



The contribution of ISA to the scientific objectives of the UN Decade of Ocean Science for Sustainable Development



SUSTAINABLE
DEVELOPMENT
GOALS



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



Acknowledgments

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DISCLAIMER

A review of the contribution of the International Seabed Authority to the implementation of the objectives of the 2023 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

The report, commissioned by the International Seabed Authority (ISA) Secretary-General, assesses the implications of the 2023 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 for the work of ISA. The review of the 2023 Agreement focuses on access and benefit-sharing of marine genetic resources, area-based management tools, environmental impact assessments and capacity-building. The report highlights the need for coherence between the 2023 Agreement and ISA's mandate, emphasizing that ISA will remain the principal regulator of activities in the Area. The report suggests ISA's existing practices in ABNJ and environmental impact assessments will be crucial, although they will need to interact with new treaty bodies. It also explores the complex implications of marine genetic resources provisions for ISA. The report underscores ISA's potential to significantly contribute to capacity-building and technology transfer and recommends strengthening relationships with the new treaty bodies through formal agreements and active engagement by states to ensure coordinated implementation.

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Abbreviations

2023 Agreement	Agreement Under the United Nations Convention of the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity or Areas Beyond National Jurisdiction
ABNJ	areas beyond national jurisdiction
BOS	Big Ocean States
CCZ	Clarion-Clipperton Zone
EIA	Environmental Impact Assessment
GEBCO	General Bathymetric Chart of the Oceans
IHO	International Hydrographic Organisation
IOC	Intergovernmental Oceanographic Commission
ISA	International Seabed Authority
CFC	Cobalt-rich ferromanganese crusts
iCAN	Capacity Development Alumni Network
ISAPF	ISA Partnership Fund
JPI-Oceans	Joint Programming Initiative Healthy and Productive Seas and Oceans
JTRC	Joint Training and Research Centre
LLDC	Landlocked Developing Country
LTC	Legal and Technical Commission
MAR	Mid-Atlantic Ridge
MSR	Marine Scientific Research
MSR Action Plan	Action Plan for Marine Scientific Research in support of the UN Decade of Ocean Science
NAFOP-CD	National Focal Points in Charge of Liaising with the Secretariat on Matters Relating to Capacity Development
NOC	National Oceanography Centre, United Kingdom of Great Britain and Northern Ireland
OBIS	Ocean Biodiversity Information System
PMN	Polymetallic Nodules
PMS	Polymetallic Sulphides
REMP	Regional Environmental Management Plan
S.H.E.	See Her Exceed Mentoring Programme
SIDS	Small Island Developing State
SRP	Strategic Research Priority
SSKI	Sustainable Seabed Knowledge Initiative
The Area	International Seabed Area
TRIDENT	Technology-based Scientific Deep Sea Mining Exploration and Exploitation Project
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNGA	United Nations General Assembly
UNTBLC	United Nations Technology Bank for Least Developed Countries
WIDSR	Women in Deep-Sea Research
WOA	World Ocean Assessment
WoRMS	World Register of Marine Species

Foreword by Michael W. Lodge, Secretary-General



It is with great pleasure that I present this report on the contribution of the International Seabed Authority (ISA) to the scientific objectives of the United Nations Decade of Ocean Science for Sustainable Development.

ISA's contribution comes in two ways. First, through the implementation of its mandate under the United Nations Convention on the Law of the Sea (UNCLOS), pertaining to the promotion and encouragement of marine scientific research (MSR) in the international seabed area (the Area). Second, through delivery against the six strategic research priorities set out in the ISA's Action Plan for Marine Scientific Research in support of the UN Decade of Ocean Science (MSR Action Plan) unanimously adopted in 2020 by all our Member States, formalizing ISA's contribution to the objectives of the UN Ocean Decade.

The MSR Action Plan also serves as the global deep-sea research agenda, reflecting the fundamental priorities agreed by the international community if we are to advance our knowledge and understanding of the deep sea and its ecosystems. Greater investment in MSR would also equip ISA with the best available science to discharge the mandate assigned to it by UNCLOS and the 1994 Agreement to ensure sound and precautionary regulation and management of the activities carried out in the Area for the benefit of all humanity.

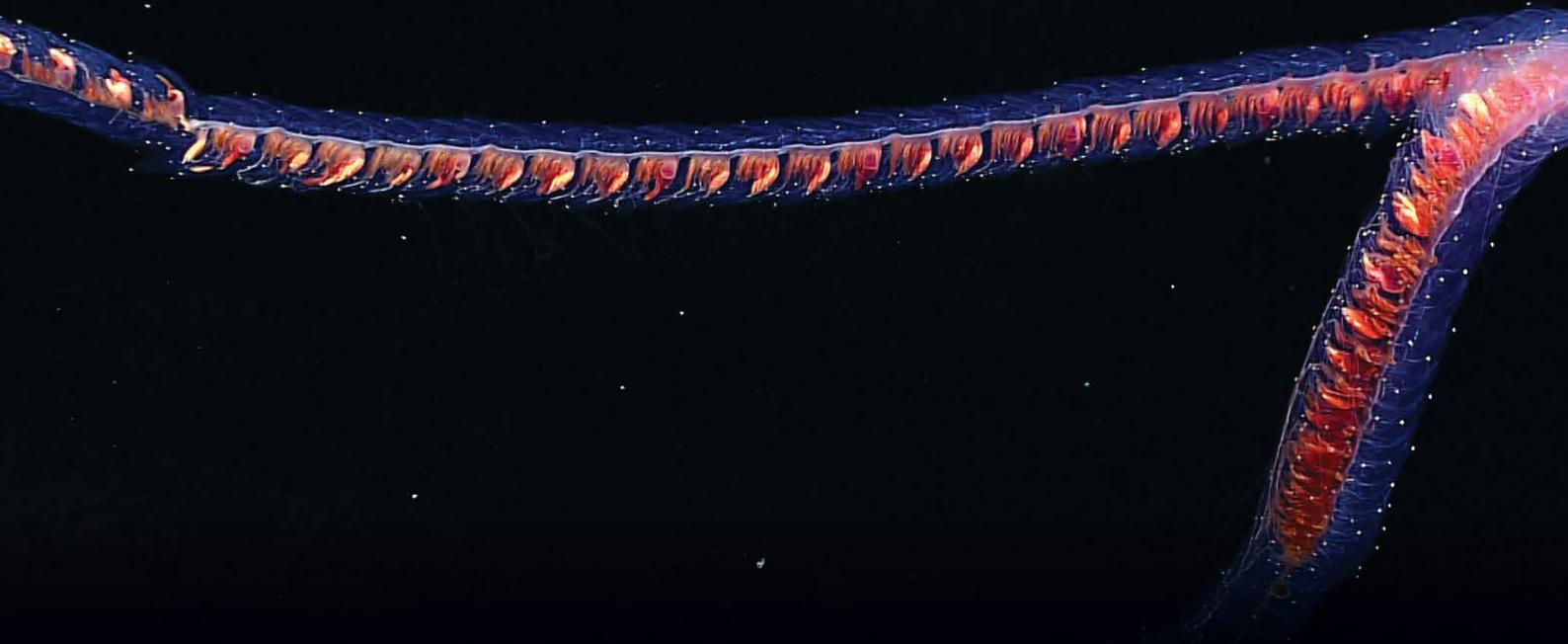
This report is a testament to the significant strides made by ISA and its partners in the four years since the adoption of the MSR Action Plan. It is remarkable to see how much has been achieved. I trust the results will give the necessary impetus to redouble our efforts in the years ahead. This is one of the key reasons that in 2023, I launched a Call for Action to increase investments in marine science and technology, promote deep-sea literacy and align research agendas with the global deep-sea research agenda.

It is worth recalling that ISA has been at the forefront of facilitating collaborative MSR in the Area since its establishment in 1994. As an organization with specialized competences, unique convening power and unparalleled access to novel data sets, ISA has the capacity to provide a platform for international scientific cooperation unlike any other that exists in the world today. It deserves to be better funded and more broadly recognized. In that respect, the recommendations presented in this report provide clear guidance for the continued successful implementation of the MSR Action Plan.

The report owes its existence to the collective efforts of a diverse group of expert individuals. I would like to extend my heartfelt thanks to the group of experts who provided strategic oversight and invaluable technical input: Dr. Tomasz Abramowski, Dr. Natalia Amezcuá, Ms. Rima Brown, Prof. Georgy Cherkashov, Dr. Suzan M. El-Gharabawy, Mr. Hank Hedge, Ms. Federica Irene Falomi, Prof. Pedro Madureira, Mr. John Astony Mataro, Dr. Sandip Mukhopadhyá, Mr. Sai Navoti, Dr. Marzia Rovere, Dr. Kathy Soapi, Dr. Samantha Smith, Mr. Joshua Tuhumwire and Prof. Gao Xiang. Their comprehensive advice and support were instrumental to the review and validation of the findings by the technical team. I also wish to acknowledge the work of the lead consultants engaged in preparing the report, Mr. Alan Evans and Ms. Eleanor Ashton, from the National Oceanography Centre, United Kingdom of Great Britain and Northern Ireland. Their dedication and expertise have certainly added an important value to the quality and depth of the analysis undertaken.

Michael W. Lodge
Secretary-General, International Seabed Authority

Executive Summary



ISA's unique mandate under UNCLOS positions it as the primary intergovernmental organization responsible for promoting MSR in areas beyond national jurisdiction.

Context

The International Seabed Authority (ISA) plays a significant role in promoting marine scientific research (MSR) within the international seabed area (the Area) as mandated by the United Nations Convention on the Law of the Sea (UNCLOS) to safeguard the marine environment by fostering a comprehensive understanding of deep-sea ecosystems. To accomplish this, ISA collaborates with various stakeholders, ensuring MSR activities benefit all humanity.

Given ISA's unique mandate over 54 per cent of the world's ocean seabed following the declaration of the UN Decade of Ocean Science for Sustainable Development in 2018, ISA Members unanimously adopted the ISA Action Plan for Marine Scientific Research (MSR Action Plan) in 2020, which established six strategic research priorities (SRPs) to guide the contribution of ISA in support of the implementation of the UN Decade. The SRPs directly contribute to addressing the 10 Challenges and seven Outcomes outlined in the UN Ocean Decade, aiming to enhance scientific knowledge about the deep-sea environment. Significant progress has been made in expanding MSR activities. The report highlights advances achieved through partnerships with contractors and stakeholders involved in deep-sea exploration and marine scientific research to collect and share environmental data annually, enriching our understanding of deep-sea ecosystems and contributing to a shared scientific database. This collaborative approach facilitates both environmental protection and sustainable technological development. The report employs a methodology that connects ISA's activities with the objectives of the UN Decade.

ISA's unique mandate under UNCLOS positions it as the primary intergovernmental organization responsible for promoting MSR in areas beyond national jurisdiction. Over the past 30 years, ISA has established a global framework to support sustainable ocean resource use through its MSR Action Plan. This framework aligns closely with the UN Decade's objectives and facilitates the advancement of scientific knowledge critical for sustainable development and resource management. The ISA's MSR Action Plan comprises six SRPs that address specific challenges. SRP 1 focuses on deep-sea exploration and the establishment of baselines, which collect vital data to understand ecosystems and enable resource assessments. SRP 2 seeks to standardize methodologies for assessing biodiversity, improving data comparability over time and across regions. The SRP 3 emphasizes technology development for ocean monitoring, advancing innovative tools that ensure environmental protection. The SRP 4 involves evaluating the impacts of human activities in the Area, guiding sustainable management efforts. The SRP 5 enhances the dissemination

of scientific data, making research findings more accessible and transparent through platforms like the DeepData repository. Finally, SRP 6 aims to strengthen the scientific capacity of Member States, particularly in developing States, to ensure equitable access to knowledge and resources. The report showcases ISA's commitment to sustainability, amplifying the impact of deep-sea research in pursuit of the collective vision for "the ocean we want."

To effectively implement its research agenda, ISA underscores the importance of strategic partnerships and diverse funding sources. Funding is derived from the ISA's regular budget, extrabudgetary contributions and the ISA Partnership Fund. Over the past decade, ISA's total budget has seen a significant increase, enabling long-term MSR initiatives and strengthening partnerships that enhance scientific capabilities. Collaboration with various organizations and stakeholders is crucial for advancing the global deep-sea research agenda, addressing sustainable ocean management challenges, and ensuring that scientific research translates into actionable policies for the benefit of all.

There has been a significant and sustained investment in environmental studies, information-sharing and application since the first exploration contracts were signed by ISA in 2001. This has built a critical mass of scientific knowledge, resulting in significant progress in our common understanding of the deep-sea environment of the Area.

Methodology

The methodology of this report involved mapping the scientific achievements enabled by ISA and conducting a stocktaking exercise of the scientific outputs delivered through exploration activities by contractors. The process was guided by 15 internationally recognized experts who provided technical input and strategic oversight. The key findings and recommendations benefited from the additional expertise of nine deep-sea experts from academia, the private sector and representatives from ISA Member States conducted through interviews (Annex I).

Key findings

The overall key findings help demonstrate ISA's pioneering role in the last decades in enabling international cooperation in support of enhanced MSR in the Area and acting as the leading force to ensure the results acquired, together with the information and data collected from deep-sea exploration activities, have steadily informed global



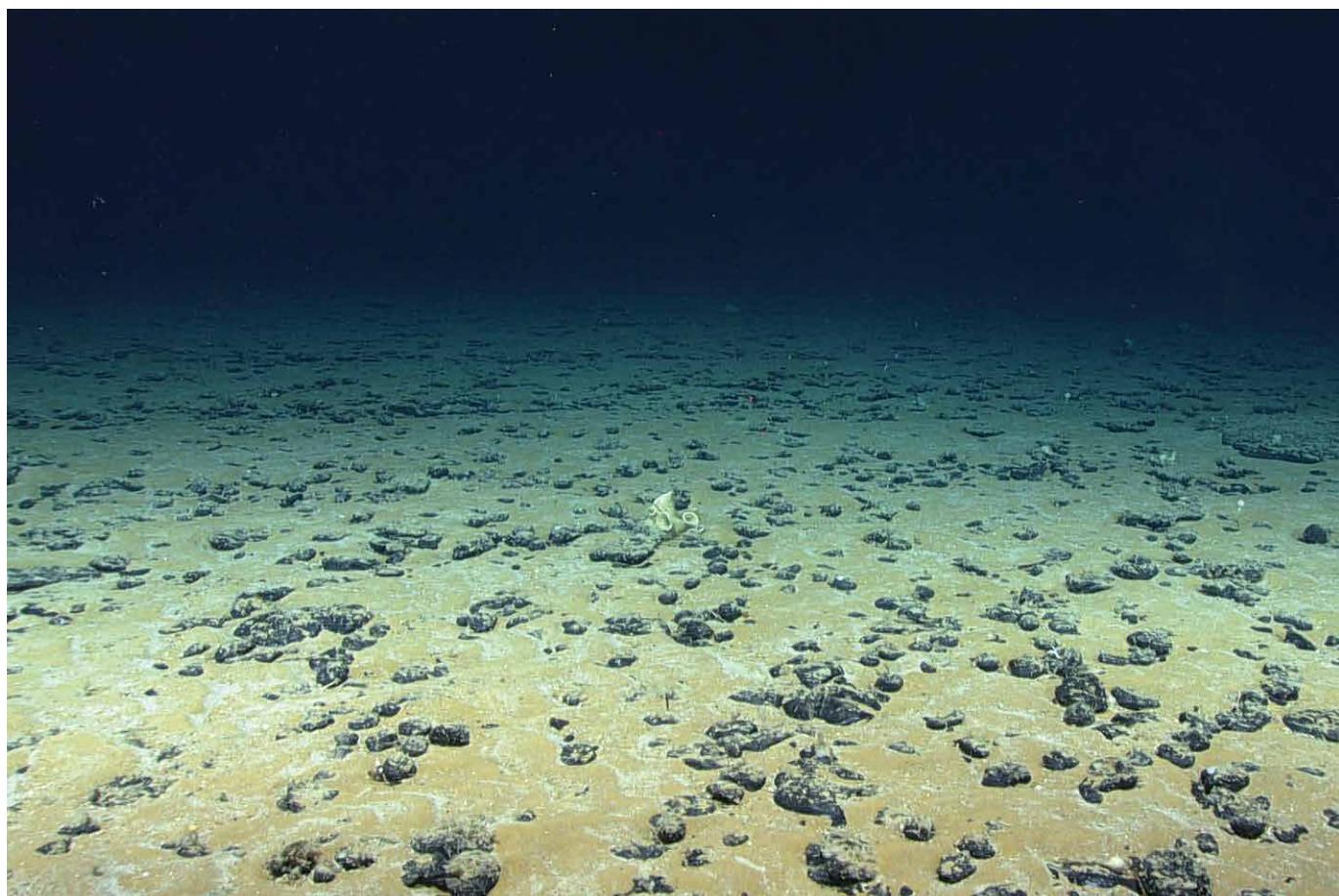
regulatory processes through which the stewardship of the Area has been successfully achieved. A striking example of this leadership role is showcased by the fact that ISA was the first intergovernmental organization to pioneer efforts for women's empowerment and leadership in deep-sea research through the establishment of the dedicated Women in Deep-Sea Research Programme in 2017. Moreover, ISA was the first intergovernmental organization to establish a global partnership fund to accelerate support for science and create incentives for increased investment in deep-sea research while ensuring that the necessary tailored capacity development and technical assistance activities address the needs identified by ISA Member States.

The knowledge generated has intrinsic scientific value in the provision of the information needed for decision-making, not only for ISA's purposes but for broader ocean governance frameworks, such as the UN Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects, the World Ocean Assessments and the Kunming-Montreal Global Biodiversity Framework. ISA-enabled knowledge generation

also provides foundational information required to deliver the Agreement Under the United Nations Convention of the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity or Areas Beyond National Jurisdiction (2023 Agreement).

The breadth and depth of this underscore the significant value and impact of the dedicated strategic framework adopted by ISA in 2020, the MSR Action Plan, which enabled focused deep-sea research diplomacy based on prioritized actions against internationally agreed scientific research objectives and targets. The impact of such a strategic approach includes

- **Promotion of scientific research:** Since the launch of the MSR Action Plan in 2020, the Secretariat organized 29 dedicated events to promote scientific deep-sea research, including online and in-person workshops, webinars, information series and side events, securing the participation of 879 experts. Notably, a quarter of participants were from least developed countries, landlocked developing countries and the Big Ocean





States. This showcases the ISA's strong convening power in advancing science for all while fostering an inclusive approach through maximizing the participation of developing States.

- Establishment of strategic partnerships:** The establishment of 44 strategic partnerships to facilitate the delivery of the MSR Action Plan reflects the financial and in-kind support received in less than five years from 19 Member States and the European Union.
- Deep-sea research diplomacy:** A successful and innovative deep-sea research diplomacy led by the ISA Secretary-General with Heads of State and governments, ocean and industry leaders to raise awareness of the added value of the ISA's work through the collective implementation of the MSR Action Plan, which progressively became the global deep-sea agenda. This engagement brought to the attention of most senior decision makers in more than 37 specific interventions the need to focus on collective action to advance scientific research priorities identified at the global level involving all interested stakeholders. Interventions were made at the UN General Assembly, during the Meeting of States Parties to UNCLOS and making statements during international celebrations, conferences, symposiums, workshops, webinars or high-level events.
- Scientific publications:** Many scientific publications facilitated the advancement of the work carried out in line with the ISA MSR Action Plan as contractors reported 431 peer-reviewed publications across 121 journals between 2020 and 2023, including 359 that have been directly informed by the results generated by ISA-regulated exploration activities. Notably, 30 per

cent of the first authors were women. During the same reporting period, the ISA Secretariat facilitated five technical studies, two policy briefs and two fact checks. All these publications were crosscutting all six SRPs of the ISA MSR Action Plan, thereby demonstrating the comprehensive approach and interlinkages of scientific activities and programmes facilitated.

- Recognition of collaborative research:** A better and wider recognition of the value of collaborative efforts between exploration contractors and the broader marine scientific community in researching environmental conditions within exploration areas and research into the potential environmental impacts of collector vehicles, resulting in over 50 peer-reviewed scientific publications.
- Investment in environmental activities:** ISA's different actions facilitate a colossal amount of investment. Since 2020, over USD100 million has been invested through environmental activities and surveys carried out by contractors. In addition to resource assessment, this serves as a significant driver for enhanced MSR in areas beyond national jurisdictions. Furthermore, ISA has allocated in its regular budget USD8.4 million over the past 10 years specifically for programmatic expenditures aimed at implementing the SRPs outlined in the MSR Action Plan. Notably, the budget line dedicated to promoting MSR has seen a fourfold increase from USD100,000 in 2014 to USD386,000 in 2024. The 2025-2026 budget saw another increase for the implementation of the ISA MSR Action Plan of USD419,5000. Since 2018, ISA has been able to secure a steady stream of extrabudgetary resources for MSR projects by establishing a new funding mechanism that builds on previous contributions while attracting new ones. Several Member States have consistently provided extrabudgetary contributions in support of MSR activities, totalling USD1.9 million until 2024.

A key outcome of the report is a set of seven recommendations that have been identified based on the need for the MSR Action Plan to evolve in line with an increasing understanding of the deep sea through the generation of knowledge, alongside an increasing recognition of the importance of the work of the ISA in the delivery of its mandates under UNCLOS.

In conclusion, the report shows the significant contribution of ISA, through the different actions implemented directly or with the support of its partners, in promoting and encouraging MSR in the Area. This in turn constitutes a remarkable contribution to the scientific objectives of the UN Ocean Decade.

Introduction and Scope



ISA facilitates a holistic multidisciplinary and multi-stakeholder approach while addressing a spectrum of scientific and technological aspects, from understanding the fundamental geology of the international seabed area to its associated ecosystem functions.

ISA mandate for the promotion and encouragement of marine scientific research in the Area

The International Seabed Authority (ISA) is mandated by the United Nations Convention on the Law of the Sea (UNCLOS) to organize and control activities carried out in the Area for the benefit of humankind (UNCLOS, Article 140(1)).¹ A key aspect of this responsibility is to take measures to ensure the effective protection of the marine environment from harmful effects that may arise from the exploration and exploitation of mineral resources of the deep sea (UNCLOS, Article 145). Understanding the characteristics of the marine environment is essential for its protection. Consequently, marine scientific research (MSR), including environmental baseline studies, is critically important. UNCLOS also mandates ISA to promote and encourage the conduct of MSR in the Area and coordinate and disseminate the research and analysis when available (UNCLOS, Article 143). MSR is one of the core elements governing the legal regime of the Area, as outlined in Section 2 of Part XI of UNCLOS. Part XIII of UNCLOS is dedicated entirely to the subject, further emphasizing the role of ISA in facilitating MSR. UNCLOS also mandates ISA to take measures to promote and encourage the transfer of technology to developing States (UNCLOS, Article 144). UNCLOS grants ISA specific and unique mandate and competences in relation to MSR, including the responsibility to cooperate with international and non-government organizations (UNCLOS, Article 169). In so doing, ISA catalyses collaborative research and technology development in the Area at a global scale for the benefit of humankind while ensuring visible, tangible, measurable and impactful results are achieved.

ISA facilitates a holistic multidisciplinary and multi-stakeholder approach while addressing a spectrum of scientific and technological aspects, from understanding the fundamental geology of the international seabed area (the Area) to its associated ecosystem functions. Given that the Area and its resources are designated as the common heritage of humankind, all MSR activities conducted within it may be considered as one of the global public goods. When placed alongside the knowledge gained from activities in the Area by ISA contractors, ISA's mandate constitutes a single, major, knowledge-generating framework unmatched by other international frameworks.

Context setting of the UN Ocean Decade

The United Nations (UN) Decade of Ocean Science for Sustainable Development (Ocean Decade) was proclaimed at the seventy-second session of the United Nations General Assembly (UNGA) in 2017. The UNGA called upon

the Intergovernmental Oceanographic Commission (IOC) to prepare an implementation plan in consultation with UN Member States, specialized agencies, funds, programmes and bodies of the UN, as well as other intergovernmental organizations, non-governmental organizations and relevant stakeholders. It also invited the UN-Oceans, an inter-agency mechanism that enhances the coordination, coherence and effectiveness of competent UN and ISA organizations, and its participants to collaborate with the IOC on the UN Ocean Decade.²

Following the proclamation of the UN Decade, ISA started actively contributing during the two years of preparatory work, including consultations with other relevant UN and other actors and stakeholders. This included information-gathering through global and regional workshops and culminated in the delivery of the Implementation Plan, which was presented at the seventy-fifth session of the UNGA in late 2020. According to the Implementation Plan, the IOC is responsible for providing the UN Secretary-General with information on implementing the UN Decade. It invited the UN-Oceans family to collaborate with the IOC-UNESCO and recognized the important role of UN entities in delivering UN Ocean Decade activities as a platform where all specific competences, mandates and outputs are needed to achieve a collective goal.

The objectives of the UN Ocean Decade are at the core of ISA's mandate to promote and encourage the conduct of MSR in the Area and to facilitate the participation of developing States in deep-sea exploration and research programmes. Recognizing these synergies, ISA has been actively collaborating with the UN Ocean Decade to achieve shared objectives, such as improved knowledge-sharing on deep-sea biodiversity and enhancing ocean observing networks.

ISA's Action Plan for Marine Scientific Research

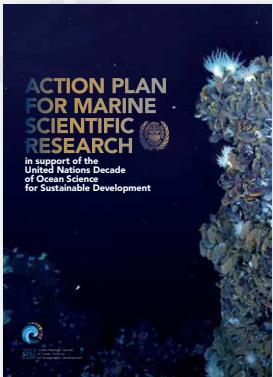
In July 2020, ISA State Members unanimously adopted the ISA Action Plan for Marine Scientific Research in support of the United Nations Decade of Ocean Science for Sustainable Development (MSR Action Plan), formalizing the specific elements upon which ISA would support the implementation of the UN Ocean Decade in line with the mandates assigned to it by UNCLOS and the 1994 Agreement.³ Full and effective implementation of provisions of UNCLOS on MSR in the Area through the MSR Action Plan offers a unique opportunity to promote MSR in the deep-ocean areas that are not easily accessible while ensuring that the results generated can benefit all.

Gaining scientific knowledge of the Area and addressing key scientific questions is a mission best addressed by

1 United Nations. 1982. United Nations Convention on the Law of the Sea. Available at: https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf.

2 UNGA. 2020. Resolution A/RES/75/239. Available at: <https://digitallibrary.un.org/record/3896779?ln=en&v=pdf>

3 ISA. 2020. Decision of the Assembly relating to the action plan of the International Seabed Authority in support of the United Nations Decade of Ocean Science for Sustainable Development (ISBA/26/A/17).



The Six Strategic Research Priorities of the ISA MSR Action Plan



SRP 1 Advancing scientific knowledge and understanding of deep-sea ecosystems, including biodiversity and ecosystems functions, in the Area.



SRP 2 Standardizing and innovating methodologies for deep-sea biodiversity assessment, including taxonomic identification and description, in the Area.



SRP 3 Facilitating technology development for activities in the Area, including ocean observation and monitoring.



SRP 4 Enhancing scientific knowledge and understanding of potential impacts of activities in the Area.



SRP 5 Promoting dissemination, exchange and sharing of scientific data and deep-sea research outputs and increasing deep-sea literacy.



SRP 6 Strengthening deep-sea scientific capacity of ISA Members, in particular developing States.

taking a holistic approach crucial for enabling international cooperation. In that line, the MSR Action Plan is structured around six strategic research priorities (SRPs), anchored in several Strategic Directions identified in the ISA Strategic Plan and associated High-Level Action Plan for the period 2019-2023, extended by the Assembly until 2025.⁴ All six SRPs of the ISA MSR Action Plan deliver tangible outputs aligned with the 10 Challenges and seven Outcomes identified in the Implementation Plan of the UN Ocean Decade (Figure 1).

Objectives of the report

This report aims to detail the scientific contribution made by ISA in advancing MSR in the Area for the benefit of all humanity accelerating with the adoption of the ISA MSR Action Plan since 2020. Its objective is to increase the strategic visibility and importance of the scientific activities and contributions made and facilitated by ISA and its global network of partners to support an internationally agreed global deep-sea research agenda.

The report also seeks to provide specifics on the extensive range and scope of research facilitated by ISA, identifying the direct impact and benefits of a global approach in supporting the UN Ocean Decade through various outputs. In doing so, a special focus is to highlight how efforts undertaken by contractors holding ISA exploration contracts advance several UN Decade Challenges. Fundamentally, annual obligations placed on contractors to acquire and share fundamental environmental data with ISA as part of their exploration programmes have proven instrumental in providing a wealth of knowledge of the deep-ocean environment and ecosystem functions. .

Methodology

The principal method used to identify the key findings of this report involved a review and analysis of documentary evidence related to ISA MSR-enabled activities across the six SRPs of the MSR Action Plan while identifying their contributions to the 10 Challenges of the UN Ocean Decade. The evidence was gathered from internal reports, publicly available materials and scientific literature.

First, the development of a matrix mapping all the activities enabled by ISA in relation to the scope of this report highlighted a strong alignment between the different initiatives delivered against the ISA MSR strategic priorities and the 10 Challenges of the UN Ocean Decade.. Given the high volume of activities and information, this report presents only a subset of key findings across all six SRPs in Chapter 3, including 6 case studies and 10 spotlights on impactful initiatives.

⁴ ISA. 2023. Statement by the President on the work of the Assembly of the International Seabed Authority at its twenty-eighth session (ISBA/28/A/18), para 48.

Figure 1. Strategic research priorities

The case studies included are:

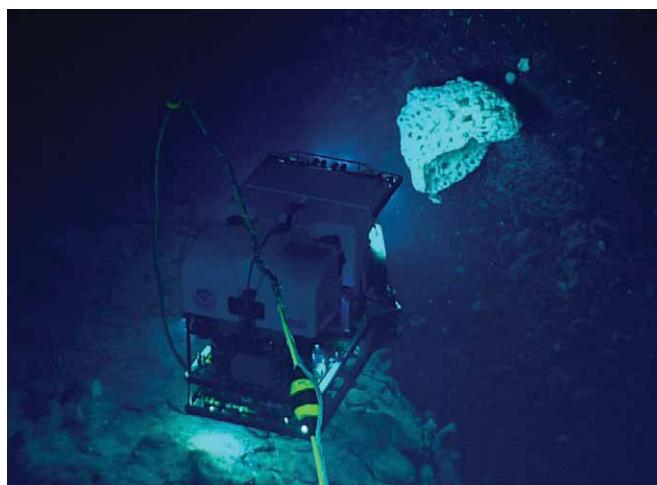
1. Decades of environmental baseline studies
2. The Sustainable Seabed Knowledge Initiative
3. How ISA assesses and catalyzes advancements in deep-sea technologies
4. Recent scientific advancements linked to environmental impact assessments
5. The one-stop shop for deep sea data: ISA's DeepData database
6. Women in deep-sea research project and the S.H.E. Mentoring Programme

The spotlights are:

- Baseline studies in physical oceanography in the Area
- Scientific outputs of contractors' activities in the Area
- The marine benthic nematode molecular protocol handbook
- Partnership with the UN Technology Bank
- Spatial analyses of potential interaction between fishing and mineral-related activities in the Area
- AREA 2030 Facilitating the high-resolution mapping of the Area by 2030
- Deep-sea literacy for children
- National expert deployment programmes
- The second capacity training course in the framework of the ISA-China JTRC
- The governance and activities of the ISA Partnership Fund

Second, the peer-reviewed scientific publications listed in the supplementary material of the annual reports submitted by all contractors from 2020 to 2023 (available to date) were summed and classified into five categories based on their scope: biology, oceanography, geology, engineering and others. The four first categories relate directly to the scientific analysis of exploration activities and the data gathered. The "others" category includes broader scientific papers and those relating to policymaking. The gender of the first author was recorded to assess the representation of women leading publications and to evaluate gender balance. Duplicates were removed, such as contractors reporting the same papers in different years or collaborative publications reported by multiple contractors. Web-unretrievable publications (e.g., articles in press) were excluded. Every scientific bibliographic reference was uploaded to the open-source reference management software Zotero, which includes the publications' DOIs for direct online access. This bibliographic library, available for download on the ISA website, will be updated annually and evolve into a one-stop shop for deep-sea MSR.⁵

A third dimension of the methodology involved strategic guidance and oversight from a group of experts appointed by the ISA Secretary-General. (Annex I). These experts, including internationally renowned specialists in various relevant fields, bring extensive knowledge and experience across the full spectrum of ISA's mandates and initiatives. A series of nine informal interviews with experts in key areas of the report findings enhanced the framing of the activities presented and the recommendations. Interviews with scientific experts from research institutions, Member States representatives and other end users provided valuable perspectives and insights. Comments from all interviewees have been aggregated, and incorporated anonymously throughout this report.



In areas beyond national jurisdiction (ABNJ), ISA is the only intergovernmental organization with a specific mandate under UNCLOS to conduct and promote MSR. For 30 years, ISA has played a critical role in the Area, including organizing the dissemination of the MSR findings to advance global understanding of the deep-sea environment and ecosystems. Through dedicated efforts to unify contributions under this mandate, as captured in the ISA MSR Action Plan, a global framework now exists that provides internationally agreed SRPs crucial to understanding deep-ocean environments while ensuring the best-informed decisions in support of the sustainable use of the resources of the deep-ocean sea floor. The adoption and implementation of the MSR Action Plan as a global deep-sea research agenda has facilitated a new impetus, highlighting the importance of MSR in promoting sustainable development and supporting a global regulatory regime grounded in the precautionary approach.

The MSR Action Plan is well-positioned to help address the 10 Challenges of the UN Ocean Decade, categorized into three objectives. Each of these objectives is essential to achieving seven societal outcomes that define "the ocean we want" (Figure 2).

5 ISA. Marine Scientific Research: The bibliographic repository. Available at: <https://www.isa.org.jm/marine-scientific-research>.

Context of ISA's contributions to the scientific objectives of the UN Ocean Decade

The Science We Need

Objective 1

focuses on knowledge generation from which solutions will be identified.

Identify required knowledge for sustainable development and increase the capacity of ocean science to deliver needed ocean data and information.

Objective 2

a focus on essential infrastructure required to underpin the ambitions of the Decade.

Build capacity and generate comprehensive knowledge and understanding of the ocean, including human interactions and interactions with the atmosphere, cryosphere and the land-sea interface.

Objective 3

foundational with emphasis is on essential, cross-cutting elements of the Decade.

Increase the use of ocean knowledge and understanding and develop capacity to contribute to sustainable development solutions.

Challenge 1 Understand and map land- and sea-based sources of pollutants and contaminants and their potential impacts on human health and ocean ecosystems, and develop solutions to remove or mitigate them;

Challenge 2 Understand the effects of multiple stressors on ocean ecosystems, and develop solutions to monitor, protect, manage and restore ecosystems and their biodiversity under changing environmental, social and climate conditions;

Challenge 3 Generate knowledge, support innovation and develop solutions to optimize the role of the ocean in sustainably feeding the world's population under changing environmental, social and climate conditions;

Challenge 4 Generate knowledge, support innovation and develop solutions for equitable and sustainable development of the ocean economy under changing environmental, social and climate conditions;

Challenge 5 Enhance understanding of the ocean-climate nexus and generate knowledge and solutions to mitigate, adapt and build resilience to the effects of climate change across all geographies and at all scales, and to improve services including predictions for the ocean, climate and weather;

Challenge 6 Enhance multi-hazard early warning services for all geophysical, ecological, biological, weather, climate and anthropogenic related ocean and coastal hazards, and mainstream community preparedness and resilience;

Challenge 7 Ensure a sustainable ocean observing system across all ocean basins that delivers accessible, timely and actionable data and information to all users;

Challenge 8 Through multi-stakeholder collaboration, develop a comprehensive digital representation of the ocean, including a dynamic ocean map, which provides free and open access for exploring, discovering and visualizing past, current and future ocean conditions in a manner relevant to diverse stakeholders;

Challenge 9 Ensure comprehensive capacity development and equitable access to data, information, knowledge and technology across all aspects of ocean science and for all stakeholders;

Challenge 10 Ensure that the multiple values and services of the ocean for human well-being, culture, and sustainable development are widely understood, and identify and overcome barriers to behaviour change required for a step change in humanity's relationship with the ocean.

Figure 2. Science challenges and societal outcomes of the UN Ocean Decade

The Ocean We Want



A clean ocean where sources of pollution are identified and reduced or removed.



A healthy and resilient ocean where marine ecosystems are understood, protected, restored and managed.



A productive ocean supporting sustainable food supply and a sustainable ocean economy.



A predicted ocean where society understands and can respond to changing ocean conditions.



A safe ocean where life and livelihoods are protected from ocean-related hazards.



An accessible ocean with open and equitable access to data, information and technology and innovation.



An inspiring and engaging ocean where society understands and values the ocean in relation to human wellbeing and sustainable development.



Advancement of scientific deep-sea research, including the contributions to the UN Decade

This section outlines how ISA promotes MSR in ABNJ, highlighting key domains of action across all six SRPs of the MSR Action Plan. Here, the focus is on the efforts and achievements since the inception of the UN Ocean Decade and the adoption of ISA's MSR Action Plan. Each example is linked to the specific SRP it primarily supports, although many contribute to progress in others. Each SRP includes an explanation of the important UN Decade Challenges that its activities address and an indication of their potential influence within the larger framework. Each SRP is supported by case studies that provide more detailed insight into the key domains of action delivered. Finally, a "Spotlight" feature highlights stand-alone topics of interest.

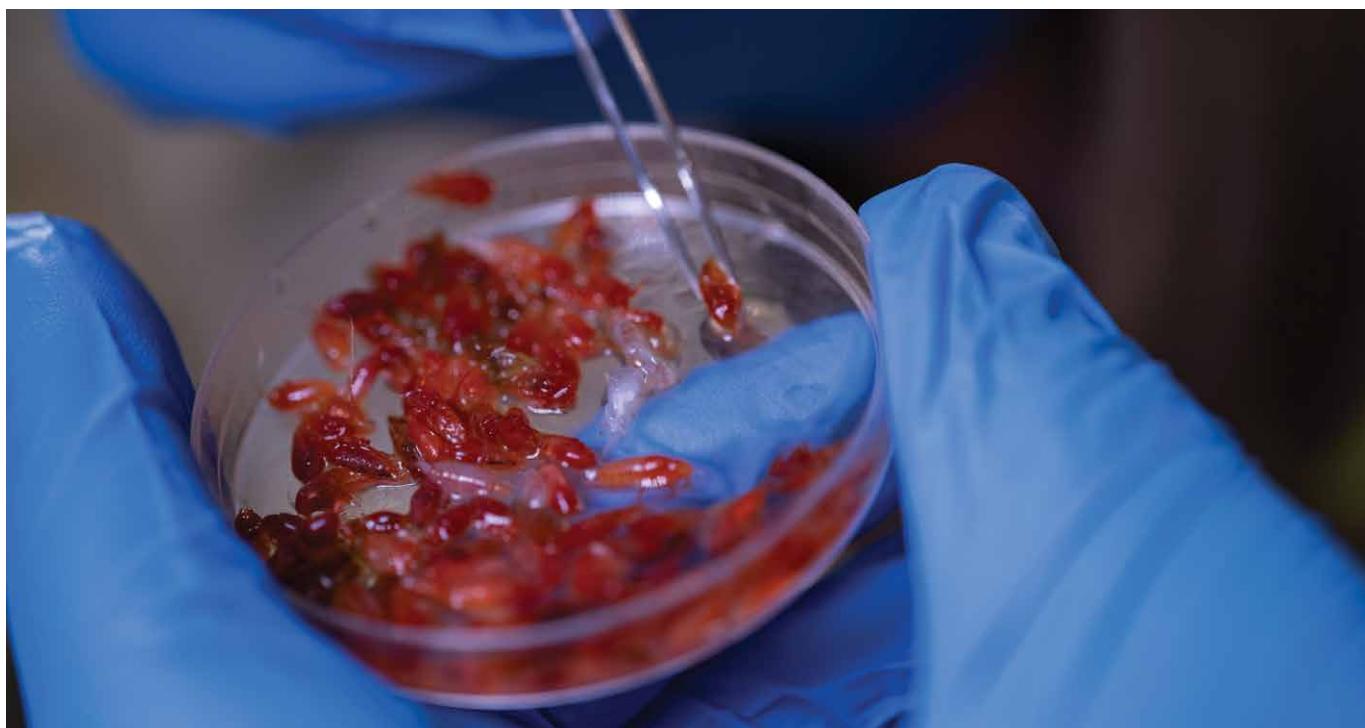
To discharge its MSR mandate and deliver the MSR Action Plan across all SRPs, ISA:

- acts as a global catalyst for strengthening scientific partnerships to advance the underpinning scientific basis
- facilitates the organization of expert workshops and commissions topic-specific reports that develop science and its processes
- delivers knowledge outputs informed by the outcomes of the above to facilitate the development of scientific tools and modelling approaches
- enables effective implementation of UNCLOS anchored in the application of the precautionary approach in support of the sustainable management of ocean resources in ABNJ.

The knowledge outputs are published on the dedicated page of the ISA website as technical studies, workshop reports, policy briefs, discussion papers and webinars targeting legal or scientific experts and a wider audience.⁶

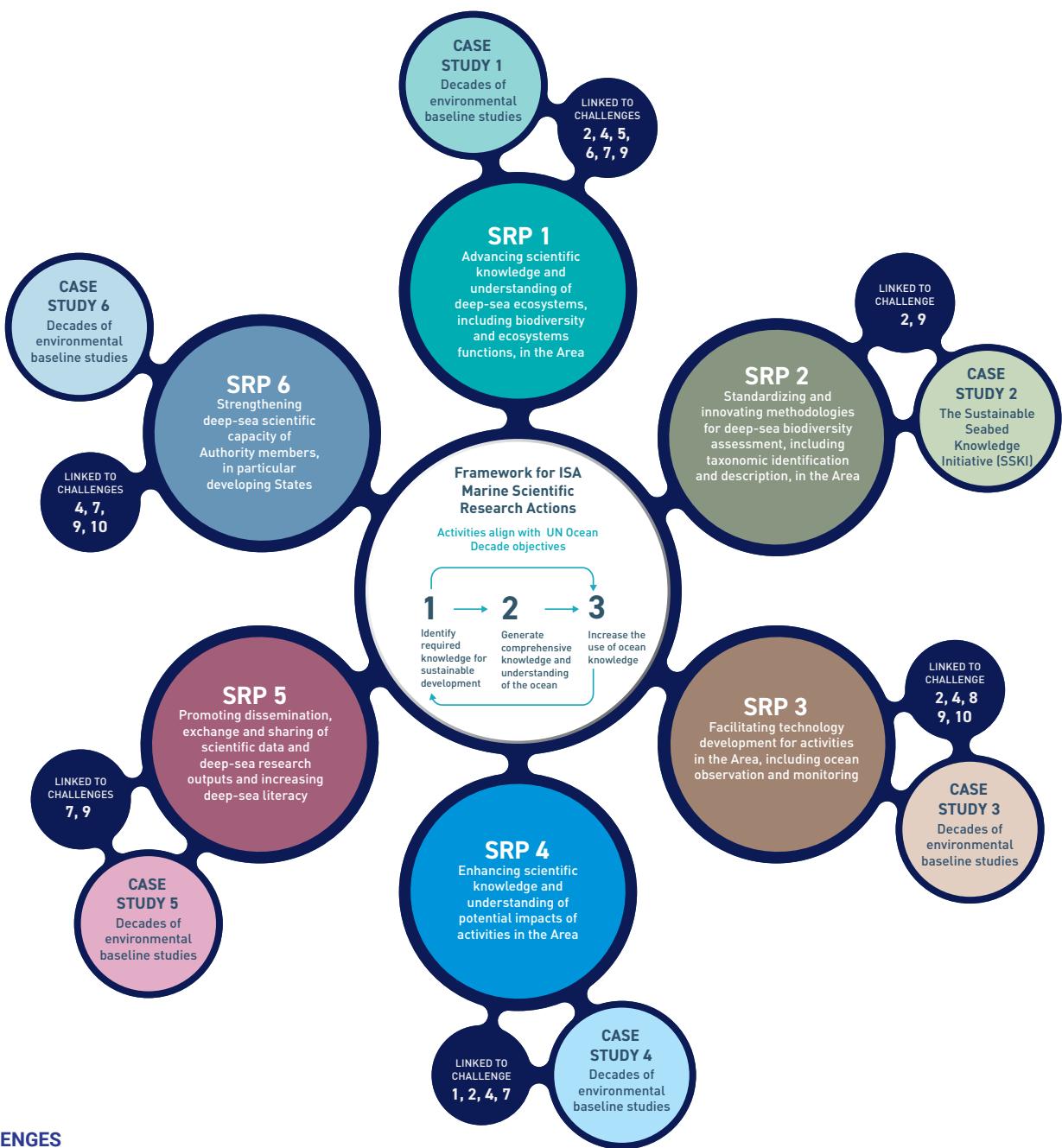
ISA ensures the participation of recognized experts from the scientific community, international and governmental organizations, non-governmental organizations, representatives of ISA contractors, experts from the Legal and Technical Commission (LTC), including, when possible, former trainees when organizing workshops. As ISA's primary technical advisory organ, the LTC consists of 41 multidisciplinary members and is responsible for advising the ISA Council. Its functions include reviewing the rules, regulations and procedures and recommending to the Council all matters relating to exploration and exploitation in the Area, including protecting the marine environment.⁷ The LTC also provides guidance and recommendations to assist contractors in complying with the ISA's rules and regulations.

ISA's holistic approach to implementing the global deep-sea research agenda is evolutionary, allowing for continual and incremental improvements by refining activities and integrating lessons learned (Figure 4).



6 ISA. Publications. Available at: <https://www.isa.org.jm/publications>.

7 UNCLOS, Article 162(2)(e).



CHALLENGES

- Understand and beat marine pollution Understand and map land and sea-based sources of pollutants and contaminants and their potential impacts on human health and ocean ecosystems, and develop solutions to mitigate or remove them;
- Protect and restore ecosystems and biodiversity Understand the effects of multiple stressors on ocean ecosystems, and develop solutions to monitor, protect, manage and restore ecosystems and their biodiversity under changing environmental, social and climate conditions.
- Sustainably feed the global population Generate knowledge, support innovation, and develop solutions to optimise the role of the ocean in sustainably feeding the world's population under changing environmental, social and climate conditions.
- Develop a sustainable and equitable ocean economy Generate knowledge, support innovation, and develop solutions for equitable and sustainable development of the ocean economy under changing environmental, social and climate conditions.
- Unlock ocean-based solutions to climate change Enhance understanding of the ocean-climate nexus and generate knowledge and solutions to mitigate, adapt and build resilience to the effects of climate change across all geographies and at all scales, and to improve services including predictions for the ocean, climate and weather.
- Increase community resilience to ocean hazards Enhance multi-hazard early warning services for all geophysical, ecological, biological, weather, climate and anthropogenic related ocean and coastal hazards, and mainstream community preparedness and resilience.
- Expand the Global Ocean Observing System Ensure a sustainable ocean observing system across all ocean basins that delivers accessible, timely, and actionable data and information to all users.
- Create a digital representation of the ocean Through multi-stakeholder collaboration, develop a comprehensive digital representation of the ocean, including a dynamic ocean map, which provides free and open access for exploring, discovering, and visualizing past, current, and future ocean conditions in a manner relevant to diverse stakeholders.
- Skills, knowledge and technology for all Ensure comprehensive capacity development and equitable access to data, information, knowledge and technology across all aspects of ocean science and for all stakeholders.
- Change humanity's relationship with the ocean Ensure that the multiple values and services of the ocean for human wellbeing, culture, and sustainable development are widely understood, and identify and overcome barriers to behaviour change required for a step change in humanity's relationship with the ocean.

Figure 3. The six SRPs and their links to UN Ocean Decade Challenges.

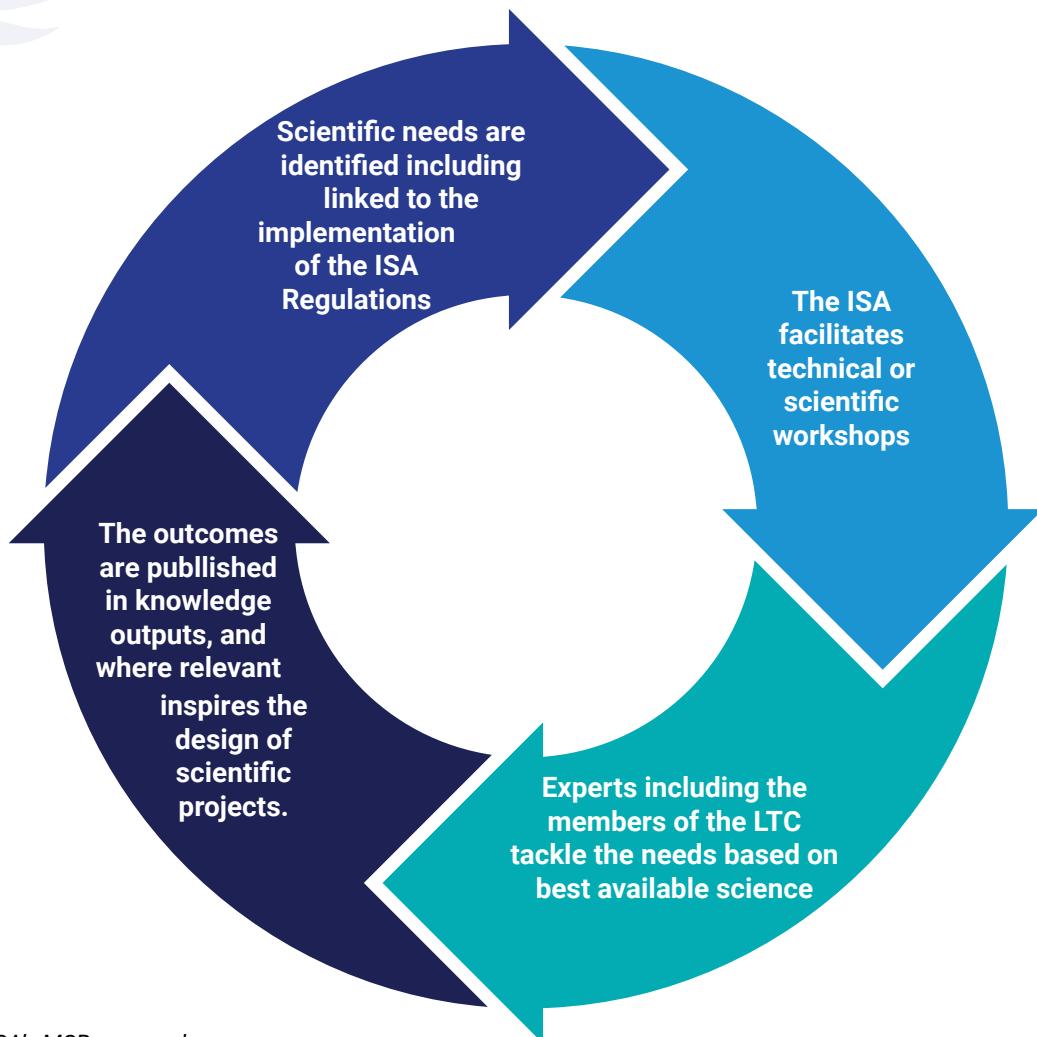


Figure 4. The ISA's MSR approach

One of the most relevant milestones demonstrating the effectiveness of ISA's approach is the development of environmental guidelines for activities in the Area. These guidelines, strictly followed by Member States, exploration contractors and, to some extent, the scientific community, are issued as recommendations for activities in ABNJ and supplement the existing global exploration regulations. They address key aspects of MSR, including establishing a statistically sound environmental baseline, data analysis, analytical techniques and the use of technology in line with the best available methodologies.⁸

ISA has organized numerous workshops to support the formulation of these guidelines, beginning with the first workshop in June 1998. c. Workshops on the standardization of environmental data have significantly improved scientific understanding and informed the revision of guidelines for polymetallic nodules (PMN).⁹ The findings and knowledge

outputs from these workshops inspired the design of six multiannual scientific research projects between 2005 and 2016, such as the Managing Impacts of Deep sea Resource Exploitation project (2013-2016), the joint Pacific Community-European Union Deep Sea Mineral project (2011-2016), the Enabling Management of Offshore Mining project at the National Institute of Water and Atmospheric Research (2012-2016) and a joint project between Japan and France entitled EcoDeep. These projects further advanced scientific requirements for establishing baseline surveys and impact monitoring. For example, the Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI-Oceans) "MiningImpact" project (2015-2017) assessed experimental and small-scale disturbances of the sea floor, using mapping technologies at various spatial scales, providing valuable insights for improving environmental management in the Area.¹⁰

⁸ ISA. 2019. Workshops. Available at: Workshop on the Development of Standards and Guidelines for the Mining Code - International Seabed Authority

⁹ ISA. 2002. Recommendations for the guidance of the contractors for the assessment of the possible environmental impacts arising from exploration for polymetallic nodules in the Area: Issued by the Legal and Technical Commission (ISBA/7/LTC/1/Rev.1).

¹⁰ JPI-Oceans. Final report August 2018 – February 2022. Available at: Microsoft Word - MI2_FinalReport_web.docx

Advancing scientific knowledge and understanding of deep-sea ecosystems, including biodiversity and ecosystems functions, in the Area

STRATEGIC RESEARCH PRIORITY 1

Deep-sea exploration for marine minerals began in 1950. It gained momentum in the 1970s with the formation of consortia in countries such as Germany, the United States, Canada, Japan, France, Belgium and Italy, among others. However, interest waned in the 1980s, partly due to the substantial resources required for deep-sea exploration. Today, a deep-sea research expedition costs from USD60,000 to USD100,000 per day, necessitating advanced planning and technical and human capacities. Multidisciplinary teams of engineers and scientists, including physical and chemical oceanographers, hydrographers for mapping, geologists, biologists and geophysicists for seismic analysis, play a critical role in deep-sea exploration. It is estimated that between 700 and 1,000 research vessels are owned by universities, research centres and private entities globally. However, only about 70 to 100 are multipurpose vessels capable of conducting research and exploration in ABNJ. There are approximately 2,136 deep-sea and marine organizations worldwide. However, only 38 per cent are universities and research laboratories. Together, this represents a relatively small pool of institutions and experts contributing to this specialized field.¹¹

The entry into force of ISA in 1994 significantly facilitated the advancement of deep-sea exploration by enabling the adoption of a robust legal framework for exploration, which incentivized investment by contractors in support of applied research in the deep-sea. Adopting ISA's exploration regulations also enabled the establishment of common global standards for data collection, methodologies and scientific programmes. Over the last 30 years, the work of ISA created a platform for international collaboration focusing entirely on the deep sea. Since 2017, the Secretariat has also made significant efforts to collect and standardize historical data

from research conducted before 1994, including data from the HMS Challenger scientific expedition and expeditions of early pioneer investors. Today, all non-confidential environmental data collected by the contractors are publicly available in ISA's global repository, the DeepData (SRP 5).

Deep-sea exploration serves two main purposes: generating scientific knowledge and establishing an environmental baseline for assessing potential future impacts. The development of these baselines, in accordance with ISA environmental guidelines, forms a crucial foundation for enhancing our general knowledge and understanding of deep-sea environments and ecosystems. A statistically robust and scientifically sound baseline is essential for evaluating the potential effects of deep-sea exploitation. Over the past 30 years, considerable efforts have been made to ensure that as much as possible data and information are collected to inform the establishment of environmental baselines.

In the context of deep-sea ecosystems and the environment in the Area, data-collection focuses on a wide range of parameters that characterize the environments explored.¹² To date, ISA has identified more than 100 parameters that must be monitored and reported annually, covering areas such as physical and chemical oceanography, sediment properties, biological communities, bioturbation, sedimentation and geological and geochemical properties. The value in the collection of baseline information is very high because it represents a major contribution to the general understanding of the deep-sea environment and ecosystems functions, directly informing the implementation of all relevant provisions of UNCLOS and confirming the leading role of ISA in ensuring the sound and responsible management of 54 per cent of the world's seabed. More broadly, baseline information underscores the importance it plays in the conservation and sustainable use of marine biodiversity in ABNJ.

¹¹ Bell, K.L.C., Quinzin, M.C., Poulton, S., Hope, A., & Amon, D. (Eds.). 2022. 2022 Global Deep-Sea Capacity Assessment. Ocean Discovery League, Saunderstown, USA. <http://doi.org/10.21428/cbd17b20.48af7fcb>.

¹² ISA. 2023. Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area: Issued by the Legal and Technical Commission (ISBA/25/LTC/6/Rev.3).

CASE STUDY 1. Decades of environmental baseline studies facilitated by ISA in the Area

The exploration work carried out by ISA contractors provides the primary source of scientific data on the Area and its resources, including environmental data. These data are supplemented by historical data sets from the research carried out by registered pioneer investors before the entry into force of UNCLOS, as well as by States and international consortia of exploration companies dating back to the

1970s. Collectively, this represents more than 40 years of dedicated research on the Area and its resources.¹³ A huge body of information has been generated over this period. Practices have been refined and built upon to the present day.

ISA has entered into 30 contracts for the exploration for PMNs, polymetallic sulphides (PMS) and cobalt-rich ferromanganese crusts (CFC) with 22 contractors.^{14 15} Contractor activities are conducted in the areas within the Clarion-Clipperton Zone (CCZ) in the Pacific Ocean, the

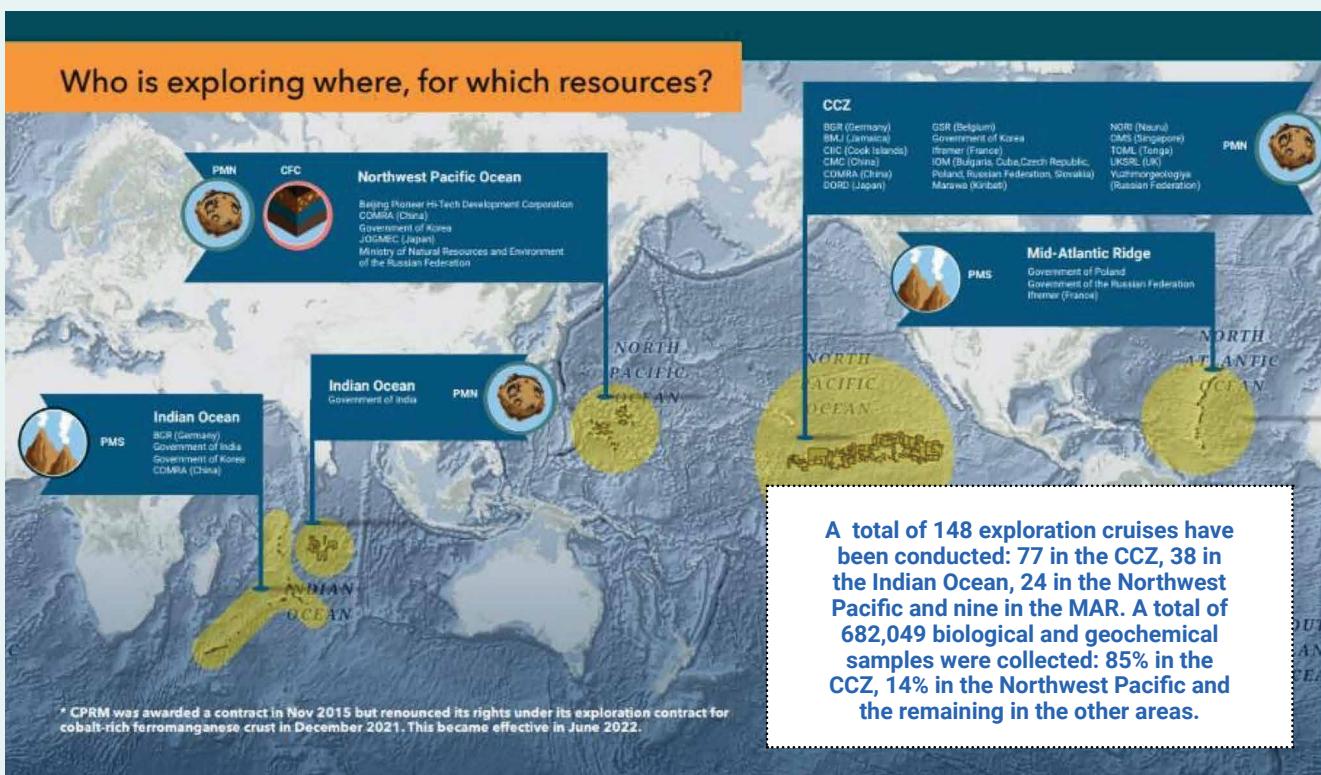


Figure 5. Exploration activities in the Area

13 ISA. 2023. Availability, content and accessibility of data and information of DeepData (ISA Fact-check 2023/1).

14 ISA. 2024. Status of contracts for exploration and related matters, including information on the periodic review of the implementation of approved plans of work for exploration Report of the Secretary-General (ISBA/29/C/5).

15 ISA. Exploration contracts. Available at: <https://www.isa.org.jm/exploration-contracts>.

Northwest Pacific Ocean, the Central Indian Ocean Basin, the Southwest Indian Ridge and the MAR. As an indication of the level of exploration activity, all the cruises conducted in the CCZ represent a total of more than 6,000 days at sea. As stated in the Exploration regulations for seabed minerals in the Area, each contractor is required “to gather oceanographic and environmental baseline data and to establish baselines against which to assess the likely effects of its programme of activities,” taking into account any recommendations issued by the LTC.¹⁶

Characterizing geology is an important aspect of exploration. The characteristics of the various mineral resources investigated by contractors include characterization of the ocean crust, tectonic evolution over geological timescales, volcanic rocks, magmatic activity, sedimentation rates, the type of sediments and seamount structures and active local geochemistry. These offer a detailed understanding of the processes and physical characteristics of the environment required for the formation of the various mineral resources.

Over 20 years ago, ISA took the first initiative and developed a geological model of PMN deposits in the CCZ.¹⁷ This technical study culminated in the development of a “Prospectors guide,” which contains a description of key factors and variables for the exploration for PMNs in the CCZ, including data on known occurrences. Another pivotal advance in the standardization of science-based practices for the classification of PMNs for sustainable deep-sea exploration and responsible recovery was published in 2014 as a technical study on PMN classification, promoting best practices in resource evaluation.¹⁸ This study underscored the variability in resource assessment methodologies among contractors. It emphasized the critical need for uniform standards to inform exploration for seabed minerals and their future use across all stakeholders.

Baseline studies undertaken by seven contractors exploring for PMS in the MAR and the Indian Ocean furthered our understanding of the complex sea floor hydrothermal formation and activity, including the identification of new hydrothermal plumes.¹⁹

Four contractors conduct explorations for CFC.²⁰ Their geological programme focuses mainly on delineating the deposits and resources through drilling core samples and multibeam echosounder.

Contractors integrate their data with geological information available from peer-reviewed literature, employing advanced statistical and artificial neural networks to develop comprehensive resource evaluation methods. This approach allows for accurate estimations of the critical minerals available in the contract areas.^{21 22} As demand is expected to rise significantly over the next two decades due to energy transitions, this knowledge quantifies the potential contribution of deep-sea minerals to the sustainable supply of minerals.²³ It contributes to the further development of the ocean economy (UN Decade Challenge 4) based on sustainable use in parallel to the protection of the marine environment, as demonstrated in the “Contribution of ISA to the achievement of the 2030 Agenda for Sustainable Development.”²⁴

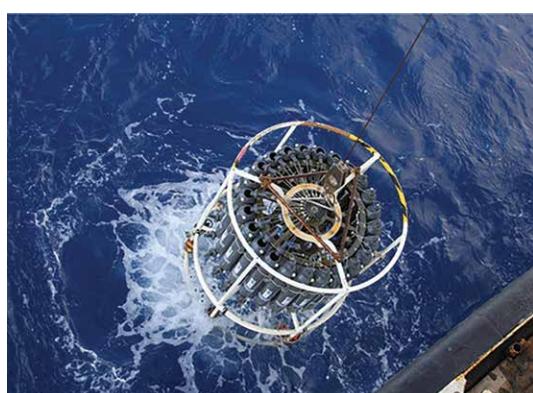
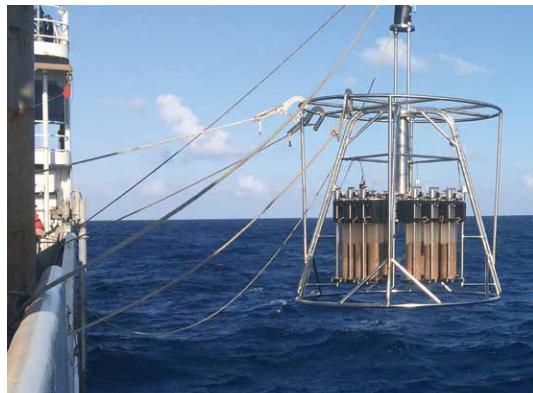
- 16 ISA. 2013. ISA. 2013. Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area: Issued by the Legal and Technical Commission (ISBA/19/LTC/8).
- 17 ISA. 2015. Technical Study 6: A Geological Model of Polymetallic Nodule Deposits in the Clarion-Clipperton Fracture Zone. Available at: <https://www.isa.org.jm/wp-content/uploads/2022/06/tstudy6.pdf>.
- 18 ISA. 2017. Technical Study 19: Polymetallic Nodules Resource Classification. Available at: <https://www.isa.org.jm/wp-content/uploads/2022/06/ts19final-web.pdf>.
- 19 Kurian, P. John, S. Rajan, Deepak Kumar Agarwal, and P. Linsky. 2022. “Indian Ocean Ridge System and Seafloor Hydrothermal Activity.” Journal of the Geological Society of India 98 (2): 155–164. <https://doi.org/10.1007/s12594-022-1951-z>.
- 20 ISA Website. Available at: [ISA_Status_of_exploration_activities_June_2024.pdf](https://www.isa.org.jm>Status_of_exploration_activities_June_2024.pdf)
- 21 Knobloch, Andreas, Thomas Kuhn, Carsten Rühlemann, Thomas Hertwig, Karl-Otto Zeissler, and Silke Noack. 2017. “Predictive Mapping of the Nodule Abundance and Mineral Resource Estimation in the Clarion-Clipperton Zone Using Artificial Neural Networks and Classical Geostatistical Methods.” In Springer eBooks, 189–212. https://doi:10.1007/978-3-319-52557-0_6.
- 22 Kuhn, Thomas, and Carsten Rühlemann. 2021. “Exploration of Polymetallic Nodules and Resource Assessment: A Case Study from the German Contract Area in the Clarion-Clipperton Zone of the Tropical Northeast Pacific.” Minerals 11 (6): 618. <https://doi:10.3390/min11060618>.
- 23 IEA. 2022. The Role of Critical World Energy Outlook Special Report Minerals in Clean Energy Transitions. Available at: <https://iea.blob.core.windows.net/assets/ffd2a83b-8c30-4e9d-980a-52b6d9a86fdc/TheRoleofCriticalMineralsinCleanEnergyTransitions.pdf>.
- 24 ISA. 2021. Contribution of ISA to the achievement of the 2030 Agenda for Sustainable Development. Available at: https://www.isa.org.jm/wp-content/uploads/2021/02/ISA_Contribution_to_the_SDGs_2021.pdf.

SPOTLIGHT 1.

Spotlight: Baseline studies in physical oceanography of the Area

Contractors are required to collect and report conductivity, temperature and depth profiles of the water column as a part of the environmental baseline data and information requested by ISA. These measurements are fundamental oceanographic observations presenting depth profiles to characterize the water column from the surface to the bottom. This is key to understanding the physico-chemical characteristics, distribution of water masses and mixing patterns of the water column, i.e. the oceanic conditions on which biological systems rely.

Oceanographic baseline data provided by contractors across the four ocean basins includes information on deep water depths that would otherwise be scarce in global inventories. Contractors' data contributes to a more comprehensive understanding of global ocean dynamics and characteristics.



SPOTLIGHT 2.

Spotlight: Scientific outputs of contractors' activities in the Area (2020-2023)

Since the adoption of the MSR Action Plan in 2020, the scientific output generated, based on the environmental studies of contractors, led to a total of 22 theses, 66 conference contributions and 431 peer-reviewed scientific publications. Eighty-three per cent or 359 of these specifically focused on data or methodologies directly associated with the offshore exploration campaigns. More than half of the publications addressed biological (120 publications) or geological topics (148 publications), while 12% (56 publications) focused on engineering and 8% (35 publications) on oceanography. The remaining publications contributed to policy views and broader topics, such as fundamental geological studies. These peer-reviewed publications are included in 121 journals, including two top journals, namely "Frontiers in marine research" and "Minerals."



120 BIOLOGY



148 GEOLOGY



56 ENGINEERING

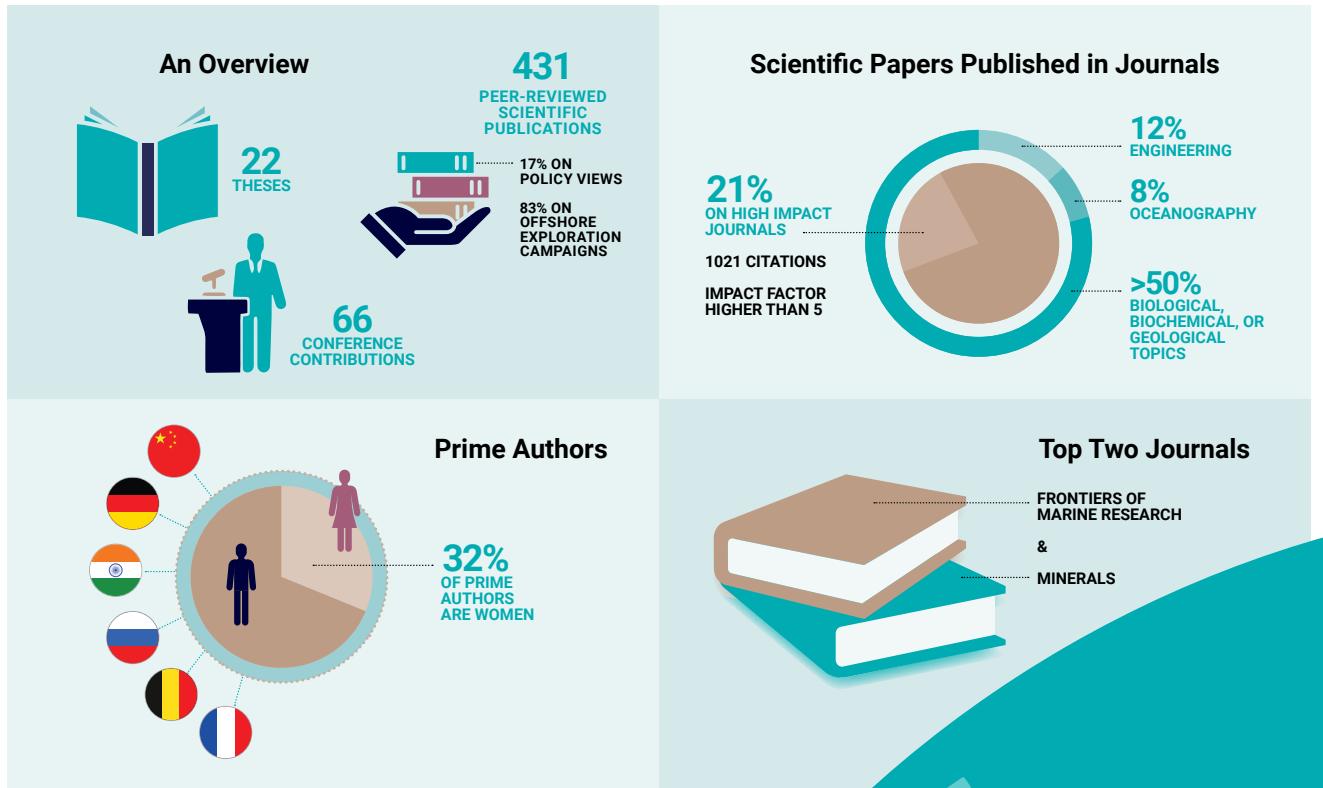


35 OCEANOGRAPHY



72 OTHER

Figure 6. Scientific publications published as an outcome of the environmental studies of contractors reported in annual reports between 2020 to 2023



A gender assessment shows that 32 per cent of prime authors are women. The top five countries affiliated with the prime authors are China, Germany, India, Russia, Belgium and France. A total of 21 per cent of the scientific papers were published in scientific journals with an impact factor higher than 5, garnering 1,021 citations. The remaining scientific publications were published in lower-impact journals. More than half of the publications tackled either biological, biogeochemical or geological topics, 12 per cent focused on engineering and 8 per cent on oceanography (Figure 6).

Advancements in cutting-edge technology development and innovation by exploration contractors have directly contributed to enhancing MSR in the Area but also in areas within national jurisdiction, environmental monitoring, modelling and mineral processing. Capacity development activities, another key responsibility of contractors, delivered through the Contractors' Training Programme, has provided world-class training focused on deep-sea research, where contractors have collectively invested more than USD10 million to enable the training of hundreds of nationals from developing States to date.

Top Two Journals



SRP 1: KEY CONNECTIONS TO UN OCEAN DECADE CHALLENGES

Analysis of data from baseline studies contributes to understanding the effects of multiple stressors on ocean ecosystems and biodiversity (Decade Challenge 2), informs resource assessment for a sustainable blue economy (Decade Challenge 4) and increases our understanding of the ocean-climate nexus (Decade Challenge 5). This oceanographic data is also valuable for forecasting natural hazards in regions prone to such events (Decade Challenge 6). The valuable contributions of contractors in the deeper layers, often conducted over several years using specialized equipment, support a sustainable ocean observing system across all ocean basins (Decade Challenge 7). Inclusion of participants from developing States in international expert workshops, exploration cruises or laboratory training represents concrete elements through which ISA supports the ongoing development of individual, institutional and organizational capacities (Decade Challenge 9).

Standardizing and innovating methodologies for deep-sea biodiversity assessment, including taxonomic identification and description, in the Area

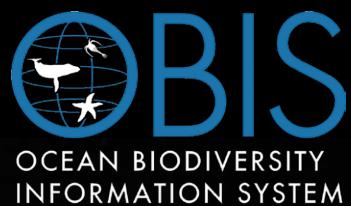
STRATEGIC RESEARCH PRIORITY 2

Standard methodologies allow for comparisons between biological data sets, either to establish whether there are changes over time or to compare the biodiversity of different areas. A common classification of organisms is critical for environmental studies to assess biodiversity and potential biodiversity loss based on a common framework and methodology.

The deep sea represents the largest habitat on Earth, known for housing rich and unique ecosystems. Facilitation of MSR on deep-sea biodiversity is a core part of the delivery of the mandate of ISA under UNCLOS. The role ISA plays in standardizing and developing innovative research methodologies for deep-sea taxonomic identification and description reflects this. By facilitating the collection of deep-

sea biodiversity data, ISA also improves data availability for scientists, Member States and other users. For example, ISA exchanges biodiversity data with the Ocean Biodiversity Information System (OBIS) through its own DeepData database. As of June 2024, the OBIS node contained 99 data sets collected between 2004 and 2021 from 456 species and 137,179 species occurrences.²⁵ These numbers continue to increase as new data is submitted to ISA on an annual basis.

ISA also fosters synergies between different user networks and beneficiaries, reinforcing iteratively the block of knowledge available and positing itself as the main platform of evidence-based information supporting concrete and practical science-policy interfaces for the sustainable use and exploration of the Area.



²⁵ ISA and OBIS data sets: <https://obis.org/node/9d2d95be-32eb-4d81-8911-32cb8bc641c8>.



SRP 2

SPOTLIGHT 3.

The “Marine benthic nematode molecular protocol” handbook

ISA has been advancing methodologies for the identification and monitoring of nematodes, which constitute up to 90 per cent of the deep-sea infauna in potential mining areas.

Recognizing the early-stage state of nematode taxonomy in 2015, ISA has developed the Marine benthic nematode molecular protocol handbook, a comprehensive guide for conducting molecular surveys of deep-sea nematodes. The handbook covers protocols from collection to molecular barcoding and identifies new technologies, such as microarray systems and massively parallel sequencing, for quicker, more precise assessments.²⁶

Marine Benthic Nematode Molecular Protocol Handbook (Nematode Barcoding)

Technical Study No. 7



ISA contractors have been instrumental in advancing the understanding of deep-sea fauna, collecting specimens for identification and testing new collection methodologies through their work to gather baseline data of biological communities. Species occurrence records total 137,179 across sites in the Indian Ocean, MAR, the Northwest Pacific and the CCZ, which accounts for the majority of records.

ISA has organized six related workshops between 2004 and 2022. Numerous technical studies were generated well before the inception of the UN Ocean Decade.²⁷ These included three workshops on taxonomic exchange and inter-calibration for different faunal classes between 2012 and 2015, where academic and contractors' experts worked in partnership, focusing on the evaluation of deep-sea samples and the difficulties encountered in assessing biodiversity in the deep sea for different faunal groups. Three workshops were facilitated between 2020 and 2022 on collaborative approaches, images and genetic-based taxonomy. This body of work produced recommendations to help move the field of taxonomic research forward. It highlighted the role of ISA as a critical factor in informing both science and policy on these issues and led to significant progress towards establishing a standardized taxonomy for deep-sea species.

In this context and building on the specific responsibilities assigned to it by UNCLOS to protect the marine environment and promote MSR in the Area, ISA launched a dedicated initiative in 2022, the Sustainable Seabed Knowledge Initiative (SSKI) to advance global deep-sea taxonomy in the Area (Case study 2).²⁸ SSKI was registered as a voluntary commitment #OceanAction41239 at the 2022 UN Ocean Conference. It accelerates species descriptions and has five objectives: increasing deep-sea biodiversity knowledge and understanding of resilience, improving consistency for biodiversity assessment, generating taxonomic data, enhancing scientific capacity in this domain and supporting global decision-making processes. Three workshops with the participation of 90 scientists have already been organized under SSKI to enhance data-sharing and identification of key taxa. Future work in this area will address the application of methods that provide a quicker understanding of the deep-sea biome, such as environmental DNA. ISA is committed to stimulating the collection and analysis of biological data through new methodologies and building capacity in the use of deep-sea biological data.

26 ISA. 2015. Technical Study 7: Marine Benthic Nematode Molecular Protocol Handbook (Nematode Barcoding). Available at: <https://www.isa.org.jm/publications/technical-study-7-marine-benthic-nematode-molecular-protocol-handbook-nematode-barcoding>.

27 ISA. Workshops and webinars: <https://www.isa.org.jm/workshops-and-webinars>.

28 ISA. Advancing deep-sea taxonomy: <https://www.isa.org.jm/isa-voluntary-commitments/advancing-deep-sea-taxonomy>.



CASE STUDY 2. The Sustainable Seabed Knowledge Initiative

Launched in 2022 at the UN Ocean Conference held in Lisbon, Portugal, SSKI aims to provide a collaborative platform to generate and disseminate new knowledge needed to inform better decision-making processes and support the effective protection of the marine environments in the Area.

The project scope include generating new knowledge, developing integrative and innovative tools, facilitate effective data sharing and use, enhancing taxonomic capacity and enhancing networking and outreach.

Workshops and other collaborative efforts have taken place to improve the taxonomy of deep-sea species since the launch of SSKI. A significant partnership is currently under way to further scale up the SSKI as a global knowledge-sharing platform.²⁹ In addition, ISA has leveraged existing samples and data sets through a global call for projects on deep-sea taxonomies, the "One thousand reasons."³⁰ The primary objective was to facilitate and expedite the description of species, providing awarded projects with access to biological samples, research facilities and taxonomic expertise.

The World Register of Marine Species (WoRMs) network of taxonomists has been engaged by ISA to help deliver SSKI. SSKI uses and promotes WoRMs' species nomenclature, helping ensure the ease of use and reuse of data, including for evidence-based decision-making.

A cornerstone of SSKI's strategy is strengthening capacity development in critical areas of biological research, such as taxonomy, bioinformatics and AI tools, while promoting cooperation between developed and developing countries for research facilities and infrastructure access. SSKI aims to establish a global community of practice to generate, assess and disseminate biodiversity data, fostering the development of information products supported by rigorous training programmes.

In 2022, SSKI was endorsed by the Council of the European Union for international ocean governance for safe, secure, clean, healthy and sustainably managed oceans and seas.³¹ The Council recognized SSKI as an example of strengthening the scientific foundations for environmental protection and management of deep-sea regions.

ISA's SSKI has produced knowledge that can be used in delivering other international agendas and frameworks, including the Kunming-Montreal Global Biodiversity Framework of the Convention on Biological Diversity, and implementing the Agreement under the United Nations Convention of the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity or Areas Beyond National Jurisdiction (2023 Agreement).

Photo: BGR



Photo: BGR



29 ISA. 2023. Implementation of the action plan of the International Seabed Authority in support of the United Nations Decade of Ocean Science for Sustainable Development Report of the Secretary-General (ISBA/28/A/8).

30 ISA. One thousand reasons: <https://www.isa.org.jm/sski/call-for-taxonomy-projects>.

31 Council of the European Union. 2022. Draft Council conclusions on International Ocean Governance. Available at: <https://data.consilium.europa.eu/doc/document/ST-15255-2022-INIT/en/pdf>.



Figure 7. The SSKI scope and expected outputs

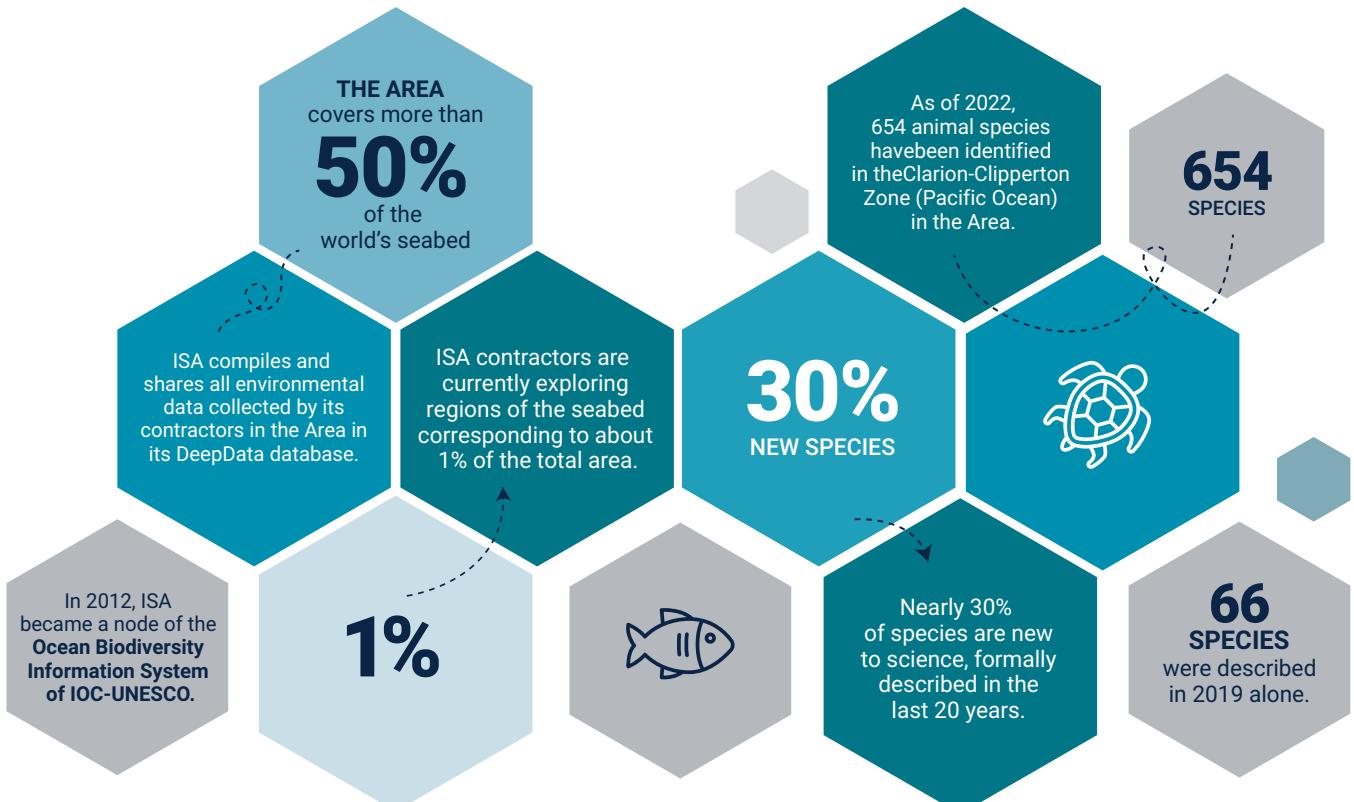


Figure 8. SSKI facts and figures



**Sustainable
Seabed
Knowledge
Initiative**



SRP 2: KEY CONNECTIONS TO UN OCEAN DECADE CHALLENGES

Advancing knowledge and understanding of biodiversity in the Area has been a long-standing priority for ISA for at least two decades. This commitment will continue. ISA makes a unique and substantial contribution to advancing the protection and restoration of ecosystems and biodiversity (UN Decade Challenge 2). It helps deliver skills and technology to all (UN Decade Challenge 9). By providing new knowledge, ISA empowers policymakers to make informed decisions for the sustainable management of the deep-sea environment, strengthening the science-policy interface to support a better future for our oceans.

Facilitating technology development for activities in the Area, including ocean observation and monitoring

STRATEGIC RESEARCH PRIORITY 3

Advancements in technology are a fundamental enabler of activities in the Area as much as a guarantee for the effective implementation of the precautionary approach through the best available science. ISA is mandated to facilitate and promote technology transfer in a manner that benefits all Member States.³² To fulfil this role, ISA acts as a focal point for the acquisition, evaluation and dissemination of marine technological knowledge relevant to the Area and for developing appropriate infrastructure for its use.³³ Since 2017, specific efforts have also been made to ensure that this part of ISA's mandate is directly addressed through capacity development. ISA has been successfully promoting the development of expert capacity through dedicated professional training and the promotion of international cooperation, ensuring that all Member States are provided with the necessary tools to participate in the activities in the Area. ISA regularly organizes capacity development initiatives. In fulfilling its mandate to transfer technology to developing States, ISA implements many activities to foster international cooperation with a view to ensuring that all States, including less technologically advanced States, have the necessary tools to participate in activities carried out in the Area.

As part of the programme of activities implemented by ISA under SRP 3, the Secretariat organized an expert scoping meeting in partnership with the National Oceanography Centre (NOC), United Kingdom of Great Britain and Northern Ireland, in 2021. The main objective was to advance technological development and innovation in support of the sustainable development of mineral resources, including in relation to environmental protection and monitoring of activities carried out in the Area.³⁴ Participants discussed ways and means to facilitate innovations for advancing smart technologies in support of an effective transition from exploration to exploitation.

In its efforts to address SRP 3, ISA closely follows the development of technological trends and innovation in the fields of MSR, exploration, environmental monitoring, modelling and mineral processing. This includes the adaptation and exploration of innovative technologies and methods, such as machine learning, advanced modelling, automation and robotics, to enhance the capability of Member States and the wider scientific community to participate in the exploration and future sustainable use of the Area.

Over the years, ISA has conducted comprehensive reviews to identify gaps and opportunities for leveraging autonomous technologies, sensor systems and robotics for better mineral resource identification and environmental assessments.³⁵ These efforts are aimed at enhancing the sustainable use of deep-seabed resources and environmental protection. Significant progress was noted in relation to the technology for environmental monitoring that is under development. This, in turn, contributes to consolidating the understanding and knowledge of the deep sea and its ecosystems. Examples include sediment plume modelling to optimize PMN collector design and research on water column chemistry that informs the potential impact of tailings discharge at various water depths. The latter is recognized as a key data-poor area by international research studies into marine biogeochemical cycles of trace elements and isotopes.

During the 2022 UN Ocean Conference, in partnership with the United Nations Technology Bank for Least Developed Countries (UNTBLC), the Indian Ocean Rim Association and the support of Bangladesh and Singapore, ISA registered a dedicated voluntary commitment #OceanAction48513, Supporting sustainable and emerging ocean economies of [least developed countries (LDCs), landlocked developing countries (LLDCs) and small island developing States (SIDS), also known as Big Ocean States (BOS)].^{36 37} The core of this initiative is to identify, through in-country needs assessment, national priorities that can be addressed through tailored capacity development activities implemented by ISA. Various mechanisms are used to achieve this, including a focus on expert training and mentoring through the placement of mid-career experts within the ISA Secretariat for not less than three months to work on specific technical, technological or research projects.

³² UNCLOS, Article 144.

³³ UNCLOS, Part XIV.

³⁴ ISA. 2021. ISA-NOC expert meeting defines pathways to advance innovation and technology development for sustainable exploitation of deep-sea minerals in the Area. Available at: <https://www.isa.org.jm/news/isa-noc-expert-meeting-defines-pathways-advance-innovation-and-technology-development>.

³⁵ ISA. 2023. Implementation of the action plan of the International Seabed Authority in support of the United Nations Decade of Ocean Science for Sustainable Development: Report of the Secretary-General (ISBA/28/A/8).

³⁶ ISA. Supporting ocean economies of LDCs, LLDCs and SIDS. Available at: <https://www.isa.org.jm/isa-voluntary-commitments/supporting-ocean-economies-of-ldcslldcs-and-sids>.

³⁷ TRIDENT. Available at: <https://deepseatrident.eu>.

SPOTLIGHT 4.

Partnership with the United Nations Technology Bank for Least Developed Countries

In 2023, following the adoption of the Doha Programme of Action for LDCs (2023-2031), the ISA Secretariat established a strategic partnership with the UNTBLDC, an organization established to enhance the contribution of science, technology and innovation for the sustainable development of LDCs. The partnership was established in line with the six key focus areas of the Doha Programme of Action to address specific capacity-building needs of LDCs in support of the sustainable development of emerging blue economies. The main objective of the partnership is to create enabling conditions for LDCs to understand better the rights recognized to them under UNCLOS. It is believed that this would support the sustainable development of emerging blue economic sectors aligned with their respective national socio-development priorities, effective engagement in the global ocean governance processes, including the activities of ISA through increased marine, scientific, technical and legal capacities and recognizing and identifying specific measures to facilitate the participation of women scientists from LDCs with deep-sea-related skills in research- and technology-oriented programmes and activities such as workshops, deployments and mentoring programmes.

A pilot project was launched with the United Republic of Tanzania and Nepal. In 2024, two mid-career professional women from both countries were deployed to the ISA Secretariat in Kingston. Ms. Sundi Kilugala Malomo, mineral trade manager from the Ministry of Minerals, the Mines Inspectorate and Environment Department of the United Republic of Tanzania, focused on the geochemistry of uranium, thorium, potassium and their radioisotopes in the marine environment. Dr. Sushmita Bhandari, a geologist from the Ministry of Industry, Commerce and Supplies, the Department of Mines and Geology, Government of Nepal, specialized in lithium geochemistry in the marine environment.



One example is ISA's participation in the 14 million Euro project by the European Union, the Technology based impact assessment tool foR sustainable, transparent Deep sea mining exploration and exploitation (TRIDENT). The TRIDENT focuses on technology-based impact assessment tools aiming to identify and design reliable, cost-effective, advanced automated monitoring systems for the exploitation of seabed minerals.³⁸ TRIDENT is spearheaded by the Institute for Systems and Computer Engineering, Technology and Science, Portugal, in collaboration with a consortium of 22 European scientific partners. The goal of TRIDENT is to create remote and automated monitoring systems specifically for deep-sea mining operations. ISA sits on its advisory board.

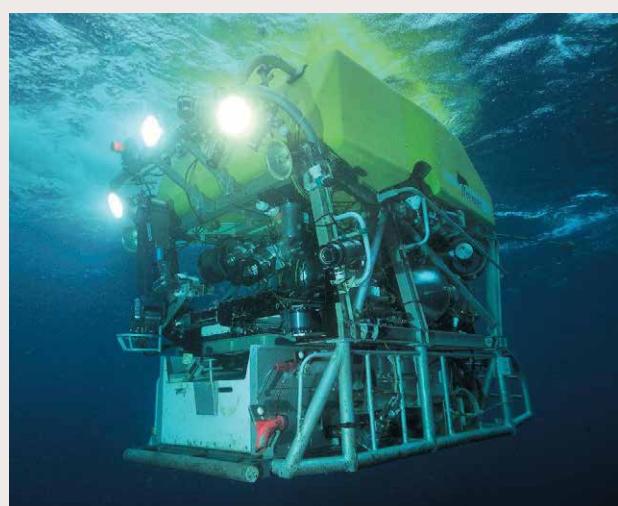
In April 2024, ISA convened an international expert scoping workshop on the advancement of technologies to support the sustainable development of mineral resources of the Area.³⁹ The workshop was an opportunity to assess the different types of existing and available technologies used in the deep sea, the best industry practices and possible strategic partnerships to build and develop the capacities of developing ISA Member States. The workshop also addressed the opportunities for future cooperation among technology developers, providers and users and identified emerging fields that could benefit from joint efforts from contractors, companies, research institutions and technology experts (Case study 3).

CASE STUDY 3. How ISA assesses and catalyses advancements in deep-sea technologies

ISA has conducted technical studies to advance deep-sea technology aimed at identifying gaps in technological development, as well as establishing classification frameworks and modelling systems in deep-sea marine science, enabling further technological advancements.⁴⁰

ISA Technical Study 29: Remote monitoring systems in support of inspection and compliance in the Area, highlights the technological advancements in the domain of remote monitoring within the deep-sea marine and maritime space, including other extractive sectors, particularly offshore oil, gas and fisheries.⁴¹ This matter was discussed in the context of the Draft exploitation regulations, focusing on the development and use of remote monitoring systems for overseeing mineral resource exploitation in the deep sea. Due to the challenging logistical environment, remote technologies simplify the process of on-site inspections and have the potential to improve compliance and data collection. This knowledge output has advanced technology development related to environmental compliance and protection in the Area by identifying the costs and opportunities of various technologies.

Building upon the findings of previous technical studies, ISA Technical Study 30: Marine mineral resources:



- 40 ISA. 2022. Technical Study 29: Remote monitoring systems in support of inspection and compliance in the Area. Available at: https://www.isa.org.jm/wp-content/uploads/2022/05/ISA_Technical_Study_29.pdf.
- 41 ISA. 2022. Technical Study 29: Remote monitoring systems in support of inspection and compliance in the Area. Available at: https://www.isa.org.jm/wp-content/uploads/2022/05/ISA_Technical_Study_29.pdf.

38 TRIDENT. Available at: <https://deepseatrident.eu>.

39 ISA Website Workshops and Webinars. Available at: Expert scoping workshop on charting future horizons: harnessing advanced technologies for the protection and sustainable use of the international seabed area - International Seabed Authority.



scientific and technological advances, explores the potential of advanced technologies in the exploration and sustainable utilization of deep-sea marine mineral resources.⁴² It demonstrates how the deployment of autonomous underwater vehicles holds the potential for improving our understanding of deep-sea minerals by high-resolution mapping and how it is more effective than using remotely operated vehicles in that task. These technologies increase our understanding of deep-sea minerals by improving the detail of surveys on nodules. The study underscores how these technologies can advance scientific knowledge and pave the way for the responsible exploitation of deep-sea marine resources. By enabling in-depth analysis of the potential environmental impacts of deep-sea mining, these technologies may support the development of responsible mining practices elsewhere.

The stocktaking workshop ISA organized in Porto, Portugal in April 2024 evaluated the current state and progress of scientific and industrial developments and highlighted five priority areas requiring further advancement: ocean observation and communication, monitoring, autonomy, automation and robotics, machine learning and artificial intelligence and mining, energy and metal processing.⁴³

Technology assessments in these priority areas will chart a course for ISA and its Member States by emphasizing the interlinkages between innovation, environmental sustainability and technological development. These initiatives stand as a testament to the ISA's commitment to promoting technological advancement, environmental protection and equitable access to deep-sea resources.

42 ISA. 2022. ISA Technical Study 30: Marine mineral resources: scientific and technological advances. Available at: https://www.isa.org.jm/wp-content/uploads/2022/05/ISA_Technical_Study-30.pdf.

43 ISA. 2024. Workshops and Webinars. Available at: Expert scoping workshop on charting future horizons: harnessing advanced technologies for the protection and sustainable use of the international seabed area - International Seabed Authority.



SRP 3: KEY CONNECTIONS TO UN OCEAN DECADE CHALLENGES

ISA's commitment to supporting deep-sea technology development and innovation is long-standing and intrinsically linked to the work that ISA has done since its establishment in 1994. By promoting and facilitating the development of cutting-edge technologies while ensuring that dedicated training opportunities are developed and implemented to enable the acquisition of knowledge in less technologically advanced countries, ISA contributes significantly to several UN Decade Challenges. Technology development facilitates the detection and mitigation of sources of marine pollution and helps to understand the intricate dynamics of ocean ecosystems and how to protect biodiversity best (Challenge 2). It underpins the development of a sustainable and equitable ocean economy (Challenge 4), contributes to the creation of a digital representation of the ocean through providing information for modelling, mapping and databases, including the DeepData database (Challenge 8), ensures equitable access to ocean science and technology (Challenge 9) and transforms humanity's relationship with the ocean (Challenge 10).

Enhancing scientific knowledge and understanding of potential impacts of activities in the Area

STRATEGIC RESEARCH PRIORITY 4

Scientific knowledge of the Area and understanding of the potential impacts of activities in the Area is a global public good. This knowledge and understanding inform policy and practice. At the same time, evidence-based decision-making underpins the adoption and implementation of measures and mechanisms to ensure the sustainable development and management of the Area and its resources for the benefit of all. Assessing the potential impacts of activities in the Area is central to the mandate and competence of ISA in ensuring the protection of the marine environment in the Area and preventing significant damage to marine flora and fauna resulting from activities in the Area.⁴⁴

To progress the science underpinning this, ISA facilitates the development of scientific tools and modelling approaches aimed at informing the best way to ensure the sustainable management of activities in the Area based on the precautionary approach. One example includes scientific activities conducted to support the development of regional environmental management plans (REMPs). Nearly 10 years after the first environmental management plan was adopted for the Area in the CCZ, ISA published Technical Study 28: Regional environmental assessment of the northern Mid-Atlantic Ridge, prepared by the Atlantic REMP project funded by the European Commission.⁴⁵ This study provides a first-ever comprehensive geological and biological overview and physical oceanography of the MAR, serving as the basis for the development of the draft REMP for the MAR that the ISA Council eventually considered.⁴⁶ The REMP is still in the development stages pending the adoption of a more general and standardized procedure for the development, review and approval of REMPs in the Area.⁴⁷

The scientific work underpinning Technical Study 28 also helped ISA formulate considerations for potential cumulative impacts by developing qualitative ecosystem models. The methodology encompasses two crucial steps: an ecosystem habitat model construction and the identification of ecosystem pressures. Scenarios were developed based on those models, including in relation to the partial or complete removal of PMS deposits. These qualitative models that have been developed represent the first-ever attempt to progress towards a comprehensive framework for assessing cumulative impacts from PMS exploitation in the Area. The value of such models can also be measured in terms of their contribution to management and policy levels because they help prioritize mitigation measures and directly inform the type of adaptive management strategies to be considered. As a result, ISA and its Member States can effectively benefit from a more accurate and systematic ecosystem-based approach to managing the marine environment.⁴⁸⁻⁴⁹

Under SRP 4, ISA also made important progress in relation to the assessment of potential impacts caused by the effects of climate change in deep-sea ecosystems of the Area and competing usages of the Area, such as submarine cables or fisheries activities.⁵⁰⁻⁵¹⁻⁵²⁻⁵³

⁴⁴ UNCLOS, Article 145.

⁴⁵ ISA. 2022. Technical Study 28: Regional environmental assessment of the northern Mid-Atlantic Ridge. Available at: https://www.isa.org.jm/wp-content/uploads/2022/11/ISA_Technical_Study_28.pdf.

⁴⁶ Weaver, P. 2022. The Atlantic Regional Environmental Management Plan (REMP) Project. Final Report. European Commission. Service Contract EASME/EMFF/2017/1.3.1.1. 43 pp. Available at: https://cinea.ec.europa.eu/document/download/49a49021-4e95-4cd8-9b40-ab9e012e053f_en?filename=REMP-project_HZ0822038ENN.en.pdf.

⁴⁷ ISA. 2022. Regional environmental management plan for the Area of the northern Mid-Atlantic Ridge with a focus on polymetallic sulphide deposits: Issued by the Legal and Technical Commission (ISBA/27/C/38).

⁴⁸ ISA 2024 Environmental Impact Assessments - International Seabed Authority

⁴⁹ ISA 2024 Regional environmental management plans - International Seabed Authority

⁵⁰ ISA 2024 The carbon cycle in the Area (ISA Fact Check 2024/1).

⁵¹ ISA. 2015. Technical Study 14: Submarine Cables and Deep Seabed Mining. Available at: https://www.isa.org.jm/wp-content/uploads/2022/06/techstudy14_web_27july.pdf. ISA. 2019. Technical Study 24: Deep Seabed Mining and Submarine Cables. Available at: <https://www.isa.org.jm/wp-content/uploads/2022/06/Technical-Study-24-amazon-jan-2020-eversion.pdf>.

⁵² ISA. 2023. Technical Study 33: Potential interactions between fishing and mineral resource-related activities in areas beyond national jurisdiction: a spatial analysis. Available at: https://www.isa.org.jm/wp-content/uploads/2023/07/ISA_Technical-Study_33.pdf.

⁵³ ISA Website. Available at: Environmental Impact Assessments - International Seabed Authority Available at: <https://www.isa.org.jm/protection-of-the-marine-environment/environmental-impact-assessments/>



SPOTLIGHT 5.

Spatial analyses of potential interaction between fishing and mineral-related activities in the Area

ISA technical study 33 “Potential interactions between fishing and mineral resource-related activities in areas beyond national jurisdiction: a spatial analysis” examines the extent of spatial overlap between fishing activities in ABNJ and areas allocated or designated by ISA between 2012 and 2020. Using publicly available data from the RAM Legacy Stock Assessment Database and the Global Fishing Watch, this study found that fishing hours in ISA contract areas and reserved areas comprise less than 2 per cent of the total in ABNJ in all years and less than 1 per cent in most years under observation. There was very limited overlap between fishing with gears that operate at or near the seafloor in ABNJ and contract areas and reserved areas for deep-sea mineral resource exploration. Fishing in ISA areas was predominantly conducted with pelagic gear, especially drifting longlines. The results of this study will inform ISA’s efforts to fully assess the potential impacts of future mining activities on fisheries and minimize such impacts through spatial planning and management.

All these processes led by ISA and the information generated by them represent significant drivers in advancing MSR in the Area, involving a wide network of stakeholders. Another important example of the significant added value brought by the work led by ISA can be found in the latest achievements made in the field of environmental impact assessments (EIAs) (Case study 4).



CASE STUDY 4.

Recent scientific advancements linked to environmental impact assessments

EIAs are key to understanding the potential impacts of activities in the Area. An EIA process entails an evaluation of the possible positive or negative effects that a proposed project may have on the environment. It is a precondition for consideration of whether deep-seabed mining is possible. Very rarely, an EIA can be required in the context of deep-sea exploration, depending on the type and nature of activities to be conducted, such as prior to the test mining or to allow wide sampling with sleds or dredges. An EIA is a structured process comprised of several stages, including the incorporation of external input and feedback loops. An environmental risk assessment presents the first step of the EIA process, listing all expected environmental effects and risks associated with the project. These are assigned a risk ranking, which identifies the primary areas of environmental issues that should be the focus of the EIA.

As of June 2024, four ISA contractors have undertaken EIAs in support of their testing of pre-prototype nodule collectors, strictly following the recommendations adopted by LTC in 2020, updated in 2023.⁵⁴ The results of the activities conducted by the different contractors have been presented in their respective environmental impact statements. The full related documentation is available on the ISA website as required under the Exploration regulations.⁵⁵ Between 2019 and 2021, two exploration contractors, the German Federal Institute for Geosciences and Natural Resources and the Global Sea Mineral Resources, partnered and engaged with the scientific community to monitor and assess the environmental impacts of in situ technical tests of a pre-prototype PMN collector vehicle (Patania II) in the CCZ. The work consisted of two expeditions each year, with a total of more than 150 days at sea. The environmental monitoring was carried out in close collaboration with research institutes from the JPI-Oceans’ MiningImpact Consortium.⁵⁶ This joint effort obtained a sound scientific basis for the analysis and modelling of mining-related impacts. The environmental monitoring of the test and its impacts provided a greater understanding and comprehensive assessment of the environmental

⁵⁴ ISA Website. Available at: Environmental Impact Assessments - International Seabed Authority Available at: <https://www.isa.org.jm/protection-of-the-marine-environment/environmental-impact-assessments/>

⁵⁵ ISA. EIAs. Available at: <https://www.isa.org.jm/protection-of-the-marine-environment/environmental-impact-assessments>.

⁵⁶ JPI-Oceans. MiningImpact 2. Available at: <https://www.jpi-oceans.eu/en/miningimpact-2>.

effects of potential future mining activities. The project informed the design of fit-for-purpose monitoring programmes and the development of responsible threshold values, standards and guidelines. Two domains that were advanced significantly are plume modelling and toxicity.

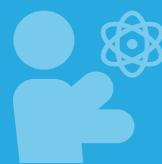
As to the plume modelling, cruises provided particularly valuable first quantitative data ever acquired on the spreading of the suspended sediment cloud and its re-deposition on the seabed in the real context. It was demonstrated that the initial form of the plume is a turbidity current. It was also shown that the height of the plume did not exceed the height of the collector vehicle, with most of the plume remaining at a height below 2 metres. The experiment further concluded that the heaviest disposition took place in the direct vicinity of the collector. These scientific outcomes were published in a peer-reviewed journal.⁵⁷ Although analyses of plume data are still ongoing, the activities of this project have produced more than 50 scientific papers already.⁵⁸

The second topic investigated during the cruise related to chemical contaminants, more specifically, the risks they represent during the process of seabed mineral exploitation. In this context, it is important to assess the spatial and temporal variability of seawater chemistry, which can be monitored through trace metals. Baseline data of trace metal concentrations collected as part of the chemical oceanography before the test were compared with data collected during the impact assessment. This allowed a direct comparison informing measures for the prevention, reduction and control of pollution. Additionally, the potential of a new technology for sampling trace metals was validated (passive sampler).⁵⁹ This scientific progress is crucial to advance the work on thresholds in this domain.

57 Muñoz-Royo, Carlos, Raphael Ouillon, Souha El Mousadik, Matthew H. Alford, and Thomas Peacock. 2022. "An In Situ Study of Abyssal Turbidity-Current Sediment Plumes Generated by a Deep Seabed Polymetallic Nodule Mining Preprototype Collector Vehicle." *Science Advances* 8 (38). <https://doi:10.1126/sciadv.abn1219>.

58 JPI-Oceans. 2022. *MiningImpact 2: Environmental impacts and risks of deep-sea mining*. Available at: https://www.jpi-oceans.eu/sites/jpi-oceans.eu/files/MI2_FinalReport_Publishable_web_2023.pdf.

59 Schmidt, Katja, Sophie A.L. Paul, and Eric P. Achterberg. 2022. "Assessing the Availability of Trace Metals Including Rare Earth Elements in Deep Ocean Waters of the Clarion Clipperton Zone, NE Pacific: Application of an In Situ DGT Passive Sampling Method." *TrAC Trends in Analytical Chemistry* 155 (May): 116657. <https://doi:10.1016/j.trac.2022.116657>.



SRP 4: KEY CONNECTIONS TO UN OCEAN DECADE CHALLENGES

All the activities described above contribute to several UN Ocean Decade Challenges. Through the promotion of SRP 4, ISA contributes uniquely to detecting and mitigating sources of marine pollution in the deep sea (Challenge 1). The results collected through such activities inform the necessary measures for the protection of biodiversity and ecosystems in the deep sea (Challenge 2) and support the development of a sustainable and equitable ocean economy (Challenge 4). Further, all the data and equipment used in the context of EIA support the advancement of global ocean observing systems (Challenge 7).



Promoting dissemination, exchange and sharing of scientific data and deep-sea research outputs and increasing deep-sea literacy

STRATEGIC RESEARCH PRIORITY 5

ISA is a knowledge-based organization where data underpins all the work carried out, particularly in relation to the implementation of the six SRPs of the ISA MSR Action Plan. The ISA mandate relating to the promotion and encouragement of scientific research includes a specific focus on the dissemination of the results of such research for the benefit of humankind. This responsibility involves sharing data and non-confidential information openly and transparently. This is not only crucial to promote deep-sea literacy but also to accurately inform decision-making processes. ISA shares regular updates about all its activities on its website, through other communications channels and participation in international forums and events. It also uses many communication tools, such as newsletters,⁶⁰ press releases⁶¹ and expert publications.⁶²

The launch of an ISA repository database, DeepData, in 2019 was a milestone in its history. The DeepData has since become the principal database for all environmental data collected in the Area (Case study 5). As of April 2024, the database had an average of 5,580 visitors every month. From a technical perspective, a major step forward in the development of DeepData was the introduction of reporting templates by LTC in 2021, providing exploration contractors with clear guidance for the submission of the baseline data they collect and have the obligation to share with ISA as part of their annual reporting.⁶³ Reporting templates facilitate the standardization of submissions by all contractors and are used as a quality assurance tool at the same time. The templates are revised and adjusted when needed.

Standardization allows ISA to share its data easily with other international databases. Since the inception of DeepData, ISA has forged scientific partnerships to improve the quality of its data further and advance scientific research. In 2021, an in-depth data quality assessment was carried out on the biological data in collaboration with the Natural History Museum of London and the Pew Charitable Trusts. The study was a first attempt to map the data collected in the CCZ to identify locations where more samples were needed and to set priorities, such as conducting comprehensive literature studies on a regional scale.⁶⁴ Regrettably, the final study published did not reflect all the inputs provided by the ISA Secretariat on the manuscript, nor did it take into account technical clarifications detailed in the ISA Fact Check 2023/1.⁶⁵ In the context of the collaboration established with the WoRMS, ISA was able to contribute to improving the quality of the taxonomic data significantly. More than 60,000 biological records were reviewed by the scientific experts of WoRMS across all regions where exploration activities are taking place.

Building on the work carried out since 2020 and the different objectives identified for storing and managing the huge amount of data owned while ensuring better access to it, the ISA Secretariat was able to formulate in 2023 a set of short, medium and long-term priorities for the period 2023 to 2028 listed in a Data Management Strategic Roadmap⁶⁶ as endorsed by the LTC.⁶⁷

Another achievement under SRP 5 is the partnership signed in 2022 between ISA and the International Hydrographic Organisation (IHO) in support of the AREA2030 seabed mapping initiative. Through this partnership, ISA is sharing bathymetric data collected by exploration contractors in support of the SEABED2030 initiative.



60 ISA. Newsletters. Available at: <https://www.isa.org.jm/isa-newsletters>.

61 ISA. News. Available at: <https://www.isa.org.jm/news>.

62 ISA. Publications. Available at: <https://www.isa.org.jm/publications>.

63 ISA. 2021. Recommendations for the guidance of contractors on the content, format and structure of annual report (ISBA/21/LTC/15)

64 Rabone, Muriel, Joris H. Wiethase, Erik Simon-Lledó, Aidan M. Emery, Daniel O.B. Jones, Thomas G. Dahlgren, Guadalupe Bribiesca-Contreras, Helena Wiklund, Tammy Horton, and Adrian G. Glover. 2023. "How Many Metazoan Species Live in the World's Largest Mineral Exploration Region?" *Current Biology* 33 (12): 2383-2396.e5. <https://doi:10.1016/j.cub.2023.04.052>.

65 ISA. 2023. Fact-check 2023/1. Available here: Availability, content and accessibility of data and information of DeepData – International Seabed Authority

66 ISA. 2024. DeepData Database - International Seabed Authority

67 ISA. 2023. Decision of the Council of the International Seabed Authority relating to the reports of the Chair of the Legal and Technical Commission (ISBA/28/C/27), para. 17.

SPOTLIGHT 6. AREA2030: Facilitating the high-resolution mapping of the Area by 2030

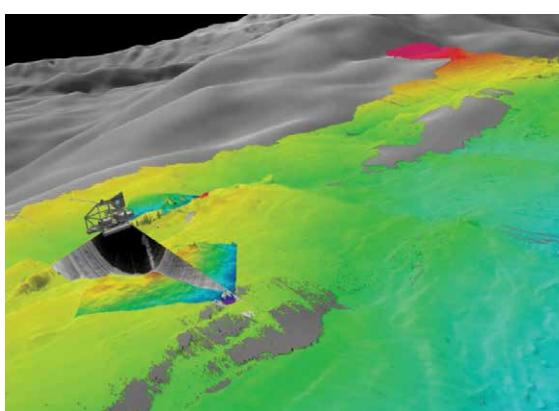
AREA2030 is a new collective initiative implemented by ISA and IHO to foster partnerships and collaboration for the high-resolution mapping of the Area by 2030. In 2017, the ISA Secretary-General convinced a number of contractors to share their bathymetry data, generally treated as confidential, for the common good. As of February 2024, 11 contractors have engaged in the initiative, sharing available bathymetric data for contract areas involving PMN, PMS and CFC. A total of 92.9 GB of data has already been made available. More efforts are under way to progress this initiative even further.

This achievement is of great value considering that the data collected between 3,000 and 6,500 m depth is at very high resolution (1 m) and constitutes a significant contribution to the global effort to improve the mapping of the ocean floor, advancing the global knowledge of the international seabed and helping further our understanding of seabed habitats, potential geohazards and a variety of potential resources.

AREA2030: Facilitating the high-resolution mapping of the international seabed area by 2030



**AREA
2030**



Since 2020, ISA has developed several initiatives to promote and enhance deep-sea literacy. This engagement is further consolidated with the registration of a dedicated voluntary commitment to promote deep-sea literacy #OceanAction48514 at the 2022 UN Ocean Conference. The main objective is to promote cooperation with international and regional scientific communities to share broader information and knowledge about the deep sea with people of all ages.⁶⁸

SPOTLIGHT 7. Deep-sea literacy for children

As part of its efforts to advance deep-sea literacy, ISA launched a dedicated activity book for children between 3 to 9 years old entitled "Life Under Water Pre-School Companion" in April 2013.⁶⁹ The book was developed in partnership with children's education experts and an elementary school in Jamaica (the Centre for Language and Culture) in two bilingual versions (English-French and English-Spanish). The main objective of this activity book is to sensitize children to the conservation and sustainable use of the ocean and marine resources and the Sustainable Development Goal 14 (Life Below Water). It has been disseminated in elementary schools in Jamaica, Trinidad and Tobago and countries in the Pacific. It is recognized as an effective tool for use in the classroom, at home or during field trips by teachers, tutors and parents because it has useful tips to preserve and protect the marine environment.



⁶⁸ ISA. Promoting deep-sea literacy. Available at: <https://www.isa.org.jm/isa-voluntary-commitments/promoting-deep-sea-literacy>.

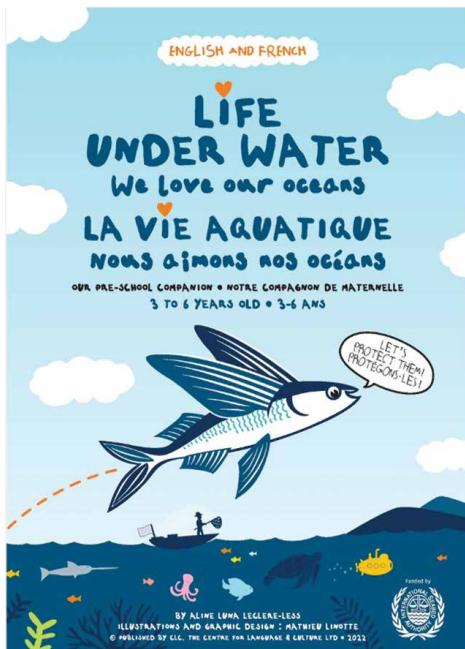
⁶⁹ ISA. Life Under Water. Available at: Life Under Water – Activity book for children - International Seabed Authority.



ISA also partnered with Wakatoon to create an interactive online cartoon for children aged 4 to 12, designed to teach them about the deep sea, its incredible creatures, its environment and the work of ISA to promote MSR, exploration and stewardship of the Area.⁷⁰

Through an open-access online application, children can explore the deep sea by colouring pages that feature ISA deep-sea scientist Dr. Olivia, who takes them on a virtual submarine adventure. The colouring pages can be converted into a two-minute video showcasing the different creatures and deep-sea environments. The activity is available in eight languages: Arabic, Chinese, English, French, Spanish, Russian, Swahili and Tongan.

The ISA Secretariat also regularly hosts open days in its headquarters welcoming school groups visiting the ISA museum. During these visits, children participate in hands-on activities that raise awareness of deep-sea research and exploration. They learn about minerals, scientific disciplines and ISA's latest research findings related to the deep sea.



70 ISA. ISA and Wakatoon present: Discover the seabed with Olivia. Available at: <https://www.isa.org.jm/isa-wakatoon>.

CASE STUDY 5. The one-stop shop for deep-sea data: ISA's DeepData database



DeepData

In 2014, LTC recommended the establishment of an ISA centralized database.⁷¹ In 2018, the ISA Secretariat organized three consultations with LTC members, contractors and external stakeholders, including the scientific community, to gather feedback on the content and structure of the database to ensure the delivery of a fit-for-purpose final product. The launch of DeepData in 2019 was anchored in the approval by Member States of the three-year Strategic Plan and the High-level Action Plan for the ISA for the period 2019–2023.^{72⁷³} Strategic direction 4, “promoting and encouraging [MSR] in the Area,” includes enhancing and expanding the sharing of data and information as a performance indicator.

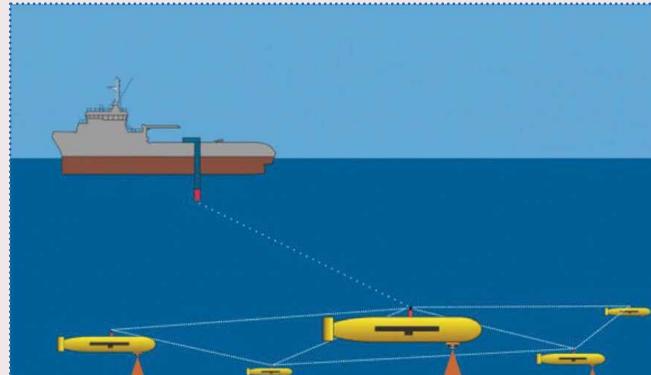
ISA enhances the collection, compilation, analysis and synthesis of the research results through DeepData, particularly from contractors. Data contained in DeepData come from an average of 3.5 cruises per year, reflecting the categories of baseline studies described in Case study 1. Non-confidential environmental data collected during exploration cruises are publicly available and downloadable. To date, DeepData contains 13 TB of data.

Expanding DeepData and further improving its quality remains a priority for ISA. To this end, ISA has invested in data quality assessments and synthesis of the biological and oceanography data as elaborated in SRP 1 and SRP 2. ISA has also engaged in strategic partnerships and collaborations to improve the sharing of data and information.

71 ISA. 2014. Summary report of the Chair of the Legal and Technical Commission on the work of the Commission during the twentieth session of the International Seabed Authority (ISBA/20/C/20), para. 38.

72 ISA. 2018. Decision of the Assembly of the International Seabed Authority relating to the strategic plan of the Authority for the period 2019–2023 (ISBA/24/A/10).

73 ISA. 2019. Decision of the Assembly of the International Seabed Authority relating to the implementation of the strategic plan for the Authority for the period 2019–2023 (ISBA/25/A/15).



In May 2021, ISA further extended access to biodiversity and biogeography data contained in DeepData by becoming the first UN entity to serve as a node of the IOC-UNESCO's OBIS, thereby enhancing the quality and reach of these data.⁷⁴

DeepData is crucial for supporting environmental policy development and it assists in the protection of the marine environment through the REMP process. In preparation for REMP workshops, ISA catalogues, cleans and pre-processes the data to make it readily usable by experts participating in the workshops. For example, over 2,000 taxonomic results and processed detailed bathymetric files were reviewed and cleaned for the REMP workshop in Japan in February 2024. ISA assessed these results against publicly available data sources (General Bathymetric Chart of the Oceans (GEBCO)).⁷⁵ Numerous high-resolution physical and chemical oceanographic data sets were also reviewed and quality checks were conducted.

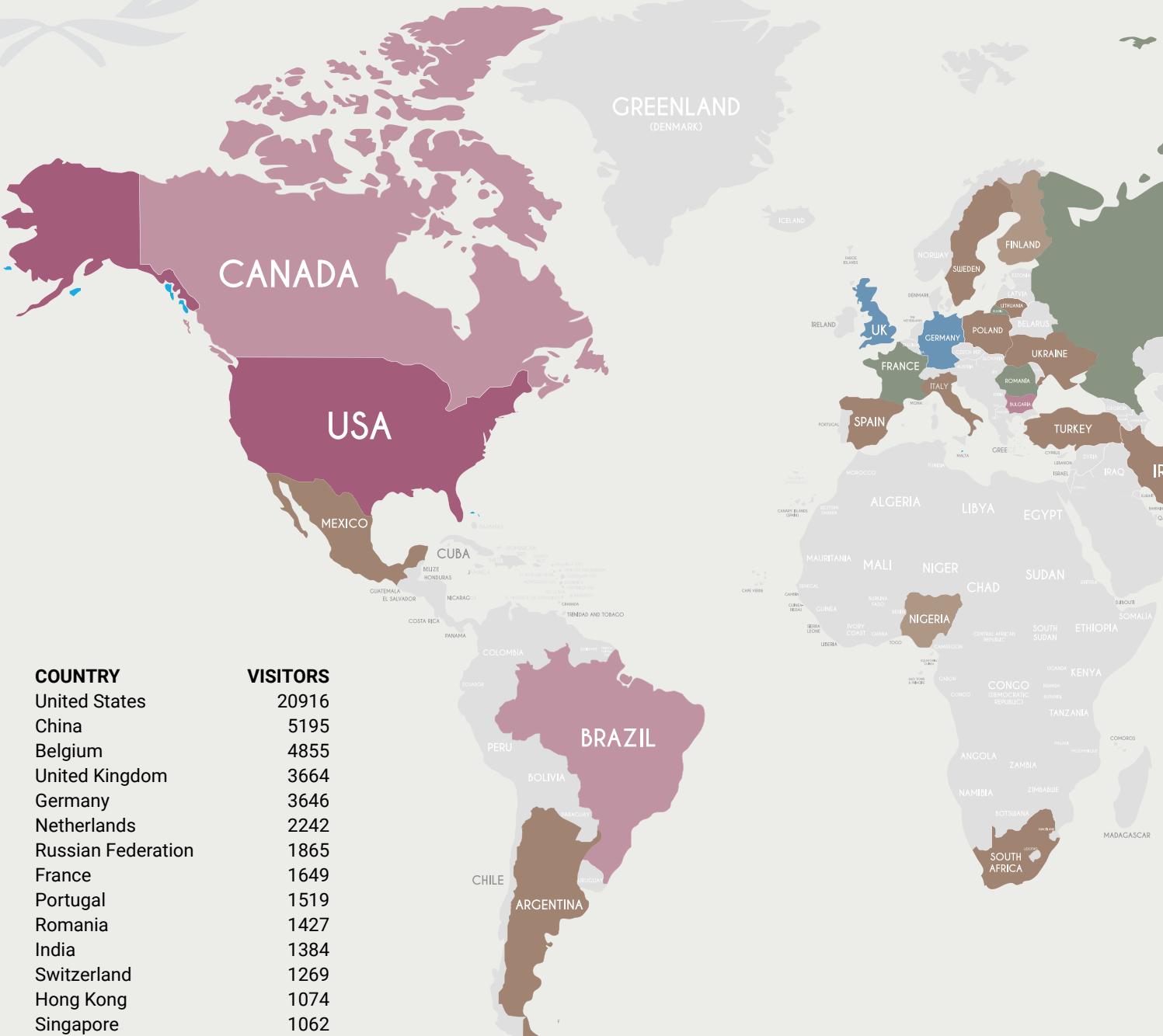
The contribution of DeepData holdings to the advancement of global knowledge and understanding of the deep sea is significant and its use is increasing exponentially.⁷⁶ Since the adoption of the MSR Action Plan, ISA has been gathering user statistics that reveal the geographic location of the DeepData users showing that the number of monthly visitors to DeepData had doubled in the three-year period from 2020-2023. Users come from all over the world, with USA, China and Belgium among the top users in 2023. (Figure 9). The data also indicates that countries of the global South, especially in Africa, could benefit from capacity development initiatives focused on the use of data, especially given that much of the continent lacks any records of visitors.



74 ISA. 2021. ISA officially joins the International Oceanographic Data and Information Exchange network of IOC-UNESCO as a node for Ocean Biodiversity Information System. Available at: <https://www.isa.org.jm/news/isa-officially-joins-international-oceanographic-data-and-information-exchange-network-ioc>.

75 GEBCO. Global ocean & land terrain models. Available at: https://www.gebco.net/data_and_products/gridded_bathymetry_data.

76 ISA. 2023. Availability, content and accessibility of data and information of DeepData (ISA Fact-check 2023/1).



Where do our users come from?

Data processing activities remain a priority as contractors continue to submit new and revised data to the ISA Secretariat. In addition, pathways to increase interactivity and user-friendliness of the interface, e.g. generation of scientific visuals, are further explored to target improved engagement by scientists and a wider audience.



SRP 5. KEY CONNECTIONS TO UN OCEAN DECADE CHALLENGES

SRP 5 realizes the first objective of the UN Ocean Decade of knowledge generation and contributes primarily to Ocean Decade Challenges on expanding the ocean observing systems (Challenge 7) and delivering knowledge and technology for all (Challenge 9). The initiatives under SRP 5 deliver accessible, timely and actionable data and information to all users, making available contractors' environmental data collected through ocean observing systems. The work done by ISA in outreach and dissemination of its work outcomes helps make the most of a unique opportunity to share globally neutral and tailored information to the public of all horizons and ages. The different initiatives implemented so far have also proven that many avenues are available to share complex information with different audiences.

Figure 9. Geographic distribution of DeepData users in 2023

Strengthening the deep-sea scientific capacity of ISA's Members, in particular developing States

STRATEGIC RESEARCH PRIORITY 6

Training and capacity-building have been an integral feature of ISA's activities since its establishment in 1994. ISA has a specific mandate to foster international cooperation through the development of an MSR programme for the benefit of developing Member States. By strengthening their research capabilities, training their personnel in the techniques and applications of research and fostering the employment of qualified personnel in research programmes in the Area, ISA builds and develops the capacities to engage effectively in the activities carried out in the Area. It is in this context that the Secretariat designs, facilitates and implements various training programmes, projects and initiatives relevant to the needs of developing States as identified by them.⁷⁷ Since 1994, more than 1,000 individuals have benefited from at least one of the capacity development activities implemented by ISA. There are multiple threads to capacity development activity. Many initiatives, partnerships and elements of work intersect with the SRP 6.

In December 2020, based on the outcomes of a workshop on capacity development, resources and needs assessments held in Kingston, Jamaica, the ISA Assembly formally endorsed a programmatic approach to capacity development, requesting the Secretary-General to prepare and implement a dedicated strategy to meet the needs identified by ISA Member States, particularly geographically disadvantaged States, LDCs, LLDCs and SIDS.⁷⁸ In November 2022, the Assembly endorsed the Capacity Development Strategy guided by the priority needs of developing States as identified by them through a needs assessment survey undertaken in 2020.^{79 80}

The Capacity Development Strategy has five key result areas:

- **KEY RESULT AREA 1:** ensuring that capacity development programmes and activities are meaningful, tangible, efficient, effective and targeted at the needs of developing States as identified by them
- **KEY RESULT AREA 2:** establishing and furthering strategic partnerships in support of capacity
- **KEY RESULT AREA 3:** strengthening institutional capacities through technology transfer and technical assistance
- **KEY RESULT AREA 4:** advancing women's empowerment and leadership in deep-sea-related disciplines through targeted capacity development activities
- **KEY RESULT AREA 5:** improving deep-sea literacy through better awareness and understanding of the legal regime of the Area and the role and mandate of ISA

Since the adoption of the Capacity Development Strategy, several of its outputs have been accomplished.

Through the establishment of a network of national focal points in charge of liaising with the Secretariat on matters relating to capacity development (NAFOP-CD), ISA was able to create a direct avenue for its Members to engage directly in the follow-up of the activities implemented.⁸¹ The members of NAFOP-CD are responsible for keeping the Secretariat informed about their countries' requirements for technical assistance, their specific needs and priorities. A meeting of NAFOP-CD is generally organized every quarter. The NAFOP-CD network has 59 members, including 23 LDCs, LLDCs and BOS representatives.



77 ISA. 2022. Capacity development strategy. Available at: https://www.isa.org.jm/wp-content/uploads/2022/12/ISA_Capacity_Development_Strategy_2022.pdf.

78 ISA. 2020. Implementing a programmatic approach to capacity development: Report of the Secretary-General (ISBA/26/A/7).

79 ISA. 2022. Capacity development strategy of the International Seabed Authority: Report of the Secretary-General (ISBA/27/A5).

80 ISA. 2021. National capacity development priorities identified by Members of the International Seabed Authority in 2020. Available at: https://www.isa.org.jm/wp-content/uploads/2022/06/Capacity_Development_Policy_Brief_01-2021_rev2.pdf.

81 ISA. 2020. Decision of the Assembly of the International Seabed Authority relating to the implementation of a programmatic approach to capacity development (ISBA/26/A/18), Annex.



SPOTLIGHT 8. National expert deployment programmes

The ISA National Expert Deployment Programme aims to strengthen the technical capacity of national experts from developing Member States of ISA in relation to activities undertaken in the Area.⁸² Such deployment provides the opportunity for officials from developing countries to be appointed on a special assignment in the Secretariat for at least three months, gaining hands-on experience on expert topics from the area of work of ISA to regulate and manage activities in the Area. The deployed national experts have an opportunity to

- join the Secretariat expert teams in advancing global research priorities in deep-sea-related matters
- gain direct exposure to multilateral discussions and processes on the co-management of global commons
- work and liaise with a diverse and international team of experts
- gain hands-on experience in MSR, the law of the sea, ocean governance, blue economy and deep-sea exploration
- contribute to the development of national policies and strategies on deep-seabed-related matters
- strengthen technical capacity through specialized training and experience.

For example, 10 African experts, including five women, were deployed within the ISA Secretariat as part of the Africa Deep Seabed Resources project in 2020. This project is the realization of a voluntary commitment, #OceanAction40945, “Supporting Africa’s blue economy,” which aims at promoting the engagement of African States in the regime of the Area and facilitating the development of appropriate institutions at a national level.⁸³

In February 2023, ISA launched an alumni network of former ISA trainees, the ISA Capacity Development Alumni Network (iCAN). The iCAN focuses on developing human resources, monitoring training impacts and enabling collaboration.⁸⁴ It currently comprises 80 members from 35 different countries, representing all five regional groups and 36 per cent women among its members.

Another pathway to leverage capacity development initiatives is through the ISA’s Joint Training and Research Centres (JTRCs) established by ISA in partnership with its Member States.⁸⁵ JTRCs are designed to promote and encourage MSR in the Area and facilitate capacity development initiatives. The first JTRC was established by ISA in cooperation with China in Qingdao in 2019. In 2024, the second JTRC was established with Egypt in Alexandria.⁸⁶ In 2023, the ISA-China JTRC organized its second training workshop on MSR and technology development. In September 2024, the ISA-Egypt JTRC hosted the first-ever EIA training course.



⁸² ISA. National Expert Deployment Programme. Available at: <https://www.isa.org.jm/wp-content/uploads/2024/01/ISA-National-Experts-Deployment-Programme.pdf>.

⁸³ ISA. Supporting Africa’s Blue Economy. Available at: <https://www.isa.org.jm/isa-voluntary-commitments/supporting-africas-blue-economy>.

⁸⁴ ISA. ISA – Capacity Development Alumni Network. Available at: <https://www.isa.org.jm/isa-capacity-development-alumni-network-ican>.

⁸⁵ ISA. ISA-China JTRC. Available at: <https://www.isa.org.jm/capacity-development-training-and-technical-assistance/isa-china-joint-training-and-research-centre>.

⁸⁶ ISA. ISA-Egypt JTRC. Available at: <https://www.isa.org.jm/capacity-development-training-and-technical-assistance/isa-egypt-joint-training-and-research-centre>.



SPOTLIGHT 8. The second capacity training course in the framework of ISA-China JTRC

The first JTRC workshop was organized online in 2022. It focused on survey and assessment of mineral resources, characteristics of deep-sea ecosystems and environmental management and the global repository of data from exploration activities in the Area.⁸⁷ The second training workshop was organized in Qingdao, China, in October 2023. It involved 25 participants from 21 developing countries, including three nationals from BOS and six from LDCs. Half of the participants were women. More than 20 experts in the field lectured in the workshop to share knowledge and experience with the trainees. The training workshop was designed to expose the trainees to cutting-edge science and technology in deep-sea-related fields with specific emphasis on topics from the MSR Action Plan and measures to ensure effective protection of the environment, deep-sea biodiversity and habitats and deep-sea technologies and equipment. During the training, participants operated underwater vehicles, met and exchanged views with deep-sea scientists and experts from the Centre for Deep Sea Research of Qingdao and from around the world and gained hands-on training on-board a research vessel.

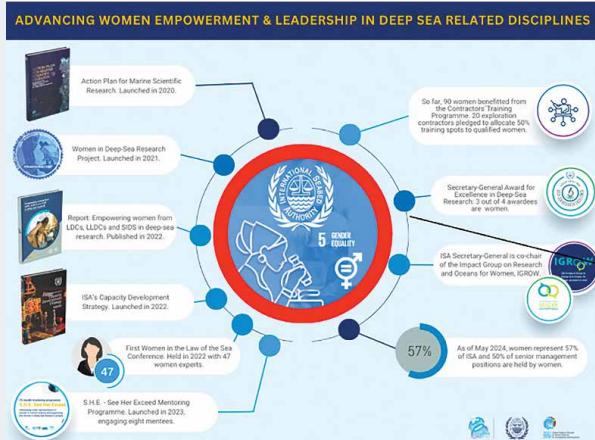
Another component of SRP 6 is delivered through the Contractor's Training Programme, which is a unique platform for world-class training focused on deep-sea research and exploration.⁸⁸ Each contractor is required to propose the equivalent of 10 training opportunities in a five-year period for the nationals of developing Member States of ISA. To date, more than 350 professionals have benefited from the Contractors' Training Programme, including 115 women and 118 personnel from LDCs, LLDCs and BOS.

Finally, women's empowerment is a crosscutting priority in all capacity development initiatives. ISA pioneered advancing this domain in deep-sea related areas (Case study 6).

⁸⁷ ISA. Joint Training Research Centers. Available at: ISA-China Joint Training and Research Centre - International Seabed Authority

⁸⁸ ISA. Contractors' training programme. Available at: <https://www.isa.org.jm/capacity-development-training-and-technical-assistance/contractor-training-programme>.

CASE STUDY 6. Women in Deep-Sea Research project and the S.H.E. Mentoring Programme



S.H.E. Mentoring Programme



In 2017, ISA registered a voluntary commitment, #OceanAction40786 on advancing women's empowerment in MSR with a special focus on women scientists from developing countries, especially LDCs, LLDCs and BOS.⁸⁹

In March 2021, at the occasion of the International Day of Women and Girls in Science, ISA formally launched the WIDSR project in partnership with the Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States. Through WIDSR, ISA established strategic partnerships with over 36 entities from governments, international and regional organizations, academia and contractors to implement activities in the four areas of action of WIDSR: policy development and advocacy, capacity development, sustainability and partnerships and communication and outreach. ISA contractors positively contribute to the implementation

⁸⁹ ISA. Advancing women's empowerment in marine scientific research. Available at: [msr](#)

⁹⁰ ISA. WIDSR project. Available at: <https://www.isa.org.jm/capacity-development-training-and-technical-assistance/contractor-training-programme>

⁹¹ ISA. 2022. Empowering women from LDCs, LLDCs and SIDS in deep-sea research: A WIDSR Report. Available at: [Women_WIDSR_Report_Web.pdf](#)

⁹² ISA. WIDSR project: S.H.E. See Her Exceed Mentoring Programme. Available at: [https://www.isa.org.jm/capacity-development-training-and-technical-assistance/contractor-training-programme](#)

⁹³ ISA. 2024. Advancing women's empowerment and leadership in deep-sea-related disciplines. Available at: [org.jm/wp-content/uploads/2024/05/Women-brief-1.pdf](#)

of the WIDSR project by pledging to reserve half of their training opportunities to qualified women applicants whenever possible. In 2023, the momentum for the pledge had grown exponentially when over 10 contractors joined the pledge, increasing the number of contractors supporting this initiative to 20 out of 22 or 90 per cent.⁹⁰

In June 2022, during the UN Ocean Conference, the WIDSR project released the first-ever gender mapping report entitled "Empowering women from LDCs, LLDCs and SIDS in deep-sea research." This report provides a detailed overview of gender-disaggregated data for deep-sea research and related disciplines, including sectors of activities, identifying the critical barriers faced by women from LDCs, LLDCs and SIDS in participation and accessing leadership roles in fields relating to MSR. The report builds on a foundational data set of primary and secondary data from 23 LDCs, LLDCs and SIDS (Bangladesh, Belize, Botswana, Cook Islands, Fiji, Jamaica, Kiribati, Lesotho, Madagascar, Malawi, Maldives, Mauritius, Mongolia, Mozambique, Myanmar, Nauru, Nepal, Seychelles, Singapore, St. Kitts and Nevis, Tonga, Trinidad and Tobago, Vanuatu) and information collected at national, institutional and individual levels on the status of women in deep-sea research and related careers. The report found that three-quarters of respondents consider deep-sea research as important. A detailed breakdown of the workforce in deep-sea research across the surveyed countries highlighted that individuals in leadership roles were predominantly male and that there was a general trend of more men being active in deep-sea research across the surveyed countries. A key outcome of this report was the need for guidance and mentoring for career progression.⁹¹

In response to these findings, in June 2023, ISA launched the See Her Exceed (S.H.E.) global mentoring programme concentrating on the promotion of the career of women scientists from developing States, including LDCs, LLDCs and SIDS, in deep-sea research through the mentorship by established professionals.⁹²

In May 2024, ISA launched a policy brief which provides an overview of all the efforts ISA has undertaken to advance women's leadership and career progression.⁹³



SRP 6. KEY CONNECTIONS TO UN OCEAN DECADE CHALLENGES

The extensive and growing portfolio of activities addressing SRP 6 aligns with multiple UN Decade Challenges. In essence, all activities under SRP 6 contribute to building skills, knowledge, and technology for all, ensuring comprehensive capacity development and equitable access to data, information, knowledge, and technology across all aspects of ocean science and for all stakeholders (Challenge 9). Additionally SRP 6 also contributes to developing a sustainable and equitable ocean economy (Challenge 4), expanding the Global Ocean Observing System (Challenge 7) and changing humanity's relationship with the ocean (Challenge 10).



Strategic partnerships and funding in support of effective implementation of the global deep-sea research agenda

Partnerships

Partnerships are critical to the delivery of ISA's mandate. Establishing strategic alliances is an integral part of the ISA Strategic Plan.⁹⁴ Under ISA's Strategic direction 4 regarding the promotion and encouragement of MSR in the Area, High-level action 4 requires ISA to "strengthen and, as appropriate, establish strategic alliances and partnerships with relevant subregional, regional, and global organizations" aligning with the UN Ocean Decade.

Political support is essential to ensure enabling conditions to facilitate MSR. Following an invite by the ISA Secretary-General, Argentina has championed the MSR Action Plan since its inception, committing to contribute and work together with ISA to promote the objectives of the UN Ocean Decade.⁹⁵ Many other Member States have since stepped up by providing funding support for targeted MSR and capacity-building programmes or activities.

In September 2023, the ISA Secretary-General launched a global call to action for accelerating progress under the 2030 Agenda through deep-sea research, technology and innovation at the high-level event during the Summit on Sustainable Development Goals.⁹⁶ The call to action aims at furthering collective action around four key priorities, namely (i) increasing investments in science and technology, (ii) aligning relevant research agendas at various levels with the ISA MSR Action Plan as global deep-sea research agenda, (iii) promoting deep-sea literacy and (iv) leveraging ISA experiences in support of the 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 (2023 Agreement). The support to call has been increasing exponentially to date; 10 Member States (Argentina, Nauru, Cook Islands, Tonga, Malta, Norway, Singapore, Bangladesh, Italy, and Mauritius) and seven international research and exploration entities signed the call.⁹⁷

A key enabler in the delivery of ISA programmatic activities with respect to MSR is collaboration with practitioners. ISA applies an inclusive approach to developing its activities, involving partners at national, sub-regional, regional and global levels, often acting as good officers between private and public sectors as well as academia and civil society (Figure 8).

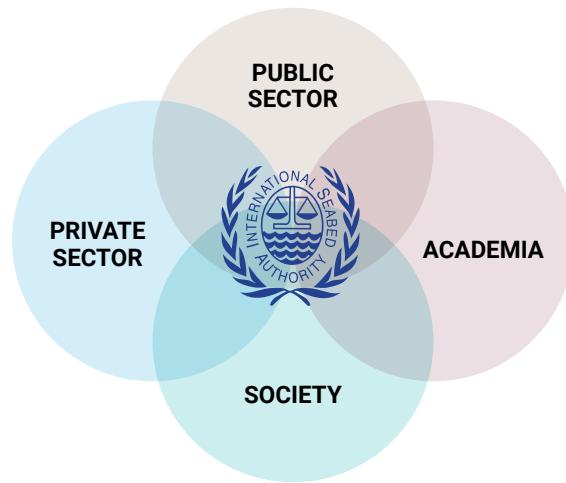


Figure 8. Quadruple Helix Collaboration

To this end, an important element of ISA partnerships centres around the relationship with its 22 contract holders (Figure 9 A), research institutes and universities who also often work together to conduct environmental programmes (Figure 9 B). Leveraging such partnerships and amplifying the value of collaborative efforts in knowledge generation is achieved through research projects and specialized scientific activities, including those enabled by ISA (Figure 9 C). As mentioned in the discussion of SRP 2, the call for taxonomic projects "One Thousand Reasons," launched in 2023, resulted in the ISA awarding 10 projects to 10 separate research institutes and universities.

ISA collaborates with other intergovernmental and UN bodies active in the marine and maritime sphere, especially those whose activities relate to UNCLOS (Figure 9 D). This is integral to delivering targeted contributions to several other global processes, as evidenced in this report.

The ability of ISA to enable MSR relevant to the implementation of the recently negotiated 2023 Agreement is particularly significant.⁹⁸ The freedom to undertake MSR is a general principle and requirement to achieve the objectives of the 2023 Agreement. The best available science and scientific information are a critical need in developing proposals and

94 ISA. 2023. Consideration, with a view to adoption, of the draft strategic plan of the International Seabed Authority for the five-year period 2024–2028 Report of the Secretary-General (ISBA/28/A/7).

95 ISA. 2020. Argentina to Champion ISA Draft Marine Scientific Research Action Plan in support of the UN Decade of Ocean Science. Available at: <https://www.isa.org.jm/news/argentina-champion-isa-draft-marine-scientific-research-action-plan-support-un-decade-ocean>.

96 ISA. 2023. Global call to action for accelerating progress under the 2030 Agenda through deep-sea research, technology and innovation launched at the SDGs Summit high level event co-organized by Bangladesh, Argentina and ISA. Available at: <https://www.isa.org.jm/news/global-call-to-action-for-accelerating-progress-under-the-2030-agenda-through-deep-sea-research-technology-and-innovation-launched-at-the-sdgs-summit-high-level-event-co-organized-by-bangladesh-arge>.

97 ISA. 2024. China, Togo and seven international research and exploration entities join the ISA in a Call for Action in support of science, technology and innovation for the stewardship of the Area and its resources for the benefit of all humanity. Available at: <https://www.isa.org.jm/news/china-togo-and-seven-international-research-and-exploration-entities-join-the-isa-in-a-call-for-action-in-support-of-science-technology-and-innovation-for-the-stewardship-of-the-area-and-its-resources>.

98 ISA. 2024. A review of the contribution of ISA to the objectives of the 2023 Agreement under UNCLOS on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdictions. Available at: https://www.isa.org.jm/wp-content/uploads/2024/06/The_contribution_of_ISA_to_the_BBNJ_objectives.pdf.



Figure 9. Partnerships with contractors (A), research projects (B), universities and institutes (C), intergovernmental entities (D) and UN agencies (E)

making decisions in relation to establishing area-based management tools (including marine protected areas) and determining emergency measures in the event of natural or human-caused disasters. They are also essential for undertaking EIAs, which will rely on readily available information to enable everyone to contribute during the consultation process and the monitoring of impacts of authorised activities. Collaboration in MSR projects is also recognized as a key contributor to developing the capacity of States to engage in the objectives of the 2023 Agreement fully.

As such, generating scientific information and collaborative opportunities enabled by ISA benefit humankind directly and support the creation of other forums. This is achieved not only through the provision of scientific understanding itself but, more importantly, by being an enduring and permanent legal framework in ABNJ.





Funding

To date, the promotion of MSR by ISA has been supported by three main funding sources: regular programme expenditures from the ISA budget, extrabudgetary contributions from Member States and, since 2022, the ISA Partnership Fund (ISAPF). The following section outlines the evolution of this funding.

ISA operates on a two-year budget cycle. This analysis covers the past 10 years of internal and external funding dedicated to promoting scientific research. From 2014 to 2024, the ISA's total budget increased by 64 per cent from USD16.5 million in the 2013-2014 to USD27.1 million in the 2024-2025 budget cycle (Figure 10).

The regular ISA budget accounts for total expenditures, including programme expenditures. ISA has a dedicated programme to promote MSR. Additional programme funds are allocated to the SRPs, such as data, technology, capacity development and ocean literacy (Figure 11).

Over the past 10 years, total programmatic funding for implementing various SRPs of the MSR Action Plan has increased by 44 per cent from USD390,000 in 2013-2014 to USD2,170,500 in the 2025-2026 budget cycle. The dedicated MSR programme expenditure (SRPs 1 and 2) has quadrupled, rising from USD100,000 in the 2013-2014 budget cycle to USD419,000 in the 2025-2026 budget cycle. The first doubling occurred during the 2017-2018 budget cycle, followed by another significant increase at the adoption of the MSR Action Plan in 2020. Capacity development (SRP 6) funding also saw an increase of 83 per cent, reaching USD396,000 in the 2025-2026 budget cycle. By the 2023-2024 budget period, the regular budget in support of the implementation of the MSR Action Plan diversified to include USD400,000 on technology

development in line with SRP 3. A similar allocation is projected for the 2025-2026 budget cycle.

Extrabudgetary funding has been secured since 2017. It ranges from USD189,000 in 2021-2022 up to USD474,000 in 2017-2018 (Figure 12). In 2023-2024, the budgetary contributions amounted to USD472,000.

A few Member States have provided consistent funding, enabling longer-term MSR activities and enhancing their overall impact. This is evident in initiatives such as the African Deep Seabed Resource project, which includes an MSR component for African experts, supported by Norway, the ISA's flagship project, SSKI, supported by Korea and European Union and ISA Secretary-General's Award for Excellence in Deep-Sea Research supported by Monaco.

A multi-donor trust fund, the ISAPF, was established in 2021 to boost ISA's capacity development and MSR activities even further, with a focus on mobilizing transformative partnerships and financial support for the implementation of the MSR Action Plan. The ISAPF Board has already provided financial support to nine projects totalling USD1,316,071. The uniqueness of ISAPF lies in its ability to secure an annually recurring USD400,000, significantly boosting long-term MSR activities and ensuring consistent support for their promotion.

The fourth and most significant funding source advancing scientific knowledge about the deep sea comes from contractors, particularly through their environmental studies and support for the ISA Contractors Training Programme, both of which contribute to the implementation of the MSR Action Plan. Since 2001, contractors invested approximately USD376 million in environmental studies and USD10 million in capacity development initiatives.

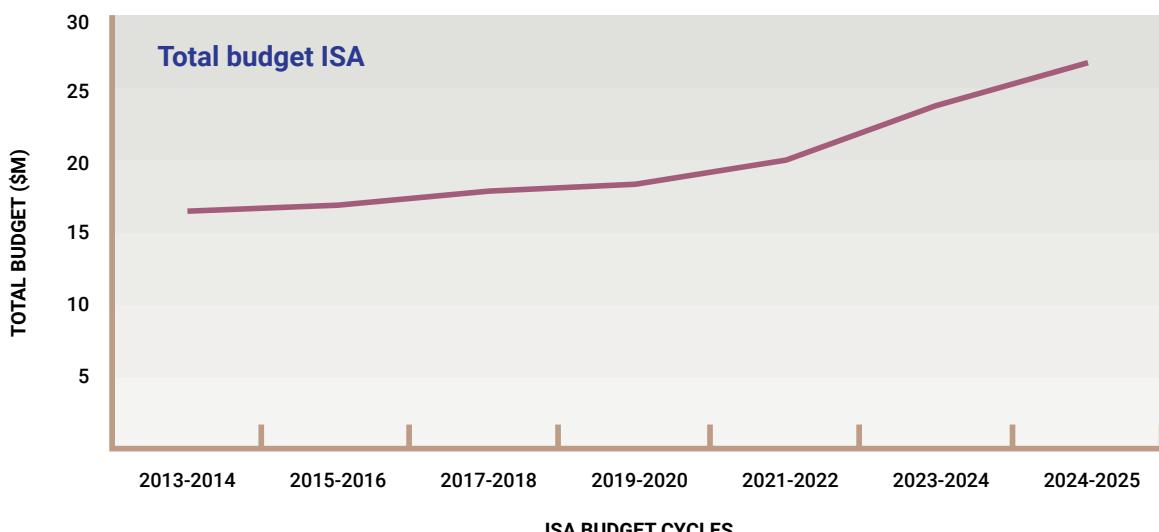


Figure 10. Evolution of the total expenditures ISA for administration, conference services and programmes

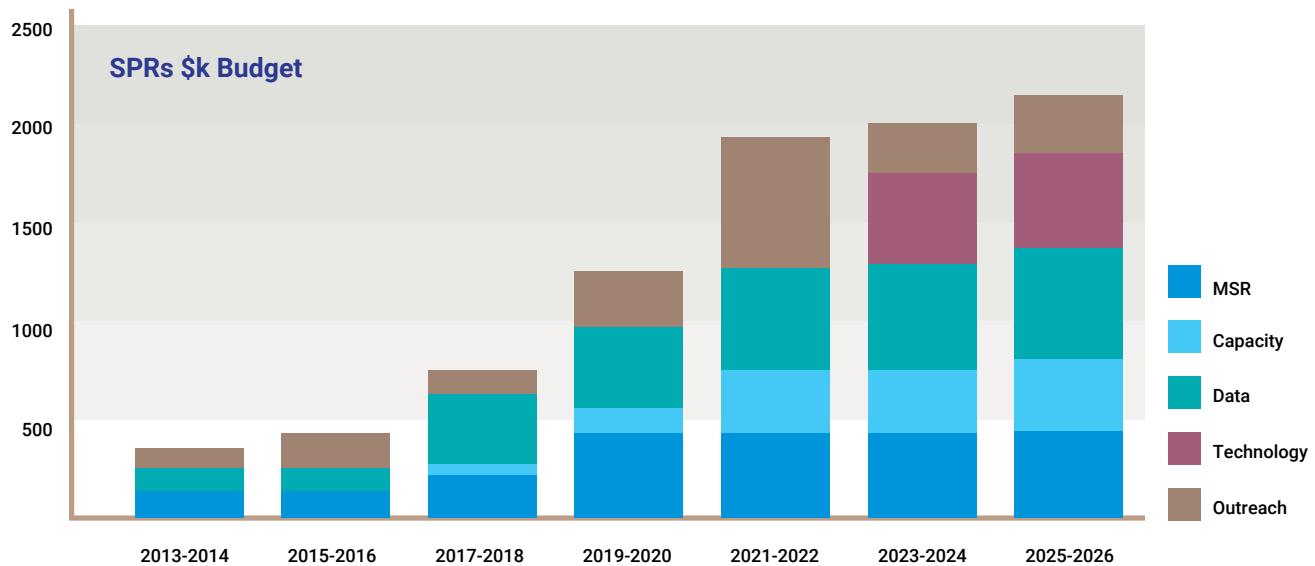


Figure 11. Evolution of ISA's programmatic expenditure to promote MSR and support the implementation of specific SRPs of the MSR Action Plan

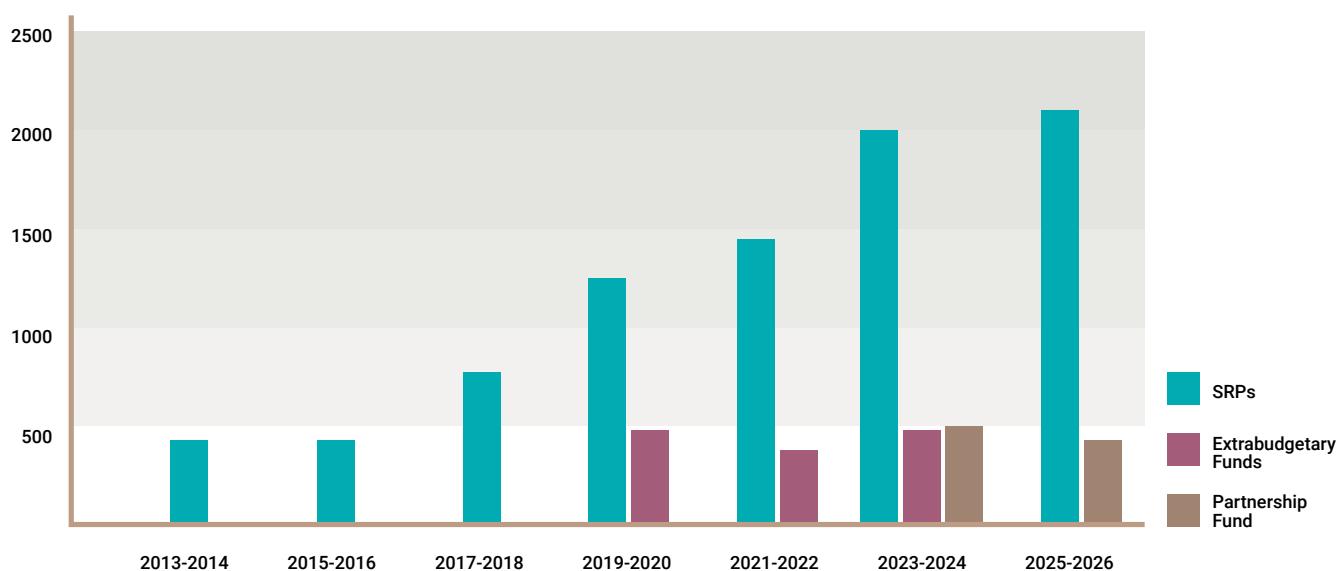
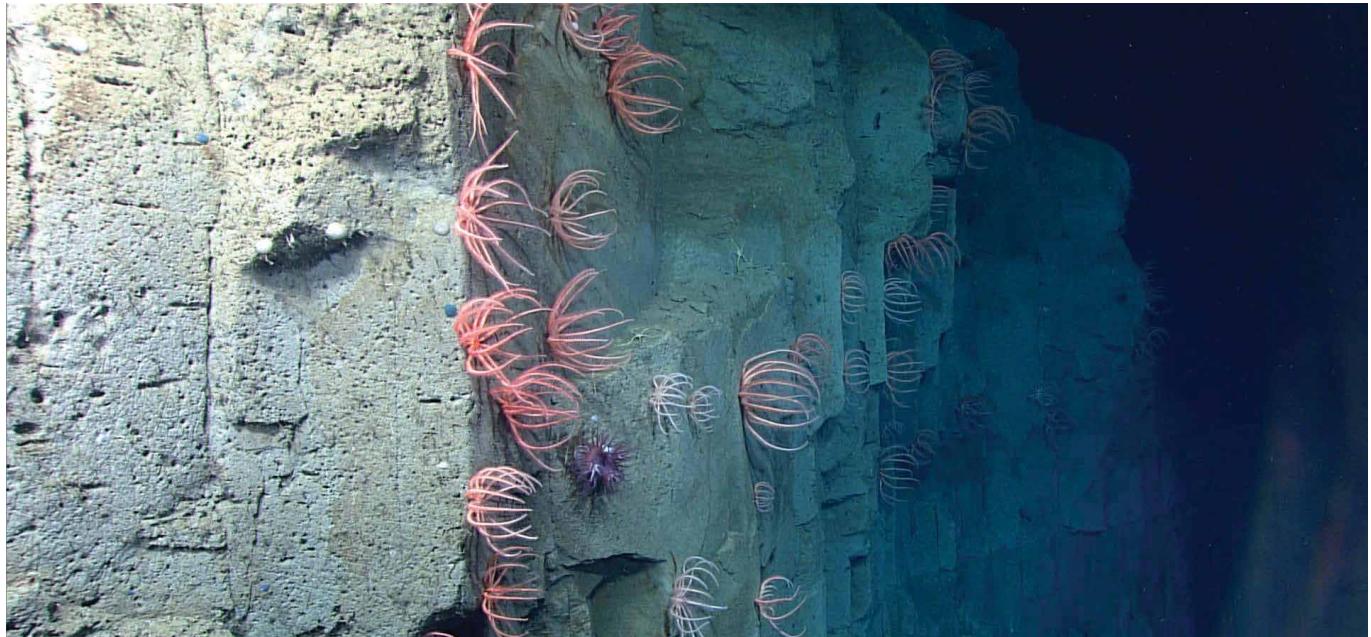


Figure 12. Evolution of ISA's regular budget for MSR promotion, data, capacity-building, ocean literacy, extrabudgetary contributions and the ISAPF



SPOTLIGHT 9.

The governance and activities of the ISA Partnership Fund

ISAPF is a multi-donor trust fund established on 3 August 2022 by the ISA Assembly during its twenty-seventh session.⁹⁹ It aims to promote and encourage MSR in the Area for the benefit of humankind and to contribute to dedicated capacity development programmes and activities aligned with the priority needs identified by developing ISA Member States.

The ISAPF aims to:

- promote MSR in the Area for the benefit of humankind
- provide qualified scientists and technical personnel from developing countries with opportunities to participate in international MSR programmes
- finance the design, development and implementation of development programmes and activities aligned with the priority needs identified by developing ISA Member States
- contribute to the implementation of the MSR Action Plan
- enhance ISA's contributions to the implementation of the 2030 Agenda for Sustainable Development and the achievement of Sustainable Development Goals.



**ISA
Partnership
Fund**

ISAPF Board was established to provide strategic guidance and direction on implementing activities and endorsing strategic priorities. It consists of two representatives of the ISA Secretariat, the Chairs of the Finance Committee and the LTC and eight representatives of Member States, including the LDCs, LLDCs or BOS. Donors contributing to other ISA-administered trust funds may also be invited to participate in the discussions.

ISAPF Board has met twice and has approved nine projects. The projects range from the design of a training course on EIA, the development of a data visualization platform for the Area, the establishment of an African Academy for Deep-Sea Diplomacy, the implementation of tailored activities to enhance the knowledge of African experts in deep-sea research through the ISA-Egypt JTRC, the promotion of deep-sea research in the Indian Ocean and the mapping of the capacity needs in the Caribbean countries to develop a targeted curriculum.¹⁰⁰

⁹⁹ ISA. 2022. Decision of the Assembly of the International Seabed Authority relating to financial and budgetary matters (ISBA/27/A/10).

¹⁰⁰ ISA. ISA Partnership Fund. Available at: <https://www.isa.org.jm/isa-partnership-fund>.

Conclusions

ISA has made substantial contributions to the scientific objectives of the UN Decade by promoting MSR, facilitating technological innovation and ensuring capacity development. Since the entry into force of UNCLOS in 1994, ISA has aligned its efforts with the goals of the UN Decade, generating critical knowledge and infrastructure and enhancing research capacities.

The adoption of the MSR Action Plan in 2020 marked a pivotal milestone for ISA, positioning it as a key player in the global deep-sea research agenda. This framework not only formalizes ISA's contributions to the UN Decade but also enhances its role as a catalyst for international collaboration in deep-sea research. The engagement of 879 experts in ISA workshops, 25 per cent of whom are from developing countries, underscores its commitment to inclusivity and global participation.

Each of the six SRPs of the MSR Action Plan has produced notable outcomes. For instance, under SRP 1, ISA facilitated workshops that informed the development of environmental guidelines for contractors, ensuring the generation of high-quality data foundational for subsequent research efforts. SRP 2 has seen the launch of the flagship project SSKI, which is transforming biodiversity assessments through innovative taxonomy tools. This project has funded initiatives to describe 1,000 species within a year, showcasing its impact on understanding deep-sea biodiversity. Under SRP 3, ISA published technical studies identifying technological gaps and prioritizing development in areas such as ocean observation, monitoring and automation. These studies are essential for

advancing technology relevant to deep-sea exploration. Under SRP 4, ISA conducted a regional environmental assessment to inform the development of a REMP for the northern MAR. This includes assessing cumulative impacts and understanding the interactions between deep-sea mining and fisheries, as well as the implications for the global carbon cycle. To enhance data sharing, SRP 5 has driven the advancement of DeepData and its Data Management Strategic Roadmap, focusing on data quality and interface improvements. Additionally, three ocean literacy tools were launched to promote awareness and understanding of deep-sea ecosystems. Significant achievements under SRP 6 include the adoption of a Capacity Development Strategy, the publication of a policy brief on capacity development needs and women's empowerment, and the implementation of programmes aimed at fostering women's participation in marine science.

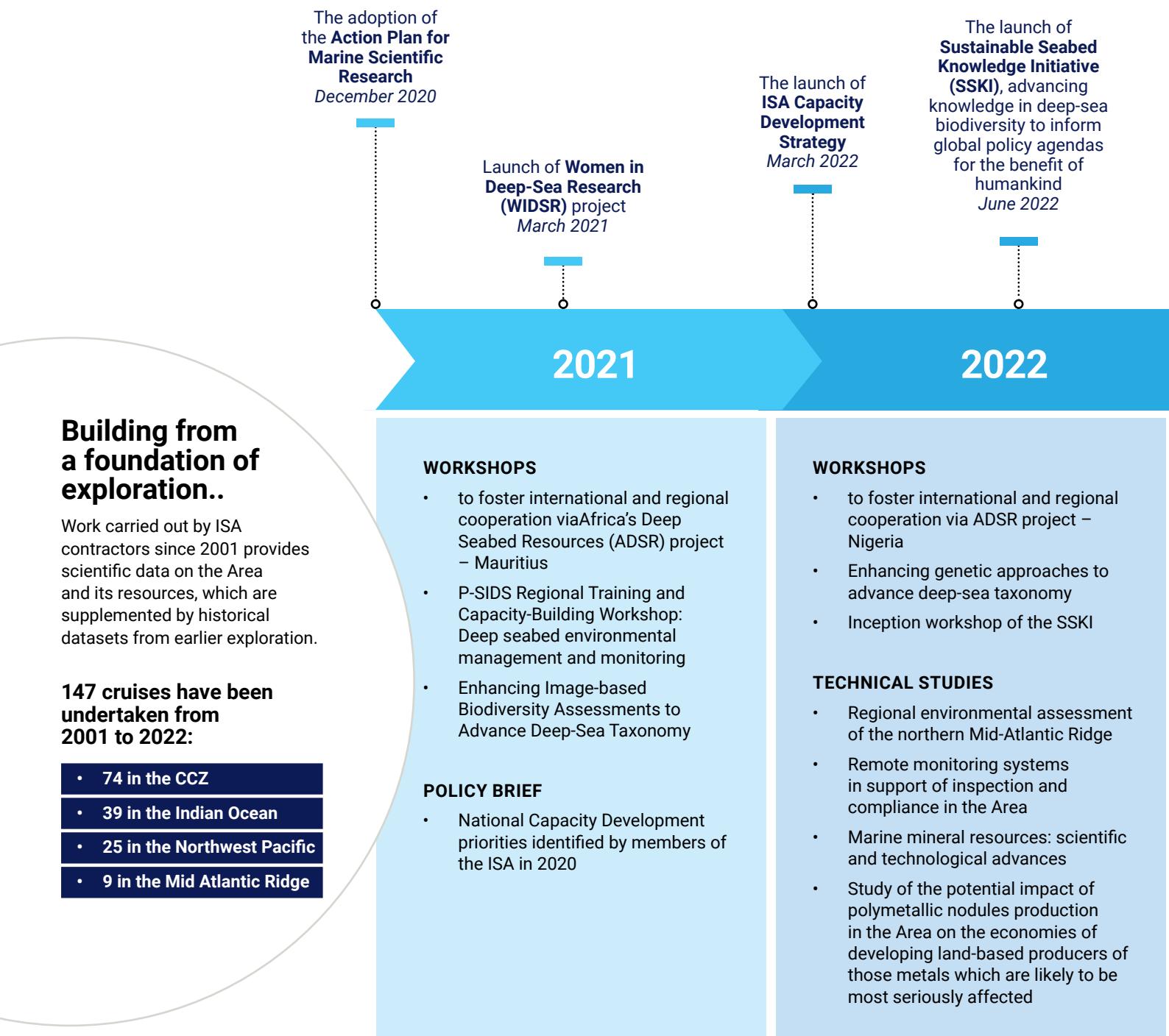
The implementation of the MSR Action Plan is supported by over USD376 million invested by contractors in environmental studies, leading to 431 publications between 2020 and 2023 throughout the field of deep-sea science. These studies provide a crucial baseline for ongoing research and knowledge development.

Funding for these initiatives has come from various sources, including the Secretariat's budget and contributions from Member States, totalling over USD100 million since 2020. The momentum generated by these efforts is set to continue, fostering transformative outcomes and enhancing the scientific community's capacity to address critical knowledge gaps in deep-sea ecosystems.





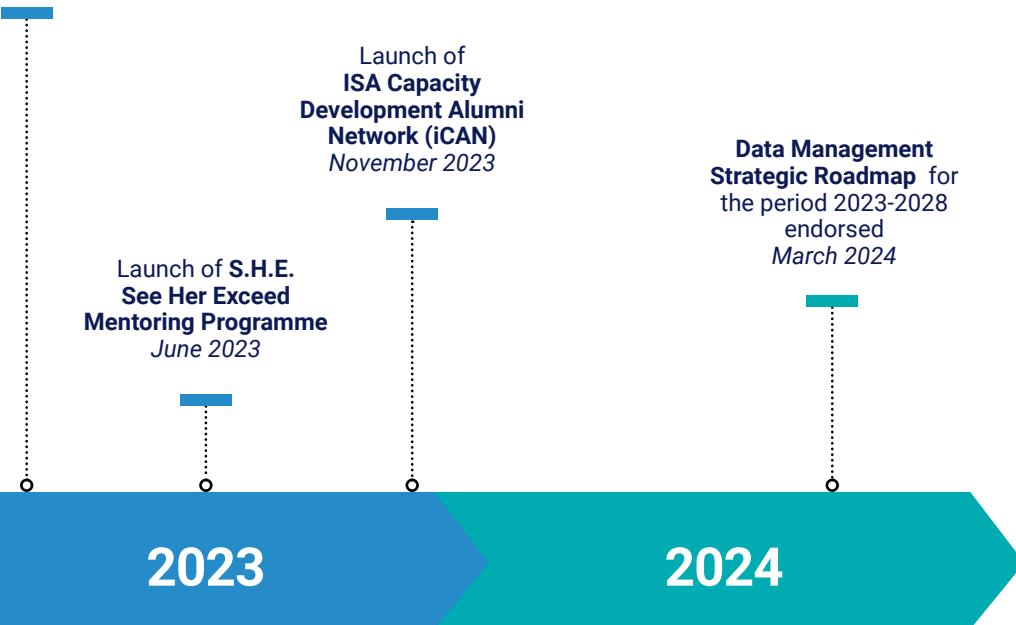
Timeline context – activities with connections to MSR Action Plan



...throughout, environmental baseline studies in the Area carried out by contract

Figure 13. A visual timeline of activities facilitated by the ISA Secretariat since the implementation of the MSR Action Plan

The ISA DeepData database (launched in 2019 and advanced in 2020 through introduction of reporting templates) is by this point widely used, with approximately 2.4 million hits from unique visitors during 2022 and more than 160 citations in scientific publications. It is the largest global repository of environmental data and information on the Area and its overlying waters beyond national jurisdiction and is publicly available.



WORKSHOPS

- ISA-Philippines National Capacity Development Workshop on deep-sea related matters
- Workshop on Enhancing Biological Data Sharing to Advance Deep-Sea Taxonomy

TECHNICAL STUDY

- Potential interactions between fishing and mineral resource-related activities in areas beyond national jurisdiction: a spatial analysis

WORKSHOPS (TO APRIL 2024)

- Expert scoping workshop on charting future horizons: harnessing advanced technologies for the protection and sustainable use of the international seabed area
- Workshop on the development of a scientific approach to identifying key deep-sea taxa in support of the protection of the marine environment in the Area

POLICY BRIEF

- Advancing women's empowerment and leadership in deep-sea-related disciplines and research: from commitment to action

ors under the guidance of the LTC continue to be a significant driver of scientific progress.

Representation of 879 Participants since 2020

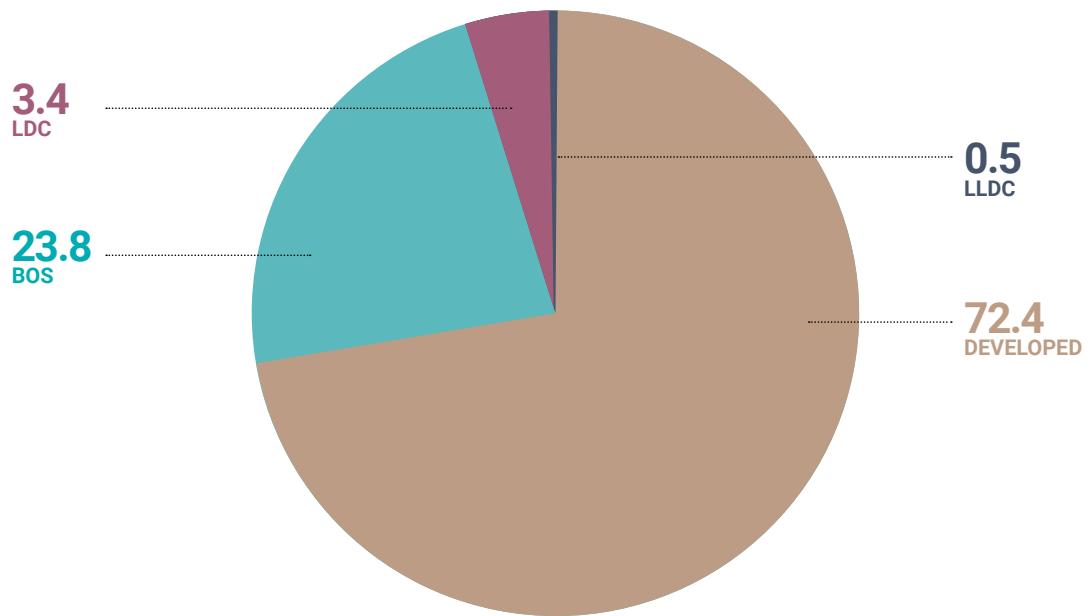


Figure 14. MSR workshop participants from developed countries, LDCs, LLDCs and BOS between 2020 and 2024

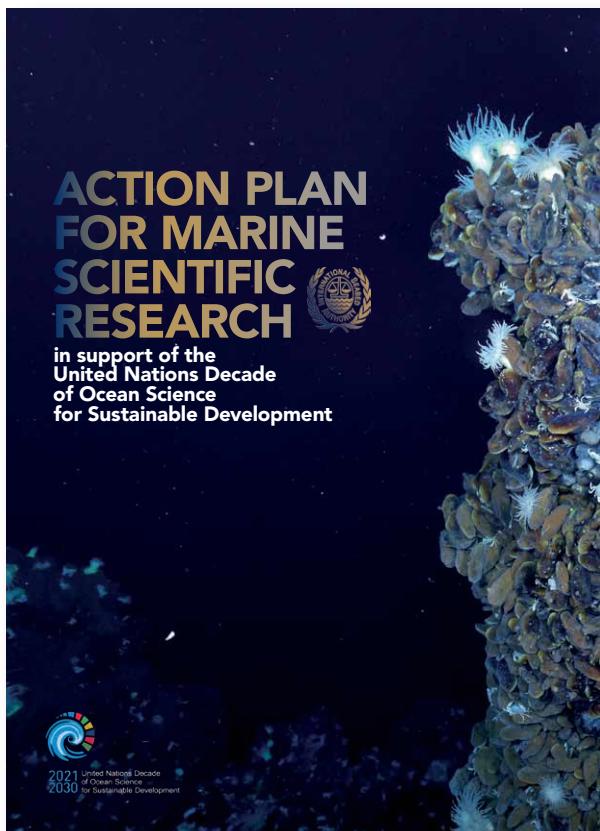
Since the launch of the MSR Action Plan in 2020, the Secretariat organized 29 dedicated events to promote scientific deep-sea research, including online and in-person workshops, webinars, information series and side events, securing the participation of 879 experts. Notably, a quarter of participants were from least developed countries, landlocked developing countries and the Big Ocean States. This showcases the ISA's strong convening power in advancing science for all while fostering an inclusive approach through maximizing the participation of developing States.



Recommendations

This report acknowledges the significant milestones of the ISA MSR Action Plan in advancing MSR in the Area, highlighting the role it plays in knowledge generation, partnerships and capacity development, especially for developing countries. As ISA approaches the midpoint of both the MSR Action Plan and the UN Ocean Decade in 2025, it is crucial to reassess future priorities to ensure the MSR framework continues to evolve with the expanding understanding of marine science needs and public interest in the deep sea. ISA's commitment to adaptive strategies and alignment with new and emerging priorities will be key to the MSR Action Plan's ongoing success.

Outlined here are a series of targeted recommendations to strengthen the impact of the MSR Action Plan. Each recommendation focuses on fostering collaboration, raising awareness and encouraging innovative approaches aligned with the expectations of decision makers and the broader scientific community. Many suggestions have longer-term objectives with substantial outcomes, while others seek to refine existing practices. Suggested activities accompany each to illustrate potential pathways for their implementation.



- 1. Enhance dissemination and outreach of scientific achievements under SRPs**
 - Publish ISA knowledge products regularly, including fact sheets, technical studies and policy briefs, following new MSR discoveries.
 - Host annual high-level dialogues and webinars to share updates on SRP advancements and discuss implementation priorities.
- 2. Develop flagship initiatives for SRPs**
 - Design environmental observation programmes in areas of high ecological interest and develop frameworks for impact assessments that guide decision-making.
 - Consider LDCs and BOS in the design to ensure inclusive benefits and equitable participation.
- 3. Prioritize regional-scale research and engagement to strengthen the science-policy interface**
 - Organize scientific workshops to assess regional marine environmental priorities, such as plume dispersal and habitat mapping, supporting the development of REMPs.
- 4. Conduct MSR horizon scanning to foster innovation**
 - Engage experts from developing States through secondments and internships to expand bibliographic resources, then assess emerging topics and conduct interviews to inform ISA's agenda.
- 5. Decentralize the implementation of the MSR Action Plan to upscale projects under the SRPs**
 - Assist the Member States in research policy development, leveraging the MSR Action Plan to align national ocean research strategies with the SRP's.
- 6. Establish a landmark ISA MSR assessment**
 - Organize a scientific symposium every five years as a platform for publishing authoritative updates on MSR and deep-sea research to solidify ISA's role in tracking and disseminating essential scientific knowledge.
- 7. Explore new funding models**
 - Facilitate partnerships with universities for MSR-focused academic opportunities and engage private companies in MSR capacity-building initiatives.



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Annex 1. Contributing Experts



Dr. Katja Schmidt

Dr. Schmidt is a marine geochemist who completed her Ph.D. and postdoc studies at Jacobs University, Bremen. She works at the German Federal Institute for Geosciences and Natural Resources, where she is the Head of the Marine Geology Laboratory in the Department of Marine Resource Exploration. With a focus on coastal ecosystems, particularly seagrass meadows and coral reefs, Dr. Schmidt's research investigates the ecological functions and services provided by these vital habitats. She has conducted extensive field studies examining the impacts of human activities and climate change on marine biodiversity, contributing valuable insights into strategies for habitat conservation and restoration. Dr. Schmidt is an active participant in international marine conservation initiatives and collaborates with various organizations to promote sustainable management practices.

Dr. Samantha Smith



Dr. Smith is a board member of the Lyell Centre for Earth and Marine Science. She heads sustainability and external relations at Global Sea Mineral Resources, focusing on marine conservation and fisheries management. She has dedicated her career to studying the interplay between marine ecosystems and human activities, with particular emphasis on sustainable fishing practices and the protection of endangered marine species. Dr. Smith has conducted extensive research on fish population dynamics, habitat restoration and the impacts of climate change on marine life. Her work has been published in numerous high-profile journals, and she is a frequent speaker at international conferences dedicated to marine science and conservation. In addition to her research, Dr. Smith is committed to education and community engagement, leading initiatives that educate local communities about marine stewardship and the importance of biodiversity. Through her work, she aims to foster a deeper understanding of marine ecosystems and promote sustainable practices that ensure the health of the oceans for future generations.

Dr. Livia Ermakova



Dr. Ermakova from FSBI VNIIOkeanogeologia is a distinguished marine biologist known for her research in marine ecology and environmental science. Her work primarily focuses on the interactions between marine organisms and their environments, with a special emphasis on the effects of climate change and pollution on marine ecosystems. Dr. Ermakova has conducted extensive studies on microbial communities in oceanic environments and their role in nutrient cycling and ecosystem health. She has published numerous papers in leading scientific journals and contributes to various international conservation projects aimed at protecting marine biodiversity. In addition to her research, Dr. Ermakova is dedicated to educating future generations of scientists advocating for marine conservation, leading workshops and outreach programmes to raise awareness of the importance of preserving ocean habitats. Her commitment to understanding and protecting marine environments makes her a leading voice in the field of marine science.

Prof. Eduardo Silva



Prof. Silva is a distinguished academic and researcher currently serving as a professor at the Higher Institute of Engineering of Porto and conducting research at the Institute for Systems and Computer Engineering, Technology and Science. With a strong background in engineering and technology, Prof. Silva specializes in areas such as systems engineering, automation and control systems. His research focuses on developing innovative solutions to complex engineering challenges, contributing to advancements in smart systems and technological applications. Prof. Silva has published numerous papers in recognized scientific journals and actively participates in international conferences, sharing his expertise and fostering collaboration within the engineering community. As an educator, he is dedicated to mentoring students and inspiring future engineers through a comprehensive curriculum that combines theoretical knowledge with practical applications, preparing them for the demands of the evolving technological landscape.



Prof. Thomas Peacock

Thomas Peacock is a Professor of Mechanical Engineering at the Massachusetts Institute of Technology Institute of Technology. He is a Fellow of the American Physical Society and recipient of an NSF CAREER Award in Physical Oceanography. Over the past twenty years, he has conducted numerous field programs throughout the global oceans. And over the past decade, his research program has conducted and published leading studies of deep-sea bed mining sediment plumes.



Dr. Taga Raijeli

Dr. Raijeli is the Permanent Secretary in the Ministry of Lands and Mineral Resources of Fiji. She led the reform of the Fiji Employment Relations Act to remove Section 88, which prohibited the employment of women in underground mines. The bill passed on International Women's Day and was a milestone achievement for women. Dr. Taga was subsequently awarded the Women in Business "Executive Woman of the Year Award" for the Public Sector in 2018. As Facilitator for the Informal Working Group on the Protection and Preservation of the Marine Environment, Dr. Taga's leadership and advocacy on environmental issues have had a profound impact on environmental regulations for deep-sea minerals. Dr. Taga has advocated for Indigenous communities to express their concerns about deep-sea mining and the protection of their customs and traditional connections to the ocean. She was also integral to the establishment of the Blue Concrete Initiative, which will improve disaster and climate resilience in the Pacific.



Dr. Facundo A. Santiago

Dr. Santiago is the Deputy Head of Mission at the Argentine Embassy in Jamaica, where he plays a crucial role in fostering diplomatic relations between Argentina and Jamaica. With a background in international relations and public diplomacy, Dr. Santiago has expertise in political analysis, economic cooperation and cultural exchange. His career has involved various roles within the Argentine foreign service, focusing on enhancing bilateral ties and promoting Argentina's interests abroad. Known for his strong communication skills and cultural sensitivity, Dr. Santiago actively engages with local communities to strengthen partnerships and collaborations. His commitment to diplomacy and international cooperation contributes to the ongoing development of Argentina's presence in the Caribbean.



Dr. Malcom Clark

Dr. Clark is a highly regarded marine scientist with extensive expertise in deep-sea ecology and conservation. His research focuses on the biodiversity of deep-sea habitats, particularly in relation to the effects of human activities such as fishing and mining on marine ecosystems. Dr. Clark began his research career in the 1980s as a fisheries biologist. He worked extensively on stock assessment of deepwater fish (in particular orange roughy) before moving his research interests to more general deep-sea ecosystems. He studied seamounts for many years and headed the Census of Marine Life on Seamounts, a major six-year international research programme. Dr. Clark's studies have involved a lot of time at sea, including over 70 surveys, submersible dives and international work in the Antarctic and southwest Pacific. Currently, Dr. Clark leads research projects by the National Institute of Water and Atmospheric Research, New Zealand, describing the biodiversity of deep-sea habitats, assessing ecological risk to these habitats and communities from fishing and mining activities and ways to improve the management of environmental impacts.



Prof. Amr Hamouda

Prof. Hamouda is a prominent marine engineer and researcher known for his contributions to the fields of hydrodynamics and marine renewable energy. With a focus on the interactions between engineering structures and marine environments, Prof. Hamouda has conducted extensive research on wave energy conversion, tidal energy systems and coastal protection. His work aims to develop sustainable technologies that harness ocean energy while minimizing environmental impact. Prof. Hamouda has published numerous articles in reputable scientific journals and is actively involved in international research collaborations that address the challenges of climate change and energy sustainability. In addition to his research, he is dedicated to educating the next generation of engineers, offering mentorship and guidance to students in marine engineering and environmental sciences. Through his innovative research and educational initiatives, Prof. Hamouda strives to promote the sustainable use of marine resources and advance the field of marine engineering.



Prof. Tomasz Abramowski

Prof. Abramowski, Director of the Interoceanmetal Joint Organization from Poland, is a renowned expert in maritime engineering and oceanography. He holds a prestigious position at a leading maritime university, where his work focuses on naval architecture, marine engineering and the sustainable development of ocean resources. Prof. Abramowski has made significant contributions to maritime safety and innovation, including research on ship design, marine propulsion systems and environmental protection in maritime operations. He is well-respected for his extensive publications and involvement in international maritime organizations. Beyond his research, he is also committed to teaching and mentoring students, preparing them to address the complex challenges of the maritime industry.



Dr. Natalia Amezcuá

Dr. Amezcuá holds a PhD in geology with a specialization in Basin Analysis and Petroleum Geoscience. She is in charge of the Deputy Direction of Strategic Resources at the Mexican Geological Survey, where she works in research and prospecting of strategic and critical minerals. Dr. Amezcuá is a former ISA contractor Trainee Programme on PMS.



Ms. Rima Browne

Ms. Browne is a Senior Knowledge Management Officer, Seabed Minerals Authority, Cook Islands and a prominent figure in maritime sustainability and policy. With a background in marine environmental science, she has dedicated her career to promoting sustainable maritime practices and environmental stewardship in the shipping industry. Ms. Browne is known for her work on developing strategies to reduce maritime pollution, enhance marine biodiversity protection and implement eco-friendly technologies within the maritime sector. Ms. Browne has collaborated with various international organizations, contributing to policy frameworks aimed at safeguarding ocean health. In addition to her advocacy and policy work, Ms. Browne actively engages in public outreach and education, raising awareness about the importance of marine conservation and sustainability among diverse audiences.



Prof. Georgy Cherkashov

Prof. Cherkashov is a Managing Director, Institute for Geology and Mineral Resources of the Ocean, Russia, a highly respected expert in marine geology and a leading authority on marine mineral resources. As a professor and researcher, he has made significant contributions to the study of sea floor geology and the exploration of deep-sea minerals. Prof. Cherkashov's research has been pivotal in advancing the understanding of PMNs, hydrothermal vent deposits and other valuable mineral resources found on the ocean floor. He has collaborated with various international marine research institutions and has been instrumental in shaping policies related to the sustainable exploitation of marine mineral resources. Prof. Cherkashov is committed to educating the next generation of marine scientists, combining his wealth of knowledge with a passion for teaching and mentorship.



Dr. Suzan Mohamed El-Gharabawy

Dr. El-Gharabawy is a marine geophysicist and environmental scientist, serving as the Vice President of the National Institute of Oceanography and Fisheries for Entrepreneurship and Community Service in Egypt. With a PhD and Master's degree in environmental science focusing on quality control, she has led numerous research projects and international expeditions exploring marine environments. Dr. El-Gharabawy has extensive experience in academia, having lectured and conducted research at various universities and institutions. She has contributed significantly to scientific literature, publishing numerous papers and scientific reports. Additionally, she has been actively involved in international conferences, workshops and symposiums, advocating for ocean conservation and sustainable development.



Mr. Hank Hedge

Mr. Hedge has a Master of Science in Natural Resource Management and a BSc in Geology. He has been actively working in the field of geology since 2011 and has both onshore and offshore experiences in mineral exploration. As a former ISA trainee, he was exposed to mineral exploration in the Area with ISA's contractors, Japan Organization for Metals and Energy Security in 2018 and China Ocean Mineral Resources R&D Association in 2022. Mr. Hedge is a senior geologist at the Ministry of Agriculture, Fisheries and Mining, a member of the ISA's iCAN and an active member of the Jamaican delegation to the ISA. He is actively engaged in discussions and campaigns for the sustainable development of the deep seabed through the promotion of MSR and capacity-building programmes.



Ms. Federica Irene Falomi

Ms. Falomi holds a Master's in Economic and Social Sciences from Bocconi University. She works as an Economic Affairs Officer at the UNTBLDC, where she coordinates the work on research, analysis and technology needs assessments, as well as technology transfer and science, technology and innovation capacity-building programmes. Previously, as a Research Fellow at Tiresia, Polytechnic University of Milan, she worked on research and advisory for the development of social innovation and impact investing in Italy and Europe. Ms. Falomi has also worked on social policy analysis and research at UNICEF Eastern and Southern Africa Regional Office in Kenya, with a focus on public finance for children and youth and as Project Manager at the Allianz Foundation.



Prof. Pedro Madureira

Prof. Madureira is an Associate Professor at the University of Évora, Portugal. Between November 2012 and March 2024, he was the Deputy Head of the Task Group for the Extension of the Portuguese Continental Shelf and the scientific and technical coordinator of the continental shelf project. In his career, Prof. Madureira served as a principal investigator of several oceanographic cruises in the North Atlantic. He has been a member of the ISA LTC from 2012 to 2022. He is a mentor within the S.H.E. Mentoring Programme as part of the WIDSR. Prof. Madureira is keen to foster women's empowerment in marine science. His main academic interests include the evolution of volcanic islands, the formation and distribution of deep-sea mineral resources, marine environment and deep-seabed exploration.



Mr. John Astony Mataro

Mr. Mataro is a senior geologist and an inspector in the Ministry of Mines of the United Republic of Tanzania with over 10 years of working experience in geological matters, marine science and ocean governance. He holds a Bachelor of Science in Geology and a Master of Environmental Studies (Science). He is a member of the Tanzania Geological Society.



Dr. Sandip Mukhopadhyay

Dr. Mukhopadhyay is a geochemist in the Ocean Sciences and Technology Division, Ministry of Earth Science, India, and a professor at the Department of Marine Science of the University of Calcutta with extensive expertise in marine geophysics and oceanographic research. His work primarily focuses on the dynamics of ocean floors, marine mineral resources and sub-sea floor geological processes. Dr. Mukhopadhyay has been involved in numerous significant research projects that explore the geological features and mineral potential of the deep sea, contributing valuable insights into sea floor spreading, tectonics and marine resource management. He has published numerous papers in peer-reviewed journals and has presented his findings at many international conferences. Dr. Mukhopadhyay also collaborates with global marine research institutions, engaging in multidisciplinary efforts to promote sustainable ocean exploration. Besides his research, he is a dedicated educator, teaching and mentoring students in marine sciences and fostering an environment of innovation and critical thinking in his academic community.



Mr. Sai Navoti

Mr. Navoti, the Chief of the SIDS Unit at the UN Department of Economic and Social Affairs, is a prominent figure in the field of ocean governance and marine policy. Prior to his current post, he served as the Senior Legal Adviser at the ISA. He also served as Lead Negotiator for the G77 and China (2013) and Lead Climate Negotiator for the Alliance of Small Island States (2012). His expertise in advocating for the conservation and sustainable use of marine ecosystems has made significant contributions to global efforts to protect the oceans. Mr. Navoti is also deeply involved in capacity-building initiatives, helping to empower coastal communities and developing local solutions for ocean conservation. He regularly participates in international conferences and workshops, sharing his knowledge and fostering international cooperation in marine policy and governance.



Dr. G. A. Ramadass

Gidugu Ananda Ramadass received the Ph.D. degree in high temperature superconductors from Indian Institute of Technology, Madras, India. He is a Scientist and Head of the Deep Sea Technologies Group, National Institute of Ocean Technology (NIOT), Chennai, India. His research areas include deep-sea technology, underwater acoustics, and marine instruments. He led the NIOT team during the 34th Indian Scientific Expedition to Antarctica in February–March 2015 with an indigenously developed polar remotely operated vehicle and carried out exploration in the lake and shelf area of Antarctica. He has handled technology development programs leading to products and patents. He has been the Chief Scientist of 15 cruises and scientific explorations onboard various research vessels. His recent work includes publications in the international journals, international conferences, and four international patents. Dr. Ramadass won the 2010 Indian National Geoscience award under the exploration of oil and natural gas category.



Dr. Marzia Rovere

Dr. Rovere is a senior researcher at the Institute of Marine Sciences of the National Research Council of Italy. Her background is in marine geology, and her main research interests concern sea floor mapping, particularly the cold seep and hydrothermal habitats, marine geo-resources, deep-sea depositional systems, geohazards, such as submarine landslides and sediment transport in coastal areas and their conflict with offshore installations. She is Vice Chair of the joint IOC-IHO GEBCO Guiding Committee and a member of the establishment team of the GEBCO Seabed 2030 initiative for achieving a complete bathymetric mapping of the ocean by 2030. She served in the ISA LTC. She sailed as chief scientist in dozens of oceanographic cruises, served as a principal investigator of several national and EU research projects and supervisor of undergraduate, MSc and PhD projects.



Dr. Kathy Soapi

Dr. Soapi has a bachelor's degree from the University of the South Pacific, a master's from the University of Sydney in Australia and a PhD at the University of East Anglia in the UK. She is currently working as the Coordinator for the Pacific Community Centre for Ocean Science based in Fiji. Before joining, she was at the University of the South Pacific, holding a range of positions, including as a Lecturer at the School of Biological and Chemical Sciences and a Manager of the Pacific Natural Products Research Centre. Dr. Soapi is a prominent marine ecologist renowned for her research on coral reef ecosystems and their response to environmental changes. She has a keen interest in science capacity development and is passionate about working at the community level on natural resource management. Dr. Soapi has conducted extensive field studies and published numerous papers in leading scientific journals, contributing to the conservation and management of coral reef habitats. She actively collaborates with various organizations and stakeholders to promote sustainable practices and raise awareness about the importance of coral reef preservation. In addition to her research, Dr. Soapi is a passionate educator, inspiring students and the public to appreciate and protect marine ecosystems through workshops, lectures and community outreach initiatives.



Mr. Joshua Tuhumwire

Mr. Tuhumwire is a geologist, graduate of Makerere University, Uganda, and Vrije Universiteit, Brussel, Belgium. He joined Uganda's civil service as a geologist at the Department of Geological Survey and Mines in 1980 and spent the next 30 years at the same institution until his retirement in 2010. During his career, Mr. Tuhumwire undertook various geological mapping and mineral exploration work, rising through the ranks to the senior management level, undertaking planning and supervising projects and eventually heading the institution as the Commissioner for 10 years. On early retirement from government service, he had a stint at consulting in mineral exploration, as well as serving as director in the corporate world in exploration and Uganda's nascent oil and gas sector. From 2007 to 2020, he was involved in the UN World Ocean Assessments (WOA), initially in the Assessment of Assessments and later in the WOA I and WOA II as a member of the group of experts. Since 2024, Mr. Tuhumwire has been a member of the group of experts for the WOA III and, since 2017, a member of the ISA LTC.



Prof. Gao Xiang

Dr. Xiang is a Professor of Engineering at the National Deep Sea Centre of China, the Executive Director of ISA-China JTRC and the Vice Secretary of the Secretariat of the UN Ocean Decade Programme "Digital Deep-sea Typical Habitats (Digital DEPTH)." Dr. Xiang used to be the technical director of the control system of the JIAOLONG 7,000 metres manned submersible and participated in four manned deep dives with a maximum dive depth of 5,755 metres. He has been the project leader of several deep-sea international training programmes for about 100 trainees.



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