

EXPLOITING SEABED LAW

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ABSTRACT

Private companies and sovereign States have begun mining the deep sea for polymetallic nodules that contain precious minerals, including cobalt, nickel, copper, and magnesium. In 2021, the small island nation of Nauru triggered a procedural “two-year rule” that requires the International Seabed Authority (ISA) to finalize regulations for deep sea mining (DSM) or consider the provisional approval of commercial exploitation applications. This two-year deadline passed in July 2023 without any resolution. ISA Members States continue to debate a precautionary moratorium on deep sea mining operations in light of inadequate scientific and environmental information about deep sea ecosystems. Meanwhile, advocates argue for scaled-up commercial mining operations in the next few years.

Mining proponents argue that harvesting valuable metals from the ocean floor is essential to facilitate a transition to a new green economy and causes less damage than land-based mining. But marine scientists warn that DSM will cause irreversible environmental damage, impacting biodiversity, migratory species, fisheries, and carbon cycling. Scientific research shows that a combination of sediment plumes, industrial contamination, and anthropogenic noise from deep sea mining have harmful impacts on marine life both on the seabed (benthic fauna) and in the waters

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above (pelagic fauna). Mining even alters the water chemistry of the deep sea.

The ISA has legal authority to regulate DSM beyond national jurisdictions. Established under the United Nations Convention on the Law of the Sea (UNCLOS), the ISA is required to act on behalf of all humankind and ensure effective protection of the marine environment. Further, under the precautionary principle, ISA officials must consider a range of social and environmental impacts.

This article describes draft ISA regulations that govern mineral exploitation on the seabed and argues these regulations fail to satisfy legal obligations under UNCLOS or properly account for scientific unknowns regarding deep sea ecology. The Article argues that a lack of transparency and mechanisms for meaningful stakeholder participation undermine core principles of ocean law. Current suction dredge mining regulations in the United States established under the Clean Water Act, and reflected in State regulation, may serve as an example for sub-jurisdictional regulation of environmentally harmful mining activities. The Article urges ISA Member States to seek a temporary DSM moratorium until the ISA can revise regulations to comply with international legal obligations, establish reliable ecological baselines, incorporate broader stakeholder participation, and harmonize ISA regulations with the new United Nations Treaty on Biodiversity Beyond National Jurisdiction (BBNJ).

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INTRODUCTION

On September 14, 2022, a commercial drill ship named the *Hidden Gem* quietly left port in Manzanillo, Mexico, and motored toward an abyssal plain deep in the Pacific Ocean known as the Clarion-Clipperton Zone.¹ The next day, the International Seabed Authority (ISA), the interstate agency tasked with overseeing mining in international waters, posted an announcement approving the first deep sea mining trial.² For the first time in nearly fifty years, a vessel would mine the deep sea beyond the reach of any national legal system. The authorization and timing of the *Hidden Gem's* departure incensed some opponents of deep-sea mining (DSM).³

¹ Elizabeth Claire Alberts, *Regulator Approves First Deep-Sea Mining Test, Surprising Observers*, MONGABAY (Sept. 16, 2022), <https://news.mongabay.com/2022/09/regulator-approves-first-deep-sea-mining-test-surprising-observers/> [<https://perma.cc/8HLE-GLT9>] (“On Sept. 14, the *Hidden Gem* – an industrial drill ship operated by a subsidiary of The Metals Company (TMC), a Canadian deep-sea mining corporation – left its port in Manzanillo, Mexico.”).

² Press Release, International Seabed Authority, *ISA Legal and Technical Commission Concludes Its Review of the Environmental Impact Statement Submitted by NORI for the Testing of a Polymetallic Nodule Collector Under Its Contract for Exploration in the Area* (Sept. 15, 2022), <https://www.isa.org.jm/news/isa-legal-and-technical-commission-concludes-its-review-environmental-impact-statement> [<https://perma.cc/8TV8-XX7N>].

³ Many DSM critics were already suspicious about ISA back-dealing with mining contractors after a *New York Times* investigation revealed that ISA officials had provided non-public information to private contractors identifying the most valuable seabed mining tracts. See Eric Lipton, *Secret Data, Tiny Islands and a Quest for Treasure on the Ocean Floor*, N.Y. TIMES (Aug. 30, 2022), <https://www.nytimes.com/2022/08/29/world/deep-sea-mining.html> [<https://perma.cc/JY8U-JPVD>] (“firm’s executives received key information from the Seabed Authority beginning in 2007, giving a major edge to their mining ambitions.”); see also AMC CONSULTANTS, *TECHNICAL REPORT SUMMARY: TOML MINERAL RESOURCE, CLARION CLIPPERTON ZONE, PACIFIC OCEAN: DEEPGREEN METALS INC.* (Mar. 26, 2021), <https://int.nyt.com/data/documenttools/2021-03-metals-company-technical-report-on-toml-mining-zone-plan/2d5350243bade994/full.pdf#page=38> [<https://perma.cc/CRU4-ENRQ>] (acknowledging that company officials had relied on data disclosed by ISA officials); Karen McVeigh, *Seabed Regulator Accused of Deciding Deep Sea’s Future ‘Behind Closed Doors’*, GUARDIAN (Apr. 1, 2022), <https://www.theguardian.com/environment/2022/apr/01/worlds-seabed-regulator-accused-of-reckless-failings-over-deep-sea-mining> [<https://perma.cc/6LAY-FGK5>] (“Some [S]tates, including Germany, are also concerned that the ISA is developing its mining standards and guidelines behind closed doors, and that current knowledge of deep-sea ecosystems and the potential effects of mining on the marine environment are insufficient to allow it to go ahead.”); Todd Woody & Evan Halper, *A Gold Rush in the Deep Sea Raises Questions About the Authority Charged with Protecting It*, L.A. TIMES (Apr. 19, 2022),

Under the ISA authorization, *Nauru Ocean Resources Incorporated* (NORI), a wholly owned subsidiary of *The Metals Company*, a Canadian Mining company, tested their deep ocean mining equipment and onboard support operations.⁴

During the mining trial, *Hidden Gem* crew lowered a dumpster sized collection vehicle over 4,000 meters (13,000 feet) and activated a collection system that used compressed air to vacuum up polymetallic nodules from the seafloor.⁵ Each deep-sea nodule can take millions of years to form and contains precious minerals, including cobalt, nickel, copper, and magnesium. The nodules also anchor fragile deep sea ecologies, providing hardscape for slow-growing creatures—many still unknown to science.⁶ A recent scientific study found that approximately 9 out of 10 species identified by deep ocean biologists in the designated mining zone were previously unknown to science.⁷ Despite potential harms to unknown species mining engineers drove a collector vehicle more than 80 kilometers across the seafloor during the trial to collect nodules from the muddy flats, kicking up sediment plumes and reaching a sustained production rate of 86.4 tons per hour.⁸ In total,

<https://www.latimes.com/politics/story/2022-04-19/gold-rush-in-the-deep-sea-raises-questions-about-international-seabed-authority> [<https://perma.cc/4Y27-WD73>] (“The authority, which was established by a U.N. treaty but operates autonomously, is pushing to set up rules that could allow seabed mining in as few as two years, despite calls from scientists and even some car companies for more research into the little-known ecosystems and the scale of damage that excavating the ocean floor could cause.”)

⁴ International Seabed Authority, *supra* note 2.

⁵ See Press Release, The Metals Company, NORI and Allseas Lift Over 3,000 Tonnes of Polymetallic Nodules to Surface from Planet’s Largest Deposit of Battery Metals, as Leading Scientists and Marine Experts Continue Gathering Environmental Data (Nov. 14, 2022), <https://investors.metals.co/news-releases/news-release-details/nori-and-allseas-lift-over-3000-tonnes-polymetallic-nodules>.

⁶ Sabrina Imbler & Jonathan Corum, *Deep-Sea Riches: Mining a Remote Ecosystem*, N.Y. Times (Aug. 29, 2022), <https://www.nytimes.com/interactive/2022/08/29/world/deep-sea-riches-mining-nodules.html> [<https://perma.cc/77EJ-QDX3>] (“Polymetallic nodules are an anchor for a fragile and slow-growing ecosystem that includes species found nowhere else on Earth. For creatures that cannot easily swim, nodules are islands to settle on and build a life. The muddy seafloor is too soft to be a home for them.”).

⁷ See Muriel Rabone et al., *How Many Metazoan Species Live in the World’s Largest Mineral Exploration Region?*, 33 CURRENT BIOLOGY 2383, 2383 (2023) (“An estimated 92% of species identified from the CCZ are new to science (436 named species from a total of 5,578 recorded).”).

⁸ The Maritime Executive, *Allseas Begins Deep-Sea Trial of Polymetallic Nodule Mining System*, MAR. EXEC. (Oct. 12, 2022), <https://maritime->

the company recovered 3,000 tones of the polymetallic nodules.⁹ At the conclusion of the trial, TMC declared operations an overwhelming success; the CEO announced to shareholders: "This is just the beginning, and we look forward to sharing more news as the trials and impact monitoring continue this quarter."¹⁰ TMC hopes to upgrade to a commercial system with a targeted production capacity of 1.3 million tons by the end of 2024.¹¹

Other mining companies have followed TMC and announced plans to ramp up DSM investment and exploitation. In February 2023, for example, Transocean, another deep mineral mining company with a market capitalization of \$3 billion and ten commercial drill ships, announced an investment in Global Sea Mineral Resources (GSR), a leading developer of robotic nodule collection technology and holder of ISA leases in the Clarion-Clipperton Zone.¹²

Despite TMC's proclamation of its mining trial success, a group of scientists hired by the company to monitor operations during the ocean trial reported serious environmental violations, even posting a video of an accidental sediment release into the ocean.¹³ These

executive.com/article/allseas-begins-deep-sea-trial-of-polymetallic-nodule-mining-system [https://perma.cc/54BK-FKQS]

⁹ *Id.*

¹⁰ *Id.*

¹¹ Press Release, The Metals Company, The Metals Company and Allseas Announce Proposed Economic Terms for Developing and Operating the World's First Commercial System to Collect Deep-Sea Polymetallic Nodules to Meet Surging Demand for Critical Battery Metals (Mar. 17, 2022), <https://investors.metals.co/news-releases/news-release-details/metals-company-and-allseas-announce-proposed-economic-terms>.

¹² Press Release, Transocean Ltd., Transocean Agrees to Investment in Global Sea Minerals Resources, Contributes Stacked Drillship (Feb. 9, 2023), <https://www.deepwater.com/news/detail?ID=27461> [https://perma.cc/PMA6-FCST] ("Transocean Ltd. (NYSE: RIG) announced today that one of its wholly owned subsidiaries has agreed to make an investment in Global Sea Mineral Resources NV ("GSR") in exchange for a non-controlling interest in the company. GSR is the deep-sea mineral exploratory division of DEME Group NV and is engaged in the development and exploration of deep-sea polymetallic nodules that contain metals critical to the growing renewable energy market and is a leading developer of nodule collection technology.").

¹³ Leyland Cecco, *Leaked Video Footage of Ocean Pollution Shines Light on Deep-Sea Mining*, *GUARDIAN* (Feb. 6, 2023), <https://www.theguardian.com/environment/2023/feb/06/leaked-video-footage-of-ocean-pollution-shines-light-on-deep-sea-mining> [https://perma.cc/LQU9-33NE] ("The scientists also said the company fell short in its environmental monitoring strategy, according to documents viewed by the Guardian.").

reports of environmental harms generated considerable concern among deep ocean scientists and environmentalists, who noted the lack of adequate monitoring and oversight of deep sea exploitation activities.¹⁴ ISA Member States, foreign governments, and non-governmental organizations echoed similar concerns after the release of the leaked pollution discharge video footage.¹⁵

¹⁴ See Gustavo Graf, *REVEALED: Undercover Video Shows Deep Sea Mining Tests Tainted by Pollution and Flawed Monitoring*, GREENPEACE (Jan. 10, 2023), <https://www.greenpeace.org/usa/news/revealed-undercover-video-shows-deep-sea-mining-tests-tainted-by-pollution-and-flawed-monitoring/> [<https://perma.cc/4XSY-ANM3>] (“Undercover footage of the latest deep sea mining tests in the Pacific Ocean by Canadian miner The Metals Company (TMC) and its Swiss operating partner and shareholder AllSeas shows that wastewater sucked up from the seabed was dumped directly onto the sea’s surface.”); see also Aline Jaeckel, *Strategic Environmental Planning for Deep Seabed Mining in the Area*, 114 MARINE POL’Y 1, 1 (2020) (“While the general impacts of seabed mining, such as habitat destruction, reduction of biodiversity, and the creation of sediment plumes, can be predicted, the precise ramifications for ecosystem structure and functioning remain uncertain.”); DEEP SEA MINING CAMPAIGN, *THE PRECAUTIONARY PRINCIPLE APPLIED TO DEEP SEA MINING* (Aug. 2021), <https://dsm-campaign.org/wp-content/uploads/2021/10/Precautionary-Principle-Deep-Sea-Mining.pdf> [<https://perma.cc/XDY9-CVC2>] (“There is clear scientific consensus that the impacts of deep sea mining would be extensive, severe and last for generations, causing irreversible species loss and ecosystem degradation. Furthermore, presumed social and economic gains are unsubstantiated and ocean-based livelihoods, food security, and cultures are at risk.”).

¹⁵ See Colin Sandell-Hay, *Deep Sea Mining Riding the Crest of a New Wave of Interest*, THE ASSAY (Dec. 2022), <https://www.theassay.com/articles/analysis/deep-sea-mining-riding-the-crest-of-a-new-wave-of-interest> [<https://perma.cc/3QZ9-H5Z2>]; Ellie Hooper, *What Is Seabed Mining and Why Does It Threaten the Oceans?*, GREENPEACE (Aug. 6, 2020), <https://www.greenpeace.org/aotearoa/story/what-is-seabed-mining-and-why-does-it-threaten-the-oceans/> [<https://perma.cc/6AL6-SEKB>] (“Because this is a relatively new and experimental technique, much of the science around the environmental impacts of seabed mining is incomplete or unproven. But scientists have expressed serious concerns over the multiple potential impacts of seabed mining, from the noise of the machinery affecting wildlife, to the activity killing animals and plants on the seabed.”); *Germany Calls for ‘Precautionary Pause’ in Seabed Mining*, REUTERS (Nov. 1, 2022), <https://www.reuters.com/business/sustainable-business/germany-calls-precautionary-pause-deep-sea-mining-2022-11-01/> [<https://perma.cc/2QPW-HVDA>] (“Germany will not sponsor any plans for deep-sea mining ‘until the deep-sea ecosystems and the impacts of deep-sea mining have been sufficiently researched.”); Maurizio Guerrero, *Opposition Grows Among Countries as Seabed-Mining Efforts Push Ahead*, PASSBLUE (Jan. 2, 2023), <https://www.passblue.com/2023/01/02/opposition-grows-among-countries-as-seabed-mining-efforts-push-ahead/> [<https://perma.cc/X7SC-JL5U>] (“At least a dozen United Nations [M]ember [S]tates, along with Latin American and Caribbean countries, oppose a plan by a global body to issue the first-ever license to a nation to explore minerals in the deep seabed in 2023. These countries are concerned about the lack of thorough information that is available to determine how much damage such mining can cause to the overall environment and the ocean

Seabed exploitation is not new. Nodules were discovered in the deep ocean over 100 years ago.¹⁶ And seabed exploitation began in the CCZ during the 1960s.¹⁷ But new technologies are accelerating the promise and perils of deep-sea extraction activities. As the market for electric vehicles grows, so too does the need for metals critical to power many of those vehicles.¹⁸ For this reason, some industry analysts claim the total market value of seabed minerals to be in the billions or even the trillions of dollars.¹⁹ Yet, companies have struggled to demonstrate the feasibility and profitability of

in particular.”); Todd Woody, *France Puts Future of Deep Sea Mining in Doubt*, BLOOMBERG (Nov. 10, 2022), <https://www.bloomberg.com/news/articles/2022-11-10/france-puts-future-of-deep-sea-mining-in-doubt?leadSource=verify%20wall> [<https://perma.cc/L8L5-YY59>] (“As the effects of climate change become increasingly threatening and the erosion of biodiversity continues to accelerate, today it does not seem reasonable to hastily launch a new project, that of deep seabed mining, the environmental impacts of which are not yet known and may be significant for such ancient ecosystems which have a very delicate equilibrium.”).

¹⁶ See Christiana Ochoa, *Contracts on the Seabed*, 46 YALE J. INT’L L. 103, 114 (2021) (“Phosphorite nodules were first discovered on the seabed in 1873 by the crew of the HMS Challenger, the ship that acted ‘as a floating lab for the world’s first large-scale oceanographic expedition, circumnavigating the globe and dredging up samples of never-before-seen creatures from the ocean floor.”).

¹⁷ See Rabone et al., *supra* note 7.

¹⁸ See Davide Castelvecchi, *Electric Cars and Batteries: How Will the World Produce Enough?*, NATURE (Aug. 17, 2021), <https://www.nature.com/articles/d41586-021-02222-1> [<https://perma.cc/Z7D8-53Y8>] (“Anticipating a world dominated by electric vehicles, materials scientists are working on two big challenges. One is how to cut down on the metals in batteries that are scarce, expensive, or problematic because their mining carries harsh environmental and social costs. Another is to improve battery recycling, so that the valuable metals in spent car batteries can be efficiently reused.”); see also, Jeanne Everett, Daniel Kammen & Stan Rowland, *Next Generation EV Batteries Eliminate the Need for Deep Sea Mining*, BLUE CLIMATE INITIATIVE (Oct. 2023) <https://www.blueclimateinitiative.org/sites/default/files/2023-10/whitepaper.pdf> (“Advances in electric vehicle (EV) battery technologies over the last several years have led to the widespread use of EV batteries that don’t use cobalt, nickel or manganese – the primary metals that mining companies seek to mine from the deep sea.”).

¹⁹ Bruno Venditti, *The Metals Company Calls Video of Mining Waste Dumped Into the Sea Misinformation as Stock Sinks*, MININGDOTCOM (Jan. 12, 2023), <https://www.mining.com/the-metals-company-calls-video-of-mining-waste-dumped-into-the-sea-misinformation-as-stock-sinks/> [<https://perma.cc/KM9R-DVAR>] (“Mining in the deep sea is still under study but metals are abundant on the seafloor. Reserves are estimated to be worth anywhere from \$8 trillion to more than \$16 trillion.”); see also EUROPEAN COMMISSION COMMUNICATION, BLUE GROWTH: OPPORTUNITIES FOR MARINE AND MARITIME SUSTAINABLE GROWTH 10 (2012) (“Global annual turnover of marine mineral mining can be expected to grow from virtually nothing to €5 billion in the next 10 years and up to €10 billion by 2030.”).

seabed mining.²⁰ Since 2000, the ISA has granted 31 exploration contracts with 22 contractors, but the viability of commercial exploitation remains unclear.²¹ In the race to reach the ocean floor, companies have voiced few concerns about present gaps in scientific knowledge about deep sea ecology or the absence of sufficient environmental data to evaluate mining impacts.²² Without transparent guidance from the ISA and an effective monitoring and enforcement regime, companies will likely continue to accelerate mining operations, despite the unknown environmental risks.

This Article argues that current ISA exploitation regulations are inadequate to protect ocean life from the environmental harms of deep-sea mining. Presently ISA mining regulations lack clear thresholds to evaluate environmental impacts. There are no standards or testing procedures for when ISA is considering whether proposed mining operations will risk damage to marine environments. There is no agreement on how mining contractors should monitor or report on their commercial mining activities. There is no legally binding guidance on inspection or compliance regimes, and no procedures for public oversight or meaningful stakeholder consultation in relation to ISA rule making or enforcement. Present mechanisms to monitor and enforce contractor compliance depend primarily on contractor self-reporting. The regulatory framework for mining exploitation also presently

²⁰ Lipton, *supra* note 3 (“Interviews and hundreds of pages of emails, letters and other internal documents show that the firm’s executives received key information from the Seabed Authority beginning in 2007, giving a major edge to their mining ambitions.”).

²¹ *Exploration Contracts*, ISA, <https://www.isa.org.jm/exploration-contracts/> [<https://perma.cc/FB3J-DL7L>] (last visited Nov. 20, 2023) (listing 31 contracts between 22 contractors).

²² See Sabine Christiansen et al., *Evaluating the Quality of Environmental Baselines for Deep Seabed Mining*, 9 FRONTIERS IN MARINE SCI. 1, 2 (Aug. 1, 2022) (“As the ISA’s Mining Code itself states, ‘baseline data documenting natural conditions prior to test-mining or testing of mining components are essential in order to monitor changes resulting from these activities and to predict impacts of commercial mining activities.’ Nonetheless, the ISA has been ‘operating in a data-deficient environment, particularly as regards resource data and environmental data for some time.’”); Hannah Lily, *Sponsoring State Approaches to Liability Regimes for Environmental Damage Caused by Seabed Mining*, No. 3 CTR. FOR INT’L GOVERNANCE INNOVATION 1, 10 (Dec. 2018) (“Unlike the ISA, as noted above, sponsoring [S]tates are empowered by the LOSC Annex III, article 21(3) to impose a stricter regime within its national law. Apart from Japan, and, possibly, Belgium, with its incorporation of the polluter pays principles and allowance for future statutory instruments, it appears no [S]tates have taken up this opportunity.”).

contravenes mandatory provisions of the United Nations Convention on the Law of the Sea (UNCLOS) and arguably violates both the precautionary principle and legal requirements that DSM be carried out without causing significant harms to the deep-sea environment.

The Article proceeds in three parts. Part I describes the role and structure of the International Seabed Authority (ISA). With a modest budget of approximately 22 million dollars and few personnel, the agency is responsible for developing and enforcing mining regulations for more than half of the world.²³ Established under Part IX of UNCLOS, the ISA also is legally bound to regulate seabed exploitation for the benefit of all humankind and to protect the deep ocean environment.²⁴ Part I also describes ISA draft exploration and exploitation regulations for deep sea mining and analyzes essential terms related to State Parties' obligations to benefit humankind and protect of marine environments.

Part II compares ISA draft regulations to federal and state mining regulations in the United States, which are presumptively less constrained by legal obligations under UNCLOS because the United States is not a signatory to the agreement. In particular, the Article focuses on rules governing suction dredge mining. Dredge mining regulations aid in the identification of shortfalls in present ISA mining exploitation regulations, including the lack of baseline environmental data and inadequate institutional mechanisms for monitoring and enforcement.

Part III describes the inherent challenges of mining the unknown. Ocean scientists have identified several significant knowledge gaps that prevent the ISA from establishing clear environmental baselines or mining operators from evaluating environmental impacts on the seabed. The Article further argues that the ISA has insufficient institutional capacity to monitor and enforce regulations and inadequate procedures to incorporate important stakeholders, including coastal communities and indigenous groups with close ties to the ocean.

²³ See U.N. ISBA, 27th Sess., U.N. Doc. ISBA/27/A/10 (Aug. 3, 2022).

²⁴ Jeff Ardron et al., *Public Participation in the Governance of Deep-Seabed Mining in the Area*, in RESEARCH HANDBOOK ON INTERNATIONAL MARINE ENVIRONMENTAL LAW 361, 361 (2nd ed. 2023) ("The ISA is thus the sole custodian of the seabed and the natural resources of the Area, which are deemed to be the 'common heritage of [hu]mankind,' a principle so fundamental to the Area that no amendment or derogation from it is permitted.").

The Article concludes with a call for a temporary moratorium on deep sea mining to allow scientists to establish reliable scientific thresholds for environmental impact assessments and permit time for Member States to revise ISA regulations accordingly. A temporary moratorium would also facilitate the harmonization of ISA regulations with the new United Nations Treaty on Biodiversity Beyond National Jurisdiction (BBNJ) and provide time for meaningful stakeholder participation.

I. SEABED MINING REGULATIONS

The United Nations Convention on the Law of the Sea (UNCLOS) establishes that seabed resources should be shared as the common heritage of humankind.²⁵ Therefore, all rights to mineral resources beyond the national jurisdictions of sovereign States are vested in humanity as a whole, without derogation, and any mining operations or exploitation of the seabed is required to benefit all of humankind.²⁶

a. The International Seabed Authority (ISA)

The International Seabed Authority (ISA) is the chief regulatory agency for the international regulation and oversight of seabed mining.²⁷ Established under Part XI of the United Nations Convention of the Law of the Sea (UNCLOS), the ISA has exclusive power to govern seabed exploration and exploitation beyond the national jurisdictions and exclusive economic zones (EEZs) of

²⁵ United Nations Convention on the Law of the Sea art. 136, *opened for signature* Dec. 10, 1982, 1833 U.N.T.S. 397 (entered into force Nov. 16, 1994) [hereinafter UNCLOS].

²⁶ *Id.* art. 311, ¶ 6.

²⁷ *See id.* art. 156, ¶ 1 (“There is hereby established the International Seabed Authority, which shall function in accordance with this Part.”); *id.* art. 143, ¶ 1 (“Marine scientific research in the Area shall be carried out exclusively for peaceful purposes and for the benefit of mankind as a whole, in accordance with Part XIII.”); *id.* art. 153, ¶ 1 (“Activities in the Area shall be organized, carried out and controlled by the Authority on behalf of mankind as a whole in accordance with this article as well as other relevant provisions of this Part and the relevant Annexes, and the rules, regulations and procedures of the Authority.”).

sovereign States.²⁸ In other words, the ISA governs the ocean floor on the “high seas,” defined as the “Area” under international law.²⁹ All UNCLOS Member States seeking to mine the seabed beyond their maritime territories are subject to the ISA’s regulatory oversight.

Several distinct organs constitute the ISA. The Assembly of the ISA includes all ISA members and for this reason is sometimes referred to as the “supreme organ” of the organization.³⁰ The Assembly is responsible for overall governance and general policies.

A more limited group of 36 Member States make up the ISA Council. These States are elected by the Assembly. Serving as the “executive organ” of the ISA, the Council manages oversight and approval of contracts for exploration and exploitation of deep-sea minerals and administers related policies in accordance with UNCLOS principles and obligations.³¹

Another critical organ to deep sea mining is the Legal and Technical Commission (LTC). Separate from the Council, the LTC presently consists of 41 expert members elected by the Council from among the candidates nominated by the State Parties.³² The LTC reviews contractor applications, supervises mining activities, assesses environmental impacts, and recommends updates or revisions to exploration and exploitation rules, regulations and procedures in the Area.³³ However, the LTC does most of its work behind closed doors. Even approved ISA observers are not

²⁸ See *id.* art. 157, ¶ 1 (“The Authority is the organization through which States Parties shall, in accordance with this Part, organize and control activities in the Area, particularly with a view to administering the resources of the Area.”).

²⁹ See *id.*; *id.* art. 1 (“‘Area’ means the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction.”).

³⁰ *Organs of the International Seabed Authority*, INT’L SEABED AUTH., <https://www.isa.org.jm/organs/> [<https://perma.cc/F5WH-S488>] (last visited Nov. 20, 2023) (referring to the Assembly as “supreme organ”).

³¹ *Structure and Mandate of The Council*, INT’L SEABED AUTH., <https://www.isa.org.jm/structure-and-mandate/> [<https://perma.cc/6AJ8-K7L9>] (last visited Nov. 20, 2023) (“As ‘the executive organ of ISA,’ the Council establishes specific policies in conformity with UNCLOS and the general policies set by the Assembly.”).

³² See *Legal and Technical Commission*, INT’L SEABED AUTH., <https://www.isa.org.jm/authority/legal-and-technical-commission> [<https://perma.cc/BXJ6-NDWJ>] (last visited Nov. 20, 2023).

³³ See HIGH SEAS ALLIANCE, SURVEY OF COMPLIANCE/IMPLEMENTATION COMMITTEES (Jul. 2020), https://www.highseasalliance.org/wp-content/uploads/2020/07/Survey-of-Compliance_Implementation-Committees.FINAL_-1.pdf [<https://perma.cc/U9PW-SUNE>] (“The LTC is entrusted with various functions relating to activities in the Area.”).

permitted to access information about mining applications, mining contractors, or intervene regarding LTC recommendations. While the LTC summarizes its work for the Council, it keeps no records of its deliberations or decision-making proceedings for stakeholders or the public.

These separate ISA organs function semi-autonomously, but also have overlapping responsibilities, and, in practice, depend on mutual assistance and cooperation to ensure accountability and oversight of seabed mining activities.

b. ISA Regulations

On July 21, 2023, the ISA Council Meeting ended with no deep-sea mining regulations adopted, despite the expiration of the two-year rule previously triggered by Nauru. Rather, the 36-member body agreed on a non-binding deadline to complete the mining code by July 2025. However, mining companies can now technically submit a mining application for approval by the LTC, even without final regulations in place. Meanwhile, nearly two dozen nations have publicly endorsed a temporary moratorium on mining operations.

ISA mining regulations, often described as the “Mining Code,” govern both exploration and exploitation activities on the ocean floor, including the mining of polymetallic nodules, polymetallic sulphides, and cobalt-rich ferromanganese crusts, among others.³⁴ Mining regulations authorize the seabed activities of private contractors, State sponsors, and commercial enterprises and prevent significant environmental harms to fragile deep sea ecologies.³⁵ Notable provisions in the current regulations include provisions to safeguard the deep ocean against “harm to the marine environment” and ensure the “protection and preservation of the marine environment.”³⁶

ISA officials began drafting the mining regulations in 2014, a process that has involved numerous workshops and expert

³⁴ Int’l Seabed Auth. Council, *Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area*, ISBA/19/C/17 (Apr. 17, 2013) [hereinafter Current Regulations].

³⁵ See Int’l Seabed Auth. Council, *Draft Regulations on Exploitation of Mineral Resources in the Area*, ISBA/25/C/WP.1 (Mar. 22, 2019) [hereinafter Draft Regulations].

³⁶ See Current Regulations, *supra* note 34, Part II, Regulation 5.

consultations to discuss potential social and environmental impacts. Draft mining regulations have been revised in 2016, 2017, 2018, 2023, and further revisions, as well as a consolidated text, are currently being considered by the Council and LTC for formal implementation in the coming years. However, none of these regulations have thus far required mandatory oversight and reporting of incidents with environmental effects. Rather, exploitation regulations primarily rely on self-reporting of environmental incidents, and only then require a downstream set of processes and protocols to mitigate harmful environmental impacts.³⁷ ISA exploration and exploitation regulations have also struggled to establish clear and reliable thresholds for environmental harms.

i. "Harm to the Marine Environment"

ISA regulations have not advanced a consistent definition of harm to the marine environment. Exploration regulations, for example, prohibit prospecting, exploring, or mining if substantial evidence indicates a risk of "serious harm to the marine environment."³⁸ But "serious harm to the marine environment" is generally defined as anything which "represents a significant adverse change in the marine environment."³⁹ Draft regulations

³⁷ See *id.* at 38-39 ("A Contractor shall, in accordance with the terms and conditions of its Environmental Management and Monitoring Plan and these regulations . . . Monitor and report annually under regulation 38 (2) (g) on the Environmental Effects of its activities on the Marine Environment, and manage all such effects as an integral part of its Exploitation activities as set out in the Standards referred to in regulation 45 . . . [and] compile and submit a performance assessment report to the Secretary-General in accordance with, and in the format set out in, the relevant Guidelines.").

³⁸ See Current Regulations, *supra* note 34, Part II, Regulation 2 ("Prospecting shall not be undertaken if substantial evidence indicates the risk of serious harm to the marine environment.").

³⁹ *Id.* Part I, Regulation 1 ("'Serious harm to the marine environment' means any effect from activities in the Area on the marine environment which represents a significant adverse change in the marine environment determined according to the rules, regulations and procedures adopted by the Authority on the basis of internationally recognized standards and practices.").

provide no clear environmental thresholds to determine the constitution of an adverse change to the environment.⁴⁰

Draft language in exploitation regulations differ from previous exploration regulations and fail to clarify the definition of serious harm. Drafts define separately the category of “serious harm” and “marine environment,” though definition of the former references the latter.⁴¹ The proposed definition of “serious harm” includes “any effect from activities in the Area on the Marine Environment which represents a significant adverse change in the Marine Environment determined according to the rules, regulations and procedures adopted by the Authority on the basis of internationally recognized standards and practices informed by Best Available Scientific Evidence.”⁴² But, the proposed language skirts the central challenge of defining with precision what constitutes an “adverse change,” all the while acknowledging that scientific expertise should inform rules, regulations and procedures.

The separate proposed definition of “Marine Environment” in the exploitation regulations includes “the physical, chemical, geological and biological components, conditions and factors which interact and determine the productivity, state, condition and quality and connectivity of the marine ecosystem(s), the waters of the seas and oceans and the airspace above those waters, as well as the seabed ocean floor and subsoil thereof.”⁴³ However, these references also lack clear environmental baselines or science-driven parameters to determine what constitutes a “significant adverse change” to deep sea marine ecology.⁴⁴ Many of these regulatory inadequacies

⁴⁰ See Lisa A. Levin et al., *Defining “Serious Harm” to the Marine Environment in the Context of Deep-Seabed Mining*, 74 MARINE POL’Y 245, 246-48 (2016) (identifying absence of clear definition of adverse change and “serious harm.”).

⁴¹ See Draft Regulations, *supra* note 35, Appendix IV, Schedule (“‘Serious Harm’ means any effect from activities in the Area on the Marine Environment which represents a significant adverse change in the Marine Environment determined according to the rules, regulations and procedures adopted by the Authority on the basis of internationally recognized standards and practices informed by Best Available Scientific Evidence.”).

⁴² *Id.*

⁴³ *Id.*

⁴⁴ See Levin et al., *supra* note 40, at 246-48 (“Unless mining proponents and permitting decision-makers have clear and comprehensive parameters for what constitutes both ‘effective protection’ as well as ‘serious harm’ and associated significant adverse change to the marine environment, there will be a risk that seabed mining could cause unacceptable impacts.”); Christiansen et al., *supra* note 22, at 3 (“While the fundamental importance of baselines is clear, their use in decision-making processes is somewhat less understood. There are at least three governance questions. First, how is the quality of environmental baselines

in DSM have been well-documented elsewhere by policy experts and environmental scientists.⁴⁵

ii. *“Protection and Preservation of the Marine Environment”*

Both current exploration regulations and draft exploitation regulations devote an entire section to the “Protection and preservation of the Marine Environment.”⁴⁶ Though, proposed language for the exploitation regulations reflects a greater deference to the precautionary principle in risk management of deep-sea environmental harms. These regulations, for example, define “best environmental practices” as “the application of the most appropriate combination of environmental control measures and strategies, that will change with time in the light of improved knowledge, understanding or technology, taking into account the guidance set out in the applicable Guidelines.”⁴⁷ The proposed regulations also incorporate references to “Best Available

assessed? There are currently no publicly available criteria for assessing the quality and completeness of baselines. Such criteria are important both for transparency of environmental decision-making and to ensure all contractors are held to the same standard and address comparable questions.”).

⁴⁵ See e.g., Christiansen et al., *supra* note 22; Levin et al., *supra* note 40; Lily, *supra* note 22; Ruth Mackenzie, *Liability for Environmental Harm from Deep Seabed Mining Activities: Defining Environmental Damage*, 8, CTR. FOR INT’L. GOVERNANCE INNOVATION, 1 (2019); Aaron Schwabach, *A Hole in the Bottom of the Sea: Does the UNCLOS Part XI Regulatory Framework for Deep Seabed Mining Provide Adequate Protection Against Strip-Mining the Ocean Floor*, 40 VA. ENV’T. L. J. 39, (2022); Hannah Lily & Elisa Morgera, *Public Participation at the International Seabed Authority: An International Human Rights Law Analysis*, 31 RECIEL 374 (2022); Jennifer M. Durden et al., *Environmental Impact Assessment Process for Deep-Sea Mining in ‘the Area’*, 87 MARINE POL’Y 194, (2017); Pradeep Singh, *Deep Seabed Mining and Sustainable Development Goal 14*, in, LIFE BELOW WATER 1, 1-13 (W. Leal Filho, A. M. Azul, L. Brandli, A. Lange Salvia, & T. Wall eds., 2020); Harald Ginzky, Pradeep Singh & Till Markus, *Strengthening the International Seabed Authority’s Knowledge-Base: Addressing Uncertainties to Enhance Decision-Making*, 114 MARINE POL’Y 103823 (2020).

⁴⁶ See Current Regulations, *supra* note 34, Part V, Regulation 31 (“In order to ensure effective protection for the marine environment from harmful effects which may arise from activities in the Area, the Authority and sponsoring States shall apply a precautionary approach, as reflected in principle 15 of the Rio Declaration, and best environmental practices.”); Draft Regulations, *supra* note 35, Part IV, Regulation 44 (“Apply the precautionary approach, as reflected in principle 15 of the Rio Declaration on Environment and Development, to the assessment and management of risk of harm to the Marine Environment from Exploitation in the Area.”).

⁴⁷ Draft Regulations, *supra* note 35, at Appendix I, Schedule.

Techniques” and “Best Available Scientific Evidence.”⁴⁸ These new definitional terms require ISA officials to integrate technological advancements and internationally recognized methodologies for environmental assessment and preservation.⁴⁹

Proposed exploitation regulations also require the submission of “Environmental Impact Statement[s]” (EIS) and the approval of a comprehensive “Environmental Management and Monitoring Plan.”⁵⁰ Management plans must provide, *inter alia*, details of the applicants’ environmental policy; summaries of potential environmental effects on the marine environment; mitigation measures to minimize environmental harm; descriptions of relevant environmental performance standards; and descriptions of ensuring how the plan will adhere to industry best practices.⁵¹

Environmental impact assessments must further reference ecological baseline assessments established prior to the commencement of mining projects and establish guidelines for how contractors must meet reporting obligations.⁵² Previous exploration regulations merely required contractors to “gather environmental baseline data” to establish and monitor baselines throughout mining projects.⁵³ The change may be suggestive of enhanced protections if scientific study can generate clear environmental baselines.

⁴⁸ *Id.* Part IV, Regulation 44 (“Apply the Best Available Techniques and Best Environmental Practices in carrying out such measures; (c) Integrate Best Available Scientific Evidence in environmental decision-making, including all risk assessments and management undertaken in connection with environmental assessments, and the management and response measures taken under or in accordance with Best Environmental Practices.”).

⁴⁹ *Id.* (“‘Best Available Scientific Evidence’ means the best scientific information and data accessible and attainable that, in the particular circumstances, is of good quality and is objective, within reasonable technical and economic constraints, and is based on internationally recognized scientific practices, standards, technologies and methodologies.”).

⁵⁰ *Id.* Part IV, Section 2 (“Preparation of the Environmental Impact Statement and the Environmental Management and Monitoring Plan”).

⁵¹ *Id.* Annex VII.

⁵² See Current Regulations, *supra* note 34, Annex IV, Section 5 (“Prior to the commencement of exploration activities, the Contractor shall submit to the Authority: (a) An impact assessment of the potential effects on the marine environment of the proposed activities; (b) A proposal for a monitoring program[] to determine the potential effect on the marine environment of the proposed activities; and (c) Data that could be used to establish an environmental baseline against which to assess the effect of the proposed activities.”).

⁵³ See Current Regulations, *supra* note 34, Part V, Regulation 32 (“Each contract shall require the contractor to gather environmental baseline data and to establish environmental baselines, taking into account any recommendations issued by the Legal and Technical Commission pursuant to regulation 39, against which to assess

Any enhancements to environmental protections in draft exploitation regulations, however, may be rendered moot by scientific uncertainty on the long-term environmental harms of DSM. Presently, there is insufficient scientific information or data to demonstrate that deep ocean environments will be unharmed by mining activities. And while the precautionary principle should prevail in such instances of scientific uncertainty and seabed mining activities should be limited or suspended until environmental baselines are established, the proposed exploitation regulations are more forward-looking. While ostensibly more cognizant of environmental protection, contractors' sustainable DSM activities still depend on comprehensive environmental monitoring plans and science-based environmental baselines still absent in draft provisions.⁵⁴

iii. Reporting Requirements

The exploitation regulations also include distinct reporting requirements.⁵⁵ Contractors are obligated to "permit effective reporting to the [ISA] in connection with environmental performance."⁵⁶ However, both ISA exploration and exploitation regulations give significant discretionary power to contractors regarding monitoring and compliance. Contractors, for example, implement their own environmental monitoring programs and self-

the likely effects of its program[] of activities under the plan of work for exploration on the marine environment and a program[] to monitor and report on such effects.").

⁵⁴ See *supra* note 45 and accompanying text (explaining that lack of environmental baselines makes seabed mining an extremely risky endeavor to engage in until its ramifications are better understood).

⁵⁵ See Draft Regulations, *supra* note 35, Section 8, Regulation 38 ("Such annual reports shall include: (a) Details of the Exploitation work carried out during the Calendar Year, including maps, charts and graphs illustrating the work that has been done and the data and results obtained, reported against the approved Plan of Work."); *id.* Section 4, Regulation 51 ("Monitor and report annually under regulation 38 (2) (g) on the Environmental Effects of its activities on the Marine Environment and manage all such effects as an integral part of its Exploitation activities as set out in the Standards referred to in regulation 45"); *id.* Regulation 52 ("A Contractor shall compile and submit a performance assessment report to the Secretary-General in accordance with, and in the format set out in, the relevant Guidelines.").

⁵⁶ *Id.* Part IV, Section 1, Regulation 46.

report annually on a mining projects.⁵⁷ While contractors are required to report to the ISA “any incident arising from activities which have caused, are causing or pose a threat of serious harm to the marine environment,” companies are left to define thresholds of seriousness.⁵⁸ The language mirrors environmental provisions that obligate contractors to report “effects on the marine environment.”⁵⁹ Here too exploitation regulations rely on contractor self-reporting of any “notifiable events” that fall under the regulations.⁶⁰ Though language in the ISA draft exploitation regulations appears more intensive and requires increased contractor monitoring, the reporting scheme still depends on contractors to self-report deviations from environmental monitoring plans or incidents that arise during mining. Considering market incentives to maximize profit and shareholder value, the lack of regular, independent oversight or environmental baselines to conduct environmental assessments invites non-compliance.

iv. Enforcement

Draft mining regulations require some mandatory inspections. Under proposed exploitation regulations, for example, contractors must permit the ISA to send inspectors to monitor contractor compliance and the mining project’s environmental effects.⁶¹

⁵⁷ See Current Regulations, *supra* note 34, Part II, Regulation 6 (“A prospector shall, within 90 days of the end of each calendar year, submit a report to the Authority on the status of prospecting.”); *id.* Part III, Regulation 32 (“The contractor shall report annually in writing to the Secretary-General on the implementation and results of the monitoring program[] referred to in paragraph 1 and shall submit data and information, taking into account any recommendations issued by the Commission pursuant to regulation 39.”).

⁵⁸ *Id.* Annex IV, Section 6; *id.* Part II, Regulation 33; *id.* Annex IV, Section 10 (“Such reports shall also contain: (a) The results obtained from environmental monitoring program[]s, including observations, measurements, evaluations and analyses of environmental parameters.”).

⁵⁹ *Id.* Annex IV, Section 5.

⁶⁰ See Draft Regulations, *supra* note 35, Part III, Section 5, Regulations 34 (“A Contractor shall immediately notify its sponsoring State or States and the Secretary-General of the happening of any of the events listed in appendix I to these regulations.”).

⁶¹ See Current Regulations, *supra* note 34, Annex IX, Section 14 (“The Contract shall permit the Authority to send its inspectors [to] . . . (a) Monitor the Contractor’s compliance with the terms and conditions of this contract and the Regulations; and (b) Monitor the effects of such activities on the marine environment.”).

Regulations also require contractors to allow inspectors at the ISA's behest and further establish inspectors' powers to issue new instructions or obligations to contractors.⁶² Inspectors must also report any findings to the ISA and coastal or flag States with concurrent jurisdiction.⁶³ The draft regulations additionally require all mining vessels and mining collectors to be fitted with remote monitoring technology that transmit activity data to the ISA and the sponsoring State – an obligation absent from the current exploration regulations.⁶⁴ If the ISA has reasonable grounds for suspecting unlawful conduct, the ISA must issue a compliance notice, describe the alleged fault, and require the contractor to take specific responsive action.⁶⁵ If the contractor does not comply within a reasonable period or willfully violates governing law, the ISA has the power to suspend or terminate the mining contract.⁶⁶ The ISA also has power to issue emergency orders should a project give the ISA reasonable belief that mining activities are harming the environment.⁶⁷

⁶² See Draft Regulations, *supra* note 35, Part XI, Section 1, Regulation 96-100.

⁶³ See *id.* Regulation 100 ("At the end of an inspection, the Inspector shall prepare a report, setting out, inter alia, his or her general findings and any recommendations for improvements in procedures or practices by the Contractor.").

⁶⁴ *Id.* Section 2, Regulation 102 ("1. A Contractor shall restrict its mining operations to the Mining Area. 2. All mining vessels and mining collectors shall be fitted with an electronic monitoring system. Such system shall record, inter alia, the date, time and position of all mining activities. The detail and frequency of reporting shall be in accordance with the Guidelines.").

⁶⁵ See *id.* Section 3, Regulation 103 ("At any time, if it appears to the Secretary-General on reasonable grounds that a Contractor is in breach of the terms and conditions of its exploitation contract, the Secretary-General shall issue a compliance notice to the Contractor requiring the Contractor to take such action A compliance notice shall . . . describe the alleged breach The Contract shall be given reasonable opportunity to make representations in writing.").

⁶⁶ *Id.* ("If a Contractor, in spite of warnings by the Authority, fails to implement the measures set out in a compliance notice and continues its activities in such a way as to result in serious, persistent and willful violations of the fundamental terms of the contract, Part XI of the Convention and the rules, regulations and procedures of the Authority, the Council may suspend or terminate the exploitation contract by providing written notice of suspension or termination to the Contractor in accordance with the terms of the exploitation contract.").

⁶⁷ See Current Regulations, *supra* note 34, Part IV, Regulation 33 ("The Council, taking into account the recommendations of the Commission, the report of the Secretary-General, any information provided by the contractor and any other relevant information, may issue emergency orders, which may include orders for the suspension or adjustment of operations, as may be reasonably necessary to

v. *Liability*

Under proposed mining regulations, contractors are liable for the “actual amount of any damage, including damage to the marine environment” that results from wrongful conduct by the contractor or their agents.⁶⁸ Conversely, the ISA is liable to contractors for damages arising from the ISA’s wrongful exercise of its powers.⁶⁹ However, absent clear environmental baselines, liability may be difficult to establish in administrative or legal proceedings. Parties will likely be unable to quantify observable harms or demonstrate contractor liability. This also generates uncertainty about how potential claims may be brought or resolved by outside stakeholders, including indigenous groups or coastal communities impacted by DSM.

vi. *Jurisdiction*

Draft regulations also raise jurisdictional questions, particularly as it relates to State sponsors. ISA draft regulations require contractors to take protective measures against environmental harm to the “jurisdiction or sovereignty of a coastal State.”⁷⁰ Additionally,

prevent, contain and minimize serious harm or the threat of serious harm to the marine environment arising out of activities in the Area.”).

⁶⁸ See *id.* Annex IV, Section 16 (“The Contractor shall be liable for the actual amount of any damage, including damage to the marine environment, arising out of its wrongful acts or omissions, and those of its employees, subcontractors, agents and all persons engaged in working or acting for them in the conduct of its operations under this contract, including the costs of reasonable measures to prevent or limit damage to the marine environment, account being taken of any contributory acts or omissions by the Authority.”); Draft Regulations, *supra* note 35, at Annex X, Section 7 (“The Contractor shall be liable to the Authority for the actual amount of any damage, including damage to the Marine Environment, arising out of its wrongful acts or omissions, and those of its employees, subcontractors, agents and all persons engaged in working or acting for them in the conduct of its operations under this Contract . . .”).

⁶⁹ See Current Regulations, *supra* note 34, Annex IV, Section 16 (“The Authority shall be liable for the actual amount of any damage to the Contractor arising out of its wrongful acts in the exercise of its powers and functions.”); Draft Regulations, *supra* note 35, Annex X, Section 7 (“The Authority shall be liable to the Contractor for the actual amount of any damage caused to the Contractor arising out of its wrongful acts in the exercise of its powers and functions.”).

⁷⁰ Draft Regulations, *supra* note 35, Part I, Regulation 4 (“Contractors shall take all measures necessary to ensure that their activities are conducted so as not to cause Serious Harm to the Marine Environment, including, but not restricted to,

contractors are obligated to “comply with the national laws of its sponsoring State or States to any matters that fall outside the jurisdiction of the flag State.”⁷¹ These regulatory provisions reflect a general principle of maritime law that a vessel’s flag State has controlling jurisdiction in the absence of superseding international law. But questions remain in the DSM context because some sovereign States have yet to enact laws that address liability stemming from offshore environmental disasters or mining harms.⁷² While ISA draft regulations make progress toward concrete liability rules for flag States, there is no ISA precedent for conflicts of laws for deep sea environmental disasters.

II. UNITED STATES MINING REGULATIONS

Beyond harmonizing the ISA mining code with the new BBNJ agreement, ISA Member States may also consider domestic approaches to mining regulation. Many countries have already enacted legislation or regulations to govern seabed mining or developed regulatory regimes for related mining activities that can inform the ISA mining code. The following section explores various federal and state mining regulations in the United States to help illustrate current shortcomings of the ISA draft regulations.

a. The Deep Seabed Hard Mineral Resources Act (DSHMRA)

In 1980, the U.S. Congress enacted The Deep Seabed Hard Mineral Resources Act (DSHMRA) to establish a legal regime for the exploration and exploitation of seabed mineral resources, pending

pollution, under the jurisdiction or sovereignty of coastal States, and that such Serious Harm or pollution arising from Incidents in their Contract Area does not spread into areas under the jurisdiction or sovereignty of a coastal State.”).

⁷¹ *Id.* Section 3, Regulation 30 (“In addition, Contractors shall: (a) Comply with the relevant national laws relating to vessel standards and crew safety of their flag State in the case of vessels, or their sponsoring State or States in the case of Installations; and (b) Comply with the national laws of its sponsoring State or States in relation to any matters that fall outside of the jurisdiction of the flag State, such as worker rights for non-crew members and human health and safety that pertains to the mining process rather than to ship operation.”).

⁷² See Lily, *supra* note 22, at 10 (“Unlike the ISA, as noted above, sponsoring [S]tates are empowered by the LOSC Annex III, article 21(3) to impose a stricter regime within its national law.”).

the creation of an international regime to govern seabed mining.⁷³ The DSHMRA outlined an approval process for seabed exploration and exploitation in areas under U.S. jurisdiction. It also included sections on environmental protection and the conservation of natural resources.⁷⁴ Section 1419(a)(1), for example, directs mining companies to assess “the effects on the environment from exploration and commercial recovery activities”⁷⁵ Section 1419 further requires:

The program shall include the development, acceleration, and expansion, as appropriate, of studies of the ecological, geological, and physical aspects of the deep seabed in general areas of the ocean where exploration and commercial development under the authority of this chapter are likely to occur, including, but not limited to –

- (A) natural diversity of the deep seabed biota;
- (B) life histories of major benthic, midwater, and surface organisms most likely to be affected by commercial recovery activities;
- (C) long- and short-term effects of commercial recovery on the deep seabed biota; and
- (D) assessment of the effects of sea-based processing activities.⁷⁶

The DSHMRA, therefore, set out a process to ensure the protection of the marine environment, even as the legislation explicitly recognized benefits of deep-sea exploitation.⁷⁷ U.S. companies engaged in seabed mining activities beyond coastal waters could also be subjected to other U.S. federal laws, including the Marine Mammal Protection Act and the Clean Water Act.⁷⁸

⁷³ 30 U.S.C. § 1441.

⁷⁴ *Id.* §§ 1419-20.

⁷⁵ *Id.* § 1419.

⁷⁶ *Id.* § 1419.

⁷⁷ Congress stated the purposes of DSHMRA are to “encourage the successful conclusion of a comprehensive [UNCLOS]” and to “assure that such exploration and recovery activities are conducted in a manner which will encourage the conservation of such resources, protect the quality of the environment, and promote the safety of life and property at sea” *See id.* § 1401.

⁷⁸ *See* Marine Mammal Protection Act, 16 U.S.C. §§ 1361-1423h; Clean Water Act, 33 U.S.C. §§ 1251-1387.

b. Federal Regulations

The Clean Water Act (CWA) authorizes mining operations through federal permits. The CWA maintains quality standards for surface waters and prohibits discharges of pollutants into navigable waters without a permit. A suction dredge mining program, for example, must comply with multiple permitting programs: (1) Section 404 permit issued by the U.S. Army Corps of Engineers or (2) Section 402 National Pollutant Discharge Elimination System (NPDES) permit issued by the U.S. Environment Protection Agency (EPA).⁷⁹ Section 404 permits authorize “the discharge of dredged or fill material into navigable waters at specified disposal sites.”⁸⁰ Mining operators must work with the Corps of Engineers to ensure the mining does not harm the environment and that navigation to waters is not disrupted by the mining operation. Section 402 establishes the NPDES permit system which authorizes mining programs that discharge pollutants from discrete conveyances, or point sources, into waters subject to federal jurisdiction.⁸¹ Section 303 requires that states designate water quality standards and identify “impaired waters,” under which miners must obtain state certification of compliance.⁸²

⁷⁹ See Clean Water Act, 33 U.S.C.A. § 1342(a), (“Except as provided in sections 1328 and 1344 of this title, the Administrator may, after opportunity for public hearing issue a permit for the discharge of any pollutant, or combination of pollutants, notwithstanding section 1311(a) of this title, upon condition that such discharge will meet either (A) all applicable requirements under sections 1311, 1312, 1316, 1317, 1318, and 1343 of this title, or (B) prior to the taking of necessary implementing actions relating to all such requirements, such conditions as the Administrator determines are necessary to carry out the provisions of this chapter.”); *id.* § 1344(a) (“The Secretary may issue permits, after notice and opportunity for public hearings for the discharge of dredged or fill material into the navigable waters at specified disposal sites.”).

⁸⁰ See *id.* § 1344(a).

⁸¹ See *id.* § 1342(a).

⁸² See Adrienne DelCotto, *Suction Dredge Mining: The United States Forest Services Hands Miners the Golden Ticket*, 40 ENV'T L. 1021, 1045-46 (2010) (“In compliance with the Clean Water Act, a “law of the United States,” a federal mining permit cannot issue until the applicable state certifies that the federal permit complies with all applicable provisions of the CWA; under section 402 of the CWA, miners must obtain a National Pollution Discharge Elimination System (NPDES) permit for any discharge from a point source into navigable waters, including those on federal lands. Section 404 of the CWA prohibits discharges of dredged or fill material into navigable waters without a dredge and fill permit.”); see also *Water, NAT'L MINING ASS'N*, <https://nma.org/category/water/> [<https://perma.cc/A483-H356>] (last visited Nov. 21, 2023).

State governors wishing to grant a permit to a mining operation that discharges into navigable waters are free to do so provided that the governor submits a description of the mining program to the EPA with a statement from the Attorney General, and state law allows such mining operations.⁸³ The EPA will approve the permits issued by proper state authorities.⁸⁴ Notably, the public must receive notice of any affected waters and be provided an opportunity for public hearing before the EPA issues the permit.⁸⁵ A federal mining permit cannot issue until the applicant state certifies that the permit complies with all provisions in the CWA.⁸⁶

The CWA also sets national water quality standards with a stated goal, among others, of “protection and propagation of fish, shellfish and wildlife.”⁸⁷ The water quality criteria quantify the

⁸³ See Clean Water Act, 33 U.S.C.A. § 1342(b) (“At any time after the promulgation of the guidelines required by subsection (i)(2) of section 1314 of this title, the Governor of each State desiring to administer its own permit program for discharges into navigable waters within its jurisdiction may submit to the Administrator a full and complete description of the program it proposes to establish and administer under State law or under an interstate compact.”).

⁸⁴ *Id.* (“The Administrator shall approve each submitted program unless he determines that adequate authority does not exist . . .”).

⁸⁵ *Id.* § 1342(B)(2) (“The Administrator shall approve each submitted program unless he determines that adequate authority does not exist . . . to inspect, monitor, enter, and require reports to at least the same extent as required in section 1318 of this title.”); *id.* § 1318(a)(A) (“the Administrator shall require the owner or operator of any point source to (i) establish and maintain such records, (ii) make such reports, (iii) install, use, and maintain such monitoring equipment or methods (including where appropriate, biological monitoring methods), (iv) sample such effluents (in accordance with such methods, at such locations, at such intervals, and in such manner as the Administrator shall prescribe), and (v) provide such other information as he may reasonably require . . .”).

⁸⁶ See *id.* § 1341(a) (“Any applicant for a Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters, shall provide the licensing or permitting agency a certification from the State in which the discharge originates or will originate, or, if appropriate, from the interstate water pollution control agency having jurisdiction over the navigable waters at the point where the discharge originates or will originate, that any such discharge will comply with the applicable provisions of [the CWA].”); see also DelCotto, *supra* note 82, at 1045 (“In compliance with the Clean Water Act, a “law of the United States,” a federal mining permit cannot issue until the applicable state certifies that the federal permit complies with all applicable provisions of the CWA . . .”).

⁸⁷ 40 C.F.R. § 131.2 (2015). (“‘Serve the purposes of the Act’ (as defined in sections 101(a)(2) and 303(c) of the Act) means that water quality standards should, wherever attainable, provide water quality for the protection and propagation of fish, shellfish and wildlife and for recreation in and on the water and take into consideration their use and value of public water supplies, propagation of fish,

highest concentration of particular pollutants permitted in a body of water that does not pose significant risk to the majority of species in a particular environment.⁸⁸ However, these are minimum environmental thresholds. States are expressly granted the authority to enact more stringent regulations than those required under the CWA.⁸⁹ The CWA contains a comprehensive list of sixty-five broad categories of toxic pollutants that the EPA can consider before issuance of suction dredge permits – the Toxic Pollutant List.⁹⁰ The CWA also contains a Priority Pollutant list which clarifies the Toxic Pollutant List in that it explicitly lists the individual pollutants within the categories of the Toxic Pollutant List.⁹¹ The EPA uses these categories to develop national discharge standards that will then apply on the state level to permitted mining operations.⁹² The statutory language implicitly grants the EPA authority to customize NPDES permits to ensure suitability for local waterways and to address the relevant pollutants for a particular jurisdiction. Thus, NPDES permits enumerate all pollutants for which the mining operation must report violations of maximum daily discharges to

shellfish, and wildlife, recreation in and on the water, and agricultural, industrial, and other purposes including navigation.”).

⁸⁸ *National Recommended Water Quality Criteria – Aquatic Life Criteria Table*, EPA, <https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table> [<https://perma.cc/XAL4-XDVF>] (last updated Aug. 25, 2023) (“This table contains the most up to date criteria for aquatic life ambient water quality criteria.”) [hereinafter *National Water Quality Criteria*].

⁸⁹ 40 C.F.R. § 131.4(a) (1994) (“States may develop water quality standards more stringent than required by this regulation.”).

⁹⁰ 40 C.F.R. § 401.15 (1981) (“The following comprise the list of toxic pollutants designated pursuant to section 307(a)(1) of the Act.”).

⁹¹ 40 C.F.R. § 423, Appendix A (“126 Priority Pollutants.”) (2015).

⁹² See EPA, PRIORITY POLLUTANT LIST (Dec. 2014), <https://www.epa.gov/sites/default/files/2015-09/documents/priority-pollutant-list-epa.pdf> [<https://perma.cc/KZL9-EGDW>] (“These are not the only pollutants regulated in Clean Water Act programs. The list is an important starting point for EPA to consider, for example, in developing national discharge standards (such as Effluent Guidelines) or in national permitting programs (such as NPDES).”).

relevant agencies.⁹³ Mining companies must further report discharges that exceed effluent limitations listed in their permit.⁹⁴

The overarching goal of the EPA, CWA, and NPDES permitting system is to *improve* water quality and protect marine environments.⁹⁵ The EPA's broad enforcement scheme helps to ensure mining operators do not act unlawfully or impermissibly pollute the environment. National EPA "standards of performance" also seek to maximize any effluent reduction achievable by the best available technology.⁹⁶ In revising existing standards of performance, the EPA is obligated to consider the "cost" of achieving the desired effluent reduction as well as *any* environmental impact.⁹⁷ The CWA also establishes the National Study Commission, which is granted power to study and investigate the economic, social, and environmental effects of achieving the effluent reduction goals.⁹⁸ Beyond these national baseline standards,

⁹³ 40 C.F.R. § 122.44(g) (1983) ("Twenty-four-hour reporting. Pollutants for which the permittee must report violations of maximum daily discharge limitations under § 122.41(1)(6)(ii)(C) (24-hour reporting) shall be listed in the permit. This list shall include any toxic pollutant or hazardous substance, or any pollutant specifically identified as the method to control a toxic pollutant or hazardous substance.").

⁹⁴ 40 C.F.R. § 122.41(l)(6)(ii)(A)-(B) (2020) ("(ii) The following shall be included as information which must be reported within 24 hours under this paragraph. (A) Any unanticipated bypass which exceeds any effluent limitation in the permit. (B) Any upset which exceeds any effluent limitation in the permit.").

⁹⁵ *National Enforcement and Compliance Initiative: Reducing Significant Non-Compliance with National Pollutant Discharge Elimination System (NPDES) Permits*, EPA, <https://www.epa.gov/enforcement/national-enforcement-and-compliance-initiative-reducing-significant-non-compliance> [https://perma.cc/9HKD-6KMW] (last updated Dec. 22, 2022) ("The objective of this initiative is to improve surface water quality by assuring that all NPDES permittees are complying with their permits.").

⁹⁶ Clean Water Act (CWA), 33 U.S.C. § 1316(a)(1) (1972) ("The term 'standard of performance' means a standard for the control of the discharge of pollutants which reflects the greatest degree of effluent reduction which the Administrator determines to be achievable through application of the best available demonstrated control technology, processes, operating methods, or other alternatives, including, where practicable, a standard permitting no discharge of pollutants.").

⁹⁷ *Id.* § 1316(b)(1)(B) (emphasis added) ("In establishing or revising Federal standards of performance for new sources under this section, the Administrator shall take into consideration the cost of achieving such effluent reduction, and any non-water quality, environmental impact and energy requirements.").

⁹⁸ *See id.* § 1325(a) ("There is established a National Study Commission, which shall make a full and complete investigation and study of all of the technological aspects of achieving, and all aspects of the total economic, social, and environmental effects of achieving or not achieving, the effluent limitations and goals set forth for 1983 in section 1311(b)(2) of this title.").

states are permitted to enact their own performance standards to improve local environmental regulations.⁹⁹

Mining operators are generally obligated under state and federal law to maintain records, install monitoring equipment including biological monitoring methods, and to sample any discharges whenever reasonably required.¹⁰⁰ The EPA has authority to inspect any mining operation where discharges are occurring, and to access any records, or check monitoring equipment.¹⁰¹ Mining records associated with an operation must also be made public unless the company can show that such public disclosure would divulge trade secrets.¹⁰² Beyond the EPA's monitoring and enforcement requirements, states are again permitted to enact their own laws to increase transparency and raise standards for inspection and monitoring.¹⁰³

⁹⁹ See *id.* § 1316(c) ("Each State may develop and submit to the Administrator a procedure under State law for applying and enforcing standards of performance for new sources located in such State. If the Administrator finds that the procedure and the law of any State require the application and enforcement of standards of performance to at least the same extent as required by this section, such State is authorized to apply and enforce such standards of performance (except with respect to new sources owned or operated by the United States).").

¹⁰⁰ Clean Water Act (CWA), 33 U.S.C. § 1318(a)(A) (1987) ("the Administrator shall require the owner or operator of any point source to (i) establish and maintain such records, (ii) make such reports, (iii) install, use, and maintain such monitoring equipment or methods (including where appropriate, biological monitoring methods), (iv) sample such effluents (in accordance with such methods, at such locations, at such intervals, and in such manner as the Administrator shall prescribe), and (v) provide such other information as he may reasonably require.").

¹⁰¹ *Id.* § 1318(a)(B) ("the Administrator . . . (i) shall have a right of entry to, upon, or through any premises in which an effluent source is located or in which any records required to be maintained under clause (A) of this subsection are located, and (ii) may at reasonable times have access to and copy any records, inspect any monitoring equipment or method required under clause (A), and sample any effluents which the owner or operator of such source is required to sample under such clause.").

¹⁰² Clean Water Act (CWA), 33 U.S.C. § 1318(a)(B) (1987) ("(i) shall have a right of entry to, upon, or through any premises in which an effluent source is located or in which any records required to be maintained under clause (A) of this subsection are located, and (ii) may at reasonable times have access to and copy any records, inspect any monitoring equipment or method required under clause (A), and sample any effluents which the owner or operator of such source is required to sample under such clause.").

¹⁰³ *Id.* § 1318(c) ("If the Administrator finds that the procedures and the law of any State relating to inspection, monitoring, and entry are applicable to at least the same extent as those required by this section, such State is authorized to apply and enforce its procedures for inspection, monitoring, and entry with respect to point sources located in such State (except with respect to point sources owned or operated by the United States).").

Both the EPA and the U.S. Army Corps of Engineers can exercise enforcement authority for a Section 404 permit.¹⁰⁴ The EPA has multiple methods of enforcement under Section 404 and Section 309 to prevent violations and protect the environment.¹⁰⁵ Under Section 309, for example, the EPA and Corps can issue compliance orders requiring violators to cease illegal discharge activity and assess daily penalties of up to \$16,000 with a cap of \$187,500.¹⁰⁶ Alternatively, the EPA or Corps may pursue judicial enforcement under Section 309 seeking injunctive relief in the form of restoration, civil penalties, and also criminal action for negligently or knowingly violating Section 404 – which is, in practice, the discharge of a pollutant from a point source into a water of the United States without an NPDES or 404 permit, or in violation of a permit.¹⁰⁷ Criminal penalties for negligent violations can include up to one year imprisonment, or a fine not less than \$2,500, and not more than \$25,000 per day of violation, or both.¹⁰⁸ Knowing violations carry a penalty of imprisonment up to 3 years or a fine not less than \$5,000 and not more than \$50,000 per day of violation, or both.¹⁰⁹ Whether negligent

¹⁰⁴ *Enforcement Under CWA Section 404*, EPA, <https://www.epa.gov/cwa-404/enforcement-under-cwa-section-404> [<https://perma.cc/R9J4-DR7Z>] (last updated Apr. 04, 2023) (“When the U.S. Army Corps of Engineers (Corps) is the permitting authority, EPA and the Corps share Section 404 enforcement authority.”).

¹⁰⁵ *See id.* (“EPA’s Section 404 enforcement program has three goals: protect the environment and human health and safety, deter violations, and treat the regulated community fairly and equitably.”).

¹⁰⁶ *See id.* (“In administrative enforcement, under Section 309(a), EPA can issue administrative compliance orders requiring a violator to stop any ongoing illegal discharge activity and, where appropriate, to remove the illegal discharge and otherwise restore the site. Under Section 309(g), EPA can assess administrative civil penalties of up to \$16,000 per day of violation, with a maximum cap of \$187,500 in any single enforcement action.”).

¹⁰⁷ *Enforcement under CWA Section 404*, EPA, <https://www.epa.gov/cwa-404/enforcement-under-cwa-section-404> [<https://perma.cc/R9J4-DR7Z>] (last updated Apr. 4, 2023) (“In judicial enforcement, Sections 309(b) and (d) and 404(s) give EPA and the Corps the authority to take civil judicial enforcement actions, seeking restoration and other types of injunctive relief, as well as civil penalties. The agencies also have authority under Section 309(c) to bring criminal judicial enforcement actions for knowingly or negligently violating Section 404.”); Clean Water Act, 33 U.S.C.A. § 1319(c)(1)-(2).

¹⁰⁸ Clean Water Act, 33 U.S.C. § 1319(c)(1)(A)-(B) (2019) (“Any person who . . . negligently violates [the CWA] shall be punished by a fine of not less than \$2,500 nor more than \$25,000 per day of violation, or by imprisonment for not more than 1 year, or by both.”).

¹⁰⁹ *Id.* (c)(2)(A)-(B) (“Any person who . . . negligently violates [the CWA] shall be punished by a fine of not less than \$5,000 nor more than \$50,000 per day of violation, or by imprisonment for not more than 3 years, or by both.”).

or knowing, repeat offenders are punished far more harshly for subsequent convictions.¹¹⁰ The CWA also levies additional penalties for fraudulent material conduct in any document filed or maintained under the CWA—this includes tampering with or falsifying any monitoring devices or methods.¹¹¹

c. State Mining Regulations

State regulations can layer on environmental protections. However, these state regulations vary from outright bans to permissive licenses and few penalties for noncompliance. California, Oregon, and Idaho illustrate the range of protections and regulatory frameworks present at the state level.

i. California

California has banned several kinds of offshore mining in recent decades, citing fears of environmental harm.¹¹² In 2009, for example, the legislature placed a moratorium on suction dredge mining until the California Department of Fish and Wildlife (CDFW) conducted an environmental review of the existing regulations and permit

¹¹⁰ *Id.* (“If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than \$100,000 per day of violation, or by imprisonment of not more than 6 years, or by both.”); *id.* (c)(1)(A)-(B) (“If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than \$50,000 per day of violation, or by imprisonment of not more than 2 years, or by both.”).

¹¹¹ Clean Water Act, 33 U.S.C. § 1319(c)(4) (2019) (“Any person who knowingly makes any false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under this chapter or who knowingly falsifies, tampers with, or renders inaccurate any monitoring device or method required to be maintained under this chapter, shall upon conviction, be punished by a fine of not more than \$10,000, or by imprisonment for not more than 2 years, or by both.”).

¹¹² See S.B. 670, Reg. Sess. (Cal. 2009) (“The Legislature finds that suction or vacuum dredge mining results in various adverse environmental impacts to protected fish species, the water quality of this state, and the health of the people of this state, and, in order to protect the environment and the people of California pending the completion of a court-ordered environmental review by the Department of Fish and Game and the operation of new regulations, as necessary, it is necessary that this act take effect immediately.”).

program.¹¹³ In 2012, the CDFW determined that suction dredge mining would cause significant and unavoidable environmental harm and thus upheld the 2009 moratorium.¹¹⁴ The CDFW also made recommendations for amendments to the California Fish and Game Code (FGC) within S.B. 673, which granted the CDFW power to regulate suction dredge mining in 2015.¹¹⁵ Mining advocates challenged California's moratorium in *People v. Rinehart*, arguing the moratorium on suction dredge mining was preempted by federal law that allowed the practice of dredge mining on federal land.¹¹⁶ The California Supreme Court ruled in favor of the moratorium, overturning the Court of Appeal's ruling that the moratorium was commercially impracticable.¹¹⁷ One of the key mining prohibitions since codified disallows the FGC's issuance of dredge mining permits unless the permitting program would "fully mitigate all identified significant environmental impacts."¹¹⁸ The FGC initially targeted mining operations that were deleterious to fish, though S.B. 637 and the subsequent amendments to the code have targeted any

¹¹³ See S.B. 637, Reg. Sess. (Cal. 2015) ("In March 2012, the Department of Fish and Wildlife completed the court-ordered environmental review and rulemaking effort, certifying the environmental impact report and adopting updated regulations to implement . . .").

¹¹⁴ *Id.* ("In certifying the environmental impact report and adopting the regulations, the department found, for purposes of the California Environmental Quality Act (CEQA), that, among other things, significant effects on the environment had to be mitigated to the extent feasible consistent with enabling statutory authority directing the department to promulgate the updated regulations, but the use of vacuum or suction dredging equipment to extract minerals would result in various significant and unavoidable environmental effects beyond the substantive reach of the department in promulgating the regulations.").

¹¹⁵ *Id.* ("The report provides specific recommendations for statutory amendments necessary to modernize the regulation of suction dredge mining under the Fish and Game Code . . .").

¹¹⁶ See *People v. Rinehart*, 230 Cal. App. 4th 419 (2014); *People v. Rinehart*, 340 P.3d 1044 (Cal. 2015); *People v. Rinehart* 377 P.3d 818 (Cal. 2016).

¹¹⁷ See *People v. Rinehart*, 377 P.3d at 830 ("Additionally, Rinehart urges the moratorium is preempted by title 30 United States Code section 612(b). We conclude no basis for preemption has been shown.").

¹¹⁸ See CAL. FISH & GAME CODE § 5653.1(b)(4) (West 2012) ("The new regulations described in paragraph (2) fully mitigate all identified significant environmental impacts.").

environmental harm whatsoever.¹¹⁹ California also enacted criminal penalties for violators of the ban on suction dredge mining.¹²⁰

ii. Oregon

Oregon, in contrast to California, has adopted a more moderate approach to offshore mining. Due to an influx of suction dredge mining,¹²¹ state officials in 2017 enacted a five-year moratorium on suction dredge mining and other motorized suction dredging in particular habitats.¹²² The Oregon legislature also convened to incorporate language from the moratorium into state law. As a result, Oregon regulations now require permits for mining operations affecting indigenous salmonids and their habitats, including chum, sockeye, Chinook and Coho salmon, and steelhead and cutthroat trout.¹²³

¹¹⁹ See *id.*; S.B. 637, Reg. Sess. (Cal. 2015); *Suction Dredge Permits*, CAL. DEP'T FISH & WILDLIFE, <https://wildlife.ca.gov/Licensing/Suction-Dredge-Permits> [<https://perma.cc/D5NP-HSSV>] (last updated Dec. 27, 2022) ("SB 637 amends Fish and Game Code section 5653 as follows: . . . Conditions Department issuance of permits on regulations implementing the section that must ensure the use of vacuum or suction dredge equipment will not cause any significant effects to fish and wildlife, as opposed to prior law which conditioned the issuance of permits on regulations ensuring suction dredging would not be deleterious to fish.").

¹²⁰ See CAL. FISH & GAME CODE § 12000(a) (West 2018); CAL. PENAL CODE § 19 (West 2019).

¹²¹ See Tracy Loew, *Suction Dredge Miners Recast Themselves as Aquatic Health Technicians, Seek Oregon Funds*, STATESMAN J. (Feb. 11, 2019), <https://www.statesmanjournal.com/story/news/2019/02/11/oregon-suction-dredge-miners-seek-state-funds-streamsavers/2807374002/> [<https://perma.cc/XAF8-5L5V>] ("California put a moratorium on suction dredge mining in 2009. Following that ban, large numbers of suction dredge miners moved to the rivers of Southern Oregon.").

¹²² S.B. 838, Reg. Sess. § 2 (Or. 2013) ("(1) A moratorium is imposed until January 2, 2021, on mining that uses any form of motorized equipment for the purpose of extracting gold, silver or any other precious metal from placer deposits of the beds or banks of the waters of this state, as defined in ORS 196.800, or from other placer deposits, that results in the removal or disturbance of streamside vegetation in a manner that may impact water quality.").

¹²³ See OR. REV. STAT. § 196.810(1)(b) (2022) ("Notwithstanding the permit requirements of this section and notwithstanding the provisions of ORS 196.800 (3) and (13), if any removal or fill activity is proposed in essential indigenous anadromous salmonid habitat, except for those activities customarily associated with agriculture, a permit is required."); OR. REV. STAT. § 196.810 at (g)(C) ("'Indigenous anadromous salmonid' means chum, sockeye, Chinook and Coho salmon, and steelhead and cutthroat trout, that are members of the family

However, the Oregon Department of Environmental Quality, pursuant to the CWA, now issues NPDES permits for some offshore mining, except where particular wildlife species or waterways are put at risk.¹²⁴ The state permits also limit the size of suction dredge hoses, particularly in protected salmonid habitats.¹²⁵ Even outside of protected habitats, a dredge mining hose is limited to a six-inch diameter.¹²⁶ Regulation of the hose size helps to prevent turbidity and reduces sediment plume impacts on the water sources and any wildlife habitats contained in them.¹²⁷ The effluent limitations under the permit forbid visible turbidity more than 300 feet downstream of the mining operation, and if this baseline is breached, the mining operation must be modified or cease altogether.¹²⁸ Discharges must be monitored with flow measurement devices with a maximum deviation of plus or minus ten percent from true discharge rates.¹²⁹

Salmonidae and are listed as sensitive, threatened or endangered by a state or federal authority.”).

¹²⁴ OR. DEP’T OF ENV’T QUALITY, GENERAL PERMIT: 700PM, NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (2020), <https://www.oregon.gov/deq/FilterPermitsDocs/700pmp permit.pdf> [<https://perma.cc/MZH3-8EKD>] [hereinafter OREGON PERMIT].

¹²⁵ *Id.* (“This general permit provides coverage under the National Pollutant Discharge Elimination System for four kinds of discharges: Discharges from motorized suction dredges not exceeding 30 horsepower and suction hoses with inside diameters no larger than four inches in diameter that do not operate in essential salmon habitat . . . Discharges from gravity or siphon suction dredges with suction hoses with inside diameters no larger than four inches in diameter that operate in essential salmon habitat.”).

¹²⁶ *Id.* (“Discharges from gravity or siphon suction dredges with suction hoses with inside diameters no larger than six inches in diameter that do not operate in essential salmon habitat.”).

¹²⁷ See *Suction Dredge Gold Mining: From Crisis to Solution*, OR. COAST. ALLIANCE, <https://oregoncoastalliance.org/suction-dredge-gold-mining-from-crisis-to-working-on-solutions/#:~:text=Oregon%20has%20always%20allowed%20suction,is%20the%20southwest%20Oregon%20coast.> [<https://perma.cc/4XMZ-P2JY>] (last visited Nov. 21, 2023) (“The problem with suction dredges is the way they churn up the riverbed. A principal issue is turbidity caused by the dredge activity; it clogs fish gills and coats gravel beds important for salmon feeding and spawning.”).

¹²⁸ OREGON PERMIT, *supra* note 124, at 8 (“Discharges from suction dredges and in-water non-motorized equipment authorized by this permit must not create visible turbidity above background beyond 300 feet downstream or down current of the mining operation. In no case may visible turbidity cover the entire wetted perimeter (from stream bank to opposite stream bank”); see *supra* note 124 and accompanying text.

¹²⁹ OREGON PERMIT, *supra* note 124, at 21 (“Appropriate flow measurement devices and methods consistent with accepted scientific practices must be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices must be installed, calibrated and maintained to

Further, mining is prohibited where “fish eggs are present” or other types of vulnerable fish or mussels.¹³⁰ The Oregon permit contains the same limits on changes in discharge of a toxic pollutant under the CWA.¹³¹

State violations in Oregon are classified as civil penalties and limited to a \$2,000 fine.¹³² But, Oregon holds mining parties strictly liable for any contamination, destruction, or pollution that exceeds the parameters set forth in the mining permit.¹³³ Wrongdoers are responsible for the value of the fish and wildlife and for habitat restoration costs.¹³⁴ Additionally, some kinds of unlawful water pollution are prosecuted as criminal felonies punishable by a fine up to \$250,000 and imprisonment up to ten years.¹³⁵ State law

insure that the accuracy of the measurements is consistent with the accepted capability of that type of device.”).

¹³⁰ *Id.* at 12 (“3. Mining equipment, including suction dredges and in-water non-motorized mining equipment must not be used where fish eggs are present. 4. No activities authorized by this permit, including operation of mining equipment, location of mining equipment, or turbid discharge, may obstruct a migrating fish from advancing upstream or downstream. 5. Mining equipment, including suction dredges and in-water non-motorized mining equipment must not be used where live freshwater mussels are present. Operations must be relocated if live mussels are encountered during excavation. 6. Mining equipment, including suction dredges and in-water non-motorized mining equipment must not be used where Pacific lamprey ammocoetes (larvae) are present.”).

¹³¹ *Id.* at 24 (“The permittee must notify DEQ as soon as it knows or has reason to believe the following: a. That any activity has occurred or will occur that would result in the discharge, on a routine or frequent basis, of any toxic pollutant that is not limited in the permit, if that discharge will exceed the highest of the following ‘notification levels . . .’”).

¹³² *See* S.B. 3, 79th Leg. Assemb., Reg. Sess., § 8 (Or. 2017) (“Subject to ORS 153.022, unlawful motorized in-stream placer mining is a Class A violation.”); OR. REV. STAT. § 153.018 (2022) (“Except as otherwise provided by law, the maximum fine for a violation committed by an individual is: (a) \$2,000 for a Class A violation.”).

¹³³ *See* OR. REV. STAT. § 468B.060 (2022) (“the person responsible for the injury, death, contamination or destruction shall be strictly liable to the state for the value of the fish or wildlife so injured or destroyed and for all costs of restoring fish and wildlife production in the affected areas, including habitat restoration.”).

¹³⁴ *See id.* (“[T]he person responsible for the injury, death, contamination or destruction shall be strictly liable to the state for the value of the fish or wildlife so injured or destroyed and for all costs of restoring fish and wildlife production in the affected areas, including habitat restoration.”).

¹³⁵ *See* OR. REV. STAT. § 468.946 (2022) (“[U]pon a second conviction for unlawful water pollution in the first degree within a five-year period, the court may require the defendant to pay an amount, fixed by the court, not exceeding \$200,000 in addition to any other sentence imposed under subsection (2) of this section.”); OREGON PERMIT, *supra* note 124, at 16 (“Under ORS 468.946, unlawful water

enforcement is also authorized to seek redress should a violator of environmental conditions fail to pay.¹³⁶ Oregon, therefore, sanctions limited offshore mining, but regulations also seek to preserve biodiversity and protect against environmental harms.

iii. Idaho

Idaho also allows offshore mining activity. However, the permitting scheme differs slightly, with some dredge permits being issued only during certain times of year.¹³⁷ Idaho's general NPDES permit also differs from Oregon. Issued through the EPA, not the Idaho Department of Environmental Quality, the permit limits the size of suction dredge hoses to five inches and caps the power of the pump powering the hose to fifteen horsepower.¹³⁸ Particular to protected waterways, dredge mining is banned altogether.¹³⁹

pollution in the first degree is a Class B felony and is punishable by a fine of up to \$250,000, imprisonment for not more than 10 years, or both.”).

¹³⁶ OR. REV. STAT. § 468B.060 (2022) (“In addition to the penalties provided for by law, the state may seek recovery of such damages in any court of competent jurisdiction in this state if the person responsible under subsection (1) of this section fails or refuses to pay for the value of the fish or wildlife so destroyed and for all costs of restoring fish and wildlife production in the affected areas, including habitat restoration, within a period of 60 days from the date of mailing by registered or certified mail of written demand therefor.”).

¹³⁷ See U.S. ENV'T. PROT. AGENCY, GEN. PERMIT NO. IDG370000, AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM FOR SMALL SUCTION DREDGE MINERS IN IDAHO 3 (2018), <https://www.epa.gov/sites/default/files/2018-05/documents/r10-npdes-idaho-suction-dredge-gp-idg370000-final-permit-2018.pdf> [<https://perma.cc/F9LX-2SU9>] [hereinafter IDAHO PERMIT] (“Most applications or Notice of Intent (NOI) are welcome year-round.* *Exception 1: NOIs for Grimes/Elk/Mores Creek, and their tributaries are due by April 1st each year. *Exception 2: NOIs for the South Fork Clearwater are welcome after May 1st each year.”).

¹³⁸ See *id.* at 5 (“This GP authorizes discharges from small suction dredge operations, defined as having intake nozzle diameters of less than or equal to 5 inches or the diametrical equivalent and a cumulative rating of 15 horsepower or less.”).

¹³⁹ See IDAHO PERMIT, *supra* note 137, at 3 (“There are 7 categories closed to dredging: National Designated Areas (see Permit Part I.D.1. for exceptions), Tribal Reservations, National Wild & Scenic Rivers, Withdrawn Rivers, State Protected Rivers, Mercury, suspended solids and/or sediment impaired streams, Waters where threatened or endangered species or their critical habitat occur (see Permit Part I.D.4. for exceptions).”); IDAHO CODE § 47-1323 (2022) (“Dredge mining in any form shall be prohibited on: (1) The middle fork of the Clearwater river, from the town of Kooskia upstream to the town of Lowell; the Lochsa river from its junction with the Selway at Lowell forming the middle fork, upstream to the Powell ranger

Further, the permit carves out exceptions for species protected under the Endangered Species Act, including bull trout, steelhead, Chinook salmon, and white sturgeon.¹⁴⁰ Additionally, suction dredging is prohibited if the operation is within 500 feet of where spawning fish or fish eggs are known to exist.¹⁴¹ The effluent limitations under the permit limit visible increase in turbidity more than 500 feet downstream of the operations, with operations mandated to be modified or ceased if that threshold is breached.¹⁴² Beyond this general limitation on discharges, certain waterways have limits on the amount of cubic yards per hour that may be dredged.¹⁴³ Like Oregon, Idaho's permit also limits discharge of any toxic pollutants under the CWA.¹⁴⁴

Violations of any permit conditions are subject to the penalties under the CWA.¹⁴⁵ Violations of Idaho state law also results in fines, ranging from \$500 to \$2,500 per day as long as the violation occurs.¹⁴⁶ The state board of land commissioners retains the authority to initiate civil action against any mining operator who

station; and the Selway river from Lowell upstream to its origin; (2) The middle fork of the Salmon river, from its origin to its confluence with the main Salmon river; (3) The St. Joe river, including tributaries, from its origin to its confluence with Coeur d'Alene lake, except for the St. Maries river and its tributaries.").

¹⁴⁰ See IDAHO PERMIT, *supra* note 137, at 3 ("Bull trout, steelhead, Chinook salmon, white sturgeon, and certain species of snails in Idaho are protected under the Endangered Species Act (ESA).").

¹⁴¹ See *id.* at 21 ("Suction dredging and discharging are prohibited within 500 feet of locations where: i. fish are spawning (See Appendix C); or ii. fish eggs or alevins are known to exist at the time dredging occurs.").

¹⁴² See *id.* at 8 ("a. Any visible increase in turbidity (any cloudiness or muddiness) above background beyond any point more than 500 feet downstream of the suction dredge operation. b. If any visible increase in turbidity is observed above background beyond any point more than 500 feet downstream of the suction dredge, operation of the suction dredge must be modified, curtailed, or ceased . . .").

¹⁴³ See *id.* at 19 ("Permittees are limited to processing an average of 2 cubic yards per hour (yd³ /hour) during the hours they are allocated . . .").

¹⁴⁴ See *supra* notes 92-94 and accompanying text (outlining CWA discharge of toxic pollutant limitations).

¹⁴⁵ See Clean Water Act, 33 U.S.C. § 1319(c)(2)(B) ("Any person who . . . B. knowingly introduces . . . any pollutant or hazardous substance . . . shall be punished by a fine of not less than \$5,000 nor more than \$50,000 per day of violation, or by imprisonment for not more than 3 years, or by both.").

¹⁴⁶ See IDAHO CODE § 47-1324(d) (2022) ("Notwithstanding any other provisions of this act, any person who violates any of the provisions of this act or regulations promulgated thereto, or who violates any determination or order promulgated pursuant to the provisions of this act, shall be liable for a civil penalty of not less than five hundred dollars (\$500) nor more than two thousand five hundred dollars (\$2,500) for each day during which such violation continues.").

violates Idaho law and to recoup all damages to the state, which includes the costs of any restoration.¹⁴⁷ Additionally, within one year of cessation of the mining operation, miners must commence restoration of any disturbed lands and replace vegetation and water necessary to the survival of fish and wildlife.¹⁴⁸ Like the CWA, Idaho also criminalizes fraudulent conduct.¹⁴⁹

IV. MINING THE UNKNOWN

Until recently, extreme water pressure and dangerous cold restricted marine research and mineral exploitation on the sea floor.¹⁵⁰ But new technologies – particularly improved submersibles and remotely operated vehicles (ROVs) – are rapidly transforming the possibilities for deep sea exploration and resource exploitation.¹⁵¹ Nevertheless, scientists and engineers still do not understand the ecological consequences of interactions with fragile deep-sea environments.¹⁵²

¹⁴⁷ See IDAHO CODE § 47-1324(b)-(c) (2022) (“The board may maintain an action in the name of the state of Idaho to enjoin any person from operating or maintaining a placer or dredge mining operation when, under an existing approved permit and bond, a permittee violates or exceeds the terms of the permit or violates a provision of this act, and the bond, if forfeited, would not be sufficient to adequately restore the land.”).

¹⁴⁸ See IDAHO CODE § 47-1314(a) (2022) (“Any person conducting a placer or dredge mining operation shall, within one (1) year of permanent cessation of operations as to the whole or any part of the permit area, commence restoration of disturbed lands in the permit area or in any portion thereof as to which operations are permanently ceased.”).

¹⁴⁹ See IDAHO CODE § 47-1324(f) (2022) (“Any person who willfully or knowingly falsifies any records, plans, specifications, or other information required by the board or willfully fails, neglects, or refuses to comply with any provisions of this act shall be guilty of a misdemeanor punishable by a fine of not less than one thousand dollars (\$1,000) and not more than five thousand dollars (\$5,000) or imprisonment not to exceed one (1) year, or both.”).

¹⁵⁰ *Deep-Sea Mining Could Help Meet Demand for Critical Minerals, But Also Comes with Serious Obstacles*, U.S. GOV'T ACCOUNTABILITY OFF. (Dec. 16, 2021), <https://www.gao.gov/blog/deep-sea-mining-could-help-meet-demand-critical-minerals%2C-also-comes-serious-obstacles> [<https://perma.cc/GY9R-2T35>].

¹⁵¹ See generally Jonathan Teague et al., *The Potential of Low-Cost ROV for Use in Deep-Sea Mineral, Ore Prospecting and Monitoring*, 147 OCEAN ENGINEERING 333 (2018) (assessing the state of ROV technologies and their potential to facilitate proliferation of low cost ROVs for deep ocean exploration and mineral and ore prospecting).

¹⁵² See *supra* notes 8, 9, 22, 40 and accompanying text (discussing lack of scientific understanding of harm to marine environment from DSM).

a. *Gaps in Scientific Knowledge*

Deep ocean scientists have identified wide-ranging knowledge gaps related to deep sea exploration and mineral exploitation.¹⁵³ Marine scientists still lack comprehensive baseline data on how ecosystems function in the deep sea and have yet to develop parameters to measure connectivity of deep ocean species or monitor deep sea health.¹⁵⁴ Nor do scientists understand the scope and scale of consequences from deep sea mining operations, though preliminary assessments have demonstrated negative ecological impacts from fine particle plumes and noise from mining operations.¹⁵⁵ Still, the overall environmental consequences of deep sea mining remain largely unknown.

Scientists have documented a rich diversity of marine organisms living in relatively unexplored seabed habitats.¹⁵⁶ Yet, mining proponents are moving forward with plans to scale up commercial operations in the next few years. ISA Council members now hope to finalize the exploitation regulations in early 2025.¹⁵⁷ In effect, this means that ISA could oversee large-scale, commercial mining

¹⁵³ See generally, Diva J. Amon et al., *Assessment of Scientific Gaps Related to the Effective Environmental Management of Deep-Seabed Mining*, 138 MARINE POL'Y 105006 (2022) (arguing that scientific knowledge gaps must be addressed under obligations set forth in UNCLOS).

¹⁵⁴ See Durden et al., *supra* note 45, at 194-95 ("The EIA process should enable the ISA to ensure that uniform and consistently high environmental standards are applied to all contractors. However, the legal instruments requiring states and contractors to undertake EIA are still incomplete, notably lacking a global detailed legally-binding requirement and mechanisms for supervision, compliance and enforcement."); see also note 24 and accompanying text.

¹⁵⁵ See Christiansen et al., *supra* note 22, at 6.

¹⁵⁶ See Levin et al., *supra* note 40, at 256 ("However, there are clearly major knowledge gaps and uncertainties and these impel invocation of the precautionary approach. The application of this approach could include a clear requirement that: 'Activities in the Area shall only take place if they do not cause serious harm to the marine environment,' the standard envisaged by the drafters of the first set of mining regulations in 1990 ([107] article 2(2))."); Schwabach, *supra* note 45, at 59-60 ("Situations like this are the reason the precautionary principle exists. We now know that polymetallic nodules are not just lifeless mineral lumps sitting around on the ocean floor waiting for someone to come pick them up. Rather, they support immensely complex, diverse, and fragile ecosystems. We also know that the damage done by early dredging experiments has not healed after several decades; the dredged areas remain lifeless deserts where (judging from similar areas that were not dredged) must once have been thriving ecosystems.").

¹⁵⁷ See Int'l Seabed Auth. Council, *Consideration with a View to Adoption, of the Draft Regulations on Exploitation of Mineral Resources in the Area*, ISBA/28.C/24 (July 21, 2023).

operations before environmental baselines or sustainability thresholds can be established – a clear violation of the precautionary principle.¹⁵⁸

Though draft ISA exploitation regulations ostensibly demand contractors, corporations, and state sponsors use “precaution” in building, testing, and executing seabed mining operations, the ISA council can approve mining operations absent ecological studies or baseline environmental data.¹⁵⁹ This despite pushback from multiple ISA Member States, environmental scientists, and NGOs.¹⁶⁰ Without a temporary moratorium on DSM, ISA officials must coordinate with State sponsors, advocacy groups, and the public international community to improve the regulations to consider broader environmental ramifications of mining operations.¹⁶¹ Gaps in the draft seabed mining regulatory regime will likely lead to environmental harm. UNCLOS mandates that the precautionary principle should prevail until those gaps can be filled.

¹⁵⁸ See Schwabach, *supra* note 45, at 65 (“Alternatively, were the United States and other non-members to become parties to either UNCLOS or otherwise subject themselves to the regulatory authority of the ISA, the precautionary principle might be incorporated into the ISA’s regulations.”); Lily & Morgera, *supra* note 45, at 378 (“And such precautionary measures should ‘result from a procedure that itself complies with human rights obligations, including those relating to the rights of freedom of expression, freedom of association and peaceful assembly, information, participation and remedy’. In other words, lack of scientific certainty confirms the need for, and arguably calls for heightened obligations of, ensuring public participation with a view to both pooling any possible information and inputs to reduce scientific uncertainty, and to enhancing guarantees of adequate decisions in the face of continued uncertainty.”).

¹⁵⁹ See generally Levin et al., *supra*, note 40 (discussing toothless language in ISA regulations mandating States and contractors apply a “precautionary” approach).

¹⁶⁰ See generally Guerrero, *supra* note 15 (outlining global resistance to seabed mining).

¹⁶¹ See Lily & Morgera, *supra* note 45, at 378 (“ISA [M]ember States need to take precautionary measures to prevent possible impacts from deep-seabed mining that may result in the reduced availability, accessibility or acceptability of marine spaces and marine resources (in the Area or in other marine areas that are ecologically connected to the Area”); Durden et al., *supra* note 45, at 195 (“Both the precautionary approach and adaptive management should continue to be integrated into the environmental management of a DSM project through the refinement of the EIA during exploitation by the acquisition and review of monitoring data.”).

b. The Precautionary Principle

There are several ways the ISA should exercise caution in the development of mining regulations, review of mining contracts, and oversight of mining operations. The approach to regulating suction dredge mining in the United States demonstrates one way to reckon with the relative value of a mining activity with uncertainty in its environmental effects.¹⁶² California's moratorium on suction dredging drove many mining operations to Oregon.¹⁶³ The influx of miners prompted the Oregon legislature to place a temporary moratorium on suction dredge mining that was to last until 2021.¹⁶⁴ During that time, legislators considered holistic perspectives from wildlife conservation groups, miners, environmental groups, scientists, and the public to take a thoughtful and deliberate approach in deciding next steps.¹⁶⁵ After much consideration and analysis, Oregon elected to lift the moratorium and enacted the state permitting scheme; however, Oregon also legislated to protect multiple kinds of fish habitats—resulting in a prohibition in many of the inland bodies of water in Oregon—and regulated the size of suction dredge hoses to minimize sediment disturbances and land erosion.¹⁶⁶ Idaho regulates similarly, permitting mining only with certain powered machinery and assuring protection for particular species of fish and their habitats.¹⁶⁷

The ISA and the DSM community can learn from the cautious regulatory approach taken by smaller states within the broader United States regulatory scheme. Such deliberate legislative action

¹⁶² See *supra* Part II.B. (detailing Oregon's and California's moratoriums as the states deal with environmental harms of suction dredge mining).

¹⁶³ See Loew, *supra* note 121 (noting migration of miners from California to Oregon due to California's suction dredge mining moratorium).

¹⁶⁴ See generally S.B. 838, Reg. Sess. § 2 (Or. 2013) (enacting Oregon's moratorium).

¹⁶⁵ See OR. CH. AM. FISHERIES SOC'Y, SUCTION DREDGE MINING IMPACTS ON OREGON FISHES, AQUATIC HABITATS, AND HUMAN HEALTH, at ES-2 (Jan. 2017), <https://olis.oregonlegislature.gov/liz/2017R1/Downloads/CommitteeMeetingDocument/124601> [<https://perma.cc/JEX8-FQCX>] ("The level of potential effects related to suction dredge mining, particularly in historically-mined systems, strongly suggests the need for state policy to further regulate suction dredge mining and grant comprehensive protection of rivers and stream.").

¹⁶⁶ *Supra* Part II.B. (detailing how S.B. 3 was designed to protect particular wildlife and prevent environmental harm).

¹⁶⁷ See generally IDAHO PERMIT, *supra* note 137 (describing small suction dredge regulations in Idaho).

from sub-jurisdictions is emblematic of how proper consideration of the precautionary principle should be adopted on the international scale.¹⁶⁸ Each state considered potentially affected phyla, and their respective habitats and ecosystems, to create a regulatory structure that balances the environmental interest in protecting and preserving wildlife with economic mining interests.¹⁶⁹

The ISA – the sole governing international authority overseeing DSM activities in the vast ocean waters not subject to national jurisdiction or within an EEZ – has a legal and ethical obligation to regulate DSM cautiously. The potential for disruption of biodiversity – and the breadth of that interruption – is even higher in the ocean than in inland fresh water systems.¹⁷⁰ There are millions of organisms potentially threatened by large sediment plumes arising from mining the sea floor.¹⁷¹ The long-term impacts from sustained seabed mining are not known.¹⁷² Beyond just revising exploitation regulations, the ISA should consider a temporary moratorium on all seabed mining activity, at least until the environmental data becomes available and the risks to the environment quantified.¹⁷³ The downstream environmental effects are presently unspecified, and thus, mining operations unnecessarily risk the integrity of ocean biodiversity and the marine

¹⁶⁸ *Supra* Part II.B. (explaining Oregon and Idaho regulation).

¹⁶⁹ *See generally* OREGON PERMIT, *supra* note 124 (discussing dredging regulations in Oregon); *see generally* IDAHO PERMIT, *supra* note 137 (discussing dredging regulations in Idaho).

¹⁷⁰ Christiansen et al., *supra* note 22, at 6 (“The studies should cover not only all aspects of biodiversity, the physical, chemical, geological, biological and sedimentary properties of the seafloor and the water column, but also the background levels of contaminants, noise, and other anthropogenic pressures prior to any testing or mining, as well as provide an integrated view on ecosystem functioning and genetic connectivity.”).

¹⁷¹ *See generally* OR. REV. STAT. § 196.810(1)(b) (2022), (detailing endangered fish populations at risk from suction dredge mining in Oregon).

¹⁷² *See* Schwabach, *supra* note 45, at 50 (“However, it was noteworthy that the effect of disturbance [from deep seabed mining] could be prolonged (e.g., lasting for decades to centuries), possibly through changes in sediment composition. In a study of impacts on seven sites over periods of up to 26 years, ‘very few faunal groups return to baseline or control conditions after two decades. The effects of polymetallic nodule mining are likely to be long term.’ A similar follow-up study of an experimental mining site in the Clarion-Clipperton Fracture Zone found that 26 years after the initial dredging, nematode biomass, density, and biodiversity remained significantly lower than outside the dredged area.”).

¹⁷³ *See id.* at 63 (“But when the magnitude of the potential harm rises to the level of a global catastrophe (as was the case with ozone depletion), precautionary measures, including avoidance of the potentially harmful activity, may be necessary.”).

environment.¹⁷⁴ As the BBNJ treaty language and suction dredge mining in the United States help illustrate, where there is uncertainty around an activity—legacy or novel—that activity must be approached with precaution—even if precaution at first means prohibition.¹⁷⁵ If a stated goal of the ISA to protect the marine environment, a halt on seabed mining activity is logical and necessary until the environmental impacts of DSM can be thoroughly understood.¹⁷⁶

California officials embraced a moratorium that remains in effect until the state can “fully mitigate all identified significant environmental impacts.”¹⁷⁷ California’s Department of Fish and Wildlife performed exhaustive research, and aggregated numerous data illustrating what the regulatory scheme would need to look like to ensure significant environmental impacts would be avoided.¹⁷⁸ Even armed with such data and recommendations, this moratorium

¹⁷⁴ See Venditti, *supra* note 19, at 2-3 (“The two videos released Monday show deep-sea sediment overflowing into the ocean from the deck of the company’s 228-meter-long former drill ship, Hidden Gem . . . The company described the incident as ‘a minor overflow,’ and said some sediment and fragments of nodules poured out of the separator and over the deck of the ship intermittently during a seven-to eight-hour test run.”).

¹⁷⁵ See *supra* Part II.B. (explaining California’s and Oregon’s moratorium on suction dredge mining).

¹⁷⁶ See Schwabach, *supra* note 45, at 59-60 (“Situations like this are the reason the precautionary principle exists. We now know that polymetallic nodules are not just lifeless mineral lumps sitting around on the ocean floor waiting for someone to come pick them up. Rather, they support immensely complex, diverse, and fragile ecosystems. We also know that the damage done by early dredging experiments has not healed after several decades; the dredged areas remain lifeless deserts where (judging from similar areas that were not dredged) must once have been thriving ecosystems.”).

¹⁷⁷ See CAL. FISH & GAME CODE § 5653.1(b)(4) (West 2018) (“The new regulations described in paragraph (2) fully mitigate all identified significant environmental impacts.”).

¹⁷⁸ See Cal. S.B. 637, 2015 Legis., Reg. Sess. (Cal. 2015) (“As to significant and unavoidable effects, in March 2012, the Department of Fish and Wildlife determined, for purposes of CEQA, that the use of vacuum or suction dredge equipment, consistent with the updated regulations implementing Section 5653 of the Fish and Game Code, could result in effects associated with the following: (1) The resuspension and discharge of mercury and trace metals. (2) Turbidity and total suspended sediment. (3) Substantial adverse changes, when considered statewide, in the significance of historical and unique archaeological resources. (4) Riparian habitat of special status passerines. (5) Effects on non-fish wildlife species and their habitat. (6) Exposure of the public to noise levels in excess of city or county standards.”).

remains in place for the foreseeable future because of the uncertain impacts of mining activities.¹⁷⁹

The California approach can also serve as an example to the ISA on how to move forward with seabed mining. Before exposing the seabed to a rash of DSM, the ISA should also “fully mitigate all identified significant environmental impacts.”¹⁸⁰ The basic distinction between California regulating suction dredge mining and the ISA regulating DSM is an important one—the ISA is regulating a seabed activity that could imperil the global environment.¹⁸¹ If California was equally cautious with mining for gold in inland water sources, the ISA should embrace similar precaution for the high seas.

Also consider Oregon. California’s moratorium on suction dredging created an exodus from California, and an influx into Oregon.¹⁸² Oregon reacted accordingly, understanding that such an increase in activity would not only threaten the environment, but the enterprise of suction dredge mining as a whole. In response, Oregon enacted a temporary moratorium, which the state later lifted under a strict permitting scheme with well-defined regulations and harsh penalties. Unaware of the environmental repercussions of increased suction dredging, Oregon prohibited it until it could better quantify the environmental harms. The ISA should adopt a similar level of caution.

An ecological approach results in a similar conclusion. Suction dredge mining occurs in inland water sources with closed ecosystems. Seabed mining, in contrast, occurs deep on the ocean floor, where environmental harms may be less contained and more difficult to measure. Biodiversity in any aquatic system depends on

¹⁷⁹ See *Suction Dredge Permits*, *supra* note 119 (“The use of vacuum or suction dredge equipment, otherwise known as suction dredging, is currently prohibited and unlawful throughout California.”).

¹⁸⁰ See CAL. FISH & GAME CODE § 5653.1(b)(4) (West 2018).

¹⁸¹ See Barclay Ballard, *Deep-Sea Mining Could Provide Access to A Wealth of Valuable Materials*, NEW ECON. (May 13, 2019), <https://www.theneweconomy.com/energy/deep-sea-mining-could-provide-access-to-a-wealth-of-valuable-minerals#:~:text=The%20deep%2Dsea%20mining%20industry%20could%20be%20worth%20as%20much,to%20be%20around%20%24150trn> [https://perma.cc/9CWV-WKEV] (“The deep-sea mining industry could be worth as much as \$1trn to the US economy each year - the value of all the gold deposits alone on the seafloor is estimated to be around \$150trn.”).

¹⁸² See Loew, *supra* note 121 and accompanying text (noting influx of dredge miners to Oregon after California moratorium enacted).

complex ecologies.¹⁸³ Seabed mining threatens already vulnerable deep ocean ecosystems.¹⁸⁴ If an activity creates unknown risk to biodiversity, the precautionary principle dictates that activity should not take place until the risks are known and quantified.¹⁸⁵ Oregon and California did that for rivers and streams. The ISA must do the same for the ocean.

The ISA's draft regulations can better reflect the precautionary principle. The United States' suction dredge mining, for example, considers particular wildlife species as well as biodiversity – the ISA should similarly seek to prohibit seabed mining in all areas where vulnerable phyla will be adversely affected.¹⁸⁶ When ocean biodiversity is at risk of harm, selective precaution of this magnitude is required.¹⁸⁷ The ISA should consider draft regulations that

¹⁸³ See Schwabach, *supra* note 45, at 50 (“Natural physical and smothering disturbance, such as that resulting from turbidites and benthic storms, has been associated with a small but statistically significant reduction in North Atlantic deep-sea nematode diversity. However, it was noteworthy that the effect of disturbance [from deep seabed mining] could be prolonged (e.g., lasting for decades to centuries), possibly through changes in sediment composition.”) (internal footnote omitted) (quoting P. John D. Lamshead et al., *Biodiversity of Nematode Assemblages from the Region of the Clarion-Clipperton Fracture Zone, an Area of Commercial Mining Interest*, 3 BMC ECOLOGY 1 (2003)).

¹⁸⁴ *Id.* at 55 (“The existence of highly complex ‘rock garden’ ecosystems centered around the polymetallic nodules was unknown when these words were drafted; thus the article refers to the ‘marine environment’ more generally. The marine environment above the ocean floor is also at risk of harm from mining operations, whether through tailings (sediment plumes, in the case of ocean mining) drifting for miles or hundreds of miles, or through noise, chemical leakage, introduced species, or any of the other possible by-products of human industrial activity.”).

¹⁸⁵ *Id.* at 51 (“Some species, especially those unable to migrate away from the disturbance, were even more heavily affected. In a study of the DISTurbance and reCOLonization experiment (DISCOL) site, where experimental dredging had been conducted in the Peru Basin in 1989, ‘Some faunal groups showed no evidence of recovery’ While some species had recovered, others, especially suspension feeders, were greatly diminished. The ecology of the dredged area had been altered, perhaps permanently. Life at the bottom the ocean, in the cold and dark and enormous pressure, moves at a slower pace than life on the surface; it repairs damage more slowly as well.”) (footnotes omitted).

¹⁸⁶ See OREGON PERMIT, *supra* note 124, at 1 (forbidding suction dredge mining in essential salmon habitats); IDAHO PERMIT, *supra* note 137, at 6 (forbidding suction dredge mining in endangered species habitat areas).

¹⁸⁷ See Schwabach, *supra* note 45, at 63 (“From an economic perspective, the precautionary principle may lead to inefficient allocation of resources. If the precautions turn out to have been unnecessary, a great deal of effort, money, and time may have been expended unnecessarily. But when the magnitude of the potential harm rises to the level of a global catastrophe (as was the case with ozone

employ environmental data quantifying, on a per organism basis, particular phyla that will be adversely affected by DSM.¹⁸⁸ If effects on particular species cannot be adequately quantified or projected, then seabed mining should be temporarily prohibited pending sufficient information.¹⁸⁹ Present exploitations regulations contain references to “marine protection” and “ensuring” and “mitigating” harm to the environment or any “adverse changes.”¹⁹⁰ But environmental baselines are absent from the regulations, including baseline data on particular deep sea marine species.¹⁹¹

The ISA could also help meet its UNCLOS obligations by regulating DSM equipment. For example, ISA regulations could limit the size of collector vehicles or suction dredge hoses and horsepower on accompanying motors to minimize sediment plumes and discharge.¹⁹² More rigorous testing of DSM equipment to determine sediment plumes dispersion should be completed before large-scale mining occurs. Equipment that causes harmful turbidity should be prohibited.¹⁹³ Current regulations mandate that mining

depletion), precautionary measures, including avoidance of the potentially harmful activity, may be necessary.”).

¹⁸⁸ See *id.* at 49-51.

¹⁸⁹ See *id.* at 63 (“If the current US administration and the states parties to Part XI have the environmental commitment to apply the precautionary principle to deep seabed mining, it will be in the best interests of mining companies and entities to fund further research in order to speed up the process of ascertaining the potential harm, if any, and its magnitude, so that steps can be taken to avoid and mitigate that harm and mining can begin.”).

¹⁹⁰ See Int’l Seabed Auth. Council, *Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area*, ISBA/19/C/17 (Apr. 17, 2013), <https://digitallibrary.un.org/record/766000?ln=en> [https://perma.cc/8GWR-SZJZ].

¹⁹¹ Jaeckel, *supra* note 14, at 1 (“At present, the International Seabed Authority (ISA), which is the international regulator for seabed mining, requires contractors engaged in mineral exploration to establish geological and environmental baselines for their respective contract areas. However, there are no criteria for evaluating what a robust baseline entails.”); Levin et al., *supra* note 40, at 256 (“To construct rules, regulations and procedures capable of ensuring effective protection of the marine environment from the harmful effects of mining activities and avoiding serious harm, a well-defined understanding of what may or may not constitute significant adverse change in deep-sea biodiversity as well as ecosystem structure and function will be needed.”) (reference omitted).

¹⁹² IDAHO PERMIT, *supra* note 137.

¹⁹³ See Carlos Munoz-Royo et al., *An in situ Study of Abyssal Turbidity-Current Sediment Plumes Generated by a Deep Seabed Polymetallic Nodule Mining Preprototype Collector Vehicle*, 8 SCI. ADVANCES (Sept. 21, 2022), <https://www.science.org/doi/10.1126/sciadv.abn1219> [https://perma.cc/SJ64-GLUL] (“These results reveal that the choice of an environmentally acceptable threshold value has a substantial influence on the extent of impact of an ambient

operations use “best available technology and methods.”¹⁹⁴ Ostensibly, this ensures the evolving use of the most advanced technologies and mining practices. However, if “best” is ill-defined within the regulatory framework, the “best” technology recognized may also be the most environmentally detrimental. Therefore, ISA testing and analysis should include holistic assessments of mining equipment, dredging vessels, and the transferring vessels to create standards to mitigate any environmental harms.¹⁹⁵ The ISA should consider similar assessments of equipment along with environmental baselines in drafting exploitation regulations.¹⁹⁶

The ISA should also establish concrete discharge baselines as part of its final exploitation regulations—just as the United States has done with suction dredging. The CWA sets national standards for water quality which includes limiting pollutant discharge.¹⁹⁷ Beyond the national limit, states have authority to transcend the CWA to better protect individualized water sources and wildlife from pollutant discharge. Exemplary are turbidity limits that prohibit turbidity from a certain distance from a mining operation.¹⁹⁸ The ISA can specifically target sediment plume dispersion to better monitor environmental harms beyond nodule extraction points.¹⁹⁹ And better assess pelagic harms to deep sea

plume. Another conclusion that can be drawn is that the scale of the plume is significantly influenced by the amount of sediment discharged.”).

¹⁹⁴ Draft Regulations, *supra* note 35, Appendix IV, Schedule.

¹⁹⁵ See Levin et al., *supra* note 40, at 253 (“Mining for cobalt-rich crusts will generate plumes of sediment, both from the physical disturbance of the seafloor, and from any discharge of processing waste. This sediment will have direct impacts on benthic communities through smothering and burying of animals, clogging of feeding structures, preventing larval settlement and coloni[z]ation, and indirectly through metal release and accumulation through the food chain. The vigorous hydrodynamic regime on seamounts suggests that the “downstream” extent of sediment plume impacts could reach well beyond the direct site of mining, over 100 s of meters.”) (footnote omitted).

¹⁹⁶ See *id.* at 256 (“Nonetheless it is important to conduct both in situ and laboratory experiments in order that our understanding of serious harm from significant adverse change induced by deep-seabed mining improves, and ecological thresholds can be identified for use by regulatory authorities.”).

¹⁹⁷ See Clean Water Act, 33 U.S.C. §§ 1251-1387.

¹⁹⁸ See *supra* notes 126, 140 and accompanying text (discussing turbidity limits under Oregon’s and Idaho’s NPDES permits).

¹⁹⁹ See Durden et al., *supra* note 45, at 199 (“The regulator expressed concern that the adverse impacts from removal of nodules at the seabed could not be avoided, remedied or mitigated, and that hard substrate habitat could not be restored to its previous state. In addition, the return of material to the seabed could adversely impact the benthic habitat at a wider scale, including destruction of potentially unique communities, and rare and vulnerable ecosystems. The plume

ecosystems and marine life.²⁰⁰ Additionally, the ISA should specifically regulate and monitor for any pollutant discharges, much like suction dredge regulations.

c. Enforcement and Liability

Present ISA enforcement and reporting structures are inadequate to ensure protection of deep ocean marine environments. There are no transparent criteria for environmental impact assessments or established baselines to track mining impacts. Contractors are generally expected to report their own wrongful conduct, which creates a clear conflict of interest and disincentivizes environmental reporting whenever it might jeopardize a contractors' mining operation or production timeline.²⁰¹ Further, in the absence of well-established and quantified definitions of adverse environmental harm, contractors and State sponsors surely will hesitate to report questionable conduct. Without a strong enforcement scheme to deter unlawful conduct, it is difficult to see how the ISA can ensure the activities in the Area benefit humankind or protect the marine environment.²⁰²

The ISA should build out the inspection and monitoring aspects of the regulatory regime. The draft regulations merely have "remote monitoring" as the principal form of surveillance.²⁰³ Contrast the ISA as the singular enforcer of DSM regulations with the suction dredging regime in the United States, which includes multiple layers of oversight.²⁰⁴ Between the local, state, and federal

generated by nodule mining could similarly impact an area much wider than the mined area.").

²⁰⁰ See *id.* at 199; Schwabach, *supra* note 45, at 55 ("The marine environment above the ocean floor is also at risk of harm from mining operations, whether through tailings (sediment plumes, in the case of ocean mining) drifting for miles or hundreds of miles, or through noise, chemical leakage, introduced species, or any of the other possible by-products of human industrial activity.").

²⁰¹ See *supra* Part I.B.3. (summarizing reporting obligations within the ISA's existing and proposed seabed mining regulations).

²⁰² See UNCLOS, *supra* note 25, art. 140, ¶ 1 ("Activities in the Area shall, as specifically provided for in this Part, be carried out for the benefit of mankind as a whole . . .").

²⁰³ See Draft Regulations, *supra* note 35, Section 2, Regulation 102 (summarizing monitoring obligations).

²⁰⁴ See, e.g., 40 C.F.R. § 131.4(a) (1994) ("States (as defined in § 131.3) are responsible for reviewing, establishing, and revising water quality standards. As

authorities, there are several tiers of compliance monitoring to insure against environmental harm.²⁰⁵ Conversely, the ISA has exclusive authority to inspect mining operations.²⁰⁶ When ocean biodiversity and the marine environment are at risk, robust monitoring and enforcement is required to prevent unlawful activity. The ISA should seek assistance from outside scientific experts and non-governmental organizations to strengthen monitoring structures and ensure compliance.²⁰⁷ Not only could that help mitigate environmental harms overall, but the incorporation of scientific and non-governmental observers into the enforcement regime may help ameliorate any conflicting interpretations of regulations.

The ISA can also learn from mining enforcement and liability regimes in the United States. The CWA, for example, penalizes contracting parties who violate a suction dredge permit with significant daily fines up to \$50,000.²⁰⁸ Penalties can also include criminal punishment, including imprisonment up to three years for

recognized by section 510 of the Clean Water Act, States may develop water quality standards more stringent than required by this regulation.”).

²⁰⁵ See, e.g., Clean Water Act, 33 U.S.C.A. § 1370 (“Except as expressly provided in this chapter, nothing in this chapter shall (1) preclude or deny the right of any State or political subdivision thereof or interstate agency to adopt or enforce (A) any standard or limitation respecting discharges of pollutants, or (B) any requirement respecting control or abatement of pollution; except that if an effluent limitation, or other limitation, effluent standard, prohibition, pretreatment standard, or standard of performance is in effect under this chapter, such State or political subdivision or interstate agency may not adopt or enforce any effluent limitation, or other limitation, effluent standard, prohibition, pretreatment standard, or standard of performance which is less stringent than the effluent limitation, or other limitation, effluent standard, prohibition, pretreatment standard, or standard of performance under this chapter; or (2) be construed as impairing or in any manner affecting any right or jurisdiction of the States with respect to the waters (including boundary waters) of such States.”).

²⁰⁶ See Current Regulations, *supra* note 34, Annex IV, Section 14 (granting authority to the ISA to inspect seabed mining operations).

²⁰⁷ See Lily, *supra* note 22, at 13 (“Although the ISA will not want to impugn matters of [S]tate sovereignty, it is hard to see how the ISA would be meeting its mandate to act on behalf of (hu)mankind as a whole if its rules allow the permitting of exploitation under the sponsorship of, for example, a sponsoring [S]tate that has not taken basic steps necessary to ensure compliance by the contractor, does not enable civil law claims against contractors within its domestic legal system, and/or has insufficient [S]tate resources or mechanisms to meet potential third-party losses. This will be especially important in the event that the overall liability regime for seabed mining in the Area continues to be predicated on principles of [S]tate liability and access to judicial remedy via (unharmonized) domestic legal systems.”) (footnote omitted).

²⁰⁸ Clean Water Act, 33 U.S.C. § 1319(c)(2)(A)-(B).

first time violations—with double penalties for subsequent violations.²⁰⁹ The CWA also levies auxiliary fines and imprisonment in fraud cases.²¹⁰

Draft ISA exploration regulations do not mandate strict monetary fines for seabed mining violations, but instead hold parties liable for “the actual amount of any damage” done to the ocean.²¹¹ But the ISA cannot quantify or measure damage to the marine environment without accurate and reliable baseline environmental data.²¹²

To deter bad actors, the ISA regulations should include well-defined penalties for violations of seabed mining regulations. Separately, ISA regulations should punish misrepresentations, fraudulent conduct, or willful failures to report environmental incidents and harms.²¹³

d. Legitimacy and Stakeholder Participation

Regulatory compliance depends in part on the legitimacy of the regulatory institution among various stakeholder groups. Seabed mining involves more than environmental considerations.²¹⁴ A wealth of research has shown that perceptions of fairness condition reactions to law and legal compliance.²¹⁵ Resource exploitation of the seabed impacts coastal communities in several ways and ISA regulations should address these explicitly and incorporate mechanisms for ongoing stakeholder participation. Because the

²⁰⁹ *Id.* § 1319(c)(2)(B).

²¹⁰ *Id.* § 1319(c)(4).

²¹¹ Current Regulations, *supra* note 34, Annex IV, Section 16.1.

²¹² See generally Current Regulations, *supra* note 34 (describing regulations, liabilities, standards, and procedure for contractors); see also Draft Regulations, *supra* note 35.

²¹³ See Current Regulations, *supra* note 34; Draft Regulations, *supra* note 35.

²¹⁴ See generally Aline Jaeckel et al., *Deep Seabed Mining Lacks Social Legitimacy*, 2 OCEAN SUSTAINABILITY 1 (2023) (discussing the social-equity dimensions of deep seabed mining).

²¹⁵ See, e.g., Jonathan D. Casper et al., *Procedural Justice in Felony Cases*, 22 L. AND SOC'Y REV. 483 (1988); TOM R. TYLER, *WHY PEOPLE OBEY THE LAW* (2006); Jason Sunshine & Tom R. Tyler, *The Role of Procedural Justice and Legitimacy in Shaping Public Support for Policing*, 37 L. AND SOC'Y REV. 513 (2003); Tom R. Tyler & Jonathan Jackson, *Popular Legitimacy and the Exercise of Legal Authority: Motivating Compliance, Cooperation and Engagement*, 20 PSYCH. PUB. POL'Y AND L. 78 (2014); Justice Tankebe, *Public Cooperation with the Police in Ghana: Does Procedural Fairness Matter?*, 47 CRIMINOLOGY 1265 (2009).

deep sea operates as both a carbon sink and a critical zone for the sustainability of global fisheries, even relatively minor changes to water chemistry or contamination from unearthed metals and sediment plumes can have detrimental effects on coastal livelihoods and food security thousands of miles from mining sites.²¹⁶ DSM can also impact migratory species with significant cultural meaning for indigenous people and coastal communities.²¹⁷

Under UNCLOS, the ISA is tasked with governance on behalf of humankind as a whole. Yet, current ISA negotiations represent a very limited cross-section of society. In particular, indigenous communities and members of coastal communities are frequently underrepresented in discussions about deep sea governance.²¹⁸ Minimally, ISA Member States should develop mechanisms to facilitate meaningful participation of coastal communities who will be directly affected by DSM activities and also seek ongoing feedback from communities with deep cultural ties to the oceans. The rush to finalize ISA regulations absent more inclusive dialogues with diverse stakeholders effectively silences many affected communities and misrepresents the interests of humanity.

V. CONCLUSION

ISA Member States are legally bound to cooperate under UNCLOS to ensure deep sea exploitation activities benefit

²¹⁶ See Jaeckel et al., *supra* note 214, at 1 (“These critically important fisheries provide revenue, nutrition, employment, and livelihoods for Pacific island communities and are already vulnerable to climate impacts. Yet such cumulative impacts on economies, wellbeing, and human rights to food and health, are seldom considered when discussing whether, and under what conditions, it is appropriate to mine the ocean floor.”) (internal citations omitted).

²¹⁷ See *id.* at 1 (“Indigenous Peoples and Local Communities (IPLCs) in Pacific Islands are intimately connected to the ocean and highly migratory species such as sharks and turtles . . . ‘DSM is not distanced from the island environment because the ocean is at the heart of one’s identity, and part of each individual’s future’.”).

²¹⁸ See generally M. K. Vierros et al., *Considering Indigenous Peoples and Local Communities in Governance of the Global Ocean Commons*, 119 MARINE POL’Y 104039 (2020) (discussing how Indigenous Peoples and local communities (IPLCs) have been underrepresented in the UN-led debate about governance over certain areas beyond national jurisdiction (ABNJ)); V. Tilot et al., *Traditional Dimensions of Seabed Resource Management in the Context of Deep Sea Mining in the Pacific: Learning from the Socio-Ecological Interconnectivity Between Island communities and the Ocean Realm*, 8 FRONTIERS MARINE SCI. 637938 (2021) (arguing for greater incorporation of local traditional marine resource management into current regulatory frameworks and seabed resource management approaches).

humankind as a whole and avoid significant harm to deep sea environments.²¹⁹ Yet, mining proponents are moving forward with plans to scale up commercial mining operations in the next few years, and the ISA may soon be asked to approve mining contracts in the absence of comprehensive regulations or baseline environmental data.

This Article argues that the ISA should enact a temporary moratorium on seabed mining until it can develop a robust regulatory framework that provides sufficient assurance that deep sea mineral exploitation will benefit all of humankind and proceed without causing significant harms to the marine environment. Present scientific knowledge gaps make it impossible to effectively monitor or assess the consequences of deep-sea mining. Seabed exploitation regulations must establish reliable environmental thresholds in order to provide adequate guidance to mining contractors and to judge the acceptability of deep-sea mining effects. Such evidence-based regulations will take time, but they are required under UNCLOS and necessary to protect marine habitats, deter environmental damage to the deep sea, and hold violators accountable.

Mining regulations in the United States underscore some of the deficiencies in ISA regulations and provide a partial blueprint for reform. California outright prohibits suction dredge mining until scientific data demonstrates that environmental effects of mining activities can be fully mitigated. Other state jurisdictions regulate mining operations and equipment to minimize sediment plumes and prevent environmental harms. The U.S. Clean Water Act further protects against environmental damage with national standards for mining discharges and substantial penalties for mining violations. ISA should consider analogous rules and institutional mechanisms to monitor and enforce deep sea exploitation regulations.

²¹⁹ See Levin et al., *supra* note 40, at 256 (“However, there are clearly major knowledge gaps and uncertainties and these impel invocation of the precautionary approach. The application of this approach could include a clear requirement that: ‘Activities in the Area shall only take place if they do not cause serious harm to the marine environment,’ the standard envisaged by the drafters of the first set of mining regulations in 1990 ([107] article 2(2)).”); Schwabach, *supra* note 45, at 59-60 (“Situations like this are the reason the precautionary principle exists. We now know that polymetallic nodules are not just lifeless mineral lumps sitting around on the ocean floor waiting for someone to come pick them up. Rather, they support immensely complex, diverse, and fragile ecosystems. We also know that the damage done by early dredging experiments has not healed after several decades; the dredged areas remain lifeless deserts where (judging from similar areas that were not dredged) must once have been thriving ecosystems.”).

Marine scientists have only recently begun to document the diversity of deep-sea organisms living in relatively unexplored seabed habitats. Under UNCLOS, these unexplored places in the deep ocean are the common heritage of all humankind. Seabed law and ISA exploitation regulations should reflect this idea and better ensure healthy oceans for future generations.