DEEP-OCEAN STEWARDSHIP INITIATIVE

POLICY BRIEF
SEPTEMBER 2018

# Deep-Sea Fundamentals

*Fig 1 The giant isopod, Bathynomus giganteus, spotted in the Gulf of Mexico. NOAA OER*

*Fig 2 A tube-dwelling anemone or cerianthid. NOAA OER*

**Marine areas beyond national jurisdiction (ABNJ) are almost entirely comprised of deep ocean, which harbor a significant portion of global biodiversity. The little that we know of the deep sea has revealed a remarkable suite of habitats that provide the planet and its inhabitants with crucial ecosystem services. A precautionary and ecosystem-based management approach is necessary to ensure the conservation and sustainable use of biodiversity in ABNJ. For this to occur, continued international cooperation is needed to advance scientific investigation.**

## Biodiversity unimagined

The deep ocean (>200 metres depth) accounts for 45% of the surface of our planet and 61% of the surface of the oceans. Providing over 95% of the planet's habitable space, this vast area is the largest ecosystem on the planet by far and much of it lies in ABNJ. The deep ocean provides critical ecosystem services that keep our planet healthy. Its great size means that it regulates our climate by removing heat and carbon dioxide from the atmosphere, cycles nutrients and chemicals, and detoxifies our oceans. The deep ocean is interconnected with the atmosphere and surface ocean by wind, waves, circulation, turbulence, upwelling and thermohaline circulation, and by the sinking of particles and migrations of animals and their larvae.

It is a common misconception that the deep ocean is one homogenous ecosystem. As on land, there are an extraordinary variety of habitats in the deep ocean. Trenches, coral and sponge gardens on seamounts, hydrothermal vents, methane seeps, wood falls and whale falls, canyons, abyssal plains, the deep pelagic and many more comprise the habitats of the deep. Each of these supports species that are often evolutionarily distinct and extremely rare. As a result, there is extremely high biodiversity. For example, more than 300 animal species have been discovered at hydrothermal vents, over 80% of which are found at no other habitat. Already, around 250,000 marine species have been described. While the full inventory of marine species has yet to be completed, it is estimated that there could be as many as 2 million marine species and more than 500 billion different types of microorganisms.

Journeying into the deep results in a loss of light, with almost complete darkness by 400 metres depth, apart from bioluminescence produced by living organisms.Temperatures hover just above freezing, pressures increase dramatically (1 atmosphere for every 10 metres depth of water) and there is extremely low food input to most of the deep sea. The extreme conditions result in novel adaptations, such as gigantism and dwarfism, and the ability to withstand very low or high temperatures or chemical concentrations.

Many species have slow metabolism, movement, growth and reproduction with late maturity, presumably as a result of low ambient temperatures and reduced predation pressure and food availability. As a result, these species may show considerable longevity, with some fish species living for more than 100 years, and some coral species for over 4000 years. However, species associated with areas of high flux to the seabed or where chemicals are utilised as a source of energy, such as hydrothermal vents, show rapid annual growth, reproduction and early maturity. The ability to cope successfully with change or impact, as well as the time to recover, will depend on the life histories of inhabiting species.

Fig 3 *An undescribed species of hydromedusae seen at over 4000 metres close to the Mariana Trench. NOAA OER*

## Out of sight and out of oversight

The deep oceans are fast becoming the next frontier for the discovery of valuable resources. Submarine cables crisscross the deep-sea floor worldwide. We are fishing deeper than ever with approximately 40% of fish caught deeper than 200 metres. Oil and gas extraction from deepwater has been occurring for over a decade. Scientific breakthroughs for medicine and industry involving deep-sea biodiversity result from investigation. Seabed mineral deposits are the latest lure. The potential impacts from extractive industries are many and will be compounded by climate change. Increasing evidence of climate change in the deep ocean is emerging with data showing rising temperatures and decreasing pH, oxygen concentrations, and food supply in vast areas thousands of metres deep. A further stress factor impacting deep-ocean ecosystems is pollution - recent studies indicate far-reaching effects of past unregulated ocean dumping and current pollution from coastal and riverine sources including by plastics and industrial chemicals.

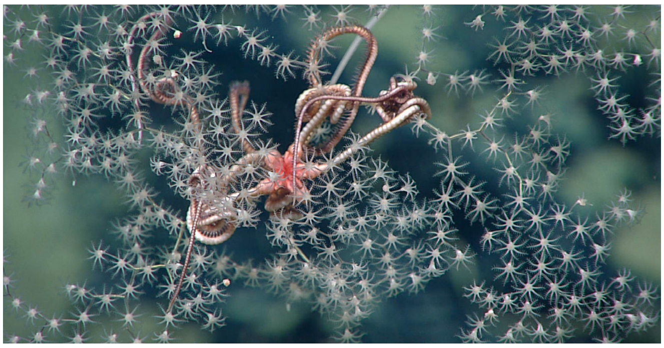

Fig 4 *A brittle star living commensally on a deep-sea octocoral. NOAA OER*

The ecological consequences of human disturbance, especially to ecosystem services, are poorly understood but are believed to be wide-ranging and have significant implications. Additionally, the full extent of deep-ocean biodiversity remains unknown. The deep ocean is a technologically challenging and expensive ecosystem to work in and as a result, only about 5% of the seafloor, and much less of the deep pelagic has been fully explored.

This results in major knowledge gaps, which restrict our ability to ensure the deep sea is governed for the benefit of all, today and in the future. **In this area of rapidly expanding human activity, there is a need to consider impacts cumulatively and to take precautionary and ecosystem-based management measures to conserve biodiversity and prevent loss of ecosystem services.**

## Thinking ahead

The deep ocean provides enormous benefits in terms of biosphere regulation, valuable resources, cultural inspiration and potentially the solutions to sustainable development challenges (now and in the future). The gaps in scientific knowledge and the interconnected nature of deep-sea life requires an ecosystem approach to management. Meanwhile, the gaps in scientific knowledge demand a precautionary approach to allow for what we have yet to discover about this vast realm. International collaboration, and the development and deployment of new technologies, is crucial to build capacity, fill gaps in knowledge, and enable a science-based approach to the conservation and sustainable use of biodiversity in ABNJ.

## Further information

Ramirez-Llodra, E., Brandt, A., Danovaro, R. et al. 2010. Deep, diverse and definitely different: unique attributes of the world's largest ecosystem, Biogeosciences, 7, 2851-2899.

Ramirez-Llodra, E., Tyler, P., Baker, M. et al. 2011. Man and the Last Great Wilderness: Human Impact on the Deep Sea. PLoS ONE 6(8): e22588.

## ABOUT DOSI

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

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*Fig 5 Sea toads or coffinfishes are a family of deep-sea anglerfishes. NOAA OER*

*Fig 6 A squat lobster living commensally on a deep-sea stony coral, Madrepora oculata. NOAA OER*

*Fig 7 A sea lily or crinoid. NOAA OER*

*Fig 8 A Batfish can walk over the bottom on their pectoral and pelvic fins. NOAA OER*

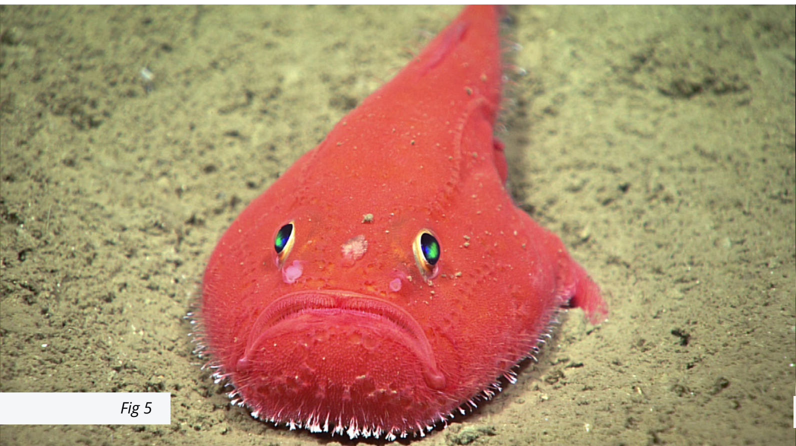

*Fig 5*

*Fig 6*

*Fig 7*

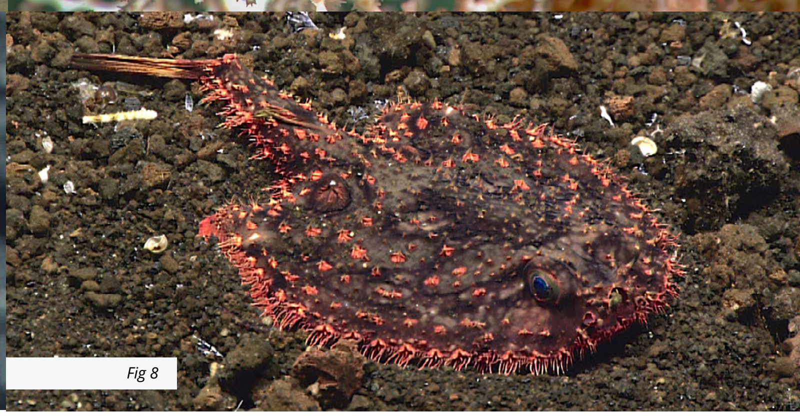

*Fig 8*