

Summary of Research – Reviewed by the DWSPP Emerging Contaminants Workgroup

Chambers, D.B. and Leiker, T.J., 2006. "A Reconnaissance for Emerging Contaminants in the South Branch Potomac River, Cacapon River, and Williams River Basins, West Virginia, April-October 2004". USGS Open-File Report 2006-1393, 23 p.

Purpose and Scope

The report was intended to be an interim data product, placing results in the hands of colleagues in a peer-reviewed, citable format. This investigation is one of many similar, ongoing studies by the U.S. Geological Survey (USGS) of the environmental occurrence of contaminants of emerging concern, including endocrine-disrupting compounds (EDCs), industrial chemicals, pharmaceuticals, household products, herbicides and pesticides. The focus on the upper Potomac River and its tributaries was motivated by findings of a high incidence of an intersex condition (oocytes in the testes) in the smallmouth bass population in this area, and by the suspicion that this effect in fish may be caused by EDCs in the aquatic habitat. The report outlines, as background for selecting sample locations and sample types, several widely recognized potential sources of contaminants in the upper Potomac River Basin: runoff from agricultural activities, municipal and domestic wastewater effluent, industrial wastewater, and pest control programs. Samples of stream-water, wastewater effluent and smallmouth blood-plasma were collected to detect occurrence of emerging contaminants including possible EDCs that may have contributed to increased intersex in the native male smallmouth bass.

The report does not attempt to provide links between what compounds were found, their potential sources and the biological effects that have been observed in the area. The purpose of the report was to present interim findings, what compounds were found at what sites and in what various media.

Overview of Findings

Pesticides, industrial compounds, and flame retardants and personal-care products were found in passive samplers and smallmouth bass blood-plasma. Some of the compounds detected in the stream waters and fish blood-plasma are suspected or potential EDCs. The study found only two EDCs (flame retardant compounds, polybrominated diphenyl ethers or PBDEs) in both stream water and fish blood-plasma samples, and they appear to be ubiquitous in the environment, also being present at sites where fish are not exhibiting intersex conditions. Other EDCs, including pesticide and herbicide compounds and an arsenic species, were found in stream water. Arsenate was also detected in wastewater effluent from a poultry processing plant. Antibiotics were found in municipal and agricultural wastewater effluents, but not in stream waters.

Many of the compounds found were in samples from the South Branch Potomac River, the adjacent Cacapon River, and in samples from a remote reference site. Other plasticizer (phthalate) compounds, also suspected EDCs, found in the fish plasma were detected in reagent blanks and may be present due to contamination associated with sampling or analytical procedures.

In part, the sampled media and analytical methods do not support making direct quantitative comparisons between the results. Different suites of analytes were tested in the various media and the results are expressed in different units of measurement. At best, a qualitative comparison of the presence of chemical substances detected can be made.

What the Findings Mean for Downstream Water Supply

The study examined a geographically discrete area of the upper Potomac River Basin, where the intersex fish were first reported. This area is relatively far removed from the downstream reaches from which the water treatment plants serving the bulk of the metro DC region draw their source water. The purpose of the study was not to track the transport and fate behavior of contaminants to these downstream reaches and to imply potential human health effects via drinking water. Therefore conclusions about the presence or significance of these compounds in the downstream reaches cannot be drawn from the data set.

Moreover, the report presents analyte masses in passive samplers, not water concentrations. Most of the compounds reported have not been sufficiently modeled to calculate a water concentration.

The compounds reported are merely present at the locations sampled; the authors did not and could not draw any conclusions about repercussions for downstream drinking water supplies.

What the Findings Establish About Fish Health

No conclusions were made about the findings and their implications for fish health. The USGS does not have sufficient data at this time to make such links, and is currently awaiting results of further analyses that may clarify relations among the compounds detected and the observed biological effects. The fish whose blood-plasma were tested in this study included both male and female mature fish without intersex characteristics and male fish with intersex characteristics. This approach was taken to represent the range of intersex conditions found at the sampling sites; however, the results do not distinguish between detected contaminants from the healthy vs. intersex fish.

The results do not show that a link exists between the compounds found in this reconnaissance and the occurrence of an intersex condition in smallmouth bass in the Potomac River Basin.

What the Findings Indicate About Sources of Contaminants

The main goal of this phase of the study was to identify chemical compounds present in the study area. As the title reflects, this was a reconnaissance for emerging contaminants, not an effort to link compounds found to sources.

Selected municipal and agricultural wastewater effluents (point sources) were sampled to determine whether they contribute antibiotic and arsenic contaminants to the stream waters.

Other industrial chemicals (such as household products, industrial chemicals and pesticides found in the stream water, some of which are suspected or potential EDCs) were not analyzed in the effluent samples. Antibiotics were detected in municipal and agricultural wastewater effluents, but the same compounds were not detected in stream water. Contrary to the erroneous BBC news summary that “municipal effluent ... contained a cocktail of at least seven compounds containing endocrine disruptors”, none of the antibiotics detected is a suspected EDC.

The sampling program design does not allow one to establish whether municipal wastewater effluent is a source of persistent contaminants or EDCs found in the stream waters.

Suggestions for Future Research

The reconnaissance results presented in this report offer only a very preliminary overview of contaminant identity and occurrence in the upper Potomac River Basin. Elucidation of the fundamental connections between contaminant sources, distribution, fate and transport in the environment, estrogenic effects of contaminants on fish and wildlife populations, and human health effects of intake of these contaminants via food, personal care products and drinking water is in its infancy regionally and nationally. Significantly expanded and more rigorous interdisciplinary studies are needed before any connection between contaminant occurrence and drinking water safety can be established.

More detailed sampling of river water and sediments can provide better spatial resolution of occurrence of suspected chemicals, and can help to identify potential sources of those chemicals that are shown to be EDCs. Such information may lead to development of a reasonable and cost-effective source control program as a precaution to reduce the exposure to EDCs for the natural fish populations and for drinking water supplies.