Copepod carcasses as microbial hot spots for pelagic denitrification

Copepods are exposed to a high non-predatory mortality and their decomposing carcasses act as microniches with intensified microbial activity. Sinking carcasses could thereby represent anoxic microenvironments sustaining anaerobic microbial pathways in otherwise oxic water columns. Using non-invasive O2 imaging, we document that carcasses of Calanus finmarchicus had an anoxic interior even at fully air-saturated ambient O2 level. The extent of anoxia gradually expanded with decreasing ambient O2 levels. Concurrent microbial sampling showed the expression of nitrite reductase genes (nirS) in all investigated carcass samples and thereby documented the potential for microbial denitrification in carcasses. The nirS gene was occasionally expressed in live copepods, but not as consistently as in carcasses. Incubations of sinking carcasses in 15NO2 3 amended seawater demonstrated denitrification, of which on average 34%-617% (n=58) was sustained by nitrification. However, the activity was highly variable and was strongly dependent on the ambient O2 levels. While denitrification was present even at air-saturation (302 lmol L^-1), the average carcass specific activity increased several orders of magnitude to 1 nmol d^-1 at 20% air-saturation (55 lmol O2 L^-1) at an ambient temperature of 7.8°C. Sinking carcasses of C. inmarchicus therefore represent hotspots of pelagic denitrification, but the quantitative importance as a sink for bioavailable nitrogen is strongly dependent on the ambient O2 level. The importance of carcass associated denitrification could be highly significant in O2 depleted environments such as Oxygen Minimum Zones (OMZ).

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