

Pennsylvania Fish and Boat Commission
Testimony Regarding Pharmaceuticals in Pennsylvania's Waterways
Pennsylvania Senate
Environmental Resources and Energy Committee
Presented by John Arway, Executive Director
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Good morning, Chairman Yaw, Chairman Yudichak and members of the Senate Environmental Resources and Energy Committee. Thank you for the opportunity to appear before you today. On behalf of our Board of Commissioners and 1.1 million anglers and over 3 million boaters statewide, I am pleased to be with you today to offer testimony about the impacts of pharmaceuticals on Pennsylvania's aquatic resources living in our 86,000 miles of streams and rivers. This continues to be a subject of increasing importance to the Pennsylvania Fish and Boat Commission (Commission or PFBC) and to me personally since I have publicly discussed the host of factors affecting the health of the Susquehanna River and its Smallmouth Bass to many audiences across the nation.

Pharmaceuticals are synthetic or natural chemicals that can be found in prescription medicines, over-the-counter therapeutic drugs and veterinary drugs. Pharmaceuticals are an essential part of treatment plans for address specific human health and animal diseases. Advances in medications have improved human, animal herd and cultured fish health. The positive and negative effects of prescribed medications on people and animals are evaluated by the research associated with their development. We commonly hear more about the adverse effects of pharmaceuticals than the positive effects and are left wondering whether the risks are worth the benefits.

Interactions among pharmaceuticals and effects on non-target organisms are even less certain. Over prescription or overuse of medications can increase release of these compounds into the environment. These substances pass through humans and animals into the waste stream and travel by various routes into our streams and rivers. This migration pathway is not well understood.

In Pennsylvania's waters, fish and aquatic life are exposed to complex mixtures of pharmaceuticals and other compounds that are released into waste streams and runoff from our landscapes. I would now like to explain the variety of effects of pharmaceuticals to fish and other aquatic life living in our Commonwealth's waters.

Recent advances in analytical methods allow various compounds to be detected in concentrations at the parts per trillion or even quadrillion ranges. A drop of chocolate in 64 quarts of milk equals a part per million (ppm) of chocolate. A part per billion (ppb) is a drop of chocolate in 16,000 gallons of milk. A part per trillion (ppt) is a drop of chocolate in 16 million gallons of milk. Our ability to detect chemicals to extraordinarily low levels now allows us to evaluate problems that we could not do in the past.

Research beginning in 1999 first showed that chemicals found in medications were being absorbed by fish and were contributing factors to a number of fish health problems. Perhaps the most troubling condition is intersex fish. This is where male fish develop female egg cells in their testis. In general, it has been previously shown that fish collected immediately downstream

of wastewater effluents have a higher percentage of intersex. However, through my testimony today you will hear that surprisingly, this is not always the case.

What pathways do pharmaceuticals take to reach our Commonwealth's waterways? One route is through point source discharges from wastewater treatment plants. Processing wastewater typically involves an activated sludge treatment process. The standard treatment process varies in the removal rate for pharmaceuticals from less than 20% to greater than 90%. Standard wastewater treatment processes were not designed to remove prescription drugs, their metabolites and other emerging contaminants. Removal rates vary depending on the product. Some chemicals, like caffeine, have high removal rates. More expensive treatment processes such as reverse osmosis, ozone and advanced oxidation can result in higher removal rates. Pharmaceuticals can also enter waterways through runoff from animal feeding operations. Application of pesticides, herbicides, manure, fungicides and fertilizers can also be washed by rain and snowmelt from fields and lawns where they are applied and be found in our streams and rivers. These chemicals can also affect the health of fish and aquatic life in much the same way as pharmaceuticals. In urbanized areas, pollutants, including pharmaceuticals, can enter waterways through combined sewer overflows (CSO's).

Chemicals that produce hormonal changes in fish are called endocrine disrupting chemicals or EDCs. One effect of exposure to EDCs is estrogenicity or the production of female sex hormones. The United States Geological Survey (USGS) Fish Health Laboratory reported in 2013 that approximately 50% of male bass in the Delaware River had intersex condition, and 10% in the Ohio River drainage were affected. Up to 100% of the males sampled in the

Susquehanna River were found to have intersex. More recent samples in the Susquehanna confirm that 90 – 100% of male Smallmouth Bass have intersex condition and that this condition is more severe than found in other drainages.

Intersex condition is attributed to early life stage exposure or chronic exposure of fish to estrogenic chemicals. More recent work has found that an egg precursor protein, vitellogenin, can indicate estrogen-like compound exposure in the short term. If vitellogenin is present in the bloodstream of female fish in non-spawning periods or in male fish anytime, then recent exposure to EDCs has likely occurred. Our current ability to detect these physiological changes in fish helps us define where pharmaceuticals and estrogen-like compounds occur.

A Pennsylvania Department of Environmental Protection (DEP) fish tissue sampling program in the Susquehanna River has been extended to its tributaries. Sadly, fish displaying estrogenic response are found everywhere we look, indicating that the problem is much broader than we thought and not the result of a single source of estrogenic compounds such as a discharge from a sewage treatment plant (STP). Chemicals that have properties similar to estrogen not only include pharmaceuticals but also many others. This finding has broadened the scope of Susquehanna studies. Finding fish with intersex condition or vitellogenin in their bloodstream is abnormal but unfortunately does not identify its specific cause.

Additional work is necessary to identify the products or mixtures of chemicals that produce these estrogenic effects. In the 2015 multi-agency Causal Analysis/Diagnosis Decision Information System (CADDIS) study, endocrine disrupting chemicals, which include those with

estrogen-like response, and pesticides were listed as likely causes for reduction of the Smallmouth Bass population in the Susquehanna River.

Pharmaceuticals and health-altering chemicals have different sources of origin and affect fish in different ways. Reproductive rates of Yellow Perch in Chesapeake Bay tributaries in Maryland were found to be lowest in highly suburbanized watersheds, which would contain a higher percentage of wastewater discharge. An anti-anxiety drug was found to alter perch socialization and feeding behavior in dilute concentrations in a Swedish study. Fathead minnows were studied in an Ontario Lake where they were exposed to estrogen and estrogen-like compounds. Impacts on reproductive organ development in males and females caused reproductive failure and near extinction of the species in the lake.

A 2006-2009 USGS study in Pennsylvania found that pharmaceuticals, hormones and organic wastewater compounds were widely distributed in Pennsylvania waters. USGS sampled water from wells used to supply livestock, streams upstream and downstream of animal feeding operations, wastewater treatment plants, and streams within five miles of a drinking water intake. While streams near wastewater treatment plants had higher concentrations of these compounds of concern, pharmaceuticals, hormones and organic wastewater compounds were widespread in their presence and followed no distinct pattern of occurrence. Products included antibiotics, a nicotine compound, acetaminophen, caffeine, an anti-seizure compound, estrone, phosphate compounds and some unexpected compounds such as a fragrance and a fire retardant. This study provides direct evidence of the wide variety of threats to the fish and aquatic life living in our Commonwealth waters.

Studies have been initiated to evaluate how pharmaceuticals in drinking water can affect humans. Many Pennsylvania waterways serve as drinking water sources. Wastewater treatment plant effluents are known significant sources of pharmaceuticals. Also pharmaceuticals and other EDCs are often disposed of in landfills where they can leach into groundwater or drain into leachate treatment systems and eventually be legally discharged into streams.

In a recent presentation to our Commissioners, Eric Wright, a Geisinger Health Systems representative, discussed the prevalence of unused medications available in homes. Geisinger has championed removal of prescription drugs from unintended use and from the environment through a “take-back” box program. Medications are gathered by the National Guard from take-back boxes from secure locations throughout the Commonwealth and transported for incineration. In 2016, The Pennsylvania National Guard serviced approximately 500 take-back boxes and collected 66,000 pounds of unused pharmaceuticals. That’s over 30 tons!

We were so impressed with this program that the Commission has partnered with Geisinger to install a take-back box in our Harrisburg Headquarters to provide a way for citizens to safely dispose of unused medications and help improve the health of the Susquehanna River and its Smallmouth Bass. Removing unused pharmaceuticals from homes keeps them from being flushed down the toilet. Pharmaceuticals removed from homes during this program included: Cardiovascular, Pain, Psychiatric, Antibiotics, Endocrine, Digestive, Anti-inflammatory, Breathing, Cold & Allergy and other medications. It was clear from this presentation that if the Geisinger take-back program didn’t exist, 30 tons of pharmaceuticals would have not have been properly disposed of and possibly released to the Susquehanna River.

How can we as a society make progress in reducing pharmaceuticals from getting into our lakes, streams and rivers? Removing unused pharmaceuticals from homes and providing proper disposal alternatives is an important first step. Improving our wastewater treatment processes to provide more effective removal of medications and break down products is another effective solution.

A study recently reported in the Journal of Environmental Science and Technology showed high intersex condition of fish in an Ontario tributary stream to Lake Erie. Municipal wastewater treatment plant upgrades from a carbonaceous active sludge to nitrifying activated sludge treatment process resulted in a decline in intersex condition from 70-100% to less than 10% within 10 years, even though the precise cause of intersex condition was unknown. Reducing agricultural and suburban runoff can also drastically reduce influx of herbicides and pesticides, some of which produce estrogenic effects.

The DEP has found that water samples in Susquehanna River tributary streams not directly impacted by wastewater treatment plants produced estrogenic effects. While we aren't completely certain about what compounds are producing the estrogenic effects, our agency is cooperating with DEP and federal agencies to further evaluate the problem. At the same time, we have strongly recommended to DEP and the United States Environmental Protection Agency (EPA) that actions need to begin on the Susquehanna River. In particular, we need to begin implementing not only studies to define the precise nature of the water quality problems, but also begin to instituting remedies to fix the problems we all know exist.

This should begin with making our bass well again. We believe an impaired designation would provide access to funding sources that will not only help clean up the river, but will assist with Pennsylvania's efforts in meeting Chesapeake Bay loading limits and goals. We are now jointly identifying Susquehanna River Basin priorities with EPA and DEP to focus our efforts on reducing pharmaceuticals, nutrients, sediment and other contaminants in the Susquehanna River Basin.

On a local level, the Commission's Save Our Susquehanna (S.O.S.) Program has partnered with individual farmers, local, state and federal government agencies and Susquehanna University to fund our first project on Limestone Run. This work in Montour and Northumberland Counties will limit runoff of sediments and nutrients, protect stream banks and provide fish habitat.

We launched the S.O.S. campaign in June 2015. To date, individuals concerned about the river and bass have contributed more than \$60,000 to the campaign, and the PFBC pledged \$50,000 in matching funds. It is critical that we continue to create public awareness about our challenges and focus our collective efforts and funding on protecting the Susquehanna River and our other Commonwealth waters. We intend to move forward and work one household, property and farm at a time to conserve our aquatic resources for this generation and generations yet to come. We appreciate the opportunity to discuss the PFBC's commitment for assisting with limiting the amount of pharmaceuticals in our Commonwealth's water to protect the health of our citizens and fish and invite your Committee to join this effort.