The combined temperature and nutrient load effects do not explain the development of harmful algal blooms

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The occurrence of harmful algal blooms (HABs) is not a new phenomenon. The first written acount of their disastrous environmental effects dates back to Biblical times. Yet throughout history, there have never been more toxic species, more algal toxins, more food-web disruption, more affected fisheries resources and more economic losses from harmful algal blooms than now (Anderson *et al*., 1993). Moreover, HAB events are expected to become even more frequent as the effects of climate change increase (Hallegraeff, 2010). The associated hypoxia, physical disturbance, food-web disruption and marine toxins of these events can lead to mass mortalities of marine life at all trophic levels. The human health impacts and the severity of the environmental damage have prompted research on the biotic and abiotic factors that drive the bloom dynamics of harmful algae. A better understanding of these variables will lead to improved HAB risk prediction, mitigation and management. While scientific consensus states that nutrient availability is crucial for HAB formation (Heisler *et al*., 2008), it is unclear how nutrients contribute to the dominance of HAB species (in blooms) as they typically do not have higher growth rates than other phytoplankton species (Glibert *et al*., 2005).

This research wants to assess the risk for harmful algal bloom development in the Belgian coastal waters. More specifically, it aims to determine the biotic and abiotic factors that allow toxic dinoflagellates such as *Prorocentrum lima* and *Protoceratium reticulatum* to outcompete common non-toxic dinoflagellates like *Prorocentrum micans* and *Scrippsiella trochoidea*. The preliminary results of the effect of nutrient loading on the growth rate of these four algal species are presented here. In brief, cultures of these naturally occurring dinoflagellates were cultured at various N:P ratios ranging from 8 to 24. By exposing these cultures to two temperature regimes (20°C and 24°C) we included the most probable climate change scenario into the test design. Algal densities were counted biweekly for four weeks. We found that nutrient loading has a significant positive effect on the growth rate of all species. Similarly, the higher temperature significantly increased their growth rate. However, as the effect of nutrients was comparable across all species, nutrient loading alone cannot explain the dominance of toxic (HAB) species over common non-toxic dinoflagellates. These results suggest that restricting the nutrient input to the Belgian coastal zone is not sufficient to reduce the risk of HAB development as water temperature, interspecific competition and allelopathic interactions are likely to be more important to determine the onset of HAB events.

References

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