

Statement of Mark Myers

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Oversight Hearing on "Ova-Pollution in the Potomac: Egg-Bearing Male Bass and Implications for Human and Ecological Health"

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Introduction

Thank you Mr. Chairman for the opportunity to present testimony on the Department of the Interior's (Department) science regarding intersexual characteristics of fish in the Potomac River. My name is Mark Myers, and I am the Director of the U.S. Geological Survey (USGS).

The USGS is a federal science agency within the Department that conducts research to understand the interrelationships among earth surface processes, ecological and biological systems, and human activities. The USGS does not conduct this science alone. We partner with other federal and state agencies, tribal governments, and non-governmental organizations, including human health agencies or academics, when a comprehensive human health assessment is required.

The USGS has collected data on endocrine disruption in fish and measured concentrations of endocrine disruptor chemicals in many rivers throughout the United States. For 12 years, the USGS has engaged in research activities concerning fish health assessments in the Potomac and Shenandoah Rivers. Fish that possess intersexual characteristics are not limited to the Chesapeake Bay Watershed. The USGS has found such fish in the Mississippi River, the Rio Grande and Colorado Rivers, the Columbia River, the Missouri River, the Las Vegas Wash and many other locations throughout the country.

My testimony today will cover the following:

- The fish health problem in the Chesapeake Bay and other rivers in the Nation;

- The role of USGS and our partners investigating the concerns;
- Current research into the potential causes of intersexual characteristics and endocrine disruption; and
- The role of our sister agency at the Department, the U.S. Fish and Wildlife Service, on this issue.

I will conclude my testimony with a brief discussion of the additional information that is needed to help managers develop solutions for this problem.

Identification of the Issue

In recent years, there have been a number of fish-health problems within the Chesapeake Bay and its watershed that are associated with changing water quality and habitat conditions. One of our major findings is the presence of intersexual characteristics in smallmouth and largemouth bass in the Potomac River.

The term “intersex” or intersexual characteristics describes a range of abnormalities in which both male and female characteristics are present within the same fish. Intersexual characteristics are most commonly described as the presence of female germ cells, which are the precursor to mature eggs, within a male reproductive organ and/or malformed reproductive ducts.

The occurrence of intersex fish has been related to chemicals, often termed endocrine disruptors, that affect the reproductive system. Endocrine disruptors are chemicals that interfere with the natural balance of hormones that regulate development, reproduction, metabolism, behavior, and the internal state of living organisms. Occasionally these abnormalities can be noted externally but most often the main reproductive organs must be examined under a microscope for diagnosis of intersexual characteristics. The presence of this abnormality or intersexual characteristic has been used as an indicator of exposure to estrogenic chemicals and has been documented in a variety of wild fish species in a number of rivers and estuaries around the Nation (*e.g.*, Florida, Colorado, California), as well as other countries, including the United Kingdom, the Seine-Maritime Bay (France), the Mediterranean Sea, and China.

Role of the U.S. Geological Survey

The USGS provides science to help understand the environment, including the factors affecting fish health. The information is used by the U.S. Fish and Wildlife Service (Service), whose role with regard to this issue is

discussed in more detail below; the U.S. Environmental Protection Agency (EPA); and other state and federal partners to better manage and restore fish, wildlife, and their habitats and to protect human health. The risk to humans from fish with intersexual characteristics is currently unknown.

The specific fish-health investigations in the Potomac Watershed that led to the discovery of intersexual characteristics in fish were conducted as part of the USGS efforts on the Chesapeake Bay Watershed. USGS programs and partners, including the Service, the Virginia Departments of Game and Inland Fisheries and Environmental Quality, the Maryland Department of Natural Resources, and the West Virginia Division of Natural Resources (WV DNR), have contributed to this work on fish health issues in the Chesapeake Bay drainage.

Recent Assessments of the Chesapeake Bay Watershed

In 2003 and 2004, in response to fish kills and increased observations of external sores and wounds on smallmouth bass and other species, WV DNR and USGS initiated fish-health assessments at selected sites in the South Branch of the Potomac River. Samples were collected, and pieces of all tissues, including reproductive organs, were removed for evaluation. During this time period, 16 out of 24 sampling events showed more than 25 percent of the male bass possessing intersexual characteristics. Sampling also indicated seasonal differences in the ratio of male bass possessing intersexual characters. Fish sampled in the spring months had a 25-40 percent higher occurrence of intersexual characteristics than those sampled during the summer months.

In 2005, through collaboration among USGS, the Service, the Virginia Departments of Game and Inland Fisheries and Environmental Quality, the Maryland Department of Natural Resources, and the WV DNR, sampling was expanded to additional sites in the Shenandoah and Potomac watersheds for determination of the extent of the intersex problem. During the late summer/early fall of 2005, samples were collected at sites farther downstream in the Potomac, specifically to look at areas associated with intersexual characteristics. These included wastewater treatment outflows; major fish kill sites; and other drainage sites for use as possible background sites. A map of sampling sites is shown in Figure 1.

These preliminary findings suggest that intersexual characteristics in fish are widespread throughout the Potomac and Shenandoah Rivers, but are at a much lower incidence in other sampled rivers in West Virginia.

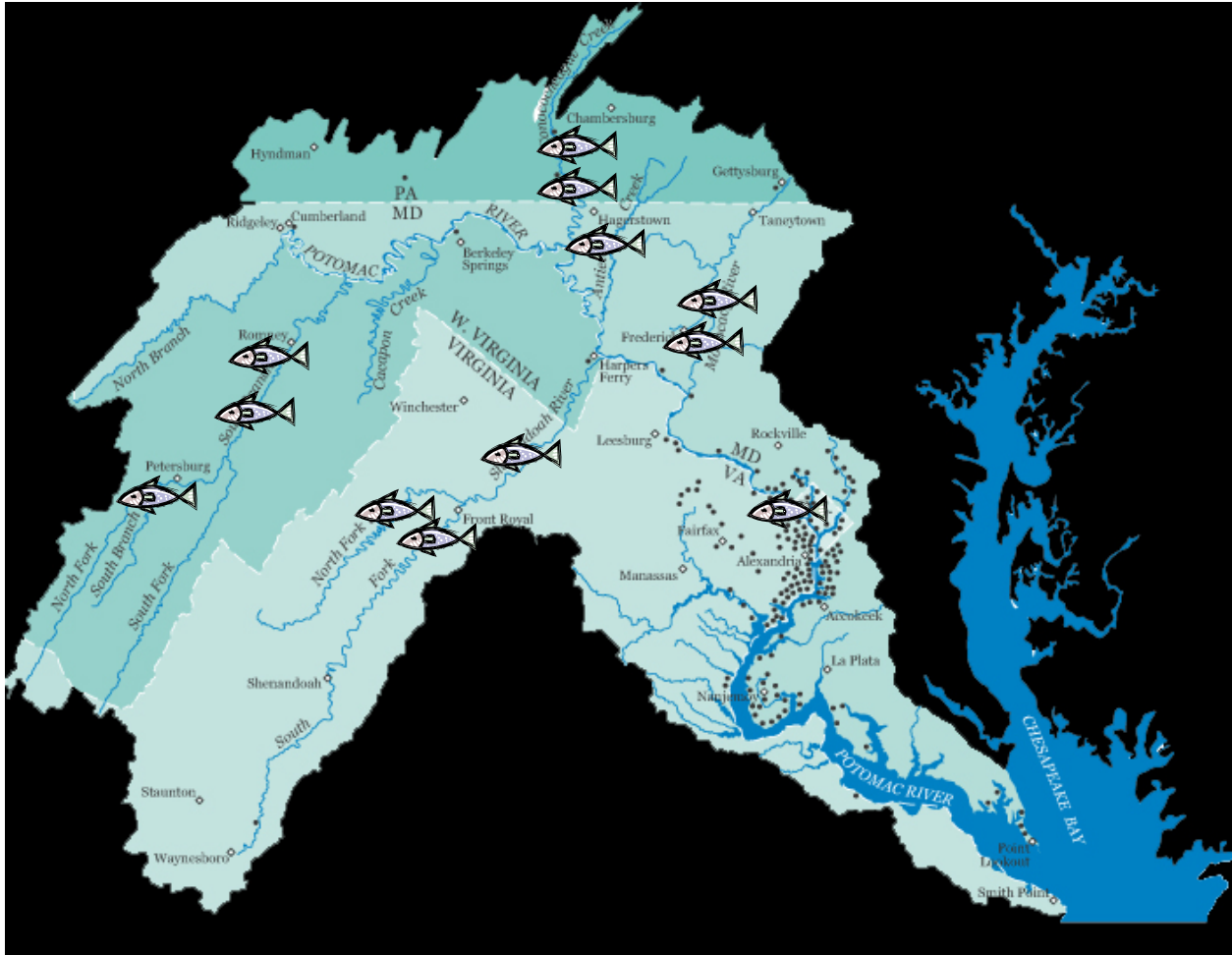


Figure 1. Map of sampling sites for largemouth and smallmouth bass within the Potomac River Watershed. Fish symbols indicate sites at were fish were collected for determination of intersexual characteristics.

Potential Causes

Potential causes of intersexual characteristics in fish include chemical contamination and changes in the temperature regime or habitat. Current research on intersexual characteristics has related numerous chemicals to reproductive effects in fish. These chemicals, often termed “endocrine disruptors,” include previously banned chemicals, such as DDT and chlordane, natural and anthropogenic hormones, herbicides, fungicides, industrial chemicals, and an emerging group of chemicals including personal care products and pharmaceuticals that may act as endocrine disruptors in fish as well as other organisms. Potential sources of these endocrine disruptors include agricultural, as well as individual use of herbicides and pesticides, human waste (discharges from wastewater treatment facilities

and individual home septic systems), animal wastes that may reach the aquatic environment through runoff, leachates from landfills, and even atmospheric deposition.

Laboratory studies have indicated that the chronic effects of exposure to low levels of these chemicals can result in negative reproductive effects on zebrafish and fathead minnows. In addition, laboratory studies of fathead minnows, medaka, rainbow trout, common carp and zebrafish have shown other negative effects on reproductive activity by endocrine disruptors. Some results indicate that exposure to environmental contaminants may be affecting both growth and reproductive physiology of individual white sturgeon in the Columbia River. However, we have not been able to conclude from field studies, like the Potomac River study, that endocrine disrupting chemicals have impacts on wild fish populations. In addition, the interactive effects of multiple endocrine disruptors on aquatic organisms are unknown.

A limited amount of information is available on the distribution of these endocrine disruptors in the Chesapeake Bay and its major river basins. During 1992-1996, the USGS conducted extensive sampling of the Potomac and the Susquehanna River Basins. Chlordane, DDT, and PCBs were detected in streambed sediment and aquatic tissues in the Potomac Basin. Sediment from over one half of the sites contained concentrations of these chemicals that posed an intermediate probability of having adverse effects on aquatic life.

In 1999 and 2000, the USGS undertook a nationwide study to provide information on the occurrence of a larger group of chemicals and endocrine disruptors that may be entering the Nation's streams through wastewater. The USGS sampled streams at 139 sites across the Nation, including one site in the Potomac River basin. The samples were analyzed for 95 different emerging contaminants including human and veterinary drugs, hormones, detergents, disinfectants, insecticides, and fire retardants. At least one of these chemicals was found in 80 percent of the streams, with mixtures of the chemicals occurring at 75 percent of the sites. Most common groups detected were steroids, nonprescription drugs and insect repellent. Only 14 of these chemicals have human health advisory criteria and measured levels rarely exceeded any of the standards or criteria. However, little is known about the majority of the chemicals found in the samples or the effects of these chemicals when they are mixed together.

The USGS has also been active in developing methods to measure hormonally active or endocrine disrupting chemicals in water sediment and tissue, as well as in developing integrative samplers such as Semi-

Permeable Membrane Devices (SPMDs) and Polar Organic Chemical Integrative Samplers (POCIS). These new methods are used to assess the environmental occurrence of these chemicals. The USGS has published a significant number of journal articles on the environmental occurrence of endocrine disruptors that provide useful information to researchers in determining the concentrations and mixtures of these chemicals for laboratory studies.

Although the effects of endocrine disruptors can be replicated in the laboratory under controlled conditions using synthetic hormones or other chemicals, it has not been possible to demonstrate a cause of the intersexual characteristics in the field. Laboratory studies that discern the causative mechanisms for endocrine disruption are also underway at several USGS Science Centers. USGS is developing new molecular and other techniques to determine the causative agents of multiple stressor situations.

Research by other scientists around the world has shown that endocrine disrupting chemicals in aquatic environments affect various fauna, from mussels to fish to birds. Some of the aspects of this issue are being addressed by the European Commission and the U.S. Food and Drug Administration to determine the potential risks of human and veterinary drugs on the environment.

Additional Information is Needed

There is a need to further document the extent of intersexual characteristics within the Chesapeake Bay and other watersheds. Identifying the chemicals that are impacting the fish, and their sources, fate, and transport will help managers develop solutions for the problem. The USGS is currently conducting a study to address some aspects of the issue in the Shenandoah Valley of the Potomac River Basin. What is learned there may be applied and expanded to other areas and other watersheds.

To help coordinate federal research activities related to endocrine disruption in the environment, the USGS is leading the planning effort for an interagency workshop in February 2007 at the USGS Headquarters in Reston, Virginia. This workshop is being organized under the Office of Science and Technology Policy and the Council on the Environment and Natural Resources. Eight federal agencies will be participating in this workshop. The major goals are to review the current knowledge about endocrine disruption in the environment, what type of research and studies each agency is currently doing and planning in this area, and most importantly, to develop specific opportunities for collaboration between agencies. The workshop will involve a variety of federal scientists and

managers in every aspect of endocrine disruption, including developing methods to detect Endocrine Disrupting Chemicals (EDC) in the environment; basic research on how they affect fish and wildlife; developing methods for monitoring and identifying sources; and different ways the discharge of EDCs can be minimized or removed from the environment.

Given our current scientific understanding of intersex in fish, the areas in which USGS science can make a valuable contribution include determining:

- What effects these endocrine disruptors have on the ability of fish to reproduce, thrive and sustain populations in the wild;
- What aquatic organisms are being affected (e.g., are only benthic feeders or fish that lay eggs in the sediment affected or are other aquatic organisms at risk), and the implications for the aquatic ecosystem;
- What chemicals and other stressors are implicated in these effects;
- How to improve our ability to predict causes of endocrine disruption in the field;
- The consequences of these effects at the population and ecosystem levels; and
- Potential causes of intersexual characteristics in fish, including chemical contamination, and changes in the temperature regime or habitat.

Role of the U.S. Fish and Wildlife Service

At the request of the Committee, this testimony also provides information developed by the Service concerning the work it is carrying out regarding this issue.

The Service's Environmental Contaminants Program is responsible for protecting the nation's fish and wildlife from environmental contaminants through scientific study, mitigation, education and habitat cleanup. The Service has been involved with studying contaminant effects on fish and wildlife since its earliest days, but the Environmental Contaminants Program (Program) really began to take form in the 1950s, when increasing awareness of pollution problems spurred the American public to demand action.

The Service's Program includes contaminants specialists stationed at more than 75 locations around the country. Service contaminants specialists specialize in detecting toxic chemicals; addressing their effects; preventing harm to fish, wildlife and their habitats; and removing toxic chemicals and restoring habitat when prevention isn't possible. They are experts on oil and chemical spills, pesticides, water quality, hazardous materials disposal and other aspects of pollution biology. The Program's operations are integrated

into all other Service activities and the Service's contaminants specialists often work in partnership with other agencies and organizations which have come to rely on our expertise.

In 1991, the Program began investigating the potential reproductive effects of endocrine disrupting contaminants on wildlife with studies on the endangered Florida panther, polar bears and their prey. To date, the Program has funded and participated in more than 23 studies that specifically looked at the effects of endocrine disrupting contaminants on wildlife across the country. Many of these studies have been directly associated with endangered species recovery actions or threats to the recovery of listed species. These studies typically included management recommendations for the removal of threats from contaminants or other corrective actions to alleviate the impacts of endocrine disrupting contaminants on wildlife.

Some examples of the geographic and taxonomic extent of the studies include: river otters (Oregon); fish, alligators, and panthers (Florida); fish and barn swallows (lower Mississippi River –Louisiana); fish and reptiles (Arizona); fish and wildlife (Nevada); polar bears and eiders (Alaska); sturgeon (middle Mississippi River - Illinois, Missouri, Iowa); mussels and paddlefish (Ohio); common loons (Maine); terns and cormorants (New York); cormorants (Michigan); fish (Delaware, Maryland, Virginia); and amphibians (Texas). All of these investigations involved wildlife and habitat sampling to determine how the wildlife were being exposed to the disruptors and provided suggested management actions to alleviate impacts of endocrine disrupting contaminants on wildlife.

Recently, the Program initiated a campaign with the American Pharmacists Association (APhA) and a myriad of other partners including pharmaceutical manufacturers, the Food and Drug Administration, DEA, Environmental Protection Agency, American Veterinary Association, AMA, PhRMA, Water Environment Federation, U.S. Geological Survey, US Pharmacopeia, Pfizer, Walgreens, AstraZeneca, and the Association of Fish and Wildlife Agencies to develop recommendations and outreach strategies regarding the disposal of unused and unwanted pharmaceuticals. One of the objectives of this campaign is to raise public awareness about disposal options for prescription drugs as a means to minimize the introduction of chemicals into the environment.

Service Involvement on the Potomac River Intersex Study of Bass

As discussed above, the Service's Chesapeake Bay Field Office Contaminants Program participated in a study to assess endocrine disruption in bass at five

locations in the Potomac River Watershed. In coordination with the states of Virginia and Maryland, and including the USGS, the Service selected two sites each on Conococheague Creek and the Monocacy River, Maryland and one on the Potomac River near the Blue Plains wastewater treatment plant, Washington, DC. In 2005, the Service collected data to determine if:

- Sewage treatment plants were releasing detectable concentrations of endocrine disrupting compounds into these water bodies;
- Male bass exposed to endocrine disrupting compounds had altered concentrations of vitellogenin, the protein precursor for egg production; and
- Male bass exposed to endocrine disrupting compounds are exhibiting intersex characteristics.

Today, the Service is working with the USGS to determine if intersex, altered vitellogenin concentrations, or altered hormone ratios can be induced in caged hatchery raised bass deployed in Monocacy River and Conococheague Creek compared to a control group of bass at the National Fish Health Research Laboratory in Kearneysville, West Virginia.

Final chemical analyses and field and laboratory data have not been completed. However, preliminary results indicate that between 80 to 100 percent of the male bass collected in the Monocacy River and Conococheague Creek exhibited intersexual characteristics. More field collections were completed in mid-June 2006 and all samples are currently being analyzed at the laboratory. A final report is expected by Spring 2007.

In sum, Interior bureaus have been carrying out and will continue field collections in the Potomac River watershed. One of our major findings is the presence of intersexual characteristics in smallmouth and largemouth bass in the Potomac River. We do not know the full extent of this phenomenon throughout the entire watershed, as studies to date have been relatively small scale, have involved a single species, and were located near obvious potential sources of endocrine disrupting chemicals. In future years, comprehensive watershed evaluation may be necessary. There is more work to be done, but we are eager to continue our collaborative efforts with federal, state, and private partners to find ways to better understand the impacts of endocrine disrupting chemicals on the Nation's fish and wildlife resources.

Thank you, Mr. Chairman, for the opportunity to present this testimony. I will be pleased to answer questions you and other Members of the Committee might have.

References

An, W. and J. Hu. 2006. Effects of endocrine disrupting chemicals on China's rivers and coastal waters. *Frontiers in Ecology and the Environment* 4: 378-386.

Ator, S.W., J.D. Blomquist, J.W. Brakebill, J.M. Denis, M.J. Ferrari, C.V. Miller and H. Zappia. 1998. Water quality in the Potomac River Basin, Maryland, Pennsylvania, Virginia, West Virginia, and the District of Columbia, 1992-1994. *United States Geological Survey Circular* 1166. 38 pages.

Daughton, C.G. and T.A. Ternes. 2006. Pharmaceuticals and personal care products in the environment: Agents of subtle change? *Environmental Health Perspectives* 107 (6): 907-938.

Feist, G.W., M.A.H. Webb, D.T. Gundersen, E.P. Foster, C.B. Schreck, A.G. Maule, M.S. Fitzpatrick. 2005. Evidence of detrimental effects of environmental contaminants on growth and reproductive physiology of white sturgeon in impounded areas of the Columbia River. *Environmental Health Perspectives* 113 (12): 1675-1682.

Jobling, S., M. Nolan, C.R. Tyler, G. Brighty, and J.P. Sumpter. 1998. Widespread sexual disruption in wild fish. *Environmental Science & Technology* 32 (17): 2498-2506.

Jobling, S., N. Beresford, M. Nolan, T. Rodgers-Gray, G.C. Brighty, J.P. Sumpter, and C.R. Tyler. 2002. Altered sexual maturation and gamete production in wild roach (*Rutilus rutilus*) living in rivers that receive treated sewage effluents. *Biology of Reproduction* 66: 272-281.

Kolpin, D.W., E.T. Furlong, M.T. Meyer, E.M. Thurman, S.D. Zaugg, L.B. Barber, and H.T. Buxton. 2002. Pharmaceuticals, hormones, and other organic wastewater compounds in U.S. streams, 1999-2000: A national reconnaissance. *Environmental Science & Technology* 36: 1202-1211.

Liney, K.E., S. Jobling, J.A. Shears, P. Simpson and C.R. Tyler. 2005. Assessing the sensitivity of different life stages for sexual disruption in roach (*Rutilus rutilus*) exposed to effluents from wastewater treatment works. *Environmental Health Perspectives* 113: 1299-1307.

Mills, L. J. and C. Chichester. 2005. Review of evidence: Are endocrine-disrupting chemicals in the aquatic environment impacting fish populations? *Science of the Total Environment* 343 (2005) 1-34.

Nash, J.P., D.E. Kime, L.T.M. Van der Van, P.W.Wester, F. Brion, G. Maack, P. Stahlschmidt-Allner and C.R. Tyler. 2004. Long-term exposure to environmental concentrations of the pharmaceutical Ethynylestradiol causes reproductive failure in fish. *Environmental Health Perspectives* 112:1725-1733.

Sohoni, P., C.R. Tyler, K. Hurd, J. Caunter, M. Hetheridge, T. Williams, C. Woods, M. Evans, R. Toy, M. Gargas and J. P. Sumpter. 2001. Reproductive effects of long-term exposure to Bisphenol A in the fathead minnow (*Pimephales promelas*). *Environmental Science and Technology* 35:2917-2925.