## Extended abstract

# Brilliant Marine Research Idea 2025

This extended abstract is part of the full report which should be submitted no later than 28 February 2026 via filantropie@vliz.be. Data of this specific final report are under embargo and are therefore not yet published online.

## 1. General information

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| Title of the idea | Exploring the impact of grazer pressure on growth and toxin production of harmful algae: a case study with copepods |
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## 2. Brilliant Marine Research Idea


Extended abstract

Several algal species synthesize highly potent toxins that bioaccumulate within marine food webs, posing substantial risks to fisheries, aquaculture, tourism, and human health. These toxins are closely associated with harmful algal blooms (HABs), whose frequency and intensity have increased in northern European coastal waters. Among human poisoning syndromes, diarrheic shellfish poisoning (DSP) and paralytic shellfish poisoning (PSP) account for the majority of reported cases and are primarily caused by yessotoxins (YTXs) and saxitoxins (STXs), respectively. While climate change and anthropogenic stressors—such as ocean warming, acidification, salinity shifts, eutrophication, and rising $CO_2$ concentrations—are recognized as key drivers of HAB dynamics, the role of biotic interactions remains insufficiently understood.

To address this knowledge gap, we investigated how grazer-derived chemical cues influence HAB species under varying thermal conditions. The dinoflagellate *Alexandrium minutum* and the cyanobacterium *Microcystis aeruginosa* were exposed to three types of copepod-derived signals: living copepods, copepod-conditioned water, and freeze-dried copepod extracts, each applied across multiple concentration levels. Two ecologically distinct copepod species were examined, the benthic *Nitokra spinipes* and the planktonic *Acartia tonsa*, alongside additional species for comparative purposes. Algal responses were assessed in terms of cell density, growth performance, and toxin production.

Results from the conditioned-medium experiments demonstrated clear species-specific and temperature-dependent effects. Chemical cues from *Acartia* with density from 60 to 125 ind $L^{-1}$ significantly reduced *Alexandrium* cell density at 15 °C and concentration combinations, whereas *Nitokra* cues (30 to 125 ind $L^{-1}$) suppressed growth mainly at elevated temperature (25 °C). In contrast, *Microcystis* exhibited enhanced growth under 25 °C when exposed to copepod-conditioned media from 30 to 250 ind $L^{-1}$ of Nitokra and 60 to 125 ind $L^{-1}$ of Acartia.

Exposure to freeze-dried copepod extracts further confirmed strong interactive effects between temperature and cue concentration. For *Alexandrium*, lower *Acartia* extract concentrations (0.8 to 4 mg $L^{-1}$) increased cell densities at 20°C, whereas high concentrations (20 to 100 mg $L^{-1}$) consistently suppressed cell density. Extract effects varied by copepod species, with *Acartia* and *Calanus* producing distinct response patterns. Overall, algal responses were strongly modulated by temperature, highlighting the importance of climate context in mediating grazer–HAB interactions.

Therefore, these findings demonstrate that copepod-derived chemical cues can either inhibit or stimulate HAB species depending on algal species, grazer species, cue concentration, and temperature. This integrative framework advances mechanistic understanding of grazer–HAB interactions and underscores the importance of biotic modulation in shaping bloom dynamics under ongoing global environmental change.