United States Environmental Protection Agency

Fish and Shellfish Program NEWSLETTER

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In This Issue

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

This issue of the *Fish and Shellfish Program Newsletter* generally focuses on pharmaceuticals.

Recent Advisory News

Kansas Issues Revised Fish Consumption Advisories

On January 2, 2018, the Kansas Department of Health and Environment (KDHE) and the Kansas Department of Wildlife, Parks and Tourism (KDWPT) issued revised fish consumption advisories for 2018. The advisories identified types of fish or other aquatic animals that should be eaten in limited quantities or, in some cases, avoided altogether because of contamination. General advice and Internet resources were also provided to aid the public in making informed decisions regarding the benefits as well as the risks associated with eating locally caught fish from Kansas waters.

Definitions:

Bottom-feeding fish: buffalos, carp, carpsuckers, catfishes (except blue and flathead catfish), sturgeons, and suckers.

Predatory fish: black basses, blue catfish, crappies, drum, flathead catfish, perches, sunfish, white bass, wiper, striper, walleye, saugeye, and sauger.

Shellfish: mussels, clams, and crayfish.

General Population: Men and women 18 years of age or older.

Sensitive Populations: Women who are pregnant, may become pregnant, or are nursing and children age 17 or younger.

Meal size (skinless fish fillets before cooking): Adults and Children age 13 and older = 8 ounces, Children age 6 to 12 = 4 ounces, Children younger than 6 = 2 ounces

Statewide Advisories

Kansas recommends the following consumption restrictions because of mercury in fish:

1. **Sensitive Populations** should restrict consumption of all types of locally caught fish from waters or species of fish not specifically covered by an advisory to one meal per week because of mercury.

2. **Largemouth, smallmouth, and spotted bass (black basses)**:

A. **Sensitive Populations** should restrict consumption of these species to one meal per month because of mercury.

B. **General Public** should restrict consumption of these species to one meal per week because of mercury.

Existing Advisories Modified for 2018

For 2018, Kansas modified fish consumption advisories for portions of Cow Creek, the Kansas River, and Little Arkansas River because of decreased levels of polychlorinated biphenyls (PCBs) in bottom feeding fish fillet samples collected in recent years.

Kansas recommends restricting consumption of bottom-feeding fish to one meal per week from the following location because of PCBs:

1. **Cow Creek** in Hutchinson and downstream to its confluence with the Arkansas River (Reno County).

2. **The Kansas River** from Lawrence (below Bowersock Dam) downstream to Eudora at its confluence with the Wakarusa River (Douglas and Leavenworth counties).

3. **The Little Arkansas River** from the Main Street Bridge immediately west of Valley Center to the confluence with the Arkansas River in Wichita (Sedgwick County).

NEW Advisories for 2018

1. **K-96 Lake** in Wichita (Sedgwick County) – Kansas recommends restricting consumption of bottom-feeding fish to one meal per month because of PCBs.

2. **Arkalon Park Lakes** in Liberal (Seward County) – Kansas recommends not eating fish or other aquatic life because the lakes are sustained solely by treated municipal wastewater.

Waterbody Specific Advisories for All Consumers

Kansas recommends not eating specified fish or aquatic life from the following locations:

1. **The Arkansas River** from the Lincoln Street dam in Wichita downstream to its confluence with Cowskin Creek near Belle Plaine (Sedgwick and Sumner counties) - bottom-feeding fish because of PCBs.

2. **Shoal Creek** from the Missouri/Kansas border to Empire Lake (Cherokee County) - shellfish because of lead and cadmium.

3. **The Spring River** from the confluence of Center Creek to the Kansas/Oklahoma border (Cherokee County) - shellfish because of lead and cadmium.

4. **Antioch Park Lake South** in Antioch Park, Overland Park (Johnson County) - all fish because of the pesticides dieldrin, heptachlor epoxide, chlordane, and dichlorophenyltrichloroethanes (DDTs).

General Advice for Eating Locally Caught Fish in Kansas

1. Sensitive populations should consider restricting their total mercury intake for both supermarket fish and locally caught species. Concerned parents and other persons may wish to consult with a physician about eating fish and mercury exposure.

2. Mercury exposure can be reduced by limiting the consumption of large predatory fish. Larger/older fish of all types are more likely to have higher concentrations of mercury.

3. Avoid the consumption of fish parts other than fillets, especially when eating bottom-feeding fish. Fatty internal organs tend to accumulate higher levels of fat-soluble contaminants such as chlordane and PCBs than fillets.

4. Consumers can reduce their ingestion of fat-soluble contaminants such as chlordane and PCBs by trimming fat from fillets, and cooking in a manner in which fat drips away from the fillet.

5. Avoid subsistence level (relying on wild-caught fish for daily nutritional needs) fishing activities in large rivers within or immediately downstream of large urban/industrial areas and wastewater outfalls. Fish in these areas are more likely to contain traces of chemical contaminants.

6. Kansas recommends not eating fish or aquatic life from surface waters sustained solely by municipal or industrial wastewater because of unknown yet potentially present pathogens, metals, organic chemicals, or other emerging contaminants. This advisory includes consumption of any aquatic life present in wastewater outfalls, waste treatment lagoons, or stormwater detention ponds.

7. In waterbodies where watches or warnings related to harmful algae blooms have been applied, fish should be consumed in moderation and care taken to only consume skinless fillets. Avoid cutting into internal organs and rinse fillets with clean water prior to cooking or freezing.

Internet Resources from KDHE, KDWPT, EPA, FDA, and the American Heart Association

To view the advisories online and for information about KDHE's Fish Tissue Contaminant Monitoring Program visit its website at: http://www.kdheks.gov/befs/fish_tissue_monitoring.htm.

For information about harmful algal blooms including current watches and warnings visit this KDHE website: http://www.kdheks.gov/algae-illness/index.htm.

For information about fishing in Kansas including licensing, regulations, fishing reports, and fishing forecasts please visit the KDWPT fishing website: http://ksoutdoors.com/Fishing.

For general information about mercury in fish, national advisories, and advisories in other states please visit this U.S. Environmental Protection Agency (EPA) website: http://www2.epa.gov/choose-fish-and-shellfish-wisely.

For information regarding personal care products and pharmaceuticals in fish, please visit this EPA website: https://www.epa.gov/fish-tech/pilot-study-pharmaceuticals-and-personal-care-products-fish-tissue.

For information about the health benefits vs. the risks of including fish in your diet please visit this American Heart Association website: http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/Fish101_UCM_305986_Article.jsp.

For technical information regarding the EPA risk assessment methods used to determine advisory consumption limits. Please visit: http://www2.epa.gov/fish-tech.

For more information, contact J.C. Reeves (KDHE) at 785-368-8053 or Kdhe.communications@ks.gov or Ron Kaufman (KDWPT) at 785-296-2870 or Ron.Kaufman@ks.gov.

Source: https://khap2.kdhe.state.ks.us/NewsRelease/PDFs/1-3-18%20Kansas%20issues%20revised%20fish%20consumption%20advisories.pdf

EPA News

EPA Selects Cleanup Plan for Kanawha River Superfund Site to Address Fish Contamination

Cleanup efforts at the Kanawha River Superfund Site in Putnam and Kanawha counties, West Virginia have been ongoing for over a decade. EPA announced on August 1, 2017 that it entered into a consent agreement with Pharmacia LLC on a cleanup plan to address dioxin contamination at the site.

The consent agreement outlined cleanup work focusing on a 14-mile stretch of the Kanawha River beginning at the confluence of the Kanawha and Coal Rivers. Cleanup work would include constructing a cap over more than nine acres of contaminated river sediments. This capping will reduce the mobility and concentrations of dioxin in the sediments that in turn will help protect prey fish (e.g., gizzard shad), sport fish, and bottom feeders in the River.

The most significant human health risks at the site are associated with fish consumption from the Kanawha River, and the consent order provides for long-term monitoring of the levels of dioxin in fish caught along this stretch.

The State of West Virginia previously issued a fish advisory for the River due to elevated levels of dioxin found in fish caught in the River: https://www.wvdhhr.org/fish/General_Advisories.asp.

Pharmacia, once known as Monsanto Company, manufactured the pesticide 2,4,5-trichlorophenocyacetic acid at a facility in Nitro, West Virginia, from 1948 to 1969. This pesticide was one of the principal components of Agent Orange, a defoliant used by the U.S. Department of Defense.

The hazardous substance at the site is a waste byproduct of the production process for the pesticide known a 2,3,7,8-tetrachlorodibenzo-p-dioxin or TCDD. Pharmacia's operations at the Nitro facility are believed to have been the primary source of TCDD contamination in the River.

EPA's selection of the cleanup plan was done in consultation with the West Virginia Department of Environmental Protection and the U.S. Army Corps of Engineers. It was preceded by a years-long engineering evaluation and cost analysis performed by Monsanto Company and Pharmacia under a 2004 EPA Consent Order.

Status of cleanup activities at the site are summarized in a Project Fact Sheet released by EPA on July 25, 2018, available here: https://semspub.epa.gov/work/03/2260535.pdf.

For more information on the Kanawha River Superfund Site, visit: https://cumulis.epa.gov/supercpad/CurSites/csitinfo.cfm?id=0305516.

An EPA fact sheet from August 2016 describing the removal plan is available at: https://semspub.epa.gov/work/03/2220345.pdf.

For more information, contact Roy Seneca at 215-814-5567 or seneca.roy@epa.gov.

Source: https://www.epa.gov/newsreleases/epa-selects-cleanup-plan-kanawha-river-superfund-site-address-fish-contamination

Other News

Bay Mussels in Puget Sound Show Traces of Oxycodone

On May 9, 2018, the Puget Sound Institute (PSI) posted a blog discussing the opioid epidemic in the waters of Puget Sound. State agencies tracking pollution levels in Puget Sound have discovered traces of oxycodone in the tissues of native bay mussels (*Mytilus trossulus*) from Seattle and Bremerton area harbors.

The mussels were part of the state's Puget Sound Mussel Monitoring Program. Every two years, scientists at the Washington Department of Fish and Wildlife (WDFW) transplant uncontaminated mussels from an aquaculture source on Whidbey Island to various locations in Puget Sound to study pollution levels. Mussels, which are filter feeders, concentrate contaminants from the local marine environment into their tissues. After the mussels have been at the transplant site for two to three months scientists analyze the contaminants in the collected mussel tissues.

Bay/Blue Mussels (commercial) *(Image courtesy of NOAA)*

The areas where the oxycodone-tainted mussels were sampled are considered highly urbanized and are not near any commercial shellfish beds. "You wouldn't want to collect (and eat) mussels from these urban bays," explained PSI's Andy James, who assisted with the study. "The oxycodone was found in amounts thousands of times lower than a therapeutic dose for humans and would not be expected to affect the mussels, which likely don't metabolize the drug," James said. The findings may raise concerns for fish, however, which are known to respond to

opioids. Lab studies show that zebrafish will learn to dose themselves with opioids, and scientists say salmon and other Puget Sound fish might have a similar response.

Scientists typically find many chemical compounds in Puget Sound waters, ranging from pharmaceuticals to illicit drugs such as cocaine, but this is the first time that opioids have been discovered in local shellfish. The contaminants in this case are thought to be passed into Puget Sound through discharge from wastewater treatment plants. Even filtered wastewater can potentially include traces of thousands of chemicals known as contaminants of emerging concern (CECs). Runoff from agriculture and stormwater are also common sources of CECs.

In addition to oxycodone, the mussels also showed high levels of the chemotherapy drug Melphalan, which is a potential carcinogen due to its interactions with DNA. The drug was found at "levels where we might want to look at biological impacts," said James. The mussels had ingested amounts of Melphalan relative by weight to a recommended dose for humans.

These Puget Sound mussel monitoring studies occur every two years and are currently funded by WDFW, the state's Stormwater Action Monitoring program, and various other regional partners. The monitoring is led by Jennifer Lanksbury, of WDFW's Toxics-focused Biological Observing System (TBiOS), along with help from a host of citizen science volunteers from across Puget Sound. PSI's Andy James worked with TBiOS on the chemical analysis and presented the findings at last month's Salish Sea Ecosystem Conference.

James and his team at the University of Washington's Center for Urban Waters in Tacoma are now using high resolution mass spectrometry to look for additional chemical exposures in the mussel tissues and to evaluate potential biological impacts on Puget Sound species.

Read more about mussel monitoring in the Encyclopedia of Puget Sound.

For more information, contact Jeff Rice at jeffrice@uw.edu.

Source: https://www.pugetsoundinstitute.org/2018/05/bay-mussels-in-puget-sound-show-traces-of-oxycodone/

Cocaine in the Water is Hurting River Eels

Smithsonian.com reported on June 20, 2018, that the Earth's waters are being laced with prescription and over-the counter medications. Some of these drugs are caffeine, antibiotics, and personal care products. Marine environments are also tainted with illegal drugs, and a recent study demonstrates just how harmful these illicit substances can be to aquatic wildlife. As Michael Marshall reports for *New Scientist*, researchers in Italy have found that small amounts of cocaine in water can make eels hyperactive and cause significant muscle damage.

These findings are disconcerting, because European eels (*Anguilla anguilla*) in the wild are critically endangered with their future compromised by factors like habitat-loss, dam construction, pollution, and over-fishing.

The researchers first took 150 European eels that had been raised on farms and divided them into several different tanks. Some of the tanks contained small amounts of cocaine—20 nanograms per liter, which corresponds to the

mean concentration of the drug that has been detected in surface waters—and some were filled with tap water. The eels were kept in the tanks for 50 days. Then two groups of the cocaine-exposed eels were placed in tanks of cocaine free water—one group for three days, the other for ten.

At the end of the experiment, the eels were killed and dissected for analysis. The results, published in *Science of the Total Environment*, showed that the cocaine-exposed eels suffered a host of adverse health effects.

While the experiment was ongoing the eels swam unusually fast but otherwise seemed as healthy as the drug-free eels. Their insides, however, told a different story. According to Joshua Rapp Learn of *National Geographic*, the researchers found that cocaine had accumulated in the animals' muscles, brains, gills, skin, and other tissue. Their muscles were swollen and even showed signs of fiber breakdown.

European eels spend up to 20 years in fresh waters then undertake a vast migration across the Atlantic to spawn in the Sargasso Sea east of the Caribbean. "This means that, in addition to sufficient energy reserves, the eel needs a healthy skeletal muscle and an efficient aerobic metabolism in order to complete successfully its migration," the study authors write. If their muscles are damaged, the eels' ability to complete the journey could be compromised.

There are a number of ways that drugs can end up in rivers, streams, and other bodies of water. Sometimes, they are improperly discarded—flushed down the toilet, for instance. In addition, human bodies only metabolize a small amount of the drugs that are consumed. The rest is excreted in urine or feces and can end up in wastewater, according to Harvard Health Publishing.

Studies have shown that a host of animals are affected by the drugs that pollute marine environments. In 2016, for example, oysters from two Oregon bays were found to contain traces of medications like antibiotics, antihistamines, and pain relievers. Fish with both male and female sex traits have been found in Northeastern waterways, and scientists believe that hormones from birth control pills might be contributing to the problem.

And, as the authors of the recent study point out, drugs in the water could potentially have negative implications for humans. It's possible that people who eat European eel may inadvertently be consuming cocaine, too: "Since the skeletal muscle is the edible part of the eel, and bioaccumulates cocaine to a large extent, these results suggest the possibility that cocaine could be taken by humans with food, although further studies are needed to verify this hypothesis," the researchers write.

Reference

Capaldo, A., G. Flaminia, M. Lepretti, G. Paolella, S. Martucciello, L. Lionetti, I. Caputo, and V. Laforgia. 2018. Effects of environmental cocaine concentrations on the skeletal muscle of the European eel (*Anguilla anguilla*). *Science of the Total Environment* 640-641:862-873.

Source: https://www.smithsonianmag.com/smart-news/how-cocaine-water-harms-european-eels-180969421/?utm_source=smithsoniantopic&utm_medium=email&utm_campaign=20180624-Weekender&spMailingID=34831632&spUserID=Njc0NzAwMjU5MjcyS0&spJobID=1302279221&spReportId=MTMwMjI3OTIyMQS2

Selected Pharmaceuticals Not Likely to Persist in Wild Fish: Results of Uptake and Elimination Testing

The U.S. Geological Survey (USGS) reported on May 30, 2018 that a laboratory study shows that both uptake and elimination of selected pharmaceuticals within bluegill tissues is rapid, indicating that persistence in bluegills in the environment is likely to be low except in those fish that reside downstream from a consistent, substantial, contaminant source.

Pharmaceutical use by humans, subsequent transport to wastewater treatment systems, and release to surface waters have been extensively studied and well documented globally. Chronic and subtle effects of pharmaceutical exposure through water have been reported for non-target fish including those effects related to reproduction, behavior, and growth. Although the effects of contaminants are related to the quantity of a contaminant that reaches an internal organ or tissue, little is known about the details of uptake and elimination of pharmaceuticals by exposed fish.

To this end, USGS, Chinese Academy of Science, and St. Cloud State University scientists investigated the uptake and elimination of five pharmaceuticals in bluegill sunfish to aid in understanding the exposure risks, if any, to aquatic organisms or to humans through fish consumption.

Scientists studied uptake and elimination of pharmaceuticals in bluegill sunfish (*Lepomis macrochirus*) pictured above to aid in understanding the exposure risks, if any, to aquatic organisms or to humans through fish consumption. *(Image courtesy of USGS/Photo Credit: Trisha Shears)*

A laboratory flow-through system was used to expose fish to pharmaceutical concentrations that mimicked those found in close proximity to continuously discharging wastewater outflows. Five commonly prescribed pharmaceuticals with different physio-chemical properties were used for the exposures:

- Diclofenac (nonsteroidal anti-inflammatory drug)
- Methocarbamol (a muscle relaxant)
- Rosuvastatin (a drug used to lower cholesterol levels)
- Sulfamethoxazole (an antibiotic)
- Temazepam (a sleep aid)

Temazepam and methocarbamol were consistently detected in bluegill samples, so their uptake and elimination was studied in more detail. Over 30-day exposures, temazepam and methocarbamol demonstrated relatively rapid uptake and rapid elimination, indicating that internal tissue concentrations were driven by external environmental concentrations. This information indicates that overall persistence of the selected pharmaceuticals within bluegill tissues in the environment is likely to be low unless they reside downstream from a consistent, substantial, external contaminant source.

The pattern of rapid uptake and elimination observed for bluegill in this study is not dissimilar to that which is observed for human subjects, indicating that the modeling of pharmaceutical uptake done as part of the drug approval process could be used to inform future study design and prioritize research needs for the Nation.

While this study provides a greater understanding of pharmaceutical persistence in fish tissue, the significance in terms of fish health has yet to be determined. This study was the first step in a longer-term challenge for the USGS Environmental Health programs as they continue to provide the science to understand the sources, transport, fate, exposure, and adverse health effects, if any of contaminants in the environment.

The USGS Toxic Substances Hydrology Program funded this study.

Reference

Zhao, J.-L., E.T. Furlong, H.L. Schoenfuss, D.W. Kolpin, K.L. Bird, D.J. Feifarek, E.A. Schwab, G.G. Ying. 2017. Uptake and disposition of select pharmaceuticals by bluegill exposed at constant concentrations in a flow-through aquatic exposure system. *Environmental Science and Technology* 51(8):4434-4444.

For more information, contact Edward T. Furlong at 303-236-3941 or efurlong@usgs.gov, or Dana W. Kolpin at 319-358-3614 or dwkolpin@usgs.gov.

Source: https://www2.usgs.gov/envirohealth/headlines/2018-05-30-pharmaceuticals_in_wild_fish.html

Recently Awarded Research

Bay Mills Community College to Partner with MSU Extension to Perform Great Lakes Research

On March 5, 2018, the Michigan SeaGrant Program announced that Bay Mills Community College in Brimley, Michigan, will partner with Michigan State University Extension to study contaminants and biodiversity in local waters.

Looking out over the pristine headwaters of the Upper Saint Mary's River, the main campus of the Bay Mills Community College (BMCC) is located between the sole outlet of Lake Superior and Waishkey (Waiska) Bay in the heart of the Bay Mills Indian Community. The Bay is an important recreational and cultural resource for members of the Bay Mills Indian Community and their neighbors, as well as for the many tourists who visit the area.

BMCC recently was awarded $216,000 to help fund research in Waishkey Bay. BMCC's project will study contaminants in the Bay, including pesticides, pharmaceuticals, personal care products, and microplastics. The project will also study the biodiversity of the Bay including surveying all mussel species present. Mussels, like clams and oysters, are good indicators of a water body's health. Many mussels in Michigan are threatened or endangered.

The project will engage BMCC students in the research as well as several partner organizations. These partners include Lake Superior State University's Environmental Analysis Lab and Wayne State University's Lumigen

Instrument Center, which will perform chemical analysis on samples collected. Bay Mills Indian Community's Biological Services Department will assist with training and sample collection and Michigan Sea Grant, a program of Michigan State University Extension, and the University of Michigan will serve as coordinators for education and outreach to the local community.

For more information, contact Elliot Nelson at 906-635-2845 or elliotne@msu.edu.

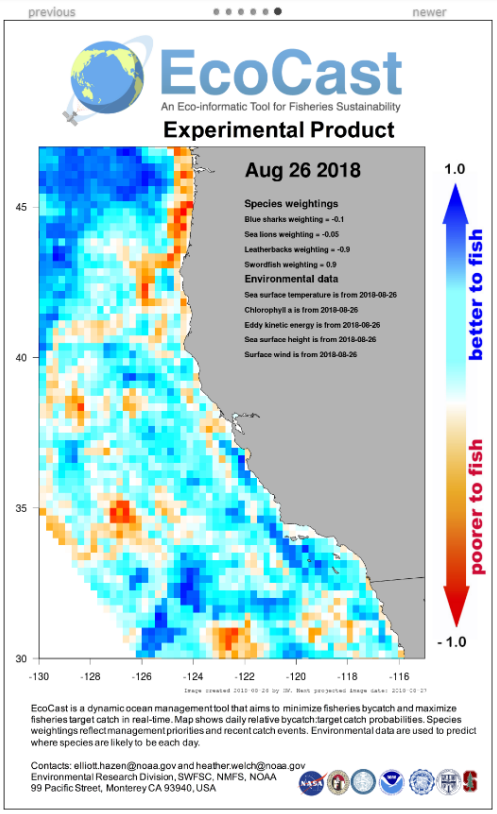
Source: http://www.miseagrant.umich.edu/news/2018/03/05/bay-mills-community-college-to-partner-with-msu-extension-to-perform-great-lakes-research/

Tech and Tools

New Tool Helps Fisheries Avoid Protected Species in Near Real Time

On May 31, 2018, the National Oceanic and Atmospheric Administration (NOAA) announced new computer-generated daily maps that will help fishermen locate the most productive fishing spots in near real time while also warning them of areas where they face the greatest risk of entangling sea turtles, marine mammals, and other protected species. Scientists developed the maps, the products of a system called EcoCast, to help reduce accidental catches of protected species in fishing nets.

Funded primarily by the National Aeronautics and Space Administration (NASA) with support from NOAA, California Sea Grant, and Stanford University, EcoCast was developed by NOAA Fisheries scientists and academic partners with input from fishermen and managers.



Sample map showing daily relative bycatch target catch probabilities. Species weightings reflect management priorities and recent catch events. Environmental data are used to predict where species are likely to be each day. *(Image courtesy of NOAA)*

EcoCast will help fishermen, managers, scientists, and others understand in near real-time where fishing vessels have the highest probability of catching targeted species and where there is risk of catching protected species. In doing so, EcoCast aims to improve the economic and environmental sustainability of fisheries that sometimes inadvertently catch and kill sensitive species. The first peer-reviewed description of the science behind the system appeared in *Science Advances*.

"We're harnessing the field of big data so that information on ocean conditions can be of most use—so fishermen can go where they're likely to find the swordfish they want to catch but avoid the species that they do not want to catch," said Elliott Hazen, a research ecologist at NOAA Fisheries' Southwest Fisheries Science Center and lead author of the new paper.

Currently NOAA Fisheries closes a large area off the West Coast to the swordfish fishery seasonally to protect leatherback turtles, which travel widely, and can be caught incidentally in the nets. Fisheries managers could use EcoCast to outline small, "dynamic closures," that shift according to the likely locations of the species they are trying to protect. Since they concentrate protection where it's needed most, dynamic closures for leatherback sea turtles could be two to 10 times smaller than the current static closures while still safeguarding the species that need it, the scientists found.

"EcoCast pioneers a way of evaluating both conservation objectives and economic profitability for sustainable U.S. fisheries," said Rebecca Lewison, a senior scientist on the project from San Diego State University and a co-author of the new paper. "By meeting both conservation and economic objectives, EcoCast is an important step forward in supporting species, their ecosystems, and our local and state economies." Dynamic closures could also support more "climate-ready" fisheries management approaches that adjust to changing ocean conditions as the climate shifts and changes over time. For instance, unusually warm conditions off the West Coast in 2014 and 2015 have driven shifts in fish and marine mammal species, forcing fishermen to adjust their efforts.

"EcoCast directly addresses both scientific priorities and fisheries management needs," said Heidi Taylor of NOAA Fisheries' West Coast Region. "The use of real-time environmental data to support dynamic ocean management provides an innovative approach to balance viable fisheries and protecting the ecosystem."

She noted that fishermen participated throughout the development of EcoCast, which should help boost its usefulness to the fishing fleet.

The EcoCast system is up and running now. To learn more about how it works, visit https://coastwatch.pfeg.noaa.gov/ecocast/about.html.

Source: https://www.fisheries.noaa.gov/feature-story/new-tool-helps-fisheries-avoid-protected-species-near-real-time

Recent Publications

Journal Articles

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

- Pharmaceuticals in water, fish and osprey nestlings in Delaware River and Bay
  Bean, T.G., B.A. Rattner, R.S. Lazarus, et al. 2018. Pharmaceuticals in water, fish and osprey nestlings in Delaware River and Bay. *Environmental Pollution* 232:533-545.

- Development of an opioid self-administration assay to study drug seeking in zebrafish
  Bosse, G.D. and R.T. Peterson. 2017. Development of an opioid self-administration assay to study drug seeking in zebrafish. *Behavioural Brain Research* 335:158-166.

- Effect of human pharmaceuticals common to aquatic environments on hepatic CYP1A and CYP3A-like activities in rainbow trout (*Oncorhynchus mykiss*): An *in vitro* study
  Burkina, V., S. Sakalli, N. Pilipenko, V. Zlabek, and G. Zamaratskaia. 2018. Effect of human pharmaceuticals common to aquatic environments on hepatic CYP1A and CYP3A like activities in rainbow trout (*Oncorhynchus mykiss*): An *in vitro* study. *Chemosphere* 205:380-386.

- Occurrence of antibiotics in mussels and clams from various FAO areas
  Chiesa, L.M., M. Nobile, R. Malandra, S. Panseri, and F. Arioli. 2018. Occurrence of antibiotics in mussels and clams from various FAO areas. *Food Chemistry* 240:16-23.

- Concentrating mixtures of neuroactive pharmaceuticals and altered neurotransmitter levels in the brain of fish exposed to a wastewater effluent
  David, A., A. Lange, C.R. Tyler, and E.M. Hill. 2018. Concentrating mixtures of neuroactive pharmaceuticals and altered neurotransmitter levels in the brain of fish exposed to a wastewater effluent. *Science of The Total Environment* 621:782-790.

- Pharmaceuticals and personal care products (PPCPs) in the freshwater aquatic environment
  Ebele, A.J., M. A-E. Abdallah, and S. Harrad. 2017. Pharmaceuticals and personal care products (PPCPs) in the freshwater aquatic environment. *Emerging Contaminants* 3(1):1-16.

- Bioaccumulation of psychoactive pharmaceuticals in fish in an effluent dominated stream
  Grabicova, K., R. Grabic, G. Fedorova, et al. 2017. Bioaccumulation of psychoactive pharmaceuticals in fish in an effluent dominated stream. *Water Research* 124:654-662.

- How cyclophosphamide at environmentally relevant concentration influences *Daphnia magna* life history and its proteome
  Grzesiuk, M., D. Mielecki, T. Pilżys, D. Garbicz, M. Marcinkowski, and E. Grzesiuk. 2018. How cyclophosphamide at environmentally relevant concentration influences *Daphnia magna* life history and its proteome. *PLoS ONE* 13(4): e0195366.

- Social hierarchy modulates responses of fish exposed to contaminants of emerging concern
  Ivanova, J., S. Zhang, R-L. Wang, and H.L. Schoenfuss. 2017. Social hierarchy modulates responses of fish exposed to contaminants of emerging concern. *PLoS ONE* 12(10): e0186807.

- Measurement of aquaculture chemotherapeutants in flocculent matter collected at a hard-bottom dominated finfish site on the south coast of Newfoundland (Canada) after 2 years of fallow
  Hamoutene, D., F. Salvo, S.N. Egli, A. Modir-Rousta, et al. 2018. Measurement of aquaculture chemotherapeutants in flocculent matter collected at a hard-bottom dominated finfish site on the south coast of Newfoundland (Canada) after 2 years of fallow. *Frontiers in Marine Science* 5:228.

- Presence of pharmaceuticals in fish collected from urban rivers in the U.S. EPA 2008-2009 National Rivers and Streams Assessment
  Huerta, B., S. Rodriguez-Mozaz, J. Lazorchak, D. Barcelo, A. Batt, J. Wathen, and L. Stahl. 2018. Presence of pharmaceuticals in fish collected from urban rivers in the U.S. EPA 2008-2009 National Rivers and Streams Assessment. *Science of The Total Environment* 634:542-549.

- Transport of pharmaceuticals and their metabolites between water and sediments as a further potential exposure for aquatic organisms
  Koba, O., K. Grabicova, D. Cerveny, et al. 2018. Transport of pharmaceuticals and their metabolites between water and sediments as a further potential exposure for aquatic organisms. *Journal of Hazardous Materials* 342:401-407.

- Antibiotic pollution in marine food webs in Laizhou Bay, North China: Trophodynamics and human exposure implication
  Liu, S., H. Zhao, H.J. Lehmler, X. Cai, and J. Chen. 2017. Antibiotic Pollution in Marine Food Webs in Laizhou Bay, North China: Trophodynamics and Human Exposure Implication. *Environmental Science & Technology*, 51(4):2392-2400.

- Usage, residue, and human health risk of antibiotics in Chinese aquaculture: A review
  Liu, X., J.C. Steele, and X.Z. Meng. 2017. Usage, residue, and human health risk of antibiotics in Chinese aquaculture: A review. *Environmental Pollution* 223:161-169.

- Environmental concentrations of metformin exposure affect aggressive behavior in the Siamese fighting fish, *Betta splendens*
  MacLaren, R.D., K. Wisniewski, and C. MacLaren. 2018. Environmental concentrations of metformin exposure affect aggressive behavior in the Siamese fighting fish, *Betta splendens*. *PLoS ONE* 13(5): e0197259.

- Exposure to wastewater effluent affects fish behavior and tissue-specific uptake of pharmaceuticals
  McCallum, E.S., E. Krutzelmann, T. Brodin, J. Fick, A. Sundelin, and S. Balshine. 2017. Exposure to wastewater effluent affects fish behavior and tissue-specific uptake of pharmaceuticals. *Science of The Total Environment* 605-606:578-588.

- A review of the pharmaceutical exposome in aquatic fauna
  Miller, T.H., N.R. Bury, S.F. Owen, J.I. MacRae, and L.P. Barron. 2018. A review of the pharmaceutical exposome in aquatic fauna. *Environmental Pollution* 239:129-146.

- Bioaccumulation of pharmaceuticals and personal care product chemicals in fish exposed to wastewater effluent in an urban wetland
  Muir, D., D. Simmons, X. Wang, T. Peart, M. Villella, J. Miller, and J. Sherry. 2017. Bioaccumulation of pharmaceuticals and personal care product chemicals in fish exposed to wastewater effluent in an urban wetland. *Scientific Reports* 7: 16999.

- Tools to assess effects of human pharmaceuticals in fish: A case study with gemfibrozil
  Oliveira, M., L. Franco, J.C. Balasch, et al. 2017. Tools to assess effects of human pharmaceuticals in fish: A case study with gemfibrozil. *Ecological Indicators*, In Press.

- Novel electrosorption-enhanced solid-phase microextraction device for ultrafast in vivo sampling of ionized pharmaceuticals in fish
  Qiu, J., F. Wang, T. Zhang, et al. 2018. Novel electrosorption-enhanced solid-phase microextraction device for ultrafast in vivo sampling of ionized pharmaceuticals in fish. *Environmental Science & Technology* 52(1):145-151.

- Multi-residue method for the determination of antibiotics and some of their metabolites in seafood
  Serra-Compte, A.,D. Álvarez-Muñoz, S. Rodríguez-Mozaz, and D. Barceló. 2016. Multi-residue method for the determination of antibiotics and some of their metabolites in seafood. *Food and Chemical Toxicology* 104:3-13.

- Reduced anxiety is associated with the accumulation of six serotonin reuptake inhibitors in wastewater treatment effluent exposed goldfish *Carassius auratus*
  Simmons, D.B.D., E.S. McCallum, S. Balshine, et al. 2017. Reduced anxiety is associated with the accumulation of six serotonin reuptake inhibitors in wastewater treatment effluent exposed goldfish *Carassius auratus*. *Scientific Reports* 7:17001.

- Uptake and metabolism of human pharmaceuticals by fish: A case study with the opioid analgesic Tramadol
  Tanoue, R., L. Margiotta-Casaluci, B. Huerta, et al. 2017. Uptake and metabolism of human pharmaceuticals by fish: A case study with the opioid analgesic Tramadol. *Environmental Science & Technology* 51(21):12825-12835.

- Evaluation of triclosan in Minnesota lakes and rivers: Part II – human health risk assessment
  Yost, L.J., T.R. Barber, P.R. Gentry, M.J. Bock, J.L. Lyndall, M.C. Capdevielle, and B.P. Slezak. 2017. Evaluation of triclosan in Minnesota lakes and rivers: Part II – human health risk assessment. *Ecotoxicology and Environmental Safety* 142: 588-596.

- Environmental concentrations of antibiotics impair zebrafish gut health
  Zhou, L., S.M. Limbu, M. Shen, et al. 2018. Environmental concentrations of antibiotics impair zebrafish gut health. *Environmental Pollution* 235:245-254.

Upcoming Meetings and Conferences

18th International Conference on Harmful Algae
October 21-26, 2018
Nantes, France

13th World Congress on Aquaculture and Fisheries
November 12-13, 2018
Melbourne, Australia

National Shellfisheries Association 111th Annual Meeting
March 7-11, 2019
New Orleans, Louisiana

2018 Organization of Fish and Wildlife Information Managers Annual Conference & Business Meeting
November 4–8, 2018
Hood River, Oregon

Fish Passage 2018: International Conference on Fish Connectivity
December 10-14, 2018
New South Wales, Australia

19th International Conference of Diseases of Fish and Shellfish
September 9-13, 2019
Porto, Portugal

Additional Information

This monthly newsletter highlights current information about fish and shellfish.

For more information about specific advisories within the state, territory, or tribe, contact the appropriate state agency listed on EPA's National Listing of Fish Advisories website at https://fishadvisoryonline.epa.gov/Contacts.aspx.

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