WRITTEN STATEMENT FOR THE RECORD OF
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

HEARING ON "HARMFUL ALGAL BLOOMS: THE IMPACT ON OUR NATION'S WATERS"

BEFORE THE
SUBCOMMITTEE ON OCEANS, ATMOSPHERE, FISHERIES, AND COAST GUARD
SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

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Introduction

Chairman Sullivan, Ranking Member Baldwin, and members of the Subcommittee, the Department of Commerce and the National Oceanic and Atmospheric Administration (NOAA) appreciates the opportunity to provide this statement for the record on the issue of harmful algal blooms (HABs) in the United States. NOAA is the lead federal agency on the topic of HABs in our coastal waters and the Great Lakes (the Environmental Protection Agency (EPA) shares jurisdiction of the Great Lakes). This statement provides the Subcommittee with scientific information on HABs and their impacts to humans, animals, and the economy and describes some of the advances NOAA has made to improving HAB research, monitoring, forecasting, and management.

HABs occur when colonies of algae or cyanobacteria—simple photosynthetic organisms that live in marine, estuarine, and freshwater environments —grow out of control and some can produce harmful toxins. HABs occur naturally, but human activities that disturb ecosystems seem to play a role in their more frequent occurrence and intensity. Increased nutrient loadings and pollution, food web alterations, introduced species, water flow modifications and temperature all play a role.

These toxic blooms have a variety of harmful effects on people, fish, shellfish, marine mammals, sea turtles, and birds. The human illnesses caused by HABs can be debilitating or even fatal. HABs harm ecosystems by smothering valuable habitats such as coral reefs and seagrass beds, piling up on beaches, or by growing to such proportions that their subsequent decomposition depletes oxygen in the water (i.e., hypoxia), killing fish, shellfish, and aquatic vegetation. HABs have been reported in every U.S. coastal state, and their occurrence is on the rise. HABs are a national concern because they negatively affect not only the health of people and marine ecosystems, but also the health of local and regional economies.

In recognition of the magnitude and impact of the issue, Congress passed the Harmful Algal Bloom and Hypoxia Research and Control Act (HABHRCA) in 1998 and most recently reauthorized the Act in 2014. HABHRCA designates NOAA as the lead federal agency

responsible for advancing our country's ability to detect, monitor, assess, and forecast HAB and hypoxia events in coastal marine waters. NOAA and the Environmental Protection Agency share jurisdiction for the Great Lakes, and EPA has jurisdiction over activities that occur in non-Great Lakes freshwater areas. NOAA supports EPA and other federal agencies in addressing freshwater HABs outside the Great Lakes. For example, we are currently providing and processing the European Space Agency's Sentinel- 3A Ocean Land Color Instrument (OLCI) satellite imagery of cyanobacteria in Lake Okeechobee in Florida. The U.S. Army Corps of Engineers (USACE), United States Geological Survey (USGS), EPA, and state partners use this data to determine where to monitor HABs.

NOAA's Approach

NOAA's role is in understanding, detecting, monitoring, and forecasting HABs, and in helping communities with decision-making related to their prevention, control, and mitigation. NOAA's HAB programs are national in scope but targeted to different regional needs. Competitive research that Congress appropriated funding for in FY 2018 and in previous years have complemented NOAA's internal research on HABs.

Partnerships with state managers, academics, and citizen scientists also bring a wealth of expertise to our HAB programs. For example, the Phytoplankton Monitoring Network engages citizen scientists in the Great Lakes and Alaska in monitoring for HABs. Through this program, we have alerted managers to previously undetected toxins in commercial shellfish beds.

Coordination and collaboration between programs within NOAA and other federal agencies ensures broad engagement and efficient use of resources in addressing complex HAB issues. The Cyanobacteria Assessment Network (CyAN) project is a National Aeronautics and Space Administration (NASA)-funded collaboration between NOAA, EPA, and the U.S. Geological Survey (USGS) to produce a real-time satellite surveillance of harmful algal blooms in freshwater lakes and reservoirs. These data products currently support states in assessing blooms and in determining where sampling is most needed.

Research

NOAA research advances our understanding of what causes and sustains HABs and their toxins, and uses that understanding to develop forecasts, prevention strategies, and other tools. Current research priorities include studying how toxins are transferred across and up the food chain and assessing the impacts of toxins on humans. NOAA also conducts socioeconomic research to assess impacts of HAB events on coastal economies, and on the costs and benefits of mitigation strategies to aid managers in devising cost-effective management strategies. Research results guide management of coastal resources to reduce HAB development, impacts, and future threats, and will feed into other HAB programs for development of tools to improve management and response.

Monitoring and Detection

NOAA enhances HAB and toxin detection and monitoring by developing fast, accurate and cost-effective identification protocols. NOAA's recent advances in automated and field-ready capabilities that can be deployed remotely or on small boats enable rapid HAB detection and monitoring. Sensors can also be added to ocean observing systems, such as underwater gliders,

for long-term monitoring of HABs. Early warning of HABs or toxins provides health officials, environmental managers, and water treatment facility operators with information to guide potential beach and shellfish bed closures or water treatment in a more appropriate timeframe.

We also build capacity within states, tribes, the seafood industry, and others, by providing access and training on proven detection technologies. This ensures that trained and equipped personnel are able to mobilize quickly during HAB events. For example, in May 2018, NOAA and partner scientists from the Phytoplankton Monitoring Network trained over thirty environmental personnel from southeast and south central Alaskan tribes in toxic phytoplankton sampling and identification.

Forecasting

NOAA's HAB forecasts serve as decision-support tools for local coastal resource managers, public health officials, and research scientists. We provide operational HAB forecasts for Lake Erie, Texas, and Florida, and are developing forecasts for the Pacific Northwest, the Gulf of Maine, and California. Short-term (twice weekly) forecasts identify which blooms are potentially harmful, where they are, how big they are, and where they are likely headed. Our HAB forecasts for the Gulf of Mexico also include information on the potential for respiratory irritation that is delivered directly to the public. Longer-term, seasonal forecasts predict the severity of HABs for the bloom season in a particular region.

NOAA is improving the spatial resolution of our monitoring and forecasts with increased use of space-based data from NOAA's Joint Polar Satellite System and leveraging European Sentinel and Metop satellite data. NOAA's National Centers for Environmental Information also provides data for retrospective analysis of past HAB events to improve future detection and response efforts.

Event Response

NOAA responds to HAB events by coordinating access to technology and expertise and ensuring proper scientific documentation to advance understanding of HABs. In some circumstances, NOAA is also able to provide financial support to defray event response costs, such as mobilization of sampling, supplies, and analytical services. For example, in August 2018, NOAA provided financial support to the Florida Fish and Wildlife Institute and Mote Marine Lab to help manage the response to a rare HAB event in Sitka, Alaska and a prolonged, severe HAB event in Southwest Florida.

Prevention, Control, and Mitigation

Over more than two decades, NOAA has produced methods and strategies to improve HAB management and response. These include toxicity test kits; technology for high volume and field-based HAB detection; and HAB forecasts. We also have funded and conduct research to move promising preventions and mitigation technologies for HABs from research to operations.

Impacts of Harmful Algal Blooms

Health Impacts

Some harmful algae produce potent toxins that cause illness or death in humans and wildlife. Both humans and animals can be exposed to algal toxins through the food they eat, the water

they drink or swim in, or the air that they breathe. Toxic algae can contribute to symptoms in humans such as digestive and respiratory complications. Acute health effects associated with marine pathogens and HAB toxins costs approximately $900 million[1] annually.

Additionally, HABs have been implicated in the deaths of many marine mammals, sea turtles, and the prey they eat. The most common impacts from algal toxins on marine mammals and sea turtles are neurological symptoms such as seizures, disorientation, or death. In addition to immediate death, algal toxins have caused long-term impacts when prey is depleted, and the animals suffer malnutrition. Persistent red tides in Atlantic and Gulf waters have caused significant sea turtle and dolphin deaths numbering in the hundreds to thousands of animals.

Other harmful algae are nontoxic to humans and wildlife but form such large blooms that they can be a nuisance to humans as well as degrade habitat quality through massive overgrowth, shading, or oxygen depletion (hypoxia).

Economic Impacts

The impact of a bloom depends on its location, duration, and toxicity. Since HABRHCA was last authorized in 2014, record-setting HABs on both coasts and the Great Lakes have had severe impacts to the seafood industry, tourism, drinking water, and property values.

2014 Great Lakes Cyanobacteria Bloom

In 2014, Toledo, Ohio, officials issued a two-day ban on drinking or cooking with tap water for more than 400,000 residents due to high levels of toxins harmful to humans resulting from a massive toxic algae bloom on western Lake Erie. Testing for the microcystin toxin and removing it from the water is expensive and time-consuming. As a result of the early and large HAB of 2015, the City of Toledo spent their $6 million water treatment budget at the beginning of the fiscal year and required an additional $3 million for the remainder of the fiscal year that were borne by non-federal entities. Beyond drinking water, the bloom affected fishing, tourism, and property values. The total impact of ecosystem service interruptions due to the 2014 HAB event was estimated at $65 million.[2]

2015 West Coast HAB

In 2015, the largest HAB in at least 15 years stretched from central California to British Columbia and the Alaska Peninsula. Record-setting concentrations of domoic acid produced by the HAB event in California, Oregon, and Washington caused marine mammal deaths and devastated commercial and recreational fisheries. The commercial Dungeness crab fishery experienced a $97.5 million[3] decrease in revenue from 2014 to 2015. This generated an economic shock for fishery-dependent communities along the West Coast; the Dungeness crab fishery generates the highest revenues and has the highest vessel participation of any fishery on

[1] R., P.Kite-Powell, E., H., & A. (2011, December 01). An estimate of the cost of acute health effects from food- and water-borne marine pathogens and toxins in the USA. Retrieved from https://iwaponline.com/jwh/article/9/4/680/31135/An-estimate-of-the-cost-of-acute-health-effects

[2] "Economic Benefits of Reducing Harmful Algal Blooms in Lake Erie", M. Bingham, S. K. Sinha, and F. Lupi, Environmental Consulting & Technology, Inc., Report, 66 pp, October 2015.

[3] National Marine Fisheries Service (2017) Fisheries of the United States, 2016. U.S. Department of Commerce, NOAA Current Fishery Statistics No. 2016.

the West Coast[4]. The 2015 event also resulted in the closure of recreational, commercial and subsistence razor clam fisheries in Washington, Oregon and California. The recreational razor clam fishery generates significant tourism-related income associated with clam digger visits to coastal communities, particularly in Washington and northern Oregon. A season-long closure of the recreational razor clam fishery is estimated to result in $24.4 million[5] in lost expenditures (2008 dollars).

2018 Florida Red Tide

When blooms are in the news and affecting shorelines, fewer people come to Florida's beaches, restaurants, and hotels. A study of HAB impacts in Okaloosa County (on Florida's Gulf Coast) estimated that the approximately $6.5 million[6] per month in losses to restaurants and hotels during blooms is seven times greater than monthly losses due to adverse weather. On August 13, 2018, in recognition of the scale of the impact to Florida's coastal communities and economies, Governor Rick Scott declared a state of emergency in seven counties stretching from Tampa Bay south to the fringe of the Everglades.

Success Stories

NOAA has a long record of accomplishments since the passage of HABHRCA in 1998, including improved HAB monitoring and detection capabilities, identification of methods to prevent the development of blooms, and forecasts to provide more efficient and comprehensive ways of assisting state managers and warning the public of potential exposure. Below we highlight several success stories on collaboration with our partners.

HAB Detection Technology Increases Seafood Exports in Alaska

A HAB toxin testing method developed by NOAA facilitates the continued export of Alaskan geoducks to China, by increasing the speed and lowering the cost of testing shellfish exports for the Paralytic Shellfish Poisoning (PSP) toxin. In 2014, China temporarily closed the $68 million geoduck export industry, stipulating that all shellfish imports had to be tested for Paralytic Shellfish Poisoning (PSP) toxin. At the time, testing took a week and cost $400 per clam. By the time divers received the test result, they often had only one day to harvest before new tests were needed. NOAA developed a faster and cheaper PSP testing method that is now used by the Sitka Tribe of Alaska to test locally harvested shellfish in their Environmental Research Lab.

Maintaining Safe Drinking Water for Lake Erie

More than 2,000 U.S. and Canadian subscribers receive NOAA's twice-weekly HAB bulletins with three- to five-day forecasts that include the bloom location and concentration. In 2015, water managers used NOAA's forecasts to strategically increase treatment and fill cisterns with safe water before the blooms reached intake pipes. Thus, drinking water was safe despite the most severe Lake Erie bloom on record. In 2018, the Sentinel-3A OLCI satellite is providing

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[4] Fuller, E. M. Samhouri, J. F. Stoll, J. S. Levin, S. A. and Watson, J. R. Characterizing fisheries connectivity in marine social–ecological systems. – ICES Journal of Marine Science, doi:10.1093/icesjms/fsx128.

[5] Karen Dyson, Daniel D. Huppert, Regional economic impacts of razor clam beach closures due to harmful algal blooms (HABs) on the Pacific coast of Washington, Harmful Algae, Volume 9, Issue 3, 2010, Pages 264-271

[6] Larkin, S., C.M Adams, Ballyram, D. Mulkey, A. Hodges. "Red Tides and Coastal Business: Measuring Economic Consequences in Florida." Working paper, Food and Resource Economics Department, University of Florida, Gainesville, FL (21 pp.), 2003.

images with a 300-meter resolution, allowing water treatment facility and public safety managers to make decisions at the scale of water intakes and swimming beaches, avoiding system or lake-wide closures.

Reopening Shellfish Harvest in Gulf of Maine

By collaborating with the U.S. Food and Drug Administration, state shellfish control authorities, test kit manufacturers, and the seafood industry to develop an onboard screening and dockside testing protocol for PSP toxins in molluscan shellfish, NOAA enabled the reopening of shellfisheries on Georges Bank, off the coast of Maine. The fishery had been closed for two decades because toxins in shellfish sometimes exceeded regulatory limits and the area was too large and remote for routine monitoring of HAB toxins. After the protocol was developed and adopted by the Interstate Shellfish Sanitation Conference, NOAA was able to help reopen 6,000 square miles of the sea floor for surf clam and ocean quahog fishing in 2013. The fishery has production potential of up to one million bushels of surf clams and ocean quahogs a year, valued at $10 to $15 million annually.

Conclusion

NOAA provides valuable science, products, and services to mitigate the human and animal health and economic impacts of HABs nationwide. Through our research, forecast, monitoring, and response activities, NOAA provides actionable information about HABs to decision-makers responsible for water treatment, aquaculture, public health, tourism, and coastal resource management. Thank you for the opportunity to provide this statement for the record.