

Harmful Algal Bloom Task Force
Consensus Document #1:

Initial Recommendations Regarding Red Tide (*Karenia brevis*) Blooms



JANUARY 2020

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On the Cover

Aerial view of red tide from the 2017-2019 bloom.

(Mote Marine Laboratory Manatee Research Program)

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JANUARY 2020

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Aerial view of red tide from the 2017-2019 bloom. (FWC)

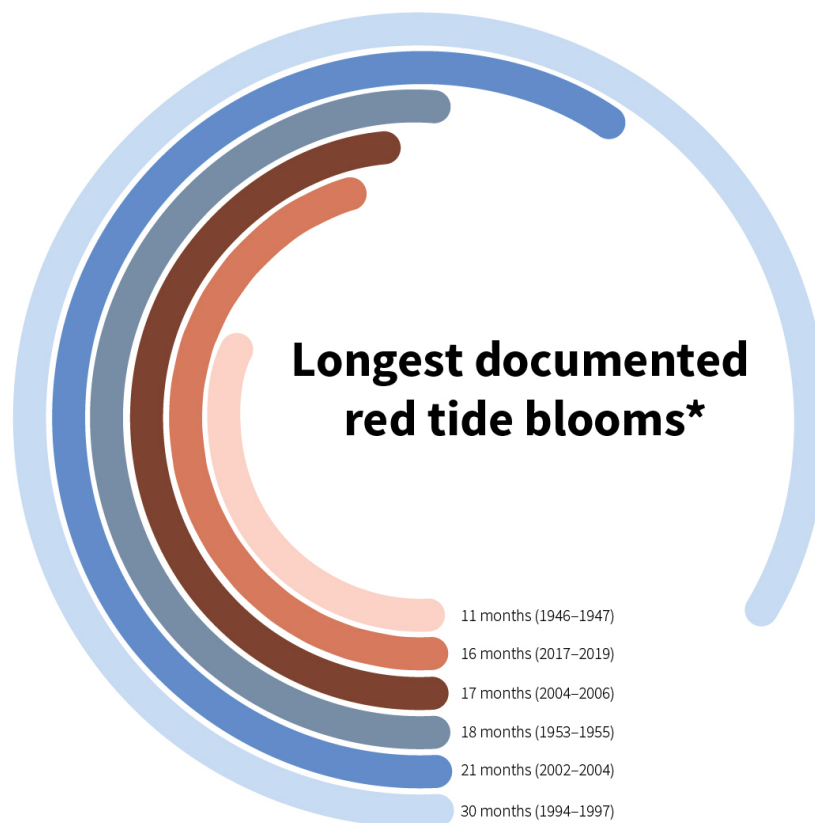
Background

The Harmful Algal Bloom (HAB) Task Force was established in 1999 (section 379.2271, F.S.). This task force was charged with assessing needs and making recommendations for strategies to research, monitor, detect, mitigate, and control HABs in Florida waters. The original HAB Task Force identified and recommended actions targeting six major issues related to HABs in Florida: red tide, toxic cyanobacteria in fresh/estuarine waters, harmful microalgae, macroalgae, *Pfiesteria*-like species, and Ciguatera.¹ Each type of HAB was reviewed from five perspectives: background information, resource impacts, public health impacts, economic impacts, and recommendations

for action. From 1999–2002, priority actions recommended by the HAB Task Force were funded through the Florida Fish and Wildlife Conservation Commission’s Fish and Wildlife Research Institute (FWC-FWRI). The funding supported investigations of economic impacts; methods to enhance monitoring and detection; and threats to human, animal and ecosystem health. Since 2002, various funding sources have supported initiatives that address priorities identified by the HAB Task Force, and cooperative work on issues related to red tide and other HABs has continued via the partnerships and networks established by this task force.

Despite past and ongoing efforts, red tide events and other HABs continue to degrade Florida's waters and harm its economy. Beginning in November 2017 and ending in February 2019, Florida experienced a *Karenia brevis* bloom of national and historical significance. This red tide generated negative impacts on the economy, wildlife, water quality, natural resources, and public health. Tourism, aquaculture, fisheries, and many coastal businesses suffered. The severe red tide affected both the Gulf and Atlantic coasts and several inland waterways. This 16-month bloom was among the longest events documented in the state's history, and it directly impacted 22 counties.

**Beginning in
November 2017 and
ending in February 2019,
Florida experienced a
Karenia brevis bloom of
national and historical
significance.**



*based on samples containing > 100,000 *Karenia brevis* cells/liter and the best available information on the duration of such concentrations. (FWC)

At the peak of the bloom, more than 400 miles of coastline were affected, with the bloom spanning thousands of square miles. To protect the public from consuming shellfish affected by toxins from the red tide (brevetoxins), state-managed aquaculture leases were closed for harvest in critically affected areas off southwest Florida from November 2017 until five months after the bloom dissipated, which is one example of long-term economic impacts that persist after blooms subside. In addition, people were exposed to aerosolized brevetoxins produced

by the red tide, with numerous reports of respiratory irritation during the most severe period in 2018 and uncertain long-term effects. During the red tide, there also were extensive fish kills of more than 100 species, large-scale mortalities of sea turtles and manatees, and an unusual mortality event for bottlenose dolphins. Overall, a review of this major event and multiple years of new data will be needed to evaluate the economic, public health, and ecological impacts of this event, including the time required for recovery.



A collection of large fish carcasses, including goliath grouper, recovered during the 2017-2019 red tide bloom. (FWC)



Governor Ron DeSantis announces appointments to the Red Tide Task Force on August 2, 2019. (Governor's Press Office)

Florida Responds

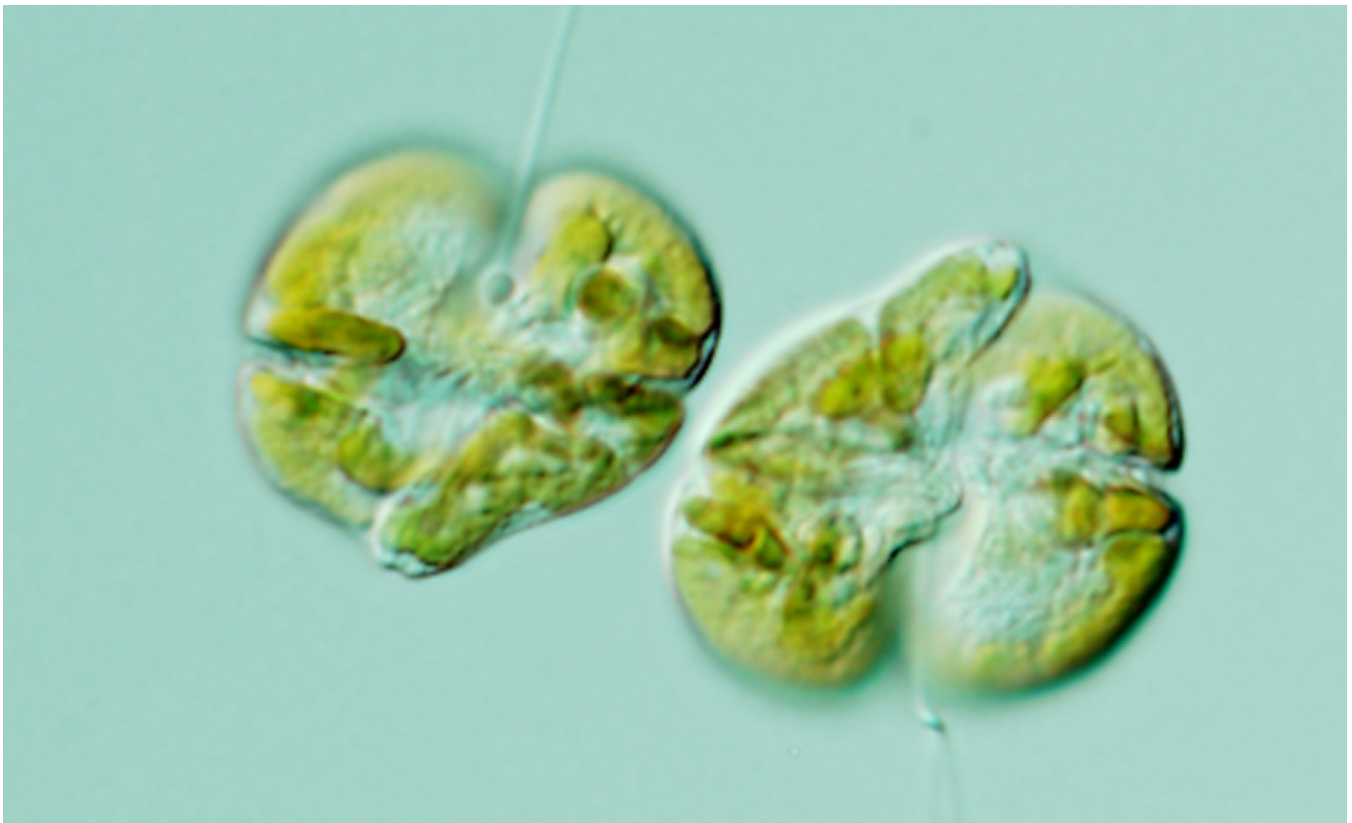
In response to the major red tide, a co-occurring blue-green algal bloom that impacted Lake Okeechobee and associated rivers and estuaries to the east and west, a hypoxic/anoxic event offshore of the greater Charlotte Harbor area, and additional HABs in other parts of Florida, the state has initiated and funded several significant actions. In January 2019, Governor Ron DeSantis issued Executive Order 19-12. The order established a Blue-Green Algae Task Force coordinated by Florida Department of Environmental Protection (DEP), which is working to reduce blue-green algal blooms. The order also directed state agencies to participate in a re-established FWC-FWRI HAB Task Force that initially will provide technical expertise and assistance for studying causes

and impacts of red tide, including effects on human health. In addition, Senate Bill 1552, signed into law in June 2019 (Chapter 2019-114, FS), established the Red Tide Mitigation and Technology Development Initiative coordinated by Mote Marine Laboratory that will lead the development of innovative technologies and approaches to address the control and mitigation of red tide and its impacts.

In August 2019, FWC-FWRI reconvened the HAB Task Force. Focusing on coastal and marine HABs, the HAB Task Force will work closely with the Blue-Green Algae Task Force and the Red Tide Mitigation and Technology Development Initiative to advance strategies to decrease the impacts of HABs in Florida.

Consistent with the Governor’s direction, the HAB Task Force has adopted an initial short-term, top-priority focus on some key issues associated with red tides caused by *Karenia brevis*.

This initial focus will be expanded in future years to include other issues associated with red tide and additional HAB species and relevant issues. The HAB Task Force has convened four times to conduct an initial review of current policies, management responses, and research. The HAB Task Force identified information gaps and priority needs related to *K. brevis* in the areas of public health, communications, management and response, and research. This effort was assisted, in part, by the comprehensive review and assessment of our current scientific knowledge of red tide that arose from the Florida Harmful Algal Bloom State of the Science Symposium hosted by Florida Sea Grant in August 2019.²



Karenia brevis (light micrograph). (FWC)



Public Health

The effects of acute and chronic exposure to red tide toxins on human health need to be understood more fully.

Karenia brevis produces neurotoxins (brevetoxins) that can affect the health of both wildlife and people. For people, brevetoxins can cause respiratory irritation or illness if inhaled or neurotoxic shellfish poisoning if contaminated seafood is eaten. The HAB Task Force considered impacts of red tide and brevetoxins on public health by reviewing information gaps and research needs related to risks from exposure to toxins and impacts on quality of life.

Information Gaps and Priority Needs

There is insufficient knowledge regarding short-term and long-term effects on human health from exposure to red tide and brevetoxins, including the associated economic consequences. Needs include assessing effects from acute exposure to toxins via inhalation, ingestion of seafood, and direct contact with skin or mucous membranes; effects from chronic, low-level exposures; risks for more susceptible subpopulations (e.g., elderly, children, immunocompromised individuals, or those exposed via their occupations); and effects on mental and social health.



A Sarasota lifeguard wears a gas mask during 2017-2019 red tide bloom to reduce the effects of aerosolized toxins.

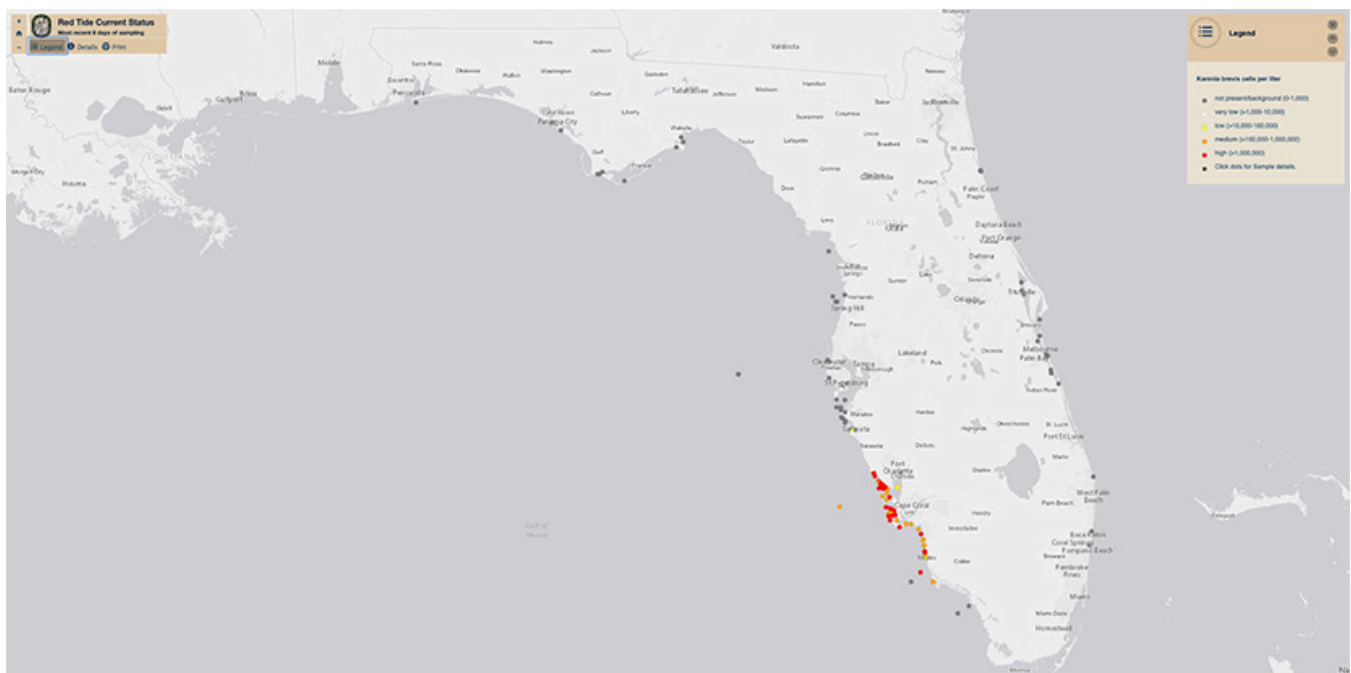
(Eve Edelheit/The Washington Post)



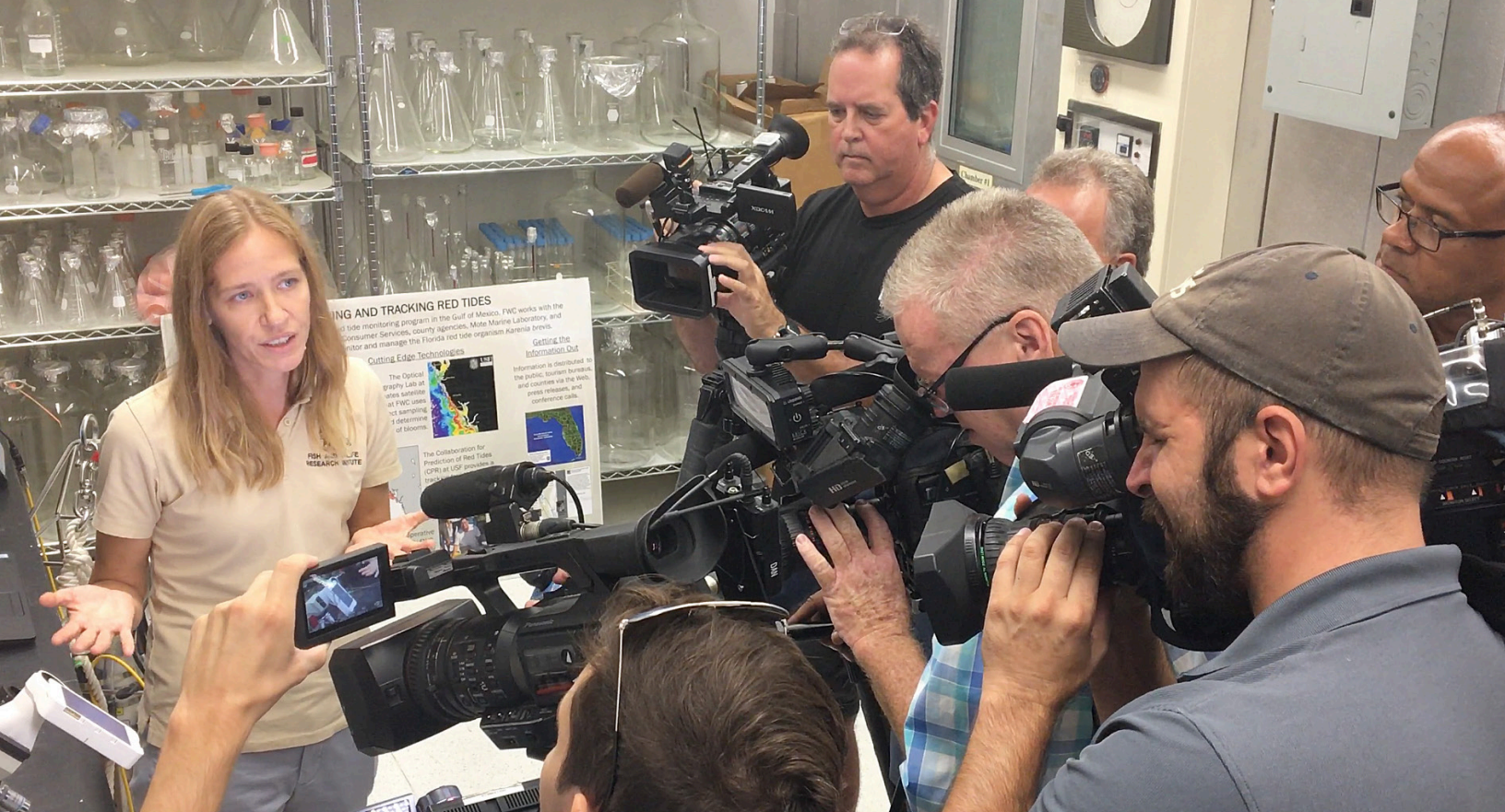
Communications

A statewide communication strategy needs to be created and implemented.

Effective communication is critical to ensuring public safety, transparency, and accountability. Communication with the public conveys information, raises awareness, educates people about strategies to reduce exposure to and impacts from red tides, and documents actions and their results to ensure transparency and accountability. Interagency communications related to red tide focus on management and responses, from the local to state levels, and they vary depending on the locations, durations, and impacts of events. Communications are also an important function of academic and research institutions, local news outlets, and non-governmental organizations. The HAB Task Force discussed current levels of integration, resources needed for improved outreach, and the status of current monitoring and surveillance systems.



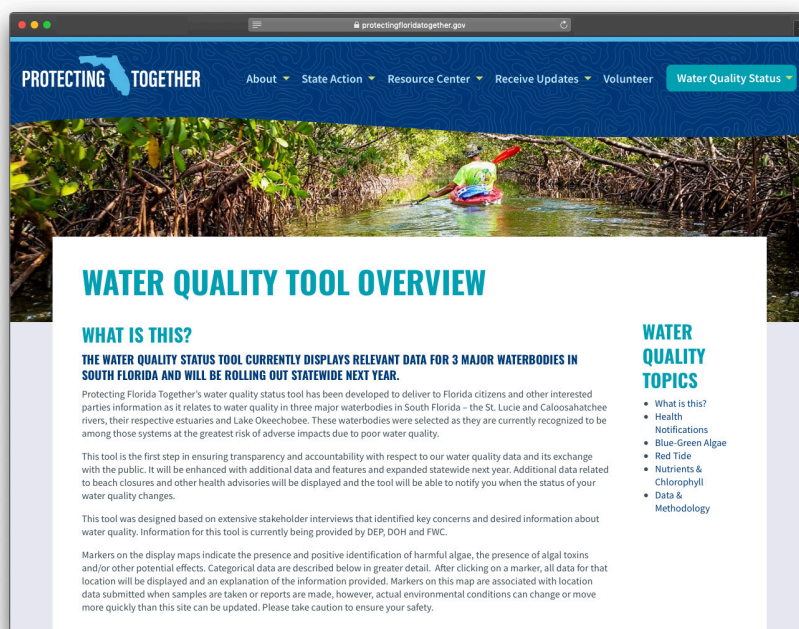
FWC-FWRI publishes a daily map of the last eight days of water sampling for presence of red tide. (FWC)



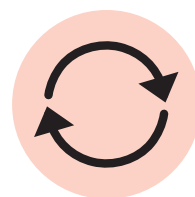
FWC-FWRI scientist Kate Hubbard speaks to the press during the 2017-2019 red tide bloom. (FWC)

Information Gaps and Priority Needs

The HAB Task Force identified a need to develop a statewide communication strategy to inform all relevant stakeholders because effective communication can serve as an effective mitigation strategy and safeguard public health. The strategy should comprise short-term responses to events and a long-term educational campaign, with both approaches using multi-lingual and multi-modal outreach materials. The HAB Task Force also discussed the need to evaluate the current status of monitoring and reporting on coastal water quality in Florida to ensure that potential human health risks are communicated to affected communities in an effective and timely manner, which should include building on the “Protecting Florida Together” website.³



Governor Ron DeSantis launched the “Protecting Florida Together” comprehensive water quality dashboard in 2019 to keep the public informed about water quality issues.



Management and Response

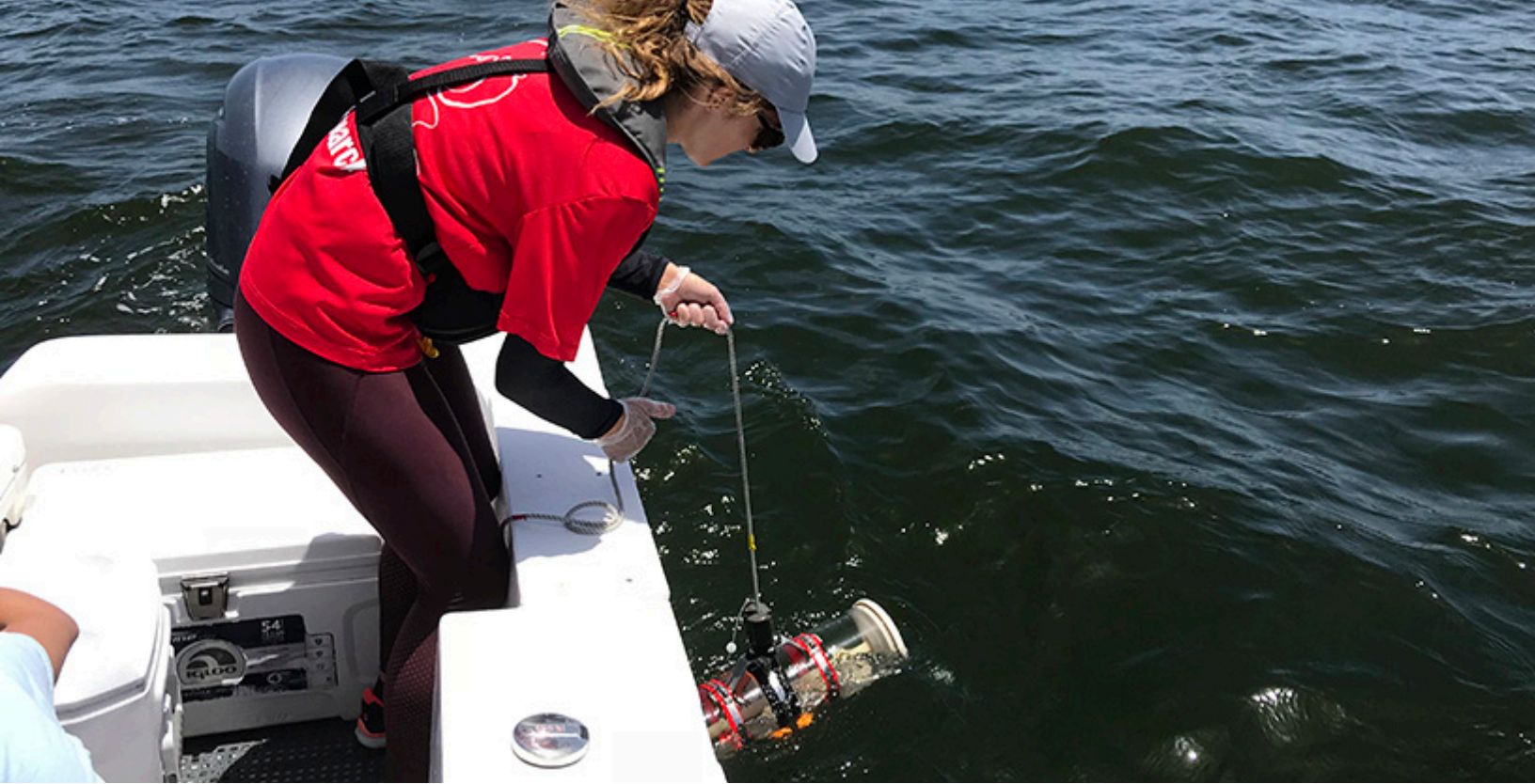
A comprehensive and integrated response plan needs to be developed and implemented.

Management of red tides requires data. The state's current monitoring for red tide includes extensive coastal and limited offshore sampling of water, multiple strategies for detecting red tides, and monitoring and detection of brevetoxins in water and shellfish. There is no routine monitoring for aerosolized toxins. The HAB Task Force considered the importance, current status, and future needs associated with monitoring *K. brevis* and responding to blooms.

Scientists at the USF College of Marine Science with FWC-FWRI deploy gliders in the Gulf of Mexico to measure different water properties that are proxies for red tide.

(USF College of Marine Science)





Water samples are collected as part of red tide event response monitoring in the Gulf of Mexico. (FWC)

Information Gaps and Priority Needs

A comprehensive statewide plan for integrated responses to red tides and their impacts needs to be created and implemented at multiple levels of government. A number of scientific and technological advances have enhanced real-time, automated detection of HABs and HAB toxins. The HAB Task Force concluded that progress depends on augmenting existing monitoring, identifying effective technologies that can be scaled appropriately, incorporating them into automated or semi-automated monitoring, and establishing standard protocols for analysis of the resulting data. An automated system should include land-based sensors for aerosolized toxins.

The state has made significant investments in developing strategies to control blooms or mitigate their impacts by establishing

and funding the Red Tide Mitigation and Technology Development Initiative and the Department of Environmental Protection's Harmful Algal Bloom Innovative Technology Grant Program. The HAB Task Force identified a concomitant need to streamline permitting that facilitates and guides entities seeking to test or implement control and mitigation technologies or approaches, including during emergency responses. The HAB Task Force recognizes that time is of the essence once a bloom begins and emergency responses are contemplated. Mitigation technologies should be evaluated and approved before they are implemented. At a minimum, interventions must be effective, efficient, scalable, and compliant.



Research

Influences on the dynamics of blooms need to be clarified, and viable ways to mitigate and control blooms need to be tested and validated.

As our scientific understanding of red tides continues to improve, insights should be applied to management and communication in a variety of ways. Improving our understanding of bloom dynamics, enhancing methods for predicting and forecasting blooms, and identifying practical and acceptable ways to control blooms would allow managers to make better-informed decisions and develop more effective responses. The HAB Task Force assessed the current state of knowledge for *K. brevis* to identify information gaps and focus on high-level, priority needs that would result in improvements to management tools and options. Research priorities were considered in four key areas: initiation, development, and termination; detection and monitoring; modelling and prediction; and mitigation and control.



Microscopy is used to examine water samples for the presence of red tide. (FWC)

Information Gaps and Priority Needs

Despite advances in our knowledge over the last few decades, additional progress in predicting red tides or mitigating their impacts requires a better understanding of the factors initiating *K. brevis* blooms (both geographically and temporally), the underlying mechanisms that influence bloom expansion and termination, the role of various nutrient sources in supporting blooms, and the effects of environmental factors (biological, chemical, and physical) on bloom termination. Understanding how climate change, major storms, and other global-scale impacts (e.g., dust in the Saharan air layer) affect red tides is critically important to inform predictive models and guide responses to blooms.

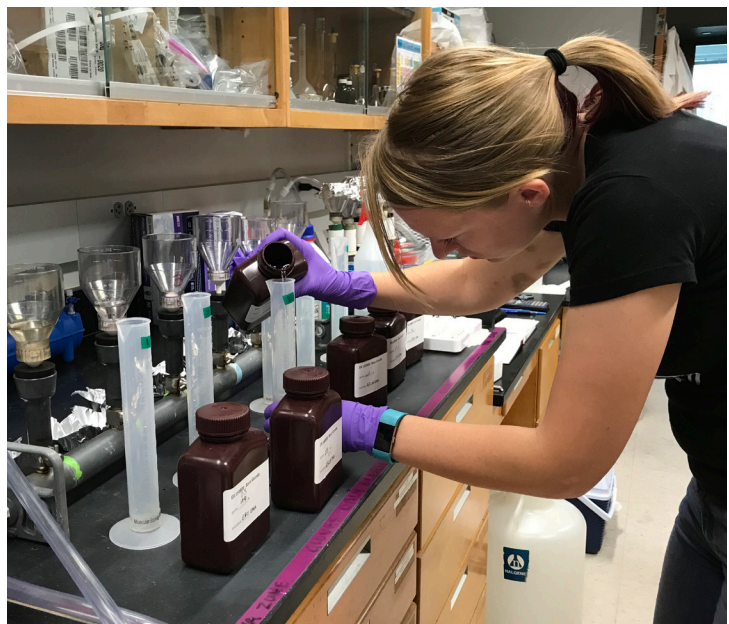
The HAB Task Force agreed that sustained, broadscale, cross-shelf (coastal and offshore) surveys incorporating multi-parameter observations (measurements in both water and air) are required to generate the data needed to address these information gaps. For example, repeated subsurface samples at multiple depths in coastal and offshore waters are crucial for calibrating and validating models.

Available predictive models for red tides rely on winds, currents, and concentrations of *K. brevis* cells to generate short-term (3–5 day) predictions of bloom movement and air quality conditions. The HAB Task Force

acknowledges that a broader suite of models that incorporates more variables is needed to support more accurate seasonal and short-term predictions. Models should address multiple stakeholder concerns, including onshore and inland transport of red tide toxins in the air, bloom dynamics and transport, and the influence of both coastal and offshore nutrient sources on red tides. The models also need to assimilate data from in situ instruments that detect HAB cells and toxins on a near real-time basis, much as meteorological stations and instruments are used to improve the accuracy of weather forecasts.

Equal in importance to understanding and predicting the dynamics of blooms and their effects, research into mitigation and control is also needed. Testing of innovative strategies and approaches needs to demonstrate that they are effective, efficient, safe, scalable, and compliant. Investment in bloom control and mitigation will have a high return. The Red Tide Mitigation and Technology Development Initiative is one example of what is needed.

Water samples collected from the Gulf of Mexico are processed as part of monitoring for red tide. (FWC)



HAB Task Force Recommended Actions

Florida's identity, economy and way of life are dependent on the health of our coastal waters. The HAB Task Force recommends that the state embrace a long-term vision and commit to sustained and significant support of multiple complementary and interconnected initiatives to address risks to public health, effective communication, management and response strategies, and research needs. To initiate progress, the HAB Task Force has identified the following actions that should be funded and integrated into a transformational strategy for the State of Florida.

Summary Recommendations



Public Health

We recommend that the state invest in improving our knowledge of the effects of red tide on human health.



Communications

We recommend that the state invest in a long-term strategy to improve communication and education about red tides and continue the ongoing effort to improve public access to data on HABs and water quality through a centralized, web-based portal.



Management and Response

We recommend that the state develop a comprehensive and integrated red tide response plan, facilitate the development and implementation of technologies that control algal blooms, and create tools to improve estimates of the economic impacts of red tide.



Research

We recommend that the state support enhanced and sustained ocean observations to improve forecasts and expand management options, development of an ensemble of red tide models, creation of technologies for detecting blooms and their impacts in real time, and research into mitigation and control of algal blooms at various spatial scales.



Public Health

We recommend that the state invest in improving our knowledge of the effects of red tide on human health.

The Florida Department of Health (DOH) should identify specific research needs regarding the short-term and long-term health impacts from exposures to brevetoxins (via dermal contact, ingestion, or inhalation) and prioritize research projects and epidemiological studies that address these needs.



DOH, with professional health associations, should develop a more aggressive training program for the state's health care professionals to improve diagnosis and reporting of HAB-related illnesses.



Communications

We recommend that the state invest in a long-term strategy to improve communication and education about red tides and continue the ongoing effort to improve public access to data on HABs and water quality through a centralized, web-based portal.

FWC and DEP, working together with DOH, the Department of Agriculture and Consumer Services (DACs), and other state partners and stakeholders, should establish a working group representing scientists, resource managers, and communication specialists to 1) review current communication and outreach strategies and tools that address red tides; 2) conduct focus groups and social science studies to identify information needed by the public and the most effective models for messaging and dissemination; 3) develop a plan to accurately and appropriately communicate risks, hazards, and other key information to all stakeholders during red tides; 4) create a long-term educational campaign that engenders a better-informed public across all

age groups and demographics; and 5) establish and maintain a repository of shared resources to promote accurate and consistent messaging.



DEP and FWC, along with other partners involved in responses to red tide, should build on the "Protecting Florida Together" water quality dashboard and continue the ongoing effort to provide the public with a single, web-based portal for timely information on the multiple HABs that affect Florida, as well as develop a data portal to be shared among state agencies and partners addressing water quality.





Management and Response

We recommend that the state develop a comprehensive and integrated red tide response plan, facilitate the development and implementation of technologies that control algal blooms, and create tools to improve estimates of the economic impacts of red tide.

FWC and DEP, working together with DOH, DACS, and other state partners and stakeholders, should review current practices and develop a comprehensive, statewide response plan that 1) incorporates a tiered approach for routine and event-driven monitoring; 2) identifies triggers for actions; 3) outlines a coordinated, interagency strategy for communication during emergencies; and 4) includes a best practice guide for local communities that defines roles and responsibilities.



FWC should work with the US IOOS Regional Associations⁴ to design and develop a robust, statewide, integrated coastal and ocean monitoring system that incorporates emerging technologies to expand multiparameter observations with an emphasis on new sensors for HAB cells and toxins in air and water.



DEP should provide clear guidance for developing, testing, and applying technologies for the mitigation or control of algal blooms. Guidelines should outline benchmarks that will streamline permitting and facilitate implementation of effective and efficient projects. This program also should address permitting requirements for large-scale efforts to control blooms, including those that are classed as an emergency or fall outside state waters.



FWC and DEP, working together with DOH, DACS, Department of Economic Opportunity, other partners, and relevant stakeholders, should engage with health and economic specialists to assess and guide development of tools and metrics to estimate the broad economic impacts of red tides from year to year.



Scientists test clay mitigation techniques for red tide.
(Dave Kulis, Woods Hole Oceanographic Institution)



Research

We recommend that the state support enhanced and sustained ocean observations to improve forecasts and expand management options, development of an ensemble of red tide models, creation of technologies for detecting blooms and their impacts in real time, and research into mitigation and control of algal blooms at various spatial scales.

FWC, with existing and new partners, should establish and sustain cross-shelf (coastal and offshore) surveys until our understanding of the factors that initiate red tides and control bloom dynamics is sufficient to develop effective management.



FWC, with existing and new partners, should identify projects that address multiple stakeholder needs by developing a suite of models to better predict short-term (days) and long-term (seasonal) bloom dynamics, onshore and inland transport of brevetoxins in air, and the roles of nutrient inputs and climate change in exacerbating *K. brevis* blooms and their impacts.



FWC, with existing and new partners, should identify projects that will improve or develop and implement capabilities for real-time detection of *K. brevis* in water and brevetoxins in both water and air.



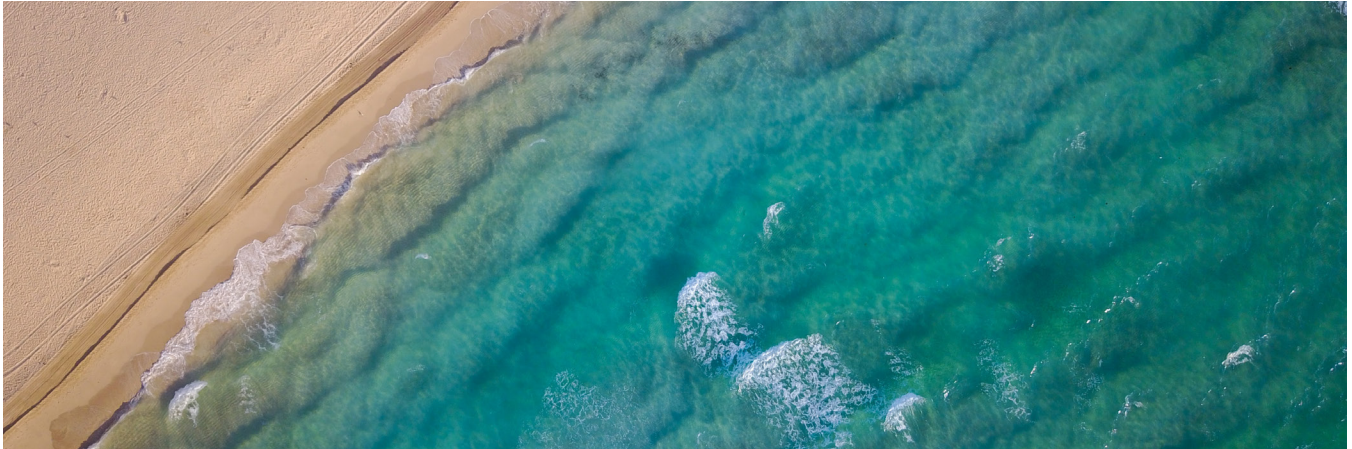
The Red Tide Mitigation and Technology Development Initiative and other partners should receive sustained funding to test strategies and approaches for mitigating and controlling blooms at multiple spatial scales.



The needs and recommended actions presented here are focused on areas most critical to advancing our understanding and management of red tides, and they are not intended to be exhaustive. Going forward, the HAB Task Force will expand discussions to encompass other important gaps in our knowledge related to red tide (e.g., trophic transfer of brevetoxins in aquatic ecosystems and effects on wildlife and domestic animals) and address unique issues posed by other HAB species. In fact, Florida faces threats from many other types of HABs. These include blooms of freshwater and estuarine cyanobacteria (numerous toxic and

non-toxic species), *Aureoumbra lagunensis* (non-toxic “brown tide”), *Pyrodinium bahamense* (a dinoflagellate that can produce saxitoxin and cause paralytic shellfish poisoning), *Pseudo-nitzschia* spp. (marine diatoms capable of producing the neurotoxin domoic acid, which can cause amnesic shellfish poisoning), and a wide range of macroalgal species. The approach of the HAB Task Force aligns well with the work of the Blue Green Algae Task Force. The combined efforts will improve Florida’s ability to respond to, manage, and minimize the harmful effects of a diversity of HABs.

Looking Beyond Challenges to Opportunities



Harmful algal blooms degrade the quality of surface waters, threaten public and ecological health, and impact the economy of the State of Florida and the nation. This threat is likely to grow with increased nutrient enrichment of coastal waters from inadequate and aging wastewater and stormwater infrastructure, an increased human population and more intensive use of land, and the need for increased production of food (agriculture and aquaculture). In addition, climate change and sea level rise will complicate our understanding of coastal risks, resilience, and responses to HABs.

The initial discussions and recommendations of the HAB Task Force are the beginning of a long-term strategic examination of vulnerabilities, adaptations, and responses to HABs. Governor DeSantis' Executive Order 19-12 recognized the critical importance of clean water and healthy ecosystems to Florida's economy and way of life. As the HAB Task Force moves forward with informed discussions and recommendations, it feels strongly that long-term success includes a vision for Florida as a global leader in innovation and technology that will ensure clean water.

Many of the initial recommendations presented here require innovative and entrepreneurial thinking, as well as development and deployment of new technologies. These needs provide fertile opportunities for private-sector innovation, investment, and job creation. This aspirational vision for clean water intersects and complements major industry sectors that drive Florida's economy today (e.g., agriculture, tourism, residential/commercial construction, information technology, marine industries, and even aviation/aerospace). Quality of life is an important consideration for all industry sectors working to attract and retain a highly skilled workforce. Now is the time for catalytic decisions regarding policies and investments that bring together research institutions, regulatory agencies, non-governmental organizations, and private-sector partners to develop innovative and entrepreneurial solutions to HABs and other problems related to water quality in Florida, with those solutions likely to benefit other parts of the United States and the world.

Long-term Focal Areas

The HAB Task Force has adopted broad, long-term focal areas within which it will evaluate existing approaches or knowledge; pinpoint gaps in our efforts or understanding; and build a prioritized portfolio of strategies and actions to fill those gaps by assessing their benefits and feasibility. The HAB Task Force will prioritize and recommend:

- actions to reduce excess loads of nutrients entering our freshwater and coastal systems developed in collaboration with the Blue-Green Algae Task Force, relevant entities identified in Executive Order 19-12, and other stakeholders;
- improvements to current policies and procedures that prevent or mitigate the impacts of harmful algal blooms on public health, ecosystem sustainability, economic viability, and other valued facets of society;
- enhancements to communication, coordination, cooperation, and collaboration among stakeholders charged with responding to harmful algal blooms and their effects; and
- strategic research into the biology and ecology of species creating harmful algal blooms; detection, tracking, modeling, and prediction of blooms; fate of algal toxins; impacts of blooms on valued facets of society; prevention, control and mitigation of blooms; and other key issues.

References

- ¹Steidinger, K.A., Landsberg, J.H., Tomas, C.R., and Burns, J.W. 1999. Harmful algal blooms in Florida. Unpublished technical report to the Florida Harmful Algal Bloom Task Force, Florida Marine Research Institute, 63pp.
- ²Krimsky, L., E. Staugler, L. Flewelling, A. Reich, B. Rosen, R. Stumpf and D. Whiting. 2020. State of the Science for Harmful Algal Blooms in Florida: *Karenia brevis* and *Microcystis* spp., Produced from the Florida State of the Science Harmful Algal Bloom Symposium, August 2019. SGR 136. Florida Sea Grant College Program, Gainesville, FL.
- ³<https://protectingfloridatogether.gov/>
- ⁴Nowlin, W., Jochens, A., and Kirkpatrick, B. 2015. The Gulf of Mexico Coastal Ocean Observing System, Harmful Algal Bloom Integrated Observing System (HABIOS) plan, https://gcoos.org/wp-content/uploads/2020/01/HABIOS-Plan_final_9_3_15.pdf

HAB Task Force Members 2019-2020



Leanne Flewelling, Chair

Florida Fish and Wildlife Conservation Commission,
Fish and Wildlife Research Institute



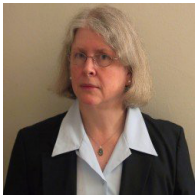
Donald Anderson

Woods Hole
Oceanographic Institution



Duane De Freese

Indian River Lagoon Council/Indian
River Lagoon National Estuary
Program



Quay Dortch

National Oceanic and
Atmospheric Administration



Jill Fleiger

Florida Department of Agriculture
and Consumer Services



Charles Jacoby

St. Johns River Water
Management District



Barbara Kirkpatrick

Gulf of Mexico Coastal
Ocean Observing System



Sherry Larkin

University of Florida



Andrew Reich

Florida Department
of Health



Rhonda Watkins

Collier County



David Whiting

Florida Department of
Environmental Protection

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