ECOHAB: *Karenia*

RECENT FINDINGS:
PHOTOCHEMICAL PRODUCTION STUDIES

Photochemical Nutrient Production Rates

Karenia brevis, like all plants, has three basic requirements for survival: sunlight, water, and nutrients. In southwest Florida where *K. brevis* blooms frequently occur, there is an abundance of light and water. Therefore, growth of *K. brevis* cells within a bloom is likely to be limited by the availability of nutrients.

Nutrients supporting *K. brevis* blooms can have numerous origins including oceanic, terrestrial (land), atmospheric (air) sources as well as recycled sources originally from other plants and animals living in the water. One source of nutrients, particularly for the element nitrogen (N), is photochemical production. This is the production of bioavailable N and phosphorus (P) compounds from the reaction of UV light with complex dissolved organic N&P compounds in seawater.

Nitrogen and phosphorus are an essential nutrients for algae, including *K. brevis*. Compounds containing nitrogen exist naturally and in numerous forms. Some of these forms may not be bioavailable or usable by algae due to their complex chemical structures. Ultraviolet radiation from sunlight can interact with some of these compounds to break down complex nutrients into simpler forms that are more easily used (e.g. ammonium and amino acids).

Quantifying the amount of bioavailable nutrients produced by photochemical reactions in coastal waters helps researchers to quantify and understand the overall flow of nutrients in and out of *K. brevis* blooms. Some questions we hope to answer by measuring photochemical-nutrient production rates include:

1. Are more nutrients made available in seawater simply from exposure to sunlight?

2. Does photochemical nutrient production rates vary in different marine environments?

3. Does photochemical production of nutrients vary with the time of year?

4. Do photochemically produced nutrients production play a significant role in supplying nutrients to *K. brevis* blooms?
5. These questions are being addressed in the laboratory and at sea by a variety of photochemical measurements and experiments.

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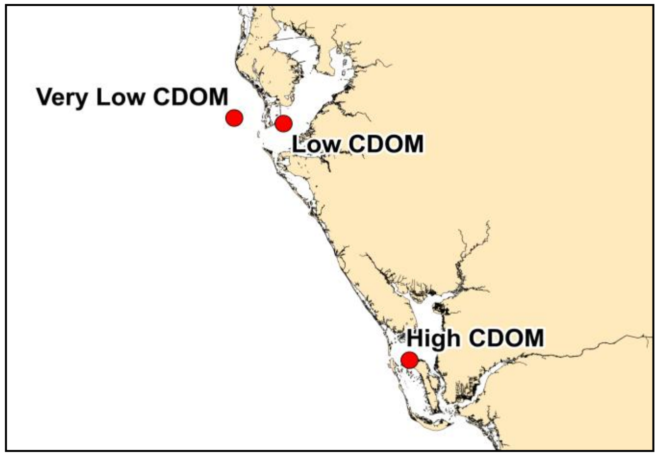
Different coastal areas in Southwest Florida have varying nutrient concentrations and nutrient quality (forms) due to different inputs from rivers and land, therefore to measure photochemical nutrient production it is important to sample a range of environments from estuarine to coastal to open ocean. To do this we conduct monthly experiments at FWRI which measure photochemical nutrient production from established sites, as well as within *K. brevis* blooms during yearly research cruises in the Gulf of Mexico. Water is collected from three representative locations monthly. One location is an estuary characterized by high concentrations of colored dissolved organic matter (CDOM) (Charlotte Harbor), another is an estuary with low DOM (Tampa Bay), and finally an offshore location with extremely low DOM. While aboard a research vessel, water is collected daily at sampling stations within estuaries, coastal bays as well as offshore along the western coast of Florida from Tampa Bay to Sanibel. CDOM is a major potential source of biologically available nutrients for photochemical reactions.

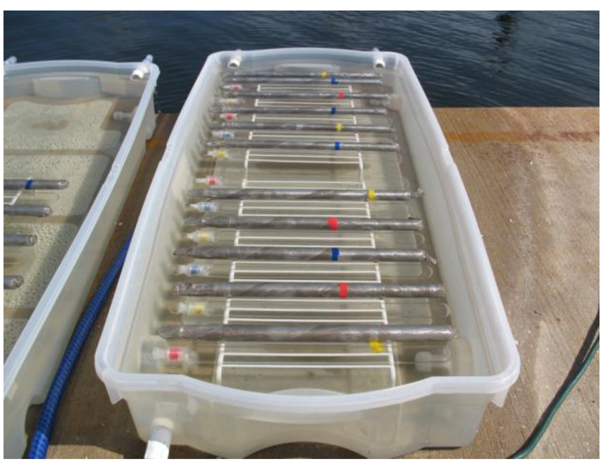


ECOHAB Monthly field sampling locations for photochemical measurements

Photochemical Experiment Design

To measure photochemical nutrient production, water collected from each site is immediately filtered to eliminate organisms that might alter the water's chemistry during the experiment. Hand-blown quartz tubes are filled with this filtered water and capped. Quartz tubes are used because they allow for UV penetration.

Half of the filled tubes are considered 'light' tubes because they will be directly exposed to sunlight during incubation, while the other half of the tubes are wrapped in aluminum foil to create 'dark' tubes so the water sample will not exposed to sunlight. These 'dark' tubes allow for the measurement of changes in nutrient concentrations during incubations that are not light related. Both dark and light tubes are placed in shallow incubators with circulating ambient water to maintain a constant temperature. Since light attenuates (is absorbed) quickly in water, it is important that the tubes lay in full sunlight in an incubator just below the water's surface.


'Light' and 'Dark' quartz tubes in incubator plumbed with flowing seawater

The tubes are placed in the incubators to maximize the amount of sunlight exposure in 24 hours. Typical incubation lengths range from 8-12 hours. To compensate for varying levels of sunlight due to clouds or time of year, measurements of ambient light are taken over the course of the incubation.

Experimental tubes placed in incubators just below the surface of the water

At the end of the incubation, tubes are removed and the water filtered for nutrient analysis including nitrate (NO_3^-), nitrite (NO_2^-), phosphate (PO_4^{-2}), siliceous acid (SiO_2), ammonium (NH_4^+), dissolved organic carbon (DOC), dissolved phosphorus (TDP), total dissolved nitrogen (TDN), humic nitrogen, and dissolved primary amines (DPA).

Once the samples have been analyzed for the nutrient content, comparison of the 'light' and 'dark' tubes will determine if any nutrients have been photochemically produced and by what amount.