EPA United States Environmental Protection Agency

Fish and Shellfish Program NEWSLETTER

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In This Issue

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

Recent Advisory News

CalEPA Updates Fish Consumption Guidelines for Inland Anglers

On August 18, 2021, the California Environmental Protection Agency (CalEPA) updated its recommendations for safely eating sport fish caught from lakes and reservoirs throughout California.

The Statewide Advisory for Eating Fish from California's Lakes and Reservoirs without Site-Specific Advice reflects the latest data on mercury and polychlorinated biphenyls (PCBs) that accumulate in fish and can pose a health risk to those who consume them. The new advisory covers 14 fish species — including brown trout, channel catfish, crappie, black bass, and rainbow trout — twice the number covered in the original 2013 advisory.

Safe eating recommendations vary based on age, gender, and the fish species being consumed.

"Many fish have nutrients that may reduce the risk of heart disease and are excellent sources of protein," said Dr. Lauren Zeise, Director of CalEPA's Office of Environmental Health Hazard Assessment (OEHHA), which issued the new advisory this week. "We are thrilled to provide Californians with these updated guidelines so they can safely eat fish low in chemical contaminants and enjoy the well-known health benefits of fish consumption."

OEHHA offers more than 100 advisories on safe fish consumption that apply to specific bodies of water in California, including lakes and reservoirs, as well as rivers, bays, and coastal areas.

The California Department of Public Health monitors biotoxins in shellfish and issues warnings, quarantines, and health advisories regarding the harvest and safe consumption of shellfish.

For more information, contact Peter Tira at Peter.Tira@wildlife.ca.gov.

Source: https://wildlife.ca.gov/News/calepa-updates-fish-consumption-guidelines-for-inland-anglers

EPA News

EPA Proposes to Restore Protective Pollution Standards for Washington Waters

On March 29, 2022, the U.S. Environmental Protection Agency (EPA) announced a proposed rule to restore protective federal water quality standards for the state of Washington. When finalized, this action would help protect the health of Washingtonians and Tribal members who eat locally caught fish.

“At EPA, we know that protecting public health goes hand in hand with following science,” said EPA Assistant Administrator for Water Radhika Fox. “This action exemplifies that connection by identifying science-based limits on harmful chemicals in Washington’s waters while advancing toward a clean water future, where people can safely eat the fish they catch.”

“It’s critical that fish from Washington waters are safe to eat, and the human health criteria are an important component of that,” said Laura Watson, director of the Washington Department of Ecology. “EPA’s proposal embraces the more protective standards that Washington Tribes and community members have championed, and we welcome this renewed commitment to safe, clean, healthy waters in our state.”

"The Tribe relies on clean water to exercise its Treaty rights and to protect the health of Tribal members, who continue to depend on fish and seafood as a fundamental part of our diet,” said Patrick DePoe, Vice Chairman of the Makah Tribal Council. “While the Tribe is disappointed in the long detour to get back to 2016 standards, it is never too late to do the right thing. Clean water will benefit the exercise of Treaty rights and all Washingtonians."

Under the Clean Water Act, the agency is proposing limits (called “human health criteria”) for dozens of chemicals that pose a health risk. Over the objections of state and Tribal leaders, the previous administration rolled back protective water quality standards established by EPA in 2016. As a result of this rollback, water quality standards being implemented in Washington are inadequate to protect human health. This proposed rule follows through on the agency’s June 2021 commitment to restore protective, science-based human health criteria in the state.

EPA’s proposal would establish clear and vital protections while providing the state with flexibility to work constructively to address compliance challenges. The proposal also supports the agency’s commitment to protecting Tribal reserved rights in water quality standards in the Office of Water’s Tribal Action Plan.

The agency will accept comment on this proposal for 60 days. EPA will also hold two virtual public hearings on this proposal. For more information, visit https://www.epa.gov/wqs-tech/federal-human-health-criteria-washington-state-waters.

For more information, contact the EPA Press Office at press@epa.gov.

Source: https://www.epa.gov/newsreleases/epa-proposes-restore-protective-pollution-standards-washington-waters

Occurrence and Effects of Harmful Algal Blooms in Fish and Shellfish

On March 22, 2022, the EPA's Office of Science and Technology hosted a webinar on the *Occurrence and Effects of Harmful Algal Blooms in Fish and Shellfish* to share information on the occurrence and impacts of harmful algal blooms (HABs) in fresh and marine fish and shellfish, and to learn about ways to protect human health and the environment from the risks of HABs and their toxins. The webinar was well attended by representatives from states, tribes, territories, federal agencies, universities, and international governments. Topics covered included:

- Freshwater impacts with presentations from the University of Geneva, CalEPA, the Big Valley Band of Pomo Indians, EPA Office of Research and Development; and
- Estuarine and marine impacts with presentations from the National Oceanic and Atmospheric Administration (NOAA); the French Agency for Food, Environmental and Occupational Health Safety; and the Northwest Indian College.

Each presentation was followed with a question and answer session. Presentations and a recording of the webinar are posted to the webinar webpage of the EPA CyanoHABs website.

For more information, contact EPA at EPACyanoHABs@epa.gov.

Source: https://www.epa.gov/system/files/documents/2022-04/habs-newsletter-apr-2022.pdf

Other News

Global Study Determines Economic Value of Shellfish and Seaweed Aquaculture

When practiced and managed well, shellfish and seaweed aquaculture can provide sustainable seafood and improve the surrounding environment. These kinds of aquaculture farms act as nursery habitats, increasing recruitment of fish to fisheries, while removing excess nutrients from marine waters. A new study by NOAA scientists and their partners assigns dollar amounts to these valuable benefits.

Workers harvest oysters at Stella Mar Oyster Co. in Connecticut. (*Photo courtesy of Stella Mar Oysters)*

The researchers examined nutrient removal by aquaculture in 17 countries and fish habitat data from 10 countries. The team also used data from the Milford Lab's GoPro Aquaculture Project, an effort that uses underwater camera footage to understand interactions between shellfish aquaculture gear and fish communities. The study also uses ongoing NOAA research on the water quality benefits of shellfish aquaculture.

As shellfish feed, they remove nitrogen by filtering it out of the water and using it to build their shells and tissues. Seaweeds also remove nutrients from the surrounding environment via photosynthesis. The researchers assigned dollar amounts to nutrient removal services using payments made for nutrient credits in areas where nutrients such as nitrogen are managed. They also assigned dollar amounts to the avoided costs of traditional ways of remediating excess nutrients—for example, upgrading water treatment plants. Considering 49 estimates, shellfish and seaweed farms removed an average of about 575 pounds of nitrogen per acre. For shellfish, the value of that ecosystem service is estimated at $1,321–7,739 per acre each year. The range for seaweed aquaculture is $753–10,110 per acre each year.

The researchers compiled data from 26 different studies to estimate the value of habitat provided by shellfish and seaweed aquaculture on a global scale. They compared fish abundance between aquaculture and natural sites. Abundance per fish species was 1.6 times higher on farms compared to other habitats. Aside from creating places to forage and hide from predators, farms serve as nursery habitat for young fish. As a result, fish production at farms was enhanced by an average of about 94 pounds per acre of extra fish each year. The additional fish produced could be worth $618 per acre each year to commercial fisheries, or $779 per acre each year to recreational fisheries.

These findings indicate that shellfish and seaweed aquaculture is not only a low impact and sustainable form of food production, but also has the unique ability to contribute towards broader goals of ecosystem recovery and resiliency.

The project is a collaboration between a multi-national team of researchers at NOAA, The Nature Conservancy, University of Melbourne and the University of Adelaide in Australia, the University of Maryland Extension, and Mississippi State University.

Read more in this NOAA Fisheries article.

For more information, contact Suzanne Bricker at suzanne.bricker@noaa.gov.

Source: https://coastalscience.noaa.gov/news/global-study-determines-economic-value-of-shellfish-and-seaweed-aquaculture/

Changing Oceanographic Conditions and Environmental Justice Concerns in the Northeast Shelf

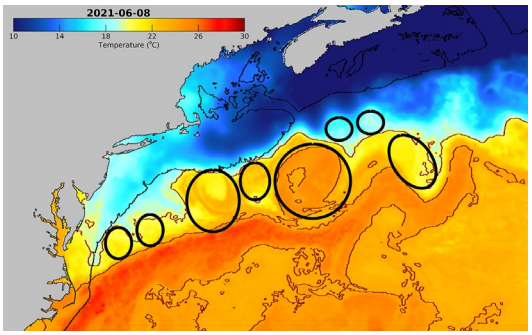
On April 5, 2022, NOAA shared two new reports that show the Northeast continental shelf marine ecosystems are experiencing notable ocean warming and changes in oceanography. The reports include new indicators that evaluate environmental justice concerns.

The Northeast shelf extends from North Carolina to Maine and is one of the most productive marine ecosystems in the United States. The annual New England and Mid-Atlantic *State of the Ecosystem* reports capture the big picture of the biology, climate, physical, and social conditions of the marine ecosystem. The assessments inform fisheries management by showing how the ecosystem is connected and changing. This ecosystem change, in turn, affects the distribution and abundance of marine species from phytoplankton to whales.

"We develop these reports along with the regional fishery management councils to provide information on current social, economic, and environmental conditions and address priority questions on factors affecting their management objectives. Every year, the Mid-Atlantic Fishery Management Council uses these reports to update their ecosystem level risk assessment. This gives managers a quick overview of conditions that may affect fisheries," said Sarah Gaichas, co-editor at the Northeast Fisheries Science Center.

Record High Temperatures and Changing Ocean Conditions

Ocean temperatures continue to warm at both the surface and bottom throughout the Northeast Shelf. Seasonal sea surface temperatures in 2021 matched or exceeded the record temperatures from 2012. Marine heatwaves measure not just high temperature but how long the ecosystem is subjected to the high temperature. The region has been experiencing more frequent and intense marine heatwaves over the last decade, including 2021. Changing oceanographic conditions, such as the stability and location of the Gulf Stream is affecting the habitats of multiple federally managed species on the Northeast shelf. 2021 was distinguished by a large number of warm core rings — currents that flow in a circular motion and broke off from the gulf stream — present in May and June, which likely partially contributed to the movement of warm, salty offshore waters onto the shelf.



Sea surface temperature (SST) data with warm core rings circled in black. The SST data are derived from the multi-sensor ultra-high resolution merged satellite sea surface temperature product and the warm core rings were annotated by Adrienne Silver, University of Massachusetts, Dartmouth, School of Marine Science & Technology. (*Photo courtesy of NOAA Fisheries/Kimberly Hyde)*

Fishing Communities Vulnerable to Environmental Justice Concerns

There are environmental justice concerns with fishing communities that are most vulnerable to changes in fishing patterns. They may have a lower ability to successfully respond and adapt to change. Federal agencies are required to address disproportionately high and adverse human health and environmental effects of federal actions on minority and low-income populations. Three of the existing NOAA Fisheries Community Social Vulnerability Indicators can be used for mandated environmental justice analysis:

- Poverty Index
- Population Composition Vulnerability Index
- Personal Disruption Index

The State of the Ecosystem reports highlight the top 10 most engaged and the top 10 most reliant commercial and recreational fishing communities. It also examines their associated environmental justice vulnerability. The top five most engaged commercial fishing communities in New England and the Mid-Atlantic and their associated environmental justice rankings are below. Communities with environmental justice concerns are ranked medium-high or above.

New England

- New Bedford, Massachusetts (High)
- Narragansett/Point Judith, Rhode Island (Low)
- Gloucester, Massachusetts (Low)
- Chatham, Massachusetts (Low)
- Portland, Maine (Medium)

Mid-Atlantic

- Cape May, New Jersey (Low)
- Reedville, Virginia (Low)
- Montauk, New York (Low)
- Point Pleasant Beach, New Jersey (Low)
- Barnegat Light, New Jersey (Low)

“Evaluating the environmental justice concerns in fishing communities allows us to identify those most vulnerable to changing fishing regulations, as well as socio-economic and climate conditions,” said Lisa Colburn, co-author and scientist at the Northeast Fisheries Science Center. “These vulnerabilities may be exacerbated by a community’s inability to adapt due to limited resources. We identify the socio-economic dimensions of vulnerability in fishing communities to provide support for the decision-making process for fisheries management, climate adaptation, and risk mitigation.”

Offshore Wind Energy Development Will Impact Fisheries

Construction of more than 20 offshore wind development projects is proposed on the Northeast shelf, covering more than 1.7 million acres by 2030. An additional six lease areas (488,000 acres) were recently identified in the New York Bight, with more areas anticipated off the Delmarva Peninsula.

According to current development plans, rapid buildout will have a greater impact on the Mid-Atlantic than New England. Floating offshore technologies are likely to be used in the Gulf of Maine in the future, with anticipated site designations beginning in 2023.

The development will affect species differently, with a negative impact on species that prefer soft bottom habitat but potentially benefiting species that prefer hard structured habitat.

Areas proposed for offshore wind development make up 1–31 percent of port revenue from fisheries in the Mid-Atlantic. Some of these port communities score medium-high to high in environmental justice concerns and gentrification vulnerability.

Recreational and Commercial Fishing Trends

While commercial landings are not yet available at the regional level, coastwide monkfish, lobster, and scallop landings declined while aggregate groundfish landings increased over recent averages.

Recreational harvest in New England reached its lowest point in 2020, driven in part by management actions to address poor or unknown stock status.

In the Mid-Atlantic, recreational effort shows a long-term increasing trend and has returned to pre-2018 levels. Fleet diversity is decreasing because of a shift away from party/charter to shore-based fishing. This shift results in a decreased range of recreational fishing opportunities. Shore-based anglers will have access to different species and sizes of fish than vessel-based anglers.

Informing Ecosystem-based Management

These reports are part of a larger NOAA-wide initiative — NOAA's Integrated Ecosystem Assessment — to provide a consistent national effort to understand and manage ecosystems. The researchers use a unique approach in which social, biological, and physical scientists work together with stakeholders and managers. This cooperation integrates information on all components of an ecosystem, including human needs and activities, into the decision-making process. Managers can then balance trade-offs and determine what is more likely to achieve their desired goals.

For more information, contact the Northeast Fisheries Science Center.

Source: https://www.fisheries.noaa.gov/feature-story/changing-oceanographic-conditions-and-environmental-justice-concerns-northeast-shelf

Recently Awarded Research

NOAA Sea Grant and Ocean Acidification Program Projects to Examine Impacts of Stressors on Shellfish Aquaculture

On September 29, 2021, NOAA announced that its Sea Grant and the Ocean Acidification Program awarded more than $2.4 million to support projects that will address the impacts of multiple stressors on and increase resilience in shellfish aquaculture through research and industry partnerships.

Shellfish aquaculture is among the fastest-growing sectors of food production, both globally and nationally. However, the vulnerability of shellfish to multiple stressors acts as a constraint on the growth of the aquaculture industry. In addition to ocean and coastal acidification, potential stressors include temperature, salinity, hypoxia, pathogens and parasites, harmful algal blooms, and environmental contaminants.

Four projects covering U.S. waters in the Gulf of Mexico, Mid-Atlantic, New England, and West Coast were selected through a joint, competitive funding opportunity. The selected projects will strengthen relationships between the shellfish aquaculture industry and the aquaculture research community; develop scientific knowledge on the impacts of ocean and coastal acidification in combination with other stressors to shellfish aquaculture; and create data products, tools, technologies, management practices and other deliverables that are broadly applicable to building resilience within the shellfish aquaculture sector.

These projects will expand collaborations between researchers and the shellfish aquaculture industry throughout all aspects of the scientific process, from project conceptualization to execution to dissemination of knowledge and development of deliverables. For this co-production of knowledge framework, at least one researcher and one shellfish grower will co-lead each project, and project investigators will work together to bolster aquaculture communities of practice. Moreover, between 14 and 35 percent of each project's awarded funds are earmarked for equitably compensating growers for their contributions.

Read the full descriptions of selected projects.

The results will bolster NOAA's Blue Economy Initiative by supporting U.S. seafood production and building coastal resiliency. Specifically, these investments support the goals of NOAA and the Department of Commerce and are consistent with Sea Grant's focus area of Sustainable Fisheries and Aquaculture. Learn more about Sea Grant's work in aquaculture and ocean acidification.

For more information, contact Hallee Meltzer at hallee.meltzer@noaa.gov.

Source: https://seagrant.noaa.gov/News/Article/ArtMID/1660/ArticleID/2882/NOAA-Sea-Grant-and-Ocean-Acidification-Program-projects-to-examine-impacts-of-stressors-on-shellfish-aquaculture

Tech and Tools

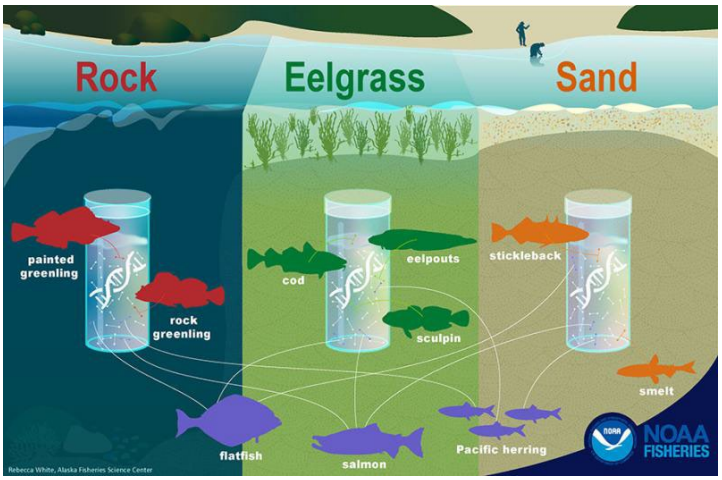
Scientists Use Innovative DNA Technology to Characterize Nearshore Marine Fish Communities in Southeast Alaska

Alaska, known for its vast geography and cold, productive waters, supports some of the most valuable fisheries in the world. However, Alaska's northern latitudes, diverse coastal habitats, and dynamic ocean conditions make studying these fisheries particularly challenging.

On March 30, 2022, NOAA announced that an innovative DNA technology may help to change that. Scientists recently demonstrated that environmental DNA (eDNA) metabarcoding can characterize nearshore fish communities in different marine habitats and tidal conditions in Southeast Alaska. Researcher organizations included:

- Alaska Fisheries Science Center's Auke Bay Laboratories
- University of Alaska Fairbanks' College of Fisheries and Ocean Sciences
- Alaska Regional Office's Habitat Conservation Division

"Environmental or eDNA can revolutionize how we assess nearshore fish communities in Alaska," said Wes Larson, manager of the science center's genetics program. "Traditionally, the only way to sample nearshore fish communities is by using beach seines or similar gear types set from either shore or small boats. Now we have another technique for generating similar data sets analyzing a simple water sample with eDNA metabarcoding."



All organisms shed DNA into the environment. Environmental DNA (eDNA) can be used to determine the identities of the fish species that are present at or near the time of sample collection. *(Photo courtesy of NOAA Fisheries)*

Larson is lead author of the collaborative study recently published in Environmental DNA. As the first eDNA metabarcoding study published on marine fish communities in Alaska, the main goals were to:

- Verify the method could be used successfully across distinct habitats
- Understand how the large tidal swings typical of many high latitude marine environments might impact fish species detection

What Is eDNA Metabarcoding?

eDNA is the genetic material shed by organisms into the surrounding environment. For example, as a fish swims through the ocean, its DNA is shed and accumulates in the water around it. Some sources of eDNA include scales, skin cells, mucus, feces, and gametes. This genetic material can be recovered from environmental samples and used to detect the presence of the fish even after it has moved through the area.

After an environmental sample — in this case, 1 liter of water — is collected and filtered, the DNA is extracted and analyzed using eDNA metabarcoding.

eDNA metabarcoding is a method of species identification that compares short sections of DNA (also known as "sequences") with a reference library of known sequences. This is similar to how a supermarket scanner uses the familiar black stripes of the universal product code (UPC) barcode to identify an item in its stock against its reference database. Metabarcoding does not focus on one specific organism. Instead, it provides a snapshot of entire communities across taxonomic groups from a single standardized sample.

Influence of Habitat and Tides

Larson and his colleagues sampled sandy beaches, eelgrass beds, and rocky shorelines along the coast of Juneau, Alaska during high and low tides. They detected 21 unique taxa (groups of fish) including salmon, Pacific herring, flatfish, pricklebacks and gunnels, sculpin, cods, sablefish, smelt, rockfish, and lingcod.

Species richness (number of species) and composition based on eDNA detections differed substantially across habitats. Rocky habitats contained fewer species, different species, and fewer positive detections for each species compared to sand and eelgrass habitats.

Larson suspects that differences in fish communities across these habitats could be driven by physical characteristics (shoreline slope and bottom depth). Bottom depths at sampling locations in rock habitats were often deeper, with slopes that descend rapidly from the collection location. In contrast, sand and eelgrass environments are characterized by more gradual slopes.

"The lower detection rates for some fish species in rocky habitats could be a function of sampling farther from the seafloor in areas where water is not well mixed between the bottom and the surface," said Larson.

In rocky habitats, the halocline (the border between layers of water that contain different amounts of salt) may act as a barrier to eDNA movement, effectively trapping surface and bottom sourced eDNA in their respective layers. The halocline may be especially pronounced in coastal southeast Alaska due to large freshwater inputs from rivers, glaciers, and precipitation.

The authors also found that tide height did not significantly influence which fish were detected except for in sand habitats. For example, the high tide sample taken at the Eagle Beach field site contained many more small open ocean fish (stickleback, smelt, Pacific herring) than the low tide sample. Larson and his coauthors hypothesized that these small pelagic fish may be moving inshore during high tide to avoid predators or to take advantage of a food source.

High Latitude Areas

This study demonstrates how eDNA metabarcoding can be used to characterize nearshore fish communities in a high-latitude marine environment. These ecosystems are influenced by large tidal swings, strong currents, and significant freshwater input from large rivers, rain, and snowmelt.

The authors concluded that marine eDNA transport was minimal, with many of the eDNA detections coming from locally abundant species. They also noted that the majority of species in the fish community were detected with eDNA regardless of tidal stage.

Larson is eager to build on this research and apply eDNA analysis to many more questions and systems. He suggested future studies could explore the extent to which habitat and nearshore physical processes influence eDNA detections.

Larson adds, "This study provides important information about how physical factors influence the fish we detect from eDNA. We can use this information for future studies sampling eDNA throughout Alaska waters."

This study provides a small peek into what researchers think is a very exciting future for eDNA in Alaska.

Gretchen Harrington at the Alaska Regional Office's Habitat Conservation Division who helped fund this work said that she is "excited about the potential of eDNA for assessing species diversity, informing environmental assessments related to new development and other projects, and identifying habitat that is essential for important fish species." The NOAA Alaska Fisheries Science Center is developing a robust eDNA program to help answer these questions and many more. Harrington hopes this work will help fisheries managers steward important resources in the face of rapid environmental change.

More Information is Available at:

Genetics Research at the Alaska Fisheries Science Center
Genetics Program at the Alaska Fisheries Science Center

For more information, contact the Alaska Fisheries Science Center at afsc.webmaster@noaa.gov.

Source: https://www.fisheries.noaa.gov/feature-story/scientists-use-innovative-dna-technology-characterize-nearshore-marine-fish

Recent Publications

Journal Articles

The list below provides a selection of research articles.

- Physiological responses of scallops and mussels to environmental variability: Implications for future shellfish aquaculture
  Alma, L., C.J. Fiamengo, S.R. Alin, M. Jackson, K. Hiromoto, and J.L. Padilla-Gamiño. 2022. Physiological responses of scallops and mussels to environmental variability: Implications for future shellfish aquaculture. Available at SSRN: https://dx.doi.org/10.2139/ssrn.4033189.

- Length-based risk analysis of management options for the southern Florida USA multispecies coral reef fish fishery
  Ault, J.S., S.G. Smith, M.W. Johnson, L.J.W. Grove, J.A. Bohnsack, G.T. DiNardo, C. McLaughlin, N.M. Ehrhardt, V. McDonough, M.P. Seki, S.L. Miller, J. Luo, J. Blondeau, M.P. Crosby, G. Simpson, M.E. Monaco, C.G. Pollock, M.W. Feeley, and A. Acosta. 2022. Length-based risk analysis of management options for the southern Florida USA multispecies coral reef fish fishery. *Fisheries Research* 249:106210.

- Commercial fishery disturbance of the global ocean biological carbon sink
  Cavan, E.L. and S.L. Hill. 2021. Commercial fishery disturbance of the global ocean biological carbon sink. *Global Change Biology* 28:1212–1221.

- Limiting factors for queen conch (*Lobatus gigas*) reproduction: A simulation-based evaluation
  Farmer, N.A. and J.C. Doerr. 2022. Limiting factors for queen conch (*Lobatus gigas*) reproduction: A simulation-based evaluation. *PLoS ONE* 17(3):e0251219.

- Fish consumption and advisory awareness in the Great Lakes basin
  He, X., M. Raymond, N. LaHue, C. Tomasallo, H. Anderson, and J. Meiman. 2022. Fish consumption and advisory awareness in the Great Lakes basin. *Science of the Total Environment* 827:153974.

- Paralytic shellfish toxins in Alaskan Arctic food webs during the anomalously warm ocean conditions of 2019 and estimated toxin doses to Pacific walruses and bowhead whales
  Lefebvre, K., E. Fachon, E.K. Bowers, D.G. Kimmel, J.A. Snyder, R. Stimmelmayr, J.M. Grebmeier, S. Kibler, D.R. Hardison, D.M. Anderson, D. Kulis, J. Murphy, J.C. Gann, D. Cooper, L.B. Eisner, J.T. Duffy-Anderson, G. Sheffield, R.S. Pickart, A. Mounsey, M.L. Willis, P. Stabeno, and E. Siddon. 2022. Paralytic shellfish toxins in Alaskan Arctic food webs during the anomalously warm ocean conditions of 2019 and estimated toxin doses to Pacific walruses and bowhead whales. *Harmful Algae* 114:102205.

- Ciguatoxin in Hawai'i: Fisheries forecasting using geospatial and environmental analyses for the invasive Cephalopholis argus (*Epinephelidae*)
  Loeffler, C.R., A. Abraham, J.E. Stopa, H.A. Flores Quintana, E.L.E. Jester, J. La Pinta, J. Deeds, R.A. Benner, and J. Adolf. 2022. Ciguatoxin in Hawai'i: Fisheries forecasting using geospatial and environmental analyses for the invasive *Cephalopholis argus* (*Epinephelidae*). *Environmental Research* 207:112164.

- Perspectives on managing fisheries for community wellbeing in the face of climate change
  Nelson, L.K., M. Bogeberg, A. Cullen, L.E. Koehn, A. Strawn and P.S. Levin. 2022. Perspectives on managing fisheries for community wellbeing in the face of climate change. *Maritime Studies.*

- A screening-level human health risk assessment for microplastics and organic contaminants in near-shore marine environments in American Samoa
  Polidoro, B., T. Lewis, and C. Clement. 2022. A screening-level human health risk assessment for microplastics and organic contaminants in near-shore marine environments in American Samoa. *Heliyon* 8(3):e09101.

- Risk assessment of norovirus illness from consumption of raw oysters in the United States and in Canada
  Pouillot, R., M. Smith, J.M. Van Doren, A. Catford, J. Holtzman, K.R. Calci, R. Edwards, G. Goblick, C. Roberts, J. Stobo, J. White, J. Woods, A. DePaola Jr., E. Buenaventura, and W. Burkhardt III. 2022. Risk assessment of norovirus illness from consumption of raw oysters in the United States and in Canada. *Risk Analysis* 42: 344-369.

- Unpacking pathways to diversified livelihoods from projects in Pacific Island coastal fisheries
  Roscher, M.B., H. Eriksson, D. Harohau, S. Mauli, J. Kaltavara, W.J. Boonstra, and J. van der Ploeg. 2022. Unpacking pathways to diversified livelihoods from projects in Pacific Island coastal fisheries. *Ambio*.

- The contribution of macroalgae-associated fishes to small-scale tropical reef fisheries
  Wilson, S.K., C.J. Fulton, N.A.J. Graham, R.A. Abesamis, C. Berkström, D.J. Coker, M. Depczynski, R.D. Evans, R. Fisher, J. Goetze, A. Hoey, T.H. Holmes, M. Kulbicki, M. Noble, J.P.W. Robinson, M. Bradley, C. Åkerlund, L.T. Barrett, A.A. Bucol, M.J. Birt, D.H. Chacin, K.M. Chong-Seng, L. Eggertsen, M. Eggertsen, D. Ellis, P.T. Y. Leung, P.K.S. Lam, J. van Lier, P.A. Matis, A. Pérez-Matus, C.V.H. Piggott, B.T. Radford, S. Tano, and P. Tinkler. 2022. The contribution of macroalgae-associated fishes to small-scale tropical reef fisheries. *Fish and Fisheries* 00:1–15.

- A review of adaptation options in fisheries management to support resilience and transition under socio-ecological change
  Woods, P.J., J.I. Macdonald, H. Bárðarson, S. Bonanomi, W.J. Boonstra, G. Cornell, G. Cripps, R. Danielsen, L. Färber, A.S.A. Ferreira, K. Ferguson, M. Holma, R.E. Holt, K.L. Hunter, A. Kokkalis, T.J. Langbehn, G. Ljungström, E. Nieminen, M.C. Nordström, M. Oostdijk, A. Richter, G. Romagnoni, C. Sguotti, A. Simons, N.L. Shackell, M. Snickars, J.D. Whittington, H. Wootton, and J. Yletyinen. 2022. A review of adaptation options in fisheries management to support resilience and transition under socio-ecological change. *ICES Journal of Marine Science* 79(2):463-479.

Upcoming Meetings and Conferences

12th International Conference on Toxic Cyanobacteria
May 22-27, 2022
Toledo, OH

American Fisheries Society Annual Meeting
August 21-25, 2022
Spokane, WA

Small Pelagic Fish: New Frontiers in Science and Sustainable Management
November 7-11, 2022
Lisbon, Portugal

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.