United States Environmental Protection Agency

Fish and Shellfish Program NEWSLETTER

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In This Issue

More information and technical resources related to fish and shellfish consumption advisories is available at: www.epa.gov/fish-tech

This issue of the Fish and Shellfish Program Newsletter generally focuses on per- and polyfluoroalkyl substances (PFAS). Some of the articles below detail instances of PFAS contamination in fish and/or shellfish in Wisconsin, Michigan, Minnesota, and South Carolina. States often determine their own toxicity values or collaborate with one another to determine toxicity values (as is the case with the Great Lakes states) and then use those values to develop state PFAS guidelines for fish and shellfish. [Additional information is available from most states online.]

Recent Advisory News

New Smelt Consumption Advisory for Lake Superior

On January 15, 2021, the Wisconsin Department of Natural Resources (WDNR) and the Wisconsin Department of Health Services (WDHS) recommended a per-and polyfluoroalkyl substances (PFAS)-based fish consumption advisory for Lake Superior, based on recent sampling results.

Due to the high levels of perfluorooctane sulfonate (PFOS) found in the samples, WDNR and WDHS updated the recommended rainbow smelt consumption advisory from an unrestricted amount to one meal per month for Lake Superior.

The sampling completed by WDNR found elevated levels of PFAS, particularly the compound PFOS, in rainbow smelt in Lake Superior. PFAS are a group of over 5,000 human-made chemicals used for decades in numerous products, including non-stick cookware, fast food wrappers, and stain-resistant sprays.

These legacy contaminants have made their way into the environment in a variety of ways, including spills of PFAS-containing materials, discharges of PFAS-containing wastewater to treatment plants, and certain types of firefighting foams.

The risk of health problems increases with the amount of contaminated fish consumed. Following this advisory will help protect individuals from excess PFAS exposure found in fish. The advisory could change in the future as WDNR and WDHS continue to learn more about the health risks from eating fish caught from this area and more fish data become available.

As part of the WDNR's statewide PFAS monitoring efforts to monitor fish tissue and water chemistry at select sites around the state, smelt were collected from two locations in Lake Superior in 2019 approximately 30 miles apart at sites near the Apostle Islands and off Port Wing. PFAS were detected in samples from both locations.

Rainbow smelt are small, silver fish that are non-native to Lake Superior. Some anglers will catch smelt through the ice, but the majority of smelt harvest occurs in the springtime as the fish migrate into nearshore areas to spawn.

"The smelt migration run starts as spring arrives and winter ice cover dissipates, which creates a popular local tradition of harvesting smelt for fish fries," said Brad Ray, Lake Superior Fisheries Unit Supervisor. "It's important for consumers to understand the potential risks associated with this new advisory."

Fish Tissue Results

In mid-December, WDNR received results from the contaminant samples taken from Lake Superior. Rainbow smelt, a popular sport fish and prey species for many predator fish and various bird species, had a high level of PFOS, one of the many types of PFAS contaminants.

"Eating fish that have high levels of PFAS may increase your risk for certain health effects," said Dr. Jonathan Meiman, Chief Medical Officer and State Epidemiologist for Occupational and Environmental Health at WDHS. "Limiting your exposure by choosing fish that are low in PFAS is the best way to reduce your risk while still maintaining the health benefits of fish consumption." Some health risks associated with PFOS include lower birth weight, possible links to increased risk of kidney and testicular cancer, harm to the immune and reproductive systems, increased cholesterol levels, and altered hormone regulation and thyroid hormones.

WDNR also received sample results from bloater chub, cisco/lake herring, lake whitefish, lake trout, and Siscowet lake trout in Lake Superior and crappie, yellow perch, channel catfish, carp, northern pike, walleye, and musky from the St. Louis River. The PFOS levels found in those fish do not warrant a consumption advisory change at this time.

WDNR and WDHS are unaware of any other PFAS-based consumption advisories for other fish species in the Great Lakes.

For consumption advice for other Great Lakes fish species based on toxic substances, such as polychlorinated biphenyls (PCBs) or mercury, please refer to the statewide safe-eating guidelines. Additional consumption advice can be found on WDNR's fish consumption webpage. To learn more about PFAS and fish, visit WDNR's PFAS webpage. For more information on PFAS and associated human health effects, visit WDHS's PFAS webpage.

For more information, contact:

- Sean Strom, WDNR Environmental Toxicologist, at 608-220-4769 or Sean.Strom@wisconsin.gov
- Elizabeth Goodsitt or Jennifer Miller, WDHS Communications Specialists, at 608-266-1683 or DHSMedia@dhs.wisconsin.gov.

Source: https://dnr.wisconsin.gov/newsroom/release/40496

Michigan Department of Health and Human Services Issued Precautionary Consumption Guideline for Lake Superior Smelt

On March 24, 2021, the Michigan Department of Health and Human Services (MDHHS) was notified by WDNR of elevated PFOS levels in Lake Superior rainbow smelt. In order to be protective of public health, MDHHS matched WDNR's guidance and issued a precautionary Eat Safe Fish guideline recommending that individuals limit Lake Superior smelt consumption to one serving per month.

For the MDHHS guidelines, a serving is considered to be an eight-ounce portion size for adults and two- or four-ounce portion size for children. The precautionary guideline takes effect immediately and replaces the existing Eat Safe Fish guideline for Lake Superior smelt issued due to mercury. MDHHS will update the smelt guideline once additional Michigan data are available later this year.

"This precautionary guideline is based on data shared by Wisconsin, which shows elevated levels of PFOS in Lake Superior rainbow smelt," said Dr. Joneigh Khaldun, chief medical executive and chief deputy for health. "PFOS is a perfluoroalkyl substance associated with harmful effects in people, including reduced fertility, thyroid disease, and liver damage. We will update this guideline once the department has additional data."

MDHHS is coordinating with the Michigan Department of Environment, Great Lakes, and Energy, Michigan Department of Natural Resources, and other agencies to collect smelt from Lake Superior, Lake Huron, Lake Michigan, and some inland lakes. MDHHS will then analyze these samples for contaminants, including PFOS. Once these data are available, MDHHS will update existing smelt consumption guidelines for these waterbodies as needed.

MDHHS Eat Safe Fish guidelines are not regulatory. MDHHS makes this information available to help Michiganders make safer choices when it comes to choosing and eating fish. Visit the Eat Safe Fish program website for additional information on MDHHS Eat Safe Fish guidelines.

For more information, call the MI-TOXICS hotline at 800-648-6942.

Source: https://www.michigan.gov/som/0,4669,7-192-29942_73920_74076-555278--,00.html

New PFOS Advisory for Rainbow Smelt in Lake Superior Issued by MN

In March 2021, Minnesota Department of Health (MDH) updated its website to include new Rainbow Smelt advice. The website specifically states, "Advice for eating Smelt from Lake Superior is now one meal per month based on levels of PFOS." This new advice can be found at https://www.health.state.mn.us/communities/environment/fish/.

The fish consumption guidelines for Lake Superior were released for two groups of people:

- Pregnant women, women who could become pregnant, and children under age 15 https://www.health.state.mn.us/communities/environment/fish/docs/lakesuppregnt.pdf

- Men, boys age 15 and over, and women not planning to become pregnant https://www.health.state.mn.us/communities/environment/fish/docs/lakesupnotpregnt.pdf

For more information, contact MDH at 651-201-4911 or Pat McCann at patricia.mccann@state.mn.us.

Source: https://www.health.state.mn.us/communities/environment/fish/docs/lakesuppregnt.pdf and https://www.health.state.mn.us/communities/environment/fish/docs/lakesupnotpregnt.pdf

EPA News

EPA Announces the Winners of the Annual Scientific and Technological Achievement Awards

On March 31, 2021, the U.S. Environmental Protection Agency (EPA) announced the winners of its 2020 Scientific and Technological Achievement Awards (STAA), an agency-wide program that recognizes the outstanding scientific work of EPA employees who published their technical work in peer-reviewed literature. STAA winning journal articles, associated with fish, are included below.

- Identification of per- and polyfluoroalkyl substances in the Cape Fear River by high resolution mass spectrometry and nontargeted screening
  McCord, J. and M. Strynar. 2019. Identification of per- and polyfluoroalkyl substances in the Cape Fear River by high resolution mass spectrometry and nontargeted screening. *Environmental Science & Technology* 53(9): 4717-4727.

- Exposure to perfluorinated alkyl substances and health outcomes in children: A systematic review of the epidemiologic literature
  Rappazzo, K.M., E. Coffman, and E.P. Hines. 2017. Exposure to perfluorinated alkyl substances and health outcomes in children: A systematic review of the epidemiologic literature. *International Journal of Environmental Research and Public Health* 14(7): 691.

- Statistical survey of persistent organic pollutants: Risk estimations to humans and wildlife through consumption of fish from U.S. rivers
  Batt, A.L., J.B. Wathen, J.M. Lazorchak, A.R. Olsen, and T.M. Kincaid. 2017. Statistical survey of persistent organic pollutants: Risk estimations to humans and wildlife through consumption of fish from U.S. rivers. *Environmental Science & Technology* 51(5): 3021-3031.

- Toxicological perspective on the osmoregulation and ionoregulation physiology of major ions by freshwater animals: Teleost fish, crustacea, aquatic insects, and Mollusca
  Griffith, M.B. 2017. Toxicological perspective on the osmoregulation and ionoregulation physiology of major ions by freshwater animals: Teleost fish, crustacea, aquatic insects, and Mollusca. *Environmental Toxicology and Chemistry* 36: 576-600.

- Coastal wetland support of Great Lakes fisheries: Progress from concept to quantification
  Trebitz, A. and J. Hoffman. 2015. Coastal wetland support of Great Lakes fisheries: Progress from concept to quantification. *Transactions of the American Fisheries Society* 144: 352-372.

- A national statistical survey assessment of mercury concentrations in fillets of fish collected in the U.S. EPA national rivers and streams assessment of the continental USA
  Wathen, J.B., J.M. Lazorchak, A.R. Olsen, and A. Batt. 2015. A national statistical survey assessment of mercury concentrations in fillets of fish collected in the U.S. EPA national rivers and streams assessment of the continental USA. *Chemosphere* 122: 52-61.

- A simple decontamination approach using hydrogen peroxide vapour for *Bacillus anthracis* spore inactivation
  Wood, J.P., M.W. Calfee, M. Clayton, N. Griffin-Gatchalian, A. Touati, S. Ryan, L. Mickelsen, L. Smith, and V. Rastogi. 2016. A simple decontamination approach using hydrogen peroxide vapour for *Bacillus anthracis* spore inactivation. *Journal of Applied Microbiology* 121: 1603-1615.

Source: https://www.epa.gov/research/scientific-and-technological-achievement-award-staa-2020

EPA Science Matters: EPA Researchers are Supporting Fishery Restoration Efforts in Northern Maine with Tribal Partners

On March 23, 2021, EPA announced its collaboration with tribal, state, federal, and international partners to develop a cloud-based population diversity database of Atlantic salmon DNA. The population diversity database is being created as part of biodiversity and sustenance fishing restoration efforts of the Houlton Band of Maliseet Indians (HMBI) tribal waterways in Northern Maine.

Cara O'Donnell and Sam St. John, Houlton Band of Maliseet Indians and Ross Jones and Robert Beaumaster, Department of Fisheries and Oceans Canada, setting fyke netting in the Meduxnekeag River.

Native American tribes in Maine have traditionally fished migrating and resident fish species, including Atlantic salmon, as a key part of their diet. However, over time, these traditional practices have been negatively impacted by industrial development which has caused decreasing water quality, loss of fish habitat, and obstacles to fish migration pathways. Additionally, interbreeding wild Atlantic salmon with less genetically diverse domesticated and farm-raised salmon has caused reduced fitness and adaptability of wild Atlantic salmon. The decline, and in some cases the elimination, of these important fish populations has meant the loss of a central component of tribes' traditional diet.

Atlantic salmon are culturally significant to the Maliseet people whose ancestors have fished and lived along the St. John River (or Wolastoq in the Maliseet language) for thousands of years. The Meduxnekeag River is an important tributary in the St. John River Watershed that begins at Meduxnekeag Lake in northern Maine and joins with the St. John River near Woodstock, New Brunswick, Canada. The Meduxnekeag River runs adjacent to HBMI Trust Lands and is a vital tribal resource. One of the primary missions of HBMI is to restore Atlantic salmon to the Meduxnekeag River.

Sharri Venno, an environmental planner for HBMI, described the importance of the Atlantic salmon, "The loss of Atlantic salmon and other sea run fish to the Houlton Band of Maliseet Indians – from the damming of the Meduxnekeag River in the 1800's, the construction of Mactaquac Dam on the Wolastoq/St. John in 1968, to the ongoing impacts of climate change- has represented an ever-increasing loss of sustenance, of traditional practices, and of spiritual ceremonies. Ultimately it is a cultural loss of relationship between the tribal community and sea run fish that I can't put into words. Restoring that relationship through the return of these fish to tribal waters will be of immeasurable value to the Tribe and their efforts to sustain the health and welfare of our community and cultural lifeways."

HBMI has taken significant steps towards the restoration of salmon in the watershed, including conducting water quality monitoring, restoring aquatic habitats and ecosystems, and partnering with EPA and other federal agencies to perform fish habitat assessments. In 2018, HBMI conducted an environmental DNA (eDNA) presence/absence study of salmon within the watershed. Results confirmed the presence of Atlantic salmon occurred only on the Canadian tributaries of the Meduxnekeag River, underscoring the importance of continued restoration efforts.

EPA researchers are working in collaboration with HBMI, as well as with the Maliseet First Nations in Canada, to help restore and reclaim their heritage of a thriving Atlantic salmon fishery in the St. John River Watershed and the Meduxnekeag River. By leveraging knowledge from key Atlantic salmon researchers and genetic experts who are working as partners on the project, HBMI can gain valuable information and resources on the Atlantic salmon population in the Meduxnekeag River and avoid expensive and time-consuming hit-or-miss trial-and-error breeding efforts.

On EPA's role in this collaborative research effort, Deb Szaro, EPA Acting Regional Administrator for Region 1, said "By initiating and facilitating this research project, EPA plays a pivotal role in the restoration of Atlantic salmon in the St. John River and furthers the efforts of the cross-boundary Wolastoq watershed restoration collaboration by convening tribal, federal, state and international partners to construct a genetic diversity mapping of salmon within the river system."

To enable more effective Atlantic salmon preservation and restoration efforts by tribal, state, federal, and international partners, EPA is collaborating closely with HBMI, the Maliseet Nation Conservation Council, U.S. Fish and Wildlife Service, the National Oceanographic and Atmospheric Administration (NOAA), Division of Fisheries and Oceans – Canada, and the University of New Brunswick, to create a cloud-based Population Diversity Database. The Population Diversity Database housing the data of genetic analysis of fish tissue samples will be used to establish routine genetic assessment of Atlantic salmon tissue and provide key information on natural diversity. Having a database of genetic information on salmon in the watershed creates the ability to consistently choose the genetic strain of salmon that has the greatest chance of survival and the closest genetics to current Atlantic salmon populations present in the Canadian side of the Meduxnekeag River, while promoting the genetic diversity necessary to re-establish and maintain the native salmon population. The data will provide valuable information for live gene banking, captive rearing, and release of salmon into tributaries with limited or nonexistent salmon populations. Using the genetic information in the Population Diversity Database, HBMI will be able to reliably select tributary-specific salmon to restore to the Meduxnekeag River. The database and genetic information will help to advance efforts to increase biodiversity and continue restoration throughout the entire St. John River

watershed and others along the Atlantic coast. In addition to informing ongoing restoration efforts, the development of the Meduxnekeag-specific genetics database will provide HBMI with information to help inform the development of next steps in the overall salmon restoration plan for the Meduxnekeag River.

Source: https://content.govdelivery.com/accounts/USEPAORD/bulletins/2c7d2c5 and https://www.epa.gov/sciencematters/working-tribal-partners-restore-fisheries-northern-maine

Other News

Effects of PFOS Exposure on Eastern Oysters

On December 2, 2020, a research collaboration between the National Centers for Coastal Ocean Science (NCCOS) scientists and the National Institute of Standards and Technology (NIST) documented the negative effects of PFOS on the health of the Eastern oyster, *Crassostrea virginica*. This research addressed existing data gaps for evaluating PFOS's chemical and biological exposure effects on a commercially important marine bivalve.

NCCOS' Allisan Aquilina-Beck (left) and Blaine West (right) collect oysters on Wadmalaw Island, SC. *(Photo courtesy of James Daugomah, NOAA NCCOS)*

NCCOS scientists in the Ecotoxicology Branch in Charleston, South Carolina, exposed *C. virginica* to a range of PFOS concentrations in seawater. Summarizing the study's major results: after a short 48-hour exposure, oysters had significant damage to their lysosomal cells (cellular repair/immune response organelles) at concentrations greater than or equal to 3 parts per million (ppm). All experimental groups contained significantly higher amounts of damaged cells when compared to oysters that were not exposed to PFOS. These results indicate that cellular damage occurs during short exposure times. The oysters were able, however, to combat the exposure using other cellular detoxifying mechanisms.

After a longer seven-day PFOS exposure, chemical analysis measured the amount of PFOS contained in the tissues. The exposure levels used in this study were similar to those observed after a documented chemical spill in 2000. Results revealed oysters accumulated 50 to over 100 times the level of PFOS relative to exposure concentrations. After two days of purging in clean seawater, almost all PFOS was eliminated from the oyster tissue. However, the small amount of chemical that remained was still at greater levels than those previously reported from field collected oysters. Therefore, longer purging times are required to lower the chemical levels in the tissue. The stability of this contaminant makes it challenging to completely remove it from the body, whether considering invertebrates or higher organisms.

PFOS is a 'forever chemical,' meaning it is an extremely persistent, manmade, organic chemical not naturally found in the environment. Originally developed in the 1950s, its popularity soared among consumer goods in the 1970s due to its ability to repel heat, oils, water, acids, and bases. PFOS is commonly used in a variety of industrial and consumer products: carpet, food packaging, clothing treatments (e.g., Scotchgard), plastics, and firefighting foams. Its widespread use and inability to naturally breakdown resulted in the chemical's environmental abundance contaminating ground waters and food sources worldwide. It was not until 2005 that the Stockholm Convention recommended a ban on production based on concerns over the chemical's inability to degrade and increasing evidence of bioaccumulation.

PFOS was singled out as the most concerning PFAS compound due to its multiple health risks. Studies have indicated chemical exposure through inhalation of dust particles and ingestion of contaminated food/drinking water could lead to detrimental developmental, reproductive, and systemic effects in humans and wildlife.

C. virginica oysters. *(Photo courtesy of Allisan Aquilina-Beck, NOAA NCCOS)*

This study shows *C. virginica's* ability to withstand acute, high concentrations of PFOS exposure while undergoing substantial cellular damage and persisting PFOS concentrations in tissues. The ubiquitous use of PFOS in manufacturing and its chemical stability is a cautionary tale for man-made chemicals. As new chemicals are manufactured to replace PFOS, experiments analyzing the fate and biological effects in estuarine species are ongoing in order to preserve both environmental and human health.

Citation: Aquilina-Beck, A.A., J.L. Reiner, K.W. Chung, M.J. DeLise, P.B. Key, and M.E. DeLorenzo. 2020. Uptake and Biological Effects of Perfluorooctane Sulfonate Exposure in the Adult Eastern Oyster *Crassostrea virginica*. *Archives of Environmental Contamination and Toxicology* 79: 333–342. https://doi.org/10.1007/s00244-020-00765-4

For more information, contact Allisan Aquilana-Beck at allisan.beck@noaa.gov.

Source: https://coastalscience.noaa.gov/news/consequences-of-a-forever-chemical-exposure-on-eastern-oysters/

WDNR Releases Latest Sampling Results Revealing Broader PFAS Presence in Madison area lakes and Yahara River Chain

On January 21, 2021, the Wisconsin Department of Natural Resources (WDNR) announced the presence of elevated levels of PFAS in surface water samples taken from Madison-area lakes and along the Yahara River.

WDNR found elevated levels of PFAS in Lake Monona and Starkweather Creek in 2019, which resulted in a new PFAS fish consumption advisory for those two water bodies. WDNR collected surface water and fish samples in 2019 due to PFAS-containing stormwater leaving the Dane County airport into Starkweather Creek and Lake Monona.

Due to public safety concerns, WDNR collected additional surface water samples in 2020 on Lakes Mendota, Monona, Upper Mud, Waubesa, and Kegonsa, as well as along sections of the Yahara River between the lakes.

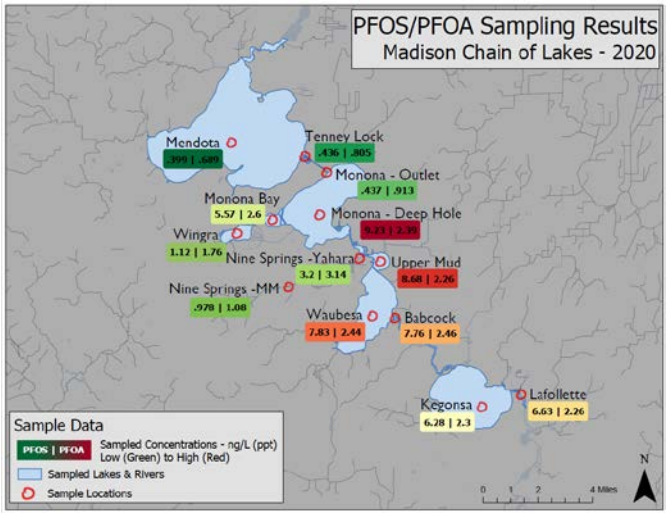
WDNR also collected samples from Lake Wingra and Nine Springs Creek. PFAS compounds were discovered throughout the areas sampled, and many of those samples were at levels above what WDNR may consider acceptable.

PFAS do not break down in the environment and have been discovered at concentrations of concern in groundwater, surface water, and drinking water. PFAS are known to bioaccumulate in the tissues of fish and wildlife. They also accumulate in the human body and pose several risks to human health.

Surface Water Sampling

Lake Mendota was found to have values below 1.0 parts per trillion (ppt) for the PFAS compounds PFOS and perfluorooctanoic acid (PFOA). However, Lake Monona had values as high as 9.2 ppt PFOS and 2.4 ppt PFOA. Values for Upper Mud were 8.7 ppt PFOS and 2.3 ppt PFOA. Waubesa had levels of 7.8 ppt PFOS and 2.4 ppt PFOA, and Kegonsa 6.2 PFOS and 2.3 ppt PFOA.

Samples taken in 2020 were analyzed for 36 PFAS compounds, including PFOS and PFOA, at the Wisconsin State Lab of Hygiene.



WDNR PFOS/PFOA Sampling Results. *(Photo courtesy of Wisconsin Department of Natural Resources)*

"The sample results indicate that PFAS compounds are present in all of the Madison area lakes. Concentrations of PFAS compounds in Lake Mendota and Lake Wingra, located upstream of Lake Monona, have lower concentrations than Lake Monona and the subsequent downstream lakes and sections of the Yahara River," said Adrian Stocks, WDNR Water Quality Program Director. "Additionally, concentrations in Lake Monona of one particular PFAS compound, PFOS, were very similar to results from WDNR sampling efforts of the lake in 2019."

The 2019 samples showed 10 ppt to 12 ppt for PFOS and less than 3 ppt for PFOA. WDNR's 2019 sampling of Starkweather Creek began following results of sampling completed at the Dane County Airport that showed elevated levels of PFAS. The stormwater system at the airport discharges to Starkweather Creek, which ultimately enters Lake Monona near Olbrich Park. PFAS contamination was found in Starkweather Creek from its headwaters northeast and east of the airport, through its length to where it discharges into Lake Monona. PFOS concentrations ranged from less than 1 ppt to 3700 ppt.

There are known discharges of PFAS compounds to soil, surface water, and groundwater on the airport property likely stemming from multiple responsible parties. WDNR has regulatory oversight in cases where there has been a

discharge of a hazardous substance to the environment. WDNR is actively working with responsible parties to discuss next steps.

2020 Fish Tissue Sampling

WDNR continues to conduct comprehensive fish contaminant monitoring on the Yahara chain of lakes, targeting a variety of species for PFAS and other contaminants. Due to the time required to process and analyze fish tissue samples, the results of this testing are expected in Spring 2021.

More information on how WDNR is addressing PFAS contamination in Wisconsin is available here.

For more information, contact:

- Adrian Stocks, WDNR Water Quality Program Director, at 608-609-0052 or Adrian.Stocks@wisconsin.gov;
- Christine Haag, WDNR Remediation and Redevelopment Program Director, at 608-422-1128 or Christine.Haag@wisconsin.gov.

Source: https://dnr.wisconsin.gov/newsroom/release/40561

Recently Awarded Research

EPA Awards Grant to University of Montana to Support Fish Advisory and Consumption Awareness

On September 16, 2020, EPA Region 8 announced an award of $128,992 to the University of Montana to support fish advisory and consumption awareness related to fish harvested through invasive species reduction efforts in Flathead Lake, Montana, and made available to food pantries.

The Confederated Salish and Kootenai Tribes have made a concerted effort to suppress the invasive lake trout population and give the trout caught to local food pantries. The project will assess the fish advisory and consumption awareness among food pantry members who receive lake trout and other fish.

Funds will be used to support six employees, research costs, sample analysis, and travel costs. The project will also initiate a monitoring scheme to estimate a baseline condition of methylmercury that differentiates between atmospheric inputs and changes due to the lake trout suppression. Based on the results, the project will host a half-day workshop with tribal environmental managers, health professionals, and other decision makers to plan for the best uses of the data. Flathead Lake is part of the Columbia River drainage basin, and this project fulfills Columbia River Basin Restoration Program goals of monitoring to evaluate trends and promoting citizen engagement.

Background

The Columbia River Basin Restoration Program was created in 2016, through an amendment to the Clean Water Act. It established both a Funding Assistance Program and a working group made up of state governments, tribal governments, industry representatives, and others.

Under the Clean Water Act, water quality is addressed by reducing pollution, including toxic chemicals that can accumulate in water, sediment, and fish tissues. Tribes and other populations who rely on fish for a substantial portion of their diet can be particularly affected by pollution in the basin.

To learn more about EPA's work in the Columbia River Basin on tribal fish consumption, chemicals of emerging concern, and other related topics, please visit https://www.epa.gov/columbiariver.

For more about the Columbia River Basin Restoration Program, as well as to read summaries of each grant recipient's work, please visit: https://www.epa.gov/columbiariver/columbia-river-basin-restoration-funding-assistance-program.

For more information, contact Laura Jenkins at 720-519-5504 or Jenkins.Laura@epa.gov.

Source: https://www.epa.gov/newsreleases/epa-awards-grant-university-montana-support-fish-advisory-and-consumption-awareness

Tech and Tools

New Tool for Assessing the Benefits, Risks and Sustainability of the Consumption of Fish

Researchers in Spain have developed a tool that helps the user make fish choices that maximize benefits and minimize risks while identifying sustainable choices.

For more information, contact Montserrat Marques at 34-977-558-553 or montserrat.marques@urv.cat.

Source: https://www.eurekalert.org/pub_releases/2021-01/uriv-ntf012021.php

Approved At-Sea Monitoring and Electronic Monitoring Providers for Groundfish Sectors

On February 3, 2021, NOAA Fisheries approved six companies to provide northeast multispecies sector at-sea and/or electronic monitoring services for fishing years 2021 and 2022. Four of the six companies are approved to provide both at-sea and electronic monitoring services: A.I.S., Inc., East West Technical Services, LLC, Fathom Research, LLC, and Saltwater, Inc. The remaining two companies, Flywire Cameras and Teem Fish, are approved to provide electronic monitoring services. Sectors must contract with an approved at-sea and/or electronic monitoring provider to meet sector monitoring requirements.

NOAA Fisheries is still reviewing applications submitted by two additional electronic monitoring providers. NOAA Fisheries will publish a notice in the Federal Register if they decide to approve these companies.

Approved Providers for Fishing Years 2021 and 2022					
Provider	**Services***	**Address**	**Phone**	**Fax**	**Website**
A.I.S., Inc.	ASM/EM	540 Hawthorn St. Dartmouth, MA 02747	508-990-9054	508-990-9055	https://aisobservers.com/
East West Technical Services, LLC	ASM/EM	91 Point Judith Rd. Unit 347 Narragansett, RI 02882	860-910-4957	860-223-6005	https://www.ewts.com/
Fathom Resources, LLC	ASM/EM	855 Aquidneck Ave. Unit 9 Middletown, RI 02842	508-990-0997	508-991-7372	https://fathomresources.com/
Flywire Cameras	EM	PO Box 55048 Lexington, KY 40511	888-315-7796	502-861-6568	https://www.flywirecameras.com/
Saltwater, Inc.	ASM/EM	733 N St. Anchorage, AK 99501	907-276-3241	907-258-5999	https://www.saltwaterinc.com/
Teem Fish	EM	90 – 425 Carrall St. Vancouver, BC V6B 6E3 Canada	778-884-2598		https://teem.fish/

**ASM/EM = At-sea and electronic monitoring; EM = Electronic monitoring*

Source: https://www.fisheries.noaa.gov/bulletin/approved-sea-monitoring-and-electronic-monitoring-providers-groundfish-sectors

Recent Publications

Journal Articles

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

- Chemical characterization of a legacy aqueous film-forming foam sample and developmental toxicity in zebrafish (*Danio rerio*)
  Annunziato, K.M., J. Doherty, J. Lee, J.M. Clark, W. Liang, C.W. Clark, M. Nguyen, M.A. Roy, and A.R. Timme-Laragy. 2020. Chemical characterization of a legacy aqueous film-forming foam sample and developmental toxicity in zebrafish (*Danio rerio*). *Environmental Health Perspectives* 128:9.

- Legacy and alternative halogenated flame retardants in Lake Geneva fish
  Babut, M., P. Marchand, A. Venisseau, B. Veyrand, and B.J.D. Ferrari. 2021. Legacy and alternative halogenated flame retardants in Lake Geneva fish. *Environmental Science and Pollution Research* 28: 7766–7773.

- Tissue distribution and bioaccumulation of legacy and emerging per-and polyfluoroalkyl substances (PFASs) in edible fishes from Taihu Lake, China
  Chen, M., L. Zhu, Q. Wang, and G. Shan. 2021. Tissue distribution and bioaccumulation of legacy and emerging per-and polyfluoroalkyl substances (PFASs) in edible fishes from Taihu Lake, China. *Environmental Pollution* 268(A): 115887.

- Environmental and dietary exposure of perfluorooctanoic acid and perfluorooctanesulfonic acid in the Nakdong River, Korea
  Choi, GH., DY. Lee, P. Bruce-Vanderpuije, et al. Environmental and dietary exposure of perfluorooctanoic acid and perfluorooctanesulfonic acid in the Nakdong River, Korea. *Environmental Geochemistry and Health* 43: 347–360.

- Associations between perfluoroalkyl acids in serum and lead and mercury in whole blood among US children aged 3–11 years
  Jain, R.B. 2021. Associations between perfluoroalkyl acids in serum and lead and mercury in whole blood among US children aged 3–11 years. *Environmental Science and Pollution Research*.

- Temporal trends of per- and polyfluoroalkyl substances in Delaware River fish, USA
  MacGillivray, A.R. 2021. Temporal trends of per- and polyfluoroalkyl substances in Delaware River fish, USA. *Integrated Environmental Assessment and Management* 17: 411-421.

- Perfluoroalkyl substances and cognitive function in older adults: Should we consider non-monotonic dose-responses and chronic kidney disease?
  Park, S.K., N. Ding, and D. Han. 2021. Perfluoroalkyl substances and cognitive function in older adults: Should we consider non-monotonic dose-responses and chronic kidney disease?. *Environmental Research* 192: 110346.

- Isolating the AFFF signature in coastal watersheds using oxidizable PFAS precursors and unexplained organofluorine
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- Sensitivity and accumulation of perfluorooctanesulfonate and perfluorohexanesulfonic acid in Fathead Minnows (*Pimephales promelas*) exposed over critical life stages of reproduction and development
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- Freshwater amphipods (*Gammarus pulex/fossarum*) and brown trout as bioindicators for PFC contamination with regard to the aquatic ecological status of a small stream
  Windisch, U., F. Springer, and T. Stahl. 2020. Freshwater amphipods (*Gammarus pulex/fossarum*) and brown trout as bioindicators for PFC contamination with regard to the aquatic ecological status of a small stream. Environmental Sciences Europe

Upcoming Meetings and Conferences

Virtual 44th Larval Fish Conference
June 24-26, 2021
Virtual

American Fisheries Society 151st Annual Meeting
November 6-10, 2021
Baltimore, MD

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.