Strengthening the International Seabed Authority's knowledge-base: Actively addressing uncertainties to enhance decision-making

1. Introduction

Deep seabed mineral resources are increasingly drawing political and economic attention. Despite unresolved legal, financial, technical and environmental issues, mining operations on the deep ocean floor are conceivable within the next decade. However, mining the deep ocean floor on a commercial scale remains a subject of dispute for a number of reasons. On the one side, some states desire greater resource independence, economic actors hope for business opportunities, and some even argue that mining deep-sea minerals is necessary to allow global energy sectors to successfully shift to renewables. On the other side, several groups, in particular the scientific community and civil society organizations, have continuously questioned the need for deep seabed mining (DSM). They assert that land-based mines provide sufficient amounts of respective mineral resources and that governments should instead focus on developing more circular economies, embrace more sustainable industrial processes, and ultimately encourage citizens to alter their consumption patterns [1-3]. In addition, given the present lack of scientific understanding of the deep ocean, the ability of prospective operators to effectively protect the marine environment from the harmful effects of mining is also a matter of pressing concern [4-5].

The UN Convention on the Law of the Sea 1982 (UNCLOS) [6] mandates the International Seabed Authority (ISA) in Kingston, Jamaica to administer the development of mineral resources of the international seabed, also referred to as 'the Area' (Article 1, 1(1) and Article 157(1), UNCLOS). UNCLOS unequivocally declares the Area as 'the common heritage of mankind' (Article 136, UNCLOS). Complying with this mandate includes ensuring the effective protection of the marine environment (Article 145 UNCLOS) and designing an equitable sharing system to distribute financial and other economic benefits derived from DSM operations (Article 140(2), UNCLOS). Thus, in keeping with its mandate to develop the mineral resources of the Area, the ISA is obliged to ensure that activities in the Area are carried out for the 'benefit of mankind as a whole […], taking into particular consideration the interests and needs of developing States' (Article 140(1) UNCLOS). Article 143(2) UNCLOS also acknowledges the importance of promoting and disseminating marine scientific research to administer and develop resources of the Area and provides the ISA with the competence to do so.

This is an extremely challenging assignment for the ISA, as present knowledge pertaining to most aspects of DSM operations – specifically the nature, sensitivity and resilience of marine ecosystems, the potential impacts of mining operations, and the availability of appropriate mining technology that is minimally invasive – is sparse and still in the developing phase.

The ongoing process of developing the regulations for commercial mining operations ('Exploitation Regulations'), however, presents a window of opportunity to actively and systematically address existing uncertainties and develop the DSM knowledge base. It is argued here that the developing Exploitation Regulations could, for example, demand more from the ISA as a whole

to more actively engage in generating and synthesizing information, making it publicly available, and consequentially applying the gained knowledge to its decision-making procedures at all relevant stages. This article aims at describing the ISA's challenges to regulate DSM in view of the numerous uncertainties involved and suggests a general approach that the ISA could take in order to actively and systematically address uncertainties regarding the effects of DSM. The extent to which international law and policy already support, and even call for future active and systematic engagement, is analysed and some suggestions for potential measures and institutional adjustments that would help begin to fill knowledge gaps are given.

2. Regulating DSM under uncertain conditions

2.1 *Uncertainties surrounding DSM operations*

It is widely accepted that a range of uncertainties exist around DSM activities. Although legal, financial and technical uncertainties remain a valid concern especially for the actors wanting to engage in DSM [4-5], this paper only focuses on the environmental knowledge gaps and how to strategically close them. Although our scientific understanding of the deep ocean and its complex ecosystems continues to improve over time, our knowledge on the diversity and abundances of species, the composition of ecosystems, and how the habitats within the deep-sea environment interrelate and interact with each other is still limited [7-8]. In the context of DSM, it is clear that commercial-scale DSM operations will "disturb, damage or remove structural elements of ecosystems, cause biodiversity loss and impact ecosystem services"[5].

Several potential impacts of DSM that are likely to occur have been identified to some extent, for example a change of bottom structure that makes habitat recolonization unlikely, fundamental alteration of community structures, significant loss of biodiversity as well as interruption with the deep sea's provision of ecosystem services, and disturbance of fauna as a result of the introduction of noise, light and suspended sediments into the water column. However, little is known about the precise extent of the resulting harm (such as the spatial scales), particularly when the individual impacts are considered in combination [9]. For instance, the potential for post-mining habitat recovery at or near mining sites is difficult to predict, and complex deep-sea processes such as species connectivity or the provision of deep-sea ecosystem services still remain poorly understood [10-11]. It is important to emphasize here that some of these impacts are not just site-specific but could reach areas well beyond the mining area [12]. Thus, activities conducted in one potential license area may also impair the legitimate rights and interests of other users of the marine space and that of adjacent coastal states [13]. In addition, while DSM operation is expected to be a major stressor on the marine environment, there are also other anthropogenic and climate stressors that will interact at the same time [14]. Hence, there is a need to understand the consequences of multiple stressors and the cumulative impacts they have on the marine environment. Finally, a proper assessment of the potential environmental impacts that could arise from energy usage, greenhouse gas emissions, and processing procedures that arise as a result of activities in the Area is also still

lacking – although the majority view here is that UNCLOS does not extend the ISA's mandate to regulate matters beyond 'activities in the Area' [15].[1]

Against this background, it is difficult to develop environmentally sound mining technologies and sustainable mining operations (which at the same time need to be economically viable). Accordingly, from a regulatory perspective, the existing knowledge gaps make the formulation of appropriate laws, standards, and thresholds to regulate DSM activities a particularly challenging task [16]. One suggestion on how to approach this predicament is through the adoption of objectives, goals and targets that serve as the foundational basis for environmental regulation [17]. However, the existence of a substantial knowledge base is a fundamental prerequisite in order to determine the exact characteristics of such objectives, goals and targets.

2.2 *Towards actively and systematically addressing uncertainties*

As explained above, the ISA has to regulate a nascent activity in the face of great uncertainty. In order to prepare and adopt its decisions on an increasingly sound and rational basis, the ISA needs to actively and systematically address the current knowledge gaps regarding the potential effects of DSM. Preparing and adopting decisions on an informed basis will help the ISA to better implement its mandate as laid down in UNCLOS and to enhance the quality and thus legitimacy of its outputs [18].[2] There are, conceivably, numerous actions and measures that may address uncertainties, and more will become evident as DSM evolves [19-21]. Eventually, such actions and measures will progress towards a broader and more systematic management approach, including full-fledged adaptive and risk management [22-26]. In order to improve decision-making outputs at the ISA, there need to be stronger, targeted and more proactive initiatives within the ISA set-up to reduce existing knowledge gaps. Thus, actively and systematically addressing uncertainties would require a combination of actions by the ISA, broadly falling within the following four categories:

- Initiating, promoting and coordinating the generation of new data and information;
- Continuously collating and synthesising existing data and information with the objective of providing an advanced scientific understanding of environmentally relevant issues pertaining to mineral exploration and exploitation;
- Making this body of knowledge accessible to all stakeholders; and
- Ensuring that this body of knowledge is considered and applied in all decision-making processes within the ISA.

3. The legal basis under UNCLOS for addressing DSM uncertainties

[1] While shipboard processing clearly falls within the remit of the ISA, this is not squarely the case with other related environmental impacts; with respect to the latter, a minority view exists that the ISA should at least recognize this as a consequence arising from activities in the Area and promote good environmental practices. However, the ISA has, recently, taken some initiative to raise awareness relating to processing technologies - see the ISA, Interoceanmetal Joint Organization (IOM) and the Ministry of the Environment in Poland Joint Workshop on Processing Technologies, Metal Recoveries & Economic Feasibility of Deep Sea Mining at the Ministry of Environment in Warsaw, Poland 3-6 September, 2018 (accessible at https://www.isa.org.jm/workshop/processing-technologies-metal-recoveries-economic-feasibility-deep-sea-mining-3-6-sept-2018).

[2] UNCLOS provisions as well as provisions of the Mining Code prescribing informed decision-making will be outlined later in this text.

As an international organization with an international legal personality, the ISA is constrained by international law in its regulatory and governance efforts. Accordingly, potential steps to address uncertainties and manage knowledge regarding DSM must be in conformity with international law as applicable to the ISA.

The principle of the Common Heritage of Mankind (CHM) provides that mineral resources in the Area belong to mankind as a whole (thereby encompassing the vested interests of both present and future generations). In addition, Article 145 requires that "necessary measures" be taken to "ensure the effective protection of the marine environment from harmful effects which may arise from [activities in the Area]", and explicitly requires the ISA to "adopt rules, regulations and procedures for […] the prevention, reduction and control of pollution and other hazards to the marine environment".

Several other provisions in Part XI of UNCLOS are also relevant to this discussion. According to Article 143(2) of UNCLOS the ISA "shall promote and encourage the conduct of marine scientific research in the Area, and shall coordinate and disseminate the results of such research and analysis when available".[3] Furthermore, Article 144(1)(a) stipulates that the ISA "shall take measures […] to acquire technology and scientific knowledge relating to activities in the Area"]. It is noteworthy to mention that both provisions also feature in the 1994 Agreement Relating to the Implementation of Part XI of UNCLOS; more specifically, in Section I to the Annex to the Agreement. The promotion of marine scientific research and the acquisition of scientific knowledge is, in fact, accorded some degree of prominence in the key instruments that establishes the ISA and prescribes its main functions. Although these provisions do not impose any hard obligations to undertake specific measures (and thereby leaving it to the discretion of the ISA on how to fulfil them), they do provide a strong, aspirational foundation for the advancement of scientific knowledge, which is ultimately desirable for improving decision-making outputs.

Complying with all these provisions in good faith demands that all decisions of the ISA must, as a general rule, be taken in a rational, careful manner, be based on sound scientific knowledge and with precaution in mind. In addition to the above, we also point to the following UNCLOS provisions as support for our contention that the ISA should govern the mineral resources of the Area with greater foresight (see Table 1):

Table 1: Other relevant UNCLOS provisions

UNCLOS Provision	Content
Article 153(5)	The ISA "shall have the right to take at any time any measures provided for under [Part XI] to ensure compliance with its provisions

[3] Article 200 UNCLOS foresees a comparable provision as it prescribes that: "States shall cooperate, directly or through competent international organizations, for the purpose of promoting studies, undertaking programmes of scientific research and encouraging the exchange of information and data acquired about pollution of the marine environment".

	and the exercise of the functions of control and regulation assigned to it thereunder or under any contract"
Article 157(2)	The ISA "shall have such incidental powers, consistent with this Convention, as are implicit in and necessary for the exercise of those powers and functions with respect to activities in the Area"
Article 160(2)(j)	The ISA has the authority to "initiate studies and make recommendations for the purpose of promoting international cooperation concerning activities in the Area"
Article 162(1)	The Council, as the executive organ of the ISA, has the power to act in conformity with the general policies established by the Assembly and determine the "specific policies to be pursued by the [ISA]"
Articles 165(c), (d), (e) and (h).	The Legal and Technical Commission (LTC), a subsidiary organ of the Council, has the mandate to carry out a broad range of duties including to supervise activities in the Area in consultation with mining entities, prepare assessments of environmental applications of activities in the Area, and make recommendations on the protection of the marine environment after taking into account expert views, as well as to "make recommendations to the Council regarding the establishment of a monitoring programme to observe, measure, evaluate and analyse, by recognized scientific methods, on a regular basis, the risks or effects of pollution of the marine environment resulting from activities in the Area, ensure that existing regulations are adequate and are complied with and coordinate the implementation of the monitoring programme approved by the Council"

We would like to emphasize that the provisions of UNCLOS, particularly regarding its generic terms, should to some extent be interpreted in the light of new developments in international law and global policy [27-29]. Two important concepts of international environmental law that have evolved since the conclusion of UNCLOS, namely, sustainable development and the precautionary approach, deserve mention in this regard and are dealt with in more detail below.[4]

[4] Not only have both concepts been integrated into numerous multilateral instruments, but both concepts have also been addressed by international courts and tribunals as a result of such proliferation.
With respect to sustainable development, see for instance, *Gabčíkovo-Nagymaros Project (Hungary vs. Slovakia)*, Judgment of the International Court of Justice of 25 September 1997, ICJ Reports 1997; *Arbitration Regarding the Iron Rhine ("Ijzeren Rijn") Railway between the Kingdom of Belgium and the Kingdom of the Netherlands*, Award of the Permanent Court of Arbitration of 24 May 2005, Reports of International Arbitral Awards Vol. XXVII.
With respect to the precautionary approach, see for instance the *Southern Bluefin Tuna Cases (New Zealand vs. Japan; Australia vs. Japan) (Provisional Measures)*, ITLOS Cases No. 3 and 4, Order of 27 August 1999, available at https://www.itlos.org/en/cases/list-of-cases/case-no-3-4/; *The MOX Plant Case (Ireland vs. United Kingdom) (Provisional Measures)*, ITLOS case No. 10, Order of 3 December 2001, available at https://www.itlos.org/en/cases/list-of-cases/case-no-10/; *Pulp Mills on the River Uruguay (Argentina vs. Uruguay)*, Judgement of the International Court of Justice of 20 April 2010, 2010 ICJ 14; and *Responsibilities and Obligations of States Sponsoring Persons and Entities with respect to Activities in the Area (Request for Advisory Opinion submitted to the Seabed Disputes Chamber)*, ITLOS Case No. 17, Advisory Opinion of 1 February 2011, available at https://www.itlos.org/en/cases/list-of-cases/case-no-17/.

The adoption of the UN Agenda for Sustainable Development 2030 and the associated Sustainable Development Goals (SDGs)[5] can be interpreted as an urgent international call for action to globally improve the conditions of the environment. It is argued here that this call also has repercussions for the interpretation of UNCLOS regarding the development of mineral resources of the Area. SDG 14 is specifically dedicated to the oceans and is aptly titled 'Conserve and sustainably use the oceans, seas and marine resources". Target 14 A demands that States should "Increase scientific knowledge, develop research capacity and transfer marine technology (…)], in order to improve ocean health (…)." In this regard, all human activities that impact the marine environment and the actors involved in those activities (particularly regulatory bodies) should scrutinize their practices to ensure that their activities are properly controlled and conducted in a manner consistent with the aspirations of SDG 14. In embracing sustainable development, the ISA has issued a statement acknowledging that "improved scientific knowledge is critical to effective management" [30-31], and has also specifically acknowledged the role it needs to play in supporting the implementation of SDG 14 [32].

Furthermore, the precautionary approach, first developed in the 1990s and now an established norm in both environmental law and resource governance, also lends support to the averment that the ISA must actively engage in addressing scientific uncertainties and managing knowledge. In broad terms, the application of the precautionary approach in relation to DSM activities, where many uncertainties exist, requires the ISA to exercise great prudence and caution in adopting adequate measures to ensure the effective protection of the marine environment from potentially harmful effects. The applicability of the precautionary approach to activities in the Area was confirmed in 2011 by the Seabed Disputes Chamber of the International Tribunal of the Law of the Sea (SDC-ITLOS)'s Advisory Opinion on the Responsibilities and Obligations of States Sponsoring Persons and Entities with respect to Activities in the Area.[6] Here, the SDC-ITLOS gave effect to the specific wordings of the Exploration Regulations (relating to Polymetallic Nodules and Polymetallic Sulphides), which included a specific obligation to 'apply a precautionary approach' to ensure the effective protection of the marine environment from harmful effects that arise from activities in the Area. The SDC-ITLOS (albeit when discussing the due diligence obligation of sponsoring States, and not the ISA[7]) observed that, "where scientific evidence concerning the scope and potential negative impact of the activity in question is insufficient but where there are plausible indications of potential risks", adherence to the precautionary approach is pivotal. One way to implement the precautionary approach in the DSM context is to adopt measures that specifically target existing knowledge

[5] United Nations General Assembly Resolution adopted on 25 September 2015 (A/RES/70/1), available at: https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.

[6] *Responsibilities and Obligations of States Sponsoring Persons and Entities with respect to Activities in the Area (Request for Advisory Opinion submitted to the Seabed Disputes Chamber)*, ITLOS Case No. 17, Advisory Opinion of 1 February 2011, available at https://www.itlos.org/en/cases/list-of-cases/case-no-17/.

[7] As the SDC-ITLOS Advisory Opinion clearly states that both the ISA and sponsoring States are under an obligation to apply the precautionary approach in respect of activities in the Area (see paragraph 131), the above observation by the SDC-ITLOS, despite having been made with respect to the sponsoring State, is arguably also applicable to the ISA.

gaps in order to reduce the surrounding uncertainties [33-34].[8] Developing a knowledge management system to better understand the potential impacts of DSM operations would enable the ISA to adopt the necessary measures as required by Article 145 of UNCLOS.

4. Current political and regulatory developments at the ISA

4.1 *The ISA's strategic orientation*

4.1.1. First periodic review pursuant to Article 154 of UNCLOS

Every five years, the Assembly is required to undertake "a general and systematic review" of how the ISA regime "has operated in practice" (Article 154 UNCLOS). Based on the outcomes of the first ever Article 154 periodic review in 2017, the ISA's Assembly has adopted several recommendations [36-37]. Some of these recommendations addressed actions that would contribute to actively and systematically addressing uncertainties and building a more profound knowledge base for DSM governance, i.e. the generation of data and information. In particular, the report points out that there is a need for "better data management and data-sharing mechanisms" and accentuates the "importance of marine scientific research". It also encourages the Secretary-General to "engage more extensively with the scientific community and deep-sea science projects". These recommendations by the Assembly have certainly also inspired the Strategic Plan described below.

4.1.2. ISA Strategic Plan

The Assembly of the ISA approved the ISA "Strategic Plan" at its annual session in August 2018 [35]. The Strategic Plan covers the period 2019–2023. The Strategic Plan reveals that the ISA to a certain extent is willing to commit itself – or at least to give some political weight – to addressing uncertainties. Table 2 provides an overview of the relevant provisions that we deem relevant in this regard.

Table 2: Relevant provisions in the ISA's Strategic Plan

Paragraph	Content
14	Developing a DSM regulatory framework under circumstances of considerable scientific, technical and commercial uncertainty is challenging. The framework should be adaptive, practical and technically feasible. For regional assessments data collection and dissemination is seen as critical. It must satisfy the extensive marine environmental protection requirements of UNCLOS, as well as take into account relevant aspects of the Sustainable Development Goals and other international environmental targets, such as the Aichi Biodiversity Targets.
15-17	The "promotion of the sharing of the results of marine scientific research" is a crucial challenge. The ISA has to "promote and encourage the conduct

[8] See also Note from the ISA Secretariat entitled 'Implementing the precautionary approach to activities in the Area' (ISBA/25/C/8), available at: https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/files/documents/25c-8-e.pdf.

	of marine scientific research and coordinate and disseminate the results […]" and "adopt strategies and seek adequate resources to enable it to strengthen cooperation with state parties, the international scientific community, contractors and relevant international organizations [...]".
27	The ISA will "adopt rules, regulations and procedures […] on the basis of best available information" and "ensure that the legal framework is […] adaptive and responsive to new technology, information and knowledge and advances in international law relating to the Area".
28	The ISA undertakes to "progressively develop, implement and keep under review an adaptive, practical and technically feasible regulatory framework based on best environmental practices", and "ensure public access to environmental information.
29	The ISA commits to "promote and encourage the conduct of marine scientific research with respect to activities in the Area", "collect and disseminate the results of research and analysis", "to be pro-active in engaging with the international scientific community" and "to compile summaries of the status of environmental baseline data and to develop a process to assess the environmental implications of activities in the Area

Although the "Strategic Plan" is arguably a document with a proactive outlook *per se*, it does not set out specific methods or concrete steps for implementation.[9]

4.2 *The Mining Code*

The Mining Code refers to the "comprehensive set of rules, regulations and procedures issued by the International Seabed Authority to regulate prospecting, exploration and exploitation of marine minerals" of the Area [38]. Recommendations and guidelines issued by the Legal and Technical Commission (LTC), the expert advisory body of the ISA, also come within the ambit of the Mining Code. Essentially, the Mining Code encompasses the regulatory outputs of the ISA issued pursuant to the general framework for deep seabed mining provided by UNCLOS.

4.2.1 The Exploration Regulations

To date, the ISA has issued three separate sets of regulations that respectively govern the prospecting and exploration of polymetallic nodules (issued in 2000, amended in 2013), polymetallic sulphides (issued in 2010) and cobalt-rich ferromanganese crusts (issued in 2012) in the Area [40-42]. This subsection examines the extent to which the Exploration Regulations contain provisions that are relatable to our call for more efforts to address existing uncertainties

[9] Note that the ISA Secretariat recently issued a Draft High Level Action Plan of the International Seabed Authority and Priorities for the 2019-2023 Period, which sets out a list of actions deemed necessary to achieve the strategic objectives that were identified in the Strategic Plan (see https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/files/documents/draft_hlap_03.05.19.pdf). In the 25th session of the ISA Assembly in July 2019, this document, alongside a document on Draft Performance Indicators, was adopted with revisions. This revised adoption includes an emphasis on a key performance indicator for Strategic Direction 4 ('Promote and encourage marine scientific research in the Area'), and calls for the ISA to specifically promote research that is necessary for the effective protection of the marine environment.

and manage knowledge through the ISA. As all three regulations are similar in content, we have limited our examination to the Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area and related matters (as amended in 2013). Table 3 summarizes the relevant provisions:

Table 3: Relevant provisions in the Exploration Regulations

Regulation	Content
18	An applicant for a plan of work shall submit a: • description of the programme for oceanographic and environmental baseline studies; • preliminary assessment of the possible impact of the proposed exploration activities on the marine environment; and • description of proposed measures for the prevention, reduction and control of pollution and other hazards, as well as possible impacts, to the marine environment.
31	In order to ensure effective protection for the marine environment from harmful effects that may arise from activities in the Area, the ISA shall apply the precautionary approach. The LTC shall develop and implement procedures for determining, based on the best available scientific and technical information, whether any proposed exploration activities would have serious harmful effects, and ensure that such activities are either managed to prevent such effects or not authorized to proceed.
32	Contractors shall gather environmental baseline data and establish environmental baselines. Contractors shall report annually in writing to the Secretary-General on the implementation and results of environmental monitoring programmes.

Although the Exploration Regulations are not as extensive as the Draft Exploitation Regulations, they do provide a foundation for the generation of environmental data (see Section 4.2.2. below). However, issues pertaining to the format of data submission by contractors (i.e. as an annual report that is classified as confidential because resource data are combined with environmental data) have greatly stifled all forms of environmental data sharing within the ISA and between stakeholders and need to be resolved, e.g. through the data management strategy that is being developed by the ISA at the moment (see Section 4.4).

4.2.2 LTC Recommendations ISBA/25/LTC/6

After the recent 25th session in March 2019, the LTC issued a revised document entitled "Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area" (ISBA/25/LTC/6). This document replaces an earlier version issued in 2013 (ISBA/19/LTC/8) and contains a detailed set of "procedures to be followed in the acquisition of baseline data, and the monitoring to be performed during and after any activities in the exploration area with potential to cause serious

harm to the environment" [43]. Although it is a non-binding document, DSM operators are expected to comply with the Recommendations to the best of their abilities [44]. The present LTC Recommendations contain several provisions that argue in favour of a greater engagement in addressing uncertainties. Table 4 considers them in more detail:

Table 4: Relevant provisions in the LTC Recommendations ISBA/25/LTC/6

Paragraph	Content
8	After the approval of an exploration contract (but prior to the commencement of exploration activities), the Contractor is required to submit to the ISA: • an impact assessment on the potential impacts of proposed exploration activities; • a proposal for a monitoring programme; and • data that could be used to establish an environmental baseline against which to assess the effect of future activities.
14-15, 17-18	These paragraphs extensively elaborate on the various types of baseline data to be collected for all types of mineral deposits.
16	The contractor is to provide raw data with annual reports to the ISA. Data will be used for regional environmental management and assessment of cumulative impacts
19-24	These contain detailed provisions pertaining to data collection methods, inventory, archival and retrieval.
26-27	These provide for the effective transmission of data from contractors to the ISA, particularly data which could be relevant for the protection of the marine environment
28-29	Cooperative research should be encouraged to generate additional data for the protection of the marine environment. The ISA shall give support in the coordination and dissemination of the results of such research.

The LTC Recommendations clearly highlight the urgent need for the collection of data and generation of new knowledge by contractors during the exploration phase, in order to address the potential impacts of the particular project, as well as to assess the effect of future activities and to utilize this information in the creation of regional environmental management plans. They also emphasize the importance of cooperative research to gather further environmental information and underline the role of the ISA in promoting such efforts. It is critical to note that both the Exploration Regulations and the LTC recommendations explicitly focus on the generation of information.

4.2.3 Draft Exploitation Regulations

The ISA is currently in the midst of drafting regulations that will govern the exploitation of mineral resources in the Area. Once finalized, this instrument will be the key document that governs the commercial exploitation of mineral resources of the Area. Here, we examine several provisions from the recently revised (in March 2019) draft of the exploitation regulations (Draft Exploitation Regulations) [39]. Table 5 identifies the most relevant provisions (known

as Draft Regulations or DRs) that systematically address scientific uncertainties and improvement of the knowledge base for DSM:

Table 5: Relevant provisions in the Draft Exploitation Regulations

Draft Regulation (DR)	Content
2	Fundamental provisions of these Regulations: - To protect the marine environment from harmful effects of DSM based on the following principles: • protection of the marine environment, including biological diversity and ecological integrity; • application of the precautionary approach; • application of the ecosystem approach; and • access to data and information relating to the protection of the marine environment, accountability and transparency and encouragement of effective public participation. - To ensure the incorporation of best available scientific evidence into decision-making processes.
3	Duty to cooperate and exchange of information - The ISA shall promote effective communication and participation. - The ISA, with the cooperation of contractors, sponsoring states and member states, shall establish programmes to observe, measure, evaluate and analyse the impacts of DSM to the marine environment, and share those findings for wider dissemination. This information shall be used to further develop 'best environmental practices' in the Area. - The ISA, member states and contractors shall cooperate with each other and with national and international scientific research agencies to: • share, exchange and assess environmental information in the Area; • identify gaps in scientific knowledge and design research programmes to address them; • collaborate with the scientific community to develop best practices; • undertake educational awareness programmes in the Area; and • promote marine scientific research.
38	Contractors shall submit annual reports that include, *inter alia*, actual results obtained from environmental monitoring programmes,

	including observations, measurements, evaluations and the analysis of environmental parameters.
39	Contractors shall maintain maps, geological, mining and mineral analysis reports, production records, processing records, records of sales or use of minerals, environmental data, archives and samples and any other data, information and samples connected with exploitation activities. The ISA has full access to this data, information and samples.
44	Regarding the protection of the marine environment, pursuant to Article 145 UNCLOS, the ISA, sponsoring states and contractors shall, *inter alia*: • apply the precautionary approach; • ensure the application of best environmental practices; • integrate best available scientific evidence in environmental decision-making; and • promote accountability and transparency in the assessment, evaluation and management of environmental effects from exploitation in the Area (including timely access to relevant environmental information).
87	Data or information that are disclosed under ISA regulations to protect the marine environment, or that are necessary for the formulation of rules and regulations and procedures concerning the protection of the marine environment, are not considered 'confidential information'. These should therefore be publically available.
90	A Seabed Mining Register shall be established and shall include, inter alia, the details of the contractors and the contractual terms, geographical areas covered by the contract, and category of minerals. This shall be publicly available.

DR2 in particular stipulates that the protection of the marine environment is integral to the development of seabed resources and makes clear that increasing scientific understanding and promoting the availability of new knowledge is key to effectively protecting the marine environment. Furthermore, DR3 firmly lays down the requirement for all stakeholders to cooperate and promote activities that increase our scientific understanding of the deep seabed. DR38 and DR39 require contractors to submit environmental reports and gather knowledge acquired through DSM activities, while DR44 brings into application several aforementioned key norms of international law and requires the integration of knowledge into DSM activities. Moreover, DR87 makes clear that data or other information which relate to the protection of the marine environment is not to be regarded as confidential. Finally, DR90 demands the establishment of a "Seabed Mining Register" with a wide range of publicly available information.

4.4 *Data Management at the ISA*

The ISA has taken some steps to manage technical environmental data and other information that it receives from member States, contractors and other stakeholders. In 2000, the central

data repository was established [45]. Until recently, however, the ISA's data repository remained fairly skeletal and did not provide a systematic and comprehensive collection of existing data and information. It did not include any of the preliminary environmental information that can be derived from plans of work approved by the ISA for exploration projects, nor those derivable from the respective annual reports or any published scientific papers or reports. It is noteworthy to mention that none of the annual reports or synthesized environmental information exist on the ISA's website.[10]

In 2016, however, the LTC issued deliberations on a "data management strategy of the ISA" [46]. The data management strategy intends to set up a system for data management, which is based on a "clear, published and adhered to set of data standards" and which is "able to answer basic questions in support of the Authority's mission", including questions regarding mineable areas or impacts on the environment.

As a consequence, the ISA Secretariat recently launched the 'ISA Deep Seabed and Ocean Database (*DeepData*)' during the 25th session of the Assembly in July 2019.[11] As this database has only been freshly launched, it is not possible to assess its substance or effectiveness at this stage. As a preliminary observation, it is hard to envision at present that this database will be able to function as anything more than a platform wherein raw data collected from contractors and scientific projects are displayed. Use of different systems and methods for data acquisition as well as differing taxonomic expertise will make cross-correlation between datasets especially challenging. In this regard, the database will have to be improved over time in order to mould it into a functional and useful tool for decision-making purposes. In particular, issues surrounding information that will be withheld due to data confidentiality, as well as the importance of enhancing transparency in the process of knowledge management, must be addressed. Specifically, the database should be open access and should provide an opportunity for stakeholders to verify and (where necessary) to dispute the scientific data and other environmental information submitted by contractors. The eventual "Inspectorate", which will be tasked to ensure compliance with the Mining Code, must also be clothed with the necessary powers to validate the data that is submitted by contractors. Nevertheless, the launch of *DeepData* is an essential step forward that is much welcomed at this point in time.

4.5 *Assessing the status quo*

From the above, we are able to surmise that recent efforts undertaken by the ISA (as reflected in the Strategic Plan and High Level Action Plan and Key Performance Indicators) to improve its approach to addressing scientific uncertainties, with particular attention aimed towards establishing environmental baselines and ascertaining potential harm to the marine environment, demonstrates that the ISA is attempting, at least on paper, to reinvigorate its efforts to understand the marine environment and its susceptibility to mining-related impacts. Furthermore, there are a number of provisions in the Mining Code that attempt to give effect to the objective

[10] Although it is acknowledged that some environmental information that result from ISA workshops can be found in ISA Technical Reports.

[11] International Seabed Authority, Press Release (30 July 2019), available at: https://www.isa.org.jm/news/isa-celebrates-milestone-anniversary-heads-state-and-government-25th-session-assembly.

of knowledge generation, and the recent introduction of *DeepData* can also be seen as a step in the right direction. However, it must be said that the political will to ensure implementation in order to effectively overcome the existing knowledge gaps is still lacking, as the methods and institutional structures within the ISA to enable and support the active pursuit of knowledge generation and information synthesis have clearly not yet been put in place.

5. Strengthening knowledge-based decision-making at the ISA

5.1 *Incorporating an ambitious strategic direction into a revised strategic plan*

As outlined above, the ISA's strategic plan addresses certain aspects of a more ambitious approach to targeting uncertainties. It does not, however, highlight these aspects as a stand-alone "strategic direction". To bring the ISA's decision-making process more in line with its overall mandate and the different regulatory objectives laid down in UNCLOS, such a specific strategic direction should be explicitly included into a revised ISA strategic plan, potentially once the term of the current strategic plan expires in 2023. The new strategic direction could be titled 'Strengthening the knowledge-base' and should highlight actions and performance indicators pertaining to information and data generation, synthetization, dissemination, and integration in decision-making processes. Such a new "strategic direction" would underline the importance of this overall approach and could serve as a framework to include and address some, if not all, of the following potential measures and additional instruments.

5.2 *Potential measures*

In order to strengthen knowledge within the ISA's management, we believe it will be necessary to catalyse the ISA's role as that of an active initiator, collator, synthesiser, distributor and implementer of knowledge. In order to enable it to function as the curator of this knowledge-base, we recommend that the ISA place more emphasis on the following four activities:

5.2.1 Environmental baseline data collection and testing of mining equipment

The gathering of environmental baseline data is an important source of information generation [47]. The Exploration Regulations and the LTC Recommendations ISBA/25/LTC/6 require contractors to submit annual reports that include the environmental baseline data collected through their exploration activities. While the said LTC Recommendations (which are non-binding) provide guidance on the types of information that are essential, contractors are not legally required to adhere to them word-for-word. Similarly, the Exploration Regulations do not compel (or incentivise) contractors to be overambitious in gathering environmental baseline information. There is no indication of what levels of environmental baseline data are deemed as adequate, and there appears to be no consequence if submissions from contractors fall short of that which is desired. The absence of adequate levels of environmental baseline data is problematic because it makes it difficult for the ISA to attach regulatory conditions on the contractor to ensure that necessary measures are in place for the effective protection of the marine environment. In addition to license-specific areas, the lack of standardised and uniform environmental baseline information also impedes the ability of the ISA to develop region-specific environmental management plans.

To pursue a more active approach to addressing uncertainties and place more responsibility on the contractor, the ISA should determine a minimum set of baseline information to be delivered by the contractor and make compliance to this minimum set of baseline information a pre-requisite to the application process for an exploitation contract. This would ensure that the necessary information to assess the existing environmental conditions at a potential mining site is gathered during the exploration phase and will thus be available before an exploitation contract is approved and advances to commercial production at the exploitation stage.

Furthermore, testing of mining equipment has the potential to generate a lot of information at an early stage of DSM operations. This measure should be seen as an essential tool to generate data and information with regard to all environmental aspects of potential mining operations [48]. This includes information on the status of the ecosystems (both before and after testing) in order to understand their resilience against impacts caused by mining operations [49], which can consequentially be used to determine the environmental appropriateness of mining technologies and techniques. Assessing the dimensions and scales of environmental impacts from a more realistic perspective is only possible through the testing of equipment on a sufficiently large scale to avoid potential errors that could arise from up-scaling [48]. As it stands, neither UNCLOS and the 1994 Implementing Agreement nor the current Exploration / Draft Exploitation Regulations make testing of mining equipment a mandatory requirement during the exploration or exploitation stage.[12]

Given that test mining will inevitably produce very important information to enable informed decision-making, we argue that the ISA should require contractors to conduct testing of equipment before an application for a plan of work for an exploitation activity is submitted, and in particular before commercial production can commence. In this regard, a two-step approach seems to make sense: First, contractors should be required to conduct a preliminary test mining project, involving the testing at least some of the essential components of a complete mining system, before they can submit an application for an exploitation project. By testing equipment already during the exploration stage, the contractor should be able to demonstrate that its mining equipment is well-suited to cope with the necessities of ensuring the effective protection of the marine environment. Second, a larger-scale test mining operation is also needed before commercial production is about to commence. The whole scale of the exploitation project will significantly change (and in fact expand) when a project moves to commercial production. Once the types of equipment pertinent for exploitation activities becomes well-established and matches with the accepted standards of “best available techniques”, the obligation to conduct

[12] For instance, DR 25 of the Draft Exploitation Regulations requires a contractor already in possession of an exploitation contract to submit a ‘feasibility study’ before the contractor can proceed to commercial production. Unless the feasibility study is accepted, the contractor may not commence production within its contract area. A ‘feasibility study’ is defined as a “comprehensive study of a mineral deposit in which all geological, engineering, legal, operating, economic, social, environmental and other relevant factors are considered”. Even though it explicitly refers to “environmental factors”, we argue that the requirement to submit a feasibility study as a precondition to commercial production is not the same as making the prior testing of mining equipment – with the purpose of determining potential environmental harm as well as technological feasibility –a mandatory requirement.

such detailed test mining projects may be adjusted and reduced in order to avoid repetitive or unnecessary testing.

With regard to strengthening the ISA knowledge, the establishment of mandatory two-step test mining process would ensure that essential information on the status of environment and marine ecosystems, as well as the nature of the impacts brought upon by the use of the relevant mining equipment could be gathered and made available to the ISA in order to enable the IAS to ensure – on this improved knowledge-base – the effective protection of the marine environment.

5.2.2 Environmental monitoring

Closely related to the above is the obligation to conduct environmental monitoring of activities in the Area. While environmental baseline data can provide valuable information on the natural conditions of the deep seabed, the actual impacts caused by exploration activities (e.g., component-testing) and exploitation activities (e.g., large-scale test mining and commercial production) can only be ascertained through monitoring efforts. Without monitoring programmes in place, as well as the prior determination of management goals, indicators and thresholds, the ISA will not be able to verify the effective protection of the marine environment. In addition, the ISA will not be able to respond to emergencies or bad practices without knowing what is actually taking place at the site. The ISA has taken some steps to catalyse monitoring as an important component of environmental management. Pursuant to DR 7 of the current Draft Exploitation Regulations, contractors must submit an Environmental Management and Monitoring Plan (EMMP) along with an application for a plan of work for exploitation. DRs 51-52 further detail the specific obligations of contractors with respect to implementing the EMMP, while Annex VII of the same outlines the content of an expected EMMP.

Furthermore, scientific initiatives for developing independent monitoring programmes and monitoring gear do exist, such as the JPI-Oceans MiningImpact project (August 2018 to February 2022). The purpose of this effort is to "independently study and comprehensively monitor in real time the environmental impact of an industrial trial to mine manganese nodules on the seafloor which will be conducted simultaneously and independently by the Belgian contractor DEME-GSR in the Belgian and German licence area in the Clarion-Clipperton-Zone" [50].

In addition to these initial steps, the ISA should expand its efforts in this area. It could, for example, require contractors to engage the services of independent agencies to verify monitoring activities, which would supplement the monitoring efforts of contractors and sponsoring States. Independent monitoring programmes would verify the actual impacts that arise from such activities, in addition to validating the environmental reports that contractors are required to submit. As such, monitoring would not only serve to measure the actual environmental harm caused as a result of activities in the Area, but also enable the ISA to feed information obtained through monitoring programmes into regional environmental management plans, in order to boost management measures and ensure that such measures commensurate with reality. Monitoring programmes will also allow the ISA to assess the compliance of contractors with the

provisions of the Mining Code and their individual contractual terms, and, where necessary, to take enforcement measures.

Furthermore, the ISA should develop the conditions for monitoring as a standard (methods, scale, frequency, duration) within the Mining Code; conditions need to be tailored to the requirements of specific projects. For example, lessons can be learned from the permission procedure for offshore windfarms in the North Sea. The authority in charge for granting offshore windfarm permission in Germany has developed a standardised investigation program (Standard Investigation Concept) with the primary aim to close existing knowledge gaps [51]. It provides guidelines for environmental monitoring that are applicable before, during and after the project. It also lays down specific requirements regarding the investigation period, the investigation area and the sampling schemes.

Such a standardization would have two major benefits that are crucial for an effective monitoring scheme. First, information would be gathered on a clear and ex-ante determined basis, which could be tailored according to the specificities of each project. Second, for the contractors, standardization provides a reliable basis and a level-playing field with regard to project planning and economic considerations.

5.2.3 Marine scientific research

The conduct of marine scientific research in the Area is essential to improve our understanding not only of the deep ocean, its ecosystems and connectivity, but also of the potentially harmful effects of DSM operations and cumulative impacts that may be caused by various overlapping anthropogenic and natural stressors. As the ISA is mandated by both UNCLOS and the 1994 Implementing Agreement to promote the conduct of marine scientific research in the Area, it is therefore obliged to encourage activities that improve the scientific understanding of the deep ocean and address existing knowledge gaps. In this regard, several steps have been taken by the ISA. One example is the ISA's recent commitment under SDG14 to work together with the University of Hawaii to "establish long-term deep sea observatories as part of a global DOOS [Deep Ocean Observing Strategy] system to monitor environmental variables and improve understanding of ecosystem functions in the deep sea" by December 2020 [52].

The ISA also became an official partner in the European JPIO MiningImpact scientific project mentioned in the chapter above. Furthermore, with respect to the UN Decade of Ocean Science, which will take place over a decade starting January 2020[13], the ISA declares that it has "enhanced its cooperation with IOC-UNESCO to work towards common scientific objectives including improved mapping of the seabed and enhancing ocean observing networks" [53]. Apart from that, the ISA should welcome research initiatives that originate beyond its auspices. One such project is the currently ongoing Nippon Foundation-GEBCO Seabed 2030 Project, which

[13] The UN Decade for Ocean Science is an initiative led by the International Oceanographic Commission of the UN Educational, Scientific and Cultural Organization (IOC-UNESCO)

endeavours to “bring together all available bathymetric data to produce the definitive map of the world ocean floor by 2030 and make it [publically] available” [54].

An institutionalized cooperation between researchers and their funding agencies, the ISA secretariat and the LTC, state representatives and observers could, at least to a certain extent, be mutually beneficial. When researchers publish and make their scientific results available to the ISA, an engagement with the ISA will allow them to better understand the informational needs from a regulatory perspective, which in turn might motivate and enable researchers and their funders to develop and conduct research of practical importance. For the ISA this cooperation would be beneficial as the results of research projects promote advanced and improved governance.

In order to establish this “institutionalized cooperation”, we propose that the ISA should compile an inventory of academic bodies and institutions that have an interest in deep ocean research. The ISA should then invite these groups to work together with each other and with the ISA to improve scientific understanding of the functioning of the deep ocean and to close knowledge gaps. To this end, it would be advisable for the ISA to arrange for regular consultations with the relevant institutions on research strategies to address the most urgent and pressing aspects pertaining to DSM. This measure would recognise the immense contribution that epistemic groups already make towards improving the regulatory process at the ISA, and provide a greater platform that allows for the integration of their expertise into decision-making processes at the ISA.

5.2.4 Environmental Strategy for the Area and Regional Environmental Management Plans

Information gathered from environmental baseline data submitted by contractors, test mining, effective environmental monitoring and marine scientific research is critical when considered from the perspective of environmental governance and the ISA’s mandate to administer the Area’s mineral resources on behalf of all mankind. Knowledge gained from these sources should therefore culminate in the creation of an environmental governance ‘masterplan’, that is, an Environmental Strategy for the Area, and additional region-specific instruments, known as Regional Environmental Management Plans (REMPs), for the regions that are of interest to DSM activities.

Establishing an overall Environmental Strategy for the Area would certainly assist the ISA as it embarks on its mandate to manage the mineral resources of the Area in the face of numerous uncertainties [55]. In this connection, a workshop entitled ‘Towards an ISA Environmental Management Strategy for the Area’ was held in Berlin in March 2017, the report of which is publically available as an ISA Technical Study [56]. The core added value of such an Environmental Strategy would be to define generic environmental objectives, which could then inform regionally defined goals/targets and the development of environmental standards or guidelines. Secondly, overarching principles that lend support to how the ISA intends to protect the environment such as the precautionary approach, the ecosystem approach, and the polluter pays principle can be defined in such an ISA Environmental Strategy.

Among other things, the Berlin workshop also called for the development of region-specific plans or REMPs. There is one precedent of a region-specific plan, namely the Environmental Management Plan for the Clarion-Clipperton Zone (EMP-CCZ), which was established by the ISA in 2012.[14] Furthermore, in its 'Preliminary strategy for the development of REMPs for the Area', released in early 2018, the ISA acknowledges the importance of REMPs as a "clear and consistent mechanism" to provide particular regional areas "with appropriate levels of protection" [57]. The document specifically identifies the following priority areas for the development of REMPs on a preliminary basis: the Mid-Atlantic Ridge, the Indian Ocean triple junction ridge and nodule-bearing province, and the North-west Pacific and South Atlantic for seamounts. Since the beginning of the implementation process [58], several workshops have been held and further workshops are planned with the aim of developing REMPs for the respective areas.

REMPs are an essential tool to ensure an effective protection of the marine environment according to Article 145 UNCLOS. REMPs should provide region-specific information for the decision-making process on activities in the respective areas. In this context, region-specific objectives could be established, the carrying capacity of the region could be taken into account, and cumulative effects and conflicts with other legitimate uses could be considered. REMPs furthermore provide a long-term planning reliability and a level playing field for contractors, in particular when shifting from exploration to exploitation.

However, there is not yet a clear legal obligation that a REMP has to be in place before an application for an exploitation activity for the respective area can be approved. Nor is there an obligation that the activity should not contradict the objectives and the management measures of the Regional Environmental Management Plan. These points have been continuously raised by several State Parties [60-61].

Additionally, there is a need to discuss whether a standardized approach concerning the contents and the procedures for the development, approval and review of a REMP should be required. Regrettably, neither the ISA Strategic Plan, the Draft Exploitation Regulations nor the "Guidance to facilitate the development of Regional Environmental Management Plans" introduced by the ISA Secretariat in July 2019, addresses or clarifies the requirements concerning the contents and the procedures for REMP development.

This was the subject-matter of a recent international workshop entitled "Towards a standardized approach for Regional Environmental Management Plans in the Area", held in Hamburg, Germany in November 2019. Apart from ensuring uniformity across all REMPs, a standardized approach ensures accountability, greater transparency and acceptability. From the contractor´s perspective it would allow for long-term planning reliance. The workshop also discussed the need to establish ad-hoc committees for the development and review of specific REMPs, as

[14] See document ISBA/18/C/22, available at: https://ran-s3.s3.amazonaws.com/isa.org.jm/s3fs-public/files/documents/isba-18c-22_0.pdf.

well as of the involvement of science and all stakeholders (including adjacent states and all relevant international bodies) throughout the process.

By requiring that a REMP be in place before any exploitation activity can be considered, and by adopting a standardized approach for the development, approval and review of all REMPs, a strong incentive is thereby created for better data generation and knowledge management. A systematic approach to information generation, assessment and application will facilitate the identification of knowledge gaps, and thereby allow the ISA to close such gaps and take more informed decisions. In addition, REMPs facilitate the use of region-specific information as a source for determining and agreeing on the appropriate management measures that are necessary for the region. These decisions can be made with the involvement of all relevant stakeholders, expertise and perspectives.

5.3 *Institutional arrangements*

As noted earlier, there is a need for institutional adjustment within the ISA that would enable it to more actively and systematically address current knowledge gaps. We argue here that the ISA should not only gather and administer existing information, but should also play a more prominent role in the assessment and evaluation of available data, inter alia, during the process of establishing REMPs for the different regions that are of interest to DSM and through intensified and pro-active cooperation with the scientific community. Performing such an enhanced role will clothe the ISA with substantial epistemic force [62-63]. Here, we offer some suggestions on how the ISA can make the necessary adjustments at an institutional level in order to ensure that information is dealt with in an efficient and effective manner.

From an existing institutional perspective, the Secretariat's Office of Environmental Management and Mineral Resources (OEMMR) should continue to play an administrative and facilitative role in knowledge management. The OEMMR description states that it is

> "responsible for the development and maintenance of information technology facilities to support needs of the Authority and the central data repository resources of the international seabed area and endeavours to promote and encourage the conduct of marine scientific research in the Area, producing and distributing publications on the work of the Authority and monitoring trends and developments of deep seabed mining activities relating to the prospecting and exploration of the Area including areas reserved for the Authority" [64].

More importantly, there appears to be an urgent need to establish dedicated and independent bodies to carry out environment-related functions, in addition to the existing structure which is overwhelmingly dependent on the LTC. It should be emphasized that the Council has the mandate to create subsidiary organs that it finds necessary to carry out its functions (Art. 162(2)(d) UNCLOS). Here, we envision several options. First, ad-hoc expert bodies or committees can be created to carry out specific functions. For instance, an independent ad-hoc expert committee can be established to develop and to continuously review a REMP for a particular region.

This body could then be tasked to collate all information related to the region, and be responsible to constantly update this body of knowledge on a regular basis. It would be necessary that the relevant expertise is represented in these ad-hoc expert committees, such as biology, geology, oceanography and spatial planning. The accommodation of all relevant interests, perspectives and further expertise needs to be ensured by a standardized procedure. Here, the LTC will still retain its responsibilities, including the receiving and consideration of proposals made by such expert committees before making a recommendation to the Council. This institutional structure ensures that region-specific expertise drives the environmental management of the particular region in question. As for all relevant regions, REMPs established via this arrangement would allow for a shared, but de facto, responsibility towards comprehensive data management.

Second, establishing a permanent advisory body dedicated to environmental and scientific matters also seems to be a viable option [65]. While the LTC would still retain some responsibilities relating to the recommendations on approval or disapproval of individual plans of work, all regional and overall environment-related tasks could be designated to this body. In fact, this body can also be tasked to provide independent assessments of the environmental plans and environmental data that are submitted by contractors. Apart from lessening the burden imposed on the LTC, proceeding with this option would further enhance the quality, speed and legitimacy of decision-making outputs, as they would be made on a more informed basis and with the necessary expertise.

Establishing an independent subsidiary organ dedicated towards environmental and knowledge management matters would not only ensure that the obligation to protect of the marine environment receives the serious attention that it deserves, but would also send out a strong message that the ISA is representing the best interests of all mankind in a manner that reflects both transparency and accountability.[15]

6. Conclusion and outlook

There are currently large knowledge gaps when considering the potential environmental impacts of DSM and the biodiversity, ecosystem functions and services of the deep ocean in general. The existing information that is available is often fragmented and difficult to find, as data are usually procured for a specific research or exploration purpose and within an isolated discipline or field. It is also clear that, despite the fact that our understanding of highly intricate and complex ecological processes within the deep-sea environment constantly advances, decision-makers do not receive the most up-to-date knowledge or might not have the expertise to comprehend it. Most significantly, given the reality that there are large knowledge gaps, and that the existing information available to decision-makers is mostly sequestered, unverified or

[15] In order to enhance transparency and accountability in decision making, as an initial step, the Rule 6 of the Rules of Procedure for the LTC could be amended in such a way so that the LTC would, in future, only meet behind closed doors if it would be dealing with confidential information. This way, open meetings would be the norm and closed meetings the exception. At present, the LTC routinely meets in private as a matter of course.

outdated, any decisions eventually taken run a high risk of lacking legitimacy, transparency, accountability and integrity.

The CHM status of the Area and its mineral resources places great responsibilities on the ISA to act on behalf of all mankind. This requires ISA decision-making to be taken with foresight. However, the current regulatory and institutional set up at the ISA presents numerous limitations which may impede its ability to meet these responsibilities. In addressing these limitations, we have argued that the ISA would have to play a more active role in initiating research, gathering data, synthesizing information, making this information available to all stakeholders, and finally applying this knowledge into all decision-making processes.

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