The life of sea sparkle: dynamics, drivers and interactions of *Noctiluca scintillans* in the Belgian part of the North Sea

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Climate driven changes and anthropogenic pressures on the marine environment have been shown to favor the increase in certain potentially harmful species. Among them, *Noctiluca scintillans*, a common dinoflagellate also known as sea sparkle, often blooms during warm summers and is known to affect plankton communities. *Noctiluca scintillans* is worldwide one of the most important and abundant red tide organisms and its blooms have been linked to increased fish and marine invertebrate mortality (Huang and Qi, 1997; Thangaraja *et al*., 2007), affecting yields in fisheries and aquaculture. Its large size (0.2–2 mm) and voracious feeding behavior enable it to feed on a broad spectrum of organisms including fish eggs, phytoplankton, zooplankton, detritus and bacteria (Quevedo *et al*., 1999). Other species feeding on the same food sources as *N. scintillans* can also be affected due to food competition (Quevedo *et al*., 1999) which might explain the significant negative correlations observed between various soft-bodied zooplankton species and *N. scintillans* in the North Sea (Heyen *et al*., 1998; Fock and Greve, 2002).

During bloom formation, *N. scintillans* can reach high densities and can often constitute a significant part of the plankton community. Because manually counting *N. scintillans* cells is too time consuming, the species is often excluded from microscopy counts. Hence, little is known about its dynamics in the Belgian Part of the North Sea (BPNS). Novel imaging techniques such as the ZooScan, however, allow for an accurate assessment of the densities and associated size measurements of such taxa. Due to the potential adverse effects of *N. scintillans* on the marine environment and its potential to increase in abundance as a result of climate change and ocean acidification (Moore *et al*., 2008), substantial research is needed to gain knowledge on the blooms, drivers and effects of *N. scintillans* in the BPNS. Based on ZooScan observations from LifeWatch time series (Mortelmans *et al*., 2019), this study explores the potential of ZooScan imaging for cell density and size estimates of species of interest such as *N. scintillans* and aims to unravel the population dynamics of *N. scintillans* in the BPNS, to determine the drivers of its dynamics, as well as to investigate the impact of the species on small soft-bodied zooplankton taxa (Ollevier *et al*., 2021).

Through the analysis of ZooScan images from WP2 net samples taken monthly at stations throughout the coastal zone of the BPNS, this study is the first to present consistently counted *N. scintillans* cell numbers and measured cell lengths. We demonstrate that imaging methods such as the ZooScan are a powerful tool to monitor and study the *N. scintillans* population. The results show that *N. scintillans* had clear seasonal dynamics with both high densities and large cell sizes in spring/summer (May-July). The occurrence of *N. scintillans* in the analyzed plankton samples and the abundance of *N. scintillans* at the observed peak intensities nearly tripled over a period of 5 years. A zero-inflated model showed a correlation of *N. scintillans* abundance with temperature as well as with phosphate concentrations, suggesting that anthropogenic influences such as climate change and riverine nutrient inputs could affect the temporal dynamics of the species. The presence and density of *N. scintillans* are likely to increase in the future, notably due to global warming with warmer water temperatures (IPCC, 2021) forming the ideal growth condition for the species. The results, on the other hand, did not show any negative impact of *N. scintillans* on the soft-bodied plankton community.

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