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Seasonal changes in zooplankton swimmer and faecal pellets collected using a sediment trap in the western Arctic Ocean

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Most studies on zooplankton community in the Arctic Ocean have been performed on the basis of net-collected samples. However, seasonal sea ice coverage in this area prevents the accurate evaluation of their seasonal changes. To overcome these challenges, analysis on zooplankton swimmers collected using a moored sediment trap is a powerful tool. In the present study, we analysed the seasonal changes in zooplankton swimmers and faecal pellets collected using a sediment trap moored at the Northwind Abyssal Plain in the western Arctic Ocean.

Samples were collected using a sediment trap moored at 184-260 m at St. NAPt (75N, 162W, bottom depth: 1975 m) in 10-15 day intervals from October 4, 2010 to September 18, 2012. The sample cups were filled with 5% buffered formalin seawater. After the trap was retrieved, a total of 52 samples were gently sieved using a 1-mm mesh, and a fine-size fraction ($<$1 mm) of each sample was filtered using a membrane filter and subsequently weighed. Next, the total mass flux (mg DM m^{-2} day^{-1}) was evaluated. Zooplankton faecal pellets were then quantified in an aliquot of the fine-size fraction, according to four morphological types (oval shape, cylinder shape, spherical shape and brown oval shape). On the basis of both the size fraction samples ($<$1 mm and $\geq$ 1 mm), species identification and enumeration of zooplankton were performed under a dissecting microscope. Furthermore, cluster analysis by Bray-Curtis similarity using the connected unweighted pair group method and the arithmetic mean was performed on the zooplankton flux data (ind. m^{-2} day^{-1}). To identify the species most responsible for the similarity between zooplankton communities, SIMPER analyses were performed on the flux data.

In addition, satellite data were obtained, which revealed the sea ice coverage period (November-June), open water period (August-October), and high chlorophyll a period (August-October). The total mass flux ranged from 0.1-263.3 mg DM m^{-2} day^{-1}, and its peaks occurred in November, which corresponded to the onset of sea ice coverage. In the faecal pellets, oval shaped and spherical shaped morphologies were predominant, and resulted in a total pellet number of 60% and 30%, respectively. With regards to the specific characteristics of the faecal pellets, the brown oval shape occurred only in the open water period (July-August) and their maximum composition during this period reached 80%. The zooplankton flux ranged from 35 to 739 ind. m^{-2} day^{-1} and was significantly higher in September-November compared with other periods (p $<$0.0001, one-way ANOVA). In addition, poecilostomatoid copepods were numerically the most dominant taxa (annual mean$\pm$1sd: 69$\pm$18%). For seasonal dominant taxa, bivalve larvae were found in October-November (53%), and barnacle larvae were abundant in August 2011 (33%) but were not present in 2012. Cluster analysis on the zooplankton flux identified five zooplankton community groups. The occurrence of each group clearly showed seasonality, and alterations in their timings corresponded with the timing of the onset or offset of ice coverage or seasonal changes in daylight hours.

On-board experiments demonstrated that the brown-oval-shaped faecal pellets might be egested by amphipods. Furthermore, the high brown-oval-shaped faecal pellets found during the open water period (July-August) might reflect the massive feeding activity of amphipods. For zooplankton swimmers, seasonal abundant bivalve and barnacle larvae may be transported from a shallower region (e.g., the Chukchi Sea). The annual change in occurrence of barnacle larvae (present in 2011, but not in 2012) may be caused by the annual changes in water mass formation in the upper layer of the St. NAPt.

Keywords: western Arctic Ocean, sediment trap, zooplankton community, faecal pellets