Ocean and Coastal Acidification in the Mid-Atlantic

Prioritizing Research Needs for 2020 and Beyond

What impacts can we expect from acidification in the Mid-Atlantic region? How do we assess the level of those impacts in shallow coastal waters versus open ocean ecosystems? What will changes in the pH of coastal waters ultimately mean for our coastal communities?

As the concentration of atmospheric CO_2 continues to rise and our coastal population rapidly expands, the Mid-Atlantic's coastal habitats are under increasing risk from changes in seawater chemistry that give rise to ocean and coastal acidification. Multiple stressors, such as eutrophication and storm runoff can exacerbate acidification that could have major impacts on species inhabiting Mid-Atlantic coastal waters. Predicting the ecological and economic impacts and developing strategies for mitigation is a critical need for natural resource managers and industry stakeholders.

Research efforts have begun to address the effects of ocean acidification on a variety of species, however many questions have yet to be answered. Research gaps in the Mid-Atlantic region include: the influence of multiple stressors on physiological and behavioral responses, the expansion of laboratory studies to field-based studies or ecosystem-level research, and the connectivity between coastal acidification impacts, ecosystem services, and the coastal economy.

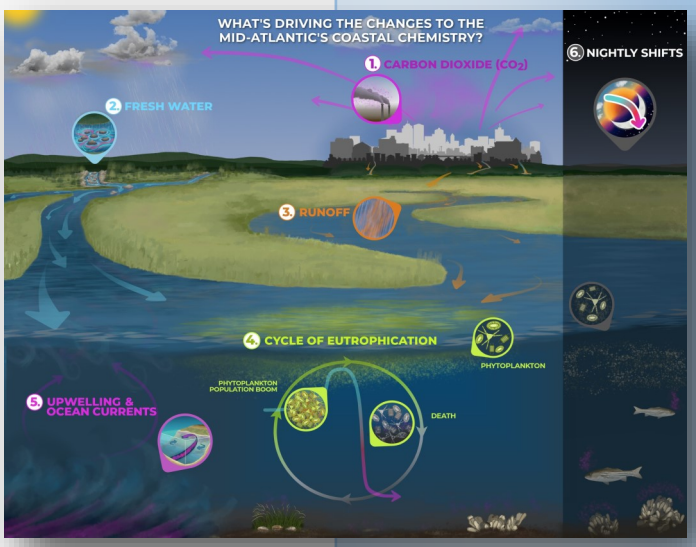


Image Credit: Sea Grant and NOAA NART.

SETTING THE PRIORITIES: MACAN WORKSHOP

In May 2019, MACAN hosted a one-day workshop to discuss current knowledge gaps and prioritize research needs related to ecological impacts of ocean and coastal acidification in the Mid-Atlantic region. The workshop brought together natural resource managers, scientists, federal and state agencies, NGO's, and members of the aquaculture industry to set regional research priorities for 2020 and beyond. Discussions centered on the six priority research areas identified in Saba *et al.* (2019)[1]. Workshop participants identified three key areas where funding and partnerships could be leveraged to advance the state of the science.

RECOMMENDATIONS FOR RESEARCH PRIORITIES

Modeling multiple drivers of coastal acidification

- Filling research gaps for major taxa

Improving experimental design

- Examining acclimation/adaptation capacity of organisms
- Ecosystem-level research considerations

Connecting impacts of acidification to ecosystem services and economy

35

Number of species **managed** by the Mid-Atlantic Fisheries Management Council and the Atlantic States Marine Fisheries Commission

24

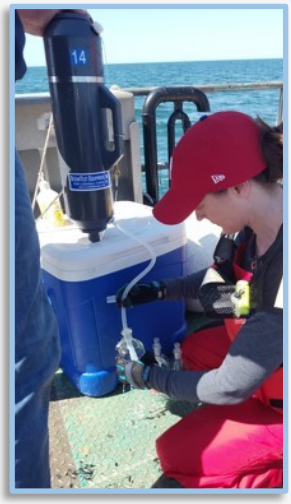
Number of species **not yet investigated** for acidification impacts[1]

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

RESEARCH PRIORITY AREA: UNDERSTANDING THE ROLE OF MULTIPLE STRESSORS IN SPECIES RESPONSE TO ACIDIFICATION

Land, atmospheric, and aquatic processes can all contribute to coastal and/or ocean acidification, but are typically not examined or quantified simultaneously. Evaluating each stressor independently makes it difficult to design experiments that test organism response under natural conditions. Research efforts should focus on understanding the relative contribution of the different sources of acidification, their variability on a daily or seasonal cycle, and how different stressors are connected.

RESEARCH PRIORITY AREA: IMPROVING EXPERIMENTAL DESIGN



Understanding the role of naturally variable carbonate chemistry, including pH and aragonite saturation state, on Mid-Atlantic fish and shellfish is an important consideration when designing experiments to evaluate ecological impacts. Research on best practices for sensors, or development of new sensors that can provide reliable data on pH and total alkalinity across a wide range of salinities and *in situ* is a critical need.

Experimental design should be optimized to differentiate between exposure to acidification versus vulnerability to or impacts of acidification. Timeframes of exposure, variation in thresholds, and interactions with other stressors should also be considered.

Future research should prioritize laboratory single-species experimental efforts and include species of economic and ecologic importance.

Future studies should focus on population and community responses to determine ecosystem-level impacts under acidifying conditions. Both direct and indirect (i.e., neurotransmitters vs. effects on prey) responses should be examined, including studies focused on invasive species, competition between species for space and/or resources, and predator-prey dynamics and community shifts. There is an immediate need for field-based studies including Free Ocean CO_2 Enrichment (FOCE) system experiments.

RESEARCH PRIORITY AREA: CONNECTING THE IMPACTS OF ACIDIFICATION TO ECOSYSTEM SERVICES AND THE ECONOMY

There is a need to develop local and global economic models and dynamic energy budgets to underscore the potential impacts of acidification on marine resources of regional importance.

LEARN MORE

1. **Saba, G.K.**, Goldsmith, K.A., Cooley, S.R., Grosse, D., Meseck, S.L., Miller, W., Phelan, B., Poach, M., Rheault, R., St. Laurent, K., Testa, J., Weis, J.S., Zimmerman, R. 2019. Recommended Priorities for Research on Ecological Impacts of Coastal and Ocean Acidification in the U.S. Mid-Atlantic. *Estuarine, Coastal and Shelf Science 225: 106188,* https://doi.org/10.1016/j.ecss.2019.04.022.

2. **Rheuban, J.E,** Doney, S.C, Cooley, S.R., Hart, D.R. 2018. Projected Impacts of Future Climate Change, Ocean Acidification, and Management on the US Atlantic Sea Scallop Fishery. *PLoS ONE 13(9): e020356*, https://doi.org/10.1371/journal.pone.0203536.

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500

millions of dollars (US$) of sea scallops are harvested annually by commercial fishermen on the U.S. East Coast.

While scientists have not examined the impact of acidification directly on sea scallops, ecological forecasting models using current projections for atmospheric CO_2 and ocean acidity show a 50% decline in sea scallop biomass could occur by 2100[2].

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 one of the research priorities, please e-mail us at info@midAcan.org.