DOSI
DEEP-OCEAN STEWARDSHIP INITIATIVE

INFORMATION SHEET

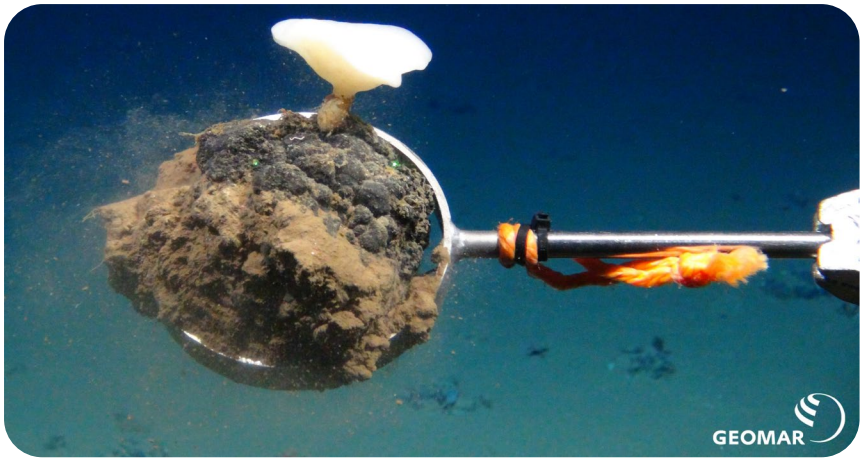
July 2023

What Does the Deep Ocean Do for You?

Polymetallic Nodule-Rich Abyssal Plains and the Water Column

Key Messages

- Polymetallic nodule fields are an important deep-sea ecosystem and host a great diversity of organisms.
- Most organisms living in nodule fields are small and include animals such as roundworms, bristle-worms and small crustaceans that reside in the soft sediment around and under the nodules.
- Nodules provide a hard substrate for corals, sponges and anemones, as well as habitat for microorganisms and small animals living inside nodule crevices.
- Abyssal plains contribute to the provision of many deep-sea ecosystem services that directly benefit humans, such as nutrient mineralization and carbon cycling, climate regulation, cultural resources, and fisheries in the waters above.
- Threats to abyssal nodule fields include pollution, potential deep-sea mining, and climate change impacts such as ocean acidification, deoxygenation, and temperature anomalies.
- Globally, few abyssal polymetallic nodule fields are protected. However, Areas of Particular Environmental Interest (APEIs), which are closed to mining contracts, have been designated in about 40% of the Clarion-Clipperton Zone (CCZ). Further APEIs are expected in other parts of the global seafloor.

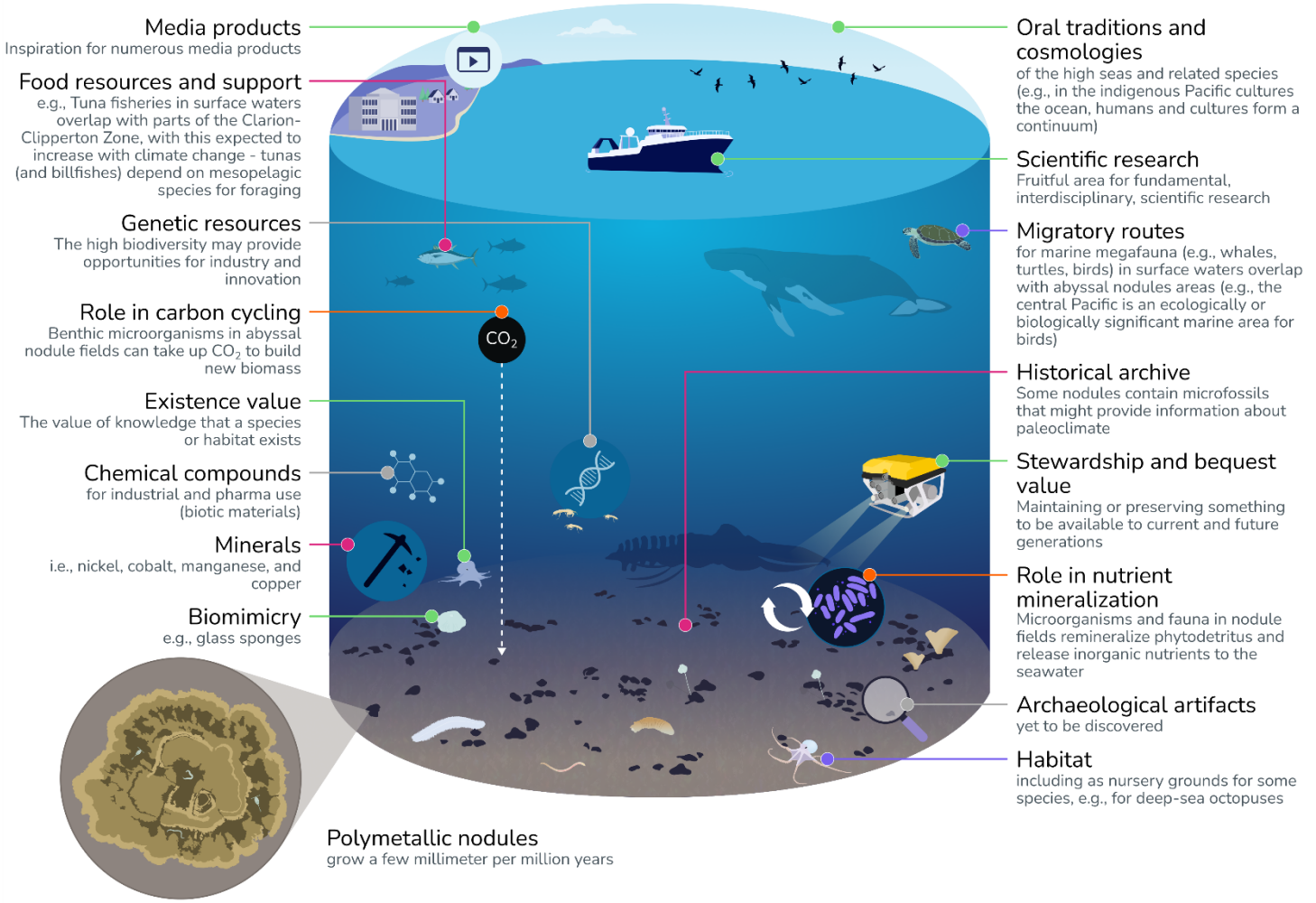


A deep-sea sponge growing on a manganese nodule. ROV Team, GEOMAR (CC BY 4.0, cropped)

The Polymetallic Nodule Field Ecosystem

Polymetallic nodules form over millions of years on the surface of abyssal plains around the world in waters between 3,000 and 6,000 m deep. In areas with soft sediment, nodules provide a hard substrate for organisms in need of attachment, such as corals and sponges. Nodules also provide microhabitats for microorganisms and small invertebrates that serve as food for larger animals. Many species that live on or in the nodules would not survive without them. Microorganisms that live on and in nodules are different from those in the surrounding soft sediment or in the water column. Most of these animals and microorganisms live either on the nodules or in the upper 5-10 cm of the surrounding soft sediment. The population density of species inhabiting nodule fields is low, as is biomass. This suggests that species in nodule fields may be rare, making them more vulnerable to local extinction if the seafloor is significantly altered or environmental conditions change.

While nodule fields were once viewed as a homogeneous habitat, it is now evident that variations in nodule size, abundance, and seafloor relief can alter local conditions to significantly affect what lives there. Nodule abundance and size varies over distance, as does the quantity, quality, and frequency of food sinking from the ocean surface. All these factors affect ecosystem structure and function in the abyss, resulting in deep-sea communities that are highly variable and diverse. Most of the biodiversity residing in nodule fields is still largely unknown to science. It is estimated that between 6,000 and 8,000 benthic species live in the Clarion-Clipperton Zone of the Norwest Pacific Ocean, of which 88-92% remain to be discovered. These poorly known seafloor communities influence and are influenced by the physical and chemical processes in the water above them.



KEY

- **Provisioning services**: result in tangible goods and/or products
- **Regulating services**: contribute to the natural production and resilience of habitats and ecosystem processes
- **Supporting services**: underlying ecosystem functions that are essential to produce other services
- **Cultural services**: non-material benefits deriving from nature
- **Option-use value**: future unknown and speculative benefits of the whole ecosystem

Human Impacts on Ecosystem Services from Polymetallic Nodule Fields

Climate change, fishing, and deep-sea mining are the main human impacts predicted to affect polymetallic nodule fields and the overlying water column. Climate change affects the productivity of the upper layers of the ocean, which are the source of most food that reaches the seafloor. Warming and loss of oxygen are also predicted to occur in abyssal areas because of climate change; the Equatorial Pacific Oxygen Minimum Zone that currently spans the Clarion-Clipperton Zone may expand.

While commercial mining of polymetallic nodules has not yet begun, the potential effects of mining on abyssal ecosystems and their services are being assessed. Nodule collector vehicles would remove the hard seafloor habitat provided by nodules and disturb the surrounding soft sediment, altering the biogeochemical and physical properties of the seafloor habitat on which most species depend. Since nodules only form over millions of years, the impacts from their removal will be extremely long-lasting. Options for nodule habitat rehabilitation are being considered, but avoiding or minimising damage is currently the only known option for protecting the biodiversity and function of abyssal polymetallic nodule fields.

Nodule collector vehicles will form a sediment plume above the seafloor as they operate. Independently monitored collector tests show that the majority of suspended sediment settles back on the seafloor within 2 km. Another sediment plume may be caused by the discharge of seawater that has been separated from the nodules. The depth at which this water is discharged will determine which parts of the ecosystem are affected. Studies of potential toxicity effects of the plumes and their extent are ongoing, though research to date indicates that the smothering effect of the sediment itself is more of a concern.

Noise and light produced during mining operations may have further impacts on marine life, though most noise related to deep-sea mining is expected to be caused by support vessels on the ocean surface. Combined, the predicted effects of mining nodules may lead to species extinctions and reduced populations. These changes would disrupt the ecosystem services provided by nodule-rich abyssal plains.

Protection of Ecosystem Services

A network of 13 Areas of Particular Environmental Interest (APEIs) has been set aside from exploitation in the Clarion-Clipperton Zone polymetallic nodule field by the International Seabed Authority, with the intention to preserve its ecosystem services. No other abyssal polymetallic nodule fields are protected in this way, though APEIs are expected to be included in future Regional Environmental Management Plans such as those for the Indian and western Pacific Oceans. In Areas Beyond National Jurisdiction, existing legal regimes and governance structures confer diffuse responsibility to operators in many regions where nodule fields occur. This creates significant challenges for ecosystem-based management.

How to Cite:

DOSI (2023). "Polymetallic Nodule-Rich Abyssal Plains" - Information Sheet. Deep-Ocean Stewardship Initiative. **https://www.dosi-project.org/wp-content/uploads/abyssal-plain-info-sheet.pdf**

About DOSI:

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

This Information Sheet was prepared by:

Lead Authors: Tanja Stratmann and Patricia Esquete

Contributors: Diva Amon, Bobbi-Jo Dobush, Brandon Gertz, Sabine Gollner, Jesse van der Grient, Maila Guilhon, Nelia Mestre, Ellen Pape and Samantha Smith. Figure by Stacey McCormack.

Contact us: DOSIcomms@gmail.com