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Item **3.2** of the Provisional Agenda

REPORT OF THE IOC EXECUTIVE SECRETARY ON THE WORK ACCOMPLISHED SINCE THE THIRTIETH SESSION OF THE ASSEMBLY

Addendum

This Addendum provides a detailed update on the work accomplished over the period June 2020 to May 2021, by IOC functions, and in English only. Period June 2019 to May 2020 was reported to the IOC Executive Council at its 53rd session in documents IOC/EC-53/3.1.Doc(1) and IOC/EC-53/3.1.Doc(1) Part2.

FUNCTION A: OCEAN RESEARCH

Foster ocean research to strengthen knowledge of ocean and coastal processes and human impact upon them

Understanding climate change and its effects on the world ocean

1. In December 2019, the World Climate Research Programme (WCRP) celebrated its 40th anniversary. The Programme underpins the work of the Intergovernmental Panel on Climate Change (IPCC), which in turn supports decision-making by the UN Framework Convention on Climate Change (UNFCCC). IOC brings the oceanographic constituency to WCRP, as the ocean is an integral and central part of the climate system. IOC's co-sponsoring of WCRP, therefore, represents an example of climate change science in action, through a value-chain approach, going from research to decision-making; this is particularly relevant and timely in light of the generally rather alarming findings of the IPCC Special Report on Ocean and the Cryosphere in a Changing Climate. A new strategic plan for WCRP up to 2029 was developed. The three co-sponsors of the Programme—IOC, the World Meteorological Organization and the International Science Council—have discussed new modalities of support by the co-sponsors, which are still being discussed and are to be reflected in the current joint Memorandum of Understanding between the WCRP co-sponsors, which dates 1993.

2. IOC has pursued a very active coordinating work aimed at federating the ocean carbon research community. The many gaps in knowledge on ocean and climate we still face, and the high degree of uncertainty related to our current knowledge, combined with the great sense of urgency to act, have prompted IOC Member States through decision IOC/EC-LI/4.2 to convene the current main players in ocean carbon research and systematic observations under the umbrella of an expert Integrated Ocean Carbon Research (IOC-R) initiative. This initiative federates: the IOC; the International Ocean Carbon Coordinating Project (IOCCP, which also operates as the Biogeochemistry Panel of the Global Ocean Observing System); the Surface Ocean-Lower Atmosphere Study (SOLAS); the Integrated Marine Biosphere Research Project (IMBeR); the Climate and Ocean Variability, Predictability and Change (CLIVAR) core project of the World Climate Research Programme (WCRP); and the Global Carbon Project (GCP). The goal of this initiative is to design an integrated research and observation agenda in the next decade in support of relevant efforts by the UNFCCC and its SBSTA (Subsidiary Body for Scientific and Technological Advice).

3. It is calculated that the world ocean absorbs approximately 26% of total anthropogenic emissions (Friedlingstein et al., 2019).[1] The future behaviour of the world ocean will depend on future emissions, and different scenarios can be formulated, including a reduced buffer capacity (IOC Technical Series 158, 2021). A first meeting of the IOC-R group took place on 28–30 October 2019 at the IOC premises in Paris. The group has worked since towards the production *of Integrated Ocean Carbon Research: A Summary of Ocean Carbon Research, and Vision of Coordinated Ocean Carbon Research and Observations for the Next Decade*, published as IOC Technical Series No. 158. The IOC-R initiative has identified four key questions for science and how these relate to current social and sustainability issues. These questions are: Will the ocean uptake of anthropogenic carbon dioxide (CO_2) continue as primarily an abiotic process? What is the role of biology in the ocean carbon cycle, and how is it changing? What are the exchanges of carbon between the land-ocean-ice continuum and how are they evolving over time? How are humans altering the ocean carbon cycle and resulting feedbacks, including possible purposeful carbon dioxide removal (CDR) from the atmosphere? Related social and sustainability issues identified were: The ocean as a [changing] sink for human-produced CO_2 and its climate change mitigation capacity; The vulnerability of ocean ecosystems to increasing CO_2 levels and our ability and need to adapt to changing ocean conditions.

[1] Friedlingstein, P. et al. 2019. Global Carbon Budget 2019, *Earth Syst. Sci. Data*, *11*(4): 1783–1838, doi:10.5194/bg-14-3685-2017.

4. IOC continues to provide active support to Member States in developing capacity to act towards, and to report on, SDG Indicator 14.3.1, which focuses on ocean acidification (cf. Function D). In its capacity as custodian agency for the indicator, the Commission has successfully developed the SDG indicator methodology in 2018, which was formally endorsed by the IAEG-SDGs, which has since been upgraded to Tier II and is now being considered for upgrading to Tier I. IOC continues to promote the application of the methodology to guide scientists and governments on how to carry out measurements following the best practices established by the ocean acidification community. This introduction to the methodology and associated training courses were achieved through dedicated activities in the Caribbean, the Middle East, East Africa and Asia, and by relying on the expertise and support of the Global Ocean Acidification Observing Network (GOA-ON), which counts more than 800 members from 101 countries, including 19 SIDS and 23 African countries. (Cf. IOC/INF-1402)

5. IOC continued to provide the function of the technical secretariat of the GOA-ON, together with the International Atomic Energy Agency (IAEA). The IOC Secretariat co-organized the "4th GOA-ON International Workshop" in Hangzhou, China, 12–14 April 2019. The Secretariat is actively involved in the organization of the "5th International Symposium on the Ocean in a High-CO2 World", originally scheduled to take place in September 2020. IOC actively supports GOA-ON submission to the call of action for Ocean Decade programmes. The proposed programme, OARS–Ocean Acidification Research for Sustainability, was submitted in January 2021. OARS aims to foster the development of the science of ocean acidification including the impacts on marine life and sustainability of marine ecosystems in estuarine-coastal-open ocean environments. The programme will address the SDG target 14.3 'Minimize and address the impacts of Ocean Acidification (OA), including through enhanced scientific cooperation at all levels'. Key components include: (i) enhancing regional collaborative efforts; (ii) coordination of capacity building in science; (iii) codesign and implement observation and research to address the threat of ocean acidification; and (iv) communication and delivery of the outputs to policy-makers and communities.

6. Capacity development tools developed by IOC include a manual on the 14.3.1 methodology, an Ocean Teacher Global Academy (OTGA) online curriculum on ocean acidification and a dedicated online data portal to assist Member States in their annual reporting on the Target. The data portal, a tool for submission, collection, validation, storage and sharing of ocean acidification data and metadata submitted towards the Sustainable Development Goal 14.3.1 Indicator, has first been used for the global data collection in 2020, with the resulting data products submitted to the UN Indicator Report. In 2021, following a second call to IOC Member States to submit data and information related to progress towards the SDG indicator 14.3.1, 30 countries submitted such data and information, which represented an increase of more than 300 percent compared to 2020. IOC provided contributions to the sections on ocean acidification, deoxygenation and blue carbon to the WMO annual *Statement on the State of the Global Climate* in 2019, and the following 2020 issue, which was presented in its preliminary version to the 25th session of the Conference of the Parties (COP25) of the UNFCCC, as well as to the WMO report on *The Global Climate in 2015–2019*. This work will continue in the context of the IOC *State of the Ocean Report*, which is under development.

7. In addition to continuing to co-sponsor the Blue Carbon Initiative together with Conservation International and IUCN, IOC now co-hosts together with Australia the secretariat for the coordination of the International Partnership for Blue Carbon, IOC co-organized and co-sponsored the International Blue Carbon Initiative (BCI) annual meeting in China in August 2018 and in September 2019 in Denmark. IOC further supported several side events during the UNFCCC COP24 and COP25 highlighting the potential of Blue Carbon Ecosystems as a nature-based solution to be applied in the Nationally Determined Contributions (NDCs) under the paris Agreement to mitigate climate change; blue carbon activities as coordinated by IOC are also of direct relevance to the adaptation work stream of the UNFCCC.

8. IOC continues to co-sponsor GESAMP Working Group 41 on Ocean Interventions for Climate Change Mitigations (formerly Geo-engineering in the Marine Environment), which provides for a continued interagency focus on the challenges and possibilities in marine geo engineering (also

referred to as 'carbon dioxide removal and negative emissions techniques'). A summary of the outputs of the working group was published in *Nature* 570, June 2019, detailing the main messages GESAMP WG report produced in March 2019 and entitled *High Level Review of a Wide Range of Proposed Marine Geoengineering Techniques*. GESAMP WG 41 is reconvening in 2020 with revised Terms of Reference with an enhanced focus on and wider societal implications of different marine geoengineering approaches on the marine environment. This will include the development of a holistic assessment framework that includes social, political, economic, ecological, ethical and other societal dimensions. IOC will facilitate the contribution of GESAMP WG 41 to the work of the United Nations Framework Convention related to 'negative emissions' (carbon removal and other similar techniques) as part of the element on climate mitigation of the Convention's programme of work.

Research on multiple ocean stressors and their effects on the world ocean

9. As reflected in the IPCC *Special Report on Oceans and the Cryosphere in a Changing Climate*, de-oxygenation is an emerging problem exemplifying the effects of climate change-induced ocean warming, and also related to eutrophication along coastal areas. IOC leads scientific and capacity development efforts related to deoxygenation, for the benefit of its Member States, through its Working Group Global Ocean Oxygen Network (GO_2NE). A new series of monthly webinars was launched in November 2020, with more than 200 participants from more than 60 countries attending each session.

10. GO_2NE held a joint workshop with GlobalHAB in June 2019, which focused on the interaction of deoxygenation and harmful algae blooms. This workshop was followed by the "2019 GO_2NE meeting", which focused on the workplan for the upcoming two years, including the organization of the "first GO_2NE Summer School" in September 2019 and the development of the Ocean Oxygen Data Portal. The GO_2NE Summer School, held at the Xiamen University's Xiang'an Campus (China), which hosts the State Key Laboratory of Marine Environmental Science, was attended by 37 students from 19 countries, including participants from Africa.

11. The IOC Secretariat contributed to the production and launching at the UNFCCC COP25 of a major book on ocean deoxygenation coordinated by IUCN. IOC co-organized with IOCCP a scoping meeting to discuss the features of and requirements on an ocean oxygen data portal on 11–12 November 2019 in Sopot, Poland, which saw the participation of more than 20 experts from 11 countries. The result, a scientific paper, ourlining international coordinated effort towards the building of a consistent quality-controlled open-access Global Ocean Oxygen Database and Atlas (GO2DAT) complying with the FAIR principles (Findable, Accessible, Interoperable, and Reusable) is expected to be published in the first semester of 2021. GO2DAT will combine data from the coastal, regional and open ocean, collected by Eulerian and Lagrangian platforms (e.g. ships, moorings, profiling floats, gliders, underway systems), measured by sensors (e.g. optodes, electrodes), and chemical Winkler titration while adopting a community-agreed, fully documented metadata format and consistent quality control (QC) procedure and quality flagging (QF) system. Following the call for international programmes contributing to the success of the Ocean Decade, GO2NE in collaboration with partners submitted the "Global Ocean Oxygen Decade" (GOOD) proposal. The activities and actions planned will raise global awareness about ocean deoxygenation, provide knowledge for action and develop mitigation and adaptation measures through local, regional and global efforts, including intensified monitoring, transdisciplinary research, bi-directional knowledge transfer among stakeholders and scientists, innovative outreach and ocean education and literacy. The high-level objective of the Decade Programme is to provide data, knowledge and best practices to enable society, stakeholders, and scientists to co-design and develop measures that can mitigate the drivers and impacts of ocean deoxygenation and provide appropriate adaptation measures where mitigation is not possible. It is envisaged that GOOD will be implemented through several projects carried out by different consortia in different regions of the world ocean.

12. The IOC Working Group on Climate Change and Global Trends of Phytoplanton in the Ocean (TrendsPO) continued the systematic compilation of phytoplankton time-series (data sets), related

analyses, and a synthesis of the findings through a drafting workshop held in early 2020 and hosted by CSIRO, Australia. This work also informs modelling efforts under the WCRP.

13. The IOC Executive Council at its 51st session agreed to establish a new IOC working group focusing on multiple stressors. A draft scientific summary for policy-makers introducing the issue of multiple stressors on marine ecosystems—working title: *Ocean under Stress: A changing ocean at all locations*—was presented at the 30th Session of the IOC Assembly in June 2019 (IOC-XXX/3). In light of the COVID-19 pandemic, the first meeting of the IOC Working Group on Multiple Ocean Stressors took place on-line and refined further the Scientific Summary for Policy-makers. The impacts of the COVID pandemic are considerable for this working group, building a new working group, hosting the first meeting online instead of face to face slowed down the drafting process. The scientific summary for policy-makers is foreseen for publication mid-2021. The Working Group will in its work assess and define experimental challenges related to multiple drivers experiments; identify links between physiological responses and ecosystem impacts; identify ecosystem-level reference points related to multiple stressors; develop indicators for systematic observations on multiple stressors; communicate arguments for the integration of the multi-stressor approach in ocean models and predictions; and, finally, identify management requirements in relation to multi-stressor research. Elucidating further these issues will be fundamental to inform Ecosystem Based Management and dedicated research actions within the framework of the UN Decade of Ocean Science for Sustainable Development. The Working Group will re-convene on-line 2nd and 4th quarter 2021.

14. The inherent variability in Eastern Boundary Upwelling Systems (EBUS) poses large challenges in projecting their responses to climate change and other ocean stressors. This has a direct impact on food security, livelihood systems of local populations, and economies. Human-induced impacts add a layer of complexity to the systems. The IOC has collaborated with the Spanish institute of Oceanography on a project proposal supported by the Spanish Agency for International Cooperation development (AECID) to add a focus on alien species and other ocean stressors to the knowledge base on the Canary Current system buit over three previous projects supported by AECID between 2016 and present, , with a view to contributing further to science-based management of the Canary Current Large Marine Ecosystem.

The Second International Indian Ocean Expedition

15. The Second International Indian Ocean Expedition began its second 5-year phase (to 2025), as agreed by its three co-sponsors in 2019 (IOC-UNESCO, Scientific Committee on Oceanic Research and Indian Ocean Global Ocean Observing System). Its expanding activity and range of endorsed projects is contributing strongly to the IIOE-2 mission, aligning with both the IIOE-2's Science Plan and Implementation Strategy. The breadth and depth of high-quality science produced continues to significantly increase. It also continues to align with the mutual objectives of IIOE-2's three co-sponsors. See the updated (March 2020) *Second International Indian Ocean Expedition (2015-2025)* (IOC/BRO/2019/6Rev.) for reference. As has been customary since the IIOE-2's inception in 2015, it worked in integration with a number of other Indian Ocean science alliances across both the oceanic and climate research sphere, including: Indian Ocean Global Ocean Observing System (a GOOS Regional Alliance); Indian Ocean Region Panel of CLIVAR/IOC-GOOS; Sustained Indian Ocean Biogeochemistry and Ecosystem Research of IOGOOS/IMBeR; Indian Ocean Observing System Resources Forum of IOGOOS; and IOC Regional Committee for the Central Indian Ocean. Together, they have developed *IndOOS-2:* A roadmap to sustained observations of the Indian Ocean for 2020-2030 (IOC/INF-1384).The IOC through its Perth Programme Office continued to play a major facilitating and coordinating role for IIOE-2, including through its hosting of the IOC IIOE-2 Coordinator and Australian Node of the IIOE-2 Joint Project Office (the other Node being based in Hyderabad, India, and supported by the Indian Government's Ministry of Earth Sciences). The IIOE-2 has engaged in various Indian Ocean related Ocean Decade planning meetings, aiming to ensure that the IIOE-2 is well positioned to make a tangible contribution to the Decade's implementation. The next annual major IIOE-2 Steering Committee meeting (generally comprising up to 100 participants) has been postponed due to the COVID-19 situation,

and will remain in planning to be held back to back with the major International Indian Ocean Science Conference 2020, also postponed after having been slated for March 2020, Goa, India. (Cf. IOC/INF-1351)

Key challenges encountered in implementation and remedial actions taken
Communicating ocean science

16. Communicating the findings of ocean science and how ocean science is conducted in various regions of the world may be difficult. However, communicating is becoming increasingly important for various reasons, including enlarging the constituency, create consensus, and engage with new actors, as well as raising awareness and increase understanding of the issues at stake. More importantly, there is a need to illustrate the contribution of ocean science to tackling societal problems, its role in promoting sustainability and in the implementation of the full suite of the SDGs. Therefore, ocean science communication initiatives have to be designed in a way that stakeholders fully understand that advancements in marine scientific knowledge have brought, and will continue to bring, many benefits to people and the planet. These include understanding global environmental change; assessing effects of anthropogenic activities; understanding the structure and function of ocean ecosystems; support the enhancement of the science-society-policy interface; and the development of technologies that enable humans to connect with and benefit from the ocean. To this end, the IOC Secretariat organized an Ocean Science Day, which was held on the margins of the 30th session of the IOC Assembly, in the morning of 27 June 2019. The half-day event was designed to be an informal exchange among ocean scientists, country representatives, engaged citizens and representatives from international organizations and the private sector, and offered an opportunity to discuss the contribution of ocean science to society in the Ocean Decade. The event was open to the general public, beyond delegations of IOC Member States. Two panels focusing on the science aspect of the UN Decade of Ocean Science for Sustainable Development were organized: “Science Imperatives for the upcoming Ocean Decade” and “Science for Society”. Member States and the general public attending Ocean Science Day appreciated, in particular, the opportunity to benefit from pedagogical presentations of complex issues related to ocean processes and the effects of human activities on these.

Structural limitations and solutions

17. Several Member States continue suffering from structural lack of capacities in research and systematic observations that hamper their application of standard operating procedures, as well as access to data. This challenge continues to be addressed by linking the activities contributing to Function A with those of Function E, as far as efforts related to training and the transfer of knowledge and technology among Member States, through proactive provision of technical assistance by IOC. However, some Member States appear to face lingering structural challenges related to infrastructural and human capacity in the area of ocean science. In turn, the Ocean Science Section encounters challenges in implementing the ocean science portfolio of IOC at a level that would assist Member States in overcoming such limitations (Cf. IOC/INF-1404). This situation requires adequate, much more ambitious and sustained, funding from Member States to expand further the scale of the multiple ocean science actions pursued by the Commission. The COVID-19 pandemic has hampered the convening of a number of expert meetings and capacity development activities in presential. While it is mostly the latter that have suffered from this situation, it has been generally possible to hold the former online, although this would not be sustainable in the future.

FUNCTION B: OBSERVING SYSTEM/DATA MANAGEMENT
Maintain, strengthen and integrate global ocean observing, data and information systems

18. The Global Ocean Observing System (GOOS) is brought to life as a system by a Core Team of the Steering Committee, panels, coordination groups, networks, and teams. They coordinate the sustained ocean observing system made up of national and network contributions.

19. The GOOS Core Team is supported by a distributed Office, with core coordination at and supported by IOC-UNESCO, and distributed and collective contributions to support staff from WMO, SCOR, the USA, the European Commission, Australia, Canada, China, France, Germany, India, Italy, Japan, Monaco and South Africa.

Ocean observing implementation and COVID-19

20. The GOOS Core Team's work assessing, anticipating, and responding to the COVID-19 pandemic's impact on global ocean observations through restrictions on movement was a major focus. The results of a survey of the impacts of COVID-19 on deployment and implementation of ocean observing networks are detailed in a GOOS briefing note available at goosocean.org/covid-19, and this work was had good media traction with a number of stories in the popular press. Coordination through GOOS observing networks, with OceanOPS, and through the Observations Coordination Group, supported by extraordinary cooperative efforts at the implementers' level, managed to mitigate the impacts through 2020 and into 2021, but there are now gaps in the observational record.

21. Work to mitigate the impact has become an important new stream of work of the GOOS Observations Coordination Group focused on resilience of the observing system, and has resulted a promising new informal partnership with the International Research Ship Operators (IRSO) group. The IOC partnership with IMOCA saw Vendée Globe deploy instruments and make measurements in the remote Southern Ocean, also contributing to observing gaps and creating opportunities to speak about GOOS to a wide audience.

Sustaining, strengthening, and expanding implementation of GOOS

22. The ocean observing network technical coordination and metadata centre under the governance of the GOOS Observations Coordination Group rebranded from JCOMMOPS to OceanOPS. The OceanOPS 5-year Strategic Plan was published (GOOS Reports, 250), and identifies a vision to be the international hub and center of excellence that provides vital services in monitoring, coordinating, and integrating data and metadata, across an expanding network of global oceanographic and marine meteorological observing communities; and a mission to monitor and report on the status of the global ocean observing system and networks, to use its central role to support efficient observing system operations, to ensure the transmission and timely exchange of high quality metadata, and to assist free and unrestricted data delivery to users across, operational services, climate and ocean health. The plan will be an important basis for making strategic decisions and fundraising for the purely extrabudgetary activity, which provides an important infrastructure for GOOS. A new Technical Coordinator post for Biogeochemical-Argo and regional coordination was established with support from Monaco, in a distributed OceanOPS team, and WMO created a regular-funded position to head OceanOPS which is expected to be filled in the second half of 2021.

Strengthening knowledge and exchange around services to boost local uptake

23. Since the disbandment of JCOMM, its Expert Team on Operational Ocean Forecasting Systems is working under GOOS. They have focused on the development of a Guide to bring together information about the ocean monitoring forecasting products and the systems that produce these products, and the development of two training courses open to IOC Member States' experts in June 2021.

GOOS at the heart of the Ocean Decade

24. In response to the Call for Decade Actions, the GOOS Core Team spearheaded the development with partners of three related programme proposals. Together, they place the transformation and co-design of observations and predictions as the foundation of much of the exciting work the Ocean Decade will carry out, and essential to help give us the ocean we need for the future we want.

25. The proposed **Ocean Observing Co-Design Programme** by GOOS will create a system co-designed with observing, modelling and key user stakeholders that will evolve ocean observing. It responds to the challenge that much of the current ocean observing system has been built focusing on scientific and technical capability and attempting to join programmes together. Rather than setting priorities based on what will give the most benefit for cost, scientists have been encouraged to compete with each other. Ocean Observing Co-Design will develop a well-designed, user-focused and driven co-design process to create a truly integrated, agile system. The programme will work with existing and new observing networks, and integrate closely with the modelling community across assessment, assimilation and prediction. It will build the process, infrastructure and tools for ocean observing co-design necessary to support the Ocean Decade.

26. The proposed **CoastPredict Programme** with GOOS will redefine the science of observing and predicting the Global Coastal Ocean to help the Ocean Decade succeed in its aims. It responds to the challenge that reducing risks and improving lives requires us to understand the coastal natural system as well as respond to ways in which climate change is affecting coastal populations. With increasing coastal urbanization, cities and megacities, there is greater need for advanced monitoring and predictions of extreme events such as flooding as well as pollution, habitat health and other hazards. CoastPredict is a co-designed transformative response to science and societal needs. It is the result of significant input from young scientists, GOOS and global bodies active in international data modelling and best practice systems. The Global Coastal Ocean concept at the center of CoastPredict considers all coastal ocean regions as an interface area. Atmosphere, land, ice, hydrology, coastal ecosystems, open ocean and humans interact on a multiplicity of space and time scales that need to be resolved with proper scientific methods and consideration of uncertainties. A coastal focus will engage island nations and indigenous or local people, inspire early career ocean professionals and be embraced by the general public.

27. The proposed ***Observing Together Programme*** by GOOS will transform ocean data access and availability by connecting ocean observers and the communities they serve through enhanced support to both new and existing community-scale projects. It responds to the challenge that today, many communities around the world are unable to access ocean data in a way that is truly useful and enables them to make informed decisions. They often struggle to see the value of investing in ocean observation. *Observing Together* will leverage the Global Ocean Observing System's network of expertise to bring needed observations and forecasts to community users and into global data streams, making every observation count. For example, in the Pacific Island countries and territories 90% of Pacific Islanders live within 10 km of the coast and most economic activities rely upon the ocean - from commercial and sustenance fishing to surfing and dive tourism. Accurate ocean information and forecasts are critical for planning, safety at sea, and disaster mitigation along the coast but oceanographic and marine forecasting expertise in the region is extremely limited. Here, the work of the programme, carried out in partnership, will include identifying ocean information user priorities, deploying new in situ ocean observing equipment and developing and delivering tools and training. When community users become aware of the real value of ocean observing and the data it produces to their lives, support for ocean science will grow.

28. Two of the proposed programmes, *Ocean Observing Co-Design and Observing Together,* are IOC contributions to the Ocean Decade. *CoastPredict* was reviewed by the first meeting of the interim Decade Advisory Board (IOC/2021/ODS/21) and asked for minor revisions before reconsideration for endorsement.

29. These three programmes designed around a theme of increasing integration for GOOS will be a central part of a larger community of practice of ocean observing and prediction programmes and projects in the Ocean Decade. Some of these will spearhead innovation and transformation of biological and ecological ocean observations, the development of ocean forecasting systems, and observing network-based improvements, all aimed to underpin the information used for disaster risk reduction and sustainable development and responding to the Ocean Decade challenge.

Tenth meeting of the GOOS Steering Committee: committed to change

30. The Tenth meeting of the GOOS Steering Committee was held online 26–29 April 2021.

31. Supported by its 2030 Strategy, an Implementation Plan that looks across the Core Team elements, and a stakeholder survey of the support structures to global and regional sustained ocean observing, the Steering Committee is committed to change. It will initiate a three-pronged approach to improving governance and support structures: designing a change process with stakeholders, critically assessing its internal architecture to be more fit for purpose and aligned with key functions, and asking its co-sponsors to design individual or joint ways of examining and evolving their GOOS governance that will be inclusive of additional stakeholders and open to recommendations.

32. The Steering Committee will focus on regional support to GOOS—critically looking at GOOS Regional Alliances, GOOS Projects with a regional scope, and their connection to both global networks and national sustained ocean observing activity—with principles of subsidiarity and resonance to identify the best scales of activity to effect change and support stakeholders, which will include regional ocean management structures.

33. Finally, GOOS will work to improve the understanding and use of Essential Ocean Variables (EOVs) as strategic assets of GOOS. Goals will include better understanding and response to how EOVs and Essential Climate Variables are used, make them more useful for reviewing the status of the observing system development and gaps, and how reviews of the observing system can be oriented.

The SC also reviewed the GOOS Implementation Plan that for the first time assembled actions across the GOOS Core Team, providing visibility towards implementation of the Global Ocean Observing System 2030 Strategy, enabled priority setting and identification of gaps, promoted the creation of cohesive cross-GOOS actions, and identified resource needs and partnerships. An executive summary of this GOOS Implementation Plan is being submitted to the IOC 31st Assembly for approval, highlighting priorities, expected outcomes, and resource gaps.

GOOS and its co-sponsor WMO

34. With the disbandment of JCOMM, two key pieces now come under the governance of the GOOS Steering Committee: the Observations Coordination Group, its networks and OceanOPS; and the Expert Team on Operational Ocean Forecasting Systems. GOOS and IODE representatives are participating in the WMO Study Group on Ocean Observations and Infrastructure Systems to define functional connections to new WMO Standing Committees and teams, as well as the Joint WMO-IOC-ISC-UNEP Study Group on the Global Climate Observing System (JSG-GCOS), which will consider the governance and structure for the Global Climate Observing System (GCOS) and make recommendations for adoption by its co-sponsors.

35. GOOS also participated in the WMO Data Conference (16–19 November 2020) and that led to a proposal from the WMO Infrastructure Commission for a WMO Unified Policy for the International Exchange of Earth System Data. For oceans, this covers in situ and remotely sensed observational data both in and above the ocean and at the sea-surface, from the open ocean to the coast, along with other data that provide necessary input to ocean monitoring and prediction and for a variety of other Earth system applications. It acknowledges the right of governments, based on their national laws and policies, to choose the manner by, and the extent to which, they make data available domestically or for international exchange – so does not override national data policies. Amongst what it defines as core data (shall be exchanged on a free and unrestricted basis) it includes “All […] physical GOOS Essential Ocean Variables […] collected as part of a GOOS observational network, programme or project consistent with the IOC Oceanographic Data Exchange Policy.” It defines as recommended data (should be exchanged) “physical […] EOVs that have been collected outside of designated GOOS activities,” and “all other observed biogeochemical and biological/ ecosystems […] GOOS EOVs [and] observations of pH, chlorophyll-A, suspended particles and downwelling

irradiance which are fundamental to address significant scientific and societal ocean/climate-related issues." The resolution will be considered by the World Meteorological Congress extraordinary session in October 2021.

Data management

36. It is noted that the Twenty-sixth Session of the IODE Committee could not take place in Sopot, Poland between 22–26 February 2021 due to the COVID-19 pandemic. It was decided to organize IODE-XXVI as an online event between 20–23 April 2021. As this document was due by end of March 2021 it excludes information on the Session.

37. No additional NODCs, ADUs or AIUs have been established by Member States during the reporting period. As for previous IODE Sessions since 2007, national reports were collected (online). Whereas the reporting on the survey in previous years included only summary tables, the Secretariat decided to provide detailed reporting by data centres for the 2019-2020 survey. The report is available through a dedicated web site on https://surveys.iode.org/2019-2020-nodc-and-adu/.

38. IODE is continuing and further developing its collaboration with, and support to, other IOC programmes and activities, including the GOSR, HAB, and SDG Indicator 14.3.1[1]; as well as more broadly the implementation of the IOC Capacity Development Strategy through its OceanTeacher Global Academy (OTGA) project in which all IOC programmes have been invited to participate as from April 2020 when Phase II of OTGA started (see also below and under Function F).

39. As a follow-up to the "Workshop on data sharing between UN agencies as a contribution to the UN Decade of Ocean Science for Sustainable Development" held on 20 April 2020, the "International data sharing workshop for non-UN IGOs, Global and Regional organisations and projects, NGOs and private sector" was held as an online event on 12 October 2020. It was attended by 84 participants. The main objective of the two events was to share information on ocean-related data products and services, to inform participants on the planned IOC Ocean Data and Information System (ODIS) and on the UN Ocean Decade.

40. The **IOC Ocean Best Practices System** (OBPS) project, established by Decision IOC-XXX/7.2.1, coordinates high level issues related to best practices by supporting the creation, publishing, discovery and access (FAIR Principles) to ocean related methods, best practices and standards. It includes the permanent repository with advanced search technology, hosted by IODE; a peer review journal on ocean best practices matters in *Frontiers in Marine Science;* support for training and capacity development in collaboration with the OceanTeacher Global Academy and other training organizations; and an outreach and engagement programme with user/creator communities. (http://www.oceanbestpractices.org). By March 2021, 1241 methodology deposits had been made into the repository and inclusivity has become a heightened mandate. A policy decision for the repository to include documentation in a foreign language (with good English abstract) is already seeing regional and indigenous community deposits; and the Steering Group has been expanded to include two Early Career Ocean Professionals (ECOP), who are chairing a new OBPS Task Team on ***Diversity, Equity, and Inclusivity in Ocean Best Practices Development*****.** The Ocean Decade call in 2020 encouraged the completion of the OBPS Strategic and Implementation Plan 2021 which underpins the OBPS Decade Programme Application submitted in January 2021. OBPS Workshop IV was held in September 2020 with some 450 active participants, with eleven Working Groups from across ocean disciplines focussing on their specific best practices and OBPS needs. More powerful search, multi-language support and multicultural engagement were some of their top recommendations, much of which are addressed in the repository upgrade and enhancements implemented as from April 2021. New areas such as pilot demonstrations of decision trees were also suggested. The outcomes from Workshop IV and from other workshops and events inform the future direction and OBPS recognizes the importance of getting continuing inputs from the community – for the repository, the training, and the outreach and collaboration.

41. Between May 2020 and March 2021, 11 million presence records were added to the **Ocean Biodiversity Information System (OBIS)** (https://www.obis.org) from 768 new datasets, providing 22,810 new marine species to OBIS. In total, OBIS now has 70 million occurrences of 154,307 species from 3,869 datasets. OBIS' priorities are improving its data quality with more advanced data quality control tools and QC reports to data providers. A registry of recommended vocabulary terms used for measurements and sampling facts is under development in collaboration with the British Oceanographic Data Centre. In addition, OBIS is developing data integration workflows for DNA-sequence derived species occurrence records, in collaboration with the Biodiversity Information Standards (TDWG), the Genomic Standards Consortium (GSC) and the Global Biodiversity Information Facility (GBIF), with whom we signed a new five year collaboration agreement.

42. Agreeing on these practices for molecular biodiversity data is also essential for managing the data resulting from the **Pacific Islands Marine Bioinvasions Alert Network** (PacMAN) (https://pacman.obis.org/) project. PacMAN is a new 3-year project led by OBIS and funded by the Flanders/UNESCO Trust Fund for the Support of UNESCO's Activities in the Field of Science (FUST) and aims to build a national early-detection/early-warning monitoring system of marine invasive species in Fiji, in close collaboration with the University of the South Pacific (USP) and local (government) stakeholders. An Implementation Partnership Agreement between IOC and USP has been signed, and USP will assist us with the local implementation of the project. A national monitoring plan is in preparation, and the first sampling campaigns should start mid-2021.

43. The **World Ocean Database** (http://wod.iode.org/) was first released in 1994 and updates have been released approximately every four years. The World Ocean Database (WOD) is the world's largest collection of vertical profile data of ocean characteristics available internationally without restriction.The WOD has been available in Amazon Web Services (AWS) through the NOAA Big Data Program (BDP) since August, 2020 at https://registry.opendata.aws/noaa-wod/ which is an important milestone for WOD. The data will remain freely available through AWS and the BDP. OTGA hosted the World Ocean Database (online) workshop in January 2021.

44. The **ODIS Catalogue of Sources** (ODISCat) (http://catalogue.odis.org), an online browsable and searchable catalogue of existing ocean related web-based sources/systems of data and information as well as products and services, was further expanded to include (as on 19 March 2021) 2042 descriptions of on-line content sources covering 16 content types. ODISCat will support the Ocean InfoHub and Ocean Data and Information System (ODIS) projects as a planning and engagement tool, helping to identify potential areas of collaboration within these projects.

45. As invited by IOC-XXX (Decision IOC-XXX/7.2.2: **Ocean Data and Information System** [ODIS]) the fully detailed and costed project proposal for the ODIS has been prepared for submission to IODE-XXVI and IOC-XXXI. The proposal defines the major components of the ODIS digital ecosystem, and clarifies the roles of the ODISCat catalogue of sources, Ocean InfoHub, and Partnership Centre for ODIS within the higher-level ODIS project, and provides a budget forecast to the end 2025. The IOC Ocean Data and Information System (ODIS) will be an e-environment where users can discover data, data products, data services, information, information products and services provided by Member States, projects and other partners associated with IOC. While ODIS will initially focus on "partners associated with IOC" this can be expanded, taking into account the partnership established under the UN Decade of Ocean Science for Sustainable Development. As such it will become a key contribution to the data chapter of the Ocean Decade implementation plan.

46. The Ocean InfoHub (OIH) Project (https://oceaninfohub.org/) is a three-year project, funded by the Government of Flanders, Kingdom of Belgium.The aim of the project is to support the initial development of the Ocean Data and Information System (ODIS) architecture, as well as develop communities of practice (information systems and their end users) in three pilot regions: Africa; the Latin America and Caribbean region; and the Pacific Island Developing states. Thus, it aims to improve access to global oceans information, data and knowledge products for management and sustainable development. The project will not be establishing a new database, but will be supporting discovery and interoperability of existing information systems. The OIH Project commenced in April

2020 with the recruitment of a project manager and a number of national and regional stakeholder consultations. Since June 2020, three regional communities of practice (Africa, LAC and PSIDs) have been established, a virtual Steering Group meeting was held over two sessions, and a Chair of the Steering Group was elected in an online voting process.

47. An expert technical working group has been expanded from 20 to over 60 technical experts (led by a chair and co-chair) with working platforms on Slack and Github. Consensus was achieved by this group on a way forward for the development of the ODIS-architecture, and this is now in development by a subcontractor, guided by a detailed Terms of Reference based on the consensus achieved by technical advisors. Planning is well underway for the training component of the project, to be implemented jointly with the OTGA, commencing in 2021. Several newsletter articles have been written, numerous presentations have been given at (virtual) international forums, conferences and meetings, and a website has been developed for the project. In total, the project has either convened, or been represented at over a hundred planning and consultative meetings.

48. The **OceanTeacher Global Academy** (OTGA) (https://www.oceanteacher.org) entered its second phase in April 2020. A call for hosting training centres (IOC Circular Letter 2795) had an initial deadline on 3rd April and was extended to 1st June 2020 given the pandemic. All applications were assessed by the relevant IOC Programmes and experts resulting in a total of 16 Regional and/or Specialized Training Centres being selected. These Centres are in South America, Africa, Europe, Asia and the Pacific. The OTGA global network of Regional and Specialised Training Centres is delivering training contributing to the sustainable management of the ocean comprising ocean sciences, services and marine data management (including marine biodiversity data and ocean best practices) relevant to the IOC Programmes and Regions. OTGA is contributing to the UN Decade of Ocean Science for Sustainable Development through the implementation of capacity development through the transfer of marine technology, ocean literacy, education and training. OTGA is also contributing to the UN Sustainable Development Goals to build the scientific and institutional capacity needed to achieve the SDGs.

49. OTGA continues to adapt to the current conditions. Through the use of the OceanTeacher e-Learning Platform, the project has successfully delivered 17 training courses for the period June 2020 to May 2021, all of which have been fully online. The first meeting of the Steering Group for OTGA was held online in October 2020 to approve the work plan for 2021, including proposed courses and sharing of work package tasks.

The 2nd International Indian Ocean Expedition (IIOE-2)

50. The extension of IIOE-2's tenure (to at least 2025) via its Steering Committee decision of 2019 was subsequently endorsed by all three of IIOE-2's principal sponsors (IOC-UNESCO, Scientific Committee on Oceanic Research [SCOR] and Indian Ocean Global Ocean Observing System Regional Alliance [IOGOOS]). The IIOE-2 continued to enhance its metrics in terms of scientific understanding of key processes in the Indian Ocean. Major multi-disciplinary and multi-national ocean expeditions have been undertaken and many high-quality scientific papers (>100) and dedicated journal volumes (~5) have already been produced across ocean, climate, and biogeochemical/ecosystem sciences. Capacity Development of projects aligned with IIOE-2 (e.g. SOLSTICE of UK/South Africa) have enabled opportunities for emerging scientists, including from less developed scientific communities of the Indian Ocean.

51. IIOE-2 was submitted for consideration and Ocean Decade Action.

52. The IIOE-2 continued to be strongly supported with its complementary and integrating science alliances: Indian Ocean Global Ocean Observing System Regional Alliance (IOGOOS); Sustained Indian Ocean Biogeochemistry and Ecosystem Research of IMBER/IOC-GOOS (SIBER); Indian Ocean Observing System (IndOOS) Resources Forum (IRF) and associated Indian Ocean Region Panel of CLIVAR/IOC-GOOS (IORP). The IndOOS community, led by IORP in conjunction with SIBER finalised and published its profoundly important seminal Decadal Review of IndOOS –

resulting in the revised framework known as IndOOS-2 for the 2021–2030 period. These communities were engaged directly or implicitly in IOCINDIO relatedmeetings.

53. All the aforementioned complementary alliances overcame the COVID-19 challenges to normal operating modalities by regularly meeting and producing tangible science outputs and solid positive plans for the post COVID-19 era. Most have met (virtually) at least twice and some three times in the past 2 years, a rate that has been in fact greater than in the past.

Perth Programme Office (PPO)

54. The IOC Perth Programme Office's sponsorship underpinning was maintained by its three sponsors (IOC-UNESCO, Australian Government (through Bureau of Meteorology) and Western Australian Government). This enabled the Office to, in turn, maintain its function as the Australian Node of the Joint Project Office of IIOE-2 (partnering with the Indian Node in Hyderabad), providing the IOC IIOE-2 Coordinator and also the secretariat function of the IRF (including providing the IRF Convener role). IOC PPO worked closely with the re-energised membership framework of IRF, ably led by new Chair Dr Sidney Thurston of NOAA USA.

55. With regard to the renewal of the PPO co-sponsorship, the Government of Western Australia re-affirmed its continued support of IOC's programmatic objectives but with financial contribution contingent on a more close alignment with WA Government's scientific needs and priorities and the wish to place the lead officer position in a WA institution. The modalities of such a re-framing is being considered through tripartite (Australian Bureau of Meteorology, WA Government and IOC) sponsor consultations. The possibility for the re-framed partnership to support the Ocean Decade as a Decade Collaborative Centre is one of the options discussed. (Cf. IOC/INF-1351)

Key Challenges Encountered in Implementation and Remedial Action Taken

56. Regarding GOOS, out of 14.5 full-time equivalent staff working in the distributed GOOS Office, only 4 are supported on IOC-UNESCO or WMO regular programme positions. WMO is in the process of recruiting a fifth, a manager for the OceanOPS centre. The ambition of the GOOS Implementation Plan would require a more than doubling on a three-year time scale of the staff support. This puts emphasis on prioritization and fundraising.

57. Regarding IODE, out of the 12 staff currently working for IODE (7 at the IOC Project Office for IODE in Ostend, Belgium) only two are employed on UNESCO regular programme positions, three FTEs are seconded by the Flanders Marine Institute (funded by the Government of Flanders, Kingdom of Belgium) and seven are project appointments, consultants or other contractual arrangement of limited duration. Support for IOC website maintenance had to be terminated as of January 2021 as this service was slowing down IODE operations. The current level of staffing has remained insufficient and a more solid foundation remains essential to maintain not only IODE's core business buit also continue and expand its cross-cutting role across all IOC programmes as well as the emerging data related activities within the Decade.

58. In order for OBIS to respond to the growing demand in providing user support and to deliver key products and services (e.g. support to the CBD and global assessments under IPBES and UN Regular Process) as well as to cover the day-to-day management and maintenance of the infrastructure a full-time data manager is urgently needed. In addition, to further develop and maintain the other IOC data portals and websites (e.g. GOSR, OA, HAB…), IODE will need an additional full-time software engineer.

59. Since March 2020, the COVID-19 has resulted in all staff at the IOC Project Office for IODE (except IT manager) to telecommute. Thanks to the high commitment by the staff this has not resulted in adverse effects on programme implementation but it has increased workload of staff due to the increase of online meetings at often family-unfriendly hours. Similar impacts haves been reported by IODE data centres in Member States.

FUNCTION C: EARLY WARNING AND SERVICES

Develop early warning systems and preparedness to mitigate the risks of tsunamis and ocean-related hazards

60. Function C centres around four main programmatic components: (i) the global Tsunami Warning System; (ii) the Global Sea Level Observing System (GLOSS); (iii) Operational Ocean Forecast Systems services under JCOMM[2]; and (iv) the Harmful Algal Bloom programme.

Tsunami Warning Systems

61. The main elements of the Tsunami Programme focus on: (i) secretariat support to the four Intergovernmental Coordination Groups (ICGs) and respective technical working groups and task teams under the four regional Tsunami Warning and Mitigation Systems in the Caribbean (CARIBE-EWS), Indian Ocean (IOTWMS), Pacific (PTWS) and North-Eastern Atlantic, Mediterranean and Connected Seas (NEAMTWS) as well as the Working Group on Tsunamis and Other Hazards related to Sea-Level Warning and Mitigation Systems (TOWS-WG) which address inter-ICG and cross-cutting coordination and harmonization; (ii) preparedness and awareness courses and workshops; and (iii) enabling research and policy development.

62. Global harmonization is facilitated through the Working Group on Tsunamis and Other Hazards related to Sea-Level Warning and Mitigation Systems (TOWS-WG). The14th meeting of the TOWS-WG was held online in February 2021 (Cf. IOC/TOWS-WG-XIV/3).

63. Governance meetings and technical working group meetings set the strategic directions and facilitate the ongoing development, guidance and harmonization of the four regional tsunami warnings systems. Support for the intergovernmental coordination of regionally harmonized tsunami warning systems was provided. The full list of meetings is available from the calendar for the IOC Tsunami Unit.

64. In the IOTWMS XII online session was organized including the Steering Group (1), WG-1 (2), WG-2 (2), Subregional Working Group for the North West Indian Ocean (1), IOWave20 Task Team (3), and Stakeholder/Expert Consultations for the UNESCAP Project (13) in March 2019 (Cf. ICG/IOTWMS-XII/3)

65. In NEAMTWS region online WGs and TTs (1) meeting was organized in November 2020 (62 participants).

66. ICG/CARIBE-EWS-XV was convened as an online meeting on 27–29 April 2021 and 6 additional online sessions were convened in 2020-2021: ICG/CARIBE-EWS Officers' Meetings (2), an Information Session (1), Working Groups (2), and Task Teams (1). (Cf. ICG/CARIBE-EWS-XV/3)

67. ICG/PTWS Steering Committee online meetings (3) were conducted in June 2020, September 2020 and January 2021. The Seventh Meeting of the PTWS Working Group 2 Task Team on Seismic Data Sharing in the Southwest Pacific and Eighth Meeting of the PTWS Regional Working Group on Tsunami Warning and Mitigation for Pacific Island Countries and Territories (PICTs), was convened on 29th March–1st April 2021. The ICG/PTWS Working Group for the South East Pacific—CPPS Grupo de Trabajo de Alerta de Tsunami del Pacífico Sudeste—met online on 10 June 2020. An online meeting of the ICG/PTWS Regional Working Group on Tsunami Warning and Mitigation System in the South China Sea Region (WG-SCS) originally scheduled on March 2019, in Guangzhou, China, was convened online on 27–28 August 2020.

68. The UNESCAP funded project on "Strengthening Tsunami Early Warning in the North West Indian Ocean region through Regional Collaboration" implemented in India, Iran, Pakistan and

[2] JCOMM was abolished at the 30th session of the IOC Assembly and is now replaced by the Joint WMO-IOC Collaborative Board .

Oman, continued to engage with the participating member states via online national consultations and regional workshops. National consultations were held with India (3 July, 19 November 2020), Iran (23 June 2020), Oman (2 July 2020) and Pakistan (11 June, 18 June, 26 October, 24 November 2020). Meetings on the Makran Probabilistic Tsunami Hazard Assessment (26 May, 30 June, 20 August 2020) and a regional workshop on Harmonization of NTWC Warnings and Products in the North West Indian Ocean (26 November 2020) were held. At the 21st UNESCAP Advisory Council meeting (5 November 2020), the Acting Head provided opening remarks and a project update. Notably, a 12-month project extension has been granted with a new end date of October 2021.

Tsunami Exercises

69. Tsunami exercises and drills help to increase tsunami preparedness and awareness of coastal communities. Regular exercises are essential to maintain operational readiness of response agencies and exercises test communications, review agency standard operating procedures, and promote emergency preparedness.

70. The CARIBE WAVE 2020 regional Exercise for the Caribbean and adjacent regions was conducted on 19 March 2020. This annual exercise has been improving and validating tsunami readiness since 2011. After months of regional and national preparation and planning, given the COVID-19 pandemic, the UNESCO IOC Intergovernmental Coordination Group for Tsunami and Other Coastal Hazards for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS) agreed to only test the communication lines at a regional level. It was left up to the Member States and Territories to decide if any additional activity would be carried out and whether to use the simulated messages for one of two tsunami scenarios: Jamaica and Portugal.

71. Given the earthquake activity in Puerto Rico as well as the M 7.8 earthquake off Jamaica and Cuba in January 2020, the expectation was that CARIBE WAVE 20 would surpass the 800,000 participants from 2019. Despite the sudden change in scope of the exercise however, CARIBE WAVE 20 was held successfully with 102,000 participants from 92% of the ICG/CARIBE-EWS Member States. The Regional Tsunami Service Provider, the Pacific Tsunami Warning Center (PTWC) disseminated text and graphical products. PTWC used various methods of communications to disseminate messages including the World Meteorological Organization Warning Information System (Global Telecommunication Systems), the Aeronautical Information Replacement System (AISR), NOAA Weather Wire, AWIPS, fax, email and social media. According to feedback as well as social media and web posts, the dummy message was successfully received, validating the communication platforms.

72. Exercise IOWave20 was conducted over a 2-week period (6 to 20 October 2020) and for the first time involved three scenarios placing all Indian Ocean member states under threat. Due to the ongoing COVID-19 pandemic, the Task Team decided to reduce the Exercise scope and scale to primarily focus on NTWCs with minimal downstream involvement. In preparation for the Exercise, the Pre-IOWave20 Webinar on Standard Operating Procedures for Tsunami Early Warning and Emergency Response was held by IOTIC and the Secretariat (28–30 September 2020). Exercise participation and preliminary analyses were reported on at the IOTWMS-IOTIC Post-IOWave20 Webinar on Lessons Learnt during Exercise Indian Ocean Wave 2020 (11–12 November 2020).

73. Countries in the North-Eastern Atlantic, Mediterranean and Connected Seas (the NEAM region) participated in a tsunami test and response exercise from 8 to 10 March 2021. NEAMwave21 coincided with the 10th commemoration of 11 March 2011 Tohoku Earthquake and Tsunami. The purpose of this exercise was to evaluate local tsunami response plans, increase tsunami preparedness, and improve coordination throughout the region. It is the fourth such international exercise in this region after NEAMWave12 (2012), NEAMWave14 (2014) and NEAMWave17 (2017).

74. Exercise Pacific Wave 2020 (PacWave20) was conducted from 1st September to 30 November 2020. The objectives of PacWave20 were revised due to COVID-19 restrictions to focus on two objectives:

- TSP-to-TWFP and NTWC communication test on November 5,2020, and
- CATAC regional exercise.

75. However, other activities were encouraged but at the discretion of each country. ITIC and NOAA PMEL conducted a series of webinar on TsuCAT (Tsunami Coastal Assessment Tool) to allow countries to choose their own scenarios and generate PTWC's enhanced text and graphical products to use in their exercises.

Tsunami Events

76. On 30 October 2020, a significant tsunami triggered by an earthquake of magnitude 7.0 Mw hit the island of Samos (Greece) and the Aegean coast of the Izmir region (Turkey). Within 8–11 minutes after the detection of the earthquake, tsunami bulletins were issued to national focal points by the Tsunami Service Providers (TSPs) accredited by UNESCO's IOC Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS). Greece and Turkey were put on "Tsunami Watch" (highest level of alert), while other countries either on "Tsunami Advisory and/or "Tsunami Information" levels.

77. At 1928Z, a M8.1 shallow thrust-fault earthquake in the Tonga-Kermadec Trench generated a tsunami that was observed locally and across the Pacific Basin. The earthquake followed nearby M7.4 foreshock that occurred ~107 minutes earlier and a M7.3 ~900 km to the south six hours earlier. The PTWC issued a Tsunami Threat Message at 1937Z based on the earthquake's magnitude, its first RIFT forecast at 1958Z, and its Final Tsunami Threat Message at 1222Z on 5 March (22 messages over 17 hours). In nearby Pacific Island Countries, warning or advisories were issued soon after, with some evacuations taking place, followed by cancellations after either no or only small waves were observed. In the eastern Pacific, the Galapagos, and parts of Central and South America had forecasts of 0.3–1 m. Maximum observed amplitudes reported by PTWC were 0.56 m at Norfolk Island west of the epicenter and 0.48 m in the Galapagos, Ecuador to the east northeast. On Raoul Island, the largest of the Kermadec Islands and near to the epicenter, data communication were knocked out by the earthquake, including for the sea level gauges that would have been used to confirm the severity of any tsunami from the M8.1 earthquake. The event was recorded on nearby New Zealand (NZ) and United States DART systems and used by the New Zealand Geosciences and the Pacific Tsunami Warning Center (PTWC) to validate forecasts during the event.

Tsunami Ready

78. In the IOTWMS, Tsunami Ready recognition process was successfully completed for the communities of Venkatraipur and Noliasahi in Odisha province of India. A virtual ceremony was held on 7 August 2020 to deliver the recognition to the representatives of the 2 communities as well as officials of Odisha State Disaster Management Authority (OSDMA). In support of the Tsunami Ready programme, IOTIC conducted an online lecture series between 4 September and 9 October 2020 featuring interactive expert sessions. While there is interest from several communities in India and other Indian Ocean Member States in implementing Tsunami Ready, COVID-19 has impacted these plans.

79. In the Caribbean the Caribbean Tsunami Warning Programme (CTWP) and the Caribbean Tsunami Information Center (CTIC) continued to support Belize (Belize City), Dominican Republic (Puerto Plata), Jamaica (Port Royal) and St. Vincent and the Grenadines (Kingstown to Argyle, St. George) to achieve Tsunami Ready recognition and new funding has been made available by Australia to support a new community to become Tsunami Ready in Grenada.

80. In the Pacific, ICG/PTWS progress is ongoing for Fiji, Solomon Islands, Vanuatu and Tonga. To complete Tsunami Ready recognition requirements and two new communities were recognized as Tsunami Ready in Costa Rica on February 2021: Samara and Tamarindo.

Targeted capacity development and technical assistance

81. Human and national capacity to deal with tsunamis are still unevenly spread among nations. Since its start the Tsunami programme has contained a strong capacity development component. The aim of these activities is to enable Member States to understand its risk and know ways in which they can mitigate the hazard, provide warning to its populations in a timely manner, and be able to carry out awareness and preparedness activities to sustain knowledge and ability-to-respond across generations.

82. The Ocean Teacher Global Academy (OTGA) project of UNESCO's International Oceanographic Data and Information Exchange of the Intergovernmental Oceanographic Commission (IOC-IODE) aims at developing a global training network to increase national capacity in coastal and marine knowledge and expertise. This will be achieved by (i) promoting the establishment of Regional and Specialized Training Centres (RTCs and STCs, respectively) as well as their close collaboration through advanced information technology; and (ii) further developing the Ocean Teacher e-Learning Platform.

83. In the backdrop of the pandemic and under the coordination of the IOC-UNESCO Tsunami Unit in close collaboration with Tsunami Information Centres (CTIC, ITIC, IOTIC, NEAMTIC) the International Tsunami Information Center (ITIC) and Indonesia BMKG were chosen as OTGA Specialized Training Centres (STC). A series of online or blended trainings will be developed by ITIC and BMKG within the framework of OTGA. Delivery is planned for 2021–2023 and will include seven courses: Tsunami Awareness, Tsunami Ready, Tsunami Early Warning Systems, Tsunami Warning and Emergency Response SOPs, TEMPP, Tsunami Warning Centre Competencies and Tsunami Hazard/Risk Assessment. These training courses will be developed based on the related IOC Manual Guides and training that have been implemented by the Tsunami Information Centres.The first training on Tsunami Awareness will be made available (online) in May/June 2021 and the second training on Tsunami Ready will be available (online) as from September 2021.

World Tsunami Awareness Day

84. The 5th November was designated as World Tsunami Awareness Day (WTAD) by the United Nations General Assembly in December 2015 through its Resolution A/RES/70/203. The resolution requested that the United Nations Office for Disaster Reduction, in collaboration with relevant organizations of the United Nations system, facilitate the observance of WTAD, starting in 2016. The 2020 edition of the WTAD was jointly organized by UNDRR and the Intergovernmental Oceanographic Commission of UNESCO, in collaboration with other UN and external partners (i.e. UNDP), notably with the sponsorship of the Government of Japan. The WTAD 2020 was structured as a 30-day "campaign" with three main events focused on Global Target (e) of the Sendai Framework for Disaster Risk Reduction 2015–2030.

85. An online live screening of the 52' documentary "Tsunamis: Facing a Global Threat" (ZED productions) by French filmmaker Pascal Guérin was broadcast. The documentary showcased field research activities facilitated by IOC-UNESCO in the aftermath of the 2018 tsunami in Palu, Indonesia. The live streaming was followed by a panel discussion with the filmmaker and top experts on 13 October.

86. In November, a series of regional (CARIBE-EWS, Indian Ocean, North Eastern Atlantic and Mediterranean Sea Pacific Island Countries and Central and South America Pacific Ocean) webinars were organised by the regional IOC teams in charge of coordinating regional tsunami early warning systems, in cooperation with UNDRR regional offices. This series of webinars focused on the need to connect state-of-the-art scientific expertise with local community preparedness to ensure science-

based tsunami local plans are in place including through IOC-UNESCO led Tsunami Ready recognition processes.

87. On 5 November, a virtual high-level event during the Third Tsunami Museum Conference showcased how museums contribute to keeping the memory of past disasters and lessons learned alive. The event featured recorded testimonials of tsunami survivors. Several Member states including Egypt, Mexico, Nigeria, Philippines, Thailand, and USA also organized events in the framework of the WTAD 2020.

Support for enabling research and policy development

88. Ongoing improvements of Tsunami warning systems and mitigation efforts are important. They contribute to sustain the system, reduce costs and uncertainty, and maintain public trust.

89. The Tsunami community contributed actively to the development of the approved Implementation Plan for the UN Decade of Ocean Science for Sustainable Development. The community has participated in several of the regional planning meetings and co-design meetings. The community has outlined the transformational steps that should be undertaken to develop more timely and accurate tsunami detection, measurement, and forecasts over the next decade (see Angove et al., 2019, Ocean Observations Required to Minimize Uncertainty in Global Tsunami Forecasts, Warnings, and Emergency Response, Frontiers of Mar. Sci., 25 June 2019, https://doi.org/10.3389/fmars.2019.00350). More recently the Working Group on Tsunamis and Other Hazards related to Sea-Level Warning and Mitigation Systems (TOWS-WG) Fourteenth Meeting (online), on 25–26 February 2021, requested that the 31st IOC Assembly at its session in 2021 consider approving the establishment of an *Ocean Decade Tsunami Programme* and recommended the establishment of a Scientific Committee to prepare a Draft *10-Year Research, Development and Implementation Plan* for this programme, to achieving transformational advances in tsunami detection, measurement and forecasting, including tsunamis generated by non-seismic sources, and making 100% of communities at risk of tsunami prepared for and resilient to tsunamis by 2030 through the implementation of the UNESCO/IOC Tsunami Ready Programme and other initiatives. (Cf. IOC/A-31/3.4.1.Doc(1))

Harmful Algal Bloom programme

90. Impacts of harmful algae on aquaculture, food safety, fisheries, tourism and other ecosystem services are permanent and widespread and intensify proportionally to the exploitation of the coastal seas. Routine monitoring and appropriate management plans can to a large degree prevent or minimize impacts.

91. IOC priorities and actions on Harmful Algal Blooms are set by the IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB) and the programme is implemented via number of global and regional initiatives. The research component under IPHAB, GlobalHAB, which is jointly sponsored with SCOR, has implemented a number of initiatives from its *Science and Implementation Plan*. The IOC Science and Communication Centre on Harmful Algae at the University of Copenhagen serves as an implementation mechanism and fundraising partner for HAB and GlobalHAB activities.

92. IOC ties together and provides and international network for a multi- and cross disciplinary community of researchers and practitioner through *Harmful Algae News* (HAN), an IOC newsletter on harmful algae and algal blooms, published 3–4 times a year since 1992. There is a team of regional Editors, and HAN also serves as newsletter for the International Society for the Study of Harmful Algae (ISSHA).

93. An international GlobalHAB workshop on evaluating, reducing and mitigating the cost of harmful algal blooms was organized in Victoria, British Columbia, Canada on 17–19 October 2019

as part of the Annual Meeting of the North Pacific Marine Science Organization (PICES) and received additional co-sponsorship from NOWPAP, ISSHA and US NOAA.

94. It has for several years been on the priority list of both IPHAB and GlobalHAB to focus specifically on Fish Killing HABs. An international workshop was held in Puerto Varas in the South of Chile June 2019 co-funded by the Chilean Centre for Studies of Harmful Algae (CREAN). HAB related fish kills are a very important issue for salmon culture.

95. GlobalHAB has formed an editorial board to develop a 'Best Practice Guidelines for the Study of HABs and Climate Change' to focus research on the occurrence of HABs under changing climate conditions. The draft guidelines were complete by early 2021 and are currently being prepared for publication.

96. GlobalHAB is also focusing is on HAB event modelling with a strong training component including development of an online textbook on HAB modelling. This was scheduled for May 2020, but has been postponed to second half 2021. This product will come one and a half year later than planned.

97. A special issue of the journal *Harmful Algae* (Impact Factor 4.138) on HABs and climate Change was published in February 2020. A 'IOC-SCOR Scientific Summary for Policy-Makers on HABs and Climate Change' is being developed based on the main messages in the papers of the special issue.

98. Collaboration between GlobalHAB and GO_2NE has been initiated and a joint expert meeting on HABs and deoxygenation was held on 11–12 June 2019 in Paris. GlobalHAB is also covering brackish and freshwater HABs and has published a scientific summary for policy-makers entitled *Solutions for managing cyanobacterial blooms*.

99. There is rapid technological development in different types of observation systems and GlobaHAB is jointly with SMHI/Sweden organizing an international workshop to test, inter-compare and train participants in various automated and non-automated observation technologies. Unfortunately, the workshop has been postponed to 2022 due the COVID-19 situation.

100. A new GlobalHAB initiative is addressing the mass occurrences of the macro algae Sargassum in both West Africa and the Caribbean. A sub-committee is established with an initial focus to join a GESAMP Task Team on Sargassum in organizing an Open Science Meeting (OSM) on Sargassum. This will involve the GESAMP technical secretaries of the sponsoring agencies that have indicated an interest in this topic (IOC, UN Environment, FAO, UNDP, WMO, IAEA) It is intended that the results of the OSM will be published as a white paper or peer-reviewed journal and will form the basis for GlobalHAB's and GESAMP's future engagement in the Sargassum issue. The dates for the OSM to be held in Mexico are pending the current COVID-19 situation.

101. The comprehensive undertaking to develop the first Global HAB Status Report (GHSR) based on data compiled in the Harmful Algal Information system (HAIS) is completed. HAIS is composed of IOC/HAEDAT, OBIS and the literature with the collaboration of IAEA, ICES, and PICES and with the financial support of Flanders (Kingdom of Belgium). HAIS thus provides the basis for the Global HAB Status Report.The GHSR will consist of the HAIS Data Portal; a special issue of the Elsevier journal Harmful Algae with regional reviews and partly open access; a paper in Nature Communications; and an IOC synthesis publication.The GHSR launch was foreseen for May 2020 but has been postponed due to the COVID-19 situation and is now (April 2021) only awaiting the publication in Nature Communications of the synthesis.

102. The IOC-IAEA-FAO-WHO Inter-agency Joint Strategy on Ciguatera Fish Poisoning is being further developed and implemented though joint workshops and alignment of agency workplans. However, the IOC-IAEA-FAO-WHO MoU (approved in IOC-UNESCO 2019) on which the strategy

is based has not yet been signed by all agencies as the approval has been delayed due to re-organization in sister agencies..

103. Through the IOC Science and Communication Centre on Harmful Algae the longstanding opportunities for capacity enhancement in monitoring of HABs continue with several annual courses. Concluding examinations give the trainees certification in identification of HAB causative species. All courses are run within the IOC Ocean Teacher platform and include a combination of preparatory e-learning, hands-on practical courses and an examination. All courses are 2020–21 given on-line due to the COVID-19 situation.The IOC Centre collaborates with the Marine Institute (Ireland) in operating the International Phytoplankton Inter-calibration (IPI) which in 2019 had 98 participants from 50 laboratories. The number of Member States participating is increasing. New laboratories from Cuba and Nicaragua were participating for the first time. There is an increase of participation from South America and Africa as well. IPI is also established within the Ocean Teacher platform. Accreditation of the IPI under ISO17043 is being prepared. In the period 2021–2024 the IPA will be implemented in partnership with the University of Las Palmas de Gran Canaria (Spain).

Marine invasive species

104. One million species are on the verge of extinction and the introduction of non-indigenous species (NIS) to new environments is listed as one of the five key drivers impacting biodiversity, according to the recent IPBES global assessment. Small Islands Developing States are particularly vulnerable to such a risk, which also creates a real biosecurity risk for human health and the sustainability of livelihoods. It is widely recognized that ship's ballast water and vessel biofouling, including the surge of new (or larger) marine structures linked to the unfolding and fast-growing blue economy, are the main vectors for the introduction and spread of NIS in the marine environment. The IOC has a number of activites addressing marine invasive species.

105. The Government of Flanders (Kingdom of Belgium), through FUST, is funding a 3-year (2020–2022) project named Pacific islands Marine bioinvasions Alert Network—PacMAN (https://pacman.obis.org/) to develop a national invasive species monitoring system as well as an early-warning decision-support tool for Pacific SIDS, offering a user-friendly dashboard indicating the potential presence of invasive species (including pathogens and pest species) or risk of invasions to support local management. The project will achieve this goal through a work plan that includes: (i) needs assessment and review of current best practices in detecting invasive species; (ii) training of local scientists in field sampling, sample processing, DNA sequencing and data management; (iii) establishing and operating national invasive species monitoring plans; (iv) building a bioinformatics pipeline to improve the availability of metabarcoding data from biofouling communities and feed these into global data infrastructures; and (v) developing the decision-support tool. Strong stakeholder engagement will ensure that the marine bioinvasions monitoring plan and the information and services of the decision-support tool contribute to and meet the requirements of local management (triggering rapid response). The project is coordinated by the OBIS secretariat at the IOC Project Office for IODE in Ostend (Belgium) with the support from the Institute of Applied Science of the University of the South Pacific as the local implementing partner.

106. IOC cosponsors with ICES and IMO a Working Group on Ballast and Other Ship Vectors (https://www.ices.dk/community/groups/Pages/WGBOSV.aspx), which provides scientific support to the development of international measures aimed at reducing the risk of transporting non-native species via shipping activities. The Group met in Weymouth, UK, March 2019 and in Sopot, Poland, in 2020 with Lisa Drake Rutherford as Chair.

107. Some Member States have recently taken steps to address the role of biofouling in the transfer of NIS and are at different stages in the development of national legislation and requirements to manage biofouling across maritime sectors. The IMO Secretariat, partnering with the Global Environment Facility (GEF) and the United Nations Development Programme (UNDP), have also stepped up their efforts to meet the challenge of biofouling. A new project was launched in January 2019, the GEF-UNDP-IMO GloFouling Partnerships, to develop suitable tools and provide capacity

building on biofouling management in twelve developing countries and Small Island Development States. The IOC has joined the three agencies to provide scientific guidance and coordinate efforts to implement projects elements addressing non-ship pathways.

108. Under the leadership of the IOC the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) has established a Working Group on Biofouling Management (WG44) with the overall objective to build a broader understanding on introduction and spread of NIS via biofouling across all maritime industries. The GESAMP Working Group will provide a global overview of the impact of biofouling across all maritime industries and structures and support the initial information requirements of the GloFouling Partnerships for understanding the role of biofouling in the transfer of NIS. The Working Group comprise experts (members) from various disciplines and sectors which are related to impact and management of biofouling.

109. The IOC has worked on a proposal for a new project on alien species and other ocean stressors in the Canary Current Large Marine Ecosystem (CCLME) (cf. Function A). The project is expected to produce an assessment of invasive alien species and other ocean stressors in the CCLME, as a basis for science-based decision-making.

Key Challenges Encountered in Implementation and Remedial Action Taken

110. For IOC Tsunami programme, the COVID-19 pandemic remained a severe challenge for regular training and capacity development activities but it was taken as an opportunity to anticipate development and deployment of online training, in close partnership with OTGA. In the same sense, the initial postponement of most of presential meetings led to a more intense use of online webinars, workshops and Intergovernmental Groups online meetings. Furthermore, the programme seized the opportunity to produce more communication and visibility—information materials, which are being disseminated through various channels, including social media.

111. To some extent, field-based activities could continue when only nationals were involved or using remote support for international experts (i.e. Tsunami Ready verification visits).

FUNCTION D: ASSESSMENT & INFORMATION FOR POLICY

Support assessment and information to improve the science-policy interface

Sustainable Development Goals (SDG)

112. In the context of the 2030 Agenda for Sustainable Development, several targets of SDG 14 are directly relevant to the work of IOC, particularly in the areas of marine pollution, ocean acidification, ecosystem-based management, as well as marine research capacity and transfer of marine technology. IOC is identified as the UN custodian agency by the Inter-agency and Expert Group on SDG Indicators (IAEG-SDGs) for SDG indicators 14.3.1 (ocean acidification) and 14.a.1 (scientific knowledge and ocean research capacity). IOC has recently provided reporting on both these indicators for inclusion in the UN Secretary General's Progress Report towards the SDGs in 2020 and 2021.

113. Significant progress was made in the collection of new data provided by Member States to IOC towards the SDG Indicators 14.3.1 and Target 14.a.1, for which the IOC has been assigned the custodianship role. Member States followed IOC's invitations to contribute to the *Global Ocean Science Report* (GOSR) 2020 online questionnaire—the basis for 14.a.1 reporting and to the newly established ocean acidification data portal for 14.3.1 reporting, developed in collaboration between the Ocean Science Section and IODE. This new portal, hosted at IODE, helps Member States, NODCs, other organizations and individual scientists to submit ocean acidification data. IOC HQ and IODE further develop a user-friendly GOSR data portal, which allows open access to all GOSR2020 data, and in particular the 14.a.1 information. In February 2020 and February 2021 IOC reported to the IAEG on both indicators. Several activities were undertaken to advance the methodology of

indicators for targets 14.3 and 14.a, as well as in relation to target 14.1 on marine pollution (Nutrients).

114. Concern over the impacts of altered nutrient inputs, N, P and Si, to coastal waters led the UN to include an “Index for Coastal Eutrophication Potential” (ICEP) as indicator for SDG Goal 14.1.1 on eutrophication: *By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution*. UN Environment is the custodian agency for Indicator 14.1.1, and the IOC is responsible to develop ICEP as the indicator. To implement ICEP, it is required to develop a component on a dissolved silica model and evaluate the effectiveness of ICEP in predicting coastal impacts at the global scale. To promote and increase the understanding of the potential of ICEP as indicator, the IOC in 2019 produced an animation for YouTube https://youtu.be/qW2nV2bsyCs. The detailed plan of work has been elaborated by the IOC N-CIRP Group of Experts in 2017. The work will require funding for two postdoctoral scholars and an expert workshop to validate models and will extra-budgetary funding. To date no funding source has been identified and ICEP was not ready to be implemented by end 2020 as originally foreseen. Unless funding is identified, IOC will remain unable to deliver the fully developed Indicator for 14.1.1.

World Ocean Assessment

115. IOC continues to provide scientific and technical support to the World Ocean Assessment (WOA) process established under the UNGA. A second cycle of assessment (2017–2020) was initiated under the UN Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects, starting with the holding of five regional workshops in 2017 to build capacity, support the development of assessment(s) and facilitate outreach and awareness-raising. Discussions with DOALOS (Secretariat of the Regular Process) have been conducted with regards to how the conclusions of the WOA-2, particularly in terms of knowledge and capacity gaps, could be addressed by the Implementation Plan of the Ocean Decade.

116. To showcase this emerging cooperaton, IOC and DOALOS organized a joint webinar on the Strengthening the Science Policy Interface for Ocean Sustainainability on 1 March 2021. Furthermore, the IOC Executive Secretary took part in the launch event of the WOA-2 report on 21 April 2021. Whislt the first World Ocean Assessment (WOA-I), released in 2015, had warned that many areas of the ocean had been seriously degraded, the latest assessment notes that the situation has not improved — and that many of the benefits that the ocean provides to people such as oxygen, food, jobs, medicine and climate regulation are increasingly being undermined by human activities. The report also identifies a number of key findindings and message for ocean science.

The proposed IOC State of the Ocean Report (StOR)

117. At the 53rd session of the IOC Executive Council, Member States considered a proposal by the IOC Secretariat to undertake an IOC State of the Ocean Report (StOR).

118. In the recent years, a renewed focus on the world ocean and appreciation of its crucial role for life on Earth, the global climate, food security, human health and wellbeing, as well as its role in the global economy, have led to an increased demand by decision-makers and society at large for relevant, strategic, current, and easily accessible information on the state of the ocean. Various high-level assessments provide comprehensive peer-reviewed analysis of the state of the ocean and climate with varying periodicities, often once in several years. Their volume and process of preparation does not allow the actualization of information at shorter intervals. However, the state of the ocean changes rapidly while the interest of accessing more regularly updated information remains unmet.

119. By its mandate, IOC is the UN body responsible for ocean science and provides a first place for the world to look for ocean-related information. An annual State of the Ocean Report (StOR), to be coordinated by IOC, will update the community of stakeholders on the current state of the ocean

and progress in expanding its management. This information can support actions by multiple stakeholders in the context of the UN Decade of Ocean Science for Sustainable Development and within various fora, including by providing evidence to support the World Ocean Assessment process.

120. At EC-53 in February 2021, Member States commented on existing infrastructures (the multiple expert groups and networks supporting the IOC programmes and activities) and further efforts needed to provide the bulk of information to describe the current state of the ocean; and length and periodicity of such possible report.

121. The IOC Secretariat provided for further views to be gathered through Circular Letter 2843; it also organized as pre-scoping expert meeting with a balanced geographic, thematic and gender representation to better inform further discussions and deliberations on the proposed StOR by IOC Member States at the 31st session of the IOC Assembly (IOC-31). Accordingly, a revised concept proposal on an IOC StOR is presented on the occasion of IOC-31 (Cf. IOC/INF-1393/rev.)

Ocean and coastal Atlases

122. Work on the **Caribbean Marine Atlas CMA** (https://www.caribbeanmarineatlas.net/), an IODE project, continued under FUST funding until 31/12/2020. The CMA is an online digital platform that supports the integrated coastal zone management (ICZM) and ecosystem-based management for Large Marine Ecosystems in the Wider Caribbean region—mainly Caribbean and North BrazilShelf Large Marine Ecosystems (the CLME+ Region). The Atlas is supporting the implementation of the CLME+ Strategic Action Programme. CMA brings together 25 countries, 7 of which are actively providing ICZM national information and data for 10 regional indicators. CMA holds more than 350 thematic layers, 30 maps and 285 documents. CMA2 recently developed a strategy to continue supporting content for CLME+ SOMEE (State of the Marine Environment and associated Economies) information adapting its content and thematic structure, to solve CLME + project needs. CMA was and remains supported by INVEMAR (Colombia) through hosting, coordination and technical support. CMA is an active member of the IHO Meso-American Caribbean Sea Hydrographic Commission (MACHC) Marine Spatial Data Infrastructure Working Group (MMSD), is working with CARIGEO initiative (Caribbean geoportal) since july 2020 and is part of ICAN steering committee.

Taking into account the end of FUST funding, a sustainability strategy is being built based on the capacities of all partners.

General Bathymetric Chart of the Oceans (GEBCO)

123. Together with the French Hydrographic and Oceanographic Service of the navy (SHOM), IOC hosted the GEBCO week on 11–20 January 2021, which includes the GEBCO Symposium, the 37th Joint IHO-IOC Guiding Committee for GEBCO and Sub-committees: TSCOM, SCOPE and SCRUM. The Symposium focused on the following themes:

- Ocean Decade of Ocean Science,
- Autonomous Mapping Technology,
- Seabed 2030 Progress & Update,
- Regional Mapping Initiatives,
- Cloud Data Transformation,
- Diversity, Equity and Inclusion in Ocean Mapping,
- Plans for Future Ocean Mapping and Data Management,
- Teledyne Caris Technology Training,
- Mapping the Gaps - Missions Around the World.

124. As a result of the completion of the terms of the current GGC Chair and Vice-Chair, elections were held for both positions. The GGC unanimously elected Evert Flier (IHO-Norway) as Chair and Dr Marzia Rovere (IOC-Italy) as Vice-Chair for the next triennium.

125. The IOC Regular Working Group on User Requirements and Contributions to GEBCO Products was reactivated and conducted a survey to identify specific needs from the IOC community to guide the development of and contributions to GEBCO products and services. The report once considered by the IOC Assembly (Cf. IOC/A-31/3.5.1.Doc) will be forwarded to the GEBCO Chairperson.

Key Challenges Encountered in Implementation and Remedial Action Taken

126. IOC's work in the area of assessments and information for policy contributes to global assessments such as the UN World Ocean Assessment, the SDG reporting framework, IPBES, IPCC and some regional assessments. IOC's comparative advantage lies in its unique position as an intergovernmental framework that advances research, identifies new scientific issues through collaborative action, and thus acts as a conduit for delivering relevant information to support decision-making of Member States. However, whilst IOC contributes to global assessment processes, IOC efforts are not always clearly visible in the end product. There is therefore a need to both explain the essential role of IOC in the upstream efforts (in terms of science, observation and data requirement) that are essential in the compilation of assessment end- products, and to increase the visibility of IOC's inputs to global assessment products, and develop relevant standalone assessment products, such as the State of the Ocean Report proposed by the IOC Executive Secretary. Core capacity related to the conduct of integrated marine assessment exists within the Secretariat, as well as expertise in indicator-based methodologies for assessing environmental, socio-economic, governance processes in the marine environment.

FUNCTION E: SUSTAINABLE MANAGEMENT & GOVERNANCE

Enhance ocean governance through a shared knowledge base and improved regional cooperation

Sustainable Development Goals – Preparation for the 2020 UN Ocean Conference

127. In Spring 2019, the UN General Assembly agreed to host the 2020 UN Ocean Conference on SDG 14 which was planned to be take place in Lisbon, Portugal, in June 2020, hosted by Portugal and Kenya. The central theme of the Conference is: Scaling up Ocean Action based on science and innovation for the period 2020–2030: stocktaking, partnerships and solutions. The conference has been postponed to 2022 due to the COVID-19 situation and no new dates have yet been announced. Prior to postponement of the conference, preparation of concept papers for a series of interactive policy dialogues had commenced. IOC convened the preparation of the concept paper for Interactive Policy Dialogue 6—Increasing scientific knowledge, research capacity and transfer of marine technology; and co-convened the preparation of the concept paper for Interactive Policy Dialogue 3—Minimizing and addressing ocean acidification, deoxygenation and ocean warming. IOC also participated in the drafting of several other concept papers.

128. Prior to the postponement of the Conference, IOC had also advanced in planning of a series of high-level events to be held during the conference proceedings related to the Decade. This series of events would have focused on launching of the Ocean Decade Alliance and provided a space for the announcement of high-level commitments to the Decade, and it is envisaged that this event will be held during the rescheduled conference, albeit with a modified agenda.

129. IOC participated in a webinar in March 2021 organised by UN DESA related to the "Communities of Action" i.e. the network of voluntary commitment (VC) holders that was established following the 2017 UN Ocean Conference. At this event, the Executive Secretary presented progress on the implementation of VCs in Community of Action 7 which is co-chaired by IOC. IOC will also

participate in an event organised by the President of the General Assembly on 1 June 2021 that aims to maintain momentum in the lead up to the 2022 event and provide informal reporting and discussion on the progress to the achievement of SDG14. The Decade will be featured prominently in this event.

Biodiversity in Areas beyond National Jurisdiction (BBNJ)

130. IOC actively contributes to the negotiation process on an International Legally Binding Instrument (ILBI) on the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction (BBNJ). In October 2020, with a view to inform the negotiation process, the Secretariat published a Non-Paper on existing and potential contributions of IOC-UNESCO to the BBNJ process (IOC/INF-1387). The 4th Intergovernmental Conference on BBNJ initially planned for March 2021 has been postponed to August 2021 due to COVID-19. Intersessional informal consultations are taking place via a virtual platform (MS Teams). The role of OBIS and OceanInfoHub as part of the BBNJ clearing-house mechanism (CHM) has been suggested by a number of Member States and Observers. It is yet unclear who will manage the BBNJ CHM, the BBNJ secretariat or IOC in close collaboration with other UN organisations. (Cf. IOC/INF-1405)

Convention of Biological Diversity

131. The Convention on Biological Diversity is currently preparing the Post-2020 Global Biodiversity Framework (GBF). In relation to coastal and marine aspects of the GBF, we made comments and suggestions on the indicators and targets, and saw they are reflected in the draft document for submission to the 24th SBSTTA. These comments and suggestions focused on the need to avoid duplication with existing processes and to optimize linkages into efforts to develop a global marine biodiversity observing system based on the Essential Ocean Variables, which are coordinated through the Biology and Ecosystems Panel of the Global Ocean Observing System with support from the Marine Biodiversity Observation Network (MBON) of GEO BON, our own Ocean Biodiversity Information System (OBIS) which act as the data platform in close collaboration with the Global Biodiversity Information Facility and many other partners.

Integrated Coastal Area Management, includind Marine Spatial Planning

132. IOC's Marine Policy and Regional Coordination Section (IOC/MPR) organized and participated in more than 300 events during this biennium in relation to our institutional activities on integrated coastal area management, marine spatial planning, large marine ecosystems and sustainable blue economy.

133. Through the MSP Global project funded throught he European Commission, IOC has increased awareness among governmental authorities and stakeholders about the importance of marine spatial planning (MSP). This awareness was accompanied in the majority of the cases with capacity development activities jointly organised to strengthen regional networks and common understanding on the importance of transboundary aspects in both planning and the development of sustainable blue economy strategies. The Government of Sweden provided in 2019 and 2020 support to IOC Secretariat to assist the regional implementation of the Joint Roadmap to accelerate Marine Spatial Planning worldwide, in collaboration with the IOC Regional Offices in Africa and the Caribbean and national institutions of the beneficiary countries. In the Mediterranean, IOC-UNESCO strengthened the collaboration with the Priority Action Programme/Regional Activity Centre (PAP/RAC) to support regional trainings and align objectives for the activities to be jointly implemented in 2020 and 2021, including the potential celebration of the Mediterranean Coast Day in 2021 in the WestMED on the theme of transboundary Marine Spatial Planning. The institutional collaboration in between IOC Secretariat and the Union for the Mediterranean was strengthened thanks to the close collaboration established in between both institutions in the context of MSPglobal.

134. Several regional and national consultations with representatives of maritime sectors were organised in collaboration with the National Focal Points in the Pacific, the Mediterranean, the

Caribbean, the Macaronesia, the Gulf of Guinea, the Indian Ocean and Small Island Developing States to review, together with sector representatives, the spatial dimension of maritime activities such as fisheries and aquaculture; oil and gas; tourism and cultural heritage; maritime transport and defence; and environment. At national and local scale, IOC staff and consultants established effective dialogues with national authorities to increase cooperation between national stakeholders and experts from the national institutions involved in MSP and blue economy processes.

135. The 5th and the 6th MSPforums planned in April 2020 in Athens (Greece) and in November 2020 in Scheveningen (The Netherlands) were cancelled, together with the agreement to postpone the organization of the 3rd International MSP Conference in 2022 if the sanitary conditions allow it.

136. The MSPglobal network is increasing and expanding across our ocean despite the limitations of the past months. The network is providing valuable inputs to share with the members of the MSPglobal International Expert Group in charge of developing the guidance on transboundary MSP that is currently in the final phase of development and will be launched in September 2021 in English, Spanish, French and Arabic. China offered the Secretariat to translate the guidelines into Chinese too.

137. The MSPglobal website (www.mspglobal2030.org) is now fully operative, contents are updated progressively and the multilingual sections are available in English, Spanish, French and Arabic. Publications on the role of maritime sectors in planning and sustainable blue economy strategies, as well as the technical reporting for the pilot case studies on current and future conditions for planning, the elaboration of policy briefs on crosscutting issues, blue economy, capacity development and climate change complements the intensive work agenda implemented during this biennium by IOC, partners and Member States. All products are available at: https://www.mspglobal2030.org/resources/

138. In the context of MSPglobal and with the support of Sweden, IOC/MPR enhanced island capacities to achieve sustainable development through education, ocean literacy for all and the reinforcement of human and institutional capacities on integrated coastal area management, marine spatial planning and sustainable blue economy. The activities implemented in Trinidad and Tobago and Cabo Verde complemented the national efforts to enhance national resilience and the sustainability of human interactions with ecological, freshwater and ocean systems as well as it favoured the interaction amongst institutions and stakeholders increasing information management and knowledge-sharing by ensuring the fullest participation of youth and social inclusion.

139. National practices implementing marine spatial planning worldwide are now for all Member States who responded the abovementioned survey. The MSPglobal website launched a new section dedicated to “MSP around the world” with all national profiles available in different languages and also includes a compendium of existing and emerging cross-border and transboundary initiatives on marine spatial planning. (Cf. IOC/INF-1395 and IOC/INF-1407)

Sargasso Sea

140. In November 2020, IOC, working in close collaboration with UNDP and the Sargasso Sea Commission, started to execute a GEF Preparatory grant (PPG) for developing a project aimted at strengthening the stewardship of an economically and biologically significant high sea area – the Sargasso Sea. As defined in the PIF, the overall objective of the Project is the facilitation of a collaborative, cross-sectoral ecosystem-based sustainable stewardship mechanism for the Sargasso Sea through improvement in the knowledge base and strengthened frameworks for collaborative management and governance. A full size project will be submitted to the GEF in October 2021.

Coastal Vulnerability

141. In line with the specific actions implemented in 2019 in Africa on integrated coastal area management and coastal vulnerability, experts' consultations on coastal and marine environmental pressures, including transboundary pressures, were organized by national experts hired by IOC Secretariat in 2020 in Ghana, Cameroon, Gabon, Angola, Mozambique and Kenya with the support and active participation of national authorities, representatives of the academia, the private sector and society. Additional lessons learnt and best practices of managing coastal risk from local community perspectives were also compiled in national experts from Bangladesh, Costa Rica, Gabon, Ghana, Lebanon, Myanmar, Senegal, Uruguay and Venezuela (Bolivarian Republic of).

142. The Secretariat provided support to Member States to make informed decisions on practical adaptation actions and measures in response to climate change to be considered in the context of integrated coastal management and marine spatial planning processes. A workbook to understand the options to address these challenges will be published in 2021. A multilingual community guide for community members interested in risk reduction efforts and how to reduce coastal hazard risk at community level following a step-by-step approach is already available in English, Spanish, French, Arabic, Russian and Portuguese.

United Nations Decade of Ocean Science for Sustainable Development (2021–2030)

143. The period from June 2020 to May 2021 was critical for the Decade. It represented the final six months of the preparation phase, and the first six months of the implementation phase, that commenced with the opening of the Decade on 1 January 2021. IOC, in consultation with Member States and all relevant stakeholders, led the preparation of the Decade and is now coordinating its implementation. Milestones in this period included the consideration of the Implementation Plan by the 75th session of the United Nations General Assembly and the adoption of A/RES/75/239 of 31 December 2020 that noted with appreciation the Implementation Plan and requested IOC to continue in its coordination role throughout the implementation phase.

144. This period also saw the successful roll-out of the first Call for Decade Actions (No. 01/2020) that solicited close to 250 potential Decade Actions including both proposed programmes and contributions. The submissions received demonstrated a high understanding of and alignment with the Ocean Decade vision and mission. A wide variety of proponents submitted programmes for consideration including Member States, research bodies and non-governmental organizations. Six submissions, including three from IOC-led programmes, were received from United Nations partners. The IOC Secretariat undertook an initial structural sorting of the submissions and then commenced a process of identifying geopgraphical and thematic synergies between programmes to facilitate the creation of a number of Communities of Practice that will encourage collaboration and lead to collective action around the Decade Challenges.

145. The 53rd Executive Council endorsed the extension of the mandate of the Executive Planning Group to act as an Interim Decade Advisory Board in the period before the establishment of the definitive Board. Two meetings of the Interim Decade Advisory Board were held during this period; in April and in May 2021. These meetings considered and made recommendations on the endorsement on Decade programmes, as well as providing advice on the conceptual framework for monitoring and evaluation for the Decade and commencing preparation of the second Call for Decade Actions No. 02/2021. Following this meeting, the Executive Secretary made decisions on endorsement of a first set of Decade programmes and contributions as reported in IOC/INF-1417. These Decade Actions represent the first building blocks of the Decade and will form a foundation for the further build-out and population of the Decade Action Framework. The Terms of the Reference for the Decade Advisory Board are being presented for endorsement in IOC/A-31/3.7.Doc (1).

146. Meetings with the UN-Oceans contact group for the Decade continued and meetings of informal working groups on communications and monitoring and evaluation provided valuable input during this period.

147. There were intensive stakeholder engagement and outreach efforts during this period. A major launch event “Brave New Ocean” was held on 3 February involving several heads of state as well as leaders of UN agencies, philanthropy and industry. This event attracted over 15,000 viewers and significant increased visibility of the Decade. Planning for the First International Ocean Decade Conference which is being hosted by Germany has continued and this event will commence with a high-level virtual opening on 1 June 2021. During this period a number of National Decade Committees and regional stakeholder groups emerged to coordinate Decade stakeholders and catalyse the development of Decade Actions. In addition, this period saw over 3,100 participants in 17 global and regional sessions of the Ocean Decade Virtual Series. The communications strategy was updated for the implementation phase, and conceptualization of the Generation Ocean communications campaign was completed with a launch planned for later in 2021. Revamping of the website has commenced including the development of an online community platform that will form the foundation of the Global Stakeholder Forum,

148. Mobilisation of resources remains a key challenge for the Decade during the transition from the planning phase to the action phase. There have been significant efforts to engage philanthropic Foundations during this period, and a resource mobilisation strategy has been prepared to guide future efforts, including with industry and international financing institutions. Additional financial or in-kind resources are urgently required to allow the full resourcing and operation of the Decade Coordination Unit. Significant mobilisation of resources will also be required to support Decade Actions; the first resource needs assessment for Decade Actions is reported in IOC/INF-1417.

149. The Ocean Decade Alliance will be a key element of the resource mobilisation efforts for the Decade. The Alliance , which was pre-launched as part of the Brave New Ocean event on 3 February 2021, has been established to leverage and multiply financial and in-kind resource commitments towards the Decade. Alliance members are listed on the Ocean Decade website and have been invited to join the Alliance both at the individual level (Ocean Decade Alliance patrons) and the institutional level. Sherpas are currently being identified for all members and a first Alliance meeting is planned in coming months.

150. **Joint WMO-IOC Collaborative Board**The JCB held a series of nine online meetings in March–June 2020 (collectively serving as its first session), which defined key points of collaboration between IOC and WMO along a value chain from observations, data systems, forecasting systems, services, science, and policy interfaces; including examination of regional approaches, capacity development, and the opportunity of the Ocean Decade.

151. Building on from this, it developed a WMO-IOC *Collaborative Strategy* that is subject to approval by this 31st IOC Assembly, and held a second session (9 March 2021) to refine the draft. It plans to capture the ideas for key joint priorities for work between IOC and WMO programmes and bodies as a work plan towards that collaborative strategy.

IOC Sub-Commission for the Western Pacific (WESTPAC)

152. WESTPAC has been taking a lead in the region in promoting and engaging individuals, institutions and countries into the Decade. In line with the IOC’s overall preparations for the Decade Implementation Plan, WESTPAC had been motivating experts, institutions, and governmental agencies into the two major peer-reviews of the Decade Implementation Plan until it was finalized and submitted to the UN General Assembly. Meanwhile, the Sub-Commission has also been assisting its Member States in planning for the Decade, by providing strategic and technical support for their decade related activities at national level.

153. Central to the Ocean Decade is the transformation of ocean science into solution-orientated research that responds to existing and emerging societal needs, WESTPAC convened the Decade Regional Dialogue on "co-designing the ocean science we need for the ocean we want" (virtual, 10 November 2020), engaging a wide range of ocean stakeholders to explore the region's opportunities and challenges and discuss best practices to deliver co-designed, solution-oriented research that could respond to the needs for sustainable development in the region.

154. There were 185 attendees from 35 countries including 10 LDCs (Least Developed Countries) and 14 Small Island Developing States. The session highlighted grand challenges for co-designed research in the region, and identified some good practices in place. The regional dialogue also concluded that Capacity development is essential and shall form an integral part of the whole co-designed, solution-oriented research process. Capacity development must be inclusive in terms of tools, adaptive to actual situations, and build on existing regionally recognized practices and networks.

155. In response to the call for Decade Actions, WESTPAC has been mobilizing actions from various stakeholders, and developing potential proposals for Decade Actions, while capitalizing on its existing programmes and networks. Those potential proposals will be presented to the 13th Intergovernmental Session of the Sub-Commission (27–29 April 2021, online). (Cf. IOC/SC-WESTPAC-XIII/3s)

156. To further catalyze partnerships and initiate the co-design of transformative solutions amongst diverse stakeholder groups in the region, WESTPAC will organize a Decade Regional Kick-off event (24–25 August 2021, online), hosted by Thailand, and develop the Decade Regional Conference Series (scheduled for 2022, 2025, 2028 and 2031), in conjunction with its triennial International Marine Science Conference.

157. The 13th Intergovernmental Session of the Sub-Commission will take place on 27–29 April 2021, hosted by the Ministry of Foreign Affairs, Bangladesh, to review its strategic direction, programme implementation, and the potential contribution to the UN Decade of Ocean Science for Sustainable Development.

IOC Sub-Commission for Africa and the Adjacent Island States (IOCAFRICA)

158. The Regional Consultative Workshop on the UN Decade of Ocean Science for Sustainable Development for Africa and the Adjacent Island States (27–29 January 2020, Nairobi, Kenya) hosted by the Government of Kenya, and the workshop on "Co-designing the Ocean Science we need for Africa" held online on 3 November 2020 offered a crucial opportunity to co-design mission-oriented research strategies and actions for the region.

159. The workshops emphasized the need to strengthen and build upon existing mechanisms and frameworks, and align with the African Unions initiatives. This includes the Agenda 2063, which recognized the Blue Economy as a major contributor to continental transformation and growth, and the 2050 African Integrated Marine Strategic Plan of Action (AIMS2050), which provides a road for increased wealth creation from Africa's oceans and seas by developing a sustainable thriving blue economy.

160. Capacity development was identified as a priority, in particular the improvement of infrastructure and facilities for research, provision of training for scientific and technical staff, as well as translation of science to policy. In particular ocean research in the region should be strengthened through stronger integration of sciences, greater investment in ocean observing systems and improved science-policy interface. Other issues highlighted include the role of youth and job creation, marine spatial planning, climate change impacts on the coastal zones, land-sea interactions and pollution, and innovative financing models for the ocean economy.

161. The following were identified as some of the key areas that the region should focus on during the Decade:

(i) Harnessing the demographic dividend by empowering the huge pool of youthful population. The focus should be on getting them into ocean sciences through focussed ocean literacy programmes, supporting skills development and mentoring to enable them fit in the job market and creating new opportunities for employment. This will facilitate the unlocking of scientific excellence and the creation of the new generation of ocean experts.

(ii) The Decade should catalyse research in the following fields: marine renewable energy and deep ocean water applications; bioprospecting, biotechnology and pharmaceuticals; mariculture and offshore aquaculture; climate change impacts and the oceans-climate nexus; baseline monitoring of essential ocean variables; mapping ecosystems and habitats; and linking the research results to societal applications.

(iii) Improving the quality and quantity of research outputs. Scientists and institutions should think beyond producing publications to transforming lives through innovation and robust application of ocean science. They should be able to demonstrate that the research results have been applied and impacted on the society.

(iv) Ocean research in the region should be strengthened through stronger integration of sciences, greater investment in ocean observing systems and improved science-policy interface. New partnerships should be developed, supported by a new ocean-climate finance, and improved ocean literacy and education to modify social norms and behaviour.

(v) Establishment of university-based ocean innovation incubator hubs, supported by the private sector, to serve as a conduit to transform research results to action via technological development that is adapted to regional and local contexts and led by African researchers.

162. The Government of Egypt will host the regional Kick-Off workshop for the UN Decade of Ocean Science for Sustainable Development for Africa and the Adjacent Islands in December 2021 in hybrid format.

The sixth session of IOCAFRICA (online 13–15 April 2021) empahsied the importance of developing a strong Ocean Decade programme for Africa and recommended the establishment of a Regional Planning Group to work on development and implementation of the programme. (Cf. IOC/SC-IOCAFRICA-VI/3s)

IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE)

163. IOCARIBE Member States are implementing the Recommendations of their 15th session. In particular those initiatives for Disaster Risk Reduction and Ecosystem-based management, including: (i) IOCARIBE-GOOS establishment of a pilot project on Improvement of Hurricane Observing Forecasting Capacity; (ii) development of an operational region-wide information and forecasting system for sargassum and oil spills; and (iil) development of a guide on best management practices for sargassum events in the coastal environment. IOCARIBE Member States, expert networks, and education and research institutions are focusing on their contribution to the Ocean Decade, and to the SDG 14 implementation progress and challenges. The UN Decade of Ocean Science for Sustainable Development Regional virtual Workshop for the Western Tropical Atlantic (WTA), 28–29 April 2020, provided a regional contribution to the Ocean Decade with a focus on IOCARIBE countries' and territories' needs and priorities in terms of transforming knowledge systems; accelerating transfer of technology; enabling training and education; fostering science-policy dialogues, and enabling scientific solutions to the Region's socio-economic challenges. IOCARIBE, as the WTA Ocean Decade Coordination mechanism has the overall responsibility for formulation of policy, principles and strategy, and for planning and coordination of the Ocean Decade

in the Western Tropical Atlantic region in consultation with the many leading UN, NGO, science, private sector, indigenous and local communities and other stakeholders of the region. IOCARIBE established on October 2020 a Regional Planning Group (WTA RPG) for the WTA-Ocean Decade to advance and coordinate strategic partnerships and actions for Western Tropical Atlantic engagement in the UN Decade of Ocean Science for Sustainable Development (2021–2030). The WTA RPG established eight Working Groups to promote multi-disciplinary and inclusive co-design and implementation partnerships to achieve each societal outcome and Capacity Development, recognizing the importance of the work of the Working Groups as the core of its strategy for advancing the Decade in the Western Tropical Atlantic Region. (See also the Executive Summary report of the Subcommission 16th session in May 2021 IOC/SC-IOCARIBE-XVI/3s).

164. The UN Decade of Ocean Science Regional virtual Workshop for the Western Tropical Atlantic, 28–29 April 2020, provided a regional contribution to the Ocean Decade with a focus on IOCARIBE countries' and territories' needs and priorities in terms of transforming knowledge systems; accelerating transfer of technology; enabling training and education; fostering science-policy dialogues, and enabling scientific solutions to the Region's socio-economic challenges. IOCARIBE established on October 2020 a Regional Planning Group (WTA RPG) for the WTA-Ocean Decade to advance and coordinate strategic partnerships and actions for Western Tropical Atlantic engagement in the UN Decade of Ocean Science for Sustainable Development (2021–2030). The WTA RPG established eight Working Groups to promote multi-disciplinary and inclusive co-design and implementation partnerships to achieve each societal outcome and Capacity Development, recognizing the importance of the work of the Working Groups as the core of its strategy for advancing the Decade in the Western Tropical Atlantic Region.

IOC Regional Committee for the Central Indian Ocean (IOCINDIO)

165. Consultations continued between the IOC Chair, Executive Secretary, the IOC Vice-chair for electoral group IV with the IOCINDIO Chair and Officers regarding the upgrade of IOCINDIO into an IOC sub-commission, in line with the corresponding decision of the IOC Assembly at its 30th session in 2019. A consultation with IOC Member States interested in the Indian Ocean was organised on 16 February 2021 to discuss the proposal and seek engagement, support and commitments (Cf. IOC/INF-1410). To be truly effective and efficient, the new sub-commission should offer Member States a wider scope for their participation in regional activities according to their priorities and needs. Its work would also be of interest and have implications for some countries of IOCAFRICA and WESTPAC. The 8th session of IOCINDIO scheduled at the end of May 2021 represents an opportunity to rally Member States of the entire Indian Ocean rim and beyond, solidify the plans, see how the new body could contribute to the Decade and add value to the multiple activities in the region (Cf. IOCINDIO-VIII/3s). Based on the results of this consultation and the regional committee session, the fully developed proposal will be presented to the IOC Assembly at its 31st session in June 2021, for consideration and decision. (Cf. IOC/A-31/3.5.6.Doc).

166. IOCINDIO was fully engaged in the preparation and the launch of the United Nations Decade of Ocean Science for Sustainable Development. Following on the recommendations of the Regional Planning Workshop for the Northern/Central Indian Ocean countries as well as ROPME Sea Area towards the UN Decade of Ocean Science for Sustainable Development (2021–2030) held in Chennai, India, 8–10 January 2020, the IOCINDIO Committee implemented the following activities:

- The Indian Ocean Youth Leadership Network of Ocean, Climate and Atmospheric Sciences was established with a follow up Group.
- The Indian Ocean Leadership Mentoring Network was established.
- The Follow up Coordinating Experts Group composed of Chairs and Rapporteurs of the Working Group established.
- A joint Working Group of IOCINDIO and African Experts was established for cooperative programmes on coastal vulnerability and mutual capacity development with a potential support of Kuwait, Bangladesh, Saudi Arabia and India and interested

African initiatives.

- IOCINDIO Member States participated in the Ocean Decade lunch and related webinars.

167. In addition, IOCINDIO Member States are pulling efforts together to organize the IOCINDIO Indian Ocean Blue Economy Summit towards the Ocean Decade, 6 May 2021. The results and report of the workshop will be presented as information documents to the Assembly. (Cf. IOC/INF-1411)

Key Challenges Encountered in Implementation and Remedial Action Taken

168. A number of important ocean governance process have been postponed due to the COVID-19 (for e.g. BBNJ, UNFCCC, SDG 14 Conference), which reduced the opportunity for IOC to showcase its contribution to ocean affairs. Most of these processes have put in place vitrual events, information sessions, engagement opportunities to keep momentum. IOC has engaged actively in these events to communicate about its work and highlight the opportunities that the Ocean Decade offers in terms of delivering transformative science based-solutions for sustainable development, as recently demonstrated in the High level event organised by the President of the UN General Assembly on 1 June 2021.

169. IOC has developed a portfolio of projects that are delivering technical assistance and capacity development through regional interventions (e.g. MSPGlobal project, Sweden support, GEF LMEs). These are generally dependent on a single donor and have set lifespans. It it therefore important to diversify the source of extra-budgetary donors and develop sustainability strategies for each of these projects. Currently, there are no regular programme staff supporting the MSP and ICAM portfolio, despite the growing demands that Member States put on the Secretariat for technical support.

170. The lack of additional resources made available to the IOC Secretariat to lead and coordinate the preparation and implementation phase of the Ocean Decade has remained a challenge over this period. Whilst financial contributions have increased from both Member States and philanthropic foundations, resources have been inadequate to fully staff the full range of responsibilities anticipated. As such, Decade-related activities have diverted human resources from other core activities under this function. Looking forward, there will be a need to rapidly secure long-term resources for the Decade Coordination Unit so that it can be fully staffed, thus allowing adequate investment by existing Secretariat staff in other core activities under this function. IOC Programmes contributing to the Decade should also be adequately resourced.

171. Regional subisdiary bodies (RSBs) serve as a key arm of IOC in regions, translating the broad spectrum of IOC global objectives into concrete actions at regional and national level. Each of these are staffed with one single IOC professional. The role of RSBs in supporting Decade coordination at regional level offers both a challenge and an opportunity. This persistent understaffing situation is indeed difficult for RSBs to deliver on the unprecedented demands of IOC Member States.

FUNCTION F: CAPACITY DEVELOPMENT
Develop the institutional capacity in all of the functions above, as a cross-cutting function

IOC Capacity Development Strategy

172. The IOC Assembly adopted the *IOC Capacity Development (CD) Strategy, 2014–2021* through Resolution XXVIII-2 and agreed that the IOC global and regional programmes should develop programmatic and regionally relevant capacity development workplans based on that strategy and related needs assessments conducted in a consistent manner, building on ongoing activities and making use of existing training and education facilities. At the first session of the Group of Experts (2018) it was decided to establish two task teams: one on CD requirements of Member States (with special attention to SIDS), and one on the implementation of the Transfer of Marine Technology/Clearing House Mechanism "portal".

173. As a follow-up, a project proposal (August 2019) was successfully submitted to the Government of Flanders/Kingdom of Belgium (FUST) for funding. It is entitled "The IOC Ocean InfoHub: development of an IOC CHM/TMT powered by a proof-of-concept ODIS architecture" which will, *inter alia*, "*establish and anchor a network of regional and thematic nodes that will contribute to the transfer of marine technology (TMT) by enhancing shared scientific and technical capacities to render a wide range of data and information products and services".* Reference is made to Function B for more information on this project. The project implementation started on 1 April 2020. It is noted that due to COVID-19 the face-to-face global and regional start-up meetings are being replaced by online meetings.

174. Through IOC Circular Letter 2793 (27 January 2020), Member States were invited to designate national IOC focal points for capacity devvelopment. This resulted in 23 additional focal points (March 2020) bringing the total to 31.

IODE's OceanTeacher Global Academy

175. Between 2015 and 2019, the IODE OceanTeacher Global Academy Project has established a global network of Regional Training Centres (RTCs) to deliver customized training for ocean experts and practitioners and to increase national and regional capacity in coastal and marine knowledge and management. OTGA currently has six designated RTCs (in Belgium, Colombia, India, Kenya, Malaysia and Mozambique) and two candidate RTCs (China and Islamic Republic of Iran). The RTC in Senegal was not active during this reporting period. During the past intersessional period, OTGA organized 12 face-to-face training courses at the 8 RTCs, involving 345 participants. Courses focused on a range of topics related to IOC programmes, contributing to the sustainable management of oceans and coastal areas worldwide, and relevant to Member States in the regions. Four different languages (English, Spanish, French and Portuguese) were used during the different training courses and workshops depending on venue, and all training resources were hosted by the OceanTeacher e-Learning Platform (www.oceanteacher.org). By April 2020, over 6,600 users had registered on the e-Learning Platform.

176. Additionally, during the reporting period, OceanTeacher supported the organization of another five training courses, involving close to 250 participants (International training course on "Instrumenting our ocean for better observation: a training course on a suite of biogeochemical sensors"; 2nd SeaDataCloud Training Course; IOC/HAB International Phytoplankton Intercomparison (IPI): IOC/HAB Training Course: Certification on Identification of Harmful Marine Algae; NF-POGO Centre of Excellence: Ocean Data Management; Marine biodiversity in rocky shores: Biological Essential Ocean Variables (EOVs) for the analysis of marine biodiversity patterns in rocky shores).

177. It is important to recall that in 2018, the IOC Project Office for IODE, host of the OceanTeacher Global Academy, achieved ISO 29990 certification as a Learning Services Provider for non-formal education and training and was accredited by the Belgian Accreditation Body (BELAC) having satisfied the requirements of the International Standard. This certification is a recognition of

the quality of learning opportunities offered by OTGA, through the IOC Project Office for IODE, and the high standard of quality learning services delivered that can support all IOC programmes in providing specialized training. The certification has been renewed in 2020.

Ocean literacy

178. The voluntary commitment "Ocean Literacy for All" coordinated by the IOC was announced at the first UN Ocean Conference (New York, June 2017). The implementation of the voluntary commitment started in August 2017, and was completed in December 2019 thanks to the support of the Swedish Government. In July 2018, the IOC Ocean Literacy Portal was launched to serve as a repository for quality education and information tools, resources, good practices and local or international success stories. The main function of the portal is to share resources on ocean topics and for different potential end-users, i.e. educators, scientists, policy-makers, private sector and media.

179. In 2018 a partnership was established with the Ocean Frontier Institute, the Dalhousie University and the National Film Board of Canada to develp a feasibility study for the internationalization of the Ocean School Programme. Ocean School is an ocean science educational programme, which uses storytelling techniques, immersive technologies and interactive media to promulgate ocean literacy. An Ocean School Teacher Training Workshop was organized in San José, Costa Rica (3–4 December 2018), in collaboration with the UNESCO Office, to test the possibility of adapting the Ocean School programme and technology to different educational systems and geographical and cultural contexts.

180. In November 2018 the First Ocean Literacy for multi-stakeholder processes in Ocean Governance workshop was organized in Paris at UNESCO HQ. Ocean Literacy experts, journalists, researchers, foundations, MSP practitioners, educators, representatives of NGOs and public authorities participated in the workshop with the aim of discussing the most effective ways to communicate ocean knowledge to different audiences, and to share best practices and innovative views on the challenges of transforming knowledge into action, using Ocean Literacy tools.The event represented a bridge between the "Ocean Literacy for All" and the "MSP Global". Between 2018 and 2019 a pilot test phase of the *Ocean Literacy for All: A Toolkit* started in collaboration with the UNESCO Network of Associated Schools (ASPNet). The toolkit is meant to provide educators and learners with innovative tools, methods and resources to understand ocean processes and functions, to alert them on the most urgent ocean issues and to provide ready to use activities to be implemented in formal and non-formal educational contexts. The toolkit was tested in schools of 36 countries, and a questionnaire was administrated to the teachers for its evaluation. The results of the questionnaire showed that 84,5% of the teachers would recommend the toolkit for their peers, and the 64,7% would use the toolkit regularly for their lectures. A clear recommendation from the teachers was to develop more educational resources for primary school students.

181. In 2019, two main activities were implemented: one related to the development of a proposal for an Ocean Literacy Strategy for the UN Decade of Ocean Science for Sustainable Development; and the second one to development a pilot ocean literacy professional development workshop for the private sector. The process has involved a series of stakeholder consultations, including an open questionnaire with over 300 respondents from across the world, a participatory multi-stakeholder workshop as well as bibliographical review. The workshop held in Venice in December 2019, was attended by 37 people from 34 countries. As a result of the workshop a set of recommendations to further develop the strategy were put forward. First of all, a statement on vision was proposed, as follows: "Enable and scale up action in all sectors of society regarding Ocean sustainability, in order to accelerate a fundamental shift in the way our ocean is managed'. Furthermore, for strategic purposes, it was proposed to focus the ocean literacy strategy on four Priority Areas, namely: Advancing Policy, Formal Education, Corporate Action and Community Engagement. The ocean literacy professional development workshop was held in Venice on 16–17 December 2019 was attended by 15 people coming from 12 countries. The course included an expert panel with representatives of media, finance, science and NGOs. It presented some good practices of

businesses that have transformed their activities towards ocean sustainability and the implementation of the Sustainable Development Goals.

182. On June 6, a session entitled 'Ocean Literacy as a Unique Opportunity to Advance Quality Education (SDG 4)' was organized in the framework of the Virtual Ocean Dialogues promoted by the World Economic Forum. The session discussed how Ocean literacy can support both formal and non-formal education processes, contributing to SDG 14 and other Sustainable Development Goals by fostering knowledge, skills, actions and learning outcomes, and how it can enhance inclusive and equitable quality education and promote life-long learning opportunities for all.

183. On the occasion of World Oceans Day, 8 June, the first Virtual Ocean Literacy Summit was organized. Under the theme ''Ocean Literacy in the context of UN Decade of Ocean Science for Sustainable Development 2021–2030", the summit focused on answering questions such as how Ocean Literacy can help transform ocean knowledge into action; which Ocean Literacy strategies are needed to contribute to the achievement of Sustainable Development Goal 14; how to bring together different backgrounds, actors and perspectives to use Ocean Literacy as a vehicle to inspire action; and how to create learning opportunities through worldwide collaboration and partnerships. Interactive discussions, with the more than 1,600 participants, centered on how ocean literacy can catalyze advocacy for sound marine policy and public action, mainstream ocean topics into educational systems, foster more responsible citizenry and behavioral changes, encourage ocean aware corporate practices, and stimulate young people to start a career in the ocean affairs. Participants highlighted the potential that the Ocean Decade offers in term of developing innovative and transformative actions across different groups of stakeholders. The summit consisted of three panels that investigated the role of the ocean in connecting, inspiring and engaging people from across the globe. It featured 19 speakers from a vast diversity of sectors including the media, private sector, governments, civil society, arts, NGOs and the scientific sector.

184. An Action Plan on Ocean Literacy was developed for approval by IOC Member States (IOC/A-31/3.5.4.Doc) as well as a dedicated Ocean Literacy Strategy in support of the Ocean Decade (Ocean Decade Series, 22). IOC and the Education Sector of UNESCO have agreed to cooperate closely in the area of ocean literacy in the context of the 41th cycle of the UNESCO Programme and Budget. The Ocean Literacy initiative has resulted into new partnerships with non-conventional partners and stakeholders of IOC, namely private foundations, leading to further and significant financial resources, vibility and impact.

Global Ocean Science Report

The second edition of the GOSR

185. The second edition of the GOSR, the *Global Ocean Science Report 2020* (*GOSR2020*), was launched in the occasion of the celebration of the IOC 60th Anniversary, an on-line event held 14 December 2020, watched by around 650 attendees.

186. The *GOSR2020* offers a global record of how, where and by whom ocean science is conducted. By analysing the workforce, infrastructures, equipment, funding, investments, publications, data flow and exchange policies, as well as national strategies, the GOSR monitors our capacity to understand the ocean and seize new opportunities. In comparison to its first edition, the *GOSR2020* addresses four additional topics: contribution of ocean science to sustainable development; blue patent applications; extended gender analysis; and capacity development in ocean science.

187. It is worth to recall that the IOC Executive Council at its 47th session (Paris, 1–4 July 2014) and the IOC Assembly at its 28th session (Paris 18–25 June 2015) through Decision EC-XLVII/6.2 and Decision XXVII/5.1 respectively, added the publication of the GOSR and its activities as part of the IOC regular programme of work. The first edition of GOSR was published in 2017.

188. The Editorial Board of the *GOSR2020*, composed of 12 members with adequate discipline, geographic and gender balance, has provided the oversight function needed to ensure the scoping of the report, quality assurance and control over its development and finalization, and continuity and renewal between the first and second editions. *GOSR2020* includes 8 chapters, as follows: 1. Introduction; 2. Definitions, data collection and analysis; 3. Funding for ocean science; 4. Research capacity and infrastructure; 5. Analysis of ocean science production and impact; 6. Ocean science for sustainable development; 7. Data and information for a sustainably managed ocean; 8. Charting ocean capacity for sustainable development.

189. The GOSR portal, considered an integral element of the *GOSR2020*, was made available in concomitance with the launch of the Report. It allows open access to thedata underpinning *GOSR2020*. In addition, it has been shaped as an online facility for the global community to submit and update data, and consult data to regularly assess progress on the efficiency and impact of policies to develop ocean science capacity.

Assessing the impacts of the COVID-19 pandemic on ocean science

190. The *Global Ocean Science Report* measures, in a systematic manner, investments in ocean science (human resources, infrastructure such as research vessels and laboratories) as a proportion of national R&D envelopes. Trends in scientific production, including through international scientific collaborations, and in the transfer of research findings to the application sectors (via patents and their licensing) are also measured by the GOSR. It is important to assess the impacts of the COVID-19 pandemic on such strategic investments in relation to the 2030 Agenda. The next edition of the GOSR, expected to be published in 2025, will allow to measure the possible impact of the global pandemic on ocean science in the long-term, including inter alia employment, diversity in ocean science, core funding, additional investments, conferences, observations and publications.

191. In the context of the UNESCO-wide response to the COVID-19 pandemic, the IOC Secretariat will lead a complementary study to the *GOSR2020* to assess the immediate response to the COVID-19 pandemic in the fields of ocean science investment and capacity, with the aim to inform science and policy action to mediate negative impacts, thus supporting efforts to ensure that indispensable services based on knowledge generated through ocean science are maintained and are not put in danger The study, *GOSR2020 snapshot study: Impacts of the COVID-19 pandemic on ocean science investments and capacities,* due in 2022, will also allow to update some of the benchmark information required for the Monitoring & Evaluation framework of the UN Decade of Ocean Science for Sustainable Development, and new information with respect to the SDG 14.a.1 indicator.

IOC Sub-Commission for Africa and the Adjacent Island States (IOCAFRICA)

192. IOCAFRICA made good progress in the implementation of its ambitious work plan adopted by its fifth session meeting from 25–27 March 2019, Nairobi, Kenya. Due to the COVID-19 pandemic, some events were moved online and others postponed to the second half of 2021. The activities implemented covered all priorities areas identified by the Sub Commission.

193. A regional training course on marine GIS was hosted by the Kenya Marine and Fisheries Research Institute in Mombasa from 28 October–1 November 2019 and attended by 22 trainees from Kenya, Mauritius, Mozambique, Nigeria, Senegal, South Africa, and Tanzania. Regional Training Centres for the new phase of the Ocean Teacher Academy programme were designated at the University of Ghana (Accra, Ghana), the Eduardo Mondlane University (Maputo, Mozambique) and the Kenya Marine and Fisheries Research Institute (Mombasa, Kenya). A joint workshop on Environmental Data Analysis planned the FAO/NANSEN programme was postponed due to the COVID-19 pandemic. The preparation of materials to be used for online training is ongoing.

194. IOCAFRICA organized an online regional workshop on “Mapping the Sea Floor around Africa“ jointly with the GEBCO SeaBed2030 project on 10 and 24 February 2021. The webinars,

attended by more than 100 participants from 25 countries provided an opportunity to review the current status of mapping in the region, identify and discuss the needs of stakeholders, and explore opportunities for collaboratively advancing seabed mapping to achieve mutually beneficial outcomes.

195. A series of national marine spatial planning workshops (including environmental pressures that impact on MSP and decision support tools) were organized with support from the Government of Sweden in the following countries in 2020: Cameroun, Gabon, Ghana, Kenya, Madagascar, Mauritius, Mozambique and Tanzania. A regional workshop was also organized for the Gulf of Guinea region. IOCAFRICA is working with the Kenya Marine and Fisheries Research Institute on a publication on “Marine Spatial Planning and the Blue Economy in Kenya”.

196. In the context of the institutional Integrated Coastal Area Management Strategy, IOCAFRICA and IOC/MPR, with the support of the Central African Countries organized a technical workshop on coastal vulnerability in Libreville, Gabon (5–7 November 2019), with the participation of national experts from Angola, Cameroon, Congo, Equatorial Guinea, Gabon, R.D. of Congo and Sao Tome and Principe.

197. The development of the regional node for the Ocean Information Hub commenced with the organization of an online stakeholders meeting in June 2020, followed by bilateral consultations with partners, including IUCN, CORDIO, UNEP (Abidjan and Nairobi Convention secretariats), and WIOMSA on developing interoperability projects. Two virtual meetings on the seaweed Sargassum for Atlantic region organized in 2020, in collaboration with UNEP and IOC’s Sub Commission for the Caribbean and Adjacent regions, agreed on working together on development of Sargassum Information Hub. IOCAFRICA is preparing four policy briefs on climate change adaptation in coastal zones of Africa focusing on (i) Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities, (ii) Changing Oceans, Marine Ecosystems and Dependent Communities, (iii) Extremes, Abrupt Changes and Managing Risks and (iv) Climate Change & Ocean Economy.

198. IOC is implementing a project, funded by the Spanish International Technical Cooperation Agency, aimed at furthering the scientific knowledge and capacity basis in the Canary Current Large Marine Ecosystem (CCLME). The project focuses on assessing the effects of climate change and ocean stressors on the natural dynamics of the Canary Current through a collaborative approach involving scientists, with a focus on female and early career ocean scientists, from Cabo Verde, Gambia, Guinea, Guinea-Bissau, Mauritania, Morocco, Senegal and Spain (Canary Islands). The results of the project have contributed to informing science-based management of the CCLME. As part of this initiative a workshop was organized in in St Vicente, Cabo Verde, from 10–13 March 2020.

199. IOCAFRICA organized a online regional tsunami awaress event with the UNDRR, and a national event for Nigeria with the Nigerian Institute of Ocean and Marine Research (NIOMR) and the National Commission for UNESCO on 5 November 2020. IOC also worked on the publication of a tsunami awareness manual in Swahili with UNDRR. An ongoing survey of the status of ocean observations along the African coastline will inform the preparation of a proposal for the development of a comprehensive African Ocean Observing System.

200. The sixth session of IOCAFRICA (online, 13–15 April 2021) adopted an ambitious work plan focusing on the strengthening the Ocean Observations and Monitoring network, improving the infrastructure for ocean data and information management, the application of ocean science to management and the improvement of ocean literacy and awareness (Cf. IOC/SC-IOCAFRICA-VI/3s). The results of the regional consultations on the UN Decade of Ocean Science for Sustainable Development fed into the preparation of the work plan. The Sub-Commission established a Regional Planning Group to support the development and implementation of regional programmes for the Ocean Decade.

IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE)

201. The IOC capacity development strategy has long been a major element of IOCARIBE's programmes and activities. IOCARIBE has a series of delivery mechanisms used for achieving its capacity development, among them IOCARIBE Strategic Sciences Plan (2017–2026), a draft capacity development strategy; a number of programmes and projects such as IOCARIBE-GOOS, CARIBE-EWS, ODINCARSA, CLME, OTGA, HAB-ANCA. Also, IOCARIBE works with a number of partner organizations such as WMO, UNEP, UN-DOALOS, IAEA, FAO, the European Commission, regional organizations and NGOs. Universities and research institutions have been important partners. Strong focus during this reporting period continues to be on Disaster Risk Reduction, Ecosystem Based Management, and Marine Spatial Planning.

202. *The IOCARIBE Medium Term Strategic Science Plan (2017–2026)* objectives are to: (i) support strategic planning of IOCARIBE Member States in relation to the development of marine sciences, oceanic observations and associated services; (ii) facilitate a coherent management of regional programmes related to the marine-coastal environment and its resources; and (iii) strengthen scientific basis supporting regional programmes. IOCARIBE SSP Lines of Action are: (i) oceans and climate; (ii) ocean science, technology and sustainable use of coastal and ocean resources with special emphasis on large marine ecosystems and integrated coastal area management; (iii) and extreme natural hazards.

203. The Sub-Commission has been working in the implementation of capacity development recommendations and their main Outcome "Strengthening IOCARIBE Member States capacity for a sustainable use of ocean and coastal resources and an increased resilience to climate change." Twenty-five Member States adopted the IOCARIBE Medium Term Strategic Science Plan (2017–2026) as the basis for developing IOCARIBE capacity development work plan, whose objectives are to: (i) support strategic planning of IOCARIBE Member States in relation to the development of marine sciences, oceanic observations and associated services; (ii) facilitate a coherent management of regional programmes related to the marine-coastal environment and its resources; and (iii) strengthen scientific basis supporting regional programmes.

204. The IOCARIBE region has been increasing its capabilities in the marine sciences in recent years. Governmental structures have also been strengthened. The inventory of higher education institutions identified 141 academic higher education institutions in the Americas that offer 777 Ocean sciences programmes. However, 70% of that capacity is concentrated in only five Latin American countries and USA. The major challenge in the ocean sciences is the asymmetrical development and capacity of Member States, and Member States low funding for ocean sciences and research.

205. IOCARIBE, IODE, CARIBE-EWS and the Marine Policy and Regional Coordination Section have carried out a series of training courses during the period June 2019–May 2020 in the region. Particularly at the OTGA Regional Training Center INVEMAR in Santa Marta, Colombia: (i) Curso de Tecnologías de la información (SIG) Aplicado al Medio Marino y Costero, 22–26 July 2019, (ii) Sistemas de Carbonatos, 21–25 October 2019, (iii) Áreas Marinas Protegidas, 18–22 November 2019 and (iv) Cambio Climatico: Carbono Azul y adaptación basada en ecosistemas marinos y costeros, 20–24 April 2020 (postponed due to COVID-19); also (v) strengthening early warning and response capacities for tsunami and other coastal hazards in Central America, 17–19 September 2019; and (vi) Marine Spatial Planning in the Scope of the Sustainable Blue Economy, 1–3 October 2019.

206. Within the cooperation with the IHO Meso-American Caribbean Hydrographic Commission (MACHC), IOCARIBE and MACHC have identified respective capacity development training offerings for 2020 and 2021 and considered co-sponsoring those of common interest to avoid duplication of effort and maximize impact. Also, they are exploring, as a part of their contribution to SEABED 2030, sharing, delivery and management of marine spatial data holdings through pilot projects with partners such as the IOC/IODE and the IOCARIBE Caribbean Marine Atlas.

207. The UN Decade of Ocean Science Regional virtual Workshop for the Western Tropical Atlantic, 28–29 April 2020, provided a regional contribution to the Decade with a focus on IOCARIBE countries' and territories' needs and priorities in terms of transforming knowledge systems; accelerating transfer of technology; enabling training and education; fostering science-policy dialogues, and enabling scientific solutions to the Region's socio-economic challenges.

IOC Sub-Commission for the Western Pacific (WESTPAC)

208. The Sub-Commission recognizes capacity development as one of key means of implementation that helps countries achieve their growth and development goals, and thus integrates capacity development as an essential part of its programmes. Since May 2020, as a result of the prolonged pandemic, WESTPAC adapted its training modality to a hybrid mode with a focus on conducting trainings at national level.

209. The Sub-Commission has been fulfilling its voluntary commitment to the UN Ocean Conference and the IOC Capacity Development Strategy (2015–2021) - "Develop research capacity and transfer of marine technology through the UNESCO/IOC Regional Network of Training and Research Centers (RTRCs) on Marine Science" (#OceanAction15266).The Regional Training and Research Centre on Marine Biodiversity and Ecosystem Health (RTRC-MarBEST) in Indonesia organized 5th training on Mangrove Health Index Development (16–21 November 2020, virtual). In addition to the international trainings in 2020, RTRC-MarBEST organized five national training activities, lasting for fourth month, attended by more than 100 participants from various regions and agencies in Indonesia. The Regional Training and Research Center on Ocean Dynamics and Climate (RTRC-ODC) rescheduled its 10th International training for 5–16 July 2021, focusing on the regional application of coupled climate models. Meanwhile, other three RTRCs, respectively on Reef Management and Restoration, Marine Toxin and Food Security, and Plastic Marine Debris and Microplastics are taking the pandemic as an opportunity to further develop their training modules and plans. Once the pandemic ends, the three RTRCs will be ready to receive young scientists from within and outside region.

210. To sustain the training effects, the Sub-Commission has also been providing opportunity for RTRCs and trainees to engage in relevant WESTPAC programme development and implementation, to help these early career professionals to apply their knowledge, interact with international experts, and further advance their capacity and cooperation.

211. During the pandemic, the Sub-Commission continuously demonstrating its unique value for IOC in turning the COVID-19 into an opportunity to address Member States' specific needs. Since May 2020, technical assistance has been provided to Malaysia, the Philippines, and Viet Nam to enhance their research capacity for ocean acidification. Furthermore, as part of the regional ocean acidification programme, WESTPAC assisted the Government of Thailand in running a national training course on ocean acidification on 25–27 November 2020, Phuket, Thailand.

212. Remote sensing is becoming an important tool for mapping marine habitats. The Sub-Commission took "demands driven, and solution oriented" approach to the development and application of remote sensing techniques. With the generous support of UNESCO/Japanese Funds-in-Trust, WESTPAC works closely with national/local authorities in Viet Nam and Thailand, selected three Marine Protected Areas, Libong Island and Pha-ngang Island in Thailand, and Con Dao site in Viet Nam, as the pilot sites to assist producing seagrass maps for marine protected area management. To this end, The first training course for Thailand stakeholders on Google Earth Engine was conducted from 16 December to 18 December 2020.

IOC Regional Committee for the Central Indian Ocean (IOCINDIO)

213. The IOCINDIO's approach to capacity development is crosscutting and based on a dual mode approach with (i) on-the-job training through research and (ii) students enrolment in academic institutions specialised in ocean sciences and technology towards a long-term local and regional

empowerment. This regional self-driven, ownership and leadership approach reinforces national institutional building. The crosscutting nature ensures that each IOCINDIO programme incorporates capacity development component (Ref. IOCINDIO-VII/3s) as opposed to a stand-alone approach. IOCINDIO Member States significantly invest national resources enabling world class national ocean sciences, technology and innovation infrastructures (institutes, universities and research centres) which lead and drive the capacity development needs and priorities in the region. It is in this context that the National Institute of Ocean Technology in Chennai, India, successfully supported and hosted the IOCINDIO Leadership workshop on regional Framework for Coastal Vulnerability, 6–7 January 2020.

214. During the reporting period, IOCINDIO Officers and the IOC Secretariat pursued mobilization and support of additional Member States and partners for implementing the IOCINDIO networking research infrastructures, facilities and human resources. Subsequently, Kuwait offered to cover the costs for the publication of peer reviewed ocean sciences academic books including: (i) syllabus of ocean and coastal ecosystem and their sustainability on the oceanography of the Gulf/ROPME Area for the use by students, researchers and academicians with online training through Webinar and on job training. This is a significant contribution to the IOC Literacy program and (ii) the Indian Ocean science with its role in the global climate system. The publication is a joint initiative with the Woods Hole Oceanographic Institution (WHOI), Woods Hole/USA.

215. Two OTGA Regional Training Centres have been established in India (INCOIS) and IR Iran (INIOAS) to provide training courses for the region. Four training courses were held during the reporting period: Discovery and Use of Operational Ocean Data Products and Services (RTC India, 1–5 July 2019), Coastal Vulnerability Mapping and analysis using QGIS (RTC India, 26–30 August 2019), Remote Sensing of Coral Reefs (RTC Iran, 20–23 October 2019), and Ocean Colour Remote Sensing – Data, Processing and Applications (RTC India, 25–29 November 2019).

UNESCO Category 2 Centres

216. In the IOCINDIO region, there are two UNESCO Category 2 Centres which are operational and significantly contribute to the endogenous capacity development, namely, the Regional and Research Centre on Oceanography for West Asia in the Islamic Republic of Iran and the International Training Centre on Operational Oceanography at the Indian National Centre for Ocean Information Services (INCOIS). Their reports are available as document IOC/INF-1386. and IOC/INF-1397.

UNESCO Chairs in ocean related fields

217. There is an increased demand from Member States for establishing UNESCO Chairs in ocean related fields. During the intersessional periods new chairs were established in Qatar and Oman.

Key Challenges Encountered in Implementation and Remedial Action Taken

218. Staffing allocated to central capacity development coordination is currently only 0.2 FTE. This is insufficient to reach the ambitions of IOC in terms of implementation of the CD strategy and reaching IOC's full potential. Similarly the secretariats of the regional subsidiary bodies are understaffed and under-resourced. The part-time Secretariat for IOCINDIO remains a critical challenge for the full realisation of the Committee's potential. Secondments/loans of personnel from Member States are being actively sought to support the work of all regional subsidiary bodies.