Dead zone or oasis in the open ocean? Zooplankton distribution and migration in low-oxygen modewater eddies

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The eastern tropical North Atlantic features a permanent mesopelagic oxygen minimum zone (OMZ) at approximately 300-600 m depth, coinciding with the daytime depth of many vertically migrating zooplankton organisms. Here, current oxygen concentrations seldom fall below 40 µmol kg^{-1}, but are thought to decline in the course of climate change. The recent discovery of mesoscale eddies that harbor a shallow suboxic (<5µmol kg^{-1}) OMZ just below the mixed layer has led us to conduct an interdisciplinary eddy hunt using satellite data and gliders, followed by ship-based sampling. We used acoustic (shipboard ADCP) and optical (Underwater Vision Profiler, UVP) profiling methods as well as vertically stratified plankton net hauls to resolve the vertical and horizontal distribution of zooplankton in relation to the oxygen concentration. The eddy was characterized by an approximately 1.5-fold increase in total area-integrated zooplankton abundance. Acoustic scatterers were avoiding O_2 concentrations below approximately 20 µmol O_2 kg^{-1}. Vertically stratified multinet hauls and UVP data suggest that there are four strategies followed by different zooplankton groups: i) shallow OMZ avoidance and compression at the surface, ii) migration to the shallow OMZ core during daytime, but paying O_2 debt at the surface at nighttime, iii) residing in the shallow OMZ day and night and iv) DVM through the shallow OMZ deeper oxygenated depths to the surface and back. For strategy i), ii) and iv), compression of the habitable volume in the surface may increase prey-predator encounter rates, potentially making zooplankton more vulnerable to predation.