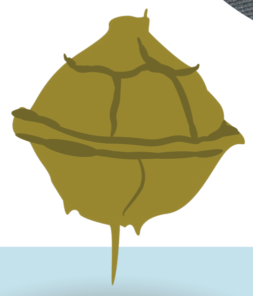
Adding a paleo-perspective to harmful algal blooms (HABs) along the West Florida Coast:

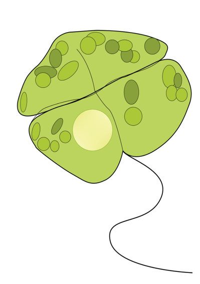
Assessing the influence of anthropogenic factors

Suzanne de Zwaan[1,2,*], Laura Villanueva[1,2], Nicole Bale[2], Judith van Bleijswijk[2], Gregg Brooks[3], Matthew Garrett[4], Rick Hennekam[5], Katherine Hubbard[4], Rebekka Larson[3], Cary Lopez[4], Gert-Jan Reichart[5], Patrick Schwing[3,6], Francesca Sangiorgi[2]

[1] Department of Marine Microbiology and Biogeochemistry (MMB), NIOZ Royal Netherlands Institute for Sea Research, PO Box 59, 1790 AB Den Burg, The Netherlands
[2] Department of Earth Sciences, Faculty of Geosciences, Utrecht University, PO Box 80.021, 3508 TA Utrecht, The Netherlands
[3] Department of Marine Science, Eckerd College, Saint Petersburg, FL, United States of America, College of Marine Science, University of South Florida, Saint Petersburg, FL, United States of America
[4] Fish and Wildlife Research Institute (FWRI), Florida Fish and Wildlife Conservation Commission (FWC), 100 Eighth Avenue SE, St. Petersburg, FL 33701 USA
[5] Department of Ocean Systems (OCS), NIOZ Royal Netherlands Institute for Sea Research, PO Box 59, 1790 AB Den Burg, The Netherlands
[6] College of Marine Science, University of South Florida, Saint Petersburg, FL, United States of America
* Corresponding author: suzanne.de.zwaan@nioz.nl



Pyrodinium bahamense



Karenia brevis

Introduction

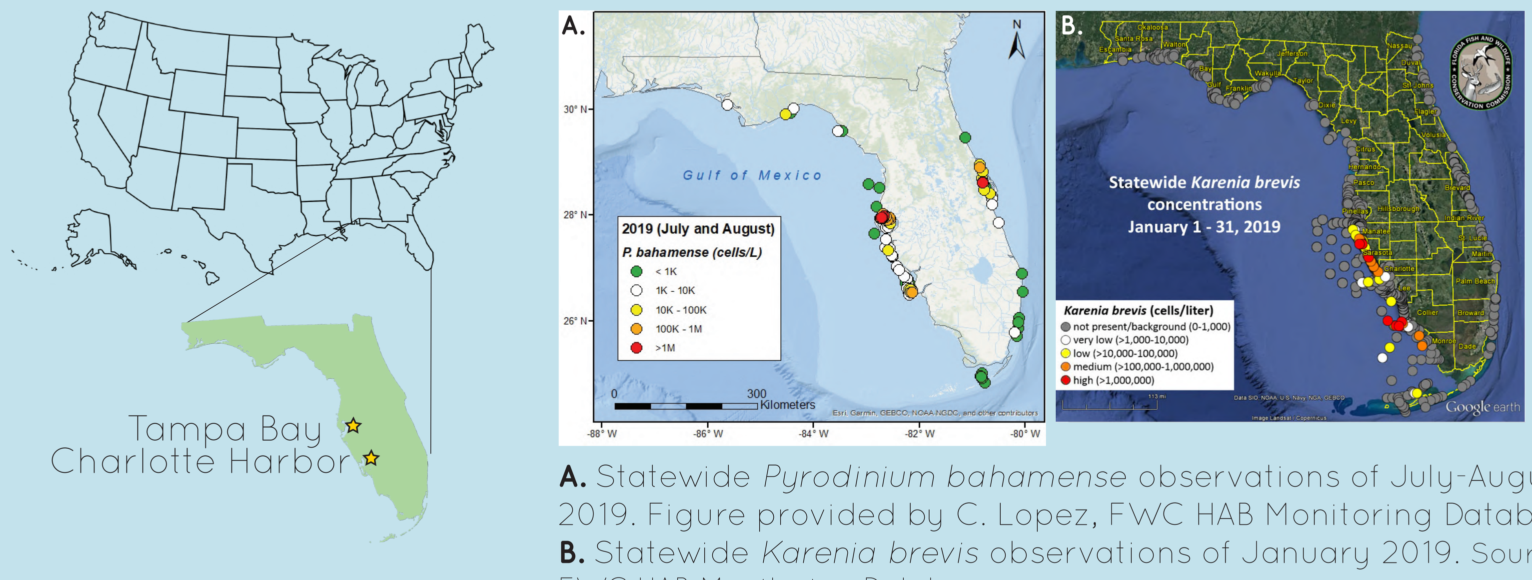
Whether harmful algal bloom (HAB) occurrences have increased globally due to climate change and anthropogenic stressors is still debated (Hallegraeff *et al.*, 2021). The western coast of Florida is a recognized hotspot for HABs of the dinoflagellate species *Karenia brevis* (Alvarez, 2021; Tominack *et al.*, 2020) and *Pyrodinium bahamense* (Lopez *et al.*, 2021; Phlips *et al.*, 2006; Usup *et al.*, 2012) that generate yearly blooms. However, the presence and frequency of these blooms in the past, as well as whether or to what extend anthropogenic impact played a role, are unknown.

Monitoring data often cover limited time and reliant on human presence. Paleoecological research offers means to examine the history of HABS in a continuous fashion and beyond the major anthropogenic impact of the last century.

We apply a multiproxy approach, involving palynology (dinoflagellate cysts), lipid biomarkers (*i.e.*, sterols), and sedimentary DNA (sedDNA) analyses in sediment cores from Tampa Bay and Charlotte Harbor estuaries and also generate nutrients and climate records from the same sediments.

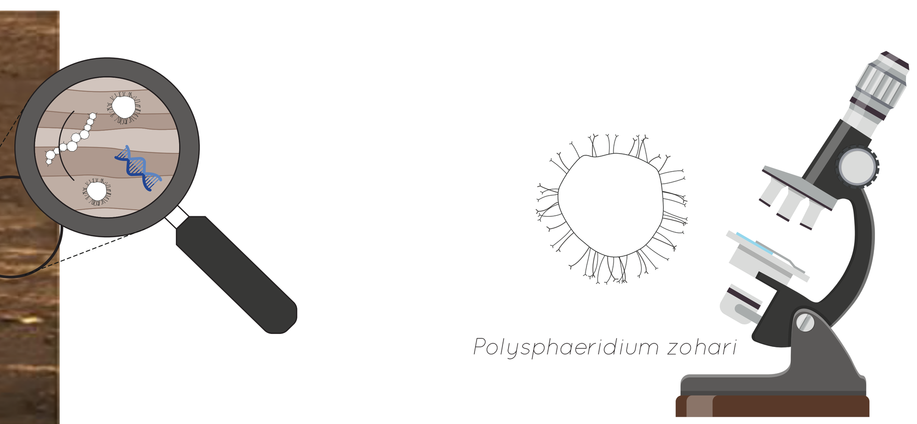
Aim

To reconstruct the presence and trends of *K. brevis* and *P. bahamense*, and identify whether changes relate to anthropogenic impact (*e.g.*, eutrophication) and climate change in Tampa Bay and Charlotte Harbor, by analyzing sediment cores preceding human occupancy.



A. Statewide *Pyrodinium bahamense* observations of July-August, 2019. Figure provided by C. Lopez, FWC HAB Monitoring Database.
B. Statewide *Karenia brevis* observations of January 2019. Source: FWC HAB Monitoring Database

Palynological approach

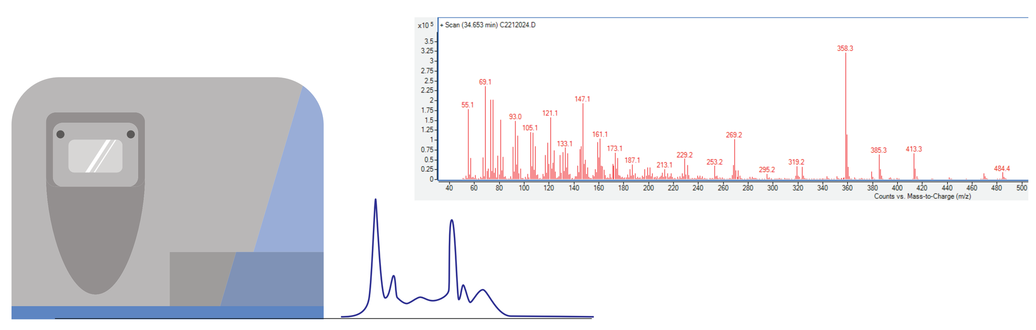


Pyrodinium bahamense is known to produce a resting cyst, called *Polysphaeridium zoharyi*.
This **dinocyst** is preserved in the sediment. Microscopy of sedimentary samples will allow tracing the **presence and abundance** of *P. bahamense* through time (Cremer *et al.*, 2007; Rochon *et al.*, 1999; Zonneveld & Pospelova, 2015).

This does not work for all species!
K. brevis does not make a fossilizable dinocyst.

To detect this species, we need another approach...

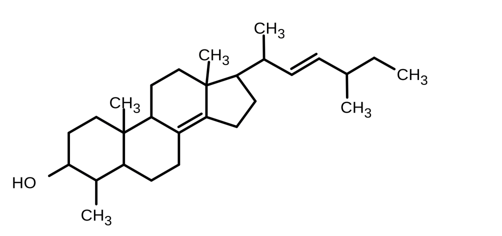
Lipid biomarker approach



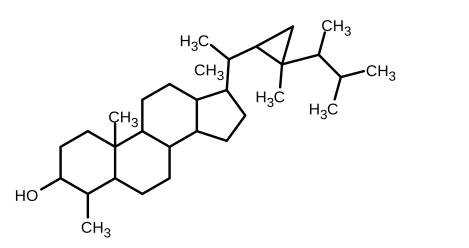
Lipid biomarkers can be preserved in the sediment.

Analyzing **species specific lipid biomarkers** from the sediment using Gas Chromatography-Mass Spectrometry (GC-MS) will help reconstruct the **presence or absence** of both ***P. bahamense*** and ***K. brevis*** in the past.

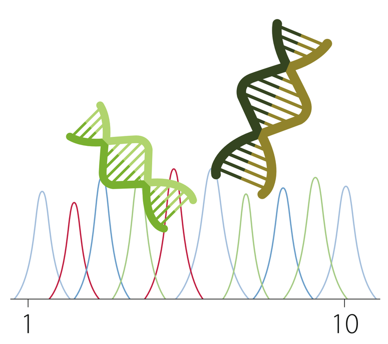
K. brevis
Brevesterol
(Leblond & Chapman, 2002)



P. bahamense
4a-methylgorgostanol
(Houle *et al.*, 2019)



Genomic approach

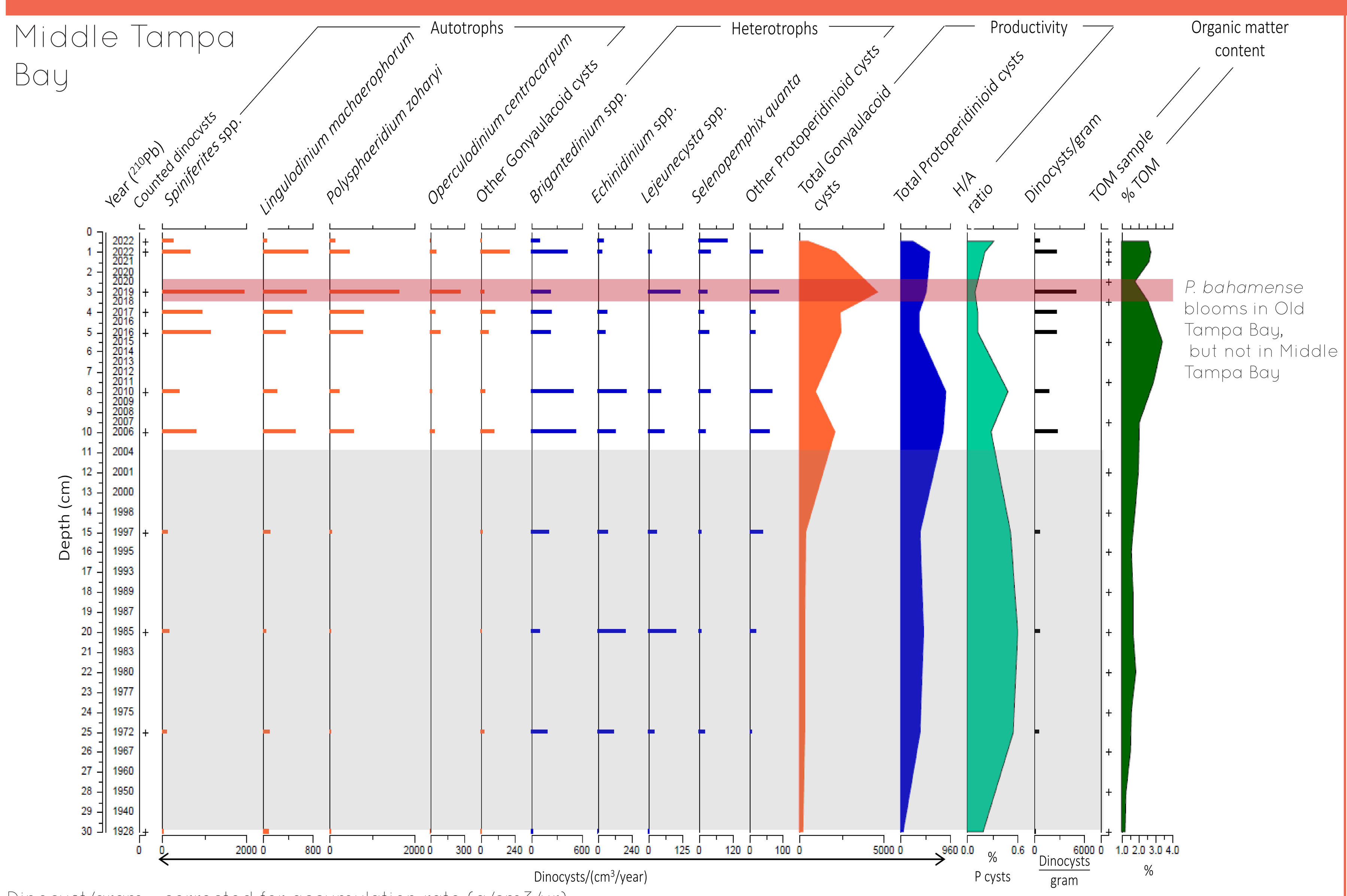


Sedimentary DNA (sedDNA) will be used to determine the **phytoplankton community** of the past, and to track the **presence or absence** of ***P. bahamense*** and ***K. brevis*** thoughout the core.

To avoid contamination with modernDNA, strict protocols will have to be followed (Siano *et al.*, 2021).

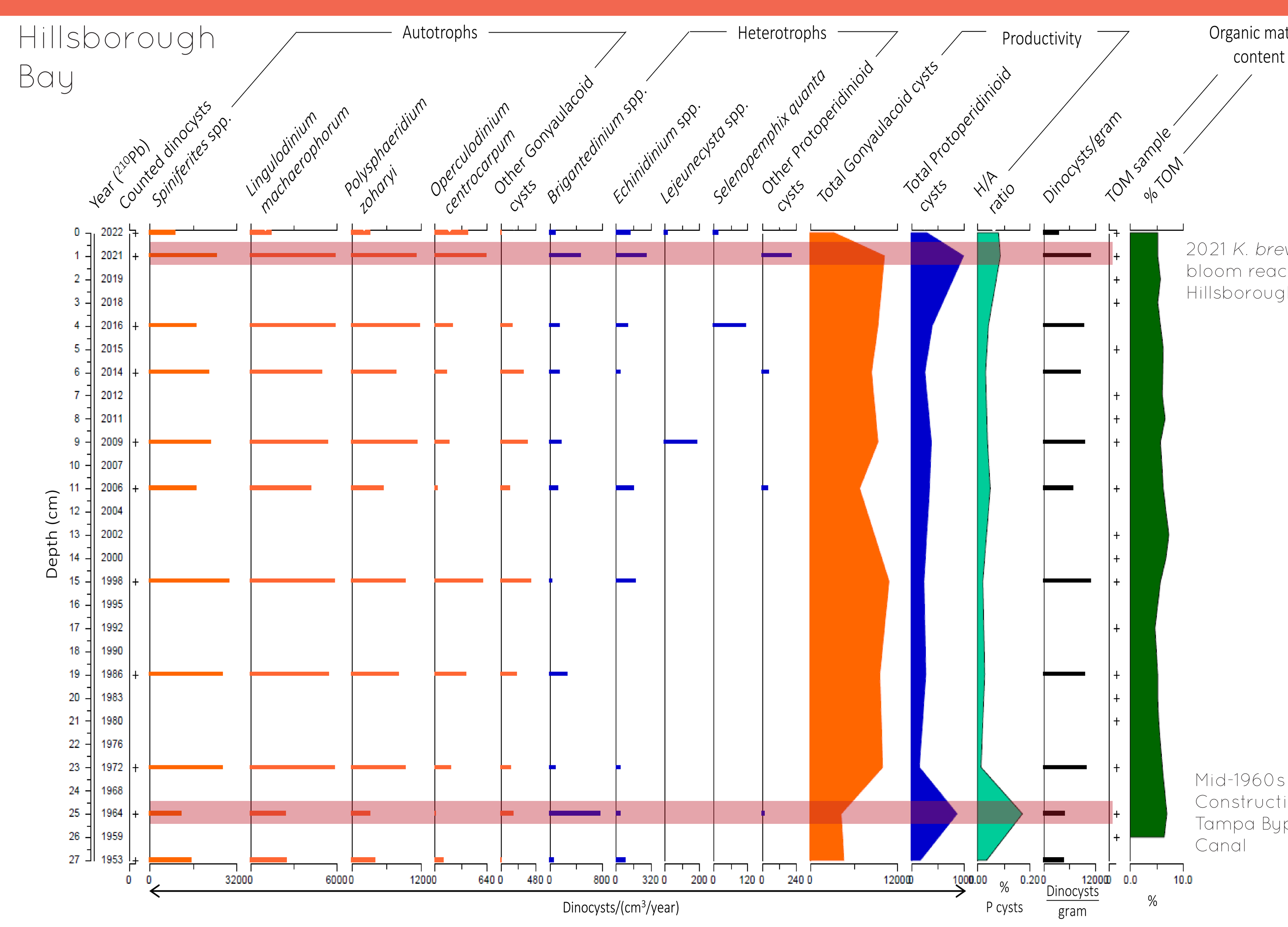
Preliminary results

Middle Tampa Bay



Dinocyst/gram - corrected for accumulation rate (g/cm3/yr)

Hillsborough Bay



Please scan the QR code for the reference list