



UNH Coastal Ocean Observing Center Great Bay Methods

Chris Hunt, Chris Manning, Megan Heidenreich, Joe Salisbury, Mike Novak, Doug Vandemark, Ru Morrison, Janet Campbell, Wade McGillis



Flow-through system

A shipboard flow-through system (Figure 1) was used to continuously measure physical and chemical properties of surface water. Water was pumped from a seacock located amidships at a depth of 0.5 m. Flow was pumped onto deck, where it was split to the flow-through system and pCO₂ equilibrator. The flow rate to all instruments in the shipboard flow-through system was 1.5 l/min. Temperature and salinity were determined by a Seabird SBE 45 thermosalinograph, and dissolved oxygen by a SBE 43 (Sea-Bird Electronics Inc., Bellevue WA). In addition, a debubbled line supplied water to WetStar fluorimeters for CDOM, chlorophyll, phycoerythrin fluorescence, as well as a C-Star for beam attenuation at 660 nm (WetLabs, Philomath OR). Outflow from the debubbled line was supplied to the MBARI ISUS nitrate sensor (Johnson and Colletti, 2002). All sensor data was logged on a computer once per second.



Figure 1. *Flow-through system equipped to measure FI-Chl, FI-CDOM, beam attenuation, DO, Temp, and Salinity. Seawater is pumped through the system from below the boat at a rate of 20L/min.*

pCO₂ system

Flow to the shipboard flow-through system was teed off to an equilibrator (Figure 2), similar to that described by Wanninkhof and Thoning (1993), but consisting of three Plexiglas chambers instead of a single chamber. Water pumped into each chamber (FLOW RATE?) ran from the top to the bottom. Using a handheld temperature and salinity sensor (YSI 85, YSI Instruments Yellow Springs OH), no temperature differences were detected between equilibrator outflow and sea surface water. Equilibrated air was drawn out of the third chamber, while ambient air was drawn into the first chamber and passed through the second and third chambers, equilibrating with the pumped water supply at each step. Equilibrated air was drawn at 100 mL/min through tubing containing a Nafion selectively permeable membrane (Perma Pure, Toms River NJ) with a counter-flowing stream of dry nitrogen, which dried the sample gas stream of water vapor. After drying, the sample was pumped to a non-dispersive infrared gas analyzer (Li-cor, LI-6262), which measured the partial pressure of carbon dioxide (pCO₂) of the sample stream. The Li-cor was calibrated several times per day with pure nitrogen and a gas mixture with CO₂ molar fraction of 819 ppm (Scott-Marin, Riverside CA). Corrections of the data for

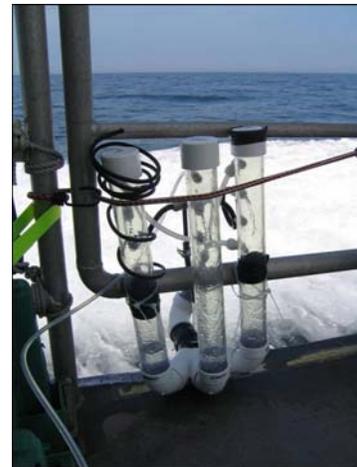


Figure 2. *Fast equilibrator for continuous pCO₂*

water vapor pressure and sea surface temperature and conversion from pCO₂ to the fugacity of carbon dioxide (fCO₂) were carried out according to the DOE (1994).

Atmospheric pCO₂ was periodically measured as well while the ship was underway to reduce interference from the ship's exhaust. Ambient air was drawn from the ship's bow through a length of Bev-a-line tubing (TPI, Georgetown DE), and pumped into the non-dispersive infrared gas analyzer described above.

Sampling The Algae

Algal samples were collected using a wide mouth 1 liter jar. The sample was then poured into 150 to 250ml bottles or jars which contained 0.02 ml of Lugol's per 1ml of bottle size. Bottles were then placed in a box to keep them in the dark until the boat returned to the lab. The boxes containing the samples were then placed in a 20 °C refrigerator. Once they were to be counted the bottles were transferred to a Styrofoam cooler and brought to the lab.

Samples were counted using a Gridded Sedgwick-Rafter 1mm² slide under 400x magnification with a Leica DME microscope. For each sample a minimum of 200 cells per slide were counted and identified to species whenever possible. Due to microscopic limitations some species were only identified to genus.

Cell counts were then calculated to determine cells per milliliter. The data was entered into an Excel spreadsheet which was later imported into ArcView GIS for analysis of the algal groups identified at each site in Great Bay (Figures 20-24).

Zooplankton Sampling

Zooplankton were collected with a 0.25 m² ring net fitted with a 333 µm mesh net. Filter volumes were derived from a General Oceanics mechanical flowmeter tied in the center of the net. Aboard the R/V *Camden Belle* the ring net was towed obliquely at approximately 2 knots (see cover photo). To avoid unintentional benthic sampling the net was not heavily weighted. It was allowed to sink vertically before the boat accelerated to towing speed, causing the net to be pulled toward the surface. Sampling at the JEL dock was achieved by tying the net to the dock and allowing the current to force water through the net. Samples were preserved with 95% ethanol. For analysis, a Hensen-Stemple pipette was used where necessary to obtain an aliquot of approximately 200 zooplankters. These were identified to species where possible.

Multi-Dimensional Scaling

Non-metric multi-dimensional scaling (MDS) was used to visualize spatial variability in the planktonic community. MDS plots are generated from a ranked similarity matrix, such that the distance from one point to another is representative of the similarity between those points (Clarke 1993). The closer two points are in the resulting plot, the more similar the planktonic composition of those samples. The degree to which the distances between all points in the plot accurately represent the similarity between them is

measured by the stress value. A stress value of less than 0.1 indicates the plot accurately represents similarities, while a stress value of greater than 0.3 indicates the points are close to being randomly placed (Clarke 1993).

References

Clarke K (1993) Non-parametric multivariate analyses of changes in community structure. *Aust J Ecol* 18: 117-143.

DOE (1994) *Handbook of methods for the analysis of the various parameters of the carbon dioxide system in sea water, version 2*, A.G. Dickson and C. Goyet, eds. ORNL/CDIAC-74.

Johnson, K., L. Coletti (2002), In situ ultraviolet spectrometry for high resolution and long-term monitoring of nitrate, bromide and bisulfide in the ocean, *Deep-Sea Research I*, **49**, 1291-1305).

Wanninkhof, R. and Thoning, K. 1993. Measurement of fugacity of CO₂ in surface water using continuous and discrete sampling methods. *Marine Chemistry* 44: 189-204.