strategies, accounts, and assessments of environmental impacts at all levels of government and across all sectors of the economy, ensuring that all activities and financial flows are aligned with biodiversity values

Headline Indicator 14.0.1 Extent to which national targets have been adopted for integrating biodiversity values into policies, regulations, planning, development processes, poverty reduction strategies and accounts at all levels, ensuring that biodiversity values are mainstreamed across all sectors and integrated into assessments of environmental impacts*

Marine biodiversity will be covered by SDG Indicator 15.9.1a[168], where marine biodiversity is included in Parties' NBSAPs and national reports, provided in accordance with Article 6 of the Convention on Biological Diversity. Data from the Sixth National Reports is available.

Headline Indicator 14.0.2 Integration of biodiversity into national accounting and reporting systems, defined as implementation of the System of Environmental-Economic Accounting.

SDG Indicator 15.9.1b[169], adopted in March 2021, will over time provide a second source of information for this Target through the UN SEEA Ecosystem Accounts.

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[165] Chivian, et al. (2008). Sustaining Life: how human health depends on biodiversity. Oxford University Press.

[166] Blasiak,et al. 2020. The ocean genome and future prospects for conservation and equity. Nature Sustainability 3:588-596.

[167] Tessnow-von Wysocki, et al. 2020. The Voice of Science on Marine Biodiversity Negotiations: A Systematic Literature Review. Frontiers in Marine Science 7:614282. https://doi.org/10.3389/fmars.2020.614282

[168] SDG Indicator 15.9.1: (a) Number of countries that have established national targets in accordance with or similar to Aichi Biodiversity Target 2 of the Strategic Plan for Biodiversity 2011-2020 in their national biodiversity strategy and action plans and the progress reported towards these targets. https://unstats.un.org/sdgs/metadata/files/Metadata-15-09-01.pdf

[169] SDG Indicator 15.9.1: (b) Number of countries that have integrated biodiversity values into national accounting and reporting systems, defined as implementation of the System of Environmental-Economic Accounting (SEEA).

Ocean Accounts[170] provide a broad framework to connect the relevant elements of the System of National Accounts (SNA), SEEA Central Framework (CF) and SEEA Ecosystem Accounting (EA) covering economic, ecological, governance and social aspects. Flows of natural resources that are extracted or harvested, including fisheries, are included under SEEA CF. Discarded catch in fisheries is included as a natural resource residual under the same framework. Accounting for the environmental assets themselves occurs under SEEA EA and marine ecosystems identified for monitoring against headline Goal A.0.1 are recommended ecosystem assets for reporting under UN SEEA EA.

Target 15

All businesses (public and private, large, medium and small) assess and report on their dependencies and impacts on biodiversity, from local to global, and progressively reduce negative impacts, by at least half and increase positive impacts, reducing biodiversity-related risks to businesses and moving towards the full sustainability of extraction and production practices, sourcing and supply chains, and use and disposal

Headline Indicator 15.0.1 Dependencies and impacts of businesses on biodiversity

This indicator needs to be developed. For marine industries information reported under Targets 4, 5 and possibly 7 would be relevant.

Marine Stewardship Council Certification

The Marine Stewardship Council (MSC)[171] has provided independent assessments of fisheries since 1999. The MSC Fisheries Standard is based on the FAO Code of Conduct for Responsible Fisheries [172]. Assessments are based on three main principles: sustainability of the stock, minimising environmental impacts, and effective fisheries management. Of 437 fisheries that have started the MSC certification process, 239 are certified, 33 are in assessment, 41 have been combined, 107 have withdrawn, 14 have been suspended and 3 are exiting[173].

Target 16

By 2030, eliminate unsustainable consumption patterns, ensuring people everywhere understand and appreciate the value of biodiversity, make responsible choices commensurate with 2050 biodiversity vision, taking into account individual and national cultural and socioeconomic condition

Headline Indicator 16.0.1 Food waste index

About one-third of food produced for human consumption is lost or wasted globally. SDG Indicator 12.3. 1a Food Loss Index has been created by FAO[174]. SDG Indicator 12.3. 1b Food Waste Index is being developed by UNEP.

[170] Dated 1 October 2020, Global Ocean Accounts Partnership. Technical Guidance on Ocean Accounting for Sustainable Development See https://www.oceanaccounts.org/technical-guidance-on-ocean-accounting-2/.

[171] https://www.msc.org

[172] http://www.fao.org/3/v9878e/v9878e00.htm

[173] https://fisheries.msc.org/en/fisheries/@@search

[174] http://www.fao.org/sustainable-development-goals/indicators/1231/en/

The Food Loss Index indicated food loss from post-harvest to distribution ranged from less than 6 to more than 20 per cent in 2016 with a global average of 14 per cent[174].

Headline Indicator 16.0.2 Biomass material footprint per capita

Average global material extraction increased from 7 to 10 tonnes per capita between 1970 and 2010[175]. The densely populated regions of Europe, Asia and the Pacific (and to some extent North America) have required large and increasing amounts of material imports including agricultural products. Biomass extraction has increased on average 2 per cent per year since 1970 (slightly higher than population growth) and forms about a quarter of global material extraction[176].

International Resource Panel Materials Resource Database

The International Resource Panel hosted by UNEP produces a data set of material flows and indicators for material footprint of consumption from starting in 1970 and covering 191 countries. Information from this database SDG indicators (especially SDG 8 and SDG 12) and it is expected that data will be updated on a yearly basis. One of the 13 material sub-categories covers wild catch and harvest.

The sustainable management of fisheries is dealt with under Target 8. Improved productivity, sustainability and resilience of aquaculture systems is addressed under Target 9. Seafood provides a cheap and locally available food source in developing regions where expanding aquaculture production helps keep prices low and accessible to low-income consumers[177]. Expanding the use of non-fish-based foods in mariculture has been identified as one of the major options for its expansion and may provide a more efficient use of agricultural products.

Biomass material footprint per capita will need to include biomass from the ocean and may also need to consider how that biomass is grown and/or harvested.

Target 17

Establish, strengthen capacity for, and implement measures in all countries to prevent, manage or control potential adverse impacts of biotechnology on biodiversity and human health, reducing the risk of these impacts

Headline Indicator 17.0.1 Indicator of measures in place to prevent, manage and control potential adverse impacts of biotechnology on biodiversity taking into account human health*

Convention on Biological Diversity: This index would need to be developed.

Target 18

By 2030, redirect, repurpose, reform or eliminate incentives harmful for biodiversity, including [X] reduction in the most harmful subsidies, ensuring that incentives, including public and private economic and regulatory incentives, are either positive or neutral for biodiversity

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[175] Schandl, et al. 2018. Global Material Flows and Resource Productivity: Forty Years of Evidence. 22:827-838.

[176] IRP (2017). Assessing global resource use: A systems approach to resource efficiency and pollution reduction. A Report of the International Resource Panel. United Nations Environment Programme. Nairobi, Kenya. https://www.resourcepanel.org/reports/assessing-global-resource-use

[177] Costello, et al. 2019. The Future of Food from the Sea. Washington, DC: World Resources Institute. Available online at www.oceanpanel.org/future-food-sea

Headline Indicator 18.0.1 Value of subsidies and other incentives harmful to biodiversity, that are redirected, repurposed or eliminated

The ocean economy was very conservatively valued at US$ 1.5 trillion in 2010 or approximately 2.5 per cent of the world gross added value and directly providing 31 million full-time jobs[178]. Projections on a "business-as-usual" scenario project a doubling of this economy to US$ 3 trillion and 40 million direct full-time jobs by 2030. Mariculture, offshore wind energy, fish processing, shipbuilding and repair are expected to be among the strongest growing components.

Fisheries subsidies were estimated to be as high as US$ 35 billion in 2016, of which US$ 20 billion directly contributed to overfishing. The size of this subsidy linked to a decline in fish stocks within biologically sustainable levels, led to agreement on Sustainable Development Goal 14.6[179] in 2015 to address harmful subsidies by 2020. It also led to the UNCTAD-FAO-UNEP Joint Statement on Fisheries Subsidies[180], a road map to ending subsidies, signed by 90 countries and supported by more than 10 global NGOs.

The road map for eliminating harmful fishing subsidies has four elements:

1. Require countries to provide information on what subsidies they are providing.
2. Prohibit those subsidies which contribute to overfishing and illegal fishing.
3. Introduce new policies tools to deter the introduction of new harmful subsidies.
4. Provide special and differential treatment to developing countries.

UNCTAD member States remain committed to delivering a comprehensive agreement on fishing subsidies by the 2021 Ministerial Conference of the World Trade Organization (WTO).

Target 19

Increase financial resources from all sources to at least 200 billion per year, including new, additional and effective financial resources, increasing by at least 10 billion per year international financial flows to developing countries, leveraging private finance, and increasing domestic resource mobilization, taking into account national biodiversity finance planning, and strengthen capacity-building and technology transfer and scientific cooperation, to meet the needs for implementing the post-2020 global biodiversity framework

Headline Indicator 19.0.1 Official development assistance

SDG Indicator 15.a.1(a)[181] is based on data collected through the OECD. Overseas Development Assistance (ODA) data has been collected since 1961 with a new ODA standard introduced in 2018. ODA to support marine activities is included.

Headline Indicator 19.0.2 19.0.2 Public expenditure and private expenditure on conservation and sustainable use of biodiversity and ecosystems

[178] OECD 2016. The Ocean Economy in 2030. DOI:https://dx.doi.org/10.1787/9789264251724-e

[179] SDG 14.6 by 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, and eliminate subsidies that contribute to IUU fishing, and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the WTO fisheries subsidies negotiation.

[180] https://unctad.org/project/regulating-fisheries-subsidies

[181] Indicator 15.a.1: (a) Official development assistance on conservation and sustainable use of biodiversity.

Target 20

Ensure that relevant knowledge, including the traditional knowledge, innovations and practices of indigenous and local communities with their free, prior, and informed consent, guides decision making for the effective management of biodiversity, enabling monitoring, and by promoting awareness, education and research

Headline Indicator 20.0.1 Indicator on biodiversity information and monitoring, including traditional knowledge, for management*,**

One measure of the success of initiatives monitored under this Target will be the quality and characteristics of ocean research and monitoring around the globe.

IOC GOOS Report Card 2021

The GOOS Observations Coordination Group reports on observations of the physical properties of the ocean annually[182]. This includes the status and coverage of in situ observing systems, satellite-based observations, emerging networks, community collaboration and technology development. GOOS has committed to extend this report card or its equivalent to biogeochemical and biological observing systems.

IOC Global Ocean Science Report 2020 (GOSR 2020)

The Intergovernmental Oceanographic Commission (IOC) of UNESCO produced the first Global Ocean Science Report in 2017 from the results of surveys of its members. The second Global Ocean Science Report was published in 2020 and is based on responses from 150 member States (GOSR2020)[183].

The number of ocean science researchers per country varies from <1 to >300 employees per million inhabitants and is correlated with GDP purchasing power parity. The global average for female ocean science participation is 37 per cent (range: 7 per cent to 72 per cent). Further information is provided on proportion of female ocean researchers (39 per cent or 10 per cent higher than for natural sciences overall), participation in international conferences (48 per cent and increasing since 2017, although only 29 per cent of women were featured speakers) and their geographic and discipline variation.

IOC-UNESCO also supports ocean literacy with tools to provide educators and learners with innovative tools, methods and resources to understand ocean processes and functions and urgent ocean issues, including opportunities to develop community building[184].

Times Higher Education Impact Rankings

The Times Higher Education Impact Rankings are presented as the only global performance tables that assess universities against the Sustainable Development Goals[185]. The second (2021) edition of this ranking included information from 768 universities in 85 countries. The number of universities offering courses relevant to SDG 14 was 201 in 2021. Rankings are based on research publication metrics, aquatic-relevant education and presence of practices that support aquatic ecosystems and their management.

Target 21

Ensure equitable and effective participation in decision-making related to biodiversity by indigenous peoples and local communities, and respect their rights over lands, territories and resources, as well as by women and girls, and youth

[182] https://www.ocean-ops.org/reportcard2021/

[183] IOC 2020. Global Ocean Science Report 2020. https://en.unesco.org/gosr

[184] IOC-UNESCO Ocean Literacy Portal. http://oceanliteracy.unesco.org

[185] https://www.timeshighereducation.com/impactrankings#!/page/0/length/25/sort_by/rank/sort_order/asc/cols/undefined

Headline Indicator 21.0.1 Land tenure in the traditional territories of indigenous peoples and local communities

SDG Indicator 1.4.2[186] is being addressed by UN-Habitat and the World Bank[187]. It derives from the Voluntary Guidelines for the Responsible Governance and Tenure of Land, Forests and Fisheries in the Context of National Food Security, endorsed by the Committee on World Food Security in 2012. Fisheries and hence the marine environment are included in the concepts from which this indicator is derived, and the definition of the indicator specifies "all land tenure types as recognized at the country level…", although the marine environment is not mentioned specifically in the metadata record[187].

It is estimated based on data from over 1,900 coastal Indigenous communities representing 27 million people across 87 countries, that total yearly seafood consumption by coastal Indigenous communities is between 1.5 and 2.8 million metric tonnes, or approximately 2 per cent of the global yearly commercial fisheries catch[188]. On average seafood consumption per capita is estimated to be 15 times higher than that for non-Indigenous communities.

Coasts provide the access between land and ocean, are often more productive than other land areas and subject to more concentrated and diverse pressures. Restrictions on access to marine resources, or "coastal grabbing" acts as a barrier to self-reliance in Indigenous communities[189]. The Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries (SSF) in the Context of Food Security and Poverty Eradication[153] address the responsible governance of tenure and support Indigenous forms of governance and preferential access rights. The guidelines note that "Tenure rights to land in the coastal/waterfront area are critical for ensuring and facilitating access to the fishery, for accessory activities …. and for housing and other livelihood support".

Reporting on progress on implementing policies that meet SSF guidelines occurs through the biannual CCRF questionnaire and is proposed for reporting on SDG Indicator 14.b.1.

Headline Indicator 21.0.2 Degree to which indigenous peoples and local communities, women and girls as well as youth participate in decision-making related to biodiversity*

Data on engagement of stakeholders is already included in NBSAPs and national reports. This would be based on self-reporting.

See comments on Headline Indicator 21.0.1 on importance of coasts to indigenous peoples and local communities.

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[186] Proportion of total adult population with secure tenure rights to land, (a) with legally recognized documentation, and (b) who perceive their rights to land as secure, by sex and type of tenure.

[187] https://unstats.un.org/sdgs/metadata/files/Metadata-01-04-02.pdf

[188] Cisneros-Montemayor, et al. 2016. A global estimate of seafood consumption by coastal Indigenous peoples. PLOS ONE 11:e0166681. Note that the group of coastal indigenous peoples was defined by the authors solely to conduct the study.

[189] Bavinck, et al. 2017. The impact of coastal grabbing on community conservation – a global reconnaissance. Maritime Studies 16:8.