Ocean Affairs and the Law of the Sea

Contribution of the Intergovernmental Oceanographic Commission of UNESCO to the Report of the Secretary-General

DEVELOPMENTS IN THE FIELD OF OCEAN AFFAIRS AND THE LAW OF THE SEA

Pursuant to United Nations General Assembly resolution 75/239 of 31 December 2020, entitled "Oceans and the law of the sea" the information below represents the contribution of the Intergovernmental Oceanographic Commission of UNESCO (IOC) to the report of the Secretary-General.

MAIN DEVELOPMENTS OVER THE PERIOD

- The Implementation Plan of the UN Decade of Ocean Science for Sustainable Development was presented to the 75th session of the General Assembly and the Decade officially commenced on 1 January 2021. The first Decade Actions were endorsed following the Call for Decade Actions No. 01/2020 which received nearly 250 submissions from partners around the world. The 28 programmes and 33 contributions that were endorsed range across all ten Decade Challenges and touch on subjects as diverse as observations and deep sea research to underwater cultural heritage and the engagement of Early Career Ocean Professionals throughout the Decade.

- The second edition of the Global Ocean Science Report (GOSR2020) was launched in December 2020. 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 the GOSR2017, 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.

- IOC continues to provide active support to Member States in developing capacity to act towards, and report on SDG Indicator 14.3.1 focusing on ocean acidification. Significant progress was made in the collection of new data for this indicator and SDG Indicator 14.a.1 for which IOC has also been assigned the custodian role. The ocean acidification data portal is now fully established and facilitates uploading of data by Member States. No additional funding has been secured for the development of the Index for Coastal Eutrophication Potential (ICEP) as an indicator for SDG 14.1.1 and as such this indicator was not implemented in 2020 as initially intended.

- IOC has convened the main players in ocean carbon research and systematic observations under the umbrella of an expert Integrated Ocean Carbon Research (IOC-R) initiative. 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). 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 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'. 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). The IOC working group on multiple ocean stressors is finalising a scientific summary for policy makers.

- Observations work at IOC focused amongst other issues on assessing, anticipating and responding to the effect of the COVD-19 pandemic on global ocean observations. To this end,

the GOOS Observations Coordination Group has focused efforts on increasing resilience of the observing system. The GOOS Core Team located in the IOC Secretariat spearheaded efforts to convene the observations community around global Decade Actions that aim to transform the global observations system over the Ocean Decade. These Actions are developed around a common theme of increasing integration for GOOS and will be a central part of a larger community of practice of ocean observations initiatives in the Ocean Decade.

- Between May 2020 and May 2021 11 million presence records were added to the Ocean Biodiversity Information System providing over 22,000 new species to the database that now contains over 70 million occurrences. The ODIS Catalogue of Sources was expanded to include more than 2000 additional descriptions of online content sources. The OceanInfoHub Project is underway to support the development of the ODIS architecture and develop communities of practice in Africa, Latin America and Caribbean, and Pacific SIDS regions. This initiative focuses on improving discovery and interoperability of existing information systems. The Ocean Best Practices repository now contains over 1200 records.

- Tsunami exercises were held in the Caribbean, Indian Ocean, Mediterranean and Pacific regions with adapted measures to take account of sanitary constraints linked to the COVID-19 pandemic. World Tsunamic Awareness Day 2020 was structured as a 30-day campaign focused on the Global Target (e) of the Sendai Framework. The first Global Harmful Algal Bloom Status Report was completed and launched and capacity development initiatives contributed. IOC is supporting development of a pilot national early detection / early warning system for marine invasive species in Fiji.

- Through the European Commission funded MSP Global project IOC carried out a large number of online training and information sessions, with a focus on developing countries and small island developing states. A major new publication on coastal vulnerability in the context of integrated coastal management and marine spatial planning is being completed and will be published in 2021.

- The Ocean Teacher Global Academy added 16 new regional training centres to its network. These centres located in South America, Africa, Europe, Asia and the Pacific will expend the global reach of the Academy which is increasingly focusing on e-learning and will incorporate training initiatives directly linked to the Ocean Decade. Ocean literacy activities focused on the development of communication and engagement assets as well as training modules for diverse actors. The Ocean Decade Ocean Literacy Action Framework was completed and the Ocean Literacy With All Programme registered as a Decade Action.

UNITED NATIONS DECADE OF OCEAN SCIENCE FOR SUSTAINABLE DEVELOPMENT

1. 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 that noted with appreciation the Implementation Plan and requested IOC to continue in its coordination role throughout the implementation phase.

2. 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.

3. 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 IOC Executive Secretary made decisions on endorsement of a first set of 28 Decade programmes and contributions. Six UN-led Decade Actions were also registered. 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.

4. 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. The Ocean Decade Monitoring and Evaluation Framework is being developed and will be rolled out by the end of 2021.

5. 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. The First International Ocean Decade Conference which is being hosted by Germany was opened with a high-level virtual event 1 June 2021 that will be followed by a series of interactive virtual sessions around the Decade outcomes. During this period a large 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.

6. 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.

OCEAN RESEARCH

Global Ocean Science Report (GOSR)

7. 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. 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.

8. 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 the data 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.

9. The GOSR 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.

10. 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.

Understanding climate change and its effects on the world ocean

11. 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).

12. 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. 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)

13. IOC continued to provide the function of the technical secretariat of the GOA-ON, together with the International Atomic Energy Agency (IAEA). 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.

14. 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 2020.

15. 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.

16. 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'. GESAMP WG 41 reconvened 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

17. 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.

18. 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, outlining 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. 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.

19. The IOC Executive Council at its 51st session agreed to establish a new IOC working group focusing on multiple stressors. 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 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.

20. 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 built 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.

OBSERVING SYSTEMS AND DATA MANAGEMENT

Ocean observing implementation and COVID-19

21. 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.

22. 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

23. 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 centre 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. 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 **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 **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 centre 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 ***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. 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

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

30. 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.

31. 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.

Data management

32. 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.

33. 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. 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.

34. 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 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 focusing 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.

35. 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.

36. 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.

37. The **World Ocean Database** (http://wod.iode.org/) was first released in 1994 and updates have been released approximately every four years. 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.

38. 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.

39. 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.

40. The **OceanTeacher Global Academy** (OTGA) (https://www.oceanteacher.org) entered its second phase in April 2020. A call for hosting training centres resulted 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 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.

EARLY WARNING AND SERVICES

Tsunami Warning Systems

41. 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. 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).

42. 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 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.

Tsunami Exercises

43. 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.

44. 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.

45. 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.

46. 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).

47. 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).

48. 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: (i) TSP-to-TWFP and NTWC communication test on November 5, 2020, and (ii) CATAC regional exercise.

Tsunami Events

49. 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.

50. 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

51. 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.

52. 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.

53. 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

54. Human and national capacity to deal with tsunamis are still unevenly spread among nations. Since its start the IOC 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.

55. 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

56. The 2020 edition of the World Tsunami Awareness Day (WTAD) was jointly organized by UNDRR and the IOC, 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. 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.

57. 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.

58. 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.

Harmful Algal Bloom programme

59. 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. 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.

60. 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).

61. 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. 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.

62. 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. 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*.

63. 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.

64. 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.

65. 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.

66. 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..

67. 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

68. 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 activities addressing marine invasive species.

69. 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.

70. 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.

71. 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.

72. 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.

73. 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). 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.

ASSESSMENT & INFORMATION FOR POLICY

Sustainable Development Goals (SDG)

74. 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.

75. 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).

76. 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.

Ocean and coastal Atlases

77. 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.

SUSTAINABLE MANAGEMENT & GOVERNANCE

Integrated Coastal Area Management, including Marine Spatial Planning

78. Through the MSP Global project funded through the 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.

79. 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.

80. 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.

81. 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.

82. 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/

83. 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.

84. 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

85. 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 aimed 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

86. 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).

87. 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.

REGIONAL INITIATIVES

IOC Sub-Commission for the Western Pacific (WESTPAC)

88. 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.

89. 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. 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.

90. To further catalyse 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.

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

91. 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. 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.

92. 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.

93. 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 focused 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.

94. 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.

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95. 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).