

The ecological role of zooplankton in the twilight and dark zones of the ocean

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Cold temperatures, increased pressure, dim light and the absence of net primary production characterize the twilight zone between 200 and 1000 m of the open ocean. Below this depth is the dark zone consisting of stable abiotic conditions and perpetual darkness, with bioluminescence, the ability of organisms to produce their own light, being the only light source. These zones, also called the meso- and bathypelagic zones, are herein referred to as the deep-sea. The main food sources for organisms inhabiting these zones are vertically migrating animals, sinking carcasses and sinking particulate organic matter (POM) produced by autotrophic and heterotrophic organisms in the euphotic zone.

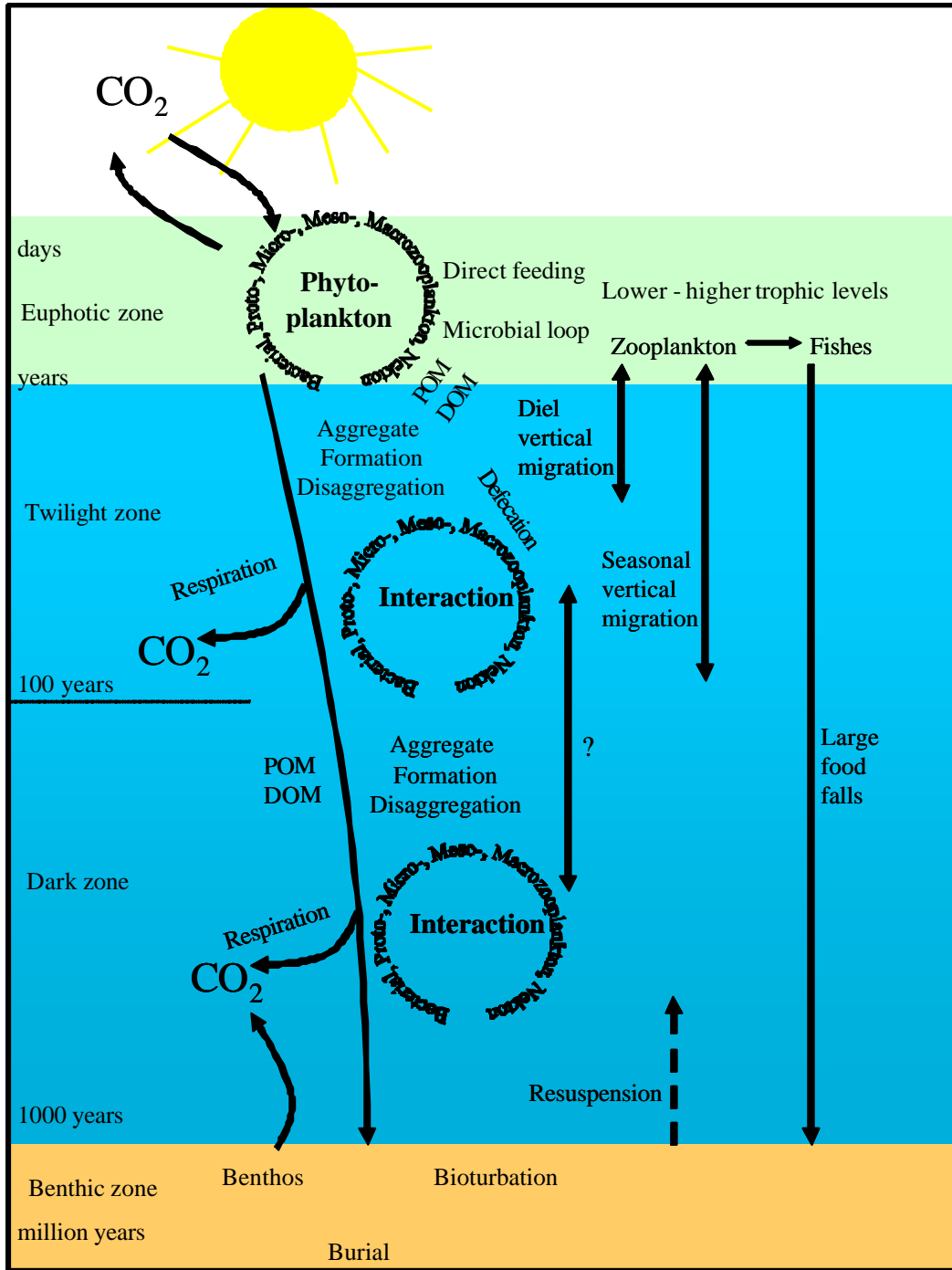
Approximately 90% of POM is remineralized as it sinks through the water column. Remineralization processes remain poorly characterized throughout the water column because they are difficult to observe and quantify. The character of the material transported to the deep-sea reflects the ecological structure of the upper ocean and influences the remineralization rate. Portions of sinking POM are transported from lower to higher trophic levels via the food chain. Longevity at these higher trophic levels probably exists in the deep-sea due to slow growth and maturity caused by low quantities of food reaching the deep.

A notable gap in understanding the linkage between trophic levels and remineralisation rates is the lack of information about gelatinous organisms. These organisms are widely distributed and occasionally occur in large numbers with biomass exceeding that of fish. This can greatly impact food web dynamics. A likely explanation for the paucity of knowledge of gelatinous organisms is the inherent difficulty of sampling them. Most gelatinous organisms are fragile and break into pieces when sampled with commonly used nets. Thus, information on their ecological role and physiological rates is very limited.

This paper will give an overview on deep-sea zooplankton ecology, its temporal distribution, and its role in organic matter cycling, while addressing gaps in knowledge. The following topics should be investigated in future research dealing with deep-sea zooplankton ecology: physiological rates and potentials of functional groups and key species, responses to different quantities and qualities of food (flux), responses to disturbances or changes in temperature, pH, O₂, pollutants etc. and, last but not least, effects of climate change on carbon transformation and storage in the twilight and dark zones.

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Hypothetical pathways of carbon in the open ocean and storage time of CO₂ in different compartments of the water column and the benthic zone.

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