EPA United States Environmental Protection Agency

Fish and Shellfish Program NEWSLETTER

August 2016
EPA 823-N-16-003

In This Issue

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

This edition of the Fish and Shellfish Program Newsletter generally focuses on perfluorinated compounds (PFCs).

Recent Advisory News

Delaware Fish Consumption Advisories

In June 2016, Delaware issued a comprehensive update to fish consumption advisories in the northern part of the state. Learn more: http://www.dnrec.delaware.gov/fw/Fisheries/Pages/Advisories.aspx.

Waterbody	Species	Contaminant of Concern	Geographical Extent	Meals/Year (8-Ounce Serving)
Shellpot Creek	All finfish	A, E, G	Governor Printz Blvd to Delaware River	1
	All finfish	A, E, G, H	Upstream of Governor Printz Blvd	2
Tidal Brandywine River	All finfish	A, B, E	River Mouth to Baynard Blvd	2
Non-tidal Brandywine River	All finfish	A, B, E	Baynard Blvd to DE/PA Line	6
Tidal Christina River	All finfish	A	I-95 at Peterson Wildlife Refuge upstream to Smalleys Dam (includes Nonesuch Creek)	12
		A, B, E, F, G	Mouth upstream to I-95 at Peterson Wildlife Refuge	1
Non-tidal Christina River	All finfish	E	Smalley's Dam to DE/MD Line	12
Tidal White Clay Creek	All finfish	A, E, F, G	River Mouth to Route 4	1
Non-tidal White Clay Creek	All finfish	A, E	Route 4 to DE/PA Line	12
Red Clay Creek	All finfish	A, B, E, F	Creek Mouth to DE/PA Line	3
Little Mill Creek	All finfish	A, E, G, H	Creek Mouth to Kirkwood Highway	1

Contaminants of concern: A) polychlorinated biphenyls (PCBs), B) dioxins and furans, E) dieldrin, F) dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethane (DDD), and dichlorodiphenyldichloroethylene (DDE), G) chlordane, H) heptachlor epoxide

For more information on the specific contaminant(s) of concern for each waterbody listed, consult the Delaware Division of Fish & Wildlife's website (www.fw.delaware.gov) or contact DNREC at (302) 739-9902, or the Division of Public Health at (302) 744-4546.

Source: http://www.dnrec.delaware.gov/fw/Fisheries/Documents/2016-Delaware-Fish-Consumption-Advisory-Table.pdf.

Michigan Fish Guidelines

On July 22, 2016, the Michigan Department of Health and Human Services (MDHHS) announced the release of the 2016 regional Eat Safe Fish Guides. These guides help residents plan their fish meals to ensure they are minimizing exposure to chemicals that can build up in fish, while still getting all of the health benefits that eating fish provides. The table below is specific to perfluorooctane sulfonate (PFOS) guidelines. Other fish may also contain PFOS, but in these cases another contaminant level exceeds the amount of PFOS and sets the guidelines. For a full list of the fish consumption guidelines, including chemicals in addition to PFOS, access the link provided below.

Region	County	Waterbody	Type of Fish	Size of Fish	Michigan (MI) Servings Per Month*
Northeast	Iosco	Allen Lake	All Other Species (other than Bluegill, Largemouth/Smallmouth Bass, and Sunfish)	Any	Do not eat**
		Au Sable River (downstream of Foote Dam; includes Van Etten Creek)	Carp	Any	Do not eat**
			Largemouth Bass	Any	Do not eat**
			Rock Bass[1]	Any	Do not eat**
			Smallmouth Bass	Any	Do not eat**
			Suckers	Any	Do not eat**
			All Other Species (other than Brown Trout, Chinook Salmon, Coho Salmon, Rainbow Trout, Steelhead, or Walleye)	Any	Do not eat**
		Clark's Marsh	Bluegill	Any	Do not eat**
			Sunfish	Any	Do not eat**
			All Other Species (other than Bluegill and Sunfish)	Any	Do not eat**
Southwest	Berrien	St. Joseph River (downstream of the Berrien Springs Dam)	Rock Bass	Any	1
	Kent	Rogue River (upstream of Rockford Dam)	Suckers[1]	Any	4
Southeast	Bay	Saginaw River	Bluegill	Any	4
			Largemouth Bass[2]	Under 18"	2
			Smallmouth Bass[2]	Under 18"	2
			Sunfish	Any	4
	Genesee	Flint River (downstream of Mott Dam)	Largemouth Bass	Any	6 per year
			Smallmouth Bass	Any	6 per year
	Saginaw	Saginaw River	Bluegill	Any	4
			Largemouth Bass[2]	Under 18"	2
			Smallmouth Bass[2]	Under 18"	2
			Sunfish	Any	4
		Flint River (downstream of Mott Dam)	Largemouth Bass	Any	6 per year
			Smallmouth Bass	Any	6 per year
			Rock Bass	Any	1

Note: PFOS can't be reduced by trimming and cooking.

*MI Serving Size:

Weight of Person	MI Serving Size
45 pounds	2 ounces
90 pounds	4 ounces
180 pounds	8 ounces

** No one should eat fish listed as do not eat, regardless of age or health. When these fish were tested, MDHHS found very high levels of chemicals. Eating even one meal of these fish could possibly lead to health problems in the future, regardless of age or health.

[1] In addition to PFOS, the guideline also includes mercury

[2] In addition to PFOS, the guideline also includes mercury and PCBs

Source: http://www.michigan.gov/mdhhs/0,5885,7-339-71548_54783_54784_54785_58671-296074--,00.html.

Other Advisory News

Alabama Fish Consumption Advisories

The Alabama Department of Public Health has released its 2016 fish consumption advisories. The main contaminants for which Alabama issues advisories are mercury, PCBs, and perfluoralkyl sulfonate. Statewide advice for at-risk groups (babies, children under 14, women who are nursing, women who are pregnant, and women who plan to become pregnant) includes the following:

- Do NOT eat any king mackerel, shark, swordfish, or tilefish.
- Limit white (albacore) tuna to 6 ounces a week.
- Eat up to 12 ounces (2 average meals) a week of a variety of fish and shellfish that are lower in mercury.
- Check local advisories about the safety of fish caught by family and friends in local lakes, rivers, and coastal areas.
- Follow the recommendations listed above when feeding fish and shellfish to young children, but serve smaller portions.

Specific advisories related to perfluoralkyl sulfonate for Area 1 (Tennessee Basin) are excerpted below:

Waterbody	Location	Species of Fish	Advisory
Baker's Creek	Baker's Creek embayment at Wheeler Reservoir. (Morgan County)	All species	1 meal/month
Wheeler Reservoir	Mid station, main river channel, Tennessee River mile 296. (Limestone County)	Largemouth bass	1 meal/month
	River miles 303 to 296. Area south of the main river channel. (Morgan County)	Largemouth bass	1 meal/month

For more information about Alabama fish consumption advisories, visit: http://www.adph.org/tox/index.asp?id=1360.

Source: http://www.adph.org/tox/assets/Fish_advisory_update_2016.pdf.

Minnesota Fish Consumption Advisories

Minnesota's site-specific fish advisories, including those for PFOS, can be found at: http://www.health.state.mn.us/divs/eh/fish/eating/sitespecific.html.

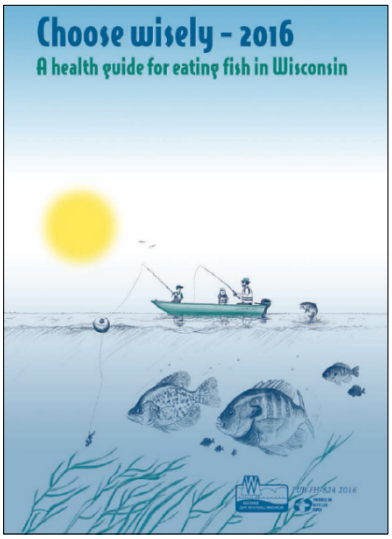
Minnesota has meal advice categories based on levels of mercury, PCBs, and PFOS in fish. Access the table at: http://www.health.state.mn.us/divs/eh/fish/eating/mealadvicetables.pdf.

Delinsky et al. (2010) published the following research regarding PFOS in Minnesota lakes and rivers:

Delinsky, A.D., M.J. Strynar, P.J. McCann, J.L. Varns, L. McMillan, S.F. Nakayama, and A.B. Lindstrom. 2010. Geographical distribution of perfluorinated compounds in fish from Minnesota lakes and rivers. *Environmental Science & Technology* 44(7):2549–2554. http://pubs.acs.org/doi/abs/10.1021/es903777s.

Wisconsin Fish Consumption Guidelines

Wisconsin released *Choose Wisely 2016: A health guide for eating fish in Wisconsin*. *Choose Wisely* provides general statewide safe-eating guidelines and exceptions to statewide advice based on higher levels of contaminants found in fish from some locations. The table below lists species/locations where exceptions are based upon PFOS. To view the full list of Wisconsin's fish consumption guidelines, including contaminants other than PFCs, access the link provided below.



Waterbody	Species*	PFOS-based Advice**
Mississippi River–Pool 3	Bluegill	1 meal/week
	Crappie	1 meal/week
Mississippi River–Pool 4	Bluegill	1 meal/week
Mississippi River–Pools 5, 5A, and 6	Bluegill	1 meal/week
	Crappie	1 meal/week

* Advice for consuming other species from these locations is based on PCBs

**WI Serving Size:

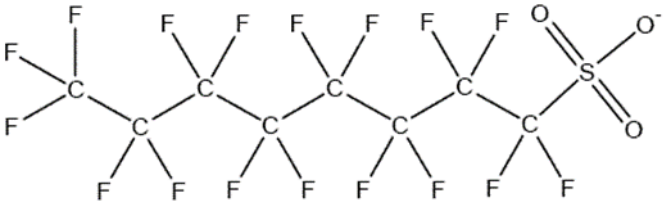
Body Weight	Fillet Weight Before Cooking
75 pounds	¼ pound (4 ounces)
150 pounds	½ pound (8 ounces)
225 pounds	¾ pound (12 ounces)

Source: http://dnr.wi.gov/topic/fishing/documents/consumption/ChooseWisely2016Web.pdf.

EPA News

EPA Releases Drinking Water Health Advisories for PFOA and PFOS

EPA has established health advisories for perfluorooctanoic acid (PFOA) and PFOS based on the agency's assessment of the latest peer-reviewed science to provide drinking water system operators, and state, tribal, and local officials who have the primary responsibility for overseeing these systems, with information on the health risks of these chemicals, so they can take the appropriate actions to protect their residents.

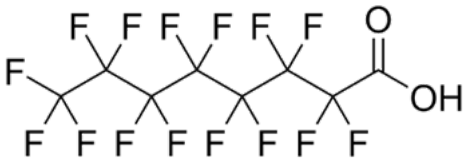


Chemical Structure of PFOS Anion. (Environment Canada. 2006. *Ecological Screening Assessment Report on Perfluorooctane Sulfonate, Its Salts and Its Precursors that Contain the C8F17SO2 or C8F17SO3, or C8F17SO2N Moiety.* Accessed May 2016. http://www.ec.gc.ca/lcpe-cepa/documents/substances/spfo-pfos/ecological_sar_pfos_eng.pdf)

To provide Americans, including the most sensitive populations, with a margin of protection from a lifetime of exposure to PFOA and PFOS from drinking water, EPA has established the health advisory levels at 70 parts per trillion.

Health advisories provide information on contaminants that can cause human health effects and are known or anticipated to occur in drinking water. EPA's health advisories are non-enforceable and non-regulatory and provide technical information to states agencies and other public health officials on health effects, analytical methodologies, and treatment technologies associated with drinking water contamination.

EPA's health advisories are based on the best available peer-reviewed studies of the effects of PFOA and PFOS on laboratory animals (rats and mice) and were also informed by epidemiological studies of human populations that have been exposed to perfluoroalkyl substances. These studies indicate that exposure to PFOA and PFOS over certain levels may result in adverse health effects, including developmental effects to fetuses during pregnancy or to breastfed infants (e.g., low birth weight, accelerated puberty, skeletal variations), cancer (e.g., testicular, kidney), liver effects (e.g., tissue damage), immune effects (e.g., antibody production and immunity), thyroid effects and other effects (e.g., cholesterol changes). To learn more about the underlying studies for the health advisories, see EPA's Health Effects Support Documents for PFOA and PFOS. For more information, visit: https://www.epa.gov/ground-water-and-drinking-water/drinking-water-health-advisories-pfoa-and-pfos.

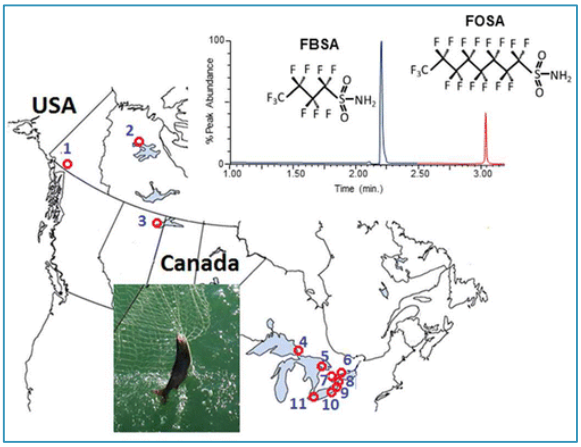


Chemical Structure of PFOA. (SIDS Initial Assessment Profile. 2008. *Final SIDS Assessment Report: PFOA.* Organization for Economic Cooperation and Development. Paris, France. April 16–18. Accessed May 2016. http://webnet.oecd.org/HPV/UI/handler.axd?id=1f391916-96ba-46f6-a7ce-c96712da3b7e)

Other News

An Industrial Chemical Finds Its Way Into Great Lakes Trout

An industrial chemical is showing up in trout from the Great Lakes. It's called perfluoro-1-butane sulfonamide, or FBSA. Researchers traced this chemical back to several products on the market. Those include detergents and surfactants first used in 2003. Surfactants are materials made to stainproof and waterproof products. This research was published in the *Environmental Science & Technology* journal by Chu et al. (2016) (http://pubs.acs.org/doi/abs/10.1021/acs.est.5b05058).



Reprinted with permission from Chu, S., R.J. Letcher, D.J. McGoldrick, and S.M. Backus. 2016. A new fluorinated surfactant contaminant in biota: Perfluorobutane sulfonamide in several fish species. *Environmental Science & Technology* 50(2):669–675. Copyright 2016 American Chemical Society.

The research team tested trout samples from eight different sites in Lakes Erie, Huron, and Ontario. They also tested fish from three other lakes in Canada. Almost all of the fish tested had low levels (in parts per billion) of FBSA. Thirty-two of the 33 samples tested positive for FBSA. Robert Letcher, one of the study's authors, says it was a surprise to find this chemical in fish. Letcher says some companies started using FBSA to replace perfluorooctane sulfonamide.

Source: http://michiganradio.org/post/industrial-chemical-finds-its-way-great-lakes-trout.

PFCs in Fish from Wisconsin's Major Rivers and Great Lakes

A recent report issued by the Wisconsin Department of Natural Resources summarizes the concentrations of PFCs found in 28 fish species from 7 river systems and Lakes Michigan and Superior, and explores the factors affecting PFC concentrations in fish fillets. PFC contamination was found to be spatially heterogeneous, with PFOS present in highest concentrations and present in the highest number of samples compared to other PFCs. PFCs in fish sampled from the Great Lakes were generally lower than those sampled from riverine locations, particularly the Mississippi River, suggesting that proximity to a PFC source is an important factor affecting concentrations. Advisory concentration ranges formulated by the Minnesota Department of Health were used to evaluate PFOS concentrations in Wisconsin fish. PFOS levels in most fish from most locations did not supersede Wisconsin's general statewide advisories or advice already in place due to PCB concentrations, although there are species from some Mississippi River locations where exceptions to general statewide advice are currently provided due to PFOS. This report and others can be found at: http://dnr.wi.gov/topic/Fishing/Consumption/moreinfo.html.

Source: http://dnr.wi.gov/files/PDF/pubs/fh/AdminReports/FH083.pdf.

Recent Publications

Journal Articles

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

Human Dietary Exposure

- Perfluoroalkyl substances in older male anglers in Wisconsin
  Christensen, K.Y., M. Raymond, B.A. Thompson, and H.A. Anderson. 2016. Perfluoroalkyl substances in older male anglers in Wisconsin. *Environment International* 91:312–318.

- Exposure to per- and polyfluoroalkyl substances through the consumption of fish from lakes affected by aqueous film-forming foam emissions—A combined epidemiological and exposure modeling approach. The SAMINOR 2 Clinical Study
  Hansen, S., R. Vestergren, D. Herzke, M. Melhus, A. Evenset, L. Hanssen, M. Brustad, and T.M. Sandanger. 2016. Exposure to per- and polyfluoroalkyl substances through the consumption of fish from lakes affected by aqueous film-forming foam emissions—A combined epidemiological and exposure modeling approach. The SAMINOR 2 Clinical Study. *Environment International* 94:272–282.

- Perfluorinated carboxylic acids in human breast milk from Spain and estimation of infant's daily intake
  Motas Guzmàn, M., C. Clementini, M.D. Pérez-Cárceles, S. Jiménez Rejón, A. Cascone, T. Martellini, C. Guerranti, and A. Cincinelli. 2016. Perfluorinated carboxylic acids in human breast milk from Spain and estimation of infant's daily intake. *Science of the Total Environment* 544:595–600.

Concentrations and Effects in Fish and Shellfish

- Comparison of perfluoroalkyl substances contamination in farmed and wild-caught European sea bass (*Dicentrarchus labrax*)
  Barbarossa, A., T. Gazzotti, F. Farabegoli, F. Romana Mancini, E. Zironi, A. Badiani, L. Busani, and G. Pagliuca. 2016. Comparison of perfluoroalkyl substances contamination in farmed and wild-caught European sea bass (*Dicentrarchus labrax*). *Food Control* 63:224–229.

- Perfluoroalkylated substances (PFASs) and legacy persistent organic pollutants (POPs) in halibut and shrimp from coastal areas in the far north of Norway: Small survey of important dietary foodstuffs for coastal communities
  Carlsson, P., J.D. Crosse, C. Halsall, A. Evenset, E.S. Heimstad, and M. Harju. 2016. Perfluoroalkylated substances (PFASs) and legacy persistent organic pollutants (POPs) in halibut and shrimp from coastal areas in the far north of Norway: Small survey of important dietary foodstuffs for coastal communities. *Marine Pollution Bulletin* 105(1):81–87.

- Chronic perfluorooctane sulfonate (PFOS) exposure induces hepatic steatosis in zebrafish
  Cheng, J., S. Lv, S. Nie, J. Liu, S. Tong, N. Kang, Y. Xiao, Q. Dong, C. Huang, and D. Yang. 2016. Chronic perfluorooctane sulfonate (PFOS) exposure induces hepatic steatosis in zebrafish. *Aquatic Toxicology* 176:45–52.

- Molecular impacts of perfluorinated chemicals (PFASs) in the liver and testis of male largemouth bass (*Micropterus salmoides*) in Minnesota Lakes
  Collí-Dulá, R.C., C.J. Martyniuk, S. Streets, N.D. Denslow, and R. Lehr. 2016. Molecular impacts of perfluorinated chemicals (PFASs) in the liver and testis of male largemouth bass (*Micropterus salmoides*) in Minnesota Lakes. *Comparative Biochemistry and Physiology, Part D: Genomics and Proteomics* 19:129–139.

- Common carp *Cyprinus carpio* responses to sub-chronic exposure to perfluorooctanoic acid
  Giari, L., F. Vincenzi, S. Badini, C. Guerranti, B.S. Dezfuli, E.A. Fano, and G. Castaldelli. 2016. Common carp *Cyprinus carpio* responses to sub-chronic exposure to perfluorooctanoic acid. *Environmental Science and Pollution Research* 23(15):15321—15330.

- Phthalates and perfluorinated alkylated substances in Atlantic bluefin tuna (*Thunnus thynnus*) specimens from Mediterranean Sea (Sardinia, Italy): Levels and risks for human consumption
  Guerranti, C., A. Cau, M. Renzi, S. Badini, E. Grazioli, G. Perra, and S.E. Focardi. 2016. Phthalates and perfluorinated alkylated substances in Atlantic bluefin tuna (*Thunnus thynnus*) specimens from Mediterranean Sea (Sardinia, Italy): Levels and risks for human consumption. *Journal of Environmental Science and Health, Part B* 51(10):661–667.

- PFOS, PFNA, and PFOA sub-lethal exposure to embryonic zebrafish have different toxicity profiles in terms of morphometrics, behavior and gene expression
  Jantzen, C.E., K.A. Annunziato, S.M. Bugel, and K.R. Cooper. 2016. PFOS, PFNA, and PFOA sub-lethal exposure to embryonic zebrafish have different toxicity profiles in terms of morphometrics, behavior and gene expression. *Aquatic Toxicology* 175:160–170.

- Perfluorinated compounds in fish from U.S. urban rivers and the Great Lakes
  Stahl, L.L., B.D. Snyder, A.R. Olsen, T.M. Kincaid, J.B. Wathen, and H.B. McCarty. 2014. Perfluorinated compounds in fish from U.S. urban rivers and the Great Lakes. *Science of the Total Environment* 499:185–195.

- Preliminary investigation of perfluoroalkyl substances in exploited fishes of two contaminated estuaries
  Taylor, M.D., and D.D. Johnson. In press. Preliminary investigation of perfluoroalkyl substances in exploited fishes of two contaminated estuaries. *Marine Pollution Bulletin*.

Concentrations in Water, Sediment, and Biota

- High levels, partitioning and fish consumption based water guidelines of perfluoroalkyl acids downstream of a former firefighting training facility in Canada
  Bhavsar, S.P., C. Fowler, S. Day, S. Petro, N. Gandhi, S.B. Gewurtz, C. Hao, X. Zhao, K.G. Drouillard, and D. Morse. 2016. High levels, partitioning and fish consumption based water guidelines of perfluoroalkyl acids downstream of a former firefighting training facility in Canada. *Environment International* 94:415–423.

- Perfluoroalkyl acids (PFAAs) and selected precursors in the Baltic Sea environment: Do precursors play a role in food web accumulation of PFAAs?
  Gebbink, W.A., A. Bignert, and U. Berger. 2016. Perfluoroalkyl acids (PFAAs) and selected precursors in the Baltic Sea environment: Do precursors play a role in food web accumulation of PFAAs? *Environmental Science & Technology* 50(12):6354–6362.

- A nationwide survey of perfluorinated alkyl substances in waters, sediment and biota collected from aquatic environment in Vietnam: Distributions and bioconcentration profiles
  Lam, N.H., C.R. Cho, K. Kannan, and H.S. Cho. In press. A nationwide survey of perfluorinated alkyl substances in waters, sediment and biota collected from aquatic environment in Vietnam: Distributions and bioconcentration profiles. *Journal of Hazardous Materials*.

- Perfluoroalkyl substances in the Ebro and Guadalquivir river basins (Spain)
  Lorenzo, M., J. Campo, M. Farré, F. Pérez, Y. Picó, and D. Barceló. 2016. Perfluoroalkyl substances in the Ebro and Guadalquivir river basins (Spain). *Science of the Total Environment* 540:191–199.

Other

- PFOS and PFOA in cereals and fish: Development and validation of a high performance liquid chromatography-tandem mass spectrometry method
  Ciccotelli, V., M.C. Abete, and S. Squadrone. 2016. PFOS and PFOA in cereals and fish: Development and validation of a high performance liquid chromatography-tandem mass spectrometry method. *Food Control* 59:46–52.

- Toxicokinetics of perfluorooctane sulfonate in rainbow trout (*Oncorhynchus mykiss*)
  Consoer, D.M., A.D. Hoffman, P.N. Fitzsimmons, P.A. Kosian, and J.W. Nichols. 2016. Toxicokinetics of perfluorooctane sulfonate in rainbow trout (*Oncorhynchus mykiss*). *Environmental Toxicology and Chemistry* 35(3):717–727.

Upcoming Meetings and Conferences

Pacific Coast Shellfish Growers Association 70th Annual Shellfish Conference and Tradeshow
October 11–14, 2016
Chelan, Washington

IX Brazilian Crustacean Congress
November 6–9, 2016
Crato, Brazil

18th International Conference on Shellfish Restoration
November 16–19, 2016
Charleston, South Carolina

67th Annual Northwest Fish Culture Concepts: A Workshop for Fish Culturists
December 6–8, 2016
Centralia, Washington

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.