Zooplankton feeding supports key physiological processes in the cold water coral *Desmophyllum dianthus*

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Scleractinian cold water corals control deep sea reef ecosystem functioning by providing structurally complex habitats to a high associated biodiversity, and by fuelling biogeochemical cycles via the release of organic matter. Despite their apparent ecological importance, our current knowledge on cold water coral ecophysiology and feeding ecology in particular is still very limited. Recent studies employing lipid biomarkers and *in situ* video surveys indicate zooplankton as a predominant food source. However, no information on the trophic significance of zooplankton to cold water corals is available to date. Hence, the present study investigates the influence of zooplankton feeding on key physiological processes in cold water corals. Laboratory incubations involving specimens of the cosmopolitan coral *Desmophyllum dianthus* were conducted to determine rates of respiration, calcification and organic carbon release under zooplankton-fed and unfed conditions. Findings revealed that the effect of zooplankton feeding (adult *Artemia salina*) was significantly positive for all monitored processes. Respiration decreased continuously in unfed corals and was significantly reduced by about 51 % after prolonged (3 wk) exclusion of zooplankton. Calcification rates declined rapidly (1 wk) and substantially under unfed conditions ultimately reaching levels as low as 31% of fed specimens. Initial total organic carbon (TOC) release rates were in the lower range of those reported for zooxanthellate warm water corals (2.0 ± 0.6 mg TOC m^{-2} h^{-1}), but decreased significantly in the absence of zooplankton hinting to TOC net uptake after 3 wk zooplankton exclusion. In fed corals, zooplankton covered approximately 3-times the daily metabolic demand for organic carbon, while TOC release represented 4.1 ± 1.5 % of zooplankton-derived particulate organic carbon input. Strong correlation of respiration and calcification rates also suggests that the availability of respiration-derived energy may significantly influence calcification in cold water corals. These findings highlight zooplankton as an essential nutritional source for *Desmophyllum dianthus*, importantly supplying respiratory metabolism, skeletal growth and organic matter release, with further implications for the role of cold water corals in reef ecosystem functioning.