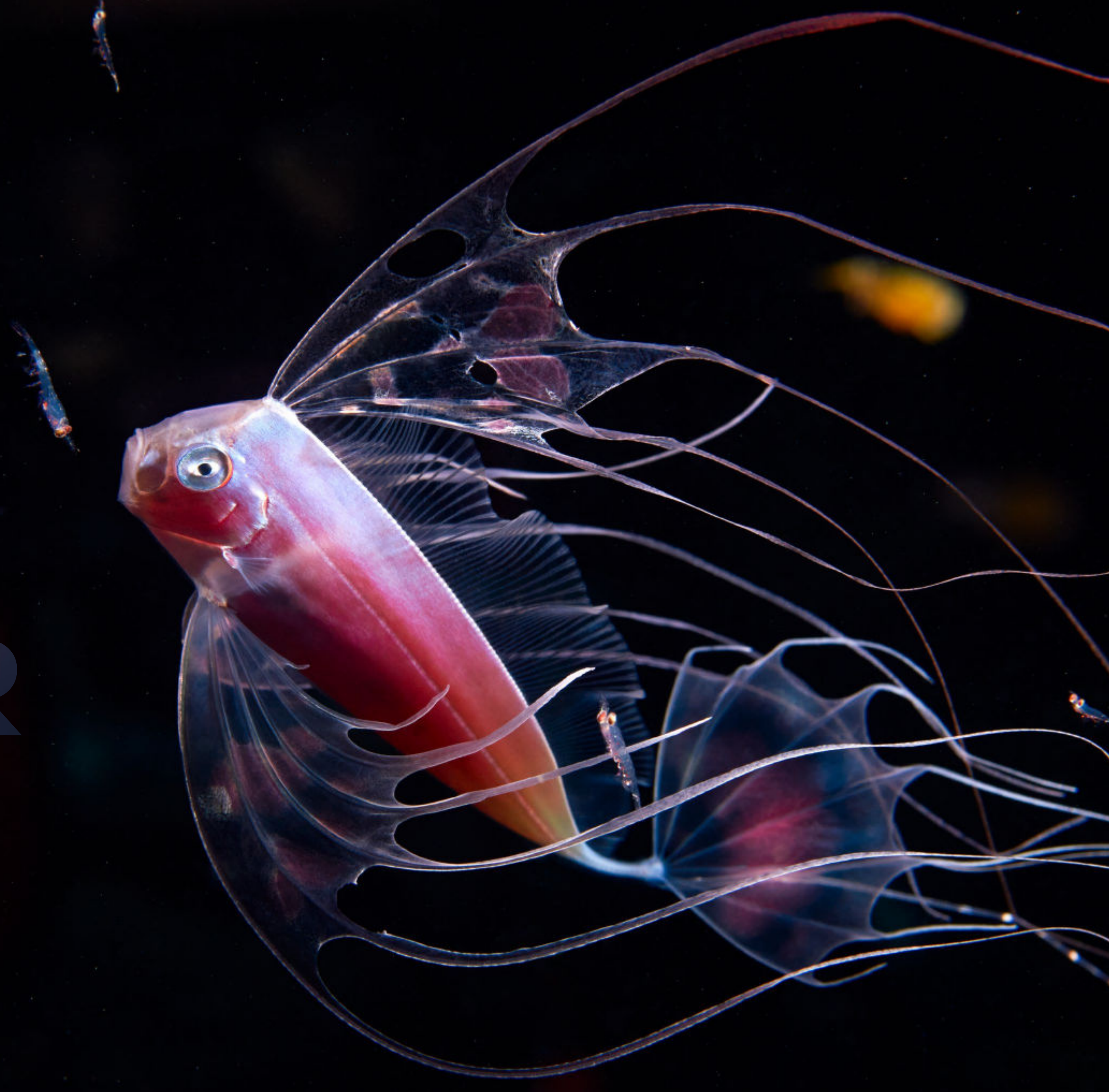
BLUE MARINE FOUNDATION

IN CLEAR SIGHT

SHINING A LIGHT ON THE OPAQUE DEEP-SEA MINING INDUSTRY



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Cover image: Mediterranean Dealfish - Trachipterus trachypterus. Credit: Alexander Semenov / Science Photo Library
The creatures featured in this report are not exclusively found in the deep sea

Abbreviations

BEIS	Department for Business, Energy and Industrial Strategy
BLUE	Blue Marine Foundation
CCZ	Clarion Clipperton Fracture Zone, nodule-rich stretch of seabed in "the Area", the site of most ISA contractor interest
DEFRA	Department for Environment, Food and Rural Affairs
"Exploitation"	The mining or extraction of minerals
"Exploration"	The search for mineral deposits
FCDO	Foreign, Commonwealth and Development Office
FOI	Freedom of Information
ISA	International Seabed Authority
LTC	Legal and Technical Commission
Mining Code	The set of rules, regulations and procedures as well as recommendations for contractors issued by the ISA to regulate prospecting, exploration and exploitation activities in the Area
Polymetallic Nodules	Concretions, containing metals such as copper, cobalt and nickel, that sit on the sedimented seafloor
"The Area"	The seafloor beyond national jurisdiction, managed by the ISA
UNCLOS	The 1982 United Nations Convention on the Law of the Sea (in force from 1994)
UK-1	One of two UKSRL contract areas
UKSRL	UK Seabed Resources Limited

Aurelia limbata - Brown banded moon jelly. Credit: Alexander Semenov / Aquatilis

Phylliroe bucephala - Planktonic nudibracnh. Credit: Alexander Semenov / Aquatilis

FOREWORD

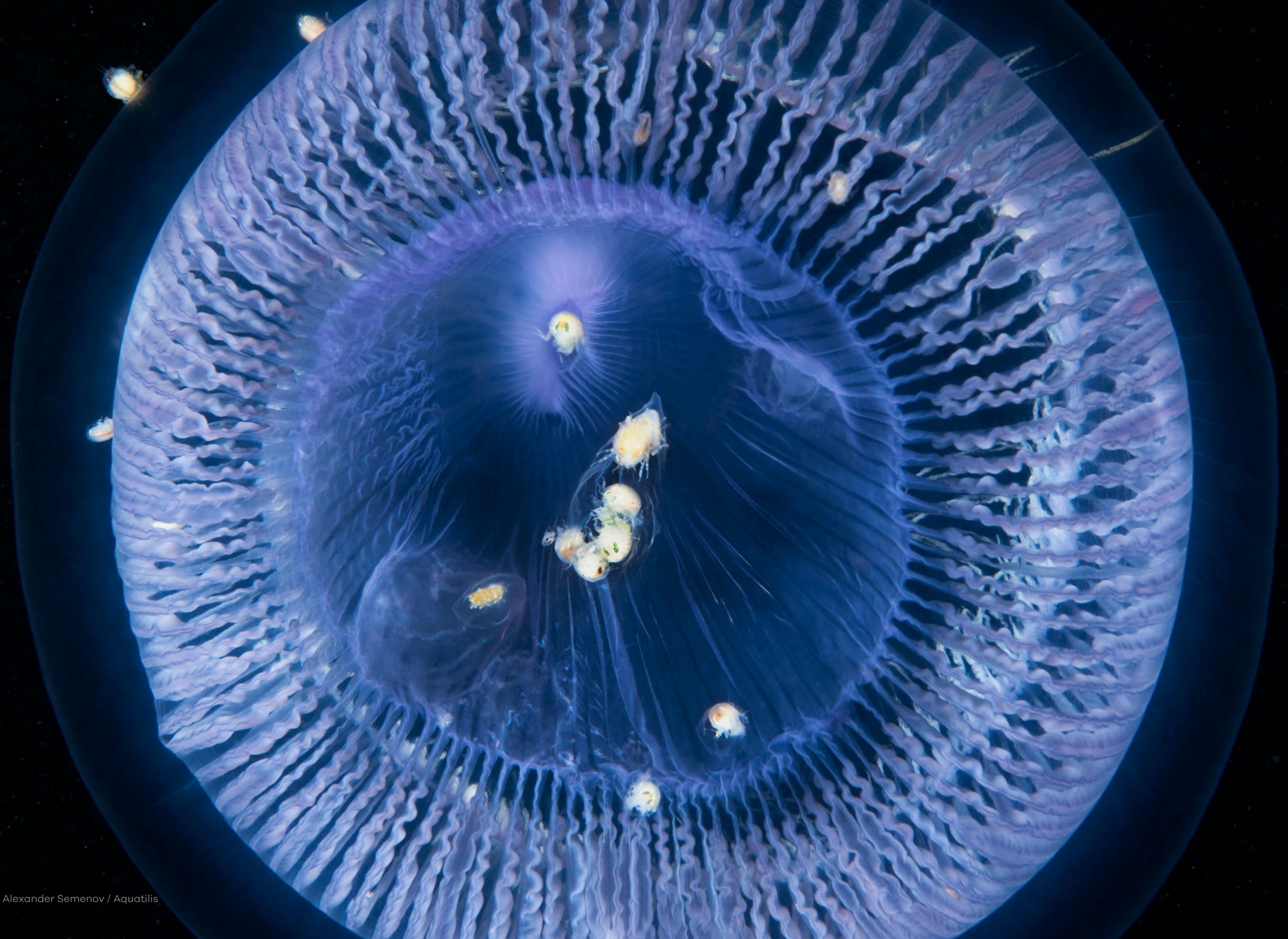
Callum Roberts
Professor of Marine Conservation, University of Exeter, and Chief Scientific Advisor, Blue Marine Foundation

Exploration for deep-sea mineral resources began in earnest nearly seventy years ago. For much of that time, experts have claimed that economic viability is about ten years in the future. Today those predictions appear recklessly optimistic, driven by wishful thinking and geopolitical posturing. The expense of mining kilometres below the ocean surface was underplayed, suitable technologies were further off than imagined and falling commodity prices from more accessible sources derailed investment. Early exploration for deep-sea minerals, we have learned, also provided a screen for covert cold war operations, so perhaps public governmental commitment to mining was less strong than it seemed.

Today, deep-sea mining has once again clambered up the political agenda. Geopolitics still plays a part in the race to exploit deep-sea minerals, but so too has soaring demand for the metals and rare earth elements that lie on the seabed. Mining corporations have invested heavily, some countries have subsidised experimental operations, and equipment has been designed and manufactured. The International Seabed Authority has licensed multiple claims to explore for minerals and is rushing through guidance on operations. This time, we really do seem on the cusp of a new industry.

But in their frenzied efforts to secure a stake in deep-sea wealth, countries have overlooked the need for reflection on the wisdom of mining the ocean floor. Since those minerals first gained world attention, we have learned much about deep-sea life. It is rich, strange, beautiful and diverse. The creatures of the abyss and their habitats are immensely fragile and susceptible to damage and loss. We know enough to foretell that mining will do untold harm to the deep sea and that its impacts will endure for millennia. What we don't know is how to limit the impacts of mining, or what its unintended consequences might be.

There is far more at stake here than national pride or corporate profits. That is why this report calls for deep-sea mining to be paused. The world needs to know far more about deep-sea life and its role in the global environmental processes that keep the planet habitable. We must find this out before the damage is done, not when it is too late.



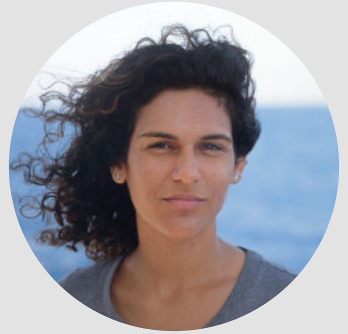
Aequorea sp. - Crystall jellyfish. Credit: Alexander Semenov / Aquatilis

CHAPTER 1

WHAT ARE THE RISKS OF DEEP-SEA MINING?

Diva J. Amon

Sepiola atlantica agressive. Credit: Alexander Semenov / Aquatilis



The deep ocean is the largest ecosystem on the planet, providing 95 per cent of all habitable space. With less than 1 per cent of it explored, there is no place on Earth that we know less about.

Dr. Diva Amon is a deep-sea biologist working at the nexus of science, policy, and communications. She studies the weird and wonderful animals living in a range of deep-sea habitats and human impacts on them, including deep-sea mining. Amon is also a founder of SpeSeas in her home country, Trinidad and Tobago, a Pew Bertarelli Ocean Ambassador, a 2020 National Geographic Emerging Explorer, and co-leads the Deep Ocean Stewardship Initiative's Minerals Working Group.

It provides an extraordinary variety of habitats including canyons, plains, mountains, trenches, hydrothermal vents, methane seeps, wood falls, whale falls, brine pools, the deep pelagic, and much more. It is a vast reservoir of biodiversity, with approximately half a million species still to be discovered, including many that have evolved remarkable characteristics to enable their survival in extreme darkness, cold, pressure and toxicity[1]. Our understanding of how the deep ocean functions remains limited, however it provides immense scientific, cultural, and ecological value, as well as a range of ecosystem services that ensure the habitability of the planet, including regulating the climate and fuelling fisheries that feed billions of people[2].

Despite our poor knowledge of this vast ecosystem, growing global mineral demands have turned attention to the deep ocean. Particular attention from investors has been focused on one type of deep-sea mineral resource known as "polymetallic nodules". These are cherry- to potato-sized concretions, containing metals such as copper, cobalt and nickel, that sit on the sedimented seafloor between 3,000 and 6,000 metres depth in vast abundances, similar to cobbles on a street[3]. Eighteen exploration contracts have been granted in international waters by the International Seabed Authority (ISA) as a precursor to the mining of this deep-sea resource. Sixteen of these, each up to 75,000 square kilometres, are located in an area of the Pacific Ocean between the Hawaiian

Islands and Mexico called the Clarion-Clipperton Zone (CCZ). This includes two areas leased to UK Seabed Resources Limited (UKSRL), a company sponsored by the Government of the United Kingdom.

The vast million square kilometre CCZ is one of the world's most pristine environments[4]. This area is home to an abundance of species that range in size, from anemone-like animals with 8-foot tentacles that billow across the seafloor to tiny worms and microbes living within the sediment[5-9]. There are also delicate corals and sponges, giant single-celled organisms called xenophyphores that create intricate exoskeletons from surrounding sediment, large red shrimps, colourful sea cucumbers, brittle stars, sea stars, fishes, jellies, and others[5,10,11]. Many of these organisms, large and small, live exclusively on the nodules, relying on them as an attachment surface to anchor to[5,12]. This includes a still undescribed species of white octopus, nicknamed 'Casper', that lays its eggs on sponge stalks on the nodules themselves[13]. Sampling suggests that most of the species inhabiting the CCZ are rare and are influenced by the shape of the seafloor, depth, nodule abundance, and the food which falls from the sea surface to the deep-ocean floor, leading to lots of variation in the communities[9,11]. Many of the species also appear to exist solely within small ranges of less than 200 kilometres, which make them more vulnerable to threats, especially given these ranges are significantly smaller than a single nodule-mining operation. In addition to the biodiversity, rich and diverse seafloor fossils from both extinct and existent whale and shark species have also been discovered across the CCZ, further demonstrating the use of this region by a wide variety of charismatic mammals, including deep-diving beaked whales[9,14].

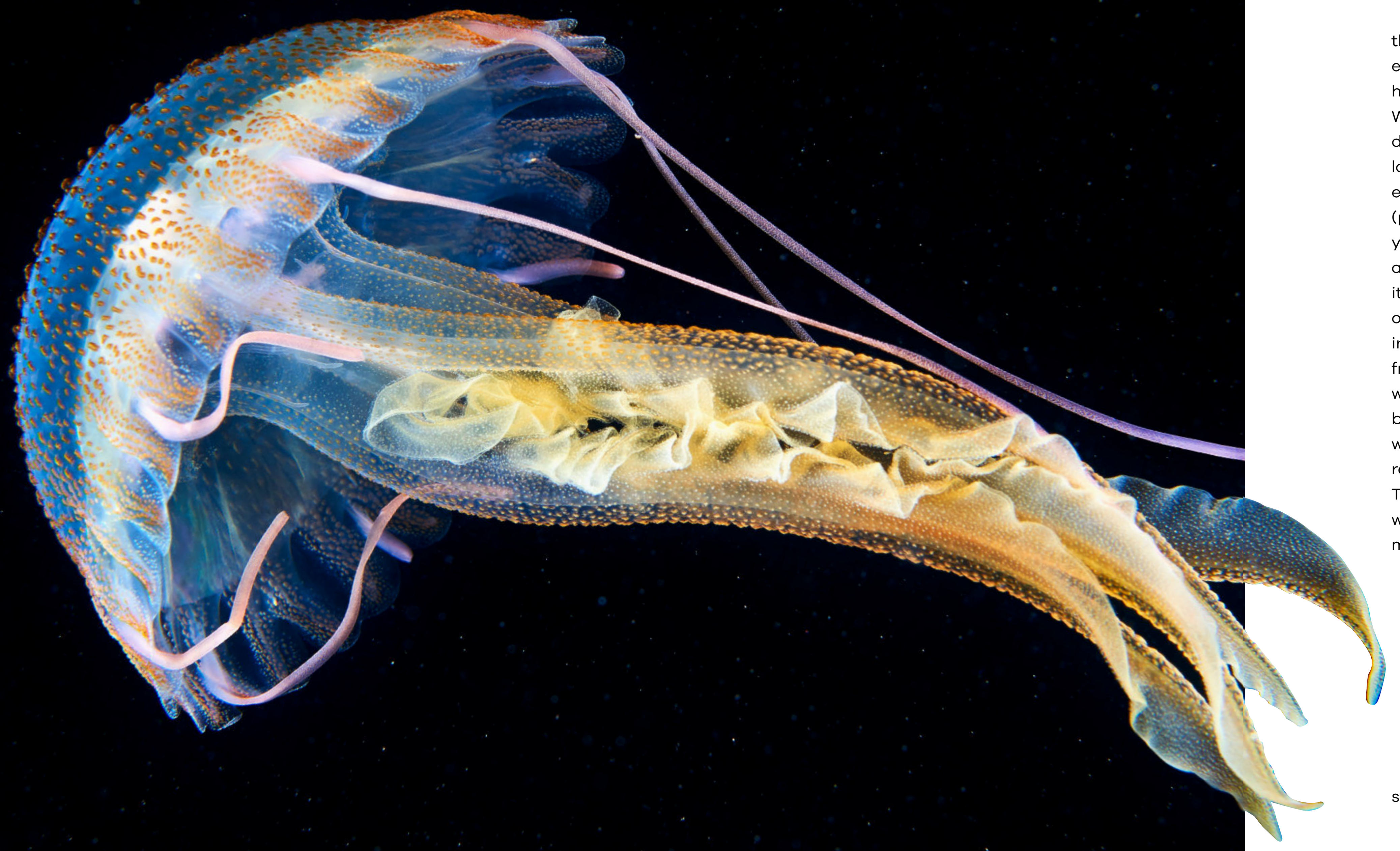
Of the two UKSRL contract areas, only UK-1, which is located in the most eastern and food-rich region of the CCZ, has been explored to any degree. Indeed, UK-1 appears to have the highest abundances of large organisms in the CCZ[5,9]. The variety of large species is also higher than expected, rivalling deep-sea hotspots such as Hawaiian canyons and Antarctic fjords[5]. Research in UK-1 and the eastern CCZ has heralded previously unknown biodiversity with over 50 per cent of the larger species, and 94 per cent of xenophyphore species, collected as a result of deep-sea mining companies baseline surveys, new to science[5,7].

Serious concerns have been raised over the potential environmental vulnerabilities related to deep-sea mining in the CCZ, especially given the vast number of unknowns about the relevant habitats and how they may be affected if mining commences[3,15]. In the absence of actual tests at

The machines will likely destroy everything in their pathway across vast areas.

Clupea pallasii marisalbi - Pacific herring roe. Credit: Alexander Semenov / Aquatilis

Once mined, we will not see recovery of those habitats in human timescales, leaving nodule-dwelling species, such as corals, sponges and anemones, without a home.



Pelagia noctiluca - Mauve stinger. Credit: Alexander Semenov / Aquatilis

the size, intensity level, and duration that we can expect from commercial mining, some knowledge has been gleaned from small-scale experiments. We know that seabed impacts will include the direct removal of nodules and sediment by large machines. The machines will likely destroy everything in their pathway across vast areas (potentially hundreds of square kilometres per year, over 20 plus years), leading to seafloor alterations that would drastically compromise its ability to continue to support the menagerie of inhabiting life, as well as allow recolonisation in the future[12,16,17]. Sediment plumes will be created from the disturbance on the seafloor. The exact way that these plumes will travel is not yet known, but models suggest that they may cloud the water column for long periods, before eventually resettling and smothering unmined seafloor areas. There will be a mining vessel at the ocean surface, which is likely to discharge return water and waste materials back into the sea, once the nodules have been brought to the surface and separated from their surrounding water. This return water may also affect the water column, and introduce new sediment plumes, which could increase the impact of mining by tens to hundreds of kilometres[18]. The disturbance from a single mining operation could easily be 2–4-fold larger than its direct mining footprint, affecting up to ~32 000 km^2 over 20 years (roughly the same size as the land area of the Netherlands)[4].

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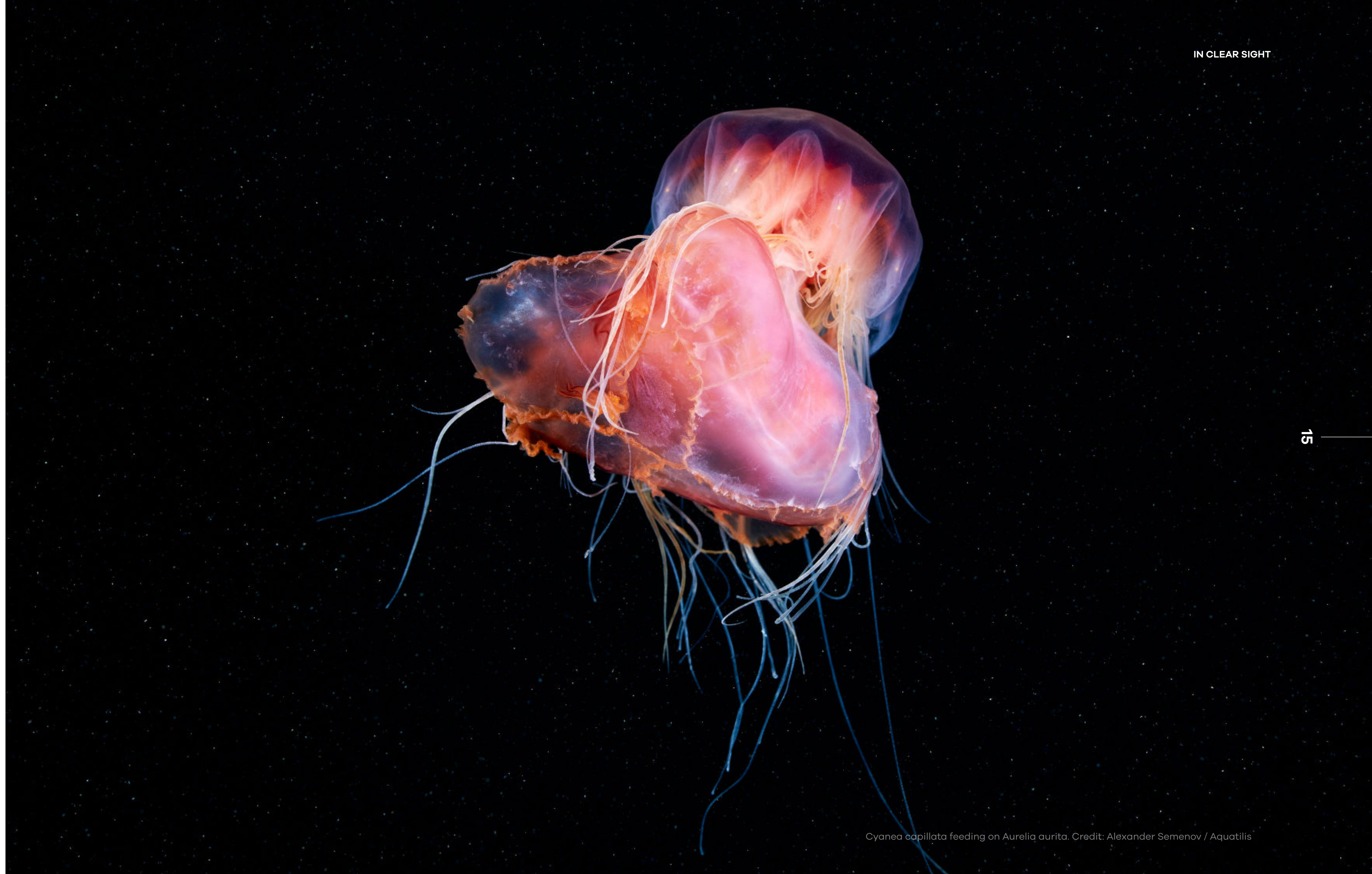
So, as well as the destruction of all animals living on the nodules that are being mined, animals living in the midwater and those much further from the mining operation could be impacted by the sediment plumes through the clogging of their gills, impairment of their feeding, and reduction of their ability to communicate[18]. Mining will also likely release contaminants and change water properties, as well as increase noise and light pollution[3,15]. Studies have shown these impacts will ultimately reduce biodiversity and alter deep-sea communities for decades[12,16,17,19,20]. However, damage caused by mining will also last much longer: nodules require millions of years to regrow. Once mined we will not see recovery of those habitats in human timescales, leaving nodule-dwelling species, such as corals, sponges and anemones, without a home. Many species inhabiting the areas where mining may occur could be forced to migrate to avoid impacts, leading to profound changes to food webs and even species extinctions[21]. This in turn could result in the loss of untapped genetic treasures that could potentially have valuable biotechnical or pharmaceutical use in the future. The impacts are also unknown on ecosystem functions and services (for example climate regulation, fisheries, nutrient cycling, detoxification), whose operations and values are themselves not yet fully understood or quantified[17,22].

It would be premature for deep-sea mining to proceed on the basis of the current state of knowledge.

While our scientific knowledge of the CCZ has grown drastically in the last half a century, it is still woefully lacking. The overused expression of "knowledge gaps" does not adequately convey the missing fundamental knowledge. Approximately 70-90 per cent of species collected in the CCZ are new to science, and a further 25-75 per cent of total species remain to be collected at sites already sampled (showing more research is needed)[9]. This figure is likely much higher for the animals inhabiting the western CCZ, a series of proposed marine protected areas on the outer rim of the CCZ (called "Areas of Particular Environmental Interest" by the ISA), and the water column, given the limited exploration of those areas. Furthermore, little to nothing is known about the ecology of the species that live in the CCZ e.g., how long they live, their positions in the food web, their functional roles, how they reproduce. This lack of basic knowledge extends to the linkages between species and habitats, the functions provided by the ecosystem, how this ecosystem varies with distance and time, as well as the environmental factors that structure these communities on regional and local scales[11].

There are also still many unknowns around the nature, severity, implications and therefore mitigation of potential deep-sea mining impacts. These include how far impacts will extend, the species-specific responses to impacts, the likelihood of species extinctions, the impacts on services provided to us by these ecosystems, and the potential for natural recovery post-mining or even human-led restoration. Furthermore, the cumulative impacts of multiple mining operations over long periods, combined with how those impacts will interact with other increasing ocean stressors, such as pollution and climate change, are not yet understood[23]. In order to take decisions about whether or not to permit mining, policy makers would need to understand: what ecosystems exist in the CCZ, how they will be affected by mining, and what level of environmental harm should be permitted. But with these huge knowledge gaps, it is very difficult to navigate such decisions, or to put regulations and management mechanisms (e.g., the design of effective marine protected areas) in place to avoid significant adverse change.

Humankind is very much still in a discovery phase in the deep ocean. Despite recent strides in data collection and analysis in the CCZ, it would be premature for deep-sea mining to proceed on the basis of the current state of knowledge. We would risk the loss of species, functions, and services before they are known, understood, and valued. Further substantial time, effort, and resources are required to gain a better understanding of this vast and remote ecosystem. Only once this information is in hand, can informed decisions be made about whether the benefits of deep-sea mining outweigh the associated risks of increasing the pressures on ocean ecosystems.



Cyanea capillata feeding on Aurelia aurita. Credit: Alexander Semenov / Aquatilis

CHAPTER 2

HOW WOULD DEEP-SEA MINING BE GOVERNED?

Pradeep Singh, IASS Potsdam

Sepiola atlantica mating. Credit: Alexander Semenov / Aquatilis

Pradeep A. Singh is a research associate at the Institute for Advanced Sustainability Studies (IASS). His expertise lies in the law of the sea, working specifically on the topic of deep-sea mining from a legal and regulatory perspective, and he attends ISA meetings as an Observer delegate. His academic qualifications include the following: LL.B. (With Distinction)(University of Malaya), LL.M. Global Environmental and Climate Change Law (University of Edinburgh) and LL.M. (Harvard Law School).

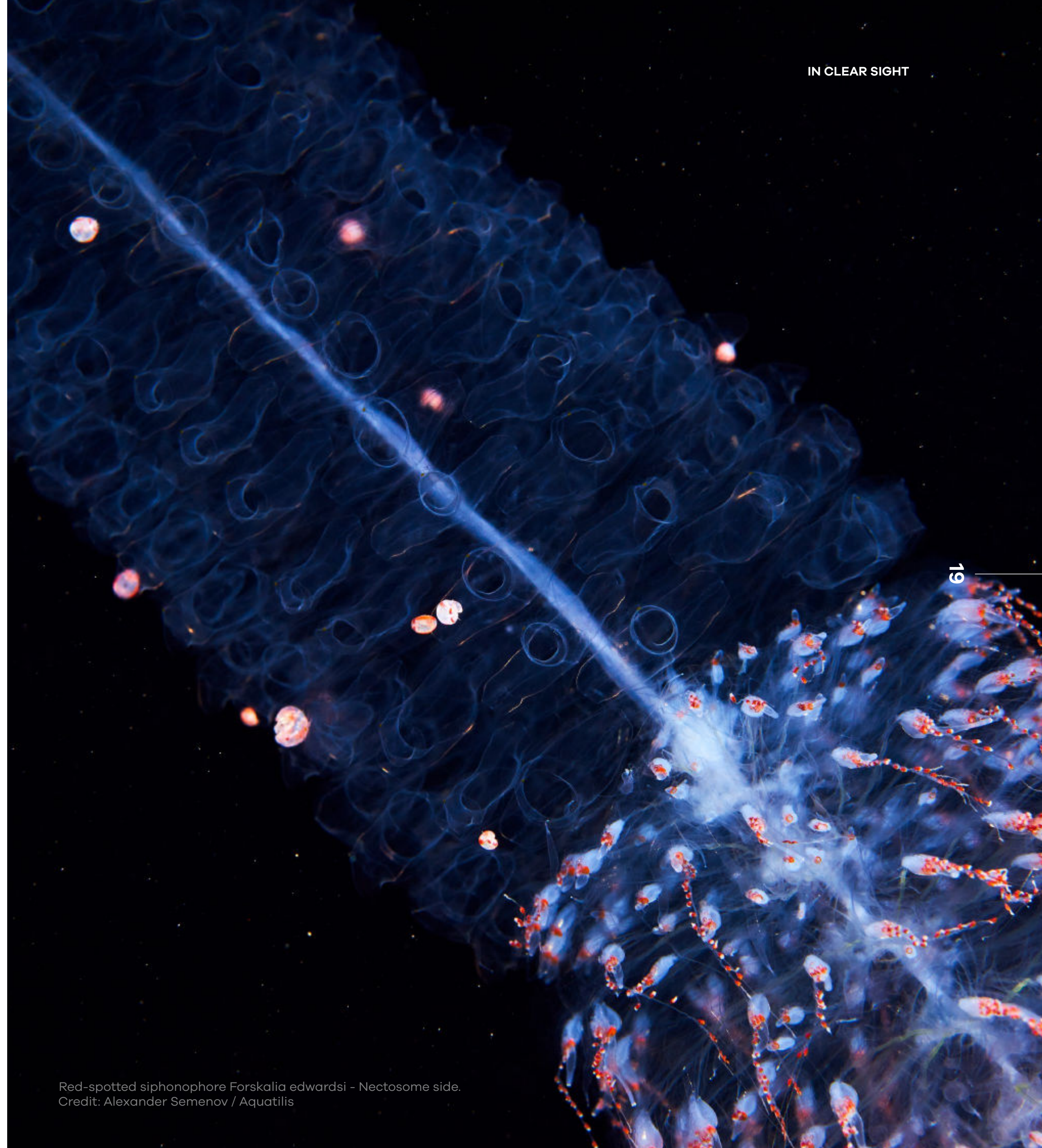
The United Nations declared in 1970 that the international seabed would be the common heritage of (hu)mankind, and that an international regime would be established to manage any mineral resources found in the deep seabed[1].

Subsequently, the UN Convention on the Law of the Sea 1982 (UNCLOS) declared that these resources should be used "for the benefit of (hu)mankind as a whole" and that any financial and other economic benefits arising from such use should be equitably distributed[2]. At present, 167 countries (member states) and the European Union are parties to UNCLOS.

UNCLOS established an autonomous international organisation called the International Seabed Authority (ISA) to act on behalf of (hu)mankind[3], with the mandate to develop rules, regulations and procedures to enable mineral exploration and exploitation (mining) activities, while simultaneously ensuring the effective protection of the marine environment from the harmful effects of mining[4]. To date, the ISA has granted 30 "exploration" contracts to some member states of UNCLOS and mining contractors/companies (who must each receive sponsorship from one or more member states). It is currently working on the completion of the core component of the "mining code", i.e. to adopt regulations for exploitation activities, which, once agreed upon, would allow deep-sea mining to start.

At the same time, multilateral international negotiations are currently ongoing with respect to designing a legally binding instrument under UNCLOS for the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction[5]. Given the imminent possibility of large-scale mining activities on the deep seabed, a thorough scrutiny of the governance of deep-sea mining and its development by the ISA is warranted.

It is ludicrous that humankind, being the owner of the resources, is kept in the dark about their abundance and value.



Red-spotted siphonophore Forskalia edwardsi – Nectosome side.
Credit: Alexander Semenov / Aquatilis

Institutional arrangements

While all member states are represented in a plenary organ (the Assembly)[6], the ISA's key decision-making body is its executive organ called the Council. This comprises of 36 states, elected out of the ISA's 167 total member states[7]. The Council is divided into five groups, with spaces reserved for countries representing major mineral importers, major mineral exporters, those making large investment in deep sea mining, developing countries with special interests, and fair geographical representation[8]. A "chamber" system of voting at the Council, i.e. voting according to interest groups, was introduced in 1994[9]. Effectively, this ensures that those member states that have significant financial interest in mining or in the commodities market would always retain an influence in overall decision-making at the ISA.

The Council relies heavily on the support of an advisory body of elected experts: the Legal and Technical Commission (LTC). The LTC is responsible for providing recommendations on environmental matters, formulating drafts of the mining code, as well as considering mining applications and providing recommendations to the Council on whether to approve or reject them[10]. On the last matter, it is hard for the Council to disagree with the recommendation of the LTC[11]. Put differently, just a handful of people are essentially making the most critical decisions.

Clearly, the LTC plays a pivotal role in the work of the ISA. However, the current composition of the LTC reveals that it seriously lacks the expertise needed to carry out its functions (only about 10 per cent of its 30 current members have environmental expertise)[12]. The work of the LTC, which has been criticized for taking place behind closed doors and for providing only very brief reports of its discussions and recommendations, also appears to be largely steered by the ISA Secretariat[13].

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The neutrality of the Secretariat has been called into question. For example, the ISA Secretary General has issued statements on behalf of the ISA (i.e. its 168 members) without consent[14], has appeared in a promotional video of a private sector mining contractor[15], and has collaborated with affiliates of private sector mining companies to publish academic papers that express a firm opinion on topics currently being negotiated at the ISA[16]. Recently, during a committee hearing at the Belgium Parliament, the Secretary-General commented that a moratorium on deep-sea mining, would be "anti science", "anti international law" and "anti development"[17]. This seems to be a very strong position statement and not in keeping with the role of an impartial facilitator.

Oikopleura vanhoeffeni - Apendicularia. Credit: Alexander Semenov / Aquatilis

Parasitic Hyperia galba inside Beroe abyssicola. Credit: Alexander Semenov / Aquatilis

The effective protection of the marine environment

As highlighted above, the ISA has an inherently tense (and perhaps even conflicting) dual role, tasked to oversee and administer mining applications and projects with an intention to generate optimum revenue, while also ensuring the effective protection of the environment from mining activities. Thus far, although the issue of environmental protection has received significant attention at the ISA, practical progress has been harder to discern. In this respect, the ISA should 'reinvent' itself and assume the role of a strong and proactive regulator[18]. While the ISA has taken some small steps towards addressing environmental impacts, such as designating nine "areas of particular environmental impacts" in one ocean basin[19] wherein no mining activities are expected to take place in the short term, there is a lot more that can be done, such as:

- Creating a dedicated scientific or environmental body with appropriate expertise to assist or collaborate with the LTC.
- Taking more direct responsibility by ensuring there is a process for environmental assessments of mining activities and ensuring there is the necessary expertise at the ISA to review project specific environmental impact assessments that have been put together by a contractor, intervening when necessary.
- Ensuring that the ISA, in particular the Council, has access to necessary financial guarantees (provided by contractors) to take immediate measures where serious harm or a threat of serious harm to the marine environment occurs and a contractor fails or is unable to remedy the situation.
- Agreeing on conservation-focussed environmental objectives, and making all ISA plans, rules and decisions subject to those objectives.
- Adopting "standards" and "guidelines" within the mining code for contractors to comply with, based on the best available scientific knowledge. In the absence of scientific certainty, the standards and guidelines should be set at conservative thresholds.
- Designing a robust environmental management plan for every region under its control, before considering any mining applications, that:
  - o is developed via an inclusive process that facilitates participation and contributions from all interested persons;
  - o identifies vulnerable species or ecosystem that require specific protections from mining impacts;
  - o determines the environmental limits of a particular region, in the context of existing stressors and other marine users, before entertaining mining applications;
  - o establishes large, permanent marine protected areas where no mining shall take place;
  - o designs a robust monitoring program so that the ISA stays informed about the quality of the region's environment and any changes to it.
- Establishing a body of inspectors with a strong environmental mandate to enable independent checks on contractors so that mining activities can be closely monitored to ensure that contractors comply with environmental rules and thresholds. It seems unacceptable to issue multiple contracts without any inspection function in place.

Mining for profit vs mining for benefit

The ISA payment models that are currently under discussions appear to proceed on the basis of ensuring an attractive rate of return for contractors[20]. The assumption here is that revenue to the ISA is only possible if contractors agree to engage in mining activities, and this will only happen if there are sufficient incentives to entice them to assume the inherent risks in engaging in this new activity.

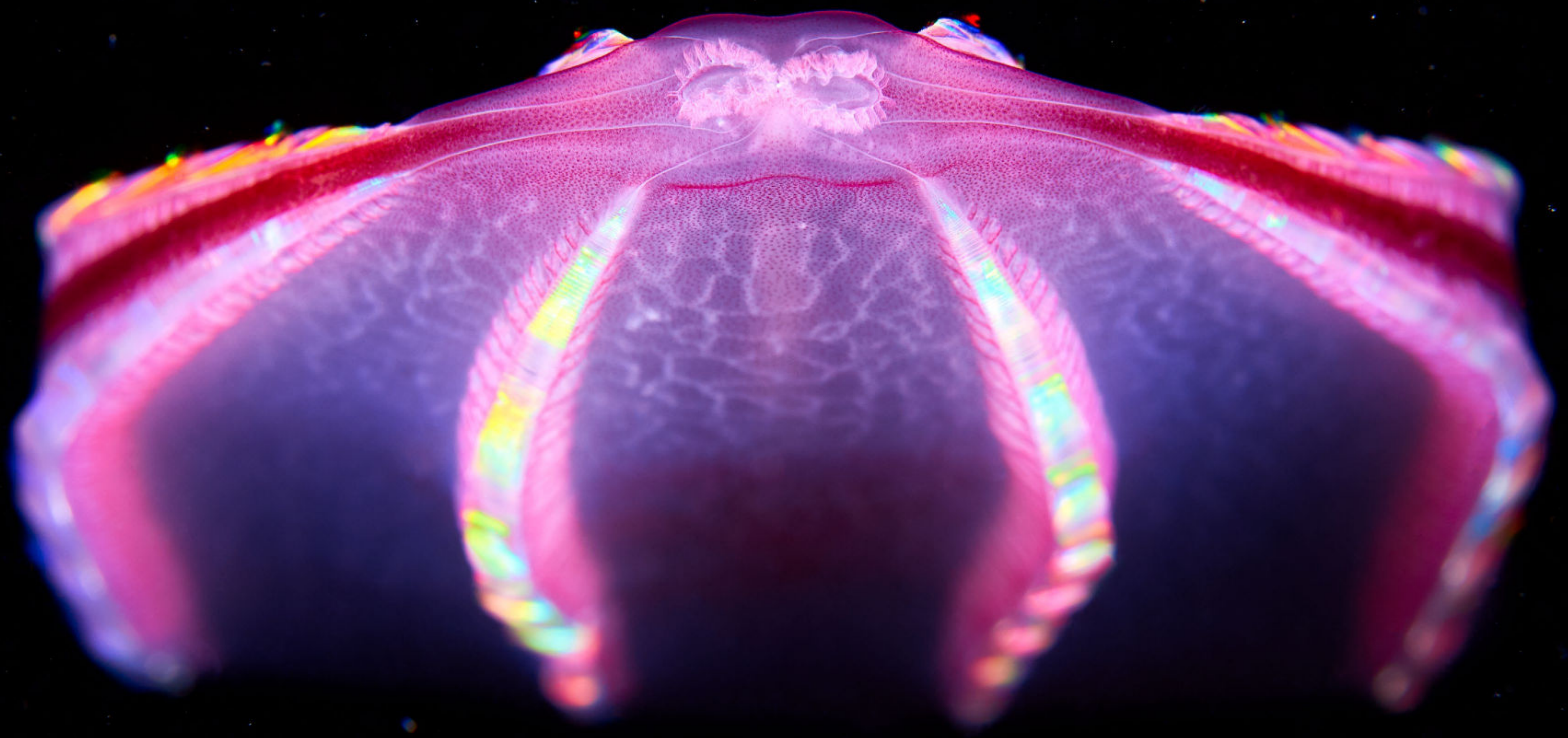
However, there is no credible suggestion that the commencement of deep-sea mining activities in the near future would generate sufficient financial revenue to make exploitation activities worthwhile to "(hu)mankind as a whole, on whose behalf the ISA shall act", who will be losing ownership of the mineral resources upon their extraction. In fact, it is possible that, apart from a small number of contractors and states holding ISA contracts who could potentially receive a windfall, only a few others will stand to benefit, as mining may only generate small amounts of money for the ISA to redistribute[21]. Furthermore, the extent of the damage to the marine environment and ecosystems, i.e. the loss of natural capital, is not appropriately reflected in the payment models being considered at the moment. Indeed, this approach appears to neglect the obvious interests of future generations in having a healthy and productive ocean to benefit from.

The ISA has developed a regime that promotes contractors conducting mining in competition with each other, as opposed to mining collaboratively and for the overall benefit of (hu)mankind. For example, data collected by contractors about the minerals on the seabed are deemed as confidential information that is withheld from the public[22]. It is ludicrous that (hu)mankind, being the owner of the resources, is kept in the dark about their abundance and value. After all, this information is necessary to make an informed decision on whether or not mining would be worthwhile, despite its devastating impacts on the environment, and whether it would result in a net benefit to (hu)mankind as a whole.

Mediterranean Dealfish - Trachipterus trachypterus.
Credit: Alexander Semenov / Science Photo Library

Tomopteris - planktonic polychaete. Credit: Alexander Semenov / Aquatilis

It is patently obvious that the ISA is not ready to proceed to the exploitation phase. There is a pressing need to slow down the ongoing regulatory process in order to allow these complex and important issues to be properly debated. A key obstacle is the increasing pressure from private sector mining companies and their sponsoring states to finalise "the mining code" as soon as possible. Indeed, there is a legal provision known as the "two year rule", which any member state can invoke, which would essentially trigger a prescribed time of two years for the ISA to 'consider and provisionally approve' a mining application, even if the regulations have not yet been adopted[23]. However, the possibility of one overzealous state triggering this provision should not be used as an excuse to speed up the finalisation of the regulations[24]. Member states must ask themselves whether proceeding with exploitation now would guarantee the protection of the marine environment and the delivery of a net benefit to (hu)mankind as a whole. If the answer at this point in time is no, then a "precautionary pause" or postponement of exploitation activities must be put in place until such time when the regime is ready to proceed.

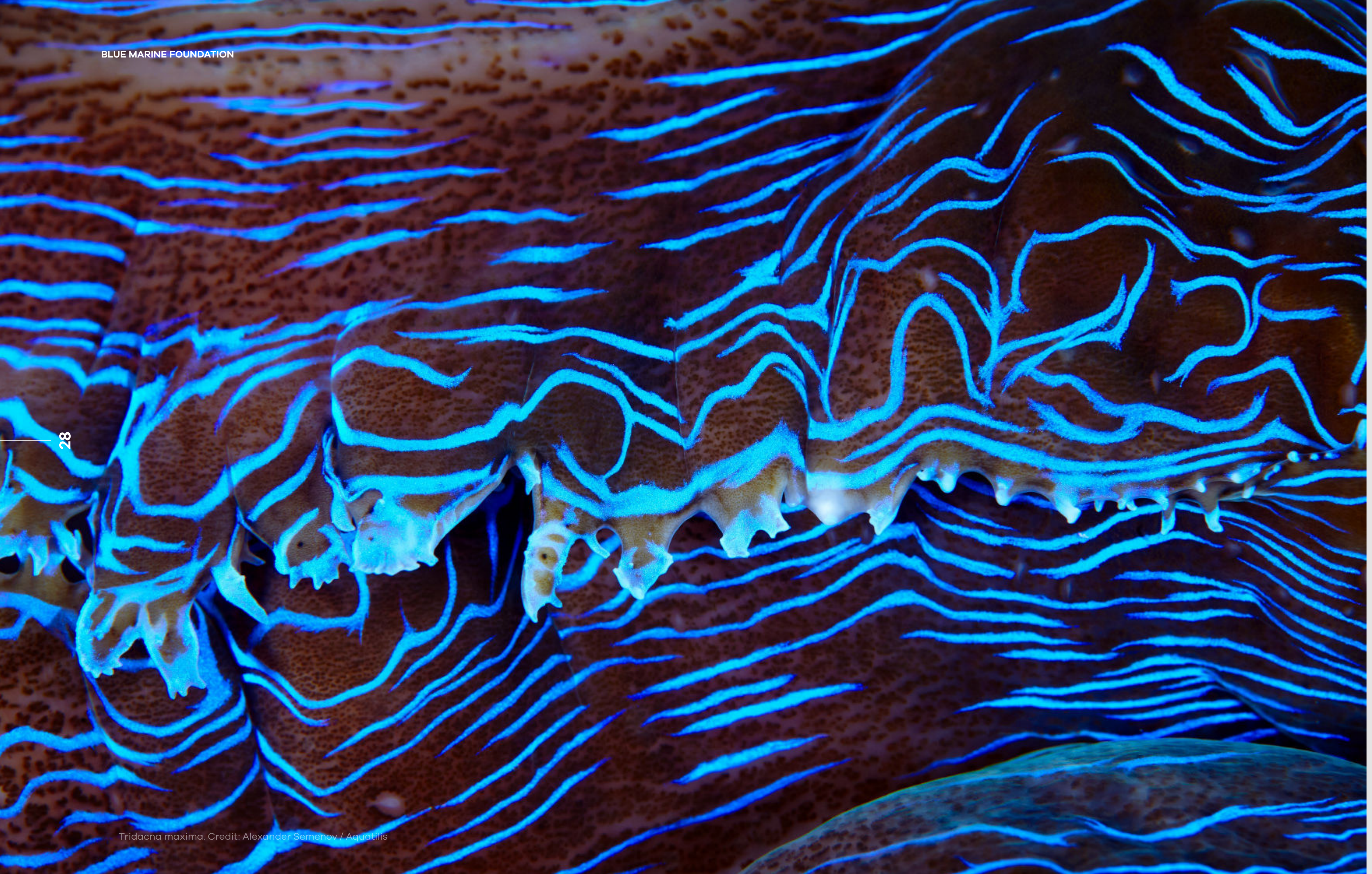


Ctenophora - Beroe forskalii. Credit: Alexander Semenov / Aquatilis

CHAPTER 3

DO WE NEED DEEP-SEA MINING?

Professor Steve Fletcher, University of Portsmouth



Tridacna maxima. Credit: Alexander Semenov / Aquatilis

Steve Fletcher is Professor of Ocean Policy and Economy at the University of Portsmouth and a member of the UN International Resource Panel. He is a coastal and ocean governance specialist focused on investigating the relationship between people and marine resources.

1. THE DRIVERS OF DEEP-SEA MINING

The intention to begin deep-sea mining has emerged at a time of extreme change in global resource consumption. Since 1970, the global population has doubled and is set to rise further, material extraction has tripled, and Gross Domestic Product has quadrupled[1].

If current trends continue, global material extraction will double again by 2060 to 190 billion tonnes per year. This is largely driven by increased domestic material consumption amongst a growing middle-class in lower- and middle-income countries and continued high levels of material consumption (of around 27 tonnes per person annually) in higher income countries[1]. The global increase in resource consumption reflects the desire for higher living standards as well as access to electronic goods, such as smartphones, laptops, and tablets[2]. These products, including the batteries that power them, rely on copper, cobalt, nickel and manganese, which are typically found in many terrestrial locations, as well as, critically, in metal-rich mineral deposits on the seabed. More broadly, growth in resource consumption reflects the linear 'take-make-waste' model underpinning much of the global economy.

A second, albeit more debatable, driver of deep-sea mining is the transition to a low-carbon green economy, particularly the adoption of efficient and clean technologies, which require the use of copper, cobalt, nickel and manganese in key products and infrastructure, such as batteries, computers, and wind turbines. Most electric vehicles, for example, are currently powered by nickel-manganese-cobalt or nickel-manganese-aluminium batteries. Despite reasonable terrestrial reserves and the potential offered by metal recycling and other resource efficient approaches, deep-sea mining is presented, particularly by the nascent deep-sea mining industry, as the only option to unlock the low-carbon economy[3,4,5]. In contrast, it has been shown that terrestrial sources of copper, cobalt, nickel and manganese can support the complete transition to renewable energy by 2050, if supplemented by improved recycling, substitution of alternatives, smarter technology and better product design[6].

Finally, it is asserted that deep-sea mining does not generate as many of the disadvantages of terrestrial mining, such as exposure of miners to dust and toxins, exploitation of child labour, human displacement and resettlement, loss of livelihood, impacts on cultural sites, aesthetic damage to landscapes, and loss of access to clean water[7,8]. Whilst this assertion has some merit, it should be recognised that efforts to reduce the negative environmental and social impacts of terrestrial mining are longstanding and substantive. Furthermore, deep-sea mining is unlikely to be immune from some of the same challenges as terrestrial mining, including concerns about labour rights, and impacts on ecologically and culturally important sites. Deep-sea mining also generates a suite of problems not experienced by terrestrial mining, including irreversible damage to vast areas of ocean floor. More fundamentally, justifying deep-sea mining through the failings of terrestrial mining is a weak argument. Deep-sea mining cannot ever entirely replace terrestrial mining, not least as the range of resources available through deep-sea mining is tiny compared to terrestrial mining, nor do the ills of terrestrial mining justify the risks posed by deep-sea mining[9].

It has been shown that terrestrial sources of copper, cobalt, nickel and manganese can support the complete transition to renewable energy by 2050, if supplemented by improved recycling, substitution of alternatives, smarter technology and better product design.

If current trends continue, global material extraction will double again by 2060 to 190 billion tonnes per year.

Beroe abyssicola ctenophore.
Credit: Alexander Semenov / Aquatilis

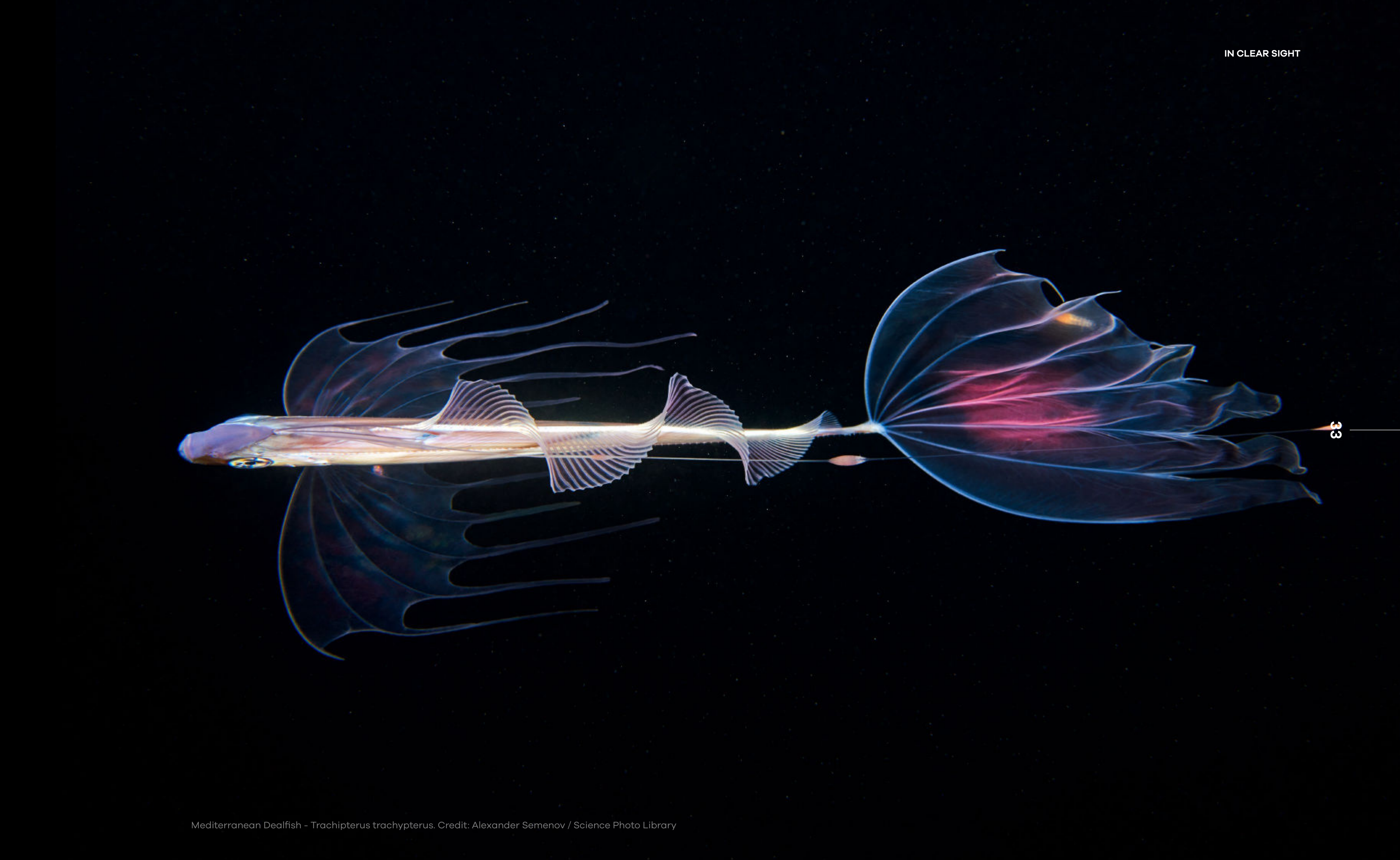
2. PRODUCTION AND RESERVES OF DEEP SEA METALS

A critical consideration in determining the need for deep-sea mining is the terrestrial reserves of copper, cobalt, nickel and manganese. Copper is an excellent conductor of electricity and is used in many electronics products and electricity infrastructure.

For example, a wind turbine contains about one metric ton of copper. The annual production of copper is approximately 20 million metric tons, with known global reserves of 870 million metric tons[10]. Of the global reserve, 50 per cent is located in Chile, Peru, Australia, and Russia. Ocean floor copper resources are thought to account for only 7 per cent of all global extractable copper deposits[11]. Manganese is essential to iron and steel production and, in oxide form, a key component of dry cell batteries. Annual manganese production is approximately 19 million metric tons with significant land-based reserves of 810 million metric tons, most of which is located in South Africa (74 per cent) and Ukraine (10 per cent[10]. Cobalt is used in rechargeable batteries. The annual production of cobalt is approximately 140,000 metric tons with a global reserve of 7 million metric tons[10]. Congo mines approximately 70 per cent of the world's cobalt, while China is the leading consumer of cobalt, with more than 80 per cent of its consumption being used by the rechargeable battery industry[10]. Nickel's resistance to corrosion and ability to withstand extreme temperature means nickel-bearing alloys are often used in harsh environments, such as in components of wind turbines. The annual global production of nickel in 2019 was 2.7 million metric tons, with known reserves of 89 million metric tons[10]. Indonesia is the world's largest producer of nickel, mining almost double the amount of nickel than any other country. Indonesia also holds the world's largest nickel reserve of 21 million metric tons[10].

In summary, copper, cobalt, nickel and manganese each has a terrestrial reserve of over 30 years (at 2019 rates of production and use) although the location of some reserves may present future access challenges. It is likely that further reserves will be found, but estimates are unavailable. While it is widely assumed that the demand for these metals will increase to support the transition to a low-carbon economy, the reality is that the material needs of the transition to a low-carbon economy are highly uncertain. Until realistic projections of the materials needed to transition to a low-carbon economy are available, the case for an urgent switch to deep sea mining is far from being proven.

Tubularia indivisa - Giant hydrozoan.
Credit: Alexander Semenov / Aquatilis



Mediterranean Dealfish - Trachipterus trachypterus. Credit: Alexander Semenov / Science Photo Library

3. ALTERNATIVES TO DEEP-SEA MINING

The sustainable management and efficient use of natural resources is embedded within the sustainable development goals and a core principle guiding the work of influential science-policy bodies, such as the UNEP International Resource Panel.

In that context, it is important to consider the plausible alternatives to deep sea mining to secure copper, cobalt, nickel and manganese. These include using terrestrial resources more efficiently and reusing and recycling metals already in the economy. Product design is key to enabling metals to be easily recovered from products and to be repaired or refurbished. Alternatively, metals can be removed from products entirely and substituted with less damaging or less scarce alternatives, or where this is not possible, metal content can be reduced. In short, there are many alternatives to deep sea mining. For example:

- **Improved resource efficiency**. The lifespan of the terrestrial reserves of copper, cobalt, nickel and manganese can be extended simply by using existing stocks more efficiently, including by reducing the absolute amount of these metals used in products. For example, nickel-free steels can be used in place of stainless steel in the power-generation and communication sectors, and the amount of cobalt used in lithium-ion batteries has the potential to be reduced[10].

- **Substitution**. Nickel, copper and cobalt have appropriate substitutes for most of their applications, including those related to the transition to a low-carbon economy. For example, copper in electrical equipment and power cables can be substituted by aluminium, while titanium can replace copper in telecommunications applications[10]. Both aluminium and titanium have substantial global terrestrial reserves and are comparatively easy to access. Of the deep sea metals, only manganese has no satisfactory substitute in its major applications[10].

- **Repair, reuse, remanufacture and refurbish**. Repairing, reusing, remanufacturing and refurbishing products, as opposed to throwing them away, retains the value of metals in the economy and reduces the need to extract virgin resources. These approaches are less wasteful and protect biodiversity while reducing costs. They also have the potential to cut greenhouse gas emissions and create new jobs[12,13].

- **Recycling**. In order for recycling to be effective, metal products must enter appropriate recycling chains characterised by suitable collection, sorting, processing and re-use. This displaces the need for new metals. Although figures vary significantly, only approximately 50 per cent of copper, cobalt, nickel and manganese are recycled[14]. This has huge potential to offset the need to begin deep sea mining and potentially to reduce terrestrial mining, as less than one-third of existing metals have a recycling rate above 50 per cent, while most speciality metals have a recycling rate of less than 1 per cent[12].

All of these measures contribute to a transition to a circular economy, which aims to maintain the value of products, materials and other resources for as long as possible within the economy. This enhances the efficiency of production and consumption, which reduces environmental and social impacts and minimises waste[15,16]. Transitioning to a circular economy represents a systemic change in the global economy, and involves a multitude of processes such as improved waste management, reduced use of resources, product design that considers materials re-use, and a culture shift by policy-makers, investors and consumers[17]. However, there is increasing global consensus that such a transition is an essential component of a sustainable future. While many people argue that such a transition is unrealistic, there are already signs of change. For example, in 2019, the European Union – the world's largest single market – adopted a Circular Economy Action Plan which aims to transition the entire European economy from a linear to a circular model as part of a "future-oriented agenda for achieving a cleaner and more competitive Europe"[18]. Opening up the ocean floor to new extractive activities, and thereby increasing resource availability at significant environmental cost, is unlikely to support these efforts and may disincentivise the adoption of more sustainable solutions within a circular economy.

Oikopleura sp. Credit: Alexander Semenov / Aquatilis

CHAPTER 4

THE UK POSITION ON DEEP-SEA MINING

Jess Rattle, Blue Marine Foundation

Clione limacina - Sea angel. Credit: Alexander Semenov / Aquatilis

Nereis pelagica swimming. Credit: Alexander Semenov / Aquatilis

Jess Rattle is Head of Communications at Blue Marine Foundation (BLUE) and heads up BLUE's Investigations Unit, working to research, expose and combat harmful and unsustainable practices affecting our ocean. In addition to deep sea mining, Jess's work on ocean governance also extends to the mismanagement of migratory fish stocks by RFMOs. She has a master's degree in Environmental Science from the University of Cape Town and is a dual British-South African national.

The UK Government positions itself as a champion for global ocean conservation. In September 2018, then-environment secretary Michael Gove called for a threefold increase in the amount of ocean that should be protected in the next decade, aligning the UK with the target to protect 30 per cent of the world's ocean by 2030.

However, this show of leadership stands in stark contrast to the UK's under-reported and highly controversial push towards deep-sea mining. As previous chapters have shown, there are significant and long-lasting risks associated with deep-sea mining. As such, only a handful of governments have ever considered pursuing the risky new industry. Surprisingly, the UK is one.

In 2013, David Cameron pledged to put Britain at the forefront of the international deep-sea mining industry which, he claimed, could be worth £40bn to the UK economy over the next 30 years, saying that "the UK is open for business"[1]. Mr Cameron's enthusiastic endorsement of deep-sea mining came after UK Seabed Resources Ltd (UKSRL), a wholly-owned subsidiary of US corporate giant Lockheed Martin, in partnership with the Department for Business Innovation and Skills (now part of the Department for Business, Energy and Industrial Strategy (BEIS)), was sponsored by the UK to obtain a national licence and an international contract to explore an area of the Pacific over 58,000 km^2 for polymetallic nodules[2].

All companies require state sponsorship in order to obtain such contracts. However, because the USA is not a member state of the ISA, nor a party to the United Nations Convention on the Law of the Sea (UNCLOS), Lockheed Martin was not able to obtain sponsorship from its own government in order to access the seabed mineral resources beyond national jurisdiction. Instead, Lockheed Martin created a British subsidiary (UKSRL) through which to channel its operations. Although the UK Government, as sponsoring state, takes responsibility and liability for UKSRL's actions, it is notable that ultimate control and ownership of UKSRL resides in the US, not the UK. UKSRL now has seabed mineral contracts over a larger area of seabed than any other company worldwide. UKSRL's two ISA contracts cover an area greater than the size of England, in the Pacific Ocean.

> **Should mining go ahead, and unforeseen damages to the environment occur as a result of the UK failing in its legal duties as a sponsoring state, the British taxpayer – and not UKSRL's owner: the enormous American weapons manufacturer – may well find themselves on the hook for the costs of compensation or remediation.**

Before actual mining can begin, a "mining code" setting out rules and regulations needs to be agreed by members of the International Seabed Authority (ISA). The risks and challenges described in previous chapters make clear the need for further data acquisition and thorough research and assessments before the ISA can complete these regulatory instruments and proceed to the exploitation phase. To do this in a robust, transparent and precautionary manner will inevitably take a considerable amount of time. However, an article in the Financial Times earlier this year described UKSRL's view that the mining code was "urgently needed", with the company's director Chris Williams stating: "It's definitely time to reach agreement on those outstanding issues and get agreed"[3]. These views appear to be shared by its sponsor, the UK Government, which, as recently as January 2020, was working towards the proposed date of 2020 to complete the mining code[4]. Such time pressure has however been opposed by other member states at the ISA, who have expressed the importance of "quality over haste" and not setting self-imposed or artificial deadlines for such an important and irreversible process[5]. Still, the UK appears to prioritise the quick completion of the regulations to such a degree that it would even be prepared for a version with only the "essential elements"[6]. The UK has also sponsored the current ISA secretary general, Michael Lodge, for re-election this year, despite questions about his neutrality, as discussed earlier in this report.

Shrimp. Credit: Alexander Semenov / Aquatilis

As a sponsoring state, the UK has various legal obligations, including a duty to protect and preserve the marine environment, to ensure the application of the precautionary approach, and to prevent, reduce and control pollution of the marine environment from activities undertaken by UKSRL. However, there is little evidence that the UK has sufficient domestic measures in place to discharge these duties or to ensure the compliance of UKSRL. Indeed, existing UK legislation states that Government is required to consider protection of the marine environment only "so far as reasonably practicable"[7]. Should mining go ahead, and unforeseen damages to the environment occur as a result of the UK failing in its legal duties as a sponsoring state, the British taxpayer – and not UKSRL's owner: the enormous American weapons manufacturer, Lockheed Martin – may well find themselves on the hook for the costs of compensation or remediation, although no amount of money would be able to undo irrevocable damage to deep-sea ecosystems.

David Cameron's bold claims promising tens of billions of pounds have remained central to the Government's defence of its seemingly pro-deep-sea mining stance. However, Freedom of Information (FOI) Act requests submitted by Greenpeace have revealed that the £40bn estimate came exclusively from industry, with the UK Government holding no independent information verifying or analysing the assumptions behind the figure. In 2018, then-energy minister Claire Perry wrote to MPs notifying them that BEIS was "commissioning independent analysis which will report in early 2019"[8] on the potential economic benefit of deep-sea mining to the UK. In February 2019, MP Perry told a parliamentary debate that they had "undertaken to analyse the potential economic value to the UK" of its deep-sea mining licences, and "that work should be completed this summer"[9]. None of this analysis has yet materialised and, as of summer 2020, an FOI request submitted by BLUE revealed that this analysis never took place, despite it being a specific recommendation made by a Parliamentary Select Committee in January 2019, which counted among its membership Lord Zac Goldsmith MP (now the responsible minister for FCDO and DEFRA), and which concluded that deep-sea mining "would have catastrophic impacts on the seafloor site and its inhabitants"[10].

Without a financial analysis, one can only assume that, after royalties are paid to the ISA and potentially some taxes to the UK Government (although no confirmation of the tax arrangements between UK and UKSRL has been provided), profits made from deep-sea mining in the UK-sponsored areas will, in the majority, go to UKSRL's parent company Lockheed Martin's shareholders – the top five of which are large US-based investment management companies. This seems to be enriching the already-rich. It does not appear to be prioritising "benefit to mankind as a whole" as called for by UNCLOS, nor particularly beneficial to the UK.

One possible explanation of this seemingly baffling situation becomes apparent when one considers Lockheed Martin's core business activities, outside of deep-sea mining. Lockheed Martin has been a partner in UK defence for almost 80 years and committed £2.9 billion to UK industry in 2018, supporting approximately 20,000 jobs in almost 700 companies[11]. A close relationship between the American parent company of UKSRL and the UK Government is also illustrated by the fact that, between 2016 and 2019, Lockheed Martin employees attended 42 meetings with UK Ministers, across several departments. The current chair of the UK Government's Technical Advisory Board, appointed by the Home Secretary, is Jonathan Hoyle of Lockheed Martin International.

In response to several FOI requests submitted by BLUE, BEIS refused to provide information pertaining to UKSRL, communications between BEIS and UKSRL, and the potential benefits of deep-sea mining – citing commercial confidentiality as the reason to withhold relevant documents from disclosure. Similarly, the UK Government has refused to release the licence it holds with UKSRL, or a copy of the plan of work that UKSRL is contracted to perform under the UK's sponsorship. Worse still, to date, the UK has held no public consultation on deep-sea mining. As a party to the Aarhus Convention which upholds UK citizens' rights to access environmental information and public participation in environmental decision-making, the UK appears to be failing in its duties to the public and to the marine environment.

Mediterranean Dealfish - Trachipterus trachypterus. Credit: Alexander Semenov / Aquatilis

BLUE therefore asks the following questions of the UK Government:

1 When will the UK Government share with the British public copies of the domestic licence between Lockheed Martin (UKSRL) and the UK, UKSRL's existing plans of work for deep-sea mineral exploration, and UKSRL's annual reports to the UK?

2 In light of the UK's commitment to the precautionary principle and its agreement "not to sponsor the issuing of any deep-sea mining exploitation licences for deep-sea mining projects until there is sufficient scientific evidence about the potential impact on deep-sea ecosystems"[12], does the UK Government consider that the ISA has "sufficient scientific knowledge" currently to proceed with the finalisation of the mining code, and the issue of a mining contract? Or will the UK confirm that it will appeal at the ISA for a proper science-backed and expert-informed process in preparing the mining code, and will not support calls for the regulations to be finalised in 2021?

3 Will the Government clarify its understanding of "sufficient scientific evidence" and "no serious harm" in relation to deep-sea mining? Given that a single deep-sea mining project would destroy hundreds of square kilometres of seafloor per year, every year, for decades, and will cause irreversible harm to deep-sea ecosystems, what is the threshold level for impact and harm that the Government thinks is reasonable in order to proceed?

4 Can the UK Government explain what performance management evaluation it undertook before nominating Michael Lodge for re-election as ISA Secretary-General? If members of the public have concerns or complaints to raise with regards Mr. Lodge, or UKSRL, or any other UK-backed aspect of the ISA, is there any forum for them to do so?

5 Does the Government plan to review and improve the national law and administrative measures currently in place to govern UK's sponsorship of UKSRL? How is the relationship between UKSRL and UK Government managed in practice? Who within the UK has regulatory responsibility for UKSRL's contractual compliance, and for UKSRL's environmental performance? How much involvement does UKSRL have in the UK's recommendations and inputs to the ISA? How are conflicts of interest identified and managed?

6 When will the report analysing the potential economic benefit of deep-sea mining to the UK be undertaken and published and can the Government explain how the decision has been taken on behalf of the nation to engage in this high-cost, high-risk industry, without a prior cost-benefit analysis?

7 Can the Government explain how the UK's position at the ISA aligns with its other ocean and environmental policies? Does the UK's support of seabed mining not undermine international calls for a move to a circular economy? Does the UK's drive to access new reserves of cobalt and nickel from the deep sea not directly dis-incentivise the reduction, re-use, and recycling of metals that is needed to stay within planetary boundaries?

8 When will the Government reveal the financial payment arrangements agreed between the UK and UKSRL, should UKSRL in the future mine under UK sponsorship?

9 How much financial support has the UK Government provided towards UKSRL's performance of its ISA contract? What benefits, if any, has the UK seen as a result of this commitment of taxpayers' money?

10 Will the UK Government commit to hold public consultations to inform the UK's position in relation to deep-sea mining? Will the Government agree that a "social licence to operate" should be sought, before the UK pushes to the forefront of this controversial new industry?

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