

Protecting Coastal Communities from Ocean Risks

NIEHS-funded research at the nexus of oceans and human health protects community health.

National Institute of Environmental Health Sciences (NIEHS)-funded researchers are helping communities understand and respond to increased health risks from the combined effects of ocean threats, including harmful algal blooms (HABs).

Scientists at the University of South Carolina's Oceans and Human Health and Center (OHHC) study three primary risks to coastal communities: HABs, which produce dangerous toxins; *Vibrio* bacteria, the leading cause of death in seafood; and microplastics, which may carry *Vibrio* bacteria, HAB toxins, and other contaminants. Geoffrey Scott, Ph.D., and Paul Sandifer, Ph.D., lead the center.



High schoolers learn water quality monitoring methods as part of an OHHC outreach event. (Photo courtesy of Paul Sandifer)

Impacts

Impacts of Research at the Nexus of Oceans and Human Health



Informing Decision-Making: Findings from South Carolina's first statewide coastal assessment in shellfish informed regulators about bioaccumulated microplastics, their types, concentrations, and uptake rates. Regulating microplastics in shellfish can reduce human exposure.



Improving Community Engagement: Researchers and students developed a strategy to successfully involve community groups in planning and conducting research.³³⁻³⁴



Understanding HAB Growth: Investigators identified nitrogen, phosphorus, and salinity conditions that accelerate HAB growth and toxin production, improving scientists' ability to predict and respond to HABs.^{14-17,29-32}



Advancing Education: Collaborating with federal agencies and research societies, OHHC created short courses to train researchers and graduate students to identify and quantify HAB species and microplastics in marine and coastal ecosystems.



Identifying Health Risks: Researchers identified negative effects of HAB toxin exposure on organs and their contributions to various diseases and illnesses.¹⁻¹⁰



Evolving Methods: Scientists created new methods to identify HAB toxins¹¹⁻¹² and assess their impact on ovarian function and fertility.¹³



Assessing Community Health: USC OHHC graduate students created "Community Report Cards" to evaluate ecosystem and human health and guide community decision-making.^{21,33}

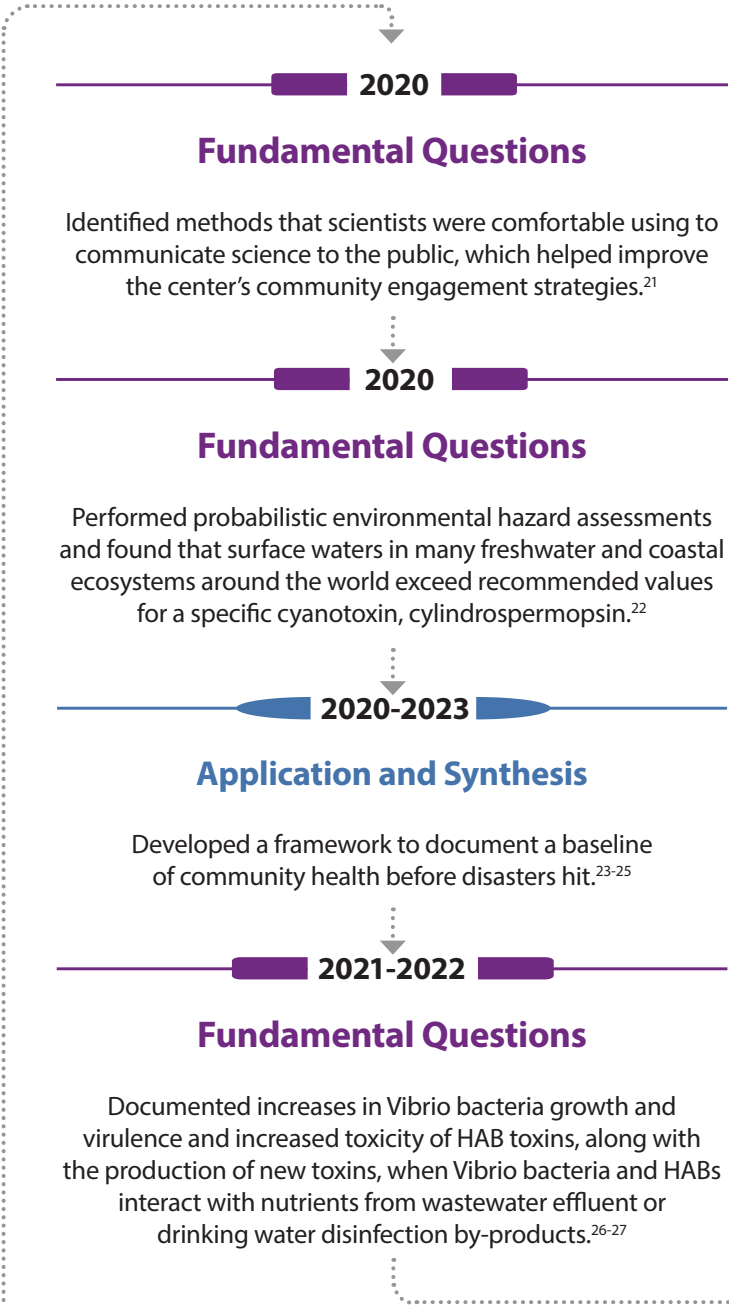
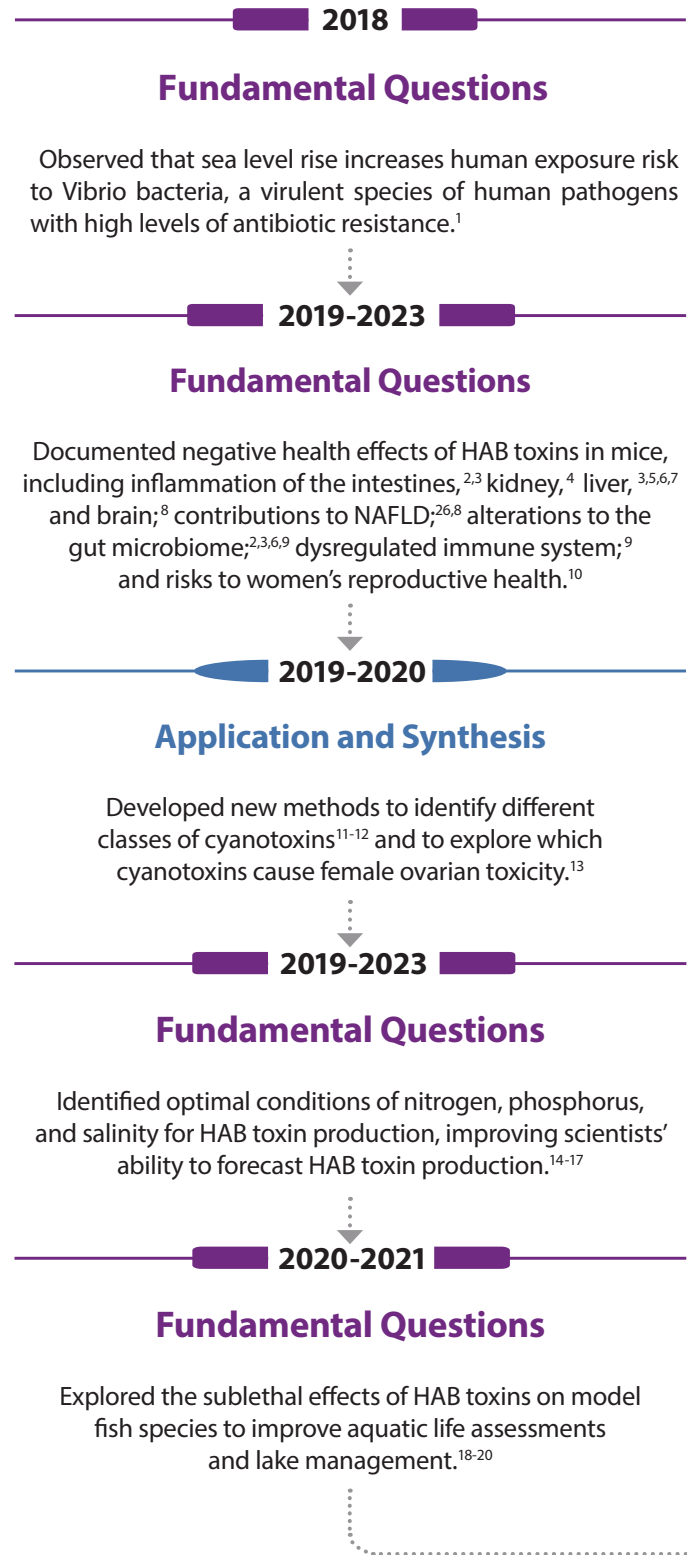
Then and Now

- **Then:** The health effects of HAB toxins, especially their link to obesity, were poorly understood.
- **Now:** HAB toxins were found to harm the intestines,^{2,3} kidneys,⁴ liver,³⁻⁷ and blood-brain barrier.⁸ They contribute to liver diseases,^{2-6,8} gut microbiome changes,^{2-3,6,9} reproductive health risks,^{10,13} and diabetes.⁵
- **Then:** Identifying HAB toxins was complex, typically limited to analyzing one toxin at a time.
- **Now:** USC OHHC researchers developed methods to efficiently identify HAB toxins,¹¹⁻¹² including less-studied ones.
- **Then:** Engaging affected communities in oceans and human health research lacked clear frameworks.
- **Now:** In collaboration with other OHHCs, the team created a framework for community-engaged research,³³ now widely adopted by other oceans and human health researchers.
- **Then:** Oceans and human health university-level teaching in the U.S. relied on an outdated, 16-year-old textbook.
- **Now:** USC OHHC scientists contributed to a new, more comprehensive edition of the textbook,³⁶ which includes practical training for public health and biomedical professionals.



A HAB sample collected and taken back to the lab for analysis. (Photo courtesy of SCHABNet)

Protecting Coastal Communities from Ocean Risks



National Institute of
Environmental Health Sciences

NIEHS supported research for all the milestones highlighted above.

Nutrient Management for Community Health

USC OHHC researchers partnered with Water Watch, a citizen science group, to monitor nutrients flowing into Lake Wateree. The collaboration supported efforts from the South Carolina Department of Health and Environmental Control (SCDHEC) to develop long-term nutrient reduction plans for the Catawba Watershed in South Carolina.

After residents around Lake Wateree raised concerns about increased HABs throughout the lake in 2018, USC OHHC and collaborators mapped the extent of blooms and determined that two-thirds of the shoreline was covered in toxic algae. They also studied the algae's toxicity. With the help of citizen scientists, researchers concluded that excess phosphorus pollution from development in Charlotte, North Carolina, was contributing to the HAB growth. This community-engaged research informed a water quality management plan for the Catawba River, led by the SCDHEC, Catawba Riverkeeper, Water Watch, and Duke Energy.

Scientists also worked with SCDHEC to help develop and implement SCHABNet, a web portal that provides information about HABs to South Carolina residents. Water Watch and other community organizations used SCHABNet to collaborate with state agencies in developing nutrient reduction plans for the watershed.

Ensuring Community Representation in City Planning

Coastal communities have an increased risk of exposure to health risks associated with rising sea levels and storm surges. To help mitigate those risks, the City of Charleston, South Carolina, proposed building a seawall near the Rosemont neighborhood.

Rosemont residents had concerns about what unintended consequences may result from the construction of the seawall. USC OHHC researchers interviewed residents and published a story map documenting those concerns. According to the team, the story map led the City of Charleston to invite the Rosemont community into their resiliency planning efforts.

"This was the first time that this community was included in these discussions," said Sandifer. "This is the result of building trust and responding to the needs of the community."



Community members walk through the Rosemont neighborhood with state and Tribal agency representatives. (Photo courtesy of Paul Sandifer)

OHHC Outreach



A HAB occurs in a residential neighborhood. (Photo courtesy of SCHABNet)

The following outreach products help advance USC OHHC researchers' goals of ensuring communities understand the relationship between oceans and human health:

[Macroplastics in South Carolina Waters: Connecting the Midlands to the Coast](#) is a documentary aimed at educating communities about the persistence and risks of plastics in the environment.

[CheckMyBeach](#) is a web-based information portal that provides beach safety tips, like predicting tides and flooding, spotting signs of HABs, or escaping rip currents, for tourists and locals.

[How's My SC River](#) is an app providing access to bacterial levels in popular recreational waters in the Midlands region of South Carolina.

[SCHABNet](#) is a web portal, operated by SCDHEC, that provides information about HABs to South Carolina residents, farmers, drinking water utilities, stormwater pond owners, public health professionals, and veterinarians.

"In the coastal zone, we have five times more people per land area and five times more water and air pollution per land area than the inland U.S.," said Scott. "The interactive effects of marine threats influence coastal ecosystem health and can adversely affect coastal residents' recreation and seafood consumption. We need Oceans and Human Health Centers to protect public health in coastal communities."

Challenges and Lessons Learned

Challenge: Exploring overlaps in findings from different projects is difficult, especially when projects are not designed to answer those questions.

Lesson: Building an adaptable and resourceful research team means experiments can be redesigned to explore novel findings and push the envelope, expanding the field's knowledge of how oceans influence human health.

Challenge: Some communities have had poor interactions with researchers and governments in the past.

Lesson: Taking the time to build relationships with communities and allowing them to reveal their own needs to researchers helps ensure that communities are both actively engaged and well represented in the co-production of knowledge.