Ocean Decade
Vision 2030
Outcomes Report

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

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Ocean Decade Vision 2030 Outcomes Report

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Acronyms

BBNJ	Biological Diversity Beyond National Jurisdiction
CBD	Convention on Biological Diversity
ECOP	Early Career Ocean Professional
EOV	Essential Ocean Variable
FAIR	Findable, Accessible, Interoperable and Reusable
FAO	United Nations Food and Agriculture Organization
IOC/UNESCO	Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization
LDC	Least Developed Country
NAP	National Adaptation Plan
NBSAP	National Biodiversity Strategy and Action Plan
NDC	Nationally Determined Contribution
SDG	Sustainable Development Goal
SIDS	Small Island Developing State
StOR	State of the Ocean Report
UNFCCC	United Nations Framework Convention on Climate Change

Introduction

The UN Ocean Decade of Ocean Science for Sustainable Development

The proposal for a UN Decade of Ocean Science for Sustainable Development (Ocean Decade) was first brought to the international community by UNESCO's Intergovernmental Oceanographic Commission (IOC/UNESCO) in 2016 in a period where ocean science was largely overlooked on the international policy landscape. While the 2030 Agenda included the major milestone of a Sustainable Development Goal (SDG) related to the ocean in the form of SDG14 - Life below water, there was little other recognition of the importance of the contribution of the ocean to the achievement of many of the other SDGs, and virtually no discussion of the role of the ocean in achieving global aspirations for climate change, biodiversity conservation or food security just to name a few.

Fast forward to 2024 and the context has radically changed, and the role of the ocean as a key influence in the condition of social, economic, and ecological systems has never been more visible. The recent adoption of the Agreement under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ agreement), the formalization of the discussion on the ocean in the United Nations Framework Convention on Climate Change (UNFCCC) through the formalisation of Ocean-Climate Dialogue, as well as the inclusion of marine targets in the Kunming-Montreal Global Biodiversity Framework are key examples of the change at the international level. At the national level, increasing numbers of governments are focusing on the role of the ocean and maritime sectors as an integral part of sustainable and equitable economic development.

This welcome evolution only increases the relevance and role of the Ocean Decade. Achievement of the ambitious global, regional, and national policy frameworks and strategic ambitions requires relevant and timely ocean science and knowledge. Critical gaps remain in ocean science and knowledge – whether they be thematic, geographical or for certain biomes. And, where knowledge exists, it is not always available in a form that allows fluid transmission and thus application across the science – policy – society interface.

With its vision of the 'science we need for the ocean we want', and its broad adopted definition of ocean science that encompasses all forms of ocean knowledge and which is founded on principles of inclusivity, equity and diversity, the Ocean Decade is an agile framework that convenes diverse stakeholders to co-create and co-deliver the science and knowledge that is needed for decision making.

Framed around its Implementation Plan, and structured around ten Ocean Decade Challenges, which represent the most immediate and pressing needs for ocean knowledge, and built on a massive portfolio of Decade Actions, the Ocean Decade aims to transform the way that ocean science and knowledge is generated and used and thus precipitate a shift from the ocean we have to the ocean we want by 2030.

Achievements of the Ocean Decade

Since its debut in January 2021 the Ocean Decade, which is being coordinated by IOC/UNESCO on behalf of the United Nations system, has become the largest global ocean science initiative ever undertaken. In just over three years, the Decade has catalysed the emergence of over 50 global ocean science programmes in which transdisciplinary teams of international partners from across society are working to contribute to fulfilment of the Ocean Decade Challenges. Contributing to these programmes are close to 350 national and regional projects, and close to 100 formal contributions of in-kind or financial resources. Over 4500 institutions are involved in these Decade Actions, and over 70,000 individuals are directly or indirectly contributing to their success. Close to USD 1 billion USD has been mobilized by the Decade Actions, although resourcing remains a critical challenge to the success of the Decade. A transformative shift in the way that ocean science is resourced – in terms of both the volume and type of resourcing – will be required to ensure the sustainability of the Decade impact.

The Decade has made good strides in delivering on its commitment to inclusivity, equity, and diversity. Thousands of Early Career Ocean Professionals are engaged in Decade Actions and 57 percent of individuals involved in Decade Actions are women. Challenges remain in ensuring geographical diversity amongst the lead institutions and individuals of Decade Actions, with few lead partner institutions based in Small Island Developing States (SIDS) or Least Developed Countries (LDCs). Continued targeted efforts are needed to support these partners in the development and resourcing of relevant Decade Actions. Over 4000 capacity development initiatives have been undertaken via the Ocean Decade and approximately 200,000 individuals have benefited from diverse forms of capacity exchange and development.

However, this success also creates challenges. The rapid growth of the Ocean Decade has been achieved through a predominantly bottom-up process which has generated strong global momentum, visibility for the role of ocean knowledge for sustainable development, and shared ownership for the success of the Decade. However, if such growth continues without a clearer pathway to achieve collective impact across themes and geographies, there is a strong risk that the massive efforts underway will be dispersed and disconnected, and a unique opportunity to consolidate efforts for transformative change will be lost. Moreover, without a clear process in the Decade to ensure that the identification of future priorities is driven by 'users' of science and knowledge, there is a risk that the science and knowledge that is generated fails to be taken up and used where it is most needed.

The Vision 2030 Process

From the outset, the Ocean Decade was designed to be adaptive so that it could respond to emerging issues and continue to evolve as an agile framework for action. The Implementation Plan envisages a series of milestone moments over the life of the Decade in which the Ocean Decade community will come together to take stock of progress and discuss future priorities for the remainder of the Ocean Decade. The 2024 Ocean Decade Conference is the first of these moments of reflection in the life of the Decade. It comes at a critical time in the Decade when there is a unique window of opportunity to build on the significant energy and momentum that has been built since the start of the Decade in 2021.

The Vision 2030 process is the operational framework that has been designed and implemented over the last twelve months to feed this process of reflection and priority setting. It is centred around the ten Ocean Decade Challenges, which form the central pillars of action for the Decade. It is a participatory and iterative process aimed at setting a tailored and specific strategic ambition or 'end goal', and associated milestones, for each Ocean Decade Challenge. In simple terms, the strategic ambition for each Ocean Decade Challenge will provide the answer to the question:

> "*What does success look like for this Challenge at the end of the Decade?*"

The associated milestones will provide information to answer the question:

> "*What do we need to have achieved at different intervals during the Decade to be on the defined path to success for this Challenge?".*

The Vision 2030 process has been developed to identify future priorities for the Decade in terms of science, knowledge, capacity, resources, or infrastructure that are needed to fulfil each Ocean Decade Challenge, as well as considering the needs to strengthen the linkages across Challenges. It also allows the Ocean Decade Challenges to be refined or updated to address emerging issues so that they remain relevant over the life of the Decade. The results of the process will contribute to the enhanced identification of priorities for resource mobilisation and for the development of new and innovative partnerships to achieve the vision of the Ocean Decade. Ultimately, the results of the Vision 2030 process will demonstrate a pathway to the success of the Decade to 2030, thus also ensuring the foundations of legacy of the Decade post-2030 in its broader goal of contributing to long-term sustainability.

The indicators and milestones developed through the process will be integrated into the Monitoring and Evaluation Framework for the Ocean Decade and thus ensure tracking of progress towards achievement of the strategic ambition at the level of the Challenges and across the Challenges. This will complement the regular analyses of the progress of Decade Actions, and the State of the Ocean Report (StOR) which is produced by IOC/UNESCO as a means of tracking progress towards the higher-level outcomes of the Ocean Decade.

The Vision 2030 process has initially focused on the strategic ambition of the Ocean Decade Challenges at the global level but provides a framework for priority actions for each Challenge that will be translated to regional and national priorities thus allowing these regional and national structures associated with the Decade to harmonise and contribute in a coherent way to the global effort while meeting locally relevant needs.

The Vision 2030 process has been coordinated by the Decade Coordination Unit within IOC/UNESCO and implemented primarily through a network of ten expert Working Groups, one for each Ocean Decade Challenge, which comprise representatives of 'users' of science and knowledge, Decade Actions, and subject matter experts. Under the leadership of two Co-Chairs, each Working Group has developed a draft White Paper that documents the strategic ambition for the Ocean Decade Challenge, together with the associated milestones and indicators. These White Papers have undergone one round of public review in early 2024 and updated drafts of these documents, together with this Outcomes Report that has been authored by the Decade Coordination Unit, will form substantive inputs to discussion at the Conference before being finalized in mid-2024.

Scope of the Outcomes Report

The Vision 2030 Outcomes Report provides a synthesis of the main outcomes of the White Papers for each of the Ocean Decade Challenges. It has been developed by the Decade Coordination Unit and has drawn on the White Papers that were authored by the Vision 2030 Working Groups. It also explores in more detail priority common themes emerging across the White Papers. The report identifies a series of transversal priorities and opportunities to hone the interactions across the Ocean Decade Challenges to strengthen and enhance the impact of the Decade. Following discussion and consensus on the priorities proposed in this zero-draft version of the report, a set of high-level indicators and milestones to measure progress against these recommendations will be developed.

The primary temporal focus of the Vision 2030 Outcomes Report is the end of the Ocean Decade in 2030. However, the Decade has been designed to be transformative, and thus there will need to be significant investment in the deliberate construction of the post-2030 legacy of the Decade. As relevant, the Vision 2030 Outcomes Report and the White Papers discuss and make recommendations to sow the seeds of that legacy post-2030.

While the 2024 Ocean Decade Conference is a critical moment for the Ocean Decade community to discuss the outcomes of the Vision 2030 process via consideration of the White Papers and the Outcomes Report, the process will not end in April 2024. The current zero draft version of the Outcomes Report will be discussed in depth at the 2024 Ocean Decade Conference, alongside the draft White Papers and feedback received will be used to refine the full set of documents. Following the finalization of the White Papers and Outcomes Report, an implementation strategy will set out the means of operationalizing the key recommendations, including the translation of the global ambition to regional and national priorities.

The strategic ambition of the Ocean Decade Challenges

The Ocean Decade Challenges

The ten Ocean Decade Challenges have a central role in the theory of change for the Ocean Decade. Defined as the most immediate and pressing needs for ocean knowledge within the Ocean Decade, they are the polestar for collective action in the Decade both individually and through innumerable implicit and explicit interactions between the Challenges. All Decade Actions are loosely organized around the Ocean Decade Challenges and the aim is that via different processes and structures the ecosystem of Decade programmes, projects, contribution, and activities work collaboratively to fulfil the Challenges. The Challenges aim to cover all facets of ocean science and knowledge and are broadly categorized into three categories. First the Challenges that address priority needs for knowledge and solutions, second the Challenges that address the infrastructure required to generate, manage, and share knowledge and solutions, and third the Challenges are more strongly focused on the cross-cutting principles underpinning success of the Decade (refer Figure 1).

The current set of Ocean Decade Challenges, which are documented in the Implementation Plan, were identified throughout the three-year preparatory process of the Ocean Decade, including through discussions in eleven regional workshops that were held from 2019 to 2020. Throughout their development, it was always recognized that the Challenges were representative of a moment in time and that their ongoing refinement and evolution would be essential to the relevance, and thus the success, of the Decade. It was also recognized that it was impossible at the beginning of the Decade to fully establish the strategic ambition or quantifiable measure of success for the Challenges. The Vision 2030 process has these two aims. It will, for the first time since the beginning of the Decade, consider the need to refine and update the Challenges and to set a quantifiable measure of success by exploring the question 'What does success look like for this Challenge at the end of the Decade?'. The Ocean Decade Challenges as they were defined in the Implementation Plan are shown in Figure 1. The following section includes the suggested refinements to the Challenges on the basis of the Vision 2030 process.

In keeping with the adaptive nature of the Decade, this process of refinement and ambition setting will continue throughout the remainder of the Decade including during the next two international Ocean Decade Conferences planned in 2027 and 2030.

Figure 1: The 2021 Ocean Decade Challenges

Strategic ambition of the Ocean Decade Challenges for 2030

This section draws from the Vision 2030 White Papers to document the strategic ambition for each Ocean Decade Challenge to 2030, as well as suggested refinements to the Challenges where relevant.

Challenge 1: Understand and beat marine pollution

By 2030, the success of Ocean Decade Challenge No. 1: Understand and beat marine pollution will be demonstrated by the establishment of new connections among scientists, the private sector, resource providers, civil society, marine-dependent populations, Indigenous communities, governmental agencies, and policymakers. These connections aim to generate scientifically sound data to enable a holistic understanding of the extent and impact of pollution across the land-ocean continuum, supporting the achievement of a cleaner and healthier ocean where all ecosystems and their inhabitants thrive free from the impacts of marine pollution, allowing for their full functioning and service provision. These connections and partnerships will lead to the development and implementation of new technologies and projects aimed at monitoring, controlling, reducing, and/or mitigating marine pollution from any source, including emerging pollutants, and including at the local,

regional, or global level. Additionally, these partnerships will support the creation and sustainability of a global network of strategically positioned sentinel sites and laboratory hubs for long-term monitoring of marine pollution.

Success will include fulfilment of critical science and knowledge gaps through a systematic global pollution assessment. This will contribute to a including a holistic understanding of the impacts of priority pollutants (e.g., pollutants found in high concentrations, or with high toxicity, or with adverse effects on human health and ecosystems) across the land to ocean continuum, a better understanding of the sources, sinks, fate and impacts of all pollutants, including the pollutants of emerging concern, and improved knowledge on the distribution and impacts of marine pollution, particularly in the Global South and deep ocean waters, which represent the largest geographical gaps. It will also include fulfilment of priority datasets gaps including long-term time series of marine pollutants; baseline and toxicity data of pollutants across the land-ocean continuum; data on the impacts of the co-occurrence of multiple pollutants; and data on the effects of climate change on the toxicity, bioavailability and impacts of multiple co-existent pollutants.

Achievement of this success will require development of regional laboratory hubs; a global network of strategically positioned sentinel sites for long-term monitoring; cost-effective, real-time monitoring systems and technologies for tracking pollutant sources, distribution, and transfers across the land-ocean continuum; capacity development programmes on harmonized protocols for the acquisition, reporting and recording of quality-controlled data on marine pollution; and environmentally robust new technologies and processes for the control and mitigation of marine pollution.

Clear bi-directional pathways to policy frameworks for marine pollution will need to be established both in terms of mechanisms for policy needs to drive the identification of key research activities, and in terms of tools to communicate science and knowledge so that it can support policy development and implementation. An example is the need to develop standardized approaches to the monitoring of plastic as a contribution to a future international legally binding instrument on plastic pollution.

Challenge 2: Protect and restore ecosystems and biodiversity

By 2030, the success of Ocean Decade Challenge No. 2 will be measured by the widespread implementation of ecosystem-based management approaches that use timely and accurate information to promote sustainable development, including, but not limited to, the effective conservation and restoration of ecosystems and biodiversity. This includes using an adaptive and proactive, albeit precautionary approach to management, meaning promoting evidence-based actions even if the information is incomplete.

Success will rely on convergence on a practical set of essential ocean biology and ecosystem variables including from among those defined by the Global Ocean Observing System (GOOS). This will require significant improvements in the methods, collection, curation, interpretation, and access to quality biological, environmental, social, economic, and cultural information. It will be of particular importance to address critical science and knowledge gaps on biology, biodiversity and ecosystem changes under diverse and dynamic geographic, social and economic conditions. This includes understanding and continuous monitoring of coastal, open ocean and deep-sea biodiversity change, connectivity and habitat interdependencies within the ocean, and the vulnerability of deep benthic, polar, coastal and estuarine ecosystems to human and climate-driven impacts. It also includes increased understanding of the potential impacts of existing and emerging activities including fishing, seabed mineral exploitation and marine carbon dioxide removal. It requires the identification of drivers of change, addressing the cumulative effects of human activities and climate change on biodiversity and developing the tools, skills and awareness needed to ensure systematic adoption of an integrated ecosystem-based management approach, including conservation and restoration measures in both national waters and areas beyond national jurisdiction (ABNJ).

As for other Ocean Decade Challenges, links between the Ocean Decade outputs and policy frameworks including the Kunming-Montreal Global Biodiversity Framework and the BBNJ Agreement require deliberate reinforcement, both in terms of how policy needs drive the prioritisation of science and knowledge generation, and how science and knowledge is used to develop and implement policy. The need for specific efforts at the national level is clear, with countries requiring targeted support to identify and fill science and knowledge gaps to meet their national commitments under these agreements. Additional efforts are required to ensure that actions of the Ocean Decade are aligned and create synergistic impact with the Decade for Ecosystem Restoration.

Local communities, particularly in many SIDS and LDCs, are particularly vulnerable to the impacts of biodiversity loss and require increased capacity to monitor and use information about marine life that complements Indigenous and local knowledge systems. Management efforts need to recognise the contribution of all knowledge systems and facilitate engagement in the design and implementation of ecosystem-based management.

An important need of management and planning is to incorporate biodiversity and environmental data into models, including local, regional, and global ocean and earth system models. This must be done at a high spatial resolution, sufficient to match physical and biological processes with specific management needs. Other issues need immediate attention. This includes interoperability of observations across projects, increasing connectivity between marine life databases and environmental and socio-economic databases, and strengthening dialogue and collaboration among stakeholders, rightsholders, natural and social scientists, and government agencies. Investments in making data interoperable and comparable spatially and temporally and understanding how to use information on biodiversity in the context of ecosystem-based management, are very high priorities. Further, to ensure sustainable development, investment needs to spur co-design activities in data collection and dissemination and strengthen the use of this information for collaborative ecosystem-based management approaches.

To reflect the above, it is proposed to refine Challenge 2 as follows.

Challenge 2 – Understand and conserve ecosystems and biodiversity: Measure and understand marine biodiversity and ecosystem change to underpin protection, conservation and restoration, including the use of timely and accurate monitoring and forecasting information, and engage local communities in the co-design and implementation of ecosystem-based management.

Challenge 3: Sustainably feed the global population

By 2030, success for this Ocean Decade Challenge 3 will be to generate the science and knowledge needed to contribute to sustainably nourishing a global population with food from the ocean. The aim of Working Group 3 was to outline what is needed to generate the science and knowledge necessary to ensure the ocean is recognized and leveraged as a key contributor to nourishing the global population. This will require a paradigm shift towards science that supports a "one food system" approach that leverages multiple disciplines to support a Blue Transformation of the aquatic food sector, as described in the Challenge 3 White Paper[1]. It will also support work across fisheries, aquaculture and value chains, a shift towards a nutrition- and human health-focused understanding of the production and distribution of aquatic foods, and a focus on equity in access and distribution to address hunger and malnutrition, whilst respecting ecological boundaries of aquatic food systems.

To fully capitalise on the potential of a Blue Transformation, the Ocean Decade must work to fill critical science and knowledge gaps related to effective governance, sustainable production, equitable access, and emerging issues (e.g. alternative aquatic foods, innovation and technology such as artificial intelligence in production, and expanding circular food systems). Critical science needs include methods for identifying and addressing the multi-level trade-offs necessary for sustainable aquatic food systems, taking into account the needs of small-scale fisheries and aquaculture in particular; science to support improved production, both of wild-caught fisheries and aquaculture; and science to improve equity and access. Overall, science must be forward-looking, exploring and evaluating new frontiers in knowledge and technology.

Success will also rely on co-design of science by engaging local agents of change, supporting two-way knowledge, lesson, and benefit sharing, and increased access to interdisciplinary science and knowledge. The Ocean Decade will need to critically harness science that may not be traditionally considered ocean science (e.g. social, economic, behavioural, health, and nutrition sciences). Capacity building will be critical to enhance local science capacity, enable knowledge and technology transfer (South-South and North-South), and develop capacity to use different knowledge systems and new knowledge. Increased recognition for the role of local brokers and decentralised institutions for capacity sharing and development is critical.

Success will also depend on leveraging and enhancing existing and building new partnerships (e.g. public-private and cross-stakeholders collaboration, cooperation with and within small-scale fisheries and aquaculture

[1] FAO (2022) *In Brief to The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation*. Rome, FAO. Available at: https://doi.org/10.4060/cc0463en.

as well as between large and small-scale industry, and with the UN Decade of Nutrition). At the Ocean Decade level, collaboration will continue with FAO, including in the context of the UN Decade of Nutrition. It is also critical to strengthen the involvement of private sector actors, spanning from production to supply chains, to advance data, technology, innovation, and capacity-building.

Success will also require an important focus on infrastructure, including data infrastructure (storage, delivery, protocols for data sharing, inexpensive data collection and visualisation methods and platforms), institutional infrastructure (especially in the Global South within the Ocean Decade ecosystem), and technical infrastructure (e.g. supply chain infrastructure for small-scale fisheries and aquaculture). Finally, technical innovation for sustainable, feasible, and cost-effective production and distribution methods, especially for small-scale fisheries and aquaculture will be critical for success, especially to address emerging issues.

To reflect the above, it is proposed to refine Challenge 3 as follows.

Challenge 3 – Sustainably nourish the global population: Generate knowledge, support innovation and develop solutions to optimize the role of the ocean in sustainably nourishing the world's population under changing environmental, social and climate conditions.

Challenge 4: Develop a sustainable and equitable ocean economy

By 2030, success for Ocean Decade Challenge No. 4: Develop a sustainable and equitable ocean economy, will be marked by significant advancements in establishing a knowledge-driven framework for informed decision-making and policy formulation. There will be enhanced collaboration among stakeholders, ensuring diverse community engagement and equitable benefit sharing. Strategic mobilization of blue finance will support investments in sustainable coastal and marine infrastructure, innovative technologies, and conservation efforts, reinforcing the economic foundation. Key policies and governance frameworks promoting sustainability and equity will be in place, laying the groundwork for a resilient and inclusive ocean economy. This success will be underpinned by improved data accessibility and capacity-building efforts, fostering a shared understanding and commitment to sustainable ocean use. The widespread adoption of sustainable ocean planning and ocean accounting systems will be critical to achieving this success.

Success will include fulfilment of the following critical science and knowledge gaps: addressing the interface between knowledge systems, policy implementation, and public-private partnerships to enable informed decision-making; focusing on biodiversity restoration, protection, and sustainable management as foundational elements of a sustainable and equitable ocean economy; increased understanding of the effects of climate change on priority maritime sectors contributing to a sustainable ocean economy, and ensuring the inclusion of local and Indigenous knowledge alongside environmental sustainability and social equity. The following priority datasets gaps will be targeted: comprehensive and up-to-date data on both human activities and state of the environment supporting informed and equitable decision-making and ensuring stakeholder and rights holder engagement in data capture and knowledge co-production. It will include the development of robust capacity development and knowledge exchange to deepen understanding of ocean-human activity interconnections, emphasizing investment in context-specific education, training, and research programs, and the integration of context-appropriate technology and innovation to support a sustainable, equitable, and resilient ocean economy.

Structured and systemic engagement with industry, government, and civil society partners from a multitude of sectors that contribute to the sustainable ocean economy will be essential for the success of this Challenge.

Based on the above, it is proposed to refine Challenge 4 as follows:

Challenge 4: Develop a sustainable, resilient, and equitable ocean economy: Generate knowledge, support innovation and multi-sectoral partnerships, and develop solutions for equitable, resilient and sustainable development of the ocean economy under changing environmental, social and climate conditions.

Challenge 5: Unlock ocean-based solutions to climate change

By 2030, success for Ocean Decade Challenge No. 5 will be marked by a move toward a more sustainable and climate-resilient ocean that aligns with the SDGs of the 2030 Agenda. Crucially, the success of Challenge 5 is intricately linked to the outcomes of Challenges 1 to 4, which focus on understanding climate-ocean interactions, controlling marine pollution, conserving biodiversity, and ensuring sustainable food production.

Success will include fulfilment of critical science and knowledge gaps with respect to climate mitigation and adaptation. Both approaches need to be addressed in parallel. Key mitigation approaches for which there are critical knowledge and solutions gaps include the development of marine renewable energies, reduction in marine pollution, the development of blue carbon, and marine carbon dioxide removal. Specifically, there is a need for research into marine renewable energy, ways of reducing marine pollution, and ways of expanding vegetated coastal ecosystems which will enable global-scale implementation by 2030. Significant new knowledge is required to understand ecological, social and technological feasibility and the full range of potential impacts of marine carbon dioxide removal initiatives. Controlled field testing of marine carbon dioxide removal must be co-designed and implemented with invested communities, modelled, and monitored before the end of the Decade. Adaptation approaches for which there are critical gaps in knowledge and solutions include increased ocean literacy/awareness, co-designed governance and co-operation, improved risk reduction policies, and improved predictive capability of ocean, climate, and weather forecasts. Ocean stewardship, improved ocean literacy, and ocean-based solutions to climate change must be enhanced by a movement towards co-designed governance and co-operation between users, including local and indigenous communities by 2030. Adaptive governance and management should be supported by decision support tools for the assessment of vulnerability and risk to coastal communities and marine industries, and for developing climate change adaptation pathways by the end of this decade.

Important gaps still remain in terms of the geographical scope of the actions under this Challenge. The identification of future priorities for science and knowledge generation should include targeted activities to support countries in the development of ocean and marine related elements of their National Adaptation Plans (NAPs) and Nationally Determined Contributions (NDCs).

Challenge 6: Increase community resilience to coastal hazards

By 2030, successful achievement of Ocean Decade Challenge No. 6 will require demonstrating substantial advancements towards enhancing resilience to coastal and ocean hazards. This includes implementing two crucial elements: (i) establishing comprehensive 'people-centred' early warning systems capable of addressing multiple hazards, and (ii) devising adaptation strategies that specifically target risks associated with the ocean, including those linked to climate change. These endeavours will play a pivotal role in guiding sustainable practices in ocean planning.

Success will also hinge on addressing critical gaps in scientific understanding and knowledge across important components such as risk assessment and risk reduction, in addition to putting in place robust institutional mechanisms for implanting novel solutions that contribute to coastal resilience. Some key elements to be addressed in this context include: gathering and generating observational and modelling datasets relevant to risk assessment, including downscaled climate scenarios for coastal regions, within robust data-sharing frameworks; promoting interdisciplinary and international research and innovation to tackle challenges comprehensively, with a focus on methodologies like Digital Twin approaches; improving standards for risk communication at both national and international levels; fostering partnerships at various scales involving local communities, public and private disaster risk reduction entities, governmental bodies, and academic institutions; building capacity in research and communication to cultivate a shared understanding of coastal resilience strategies; and enhancing resilient infrastructure and promoting sustainable resource management along coastlines to underpin nature based solutions to coastal resilience. To achieve this ambition, it is imperative to establish stronger partnerships with existing international UN programs dedicated to disaster risk reduction and coastal resilience. It will also be important to establish a Coastal Resilience Review of Requirement (C3R) process, which involves clearly identifying diverse stakeholder needs and implementing a periodic consultation mechanism with Member States to assess progress in coastal areas worldwide and residual science and knowledge gaps.

Based on the above it is proposed to Challenge 6 as follows:

Challenge 6 - Increase community resilience to ocean and coastal risks: Enhance people centred multi-hazard early warning services for ocean and coastal hazards and develop adaptation strategies, including those that incorporate nature-based solutions to coastal resilience, and that target risks associated with the ocean including those linked to climate change.

Challenge 7: Expand the global ocean observing system

By 2030, success for Ocean Decade Challenge No. 7 is to have a clear roadmap to enable the achievement of a sustainable and sustained, co-designed, fit for purpose, multidisciplinary and geographically expanded global ocean observing system. The system would be developed to deliver accessible, societally relevant data to all countries and users to manage risk, respond to climate change, forecast weather and extremes, monitor and manage ocean health and offer real time services. Monitoring and transforming ocean data into useful information will require integration across disciplines, across national observing systems, and across stakeholders, as well as the implementation of innovative and diversified alternatives to current technological, cultural, capacity building, and economic models, incentivising the private and philanthropic sectors.

A successful expanded ocean observing system will be achieved by strengthening and expanding the existing array of in situ and remote observing platforms and developing new or enhanced automated technologies, sensors, and platforms to fulfil critical science and knowledge gaps. Some of these knowledge gaps include remote areas like the high seas and the Southern Ocean, hard-to-access areas like the deep ocean and polar oceans, and coastal areas in the Global South especially those areas experiencing rapid change, making sure that the capabilities of the observing networks provide spatial and temporal resolutions that are fit for purpose. Thematic priorities for ocean observing are weather (including events), hazards, ocean health and marine biodiversity and resources.

Coordinating and democratizing the generation, access, processing, and use of ocean data, including developing AI integrated models and machine learning tools to extract more user-ready information from existing datasets, prioritized by their societal relevance and aligning with Essential Ocean Variables (EOVs) will be critical. A major success will be to have all data made Findable, Accessible, Interoperable and Reusable (FAIR).

Based on the above, it is proposed to refine Challenge 7 as follows:

Challenge 7 - Sustainably expand the global ocean observing system: Ensure a sustainable and sustained ocean observing system across all ocean basins that delivers accessible, timely, and actionable data and information to all users.

Challenge 8: Create a digital representation of the ocean

By 2030, success for Ocean Decade Challenge No. 8 is to have in place the enabling environment consisting of a set of operational tools and services facilitating the creation of, and access to, an increasing number of digital representations and digital twin applications of the ocean, as well as the underpinning data and information needed to develop them. While creating a comprehensive digital representation of the Ocean, is the ultimate objective of Decade Challenge 8, the strategic ambition for this challenge by 2030 is to deliver concrete outcomes and the transformational change needed to create the enabling environment and initial digital content necessary to deliver a fully comprehensive digital representation of the Ocean as envisaged in the ambitions of Challenge 8, in the longer term.

As part of this strategic ambition, all observations, datasets, data products, information and knowledge outputs generated by Decade Actions should be Findable Accessible, Interoperable and Reusable (FAIR) by all. At minimum Decade Actions should deliver 10 societally relevant priority global base-layers accessible via a global online dynamic Digital Atlas, complemented by a minimum of 10 local use cases (prioritizing SIDS and LDCs). The latter will serve to stress test the inclusiveness of the interoperable sharing environment and address challenges in using and contributing to the Decade's distributed data and information ecosystem.

In delivering this strategic ambition there is a need for the following specific resources, tools and services to be developed and in place by 2030: a federated global Ocean Data Discovery and Access Service (DDAS) with a dynamic map viewer, underpinned by an Ocean Data Help Desk and distributed Data Ingestion Service; a global Technical and Organizational Structure for Ocean Forecasting; a user-friendly global Digital Atlas of

the Ocean, providing access to a minimum of at least ten global base layers and at least ten local higher resolution use cases; a set of sustained platforms, mechanisms and tools actively used to store, share and exchange ocean information and knowledge generated by Decade Actions beyond data and data products; and tailored and enhanced capacity development resources and facilities to boost digital literacy.

Challenge 9: Skills, knowledge and technology for all

By 2030, success for Ocean Decade Challenge No. 9 will be reached when: (i) the skills required by scientists, resource users, educators, communicators, managers, and policy-makers to understand and manage the ocean are evenly developed and distributed with emphasis on LDCs and SIDS; (ii) the funding, infrastructure, and technology required to understand and manage the ocean across regions and communities is evenly developed and distributed with emphasis on LDCs and SIDS; (iii) scientists from currently under-represented groups (i.e., women, ECOPs, indigenous communities, LDCs and SIDS, people with disabilities, and others) are well-represented in ocean science, communication, management, and policy; and (iv) wider access to ocean data, knowledge, and information among different users of the ocean has been achieved, and language barriers/restrictions have been mediated.

Success will build on decades of ongoing work in capacity development in ocean science through mandated United Nations agencies, including IOC/UNESCO and non-UN partners. It will include fulfilment of the following critical capacity development needs, i.e. skills development, representation, funding, infrastructure, technology, access to data and information, publishing of research findings, better representation of scientists from LDCs and SIDS in international journals, meetings, advisory panels, and planning committees, and promotion of the use of multiple languages in ocean science communication. Success will require: (i) the development of technical, data management, communication, negotiation, conflict resolution, stakeholder engagement, policy formulation, analysis, and implementation skills, (ii) significant representation of currently under-represented groups in ocean science, communication, and policy, (iii) availability of a framework for infrastructure/technology distribution and tracking, and development of low-cost technologies/instrumentations and enabling access to advanced technology, including cloud resources, in underserved areas and regions, (iv) the establishment of a mechanism for distributing and tracking of funding, considering geographical, economic, and research capacity needs and facilitating the inclusion of under-resourced coastal countries and indigenous communities in international research consortia to ensure access to collaborative funding opportunities, (v) development and implementation of policies that promote open access to ocean data and information, standardised data formats to enhance interoperability and ease of sharing and good ethical data governance, and (6) promotion of constructive, multi-directional partnerships as well as regional and sub-regional coordination mechanisms, enabling sharing of expertise.

Challenge 10: Change humanity's relation with the ocean

By 2030, success for Ocean Decade Challenge No.10 will be evidenced through a culture shift in the ocean community leading to implicit understanding that ocean threats are an outcome of human behaviour. This will require a shift in the way that ocean science, in the broad sense that it is defined in the Decade, is formulated, practiced and communicated to ensure all societal actors have strengthened emotional connections with the ocean, and that they understand the vital role that the ocean plays in human and planetary well-being, and have increased motivation, capability, and opportunity to make decisions and behave in ways that ensure a healthy ocean. Importantly, this ambitious shift needs to target all sectors of society, including as a priority, policy and decision makers, whose understanding and use of ocean science is critical for on the ground change.

Success will include fulfilment of the critical science and knowledge gaps including increased priority and practice of science that embraces multiple knowledge systems, transdisciplinary collaboration, and an ocean health-centred approach. This includes increased priority of Indigenous-led and community-based research; and increased priority and appreciation of marine social sciences, particularly public perceptions ocean research; marine citizenship and identity research; behavioural science research linked to ocean education, communication, and culture; research on ocean literacy as a policy tool; social impact measurement research; science communication through immersive technology, storytelling, and the arts.

Success will depend on the generation, sharing and use of the crucial datasets including human-ocean connection / human-ocean values dataset(s) that need to be integrated into the global ocean observing system and digital ocean infrastructure; pro-ocean behaviour change methodologies, case studies, and effective practices; impact mapping of regional and global ocean literacy key initiatives; and ocean culture mapping - a

global body of evidence (contextual, place-based knowledge) of cultural connections and heritage as a driver of pro-ocean behaviour.

Furthermore, success will require development of a co-developed theory of change to action key drivers of Challenge 10 to help guide the strategic direction of the newly launched Decade Coordinating Office (Connecting People and Ocean); a research coordination team to support implementation of a collaborative global ocean literacy survey to measure ocean connection and values, as well as motivators, enablers, barriers to action and/or behaviour change; a global network of ocean communications experts and regional ocean communications communities of practice to support training, accreditation, upskilling, knowledge exchange, and impact measurement; a global network of marine education / ocean-climate education experts (formal, informal, and non-formal educators) to support teacher training, certification programmes, and knowledge exchange; establishment of a Global Blue Schools Network, building off success of the All-Atlantic and European Blue Schools Networks) to bridge practitioner best practices with research and training (see above); and a global framework for amplifying current best practice and identifying and sharing communities and projects that demonstrate practices and solutions specific to cultural connections, heritage, language, and place-based innovations for human-ocean health.

Based on the above, it is proposed to refine Challenge 10 as follows:

Challenge 10 - Restore society's relationship with the ocean: Meaningful society-ocean connections are strengthened, driving increased motivation, capability, and opportunity for people, across all sectors of society, to make decisions, act, and behave in ways that ensure a healthy ocean.

Interactions between the Ocean Decade Challenges

The ten Ocean Decade Challenges were not designed to act in isolation and there are innumerable links, areas of influence, and interactions between all Challenges. To avoid the creation of ten new silos of activity in the Decade, Decade Actions, particularly at the level of Decade programmes, are required to demonstrate how they contribute to multiple challenges and Decade structures, including the decentralised coordination structures and Communities of Practice that have been established to reduce barriers and foster exchange between Challenges.

While recognising that all interactions between Challenges are important, the Vision 2030 process has identified several areas of intersection between Challenges where there is currently less focus or activity in the Decade, and where gaps exist that could be filled by existing or future Decade Actions, including through the development of partnerships outside the ocean community such as in the health sector or with economic sectors. The following discussion does not pretend to represent an exhaustive picture of the vital links that exist across Challenges or of where future action is required but provide an illustration of key areas where the Vision 2030 process has identified gaps.

Marine pollution, land-based pollution, and the circular economy: Challenges 1 and 4

As recognised in the White Paper for Challenge 1, management of land-based sources of pollution, including promotion of circular economy approaches, is key to managing marine pollution. In parallel, the White Paper for Challenge 4 highlights the importance of engaging industry as a partner in the development of sustainable, equitable and resilient ocean economies. Management of land-based sources of pollution and promotion of solutions for a circular economy requires engagement with industry partners beyond those that are typically most commonly involved in dialogue on a sustainable ocean economy that tends to focus on maritime sectors. Yet failure to engage with a broader set of industry partners undermines both the ability to holistically address marine pollution and to develop a truly resilient ocean economy. The Decade can provide a framework for engagement of land-based industry and other partners essential to management of land-based pollution and promotion of a circular economy, thus contributing to both Challenges 1 and 4.

Biodiversity, fisheries and climate change and links to a sustainable ocean economy: Challenges 2, 3, 4 and 5

The fisheries sector is of fundamental importance to economies and wellbeing in many countries, including in numerous SIDS and LDCs. Effective and ecosystem-based fisheries management will therefore be an

important pillar of sustainable ocean economies. Yet climate change is affecting fisheries and the ecosystems that support them. Therefore, new models and decision tools are required to effectively manage fisheries and their contribution to a sustainable ocean economy. While a small number of Decade programmes are generating knowledge and solutions for climate resilient, ecosystem-based management of fisheries, links to biodiversity- focused Decade Actions, and to future initiatives supporting sustainable ocean planning and sustainable ocean economies at the national level, could be strengthened for optimal impact.

Ecosystems and coastal resilience: Challenges 2 and 6

The White Paper for Challenge 2, which explores ecosystem protection and management, identifies the need to increase science, knowledge and tools to enhance ecosystem-based management approaches and to increase the focus of activity in the Decade on ecosystem restoration, including in alignment with the UN Decade of Ecosystem Restoration. Discussions around Challenge 6, related to coastal resilience, identify a need for an increased knowledge and solutions for adaptation strategies to coastal and ocean hazards, including adaptation strategies that are based on or incorporate nature-based solutions. The confluence between ecosystem-based management approaches and nature-based solutions for coastal resilience requires increased attention in the Decade, specifically in relation to the development of knowledge, solutions and tools that can be co-designed and implemented by local communities. There is a significant amount of work on this issue happening at the grassroots level, often with the support of civil society and NGOs, and in addition to filling knowledge gaps, the Decade could provide a global and regional framework for the sharing of experiences, knowledge and tools.

Sustainable ocean economies and climate change: Challenges 4 and 5

The White Paper for Challenge 4, related to the development of a sustainable and equitable ocean economy, recognises the need for significant new knowledge and solutions to underpin sustainable and equitable economic development, including knowledge that takes into account changing climate conditions. Challenge 5, related to the ocean-climate nexus, identifies the need for decision support tools to assess and manage vulnerability and risk to coastal and marine industries. Both White Papers recognise the current gaps and the fundamental role of industry in the co-creation and delivery of such knowledge and solutions. Currently Challenge 4 is one of the most under-represented Challenges in the ecosystem of Decade Actions. The emergence of a new global Decade programme on Sustainable Ocean Planning will provide a robust framework to advance new Decade Actions, both nationally and in transboundary areas, which can contribute to the development of sustainable ocean economies. Tools, support and capacity development initiatives that facilitate consideration of resilience issues in sustainable ocean planning will be included as part of this programme.

Ocean observations and data: the foundational role of Challenges 7, 8 and links to all other Challenges

Almost without exception, the series of White Papers make reference to the need to enhance, geographically and thematically expand and sustain ocean observations, data collection, and ocean data sharing and management, including improvement of resolution and temporal coverage, as a means of achieving success across all the Ocean Decade Challenges. Examples include the cited need for increased coverage of biological, pollution and climate parameters, and the need to integrate social and human datasets. In the first instance this should be addressed by making the vast amounts of already existing data more findable, accessible, interoperable, and reusable (FAIR). Useful datasets are often incomplete, scattered across different local, national or thematic databases, or not shared at all. In addition, there is an urgent need to expand and enhance global ocean observation capabilities with cost-effective, innovative technologies and autonomous systems, alongside the need for comprehensive training programs to improve data literacy and management. There's also a clear demand for identifying societally relevant datasets, prioritizing under-observed regions, and establishing coordinated databases that adhere to FAIR principles. These observations emphasise the importance of an integrated, collaborative approach that takes advantage of technology and innovation.

The recognition of this underlying role of ocean observations and data is also strongly highlighted in the conclusions and recommendations of the White Papers for Challenges 7 and 8 themselves. The need for expansion to areas and themes that are less well represented, and the links across the value chain from observations to data and then to user-focused services and applications including forecasting, prediction and modelling are being strengthened through several major Decade programmes including CoastPredict, DITTO and Ocean Observations Co-Design. The triumvirate of decentralised coordination structures that coordinates

across these Decade Actions - the Ocean Observations DCO, Data Sharing DCO and the Ocean Prediction DCC - have developed a roadmap to further cultivate interactions and synergies across the value chain from observations to end user services, and will continue to play crucial role connecting with Decade Actions and coordination structures focused on other themes and less well represented geographies.

Foundational role of capacity development: Challenge 9 and all other Challenges

A key tenet of the Ocean Decade is to 'leave no one behind'. Capacity development and exchange, and equitable access to technology, infrastructure and information is essential to achieving this. The Ocean Decade Implementation Plan includes a comprehensive capacity development strategic framework that draws on decades of work by IOC/UNESCO and partners to identify the key areas of focus of capacity development in the Decade. This includes a strong focus on 'capacity exchange' within and between regions, for example SIDS, an objective to develop new capacity development initiatives to meet emerging needs within the Decade, and a focus on sustained and sustainable capacity development outcomes for beneficiaries in SIDS, Least Developed Countries and for Early Career Ocean Professionals. Many actions endorsed by the Ocean Decade call out the need for capacity development and sharing to achieve their goals, and some Decade-endorsed actions are focused exclusively on capacity development and sharing. All of the White Papers identify capacity development needs specific to Ocean Decade Challenges that range from distinct needs in science and research, to broader needs related to co-design or approaches to engage Indigenous and local knowledge holders. In parallel to the Vision 2030 process, the Ocean Decade Capacity Development Facility has been initiated to identify and fill priority capacity development needs, with a focus on SIDS, LDCs and ECOPs. The Facility will serve as a unifying and evolutive framework that will capture the needs identified via the Vision 2030 process from across the Ocean Decade Challenges, and from other sources to develop a real-time understanding of capacity development needs that can be met directly through the Decade, including from existing and future Decade-endorsed actions, and via collaborations with partners.

Foundational role of behaviour change: Challenge 10 and all other Challenges

The White Papers for Challenges 1 through to 9 clearly articulate the causal link between human behaviour and the future health of the ocean: If we continue to behave as we do at a global scale, there will be catastrophic consequences. Challenge 10 is fundamental to operationalizing the changes and scale of global action needed across society to avoid this fate. Challenge 10 bridges the transformative science solutions (Challenges 1 to 5), and the technology, data, and capacity infrastructure and resources (Challenges 7to 9) with society, amplifying relevance and building meaningful pathways for engagement. Through four key drivers that are foundational to "restoring society's relationship with the ocean"–multiple knowledge systems, communications, education, and cultural connections (see section 3)–societal-ocean connections and pro-ocean behaviours are strengthened. Such outcomes are interdependent with increased political will, policies and laws, and economic and governance structures that support ocean health, human health, community well-being, and planetary well-being. Figure 1 below provides a conceptual framework for Challenge 10 in relation to the other Challenges.

Achieving the strategic ambitions outlined in the Vision 2030 set of white papers hinges upon a culture shift in the way that science is formulated, practiced, and communicated; and an implicit understanding by both the ocean community and society at large that ocean threats are an outcome of human behaviour. Each white paper has identified critical changes required within science and the ocean community, as well as the desired societal-level change (See Appendix B for a summary table). In actualizing these changes, our collective efforts will enable all sectors of society to strengthen connections with the ocean; understand the vital role that the ocean plays in human and planetary well-being; and have increased motivation, capability, and opportunity to make decisions and behave in ways that ensure a healthy ocean.

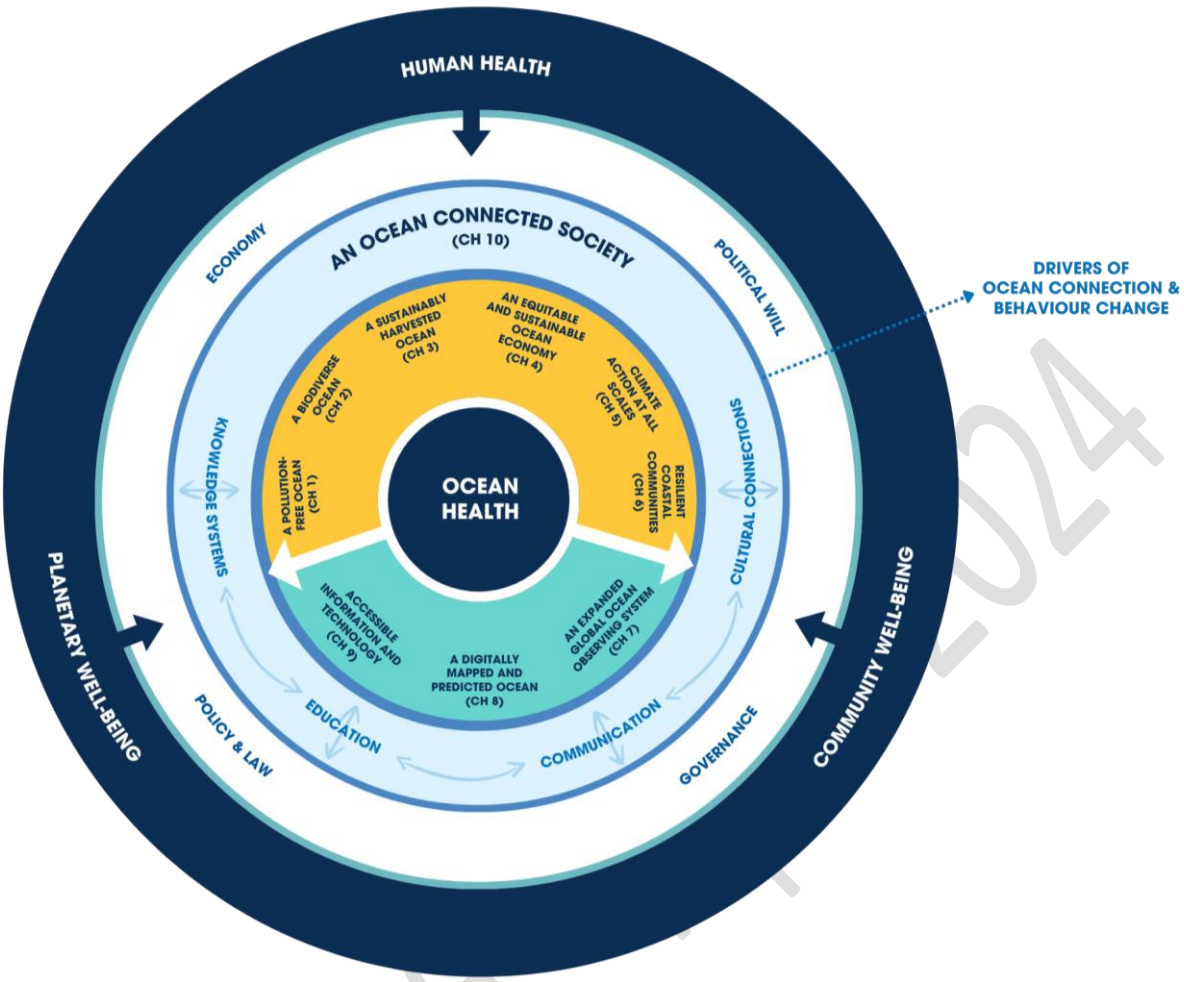

Figure 2: Conceptual Framework for Ocean Decade Challenge No. 10

Ocean health and human health: links to Challenges 1, 2, 3 and 10

The links between ocean health and human health are increasingly well understood and receiving enhanced levels of attention, including in a new Blue Paper entitled 'How can a healthy ocean improve human health and enhance wellbeing on a rapidly changing planet?' commissioned by the High Level Panel for a Sustainable Ocean Economy that will be launched during the 2024 Ocean Decade Conference. The links include both the potential for a resilient and healthy ocean to generate benefits to support human health, and the negative human health impacts that can result from a poorly managed ocean. Many of the Vision 2030 White Papers, particularly those related to marine pollution, ecosystems and biodiversity, sustainable aquatic food, and behaviour change, highlight the links between ocean health and human health. In the context of the Ocean Decade, these links, while implicit, are not explicitly highlighted nor are they currently the focus of any major Decade Actions. As part of the refinement of the Ocean Decade Challenges, ocean health - human health links have been better highlighted and collaboration with the Ocean Panel will continue to explore the role of the Decade in filling critical knowledge and science gaps.

Recommendations to meet strategic ambition of the Ocean Decade Challenges for 2030

This section documents a proposed set of key recommendations that have emerged throughout the Vision 2030 process that will be necessary to meet the strategic ambition of the Ocean Decade Challenges for 2030. While the recommendations are written to be relevant at the global level, all recommendations require further distillation to the regional and national level, including development of specific recommendations that address barriers and obstacles for skills, technology, and capacity in Least Developed Countries, SIDS and in other under-represented groups.

The suggested recommendations will be discussed and refined during the 2024 Ocean Decade Conference leading to a final set of Vision 2030 outcome recommendations. The recommendations have been categorized into recommendations related to science and knowledge gaps, recommendations related to infrastructure, and recommendations related to best practices and standards. The following section contains suggested recommendations for a series of cross-cutting issues to build on these Challenge- specific recommendations.

Science and knowledge priorities to be addressed through new or existing Decade Actions

Across the White Papers and the related consideration of crucial interactions between Challenges, a series of priority science and knowledge gaps have been identified that can be addressed through new Decade Actions or via the consolidation and strengthening of existing Decade Actions. The priorities are for the generation of co-designed and co-delivered science and knowledge to underpin solutions and management for the following issues:

- Knowledge of the global distribution, fate, toxicity, and human health and ecosystem impacts of **marine pollution, including priority emerging pollutants**, across the land-ocean continuum, and from the surface to the deep sea.
- Develop the knowledge and tools to enhance **marine and coastal ecosystem-based management approaches**, including biodiversity and ecosystem conservation and restoration and promoting knowledge and tools to facilitate upscaling of successful initiatives.
- Develop a better understanding of **deep-sea ecosystems** including how habitat and species are connected, and enhanced predictive capacity of abundance and distribution, ecosystem services modelling, and vulnerability assessment vis a vis climate change and human impacts including new or potential emerging economic sectors including fisheries, seabed mining, and marine carbon dioxide removal.
- Knowledge to encourage **sustainable, resilient, and equitable small-scale fisheries and aquaculture**, and in particular support an enabling environment equitable access to and distribution of aquatic food, centred around an integrated food systems approach.
- Knowledge and innovation to strengthen **sustainable aquatic food production and innovation** for new frontiers with a focus on developing countries and strengthened public-private partnerships.
- Tools, skills, and knowledge for **evidence-based Sustainable Ocean Plans** at the national level and in relevant transboundary areas including the adoption of ocean accounting as a means of supporting decision making.
- Co-created solutions and knowledge with industry, both within and external to, marine and coastal sectors, to contribute to **sustainable and climate resilient ocean economy projects**, prioritizing those that integrate environmental conservation with socio-economic benefits for local communities, and including for the establishment of dedicated financial mechanisms.
- Knowledge to rapidly scale up **climate mitigation** including through marine renewable energy and management of coastal ecosystems.

- Knowledge leading to timely understanding of the technical, ecological, and social feasibility, potential impacts of **proposed marine carbon dioxide removal** initiatives and to understand the scale-up potential, and inform any eventual monitoring, verification, and regulation frameworks.

- Knowledge to underpin adaptive governance and management systems and decision support tools for the **assessment of vulnerability and risk to coastal communities and marine industries**, and for developing climate change adaptation pathways including local adaptation strategies that align with ecosystem-based management approaches and incorporate or are based on nature-based solutions for coastal resilience.

- Knowledge to underpin **economic models for ocean investment** to diversify and accelerate investment in ocean science including for sustained and sustainable ocean observing and infrastructure from new actors, including resourcing for SIDS, LDCs.

- **Capacity development, sharing, and coordination,** including the development of funding models, skill sets, employment opportunities, access to data, and inclusion in global decision-making entities for scientists and policymakers from SIDS and LDCs and from other under-represented groups and regions, and a greater opportunity for inter-cultural and inter-regional exchange for ocean scientists and policymakers from all regions.

- Transdisciplinary **social science research on human-ocean connection**, behaviour change, and cultural engagement to inform the creation of a human values / human impact data set to be integrated into Ocean Decade digital infrastructure.

- Transdisciplinary knowledge on the **connections between ocean health and human health** including proactive engagement of health sector stakeholders in the Ocean Decade via tailored communications, outreach, and messaging.

Infrastructure

To support achievement of the strategic ambitions of the Ocean Decade Challenges including through fulfilment of the above science and knowledge gaps, priority infrastructure elements have been identified. These include the establishment and sustainable and sustained resourcing of:

- A global network of long-term sentinel stations to monitor marine pollution and a complementary network of regional laboratory hubs that can have a dual capacity development and exchange function.
- An open and accessible information system to support risk assessment and management, leveraging observations, advanced numerical/AI models, and people-centred early warning systems for multiple hazards.
- Expanded, upgraded and sustained ocean observing infrastructure in poorly observed ocean basins including polar regions, least developed countries, SIDS, and priority coastal systems with a priority on observations of weather (including events), hazards, ocean health and marine biodiversity and resources.
- Expanded access to and use of autonomous technology, sensors and platforms, including easy to use, reliable, robust and affordable technology for observations to underpin the democratic generation, access and use of ocean observations, data, information and knowledge.
- Tools and infrastructure for a Digital Atlas of the Ocean and a functional federated global Ocean Data Discovery and Access Service with a dynamic map viewer and supported by a permanent Data Help Desk.

Policies, standards, and best practices

Underpinning the above recommendations, a series of required standards and best practices have been identified to be developed and/or promulgated via the Ocean Decade framework including:

- Identification of a core set of marine life and ecosystem variables including the most relevant variables at regional and national levels and a global framework for global marine life observation, data interoperability, and quality assurance.
- Standardised methods for research, for example around marine pollution research through protocols for monitoring of marine plastic, to be shared through a newly created network of regional laboratories.
- Increase national, regional, and global coordination that uses the GOOS framework to ensure standards, and best practices for an expanded global ocean observing system.
- Development of a Global Technical and Organizational Structure for Ocean Forecasting, and promotion of best practices, data standards, shared architectures, and tools to foster ocean prediction worldwide, leveraging the coming innovations derived from the digital twining concept.
- Foster and widely promote the use of recommended platforms, mechanisms and tools actively used to store, share and exchange ocean information and knowledge, beyond data and data products and inclusive of Indigenous and local knowledge and sharing of practices, principles and approaches to respect and protect knowledge, particularly knowledge of Indigenous and local communities.

Looking across the Ocean Decade

The Ocean Decade Challenges have an important role as individual issues around which collective action is being galvanized in the Decade. However, they are not intended to work in isolation of each other and the links and interactions between and across the Challenges are significant. This section draws on the series of individual White Papers to explore a range of priority, transversal issues that have emerged across two or more Ocean Decade Challenges. It does not claim to be an exhaustive list of the cross-cutting issues and challenges that the Decade will need to address in coming years but aims to highlight those areas that have been weaker in Decade implementation to date or that have emerged since the start of the Decade.

Policy needs as drivers of science and knowledge priorities

The essence of the Ocean Decade is its focus on science and knowledge that is solutions-oriented and that contributes to sustainable development. In this context, sustainable development is taken to mean the full set of policies, strategies and decisions at local, national, regional, and international levels that contribute to fulfilment of the 2030 Agenda for Sustainable Development. The current growth of the Ocean Decade has been strongly bottom-up and largely driven by the scientific community, with research institutions accounting the vast majority of lead partner institutes for Decade Actions. While Decade Actions are required to demonstrate that they have consulted with users of knowledge and identified the potential use of the science and knowledge they are generating for policy or decision making, this has been an observed weakness of many of the Decade programmes and projects submitted for endorsement.

As the Decade evolves and moves into the second half of its implementation, there is a need to develop and ingrain systematic and reinforced processes for policy, whether it be local, national, regional or international, to drive scientific priorities that are being addressed through Decade Actions. Achievement of this objective can be achieved through a multi-faceted approach including:

- Working across the UN system and more broadly to identify critical knowledge and science gaps that remain for the successful implementation of global policy frameworks and tailoring Calls for Decade Actions to fill these gaps including to support implementation of the Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction (BBNJ Agreement) and the Kunming-Montreal Global Biodiversity Framework.
- Working with Member States and national actors, with a focus on SIDS and Least Developed Countries, to raise awareness of the importance of ocean science and knowledge for policy development and implementation, and to build skills and provide tools for national policy makers to be active partners in the co-design and co-delivery of ocean science and knowledge initiatives.
- Empowering and supporting regional and national Decade structures including decentralized coordination structures, regional taskforces, and National Decade Committees to develop and implement processes to engage with policy makers and understand key science and knowledge gaps that can influence the development of future Decade Actions.
- Developing tools, skills and resources for Decade Actions to communicate with policy makers and relay pertinent science and knowledge outcomes to influence policy.
- Requiring clearer identification of tangible policy outcomes at the time of endorsement of Decade Actions and in the reporting by Decade Actions.
- Increasing support to skills building in co-design and co-delivery of Decade Actions as a means of ensuring users, including policy makers are included in the formulation and design of Decade Actions.

Embracing all knowledge systems in the Ocean Decade

The definition of ocean science in the Ocean Decade is broad and refers to the importance of alternative knowledge systems of the ocean, including Indigenous and local knowledge. The Ocean Decade has observed a massive shift in thinking and discourse on this issue over the last three years, with the engagement of Indigenous and local knowledge holders and the importance of alternative knowledge systems now an accepted and indeed valued approach within the ocean science community. As a clear demonstration of this,

each individual White Paper developed during the Vision 2030 process identified the importance of embracing Indigenous and local knowledge as a precursor to the fulfilment of the Challenge. Yet, challenges remain in the means of transforming principles into action to ensure real and meaningful engagement of Indigenous and local knowledge holders throughout the complex ecosystem of the Ocean Decade. The Ocean Decade can contribute to overcoming barriers to such engagement through a range of actions as follows:

- Including expertise on Indigenous and local knowledge in the Decade Coordination Unit, and, as relevant, in decentralized coordination structures.
- Establishing a reference group of Indigenous and local community representatives to act as an informal advisory body for the Ocean Decade.
- Requiring that Decade governance and coordination structures, including committees, working groups and networks, include representation from Indigenous and local communities.
- Collating a pool of resources and capacity development initiatives, including via the Capacity Development Facility, so that the Ocean Decade becomes a trusted and broad source of resources on Indigenous and local knowledge.
- Changing the Decade lexicon in relation to inclusivity, equity, and diversity to systematically refer to 'geographical, generational, gender and knowledge systems diversity'.

Creating greater impact through enhanced action at the national level

The Ocean Decade is a global initiative, yet working at the national level is vital to achieving real impact in numerous spheres, including policy and governance, community engagement, and ocean literacy. National level action is also important in terms of mobilising resources, given the predominance of investment in ocean science by national funding agencies. Close to 40 countries have created National Decade Committees as voluntary, multi-stakeholder platforms that have the broad objective of translating the global ambition of the Ocean Decade to the national level by fostering national dialogue on ocean science priorities and influencing national funding priorities. National Decade Committees potentially have an invaluable role to play in achieving the Decade's success and several of the Committees are on the path to realizing significant national impact. Yet, to date, many Committees have struggled to fill this role due to a clear mandate, lack of political influence, inadequate diversity in membership across sectors, or available resources. Creation of additional National Decade Committees is an aim of the Decade, but only where they are functional and have a clear and beneficial role to play. It will remain challenging to achieve this without a strong motivation for countries to invest the time and resources in the establishment and operation of these Committees. This is particularly true in resource-limited areas including LDCs and SIDS.

Across several of the Ocean Decade Challenges there are clear opportunities for the Decade to generate tangible outcomes and benefits at the national level. Many of these opportunities have a focus on strengthened ocean-related policy, including policy to meet international commitments or to support national economic development. Developing and implementing processes and initiatives to support these opportunities can be undertaken in parallel with support to countries to create or strengthen National Decade Committees. Key actions to be carried out in this regard can include:

- Use the framework of the new Decade Programme on Sustainable Ocean Planning to engage countries in dialogue on the role that Sustainable Ocean Plans can play as a unifying framework for national action for sustainable ocean management.
- Develop process and guidance for countries to identify and fulfil knowledge needs to allow development of comprehensive policies and governance frameworks for Sustainable Ocean Plans promoting sustainable management of ocean resources and ensuring equitable access and benefits distribution among all stakeholders, particularly marginalized and Indigenous communities.
- Develop process and guidance for countries to identify and fulfil knowledge needs that will allow integration of ocean related issues in National Adaptation Plans, Nationally Determined Contributions and National Biodiversity Strategy and Action Plans.
- Develop analytical work on the return on investment in ocean science by national funding agencies in terms of the quantitative benefits for economic development.

- Develop tools to facilitate alignment between national funding priorities and the needs of Decade Actions, including via expansion of the nascent philanthropic matchmaking tool to be available for national funding agencies.
- Dialogue and exchange through decentralised coordination structures and regional taskforces to support the development and operation of new National Decade Committees in under-represented areas such as SIDS and LDCs, including exploration of innovative models for such Committees in low capacity countries.

Meaningful engagement of industry and the innovation sector

Industry has a unique role to play in the Ocean Decade including as a crucial actor in the co-design and co-delivery of Decade Actions and in the co-creation of technology and innovation to support Decade Action implementation and outcomes. Numerous White Papers developed for the Vision 2030 process, including those related to marine pollution, aquatic food systems, sustainable ocean economy, ocean observations, the digital ocean, and behaviour change, identify the need to increase engagement with industry as engaged partners in knowledge and solutions to meet the defined strategic ambition. To date, the most successful examples of industry engagement in the Decade have been in the area of ocean data. The Ocean Decade Corporate Data Group brings together close to ten major industrial stakeholders who are committed to unlocking privately held ocean data for the benefit of the Decade. Successful use cases around seabed mapping and climate and biodiversity have started to demonstrate the means of dismantling barriers to data sharing, and the benefits that can result. Based on this positive experience, there is a strong basis for increasing diversity of engagement of industry in the Decade. However, industry is far from a homogeneous stakeholder group and thus the approach will be to build on existing engagement with core industry partners and expand this to other priority sectors where there is interest and a clear pathway for engagement.

It is anticipated that priorities for future engagement will include the tourism sector based on their interests in coastal resilience, community management, and potential collaboration around ocean literacy and communications; the insurance sector which relies on ocean risk data that can be generated via the Decade; and the financial sector with a strong interest in evidence based metrics for ocean-related investments.

In addition to this targeted engagement, the Decade will more explicitly encourage broad industry engagement in the co-design and co-delivery of Decade Actions through inclusion of new requirements in the Decade Action endorsement process. The Ocean Decade will also explore the feasibility of launching an industry - Ocean Decade partnership programme which proactively match-makes industry partners to Decade Actions to jointly develop and deploy knowledge, innovation, and solutions to context-specific challenges across Ocean Decade Challenges.

Targeted, expanded and sustained financing and resourcing

Ensuring adequate financing and resourcing remains a challenge across all Ocean Decade Challenges and was raised as a barrier to success in all the Vision 2030 White Papers. While Decade Actions have mobilised significant funds to commence implementation, critical gaps remain, both in terms of financing for the Decade Actions and to support the structures, processes and coordination of the Decade. From its inception, the Ocean Decade was conceived as playing a match-making role between the needs of Decade Actions and the priorities of resource providers. Some success has been achieved in this regard, for example through the establishment of the Ocean Decade Alliance, the active network that exists in the Foundations Dialogue, and through a series of sponsored Calls for Decade Actions with national funders and philanthropy. Yet, the pace and scale of growth of the Decade has meant that the unmet demand far outweighs the new resources that have been mobilised.

Looking towards 2030, the principal role of the Decade as a matchmaker between Decade Actions and resource providers is not envisaged to change. Resource providers for ocean science and thus for the Decade are not a homogenous group. National funding agencies, philanthropy, regional and international development banks, and international financing instruments all require different approaches and different levels of success and engagement have been achieved with these groups. If the ambition of the Decade to trigger a transformation in the way that ocean science is funded is to be achieved, increased efforts and a more nuanced strategic approach that targets the specific context of different groups is required.

To this end, the Decade will adopt a more deliberate two-pronged approach to this role. The first approach will continue and expand current efforts at the central level to map the landscape of resource providers and their specific interests, and to proactively communicate with them around the investment opportunities through the

Decade that meet these interests. This work will focus on partners where existing successes have been achieved such as philanthropy, but also focus on groups where there has been less engagement, including multilateral development banks and international financing instruments. The second approach, will be a new stream of work, will support Decade Actions and coordination structures to engage with funders and resource providers. Specific actions that will be initiated include:

- Actively work with philanthropic partners to activate the Funders Collaborative initiative that has established the architecture for a pooled fund to support Decade Actions in co-design, communications and capacity development, and to ensure the sustainability of the Philanthropic Matchmaking Tool that will be launched as a pilot at the 2024 Ocean Decade Conference.
- Identify partners to expand the Philanthropic Matchmaking Tool for use by national funding agencies in order to increase the information available to Member States on the investment opportunities through the Decade.
- Develop mentoring initiatives and resources for Decade Actions for fundraising and resource mobilisation and a dedicated web-based portal inventorying real-time funding opportunities for Decade Actions.

Continued attention to enhancing diversity, inclusivity and equity in the Ocean Decade

As recognised in the Ocean Decade Implementation, the ambition of the Ocean Decade and the challenges that need to be met by 2030 are of a scale that no one discipline, geography or gender can address them alone. Diversity, equity and inclusivity in the Ocean Decade is not just the right thing, it is essential to the success of the Decade. The Decade was designed with this in mind. All Decade structures, processes and Decade Actions are conceived to ensure generational, gender and geographic diversity. Looking towards 2030, additional initiatives will be adopted to ensure the continuous removal of barriers that hinder participation by certain groups and to increase overall diversity.

Geographical diversity remains a challenge for the Decade. Since the start of the Decade, SIDS and LDCs have been under-represented in leading roles in Decade Actions. While a large proportion of Decade Actions report to be working in SIDS or LDCs, and some actions focus exclusively on exchanges with SIDS and LDCs, a negligible number are led by institutions or individuals from these countries. Diverse measures that have been implemented to redress geographic inequity include the development of specific capacity development initiatives focused on SIDS and LDCs, including existing Decade Actions and the emergence of the Ocean Decade Capacity Development Facility as a consolidating framework for support to SIDS and LDCs, support to regional taskforces and decentralised coordination structures in Africa, the South Pacific and Caribbean SIDS including regional priority setting processes, collaboration with partners to develop new sources of funding for Decade Actions led by SIDS or LDC partners, and provision of travel support and opportunities for meaningful engagement in ocean meetings and events. Strengthening of these measures will continue, as will support to the establishment of National Decade Committees within under-represented regions as a means of increasing visibility of, and advocacy for ocean science and knowledge to underpin sustainable development.

The ambitions of the Ocean Decade in Africa are being promoted under the stewardship of the Ocean Decade Africa Taskforce and will accelerate through the implementation of a new continent-wide Ocean Decade programme on sustainable ocean management in Africa that will be launched at the 2024 Ocean Decade Conference. With a strong global focus on SIDS in 2024 including through the Fourth UN International SIDS Conference that will fall just after the 2024 Ocean Decade Conference, there is a unique opportunity to build on the strategic collaboration between the Ocean Decade Alliance and the SIDS Coalition for Nature to develop a SIDS-focused action plan for ocean science to identify the highest priority needs for SIDS.

Gender diversity is relatively strong in the Decade. Around 57 percent of individuals involved in Decade programmes are women, although this global number masks disparities among certain geographies and sectors where female participation is lower. An Ocean Decade Gender Roadmap will be prepared in coming months, building on existing initiatives and actions working within and outside the Ocean Decade to enhance gender equity in ocean science, to identify the additional efforts that are needed to redress gender equity and propose concrete actions for coming years.

Similarly, the engagement of Early Career Ocean Professionals (ECOPs) is strong in the Decade. Over 4,500 ECOPs are working on Decade Actions and the Ocean Decade ECOP programme has established a network of numerous regional and national hubs to promote networking and exchange between ECOPs. Capacity development, access to funding and opportunities to actively engage in international events and meetings are areas that could benefit from reinforcement in relation to ECOPs. The Capacity Development Facility includes ECOPs as one of its target groups, and the abovementioned actions related to resource mobilisation will include a specific focus on mobilising resources for ECOPs. As has been the case for the 2024 Ocean Decade Conference, the Ocean Decade and partners will systematically work to provide travel support and opportunities for meaningful engagement in ocean meetings and events.

Optimising Ocean Decade coordination for collective impact and ownership

The Ocean Decade is a complex, fluid initiative that works at different temporal, geographic and thematic scales. Its coordination is challenging and often described as hard to navigate. Common reflections emerging from the White Papers are that the coordination of the Decade does not adequately encourage collective action across Decade Actions, and that entry points for new partners are hard to locate. Without attention to improved coordination, it will be problematic to implement the above series of recommendations. Immediate actions that can be implemented to redress these issues and continue to strengthen the effectiveness of coordination including:

- Proactive development of partnerships to fill important gaps in the network of decentralized coordination structures (i.e. Decade Coordination Offices and Decade Collaborative Centres) for under-represented regions and for those Ocean Decade Challenges that have no coordinating mechanism, including targeted resource mobilisation for decentralized coordination structures that have been established but which are struggling to find adequate resources for operation.
- Continued improvement of the coordination with and across the network of Decade Coordination Offices and Decade Collaborative Centres to ensure that the significant investment made by partners in the operation of these structures is optimized.
- Redefinition of the membership Communities of Practice to welcome and encourage engagement by Decade partners beyond endorsed Decade Actions and increased guidance and support from the Decade Coordination Unit for the functioning of these groups so that they can fulfil their roles as platforms for exchange, collaboration and partnership development.
- Continuous improvement of Decade related communications and messaging tailored to specific stakeholder groups to clearly identify the ‘how’, ‘why’ and ‘what’ of the Ocean Decade and indicate clear pathways for, and benefits of, engagement.

Looking forward

The next 18 months: from Barcelona to Nice

The next 18 months represent an unparalleled moment in the global ocean landscape. Building on the momentum generated through recent advances in global policy frameworks including the adoption of the BBNJ Agreement, the Kunming – Montreal Global Biodiversity Framework, and the formalization of the Ocean Climate Dialogues in the UNFCCC, the global ocean community will convene in a series of landmark gatherings between now and June 2025.

The 2024 Ocean Decade Conference falls at the beginning of a series of milestone international convenings. It will be followed by the Our Ocean Conference (Greece, April 2025), the Fourth UN International SIDS Conference (Antigua & Barbuda, May 2024), Immersed in Change Congress (Costa Rica, June 2024), the 16th Conference of Parties of the Convention on Biological Diversity (Colombia, November 2024), and the 29th Conference of Parties of the UNFCCC (Azerbaijan, November 2024) and will culminate in the 2025 United Nations Ocean Conference in Nice, France (June, 2025). These events will be held in a landscape of numerous regional and national events that will allow for the translation of the global Vision 2030 outcomes to different geographic contexts.

These gatherings can be used to set the cadence for the translation to action of the recommendations emerging from the Vision 2030 process, and to raise global awareness of the foundational role of ocean science and knowledge to underpin sustainable ocean management and sustainable development. The DCU is working with partners involved in the organization of these events to ensure strong visibility of the Ocean Decade and create opportunities for engagement with diverse actors to build partnerships to implement the recommendations of the Vision 2030 process.

Throughout this series of meetings, the work of the Ocean Decade will continue both at the global level, and regionally and nationally. Following the 2024 Ocean Decade Conference, the recommendations of the Vision 2030 White Papers and Outcomes Report will be finalised. A key next step will be to translate and explore synergies between the global vision presented in the recommendations and regional and national priorities. Regional decentralised coordination structures, regional taskforces and National Decade Committees will be instrumental in leading this work.

The regular series of Calls for Decade Actions will continue. The next Call for Decade Actions No.07/2024 will open just days after the 2024 Ocean Decade Conference and will aim to galvanise contributions to the Decade, to strengthen existing Decade Actions and to reinforce the network of decentralized coordination structures. Call for Decade Actions No. 08/2024 will open in October 2024 and will be the first Call to be constructed based on priority recommendations from the Vision 2030 process as a means of deliberately filling identified gaps and priorities.

2027 and 2030: Reconvening the Ocean Decade community and looking to the future

The 2024 Ocean Decade Conference is the first in-person gathering of the Ocean Decade Community following the virtual launch Conference in 2021. As envisaged in the Implementation Plan, it will be followed by International Ocean Decade Conferences in 2027 and 2030 that will have an important function of assessing progress and building on the Vision 2030 outcomes and recommendations. These future Conferences will also be critical milestones in the construction of the post-2030 legacy of the Ocean Decade. The global challenge that the Ocean Decade is attempting to address is to ensure that ocean science and knowledge is relevant, inclusive, sustained, and used for sustainable development. This challenge will not disappear on 31 December 2030 with the formal end of the Ocean Decade. In many ways, the success of the Ocean Decade will be most visible in the years following 2030. As the Ocean Decade sails slowly but surely into the second half of its lifetime, efforts will need to increase to ensure the durability and longevity of key initiatives, structures, processes and resourcing. This will be a key focus of the mid-term review of the Ocean Decade in 2025 and a key theme underpinning discussions in the next two Ocean Decade Conferences in 2027 and 2030.

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

Proclaimed in 2017 by the United Nations General Assembly, the UN Decade of Ocean Science for Sustainable Development(2021-2030), provides a convening framework to develop the scientific knowledge and partnerships needed to catalyse transformative ocean science solutions for sustainable development, connecting people and our ocean. The Ocean Decade is coordinated by UNESCO's Intergovernmental Oceanographic Commission (IOC).

Established during the Preparatory Phase and to continue throughout implementation until 2030, the IOC's Ocean Decade Series will provide key documentation about this global initiative and aims to serve as a primary resource for stakeholders seeking to consult,monitor and assess progress towards thevision and mission of the Ocean Decade.

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