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TITLE: Relationships between oxygen, organic matter and the diversity of bathyal macrofauna

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ABSTRACT:

The relationships of environmental factors with measures of macrobenthic community diversity were examined for the total fauna, and for polychaetes only, from 40 bathyal stations in the North Atlantic, eastern Pacific and Indian Oceans (154?3400 m). Stepwise multiple regression revealed that depth, latitude, sediment organic-carbon content and bottom-water oxygen concentration are significant factors that together explained 52?87% of the variation in macrobenthic species richness (E[s100]), the Shannon?Wiener index (H?), dominance (D), and evenness (J?). Percent sand and percent clay were not significant factors. After removal of depth and latitudinal effects, oxygen and organic-carbon concentrations combined accounted for 47, 67, 52 and 32% of residual variation in macrobenthic E(s100), H?, D, and J?, respectively. Organic carbon exhibited a stronger relationship than oxygen to measures of community evenness, and appeared to have more explanatory power for polychaetes than total macrobenthos. When only stations with oxygen <1 ml l-1 were considered, oxygen concentration became the dominant parameter after depth. Results suggest existence of an oxygen threshold (<0.45 ml l-1), above which oxygen effects on macrobenthic diversity are minor relative to organic matter influence, but below which oxygen becomes a critical factor. Our regression results lead us to hypothesize that for bathyal faunas, oxygen at low concentrations has more influence on species richness, while organic carbon regulates the distribution of individuals among species (community evenness). Examination of rarefaction curves for Indo-Pacific stations reveals that total macrobenthos, polychaetes, crustaceans and molluscs all exhibit reduced species richness within oxygen minimum zones (OMZs). However, representation under conditions of hypoxia varies among taxa, with polychaetes being most tolerant. Molluscs and crustaceans often (but not always) exhibit few individuals and species in OMZs, and sometimes disappear altogether, contributing to reduced macrobenthic diversity and elevated dominance in these settings. The linear negative relationship observed between bathyal species richness and sediment organic-carbon content (used here as a proxy for food availability) may represent the right side (more productive half) of the hump-shaped, diversity?productivity curve reported in other systems. These analyses suggest there are potentially strong influences of organic matter and oxygen on the diversity and composition of bathyal macrobenthos, especially in the Indo-Pacific Ocean.

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