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R. Giesecke, T. Vallejos, M. Sanchez, K. Teiguiel

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Plankton dynamics and zooplankton carcasses in a mid-latitude estuary and their contributions to the local particulate organic carbon pool

Giesecke R.[1,2,3], Vallejos T.[1]. Sanchez M.[1], Teiguiel K.[1]

[1] Instituto de Ciencias Marinas y Limnológicas, Facultad de Ciencias, Universidad Austral de Chile P.O. Box 567, Valdivia, Chile

[2] Centro de Estudios en Ecología y Limnología Chile, Geolimnos, Carelmapu 1 N°540, Valdivia, Chile

[3] Research Center: Dynamics of High Latitude Marine Ecosystems (FONDAP-IDEAL). Universidad Austral de Chile.

Abstract

Estuaries are among the most productive aquatic ecosystems in coastal areas. Their productivity is linked to the formation of fronts generating mixing and retention of nutrients that can be used by autotrophs. Estuaries exhibit strong thermoclines and haloclines that may significantly affect zooplankton survival, while producing carcasses that could act as an alternative pathway of particulate organic carbon recycling. We investigated the in situ abundance of dead mero- and holozooplankton along the Valdivia River estuary, south-central Chile, during contrasting fresh water discharge conditions (summer, winter and spring), including the potential contribution of zooplankton carcasses to the particulate organic carbon standing stock along the estuary. Zooplankton samples were collected at four stations along the estuary during high tide at the surface, in the pycnocline and below the pycnocline. During autumn and winter the zooplankton community was mostly dominated by copepods, while during summer barnacle nauplii outnumbered copepods fourfold on average. During this study (29.5% ± 1.8% S.E.) of the net-captured zooplankton community, including A. tonsa, Paracalanus spp., Oikopleura spp., copepod nauplii, Podon spp. and barnacle nauplii, appeared to have been dead at collection. Highest overall mortality occurred in winter (44 ± 3.1% S.E.), with lower mortality during spring (26 ± 3.8% S.E.) and summer (19 ± 2.7% S.E.). The instantaneous mortality of copepods (Paracalanus spp. and Acartia tonsa) and copepod naupliar stages was always greater at the surface, associated with brackish water, while dead barnacle nauplii were usually distributed homogenously in the water column. The zooplankton carcass standing stock averaged ~ 0.2 mg C m^{-3} (in spring and winter) contributing to 0.03-0.22% of the POC produced in the estuary, while in summer carcasses reached up to 2.99 mg C m^{-3} with a contribution up to 0.87% of the POC. The summer contribution is linked to the presence of large amounts of dead barnacle nauplii that are a pulsed source to the estuary of highly labile POC.