

Gelatinous zooplankton in the Belgian part of the North Sea and the adjacent Schelde estuary: a real problem?

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Summary

Gelatinous zooplankton has been largely understudied in ecosystems worldwide, and the absence of quantitative long-term abundance data impedes drawing conclusions on a potential rise of these organisms. This study presents results from monthly samples taken in 2011-2012 at six locations in the Belgian part of the North Sea and the adjacent Schelde estuary.

Three Scyphozoa, three Ctenophora and 27 Hydrozoa taxa were identified. Densities of gelatinous zooplankton never outnumbered the non-gelatinous zooplankton. Average gelatinous zooplankton densities reached up to 18 ind.m⁻³ near the coast and gradually declined towards the open sea (60 km offshore). In the brackish Schelde estuary, average densities remained below 4 ind.m⁻³. Gelatinous zooplankton densities were highest in autumn throughout the study area.

We conclude that the observed distribution of gelatinous zooplankton is driven by a limited number of environmental variables (temperature and salinity).

One of the three non-indigenous gelatinous species found in the area is *Mnemiopsis leidyi*. The peak densities did not reach worrying densities but data from this and other studies indicate that Dutch estuaries and Belgian ports provide optimal conditions and potential for year round presence and thus reproduction. Further regular monitoring is needed to estimate the gelatinous future of the Southern North Sea.

Introduction

Global ocean ecosystems are thought to be heading towards a gelatinous future, a perception that is strengthened by an increased reporting of problems caused by jellyfish. However, gelatinous zooplankton has been largely understudied in most ecosystems worldwide, and the absence of quantitative long-term abundance data actually impedes drawing conclusions on the potential rise of these organisms. Jellyfish densities show large inter-annual fluctuations, which makes it difficult to distinguish natural fluctuations in jellyfish populations from changes caused by on-going anthropogenic perturbations. Global warming and overfishing, but also local phenomena such as eutrophication, habitat modification and transport of non-indigenous species might cumulatively affect the ecosystem and intensify the natural fluctuations in jellyfish abundance. The introduction of the ctenophore *Mnemiopsis leidyi* for example had a substantial effect on the ecosystem of the Black Sea when densities increased. Most jellyfish are carnivores feeding on almost anything, from unicellular organisms to much larger prey. Consequently, the predation and competition pressure on the co-occurring plankton community and on higher trophic levels (e.g. fish) can be considerable during jellyfish blooms. Considering the haziness regarding the inter-annual and seasonal fluctuations in jellyfish populations, and the potential impact of gelatinous zooplankton on the non-gelatinous zooplankton community, this study contemplates the community structure and dynamics of

gelatinous zooplankton in the Belgian Part of the North Sea (BPNS) and Schelde estuary in the light of a jellification risk as data from these two areas is scarce or absent.

This study therefore aims to characterise the gelatinous zooplankton community in the BPNS and the adjacent Schelde estuary, to investigate the spatial and temporal distribution patterns of this community in relation to some structuring environmental variables, and to discuss the relation between gelatinous zooplankton and the rest of the zooplankton community. Ultimately, this study can form the baseline for the further evaluation of the jellification process in the BPNS.

Materials and methods

In 2011-2012, monthly samples were taken at six locations in the Belgian part of the North Sea and the adjacent Schelde estuary. Undulating WP3 net tows (Ø 1 m, mesh size 1000 µm) were executed in order to adequately sample the gelatinous zooplankton. Environmental variables were measured at each location. Spatial and temporal differences in the species composition of the samples were investigated using PERMANOVA (Permutational ANOVAs) to test for the factors season and location. Finally, the environmental variables were related to the patterns in gelatinous species composition and abundance via distance-based linear models (DistLM) using the Primer version 6, Permanova+ software.

Results and Discussion

Three Scyphozoa, three Ctenophora and 27 Hydrozoa taxa were identified. Densities of gelatinous zooplankton never outnumbered the non-gelatinous zooplankton. Average gelatinous zooplankton densities reached up to 18 ind.m⁻³ near the coast and gradually declined towards the open sea (60 km offshore). In the brackish Schelde estuary, average densities remained below 4 ind.m⁻³. Gelatinous zooplankton densities were highest in autumn throughout the study area. Spring had the lowest densities of gelatinous and non-gelatinous zooplankton. Overall, the same species assemblage was present across the study area and the seasons, however the little variation that was noted in terms of density was driven by a limited number of environmental variables: temperature, oxygen concentration and salinity. Temperature and oxygen concentration are both related to 'season'. Temperature has a big influence on the budding or strobilation process of Hydrozoa and Scyphozoa with characteristic temperature ranges for each species. Salinity is related to sampling location. Most gelatinous zooplankton species prefer areas with high salinity in contrast to the brackish Schelde estuary. Other species, such as *Rathkea octopunctata*, have a very wide range of salinity and can be observed in areas with very low salinities. *Pleurobrachia pileus* is omnipresent in the coastal zone as they rely on tidal currents, moreover they do not depend on a sessile phase in their life cycle which means they can be observed year round. Three non-indigenous gelatinous species were found in the area: *Nemopsis bachei*, *Lovenella assimilis* and *Mnemiopsis leidyi*. The peak densities of the latter did not yet reach worrying densities: highest density at sea of 0.55 ind.m⁻³ observed in autumn. However, in the ports, densities up to 18.37 ind.m⁻³ were found. Moreover, *M. leidyi* larvae were observed in the ports as well as in the Schelde estuary. In addition to other studies, this study shows that the Dutch estuaries and Belgian ports provide optimal conditions and potential for a year round presence and thus reproduction of *M. leidyi*. Further regular monitoring is needed to estimate the gelatinous future of the Southern North Sea.