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TITLE: Zooplankton diel vertical migration and downward C flux into the oxygen minimum zone in the highly productive upwelling region off northern Chile

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ABSTRACT:

Abstract. Diel vertical migration (DVM) can enhance the vertical flux of carbon (C), and so contributes to the functioning of the biological pump in the ocean. The magnitude and efficiency of this active transport of C may depend on the size and taxonomic structure of the migrant zooplankton. However, the impact that a variable community structure can have on zooplankton-mediated downward C flux has not been properly addressed. This taxonomic effect may become critically important in highly productive eastern boundary upwelling systems (EBUSs), where high levels of zooplankton biomass are found in the coastal zone and are composed by a diverse community with variable DVM behavior. In these systems, presence of a subsurface oxygen minimum zone (OMZ) can impose an additional constraint to vertical migration and so influence the downward C export. Here, we address these issues based on a vertically stratified zooplankton sampling at three stations off northern Chile (20?30? S) during November?December 2015. Automated analysis of zooplankton composition and taxa-structured biomass allowed us to estimate daily migrant biomass by taxa and their amplitude of migration. We found that a higher biomass aggregates above the oxycline, associated with more oxygenated surface waters and this was more evident upon a more intense OMZ. Some taxonomic groups, however, were found closely associated with the OMZ. Most taxa were able to perform DVM in the upwelling zone withstanding severe hypoxia. Also, strong migrants, such as eucalanid copepods and euphausiids, can exhibit a large migration amplitude (?500 m), remaining either temporarily or permanently within the core of the OMZ and thus contributing to the release of C below the thermocline. Our estimates of DVM-mediated C flux suggested that a mean migrant biomass of ca. 958 mg C m?2 d?1 may contribute with about 71.3 mg C m?2 d?1 to the OMZ system through respiration, mortality and C excretion at depth, accounting for ca. 4 % of the net primary production, and so implies the existence of an efficient mechanism to incorporate freshly produced C into the OMZ. This downward C flux mediated by zooplankton is however spatially variable and mostly dependent on the taxonomic structure due to variable migration amplitude and DVM behavior.

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