Ocean and Coastal Acidification in the Mid-Atlantic

Optimizing Monitoring for 2020 and Beyond

What are the monitoring priorities for the Mid-Atlantic region? How can existing monitoring efforts be leveraged to fill spatial and temporal data gaps? What opportunities are available to expand these efforts into a more robust regional acidification monitoring program?

The Mid-Atlantic region has a long history of water quality monitoring, with over 40 years of data from the Chesapeake Bay Program alone. This extensive monitoring infrastructure helps resource managers predict and plan for impacts to economically important fish and shellfish, their habitats, and the marine-based industries that rely on healthy coastal waters. As coastal and ocean waters in the Mid-Atlantic become more acidic due to rising atmospheric CO_2 and the influence of local drivers (e.g. stormwater runoff and eutrophication), our vulnerable species may be increasingly at risk.

Despite the breadth of water quality monitoring data available, several gaps in efforts to monitor carbonate chemistry have been identified using recently developed acidification monitoring maps[1] and are summarized in a review by Goldsmith e*t al.* (2019)[2]. Specifically, sampling does not occur frequently enough to capture short-term episodic events; often only one acidification parameter such as pH is measured; and most sampling efforts are concentrated in surface waters. Developing a robust acidification monitoring program to fill monitoring gaps and identify areas of enhanced vulnerability is a high priority for MACAN for the Mid-Atlantic region.

SETTING THE PRIORITIES: MACAN WORKSHOP

In May 2019, MACAN hosted a one-day workshop to discuss gaps and prioritize monitoring needs for ocean and coastal acidification in the Mid-Atlantic region. The workshop brought together natural resource managers, scientists, federal and state agencies, NGO's, and stakeholders to discuss ways to optimize existing monitoring efforts and develop a more comprehensive, cost-effective monitoring network in the Mid-Atlantic region. Discussions centered on the seven monitoring recommendations identified in Goldsmith *et al*. (2019)[2]. Workshop participants identified four key areas where funding and partnerships could be leveraged to improve our understanding of baseline levels, evaluate emerging trends, and focus our resources on areas of enhanced vulnerability.

Acidification Monitoring Recommendations

Expand current acidification monitoring to leverage existing infrastructure and funding

- Include a second carbonate chemistry parameter via water sampling or additional sensors at existing monitoring sites or platforms
- Monitor subsurface and bottom waters to complement surface water sampling

Consider other drivers that may affect acidification

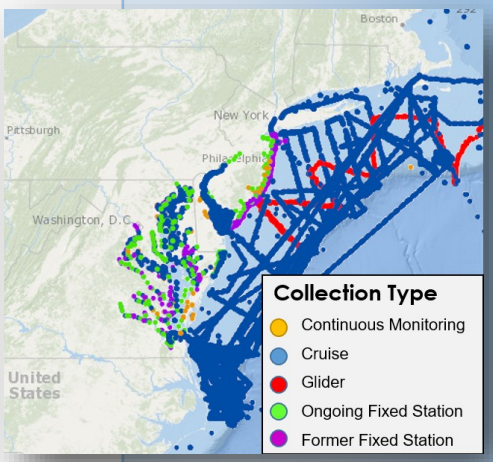
- Combine carbonate chemistry measurements with other water quality and biological measurements

Identify best available sensor technology for long-term, in situ monitoring

- Monitor across salinity gradients
- Increase sampling frequency to capture spatial and temporal variability

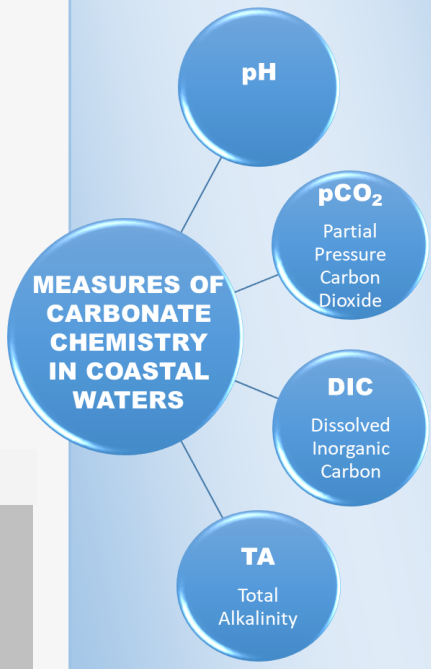
Focus monitoring efforts in regions with enhanced vulnerability

- Include habitats of commercially or recreationally important species



7 maps developed by MACAN to examine current efforts and gaps in acidification monitoring in the Mid-Atlantic Region.

Maps are available on MARCO Mid-Atlantic Ocean Data Portal[1].



4 carbonate chemistry parameters can be measured, but at least two of the four parameters need to be measured simultaneously to fully understand the state of acidification.

For more information, view the Mid-Atlantic Coastal Acidification Network website at MidACAN.org.

MONITORING PRIORITY: LEVERAGE EXISTING INFRASTRUCTURE AND FUNDING TO EXPAND CURRENT MONITORING EFFORTS

Most water quality monitoring programs in the Mid-Atlantic only collect one carbonate chemistry parameter in their suite of data[1] , or are lacking co-located water quality or biological measurements. There is a critical need to expand current monitoring efforts to help decision makers predict impacts and develop adaptation strategies for species and habitats that are vulnerable to acidification or a combination of multiple stressors. Opportunities for expansion include:

- Partnering with water quality monitoring programs coordinated by state agencies, non-profits, etc., to include additional carbonate chemistry, water quality, and biological parameters
- Incorporating a second parameter, e.g. pCO_2 or Total Alkalinity, to moored stations with existing pH measurements
- Expanding monitoring sites to tributaries, coastal bays, and estuarine systems to better understand organismal response and the influence of local drivers
- Focusing monitoring in areas with enhanced vulnerability, such as shellfish beds

MONITORING PRIORITY: DEVELOP NEW COST-EFFECTIVE MONITORING PROGRAMS TO FILL DATA GAPS

Workshop participants highlighted the need for guidance on which parameters and sampling methods to implement and the costs associated with sensor technologies, data collection, and QA/QC. Developing a comprehensive document summarizing and comparing readily available monitoring technologies would be beneficial to resource managers and stakeholders as they design future programs to monitor acidification and other stressors in estuarine and coastal waters. Information needs include: identifying which carbonate chemistry parameters could be added to a new or existing program; the type of sampling protocol to implement; a comparison of sensor technologies and their associated costs; considerations for spatial vs. temporal sampling at single sites; and a list certified laboratories to perform the analyses. Opportunities for academic-state partnerships to leverage funding and staff resources could also be explored.

Additional opportunities to leverage funding as new monitoring programs are developed include:

- Exploring ways to involve fishermen and other stakeholders in data collection, using low-cost technologies such as Raspberry Pi sensors or water bottle sampling methods.
- Exploring the use of future infrastructure such as offshore wind platforms or ferry boats as opportunities for cost-efficient sensor placement and data collection.

LEARN MORE

1. MARCO Mid-Atlantic Ocean Data Portal: Acidification Monitoring Locations. http://portal.midatlanticocean.org/
2. Goldsmith, K.A., Lau, S., Poach, M., Sakowicz, G., Trice, T.M., Ono, C.R., Nye, J., Shadwick, E.H., StLaurent, K., Saba, G.S. 2019. Scientific considerations for acidification monitoring in the U.S. Mid-Atlantic Region" *Estuarine, Coastal and Shelf Science 225: 106188,* https://doi.org/10.1016/j.ecss.2019.04.023.
3. VIMS: Chesapeake Bay Daily Forecasts for Ocean Acidification. https://www.vims.edu/research/topics/dead_zones/forecasts/cbay/acidification/

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In addition to monitoring for long-term trends, MACAN's stakeholders need real-time data to be readily available, particularly near aquaculture operations.

"Oyster farmers want to be able to access real-time data on a smart phone; we don't want to take water samples."

-Workshop participant

Researchers at the Virginia Institute of Marine Science are beginning to incorporate regional forecast models into smart phone applications to provide daily nowcasts and 2-day forecasts of relevant acidification metrics, such as pH[3].

ABOUT US

MACAN is a network of scientists, tribal, federal, and state agency representatives, resource managers, and affected industry partners who seek to coordinate and guide regional observing, research, and modeling of estuarine, coastal, and ocean acidification in the Mid-Atlantic. Our members are key to advancing the state of the science and providing outreach to policymakers and the public across the region.

If you would like to become a member of MACAN, get involved in a working group, or build collaborations to address acidification monitoring priorities in the Mid-Atlantic, please e-mail info@midAcan.org.