EPA United States Environmental Protection Agency

Fish and Shellfish Program NEWSLETTER

September 2017
EPA 823-N-17-009

In This Issue

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

Recent Advisory News

Arizona Fish Consumption Advisories

The Arizona Department of Environmental Quality (ADEQ) monitors contaminants in fish tissues statewide, prioritizing water bodies that are popular fishing spots (view videos here). When ADEQ's tests show a fish species found in a stream or lake with a contaminant level higher than health standards, ADEQ issues a fish consumption advisory that identifies the contaminant of concern and provides guidance for which fish to eat and how much. The complete list of advisories can be found in the ADEQ Fish Consumption Advisories Fact Sheet.

Each year, ADEQ works in collaboration with the Arizona Game and Fish Department (AZGFD) to sample fish from up to 20 Arizona streams and lakes. This testing has identified fish to avoid ("red light") and fish that can be eaten in limited amounts ("orange light"). In the past, the public and anglers were routinely informed about consumption advisories, but never which fish species at which locations can be caught, eaten and enjoyed without limits.

For the first time in Arizona, in September 2017, ADEQ and AZGFD launched an initiative to highlight a "green light" list of fish species from specific waters that may be eaten without limits (also see infographic and press release). The list includes all trout statewide. Arizona has a total of 220 waters that AZGFD manages for trout, making up approximately 40,000 surface acres of lakes and 1,000 miles of rivers or streams. These "Green Light Fisheries" also include channel catfish supplied for the AZGFD Community Fishing Program. Notable "green light" fisheries include largemouth bass at Lake Havasu, as well as flathead catfish and largemouth bass from the Colorado River in Yuma.

Are fish caught in Arizona waters healthy to eat?

Yes, when you follow Arizona's fish consumption guidelines. To protect the health of everyone who wants to enjoy eating fish caught in Arizona waters, the State of Arizona issues fish consumption advisories. These advisories recommend healthy amounts of affected fish to eat and let the public know about possible adverse health effects from eating more than the recommended amount of these fish on a regular basis during a lifetime.

Fish are part of a healthy diet and are a good source of low-fat protein. However, mercury levels in fish can be high because mercury can attach to muscle through a process called

bioaccumulation. You can lower potential health risks from eating fish containing mercury by following fish consumption advice. You also can lower the amount of pollutants you consume and increase healthful benefits by eating smaller, younger fish, or eating specific fish types, such as trout or bluegill, which contain less mercury.

Is it healthy to swim or wade in lakes with fish consumption advisories in Arizona?

Yes. Fish consumption advisories have no effect on recreational uses by people and domestic animals. In aquatic ecosystems, such as lakes and streams, where fish consumption advisories are in effect, only tiny amounts of the pollutants found in the fish are in the water. These pollutants are contained in the organisms inhabiting that ecosystem, which leaves extremely small amounts available in the water. Certain pollutants in aquatic ecosystems can accumulate in living organisms like fish and aquatic insects because they bind to muscle or fat and move through the food web cycle from one organism to another.

Is it O.K. to fish in lakes with fish consumption advisories?

Yes. Children and adults of all ages can enjoy fishing and recreational water uses, including swimming, without concern.

What is ADEQ doing about mercury in the environment?

ADEQ collects and analyzes data and conducts research to determine mercury sources in Arizona and develop feasible methods to lower mercury levels. Long-term strategies at the state and federal levels include reducing mercury in consumer products, encouraging development of new or alternative technologies and facilitating proper disposal of mercury-containing products. Reducing mercury contamination is a collaborative effort among state and federal agencies including AZGFD, Arizona Department of Health Services, U.S. Environmental Protection Agency (EPA), U.S. Geological Survey (USGS), land managers, and other public and private groups.

More information about Arizona's fish consumption advisories

Arizona's mercury fish consumption advisories are based on the risk associated with eating fish from rivers, lakes, and reservoirs throughout the state. The advisories and recommended consumption are based on the same risk analysis methods EPA used for its national mercury advisory (including the national fish tissue standard of 0.3 mg/kg for methylmercury).

The newest fish consumption advisories issued by ADEQ are below (also see press release):

Arizona Fish Consumption Advisories for Mercury		
Water Body Name	**Species (Advisory Issue Date)**	**Advice**
Becker Lake	Largemouth bass (August 2017)	Limit Consumption
Black Canyon Lake	Largemouth bass (August 2017)	Limit Consumption
Canyon Lake	Yellow bass (August 2017)	Limit Consumption
Limit Consumption = ADEQ recommends that adults eat only 2.5 ounces (uncooked weight) per week and children 12 years of age and younger limit consumption to 2 ounces per month (uncooked weight) of this fish species from this water body.		

To learn more about ADEQ's Arizona Fish Consumption Advisories and access the online, interactive geographic information system (GIS) eMap, visit http://azdeq.gov/fishadvisories. For more information about the joint EPA

and U.S. Food and Drug Administration (FDA) Advice About Eating Fish, visit https://www.epa.gov/fish-tech/2017-epa-fda-advice-about-eating-fish-and-shellfish.

For more information, contact:

Sam Rector, Aquatic Biologist
ADEQ Fish Consumption Advisories Program Lead
smr@azdeq.gov

Sources: http://azdeq.gov/fca; http://static.azdeq.gov/fs/fish_consumption%20advisories.pdf.

New Fish Consumption Advice for Hanford Reach, Columbia River, Washington

In August 2017, the Washington State Department of Health (DOH) added the 150-mile stretch of the Columbia River from McNary Dam to the Interstate-90 bridge near Vantage to its growing list of waterways with fish consumption advisories.

After testing levels of mercury and polychlorinated biphenyls (PCBs) in six fish species found in that section of the Columbia River, DOH recommends the following meal limits:

Location	Fish Species	Advisory
Columbia River: McNary Dam to the Interstate-90 bridge near Vantage	Northern pikeminnow	DO NOT EAT
	Carp, mountain whitefish, white sturgeon	1 meal/month
	Bridgelip sucker, largemouth bass, walleye	2 meals/month
	Smallmouth bass	4 meals/month
	Lamprey, salmon, shad, and steelhead	Healthy Choices

Fish is a nutritious source of protein and omega-3 fatty acids, and DOH recommends eating at least two seafood meals per week as part of a heart healthy diet. To reduce your exposure to contaminants in fish, eat a variety of fish from a variety of sources. Before you fish, check for advisories at www.doh.wa.gov/fish or call 1-877-485-7316.

The DOH website is your source for *a healthy dose of information*. Information is also available on Facebook and Twitter.

For more information, contact Dave McBride at Dave.Mcbride@doh.wa.gov.

Source: https://www.doh.wa.gov/Newsroom/2017NewsReleases/17119HanfordAreaFishAdvisoryNewsRelease.

EPA News

EPA Announces Innovative Mussel Research to Address Water Quality Issues

On August 22, 2017, EPA Region 3 announced a new project to develop innovative methods to improve the understanding of the distribution of freshwater mussels. EPA will partner with the West Virginia Department of Natural Resources, the Maryland Department of Natural Resources, and the Pennsylvania Department of Environmental Protection in this effort. The project is one of 14 research projects addressing priority environmental and human health problems through partnerships among EPA's research office, regional offices, and states.

Freshwater mussels improve water quality by filtering and sequestering pollutants and suspended particulates, cycling nutrients, and removing harmful toxins and pathogens that are threats to public health. Currently, it takes extensive time, effort, and money to assess mussel populations, but now it is possible to monitor mussels by collecting water and/or sediment samples and analyzing for their DNA. This new method of detecting mussel populations lowers the level of effort in traditional freshwater mussel assessments and will help provide an early warning system for water quality changes, act as sensors for drinking water, and help promote mussel restoration and management in regional watersheds.

The selected projects focus on nonpoint source nitrogen pollution, volatile organic compounds, harmful algal blooms, roadway air pollution, and other environmental and human health issues across the country. The projects will employ innovative approaches including citizen science, crowdsourcing, a challenge competition, and advanced monitoring technologies.

Learn more about this project and the other projects at https://www.epa.gov/innovation/2017-regionalstate-innovation-projects.

For more information, contact Amy Bergdale at Bergdale.Amy@epa.gov.

Source: https://www.epa.gov/newsreleases/epa-announces-innovative-mussel-research-address-water-quality-issues.

Other News

New 3D Fish Liver Model for Aquatic Toxicology

In a report released in July 2017, researchers at the Brown University Superfund Research Program Center announced the development of a new 3D liver cell model that can be used to screen chemicals for toxicity in fish. The new model uses fish liver cells cultured to form 3D microtissue so researchers can assess liver toxicants over time and after single and repeated exposures. According to the authors, the fish-specific testing platform is an alternative to expensive, time-consuming, whole-animal assays, and is suitable for screening the potential adverse effects of environmental pollutant mixtures and newly identified contaminants.

Toxicity testing is used to make predictions about whether a chemical is potentially harmful to animals, as well as humans. Often, toxicity tests are conducted on whole animals, but this can take a great deal of time, money, and animals to do these tests. As an alternative, researchers can conduct an initial screening on cells from a few organs that are particularly sensitive or vulnerable.

Compared to a single layer of cells often used in toxicology, 3D liver microtissues live longer and are better differentiated, meaning they act more like real livers and can better predict the response of fish. This cell-based method provides a bridge between conventional single layer cell assays and whole-animal toxicity studies.

Testing the 3D Cell Model

In the laboratory, the new microtissue model was tested using benzo(a)pyrene (BaP), a common and well-characterized contaminant.

To test the response of the microtissue model to BaP exposure, researchers measured levels of the enzyme cytochrome P450 1A (Cyp1a), which is a biological marker of toxicant exposure and cellular response. Like other organic pollutants, BaP is metabolized by Cyp1a and other enzymes to make it easier for the body to excrete the compound. However, these resulting reactive metabolites can cause greater damage than the parent compound, leading to oxidative stress and DNA damage. Even at low levels, BaP is a known potent inducer of the enzyme Cyp1a.

Using assays to measure Cyp1a gene and protein expression, the researchers demonstrated that the 3D model is sensitive to BaP. They detected induction of Cyp1a by measuring gene expression after 24 hours of exposure at concentrations of BaP as low as 1 nanomole per liter, comparable to what may be found in the environment.

In addition to measuring gene expression, they also used immunofluorescence to detect and visualize the location of Cyp1a protein within the microtissue. Immunofluorescence showed that the highest levels of Cyp1a were at the periphery, with lower levels in the cells in the center. Unlike single layers of cells, which are exposed more directly, the 3D microtissue's multilayered structure more closely mimics a fish's liver by acting as a barrier to toxicant transport.

Cell death followed the same gradient as Cyp1a levels in the microtissue, with higher cell death in the periphery. According to the authors, this implies that the cells with the greatest adaptive response, as indicated by induction of Cyp1a, are also the cells experiencing the greatest toxicity. After the exposure period, the researchers observed a decline in Cyp1a expression. They also performed repeated exposures, which showed that Cyp1a levels in response to a second exposure were comparable to the first exposure.

A Highly Sensitive Screening Tool

The researchers found that the microtissues maintained viability and differentiation for at least 8 days. They observed that this type of 3D cell culture encourages cells to act more like tissues in the body and keeps cells alive longer, which allows adverse effects to be followed over an extended exposure period or even after the exposure is over.

Moving forward, researchers plan to use the 3D cell culture to determine the aquatic toxicity of carbon nanomaterials alone and in mixtures, as well as the potential protective effect of carbon nanomaterials on BaP toxicity.

For more information, contact Agnes B. Kane at Agnes_Kane@brown.edu.

Study Citation:

Rodd, A.L., N. Messier, C.A. Vaslet, and A.B. Kane. 2017. A 3D fish liver model for aquatic toxicology: Morphological changes and Cyp1a induction in PLHC-1 microtissues after repeated benzo(a)pyrene exposures. *Aquatic Toxicology* 186:134–144. doi:10.1016/j.aquatox.2017.02.018.

Source: https://tools.niehs.nih.gov/srp/researchbriefs/view.cfm?Brief_ID=271.

Human Contraceptive Gestodene Affects Fish Reproductive Behavior

Synthetic hormones are one class of chemicals that are designed to alter endocrine function as in the case of gestodene (GES), which is used as a human contraceptive. Thus far, research on the exposure and effects of synthetic hormones has mainly focused on the reproduction of aquatic vertebrates including changes to circulating hormone concentrations, egg deposition or sperm characteristics, changes in ovarian or testicular tissues, and development of secondary sexual characteristics in fishes. Although behavior has been recognized as a sensitive endpoint that is critical for successful reproduction, comparatively few studies have examined endocrine disrupting chemical exposure effects on behavior in fish.

In this study, scientists investigated the exposure effects of GES on reproductive behaviors of fathead minnows (*Pimephales promelas*) while also retaining the more traditional measures of biological endpoints (for example, the number of eggs deposited and the development of secondary sex characteristics). Scientists intentionally selected an eight-day exposure period due to their interest in examining the potential short-term effects of GES exposure on behavior. Fish were exposed to two levels of GES to bracket environmental concentrations of similar synthetic hormones (10 and 100 nanograms per liter [ng/L] and controls) using a flow-through system in the laboratory.

This research documents that short-term exposure of adult fathead minnows to GES at environmentally relevant concentrations induced rapid and negative effects on reproductive behavior, egg deposition, and sexual development. Exposure to GES caused rapid changes in normal reproductive behavior of both male and female fathead minnows. After only one day, males exposed to GES were more aggressive and less interested in courtship and mating, and exposed females displayed less female courtship behavior. In contrast to behavioral changes, GES exposure only affected the development of secondary sex characteristics in female fathead minnows (females developed characteristics typical in males). Consistent with previous research, GES exposure negatively affected the number of eggs deposited by fathead minnows (63- and 95-percent declines in the number for eggs in the 10- and 100-ng/L treatment groups, respectively). No changes in ovarian or testicular tissue histology were observed. The study results suggest that effects on egg deposition measured in this short-term study are primarily

due to altered reproductive behavior. The rapid changes in behavior and decreased egg production from GES exposure suggest that exposed populations of wild fish may be similarly influenced.

Study Citation:

Frankel, T.E., M.T. Meyer, D.W. Kolpin, A.B. Gillis, D.A. Alvarez, and E.F. Orlando. 2016. Exposure to the contraceptive progestin, gestodene, alters reproductive behavior, arrests egg deposition, and masculinizes development in the fathead minnow (*Pimephales promelas*). *Environmental Science & Technology* 50(11):5991–5999. doi:10.1021/acs.est.6b00799.

For more information, contact Michael T. Meyers at Mmeyer@usgs.gov or visit the USGS Toxic Substances Hydrology Program's Contaminants of Emerging Concern in the Environment Investigation website.

Source: https://toxics.usgs.gov/highlights/2016-10-25-gestodene_affects_fish.html.

Pesticides Prevalent in Midwestern Streams

On August 9, 2017, USGS announced the completion of a study on pesticide sampling efforts in 11 Midwestern states—Illinois, Indiana, Iowa, Kansas, Kentucky, Minnesota, Missouri, Nebraska, Ohio, South Dakota, and Wisconsin. More than 180 pesticides and their byproducts were detected in small streams throughout these states, some at concentrations likely to harm aquatic insects.

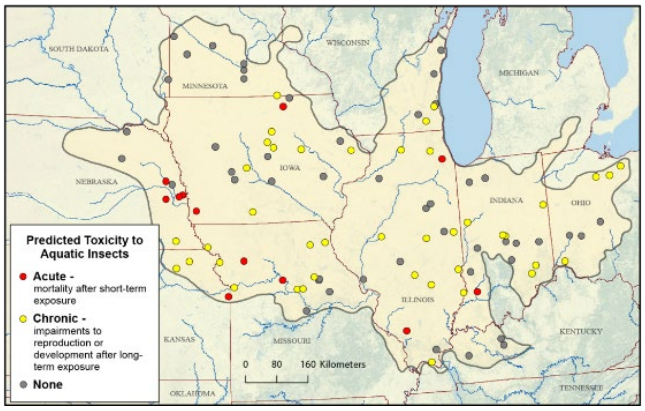
The mixtures of pesticides are more complex than previously reported by USGS—94 pesticides and 89 pesticide byproducts were detected. On average, 52 pesticide compounds were identified in each stream.

At least one pesticide in at least half of the 100 streams sampled exceeded a threshold predicted to cause harm to aquatic insects and other stream organisms, ranging from acute effects (i.e., death after a short-term exposure) to chronic effects (i.e., longer term impairments to reproduction and development). Two to four pesticides exceeded this threshold in more than a quarter of the streams. Aquatic insects, like mayfly and stonefly larvae, are critical to stream health because they are an essential link in the aquatic food web. Pesticides were not measured at levels predicted to be toxic to fish in 95 of the 100 streams tested. Potential impacts on human health were not assessed because the small streams sampled in agricultural and urban areas are unlikely to be used as sources of drinking water.

"About 150 million pounds of pesticides are applied annually in the Midwestern U.S.," said Lisa Nowell, USGS research chemist and lead scientist for the study. "Understanding which pesticides are occurring at levels potentially toxic to aquatic life, and where they occur, is crucial to informing management decisions."

While numerous pesticides were detected at low levels, only a few—atrazine, acetochlor, metolachlor, imidacloprid, fipronil, and organophosphate insecticides—were predicted to be major contributors to toxicity. The first three are widely used agricultural herbicides, and the latter three are insecticides used in both residential and agricultural settings.

This is one of the most extensive assessments of pesticides in streams to date: 1,200 samples were collected at 100 Midwest streams over a 12-week period during the 2013 growing season and analyzed for 228 pesticide compounds. Numbers of streams tested in each state include the following (the number of sites are in parentheses): Illinois (19), Indiana (15), Iowa (17), Kansas (3), Kentucky (3), Minnesota (7), Missouri (14), Nebraska (8), Ohio (7), South Dakota (1), and Wisconsin (6).



Map of streams tested for pesticides in 11 Midwestern states, showing predicted toxicity to aquatic insects. *(Image courtesy of USGS)*

This study is the first in a series of five regional stream quality assessments (RSQA) that also includes the Southeast, Pacific Northwest, Northeast, and California. To learn more about the comprehensive Midwest streams assessment and the other regional assessments visit the USGS RSQA website.

Study Citation:

Nowell, L.H., P.W. Moran, T.S. Schmidt, J.E. Norman, N. Nakagaki, M.E. Shoda, B.J. Mahler, P.C. Van Metre, W.W. Stone, M.W. Sandstrom, and M.L. Hladik. In press. Complex mixtures of dissolved pesticides show potential aquatic toxicity in a synoptic study of Midwestern U.S. streams. *Science of the Total Environment*. doi:10.1016/j.scitotenv.2017.06.156.

Source: https://www.usgs.gov/news/pesticides-prevalent-midwestern-streams.

Recently Awarded Research

EPA Awards $120,000 to Cape Fear River Watch, Inc. to Reduce Risks to Subsistence Fishers in New Hanover and Pender Counties in North Carolina

On October 6, 2016, EPA Region 4 announced Cape Fear River Watch, Inc. is among 10 community-based organizations selected nationally to receive competitive cooperative agreements to address environmental justice issues. Each of this year's recipients will receive up to $120,000 to support two-year projects. The projects will address a variety of environmental justice issues through innovative project activities in areas like green infrastructure, stormwater management, and recycling.

The Cape Fear River Watch project is focused on the issue of subsistence fishing in New Hanover and Pender Counties in North Carolina. The Northeast Cape Fear River is impaired, and high levels of mercury contamination have been detected in fish tissue samples. Subsistence fishers and their families are at risk from exposure to mercury and other toxins in the fish tissue. The project partners include the Wake Forest School of Medicine, New Hanover County National Association for the Advancement of Colored People, New Hanover County Department of Health, the Duke University Environmental Law & Policy Clinic, and others from the Southeast North Carolina Environmental Justice Coalition. Since receiving the grant, Cape Fear River Watch and its partners have designed

and implemented a survey for residents of the Wilmington, North Carolina area to assess subsistence fish consumption patterns in the Northeast Cape Fear River basin that educates and empowers subsistence fishers to protect their health using culturally-specific techniques and language. Results from the survey will inform an education campaign to aid subsistence fish consumers with reducing exposures to toxins found in locally-caught fish, especially for vulnerable populations.

EPA's Environmental Justice Collaborative Problem-Solving Cooperative Agreement Program provides funding for non-profit and tribal organizations to partner with stakeholders from across industry, government, and academia to develop and implement solutions that significantly address environmental and/or public health issues in America's low-income and/or minority communities.

The community-based organizations will use EPA's Environmental Justice Collaborative Problem-Solving model to execute a wide array of project plans aligned with EPA's priorities of making a visible difference in communities, protecting America's waters, taking action on toxics and chemical safety, and addressing climate change and improving air quality. The neighborhoods and communities participating in these projects have been impacted by environmental harms plaguing their local areas.

Visit https://www.epa.gov/environmentaljustice/environmental-justice-collaborative-problem-solving-cooperative-agreement-2 for a full description of the 2016 Environmental Justice Collaborative Problem-Solving Cooperative Agreement projects.

More information about EPA's Environmental Justice Collaborative Problem Solving Cooperative Agreement Program can be found on the Office of Environmental Justice's Environmental Justice Grants, Funding, and Technical Assistance webpage at https://www.epa.gov/environmentaljustice/environmental-justice-grants-funding-and-technical-assistance.

Connect with EPA Region 4 on Facebook and on Twitter.

For more information, contact Davina Marraccini at Marraccini.Davina@epa.gov.

Source: https://www.epa.gov/newsreleases/epa-awards-120000-cape-fear-river-watch-inc-reduce-risks-subsistence-fishers-new.

Recent Publications

Journal Articles

The list below provides a selection of research articles focusing on endocrine disrupting chemicals.

- Preliminary assessment on the bioaccessibility of contaminants of emerging concern in raw and cooked seafood
  Alves, R.N., A.L. Maulvault, V.L. Barbosa, S. Cunha, C.J.A.F. Kwadijk, D. Álvarez-Muñoz, S. Rodríguez-Mozaz, Ò. Aznar-Alemany, E. Eljarrat, D. Barceló, M. Fernandez-Tejedor, A. Tediosi, and A. Marques. 2017. Preliminary assessment on the bioaccessibility of contaminants of emerging concern in raw and cooked seafood. *Food and Chemical Toxicology* 104:69–78.

- Re-evaluating the significance of estrone as an environmental estrogen
  Ankley, G.T., D. Feifarek, B. Blackwell, J.E. Cavallin, K.M. Jensen, M.D. Kahl, S. Poole, E. Randolph, T. Saari, and D.L. Villeneuve. 2017. Re-evaluating the significance of estrone as an environmental estrogen. *Environmental Science & Technology* 51(8):4705–4713.

- Pyrethroid pesticides as endocrine disruptors: Molecular mechanisms in vertebrates with a focus on fishes
  Brander, S.M., M.K. Gabler, N.L. Fowler, R.E. Connon, and D. Schlenk. 2016. Pyrethroid pesticides as endocrine disruptors: Molecular mechanisms in vertebrates with a focus on fishes. *Environmental Science & Technology* 50(17):8977–8992.

- Mechanism of action of endosulfan as disruptor of gonadal steroidogenesis in the cichlid fish *Cichlasoma dimerus*
  Da Cuña, R.H., G.R. Vázquez, L. Dorelle, E.M. Rodríguez, R.G. Moreira, and F.L. Lo Nostro. 2016. Mechanism of action of endosulfan as disruptor of gonadal steroidogenesis in the cichlid fish *Cichlasoma dimerus*. *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology* 187:74–80.

- The toxic effects of chlorophenols and associated mechanisms in fish
  Ge, T., J. Han, Y. Qi, X. Gu, L. Ma, C. Zhang, S. Naeem, and D. Huang. 2017. The toxic effects of chlorophenols and associated mechanisms in fish. *Aquatic Toxicology* 184:78–93.

- Effects of food-borne exposure of juvenile rainbow trout (*Oncorhynchus mykiss*) to emerging brominated flame retardants 1,2-bis(2,4,6-tribromophenoxy)ethane and 2-ethylhexyl-2,3,4,5-tetrabromobenzoate
  Giraudo, M., M. Douville, R.J. Letcher, and M. Houde. 2017. Effects of food-borne exposure of juvenile rainbow trout (*Oncorhynchus mykiss*) to emerging brominated flame retardants 1,2-bis(2,4,6-tribromophenoxy)ethane and 2-ethylhexyl-2,3,4,5-tetrabromobenzoate. *Aquatic Toxicology* 186:40–49.

- Effects on biotransformation, oxidative stress, and endocrine disruption in rainbow trout (*Oncorhynchus mykiss*) exposed to hydraulic fracturing flowback and produced water
  He, Y., E.J. Folkherts, Y. Zhang, J.W. Martin, D.S. Alessi, and G.G. Goss. 2017. Effects on biotransformation, oxidative stress, and endocrine disruption in rainbow trout (*Oncorhynchus mykiss*) exposed to hydraulic fracturing flowback and produced water. *Environmental Science & Technology* 51(2):940–947.

- Gonado-histopathological changes, intersex and endocrine disruptor responses in relation to contaminant burden in Tilapia species from Ogun River, Nigeria
  Ibor, O.R., A.O. Adeogun, O.A. Fagbohun, and A. Arukwe. 2016. Gonado-histopathological changes, intersex and endocrine disruptor responses in relation to contaminant burden in Tilapia species from Ogun River, Nigeria. *Chemosphere* 164:248–262.

- Multi-class of endocrine disrupting compounds in aquaculture ecosystems and health impacts in exposed biota
  Ismail, N.A.H., S.Y. Wee, and A.Z. Aris. 2017. Multi-class of endocrine disrupting compounds in aquaculture ecosystems and health impacts in exposed biota. *Chemosphere* 188:375–388.

- Changing agricultural practices: Potential consequences to aquatic organisms
  Lasier, P.J., M.L. Urich, S.M. Hassan, W.N. Jacobs, R.B. Bringolf, and K.M. Owens. 2016. Changing agricultural practices: Potential consequences to aquatic organisms. *Environmental Monitoring and Assessment* 188:672.

- Endocrine active contaminants in aquatic systems and intersex in common sport fishes
  Lee Pow, C.S.D., J.M. Law, T.J. Kwak, W.G. Cope, J.A. Rice, S.W. Kullman, and D.D. Aday. 2017. Endocrine active contaminants in aquatic systems and intersex in common sport fishes. *Environmental Toxicology* 36(4):959–968.

- Histopathological liver and testis alterations in male half-smooth tongue sole (*Cynoglossus semilaevis*) exposed to endocrine disruptors
  Li, F., L. Yao, W. Sun, Y. Jiang, Z. Li, and Y. Zhai. 2017. Histopathological liver and testis alterations in male half-smooth tongue sole (*Cynoglossus semilaevis*) exposed to endocrine disruptors. *Journal of Coastal Research* 33(3):678–683.

- Effects of environmental chemicals on fish thyroid function: Implications for fisheries and aquaculture in Australia
  Nugegoda, D., and G. Kibria. 2017. Effects of environmental chemicals on fish thyroid function: Implications for fisheries and aquaculture in Australia. *General and Comparative Endocrinology* 244:40–53.

- Reproductive effects on freshwater fish exposed to 17α-trenbolone and 17α-estradiol
  Robinson, J.A., J.P. Staveley, and L. Constantine. 2017. Reproductive effects on freshwater fish exposed to 17α-trenbolone and 17α-estradiol. *Environmental Toxicology & Chemistry* 36(3):636–644.

- Occurrence and biological effects of endocrine disrupting chemicals in the Yellow River (Zhengzhou section)
  Song, W.T., and Z.J. Wang. 2016. Occurrence and biological effects of endocrine disrupting chemicals in the Yellow River (Zhengzhou section). *Bulletin of Environmental Contamination and Toxicology* 97(6):763–769.

- Human exposure to brominated flame retardants through the consumption of fish and shellfish in Tarragona County (Catalonia Spain)
  Trabalón, L., L. Vilavert, J.L. Domingo, E. Pocurull, F. Borrull, and M. Nadal. 2017. Human exposure to brominated flame retardants through the consumption of fish and shellfish in Tarragona County (Catalonia Spain). *Food and Chemical Toxicology* 104:48–56.

- Medium- and long-term effects of estrogenic contaminants on the middle River Po fish community as reconstructed from a sediment core
  Viganò, L., J.L. Loizeau, A. Mandich, and G. Mascolo. 2016. Medium- and long-term effects of estrogenic contaminants on the middle River Po fish community as reconstructed from a sediment core. *Archives of Environmental Contamination and Toxicology* 71(4):454–472.

- Thermal modulation of anthropogenic estrogen exposure on a freshwater fish at two life stages
  Ward, J.L., M.K. Cox, and H. Schoenfuss. 2017. Thermal modulation of anthropogenic estrogen exposure on a freshwater fish at two life stages. *Hormones and Behavior* 94:21–32.

- Exposure to bisphenol B disrupts steroid hormone homeostatis and gene expression in the hypothalamic-pituitary-gonadal axis of zebrafish
  Yang, Q., X. Yang, J. Liu, W. Ren, Y. Chen, and S. Shen. 2017. Exposure to bisphenol B disrupts steroid hormone homeostatis and gene expression in the hypothalamic-pituitary-gonadal axis of zebrafish. *Water, Air, and Soil Pollution* 228:112.

Upcoming Meetings and Conferences

2017 State of Lake Michigan Conference
November 7–10, 2017
Green Bay, Wisconsin

68th Annual Northwest Fish Culture Concepts
December 5–7, 2017
Redding, California

19th International Conference on Shellfish Restoration & Shellfish Reef Restoration Network Meeting
February 19–21, 2018
Adelaide, Australia

110th Annual National Shellfisheries Association Meeting
March 18–22, 2018
Seattle, Washington

9th International Crustacean Congress (ICC 9)
May 22–25, 2018
Washington, District of Columbia

9th U.S. Symposium on Harmful Algae
November 11–17, 2017
Baltimore, Maryland

The Society for Integrative & Comparative Biology Annual Meeting 2018
January 3–7, 2018
San Francisco, California

Aquaculture America 2018
February 19–22, 2018
Las Vegas, Nevada

European Geosciences Union General Assembly 2018
April 8–13, 2018
Vienna, Austria

9th International Charr Symposium
June 18–21, 2018
Duluth, Minnesota

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.