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TITLE: Environmental Influences on Regional Deep-Sea Species Diversity

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ABSTRACT:

? Abstract Most of our knowledge of biodiversity and its causes in the deep-sea benthos derives from regional-scale sampling studies of the macrofauna. Improved sampling methods and the expansion of investigations into a wide variety of habitats have revolutionized our understanding of the deep sea. Local species diversity shows clear geographic variation on spatial scales of 100?1000 km. Recent sampling programs have revealed unexpected complexity in community structure at the landscape level that is associated with large-scale oceanographic processes and their environmental consequences. We review the relationships between variation in local species diversity and the regional-scale phenomena of boundary constraints, gradients of productivity, sediment heterogeneity, oxygen availability, hydrodynamic regimes, and catastrophic physical disturbance. We present a conceptual model of how these interdependent environmental factors shape regional-scale variation in local diversity. Local communities in the deep sea may be composed of species that exist as metapopulations whose regional distribution depends on a balance among global-scale, landscape-scale, and small-scale dynamics. Environmental gradients may form geographic patterns of diversity by influencing local processes such as predation, resource partitioning, competitive exclusion, and facilitation that determine species coexistence. The measurement of deep-sea species diversity remains a vital issue in comparing geographic patterns and evaluating their potential causes. Recent assessments of diversity using species accumulation curves with randomly pooled samples confirm the often-disputed claim that the deep sea supports higher diversity than the continental shelf. However, more intensive quantitative sampling is required to fully characterize the diversity of deep-sea sediments, the most extensive habitat on Earth. Once considered to be constant, spatially uniform, and isolated, deep-sea sediments are now recognized as a dynamic, richly textured environment that is inextricably linked to the global biosphere. Regional studies of the last two decades provide the empirical background necessary to formulate and test specific hypotheses of causality by controlled sampling designs and experimental approaches.

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