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Fish and Shellfish Program NEWSLETTER

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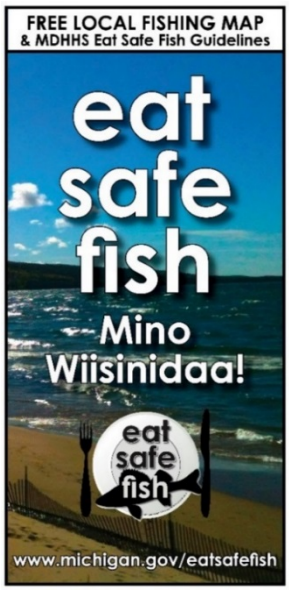
In This Issue

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

This edition of the Fish and Shellfish Program Newsletter generally focuses on microplastics.

Recent Advisory News



Michigan's Subsistence Fish Consumption Education Program

One priority of the Michigan Department of Health and Human Services' (MDHHS) Division of Environmental Health is to educate subsistence-level anglers in both urban and rural Michigan about ways to choose fish that are lower in contaminants and safer to eat from the waterbodies that they are fishing.

Rather than relying on people seeking out the information MDHHS brings the information to the shoreline anglers through the River Walker program by posting informative signs that use plain language and attractive design at popular fishing access points, distributing materials (developed with the goal of educating individuals with low literacy rates) to locations frequented by anglers, and by bringing the outreach materials directly to the individuals who are fishing.

The River Walker program uses two community members—ideally experienced anglers themselves—who visit pre-determined shoreline fishing locations throughout the spring and summer. They explain, one-on-one, the fish consumption guidelines and the reasons for the guidelines, and provide the anglers with outreach materials.

MDHHS also works with communities in more rural parts of Michigan, including the Keweenaw Bay Indian Community (KBIC) in Michigan's Upper Peninsula. Collaborating with stakeholders from KBIC Tribal Health and KBIC Natural Resources, MDHHS developed area-specific brochures for the Torch Lake Area of Concern, incorporating the language of the Anishinaabe, Ojibwe, and cultural and historical information on the Tribal Fishing legacy. These brochures are distributed by trusted community entities including the Tribal Health Clinic, the KBIC Natural Resources Department, and at special events like the annual summer KBIC Kids' Fishing Derby held in Baraga, Michigan. For more information, visit: www.michigan.gov/eatsafefish.

Puget Sound, Washington, Dungeness Crab and Spot Prawn Consumption Advisory

In July 2016, the Washington State Department of Health (DOH) issued the *Puget Sound Dungeness Crab and Spot Prawn Consumption Advisory*. In 2011 and 2012, Washington State Department of Fish and Wildlife (WDFW) conducted an assessment of toxic chemical contaminants in Puget Sound Dungeness crab and spot prawn. Sampling was conducted in nine WDFW Marine Areas and three urban embayments. The contaminants investigated were persistent organic pollutants which included polychlorinated biphenyls, polybrominated diphenyl ethers, polycyclic aromatic hydrocarbons, and organochlorine pesticides as well as six metals (mercury, arsenic, cadmium, copper, lead, and zinc). WDFW evaluated how much of these contaminants were in Dungeness crab muscle (meat), hepatopancreas (crab butter), spot prawn muscle (tail), and head tissue. Washington State DOH used this information to determine if they were safe to eat. Results of the analysis are available at http://www.doh.wa.gov/Portals/1/Documents/Pubs/334-378.pdf. The table below displays the Dungeness crab and spot prawn consumption guidance for each Puget Sound Recreational Marine Area and three urbanized embayments.

Marine Area/Location	Dungeness Crab Avoid Dungeness crab butter		Spot Prawn Avoid spot prawn heads	
	Crab Meat Consumption Guidance	Crab Butter Consumption Guidance	Spot Prawn Meat Consumption Guidance	Spot Prawn Heads Consumption Guidance
6 East Juan de Fuca Strait	Unrestricted*	4 servings per month	Unrestricted*	8 servings with heads per month
Exception: Port Angeles Harbor	4 servings per month	Do not eat crab butter	N/A	N/A
7 San Juan Islands	Unrestricted	4 servings per month	Unrestricted	Unrestricted
8.1 Deception Pass, Hope Island & Skagit	Unrestricted	4 servings per month	Unrestricted	Do not eat heads
8.2 Port Susan/Port Gardner	Unrestricted	1 serving per month	Unrestricted	Do not eat heads
9 Admiralty Inlet	Unrestricted	2 servings per month	Unrestricted	Do not eat heads
10 Seattle-Bremerton	8 servings per month	Do not eat crab butter	Unrestricted	Do not eat heads
Exception: Elliott Bay	2 servings per month	Do not eat crab butter	8 servings per month	Do not eat heads
Exception: Sinclair Inlet	2 servings per month	Do not eat crab butter	8 servings per month	Do not eat heads
11 Tacoma-Vashon	Unrestricted	2 servings per month	Unrestricted	Do not eat heads
Exception: Commencement Bay	4 servings per month	2 servings per month	4 servings per month	Do not eat heads
12 Hood Canal	Unrestricted	2 servings per month	Unrestricted	8 servings with heads per month
13 South Puget Sound (South of the Tacoma Narrows)	Unrestricted	1 serving per month	Unrestricted	Do not eat heads

*Consumption is unlimited.
N/A: not applicable

Note: A serving is 8 ounces uncooked seafood for a 160 pound adult. If you weigh more or less than 160 pounds, add or subtract one ounce for every 20-pound difference in body weight.

If you eat the recommended amount from an area that has restrictions, no other seafood should be eaten that week or month.

Source: http://www.doh.wa.gov/Portals/1/Documents/Pubs/334-400.pdf.

New Jersey Guide to Health Advisories for Eating Fish and Crab

New Jersey updated its fish consumption advisories in 2016 using the results of a study involving the analysis of 149 samples of 12 fish species collected from 11 lakes, rivers, ponds, and reservoirs that flow into the upper and lower portions of the Raritan River. The table below only includes new, revised, or updated 2016 fish advisories. For a full list of the fish consumption guidelines, access the link provided below.

Type of Waterbody	County/ Location	Waterbody	Species	General Population- Eat No More Than: [2] [3]	High Risk Population- [1] Eat No More Than: [2] [3]	New, Revised, or Updated Advisory [4]
Estuarine and Marine	Includes the Raritan Bay, tidal Raritan River (up to the Rt. 1 bridge), and all tidal tributaries)	Raritan Bay Complex	Striped Bass	One meal per month	Do not eat	Updated
			Redbreast Sunfish	One meal per week	One meal per month	New
			Channel Catfish	One meal per month	Do not eat	New
Freshwater	Statewide	Applies to all except Pinelands Region and waterbody specific advisories	Common Carp	One meal per month	Do not eat	New
	Mercer County	Carnegie Lake at Princeton	Largemouth Bass	No restrictions	One meal per month	Updated
			Bluegill Sunfish	No restrictions	One meal per week	Revised
			Common Carp	One meal per month	One meal per month	New
	Middlesex County	Davidsons Mill Pond at Deans	Largemouth Bass	One meal per week	One meal per month	Updated
			Bluegill Sunfish	No restrictions	One meal per week	Updated
			Yellow Bullhead	No restrictions	One meal per week	New
		Farrington Lake at Milltown	Largemouth Bass	Four meals per year	Do not eat	Revised
			Bluegill Sunfish	No restrictions	One meal per week	Updated
			Common Carp	One meal per month	One meal per month	New
		Manalapan Lake at Jamesburg	Largemouth Bass	No restrictions	One meal per week	Revised
			Yellow Perch	No restrictions	One meal per week	Updated
			Brown Bullhead	One meal per week	One meal per week	New
		Weston Mill Pond at New Brunswick	Largemouth Bass	No restrictions	One meal per month	Revised
			Bluegill Sunfish	No restrictions	One meal per week	Updated
			Brown Bullhead	One meal per week	One meal per month	Updated
	Somerset County	Millstone River at Manville	Largemouth Bass	No restrictions	One meal per month	Revised
			Chain Pickerel	No restrictions	One meal per week	New
			Channel Catfish	One meal per week	One meal per month	New
			Bluegill Sunfish	No restrictions	One meal per week	Updated
			Common Carp	One meal per month	One meal per month	Revised
		Raritan River- Confluence of the Millstone River at Millstone	Smallmouth Bass	One meal per week	One meal per month	Revised
			Redbreast Sunfish	One meal per month	One meal per month	Revised
			Channel Catfish	One meal per month	Do not eat	Updated
	Mercer County	Peddie Lake at Hightstown	Largemouth Bass	One meal per week	One meal per month	Updated
			Bluegill Sunfish	No restrictions	One meal per week	Updated
			Brown Bullhead	One meal per week	One meal per week	New
		Rosedale Lake at Pennington	Largemouth Bass	No restrictions	One meal per week	Revised
			Bluegill Sunfish	No restrictions	No restrictions	Updated
			Common Carp	One meal per week	One meal per month	Updated
	Hunterdon County	Round Valley Reservoir at Lebanon	Smallmouth Bass	No restrictions	One meal per week	New
			Bluegill Sunfish	No restrictions	One meal per week	Updated
			American Eel	One meal per month	One meal per month	New

[1] High risk individuals include infants, children, pregnant women, nursing mothers, and women of childbearing age.

[2] One meal is defined as an eight-ounce serving.

[3] Eat only the fillet portions of the fish. Use proper trimming techniques to remove fat, and cooking methods that allow juices to drain from the fish (e.g., baking, broiling, frying, grilling, and steaming). See text for full description.

[4] New indicates new advisory; revised indicates an advisory changed; updated indicates new data-no change in advisory.

Source: http://www.nj.gov/dep/dsr/fishadvisories/2016-fish-advisories.pdf.

EPA News

EPA Studying Microplastics Occurrence in Great Lakes Sport Fish

Microplastics (plastics < 5 mm in size in any dimension) have been found to be ubiquitous in freshwater, estuarine, and marine ecosystems around the world. Primary microplastics, such as the microbeads used in cosmetic products, are intended for product use, while secondary microplastics form in the environment from the breakdown of larger plastic items such as grocery bags. Recent global reports of microplastics in a variety of fish and shellfish species have raised concerns about their potential human health and ecological impacts.

Microplastics seen during a marine debris removal mission. (*Image courtesy of NOAA*)

The Office of Wetlands, Oceans and Watersheds (OWOW) and the Office of Science and Technology (OST), both within EPA's Office of Water, are working with EPA's Great Lakes National Program Office (GLNPO) to assess the occurrence of microplastics in the stomachs of Great Lakes sport fish. The study is being funded and managed by the Trash Free Waters program in OWOW.

Microplastics have been found in the Great Lakes in both water and sediment. Fish in the Lakes may ingest microplastics either directly during feeding, or indirectly by ingesting smaller fish that have ingested microplastics. Fish for the microplastics study were collected in 2015 as part of the joint OST/GLNPO Great Lakes Human Health Fish Fillet Tissue Study conducted under EPA's 2015 National Coastal Condition Assessment. The fish stomachs were not used for the OST/GLNPO human health fish tissue study but were provided for the microplastics analysis.

Analysis of the fish stomachs for microplastics will be conducted by a laboratory at the California Department of Public Health in collaboration with colleagues in EPA Region 9. The analysis will determine the amount of plastics in the fish stomachs down to very small particle sizes, as well as the types of plastics present. The results of this study will improve the current understanding of microplastics distribution in the Great Lakes and their occurrence in fish.

Sources: http://www.lakescientist.com/microplastics-pollution-great-lakes-ecosystem-summary-presentations-iaglr-2014/; http://www.gesamp.org/work-programme/workgroups/working-group-40/wg-40-brochure.

For more information, contact Bob Benson (Benson.Robert@epa.gov) or Leanne Stahl (Stahl.Leanne@epa.gov).

Other News

Vancouver Island University Study Looks at Effects of Microplastics on Shellfish

A team of researchers collected 2,000 oysters and 1,000 clams from Baynes Sound and moved them to 22 different beaches on Vancouver Island and the northern Sunshine Coast. Half of the tagged shellfish are at fish farms. Research team leader Garth Covernton says tests of the shellfish for microplastic levels were done prior to being moved. The plan is to leave them for the summer and then collect them in the fall to look at levels in microplastics, to see if there are regional differences or differences between wild sites and fish farm sites. "I have sites up in Quadra where there's less human development and ones in Baynes Sound, near Denman, where there's high concentrations of human activity," said Covernton. "So it's really comparing the effects that might have on the microplastic that shellfish are ingesting."

Covernton says the long-term effects that microplastics have on shellfish are unclear, but there is a growing case that says the tiny pieces of plastic are harming shellfish. "For instance, for oysters, which could be a concern for the shellfish aquaculture industry, there has been recent work showing that oyster reproductive output actually decreases when they've been fed microplastics [*sic*]."

Source: http://nanaimonewsnow.com/article/504934/viu-study-looks-effects-microplastics-shellfish.

Bellies Full of Microplastic Rob Baby Fish of Their Basic Instincts

When exposed to microplastics, baby fish stop eating natural food and prefer consuming the pollutant, according to a report from ecologists at Uppsala University in Sweden. The dietary switch derails the basic instincts of the fish, the researchers found, elevating the likelihood of being caught by predators. The findings may explain why populations of European perch (*Perca fluviatilis*)—the main species analyzed in the study—have declined in the Baltic Sea. "Perch are common and popular recreational fish in Sweden," said Oona Lönnstedt, an Uppsala ecologist and the project's leader. "But they have seen continuous and rapid declines in density and abundance since the mid-1990s in the Baltic Sea." The trend is especially true for young perch, and the cause remains unknown. Some experts blame habitat destruction, while others cite too much salty runoff from land due to climate change. But two years ago, Lönnstedt and her colleagues set their sights on microplastics as a leading factor.

Recent estimates suggest up to 236,000 metric tons of microplastics wash into the oceans each year. That's equivalent to the weight of 1,300 blue whales, and it may represent just one percent of the total contained in oceans. The Baltic Sea carries about 25 to 40 plastic particles per gallon of water—or 229 quadrillion pieces across its entire volume. Lönnstedt's study examined how microplastics influence every stage of European perch development. The team started with eggs collected from the Baltic Sea. They raised 60 of these embryos in three tanks carrying either no microplastics, an average amount observed in parts of the Baltic Sea (40 particles per gallon) or an extreme level (300 particles per gallon). Sans pollution, the eggs hatched about 96 percent of the time, but birth rates fell with both average (89 percent) and extreme (81 percent) quantities of microplastics.

The researchers raised European perch for 10 days in regular water with the perch's favorite food, brine shrimp, and then added microplastics to the tanks. "The biggest surprise in this study was the fact that larvae preferentially ate microplastic particles," said Lönnstedt. "They literally stuffed themselves with the microbeads and ignored their natural food source." Larval fish exposed to microplastics also became lethargic, spent more time in a motionless state and swam shorter distances across their aquarium.

Tiny microplastics that can be ingested by a range of freshwater life. (*Photo by Chesapeake Bay Program, CC BY-NC 2.0*)

One way baby perch survive their vulnerable youth is by smelling predators. Predators exude repulsive scents that the baby fish can sniff and avoid. When the team squirted drops of these chemical alarms into the tanks, they found fish with microplastics were less likely to flee. The microplastics impaired the perch's olfactory reflexes. There could be two potential reasons for this. Either the plastic particles exude toxic chemicals that interfere with nerve development, effectively altering their behaviors and olfactory responses," Lönnstedt said. "Alternatively, the fish are lacking so much energy, due to plastic-filled stomachs, that they simply have no energy…and consequently ignore the chemical threat cues of predators."

In a separate experiment, the team added a perch predator—Northern pike (*Esox lucius*) and then monitored survival for 24 hours. Without microplastics, 46 percent of baby perch survived the night. Average microplastic levels cut 24-hour survival by another 20 percent. None survived against predators with high levels of microplastics.

Perch may not be suffering alone. Since completing this study, Lönnstedt and her colleagues have recorded similar (unpublished) patterns in other species of larval fish, both tropical (coral reef damselfish) and temperate (pike and flounder). "In this way, the plastic contaminants are transferred from the small prey fish to the larger predatory pike and are likely to bioaccumulate in the food chain," Lönnstedt said. "If this process takes place in the marine ecosystem, plastics can affect the health of food webs, which include humans as an apex predator."

The next step in the project will be examining the process in nature. They've found European perch in the Baltic Sea with bellies filled with plastic, but this needs to be studied more in depth, according to Lönnstedt. The other open question is whether all types of plastic cause these problems. This study used polystyrene, a common and inexpensive polymer found in fishing floats, buoys, packaging and insulation, toys, kitchen appliances, lids, bottles, and disposable cutlery.

Lönnstedt, O.M., and P. Eklöv. 2016. Environmentally relevant concentrations of microplastic particles influence larval fish ecology. *Science* 352(6290):1213–1216.

Source: http://www.pbs.org/newshour/rundown/microplastics-rob-baby-fish-of-their-basic-fear-instincts/.

Recent Publications

Journal Articles

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

Accumulation in Fish and Shellfish

- Transfer of benzo[a]pyrene from microplastics to *Artemia* nauplii and further to zebrafish via a trophic food web experiment: CYP1A induction and visual tracking of persistent organic pollutants
  Batel, A., F. Linti, M. Scherer, L. Erdinger, and T. Braunbeck. 2016. Transfer of benzo[a]pyrene from microplastics to *Artemia* nauplii and further to zebrafish via a trophic food web experiment: CYP1A induction and visual tracking of persistent organic pollutants. *Environmental Toxicology and Chemistry* 35(7):1656–1666.

- Ingestion of microplastics by demersal fish from the Spanish Atlantic and Mediterranean coasts
  Bellas, J., J. Martínez-Armental, A. Martínez-Cámara, V. Besada, and C. Martínez-Gómez. 2016. Ingestion of microplastics by demersal fish from the Spanish Atlantic and Mediterranean coasts. *Marine Pollution Bulletin* 109(1):55–60.

- Plastic ingestion by fish in the Southern Hemisphere: A baseline study and review of methods
  Cannon, S.M.E., J.L. Lavers, and B. Figueiredo. 2016. Plastic ingestion by fish in the Southern Hemisphere: A baseline study and review of methods. *Marine Pollution Bulletin* 107(1):286–291.

- Microplastic ingestion by wild and cultured manila clams (*Venerupis philippinarum*) from Baynes Sound, British Columbia
  Davidson, K., and S.E. Dudas. 2016. Microplastic ingestion by wild and cultured manila clams (*Venerupis philippinarum*) from Baynes Sound, British Columbia. *Archives of Environmental Contamination and Toxicology* 71(2):147–156.

- Microplastics in mussels along the coastal waters of China
  Li, J., X. Qu, L. Su, W. Zhang, D. Yang, P. Kolandhasamy, D. Li, and H. Shi. 2016. Microplastics in mussels along the coastal waters of China. *Environmental Pollution* 214:177–184.

- Microplastic interactions with North Atlantic mesopelagic fish
  Lusher, A.L., C. O'Donnell, R. Officer, and I. O'Connor. 2016. Microplastic interactions with North Atlantic mesopelagic fish. *ICES Journal of Marine Science* 73(4):1214–1225.

- High levels of microplastic ingestion by the semipelagic fish bogue *Boops boops* (L.) around the Balearic Islands
  Nadal, M.A., C. Alomar, and S. Deudero. 2016. High levels of microplastic ingestion by the semipelagic fish bogue Boops boops (L.) around the Balearic Islands. *Environmental Pollution* 214:517–523.

- Plastic ingestion by estuarine mullet *Mugil cephalus* (Mugilidae) in an urban harbour, KwaZulu-Natal, South Africa
  Naidoo, T., A.J. Smit, and D. Glassom. 2016. Plastic ingestion by estuarine mullet *Mugil cephalus* (Mugilidae) in an urban harbour, KwaZulu-Natal, South Africa. *African Journal of Marine Science* 38(1):145–149.

- Plastic ingestion by pelagic and demersal fish from the North Sea and Baltic Sea
  Rummel, C.D., M.G.J. Löder, N.F. Fricke, T. Lang, E.M. Griebeler, M. Janke, and G. Gerdts. 2016. Plastic ingestion by pelagic and demersal fish from the North Sea and Baltic Sea. *Marine Pollution Bulletin* 102(1):134–141.

- Microplastic contamination in natural mussel beds from a Brazilian urbanized coastal region: Rapid evaluation through bioassessment
  Santana, M.F.M., L.G. Ascer, M.R. Custódio, F.T. Moreira, and A. Turra. 2016. Microplastic contamination in natural mussel beds from a Brazilian urbanized coastal region: Rapid evaluation through bioassessment. *Marine Pollution Bulletin* 106(1–2):183–189.

- Chemical pollutants sorbed to ingested microbeads from personal care products accumulate in fish
  Wardrop, P., J. Shimeta, D. Nugegoda, P.D. Morrison, A. Miranda, M. Tang, and B.O. Clarke. 2016. Chemical pollutants sorbed to ingested microbeads from personal care products accumulate in fish. *Environmental Science & Technology* 50(7):4037–4044.

Fish and Shellfish Health

- Uptake and accumulation of polystyrene microplastics in zebrafish (*Danio rerio*) and toxic effects in liver
  Lu, Y., Y. Zhang, Y. Deng, W. Jiang, Y. Zhao, J. Geng, L. Ding, and H. Ren. 2016. Uptake and accumulation of polystyrene microplastics in zebrafish (*Danio rerio*) and toxic effects in liver. *Environmental Science & Technology* 50(7):4054–4060.

- Intestinal alterations in European sea bass *Dicentrarchus labrax* (Linnaeus, 1758) exposed to microplastics: Preliminary results
  Pedá, C., L. Caccamo, M.C. Fossi, F. Gai, F. Andaloro, L. Genovese, A. Perdichizzi, T. Romeo, and G. Maricchiolo. 2016. Intestinal alterations in European sea bass *Dicentrarchus labrax* (Linnaeus, 1758) exposed to microplastics: Preliminary results. *Environmental Pollution* 212:251–256.

- Oyster reproduction is affected by exposure to polystyrene microplastics
  Sussarellu, R., M. Suquet, Y. Thomas, C. Lambert, C. Fabioux, M.E.J. Pernet, N.L. Goïc, V. Quillien, C. Mingant, Y. Epelboin, C. Corporeau, J. Guyomarch, J. Robbens, I. Paul-Pont, P. Soudant, and A. Huvet. 2016. Oyster reproduction is affected by exposure to polystyrene microplastics. *Proceedings of the National Academy of Sciences of the United States of America* 113(9):2430–2435.

- Effect of microplastic on the gills of the shore crab *Carcinus maenas*
  Watts, A.J.R., M.A. Urbina, R. Goodhead, J. Moger, C. Lewis, and T.S. Galloway. 2016. Effect of microplastic on the gills of the shore crab *Carcinus maenas*. *Environmental Science & Technology* 50(10):5364–5369.

Other

- First evidence of microplastics in the African Great Lakes: Recovery from Lake Victoria Nile perch and Nile tilapia
  Biginagwa, F.J., B.S. Mayoma, Y. Shashoua, K. Syberg, and F.R. Khan. 2016. First evidence of microplastics in the African Great Lakes: Recovery from Lake Victoria Nile perch and Nile tilapia. *Journal of Great Lakes Research* 42(1):146–149.

- Are we eating plastic-ingesting fish?
  Miranda, D.D.A., and G.F. de Carvalho-Souza. 2016. Are we eating plastic-ingesting fish? *Marine Pollution Bulletin* 103(1–2):109–114.

Upcoming Meetings and Conferences

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

109th Annual Meeting of the National Shellfisheries Association
March 26–30, 2017
Knoxville, Tennessee

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.