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Factors Influencing Functional Structure of Epi-faunal Communities

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Introduction

Body size of organisms affects many ecological functions including energy and nutrient cycling, and secondary production. One of the most common characteristics of deep-sea benthos is the small size of most species. Our study results are consistent with this paradigm and hence with our hypothesis, in that the second smallest organism category had the highest occurrence, while large organisms had the lowest occurrence in epi-faunal communities across the Chukchi Borderland [1]. Low occurrence of the smallest size category is unsurprising given that we targeted epi-benthic mega-fauna. A series of studies reporting reduced average body size with depth for deep-sea meio-fauna and macro-fauna generally support size structure hypothesis for these groups. This decrease in body size with depth has also been found for epi-fauna [2]. Opposite to this trend, some deep-sea taxa with larger body sizes than in shallow areas have also been documented, in some cases resulting in gigantism [3]. This phenomenon, often attributed to low temperature and high oxygen availability that causes slow growth rate and longevity, has been found for deep-sea isopods, amphipods, pycnogonids, ostracods, and anemones but in our study, only the very large pycnogonid Colossendeis proboscidea could fit this concept. Overall, we confirm our hypothesis that the majority of epifauna found in our study was non-sessile, most were crawlers but swimmers were also found [4]. Not unexpectedly, burrowers were less common, given the focus of the study was epifauna. As a consequence of the ability to move organisms can escape from disturbance, disperse or migrate and increases the chance of finding scarce and patchy food compared to sessile or less mobile organisms [5]. Still, movement rates of epibenthic megafauna are generally lower in the deep sea compared to shelves. For example, deep-sea brittle stars and holothurians move, respectively, when compared in shallow waters [6]. When stimulated, for example by food, however, many deep-sea animals can move faster. For example, we observed unusual swimming behaviour in the brittle star Ophiostriatus striatus, perhaps an adaptation to access patchy food falls. Remotely operated vehicle observations such as ours, hence, increase our often scarce knowledge of traits of deep-sea taxa. Besides mobile taxa, we did also find an unexpectedly high occurrence of the modality sessile in our study, especially obvious in remotely operated vehicle imagery [7]. Sessile taxa in our study area, including ascidians, sponges, stalked cirripedes and crinoids, and zoanthid and nephtyid cnidarians were in part present on the numerous drop stones providing hard substrate for these organisms [8]. Trophic structure of the Arctic benthic deep-sea communities is poorly studied, though feeding habits influence energy flow, nutrient cycling, secondary production, organic matter decomposition, and nutrient regeneration. We do know that the major food source is organic detritus originating mostly from the upper productive zone [9]. This organic material often undergoes strong transformation while sinking, decreasing nutritional value and particle size. The paradigm that deposit feeding is among the best strategies to collect and process this organic detritus efficiently has indeed been supported for both macro-faunal and mega-faunal deep-sea communities [10]. The deposit feeders were also common yet not dominant in our study area, only partly confirming our hypothesis. Predators and suspension-feeders, however, were more common among our epi-faunal taxa. This is contrary to a trend of decreasing proportions of predatory asteroid and gastropod species with depth. Our findings, however, are in agreement with other studies that found that predation is in fact common in oligotrophic seas or in areas with little food input, and are supported by high nitrogen isotope values in certain taxa of our study area. One theory states that prey can be more easily detected in the deep sea compared to shallow water environments, as flow in the benthic boundary layer is slow and thus chemical gradients and pressure waves produced by prey should be more persistent and provide better information for prey location. Facultative predation is even known for specific deep-sea species of, for example, sponges, and bivalves, suggesting feeding modes may be unusual, highly plastic and require more study. A stable isotope-based assessment for the study area is on-going and will provide more clarification of the species' feeding modes and trophic levels.

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Conflict of Interest

None

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