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A perfect match? Climate control of zooplankton phenology and potential feedbacks to eutrophication in the northern Baltic Sea

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The northern Baltic Sea is a seasonally ice-covered brackish environment with pronounced seasonality in phytoplankton and zooplankton occurrence, characteristic of high-latitude marine ecosystems. Phytoplankton and zooplankton are typically temporally separated (mismatch) in spring, resulting in a pronounced spring bloom and significant vertical export of organic matter from the water column to the benthos. However, a compilation of historical observations from a coastal area of the western Gulf of Finland reveals a closer match in the phenology of phyto- and mesozooplankton during mild conditions characterized by high water temperature in winter and spring and absence of winter sea ice. The lower vertical export observed under these conditions indicate enhanced mesozooplankton control of vertical export in mild years, conceivably governed by higher survival and individual growth rates. These findings suggest that the frequency of match scenarios during spring will increase in coming decades in response to a projected increase in water temperature. While higher temperature likely also favours microzooplankton growth, the restricted data on inter-annual variation in this group and potential for top-down regulation by mesozooplankton makes their role in match/mismatch scenarios a critical knowledge gap. Eutrophication causing excessive organic matter deposition to the seafloor has contributed to sediment anoxia and subsequent internal nutrient loading in the Baltic Sea. A climate related increase in match events in spring should therefore affect sediment oxygen conditions positively, which in turn will reduce internal loading and counteract eutrophication in the long-term.

Keywords: Match/mismatch, spring bloom, mesozooplankton, Baltic Sea, organic matter export, climate change, temperature, sea ice, eutrophication

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