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Summary

In paragraph 358 of its resolution 73/124, the General Assembly decided that the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea would focus its discussions at its twentieth meeting on the theme "Ocean Science and the United Nations Decade of Ocean Science for Sustainable Development". The present report was prepared pursuant to paragraph 370 of Assembly resolution 73/124, with a view to facilitating discussions on the topic of focus. It is being submitted to the Assembly for its consideration and to the States parties to the United Nations Convention on the Law of the Sea, pursuant to article 319 of the Convention.

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I. Introduction

1. The ocean remains one of the least known areas of the planet. The First Global Integrated Marine Assessment (first World Ocean Assessment (WOA I)) notes that our understanding of the processes that are taking place is currently not keeping up with the pace of changes in the oceans.[1]

2. The General Assembly has consistently highlighted the importance of marine science[2] for eradicating poverty, contributing to food security, conserving the world's marine environment and resources, helping to understand, predict and respond to natural events and promoting the sustainable development of the oceans and seas. The 2030 Agenda for Sustainable Development (2030 Agenda), in its Sustainable Development Goal 14 (SDG 14), further confirms the important role of scientific knowledge, research capacity and transfer of marine technology for sustainable development.

3. The United Nations Convention on the Law of the Sea (UNCLOS), which sets out the legal framework within which all activities in the oceans and seas must be carried out, in its preamble, puts forward the goal of promoting the equitable and efficient utilization of ocean resources, the conservation of their living resources, and the study, protection and preservation of the marine environment. Ocean science plays a key role in that regard. With other instruments, including the 1995 United Nations Fish Stocks Agreement, UNCLOS requires, inter alia, that the best available scientific evidence or information be used when adopting conservation and management measures.

4. In recognition of the critical importance of the role of ocean science, the Assembly proclaimed the United Nations Decade of Ocean Science for Sustainable Development for the 10-year period beginning on 1 January 2021.[3] Most recently, the General Assembly decided that the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea would focus its discussions at its twentieth meeting on "Ocean Science and the United Nations Decade of Ocean Science for Sustainable Development". To facilitate these discussions, the present report provides an overview of ocean science and its role, gaps in information, knowledge and capacity among others, and ways to advance ocean science and fill existing gaps. It is beyond the scope of this report to provide a comprehensive substantive assessment of scientific knowledge concerning the oceans.

5. The report builds on WOA I, the Global Ocean Science Report (GOSR) of the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO),[4] together with other reports and scientific and

[1] United Nations, First Global Integrated Marine Assessment: World Ocean Assessment I (Cambridge University Press, 2017).
[2] The terms "ocean science" and "marine science" are used interchangeably in this report.
[3] Resolution 72/73, para.292. The resolution followed the endorsement by the IOC Assembly of the proposal for the Decade in IOC Resolution XXIX-1.
[4] IOC-UNESCO, Global Ocean Science Report - The current status of ocean science around the world, 2017.

technical publications, as well as the contributions submitted by States and relevant organizations and bodies upon the Secretary-General's invitation.[5]

II. Ocean science and its role

A. Scope and uses of ocean science

6. Ocean science is understood to encompass a range of disciplines related to the study of the ocean, including physical, biological, chemical, geological, hydrographic, health and social sciences, as well as the humanities, engineering and multidisciplinary research.

7. Ocean science is key to understanding such fundamental aspects as the geology and geophysics of ocean basins, the physical processes at work in the oceans and seas, the input, distribution and impact of substances and energy input into the oceans, the occurrence and distribution of flora and fauna, the biological processes that regulate and sustain the productivity of ecosystems, the links between the ocean and atmosphere, including the effects of climate change and ocean acidification on the ocean, and the way in which all these elements interact. Scientific understanding is fundamental to an effective management of human activities that rely on and affect the oceans and seas. For example, ocean science plays a critical role in the fisheries management process, including for the adoption of conservation and management measures. Ocean science also has an important role to play in understanding the cumulative impacts of various activities taking place at sea and on land, including extractive activities, shipping, agriculture, coastal development and industrial production, and designing appropriate management measures to ensure that tipping points are not reached. Ocean science also provides the supporting data needed to establish the baselines from which the outer limits of the various maritime zones are set out or to compile nautical charts for safe navigation. It is also essential to predict or forecast, mitigate and guide the adaptation of societies and infrastructure to natural and anthropogenic events and changes, in particular climate change. Ocean science can further assist a better understanding of the relationship between humans and the ocean and related socioeconomic aspects. Several contributions to this report also indicate that ocean science has an important role to play in monitoring and surveillance activities.

8. Ocean science is thus of critical importance to decision-makers and a wide range of sectors and users at the national, regional and global levels. At the global level, ocean science can inform several processes, including the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects (Regular Process), the Review Conference on the United Nations Fish Stocks Agreement, the Intergovernmental Conference on an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, the processes under the United Nations Framework Convention on Climate Change and the 2030 Agenda.

[5] The full text of these contributions is available on the website of the Division for Ocean Affairs and the Law of the Sea at www.un.org/depts/los/general_assembly/general_assembly_reports.htm.

B. Ocean science for sustainable development, including its cross-cutting role in SDG14 and the 2030 Agenda for Sustainable Development

9. Managing human activities that rely on and affect the oceans and seas, in a sustainable manner and in accordance with international law, including UNCLOS and other relevant international instruments, requires informed decision-making. The role of science in furthering sustainable development has long been recognized, including in the outcomes of major conferences on sustainable development.[6] Ocean science is also essential to realizing SDG 14: Conserve and sustainable use the oceans, seas and marine resources for sustainable development.

10. Ocean science cuts across SDG 14 and each of its interrelated targets. Indeed, in addition to the cross-cutting target focused on increasing scientific knowledge and developing adequate research capacity and transfer of marine technology,[7] several other SDG 14 targets expressly contemplate a central role for science in achieving their objectives, including through enhanced scientific cooperation at all levels,[8] science-based management[9] and reliance on the best available scientific information.[10]

11. For example, ocean science has an important role to play in achieving target 14.4, which calls for regulating harvesting, ending overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implementing science-based management plans, in order to restore stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield, including through the collection of data to inform the development and implementation of science-based management plans.[11]

12. Ocean science also supports the management of other anthropogenic pressures as called for, for example, in target 14.1 (prevent and significantly reduce marine pollution of all kinds by 2025),[12] target 14.2 (sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts by 2020),[13] target 14.3 (minimize and address the impacts of ocean acidification)[14] and target 14.5 (conserve at least 10 per cent of coastal and marine areas by 2020).[15] Scientific knowledge is also fundamental to the implementation of international law as reflected in UNCLOS, which is called for in target 14.c. The vital role of ocean science is further exemplified by the fact that more than 500 voluntary commitments registered in the context of the

[6] See, for example, Chapter 31 of Agenda 21; chapter X of the Johannesburg Plan of Implementation; and paragraph 272 of "The future we want".
[7] Target 14.a.
[8] Target 14.3.
[9] Target 14.4.
[10] Target 14.5.
[11] ICCAT, ICES and NPAFC contributions.
[12] IAEA, IMO and IOC contributions.
[13] SCBD and IOC contributions.
[14] IAEA, ICES, IOC and UNFCCC contributions.
[15] SCBD and ICES contributions.

2017 United Nations Conference to Support the Implementation of SDG 14 (Ocean Conference) are directed at increasing scientific knowledge, capacity-building and technology transfer.[16]

13. Ocean science also supports the development of the cross-sectoral and integrated solutions needed to achieve SDG 14 and the other related and mutually reinforcing goals and targets of the 2030 Agenda.[17] Advances in scientific knowledge, as well as technological innovation, that are directed at achieving one target may equally assist in achieving other goals and targets. For example, in addition to contributing to the achievement of target 14.4, efforts to advance knowledge regarding the status of fish stocks might equally support the achievement of targets 14.6 and 14.7 as well as SDGs 2, 6, 7, 8, 9, 11 and 12.

14. More broadly, much of the information needed to understand the ocean and ocean acidification is also needed to understand climate change. In this regard, efforts to strengthen the scientific knowledge base regarding changes in ocean temperature, sea-level rise, salinity, carbon dioxide absorption, nutrient distribution and cycling and deoxygenation will support synergistic implementation of SDGs 13 and 14 (see para.21).[18]

15. Ocean science also has a role to play in achieving gender equality and empowering women and girls, as called for under SDG 5. For example, in 2017 on average, female scientists accounted for 38 percent of researchers in ocean science – about ten percentage points higher than the global share of female researchers (see para. 25).

III. Identifying gaps in knowledge and ocean science

A. Current state of knowledge and ocean science

16. Our knowledge of the ocean, including its physical structure, the state of its waters and its biota, and our understanding of the role played by the ocean in the planet's ecosystem, including the major ecosystem services it provides, the ways it functions, and our relationships to it, have been considerably enhanced in the last 50 years. Steady progress has been made, for example, in increasing our understanding of the essential links between the ocean and atmosphere, including the effects of climate change on the ocean, such as ocean warming, sea-level rise, ocean acidification, shifts in ocean salinity and oxygen content, ocean stratification and changes in ocean circulation, as also reflected in recent reports of the Intergovernmental Panel on Climate Change (IPCC).[19]

17. Much information has been generated to provide scientific information related to the use of the ocean and its resources, and to help understand the impacts of such use. The Ocean

[16] https://oceanconference.un.org/coa/ScientificKnowledge. See also ICES contribution.
[17] For further details on interlinkages between SDG14 targets and other SDG Goals in the 2030 Agenda for Sustainable Development, see "Mapping the linkages between oceans and other Sustainable Development Goals: A preliminary exploration", DESA Working Paper No.149, document ST/ESA/2017/DWP/149.
[18] UNFCCC and WMO contributions.
[19] UNFCCC contribution.

Biogeographic Information System, which emanated from the decade-long Census of Marine Life, has recorded 55 million observations of over 120,000 marine species. The process, under the Convention on Biological Diversity (CBD) related to the identification of ecologically and biologically significant areas (EBSAs) has allowed the description of 321 EBSAs.[20] Our understanding of the relationship between ocean health and human well-being, including the impacts of the increasing inputs of harmful material into the ocean, has been markedly improved.[21] WOA I provides a synthesis of scientific knowledge regarding the state of the marine environment, including socioeconomic aspects.

18. The GOSR indicates that ocean science is expanding in magnitude and scope, resulting in greater scientific output.[22] Contributions to the present report provide examples of scientific activities being undertaken in the following areas: hydrography;[23] assessment of ocean change;[24] ocean-climate nexus;[25] marine biodiversity and ecosystems,[26] including deep-sea marine taxonomy;[27] marine social-ecological systems;[28] conservation and management of fish stocks and other marine living resources;[29] and environmental impact of various activities such as shipping.[30] This expansion in ocean science results partly from an increase in investment in ocean science by States[31] and private sources.

19. Ocean science relies on skilled individuals, ocean science institutions and marine laboratories that are specialized or work across a wide range of disciplines, and on a broad array of equipment and technologies (see Section IV.B).[32] A number of States have developed marine policies that encompass marine science and technology plans and strategies. A number of States and relevant organizations have developed infrastructures related to marine science and technology, such as oceanographic institutes, but these are at different levels of development.[33]

B. Gaps in knowledge and ocean science

20. Although our understanding of the oceans is improving, there remain considerable gaps and disparities in knowledge, which can hamper the ability of policy-makers to make informed

[20] SCBD contribution.
[21] Summary of the First Global Integrated Marine Assessment.
[22] Global Ocean Science Report.
[23] IHO contribution.
[24] IAEA contribution.
[25] UNFCCC and WMO contributions.
[26] ISA, SCBD, ICES and NEAFC contributions.
[27] ISA contribution.
[28] ECLAC contribution.
[29] ICCAT, ICES, NEAFC and NPAFC contributions.
[30] IMO and UNCTAD contributions.
[31] IOC contribution.
[32] Global Ocean Science Report.
[33] Preparatory process of the United Nations Conference to Support the Implementation of Sustainable Development Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development - Note by the Secretary-General (A/71/733). See also EU and USA contributions.

decisions. WOA I notes that many areas still require further investigation to fully comprehend the role of the ocean in the earth ecosystem.[34] For example, there is a need to better understand ecosystem processes and functions and their implications for ecosystem conservation and restoration, ecological limits, tipping points, socio-ecological resilience and ecosystem services and their valuation. In particular, the effects upon biodiversity and ocean productivity from cumulative impacts as well as socioeconomic impacts are often not well understood.[35]

21. Additional information is needed to better understand the ocean-climate nexus, including on sea temperature, sea-level rise, salinity distribution, carbon dioxide absorption, and nutrient distribution and cycling.[36] The IPCC special report on "The Ocean and Cryosphere in a Changing Climate" is expected to be published in September 2019.[37]

22. Further information is also needed on marine biodiversity, including the number and distribution of marine species, the health and reproductive success of populations, as well as marine taxonomy, including deep-sea taxonomy, in particular for the species and habitats that have been scientifically identified as threatened, declining or otherwise in need of special attention or protection.[38]

23. Additional examples of specific knowledge gaps can be found in recent reports of the Secretary-General on oceans and the law of the sea and on sustainable fisheries and the background information for the 2017 Ocean Conference.[39] These relate to: anthropogenic underwater noise and its impacts on the marine environment and marine species;[40] some marine ecosystems and processes;[41] pollution, including the life cycle and impacts of marine debris, plastics and microplastics, heavy metals and other hazardous substances;[42] understanding species and the diversity of marine resources,[43] including the status of some highly migratory fish stocks and straddling fish stocks, discrete high sea stocks and non-target, associated and dependent species;[44] integrated coastal zone management;[45] the effectiveness and impact of conservation measures, including with regard to their socioeconomic benefits and how marine and land-based human activities alter their effectiveness.[46]

[34] IOC contribution.
[35] A/71/73; Summary of the First Global Integrated Marine Assessment.
[36] Summary of the First Global Integrated Assessment. See also IOC, UNFCCC, ECLAC and WMO contributions.
[37] See https://www.ipcc.ch/report/srocc/.
[38] Summary of the First Global Integrated Marine Assessment; ISA contribution.
[39] Available at https://www.un.org/depts/los/general_assembly/general_assembly_reports.htm and https://oceanconference.un.org/documents.
[40] A/73/68.
[41] A/71/733.
[42] A/71/74 and Concept paper for Partnership Dialogue 6.
[43] A/71/733.
[44] A/CONF.210/2016/1.
[45] A/71/733.
[46] Ibid.

24. In addition, the level of knowledge concerning socioeconomic aspects, including the gender dimension, remains limited owing to insufficient studies so far on this aspect. There are also widespread gaps in the skills needed to assess the ocean with respect to, for example, the integration of environmental, social and economic aspects.[47]

25. Furthermore, the level of our knowledge regarding different parts of the ocean varies considerably. Recent calculations show that only 18% of information on ocean depths is available and a much lesser percentage is covered at the level of accuracy expected from the current state of technology.[48] Knowledge of deep waters and seabed in areas beyond national jurisdiction, including the interaction between the physical structure and the biota in those areas, is limited.[49] Among the four main ocean basins, least is known about the Arctic Ocean and the Indian Ocean. Parts of the Atlantic Ocean and the Pacific Ocean in the northern hemisphere are better studied than those in the southern hemisphere. The North Atlantic and its adjacent seas are the most studied but major gaps also remain there.[50] Moreover, disparities in scientific capacity, particularly in developing countries, contribute to uneven distribution of scientific knowledge (see Section IV.E). Female participation in ocean science also remains insufficient and ranges across the different categories of ocean science from 4 percent to more than 62 percent.[51]

26. Closing those knowledge gaps calls for an ambitious programme of action in ocean science.[52] Enhanced international and interdisciplinary scientific collaboration paired with capacity building and technology transfer are also needed.[53] The acquisition of sufficient credible scientific data and information requires major investment. However, government funding for ocean science remains modest overall, and faces sustainability challenges in a number of countries.[54] In many cases, national ocean research policies, scientific advisory mechanisms and oceanographic institutes are lacking.[55]

IV. Advancing ocean science and addressing related gaps

A. Role of UNCLOS and its implementing agreements in advancing ocean science

[47] Summary of the First Global Integrated Marine Assessment.
[48] EU, IHO, WMO contributions.
[49] Summary of the First Global Integrated Marine Assessment.
[50] Ibid.
[51] Global Ocean Science Report.
[52] Summary of the First Global Integrated Marine Assessment.
[53] IOC contribution.
[54] The Global Ocean Science Report found that ocean science accounts for less than 4% of the total research and development expenditures worldwide. See IOC contribution.
[55] IOC contribution.[56] The Convention does not define the term “marine scientific research” owing to the different views expressed during the negotiations of the Convention on what the activity might encompass, in particular whether it is limited to fundamental research or also covers applied research and industrial research undertaken with a view to commercial exploitation or military use (see United Nations, Marine Scientific Research – A revised guide to the implementation of the relevant provisions of the United Nations Convention on the Law of the Sea, 2010). Article 251 of the Convention therefore requires States to seek to promote through competent international organizations the establishment of general criteria and guidelines to assist States in ascertaining the nature and implications of marine scientific research.

27. The Convention recognizes the key role of ocean science in its Part XIII, which sets out a comprehensive legal framework for marine scientific research (MSR).[56] In particular, besides the specific rules it lays down for the conduct of MSR in the various maritime zones, including with regard to the consent for MSR undertaken within national jurisdiction, Part XIII reaffirms that States and competent international organizations have the right to conduct MSR and shall promote and facilitate the development and conduct of such research; that such research shall be conducted exclusively for peaceful purposes; that it shall be conducted with appropriate scientific methods and means compatible with the Convention; that it shall not unjustifiably interfere with other legitimate uses of the sea compatible with the Convention and shall be duly respected in the course of such uses; that it shall be conducted in compliance with all relevant regulations adopted in conformity with the Convention including those for the protection and preservation of the marine environment; and that it shall not constitute the legal basis for any claim to any part of the marine environment or its resources. Part XIII further sets out the obligation to promote international cooperation in MSR, to create favourable conditions for the conduct of such research and to make available by publication and dissemination knowledge resulting from MSR and promote the flow of scientific data and information and the transfer of knowledge. Part XIII also addresses scientific research and installations or equipment, as well as responsibility and liability. While some States have adopted measures of a legislative, regulatory or policy nature to implement Part XIII, such measures do not seem to be widespread.[57]

28. In addition to Part XIII of the Convention, UNCLOS provides for the development and transfer of marine technology in its Part XIV (see Section IV.B). Other provisions of relevance to ocean science are found throughout the Convention,[58] some of which have also contributed to advancing ocean science in an indirect manner. For example, article 76 of and annex II to the Convention contain an obligation for coastal States wishing to delineate their continental shelves beyond 200 nautical miles from the territorial sea baselines to submit scientific information on the limits of the continental shelf beyond 200 nautical miles to the Commission on the Limits of the Continental Shelf. The data newly acquired in that context has improved the spatial coverage and resolution of primarily bathymetric and seismic data regarding continental margins and has contributed to a better geoscientific understanding of these areas. Similarly, activities of exploration for mineral resources in the Area in accordance with Part XI of UNCLOS and the Part

[56] The Convention does not define the term “marine scientific research” owing to the different views expressed during the negotiations of the Convention on what the activity might encompass, in particular whether it is limited to fundamental research or also covers applied research and industrial research undertaken with a view to commercial exploitation or military use (see United Nations, Marine Scientific Research – A revised guide to the implementation of the relevant provisions of the United Nations Convention on the Law of the Sea, 2010). Article 251 of the Convention therefore requires States to seek to promote through competent international organizations the establishment of general criteria and guidelines to assist States in ascertaining the nature and implications of marine scientific research.

[57] See http://www.un.org/Depts/los/LEGISLATIONANDTREATIES/index.htm.

[58] For example, articles 19, 21 and 52 (innocent passage); 40 (transit passage); 54 (archipelagic sea lanes passage), 56 and 62 (exclusive economic zone), 87 (freedom of the high seas), 123 (enclosed or semi-closed seas), 143 and 155 (the Area), 200, 201, 202 and 204 (protection and preservation of the marine environment.

XI Agreement have contributed to the acquisition and dissemination of important data on deep-sea ecosystems.

29. The United Nations Fish Stocks Agreement also requires the promotion and conduct of scientific research and the development of appropriate technologies in support of fishery conservation and management and, to that end, includes a number of provisions for the collection and provision of information and cooperation in scientific research as well as standard requirements for the collection and sharing of data.[59]

B. Technologies and data infrastructure

30. Innovation in technologies related to ocean science is critical to improve knowledge of the oceans and seas. Ocean science projects have stimulated technological advancements which, in turn, have accelerated the pace at which scientific knowledge of the ocean is generated.

31. The application of advanced technology to ocean science and the development of new technologies, including satellites and remote-sensing techniques, airborne laser scanning, autonomous underwater vehicles (AUVs) and remotely operated vehicles (ROVs), floats and sensors and new measurement devices and techniques, such as multi-beam sonars, have enhanced the range of technical options available to improve our knowledge of the ocean, particularly in remote or difficult-to-access environments, such as the polar regions, the deep ocean floor and mangroves.[60]

32. Remote sensing and satellite imagery can provide very detailed and accurate information about essential oceanic variables.[61] For example, satellite imagery has been used to track fragile or threatened ecosystems or habitats in real time and for early warning of events, such as algal blooms.[62] Earth observing satellites represent some of the most valued components of the international Global Ocean Observing System (GOOS) and of the Global Climate Observing System (GCOS).[63]

33. In the future, SMART cable systems could integrate ocean sensors into undersea telecommunication cables, with the potential to provide near global coverage at a fraction of the costs of single-purpose science-only systems. Airborne laser scanning and mathematical derivation of the seabed topography from satellite imagery have enhanced the range of technical options available to complete our image of the oceans.[64] Environmental DNA is being explored as a way to cost-effectively assess biodiversity and track invasive species, harmful algal blooms,

[59] Articles 5, 14 and Annex I.
[60] ECLAC, IHO, IOC and WMO contributions. Also see Global Ocean Science Report.
[61] See https://www.un.org/regularprocess/sites/www.un.org.regularprocess/files/segment_2_p2-4_wahid_moufaddal_ropme.pdf.
[62] ECLAC contribution.
[63] IOC contribution.
[64] IHO contribution.

aquaculture pathogens, migratory species, larval dispersal, and endangered populations.[65] Hydrophones have also been used to understand the acoustic landscape of species of priority conservation or commercial interest and to assist in monitoring and surveillance.[66] New technologies include acoustic monitoring for salmon tracking and geometric and biomolecular techniques for the identification of species.[67] Technology is under development to avert, minimize and address loss and damage from slow onset events, non-economic losses and irreversible impacts from climate change.[68]

34. Notwithstanding the importance of emerging technologies and the application of older technology for ocean science purposes, research vessels continue to be an essential component of ocean research infrastructure. While evolving science needs, cost pressures and newer technologies, such as AUVs and ROVs, have changed the ocean science infrastructure, this has not lessened the reliance on well-equipped ships as research vessels are fundamental to deploying and recovering new observing technologies and to explore the vast areas of the ocean poorly observed to date.[69]

35. Challenges and gaps remain however. Sustained investment is essential to develop the required technology and continuously improve existing one.[70] Higher resolution observations in the upper ocean, rapid delivery of data for weather forecasts, and extension of the observing system into the deep ocean are also needed,[71] along with observations of additional parameters in order to incorporate more earth system processes, such as chemistry and biology. Efforts are on-going to address some of these challenges and gaps. For example, WMO is working with partners to incorporate new technologies into GOOS, including satellites, autonomous vehicles and sensors, to address key existing gaps in observations.[72] IOC, WMO and the International Telecommunication Union have established a joint task force to seek to integrate bottom pressure, temperature, and acceleration sensors into cables.[73] In 2018, the IOC Executive Council approved the measurement of new biogeochemical parameters on Argo floats to increase knowledge of the large-scale evolution of the ocean's biogeochemistry and associated impacts on marine ecosystems.[74]

36. Other challenges include the need for ongoing assistance to ensure developing countries can fully benefit from technologies and data in ocean science (see also Section IV.E).[75] The

[65] USA contribution.
[66] ECLAC contribution.
[67] NPAFC contribution.
[68] UNFCC contribution.
[69] IOC contribution.
[70] Global Ocean Science Report.
[71] WMO contribution.
[72] WMO contribution.
[73] IOC contribution.
[74] IOC contribution.
[75] OHRLLS contribution.

implementation of Parts XIII and Part XIV of UNCLOS require strengthening, taking into account also the IOC Criteria and Guidelines on the Transfer of Marine Technology.[76]

37. In addition, questions of a legal nature, in particular concerning the application of the legal framework set out in Part XIII of the Convention (see Section IV.A), have arisen with regard to the use of new technologies, such as floats or gliders, or methods of collecting data, such as the voluntary observing ship scheme under WMO, and require further consideration.[77]

38. Another challenge that requires consideration is the way data collected is accessed, collated, shared and transformed into information. Technological developments and improvements have led to the production of new kinds of data at an accelerated rate, in an unprecedented amount[78] and over larger spatial areas. While IOC's Oceanographic Data and Information Exchange programme has developed a global network of nearly 100 oceanographic data centres and hundreds of online data and information services and products, it is becoming increasingly difficult to extract and process data and information as a result of, inter alia, differences in language, interface, technology and formats.[79] The adoption and implementation of internationally-accepted standards and best practices for the management and exchange of data and the adoption and implementation of data policies that support open access therefore require further consideration.

39. In that regard, the IOC is developing the Ocean Data and Information System to integrate existing data exchange systems using common data exchange formats and protocols to facilitate access to the vast amounts of ocean knowledge.[80] Other online platforms have also been established to facilitate information-sharing and scientific collaboration, for example on marine biodiversity and deep-sea ecosystems.[81] ICCAT is exploring new ways to communicate and present the results from complex data collection to a broad range of stakeholders and is supporting research initiatives and projects to introduce emerging technologies and modeling approaches such as satellite/acoustic tags and advanced analytical models.[82] IHO has supported enhanced application of new technologies through definition of harmonized procedures, adaptation of quality standards, coordination of capacity-building, training and education.[83] IAEA is developing and sharing new analytical methods and reference materials.[84]

[76] IOC Resolution XXII-12.
[77] See Resolution XX-6 of the IOC Assembly regarding the deployment of profiling floats in the high seas within the framework of the Argo Programme. See also WMO Technical Workshop, "Enhancing ocean observations and research, and the free exchange of data, to foster services for the safety of life and property", Geneva, 5-6 February 2019 (https://public.wmo.int/en/events/meetings/technical-workshop-enhancing-ocean-observations-and-research-and-free-exchange-of).
[78] Global Ocean Science Report.
[79] IOC contribution.
[80] IOC contribution.
[81] SCBD, ISA contributions.
[82] ICCAT contribution.
[83] IHO contribution.
[84] IAEA contribution.

C. Strengthening the integration of traditional knowledge of indigenous peoples and local communities in ocean science

40. Indigenous and local knowledge systems embody distinct and diverse understandings and values which enrich and expand the knowledge base for decision-making.[85] In recent decades, the important role of such knowledge systems in addressing contemporary sustainability challenges has increasingly been recognized, including with respect to enhancing understanding of the health and role of the ocean and the stressors on its ecosystems[86] since many cultures have built broad traditional knowledge of the ocean.[87] Women are frequently the primary holders of local and indigenous knowledge concerning natural resources, and play a central role in the transmission, preservation and elaboration of such knowledge.[88]

41. Efforts to understand and better integrate the wealth of traditional knowledge held by indigenous peoples and local communities regarding the oceans are underway in several global fora and processes, including with respect to the conservation and sustainable use of marine biological diversity,[89] climate change assessment and adaptation,[90] disaster risk reduction[91] and sustainable development.[92] Through its Local and Indigenous Knowledge Systems programme, UNESCO also works to support the meaningful inclusion of local and indigenous knowledge systems in these fora and processes.[93]

42. At the regional level, efforts to incorporate traditional knowledge of indigenous and local communities are also ongoing within regional fisheries management organizations (RFMOs), including through participation of traditional knowledge holders in research, training and outreach programmes,[94] and more generally with respect to the conduct of ocean science[95] and natural resource management.[96]

[85] "Indigenous and Local Knowledge(s) and Science(s) for Sustainable Development", Policy Brief by the Scientific Advisory Board of the UN Secretary-General, 5 October 2016.
[86] See, for example, "Our Ocean, Our Future: Call for Action", resolution 71/312, paras. 10 and 13; Convention on Biological Diversity, article 8(j); Aichi Biodiversity Targets, Target 18; "The future we want", resolution 66/288, para. 197; Fifth Assessment Report, Intergovernmental Panel on Climate Change, 2014; Paris Agreement, article 7.5.
[87] First Global Integrated Marine Assessment.
[88] See http://www.unesco.org/new/en/natural-sciences/priority-areas/gender-and-science/cross-cutting-issues/women-and-local-knowledge/.
[89] See the SCBD contribution. See also the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Work Programme 2014-2018, Deliverable 1(c).
[90] See, for example, Fifth Assessment Report, Intergovernmental Panel on Climate Change, 2014, and UNFCCC Conference of the Parties Decision 1/CP.1.
[91] See, in particular, paras. 19(g), (i) and 36(v) of the Sendai Framework.
[92] See 2030 Agenda, paras. 52 and 79; SAMOA Pathway, para. 80; and OHRLLS contribution.
93 See https://en.unesco.org/links.
[94] ICCAT and NPAFC contributions.
[95] ICES contribution.
[96] EU contribution.

43. While work has advanced with respect to the integration of traditional knowledge in efforts to understand marine ecosystems and sustainably use the oceans and their resources, there are opportunities to build on existing mechanisms, tools and procedures for fostering effective collaboration between these knowledge systems. Inclusive multi-stakeholder dialogues and knowledge exchange platforms at all levels are required, as are efforts towards co-production of knowledge, including training and capacity-building initiatives to facilitate such collaborative efforts between scientists, traditional knowledge holders and policy-makers.

D. Strengthening the science-policy interface

44. Strengthening the science-policy interface to ensure that relevant data is collected, analysed and communicated to policy-makers and ultimately incorporated into policy, is critical for the sustainable development of the oceans and their resources. A number of global, regional and national processes and initiatives contribute to this goal.

45. For example, scientific assessments and syntheses are continuously being prepared to provide policy-makers with up-to-date knowledge on various issues. A notable example is the Regular Process which reviews the state of the marine environment, including socioeconomic aspects, on a continual and systematic basis by providing regular assessments at the global and supraregional levels and an integrated view of environmental, economic and social aspects. The assessments produced in the context of the Regular Process are intended to support informed decision-making and thus contribute to managing human activities in a sustainable manner. In that regard, apart from the second world ocean assessment, another major outcome of the second cycle of the Regular Process (2016-2020), is support provided to other ocean-related intergovernmental processes, including through the technical abstracts of WOA I on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction; the impacts of climate change and related changes in the atmosphere; and the ocean and the sustainable development goals under the 2030 Agenda. WOA I provided the necessary baselines against which trends and gaps can be identified in the context of the second cycle of the Regular Process.

46. Recent other assessments that have or are being undertaken include the upcoming IPCC special report on "The Ocean and Cryosphere in a Changing Climate", a global assessment on biodiversity and ecosystem services, including a chapter on the open ocean, to be released in 2019 by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services,[97] the CBD's scientific syntheses and global biodiversity outlooks,[98] FAO's *State of World Fisheries and Aquaculture* (SOFIA),[99] UNEP's global environmental outlooks,[100] and regional assessments

[97] IPBES/4/19 at https://www.ipbes.net/event/ipbes-4-plenary.
[98] SCBD contribution.
[99] See http://www.fao.org/fishery/sofia/en.
[100] See https://www.unenvironment.org/resources/global-environment-outlook.

of the marine environment by some regional seas programmes and conventions,[101] RFMOs,[102] or in the context of various large marine ecosystems transboundary diagnostic analyses. It will be important to ensure compatibility and synergies between assessments at the global and regional levels and that the assessments support one another. Reports or assessments on the state of the marine environment (or of the environment) at the national level have also been undertaken.[103]

47. Tools and methodologies are also being developed for measurements, evaluations and modelling to facilitate interoperability of data and also assist in the development of regulations or in the implementation of various instruments. For example, IOC has developed a methodology to measure blue carbon storage to assist national efforts and reporting in light of the potential of blue carbon ecosystems as a nature-based solution to be applied in the nationally determined contributions under the Paris Agreement.[104] Under the Coupled Model Intercomparison Project of the World Climate Research Programme, WMO is coordinating the models used by the IPCC and UNFCCC in support of climate model diagnosis, validation, intercomparison, documentation and data access.[105] Scientific advice from GESAMP has been crucial in the development of the amendments to the London Protocol on sequestration of carbon in sub-seabed geological formations and on marine geoengineering.[106] Efforts are currently on-going to implement the global indicator framework for the follow-up and review of the SDGs and their targets, including with respect to methodological development.[107]

48. In some cases, the science-policy interface is strengthened through the institutionalization of scientific committees as a formal part of institutional arrangements,[108] while, in other cases, advice is provided by external partners.[109] For example, the Standing Committee of Research and Statistics under ICCAT provides scientific advice to the Commission.[110] NEAFC receives scientific advice from ICES particularly on fisheries resources management.[111] OSPAR and NEAFC have benefited from ICES advice towards the identification of EBSAs in the North East Atlantic, and in relation to deep sea sharks, rays and chimaeras. IMO has been relying on GESAMP (see para. 47).

[101] See e.g., Regional State of the Coast Report Western Indian Ocean at https://www.unenvironment.org/nairobiconvention/regional-state-coast-report-western-indian-ocean-split and State of the Environment of the Black Sea reports at http://www.blacksea-commission.org/_publications.asp.
[102] NPAFC contribution.
[103]See information provided in the context of the Regular Process at https://www.un.org/regularprocess/content/multi-stakeholders and http://www.un.org/depts/los/global_reporting/2017_NewZealand/Summary_NewZealand.pdf. See also USA, Colombia contributions for other activities.
[104] IOC contribution.
[105] WMO contribution.
[106] IMO contribution.
[107] See https://unstats.un.org/sdgs/indicators/indicators-list/.
[108] ICCAT, NPAFC, SCBD contributions.
[109] NEAFC, ICES and IMO contributions.
[110] ICCAT contribution.
[111] NEAFC contribution.

49. Conferences, workshops, forums and projects have also been used to strengthen the science-policy interface. For example, the informal consultations of States Parties to the United Nations Fish Stocks Agreement in 2018 focused on the topic "Science-policy interface".[112] A Multi-stakeholder Dialogue and Capacity-building Partnership Event ("Multi-stakeholder Dialogue") was held under the auspices of the Regular Process in January 2019[113] to, inter alia, bring various actors together to explore ways to strengthen the science-policy interface (see also Section IV.E) and identified a number of required actions. Other activities highlighted in the contributions include capacity-building activities carried out in the framework of the Sustainable Ocean Initiative (SOI) of the CBD Secretariat to bridge ocean science and policy in support of cross-sectoral conservation and sustainable use of marine and coastal biodiversity.[114] UNCTAD is strengthening the capacity of policy-makers to understand climate change impacts on coastal transport infrastructure, in particular seaports and airports, and take appropriate adaptation response measures.[115] The United Nations Environment Assembly has held science-policy forums,[116] while the European Commission is organizing "science meets policy workshops" and "bridging the gaps conferences".[117]

E. Strengthening the capacity to carry out ocean science

50. Ocean science depends on skilled human resources, technical and institutional infrastructure, financial support and international cooperation, among others. As indicated in the GOSR, human resources that drive ocean science are concentrated in certain countries and vary worldwide by age and gender.[118] Illustrative of the disparity in ocean science expertise among regions and gender is the composition of the Regular Process Pool of Experts.[119] National ocean research policies and scientific advisory mechanisms that could define a pathway to support the development of necessary capacity are mostly missing.[120] Gaps in human and institutional capacity and lack of resources still hamper developing countries from taking full advantage of ocean science.[121] The importance of developing human and institutional capacity related to ocean science cannot therefore be overstated.

51. Contributions to this report emphasize the importance of strengthening capacity to carry out research in the ocean space,[122] benefit from adequate infrastructure and technology to conduct observations,[123] and collect, store, collate and analyse data.[124] The need to strengthen capacities to

[112] ICSP13/UNFSA/INF.2.
[113] https://www.un.org/regularprocess/content/multi-stakeholders.
[114] SCBD contribution.
[115] UNCTAD contribution.
[116] See https://www.unenvironment.org/events/unea/unea-2.
[117] See http://ec.europa.eu/environment/integration/research/interface_en.htm.
[118] Global Ocean Science Report.
[119] See https://www.un.org/regularprocess/content/pool-experts.
[120] IOC contribution.
[121] IOC contribution.
[122] Sri Lanka, IHO, IOC, OHRLLS and UNCTAD contributions.
[123] Contributions of Colombia, USA, ICES, IOC, UNCTAD, and WMO contributions.
[124] IOC and UNCTAD contributions.

assess capabilities in ocean science as well as capacity-building needs is also highlighted.[125] Previous reports of the Secretary-General on oceans and the law of the sea also provide an overview of the needs of States in ocean science capacity and of a number of capacity-building programmes and projects[126] to strengthen that capacity. Such information is also available in the capacity-building inventory under the Regular Process.[127]

52. UNCLOS mandates the development of the marine scientific and technological capacity of States, particularly of developing States. In that regard, the implementation of Part XIV of the Convention is particularly critical, including the establishment of national and regional marine scientific and technological centres. In addition, SDG14.a calls for increasing scientific knowledge, developing research capacities and transferring marine technology, taking into account the IOC Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular SIDS and LDCs.

53. Means for strengthening ocean science capacity include raising public awareness and increasing ocean literacy;[128] holding workshops, seminars and trainings, such as the DOALOS/IOC training programme on the conduct of marine scientific research under UNCLOS;[129] developing or strengthening forums for multi-stakeholder and/or inter- or multi-disciplinary collaboration;[130] sharing data, knowledge and research results;[131] enhancing local emergency action capabilities for integrated multi-hazard warning systems through public education and developing the knowledge, tools, and capabilities to observe the global ocean;[132] and developing manuals, standards, procedures and methodologies.[133] Public-private partnerships also have a role to play in strengthening capacity to conduct and benefit from ocean science.

54. At the Multi-stakeholder Dialogue, an analysis of which capacity-building needs should be prioritized was also identified as an important initial step towards the strengthening of capacity in ocean science, as was the need for enhanced North-South, South-South and triangular cooperation.[134] Scientific priorities may determine the relative proportion of institutions specializing in a field, the share of funding that is invested in ocean science, the number and type of research publications published, and how data is managed and can be accessed.[135]

[125] Azerbaijan, ECLAC, IOC contributions.
[126] See, for example, A/46/722; A/47/512 and A/65/69.
[127] https://www.un.org/regularprocess/content/inventory.
[128] USA, IOC, ISA, OHRLLS, SCBD and UNCTAD contributions.
[129] Colombia, ICES, IHO, IOC, SCBD and WMO contributions.
[130] Colombia, EU, USA, IOC, UNCTAD and UNFCCC contributions.
[131] Colombia, Sri Lanka, ICCAT, IOC, ISA, OHRLLS and WMO contributions.
[132] USA, IOC and WMO contributions.
[133] IHO and UNCTAD contributions.
[134] Conclusions from the Multi-stakeholder dialogue and capacity-building partnership event (at: https://www.un.org/regularprocess/content/multi-stakeholders).
[135] Global Ocean Science Report.

55. The General Assembly has established a Technology Bank to, inter alia, strengthen the science, technology and innovation capacity of LDCs.[136] The IOC Capacity Development Strategy focuses, *inter alia*, on the development of human resources. IOC has also launched an Ocean Literacy framework. Efforts to strengthen the capacity of policy-makers and enhance the science-policy interface are also ongoing in a number of organizations (see Section IV.D).[137] The assessments produced in the context of the Regular Process contribute to strengthening capacity and filling gaps, including at the national level. Efforts are also underway to improve access to, and understanding of, existing data, including through support to global, regional and national data centres for effective and efficient management and exchange of ocean data and to promote open access to those data.[138]

56. However, ocean science relies on sustained funding.[139] Ensuring financial support for ocean science capacity-building, which is an important factor in strengthening the capacity of developing countries to conduct ocean science,[140] including through exploring and encouraging alternative funding models, remains a challenge.[141] During the Multi-stakeholder Dialogue, it was proposed that guidance could be developed on how to carry out capacity-building analyses, including by mapping funding issues and effective use of resources.

F. United Nations Decade of Ocean Science for Sustainable Development

57. The United Nations Decade of Ocean Science for Sustainable Development is a ten-year global framework designed to foster scientific research and bolster technological innovation towards a healthier, more sustainable ocean. It is anticipated that the Decade will address knowledge gaps through integrated research, enable action at all levels, including by catalyzing investments in ocean science and stimulating the research agenda at the national level, and build capacities by, inter alia, improving ocean literacy.[142] Ultimately, the Decade should ensure that ocean science can fully support countries in creating improved conditions for the sustainable development of the ocean.

58. Having proclaimed the Decade, the General Assembly called upon the IOC to prepare an implementation plan, in consultation with Member States, specialized agencies, funds, programmes and bodies of the United Nations, as well as other intergovernmental organizations, non-governmental organizations and relevant stakeholders. UN-Oceans and its participants were invited to collaborate with IOC on the Decade.[143] The implementation plan will be presented to the General Assembly in 2020.

[136] See http://unohrlls.org/technologybank/
[137] ECLAC, IOC, NEAFC, NPAFC, SCBD, UNCTAD, WMO contributions.
[138] IHO, IOC and WMO contributions.
[139] Global Ocean Science Report.
[140] IOC, OHRLLS and UNCTAD contributions.
[141] Sri Lanka, IOC and UNCTAD contributions.
[142] IOC contribution.
[143] A/72/73, paragraphs 292-295.

59. A preparatory phase currently underway aims to: develop and agree a governance arrangement for both the planning phase and the Decade; outline the form and structure for the Decade; engage and consult relevant communities; develop a resource mobilization plan; communicate the purpose and expected results; and draft an implementation plan.[144]

60. In that context, a roadmap including proposals for governance arrangements, as well as a guiding framework to further develop the concept, objectives, outcomes and modalities for the Decade's implementation and engagement strategy was prepared[145] and taken note of by the IOC Executive Council.[146] The roadmap proposes two overarching goals for the Decade, namely, to generate the scientific knowledge and underpinning infrastructure and partnerships needed for sustainable development of the ocean, and to provide ocean science, data and information to inform policies for a well-functioning ocean in support of all SDGs of the 2030 Agenda.

61. The roadmap also identifies six strategic objectives and a number of societal outcomes,[147] It defines a number of research and development priority areas to achieve these outcomes: a comprehensive digital atlas of the ocean; a comprehensive ocean observing system for all major basins; quantitative understanding of ocean ecosystems and their functioning; a data and information portal; an integrated multi-hazard warning system; ocean in earth-system observation, research and prediction, supported by social and human sciences and economic valuation; and capacity-building and accelerated technology transfer, training and education and ocean literacy.[148]

62. The priority research and development areas will be adapted to the scientific priorities identified during regional consultation workshops to be conducted in 2019 and 2020 as part of the preparatory process.[149] Two Global Planning Meetings will also take place during this period, with the first meeting taking place from 13-15 May 2019 to address the status of ocean research in light of the Decade's objectives. It will also provide an opportunity to further develop the research and development priority areas identified above and to address cross-cutting issues, such as capacity development, financing and ocean literacy.

63. A number of contributions to this report refer to current and proposed national, regional and global activities contributing to the goals, objectives and outcomes of the Decade and include suggestions of possible initiatives, ideas, proposals and perspectives for the Decade.[150] These include: identifying gaps in capacity-building in the field of the law of the sea and determining appropriate means of reducing these gaps in developing countries; enhancing collaboration between maritime education institutes of developing and developed countries; encouraging

[144] IOC contribution.
[145] Revised roadmap for the United Nations Decade of Ocean Science for Sustainable Development (IOC/EC-LI/2 ANNEX 3).
[146] Resolution EC-LI.
[147] IOC contribution.
[148] IOC contribution.
[149] IOC contribution.
[150] Colombia, EU, Indonesia and USA contributions.

cooperation between developing and developed countries on the implementation of international commitments; assisting developing countries in the assessment of marine pollution risks and the establishment of management tools for the prevention of marine pollution; and aligning the emerging priorities of the Decade with activities at the national level.[151]

64. The need to address the following aspects was also noted: data, including data access, compatibility and innovative technologies; ocean observation, including seabed mapping and space-based observations; integrated multi-hazard warning systems;[152] underwater noise; Arctic research; sea-level rise and ocean acidification; abandoned, lost or otherwise discarded fishing gear; the land-sea interface; protection of the coastal zones from natural disasters; management of marine resources;[153] fisheries governance;[154] the science-policy interface; enabling environment for governance, innovative financing and capacity-building;[155] The need to mobilize interdisciplinary and transformative actions towards achieving the SDGs was also noted.[156] The need for stronger communication of the Decade at the national level, coordinated by the national commission of UNESCO and relevant bodies, was highlighted.[157]

65. The importance of aligning the Decade not only with the 2030 Agenda, but with a number of other multilateral frameworks and initiatives was also stressed.[158] In that regard, synergies with the Regular Process (see Section IV.D) are notable.[159] The activities to be developed in the framework of the Decade can complement and support the Regular Process. They will provide a coordinated framework for formulating research questions, conducting collaborative research, collecting and disseminating data, and building technical capacity, all of which are essential building blocks for the conduct of robust integrated marine assessments.[160] In turn, the trends that the second world ocean assessment will evaluate and the gaps it will identify could inform the Decade. Another clear pathway for synergies lies in capacity-building, which is crucial for both the Decade and the Regular Process.

66. In their contributions a number of global and regional intergovernmental organizations noted the synergies between their workplans and activities and the priority areas proposed during the Decade.[161] It was noted that the Decade could provide an opportunity to meet the needs of States for scientific evidence and support the implementation of nationally determined

[151] Azerbaijan contribution.[152] USA contribution.
[152] USA contribution.
[153] EU contribution.
[154] ECLAC contribution.
[155] EU contribution.
[156] Indonesia contribution.
[157] Indonesia contribution.
[158] For example, the UNFCCC, the Sendai Framework for Disaster Risk Reduction, the United Nations Convention to Combat Desertification, the Convention on Biological Diversity, the Ramsar Convention on Wetlands and the Addis Ababa Action Agenda on Sustainable Financing.
[159] EU contribution.
[160] IOC/EC-LI/2 Annex 3 Revised Roadmap for the UN Decade of Ocean Science for Sustainable Development
[161] See FAO, IAEA, ICCAT, IMO, NPAFC contributions.

contributions, national adaptation plans, long-term strategies and the global stocktake in the context of UNFCCC.[162]

67. IOC noted that, without additional resources, the secretariat may not be in a position to deliver a Decade implementation plan which fully reflects the needs of all States.[163] To date, three States have made financial contributions to support planning activities for the Decade.[164]

G. Promoting international cooperation and coordination

68. Advancing science to improve knowledge of the ocean requires concerted international cooperation and coordination. In particular, challenges in applying a holistic approach towards understanding and addressing cumulative impacts of anthropogenic pressures require multidisciplinary and transdisciplinary research on oceans and cross-sectoral cooperation.[165] Enhancing such cooperation and coordination will enable all States to engage in ocean research, and ultimately increase scientific output and impact.[166]

69. The integrative nature of the 2030 Agenda, which requires strengthening interdisciplinary cooperation and coordination, provides opportunities to identify critical research priorities through a more coordinated international research agenda.[167] The United Nations Decade of Ocean Science for Sustainable Development will likely assist in that regard. In addition, the Regular Process could play a major role to that end, including by strengthening the science-policy interface.

70. Bilateral and multilateral cooperation, including North-South, South-South and triangular cooperation, are on-going in a number of areas such as seabed mapping, deep-sea exploration, oceanographic observation, ocean innovation, and data cooperation and exchange.[168] Other matters addressed through cooperative initiatives include ocean acidification,[169] ocean and climate change,[170] de-oxygenation,[171] eutrophication and nutrients,[172] marine plastics[173] and the

[162] UNFCCC contribution.
[163] IOC contribution.
[164] IOC contribution.
[165] EU contribution.
[166] Global Ocean Science Report.
[167] *Science for Sustainable Development*, Policy Brief by the Scientific Advisory Board of the Secretary-General of the United Nations, 5 October 2016.
[168] EU and USA contributions.
[169] IAEA and IOC contributions.
[170] UNCTAD and UNFCCC contributions.
[171] IOC contribution.
[172] IOC contribution.
[173] IOC contribution.

conservation and sustainable use of marine biological diversity,[174] as well as oceanographic observation more generally.[175] These cooperative initiatives include GCOS and GOOS.

71. Strategic partnerships, including among international organizations, and between such organizations and their stakeholders, including the scientific community and academia, are also an important interdisciplinary and cross-sectoral collaborative tool.[176] For example, ICES has entered into cooperation agreements with other international organizations which have related objectives, including with FAO and the IOC.[177] IHO has initiated a campaign to crowdsource bathymetry data from the most diverse range of contributors possible in order to store and freely provide all depth data contributed through governmental, commercial, academic and private bodies.[178] IOC is collaborating with Xiamen University to educate and build expertise regarding the issue of deoxygenation.[179] Regional seas organizations and RFMOs are increasingly sharing information, including through such platforms as the SOI Global Dialogue with Regional Seas Organizations and Regional Fisheries Bodies.[180]

72. Scientific collaboration to promote the integrated and cross-sectoral management of human activities that rely on and affect the oceans and seas is supported by various organizations and bodies of the United Nations system, including through inter-agency cooperation. For example, GESAMP serves as a mechanism for coordination and collaboration regarding the provision of scientific advice to the UN system.[181] UN-Oceans, an inter-agency mechanism which presently comprises 28 members and seeks to strengthen and promote coordination and coherence of United Nations system activities on coastal and ocean issues[182] is facilitating contributions from its members to the United Nations Decade of Ocean Science for Sustainable Development and the second cycle of the Regular Process.

73. Scaling up of the interdisciplinary and cross-sectoral cooperative efforts and identifying synergies among existing initiatives could significantly contribute to advancing ocean science while addressing resource constraints.

V. Conclusions

74. Ocean science plays an important and cross-cutting role in achieving the 2030 Agenda: Ocean science encompasses a wide range of disciplines, some of which are at more advanced stages than others, with social sciences presently lagging behind. Ocean science is a critical underpinning to addressing complex global sustainability challenges such as poverty eradication,

[174] SCBD contribution.
[175] IOC contribution.
[176] IOC contribution.
[177] ICES contribution.
[178] IHO contribution. Also see EU contribution.
[179] IOC contribution.
[180] SCBD and NEAFC contributions.
[181] IMO contribution.
[182] See http://www.unoceans.org/.

food security and nutrition, sustainable ocean-based economy, protection and preservation of the marine environment, understanding, predicting and responding to natural events, and climate change mitigation and adaptation. The important and cross-cutting role of ocean science in supporting the achievement of SDG 14 of the 20230 Agenda and each of its interrelated targets is reflected in target 14.a. Ocean science also contributes to the achievement of other SDGs.

75. Gaps and disparities in knowledge remain: While our knowledge of the oceans has improved over the last 50 years, our current understanding of ocean processes is not adequate and is not keeping up with the pace of changes in the oceans. Thus, important gaps remain as outlined in the present report. Advancing ocean science globally and filling gaps in knowledge presents a number of challenges, including insufficient funding and competition for funds, limited human, institutional and technological and infrastructure capacity in some regions, particularly in developing countries, shortage of national policies or regulatory frameworks to promote ocean science, as well as challenges in data acquisition, analysis, management and dissemination.

76. Opportunities exist to advance ocean science and address challenges and related gaps: Opportunities exist to narrow and close various gaps. It is imperative to continue increasing the awareness of the provisions of UNCLOS and its implementing agreements, as well as those of other legal instruments that complement UNCLOS, and to address any challenges in the implementation of the legal framework. It is also critical to further develop technologies and infrastructure and to acquire, process, disseminate and publicize the necessary data in a coherent manner. Further actions to advance ocean science include the adoption and implementation of internationally-accepted standards and best practices for the management and exchange of data and the adoption and implementation of data policies that support open access. Continuing to expand the corpus of available information and knowledge by incorporating other sources, such as the traditional knowledge held by indigenous peoples and local communities, will also be important in order to enrich decision-making. It is paramount to further increase efforts to ensure that science is responsive to the needs of policy-makers and other stakeholders and to strengthen the science-policy interface for informed decisions. In that regard, consideration could be given in the context of the Regular Process to the development of a comprehensive strategy during a third cycle to more effectively reach policy-makers.

77. There is an essential need to build ocean science capacity: It will be important to develop a coherent programme for capacity-building for conducting marine assessments, and particularly integrated assessments. Further awareness-raising and enhancement of ocean literacy worldwide, expansion of training activities as well as other measures to develop the requisite capacities as well as the development and transfer of marine technologies are indispensable. Establishing national reporting mechanisms on ocean science capacity, productivity and performance are necessary first steps for the identification of capacity-building gaps, needs and opportunities.

78. There is an essential need for multidisciplinary and transdisciplinary research and cross-sectoral cooperation: Continuously strengthening multidisciplinary and cross-sectoral multi-stakeholder cooperation and coordination at all levels is essential in addressing capacity and other gaps in ocean science. Existing mechanisms, initiatives and partnerships can be further built upon

in that regard. Assuring adequate and sustainable funding by, inter alia, exploring alternative funding models, including joint ocean science projects and expeditions to reduce the costs of field expeditions, is key for the success of these endeavours.

79. There is a role for the General Assembly in advancing ocean science: As the global body with a comprehensive, cross-sectoral overview of oceans and the law of the sea, the General Assembly has a role in spearheading the required changes. Under its overall oversight and with support from all relevant stakeholders, the United Nations Decade of Ocean Science for Sustainable Development that the Assembly declared for 2021-2030 has the potential to universally foster the necessary momentum and action to significantly advance ocean science for the benefit of the ocean and society, within the framework provided by the Convention.