Casco Bay Estuary Partnership Carbonate chemistry installation

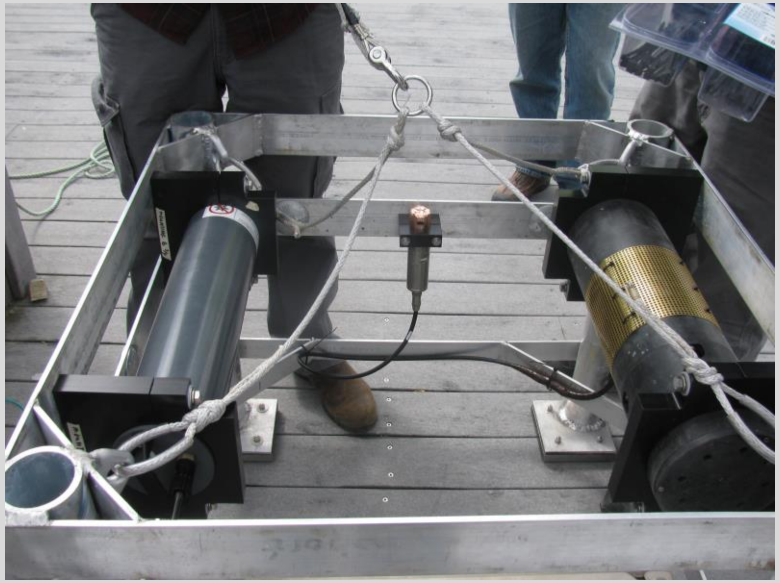
Presented at: Casco Bay Estuary Partnership
Monitoring Network meeting
February 17, 2022

To calculate omega, University of New Hampshire installed four instruments:

- Satlantic SEAFET pH sensor (owned by CBEP);
- Sunburst Submersed Automated Monitoring Instrument (SAMI) for CO_2 (owned by UNH);
- Aanderaa Optical Oxygen Optode sensor (owned by CBEP); and
- Seabird conductivity (salinity) and temperature sensors (owned by UNH).

UNH built a cage to house the sensors:

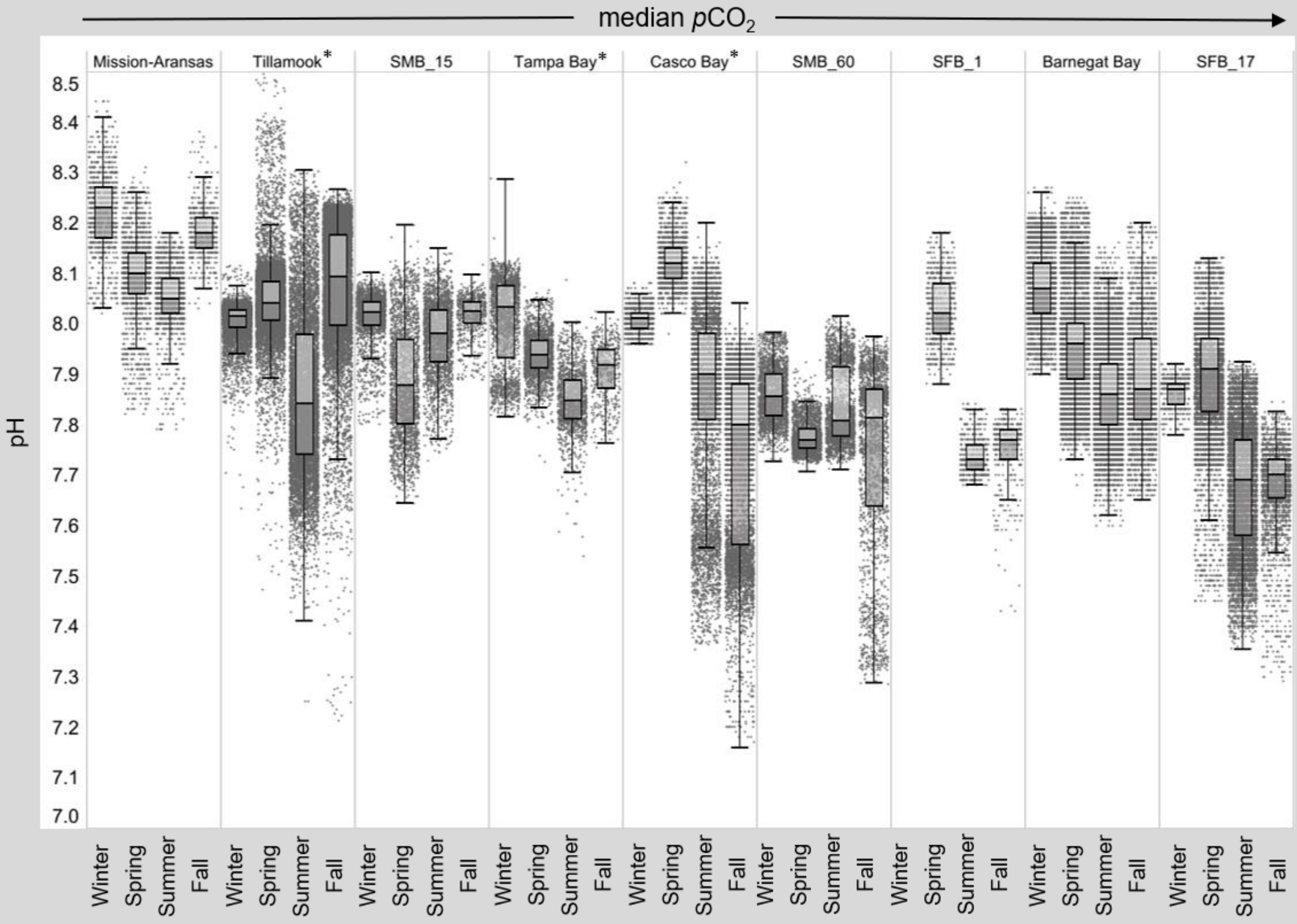
- Attached via a davit within a secure box at the pier in about 1 to 5 meters of water (depending on tide).
- Rests on the bottom and the sensors are about ½ meters off the bottom and always submerged.



Seasonal patterns of temperature, salinity, dissolved oxygen, pH total scale, pCO_2 and measured or derived carbonate chemistry were recorded for five years from April 2015 to June 2020.

pH among the lowest of all seven NEPs

From Rosenau et al., 2021



Preliminary one-dimensional ecosystem modeling suggests there is an external source of CO_2 to this site that provides positive flux of CO_2 to the atmosphere year round

State of the Bay Report includes this data and compares also to Friends of Casco Bay deployments

The SeaFet will be used to help validate continuous monitoring at these sites.

DRIVERS & STRESSORS | CONDITION OF THE BAY K. Coastal Acidification | HUMAN CONNECTIONS

Coastal Acidification Varies Seasonally, Daily, and Among Locations in Casco Bay

Scientists Are Investigating Local Patterns and Causes of Acidification

WHY IT MATTERS

Lobsters, clams, and many other marine species build their shells out of carbonate minerals that they extract from seawater. Acidification of the water can make it more difficult for them to build their shells, or even cause shells to dissolve. Four out of every five dollars in Maine fisheries comes from shell-building species. Lobster represents about 75 percent of the fisheries' total value, and clams, oysters, urchin, and scallops account for another five or six percent.

In offshore waters, the primary cause of acidification is carbon dioxide (CO_2) from the atmosphere dissolving into the water. One quarter of the carbon dioxide released to the atmosphere by human activity annually is absorbed by the ocean, making ocean acidification a global concern. Near the coast, however, other localized sources such as rivers and nutrient pollution are major contributors to acidification, which refers to changes in not only pH but also availability of carbonate ions. Coastal acidification interacts with other environmental stressors like climate change, invasive species, and poor water quality to affect the ecosystem.

Dissolved Carbon Dioxide Rises over the Summer and Fall

Carbon dioxide levels in the Bay (temperature-corrected) are at their lowest in the spring, and climb steadily through the fall. Levels are above atmospheric concentrations (~ 400 µAtm) most of the year.

STATUS & TRENDS

Data are limited, especially for the winter months, but about ten percent of all observations in Casco Bay show conditions corrosive enough to dissolve carbonate minerals like clam shells. Scientists from the University of New Hampshire, with funding through Casco Bay Estuary Partnership, have monitored coastal acidification near Southern Maine Community College (SMCC) in South Portland for five years. The monitoring reveals seasonal and daily variations reflecting biological activity in the ecosystem. Carbon dioxide levels fluctuate seasonally and daily, in synchrony with cycles of photosynthesis, respiration, and decomposition. In late summer and fall, levels of carbon dioxide hit their peak, pH drops, and acidification reaches levels of concern. For most of the year, levels of carbon dioxide dissolved in the Bay's waters are higher than atmospheric levels, meaning the Bay seldom absorbs carbon dioxide from the atmosphere.

pH Decreases from Summer to Fall

At SMCC, pH shows a clear seasonal pattern, dropping over the course of the year by as much as a half of a pH point. pH is measured on a logarithmic scale, so that difference in pH represents a change in acidity by a factor of 3.

SHELL DAY
AUGUST 22
2019

Using Data Repositories for Coastal Acidification Monitoring Data

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Tom Shyka, Northeast Regional Association of Coastal Ocean Observing Systems
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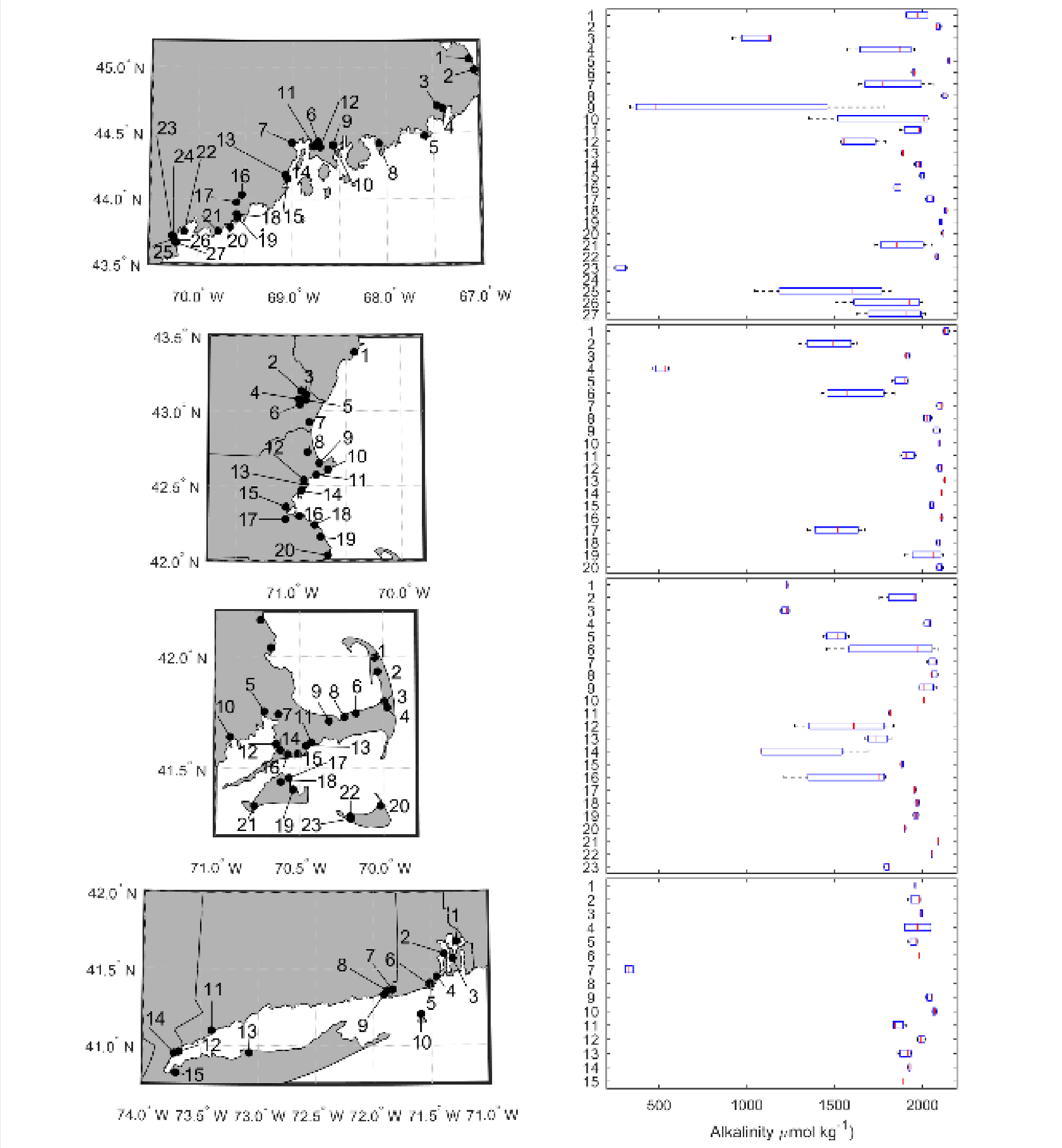
March 2022



J E Rheuban, P R Gassett,, D C McCorkle, C W Hunt, M Liebman, C Bastidas, K O'Brien-Clayton, A R Pimenta, E Silva, P Vlahos, R J Woosley, J Ries, C M Liberti, J Grear, J Salisbury, D C Brady, K Guay, M LaVigne, A L Strong, E Stancioff and E Turner. 2021. Synoptic assessment of coastal total alkalinity through community science. Environmental Research Letters 16(2): 024009. http://dx.doi.org/10.1088/1748-9326/abcb39

Parker Randall Gassett, Katie O'Brien-Clayton, Carolina Bastidas, Jennie E. Rheuban, Christopher, W. Hunt, Elizabeth Turner, Matthew Liebman, Emily Silva, Adam, R. Pimenta, Jason. Grear, Jackie Motyka, Daniel McCorkle, Esperanza Stancioff, Damian, C. Brady and Aaron, L Strong. 2021. Community Science for Coastal Acidification Monitoring and Research, Coastal Management, DOI: 10.1080/08920753.2021.1947131

With the Downeast Institute and the Maine Coastal Program, testing buffering with crushed oyster shells on a mudflat for recruitment of juvenile clams