

ICES/PICES 6ZPS 2016/W1

Too Hot To Breathe: The impact of rising temperature and decreasing oxygen on zooplankton individuals and populations

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Coastal and estuarine systems are increasingly affected by both rising temperatures and decreasing oxygen (hypoxia), due to the combined impacts of climate change and anthropogenic influence. Hypoxia is often defined as a specific concentration of dissolved oxygen, however the effect of oxygen concentration on individuals is also impacted by temperature, which affects metabolic rates and the saturation of oxygen in water. Understanding the relationship between temperature and the supply and demand of oxygen for individuals and populations, as well as the variability in that relationship, is key to understanding the impacts of rising temperatures and increasing hypoxia. Focusing on the copepod *Acartia tonsa*, we have used observational data and empirical relationships to examine whether different metrics for describing response to oxygen can explain the observed distributions and abundances. Specifically we determined the depth of the critical and lethal partial pressure of oxygen as well as the 2 mg/L oxycline to see how these differ seasonally in the Chesapeake Bay and the Northern Gulf of Mexico, and whether there is a relationship between these metrics and copepod distribution. In summer the 2 mg/L oxycline was correlated with lethal partial pressures, whereas in spring and autumn oxygen was below the critical threshold even when above 2 mg/L or above the lethal partial pressure. Thus, even if not lethal and not considered hypoxic, water in spring and autumn may have had non-lethal impacts on copepods. Similar techniques may be applicable to other taxa to develop temperature dependent indicators of conditions.

Keywords: Copepods, *Acartia*, Temperature, Hypoxia

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