Harmful Algae 145 (2025) 102857

Contents lists available at ScienceDirect

Harmful Algae

journal homepage: www.elsevier.com/locate/hal

Multi-year dynamics of harmful algae in Disko Bay, West Greenland

Cora Hoerstmann [a,*], Per Juel Hansen [b], Nina Lundholm [c], Bernd Krock [a], Uwe John [a,d,*]

[a] Alfred Wegener Institute Helmholtz Center for Polar and Marine Research, Am Handelshafen 12, 27570 Bremerhaven, Germany
[b] Marine Biology Section, University of Copenhagen, Strandpromenaden 5, 3000 Helsingør, Denmark
[c] Natural History Museum of Denmark, University of Copenhagen, Øster Farimagsgade 5, 1353 Copenhagen, Denmark
[d] Helmholtz Institute for Functional Marine Biodiversity, Ammerländer Heersstraße 231, 26129 Oldenburg, Germany

ARTICLE INFO

Dataset link: https://data.g-e-m.dk/datasets

Keywords:
Metabarcoding
18S V4 rRNA gene
Long-term monitoring
Boosted regression tree (BRT) model
Particulate toxins

ABSTRACT

Harmful algal blooms (HABs) increasingly affect Arctic coastal ecosystems, due to hydrographic and bathymetric conditions that support the accumulation of cells and cysts, and coupled with increasing temperatures, extensive bloom events can be easily triggered. However, various harmful algae species have been reported in the past and it is unclear which are most threatening in Greenlandic waters, a region that vitally depend on its fisheries. Here, we explore the diversity and succession of harmful algae by metabarcoding at a multi-year station in Greenlandic coastal waters, offering a comprehensive analysis of species dynamics over time. Dinoflagellates, diatoms and haptophytes, known for their toxin production and potential negative effects on ecosystems and food webs, were regularly detected across years and throughout all sampled months. Yet, results also indicate significant inter-annual variability in harmful algal occurrences, with high abundances of *Alexandrium* and increasing abundances of *Aureococcus, Prymnesium*, and *Pseudo-nitzschia.* Through a boosted regression tree analysis of the ecological drivers of HABs in Arctic waters, we identified an important role of climate-induced environmental variables such as temperature, salinity, and the number of ice-free days year^{-1}. These findings provide critical baseline data for understanding the future risks of HABs in the Arctic and underscore the importance of ongoing, high-resolution monitoring.

1. Introduction

Rising sea level and atmospheric temperatures and associated rapid ice melt have severely changed the Arctic sea and icescape with associated changes in nutrient input and primary productivity pattern (Ardyna and Arrigo, 2020). Additionally, temperate microalgal species are migrating north, creating a potential risk for endemic algal species and higher trophic levels up to human societal impacts (Ardyna and Arrigo, 2020). Further, environmental change forms increasingly beneficial habitat structures for various harmful algae promoting cyst germination, growth, and, subsequently, formation of harmful algal blooms (HABs) (Natsuike et al., 2017; Bruhn et al., 2021; Anderson et al., 2021, 2022). Particularly, the warming of the Arctic, resulting in thinning sea ice and longer open water periods with stratified water columns, could allow a competitive advantage for harmful algae (HA) to dominate local ecosystem dynamics (Olsen et al., 2019). HABs pose a direct threat to human health through the consumption of contaminated shellfish, and impacting society by causing extensive socio-economic damage through the mortality of fish and invertebrates (Brown et al., 2020).

Numerous HA species have already been detected in the Arctic (McKenzie et al., 2021). Notably, various toxin-producing diatoms of the genus *Pseudo-nitzschia* have been documented in regions such as Iceland, Western Greenland, Baffin Bay, Barrow Strait, Beaufort Sea, Bering Strait, and subarctic regions around Norway (Pućko et al., 2019; Hubbard et al., 2023; Cembella et al., 2023; Schiffrine et al., 2024). Also, toxic dinoflagellate species of the genera *Alexandrium* and *Dinophysis* have been identified (Okolodkov and Dodge, 1996; Pućko et al., 2019; Bruhn et al., 2021; Dhifallah et al., 2022; Fachon et al., 2024). Harmful algal species have also already been recorded in Greenlandic waters; for instance, *Alexandrium* species have been isolated and shown to be toxic (Baggesen et al., 2012; Tillmann et al., 2016; Rodríguez-Marconi et al., 2024), as have *Pseudo-nitzschia* species (Tammilehto et al., 2012; Lundholm et al., 2018). Moreover, *Phaeocystis* spp., which can produce mucilage causing harmful, anoxic environments, have been detected in western Greenland (Krawczyk et al., 2018; Rodríguez-Marconi et al., 2024). The increasing risk of harmful bloom events in Greenland's coastal waters necessitates effective monitoring efforts to detect shifts in

* Corresponding authors at: Alfred Wegener Institute Helmholtz Center for Polar and Marine Research, Am Handelshafen 12, 27570 Bremerhaven, Germany.
E-mail addresses: cora.hoerstmann@awi.de (C. Hoerstmann), uwe.john@awi.de (U. John).

https://doi.org/10.1016/j.hal.2025.102857
Received 21 January 2025; Received in revised form 21 March 2025; Accepted 2 April 2025
Available online 4 April 2025