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TITLE: Modeling the Population Effects of Hypoxia on Atlantic Croaker (Micropogonias undulatus) in the Northwestern Gulf of Mexico: Part 2?Realistic Hypoxia and Eutrophication

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ABSTRACT:

Quantifying the population-level effects of hypoxia on coastal fish species has been challenging. In the companion paper (part 1), we described an individual-based population model (IBM) for Atlantic croaker in the northwestern Gulf of Mexico (NWGOM) designed to quantify the long-term population responses to low dissolved oxygen (DO) concentrations during the summer. Here in part 2, we replace the idealized hypoxia conditions with realistic DO concentrations generated from a 3-dimensional water quality model. Three years were used and randomly arranged into a time series based on the historical occurrence of mild, intermediate, and severe hypoxia year types. We also used another water quality model to generate multipliers of the chlorophyll concentrations to reflect that croaker food can be correlated to the severity of hypoxia. Simulations used 100 years under normoxia and hypoxia conditions to examine croaker population responses to the following: (1) hypoxia with food uncoupled and coupled to the severity of hypoxia, (2) hypoxia reducing benthos due to direct mortality, (3) how much hypoxia would need to be reduced to offset decreased croaker food expected under 25 and 50% reduction in nutrient loadings, and (4) key assumptions about avoidance movement. Direct mortality on benthos had no effect on long-term simulated croaker abundance, and the effect of hypoxia (about a 25% reduction in abundance) was consistent whether chlorophyll (food) varied with hypoxia or not. Reductions in hypoxia needed with a 25% reduction in nutrient loadings to result in minimal loss of croaker is feasible, and the croaker population will likely do as well as possible (approach abundance under normoxia) under the 50% reduction in nutrient loadings. We conclude with a discussion of why we consider our simulation-based estimates of hypoxia causing a 25% reduction the long-term population abundance of croaker in the NWGOM to be realistic and robust.

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