2020

Multnomah Channel and Scappoose Bay Fish Advisory for Resident Fish and Shellfish Technical Report

Oregon Health Authority
PUBLIC HEALTH DIVISION

Contents

Waterbody background

Multnomah Channel is a 21.5-mile distributary of the Willamette River in Portland. The channel flows northwest then north where it meets the Columbia River near St. Helens, in Columbia County. Sturgeon Lake to the south and Scappoose Bay to the west influence the channel at separate locations along the waterway.

Multiple current and former industrial facilities have contributed contamination to Scappoose Bay and the northern end of Multnomah Channel at the City of St Helens. These facilities include:

- Multnomah Plywood – A former mill with log storage and handling facilities that operated between 1957 and 1992. Primary contaminants include phenols and petroleum hydrocarbons.
- Armstrong World Industries – A former fiberboard manufacturing facility that operated between 1930 and 2018. Primary contaminants include metals, (primarily arsenic and mercury) and dioxins/furans.
- Pope & Talbot – A former wood treating facility that operated between 1912 and 1960. Primary contaminants include creosote-related polycyclic aromatic hydrocarbons (PAHs).
- Boise Cascade Mill – A pulp and paper mill that began operation in the 1920s. Primary contaminants include PAHs, polychlorinated biphenyls (PCBs), and dioxins/furans.

Clean-up efforts and environmental assessment related to these industrial sites in Scappoose Bay are being conducted by Oregon Department of Environmental Quality (DEQ). As part of those efforts, fish tissue and shellfish data were collected in Scappoose Bay, near the Armstrong World Industries site, along the lower 3 miles of the Multnomah Channel, and at the mouth of the Columbia River. Although the primary sources of contamination are located within Scappoose Bay, it is assumed that fish move freely between Scappoose Bay and the Multnomah Channel.

Fish and shellfish species in Multnomah Channel and Scappoose Bay

The channel and bay are home to many resident fish and shellfish. There are also several species of migratory fish.

Resident species[1] – These include bass, panfish (bluegill and crappie), sculpin, bullhead, catfish, yellow perch, flounder and other small fish, crayfish, and clams. The primary concern for the Oregon Health Authority (OHA) is the potential human health risks associated with the consumption of resident fish from Multnomah Channel and Scappoose Bay.

Migratory species[2] – The channel has a productive fishery for spring Chinook and Coho salmon and is also home to steelhead, sea-run cutthroat trout, shad, and sturgeon.

1 Fish and shellfish that live most of their life in these areas

2 Fish born in fresh water but spend most of their life in the ocean, then migrate back to fresh water to spawn

Map of Multnomah Channel and Scappoose Bay
(Courtesy of Scappoose Bay Watershed Council)

Migratory species in the channel and bay spend a large portion of their lives in the Pacific Ocean, in estuaries near the ocean, and other areas such as the Columbia River. Advisories typically do not include migratory species unless tissue data are available to determine otherwise. OHA has tissue data showing sturgeon with elevated PCB concentrations[3] and plans to use these data on a separate advisory for sturgeon that will have a broader geographic boundary.

Overall, contamination concentrations in salmon, steelhead, shad, and sea-run cutthroat trout would be significantly less. Therefore, they are not part of this fish advisory.

Note: According to Oregon Department of Fish and Wildlife regulation, it is illegal to harvest or possess any freshwater mussels or clams except for tribal harvesting. However, anecdotal information indicates that people, especially subsistence fishers, might harvest shellfish from these areas. Therefore, we have calculated clam meal allowances based on available data for both tribal members who wish to follow the recommended meal allowances and subsistence fishers illegally harvesting and consuming shellfish. The advisory specifically states that the harvesting of clams by the general public is illegal.

3 It is uncertain where sturgeon accumulated PCBs from the Portland Harbor Superfund site since this species is migratory and therefore not confined to this site.

Background: Fish and aquatic biota studies performed in 2010 and 2011

DEQ performed a clean-up effort and environmental assessment related to the industrial sites in Scappoose Bay along the Multnomah Channel. As part of those efforts and under DEQ oversight, Windward Environmental, a consulting firm, collected aquatic biota tissue for sampling and analysis in 2010 and bass in 2011. The firm collected tissue at various locations in Scappoose Bay, near the Armstrong World Industries site, Multnomah Channel, and the Columbia River. Tissue data provide information regarding concentrations of chemicals in fish and other biota collected in the area.

Results of the tissue data showed that consumption of fish and shellfish in the channel and the bay posed a potential health risk. In a technical report dated August 16, 2012, OHA staff used the 2010 and 2011 data to determine if OHA needed to issue an advisory for Multnomah Channel. At the time of the report, staff and management believed that the mainstem Willamette River advisory and meal recommendations issued in 1997 were protective of people consuming fish from the channel and no advisory was issued. Following is an excerpt from the 2012 technical report:

> "We found no data that supports issuing additional fish consumption advisories at this time. An advisory for limiting the consumption of resident fish from the main stem of the Willamette River, including the Multnomah Channel has been in place since 1997. The existing advisory cites mercury, PCBs, and dioxins/furans as contaminants of concern."

Reason for a re-evaluation of 2010 and 2011 tissue data

At the end of 2012, after the fish tissue data were evaluated and a technical report was written, OHA updated its Fish Consumption Advisory Standard Operating Guidance (SOG), the document that specifies the approach OHA uses to calculate meal recommendations for fish advisories. In keeping with the update, OHA began calculating meal recommendations for general and vulnerable populations[4] separately using the combined mean concentrations for PCBs and mercury. Both PCBs and mercury have similar neurological effects on unborn fetuses and young children, so their effects are additive. Although the data are the same, OHA needed to re-evaluate meal calculations to ensure consistency with updated methods and, if necessary, issue a separate advisory for the channel and the bay and all resident fish and shellfish, not just bass.

OHA regularly receives questions from people who fish in the channel and Scappoose Bay about OHA's fish consumption advice for this area. This is another factor that contributed to OHA's decision to review the available data for Multnomah Channel and Scappoose Bay and revisit the need for a fish consumption advisory there.

2010 aquatic biota sampling

Species targeted for collection and analysis were carp, smallmouth bass, sculpin, crayfish, and clams. Sampling evaluated concentrations of COC (arsenic, mercury, dioxins/furans, and PCBs) in fish collected in Scappoose Bay, Multnomah Channel, and at the mouth of the Columbia River. COC concentrations in biota tissue indicated the following:

- **Arsenic, mercury, and dioxins/furans** – No relative differences in concentrations found in biota tissue across areas sampled.
- **PCBs** – Concentrations in tissue in Scappoose Bay were lower than or similar to concentrations in other locations sampled.
- Of all species analyzed, carp had the highest concentrations of total mercury across all biota samples.

4 Pregnant women, fetuses, young children and women of childbearing age

2011 smallmouth bass sampling

The following information summarizes key findings from the 2011 bass tissue data. Sampling evaluated concentrations of COC in bass collected in Scappoose Bay, Multnomah Channel, and at the mouth of the Columbia River. COC concentrations in bass tissue indicated the following:

- **Arsenic** – Total arsenic tissue concentrations were similar across locations sampled
- **Mercury** – Tissue concentrations were lower in samples collected in Scappoose Bay than in Multnomah Channel
- **Dioxins/furans** – Tissue concentrations were similar across all locations
- **PCBs** – Tissue concentrations were lower in Scappoose Bay than in Multnomah Channel

Risk factors

Contaminants in the channel and the bay can come from sediment and upland sources. PCBs and dioxins/furans are prevalent in waterways of former industrial areas and are persistent in the environment. Mercury and arsenic can come from natural sources, industrial byproducts, and agricultural processes. Because these contaminants can accumulate within species and move up in the food chain, ingestion of contaminated fish and shellfish is the primary risk pathway of concern for people and wildlife.

The characteristics, activities, and habitats of fish and shellfish can make them more prone to the bioaccumulation of certain types of contaminants as outlined below.

Lipophilic[5] contaminants like PCBs and dioxins/furans bioaccumulate in fish and shellfish that:

- are high in fat content
- live near the sediment
- are bottom feeders, or
- are filter feeders like clams that draw contaminated water in and sieve particles through specialized gills or siphons (continuous passive bioaccumulation)

Metals like mercury (in the form of methylmercury) bioaccumulate within fish and shellfish tissue (fillet or meat) and can biomagnify up the food chain so that fish at the top have the highest concentrations.

Any fish or shellfish can bioaccumulate mercury, but some characteristics that make them more predisposed include:

- a predatory nature - eating other contaminated fish increases their body burden
- older, larger fish - the longer they live the more time they can bioaccumulate metals
- living in environments where the concentration of metals is high, and they do not migrate
- filter feeders like clams that draw contaminated water in and sieve particles through specialized gills or siphons (continuous passive bioaccumulation)

5 Combine with or accumulate in the fatty portions of fish and shellfish tissue

Consumption of fish and shellfish with elevated concentrations of COC can be of health concern for the following reasons:

- **PCBs** – Exposure to elevated concentrations can impair reproduction, cause neurobehavioral and developmental deficits in children, impair the immune system and thyroid function, and increase lifetime cancer risk.
- **Dioxins/furans** – Exposure to lower concentrations can cause a variety of effects in animals, such as weight loss, liver damage, endocrine system disruption, weakened immune system, reproductive damage, birth defects and increase lifetime cancer risk.
- **Mercury** – Exposure can cause memory loss, neuromuscular and nervous system effects, cognitive and motor dysfunction, and kidney damage. When exposed in the womb, mercury can cause permanent neurodevelopmental defects that persist throughout childhood and adulthood. Once bound in body tissues, mercury is difficult to eliminate.
- **Arsenic** – Exposure to arsenic can cause skin disorders, an increased risk for diabetes, high blood pressure, and several types of cancer.

Because PCBs and mercury have additive health effects[6] OHA calculates meal recommendations for each contaminant and then for both contaminants combined.

6 The combined effect produced by the action of two or more contaminants, being equal to the sum of their separate effects

Results for resident fish and shellfish

Resident fish and shellfish were collected from areas within Scappoose Bay, the lower 3 miles of the Multnomah Channel, and the mouth of the Columbia River. Table 1 shows the locations where fish and shellfish were collected. Tables 2–6 show fish tissue concentrations of COCs in smallmouth bass, sculpin, clam, crayfish, and carp. Sculpin is small and bony and not typically consumed by people, but we report data from these fish in case some people consume them. Sculpins were collected with co-located sediment samples for contaminant uptake comparison.

Smallmouth bass and carp – Data received was for fillet and whole body. Whole body meal recommendation were calculated for these species to take into account the cultural practices of some fisher people who consume the whole fish and not just the fillet.

Sculpin – Data received was for whole body only. Fillet data and meal recommendations were calculated for this species in case fisher people eat just the fillet and not the whole body.

Table 1. Fish and shellfish collection locations

Multnomah Channel				
SMB	Sculpin	Clam	Crayfish	Carp
12	0	128	10	10

Scappoose Bay				
SMB	Sculpin	Clam	Crayfish	Carp
0	0	64	0	5

Armstrong World Industries Site				
SMB	Sculpin	Clam	Crayfish	Carp
7	10	320	30	10

Columbia River				
SMB	Sculpin	Clam	Crayfish	Carp
1	0	64	0	5

Table 2. Tissue concentrations in smallmouth bass

Analyte	Tissue type	Mean mg/kg	Minimum mg/kg	Maximum mg/kg	Standard deviation mg/kg
Number of samples collected: 8 Number of total organisms: 20					
Mercury	Whole Body	WB not calculated for metals-they do not accumulate in fat			
	Fillet	2.04E-01	1.24E-01	3.61E-01	6.94E-02
Total PCB Congeners	Whole Body	1.16E-01	5.87E-02	1.86E-01	4.95E-02
	Fillet	1.74E-02	6.62E-03	2.97E-02	9.61E-03
Dioxin/Furans TEQ	Whole Body	9.42E-07	6.99E-07	1.59E-06	2.44E-07
	Fillet	1.88E-07	1.3E-07	3.24E-07	4.12E-08
Arsenic	All data were under the reporting limit, so no meals were calculated				

Table 3. Tissue concentrations in sculpin

Analyte	Tissue type	Mean mg/kg	Minimum mg/kg	Maximum mg/kg	Standard deviation mg/kg
Number of samples collected: 2 Number of total organisms: 10					
Mercury	Whole Body	9.47E-02	9.44E-02	9.50E-02	4.24E-04
	Fillet	4.74E-02	4.72E-02	4.75E-02	2.12E-04
Total PCB Congeners	Whole Body	4.82E-02	4.48E-02	5.16E-02	4.78E-03
	Fillet	2.41E-02	2.24E-02	2.58E-02	2.39E-03
Dioxin/Furans TEQ	Whole Body	1.71E-06	1.61E-06	1.81E-06	1.41E-07
	Fillet	8.55E-07	8.05E-07	9.05E-07	7.07E-08
Arsenic	Whole Body	3.92E-02	3.06E-02	4.77E-02	1.21E-02
	Fillet	1.96E-02	1.53E-02	2.39E-02	6.05E-03

Table 4. Tissue concentrations in clams

Analyte	Tissue type	Mean mg/kg	Minimum mg/kg	Maximum mg/kg	Standard deviation mg/kg
Number of samples collected: 9 Number of total organisms: 576					
Mercury	Soft Tissue	8.75E-03	6.91E-03	1.13E-02	1.50E-03
	Fillet	N/A			
Total PCB Congeners	Soft Tissue	3.92E-02	3.23E-02	4.84E-02	6.18E-03
	Fillet	N/A			
Dioxin/Furans TEQ	Soft Tissue	1.02E-06	1.69E-07	2.47E-06	7.62E-07
	Fillet	N/A			
Arsenic	Soft Tissue	7.08E-02	3.00E-02	1.69E-01	4.29E-02
	Fillet	N/A			

Table 5. Tissue concentrations in crayfish

Analyte	Tissue type	Mean mg/kg	Minimum mg/kg	Maximum mg/kg	Standard deviation mg/kg
Number of samples collected: 8 Number of total organisms: 40					
Mercury	Whole Body	5.39E-02	2.63E-02	7.83E-02	1.79E-02
	Fillet	N/A			
Total PCB Congeners	Whole Body	6.88E-03	5.06E-03	8.19E-03	1.11E-03
	Fillet	N/A			
Dioxin/Furans TEQ	Whole Body	5.83E-07	2.02E-08	9.08E-08	2.68E-07
	Fillet	N/A			

Analyte	Tissue type	Mean mg/kg	Minimum mg/kg	Maximum mg/kg	Standard deviation mg/kg
Arsenic	Whole Body	4.21E-02	2.60E-02	6.20E-02	1.23E-02
	Fillet	N/A			

Table 6. Tissue concentrations in carp

Analyte	Tissue type	Mean mg/kg	Minimum mg/kg	Maximum mg/kg	Standard deviation mg/kg
Number of samples collected: 6 Number of total organisms: 30					
Mercury	Whole Body	WB not calculated for metals-they do not accumulate in fat			
	Fillet	1.42E-01	6.93E-02	1.86E-01	3.95E-02
Total PCB Congeners	Whole Body	1.30E-01	7.33E-02	1.77E-01	3.89E-02
	Fillet	7.69E-02	3.23E-02	1.27E-01	3.52E-02
Dioxin/Furans TEQ	Whole Body	3.26E-06	1.89E-06	6.78E-06	1.69E-06
	Fillet	1.61E-06	1.03E-06	3.40E-06	8.99E-07
Arsenic	Whole Body	WB not calculated for metals-they do not accumulate in fat			
	Fillet	1.64E-02	8.10E-03	3.13E-02	7.86E-03

Meal recommendations

Table 7 has meal recommendations for resident fish. Migratory fish like salmon, steelhead, shad, and sea-run cutthroat trout are migratory fish and are not covered by this advisory. These species accumulate much less contamination than resident fish species and are a healthful choice of additional fish meals to consume. For advice on the types of fish to purchase and consume to reduce exposure to contaminants, refer to OHA's Fish and Seafood Guide (fish card)[7]

Recommendations for reducing exposure to PCBs can be found on OHA's website.[8]

Table 7. Recommended meals per month for resident fish and shellfish under this advisory

Fish species	Meals/Month Recommended Consumption Rates*				Contaminant Driver	Comments
	Fillet	Fillet	Whole Body	Whole Body		
	GP[9]	VP[10]	GP	VP		
Smallmouth bass	6	4	1	1	PCBs	Meals apply to resident fish occupying the same level in the food chain and living in similar habitats
Sculpin	6	4	3	3	PCBs & Dioxins/ Furans	Not a fish eaten widely-too bony with not much meat
Clams			5	5	PCBs & Dioxins/ Furans	The public cannot harvest or be in possession of clams or mussels[11]
Crayfish			11	11	Dioxins/Furans	Meals apply to the muscle. Heads and internal juices should not be eaten
Carp	2	2	1	1	PCBs	Meals apply to high-fat resident fish occupying the same level in the food chain and living in similar habitats

* IF PEOPLE EAT THE MAXIMUM AMOUNT OF RECOMMENDED FISH IN A MONTH, THEY SHOULD NOT CONSUME ANY OTHER RESIDENT FISH FROM THE CHANNEL OR BAY DURING THAT MONTH. PEOPLE CAN AVERAGE MEALS/MONTH ACROSS SEVERAL WEEKS (E.G., IF CONSUMPTION IS HIGHER IN ONE WEEK, CUT BACK FOR THE NEXT WEEK OR TWO).

7 https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/FISHCONSUMPTION/Documents/Fish%20and%20Seafood%20Guide-Commercially%20caught%20fish%20in%20stores%20and%20markets.pdf

8 https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/FISHCONSUMPTION/Pages/Fish-and-PCBs.aspx

9 General population

10 Vulnerable population

11 Tribal members have harvest rights to clams and mussels in freshwater

Summary

Although OHA's maximum meal recommendations in Table 7 cover the species of fish for which data were available, the OHA fish advisory protocol dictates following these recommendations for all resident fish species. As mentioned earlier, the major species found in the channel and bay include bass, panfish (bluegill and crappie), sculpin, bullhead, catfish, yellow perch, flounder, and other small fish, crayfish, and clams.

Based on available data, the advisory outlined in Table 7 represents the most consistent health-protective approach while encouraging people to eat fish for its health benefits. If more fish tissue data from Multnomah Channel and Scappoose Bay become available in the future, OHA will evaluate those data and update the current advisory as warranted.

Discussion

In preparing meal recommendations, OHA analyzed data from whole-body tissue samples as well as fish fillets to provide a protective estimate of the potential contaminant exposure based on consumption practices. People who fish in the channel and bay may come from many diverse ethnicities and cultures with different practices associated with the preparation, cooking, and consumption of fish. Some cultural cooking practices such as stews and soups involve eating most of the fish, except potentially the viscera.

Limitations

Limitations are a part of all submitted data and the meal recommendations calculated from that data. Limitations include but are not limited to:

- The uncertainty of applying an advisory to all resident fish in the same waterbody based on samples taken from a limited number of individual species.
  - It is possible that one species of fish accumulates more or less of a contaminant than another, even though both species are piscivorous[12], top predators, bottom feeders, or have more lipid[13] content. However, data are not available for every species that an angler could potentially catch in any given area. Therefore, the prudent and health-protective course is to assume that the species of fish caught in a waterbody will accumulate contaminants in a similar way to the fish for which OHA has data.
- The fact that concentrations of many organic compounds such as dioxins, furans, and PCBs are tied to the amount of organic carbon in sediment and lipids in tissue. For example, a fish with lipid content of 4% living in the same area as one with 2% may have twice as much of these contaminants in their tissue simply because of the relative difference in lipid content.
- Limited knowledge of the migration patterns of resident fish from the Lower Willamette River, Scappoose Bay, and the last 3 miles of the Channel. It's possible for people fishing within the 18-mile section of the Channel where fish and shellfish data was not collected to catch contaminated fish that have migrated into the area. However, since meal recommendations have been applied to the Lower Willamette and will soon be implemented in Scappoose Bay and the Multnomah Channel, the 18-mile stretch within the Channel could be a healthier place for people, especially subsistence fishers to harvest.
- Available fish and shellfish data were collected as part of DEQ cleanup efforts and are therefore focused on areas within Scappoose Bay, the lower 3 miles of the Multnomah Channel, and the Columbia River. There are no fish and shellfish data available for the approximately 18-mile-long upper reach of the Multnomah Channel that extends to the Lower Willamette River.
- Use of the arithmetic mean which assumes that fishers, over a lifetime, will catch a random distribution of fish over the distance of a water body covered by an advisory, consuming fish with differing concentrations of a contaminant.

12 Prey on other fish

13 Organic compounds including fats, oils, and cholesterol

- This may or may not reflect the practice of some fisher people, especially subsistence fishers relegated to an area of the river because they don't have the means to fish elsewhere.

  It is possible that a person consistently fishing in one spot over a lifetime could catch fish higher or lower in COC than the mean used to calculate this advisory (e.g., people fishing near the river where COC in fish are higher than those found in fish tissue from the channel and the bay).

- With all fish studies, data are not available to determine the concentration of COC in all fish species. Therefore, OHA must extrapolate the fish tissue data available to all resident fish in a water body, even though some resident species for which data are not available may have lower concentrations of COC.

Recommended fish advisory boundary

The consumption of more than the recommended fish meals from any area in the channel and bay is a potential health risk. For this reason, OHA believes the boundary for this fish advisory should include Multnomah Channel from the Sauvie Island Bridge to its confluence with the Columbia River and all of Scappoose Bay.

PUBLIC HEALTH DIVISION
Phone: 971-673-0482
Fax: 971-673-0979

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