DEEP-OCEAN STEWARDSHIP INITIATIVE

Information Sheet

October 2022

Scientific Knowledge is Currently Insufficient for Effective Environmental Management of Deep-Seabed Mining

As nations consider mining mineral-rich deposits found on the deep seabed in areas beyond national jurisdictions, a recent study has revealed just how little we know about these parts of the deep sea and how they might be affected by mining activities. The study, published in *Marine Policy*, is the culmination of a comprehensive review of peer-reviewed articles and consultation with scientists, contractors, and members and staff of the International Seabed Authority (ISA) to determine the critical scientific gaps that should be addressed by the ISA before mining begins. Addressing these gaps will help ensure the 'effective protection of the marine environment' from harmful effects which may occur from seabed-mining activities. The findings show that, in most regions, **there is currently insufficient scientific knowledge to enable evidence-based decision-making in line with the ISA's environmental obligations**. This study also indicates that it would be impossible to close these scientific knowledge gaps within the next decade.

Only 1.1% of scientific topics assessed across regions and resources covered by mineral exploration contracts had sufficient information to enable evidence-based management of deep-seabed mining (Figure 1).

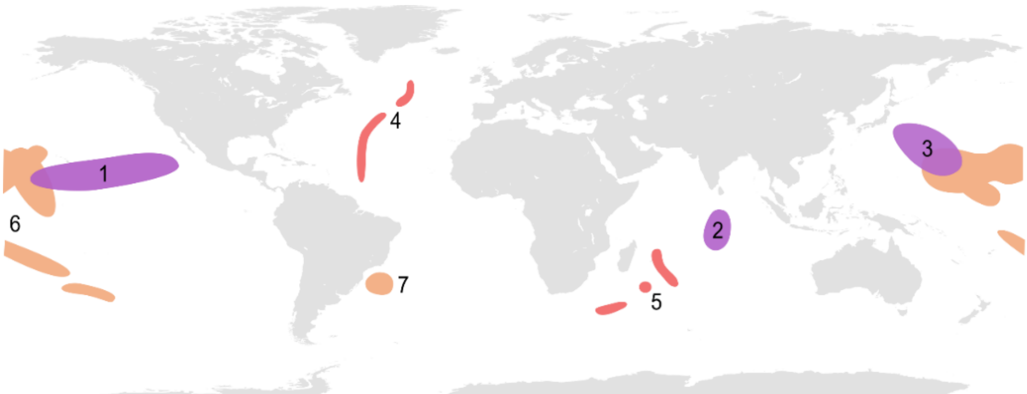
Key Findings

Overall:

- The northern Mid-Atlantic Ridge and the Clarion Clipperton Zone - the best studied regions for which the ISA has issued exploration contracts - each only had sufficient information for one of the 20 scientific topics assessed (Figure 1).
- Ecological baselines for midwater ecosystems do not exist for any of the regions where ISA exploration contracts have been issued.
- 88% of experts consulted agreed that current scientific knowledge is too sparse to ensure the protection of the marine environment from impacts of deep-seabed mining.
- 90% of experts consulted estimated it would take from six to more than 20 years to build the scientific knowledge needed to properly protect the marine environment from deep-seabed mining.

The Clarion Clipperton Zone:

- We have inadequate knowledge. 85% of the scientific topics assessed were dominated by knowledge gaps or had no knowledge (Figure 1).
- The majority of species are not even known. Biologists estimate that up to 75% of animal species are yet to be discovered in areas that have been sampled.
- The ecosystem is poorly understood. Many species have only been collected once or twice, which is not enough to draw sound conclusions on their ecological attributes (species abundance, diversity, ranges, relationships with other species, contribution to overall ecosystem function, extinction risks, and vulnerability to and recovery from deep-seabed mining).
- Areas established for conservation are poorly known. The Areas of Particular Environmental Interest (APEIs) are severely under-sampled. Some are located at considerable distances from the contractor areas and their biological communities may have significant differences, leading to questions about their effectiveness.



Location

1. Clarion-Clipperton Zone
2. Central Indian Ocean Basin
3. West Pacific
4. Mid-Atlantic Ridge
5. Indian Ocean Ridges
6. West Pacific Prime Crust Zone
7. South Atlantic Rio Grande Rise

Knowledge

- Scientific knowledge enables evidence-based management
- Few gaps in scientific knowledge for evidence-based management remain
- Scientific knowledge gaps for evidence-based management dominate
- There is no or next to no scientific knowledge to enable evidence-based management

Key Scientific Gaps			Habitat								
			Nodules			Active Sulfides		Inactive Sulfides		Cobalt-rich Ferromanganese Crusts	
Theme	**Topic**	**Sub-Topic**	**1**	**2**	**3**	**4**	**5**	**4**	**5**	**6**	**7**
Environmental Baselines	Abiotic	High-resolution bathymetry									
		Oceanographic setting (e.g., currents, oxygen minimum zones, temperature, turbulence levels, sound, suspended particles)									
		Seabed properties (e.g., sediment characteristics, oxygen penetration, redox zonation, metal reactivity)									
	Biotic*	Natural disturbance regimes									
		Species taxonomy									
		Trophic relationships									
		Life histories (e.g., age of maturity, longevity, reproduction, fecundity)									
		Spatial variability									
		Temporal variability									
		Connectivity (e.g., dispersal mechanisms, species ranges, source/sink populations)									
		Ecosystem functions and services									
Deep-Seabed Mining	Impacts	Removal of resources									
		Plumes									
		Contaminant release and toxicity									
		Noise, vibration and light									
		Cumulative impacts									
	Resilience										
	Management	Environmental goals and objectives									
		Survey and monitoring criteria									
		Effectiveness of mitigation strategies									

*Fig. 1. The current level of scientific knowledge in relation to evidence-based environmental management of deep-seabed mining in regions where exploration contracts have been granted by the ISA. This has been compiled from a synthesis of the peer-reviewed literature and expert opinion, and includes both target and non-target areas within each region. * denotes benthic and pelagic habitats. Disclaimer: since the publication of this study, knowledge in some of these categories has increased, but knowledge gaps still dominate.*

How Much Scientific Information is Enough?

Closing the necessary scientific gaps related to deep-seabed mining is an essential and monumental task that requires clear direction, substantial resources, and robust coordination and collaboration. For example, an average 60-day expedition to the Clarion-Clipperton Zone costs millions of US dollars and requires several years to complete the sample processing and data analysis needed to help establish an environmental baseline. To describe natural conditions and variability in space and time in the same contract area would take several more research expeditions over many years. Broader regional sampling will then be needed in non-targeted areas to evaluate regional patterns. Even though it is difficult to know when sufficient scientific information exists to inform decision-making, at a minimum we need answers to questions essential to predicting, evaluating, and managing impacts from deep-seabed mining, such as:

- What species are present, which are most vulnerable to deep-seabed mining, and how do they vary with environmental parameters over space and time, including between different mineral resources?
- What ecosystem functions are present, and how do they vary with environmental parameters over space and time, including between different mineral resources?
- How are species in mining regions interlinked, both on the deep seafloor and in the broader ocean ecosystem?
- How much impact can occur before food-web integrity and ecosystem functions are disrupted?
- Can we distinguish mining impacts from natural seasonal or annual variability at the contractor and regional scale?
- What are the environmental impact thresholds from mining that these ocean ecosystems can tolerate?
- Are species capable of repopulating after mining disturbance, and what is needed to constitute an ecologically viable population?
- How will ecosystem recovery be affected by or interact with other stressors such as climate change?

Until such questions can be answered, there will be insufficient information for developing informed environmental impact assessments or formulating adequate environmental monitoring and management plans. Thorough research on these topics is also needed for the ISA to effectively regulate the development of regional environmental management targets and thresholds, area-based management tools, and more.

Closing the Scientific Gaps: A Proposed Road Map

This study proposed a potential road map of activities that could stimulate a much-needed discussion on how to answer these questions and close key scientific gaps before any exploitation is authorized (Figure 2). These activities included the delineation of environmental goals and objectives, the synthesis of data that already exist (including relevant traditional knowledge of Indigenous Peoples and local communities), as well as the establishment of a strategic and coordinated international research agenda to generate critical deep-sea environmental, biological, and ecological information.

Even if the narrowest approach to environmental research is undertaken, the proposed road map will likely take several decades for all resources in all regions.

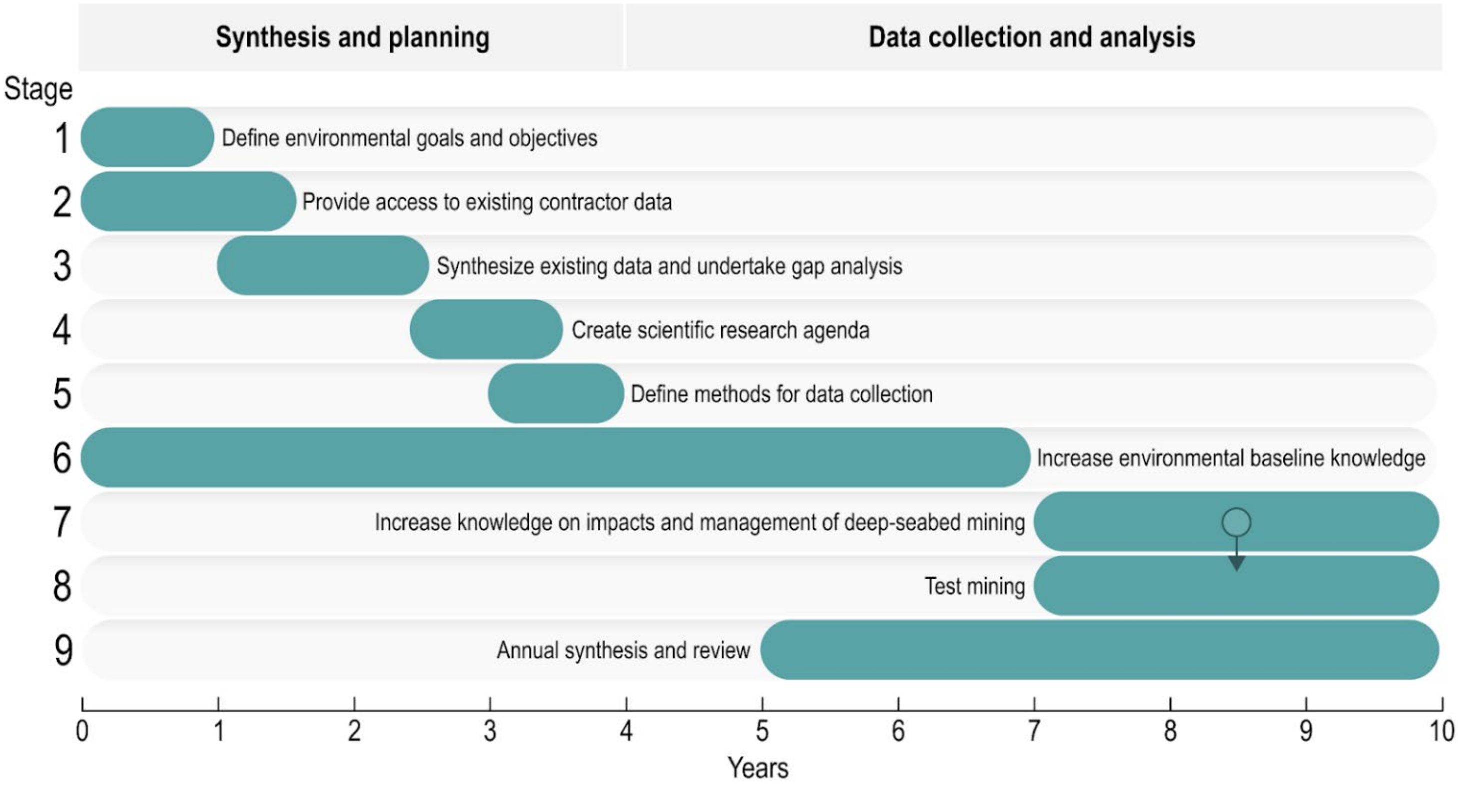


Fig. 2. A proposed road map for closing key scientific gaps related to deep-seabed mining. This road map is applicable to any resource (polymetallic nodules, polymetallic sulfides, cobalt-rich ferromanganese crusts) in any relevant region with exploration contracts. It is broadly anticipated that a decade (or more) could apply to each resource in each region. Regions with more scientific knowledge than others (e.g., the Clarion-Clipperton Zone) may require less time. This process can occur concurrently for each resource in each region shortening the potential multidecadal time frame, although this will depend on resources available.

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How to Cite:

DOSI (2022). "Scientific Knowledge is Currently Insufficient for Effective Environmental Management of Deep-Seabed Mining." Deep-Ocean Stewardship Initiative Information Sheet. **https://www.dosi-project.org/wp-content/uploads/DSM-Management-Knowledge-Info.pdf**

About DOSI:

The Deep-Ocean Stewardship Initiative is a global network of experts that seeks to integrate science, technology, policy, law and economics to advise on ecosystem-based management of resource use in the deep ocean and strategies to maintain the integrity of deep-ocean ecosystems within and beyond national jurisdiction.

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Paper referenced:

Diva J. Amon, Sabine Gollner, Telmo Morato, Craig Smith, Chong Chen, Sabine Christiansen, Bronwen Currie, Jeffrey Drazen, Tomohiko Fukushima, Matthew Gianni, Kristina Gjerde, Andrew Gooday, Georgina Guillen Grillo, Matthias Haeckel, Thembile Joyini, Se-Jong Ju, Lisa Levin, Anna Metaxas, Kamila Mianowicz, Tina Molodtsova, Ingo Narberhaus, Beth Orcutt, Alison Swaddling, Joshua Tuhumwire, Patricio Urueña Palacio, Michelle Walker, Phil Weaver, Xue-Wei Xu, Clement Yow Mulalap, Peter Edwards, Chris Pickens. "Assessment of scientific gaps related to the effective environmental management of deep-seabed mining." Marine Policy 138 (2022): **https://doi.org/10.1016/j.marpol.2022.105006**