Tracking Trouble: Spatial and Temporal Distribution of Potentially Harmful Algae Species in Clayoquot Sound, BC

TACOMA

Kathryn Barlow, Mikayla Mayes, Cheryl Greengrove, and Julie Masura

UWT Environmental Science

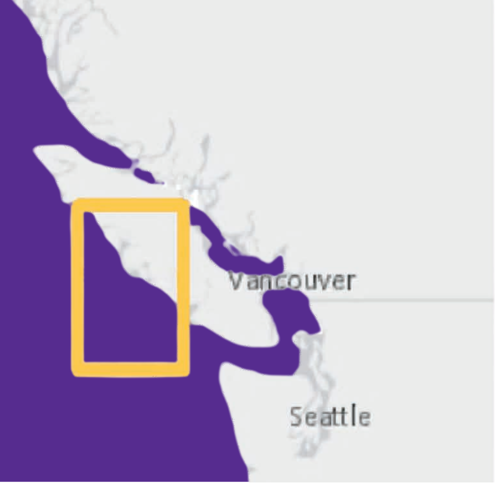

Figure 1: Location of Clayoquot Sound, Vancouver Island BC, Canada

Introduction/Background

Harmful algal species such as *Alexandrium spp., Pseudo-nitzschia spp.,* and *Dinophysis spp*. are known to cause harmful algal blooms (HABs), where toxins accumulate in bivalves and can lead to paralytic (PSP), amnesic (ASP), and diarrhetic shellfish poisoning (DSP) in humans respectively. These blooms disrupt aquaculture industries and can cause significant economic losses. Additionally, harmful algae may damage marine animals causing fish kills and threatening overall ecosystem stability. Increasing frequency and severity of blooms are influenced by changing water properties, such as temperature which creates warmer conditions that can enhance algal growth rates and extend bloom seasons. Clayoquot Sound is a coastal area on Vancouver Island (Fig1) that has experienced previous HAB events. Its unique fjord-like inlet structures and presence of shallow sills carved from the last glaciers, along with the regions cultural and socio-economic importance make it a complex and valuable area to study.

This study investigates the spatial and temporal distribution of select potentially harmful algal species in Clayoquot Sound to assess their prevalence and potential risks to human health, aquaculture, and local economies. I compiled and analyzed distribution patterns of the three target HABs species and evaluated changes over the past 17 years, comparing findings with historical data from Fisheries and Oceans Canada. We hypothesize that HABs will become increasingly prevalent as water temperatures rise. The results will support future monitoring and management strategies to mitigate HAB impacts in this region.

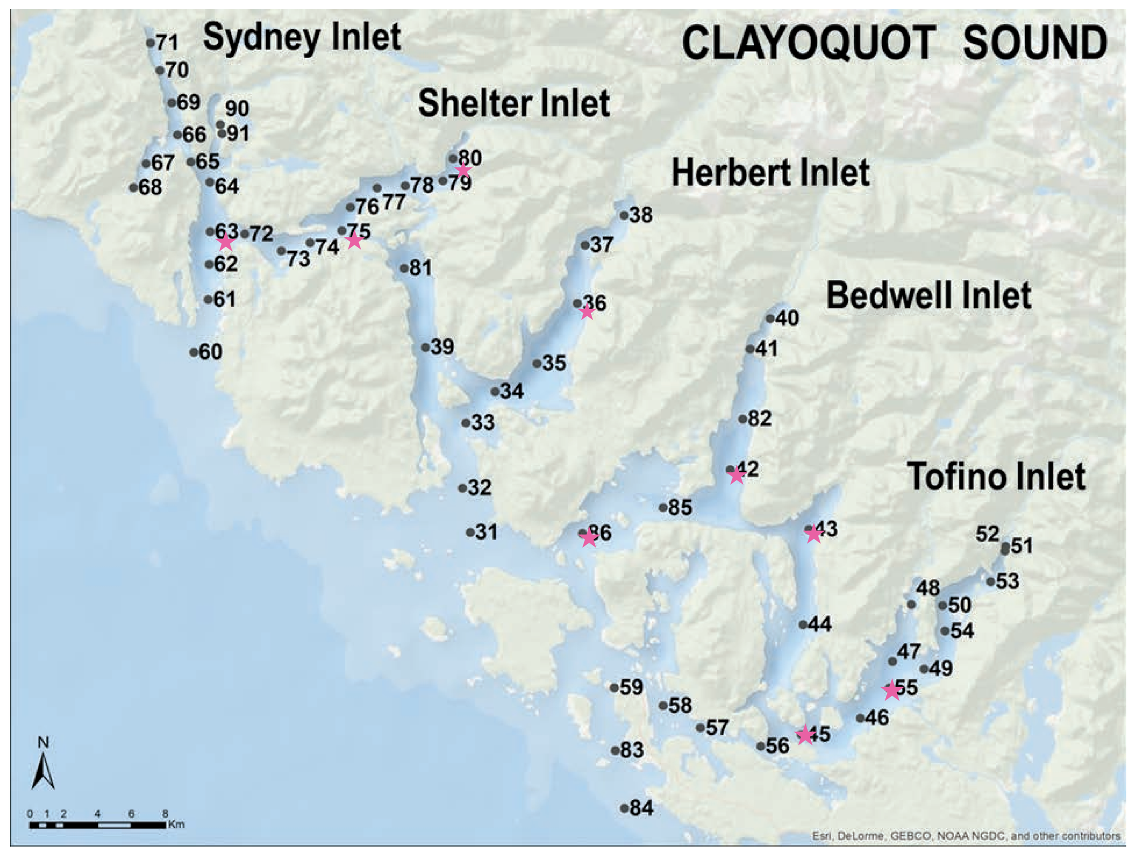

Figure 2: Inlets of Clayoquot Sound and survey station locations. Clayoquot Sound is located on the West Coast of Vancouver Island, BC Canada. Stations denoted with a ★ are used in comparison to historical data due to proximity to historical survey stations

Methods

Field Methods

- A Seabird 19 CTD collected Conductivity, Temperature, Depth, Salinity, Density, Dissolved Oxygen, Fluorescence, and Transmissivity data profiles
- Phytoplankton net samples collected via a 10m vertical net tow using a 20 micron net
- Discrete water samples for phytoplankton and nutrients were taken at surface (1m), thermocline (10m) and at bottom depth.
- Nutrient samples filtered through 0.45 micron filter and analyzed by UW Seattle Marine Chemistry Lab

Laboratory Methods

- Phytoplankton samples fixed with formalin
- Phytoplankton cells in all samples were counted using a 0.1mL Palmer-Maloney slide at 200x magnification on a Olympus BX compound microscope.
- Net counts were qualitative while surface and thermocline samples were quantitative.

Results

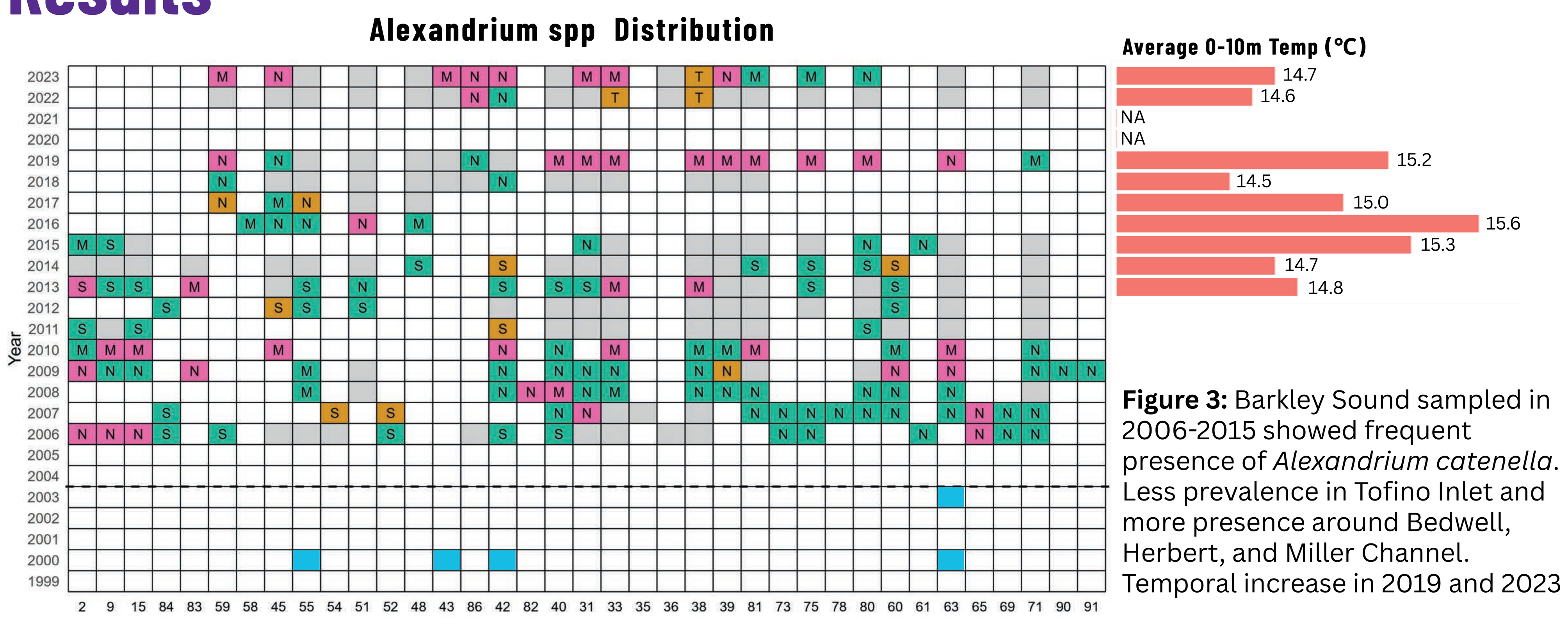

Figure 3: Barkley Sound sampled in 2006-2015 showed frequent presence of *Alexandrium catenella*. Less prevalence in Tofino Inlet and more presence around Bedwell, Herbert, and Miller Channel. Temporal increase in 2019 and 2023

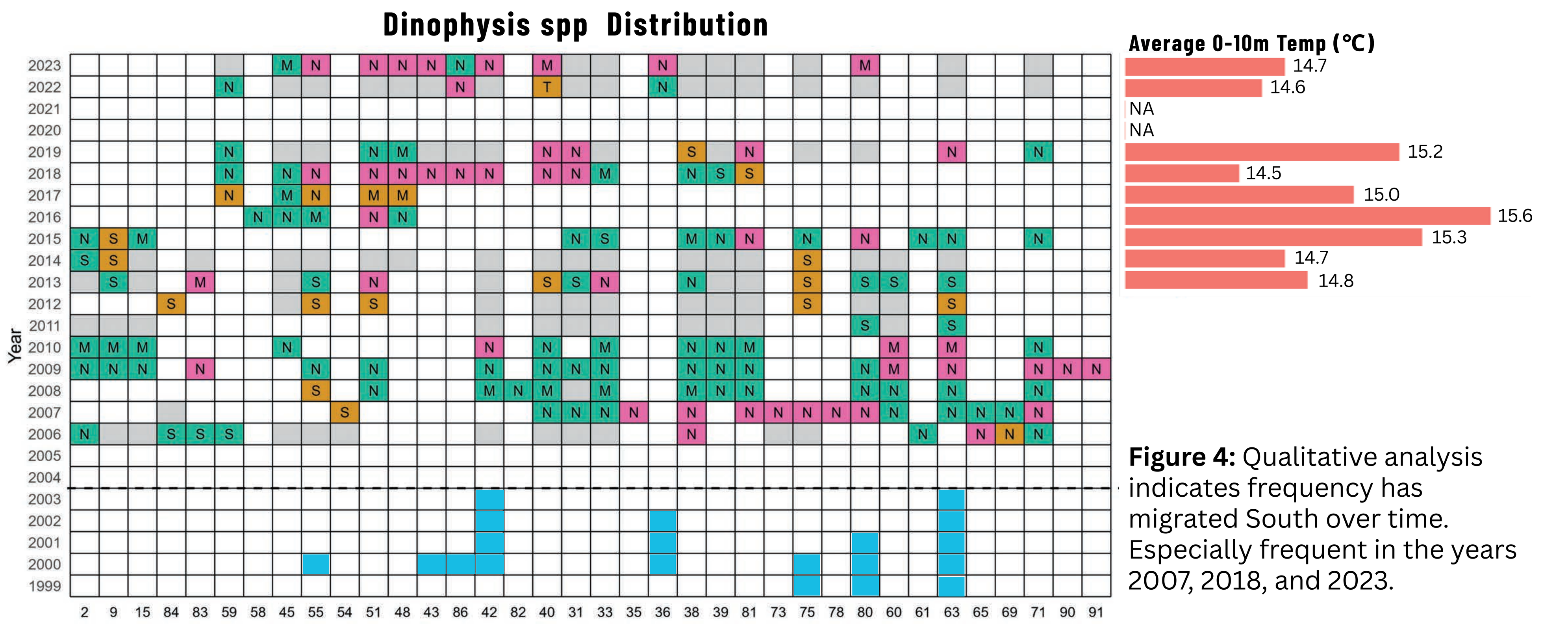

Figure 4: Qualitative analysis indicates frequency has migrated South over time. Especially frequent in the years 2007, 2018, and 2023.

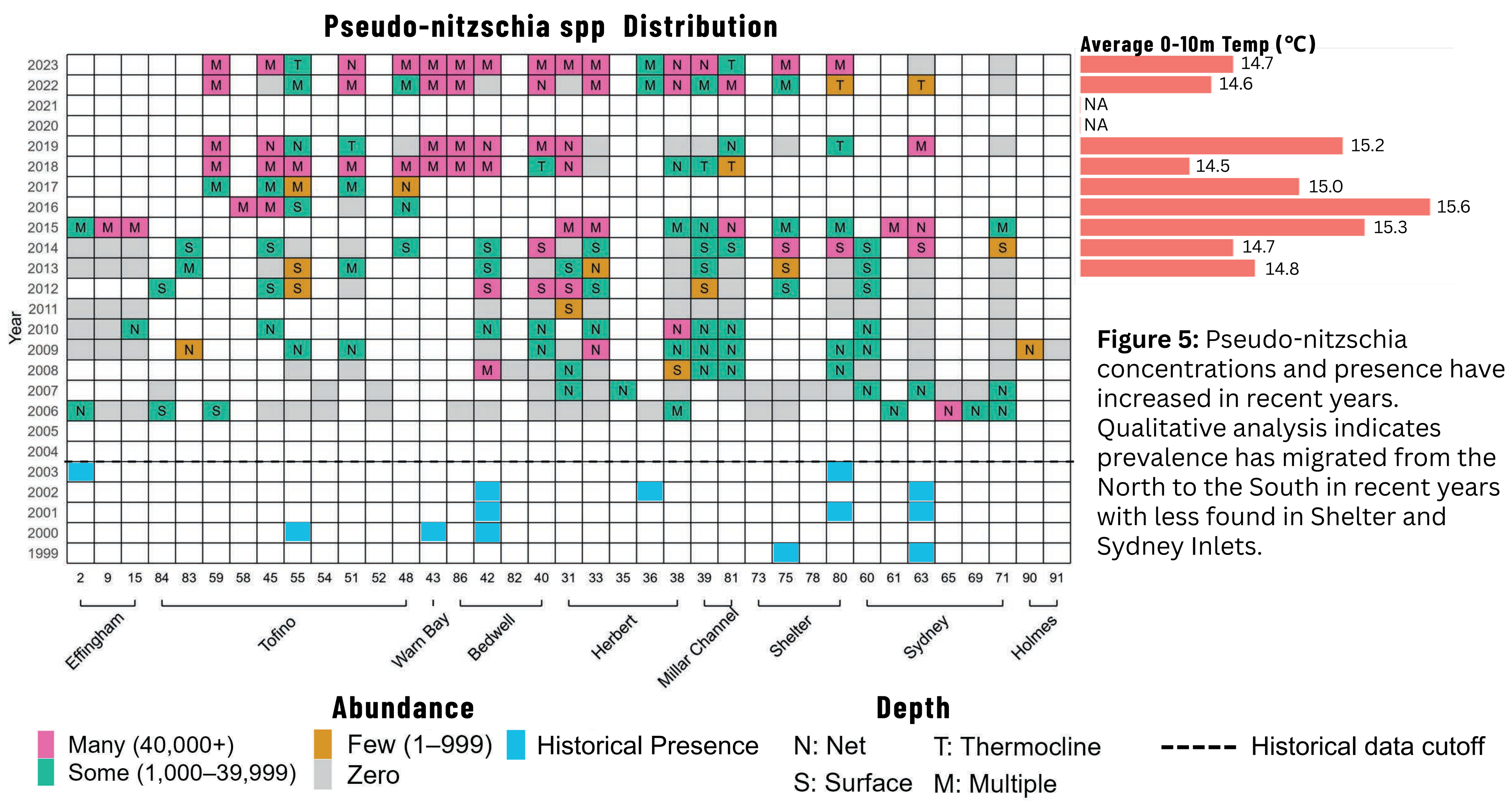

Figure 5: Pseudo-nitzschia concentrations and presence have increased in recent years. Qualitative analysis indicates prevalence has migrated from the North to the South in recent years with less found in Shelter and Sydney Inlets.

Photo 1: Deployment of CTD in the field
Photo credit: Kathryn Barlow

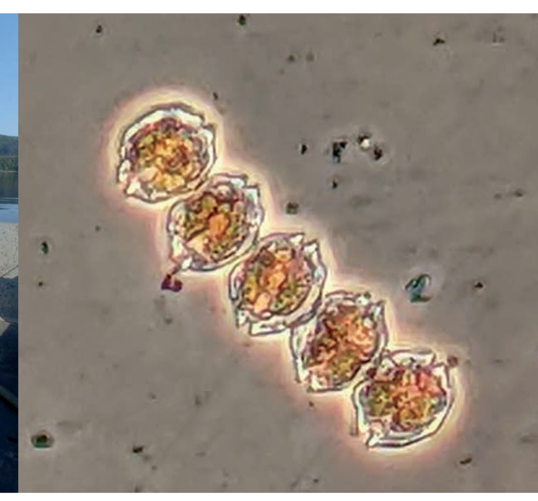

Photo 2: Chain of *Alexandrium catenella.*
Photo credit: Kathryn Barlow

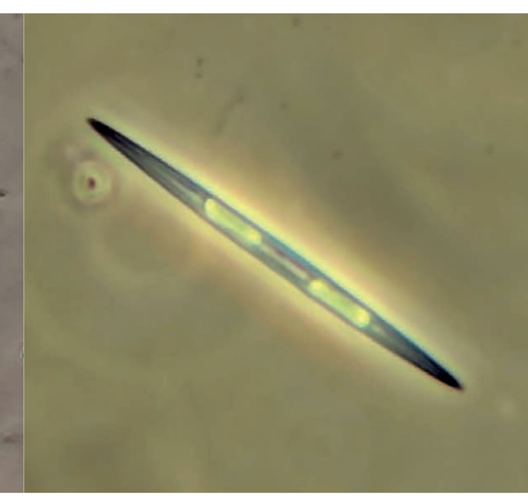

Photo 3: *Pseudo-nitzschia spp.*
Photo credit: Kathryn Barlow

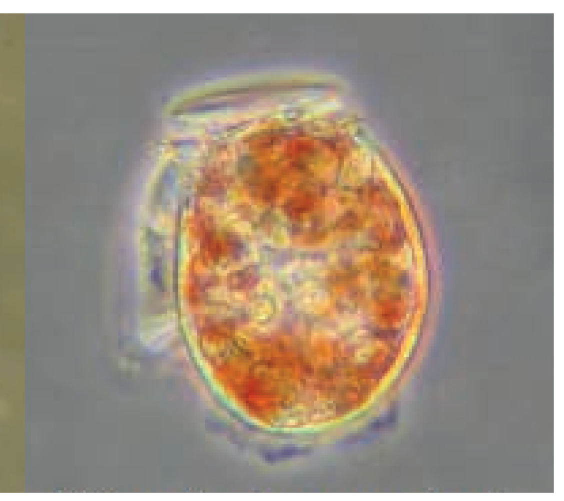

Photo 4: *Dinophysis spp.*
Photo credit: Kathleen Newell

Quick Take Aways

Phytoplankton

- Base of the marine food web; most are harmless.
- Some produce toxins that accumulate in shellfish.

Target Species

- Alexandrium, Pseudo-nitzschia, and Dinophysis cause PSP, ASP, and DSP respectively.
- Thrive in warm, nutrient-rich waters.

Conclusion

- No qualitative correlation found between increase in water surface temperature and increase in three target species
- Different temporal and spatial distribution depending on the species
- Presence of HABs in historic data is similar to UWT data

Conclusions & Future Work

Spatial and Temporal Trends

- Different spatial and temporal trends for each species of interest
- Comparison with Fisheries and Oceans Canada data contributes to further understanding long term presence of HABs in Clayoquot Sound

Environmental Drivers

- Rising sea surface temperatures correlate with higher frequencies of algal blooms
- Hypothesis that conditions may extend bloom duration and enhance growth rates of toxin-producing species is not supported by this study

Conclusions and Future Directions

- Long-term monitoring reveals HABs are becoming more frequent and spatially widespread in Clayoquot Sound making continued high-resolution sampling critical.
- Change in methods after 2015 may contribute to an apparent increase in HABs over time
- Data from this study will inform:
  - Shellfish safety monitoring.
  - Early warning systems for aquaculture.
  - Ecosystem-based management planning.
  - Inform spatial focus for future monitoring

Acknowledgements

Clayoquot Biosphere Trust for funding boat time on the R/V Beach Hopper and Captain Toby Theriault for taking us sampling. The UWT Mary Cline award for funding the rental of an SUV that provided transportation to the sampling site in Tofino, BC Canada. The Ahousaht First Nation and the Maaqutusiis Hahoulthee Stewardship Society for allowing us to sample in their territorial waters.

References