Protecting the Ocean Twilight Zone

The Awe and Wonder of the Mesopelagic



Mesopelagic fish are among the most abundant vertebrate species on Earth, with some species estimated to be in the quadrillions. Hidden away where they live in deeper waters, many have large eyes and glow in the dark to see in the dim light. These mythical-looking creatures are just one of the many fascinating aspects of this ecological gem. ***Photo credit: Paul Caiger, ©Woods Hole Oceanographic Institution***

The Ocean Twilight Zone (OTZ) provides a critical ecosystem link between the surface waters and the abyss, and what happens here will affect the food supply and climate resilience through the entire ocean. Formally called the mesopelagic zone, the water column between 200 and 1,000 meters depth is a place where little sunlight penetrates. Species living in the OTZ have evolved in fascinating ways to thrive in this deep-sea environment, including species that generate their own light sources (known as bioluminescence) or massively expand their jaws and stomachs to consume prey much larger than themselves. By volume the OTZ only comprises 20% of the ocean yet it is home to upwards of 90% of the fish biomass on the planet and thus of outsized importance when it comes to marine biodiversity, ecological function and carbon sequestration. Mesopelagic communities, including fishes, squids, jellyfish and shrimp, are critically important food sources for commercially important tunas and swordfish and sharks, marine mammals and seabirds. Mesopelagic fishes are part of the largest migration of animals on the planet and as such act as a "biological pump" for moving carbon from the surface to deep water. About 90% of the carbon that gets into the mesopelagic remains there, with the rest sinking to the deep ocean where it feeds and shapes benthic ecosystems, locked away for hundreds or thousands of years. This little appreciated region is truly an area of awe and wonder- and tremendous importance to the health of our planet.

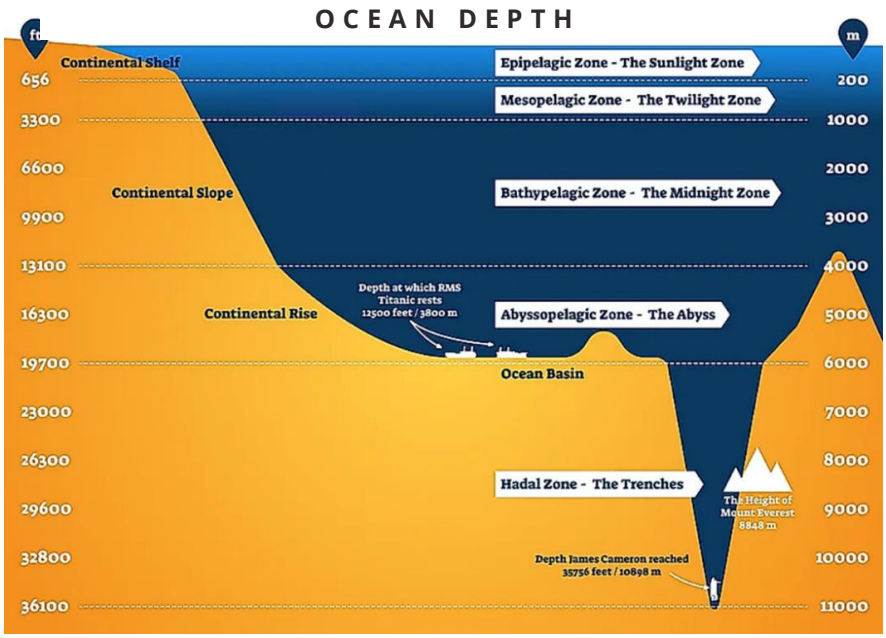
By some estimates, the twilight zone accounts for upwards of

90%

of the fish biomass on the planet.

The Zone's Critical Ecological and Climate Benefits

The twilight zone is a host to a large proportion of the ocean's biodiversity. As a critical component of the ocean food web, these species serve as key prey for whales, dolphins, and seabirds as well as for species valuable to fishing industries, such as tuna and swordfish. Remarkably, many well-known, surface-dwelling species are dependent on out-of-sight species lurking in the twilight zone.



5 zones of the ocean. Image credit: VectorMine/Shutterstock.com

The unique behavior of these species is what also renders the mesopelagic zone crucial for climate regulation. The surface ocean absorbs roughly a quarter of the globe's carbon dioxide emissions, but it is the mesopelagic zone that serves as the gateway for the long-term storage of atmospheric carbon in the deep sea. As a result of daily mass migrations, **mesopelagic species transfer up 2- 6 gigatons of carbon per year from surface waters to the deep sea**. **Functioning as the engine of the ocean's carbon cycle, this amount of carbon drawdown is equivalent to twice the amount of emissions produced by cars worldwide annually.**

Emerging Threats

Recognizing the significant abundance of fish biomass that exists in the mesopelagic zone, there is interest in commercial extraction. While past exploratory fisheries have not resulted in fishing at scale, pressure is rising as current stocks of small pelagics, such as anchoveta, which are critical inputs to fishmeal and fish oil production, are declining or shifting their distributions due to climate change. The allure of this biomass to meet the needs for fish oil and fish meal continues to spur investments in securing large scale viable fisheries. A key species, Lanternfish — smaller in size and shape than a pencil — are estimated to number in the quadrillions. Their volume, alongside their high concentration of omega-3 fatty acids, make them a desired source of raw materials for fish meal/oil for the aquaculture industry, for pet food, and for various health food supplements for humans.

The mesopelagic environment is also feeling the impacts of climate change, with warming and deoxygenation documented globally. And toxic sediment plumes released into the mesopelagic zone are likely to add to these climate and fishery threats, as deep-sea mining for minerals below the zone moves closer to commercial reality. And finally, a threat that is perhaps more imminent is the large-scale deployment of technical approaches to marine carbon dioxide reduction (mCDR). These approaches essentially aim to mimic what mesopelagic species do naturally—efficiently draw down carbon from the surface deep into the ocean—through modifications to the chemical carbon pump (e.g., ocean alkalinity enhancement) or the biological carbon pump (e.g., ocean iron fertilization). What is unknown is how these approaches may impact the functioning of the mesopelagic. Now is the time to protect these communities and encourage the necessary research into impacts to inform how activities such as mCDR might adversely affect the mesopelagic zone and until we understand how and whether exploitation could be done in a manner that preserves their important role in the ecosystem and the biological carbon pump.

Charting a Sustainable Future



Given what we know about the importance of the OTZ, it is imperative that their critical ecological and climate services are protected. Mesopelagic communities exist within individual country EEZs and in the high seas. A number of published papers have identified pathways for large-scale protections. They include actions within country EEZs based on existing governance frameworks, including through the Global Biodiversity Framework under the Convention on Biological Diversity (CBD), expert guidance from the UN Food and Agriculture, the IPCC, and the larger scientific community, actions by regional fishery management organizations (RFMOs), expansion of the role of the London Protocol on regulating mCDR research; and the soon to be ratified BBNJ agreement. An important catalyst for coherent and integrated action can be achieved through the development and passage of international resolutions under the International Union for the Conservation of Nature and Natural Resources (IUCN) or the United Nations General Assembly (UNGA). Such resolutions could help signal the importance of this issue, drive increased ambition for the protection of the mesopelagic zone, and spur subsequent implementation actions via countries, RFMOs, the BBNJ Agreement, the London Protocol, as well as support collaborative research and consideration of further governance mechanisms needed.

There are important upcoming opportunities for expressing public commitments for protecting the OTZ including the UN Ocean Conference in June 2025 and passage of an IUCN resolution in the fall of 2025. A dialogue is needed amongst governments, scientists, ocean related businesses and civil society to determine the best pathways to protect the communities of the OTZ given the critical contributions to the health of our planet. For further information please contact:

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