



mabik
NATIONAL MARINE BIODIVERSITY INSTITUTE OF KOREA



WORKSHOP REPORT

Contents

Abbreviations.....	3
INTRODUCTION	4
Part I: Technical session meeting for invited experts and SSKI partners	6
Item 1. Opening of the workshop	6
Item 2. Biodiversity assessment and monitoring in the context of ISA	8
Item 3. SSKI: implementation plan (V.0).....	8
Item 4. New knowledge of deep-sea biodiversity in the area.....	8
Item 5. Innovative tools for advancing taxonomic identification.....	10
Item 6. Deep-sea data sharing, capacity development and uptake of science	11
Item 7. Summary, next steps and conclusion	11
Item 8. Closure of the workshop – part I.....	12
Part II: Hybrid public session for registered participants, invited experts and SSKI partners.....	13
Item 1. Opening of the workshop	13
Item 2. SSKI: implementation plan (v.1.0).....	13
Item 3. Strengthening collaboration to support further development of deep-sea taxonomic knowledge platform and necessary long-term capacity development within the context of ISA.....	14
Item 4. Summary and conclusion	14
Item 5. Closure of the workshop – part II.....	15
Annex I: List of participants	16
Annex II: Summary of theme presentations	22
Annex III. Summary of activities proposed by participants	31

Abbreviations

BOLD	Barcode of Life Data System
CCZ	Clarion-Clipperton Zone
EC	European Commission
EU	European Union
FAIR	findable, accessible, interoperable and reusable
Ifremer	Institut français de recherche pour l'exploitation de la mer
IOM	Interoceanmetal Joint Organization
IORA	Indian Ocean Rim Association
ISA	International Seabed Authority
JAMSTEC	Japan Agency for Marine-Earth Science Technology
JTRC	ISA-China Joint Training and Research Centre
LTC	Legal and Technical Commission
MABIK	National Marine Biodiversity Institute of Korea
MOF	Ministry of Ocean and Fisheries, Republic of Korea
NIC	NIWA Invertebrate Collection
NIWA	National Institute of Water and Atmospheric Research, New Zealand
NUS	National University of Singapore
OBIS	Ocean Biodiversity Information System
OEMMR	Office of Environmental Management and Mineral Resources
REMP	regional environmental management plans
SSKI	Sustainable Seabed Knowledge Initiative
UNCLOS	United Nations Convention on the Law of the Sea
WoRDSS	World Register of Deep-Sea Species
WoRMS	World Register of Marine Species

INTRODUCTION

1. In accordance with the United Nations Convention on the Law of the Sea (UNCLOS), the International Seabed Authority (ISA) is mandated to regulate and control activities in the international seabed area (the Area) for the benefit of humankind as a whole. At the core of its mandate is to take the measures necessary to ensure effective protection of the marine environment from potentially harmful effects that may arise from seabed activities. In addition, ISA is mandated to promote and encourage marine scientific research in the Area and coordinate and disseminate the results of such research and analysis when available. The importance of this obligation is highlighted by the Strategic Plan of ISA for the period 2019-2023 (ISBA/24/A/10), particularly strategic direction 4 (“Promote and encourage marine scientific research in the Area”), which is being implemented through the High-level Action Plan for 2019-2023 (ISBA/25/A/15). To support the fulfilment of these mandates and the United Nations Decade of Ocean Science, the ISA Assembly adopted 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) in 2020.

2. In line with this strategic framework, the ISA Secretariat, in collaboration with various scientific organizations, developed the Sustainable Seabed Knowledge Initiative (SSKI) as a flagship initiative to advance the implementation of the Action Plan for the United Nations Decade of Ocean Science. Launched at the second United Nations Ocean Conference in June 2022, SSKI aims to strengthen cooperation among various stakeholders to generate, assess and disseminate deep-sea biodiversity data and information in the Area. SSKI will also implement activities at both regional and global levels to build the scientific capacity of experts and scientific institutions, especially in developing States, on biodiversity assessment and ecosystem monitoring in the Area. Furthermore, the SSKI aims to enhance the uptake of deep-sea science in global ocean policy by facilitating the integration of robust scientific data and information into decision-making processes in collaboration with relevant international organizations.¹

3. In this context, the ISA Secretariat, in collaboration with the National Marine Biodiversity Institute of Korea (MABIK) and with financial support from the European Commission (EC), convened an inception workshop from 29 November to 1 December 2022 at MABIK in Seocheon, the Republic of Korea. The workshop was conducted in two separate sessions: 1) a technical session from 29-30 November 2022 and 2) an in-person/online hybrid public session on 1 December 2022.

4. The main objectives of the workshop were: (i) to develop a comprehensive implementation and monitoring plan for SSKI on advancing deep-sea species identification and description, as well as developing innovative tools for deep-sea biodiversity assessments in the Area, (ii) to identify key partners and opportunities for further resource mobilization and collaboration and (iii) to discuss practical means and ways of enhancing the role of SSKI in strengthening the scientific basis for effective ocean governance.

5. The technical session aimed to establish a practical approach to implement SSKI activities, including modalities, timeline and monitoring of outputs, to develop strategies to ensure effective stakeholder engagement and mobilize partners and resources, and to identify potential opportunities and partners to enhance SSKI’s contribution to the science-policy interface for sustainable ocean governance. The hybrid session focused on presenting the results of the technical session, presenting

¹ ISA. Sustainable Seabed Knowledge Initiative. Available at: <https://www.isa.org.jm/sski>.

the advanced copy of the SSKI implementation and monitoring plan and exploring potential ways and means to enhance collaboration among members and stakeholders of ISA, including the scientific community, contractors and decision makers, for effective implementation of SSKI.

6. The workshop outcomes allowed the ISA Secretariat to identify ways and means for a successful implementation of SSKI activities. This included a network of relevant institutions and experts to expand research efforts on deep-sea biodiversity assessments and actively engage various stakeholders. The workshop also allowed to identify opportunities for resource mobilization for deep-sea biodiversity research to ensure effective contribution to various global agendas and strategies on marine scientific research, especially the ISA Action Plan for the United Nations Ocean Decade and other global processes for sustainable ocean governance.

7. Part I of the workshop (technical session) was attended by 26 invited experts. A total of 52 participants attended Part II of the workshop (hybrid in-person/online session). The full list of workshop participants is provided in Annex I of this report.

8. The ISA Secretariat issued an information note for participants containing logistical details to facilitate their participation, including information on how to join the online workshop and navigate different functions of the online meeting platform. The workshop was conducted in English.

9. The workshop commenced at 9:00 UTC (Seocheon, Republic of Korea; GMT+9) on Tuesday, 29 November 2022.

Part I: Technical session meeting for invited experts and SSKI partners

10. Part I was conducted on 29 and 30 November 2022. The ISA Secretariat moderated the workshop.

Item 1. Opening of the workshop

11. The ISA Secretary-General, H.E. Mr. Michael Lodge, delivered his opening remarks. He first expressed his appreciation to the Government of Korea for welcoming the ISA delegation and for supporting the work of ISA in many of the scientific and technical initiatives of the Secretariat. He mentioned that a letter to continue the cooperation between the ISA and the Ministry of Oceans and Fisheries had been signed, an important agreement to continue advancing scientific knowledge of deep-sea ecosystems and biodiversity in the Area. He also expressed his gratitude to the European Union (EU) for the financial support of SSKI. Mr. Lodge highlighted that the energy transition creates a demand for critical minerals regarding availability and location. Minerals are increasingly a part of this overall picture. Poor practices, whether on land or at sea, damage the environment and human health. He stressed that deep-sea exploration has been taking place since the 1970s under the framework of the international law of the sea. Although much of the underlying interest in marine mineral resource potential is a response to a societal need, these exploration activities have also contributed to remarkable gains in our collective knowledge of the deep-sea environment and biodiversity. He highlighted the role of ISA in setting parameters for the conduct of exploration work through regulations and that ISA's regulatory system has prioritized collecting environmental data. He emphasized that the outputs of ISA's workshop series on deep-sea taxonomic standardization have been translated into improved standardization and quality of data in DeepData and enhanced connections with other existing biodiversity databases, such as Ocean Biodiversity Information System (OBIS). He then highlighted that SSKI poses the challenge of increasing the number of described deep-sea species by at least one thousand by 2030 and noted that improved species knowledge and classification are critical to generating data and information on marine biodiversity. As indicated in the SSKI proposal, better tools and data quality will help strengthen the scientific basis for programmes to monitor impacts on the marine environment and management measures adopted under regional environmental management plans (REMPs). He stressed that the core purpose of SSKI is to promote a strong and inclusive network of scientists who can collaborate through a global knowledge-sharing platform. This will facilitate an interdisciplinary nexus between governments, scientific communities, international organizations and relevant industries to co-generate data and co-create information on deep-sea biodiversity, facilitate access to these data and use them to ensure an effective policy-science interface. He concluded his speech by stating that collective work can lead to integrating and innovating taxonomic tools, including enhanced reference libraries of images and DNA sequences, to facilitate species identifications and build a new generation of deep-sea taxonomists.

12. Mr. Myeong-dal Song, Deputy Minister for Marine Policy Office of the Ministry of Ocean and Fisheries (MOF), Republic of Korea, delivered his opening remarks. He first expressed his gratitude to H.E. Mr. Michael Lodge, the ISA Secretariat and Dr. Choi Wan-hyun and MABIK for co-hosting the SSKI inception workshop to build a cooperative platform to enhance understanding of the deep-sea ecosystem. He thanked Fredrik Ekfeldt, Minister Counsellor and the Deputy Head of the EU Mission in the Republic of Korea, for joining the opening ceremony. He also expressed his appreciation to all speakers and participants attending this workshop. Mr. Song then highlighted the importance of deep-sea habitats and emphasized that international cooperation is essential to share deep-sea knowledge and information. He then noted that MOF has been sponsoring deep-sea taxonomy workshops jointly organized by MABIK and ISA since 2020. He also mentioned that a letter of cooperation between MOF

and ISA had been signed in the previous week, pledging to work together to advance scientific knowledge on deep-sea ecosystems and promote sharing of deep-sea knowledge and information, including deep-sea taxonomy. He highlighted that the SSKI inception workshop would serve as a stepping stone to strengthening cooperation among deep-sea research institutions and experts worldwide. Mr. Song then noted MOF's efforts to systematically discover marine bio-resources in the deep sea and high seas and the plans to collect species of useful bio-resources with industrial potential and promote industrial utilization. He also mentioned the Biodiversity Beyond National Jurisdiction treaty, which was under discussion, for the protection and use of the marine ecosystem in a balanced way. He stressed that MOF would spare no effort to build a foundation for the conservation of biodiversity on the high seas and its sustainable use through the Biodiversity Beyond National Jurisdiction treaty. He hoped the workshop would be a meaningful opportunity to build a global network through valuable discussions to enhance knowledge of deep-sea ecosystems and strengthen research capabilities. He concluded his remarks by reiterating his appreciation to everyone attending the event.

13. Mr. Fredrik Ekfeldt, Minister Counsellor and the Deputy Head of the EU Mission in the Republic of Korea, delivered his opening remarks. On behalf of the EC, he expressed his gratitude to be part of the SSKI, which will provide a very important contribution to the knowledge of deep-sea biodiversity and ecosystems. He highlighted that the workshop was an important step to dive into the key questions of biodiversity assessment, taxonomy and the necessary tools to enhance public knowledge of the deep sea. He mentioned the European Green Deal, an integral part of the EC's strategy to implement the United Nation's 2030 Agenda and the sustainable development goals. Mr. Ekfeldt noted that the EU had adopted the 2030 Biodiversity to halt biodiversity loss. This is a comprehensive, ambitious, long-term plan to protect nature and reverse the degradation of ecosystems. He stressed that, in line with the precautionary principle, more research and knowledge are needed on the risks and effects of deep-sea mining on the marine environment, biodiversity and human activities. He then highlighted that the EU calls for advanced knowledge, better technologies, and operational practices to demonstrate no harmful effects on the environment before marine minerals in the Area can be exploited. He mentioned the latest developments at ISA on the draft regulations for the exploitation of marine minerals in the Area, which led the EC to confirm the position of the Biodiversity Strategy and strengthen it in its updated international ocean governance agenda adopted in June 2022. In this agenda, the EU advocates for prohibiting deep-sea mining until scientific gaps are properly filled until it can be demonstrated that no harmful effects arise from mining and the necessary provisions in the exploitation regulations for the effective protection of the marine environment are in place, as required under UNCLOS. The EU is also committed to finalizing an ambitious implementing agreement under UNCLOS on the conservation and sustainable use of marine biological diversity in areas beyond national jurisdiction. He then stressed that improving knowledge of seabed ecosystems in the Area is paramount for the successful implementation of EU political priorities as it is the necessary step to establish a solid baseline for protecting these ecosystems. ISA has an important role as a global repository of data and information relating to the Area and the marine environment and its resources. He noted that EC had funded several projects aimed at identifying and mitigating the impacts of deep-seabed mining on the marine environment and also has good cooperation with ISA, notably through the EU-sponsored project on the Atlantic REMP, which produced the solid scientific foundation for the development of a REMP for the Area in the northern Mid-Atlantic Ridge. He then highlighted that SSKI seeks to fill the gaps in knowledge of seabed ecosystems, their connectivity and the interrelation between endemism of species and conglomeration of seabed minerals, an effort fully in line with the EU science-based approach to environmental protection, with the precautionary principle and with the EU policy framework. He concluded his opening remarks by stating that SSKI is a timely and necessary

initiative and that the EC is a proud contributor to its first phase. He wished all participants a very good and fruitful workshop.

14. Dr. Wan-hyun Choi, the President of MABIK, delivered his opening remarks. On behalf of MABIK, he welcomed the participants to the workshop. He thanked H.E. Mr. Michael Lodge for their continued collaboration on advancing marine scientific research in the Area. He extended his appreciation to Mr. Myeong-dal Song for MOF's continuous support towards the work of MABIK and to Mr. Fredrik Ekfeldt for supporting the workshop. Dr. Choi highlighted that science and technology are shedding light on the mystery of deep-sea species, and taxonomy allows us to take the first step. He mentioned MABIK's mission to cultivate knowledge of marine bio-resources, collect and preserve their specimens, and promote ocean literacy. MABIK hosts over 11,000 marine species and 570,000 specimens in the Marine Bio-Resource Information System. He expressed his wishes to further collaborate with ISA to increase their capacity to collect and preserve deep-sea specimens for an advanced understanding of deep-sea biodiversity. He then noted the importance of effective collaboration across disciplines to increase public knowledge of deep-sea biodiversity successfully. He stressed that MABIK is pleased to join ISA's SSKI as a key partner and host the inception workshop. He mentioned he is confident that the collaborative framework established under SSKI, including the global science-industry partnerships, will bring forth transformative change in our understanding of deep-sea biodiversity. He then noted MABIK's plans to expand their collaboration with ISA into a multi-year partnership. He ended his opening remarks by reiterating his gratitude to all workshop participants and wishing for a fruitful discussion.

Item 2. Biodiversity assessment and monitoring in the context of ISA

15. Under this item, Tomohiko Fukushima (JOGMEC, Japan and a new member of the Legal and Technical Commission (LTC), effective as of January 2023) delivered a theme presentation on "Evaluation of Species Diversity in Environmental Conservation Measures."

16. Summary of the above presentation is provided in annex II to this report.

17. Participants were invited to ask questions and exchange insights and views in response to the presentation above.

Item 3. SSKI: implementation plan (V.0)

18. Under this item, Luciana Genio (ISA Secretariat) introduced the SSKI and its draft implementation plan (v.0).

19. Summary of the above presentation is provided in annex II to this report.

20. Participants were invited to ask questions and exchange insights and views in response to the presentation above.

Item 4. New knowledge of deep-sea biodiversity in the area

21. Under this item, selected experts were invited to deliver presentations on two different themes to identify needs and appropriate approaches for advancing knowledge on deep-sea biodiversity in the Area:

- Theme 1: Review of taxonomic data contained in DeepData and other publicly available sources
 - Muriel Rabone (Natural History Museum London, UK) and
 - Ruiyan Zhang (ISA Secretariat).
 - Theme 2: Access to taxonomic expertise
 - Tammy Horton (National Oceanography Centre, UK).
22. Summaries of the above presentations are provided in Annex II of this report.
23. Participants were invited to ask questions and exchange insights and views in response to the ideas, examples and experiences presented by the panellists.
24. This was followed by a group discussion with the following guiding questions:
- What activities could contribute to SSKI's expected outputs introduced in agenda item 3 on generating new knowledge?
 - How feasible are these activities? What are the potential risks associated with the activities in achieving the outputs?
 - How can these activities scale up existing initiatives or replicate the efforts in different areas?
 - Who are the potential partners?
 - What is the estimated budget for the activity?
25. The following points, inter alia, were highlighted during the discussion:
- *Enhancing deep-sea species identification.* Participants stressed the importance of increasing the number of experts in taxonomy, which could be promoted by training workshops, mentoring programmes and exchange visits. They highlighted that the taxonomy work requires intensive training to achieve the minimum required skills. Workshops could be undertaken in museums or other facilities holding biocollections. The workshops would be focused on specific groups of organisms or geographic areas. This existing format is known to lead to numerous publications. Taxonomists could also be accompanied by students, resulting in capacity-building. The ISA could provide financial support for travel and work expenses.
 - *Capacity building.* The importance of workshops on data analysis was also pointed out. This could provide skills for people to analyse their data and access public data. Such workshops could be provided by existing initiatives, such as the European Marine Biological Resource Centre.
 - *Tools.* The use of machine learning in taxonomy to assist species identification was proposed. This could facilitate the use of the available information. Machine learning could assist taxonomists in identifying specimens already described. However, for new species description, high taxonomic expertise is required. Participants also stressed the importance of species checklists and the integration of different lists to eliminate duplicates in the databases. ISA Secretariat noted that OBIS is already doing this integration.
 - *Data sharing.* Participants noted the challenges in communication among projects and institutions, leading to delays in species identification.
 - *Centralized registry.* Participants suggested the creation of a registry of expertise and biocollections, connecting facilities, samples and experts. This could lead to increased

species identification. ISA could centralize the registry.. In addition, available resources from other sources could fit into this framework.

- *Raising awareness on the importance of taxonomy.* Participants shared concerns about convincing funding agencies and decision makers to invest more in taxonomy. Taxonomy is the bottleneck in increasing knowledge of deep-sea biodiversity, which should be communicated to broader audiences. Participants stressed that it also underpins economic activities. In addition to taxonomic information, ecological and trait information could be valuable for ecosystem functioning assessments and raising awareness on this topic.

Item 5. Innovative tools for advancing taxonomic identification

26. Under this item, a panel discussion was organized with the following experts, who delivered brief presentations on potential activities to be implemented under SSKI to develop integrative taxonomic tools for species identifications:

- Leen Vandepitte, World Register of Marine Species (WoRMS)
- Daniela Zeppilli, L'Institut français de recherche pour l'exploitation de la mer (Ifremer), France
- Hiromi Watanabe, Japan Agency for Marine-Earth Science Technology (JAMSTEC), Japan
- Kerry Howell, University of Plymouth, United Kingdom.

27. Summaries of the above presentations are provided in Annex II of this report.

28. Participants were invited to ask questions and exchange insights and views in response to the ideas, examples and experiences presented by the panellists.

29. This was followed by a group discussion with the following guiding questions:

- What activities could contribute to SSKI's expected outputs introduced in agenda item 3 on developing integrative tools?
- How feasible are these activities? What are the potential risks associated with the activities in achieving the outputs?
- How can these activities scale up existing initiatives or replicate the efforts in different areas?
- Who are the potential partners?
- What is the estimated budget for the activity?

30. The following points, inter alia, were highlighted during the discussion:

- *Tools.* Participants highlighted the importance of collaboration with existing initiatives to facilitate the development of tools (e.g., the collaboration with WoRMS to create a species checklist for Clarion-Clipperton Zone (CCZ) and other regions. In addition, the importance of collaboration with BOLD for DNA libraries was noted.
- *Capacity building.* Participants discussed the Contractors Training Programme could be used for expanded training. The need for training in data management was noted, which could be undertaken either in person or online.
- *Data quality.* Participants highlighted the importance of a data quality control team. Needs for capacity development in this area were also identified, which could be

addressed with existing courses available. Participants mentioned the Darwin Core for minimum standards.

- *Functional traits.* In addition to taxonomy, functional trait information could be of great value to facilitate species identification and to understand their role in ecosystems. Genetic information to identify microbial functional traits is already widely used.

31. After the group discussion, the ISA Secretariat summarized the main points highlighted during the discussion, including proposed new activities and potential new partnerships for advancing biodiversity knowledge in the Area and developing integrative tools for species identification and description to be considered in the draft of the SSKI implementation plan (v.1).

Item 6. Deep-sea data sharing, capacity development and uptake of science

32. Under this agenda item, participants were invited to continue the discussion initiated in Items 4 and 5 with the guiding questions:

- What activities could contribute to SSKI's expected outputs introduced in agenda item 3 on data sharing, capacity development and uptake of science?
- How feasible are these activities? What are the potential risks associated with the activities in achieving the outputs?
- How can these activities scale up existing initiatives or replicate the efforts in different areas?
- Who are the potential partners?
- What is the estimated budget for the activity?

33. During this session, participants were divided into groups and asked to propose activities for SSKI, answering these questions above.

34. After the group discussion session, representatives of the groups presented their proposals for activities to all participants.

35. Participants were invited to ask questions and exchange insights and views in response to the presentation of each group.

36. The activities were compiled into five components by the ISA Secretariat. The summary of the activities is provided in Annex III of this report.

37. The ISA Secretariat summarized the main points highlighted during the discussion, including proposed new activities and potential new partnerships for data sharing, capacity development and science uptake to be considered for the draft of the SSKI implementation plan (v.1).

38. The activities proposed by the participants assisted the ISA Secretariat in drafting the SSKI implementation plan, including expected outputs with a target timeline, success criteria and indicators to measure progress and success, and identification of key partners for implementing activities and further mobilization of resources.

Item 7. Summary, next steps and conclusion

39. The ISA Secretariat provided a summary of the workshop results, including the draft of the SSKI implementation plan considering the activities proposed in under items 4 to 6 and summarized in Annex III.

40. Participants were invited to consider the workshop results and provide comments and suggestions.

Item 8. Closure of the workshop – part I

41. The workshop closed at 17:00 on Wednesday, 30 November 2022.

Part II: Hybrid public session for registered participants, invited experts and SSKI partners

42. The workshop commenced at 14:00 (Republic of Korea; GMT+9) on Thursday, 1 December 2022.
43. The ISA Secretariat moderated the workshop.

Item 1. Opening of the workshop

44. Mr. José Dallo Moros, the Director of the ISA Office of Environmental Management and Mineral Resources (OEMMR), delivered his opening remarks. Mr. Moros welcomed the participants and expressed his appreciation to MABIK for supporting SSKI and the EU for their financial support. He first stressed two complementary strategic outcomes of the technical session of the workshop: to contribute to advancing scientific knowledge of the deep-sea ecosystems and to ensure that all countries, including less technologically advanced ones, can participate effectively and build their scientific expertise. He noted that deep-sea exploration has increased public knowledge of the deep-sea environment and biodiversity. He stressed that ISA had organized workshops on deep-sea taxonomy standardization, helping to improve the standardization and quality of the information in DeepData and enhancing the connection with existing biodiversity databases. Currently, DeepData has about 60,000 records of species occurrences. The SSKI aims to increase the number of described deep-sea species by at least one thousand by 2030. Mr. Moros highlighted that better tools could help strengthen the scientific basis for monitoring impacts on the marine environment and adopting management measures. He emphasized that ISA aims to create a strong and inclusive network of scientists to collaborate and increase public knowledge on deep-sea biodiversity, innovate taxonomy tools to facilitate species identification and build a new generation of deep-sea taxonomists. Mr. Moros concluded his opening remarks by calling for the support of participants to continue working together to help deliver these objectives.

45. Dr. Yong Rock An, Chief Manager of the MABIK, delivered his opening statements. On behalf of MABIK, he welcomed the participants to the SSKI inception workshop. He expressed his gratitude to H.E. Mr. Michael Lodge for the continuous collaboration in advancing marine scientific research in the Area. He also expressed his gratitude to the MOF for the continuous support of the work of MABIK. He stressed that taxonomy allows us to take the first step to understanding the biodiversity of the deep sea. He mentioned that MABIK was created in response to the need to cultivate the knowledge of marine bioresources collections and the preservation of their specimens and to promote ocean literacy. He expressed his wishes to continue collaborating with the ISA to increase the capacity to collect and preserve deep-sea specimens for an advanced understanding of deep-sea biodiversity. He then stressed that effective collaboration across disciplines is needed to increase public knowledge of deep-sea biodiversity. He emphasized that MABIK is pleased to join SSKI as a key partner and host the inception workshop. He expressed his confidence that the collaborative work established under SSKI will lead to transformative changes in public understanding of deep-sea biodiversity. He mentioned that the collaboration between ISA and MABIK had been renewed to continue promoting deep-sea research. He concluded his opening remarks by reiterating his wishes for a fruitful discussion.

Item 2. SSKI: implementation plan (v.1.0)

46. Under this item, Luciana Genio (ISA Secretariat) provided a presentation on the SSKI implementation plan (v.1.0).

47. Summary of the above presentation is provided in Annex II of this report.

48. Participants were invited to ask questions and exchange insights and views in response to the presentation.

Item 3. Strengthening collaboration to support further development of deep-sea taxonomic knowledge platform and necessary long-term capacity development within the context of ISA

49. Under this item, a panel discussion was organized with the following experts, who delivered brief presentation “Strengthening collaboration to support further development of deep-sea taxonomic knowledge platform and necessary long-term capacity development within the context of ISA.”

- Kamila Mianowicz, Interoceanmetal Joint Organization (IOM), Poland,
- Tan Koh Siang, Lee Kong Chian Natural History Museum, Singapore,
- Sadie Mills, National Institute of Water and Atmospheric Research Ltd. (NIWA), New Zealand,
- Xiang Gao, ISA-China Joint Training and Research Centre (JTRC), China.
- Melyne Tarer, Indian Ocean Rim Association (IORA).

50. Summaries of the above presentations are provided in Annex II of this report.

51. Participants were invited to ask questions and exchange insights and views in response to the ideas, examples and experiences presented by the panellists.

52. This was followed by a short Q&A session. The following points, inter alia, were highlighted during the discussion:

- Participants were interested in learning about existing resources available for training across various institutions and initiatives.
- Technical aspects regarding taxonomic resolution, and sampling technologies over wide ranging ocean depths were discussed.
- Capacity training could be offered through the ISA-IORA partnership.
- It was noted the large amount of new the data collected by ISA exploration contractors would be shared with the scientific community through ISA DeepData database to identify the specimens more accurately.
- The importance of collaboration and standardization of data among contractors was noted.

Item 4. Summary and conclusion

53. The ISA Secretariat provided a summary of the workshop results, including the perspectives for the draft of the SSKI implementation plan.

54. Dr. Luciana Genio, ISA OEMMR Environmental Coordinator, noted that the importance of taxonomy was highlighted during the workshop. She then stressed that an important question of how to value the taxonomy work and communicate it to Member States and decision makers better to obtain support remains open. She also reiterated that there is a challenge in accessing samples and that some solutions were discussed during the workshop.

55. Mr. José Dallo Moros, ISA OEMMR Director, expressed his appreciation to all workshop participants, both in-person and online, to MABIK and the organizing committee. He ended by highlighting that the goal of SSKI is to bring stakeholders together for better decisions.

Item 5. Closure of the workshop – part II

56. The workshop closed at 17:30 (Republic of Korea; GMT+9) on Thursday, 1 December 2022.

Annex I: List of participants

Part I: In-person technical meeting

1. Ms. Alana Hazel Candice Jute
Institute of Marine Affairs
Trinidad and Tobago
Email: alana.jute@gmail.com
2. Ms. Claudia Akemi Pereira Namiki
Researcher
Instituto Oceanográfico, Universidade de São Paulo
São Paulo, Brazil
Email: claunamiki@gmail.com
3. Ms. Daniela Zeppilli
Head of the Deep Sea Laboratory
Ifremer
Plouzané, France
Email: daniela.zeppilli@ifremer.fr
4. Mr. Eulogio Hernan Soto
Professor
Universidad de Valparaíso
Valparaíso, Chile
Email: eulogio.soto@uv.cl
5. Ms. Eun-Bi Kim
Researcher
Korea Institute of Ocean Science and Technology
Busan, Republic of Korea
Email: kimeb@kiost.ac.kr
6. Mr. Franck Lejzerowicz
Researcher
University of Oslo
Oslo, Norway
Email: f.l.p.lejzerowicz@ibv.uio.no
7. Ms. Hiromi Watanabe
Researcher
JAMSTEC
Yokosuka, Japan
Email: hwatanabe@jamstec.go.jp
8. Ms. Hye-Won Moon
Researcher
MABIK
Seocheon, Republic of Korea
Email: hwmooon@mabik.re.kr
9. Ms. Inkyeong Moon
Researcher

- Korea Institute of Ocean Science and Technology
Busan, Republic of Korea
Email: moonik@kiost.ac.kr
10. Ms. Kamila Mianowicz
Scientist, Senior Specialist
IOM
Poland
Email: k.mianowicz@iom.gov.pl
11. Ms. Kerry Howell
Professor
Plymouth University
Plymouth, United Kingdom
Email: kerry.howell@plymouth.ac.uk
12. Ms. Leen Vandepitte
Data manager
World Register of Marine Species
Belgium
Email: leen.vandepitte@vliz.be
13. Ms. Magdalini Christodoulou
Researcher
Senckenberg am Meer; Biologiezentrum, OO Landes Kultur
Germany
Email: magdalini.christodoulou@senckenberg.de
14. Ms. Maiango Teimarane
Ministry of Fisheries and Marine Resources Development
Kiribati
Email: maiangot@mfmrd.gov.ki
15. Ms. Maria Eugenia Goya
Ministerio de Relaciones Exteriores, Comercio Internacional y Culto
Argentina
Email: geh@mrecic.gov.ar
16. Ms. Matereti Buren
Ministry of Fisheries and Marine Resources Development
Kiribati
Email: materetib@fisheries.gov.ki
17. Ms. Melyne Tarer
Geopolitical Analyst x Blue economy expert
IORA
Paris, France
Email: melyne.tarer@iora.int
18. Ms. Muriel Rabone
Data and Sample Coordinator
Natural History Museum London
London, United Kingdom
Email: M.Rabone@nhm.ac.uk

19. Mr. Nicolas Pade
Executive Director
European Research Infrastructure EMBRC-ERIC
Paris, France
Email: nicolas.pade@embrc.eu
20. Ms. Tammy Horton
Researcher
World Register of Marine Species
Southampton, United Kingdom
Email: tammy.horton@noc.ac.uk
21. Mr. Tan Koh Siang
Researcher
National University of Singapore
Singapore
Email: tmstanks@nus.edu.sg
22. Mr. Tomohiko Fukushima
Researcher
JOGMEC
Japan
Email: fukushima-tomohiko@jogmec.go.jp
23. Ms. Tremaine Bowman
University of the West Indies
Trinidad and Tobago
Email: tremaine.bowman25@gmail.com
24. Ms. Valerie Allain
Researcher
South Pacific Community
Nouméa, New Caledonia
Email: valeriea@spc.int
25. Ms. Vivian Helena Pellizari
Professor
Instituto Oceanográfico, Universidade de São Paulo (USP)
São Paulo, Brazil
Email: vivianp@usp.br
26. Ms. Yeon Jee Suh
Researcher
Korea Institute of Ocean Science and Technology
Busan, Republic of Korea
Email: yjsuh@kiost.ac.kr

Part II: In-person/ online hybrid session

27. Mr. Abdirahman Hassan Mohamed
Somali Marine Resources Research Organization
Somalia
Email: inahassan2006@gmail.com

28. Ms. Aghogho Kolawole-Daniels
Researcher
Nigerian Institute for Oceanography and Marine Research
Lagos State, Nigeria
Email: christghogho@gmail.com
29. Ms. Amber Cobley
Senior Policy Adviser
Department for Environment, Food and Rural Affairs
Southampton, United Kingdom
Email: amber.chandler-cobley@defra.gov.uk
30. Ms. Annemiek Vink
Researcher
Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)
Hannover, Germany
Email: annemiek.vink@bgr.de
31. Mr. Auguste Kikouagni
Ministry of Mines, Industry and Technological Development
Cameroon
Email: kikouagni4@yahoo.com
32. Ms. Chisato Murakami
Deep Ocean Resources Development Co., Ltd.
Japan
Email: chisato@dord.co.jp
33. Mr. Christopher Williams
Managing Director
UK Seabed Resources Ltd
London, United Kingdom
Email: christopher.j2.williams@lmco.com
34. Mr. Dan Zhang
China Ocean Mineral Resources R&D Association
China
Email: zhangdan@cimamnr.org.cn
35. Ms. Ellen Pape
Researcher
University of Ghent
Ghent, Belgium
Email: ellen.pape@ugent.be
36. Ms. Elodie Vourey
Researcher
South Pacific Community
Nouméa, New Caledonia
Email: elodiev@spc.int
37. Mr. Georgios Kazanidis
Offshore Industries Advice Manager
Joint Nature Conservation Committee
Edinburgh, United Kingdom

Email: Georgios.Kazanidis@jncc.gov.uk

38. Mr. Jianxin Xia
Beijing Pioneer
China
Email: jxxia@vip.sina.com
39. Ms. Leigh Marsh
Researcher
NORI
United Kingdom
Email: leigh@metals.co
40. Ms. Lin Zhu
Beijing Pioneer
Beijing, China
Email: isclaritas@sina.com
41. Mr. Sabyasachi Sautya
Scientist
Ministry of Earth Sciences
India
Email: sautya@nio.org
42. Ms. Samantha Smith
Environmental management specialist
Global Sea Mineral Resources NV
Toronto, Canada
Email: samantha@blueglobesolutions.com
43. Mr. Sandip Kumar Mukhopadhyay
Scientist
Ministry of Earth Sciences
West Bengal, India
Email: sandip.m@gov.in
44. Ms. Stefanie Kaiser
Researcher
Senckenberg Research Institute
Frankfurt, Germany
Email: stefanie.kaiser@senckenberg.de
45. Ms. Victoria Sadie Mills
Collection Manager
NIWA
Auckland, New Zealand
Email: sadie.mills@niwa.co.nz
46. Mr. Xiang Gao
ISA-China Joint Training Research Centre
China
Email: gaox@ndsc.org.cn
47. Mr. Xue-Wei Xu
Professor

Second Institute of Oceanography, Ministry of Natural Resources of China
Hangzhou, China
Email: xuxw@sio.org.cn

ISA Secretariat – organizing committee

48. Mr. Changsung Lim
Associate Programme Management Officer
OEMMR, ISA
Canada/ Jamaica
Email: clim@isa.org.jm
49. Ms. Fabiana Paula
Project Assistant (Marine Scientific Research), Consultant
OEMMR, ISA
Brazil
Email: fabianaspaula@gmail.com
50. Mr. José Dallo Moros
Director
OEMMR, ISA
Spain/ Jamaica
Email: jdallo@isa.org.jm
51. Ms. Luciana Genio
Environmental Coordinator
OEMMR, ISA
Portugal / Jamaica
Email: lgenio@isa.org.jm
52. Ms. Ruiyan Zhang
ISA Intern/ PhD candidate
OEMMR, ISA / Shanghai Jiao Tong University
China
Email: rzhang@isa.org.jm

Annex II: Summary of theme presentations

Part I: In-person technical meeting

- *Presentation delivered under agenda item 2*

Evaluation of Species Diversity in Environmental Conservation Measures

Tomohiko Fukushima, JOGMEC, Japan, an LTC member

Although there are differences in degree, developing deep-sea mineral resources cannot avoid impacts on the seabed ecosystem. Therefore, appropriate ecosystem assessment and conservation measures based on diverse information and accurate scientific knowledge are required. In practice, however, there is a communication gap between rule-makers, such as LTC and Council members, and rule-followers, such as contractors and field researchers. For example, even if the rules call for an accurate list of species names, a person in charge of identification cannot do so accurately if taxonomic progress is insufficient. Also, if the rules require long-term monitoring on the premise that the ecosystem will recover to its original state, even if the biomass controlled by the carrying capacity can correspond, species diversity and dominant species, influenced by chance, do not always return to their original state. Given those facts, Mr. Fukushima introduced the monitoring survey results undertaken 25 years after the benthic impact experiment conducted at the CCZ in 1994 and discussed the issues and countermeasures regarding managing the deep-sea ecosystem. Regarding knowledge gaps in taxonomic classification/identification, it is important to repeat knowledge dissemination activities aimed at mutual understanding. On the other hand, in managing species-level, such as species diversity and dominant species, it is also important to consider alternative measures, such as area-based management tools, while considering ecological knowledge. In any case, sharing information between sectors and using a combination of cross-disciplinary knowledge is important. In that sense, this workshop can be said to be an important attempt.

- *Presentation delivered under agenda item 3*

SSKI: Implementation plan (V.0)

Luciana Genio, ISA Secretariat

ISA is responsible for adopting appropriate rules, regulations and procedures to manage exploratory activities in the Area effectively. This includes guidelines for baseline studies, monitoring programmes and assessing impacts that may arise from activities and REMPs. Standardizing methodologies for deep-sea biodiversity assessment in the Area is one of the six strategic research priorities emphasized in the ISA Action Plan for marine scientific research in support of the United Nations Decade of Ocean Science. One of the objectives of ISA is to contribute to the achievement of relevant goals and targets of the 2030 agenda for sustainable development, as well as other international environmental targets. In this context, the SSKI aims to enable the ISA to strengthen cooperation with all interested stakeholders to obtain, assess and disseminate quantitative and qualitative data and information openly and transparently to ensure effective protection of the marine environment. SSKI focuses on advancing the knowledge of deep-sea ecosystems and biodiversity to create conditions for effectively fulfilling ISA's environmental mandate in accordance with agreed international goals and objectives. The five

components of SSKI aim to: (i) increase knowledge of deep-sea ecosystems, including an understanding of their evolutionary history, connectivity and resilience to environmental change, (ii) improve consistency, efficiency and reusability of scientific data and information for biodiversity assessments through integrative tools, (iii) increase generation and flow of taxonomic data and information, including the enhanced data availability, accessibility and interoperability, (iv) increase global scientific capacity in deep-sea biodiversity assessments and (v) inform ISA decision-making process and other relevant global policy agendas by improved deep-sea biodiversity knowledge. SSKI's framework will promote several activities in collaboration with key partners to deliver outputs in these five components. Participants of the technical session of the workshop were invited to contribute with discussions and suggestions to identify effective activities that could contribute to reaching SSKI's targets.

- *Presentations delivered under agenda item 4*

Theme 1. Review of taxonomic data contained in DeepData and other publicly available sources

Review of taxonomic data contained in DeepData and other publicly available sources: a CCZ case study

Muriel Rabone, Natural History Museum London, UK

The CCZ has been under mineral exploration since the 1970s. However, an increase in publications was observed only recently. Biodiversity inventories are critical for environmental protection. Therefore, full-scale assessments are required. The scope of the study was to perform a synthesis of CCZ benthic metazoan biodiversity from all published sources and to review the biological data holdings of DeepData and its utility for research. The data was collected from the different databases in July 2021, and a systematic review was undertaken, yielding over 100,000 records. Based on the georeferenced records, it was possible to observe more records on the eastern and central CCZ. Misidentifications and unnamed species were observed in the records. For the CCZ, 182 new species and 31 new genera were recorded. Regarding the review of the DeepData, taxonomic data quality issues were identified in addition to duplications and limitations with using identifiers. This resulted in mismatches of data between DeepData and OBIS-ISA node. However, a major increase in data availability was observed. Moreover, by mapping data to Darwin Core for publication of biological data on OBIS-ISA, important steps towards findable, accessible, interoperable and reusable (FAIR) data will be accomplished. In conclusion, there has been a remarkable increase in taxonomic knowledge of the CCZ, particularly over the past five years. The new CCZ checklist can be iteratively updated and integrated into WoRMS and the World Register of Deep-Sea Species (WoRDSS), allowing for progressive improvements.

Review of taxonomic data contained in ISA DeepData database

Ruiyan Zhang, ISA Secretariat

The launch of the DeepData database in 2019 allows the deep-seabed-related data collected by Contractors and related parties in the Area to become FAIR. DeepData is in an early stage of development. It is important to review and improve it constantly to provide a better service to the public. In this study, we reviewed all the biological data contained in the DeepData database in the Indian Ocean polymetallic sulphides and polymetallic nodules, the Northwest Pacific Ocean cobalt-rich ferromanganese crusts and the Mid-Atlantic Ridge polymetallic sulphides areas. A total number of

16,744 records were retrieved, including benthic fauna, pelagic and air-breathing taxa. Around 45 per cent of the records are identified as species, and 1,318 species are known from the three regions. The review of DeepData records allows a glimpse of the taxonomic information available in the area. It also reveals the potential gaps and needs to be addressed under SSKI, such as the necessity to identify historical specimens. A recommendation for future improvement of the DeepData was also proposed, including improvement in the submission template and web interface instructions, regular training workshops to link the data providers, data managers and users and implement interactive modules with other databases, such as OBIS and WoRMS.

Theme 2. Access to taxonomic expertise

WoRMS-ISA Collaboration & Access to Taxonomic Expertise

Tammy Horton, Ex-Chair of the Steering Committee, WoRMS, Deep-Sea Taxonomist, National Oceanography Centre, Southampton

The WoRMS taxonomic expert editors are the driving force behind the WoRMS, supported by the Data Management Team at Flanders Marine Institute, the VLIZ, in Belgium. The taxonomic editors volunteer their time on WoRMS and are the go-to people with knowledge of their group of responsibility in WoRMS. This access to expertise will be critical to the success of the SSKI programme.

Collaborations between OBIS, WoRMS and ISA have been strengthened and formalized. These collaborations allow feedback between each database to improve all the data held. We have recommended using WoRMS nomenclature as a global standard to provide a robust and standardized taxonomy, provided advice on using WoRMS tools, and discussed the incorporation of Open Nomenclature into the ISA DeepData database.

Our collaborative activities will focus on the deep-sea taxonomic platform WoRDSS, a thematic database of deep-sea species already in WoRMS, marked as occurring at ocean depths greater than 500 metres. It was launched almost 10 years ago and now contains more than 28,000 taxa, over 11 per cent of marine species. We will seek to undertake a periodic scientific review of DeepData and WoRDSS to improve both data sets, flagging those taxa missing in WoRDSS and pointing out any errors in the inclusion of shallow water taxa in DeepData.

We will also develop training activities for providers and users of taxonomic data related to activities in the Area to standardize the data, enhance data exchange and share and raise awareness of deep-sea biodiversity.

By working together and providing access to taxonomic expertise, we can improve data quality and the consistency of data sets. The two-way comparisons between DeepData and WoRDSS will ensure new taxa from the Area are incorporated and that databases are quality-checked and up-to-date. It is well-known that there is a high proportion of new species and uncertain identifications in deep-sea faunal data sets. Current identifications are often only possible at the genus or family level. The use of robust open nomenclature to clarify this information and make data sets more transparent and clearer to users will, in the interim, facilitate the comparison of identifications between data sets and provide notification about these potential new species to taxonomists for future study.

Taxonomist experts may be unaware of the specimens already collected and where or how these can be located and studied. Through the new SSKI programme, there will be opportunities to link interested

scientists with samples to study. Supported by the SSKI programme, this will result in improved taxonomy through new species descriptions. This improved taxonomy will provide us with a greater understanding of the biodiversity and species distributions in the Area and, in turn, will allow for informed management and policy decisions.

- *Presentations delivered under agenda item 5*

Innovative tools for advancing taxonomic identifications: compiling a CCZ checklist

Leen Vandepitte, WoRMS

The WoRMS is an authoritative classification and catalogue of marine names. It is an expert-based taxonomic status, following international standards. WoRMS contains over 500 editors, of which 307 focus on marine organisms. Aphia is the system behind WoRMS compiling different components, including taxonomy, distribution, attributes, specimen data, vernacular names, identification keys, notes, links, images and internal database management. All information is source-based, from published taxonomy and literature. Regarding taxonomy, each name contains a Life Science Identifier, which is unique, persistent/stable and location-independent. Within the Aphia platform, based on the information added, three species databases can be created: global species databases, regional species databases and thematic species databases. The latest comprises the WoRDSS. It is important to note that each piece of information is registered only once, avoiding duplications, but it can appear in different databases. The CCZ checklist will be part of the WoRDSS and, therefore, a regional register within a thematic register. This will be developed as part of the ISA-WoRMS collaboration, which SSKI supports. The work will start by comparing DeepData with WoRDSS. The CCZ taxa will be identified and linked to WoRDSS. Then, the distribution information of CCZ species will be added to Aphia. Finally, the CCZ checklist will be available in the WoRDSS portal. Each distribution added to the checklist will be linked to published literature, and additions and corrections are always possible.

Biodiversity underestimation in our bLUe planEt: artificial intelligence REVOLUTION in benthic taxonomy: the BLUE REVOLUTION project

Daniela Zeppilli, Ifremer, France

Radhakrishnan Ranju, Pierre-Antoine Dessandier and the BLUE REVOLUTION team

Considering the growing anthropogenic pressures on marine ecosystems, we have the scientific and moral obligation to find a way to resolve the problem of biodiversity description. The BLUE REVOLUTION project will develop in situ/onboard/in-the-field methods (holographic microscopy and 3D-fluorescence imaging) linked with classification tools for high throughput analysis using accurate automated taxonomic classification (AI), allowing for quantitative, genetic and functional data of benthic communities being generated at speeds unseen before. BLUE REVOLUTION will produce a standardized method for building open access reference libraries/data repositories of benthic diversity together with fast and reliable tools for rapid and accurate impact assessments and biodiversity surveys. This project will provide the training and education of the next generation of benthic integrated taxonomists/ecologists with skills in species identification coupled with strong hypothesis-based research programmes and the ability to employ cutting-edge techniques. BLUE REVOLUTION developments will be useful in deep-sea ecosystems (owing to the reduction of animal size with

increasing water depth) to monitor a wide range of human impacts, including the exploitation of mineral resources. With the support of ISA and the Government of France, Ranju Radhakrishnan, from India, started an 18-month postdoctoral fellow at Ifremer in the framework of the BLUE REVOLUTION project in September 2022. Dr. Radhakrishnan is developing and testing 3D-imaging techniques for the identification of foraminifera from deep-sea ecosystems found in areas currently explored for mineral resources (both from nodules area and sea floor massive sulphides sediments). In particular, Dr. Radhakrishnan is working on developing fluorescence imaging identification of living benthic foraminifera and testing automatic identification of benthic foraminifera. Her work will feed open access depositories with morphology, functional and genetic species information from ecosystems explored for mineral resources.

Image-based analysis of plankton/meiofauna collections

Hiromi Watanabe, JAMSTEC, Japan

Population connectivity among remote locations facing anthropogenic disturbance, such as deep-sea mining, has been mostly estimated by population genetic analyses. However, the connectivity among populations is mediated by planktonic larval dispersal in the real ocean and the ecology and physiology of planktonic larvae of deep-sea animals and further estimation of larval dispersal potential are also important to estimate the resilience of specific animal communities associated with the environments facing deep-sea mining, such as hydrothermal vents. Animal distribution and behaviour are basic information but time-consuming to obtain. Ms. Watanabe introduced some ideas to obtain and identify plankton image data quickly. She applied this method to analyse meiofauna, a composition used as a parameter in environmental impact assessments. A feasibility study shows that the method could briefly show the community change according to the depth. However, it may take more time for the automatic classification of plankton. Even manual classification saves time for analysis, and the image archive of the specimens enables us to review the classification by other researchers, resulting in the transparency of the analysis. World Wide Web of Plankton Image Collection is one of the projects that accelerate the image-based analyses of plankton. Soundscape may be another application to elucidate the distribution and behaviour of animals in the deep ocean. A combination of multiple approaches will help our understanding of deep-sea ecosystems.

Introducing a standardized marine taxon reference image database to help promote standardization in deep-sea image annotation

Kerry Howell, University of Plymouth, UK

Cameras have revolutionized marine ecology, enabling us to survey and monitor benthic environments in non-invasive ways. Platforms, such as remotely operated vehicles and autonomous underwater vehicles, can collect vast image data sets that can be analysed to extract biological information. These images have to be annotated by professional ecologists to identify and count animals. However, this process has many challenges, including inconsistencies in identification. This is particularly problematic while dealing with “difficult” taxa, such as those that require microscopic examination. A lack of standardized terms to describe species into morphotypes makes it difficult to combine data. This limits the reuse of data, particularly in artificial intelligence approaches. SMarTaR-ID was invented to

solve these problems, as it is a common language to help standardize annotations. It helps to identify specimens of the closest morphological types in the catalogues. SMarTaR-ID is also a reference library for organisms, providing a catalogue of images of the different species seen; the entire database can be exported as a pdf. It is also a tool to help with annotation, containing taxonomic, morphological and regional filters to narrow down the options for animal identification. In the future, other filters will be added, including temperature, depth, substrate and behaviour. The research group is also working on additional tools to improve identification, providing information that cannot be seen in the images. The ultimate aims are to raise the quality and consistency of animal identifications from image-based data beyond the ability to combine data sets and to enable artificial intelligence to interpret image-based data in the future. The SMarTaR-ID project is now part of the Challenger 150 United Nations Decade of Ocean Science programmes, the technical working group on megafaunal image-based analysis. The goal is to make data FAIR and develop standards across disciplines.

Part II: Hybrid public session for registered participants, invited experts and SSKI partners

- *Presentation delivered under agenda item 2*

SSKI: Implementation plan (V.1)

Luciana Genio, ISA Secretariat

One of the strategic plans of ISA is protecting the marine environment. This strategic plan includes the development of a regulatory framework, development of REMPs and assessments, access to environmental information, development of methodologies and monitoring programmes, and environmental impact and risk assessment. Standardizing methodologies for deep-sea biodiversity assessments in the Area is one of the six strategic research priorities emphasized in the ISA Action Plan for marine scientific research in support of the United Nations Decade of Ocean Science. In this regard, taxonomic standardization is key in allowing for comparisons across studies and areas. SSKI aims to enable ISA to strengthen cooperation with stakeholders to obtain access to and disseminate quantitative and qualitative data openly and transparently to ensure effective protection of the marine environment. The key output of the initiative will be a knowledge-sharing platform. SSKI focuses on advancing the knowledge of deep-sea ecosystems and biodiversity to enable conditions for effectively fulfilling ISA environmental mandate. SSKI contains five components (i) generating new knowledge on deep-sea biodiversity and producing biogeographic and phylogeographic maps to assess evolutionary history, connectivity and resilience of deep-sea ecosystems, (ii) unlocking biodiversity knowledge of seabed through integrative and innovative tools that improve the consistency, efficiency and reusability of scientific information collected in the Area, (iii) innovating the generation and flow of taxonomic data, including the enhanced data availability, accessibility and interoperability, (iv) building a global network of deep-sea taxonomists and centres of excellence and (v) delivering data products that will strengthen scientific and technical capabilities of ISA and its stakeholders to support the implementation of the Mining Code, including environmental planning, monitoring plan and risk/impact assessments. During the technical session of the workshop, a list of targeted outputs was presented to the participants, who were invited to propose activities that could contribute to the outputs. The summary of outputs and activities proposed is presented in Annex III.

- *Presentations delivered under agenda item 3*

Strengthening collaboration to support further development of deep-sea taxonomic knowledge platform and necessary long-term capacity development within the context of ISA

IOM perspective: Strengthening collaboration to support further development of deep-sea taxonomic knowledge platform

Kamila Mianowicz, IOM, Poland

IOM is the multinational ISA contractor for the exploration of polymetallic nodules in the CCZ, with more than 35 years of exploration activity focusing on prospecting for the resources and gathering the environmental baseline information.

The IOM environmental work currently focuses on filling in the knowledge gaps (following the LTC recommendations in ISBA/25/LTC/6/Rev.2) and revising legacy data, including taxonomic identification of benthic organisms from past cruises. Changes in the LTC requirements with respect to the environmental baseline studies included sampling standards, state of preservation of biological samples (incl. degeneration of DNA excluding the application of metabarcoding), insufficient quality of images from past cruises, limited access to original metadata and/or changes in metadata standards are only a few challenges to tackle over time.

Limited access to taxonomic expertise is a key issue and has been extensively discussed (i.e., during previous ISA/MABIK workshops). Many deep-sea species are still undescribed/unknown. The scientific names of others are sometimes tentative, or synonyms are in use. A common problem is misidentification. Some of those issues can be solved by using AphiaID, a unique and persistent identifier of a taxon (Vandepitte et al. 2015, Ahyong et al. 2022).

IOM has already undertaken some steps to overcome the challenges listed above, including (1) establishing cooperation with academia to advance species identification, (2) adopting and rigorously following standards and guidelines for sampling, samples processing (LTC recommendations), metadata standards (MiXs Genomic Standards Consortium, Darwin Core) and data reporting (DeepData, Open Nomenclature) and (3) enabling communication of the IOM database with other databases: (WoRMS, DeepData).

The National University of Singapore and deep-sea mining

TAN Koh Siang, Lee Kong Chian Natural History Museum, Singapore

Singapore first became involved in the quest for deep-sea mineral exploration in 2014, when Ocean Mineral Singapore Pte. Ltd., a unit of Keppel Corporation, secured a contract with the ISA to explore how polymetallic nodules can be harvested sustainably from the CCZ in the eastern Pacific Ocean. Ocean Mineral Singapore Pte. Ltd. then engaged researchers from the National University of Singapore (NUS) to conduct environmental studies and surveys through the Keppel-NUS Corporate Laboratory. Since then, a small team of biologists from the Tropical Marine Science Institute and the Lee Kong Chian Natural History Museum participated in two joint cruises with the UK Seabed Resources team to the CCZ in 2015 and 2020 to collect environmental and biological data in the Singapore claim area. In addition, the NUS team also organized a joint deep-sea biodiversity expedition to southwest Java with the Indonesian Institute of Sciences in 2018. These cruises, together with others elsewhere in the

Indian Ocean and the South China Sea, have provided researchers with many opportunities to learn how to plan and organize a deep-sea cruise and carry out deep-sea sampling. The material obtained has, in turn, led to the discoveries of many new species, the characterization of abyssal communities, and forming the basis of two doctoral theses on the biodiversity of sponges and tanaid crustaceans in the CCZ by NUS researchers. Given the small size of the deep-sea research community worldwide, these activities have also reiterated the importance of international collaboration. It cannot be overemphasized that the expertise developed by the next generation of biologists will be critical for the future management and well-being of the unique environment in the CCZ.

Strengthening collaboration to support further development of deep-sea taxonomic knowledge platform and necessary long-term capacity development within the context of ISA

Sadie Mills, NIWA, New Zealand

The NIWA Invertebrate Collection (NIC) in Wellington, New Zealand houses ~350,000 jars of marine invertebrates and 60 per cent are collected deeper than 200 m. NIC collaborates with taxonomists in New Zealand and overseas to support the development of deep-sea taxonomic knowledge and develop long-term capacity for taxonomy. We have in-house taxonomic expertise in Porifera, Decapoda, Peracarida, Nematoda, Bryozoa, Annelida and Ascidiacea and parataxonomic expertise in Echinodermata, Pycnogonida, Natant Decapoda, Cnidaria (corals, hydrozoans) and Cephalopoda. Where we do not have in-house expertise, we collaborate with New Zealand and international taxonomists. Experts collaborate to describe deep-sea fauna and provide training to staff, students and visitors. Our strategy to build expertise begins by analysing the taxonomic gaps: NIC built a list of experts we call on and targeted taxonomic training at our gaps by inviting experts to run workshops and identify collections, usually timed to coincide with specialist conferences. For example, NIWA hosted deep-sea coral identification workshops in 2009 and 2013, a deep-sea anemone identification workshop in 2019, recently hosted an online Meioscool workshop following the 2022 Meiofauna conference and will host an Amphipod bioinformatics and phylogeny workshop after the International Crustacean Congress in May 2023. Visiting experts have provided group training to identify specimens to a high level and provided focused training to individuals. Creating identification guides and biodiversity memoirs has passed taxonomic knowledge to a wide audience.² Depositing voucher specimens from seabed sampling activities at distributed natural history collections will assist with collaboration and knowledge-sharing. However, careful attention should be paid to local and international laws concerning the deposition of type specimens and sharing of specimen data. NIC specimen data and international museums are available through the OBIS and could be linked to ISA DeepData.

ISA-China JTRC's cooperation and efforts in the capacity development of ISA

Xiang Gao, JTRC, China

The JTRC was established under the ISA strategic plan for 2019-2023. In October 2019, ISA and the Ministry of Natural Resources of China signed a memorandum of understanding in Beijing. JTRC was officially launched in November 2020. The mission of JTRC includes (i) promoting training and capacity-building opportunities, (ii) stimulating and advancing the conduct of marine scientific research

² NIWA Biodiversity Memoirs. Available at: <https://niwa.co.nz/oceans/niwa-biodiversity-memoirs>.

by developing states, (iii) fostering cooperation in marine scientific research and technological development and (iv) increasing participation of developing states in the activities in the Area. The framework for organizing training programmes under the JTRC provides specifications for the management, organization, implementation and summary and report of training activities. JTRC has also implemented an online training platform and invited the top experts in several fields to 80 sessions of courses on the following topics: fundamentals, polymetallic nodule resources, polymetallic sulphide resources, cobalt-rich ferromanganese crust resources, environment and ecosystem, technology and equipment, operation and practice and international marine cooperation. JTRC also organized training workshops. The first was held in May 2022 on mineral resources, environment management and data, with expressive participation of developing countries and women. JTRC will promote joint research programmes with international partners in connection with ISA's mandate for capacity development.

Strengthening collaboration to support further development of deep-sea taxonomic knowledge platform and necessary long-term development

Melyne Tarer, IORA

The IORA is an association aiming at sustainable development in the Indian Ocean focused on regional cooperation. It aims to promote socioeconomic cooperation. IORA's six priority and focus areas include maritime safety and security, trade and investment facilitation, fisheries management, disaster risk management, tourism, cultural exchanges, academic, science and technology cooperation, blue economy and women's economic empowerment. IORA has 23 member states and 10 dialogue partners. The blue economy is one of the priorities of IORA, including fisheries and aquaculture, renewable ocean energy, seaports and shipping, offshore hydrocarbons and seabed minerals, deep-sea mining, marine tourism and marine biotechnology, ocean observation, research and development. A blue economy working group has been formed. In March 2022, IORA signed a memorandum of understanding with ISA to increase the understanding of deep-sea ecosystems and the utilization of deep-sea taxonomy. IORA aims to increase regional capacities through partnership programmes for small island developing States and least developed countries, training and capacity buildings (fusion centre), and strengthening cooperation with national agencies of the member states.

Annex III. Summary of activities proposed by participants

Component 1: New knowledge

Proposed activity	Feasibility	Existing initiatives	Potential partners	Timeframe
Workshop series for species identification and description.	High –format exists, the challenge is the access to samples.	SOSA/Senckenberg, Comprehensive Marine Bio Survey 2014 (Singapore).	Senckenberg, Museum of Natural History, DiSSCO, EMBRC, JAMSTEC, ISA contractors.	Short – 12-mo preparation, can be run as many times as necessary.
Registry of taxonomic expertise and biocollections to promote experts' research visits	Medium – requires coordination and willingness to participate.	INDEEP, Deep-Sea Biology Society, DOSI Working Groups, Challenger 150.	DiSSCO, iDigBio, ISA contractors, national museum collections.	Medium – leadership needs to be identified for maintaining and monitoring outputs and impact.

Component 2: Integrative tools

Proposed activity	Feasibility	Existing initiatives	Potential partners	Timeframe
CCZ species checklist	High – collaboration established, data compiled.	WoRMS	NHM	Short – 6-mo.
COI Reference library for CCZ.	High – database exist, collaboration will increase the number of existing records.	Senckenberg, BOLD database.	SGN, NHM, IFREMER, Gent University, Singapore University.	Short – 6-mo preparation.
Species lists for hydrothermal vent sites.	Medium – subject to the willingness to share/collaborate.	C150, DOSI, Seabed 2030, PHYCONET, INTER RIDGE, ISA contractors.	C150, JAMSTEC, Hong Kong Uni. Sci & Tech, SIO, ISA contractors.	Medium – collaboration needs to be established.

Component 3: Data sharing

Proposed activity	Feasibility	Existing initiatives	Potential partners	Timeframe
Data quality team for revision and publication of legacy data.	High – collaboration established, data compiled.	WoRMS, OBIS.	DeepData (ISA), ISA contractors.	Short – 3-mo preparation.
Data training: data entry, metadata, database building, FAIR data, Open Science Principle, data standards.	High – courses exist in many academic institutions.	PANGEA, European Open Science Cloud (EOSC), ELIXIR, EMBRC.	DeepData (ISA), OBIS, WoRMS, EMBRC-ERIC, GBIF, ISA Deep Dive.	Short – courses exist or are in development, can be combined with in-person workshops.

Incorporate standard vocabularies for functional traits.	Medium – require research to adapt to deep-sea.	Tara Oceans, Malaspina, iAtlantic Australian Microbiome.	Ifremer– DeepREST, D OOS/GOOS.	Medium – collaboration needs to be established.
--	---	--	--------------------------------	---

Component 4: Capacity development

Proposed activity	Feasibility	Existing initiatives	Potential partners	Timeframe
Dedicated training for taxonomic identification and descriptions.	High – format exists, but funding needs to be secured.	ISA Contractors Training Programme	ISA contractors, museums, biocollections, universities.	Short – time to launch a call and secure funding, can be run as long as funding allows.
Bioinformatics and data analysis mentoring programme.	Medium – subject to mentor’s availability.	Bioinformatics institutes, research labs.	IORA Blue economy initiative	Medium – time to launch call and secure funding.
Capacity development on artificial intelligence	Medium – subject to the willingness to share/collaborate	C150, EcoTaxa, ZooScan, BlueRevolution	IFREMER, Université de Sorbonne, JAMSTEC/C150, University of Plymouth.	Medium – collaboration needs to be established.

Awareness-raising

On the importance and economic value of taxonomy as fundamental data and information for environmental management and sustainable use of biodiversity. Possible approaches:

- Flagship species – link to ecosystem services
- Literacy on modern technologies for taxonomy to attract new generations
- Blue economy – explore opportunities for technological innovation
- Social media.