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Changes in higher trophic level productivity, diversity and niche space in a rapidly warming continental shelf ecosystem

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There is ecological and socioeconomic interest in what controls the diversity and productivity of ecosystems; however, that focus has intensified with the accelerated changes seen in the environment due to shifting climate conditions. The U.S. Northeast Shelf continental shelf marine ecosystem (NES) has been intensely studied and found to be among the more rapidly warming marine systems worldwide. Furthermore, many constituent species have experienced significant distributional shifts. However, the system response of the NES to climate change goes beyond simple shifts in species distribution. The fish and macroinvertebrate communities of the NES have increased in species diversity and overall productivity in recent decades, despite there being no significant decline in fishing pressure. Species distribution models constructed using random forest classification and regression trees were fit for the dominant species in the system. Over time, the areal distribution of occupancy habitat has increased for approximately 80% of the modeled taxa, suggesting most species have significantly increased their range and niche space. These niche spaces were analyzed to determine the area of niche overlap between species pairs. For the vast majority of species pairs, interaction has increased over time suggesting greater niche overlap and the probability for more intense species interactions. These interactions could include both predation and competition. Furthermore, the species taxonomic composition and size structure indicate a potential tropicalization of the fish community. The system and community changes are consistent with the view that the NES may be transitioning from a cold temperate or boreal ecoregion to one more consistent with the composition of a warm temperate or Carolinian system.

Keywords: species interactions, niche overlap, biodiversity, habitat, species distribution model

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