United States Environmental Protection Agency

Fish and Shellfish Program NEWSLETTER

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In This Issue

https://www.epa.gov/fish-tech

This issue of the *Fish and Shellfish Program Newsletter* generally focuses on harmful algal blooms (HABs).

Recent Advisory News

Health Advisories and Closures for California Finfish, Shellfish, and Crustaceans

The California Department of Public Health (CDPH) coordinates a routine monitoring program along the California coast to sample mussels and other shellfish like clams and scallops for the presence of paralytic shellfish poisoning (PSP) and domoic acid toxins. Commercial shellfish harvesters are also required to provide weekly shellfish samples to CDPH for PSP toxin assay and domoic acid analysis. If toxin levels are high enough, warnings and quarantines are issued to protect the recreational fishing public and shellfish consumers.

CDPH also has a coastwide, volunteer-based phytoplankton monitoring program which detects the naturally occurring, microscopic algae that produce PSP and domoic acid toxins. When toxin levels begin increasing, CDPH may expand its shellfish sampling effort to include other seafood species. If toxin levels increase beyond the federal alert level for either toxin, then CDPH will immediately issue a health advisory for all potentially impacted seafood species in the affected region.

The California Department of Fish and Wildlife (CDFW) website was established as a source of information for fishermen and the fishing industry. When circumstances arise, CDPH warnings, quarantine information, and health advisories about consuming California's ocean finfish, shellfish, and crustaceans are posted there.

The California Office of Environmental Health Hazard Assessment (OEHHA) also issues consumption advisories based on the amount of mercury or other chemical contaminants found in finfish, shellfish, and crustaceans. Safe eating guidelines to help the public reduce its exposure to chemicals in sport fish are also available from OEHHA.

CDPH and CDFW advise recreational and commercial fishers to check their web pages frequently, or call the Domoic Acid Fishery Closure Information Line at 831-649-2883 for the most up-to-date information on health advisories and fisheries closures.

Spiny Lobster Fisheries: Open and Closed Ocean Waters

- **The recreational spiny lobster fishery is open statewide.** The fishery is open every year from 6:00 a.m. on the Saturday preceding the first Wednesday in October through the first Wednesday after the 15th of March per California Code of Regulations Title 14, Section 29.90(a).

- **The commercial spiny lobster fishery is open statewide.** The fishery is open every year between the first Wednesday in October and the first Wednesday after the 15th of March per California Code of Regulations Title 14, Section 121(a).

Dungeness and Rock Crab Fisheries: Open and Closed Ocean Waters

Recreational Fisheries for Dungeness Crab and Rock Crab

- **The recreational fishery for all rock crab species is open statewide.** *North of 40°00.00' N. lat., near the Mendocino/Humboldt county line*, the CDPH recommends that consumers not eat the viscera (internal organs, also known as "butter" or "guts") of crabs. The viscera usually contain much higher levels of domoic acid than crab body meat.

- **The recreational fishery for Dungeness crab is closed statewide.** Every year, the fishery is closed for a period of time through the first Saturday in November per California Code of Regulations Title 14, Section 29.85(a)(2).

Commercial Fisheries for Dungeness Crab and Rock Crab

- **The commercial rock crab fishery is open from near the Mendocino/Humboldt county line** (40°00.00' N. lat.) to the U.S./Mexico border as of April 20, 2018. The fishery closure north of the Mendocino/Humboldt county line will remain in effect until state health agencies determine that domoic acid levels no longer pose a significant risk to public health and recommend the fisheries be opened, and the director of the California Department of Fish and Wildlife (CDFW) provides notification of fishery reopening to commercial fishermen.

- **The commercial fishery for Dungeness crab is closed statewide.** Every year, the fishery is closed for a period of time through November 14 (south of the Mendocino/Sonoma county line) or December 1 (north of the Mendocino/Sonoma county line) per Fish and Game Code Section 8276. The opening date may be delayed due to poor crab market readiness.

Razor Clam Fishery Closure

- As of April 27, 2016 the recreational take and possession of razor clam is **prohibited from Humboldt and Del Norte county beaches until further notice**.

- Read the CDFW Declaration of Fisheries Closure Due to a Public Health Threat Caused by Elevated Levels of Domoic Acid in Razor Clams (January 30, 2017).

- See the latest information on domoic acid levels in razor clams in Del Norte and Humboldt counties (scroll down the page to the **Links** section).

Additional Information

The following resources are available:

- **Domoic Acid Fishery Closure Information Line**: 831-649-2883
- **Shellfish Biotoxin Information Line**: 510-412-4643 or toll-free at 800-553-4133 *(Maintained by CDPH)*
- Crabs web page (*Links to CDFW website)*
- Domoic Acid FAQs (*Links to CDPH website)*
- Marine Biotoxin Monitoring Program (*Links to CDPH website)*
- Annual Mussel Quarantine (*Links to CDPH website)*
- Shellfish Program (*Links to CDPH website)*
- Phytoplankton Monitoring Program (*Links to CDPH website)*
- Fukushima Disaster Information (*Links to CDFW website)*
- Harmful Algae web page (*Links to Woods Hole Oceanographic Institute website)*
- Harmful Algal Blooms (*CDFW 2011 Status of the Fisheries Report)*
- Oregon Recreational Shellfish Biotoxin Closures
- Washington Shellfish Safety Information

For more information contact AskMarine@wildlife.ca.gov or 831-649-2870.

Source: https://www.wildlife.ca.gov/fishing/ocean/health-advisories

State Updates *Your Guide to Eating Fish Caught in Florida*

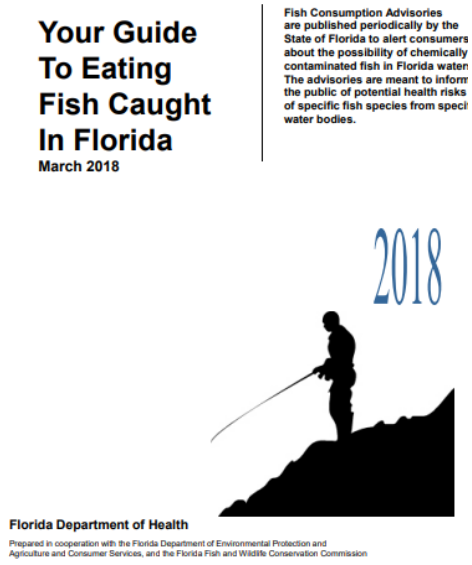
The Florida Department of Health (DOH), the Florida Department of Environmental Protection (DEP), the Florida Fish and Wildlife Conservation Commission (FFWCC), and the Florida Department of Agriculture and Consumer Services (DACS) operate jointly to determine if environmental chemicals are present in fish from Florida waters. In most instances, FFWCC determines what fish species should be sampled and collects those samples. DEP measures the levels of chemicals in the fish tissue. DOH determines the potential for adverse human health effects from consuming fish and issues fish consumption advisories when needed. DACS provides input on issues related to commercially available seafood (grocery stores, etc.) in Florida.

Recently, DOH revised "Your Guide to Eating Fish Caught in Florida" (March 2018) and it can be read here: http://www.floridahealth.gov/programs-and-services/prevention/healthy-weight/nutrition/seafood-consumption/_documents/advisory-brochure.pdf.

The most current fish advisories are available in a searchable database online at https://dchpexternalapps.doh.state.fl.us/fishadvisory/. The public can look up advisories by waterbody type (fresh or marine), county, and specific location. Results show consumption guidance and the contaminant causing the advisory for the waterbody.

More information about fish consumption advisories in Florida can be found here: http://www.floridahealth.gov/programs-and-services/prevention/healthy-weight/nutrition/seafood-consumption/fish-advisories-page.html.

For more information, contact the Florida Department of Health Public Health Toxicology Section at phtoxicology@flhealth.gov or 850-245-4250.



Your Guide to Eating Fish Caught in Florida. *(Image courtesy of Florida DOH)*

Source: http://www.floridahealth.gov/programs-and-services/prevention/healthy-weight/nutrition/seafood-consumption/advisory-overview.html

EPA News

The Cyanobacteria Assessment Network – Recent Success in Harmful Algal Bloom Detection

Cyanobacteria blooms, which can become harmful algal blooms (HABs), are a huge environmental problem across the U.S. They are capable of producing dangerous toxins that threaten the health of humans and animals, the quality of drinking water supplies, and the ecosystems in which they develop. Scientists at EPA are part of a team of specialists using remote sensing data to improve cyanobacteria detection methods. Improving the detection process would help state environmental and health agencies better determine whether to post public advisories to protect human health.

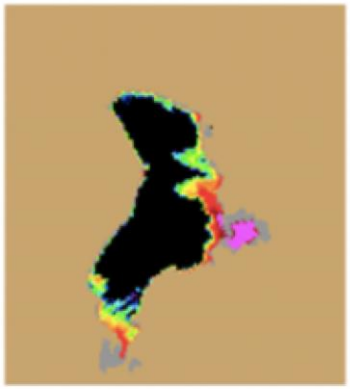
The Cyanobacteria Assessment Network (CyAN), a multi-agency project involving EPA, National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Geological Survey (USGS), uses historical and current satellite data to provide an early warning indicator system for HABs in U.S. freshwater systems. Since the project's inception in October 2015 CyAN imagery has been used to detect algal blooms in Ohio, Florida, California, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, and Utah before traditional monitoring efforts alerted watershed managers.

Due to the severity of Utah's cyanobacteria blooms in 2016, EPA Region 8 requested technical assistance from EPA Office of Research and Development (ORD) to utilize CyAN's early warning indicator system to support cyanobacteria monitoring activities for the State of Utah. Satellite data products and imagery acquired approximately one week after the Utah Division of Water Quality's (UDWQ's) routine monthly sampling in mid-

June identified that a bloom was developing in Provo Bay. Based on this information UDWQ scientists returned to the area for follow-up sampling.

"The images we've been receiving through the CyAN project have been tremendously helpful to UDWQ. The near-daily spatial extent and relative magnitude coverage provides the foundation for a wide range of useful outputs," said Benjamin M. Holcomb, Coordinator of Biological Assessment and HAB Programs with UDWQ.

Sentinel-2 image - June 27, 2017 showing an algal bloom in Provo Bay.



CyAN 53 image of an algal bloom showing areas of highest cyanobacteria concentrations: June 25, 2017.

UDWQ used CyAN data products and imagery to monitor evolving algal blooms and deploy additional sampling resources. *(Images courtesy of EPA)*

Mr. Holcomb explained that by providing near-immediate alerts when cyanobacteria are reaching human health thresholds, CyAN gives organizations like UDWQ the ability to respond more quickly than if they were relying on public reports and monthly sampling. It also ensures that their in-situ, bloom-response data are representative of recent bloom conditions, which allows them to better target field sampling and more efficiently use their limited resources. Also, Mr. Holcomb added that the satellite images can be easily shared with response agencies as a useful visual communication aid.

The goal of this project is to provide access to satellite images and data on the concentration and extent of chlorophyll-*a* and cyanobacteria in the continental U.S. through an Android mobile application and other interactive resources. As CyAN continues to grow, so will scientists' understanding of the connections between human health, economic values, and environmental conditions to cyanobacteria and phytoplankton blooms.

For more information contact, EPA Office of Science Information Management at the following link: https://www.epa.gov/sciencematters/forms/contact-us-about-science-matters

Source: https://www.epa.gov/sciencematters/cyanobacteria-assessment-network-recent-success-harmful-algal-bloom-detection

ORD Developing Methods for Measuring Total Microcystins in Fish Tissue

EPA ORD is developing methods for measuring total microcystins in fish tissue using the 2-methoxy-3-methyl-4-phenylbutyric acid (MMPB) procedure. ORD has completed the first phase of this research. Existing fillet and whole fish homogenates were spiked with three congeners of microcystins (LR, LA, and RR) both individually and as mixtures to develop a method for their recovery and measurement using the MMPB derivatization method. The

second phase of the project is to field-test this method on fish collected from waterbodies experiencing algal blooms and compare results with individual congener measurements.

ORD will be using fish from lakes, reservoirs, or rivers that have been exposed to algal toxins on a frequent basis, including golden algae blooms (ORD will be developing a method for testing Prymnesins at a later date). ORD will process those fish and assess them for total microcystin using the MMPB method. To date, fish samples have been received from Lake Okeechobee in Florida, Utah Lake in Utah, and Bantam Lake in Connecticut.

Size Criteria by Trophic Level	
Species	**Size Criteria**
Largemouth Bass	=/> 2 lbs
Smallmouth Bass	1-2 lbs
Walleye	1-2 lbs
Northern Pike	=> 2lbs
Common Carp	=/> 2 lbs
Channel Cat	=/> 2 lbs
Golden Shiner	Largest
Blue Gill	> 80 mm
Pumpkin Seed	> 80 mm
White Sucker	> 200 mm
Brown Bullhead	> 250 mm
Gizzard shad	> 160 mm
Bluntnose Minnows	Adults
Emerald Shiners	Adults

More Information on Fish Samples

ORD is using three to five fish of similar size (<25% difference in length) from multiple trophic levels (bass, carp, channel catfish, bullheads, sunfish, gizzard shad) and minnows (20 or more) using the size criteria (when possible) in the table to above.

For more information on this effort, contact Jim Lazorchak at Lazorchak.Jim@epa.gov and Toby Sanan at Sanan.Toby@epa.gov.

EPA CyanoHABs Webpage and Monthly Newsletter

In order to educate and inform the public about HABs, EPA releases a monthly newsletter specifically focusing on cyanobacteria HABs (cyanoHABs). It spotlights freshwater HABs and provides information on beach closures, health advisories with respect to HABs, current news, and recently published journal articles. The newsletter also lists upcoming conferences, workshops, webinars, and useful resources.

For more information, visit EPA's cyanoHAB website or contact Dr. Lesley D'Anglada at Danglada.Lesley@epa.gov or 202-566-1125.

The 2018 issues of the CyanoHABs Newsletter can be accessed at https://www.epa.gov/nutrient-policy-data/cyanohabs-newsletters-2018.

Other News

Toxic Cyanobacteria Blooms Impair Mussel Growth in Lake Erie

On January 30, 2018, NOAA's National Centers for Coastal Ocean Science (NCCOS) reported on a new study it was conducting with USGS. The study indicates that detected amounts of cyanobacteria and microcystin, one of the toxins the bacteria produce, did not cause mussel mortality in Lake Erie from 2013 to 2015. However, the researchers did find that the measured concentrations of both cyanobacteria and microcystin impaired mussel growth, with microcystin having a larger negative effect on mussel growth than cyanobacteria.

Lake Erie supports commercial fisheries that rely, in part, on mussels in the lake as a source of food. After being absent for most of the late 1980s and 1990s, cyanobacteria have again become prevalent seasonally in western Lake Erie, causing concern that cyanobacteria blooms and associated cyanotoxins could reduce production of mussels and ultimately affect fisheries.

USGS scientists retrieve mussels from a monitoring station in Lake Erie. Credit: Sean Bailey, USGS. *(Image courtesy of NOAA NCCOS)*

The western part of the lake also provides drinking water to large coastal communities, and recent cyanobacteria blooms have resulted in episodic drinking water shutdowns along Lake Erie and the creation of a large international effort to identify causes and potential management strategies to minimize adverse effects to humans and other organisms.

For more information contact Timothy Wynne at timothy.wynne@noaa.gov.

Source: https://coastalscience.noaa.gov/news/toxic-cynobacteria-blooms-impair-mussel-growth-lake-erie/

Four Different Algal Toxins Found in San Francisco Bay Mussels

NCCOS reported on March 15, 2018, that scientists have identified four kinds of algal toxins in mussels collected from San Francisco Bay. The study, published in *Harmful Algae*, is the first to report the co-occurrence of both freshwater and marine toxins in mussels consumed by humans and animals.

The researchers, led by Dr. Misty Peacock while at the University of California Santa Cruz (currently at Northwest Indian College), found nearly all mussels collected from the bay were contaminated with at least one of the detected algal toxins, and 37% contained all four—one of which originates in freshwater.

Mussels in the bay were contaminated with the following toxins:

- **Domoic acid –** a neurotoxin that causes amnesic shellfish poisoning in humans and is produced by marine diatoms in the genus *Pseudo-nitzschia*.
- **Paralytic shellfish toxins** (saxitoxins) – cause paralytic shellfish poisoning and are associated with marine dinoflagellates in the genus *Alexandrium*.
- ***Dinophysis* shellfish toxins** (okadaic acid and derivatives) – cause diarrhetic shellfish poisoning and are produced by marine dinoflagellates in the genus *Dinophysis*.
- **Microcystins** – hepatotoxins that cause liver damage in people and animals and are produced by freshwater cyanobacteria in the genus *Microcystis*.

Contaminated mussels pose a serious health threat to people and animals who eat them. Even though San Francisco Bay lacks commercial shellfish operations, people still harvest and eat mussels from the bay. While commercially harvested shellfish are generally safe because they undergo regular testing, neither microcystins nor *Dinophysis* shellfish toxins are routinely monitored in California shellfish.

California sea lions are becoming sick, and dying in some cases, from ingesting domoic acid—a neurotoxin that accumulates in fish and shellfish they consume. *(Image courtesy of NOAA)*

HAB monitoring has generally been waterbody-dependent, focusing either on marine or freshwater toxins, but not both. For example, cyanobacterial toxins were previously considered a public health issue only for freshwater, with concerns about adverse effects to drinking and recreational waters.

The publication stems in part from a NOAA-funded Monitoring and Event Response for Harmful Algal Bloom (MERHAB) research project that aims to address this emerging HAB concern. Senior study author Raphael Kudela, the Lynn Professor of Ocean Health at the University of California Santa Cruz, is working closely with state and federal agencies to assess health risks and develop better monitoring tools. According to Dr. Kudela these findings and other recent studies are prompting several California agencies to consider changes to their monitoring programs.

For more information, contact Marc Suddleson at marc.suddleson@noaa.gov.

Source: https://coastalscience.noaa.gov/news/four-different-algal-toxins-found-san-francisco-bay-mussels/?utm_medium=email&utm_source=GovDelivery

Recently Awarded Research

NCCOS Funds $6.8M for New and Continuing HAB Research

On September 6, 2018, NCCOS announced support for 28 new and continuing HAB research awards in 2018. These awards, totaling $6.8 million, fund projects around the nation through the Ecology and Oceanography of Harmful Algal Blooms, Monitoring and Event Response for Harmful Algal Blooms, and Prevention, Control, and Mitigation of Harmful Algal Blooms programs and involve over 85 scientists across 54 institutions around the U.S.

“NCCOS is funding the latest scientific research to support environmental managers trying to cope with increasing and recurring toxic algae that continue to impact marine and human health and coastal economies,” said NCCOS Director Steve Thur, PhD. “Improved understanding of these coastal harmful algal bloom threats will lead to better predictions, mitigation and possibly solutions in impacted U.S. coastal regions.”

NCCOS HAB competitive research programs develop science-based solutions to address expanding HAB impacts that are affecting coastal resources and economies in every U.S. coastal region. HAB species and impacts vary regionally and NCCOS projects are advancing the understanding of bloom toxicity, applying new technologies to detect HABs and their toxins in the field, producing HAB forecasts, and exploring HAB prevention and control methods. Summaries of new and continued research projects by region are below. NCCOS projects are the result of a rigorous competitive peer-review process that ensures support for the highest quality science.

Gulf of Mexico and Caribbean

Karenia brevis, the Florida red tide alga that occurs throughout the Gulf of Mexico, causes mortality of fish, turtles, marine mammals, and birds; neurotoxic shellfish poisoning (NSP); and respiratory irritation in beachgoers. *Gambierdiscus* species, which grow on coral reefs in the Gulf and Caribbean, cause fish to become so toxic that human consumers become ill with ciguatera fish poisoning (CFP). Newly funded research projects will help determine the processes that terminate red tides and help mitigate toxin effects in threatened Florida manatees. Continued research will help the State of Florida improve its already-rigorous NSP monitoring and management framework. It will also fund the development of models for predicting CFP in reef-dwelling fish.

Lake Erie

The Great Lakes, and western Lake Erie in particular, are subject to cyanobacterial HABs, primarily *Microcystis* that can produce microcystins. These are liver toxins that can contaminate drinking water, harm wildlife, and prevent recreational use of water bodies. Current Lake Erie HAB forecasts can predict *Microcystis* biomass, but the cells are not always toxic. Newly funded and continuing research will take different approaches to predicting the actual toxicity of *Microcystis* blooms in Lake Erie in order to provide early warning and improve management of drinking water and recreational use.

New England

Along the New England coast blooms of *Alexandrium* produce neurotoxins that can accumulate in shellfish, causing PSP in human consumers. To protect human health, sections of the coast must be closed to shellfish harvesting. New research will investigate how microscopic animals control the growth and toxicity of *Alexandrium*. Continuing research will use remote toxin sensors to determine how shellfish in the eastern Gulf of Maine become toxic. The information from both studies will be incorporated into predictive models that forecast when and where *Alexandrium* blooms will occur in the Gulf of Maine, helping state managers and the shellfish industry protect public health and minimize economic disruption.

Chesapeake and Delaware Bays

The Chesapeake and Delaware Bays are subject to a variety of HABs that can kill fish and shellfish. While they do not threaten human health, they can have severe impacts on fisheries and aquaculture. New funding will support research in Delaware Bay investigating the role of nitric oxide in promoting blooms of *Heterosigma*. In the lower Chesapeake Bay a new study to better predict *Margalefidinium* (formerly *Cochlodinium*) and *Alexandrium monilatum* blooms and a continuing project on the toxicity and food web impacts of *A. monilatum* will help the

shellfish industry minimize their impacts. A study of a naturally occurring compound that may control some toxic HABs will continue to test its effectiveness and environmental impacts.

California

Amnesic shellfish poisoning (ASP)-causing *Pseudo-nitzschia* is of particular concern along the California coast. New research will improve modeling efforts to predict *Pseudo-nitzschia* blooms off Southern California and support environmental management efforts. A continuing project to understand the controlling factors of *Pseudo-nitzschia* toxin production and bloom formation will also help to improve early warning models. Another continuing project is development of a strategy to add monitoring of multiple marine and freshwater HAB toxins (microcystins, ASP-, diarrhetic shellfish poisoning (DSP)-, PSP-causing) occurring simultaneously in shellfish and other organisms in estuaries. This is an emerging ecosystem and public health problem.

Pacific Northwest and Alaska

Both PSP and ASP are problems in the Pacific Northwest and Alaska, impacting commercial, recreational, and tribal subsistence shellfish harvesting. A continuing project is transitioning an early warning system for *Pseudo-nitzschia* for Oregon and Washington ocean beaches, and another project aims to uncover the mechanisms behind wintertime occurrences of PSP-toxicity in geoduck clam fisheries in Southeast Alaska. Predictive modeling and HAB monitoring provides managers with an early warning of when and where toxic blooms will affect shellfish harvests, thereby providing better public health protection and safeguarding coastal economies.

National Projects

Dinophysis, the HAB causing DSP has suddenly appeared in multiple areas in the U.S. in the last ten years. Continuing research supports a cross-regional study to find common factors that have led to the sudden appearance of this emerging HAB as well as to improve monitoring. Another continuing project is testing methods of measuring DSP toxins in shellfish in order to protect human health.

A full list of awards and their abstracts can be found here.

For more information, contact Elizabeth Turner at elizabeth.turner@noaa.gov.

Source: https://coastalscience.noaa.gov/news/nccos-funds-6-8m-for-new-and-continuing-harmful-algal-bloom-research/

Tech and Tools

Portable Red Tide Detector Debuts at NOAA Emerging Tech Workshop

On September 21, 2017, NCCOS reported on a portable, hand-held instrument that uses genetics to detect the red tide-causing organism *Karenia brevis* in the field. This was featured at the second NOAA Emerging Technologies for Observations Workshop. The device, dubbed a "tricorder" after the fictional Star Trek hand-held life detector, is the first of its kind and is able to provide direct results to end users such as government agencies and businesses.

John Paul, PhD, uses a portable tricorder to identify the Florida red tide organism, *Karenia brevis*. Credit: University of South Florida. *(Image courtesy of NOAA NCCOS)*

This technology speeds up the decision-making process in closing beaches and shellfish harvesting beds, as well as helping to determine the cause of fish kills. The tricorder uses a biotechnology technique called nucleic acid sequence-based amplification to target the messenger RNA in the carbon fixation gene specific to *K. brevis*.

Red tides in Florida coastal waters (caused principally by *K. brevis*) can threaten human health and cost millions in tourism, agriculture, seafood, and leisure industries. Currently the State of Florida detects and enumerates *K. brevis* through the relatively slow, labor-intensive and expert process of light microscopy to differentiate this toxic alga from closely related non-toxic and less toxic species.

Data from the hand-held tricorders get uploaded to the Gulf of Mexico Coastal Ocean Observing System (GCOOS) for automated processing and calculation of *K. brevis* cell abundance and data visualization. Users include the Florida Department of Environmental Protection, Florida Department of Agriculture and Consumer Services, and the Florida Fish and Wildlife Conservation Commission.

The project is co-led by Dr. John Paul of the University of South Florida and Dr. Kate Hubbard of the Florida Fish and Wildlife Conservation Commission and is supported by an NCCOS Prevention, Control, and Mitigation of HABs Program project.

Learn more about the red tide-detecting tricorder here. The second NOAA Emerging Technologies for Observations Workshop was held August 22-23, 2017, at the NOAA Center for Weather and Climate Prediction, College Park, Maryland. The workshop highlighted new environmental observing capabilities and applications that can improve NOAA services and enhance organizational efficiency.

For more information, contact John Wickham at John.Wickham@noaa.gov.

Source: https://coastalscience.noaa.gov/news/portable-red-tide-detector-debuts-noaa-emerging-tech-workshop/

Recent Publications

Journal Articles

The list below provides a selection of research articles focusing on HABs.

- Fluorescence probes for real-time remote cyanobacteria monitoring: A review of challenges and opportunities
  Bertone, E. , M.A. Burford, and D.P. Hamilton. 2018. Fluorescence probes for real-time remote cyanobacteria monitoring: A review of challenges and opportunities. *Water Research* 141:152-162.

- The blue mussel *Mytilus edulis* is vulnerable to the toxic dinoflagellate Karlodinium armiger—Adult filtration is inhibited and several life stages killed
  Binzer, S.B., R.B.C. Lundgreen, T. Berge, P.J. Hansen, and B. Vismann. 2018. The blue mussel *Mytilus edulis* is vulnerable to the toxic dinoflagellate *Karlodinium armiger* – Adult filtration is inhibited and several life stages killed. *PLoS One* 13(6): e0199306.

- Assessment of saxitoxin sensitivity of nerves isolated from the Pacific oyster, *Crassostrea gigas*, exposed to *Alexandrium minutum*
  Boullot, F., C. Fabioux, H. Hegaret, P. Soudant, et al. 2018. Assessment of saxitoxin sensitivity of nerves isolated from the Pacific oyster, *Crassostrea gigas*, exposed to *Alexandrium minutum*. *Toxicon* 149: 93.

- Combined effects of warming and acidification on accumulation and elimination dynamics of paralytic shellfish toxins in mussels *Mytilus galloprovincialis*
  Braga, A.C., C. Camacho, A. Marques, A. Gago-Martínez, et al. 2018. Combined effects of warming and acidification on accumulation and elimination dynamics of paralytic shellfish toxins in mussels *Mytilus galloprovincialis. Environmental Research* 164: 647-654.

- Size-based interactions and trophic transfer efficiency are modified by fish predation and cyanobacteria blooms in Lake Mývatn, Iceland
  Ersoy, Z., E. Jeppesen, S. Sgarzi, I. Arranz, M. Cañedo-Argüelles, et al. 2017. Size-based interactions and trophic transfer efficiency are modified by fish predation and cyanobacteria blooms in Lake Mývatn, Iceland. *Freshwater Biology* 62(11): 1942-1952.

- A global analysis of the relationship between concentrations of microcystins in water and fish
  Flores, N.M., T.R. Miller, and J.D. Stockwell. 2018. A global analysis of the relationship between concentrations of microcystins in water and fish. *Frontiers in Marine Science* 5: 30.

- Shifts in coastal fish communities: Is eutrophication always beneficial for sticklebacks?
  Gagnon, K., M. Gräfnings, and C. Boström. 2017. Shifts in coastal fish communities: Is eutrophication always beneficial for sticklebacks? *Estuarine, Coastal and Shelf Science* 198(A): 193-203.

- The effects of red tide (*Karenia brevis*) on reflex impairment and mortality of sublegal Florida stone crabs, *Menippe mercenaria*
  Gravinese, P.M., S.M. Kronstadt, T. Clemente, C. Cole, et al. 2018. The effects of red tide (*Karenia brevis*) on reflex impairment and mortality of sublegal Florida stone crabs, *Menippe mercenaria*. *Marine Environmental Research* 137: 145-148.

- Physiological effects caused by microcystin-producing and non-microcystin producing *Microcystis aeruginosa* on medaka fish: A proteomic and metabolomic study on liver
  Le Manach, S., B. Sotton, H. Huet, C. Duval, et al. 2018. Physiological effects caused by microcystin-producing and non-microcystin producing *Microcystis aeruginosa* on medaka fish: A proteomic and metabolomic study on liver. *Environmental Pollution* 234: 523-537.

- Quantifying harmful algal bloom thresholds for farmed salmon in southern Chile
  Montes, R.M., X. Rojas, P. Artacho, A. Tello, and R.A. Quiñones. 2018. Quantifying harmful algal bloom thresholds for farmed salmon in southern Chile. *Harmful Algae* 77: 55-65.

- Pre-ingestive selection capacity and endoscopic analysis in the sympatric bivalves *Mulinia edulis* and *Mytilus chilensis* exposed to diets containing toxic and non-toxic dinoflagellates
  Navarro, J.M., J. Widdows, O.R. Chaparro, A. Ortiz, and C. Mellado. 2018. Pre-ingestive selection capacity and endoscopic analysis in the sympatric bivalves *Mulinia edulis* and *Mytilus chilensis* exposed to diets containing toxic and non-toxic dinoflagellates. *PLoS One* 13(2): e0193370.

- Development of a method to assess the ichthyotoxicity of the harmful marine microalgae *Karenia* spp. using gill cell cultures from red sea bream (*Pagrus major*)
  Ohkubo, N., Y. Tomaru, H. Yamaguchi, S. Kitatsuji, and K. Mochida. 2017. Development of a method to assess the ichthyotoxicity of the harmful marine microalgae *Karenia* spp. using gill cell cultures from red sea bream (*Pagrus major*). *Fish Physiology and Biochemistry* 43(6): 1603-1612.

- Developmental neurotoxicity of *Microcystis aeruginosa* in the early life stages of zebrafish
  Qian, H., G. Liu, T. Lu, and L. Sun.2018. Developmental neurotoxicity of *Microcystis aeruginosa* in the early life stages of zebrafish. *Ecotoxicology and Environmental Safety* 151:35-41.

- Application of activated carbon to accelerate detoxification of paralytic shellfish toxins from mussels *Mytilus galloprovincialis* and scallops *Chlamys farreri*
  Qiu, J., H. Fan, T. Liu, X. Liang, et al. 2018. Application of activated carbon to accelerate detoxification of paralytic shellfish toxins from mussels *Mytilus galloprovincialis* and scallops *Chlamys farreri. Ecotoxicology and Environmental Safety* 148: 402-409.

- Harmful Algal Blooms: A Compendium Desk Reference
  Shumway, S. E., ed., J.M. Burkholder, ed., and S.L. Morton, ed. 2018. *Harmful Algal Blooms: Compendium Desk Reference.* Hoboken, NJ: John Wiley & Sons.

- Effects of harmful algal blooms on fish: Insights from *Prymnesium parvum*
  Svendsen, M.B.S., N. R. Andersen, P.J. Hansen, and J.F. Steffensen. 2018. Effects of harmful algal blooms on fish: Insights from *Prymnesium parvum*. *Fishes* 3(1): 11.

- Detection of potential harmful algal bloom-causing microalgae from freshwater prawn farms in Central Luzon, Philippines, for bloom monitoring and prediction
  Tayaban, K.M.M., K.L. Pintor, and P.G. Vital. 2018. Detection of potential harmful algal bloom-causing microalgae from freshwater prawn farms in Central Luzon, Philippines, for bloom monitoring and prediction. *Environment, Development and Sustainability* 20(3): 1311-1328.

- Cyanobacteria blooms induce embryonic heart failure in an endangered fish species
  Zi, J., X. Pan, H. MacIsaac, J. Yang, et al. 2018. Cyanobacteria blooms induce embryonic heart failure in an endangered fish species. Aquatic Toxicology 194: 78-85.

Upcoming Meetings and Conferences

13th World Congress on Aquaculture and Fisheries
November 12-13, 2018
Melbourne, Australia

Aquaculture 2019
March 7-11, 2019
New Orleans, Louisiana

Fish Passage 2018 - International Conference on River Connectivity
December 10-14, 2018
Albury, New South Wales, Australia

National Shellfisheries Association 111th Annual Meeting
March 7-11, 2019
New Orleans, Louisiana

Additional Information

This monthly newsletter highlights current information about fish and shellfish.

For more information about specific advisories within the state, territory, or tribe, contact the appropriate state agency listed on EPA's National Listing of Fish Advisories website at https://fishadvisoryonline.epa.gov/Contacts.aspx.

For more information about this newsletter, contact Sharon Frey (Frey.Sharon@epa.gov, 202-566-1480).

Additional information about advisories and fish and shellfish consumption can be found at https://www.epa.gov/fish-tech.