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Linking climate change to community-level impacts on copepods via a new, trait-based model: Life-history and metabolic mechanisms compared

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A new, trait-based copepod model ("Coltrane": Copepod Life-history Traits and Adaptation to Novel Environments) has been developed, drawing on past work on both optimal annual routines and trait-based plankton metacommunity models, in order to evaluate climate impacts on copepods via 1) phenology and life history and 2) temperature and energy budgets in a unified framework. In an idealized global-scale testbed, the model correctly predicts life strategies in large Calanus spp. ranging from multiple generations per year to multiple years per generation. In a Bering Sea testbed, the model replicates the dramatic variability in the abundance of C. glacialis/marshallae observed between warm and cold years of the 2000s, and indicates (consistent with recent field studies) that sea ice-linked prey phenology is a more important driver than temperature per se. In a Disko Bay, West Greenland testbed, the model predicts the viability of a spectrum of large-copepod strategies from income breeders with a adult size ~100 µgC reproducing once per year through capital breeders with an adult size > 1000 ugC with a multiple-year generation length. This spectrum corresponds closely to the observed life histories and physiology of local populations of C. finmarchicus, C. glacialis, and C. hyperboreus. Futhermore, the model replicates the observed range of stored lipid content of these copepod populations (30–60%, C. finmarchicus–C. hyperboreus), suggesting a means for linking changes in temperature and primary production to the energy content as well as size structure of the copepod community.

Keywords: copepods, model, life history, climate change, arctic, phenology, lipids

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