National Water Quality Monitoring Council

Oceanography, Vol.20, No.2

Investigation of water quality and algae-bacteria interaction in New Jersey coastal waters

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KEAN UNIVERSITY

DESS

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- **What is water quality?**
  - Water quality describes the condition of the water, including *chemical, physical, and biological* characteristics
  - Measured by dissolved oxygen, salinity, turbidity, quantities of pesticides, herbicides, heavy metals, and other contaminants, and bacteria levels, concentration of microscopic algae, etc.
- **Why choose algae-bacteria interaction?**
  - Algae: contribute to primary production and base of food web in coastal water
  - Bacteria: natural recycler to regenerate nutrients for other organisms

Algae

Bacteria

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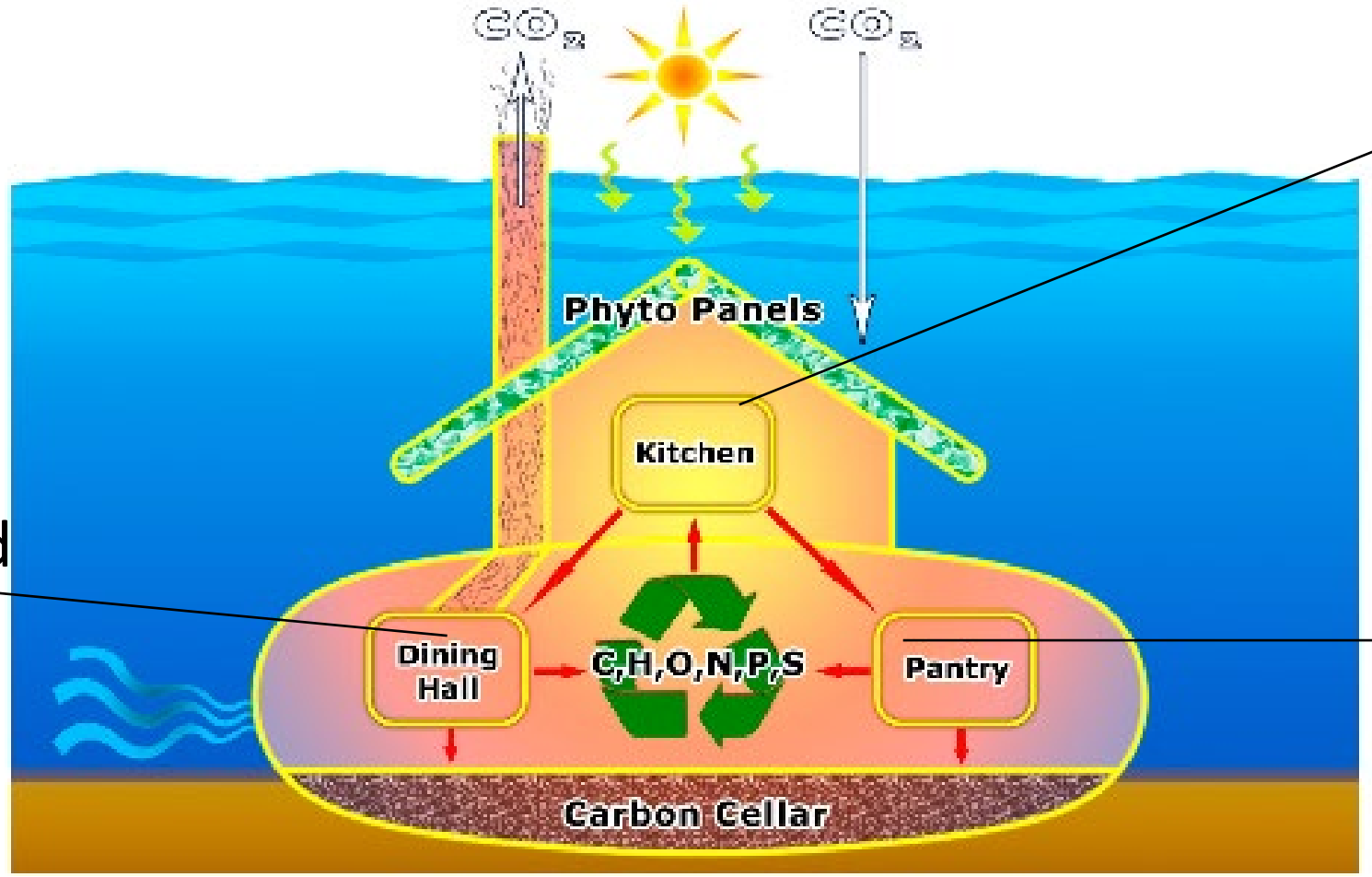
Underwater household-Microbial Cooking



Algae prepare food

Bacteria consume food and recycle nutrients

Store food as organic matter

Biddanda et al, 2021

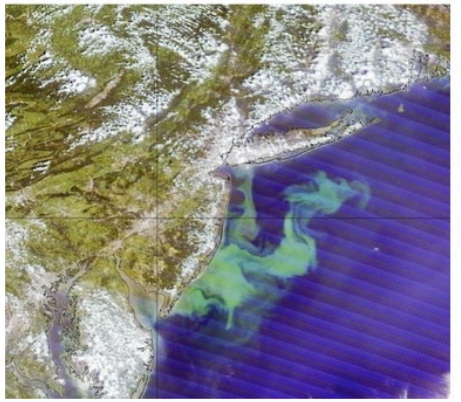
Algal blooms in New Jersey (NJ)

- Algal bloom events in NJ (Olsen, 1989; Gastrich, 2000)
- Harmful Algal Blooms (HABs): produce toxins

Tom Dunphy, Patch Staff

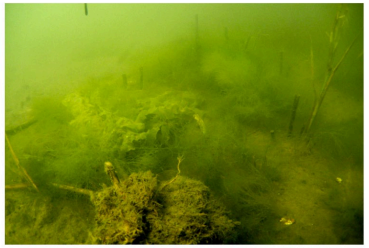
Coastal Care

Stony Brook University News



Courtesy of Mid-Atlantic Regional Association Coastal Ocean Observing System. A map displaying a massive algae bloom sitting off the coast of New Jersey.

- Impacts:
  - Turbid water



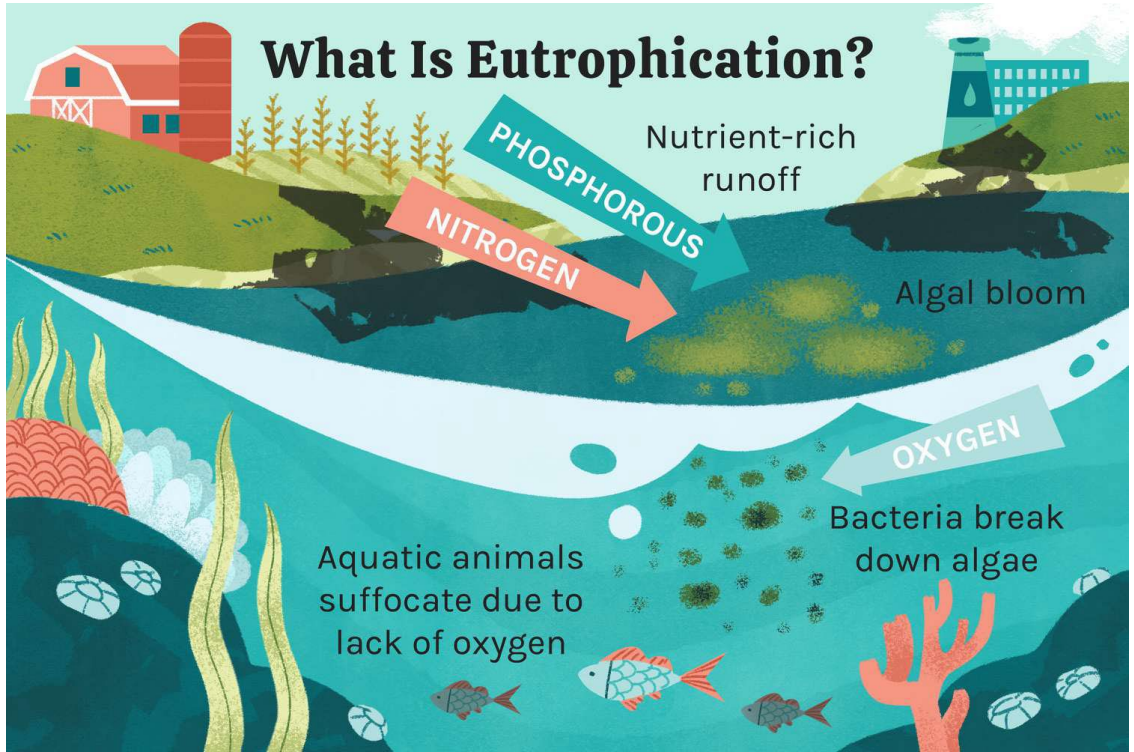
An underwater photo in Barnegat Bay shows heavy algae growth. © Mark Yokoyama

  - fuel bacteria growth that uses oxygen, low oxygen ”dead zone”
  - HABs produce hazardous toxins to human

via www.thefruitdoctor.com

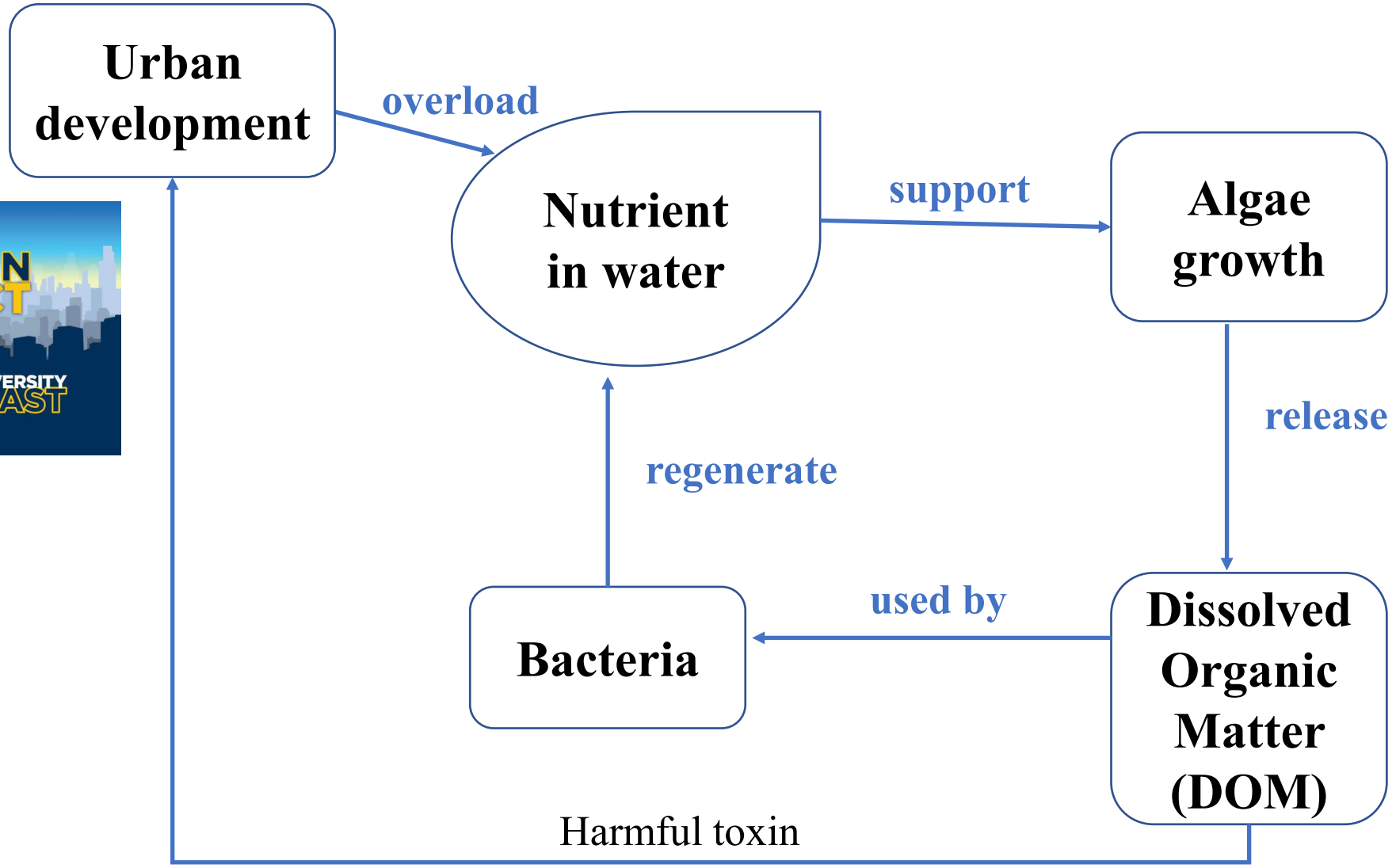
Algal blooms and climate change

- Drivers of algal blooms: nutrients (nitrate, ammonium, phosphate), hydrodynamics, algae life and species, etc.
- Eutrophication (excessive nutrients) in NJ coastal water (Kennish et al, 2007)



- Algal blooms may be intensified under climate change

Research Question: How do NJ coastal water quality and algae-bacteria interactions vary over time and space?

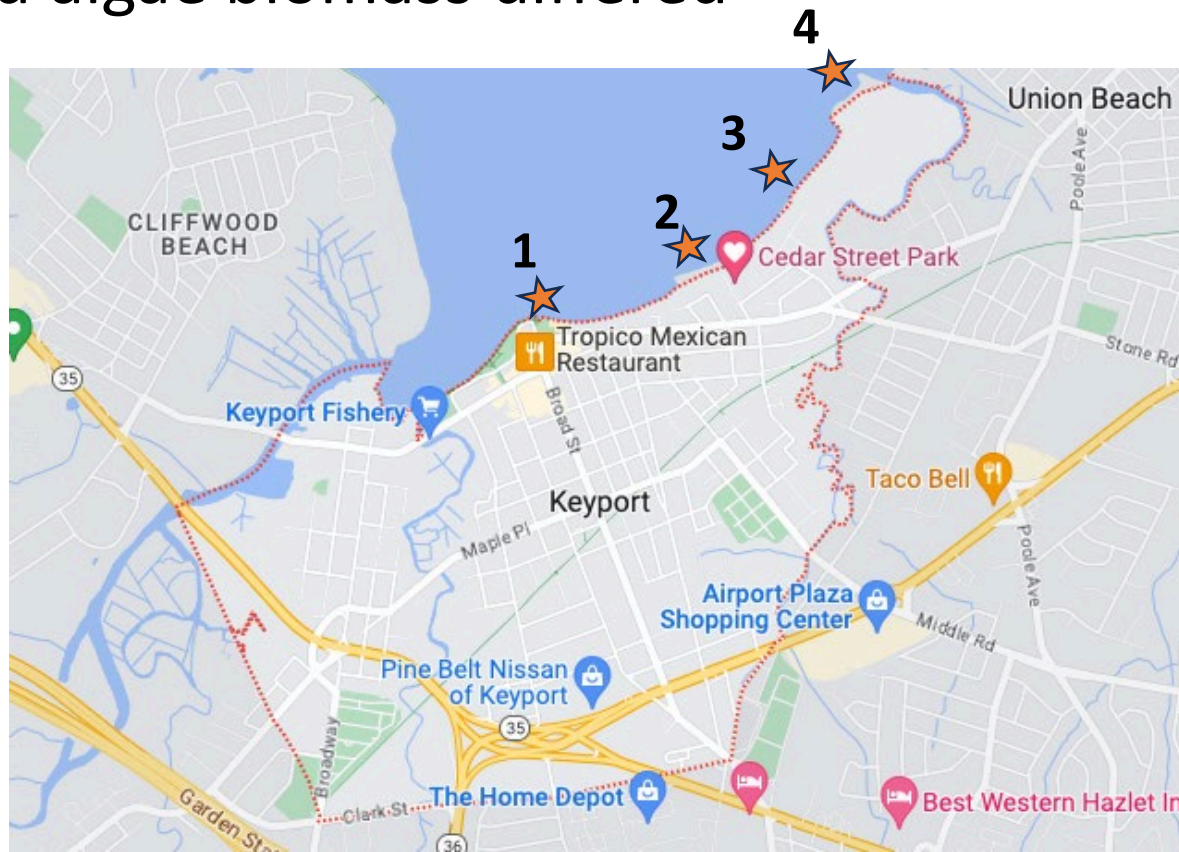


Time-series field study and in-lab incubation on NJ coastal waters

- Algal bloom events and HAB species found in New Jersey coastal waters (Ren, 2013)
- Water quality factors such as nutrients and algae biomass differed spatially.

Study sites: Keyport Harbor

- Site 1: close to Matawan Creek and a fishing pier
- Site 2: close to a park
- Site 3: close to a paving & sealcoating company
- Site 4: close to Chingarora Creek



Field sampling and analyses

Chelsea Oti, Ben Aharoni, Derek Melendez

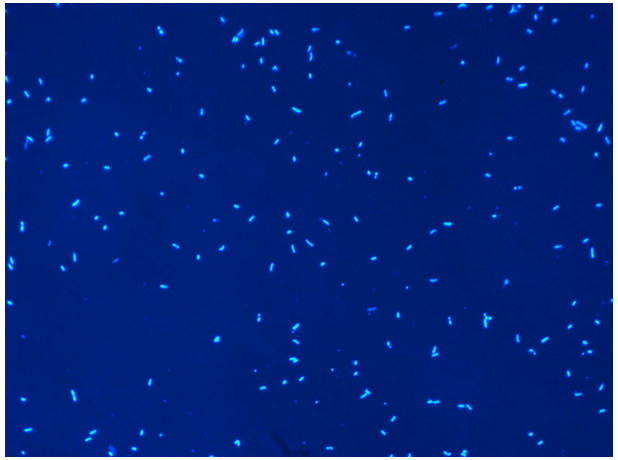
- Seasonal field sampling of inorganic nutrients (nitrate+nitrite, ammonium, phosphate), dissolved organic carbon (DOC), chlorophyll (indicator of algae biomass), and bacterial abundance across multiple sites.

Sampling

Total Organic Carbon Analyzer

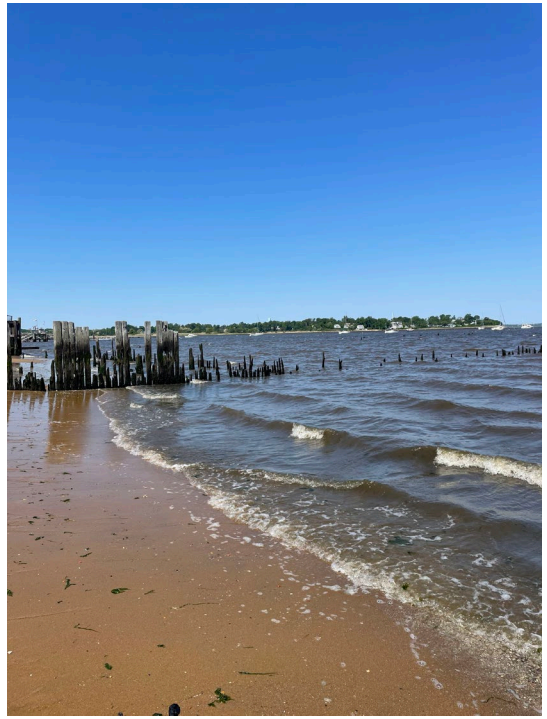
Spectrophotometer

Bacteria microscopic counting

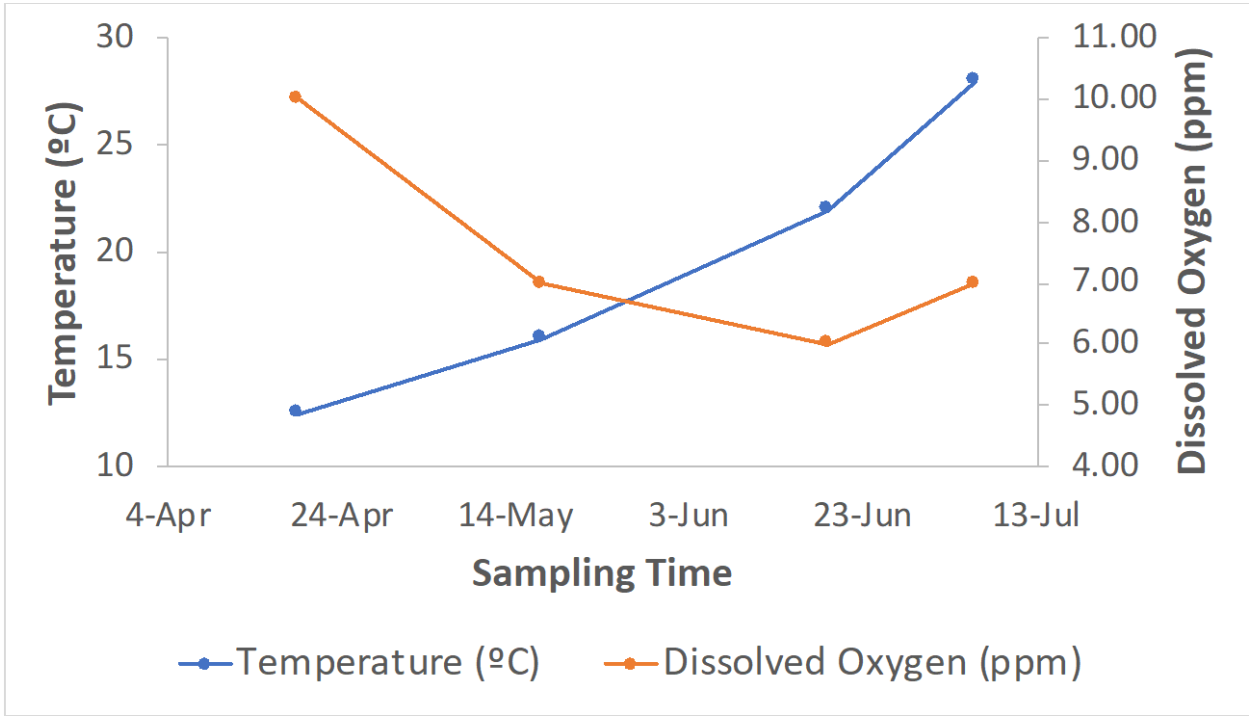


Water quality changes over time

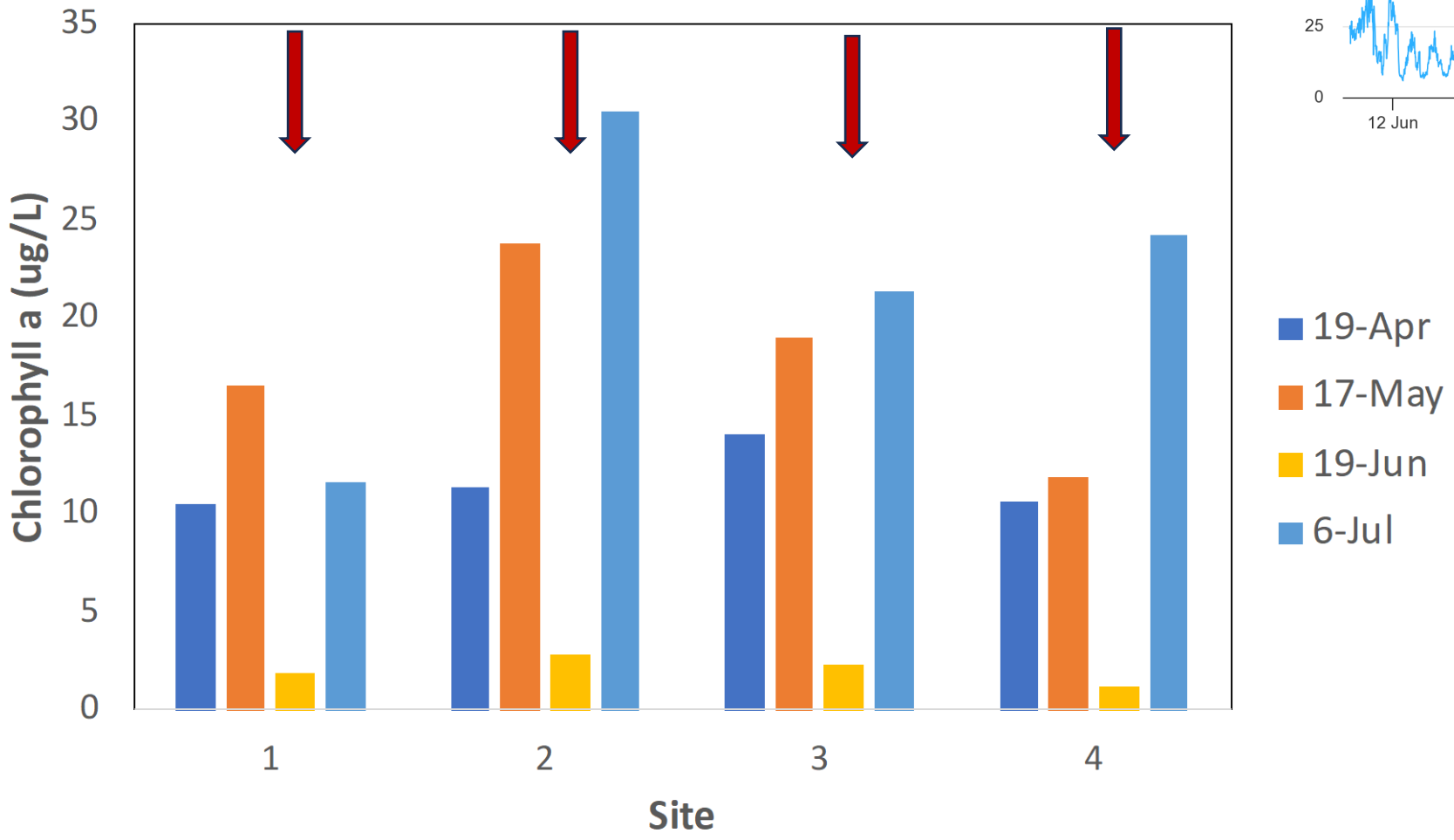
May 2023

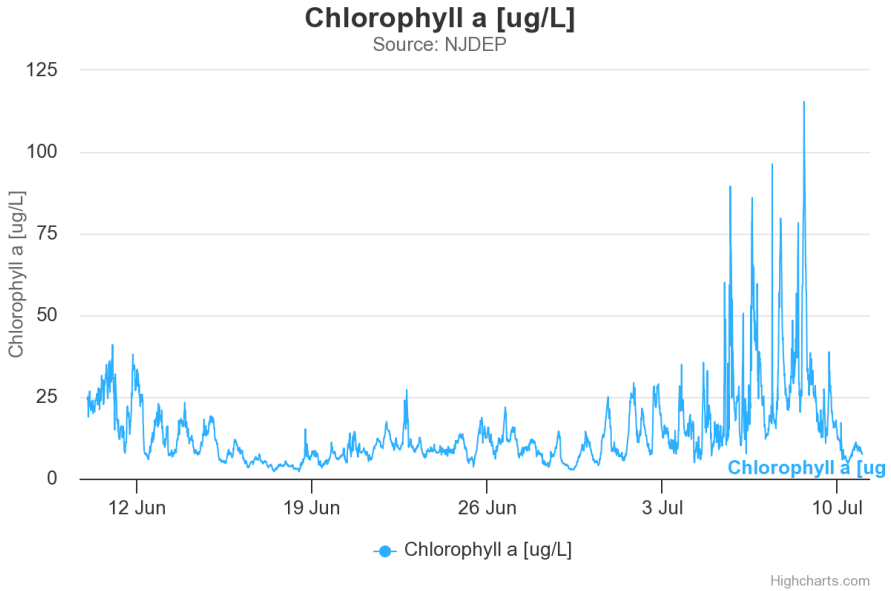


July 2023



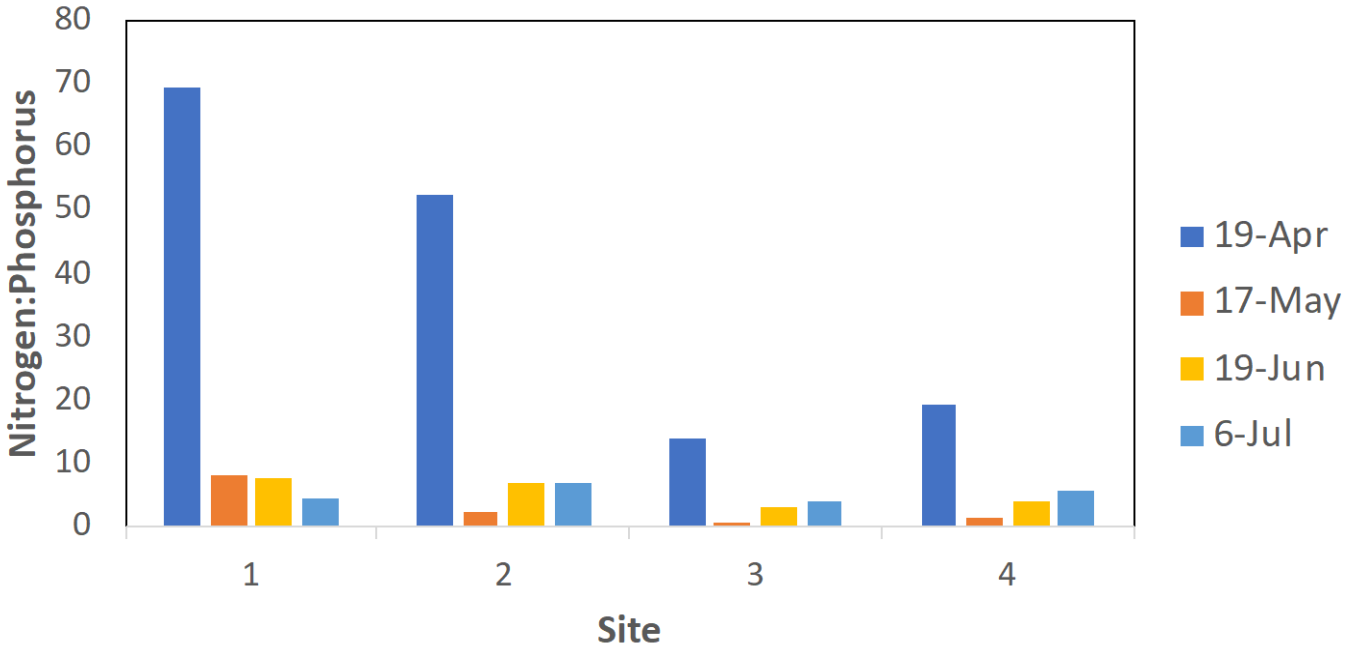
Algae growth in summer

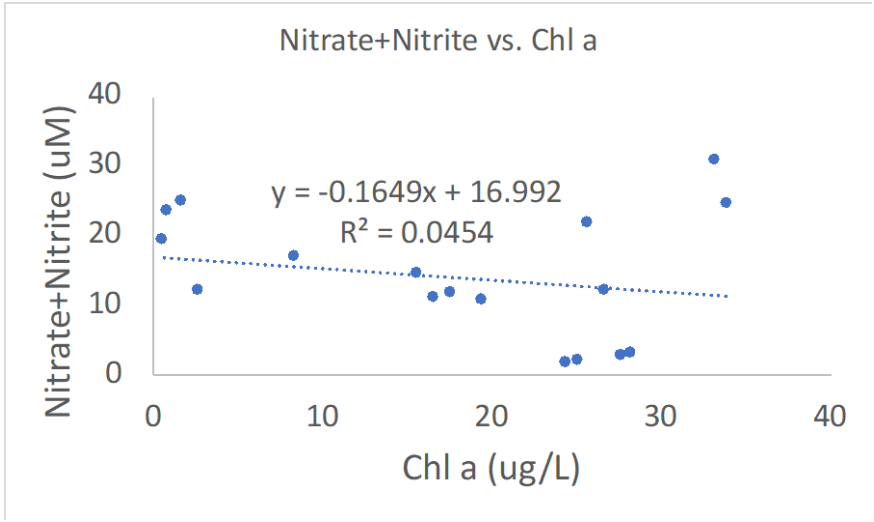


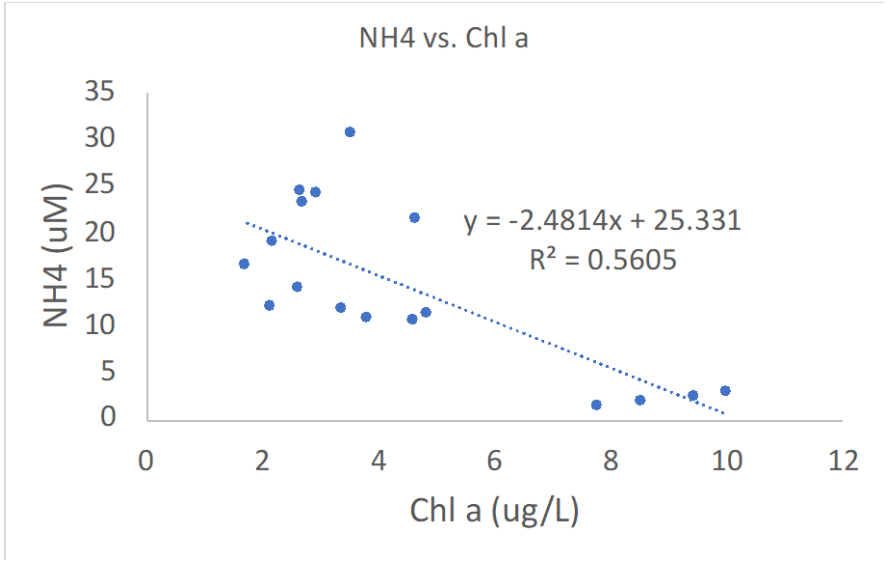


- Temporal variability: Higher algae biomass in summer
- Spatial variability: Higher algae biomass at Site 2
- Wildfire effects in June?

Nitrogen is the driving factor of algal growth in summer



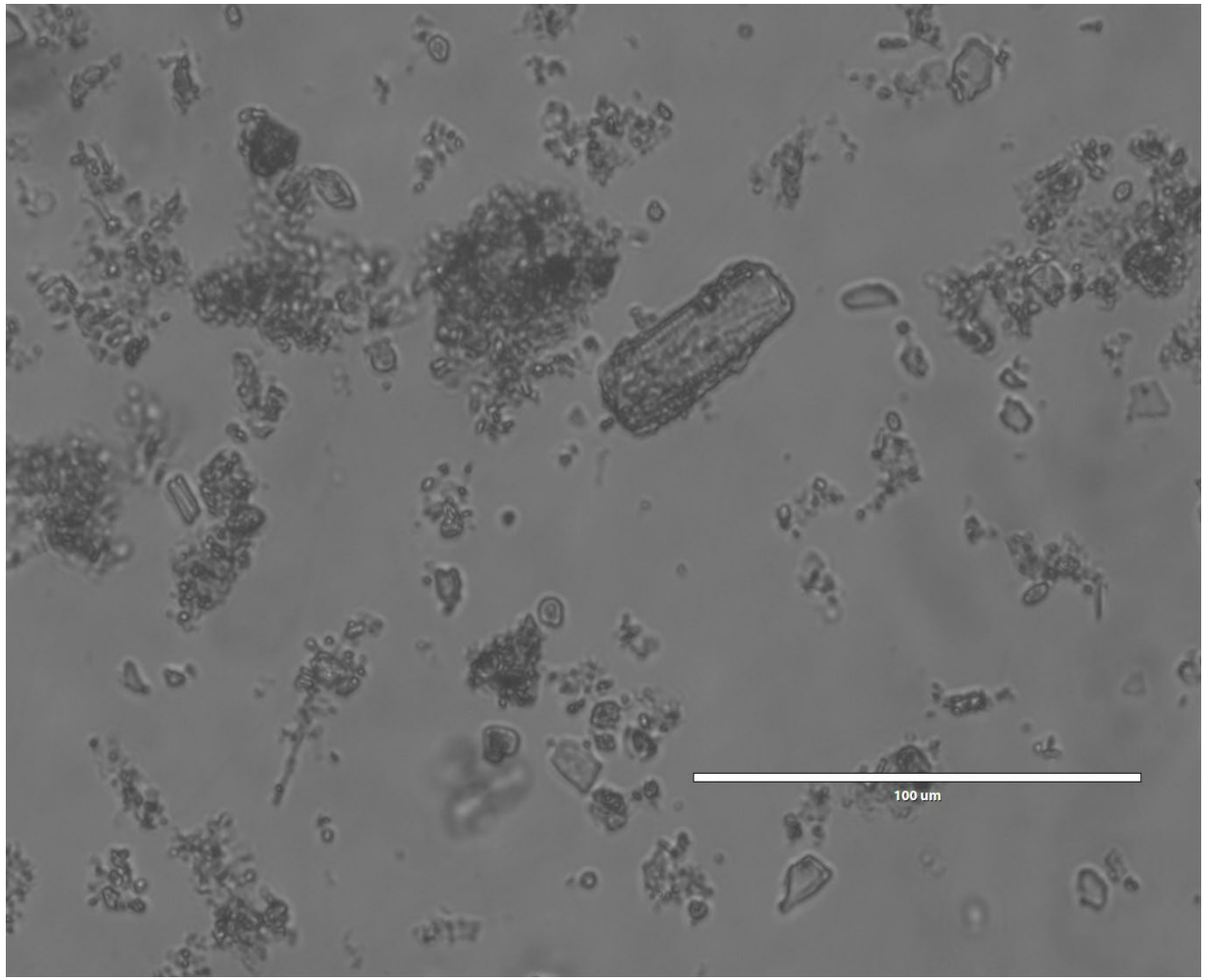




Different algae may use different nitrogen species at various time

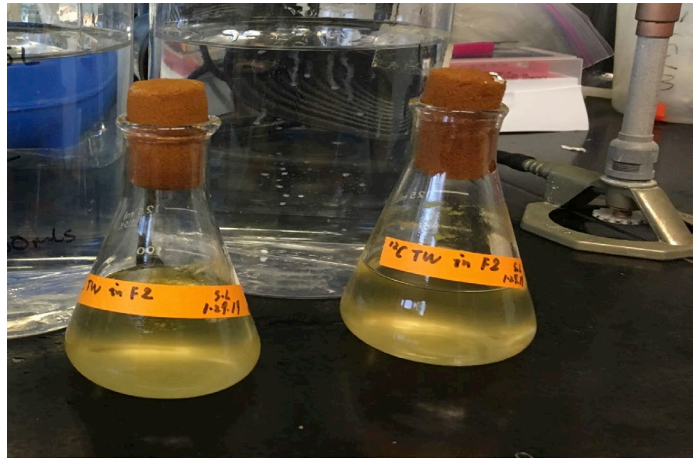
Algae images under microscope

- By Spencer Thompson

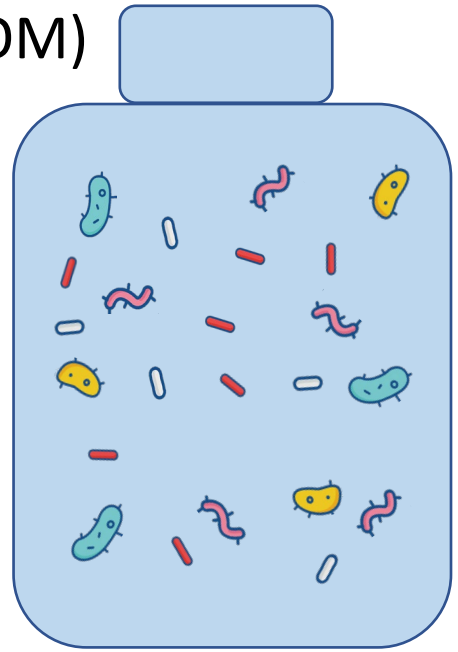


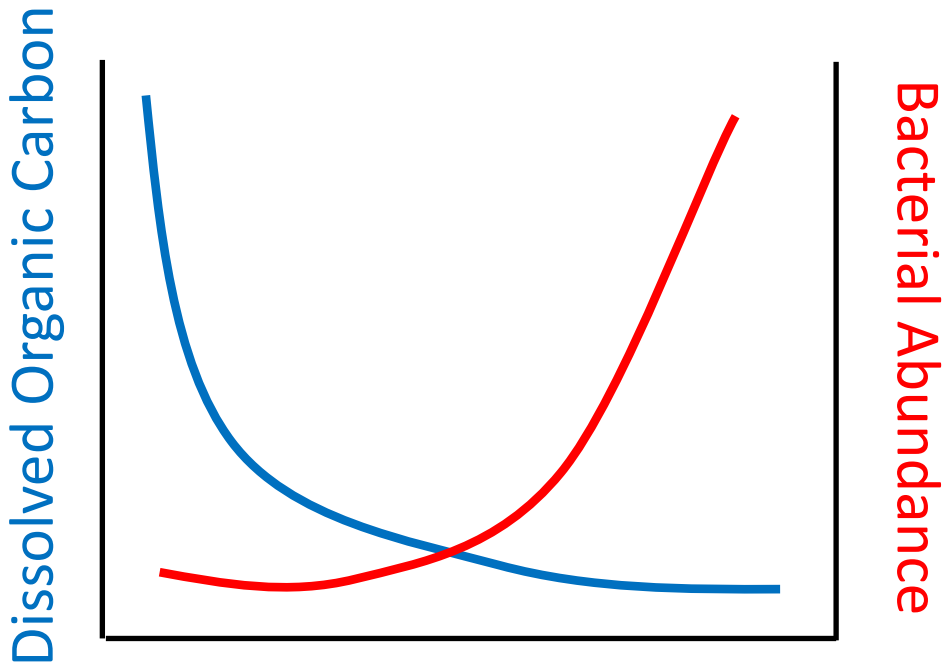
Incubation study

Algae culturing

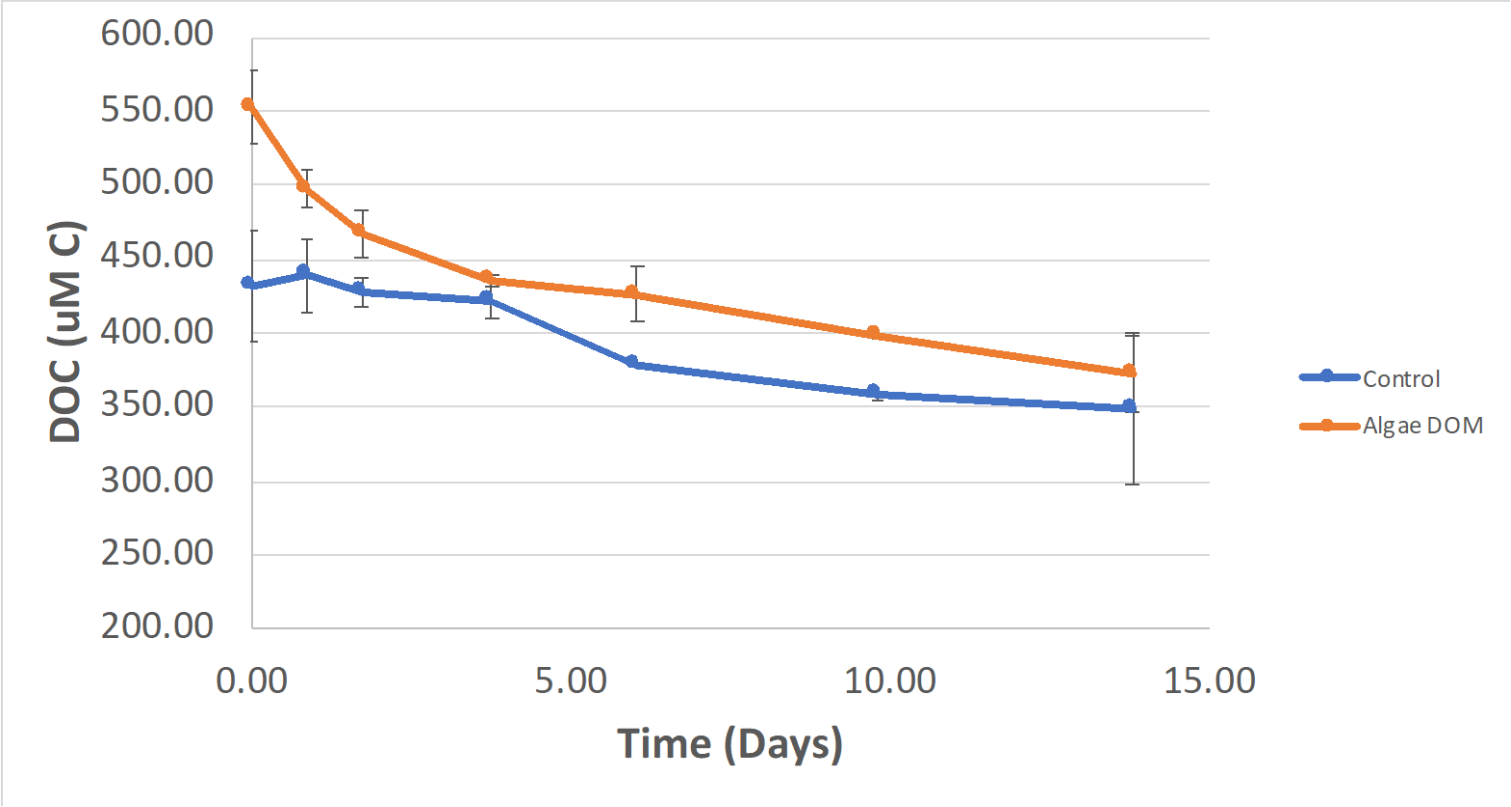


Dissolved organic matter (DOM)





High bacterial activity in summer



Bacteria removed algae DOM within 2 weeks in summer.
Maybe less active in winter?

Conclusions and future works

- Algal blooms occurred in the summer and nitrogen may be the driving force of algae growth in the NJ coastal water in summer.

- Collect more temporal and spatial baseline data for future management planning, coping with natural or anthropogenic disturbance, and increasing coastal resilience.

- Understanding the effect of algal blooms on water quality is essential for assessing coastal water ecosystem health under climate change.

Acknowledgements

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- Kean University Hennings College

KEAN

VISIT KEYPORT