Global Manual on Ocean Statistics

Towards a definition of indicator methodologies

February 2018 (final draft)

UN environment

14 LIFE BELOW WATER

Executive summary

The purpose of the *Global Manual on Ocean Statistics* is to support countries in their efforts to track progress against the delivery of Sustainable Development Goal (SDG) 14 (Life below water), by providing guidance for implementing three indicators under UN Environment custodianship: (14.1.1) "*Index of Coastal Eutrophication (ICEP) and floating plastic debris density*"; (14.2.1) "*Proportion of national exclusive economic zones managed using ecosystem-based approaches*"; and (14.5.1) "*Coverage of protected areas in relation to marine areas*". As methodologies for SDG Indicators 14.1.1 and 14.2.1 are currently being tested and developed ("tier 3" indicator), and so as to begin tracking progress against SDG Targets 14.1 and 14.2, the *Global Manual* presents step-by-step methodologies for "proxy" indicators, in line with Regional Seas Core Indicators: *"Chlorophyll-a concentration"* as proxy indicator for eutrophication (14.1.1); *"beach litter"* as proxy indicator for marine plastic litter (also 14.1.1); and "*Integrated Coastal Zone Management (ICZM) protocols"* as proxy indicator for ecosystem-based management in coastal zones (14.2.1). For SDG Indicator 14.5.1 ("tier 1" indicator), an established methodology for calculating the coverage of protected areas in relation to marine areas is presented which uses a global, authoritative database of protected areas (World Database on Protected Areas). The methodologies presented in the *Global Manual* are designed to be globally applicable approaches that provide the minimum data required to implement the SDG indicators at country-level. Recognising that countries may have different national capacities for monitoring, the *Global Manual* proposes one 'core parameter' and a number of 'supplementary parameters' for each indicator. Country missions to Colombia and Fiji were undertaken to support the development of the *Global Manual*, and provided useful country-level perspectives and insights. It was, for instance, noted that the level of capacity will vary significantly across countries. Further, some nations may rely more than others on regional bodies and non-governmental organisations for one or more stages of the indicator process (data production and management, analysis, reporting). Also, countries with comparatively large national waters compared to their terrestrial jurisdictions, such as island and multi-island nations, will be faced with additional technical and other challenges when it comes to monitoring their waters in the context of the Sustainable Development Goals. Beyond the implementation challenges at country level and leaving aside the question of the high seas, it remains that the current suite of agreed and proxy indicators for the three Targets considered in the *Global Manual* only partially address the rather broad SDG 14 Targets they fall under, indicating that additional indicators will be needed for countries to comprehensively monitor SDG 14 implementation.

Contents

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List of acronyms

Acronym	English name
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
AZE	Alliance for Zero Extinction
BOD	Biological oxygen demand
CAFF	Conservation of Arctic Flora and Fauna
CBD	Convention on Biological Diversity
CCAMLR	Convention for the Conservation of Antarctic Marine Living Resources
CEOS	Committee on Earth Observation Satellites
CMEMS	Copernicus Marine Environment Monitoring Service
COD	Chemical oxygen demand
CPPS	Commission for the South Pacific
CSO	Civil Society Organisation
CZCS	Coastal Zone Color Scanner
DIN	Dissolved inorganic nitrogen
DIP	Dissolved inorganic phosphorus
EBSA	Ecologically or Biologically Significant marine Areas
ESA	European Space Agency
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FAO	Food and Agriculture Organization (of the United Nations)
GCOM-C	Global Changing Observation Mission
GEF-TWAP	Global Environment Facility Transboundary Waters Assessment Programme
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection
GIS	Geographic information system
HELCOM	Baltic Marine Environment Protection Commission – Helsinki Commission
IAEG-SDGs	Inter-agency and Expert Group on SDG Indicators
IBA	Important Bird and Biodiversity Area
IBTS	International Bottom Trawl Surveys
ICC	International Coastal Clean-up
ICEP	Index of Coastal Eutrophication
ICZM	Integrated Coastal Zone Management
INVEMAR	Colombian Marine and Coastal Research Institute
IOC-UNESCO	Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization
IUCN	International Union for Conservation of Nature
JAMP	Joint Assessment and Monitoring Programme
JAXA	Japan Aerospace Exploration Agency
JRC	Joint Research Council (of the European Commission)
KBA	Key Biodiversity Area
MAB	Man and Biosphere Reserves (UNESCO)
LME	Large Marine Ecosystem
MERIS	Medium Resolution Imaging Spectrometer
MODIS	Moderate Resolution Imaging Spectroradiometer
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive

MSP	Marine (or Maritime) Spatial Planning
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NOWPAP	Northwest Pacific Action Plan
OSPAR	Oslo Paris Convention for the Protection of the Marine Environment of the North-East Atlantic
OLCI	Ocean and Land Colour Instrument
OLI	Operational Land Imager
PDF	Portable Document Format
PERSGA	Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden
PNN	National Natural Parks (Colombia)
PSSA	Particularly Sensitive Sea Area
ROMPE	Regional organization for the Protection of the Marine Environment
RUNAP	Colombian National Register of Protected Areas (in Spanish: Registro Único de Áreas Protegidas)
SeaWiFS	Sea-Viewing Wide Field-of-View Sensor
SDG	Sustainable Development Goals
SPREP	Secretariat of the Pacific Regional Environment Programme
STEP	Science Toolbox Exploitation Platform
TOC	Total organic carbon
TRIS	Thermal Infrared Sensor
UAC	Coastal and Oceanic Environmental Unit (in Spanish: Unidad Ambiental Costera)
UN	United Nations
UNEP	UN Environment
UNEP-MAP	UN Environment Mediterranean Action Plan (also Barcelona Convention)
UNEP-WCMC	UN Environment World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNSD	United Nations Statistics Division
VIIRS	Visible Infrared Imaging Radiometer Suite
VME	Vulnerable Marine Ecosystem
WDPA	World Database on Protected Areas
WFD	Water Framework Directive
WHS	World Heritage Site

List of Regional Seas Programmes

Antarctic Sea	Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), Antarctic Treaty
Arctic Sea	Arctic Council, Ottawa Declaration
Baltic Sea	Helsinki Commission (HELCOM), Helsinki Convention
Black Sea	Black Sea Commission, Bucharest Convention
Caspian Sea	Caspian Environment Programme, Tehran Convention
East Asian Seas	East Asian Seas Action Plan
Mediterranean Sea	UN Environment Mediterranean Action Plan (UNEP-MAP), Barcelona Convention
Northeast Atlantic	Oslo-Paris Convention (OSPAR) for the Protection of the Marine Environment of the North-East Atlantic
Northeast Pacific	Antigua Convention
Northwest Pacific	Northwest Pacific Action Plan (NOWPAP)
Pacific	Pacific Regional Environment Programme, Secretariat of the Pacific Regional Environment Programme (SPREP), Noumea Convention
Red Sea and Gulf of Aden	Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA), Jeddah Convention
ROMPE Sea Area*	Regional organization for the Protection of the Marine Environment (ROMPE), Kuwait Convention **(the ROMPE Sea Area refers to the marine and coastal areas of Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates)*
Sargasso Sea	Hamilton Declaration
South Asian Seas	South Asia Cooperative Environment Programme, South Asian Seas Action Plan
Southeast Pacific	Permanent Commission for the South Pacific (CPPS), Lima Convention
West and Central Africa	Abidjan Convention
Western Indian Ocean	Nairobi Convention
Wider Caribbean	Caribbean Environment Programme, Cartagena Convention

Part 1: Context of the *Global Manual*

Chapter 1: Introduction

Sustainable Development Goals and indicators

At the United Nations (UN) General Assembly in September 2015, Heads of States and Governments agreed on 17 Sustainable Development Goals (SDGs) as framework for the 2030 Agenda for Sustainable Development. The SDGs integrate the three dimensions of sustainable development (biosphere, society and economy, as illustrated in Figure 1) and aim to foster action for people, planet, prosperity, peace and partnership. For each high level goal, a number of specific targets have been agreed by the countries. (Further details on the individual SDGs and targets can be found at https://sustainabledevelopment.un.org/sdgs).

Figure 1: Illustration of the 17 Sustainable Development Goals across the three spheres of sustainable development: biosphere, society and economy. Credit: Azote Images for Stockholm Resilience Centre.

To keep track of progress against these global goals and associated targets, the Inter-agency and Expert Group on SDG Indicators (IAEG-SDGs) developed a framework of over 200 indicators, which was adopted by the UN General Assembly in July 2017. Countries are leading on the delivery of the SDGs, on a voluntary basis, and are encouraged to use the framework of globally agreed indicators to report on progress. This will require a significant level of capacity and resources from countries: many indicators do not currently have internationally established methodologies nor available data and/or associated monitoring schemes in place. Countries are encouraged to prioritise and develop their various monitoring schemes over time, in accordance to their national capacities.

To facilitate the implementation of the global indicator framework, the indicators have been classified into three tiers based on the global availability of methodologies and data (see Table 1 for tier classifications). Tier classifications are reviewed annually based on changes in methodologies and data availability and progress in the development of the indicators (as documented in associated work plans)[1].

Table 1: Tier classification for global SDG indicators (Source: https://unstats.un.org/sdgs/iaeg-sdgs/tier-classification/).

	Tier classification criteria/definitions
Tier 1	Indicator is conceptually clear, has an internationally established methodology and standards are available, and data are regularly produced by countries for at least 50 per cent of countries and of the population in every region where the indicator is relevant.
Tier 2	Indicator is conceptually clear, has an internationally established methodology and standards are available, but data are not regularly produced by countries.
Tier 3	No internationally established methodology or standards are yet available for the indicator, but methodology/standards are being (or will be) developed or tested.

Data and information flows for reporting on SDG indicators

Currently, there are few consistent approaches for data collection and reporting for global targets such as the SDGs, or the Aichi Targets of the UN Strategic Plan for Biodiversity (2010-2020). While social and economic data might be collected by National Statistics Offices in the countries, environmental and ecological data are often collected by Non-Governmental Organisations and research institutes at country, regional or even global levels. To support the global reporting process for SDGs, the Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs) is developing guidelines on data and information flows from national to global levels, as illustrated in Figure 2.

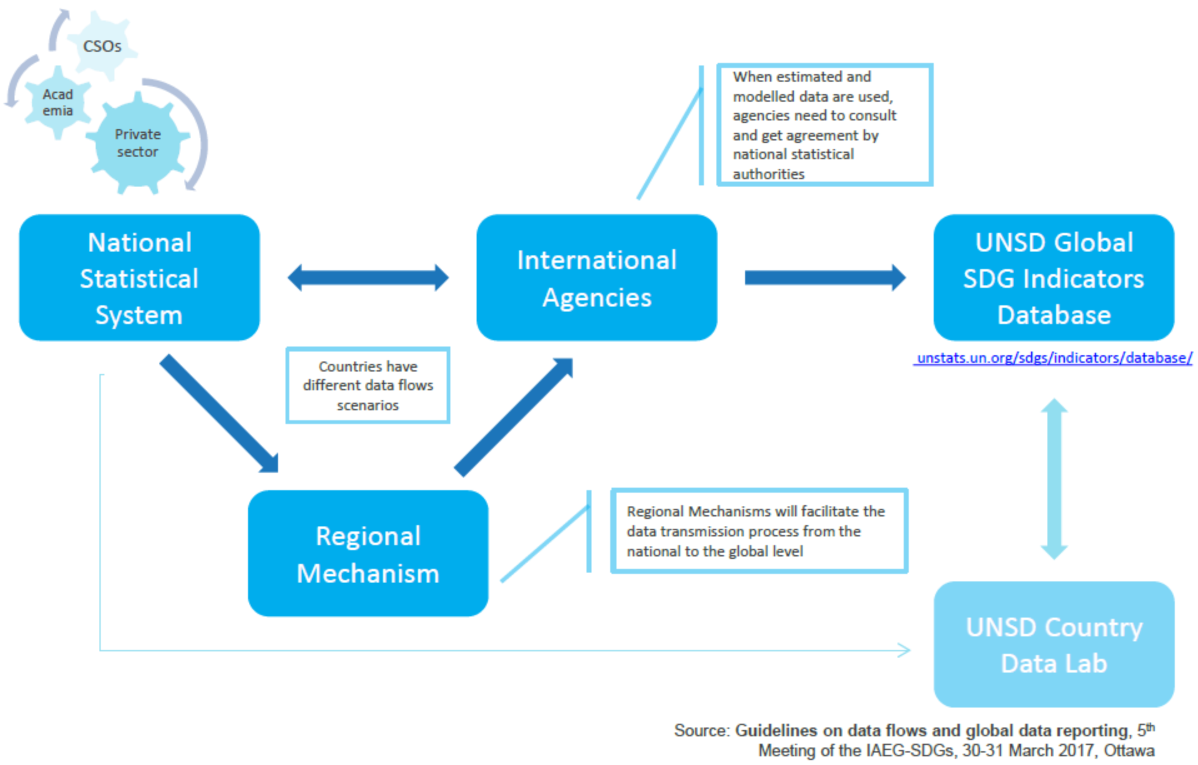

Figure 2: Anticipated Sustainable Development Goal data flow and reporting process. UNSD: UN Statistics Division; CSOs: Civil Society Organisations.

[1] Inter-agency Expert Group on SDG Indicators: https://unstats.un.org/sdgs/iaeg-sdgs/

According to the IAEG-SDGs reporting guidelines, the monitoring data underlying the indicators will be collected and processed at the national level by relevant public and private-sector institutions, and brought together in reporting platforms by the National Statistics Office of the country. From here, the data and information will be transmitted to international agencies, either directly or through regional mechanisms such as the Regional Seas Programmes[2]. The international agencies will then aggregate the country-level data at regional and global levels and submit these aggregates, along with the country data, into the Global SDG Indicators Database (www.unstats.un.org/sdgs/indicators/database), which is maintained by the UN Statistics Division (UNSD).

Each SDG indicator falls under the responsibility of a specific international agency which functions as custodian agency for the indicator. Custodian agencies are UN bodies and other international organisations, such as the UN Environment World Conservation Monitoring Centre (UNEP-WCMC), that are responsible for facilitating the data and information flow from the national to the global level. The custodian agencies also have the responsibility to standardise SDG indicator methodologies and to support countries in strengthening national statistical capacity and reporting mechanisms.

Detailed information on the SDG reporting process will be available in the *Guidelines for regional follow-up and review of SDG Oceans* which are currently being drafted by UN Environment (Ecosystem Division). In particular, these guidelines provide further background and justification for the approach taken by the present *Global Manual on Ocean Statistics*, which is using the Regional Seas Programmes' on-going work on indicators as a framework for SDG indicator methodologies.

SDG 14 'Life below water' and country-level perspectives

Sustainable Development Goal SDG 14 *'Life below water'* sets the aim to *conserve and sustainably use the oceans, seas and marine resources for sustainable development*. UN Environment is the custodian agency for three indicators related to SDG 14:

14.1.1 Index of Coastal Eutrophication (ICEP) and floating plastic debris density

14.2.1 Proportion of national exclusive economic zones managed using ecosystem-based approaches

14.5.1 Coverage of protected areas in relation to marine areas

The purpose of the *Global Manual on Ocean Statistics* is to support countries in their efforts to track progress against the delivery of SDG 14, by providing a step-by-step guide to implementing the three indicators under UN Environment custodianship (see Table 2 for indicators and related SDG 14 Targets). In this context, country missions to Colombia and Fiji (see reports in Appendix 3), were carried out to inform the development of the *Global Manual*. The government representatives that were consulted during these missions supported the proposed step-by-step structure of the indicator methodologies, which was thought to promote coherent approaches across and within countries.

[2] For information about the Regional Seas Programmes: http://web.unep.org/regionalseas/who-we-are/regional-seas-programmes

Table 2: Sustainable Development Goal (SDG) 14 Targets for which UN Environment is the custodian agency of the indicators. See Table 1 for tier classification. SDG Target 14.1 is analogous to Aichi Target 8[3] of the UN Strategic Plan for Biodiversity 2010-2020, for which global indicators are not yet available. SDG Target 14.5 is analogous to Aichi Target 11[4].

Target number	Target name	Indicator number	Indicator name	Custodian agency (and others involved)	Tier class.
14.1	By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution	14.1.1	Index of Coastal Eutrophication (ICEP) and floating plastic debris density	UN Environment (IOC-UNESCO, FAO)	3
14.2	By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	14.2.1	Proportion of national exclusive economic zones managed using ecosystem-based approaches	UN Environment (IOC-UNESCO, FAO)	3
14.5	By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information	14.5.1	Coverage of protected areas in relation to marine areas	UN Environment (UNEP-WCMC)	1

SDG Indicators 14.1.1 and 14.2.1 are classified as tier 3 since the methodologies for these indicators are currently being tested and developed. The indicators are expected to be operational from 2021 onwards[5]. In the meantime, to begin tracking progress against Targets 14.1 and 14.2, proxy indicators will be used. For SDG Indicator 14.1.1, Chlorophyll-a concentration has been agreed as provisional proxy indicator for eutrophication, and beach litter as proxy indicator for marine plastic litter. For SDG Indicator 14.2.1, Integrated Coastal Zone Management (ICZM) protocols have been agreed as proxy indicator for ecosystem-based management in coastal zones. These proxy indicators are in line with Regional Seas Core Indicators 1, 3 and 22, which were agreed by the Regional Seas Conventions and Action Plans at their 18th Global Meeting in 2016 (UNEP 2016a). A guidance document on *Implementing the Regional Seas Core Indicators: Towards Coordinated Regional Seas Assessment* is being produced in parallel to this *Global Manual* by the UN Environment Global Programme of Action

[3] Aichi Target 8: *By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity*. For more information about the target: https://www.cbd.int/aichi-targets/target/8

[4] Aichi Target 11: *By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, 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*. For more information about the target: https://www.cbd.int/aichi-targets/target/11

[5] These indicators will be operational from 2021 according to the Work Plans for tier 3 indicators, prepared by the UN Statistics Division with inputs provided by international and regional entities responsible for global data compilation. Available at: https://unstats.un.org/sdgs/files/meetings/iaeg-sdgs-meeting-05/TierIII_Work_Plans_03_03_2017.pdf

for the Protection of the Marine Environment from Land-Based Activities (GESAMP). A full list of the 22 Regional Seas Core Indicators is provided in Appendix 1 (UNEP 2016b).

For SDG Indicator 14.5.1, an internationally established methodology already exists (tier 1 indicator). The coverage of protected areas in relation to marine areas is calculated using the World Database on Protected Areas (WDPA), based on national data which countries either submit into the WDPA, or approve.

The *Global Manual* provides step-by-step methodologies for implementing the proxy indicators for SDG Indicators 14.1.1 and 14.2.1. The methodologies are designed to be globally applicable approaches that provide the minimum data required to implement the SDG indicators at country-level. This is particularly relevant to countries with limited resources and technical capacities, notably countries with relatively large marine national waters such as "island nations". For SDG Indicator 14.5.1, the *Global Manual* points towards the existing methodology based on the WDPA. Recognising that countries may have different national capacities for monitoring, the *Global Manual* proposes one core parameter and a number of supplementary parameters for each indicator. It is expected that all countries will monitor and report on the core parameter. Where the capacity and resources exist, countries may choose to also monitor and report on any or all of the supplementary parameters.

Importance and challenge of monitoring the ocean

The ocean provides essential ecosystem services for human populations, from global climate regulation to local livelihoods and nutrition. Monitoring is key to understanding the ocean: How is the state of the ocean changing? Who is benefiting from the change and who is losing out? What is causing the changes? How well are our efforts to address the changes working?

The ocean covers 70 percent of the surface of the Earth. Yet, compared to terrestrial systems, marine ecosystems and biodiversity are still poorly understood. The main reason for our limited understanding of the ocean is that most marine ecosystems are remote, vast in size and difficult to access, making marine research expensive and logistically challenging. Gathering data on marine biodiversity and ecosystem conditions requires advanced technologies and equipment, such as oceanographic research vessels, submersibles, remotely operated vehicles, specially designed sensors and remote sensing facilities. Moreover, the dynamic and connected nature of the marine environment present additional challenges: monitoring methodologies that work well in one location may not be suitable or relevant in another. Another layer of complexity is added by a multitude of different jurisdictions, or lack thereof, in the ocean. Depending on the country, territorial waters can extend to 12 nautical miles and exclusive economic zones (national waters) can reach out to 200 nautical miles. However, over 60 percent of the ocean surface and nearly 95 percent of the volume lie in areas beyond national jurisdiction, also called the high seas, where responsibilities for monitoring and reporting are not always straightforward.

In the high seas, monitoring often relies on international scientific cooperation efforts, due to of the vast areas involved and the cost of accessing remote marine environments, including the deep sea. One cost-effective method for accessing these areas, requiring low technological capacity, is through international remote sensing initiatives that use satellite telemetry to monitor large areas of the high seas over time. These remote sensing initiatives provide insight on physical, biological and biogeochemical ocean parameters. However, satellite sensors are less suitable for monitoring species and habitat biodiversity, or even pollutants such as marine plastics, for which *in situ* data collection is usually more appropriate. The issue here is that the cost of *in situ* monitoring and lack of national mandates in the high seas limit the options for such primary data collection. The challenges and limitations facing monitoring in the high seas are particularly problematic for transboundary marine issues such as ocean acidification or marine plastics. For such issues, the monitoring of national waters, which is the primary focus of the SDG indicators, only shows part of the picture.

Lastly, when monitoring the ocean, it is important to consider the high degree of connectivity that exists within the marine environment, but also between marine and terrestrial systems. Most of the changes in marine ecosystems are caused by activities on land. For example, nutrient run-off from agriculture is a main cause of eutrophication of coastal waters, and mismanaged plastic waste from coastal communities often ends up in the ocean. About 40 percent of the Earth’s population lives on the coast, and approaches like Integrated Coastal Zone Management (ICZM) have recognised the need for integrated marine and terrestrial management of these coastal zones. In this context, it is important to note that the agreed SDG 14 Indicators (and proposed proxies) relate to measuring the state and quality of the impacted ecosystems, rather than measuring the drivers and pressures underlying these. Hence, their purpose is to assess the success of measures put in place to prevent marine issues such as marine litter or eutrophication.

About the *Global Manual*

The *Global Manual on Ocean Statistics* provides guidance for national governments and national institutions to support the country-level implementation of SDG Indicators 14.1.1, 14.2.1 and 14.5.1 (full names in Table 2) in their national waters. Each indicator is addressed in one of the following chapters (Chapters 2, 3 and 4), which contain:

1) A review of existing indicator approaches and methodologies currently used by the 18 Regional Seas Programmes, and other key intergovernmental, international or regional bodies, that are/can be used as proxy indicators for the SDG indicators (tables in Appendix 2 provide full detail per Regional Seas Programme);
2) A proposed globally applicable step-by-step methodology that countries can use to implement the proxy indicators;
3) In-country insights on national monitoring programmes and experience of implementing relevant indicators obtained during two country missions (Colombia, Fiji), with full reports in Appendix 3.

Part 2: Step-by-step guides to indicator implementation

Chapter 2: Indicator 14.1.1: Index of Coastal Eutrophication (ICEP) and Floating Plastic debris Density

Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution

Index of Coastal Eutrophication (ICEP)

Review of existing indicators

A review of existing indicators and methodologies currently used by Regional Seas Programmes and other key intergovernmental, international or regional bodies highlights three main approaches for monitoring coastal eutrophication.

1) Indicators for the cause of eutrophication (nutrient input and concentrations): Coastal eutrophication is mainly caused by nutrient enrichment of coastal environments. Nutrient enrichment is a direct consequence of nutrient inputs from land-based (and atmospheric) sources, in particular phosphorous and nitrogen run-off from agricultural fertilisers, livestock waste and domestic wastewater. Five Regional Seas Programmes[6], as well as the European Union (EU) Marine Strategy Framework Directive (MSFD, subsequently referred to as "Marine Directive"), include input and concentrations of nutrients (nitrogen and phosphorous) as indicators or assessment criteria for eutrophication. Nutrient concentrations are measured from *in situ* water samples using colorimetric, fluorometric and UV spectrometric methods (for information about sampling and measuring methods for nutrients, see for example OSPAR's eutrophication monitoring guideline on nutrients (OSPAR 2013a)).

2) Indicators for the direct effects of eutrophication (e.g. Chlorophyll-a concentrations, biomass growth, water clarity/turbidity): Nutrient enrichment of coastal waters causes excessive growth of plants, algae and phytoplankton. This can be monitored by measuring the abundance of indicator species, the clarity or turbidity of the water, or Chlorophyll-a concentrations. Chlorophyll-a is a pigment contained in plants, algae and phytoplankton that can be used to measure biomass levels, thus providing a proxy indicator for eutrophication. Chlorophyll-a is the most frequently used indicator/assessment criterion for eutrophication (or primary productivity) across the 18 Regional Seas Programmes[7]. In addition, the European Environment Agency, the EU Marine Directive, the United States National Oceanic and Atmospheric Administration (NOAA) and the Global Environment Facility Transboundary Waters Assessment Programme (GEF-TWAP) also use Chlorophyll-a as indicator for eutrophication (or primary productivity).

[6] Regional Seas Programmes that use input and concentrations of nutrients as indicator for eutrophication: OSPAR (Northeast Atlantic), HELCOM (Baltic Sea), UNEP-MAP (Mediterranean Sea), CPPS (Southeast Pacific) and NOWPAP (Northwest Pacific)

[7] Regional Seas Programmes that use Chlorophyll-a as indicator for eutrophication: OSPAR (Northeast Atlantic), HELCOM (Baltic Sea), UNEP-MAP (Mediterranean Sea), Nairobi Convention (Western Indian Ocean), NOWPAP (Northwest Pacific), (ROMPE sea area), PERSGA (Red Sea and Gulf of Aden) and CPPS (Southeast Pacific)

Regional Seas Programmes use two methodological approaches for monitoring Chlorophyll-a:

1) *In situ* measurements, and
2) Remote sensing using satellite images.

In situ measurements can be obtained from ships carrying measuring devices (e.g. the Continuous Plankton Recorder[8]), or from moorings, buoys and autonomous underwater vehicles equipped with sensors. Setting up Chlorophyll-a observatories, where these are not already in place, requires considerable technological and resource capacity. One way of reducing the costs of *in situ* measurements is to use ships of opportunity, such as commercial vessels or ferries. A less resource intensive alternative to *in situ* measurements is to monitor Chlorophyll-a using satellite remote sensing. Remote sensing also enables larger temporal and spatial coverage, compared to *in situ* methods, for example providing daily snapshots of an area of approximately 500 metres. Remote sensing can also be coupled with modelling, allowing to fill gaps in satellite data that might be caused, for example, by cloud cover.

3) Indicators for the indirect effects of eutrophication (e.g. dissolved oxygen levels): Lastly, four Regional Seas Programmes[9] and the EU Marine Directive use dissolved oxygen levels in the water as an additional indicator for eutrophication. Oxygen depletion (hypoxia or anoxia) is an indirect effect of nutrient enrichment caused by bacterial decomposition of large amounts of dead plants and algae. Dissolved oxygen levels can be determined from water samples using electrochemical or optical sensors (see for example OSPAR's eutrophication monitoring guideline for oxygen (OSPAR 2013b).

The eutrophication indicators related to these methodologies are summarised in Table 3.

Table 3: Summary of eutrophication indicators and assessment criteria currently used by Regional Seas Programmes and other key intergovernmental, international or regional bodies. (Note: indicators in italics are not explicitly for eutrophication) (CPPS: Permanent Commission for the South Pacific (Southeast Pacific); EU MSFD: European Union Marine Strategy Framework Directive; EU WFD: European Union Water Framework Directive; GEF-TWAP: Global Environment Facility Transboundary Waters Assessment Programme; HELCOM: Helsinki Commission (Baltic Sea); Nairobi Convention (Western Indian Ocean); NOAA: National Oceanic and Atmospheric Administration; NOWPAP: Northwest Pacific Action Plan (Northwest Pacific); OSPAR: Oslo-Paris Convention (Northeast Atlantic); ROMPE: Regional organization for the Protection of the Marine Environment (ROMPE sea area); UNEP-MAP: UN Environment Mediterranean Action Plan (Mediterranean Sea)).

Regional Seas Programme/ Organisation	Indicator/assessment criteria
OSPAR	Harmonised assessment criteria: Category I: Degree of nutrient enrichment 1) Riverine inputs and direct discharges [nitrogen, phosphorous] 2) Nutrient concentrations [DIN and/or DIP] 3) N/P ratio Category II: Direct effects of nutrient enrichment (during growing season) 1) Chlorophyll-a concentration (area specific) 2) Phytoplankton indicator species (area specific) 3) Macrophytes including macroalgae (area specific) Category III: Indirect effects of nutrient enrichment (during growing season) 1) Oxygen deficiency 2) Zoobenthos and fish 3) Organic carbon/organic matter (area specific) Category IV: Other possible effects of nutrient enrichment (during growing season) 1) Algal toxins
HELCOM	Core Indicators for eutrophication:

[8] Continuous Plankton Recorder: https://www.sahfos.ac.uk/services/the-continuous-plankton-recorder/

[9] Regional Seas Programmes that use dissolved oxygen levels as indicator for eutrophication: OSPAR (Northeast Atlantic), HELCOM (Baltic Sea), NOWPAP and CPPS (Southeast Pacific)

	1) Water clarity 2) Nitrogen/DIN 3) Total nitrogen 4) Chlorophyll-a concentration 5) Oxygen debt 6) Inputs of nutrients to the sub basins 7) Phosphorus/DIP 8) Total phosphorus 9) Cyanobacterial bloom index
UNEP-MAP	Common Indicators under Ecological Objective 5 Eutrophication: 1) Common Indicator 13 Concentration of key nutrients in water column 2) Common Indicator 14 Chlorophyll-a concentration in water column
Nairobi Convention	*Chlorophyll-a concentration as indicator of phytoplankton primary productivity*
NOWPAP	Common Procedures for Eutrophication Assessment (minimum required parameters): 1) Trend in chemical oxygen demand (DOD) or Total Organic Carbon (TOC) 2) Frequencies of red tide and hypoxia events 3) Level and trend in satellite derived Chlorophyll-a
ROMPE	*Chlorophyll-a concentration as indicator of phytoplankton biomass*
CPPS	Indicator 7 Water Quality Index, parameters include: 1) Phosphate 2) Nitrate 3) Dissolved oxygen 4) Chlorophyll-a
European Environment Agency	Indicator 23 Chlorophyll in transition, coastal and marine waters
EU MSFD (Marine Directive)	Descriptor 5 (Eutrophication) indicators: Criteria 5.1 Nutrients levels: • 5.1.1 Nutrients concentration in the water column. • 5.1.2 Nutrient ratios (silica, nitrogen and phosphorus), where appropriate. Criteria 5.2 Impacts of litter on marine life: • 5.2.1 Chlorophyll concentration in the water column. • 5.2.2 Water transparency related to increase in suspended algae, where relevant. • 5.2.3 Abundance of opportunistic macroalgae. • 5.2.4 Species shift in floristic composition such as diatom to flagellate ratio, benthic to pelagic shifts, as well as bloom events of nuisance/toxic algal blooms (e.g. cyanobacteria) caused by human activities. Criteria 5.3 Indirect effects of nutrient enrichment: • 5.3.1 Abundance of perennial seaweeds and seagrasses (e.g. fucoids, eelgrass and Neptune grass) adversely impacted by decrease in water transparency. • 5.3.2 Dissolved oxygen, i.e. changes due to increased organic matter decomposition and size of the area concerned.
EU WFD	*Chlorophyll-a as phytoplankton parameter indicative of biomass*
UN Strategic Plan for Biodiversity (2010-2020)	Indicators for 'Trends in nutrient levels' (Aichi Target 8.4) include: 1) Trends in Nitrogen deposition 2) Trends in Loss of reactive nitrogen to the environment 3) Trends in Global surplus of nitrogen 4) Proportion of bodies of water with good ambient water quality 5) Proportion of wastewater safely treated
GEF-TWAP	*Chlorophyll-a concentrations and trends as indicator for productivity*
NOAA	Chlorophyll-a as indicator of primary eutrophication symptoms

Agreed indicators for SDG reporting

The agreed indicator for eutrophication under SDG Target 14.1, as proposed by the IAEG-SDGs, is the 'Index of Coastal Eutrophication (ICEP)' (14.1.1 part 1). This indicator is classified as tier 3, meaning that internationally established methodologies or standards are not yet available. The ICEP index is based on concentrations and ratios of nitrogen, phosphorous and silica in the nutrient loads delivered by rivers to coastal waters (Garnier et al. 2010). The index assumes that excess concentrations of nitrogen or phosphorus relative to silica will result in increased growth of potentially harmful algae.

ICEP is expressed in kilograms of carbon (from algae biomass) per square kilometre of river basin area per day (kg C km^{-2} d^{-1}). The Global Environment Facility Transboundary Waters Assessment Programme (GEF-TWAP) applied the ICEP indicator in their assessment of large marine ecosystems, defining five colour coded risk categories for the ICEP indicator, ranging from 'lowest' to 'highest' risk (Seitzinger and Mayorga 2016)[10]. The ICEP methodology is currently being further developed under the leadership of IOC-UNESCO (Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization) and tested in pilot countries, with the aim to be operational for tracking progress against SDG Target 14.1 by 2021.

In the interim, Chlorophyll-a concentration (surface waters) will be used as a proxy indicator for eutrophication under SDG Target 14.1. Chlorophyll-a is one of the 22 Core Indicators of the Regional Seas Conventions and Action Plans[11] and is currently being used as indicator for eutrophication by eight Regional Seas Programmes[12]. Remote sensing from satellite images is the most common methodology for measuring Chlorophyll-a concentrations. The main advantages of remote sensing, compared to *in situ* methods, are 1) high temporal and spatial coverage, and 2) low technology and resource capacity requirements.

Step-by-step guide to implementing the indicator

SDG Indicator 14.1.1: Index of Coastal Eutrophication (ICEP) […]

Proxy indicator: Chlorophyll-a concentration

Methodology: Remote sensing using satellite images

Step one — Identify whether eutrophication is an issue in national waters that requires monitoring.

Step two — If yes, identify the national authority/agency/organisation responsible for monitoring and reporting on eutrophication.

Step three — Identify sources of satellite data for the national waters under consideration. A number of different data portals provide freely accessible data on Chlorophyll-a as well as links to other relevant databases; examples include: the Copernicus Marine Environment Monitoring Service (CMEMS)[13], NOAA (National Oceanic and Atmospheric Administration) CoastWatch/OceanWatch[14], the NASA (National Aeronautics and Space Administration) OceanColor Web[15] and the ChloroGIN[16] data portals. International efforts that can support accessibility of Chlorophyll-a satellite data include the Group

[10] See Seitzinger and Mayorga (2016) for further details about how the ICEP was calculated in the GEF-TWAP Large Marine Ecosystem Assessment. Available at: http://www.geftwap.org/publications/lmes-technical-report

[11] See Appendix 1 for a list of all 22 Regional Seas Core Indicators.

[12] Regional Seas Programmes that use Chlorophyll-a as indicator for eutrophication: OSPAR (Northeast Atlantic), HELCOM (Baltic Sea), UNEP-MAP (Mediterranean Sea), Nairobi Convention (Western Indian Ocean), NOWPAP (Northwest Pacific), ROMPE (Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates), PERSGA (Red Sea and Gulf of Aden) and CPPS (Southeast Pacific)

[13] Copernicus Marine Environment Monitoring Service: http://marine.copernicus.eu

[14] NOAA CoastWatch/OceanWatch: https://coastwatch.noaa.gov/cw_html/index.html

[15] NASA OceanColor Web: https://oceancolor.gsfc.nasa.gov/data/overview/

[16] ChloroGIN data portals: www.chlorogin.org/index.php

on Earth Observations (GEO)[17] and the Committee on Earth Observation Satellites (CEOS)[18]. Satellite data are available from a number of satellite missions, including:

Sentinel-3 OLCI	EU Copernicus satellite(s), launched by ESA (European Space Agency) and operated by EUMETSAT (European Organisation for the Exploitation of Meteorological Satellites). Data available from 2016. Global coverage, max spatial resolution 300m, orbit cycle 27 days. Currently 1 satellite but shortly become a constellation of 2. The two in-orbit SENTINEL-3 satellites enable a short revisit time of less than two days for OLCI (Ocean and Land Colour Instrument).
ASTER-Terra	NASA satellite carrying the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER). Global coverage. Data available form 1999.
MODIS-Aqua	NASA satellite carrying a Moderate Resolution Imaging Spectroradiometer (MODIS). Global coverage, max spatial resolution 300m. Data available from 2002.
VIIRS	Visible Infrared Imaging Radiometer Suite. Global coverage, max spatial resolution 750m. Data available from 2012.
SeaWiFS	Sea-Viewing Wide Field-of-View Sensor. NASA satellite, no longer operational. Global coverage, spatial resolution 1.1km, historical data are available covering the period 1997-2010.
MERIS	Medium Resolution Imaging Spectrometer. ESA satellite, no longer operational. Global coverage, max spatial resolution 500m, historical data are available covering the period 2002-2012.
GCOM-C	Global Changing Observation Mission. Satellite launched by the Japan Aerospace Exploration Agency (JAXA). Launched in Dec 2017, global coverage, max spatial resolution 250m.
CZCS	Coastal Zone Color Scanner. NASA satellite, no longer operational. Global coverage, max spatial resolution 800m, historical data available covering period 1978-1986.
Landsat 8	NASA satellite. Launched in Feb 2013. Carrying the Thermal Infrared Sensor (TIRS) with 100m spatial resolution, and the Operational Land Imager (OLI) with 30m spatial resolution.

Step four Define Chlorophyll-a levels for five eutrophication status categories (based on the GEF-TWAP risk categories) that are appropriate for national circumstances. National Chlorophyll-a thresholds can be calculated using historical data (from satellites and *in situ* when available), modelling outputs and expert judgement.

Eutrophication status category	Chlorophyll-a levels μg l^{-1}
Lowest	Appropriate to country
Low	Appropriate to country
Medium	Appropriate to country
High	Appropriate to country
Highest	Appropriate to country

[17] GEO Blue Planet: http://geoblueplanet.org

[18] Committee on Earth Observation Satellites: http://ceos.org

Step five Identify the local seasonal cycle of phytoplankton growth. This will vary with the latitude of the country and seasonal events such as the spring bloom and summer crops. Chlorophyll-a should be monitored during the growing season.

Step six Analyse the satellite data using appropriate algorithms for the prediction of apparent optical properties of coastal waters. A number of software packages, online toolboxes and web portals are available to support the processing and analysis of satellite data, for example: NASA SeaDas[19], the Science Toolbox Exploitation Platform STEP[20] provided by the European Space Agency, the ChloroGIN portal or the Global Earth Observation System of Systems' (GEOSS) Common Infrastructure Portal[21].

Chlorophyll-a concentration is the core parameter that should be monitored and reported on by all countries. Where national capacity to do so exists, *in situ* measurements of Chlorophyll-a, as well as measurements of supplementary parameters (*in situ* or from remote sensing), should be used to complement and ground truth remote sensing and modelled data and enable a more detailed assessment of eutrophication. In particular, monitoring of supplementary eutrophication parameters is advisable to determine whether an increase in Chlorophyll-a concentration is directly linked to an anthropogenic increase in nutrients. Please refer to Table 4 for core and supplementary parameters for monitoring eutrophication under SDG Target 14.1. Further details and references for guidelines on *in situ* monitoring of eutrophication can be found in Appendix 2.

Table 4: Core and supplementary monitoring parameters for eutrophication to track progress against SDG Target 14.1.

Monitoring parameters	Core parameter	Supplementary parameter	Parameter available from remote sensing
Chlorophyll-a (remote sensing)	X		X
Chlorophyll-a (*in situ*)		X	
Nitrogen/DIN (dissolved inorganic nitrogen)		X	
Total nitrogen		X	
Phosphorus/DIP (dissolved inorganic phosphorus)		X	
Total phosphorus		X	
Dissolved oxygen		X	
Biological/chemical oxygen demand (BOD/COD)		X	
Total organic carbon (TOC)		X	X (indirectly)
Turbidity		X	X
Water clarity/transparency		X	X
Cyanobacterial bloom		X	X
Species shift in floristic composition		X	X (being developed)
Abundance of opportunistic macroalgae		X	X (being developed)
Abundance of perennial seaweeds and seagrasses adversely impacted by decrease in water transparency		X	X (experimental)

[19] NASA SeaDas: https://seadas.gsfc.nasa.gov/

[20] ESA science toolbox exploitation platform STEP: http://step.esa.int/main/

[21] GEOSS Common Infrastructure Portal: http://www.earthobservations.org/gci.php

At the national level

Text Box 1 summarises findings from the country missions to Fiji and Colombia on national monitoring programmes for eutrophication, and national capacity for using satellite remote sensing to collect Chlorophyll-a data for tracking progress against SDG Target 14.1.

Text Box 1: Insights from the country missions on eutrophication monitoring using Chlorophyll-a

Fiji: Focus on regional scale and institutions

Fiji does not currently have a national monitoring programme for eutrophication. Using satellite remote sensing to provide Chlorophyll-a data for monitoring eutrophication was seen as a possible option by the government representatives consulted during the country mission. However, an issue of scale was noted: would satellite image resolutions be sufficiently fine for the monitoring of eutrophication around small islands? For Fiji and other small, multi-island states in the Pacific, satellite remote sensing of Chlorophyll-a might be more appropriate to monitor eutrophication at a regional scale than at country/island level.

In this context, it is worth noting that, for Fiji and other Pacific island states, regional institutions play an important role in data collection, indicator assessment, reporting and policy implementation. Key regional bodies are the Secretariat of the Pacific Regional Environmental Programme (SPREP; i.e. the Secretariat of the Pacific Regional Seas Programme), and the Pacific Community, a regional intergovernmental organisation that supports the island states and has responsibility for data. This regional support is key as Pacific island states often lack the resources and capacity for large scale data collection and monitoring.

Of note is the fact that SDG Indicator 14.1.1 is not included in the 109 SDG indicators that the Pacific SDGs Taskforce and the Pacific Statistics Steering Committee has decided to take forward in the region. This could present a major issue for countries in the region, such as Fiji, given the major role that regional bodies play there in monitoring and reporting.

Colombia: Strong in-country capacity for national monitoring

Colombia is not currently monitoring eutrophication at national level. It is understood that data collected on dissolved oxygen, nutrients, Chlorophyll-a and microplastics feed into the national indicator on marine and coastal water quality.

For Chlorophyll-a, Colombia is using satellite observations from the NASA MODIS-Aqua mission, with daily temporal resolution, and spatial resolution of 1 km, as well as monthly composite images at 4 km. The Chlorophyll-a satellite data are calibrated with samples taken *in situ* and measured in the laboratory by spectrophotometry, using the Lorenzen method.

Colombia has in-country capacity for using satellite remote sensing to monitor Chlorophyll-a concentrations at national level. The country is currently planning a pilot study at sub-national level and developing a roadmap for monitoring Chlorophyll-a.

Floating Plastic debris Density

Review of existing indicators

A review of existing indicators and methodologies used by Regional Seas Programmes and other key intergovernmental, international or regional bodies shows that marine plastic debris is currently monitored in four areas of the marine environment.

1) Plastic debris washed/deposited on beaches or shorelines (beach litter): Beach litter monitoring is done through beach surveys following standardised monitoring protocols or guidelines. UN Environment and IOC-UNESCO have jointly produced *Guidelines on Survey and Monitoring of Marine Litter* (Cheschire et al. 2009), which include operational guidelines for beach litter surveys and are used as guidance by several Regional Seas Programmes. The European Commission's Joint Research Centre also provides beach litter monitoring protocols in its *Guidance on Monitoring of Marine Litter in European Seas* (European Commission JRC 2013). Further available guidance documents and toolboxes for beach litter monitoring are listed in Table 5. Beach litter surveys often take place in connection with beach clean-ups involving the local public. For example, the Ocean Conservancy's International Coastal Clean-up (ICC) initiative organises beach clean-ups around the world using standardised ICC data cards[22]. The ICC data cards are used as protocols to collect beach litter data in the four NOWPAP (Northwest Pacific) countries as well as some of the Caribbean Member States of the Cartagena Convention. Another avenue for collecting beach litter data is through citizen science programmes, such as the Marine LitterWatch application and data viewer of the European Environment Agency, or NOAA's Marine Debris Monitoring and Assessment Citizen Science Project[23].

Table 5: Available guidance material for beach litter monitoring produced by Regional Seas Programmes and other intergovernmental, international, regional bodies or national bodies. (CCAMLR: Convention for the Conservation of Antarctic Marine Living Resources (Antarctic Sea); JRC: Joint Research Centre (European Commission); NOAA: National Oceanic and Atmospheric Administration; NOWPAP: Northwest Pacific Action Plan (Northwest Pacific); OSPAR: Oslo-Paris Convention (Northeast Atlantic); IOC-UNESCO: Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization).

Regional Seas Programme/ Organisation	**Monitoring protocols and guidelines**	**Available at:**
CCAMLR (Antarctic Sea)	The *Arctic Marine Strategic Plan 2015-2025* provides standard data forms and instructions for beach survey data collection (Arctic Council 2015)	https://oaarchive.arctic-council.org/handle/11374/413
European Commission Joint Research Centre (JRC)	*Guidance on Monitoring of Marine Litter in Europeans Seas* (European Commission JRC 2013)	https://ec.europa.eu/jrc/sites/jrcsh/files/lb-na-26113-en-n.pdf
NOAA	*NOAA Marine Debris Shoreline Survey Field Guide* (Opfer et al. 2012), and a monitoring toolbox with protocol documents and field data sheets	https://marinedebris.noaa.gov/sites/default/files/ShorelineFieldGuide2012.pdf
NOWPAP (Northwest Pacific)	*Guidelines for Monitoring Marine Litter on the Beaches and Shorelines of the Northwest Pacific Region* (NOWPAP CEARAC 2007)	http://www.cearac-project.org/RAP_MALI/monitoring%20guidelines.pdf
OSPAR (Northeast Atlantic)	*Guidelines for monitoring marine litter on the beaches in the OSPAR Maritime Area* (OSPAR 2010)	https://www.ospar.org/ospar-data/10-02e_beachlitter%20guideline_english%20only.pdf
UN Environment and IOC-UNESCO	*UNEP/IOC Guidelines on Survey and Monitoring of Marine Litter* (Cheshire et al. 2009)	http://staging.unep.org/gpa/Documents/Publications/MarineLitterSurveyandMonitoringGuidelines.pdf

[22] Ocean Conservancy International Coastal Clean-up data card: http://act.oceanconservancy.org/ site/DocServer/ICC_Eng_DataCardFINAL.pdf?docID=4221

[23] NOAA Marine Debris Monitoring and Assessment Citizen Science Project: https://marinedebris.noaa.gov/research/marine-debris-monitoring-and-assessment-project

UN Environment	*Marine plastic debris and microplastics – Global lessons and research to inspire action and guide policy change* (UNEP 2016b)	https://wedocs.unep.org/rest/bitstreams/11700/retrieve

2) Plastic debris in the water column: Marine litter in the water column is mainly monitored through visual observations from ships or airplanes. Other methods include surface water and water column trawls and remote sensing. Visual observations and trawls usually make use of monitoring activities for other ecological variables (e.g. fish populations). HELCOM (Helsinki Commission, Baltic Sea), UN Environment Mediterranean Action Plan (UNEP-MAP; Mediterranean Sea) and the South Asian Seas Action Plan have indicators and methodologies in place for monitoring marine litter in the water column. Methodologies for floating litter are also included in the guidelines from UN Environment/IOC-UNESCO and the European Commission Joint Research Centre.

3) Plastic debris on the seafloor/seabed: Methodologies used to monitor litter on the seafloor include that used by Europe's International Bottom Trawl Surveys (IBTS) and other fish bottom trawls, as well as visual observations by divers and snorkelers (shallow waters), submersibles and camera tows (shallow and deeper waters). Three European Regional Seas Programmes[24] currently have indicators and monitoring methodologies in place for seafloor litter. Guidance on seafloor litter monitoring methodologies is also included in the guidelines from UN Environment/IOC-UNESCO and the European Commission Joint Research Centre.

4) Plastic ingested by biota (e.g. sea birds): OSPAR (Northeast Atlantic), UNEP-MAP (Mediterranean Sea) and the EU Marine Directive also include provisions for monitoring marine plastic litter through analysis of plastic ingested by stranded marine biota (mainly seabirds, turtles and fish). This approach is limited by the natural range of the indicator species and consistency of availability of stranded animals, as well as requiring the capacity to collect and analyse the animals. In addition to ingestion by marine biota, the EU Marine Directive, as well as the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR, Antarctic Sea), also consider marine plastic found in nests and seabird colonies and marine mammal entanglement.

The marine plastic debris indicators related to these methodologies are summarised in Table 6. While the monitoring methods described above focus largely on macroplastics, some of the existing indicators also refer to microplastics. HELCOM (Baltic Sea) and the European Commission Joint Research Centre provide guidance on monitoring methodologies for microplastic particles: 1) manta trawls/plankton nets in the water column, and 2) sieving of sediment/sand samples from beaches or the seafloor. Further guidance on sampling and analysing of microplastics is provided by the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), Working Group 40[25], which in 2016 produced a report on *Sources, Fate and Effects of Microplastics in the Marine Environment* (GESAMP 2016) to inform the Second UN Environment Assembly.

Since their 2016 report, the remit of GESAMP Working Group 40 has been expanded to include both macro- and microplastic litter. GESAMP Working Group 40 is currently working on developing guidelines on terminology and methodologies for the sampling and analysis of marine macro- and microplastics, including size and shape definitions of particles, and sampling protocols for the whole

[24] Regional Seas Programmes that are monitoring seafloor litter: OSPAR (Northeast Atlantic), HELCOM (Baltic Sea) and UNEP-MAP (Mediterranean Sea)

[25] GESAMP Working Group 40 is led by IOC-UNESCO and UN Environment.

spectrum of particle/object sizes in surface and sub-surface seawater, seabed sediments, shorelines and biota.

Table 6: Summary of marine plastic debris indicators currently used by Regional Seas Programmes and other key intergovernmental, international or regional bodies. (EU MSFD: European Union Marine Strategy Framework Directive; HELCOM: Helsinki Commission (Baltic Sea); NOWPAP: Northwest Pacific Action Plan (Northwest Pacific); OSPAR: Oslo-Paris Convention (Northeast Atlantic); UNEP-MAP: UN Environment Mediterranean Action Plan (Mediterranean Sea)).

Regional Seas Programme/ Organisation	Indicator/assessment criteria
OSPAR	Three marine litter indicators: 1) Beach litter 2) Plastic particles in Fulmars' stomachs 3) Seabed litter Indicators under development: • Indicators using other biota • Indicators for microplastics
HELCOM	HELCOM indicators for marine litter: 1) Indicator on beach litter 2) Status of implementation of the HELCOM Regional Action Plan on Marine Litter Indicators under development: • Litter on the seafloor • Micro litter in the water column
UNEP-MAP	Common Indicators under Ecological Objective 10 Marine Litter: • Common Indicator 22: Trends in the amount of litter washed ashore and/or deposited on coastlines. • Common Indicator 23: Trends in the amount of litter in the water column including microplastics and on the seafloor. • Candidate Indicator 24: Trends in the amount of litter ingested by or entangling marine organisms focusing on selected mammals, marine birds, and marine turtles.
NOWPAP	Indicator for marine litter (Ecological Quality Objective 5) to be developed
UN Environment	Beach litter as proxy indicator for floating plastic debris density
EU MSFD (Marine Directive)	Descriptor 10 (Marine litter) indicators: Criteria 10.1 Characteristics of litter in the marine and coastal environment: • 10.1.1 Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source. • 10.1.2 Trends in the amount of litter in the water column (including floating at the surface) and deposited on the seafloor, including analysis of its composition, spatial distribution and, where possible, source • 10.1.3 Trends in the amount, distribution and, where possible, composition of microparticles (in particular microplastics). Criteria 10.2 Impacts of litter on marine life: • 10.2.1 Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis).
UN Strategic Plan for Biodiversity (2010-2020)	[…] Floating Plastic Debris Density (Aichi Target 8)
Ocean Conservancy	Ocean Trash Index: presence of litter items in five 'activity categories': 1) Shoreline and recreational 2) Ocean and waterway 3) Smoking related 4) Dumping 5) Medical or personal hygiene

Agreed indicators for SDG reporting

The agreed indicator for marine plastic litter under SDG Target 14.1, as proposed by the IAEG-SDGs, is 'Floating Plastic debris Density' (14.1.1 part 2). This indicator is classified as tier 3, meaning that internationally established methodologies or standards are not yet available. The GESAMP guidelines will provide key information for the development of a methodology for the agreed SDG indicator, which may combine in situ data and modelling (surface water circulation). The 'Floating Plastic debris Density' indicator is expected to be operational for tracking progress against SDG Target 14.1 in 2021.

In the interim, beach litter will be used as a proxy indicator for marine plastic litter. Beach litter one of the 22 Core Indicators of the Regional Seas Conventions and Action Plans[26], and data on beach litter are currently collected in seven Regional Seas[27].

Step-by-step guide to implementing the indicator

SDG Indicator 14.1.1: […] Floating Plastic debris Density

Proxy indicator: Beach litter

Methodology: Beach litter surveys following the UN Environment/IOC-UNESCO operational guidelines[28] (Cheshire et al. 2009)

Step one Identify the national authority responsible for gathering data and reporting on marine pollution and the agency/organisation responsible for implementing beach litter surveys.

Step two Conduct beach litter surveys following the UN Environment/IOC-UNESCO operational guidelines, which are provided in Appendix 4.

Key questions and monitoring parameters that beach litter monitoring programmes should address are:

Monitoring questions	**Monitoring parameters**
Are litter management/mitigation strategies effective?	Litter quantity (counts/weight) and change through time
What are the sources and activities leading to production of marine litter?	Litter categories (indicator items of certain types of uses), disaggregated by gender where possible
Is there a threat to marine biota and ecosystems?	Litter categories (indicator items that may present specific risks to wildlife)

National efforts to collect data on beach litter can be supported by campaigns to engage members of the public as volunteers in beach clean-ups (see for example the Ocean Conservancy's International Coastal Clean-up (ICC) initiative[29]) or citizen science programmes (see for example NOAA's Marine Debris Monitoring and Assessment Citizen Science Project[30]).

Beach litter is the core parameter that all countries should monitor and report on. Where in-country capacity or opportunities exist to conduct more extensive marine litter monitoring, countries can also conduct surveys of floating plastics, plastics on the seafloor or microplastics (as described above). Please refer to Table 7 for core and supplementary parameters for monitoring marine plastic litter

[26] See Appendix 1 for a list of all 22 Regional Seas Core Indicators.

[27] Regional Seas Programmes that are using beach litter as indicator for marine plastic litter: OSPAR (Northeast Atlantic), HELCOM (Baltic Sea), UNEP-MAP (Mediterranean Sea), NOWPAP (Northwest Pacific), South Asian Seas, Caribbean and CCAMLR (Antarctic Sea)

[28] The UN Environment/IOC-UNESCO methodology for comprehensive beach surveys has been developed with reference to a number of existing survey protocols, including OSPAR and NOWPAP protocols.

[29] Ocean Conservancy International Coastal Clean-up initiative: https://oceanconservancy.org/trash-free-seas/international-coastal-cleanup/

[30] NOAA Marine Debris Monitoring and Assessment Citizen Science Project: https://marinedebris.noaa.gov/research/marine-debris-monitoring-and-assessment-project

under SDG Target 14.1. Further details on methodologies and guidelines for this can be found in Appendix 2.

Table 7: Core and supplementary monitoring parameters for marine plastic litter to track progress against SDG Target 14.1.

Monitoring parameters (and methods)	Core parameter	Supplementary parameter
Beach litter (beach surveys)	X	
Beach litter microplastics (beach samples)		X
Floating plastics (visual observation, manta trawls)		X
Floating microplastics (manta trawls, e.g. Continuous Plankton Recorder)		X
Water column plastics (demersal trawls)		x
Water column microplastics (demersal plankton trawls)		X
Seafloor litter (benthic trawls (e.g. fish survey trawls), divers, video/camera tows, submersibles, remotely operated vehicles)		X
Seafloor litter microplastics (sediment samples)		X
Plastic ingestion by biota (e.g. birds, turtles, fish)		X
Plastic litter in nests		X
Entanglement (e.g. marine mammals, birds)		X

At the national level

Text Box 2 summarises findings, from the country missions to Fiji and Colombia, on national monitoring programmes for marine plastics, and on using beach litter surveys for tracking progress against SDG Target 14.1.

Text Box 2: Insights from the country missions on marine plastics monitoring using beach litter

Fiji: Potential to capitalise on existing beach clean-ups

Fiji does not currently have a national monitoring programme for marine plastics. Beach clean-ups do take place in the country; however, these events tend to be organised locally and data are not generally collected. *A future national monitoring programme could build on these local beach clean-ups by integrating them into the step-by-step methodology for the beach litter proxy SDG indicator.*

Some national and regional data are also available for microplastic concentrations in surface waters, sediments and organisms. These microplastics data are gathered using NOAA methodologies for marine samples.

As already noted for eutrophication monitoring (see Text Box 1), regional bodies play a key role in Fiji and other Pacific island states with regard to data collection, indicator assessment, reporting and policy implementation. As noted earlier, SDG Indicator 14.1.1 is not included in the 109 SDG indicators that the Pacific SDGs Taskforce and the Pacific Statistics Steering Committee decided to take forward in the region.

Colombia: Focus on microplastics

Colombia is not currently monitoring marine plastics at the national level. However, microplastics data are being collected in six pilot stations from *in situ* sediment, water and fish samples. These data are understood to feed into the national marine and coastal water quality indicator.

Other elements of Target 14.1

SDG Target 14.1 is very broad, when considering the different types and causes of pollution in the marine environment, which include:

- Marine debris (in particular plastics and microplastic particles),
- Nutrient enrichment (main cause of eutrophication),
- Persistent toxins (polychlorinated biphenyls, heavy metals, and others),
- Oil (slicks, spills, pollution from ships),
- Thermal pollution (heat),
- Noise pollution,
- Light pollution,
- Pathogens (from sewage and livestock waste), and
- Wastewater.

SDG Indicator 14.1.1 only addresses the first two types of pollution (plastic debris and nutrient load).

Chapter 3: Indicator 14.2.1: Proportion of national exclusive economic zones managed using ecosystem-based approaches

Target 14.2: By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans

Review of existing indicators

Indicator 14.2.1 refers to the management of exclusive economic zones using ecosystem-based approaches. From an ecological perspective, ecosystem approaches consider the connections between the living organisms, habitats, physical and chemical conditions within an ecosystem, focusing on the importance of ecological integrity, biodiversity and overall ecosystem health. From a management perspective, ecosystem-based approaches refer to integrated management strategies for socio-ecological systems that consider ecological, social and economic factors and apply principles of sustainable development. These different ways of interpreting the 'ecosystem-based approach' are reflected in existing indicators. A review of these indicators and their underlying methodologies shows two ways in which Regional Seas Programmes and other key intergovernmental, international or regional bodies are monitoring and assessing the implementation of ecosystem-based approaches.

1) Ecological indicators for the quality of marine ecosystems: OSPAR (Northeast Atlantic) and UNEP-MAP (Mediterranean Sea) are using ecological indicators to monitor and assess the implementation of the ecosystem approach. The OSPAR indicators are in line with the descriptors of 'good environmental status' which are used to assess ecosystem-based marine management under the EU Marine Directive. The ecological indicator approach taken by OSPAR, UNEP-MAP and the European Union requires the measurement and monitoring of a large number of biochemical parameters for an integrated assessment of the state of marine ecosystems and biodiversity. This implies high levels of resources and technical capacity for ecological monitoring. Moreover, as evidenced by experience in the OSPAR region (Northeast Atlantic), the applicability and relevance of ecological indicators and associated methodologies may vary between different locations within one region.

2) Indicators for integrated management and planning strategies for socio-ecological systems: Other ecosystem approach indicators are based on the implementation status of marine area-based, integrated planning and management approaches, such as Marine/Maritime Spatial Planning (MSP) or Integrated Coastal Zone Management (ICZM). HELCOM (Baltic Sea) has adopted the ecosystem approach as one of ten Baltic Sea Broad-Scale Maritime Spatial Planning Principles (HELCOM-VASAB 2010) and has identified *drawing up and application of maritime spatial plans throughout the Baltic Sea by 2020* as one of the HELCOM regional targets that will contribute towards the delivery of SDG 14.2 (HELCOM 2017). The HELCOM indicator for the delivery of this target is '*number of countries having maritime spatial plans coherent across borders and applying the ecosystem approach'*. Similarly, the Strategic Action Plan under the Nairobi Convention (Western Indian Ocean Region) includes '*Integrated Coastal Zone Management policies, plans and/or legislation in place in all countries'* as one of the indicators for protection, restoration and sustainable management of critical coastal habitats (Nairobi Convention Secretariat 2009). The Nairobi Convention indicator is translated into a target with a baseline and short, medium and long-term outcomes against which progress can be measured. In comparison to ecological indictors, management based indicators incur low implementation costs, as they do not require technical capacity or resources for ecological monitoring, and can easily be applied at regional and national levels across the world.

The ecosystem approach indicators and assessment criteria described here are summarised in Table 8. Referring back to SDG 14, Target 14.2 calls for sustainable management and protection of marine and coastal ecosystems. Integrated planning and management approaches, such as Marine/Maritime Spatial Planning or Integrated Coastal Zone Management, have been identified as key tools for sustainable, ecosystem-based management (Ehler and Douvere 2009). Consequently, the implementation of these approaches can be considered as a valid indicator for ecosystem-based management.

Table 8: Summary of ecosystem approach indicators and assessment criteria currently used by Regional Seas Programmes and other key intergovernmental, international or regional bodies. (EU MSFD: European Union Marine Strategy Framework Directive; HELCOM: Helsinki Commission (Baltic Sea); ICZM: Integrated Coastal Zone Management; MSP: Marine Spatial Planning; NOWPAP: Northwest Pacific Action Plan (Northwest Pacific); OSPAR: Oslo-Paris Convention (Northeast Atlantic); UNEP-MAP: UN Environment Mediterranean Action Plan (Mediterranean Sea)).

Regional Seas Programme/ Organisation	**Indicator/assessment criteria**
OSPAR	Ecological indicators that are in line with MSDF Descriptors of good environmental status
HELCOM	HELCOM indicator for maritime spatial planning: Number of countries having maritime spatial plans coherent across boarders and applying the ecosystem approach
UNEP-MAP	Common Indicators (ecological indicators)
NOWPAP	Mid-Term Strategy 2018-2023 Objective: NOWPAP countries increasingly apply ecosystem-based approach to planning and management as a basis to achieve healthy and productive coastal and marine ecosystems. Outcomes/ Expected Accomplishments for this priority area: • NOWPAP member states are developing and applying ecosystem-based management policies, tools and practices to support sustainable development of coastal zones and the marine environment; • Planning and decision-making processes for ICZM and MSP by NOWPAP member states recognize inter-connectedness between the land and the sea and promote cross-sectoral cooperation; • 1.3. Planning mechanisms, including integrated water resources management, ICZM and MSP in NOWPAP member states contribute to reduced pressures on the coastal and marine environment.
EU MSFD (Marine Directive)	Descriptors of good environmental standard (ecological indicators)

Agreed indicators for SDG reporting

The agreed indicator for sustainable management under SDG Target 14.2, as proposed by the IAEG-SDGs, is ‘Proportion of National Exclusive Economic zones managed using ecosystem-based approaches’ (14.2.1). This indicator is classified as tier 3, meaning that internationally established methodologies or standards are not yet available. The methodology for the proposed SDG Indicator 14.2.1 is under development and is expected to be operational for tracking progress against SDG Target 14.2 in 2021.

In the interim, Regional Seas Coordinated Indicator 22 ‘Integrated Coastal Zone Management (ICZM) protocols’ will be used as proxy indicator. This will later be expanded to include Marine/Maritime Spatial Planning and other forms of area-based, integrated planning and management approaches applied in exclusive economic zones.

Step-by-step guide to implementing the indicator

SDG Indicator 14.2.1: Proportion of national Exclusive Economic Zones managed using ecosystem-based approaches

Proxy indicator: Integrated Coastal Zone Management (ICZM) protocol

Methodology: Assessing implementation status of ICZM plans

Step one Identify national authorities/agencies/organisations responsible for coastal and marine/maritime planning and management.

Step two Identify and spatially map the boundaries of ICZM plans at national, sub-national and local level.

Step three Determine the status of implementation of each ICZM plan, and categorise the spatial map according to implementation stages:

1) Initial plan preparation
2) Plan development
3) Plan adoption/designation
4) Implementation and adaptive management

The spatial map showing the boundaries of ICZM plans (produced in step two) can also be used to calculate the proportion of national waters, or national exclusive economic zone, covered by ICZM plans. This can be done by overlaying the spatial layer of ICZM plans with a spatial layer of national waters, or of the exclusive economic zone, to identify where the two layers coincide (following a similar methodology to calculating marine protected area coverage for SDG Indicator 14.5.1 described in Chapter 4).

All countries should report on the spatial boundaries of their ICZM plans and the implementation stage as the core parameter. Where in-country capacity or opportunities exist, countries can also assess the implementation of other area-based, integrated management and planning approaches, or monitor ecological parameters. Please refer to Table 9 for core and supplementary parameters for monitoring the implementation of ecosystem-based approaches under SDG Target 14.2. Further details on methodologies and guidelines for this can be found in Appendix 2.

Table 9: Core and supplementary monitoring parameters for implementation of the ecosystem-approach to track progress against SDG Target 14.2.

Monitoring parameters	Core parameter	Supplementary parameter
ICZM (Integrated Coastal Zone Management) plan boundary and implementation status	X	
Other area-based, integrated planning and management in place in waters under national jurisdiction, including exclusive economic zones (e.g. marine/maritime spatial planning, marine protected areas, marine zoning, sector specific management plans)		X
Ecological parameters (e.g. state of biodiversity, water quality, habitat quality, ecosystem health)		X

At the national level

Text Box 3 summarises findings from the country missions to Fiji and Colombia on national efforts towards monitoring the implementation of ecosystem-based approaches and using ICZM plans for tracking progress against SDG Target 14.2.

Text box 3: Insights from the country missions on monitoring the implementation of ecosystem-based approach using ICZM

Fiji: Awaiting a national marine spatial planning framework

Fiji is committed to implementing marine spatial planning across its entire national waters, including the Exclusive Economic Zone. One way for Fiji to realise this commitment might be to adopt a similar approach to that taken in Colombia, which has developed its own tailored ICZM approach, based on UNESCO's *Methodological Guide to Integrated Coastal Zone Management* (Henocque and Denis 2001). This way forward was noted by participants consulted during the in country mission.However, a national framework for marine spatial planning or ICZM in Fiji is not yet in place. Consequently, there is currently no clear plan for the implementation of SDG Indicator 14.2.1 or its proxy ICZM indicator. A possible option noted during the country mission would be for Fiji to assess the implementation of ecosystem-based management in its waters through Locally Managed Marine Areas, which are taking an ecosystem based approach.

Colombia: A national indicator on ICZM implementation

Colombia is already implementing its own national proxy indicator for SDG Indicator 14.2.1. The national indicator '*progress in the implementation of planning instruments for marine and coastal zones*' provides information on the existence, and state of implementation progress of ICZM in geographically defined coastal zone areas, which are referred to as *Coastal and Oceanic Environmental Units* (UAC in Spanish). The indicator measures the number of UACs that are making progress towards the implementation of ICZM, and specifies what stage of the ICZM implementation process each UAC is at. It is calculated using the following formula:

$$\frac{\text{\# UAC with progress in N stage from the ICZM methodology x 100}}{\text{\# Total of UAC in coastal zones}}$$

Where 'N' refers to one the following stages:
1. Preparation
2. Characterization
3. Diagnostic
4. Foresight and environmental zoning
5. Guidelines
6. Formulation
7. Adoption
8. Implementation/Execution
9. Monitoring and evaluation

The indicator results are spatially presented as a map, onto which the UACs are colour-coded depending on their ICZM implementation stages (see Figure 3). The Colombian indicator currently focuses on coastal areas but has the potential to be adapted to include the country's Exclusive Economic Zone.

Colombia's national indicator approach is very similar to the step-by-step methodology for the 'ICZM protocol' indicator presented in the *Global Manual*. The Colombian formula to calculate ICZM implementation progress could provide an alternative option to the step-by-step methodology for countries to implement the proxy indicator for SDG Target 14.2.

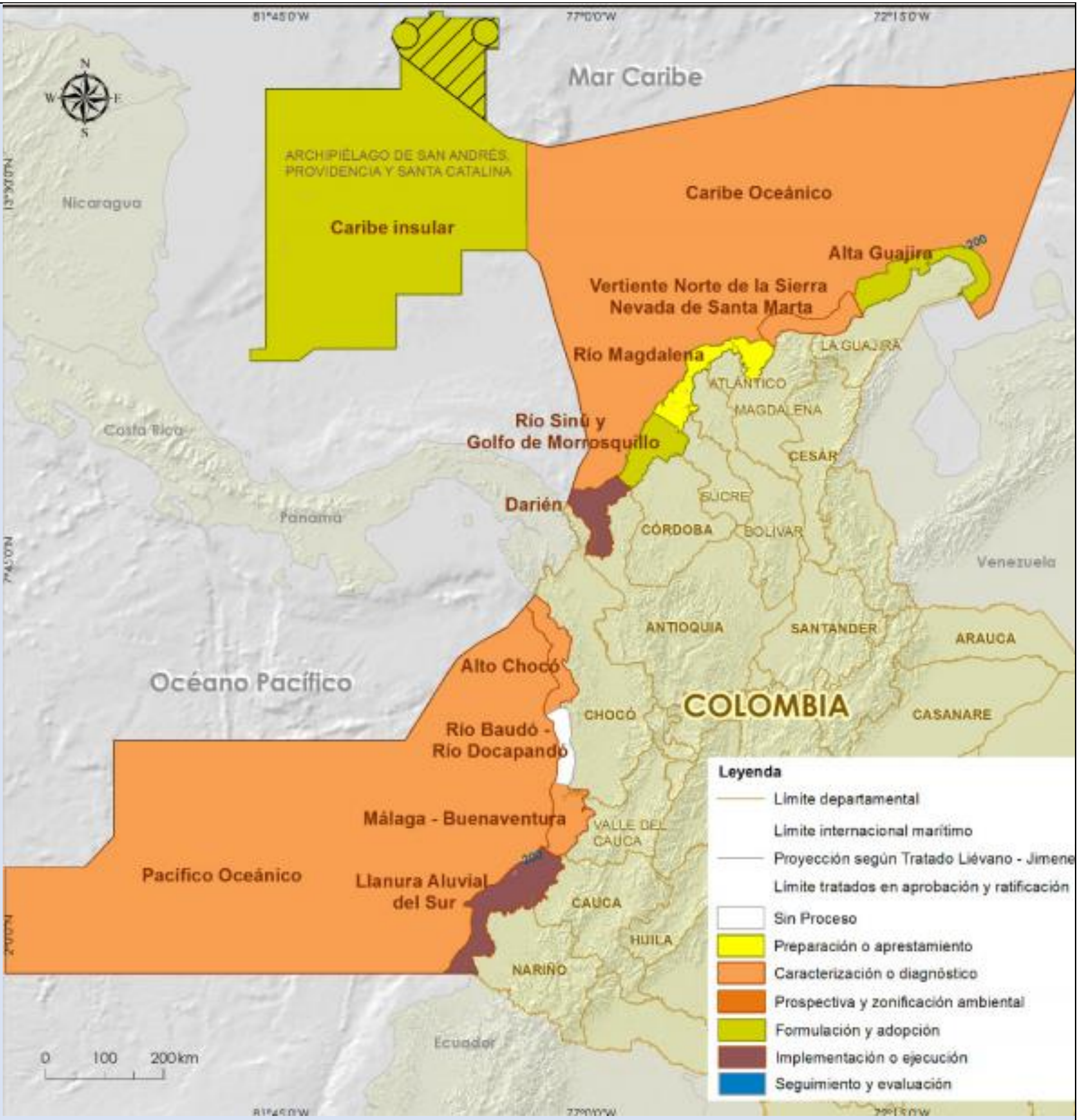

Figure 3: Spatial distribution of progress in the implementation of Integrated Coastal Zone Management (ICZM) for the period of 1999-2014 in Colombia, based on the national indicator 'progress in the implementation of planning instruments for marine and coastal zones'. The colours refer to the different implementation stages: White: no progress; Yellow: preparation; Orange: characterization; Red: foresight and environmental zoning; Green: formulation and adoption; Brown: implementation/execution; Blue: monitoring and evaluation. (Source: INVEMAR 2015)

Other elements of Target 14.2

SDG Target 14.2 is broad and encompasses three objectives for marine and coastal ecosystems: 1) sustainable management and protection, 2) resilience, and 3) restoration. SDG Indicator 14.2.1 addresses the first objective: ecosystem-based approaches are a key element of sustainable management and encompass marine and coastal protection. The latter is further covered by SDG Target 14.5[31]. This overlap between SDG Targets 14.2 and 14.5 was noted during the country mission, by government representatives from Fiji, as a possible challenge for implementing the related SDG

[31] SDG Target 14.5 *By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information*

indicators. As the Fiji government representatives explained, it is not always clear whether conservation efforts are part of sustainable management or marine protection, and thus whether they should be counted towards SDG Target 14.2 or 14.5.2.

The objectives of resilience and restoration are not covered by SDG Indicator 14.2.1. Resilience and restoration are partially covered by ecological indicators and ecosystem-based monitoring programmes, like those under OSPAR (Northeast Atlantic), UNEP-MAP (Mediterranean Sea) and the EU Marine Directive, which provide information about the status and trends of marine and coastal ecosystems.

Other existing indicators for resilience and restoration tend to focus on individual marine and coastal habitats, such as coral reefs, seagrass, saltmarsh and mangroves. These individual indicators cannot be easily aggregated, making it difficult to develop a standardised indicator and methodology for resilience or restoration of marine ecosystems. One possible solution is to focus on a set number of regionally relevant critical habitats, for example the four 'critical habitats' identified by NOWPAP (Northwest Pacific) and CPPS (Southeast Pacific): mangroves, reefs, seagrass and saltmarsh. Once a small number of critical habitats is selected, countries could be encouraged to monitor and report on the status and trends of those habitats that happen to occur in their jurisdiction.

Chapter 4: Indicator 14.5.1: Coverage of protected areas in relation to marine areas

Target 14.5: By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information

Review of existing indicators

A review of existing indicators and methodologies for monitoring the coverage of Marine Protected Areas (MPAs) used by Regional Seas Programmes and other key intergovernmental, international or regional bodies shows that six Regional Seas Programmes currently have indicators, assessment criteria or reporting in place for MPA coverage, as does the Global Environment Facility Transboundary Waters Assessment Programme (GEF-TWAP). Table 10 summarises the key criteria of the different approaches. The two most frequently assessed and reported criteria are 'number of MPAs' and 'total (surface) area covered by MPAs (coverage in km^2)'. Some Regional Seas Programmes also calculate 'the percentage of total marine area covered by MPAs (percentage %)' or 'changes in coverage (in km^2 or percentage %)'.

Table 10: Key criteria of existing indicators, assessment criteria or reporting requirements related to Marine Protected Areas (MPAs) that are currently used by Regional Seas Programmes and by the Global Environment Facility Transboundary Waters Assessment Programme (GEF-TWAP). (OSPAR: Oslo-Paris Convention (Northeast Atlantic); HELCOM: Helsinki Commission (Baltic Sea); Bucharest Convention (Black Sea); NOWPAP: Northwest Pacific Action Plan (Northwest Pacific); CPPS: Commission for the South Pacific (Southeast Pacific); Arctic Council (Arctic Sea).

	OSPAR	HELCOM	Bucharest Convention	NOWPAP	CPPS	Arctic Council	GEF-TWAP
Number of MPAs	✓	✓	✓	✓	✓	✓	✓
Total area covered by MPAs (km^2)	✓	X	✓	✓	X	✓	✓
Percentage of total marine area covered by MPAs (%)	✓	✓	X	✓	X	✓	X
Trends/changes in MPA coverage (km^2; %)	X	X	✓	X	✓	✓	✓
Distribution across IUCN management categories	X	X	X	X	✓	✓	X
Management in place	✓	✓	X	X	X	X	X
Percentage of marine areas covered by MPAs in relation to Aichi Target 11[32]	X	X	X	✓	X	X	X
Ecological coherence	✓	X	X	X	X	X	X
Geographic extent (in terms of global distribution of MPAs)	X	X	X	X	X	X	✓

[32] UN Stratgic Plan for Biodiversity (2010-2020) – Aichi Target 11 *By 2020, at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, 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 landscape and seascape.* For more information about the target: https://www.cbd.int/sp/targets/rationale/target-11/

Existing regional approaches to calculating MPA coverage require clear definitions of 1) what is considered as an MPA, and 2) the total (surface) area considered by the indicator. These are prerequisite for being able to calculate MPA coverage, and the proportion (percentage) of total marine area covered. Some Regional Seas Programmes, for example OSPAR (Northeast Atlantic) and HELCOM (Baltic Sea) have their own definitions of what they consider as an MPA. Others use the protected area definition[33] and management categories[34] of the International Union for Conservation of Nature (IUCN). CPPS (Southeast Pacific) and the Arctic Council (Arctic Sea), for example, report on the distribution of MPAs across IUCN management categories.

MPA coverage indicators and assessment criteria currently used by Regional Seas Programmes and other key intergovernmental, international or regional bodies are summarised in Table 11.

Table 11: Summary of marine protected area (MPA) coverage indicators and assessment criteria currently used by Regional Seas Programmes and other key intergovernmental, international or regional bodies. (Arctic Council (Arctic Sea); Bucharest Convention (Black Sea); CPPS: Permanent Commission for the South Pacific (Southeast Pacific); GEF-TWAP: Global Environment Facility Transboundary Waters Assessment Programme; HELCOM: Helsinki Commission (Baltic Sea); IUCN: International Union for Conservation of Nature; NOWPAP: Northwest Pacific Action Plan (Northwest Pacific); OSPAR: Oslo-Paris Convention (Northeast Atlantic).

Regional Seas Programme/ Organisation	Indicator/assessment criteria
OSPAR	Criteria for assessing the ecological coherence of OSPAR MPAs: 1) Geographically well distributed (connectivity), 2) Cover at least 10% in area of all biogeographic provinces (representativeness), 3) Represent all EUNIS Level 3 habitat classes and OSPAR threatened and/or declining species and habitats (features and resilience).
HELCOM	HELCOM indicators: 1) Coverage of protected areas in relation to marine areas, including in individual sub-basins of the Baltic Sea and exclusive economic zone 2) Percentage of HELCOM MPAs having management plans or measures in place
Bucharest Convention	Indicator for Ecological Quality Objective 2b (Conserve coastal and marine habitats and landscapes): Number and total area of marine and coastal protected areas increased
NOWPAP	Reporting on: • Number of MPAs • Area of MPAs in km^2 • Total regional coverage of MPAs in % of exclusive economic zone
CPPS	Indicator 1: Marine and Coastal Protected Areas, reported as: 1) Number of marine and coastal protected areas per IUCN category 2) Total surface of marine and coastal protected areas per IUCN category (km^2) 3) Marine and coastal surface area by country 4) Marine and coastal protected areas in the Southeast Pacific 5) Increase in surface area of marine and coastal protected areas by country 2004–2015 (km^2) 6) Percentage of marine and coastal protected areas in relation to Aichi Target 11
Arctic Council	Reporting on: 1) Number and area covered (% and km^2 of Arctic marine area), based on clear definitions of Arctic marine area boundaries (from the Conservation of Arctic Flora and Fauna (CAFF) working group) and of MPAs;

[33] IUCN definition of protected area: "*a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values*" (Dudley, N. (ed.) 2008. Guidelines for Applying Protected Area Management Categories. IUCN: Gland, Switzerland. p.8-9.)

[34] IUCN protected area management categories: Ia Strict Nature Reserve, Ib Wilderness Area, II National Park, III Natural Monument or Feature, IV Habitat/Species Management Area, V Protected Landscape/Seascape, VI Protected area with sustainable use of natural resources. Online: https://www.iucn.org/theme/protected-areas/about/protected-area-categories

	2) Trends in marine protected area coverage within the CAFF boundary 1900-2016 (in % of area covered) 3) Distribution of MPAs across each of the six IUCN Management Categories (in % of area covered) Also reporting on number and area covered (% and km^2) of other area-based measures of importance for Arctic marine biodiversity, including % within MPAs: 1) Areas of heightened ecological and cultural significance 2) Ecologically or Biologically Significant marine Areas (EBSAs) 3) Particularly Sensitive Sea Areas (PSSAs)
GEF-TWAP	Indicator: Change in protected area coverage within Large Marine Ecosystems (LMEs) 1) Number 2) Total area 3) Geographic extent 4) Index of percentage change (1982-2014) in total area covered by MPAs per LME 5) Cumulative area of MPAs in all LMEs

Agreed indicators for SDG reporting

The agreed indicator for SDG Target 14.5, as proposed by the IAEG-SDGs, is ‘Coverage of protected areas in relation to marine areas’ (14.5.1). This indicator is classified as tier 1, meaning that data and methodology are internationally established and available globally. Many countries already collect and manage data on the coverage of coastal and marine areas by marine protected areas, including the underlying geographic datasets. These data are largely curated by relevant Ministries (e.g. of the Environment) or National Park Agencies. The national data (including boundary data in a GIS format, along with associated ancilliary information such as MPA name, reported surface area, name of the management authority, etc.) are reported by the relevant authorities to the World Database on Protected Areas (WDPA)[35], a global authoritative database curated by UNEP-WCMC, with support from IUCN. Using the information in the WDPA, national-level statistics can be produced on protected area coverage for every country and territory, on a monthly basis. A more detailed description of the concepts, methodology and data sources for the indicator is provided by the SDG 14.5.1 metadata[36], available from the SDG indicators metadata repository[37].

Step-by-step guide to implementing the indicator

SDG Indicator 14.5.1: Coverage of protected areas in relation to marine areas

Methodology: National statistics on protected area coverage based on the World Database on Protected Areas (WDPA)

<u>Countries that are already regularly reporting national data on marine protected areas to the WDPA</u> do not need to take further action towards reporting against SDG Indicator 14.5.1. Using data reported by the relevant authorities, UNEP-WCMC calculates national-level statistics on the coverage of coastal and marine areas by MPAs, and makes the information available to the UN Statistics Division at their request. Countries can view the national-level statistics produced using the WDPA via the Protected Planet website (www.protectedplanet.net/c/unep-regions), where details of the step-by-step

[35] UNEP-WCMC and IUCN 2018. Protected Planet: The World Database on Protected Areas (WDPA) [Online], Cambridge, UK: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net

[36] SDG Indicator 14.5.1 metadata: https://unstats.un.org/sdgs/metadata/files/Metadata-14-05-01.pdf

[37] SDG indicators metadata repository: https://unstats.un.org/sdgs/metadata/

methodology for calculating national protected area coverage can also be accessed[38] (see also Text Box 4).

Countries that are not yet, or irregularly reporting their national data to the WDPA are encouraged to do so, according to the data submission guidelines available in the WDPA User Manual (www.wcmc.io/WDPA_Manual). A detailed description of the indicator methodology, including guidance to countries for the compilation of data at national level, is also available in the SDG 14.5.1 metadata (https://unstats.un.org/sdgs/metadata/files/Metadata-14-05-01.pdf).

All countries, via the WDPA, should report on coverage of marine and coastal areas by protected areas as the core parameter. Where in-country capacity or opportunities exist, countries can also assess supplementary parameters to address other elements of SDG Target 14.2 (described in the following section). Please refer to Table 12 for core and supplementary parameters for monitoring progress towards SDG Target 14.5.

Table 12: Core and supplementary monitoring parameters to track progress against SDG Target 14.5. Note: the list of supplementary parameters in this table is not exhaustive.

Monitoring parameters	Core parameter	Supplementary parameter
Coverage of marine and coastal areas by protected areas	X	
Coverage, by protected areas, of areas of importance for biodiversity and derived ecosystem services		X
Management effectiveness of protected areas		X
Connectivity of protected areas		X
Equity in protected area benefits and costs		X

Text Box 4: Calculation of marine protected area coverage (WDPA methodology):
When calculating protected area coverage, answers to the following questions will have a major influence on the resulting coverage statistics:

1) What is a protected area?
When calculating protected area coverage, UNEP-WCMC only use sites that have been reported as meeting the IUCN definition of protected area[39] and/or that of the Convention on Biological Diversity[40]. For more information on protected areas, see the dedicated page on the Biodiversity a to z[41].

2) What protected areas data are used?
UNEP-WCMC does not include all sites in the WDPA in protected area coverage calculations. "Proposed" protected areas are excluded, as are sites submitted as points with no reported area.

[38] WDPA methodology for calculating protected area coverage: www.protectedplanet.net/c/calculating-protected-area-coverage

[39] IUCN definition of protected area: "a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values" (Dudley, N. (ed.) 2008. Guidelines for Applying Protected Area Management Categories. IUCN: Gland, Switzerland. p.8-9)

[40] CBD definition of protected area: *a geographically defined area, which is designated or regulated and managed to achieve specific conservation objectives* (Art. 2 of the Convention on Biological Diversity)

[41] Biodiversity a to z: protected areas: http://www.biodiversitya-z.org/content/protected-area

Currently UNESCO Man and Biosphere Reserves (MAB)[42] are excluded, on the basis that that the MAB sites currently in the WDPA include buffer and transition zones that in many cases are not protected areas (MAB Core areas usually coincide with protected areas designated at a national level and are therefore generally accounted for in the calculations). In cases where data providers request that their data are not shared, UNEP-WCMC uses these data to calculate coverage statistics, but does not make them available through the Protected Planet website.

3) Which base map (coastline) layer is used?

UNEP-WCMC uses a custom-designed dataset combining exclusive economic zones and terrestrial country boundaries, a simplified version of which has been published by Brooks et al. (2016)[43]. This may differ from the more detailed national base layers used by countries to generate their own statistics. Therefore, there is an acknowledged potential for the results to differ slightly from those produced by countries.

At the national level

Text Box 5 summarises findings from the country missions to Fiji and Colombia on national efforts towards monitoring and reporting on marine protected area coverage to track progress against SDG Target 14.5.

Text box 5: Insights from the country missions on marine protected area coverage

Fiji: An ambitious national target

According to Protected Planet, 0.92% of Fiji's national waters are currently covered by protected areas: 11,953km^2 of a total marine area of 1,293,035km^2 (UNEP-WCMC 2018a). During the country mission, it was noted that data on Fiji's MPAs are submitted to the WDPA by the National Trust of Fiji, with plans for the Fiji Locally Managed Marine Areas, the Ministry of Environment and the Secretariat of the Pacific Regional Environment Programme to contribute information in the future.

Fiji has set itself an ambitious target to put 30% of its national waters under protection by 2020.

Colombia: A National Register of Protected Areas

In Colombia, the National Natural Parks (PNN in Spanish) is the national administrative body responsible for coordinating the national system of protected areas; collated data on protected areas are submitted to the WDPA. According to Protected Planet, 10.45% of Colombia's national waters are currently covered by protected areas: 76,392km^2 of a total marine area of 730,742km^2 (UNEP-WCMC 2018b).

All information related to protected area coverage is also made available by PNN on the National Register of Protected Areas (RUNAP in Spanish)[44]. RUNAP is a centralised protected area database on which Colombian environmental authorities can register protected areas under their jurisdiction, and upload information about these sites. PNN staff provide technical support and training where required to facilitate this process. The information uploaded into RUNAP includes metadata, geographic data and related images. RUNAP has an in-built validation and quality control process

[42] Protected Planet description of UNESCO Man and Biosphere Reserves: https://www.protectedplanet.net/c/world-database-on-protected-areas/internationally-designated-protected-areas/man-and-the-biosphere-reserves

[43] Data from Brooks et al. 2016: http://datadryad.org/resource/doi:10.5061/dryad.6gb90.2

[44] Colombia's National Register of Protected Areas (RUNAP): http://runap.parquesnacionales.gov.co/

to ensure that all metadata and geographical data are accurate before being uploaded into the system. All data on protected area coverage are made freely available on the RUNAP website a month after a protected area has been declared. Data users can download geographic data in GIS (Geographic Information System) format (shapefile) and metadata as PDF (Portable Document Format).

Other elements of Target 14.5

Coverage, by protected areas, of areas of importance for biodiversity

Protected area coverage alone does not give a full indication of the importance of an area in terms of biodiversity (and derived ecosystem services), for example the diversity of species that have been protected or the number of people who are benefiting from the protected area (Gill et al. 2017). As such, a calculation of the relative coverage, by protected areas, of those marine areas which are of particular importance for biodiversity (and derived ecosystem services) is a useful approach to assess the comprehensiveness and value of an MPA network.

The first step, in such a calculation, is to determine which areas are of importance for biodiversity. A number of different attributes can be considered when defining areas of biodiversity importance. Table 13 presents the attributes included in some of the most widely used, internationally recognised prioritisation (via criteria) schemes for conservation. These schemes also offer spatial data layers to allow locating these areas on the ground. Countries may choose to select one or multiple schemes from this list, or they may define their own national criteria for biodiversity importance. Then and depending on available data, information and knowledge, a spatial layer can be created that shows areas considered to be important for biodiversity (and derived ecosystem services).

Table 13: A summary of attributes of biodiversity importance included in widely known and used prioritisation schemes for conservation (abbreviations are explained below the table). (Adapted from: Dunn et al. (2014) The Convention on Biological Diversity's Ecologically or Biologically Significant Areas: Origins, development, and current status).

	EBSA	VME	PSSA	WHS	Ramsar	IBA	KBA	Natura 2000	AZE Sites
Uniqueness or rarity	✓	✓	✓	✓	✓	✓	✓	✓	✓
Special importance for life history stages of species	✓	✓	✓	✓	✓	✓	✓	✓	✓
Importance to threatened or endangered species	✓	✓	✓	✓	✓	✓	✓	✓	✓
Vulnerability, fragility, sensitivity or slow recovery	✓	✓	✓	X	?	X	✓	?	X
Productivity	✓	X	✓	✓	X	X	✓	X	X
Biodiversity	✓	X	✓	✓	✓	X	?	X	X
Naturalness	✓	X	✓	✓	✓	X	✓	X	X
Structure	X	✓	✓	X	X	X	?	X	X
Historical geomorphological importance	X	X	X	✓	X	X	X	X	X

<u>Acronyms – explanation and relevant policy instrument/organisation</u>
EBSA: Ecologically or Biologically Significant marine Areas – Convention on Biological Diversity (CBD)
VME: Vulnerable Marine Ecosystem – UN Food and Agriculture Organisation (FAO)
PSSA: Particularly Sensitive Sea Area – International Maritime Organisation (IMO)
WHS: World Heritage Site – UN Educational, Scientific and Cultural Organisation (UNESCO)
Ramsar: Ramsar Sites (Wetlands of International Importance) – Convention on Wetlands of International Importance (Ramsar Convention)

IBA: Important Bird and Biodiversity Areas – BirdLife International
KBA: Key Biodiversity Areas – International Union for Conservation of Nature (IUCN), BirdLife International, PlantLife International, Conservation International, Critical Ecosystem Partnership Fund and others (Note: KBAs include IBAs and AZE Sites)
Natura 2000: European network of protected sites under the European Habitats and Birds Directives – European Union
AZE Sites: Alliance for Zero Extinction Sites – Alliance for Zero Extinction

The second step is to calculate the relative coverage, by protected areas, of areas of biodiversity importance. This is done by overlaying the spatial layer of areas of biodiversity importance with the spatial layer of protected areas, in the national waters of the country. The results can be represented on a map or as a graph showing trends in relative coverage over time. This approach is already being used, at the global scale, for tracking progress against Aichi Target 11 of the UN Strategic Plan for Biodiversity (2010-2020), using the indicator "Protected Area Coverage of Key Biodiversity Areas"[45].

Management effectiveness of protected areas

The designation of a protected area does not necessarily ensure that conservation objectives are met, or that they have even been set and documented as part of a management plan. Effective management is essential to ensure that a protected area achieves the intended benefits for biodiversity and ecosystem services. A number of well-recognised mechanisms for assessing management effectiveness of protected areas exist, for example from IUCN (Hockings et al. 2006). One current approach to assess, at the global scale, the status and trends in effectiveness of management of protected areas is the Aichi 11 indicator "Protected Areas Management Effectiveness"[46], which records the number and area of assessments of management effectiveness completed by countries, and the overall management effectiveness score for each aspect of management.

[45] https://www.bipindicators.net/indicators/protected-area-coverage-of-key-biodiversity-areas. Note that information on the applicability of this approach in the context of the SDGs is available in the SDG 14.5.1 metadata (https://unstats.un.org/sdgs/metadata/files/Metadata-14-05-01.pdf).

[46] https://www.bipindicators.net/indicators/protected-area-management-effectiveness

Chapter 5: Findings on the bigger picture of SDG 14 – from national implementation to global monitoring

Implementing SDG indicators at country level

The *Global Manual on Ocean Statistics* is intended to support countries in their efforts to implement indicators for tracking progress against SDG 14. The country missions to Fiji and Colombia highlighted that countries start off from different contexts, and face different challenges, in implementing the SDG indicators. Some countries, like Colombia, already have centralised data gathering systems and/or national indicators in place that can be built on to implement the SDG indicators. In contrast, Fiji and other Pacific island nations are only just starting to address the SDG targets and indicators at country level; here, the SDG process is mainly being driven forward at the regional level by the Pacific Regional Seas Programme and other regional institutions. One common challenge that countries in both regions share is limited funds and capacity for monitoring programmes.

The recommendation that can be drawn from these country insights is that, where possible, the implementation of indicators for SDG 14 should be aligned with, and build on, existing national and regional monitoring programmes and indicators, so as to optimise the use of limited available resources. The Regional Seas Programmes are well placed in supporting countries to identify these synergies, and find efficient ways of implementing the SDG indicators.

Coordinated international monitoring of transboundary issues

As mentioned in the introduction to the *Global Manual*, many issues remain to be resolved in order to achieve more complete global monitoring of transboundary marine issues, including in areas beyond national jurisdiction. This will require countries to work together in a coordinated effort using both satellite remote sensing and *in situ* international surveys, including shared data collection protocols, good data sharing practices, innovative and cost-effective sampling methodologies. The Regional Seas Programmes are working towards coherent and coordinated monitoring approaches within, as well as across, regional seas, and could play an important role in facilitating coordinated international monitoring efforts.

Globally applicable methodologies to track global progress

Finally, the *Global Manual* recognises that the agreed SDG and proxy indicators only capture part of the associated SDG targets. In the long-term, these limitations will have to be addressed to ensure that SDG 14 is fully met. In the meantime, however, it is important to focus on what can be realistically achieved by all countries, so that data can be meaningfully aggregated to give a global picture of progress towards SDG 14. The *Global Manual on Ocean Statistics* aims to support this effort by providing step-by-step indicator methodologies that require minimum resources and technical capacity, can be integrated with existing national and regional approaches, and provide the minimum parameters required to monitor progress against SDG Targets 14.1, 14.2 and 14.5.

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The following appendices are provided as separate documents:

Appendix 1: List of 22 Regional Seas Core Indicators

Appendix 2: Summary tables of existing indicators (Regional Seas Programmes)

Appendix 3: Country case study reports (Colombia, Fiji)

Appendix 4: Operational Guidelines for Comprehensive Beach Litter Assessment (UNEP/IOC)