

Evaluation of Contaminants in Fish

OCCOQUAN BAY NATIONAL WILDLIFE REFUGE

WOODBIDGE, VIRGINIA

Letter Health Consultation

October 30, 2014

Virginia Department of Health
Division of Environmental Epidemiology
109 Governor Street
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Patricia McMurray
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Dear Pat McMurray,

Thank you for the opportunity to review the fish tissue results collected between the summer of 2012 and winter of 2013 at the Occoquan Bay National Wildlife Refuge. *A review of the metals, pesticides, and polychlorinated biphenyls tissue concentrations in fish fillets you provided and their public health implications are provided in this consultation.* Eating bluegill, channel catfish, or largemouth bass caught at the refuge was determined not to be a health risk.

BACKGROUND

The Occoquan Bay National Wildlife Refuge (OBNWR) is located in the town of Woodbridge in Prince William County, Virginia. It is part of the former U.S. Army Woodbridge Research Facility, which closed in September 1994. The OBNWR was subsequently transferred to the Department of the Interior (DOI) for incorporation into the National Wildlife Refuge System and is currently managed by the DOI and U.S. Fish and Wildlife Service.

Fishing in Operable Unit 1 pond is currently restricted to catch-and-release only. Fish were collected from Operable Unit 1 pond in 2012-2013 and the concentrations of pesticides, metals, and polychlorinated biphenyls in fish fillets and whole fish were reported. Sampling was done as part of the site's long-term monitoring plan and wish for the existing fishing restrictions on Operable Unit 1 pond to be lifted.

Sampling and Data Analysis

Six fish each from two species (channel catfish, and largemouth bass) were collected in June 2012 and six fish each from three species (bluegill, channel catfish, and largemouth bass) were collected in February 2013. Fish fillets were analyzed for pesticides, polychlorinated biphenyls

(PCBs), and metals using the following laboratory methods SW 8081A, SW 8082, and SW 6010B, respectively. No additional sampling or analysis was provided. Fish collected in 2013 are the same species as those collected in 2012 with the addition of bluegill; therefore, 2012 fish tissue results were not reviewed. The concentrations of chemicals found in fish fillets are presented in Table 1. Fish were analyzed for multiple pesticides, polychlorinated biphenyls, and metals.

DISCUSSION

The comparison of fish tissue data with health-based screening values (SV) is one of the first steps in the public health assessment process to determine if the fish is safe for human consumption. When a contaminant is detected at a concentration less than its respective SVs, exposure is not expected to result in health effects and the contaminant is not considered further as part of the public health assessment process. **It should be noted that contaminants detected at concentrations that exceed their respective SVs, do not necessarily represent a health threat.** Instead, SVs are used to identify those contaminants that warrant a more detailed evaluation to determine whether the fish is safe for consumption with additional restrictions.

SVs can be based on either carcinogenic or non-carcinogenic effects. Cancer-based SVs are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factor. SVs based on cancerous effects account for a lifetime exposure with an estimated excess lifetime cancer risk of 1 extra case per 1 million exposed people. Non-cancer values are calculated from ATSDR's minimal risk levels (MRLs). When a cancer and non-cancer SV exists for the same chemical, the lower of these values is used as the SV (Table 1).

To determine the non-cancer SV the following equation and assumptions were used:

$$SV = \frac{MRL \times BW \times T}{MS \times NM}$$

Where:

- SV = acceptable concentration of contaminant in edible portions of fish in milligrams per kilograms (mg/kg)
- MRL = minimal risk level for specific contaminant in milligrams per kilogram per day (mg/kg/day)
- BW = consumer adult body weight in kilograms (80 kg)
- T = time period 30 days (days/month)
- MS = average fish meal size in kilograms (0.227 kg = 8 ounces)
- NM = number of allowable meals per month (2 meals/month)

If an MRL was not available for a contaminant then the EPA Region III SV was used. These values are risk-based concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data. SVs are considered by EPA to be protective for

humans (including sensitive groups) over a lifetime. SVs used for mercury and polychlorinated biphenyls were based on VDH's existing fish consumption guidelines.¹

After comparing the fish tissue concentrations with their respective SV (Table 1), the only SV that was exceeded was for inorganic arsenic (EPA Region III cancer SV, 2.8E-03 mg/kg). EPA uses different exposure assumptions than VA; therefore, the SV was evaluated further using VA exposure assumptions (below) and the following equation:

$$SV = \frac{RL \times BW \times EDF \times T}{CSF \times MS \times NM}$$

Where:

- SV = acceptable concentration of arsenic in edible portions of fish in milligrams per kilograms (mg/kg)
- RL = acceptable risk level for incremental increase in cancer over the background incidence (10^{-5} or one additional cancer in a population of 100,000 people)
- BW = consumer adult body weight in kilograms (80 kg)
- EDF = exposure duration factor (78 years \div 32 years = 2.44)
- T = time period 30 days (days/month)
- CSF = inorganic arsenic cancer slope factor: 1.5 milligrams per kilograms per day (mg/kg/day)⁻¹
- MS = average fish meal size in kilograms (0.227 kg = 8 ounces)
- NM = number of allowable meals per month (2 meals/month)

The cancer SV calculated using the equation above for inorganic arsenic was 8.6E-02, which was not exceeded in any fish tissue reported.

¹ Virginia Department of Health Fish Consumption Guidelines are posted online at [Virginia Regulatory Town Hall](http://www.townhall.virginia.gov/index.cfm) found here: <http://www.townhall.virginia.gov/index.cfm>

Table 1. 2013 Fish tissue contaminant concentrations and screening values

Fish Species (number of samples collected)							
Contaminant	largemouth bass (6)		channel catfish (6)		bluegill (6)		Screening Value (mg/kg) ¹
	Number of detects	Average Concentration (mg/kg)	Number of detects	Average Concentration (mg/kg)	Number of detects	Average Concentration (mg/kg)	
4,4'-DDD	3	2.7E-05	2	4.7E-05	2	4.0E-04	1.7E-02
4,4'-DDE	6	5.4E-04	2	1.1E-03	5	6.3E-04	1.2E-02
4,4'-DDT					2	9.5E-04	1.2E-02
alpha-BHC	4	4.6E-05			3	9.4E-05	6.6E-04
beta-BHC	5	7.9E-05			1	1.5E-04	2.3E-03
delta-BHC ²	2	7.3E-05	1	4.2E-05		0.0E+00	2.3E-03
gamma-BHC (Lindane)	3	6.4E-05	2	1.1E-04	3	1.5E-04	3.8E-03
gamma chlordane ³							1.2E-02
Aldrin	4	6.9E-05			2	1.2E-04	1.6E-01
Dieldrin	2	4.8E-05			3	1.2E-04	2.6E-01
Endosulfan II ⁴	1	3.5E-05			2	9.7E-05	2.6E+01
Endosulfan sulfate ⁴	5	7.6E-05	2	1.6E-04	4	1.1E-04	2.6E+01
Endrin	5	6.0E-05	2	1.5E-04	4	1.5E-04	1.6E+00
Endrin aldehyde ⁵			2	8.8E-05			1.6E+00
Endrin ketone ⁵	4	3.0E-04	2	6.3E-04	4	3.2E-04	1.6E+00
Heptachlor	2	7.3E-05					9.2E-04
Heptachlor epoxide	4	9.1E-05			1	1.1E-04	4.6E-04
Methoxychlor	6	2.3E-04	2	4.0E-04	4	2.7E-04	7.7E+00
PCB-1260 ⁹	6	6.9E-03	2	1.8E-02	5	1.5E-02	1.0E-01
Arsenic ⁶	6	3.8E-02	2	2.4E-02	6	3.4E-02	2.8E-03
Barium	6	1.9E-01	2	1.3E-01	6	2.5E-01	1.1E+03
Cobalt	6	8.1E-03	2	8.5E-03	6	8.6E-03	4.6E-01
Copper	6	1.7E-01	2	3.5E-01	6	2.3E-01	6.2E+01
Lead	6	8.9E-03	1	8.3E-03	5	8.3E-03	
Mercury ⁹	6	2.6E-01	2	1.7E-01	6	5.9E-02	5.0E-01
Nickel ⁷	1	1.2E-02	1	1.2E-02	1	1.2E-02	4.8E-01
Selenium	6	3.2E-01	2	2.6E-01	6	3.7E-01	2.6E+01
Thallium ⁷	2	2.5E-03					1.5E-02
Tin	6	1.8E+00	2	3.1E+00	6	2.4E+00	9.3E+02
Zinc ⁸	6	4.9E+00	2	4.5E+00	6	5.0E+00	1.6E+03

(Source: DEQ) ¹Boldface screening values are calculated using minimal risk levels otherwise Environmental Protection Agency Region III screening value. ²Screening value for technical BHC used. ³Screening value for chlordane used. ⁴Screening value for endosulfan used. ⁵Screening value for endrin used. ⁶Inorganic arsenic (assumed to be 10% of total arsenic). ⁷Soluble salt screening value used. ⁸Zinc and compounds screening value used. ⁹Virginia Department of Health screening values used for mercury and polychlorinated biphenyls. mg/kg=milligram/kilogram. Shaded boxes=data not provided/available.

CONCLUSION

Eating bluegill, channel catfish, or largemouth bass from the Occoquan Bay National Wildlife Refuge pond is not a public health hazard because the concentrations of contaminants in fish tissue collected in 2013 are below health-based screening values.

I trust that the above information will be of help to you. Should you have any additional questions or concerns please contact Dwight Flammia, Ph.D. at (804) 864-8127 or via email at dwight.flammia@vdh.virginia.gov.

REPORT PREPARATION

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