2017–2018

Updated Fish Advisory for Resident Fish and Shellfish

Lower Willamette River

Oregon Health Authority
PUBLIC HEALTH DIVISION
Environmental Public Health

Contents

Water body background

Portland Harbor encompasses an approximate 10 mile stretch of the Willamette River from the southern end of Sauvie Island to just south of the Fremont Bridge (river mile 1.9 to 11.8). The site has been subject to decades of contamination from a variety of shipping, industrial and commercial activities. Key contaminants at the site include polychlorinated biphenyls (PCBs), dioxins and furans, pesticides, polycyclic aromatic hydrocarbons (PAHs), and metals. The Environmental Protection Agency (EPA) designated Portland Harbor a Superfund site in December 2000.

The Willamette River is of cultural significance to at least six federally recognized Native American Tribes. The majority of the Study Area is currently zoned for industrial land use and is designated an "Industrial Sanctuary" (City of Portland 2006a).

The Willamette River provides habitat for invertebrates, fishes, birds, mammals, amphibians, reptiles, and aquatic plants and is home to a variety of resident and anadromous species of fish including some protected under the Endangered Species Act. The lower Willamette River has been designated by the National Marine Fisheries Service as critical habitat for several salmon species that migrate through the study area. The river is not only enjoyed for its recreational opportunities, but also for fishing by many different populations; including the Tribes and subsistence fishers in the area.

Previous studies and advisories

In 2002 and 2003 the Oregon Health Authority (OHA) received fish tissue data from the EPA and the Department of Environmental Quality (DEQ) for fish collected at the Portland Harbor Superfund Site. These data indicated that PCBs in resident fish in the Portland Harbor study area were detected at levels of concern to human health. Based on these data OHA issued an advisory for the Portland Harbor study area in June 2004, describing the boundary of the advisory, and providing meal recommendations for resident fish for general and vulnerable populations of one and zero, respectively.

Purpose and current status

Consuming fish and shellfish contaminated with PCBs from within the Portland Harbor remains the primary concern to human health. Dioxins/furans are also contaminants of concern as a secondary contributor to overall risk and hazard estimates. Mercury also contributes to risk, but this contaminant primarily originates from a combination of naturally occurring geological sources and deposition from global atmospheric transport of fossil fuel combustion emissions.

As part of the Portland Harbor Superfund remedial investigation and feasibility study (RI/FS), EPA and DEQ collected fish and shellfish tissue data in 2005, 2007 and 2009, and additional data from small mouth bass in 2011 and 2012. OHA is using the recent data to update the June 2004 meal recommendation advisory, and to expand the advisory boundary based on the spatial distribution of fish collected from outside the Portland Harbor study area.

In January 2017, the EPA issued the final Record of Decision (cleanup plan) for the Portland Harbor Superfund Site. The selected remedy is a final cleanup action for the in-river portion of the site from approximately river mile 1.9 to 11.8. The cleanup action is designed to reduce risks to human health and the environment by actively remediating 394 acres of contaminated sediments through a combination of dredging, capping, in-situ treatment and enhanced natural recovery. The remainder of the site will be remediated through monitored natural recovery. Cleanup is projected to take around 13 years to complete. It is unknown how long it will take for the contaminants of concern in fish tissue to be at a level where an advisory will not be necessary to protect human health.

Figure 1. Map of Portland Harbor Study Area
(Courtesy of Bureau of Environmental Services)

Major fish & shellfish species in the Willamette

Resident species — These include bass, carp, brown bullhead, black crappie, northern pike minnow, largescale sucker, crayfish, clams, and mussels.

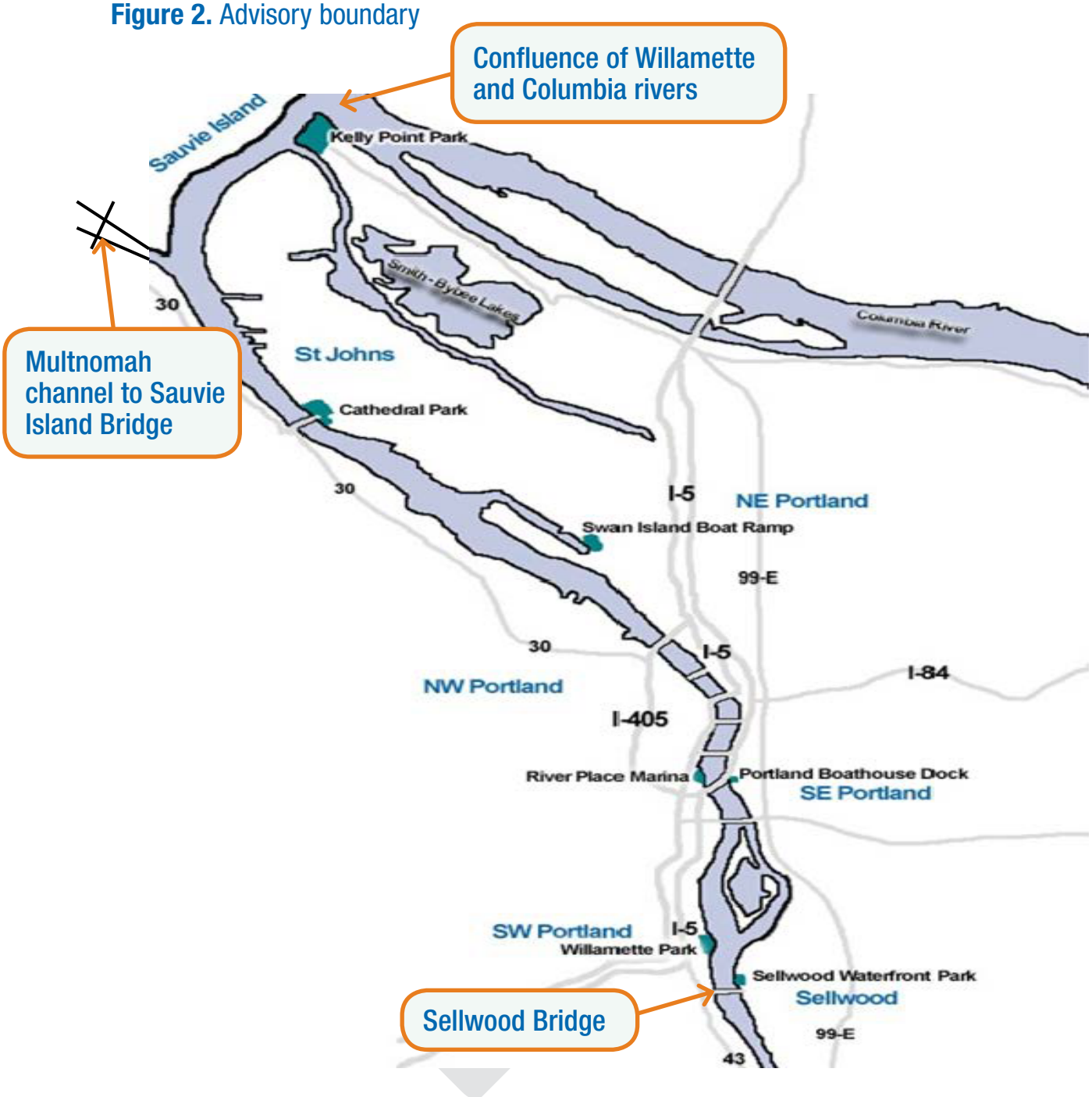
Anadromous and migratory species — Salmon, steelhead, Pacific lamprey, and sturgeon.

Salmon and steelhead spend much of their life in the Pacific Ocean. Sturgeon have large home ranges and may spend a significant portion of their life outside of Portland Harbor. Pacific lamprey migrate to the ocean as young adults and come back to the Willamette River to spawn. Levels of PCB contamination in sturgeon and lamprey are elevated and will warrant a separate advisory, but the level of PCB contamination in these two species is not confined or necessarily related to the area of the Portland Harbor Superfund site. Overall, contamination levels in salmon and steelhead are significantly less, and do not warrant a fish advisory because the risk to human health is low.

Updated fish advisory boundary

The updated fish advisory boundary covers a portion of the Lower Willamette River from the Sellwood Bridge to its confluence with the Columbia, including Multnomah Channel from its confluence with the Willamette to the Sauvie Island Bridge. See Figure 2 below for a map of the advisory boundary.

Figure 2. Advisory boundary



Data sources and assessment

The Portland Harbor Superfund site is large (see Figure 1 above) and complex. Multiple rounds of fish tissue sampling were collected within the Site as part of the RI/FS. In addition, fish tissue data have been collected by other parties upstream of the Portland Harbor Site. Fish tissue results have been reported in three documents: 1- Final Remedial Investigation Report (RI); 2 - Baseline Human Health Risk Assessment (BHHRA, Appendix F of the RI) dated March 28, 2013; and 2012 Smallmouth Bass Tissue Study. The final BHHRA report with data tables, including Table 3-12 showing resident species data, can be found here: https://semspub.epa.gov/work/10/100017312.pdf. Readers can refer to these documents for information regarding fish species selected, tissue analysis, sample type, and sample numbers.

OHA calculated meal recommendations for bass, carp, brown bullhead, black crappie, clams, mussels and crayfish using data provided by the EPA and DEQ. These data are summarized in Tables 8 and 9 below.

Results for resident fish

Tissue concentrations of risk-driving contaminants in bass, carp, brown bullhead, and black crappie are shown in Tables 1 through 4 below.

Fish tissue concentrations indicate that PCBs, mercury, and dioxins/furans dominate the risk profile related to human fish consumption of resident fish and shellfish from the Portland Harbor Superfund Site. For these contaminants of concern, the grouped mean tissue concentrations for each of the four species are shown in Tables 1 through 4 below. All data points in these tables have been rounded due to formatting. The grouped mean concentration used in the calculation of meal recommendations found in Table 8 were not rounded, however rounding did not alter the number of meals recommended. Field replicates and other specific samples were deleted from datasets before meal recommendations were calculated. Beyond field replicates, excluded samples are listed at the bottom of each species table. For a full list of the contaminants tested, see BHHRA Table 3-12 in Appendix F of the RI, and the 2012 Smallmouth Bass Tissue Study referenced above.

PCBs and dioxins and furans are persistent in the environment and can accumulate within individual species, eventually moving up through the food chain. Thus, higher levels of PCBs and dioxins and furans in fish species that are highly predatory and/or bottom feeders are observed. Top predators, such as bass, tend to be long-lived and accumulate contaminants over the course of their lives.

Bottom feeders, such as carp, tend to come into a lot of contact with contaminated sediment, water, and prey located on the river bottom. Bottom feeders also tend to have a high fat content where lipophilic (fat loving) contaminants such as PCBs can accumulate.

Mercury is also persistent in the environment and accumulates in fish tissue in the form of methylmercury. Methylmercury accumulates up the food chain so that fish at the top of the food chain such as smallmouth bass will have the highest levels of mercury. Unlike PCBs and dioxins and furans, methylmercury accumulates in the muscle tissue rather than the fat of fish.

According to OHA's Fish Consumption Advisory Standard Operating Guidance, last updated in 2015 (see discussion below), OHA calculates meal recommendations for vulnerable populations (e.g. pregnant women and young children) using the mean concentrations for both PCBs and mercury because the risks associated with the two contaminants are additive. Both PCBs and mercury have similar neurological effects on unborn fetuses and young children.

For all other contaminants analyzed, Fish Advisory Program staff reviewed the data and calculated meal recommendations as appropriate.

Table 1. Mean tissue concentrations of contaminants of concern for bass

Tissue Type	No. of Samples*	No. of Fish	Analyte	Grouped Mean (mg/kg)	Min (mg/kg)	Max (mg/kg)	Stnd Deviation (mg/kg)
Whole body	100	124	PCB Congeners (total)	0.27	0.03	6.46	0.99
Fillet	50	122					
Whole body	8	32	Mercury	0.14	0.06	0.35	0.07
Fillet	23	113					
Whole body	8	32	Dioxin/Furans TEQs (total)	0.0000011	0.00000019	0.0000087	0.000002
Fillet	18	90					
Whole body	8	32	Arsenic	0.22	0.14	0.39	0.07
Fillet	18	90					

* Some samples were composites of multiple fish. Therefore, the number of fish is greater than the number of samples.

Excluded samples: Combined fillet and body without fillet, body without fillet, whole body calculated, whole body without fillet and PCB aroclors. PCB Aroclor data was excluded since there was sufficient total PCB congener data to use for meal consumption calculations. Total PCB congeners are preferred over Aroclors when calculating meal recommendations.

Table 2. Mean tissue concentrations of contaminants of concern for carp

Tissue Type	No. of Samples*	No. of Fish	Analyte	Grouped Mean (mg/kg)	Min (mg/kg)	Max (mg/kg)	Stnd Deviation (mg/kg)
Whole body	2	10	PCB Congeners (total)	2.11	0.21	19.72	5.83
Fillet	9	45					
Whole body	3	15	Mercury	0.07	0.04	0.19	0.039
Fillet	11	55					
Whole body	2	10	Dioxin/Furans TEQs (total)	0.0000026	0.0000019	0.0000044	0.00000095
Fillet	9	45					
Whole body	11	55	Arsenic	0.11	0.04	0.21	0.06
Fillet	2	10					

* Some samples were composites of multiple fish. Therefore, the number of fish is greater than the number of samples.

Excluded data: Combined fillet+body without fillet, body without fillet, whole body calculated, whole body without fillet and PCB aroclors. PCB Aroclor data was excluded since there was sufficient total PCB congener data to use for meal consumption calculations. Total PCB congeners are preferred over Aroclors when calculating meal recommendations.

Table 3. Mean tissue concentrations of contaminants of concern for brown bullhead

Tissue Type	No. of Samples*	No. of Fish	Analyte	Grouped Mean (mg/kg)	Min (mg/kg)	Max (mg/kg)	Stnd Deviation (mg/kg)
Whole body	2	10	PCB Aroclors	0.26	0.05	1.7	0.81
Fillet	2	10					
Whole body	2	10	Mercury	0.05	0.03	0.07	0.02
Fillet	2	10					
Whole body	2	10	Arsenic	0.03	0.02	0.05	0.01
Fillet	2	10					

*Samples were composites of multiple fish. Therefore, the number of fish is greater than the number of samples.

Excluded data: Dioxin/Furan TEQs and total PCB congeners due to the insufficient number of samples analyzed.

Included data: PCB Aroclor data. Aroclor data is used when little or no data is available for total PCB congeners.

Table 4. Mean tissue concentrations of contaminants of concern for black crappie

Tissue Type	No. of Samples*	No. of Fish	Analyte	Grouped Mean (mg/kg)	Min (mg/kg)	Max (mg/kg)	Stnd Deviation (mg/kg)
Whole body	2	10	PCB Aroclors	0.04	0.02	0.11	0.04
Fillet	2	10					
Whole body	2	10	Mercury	0.06	0.03	0.1	0.03
Fillet	2	10					
Whole body	2	10	Arsenic	0.2	0.13	0.29	0.07
Fillet	2	10					

*Samples were composites of multiple fish. Therefore, the number of fish is greater than the number of samples.

Excluded data: Dioxin/Furan TEQs and total PCB congeners due to the insufficient number of samples analyzed. Body w/o fillet and combined fillet + body w/o fillet.

Included data: PCB Aroclor data. Aroclor data is used when little or no data is available for total PCB congeners.

Results for shellfish

Tissue concentrations of risk-driving contaminants in crayfish, freshwater clams, and freshwater mussels are shown in Tables 5 through 7 below.

Although the harvesting and posession of freshwater clams and mussels is illegal (except for Tribal harvesting rights for mussels), anecdotal information indicates that people, especially subsistence fishers, may be taking clams and mussels from the river. Therefore, we have calculated meal allowances for these shellfish species in the event illegally harvested shellfish are consumed, or the Tribes wish to see OHA's recommended meal allowance. The advisory that is issued will specifically state that it is illegal for the general public to harvest and posess clams and mussels from the river.

Table 5. Mean tissue concentrations of contaminants of concern for crayfish

Tissue Type	No. of Samples*	No. of Crayfish	Analyte	Grouped Mean (mg/kg)	Min (mg/kg)	Max (mg/kg)	Stnd Deviation (mg/kg)
Whole body	17	139	PCB Congeners (total)	0.11	0.01	1.19	0.28
	33	277	Mercury	0.03	0.02	0.04	0.006
	18	139	Dioxin/Furan TEQs (total)	0.0000016	0.00000021	0.000018	0.0000043
	33	267	Arsenic	0.35	0.24	0.5	0.06

*Samples were composites of multiple crayfish. Therefore, the number of crayfish is greater than the number of samples.

Excluded data: One non-detect data point for Arsenic. PCB Aroclor data was excluded since there was sufficient total PCB congener data to use for meal consumption calculations. Total PCB congeners are preferred over Aroclors when calculating meal recommendations.

Table 6. Mean tissue concentrations of contaminants of concern for clams

Tissue Type	No. of Samples*	No. of Clams	Analyte	Grouped Mean (mg/kg)	Min (mg/kg)	Max (mg/kg)	Stnd Deviation (mg/kg)
Body w/o Shell	44	1883	PCB Congeners (total)	0.24	0.05	2.65	0.44
	34	1737	Mercury	0.01	0.01	0.03	0.01
	38	1788	Dioxin/Furan TEQs (total)	0.0000009	0.0000004	0.000006	0.000001
	37	1854	Arsenic	0.94	0.65	1.25	0.12

*Samples were composites of multiple clams. Therefore, the number of clams is greater than the number of samples.

Excluded data: From nine to 12 samples were excluded, depending on the analyte, because the number of clams per composite was unknown. This decision was made because there was an abundance of other samples, and the number of clams per composite allowed for weighting of the average. Excluded samples included all depurated clams in each analyte data set. PCB Aroclor data was excluded since there was sufficient total PCB congener data to use for meal consumption calculations. Total PCB congeners are preferred over Aroclors when calculating meal recommendations.

Table 7. Mean tissue concentrations of contaminants of concern for mussels

Tissue Type	No. of Samples*	No. of Mussels	Analyte	Grouped Mean (mg/kg)	Min (mg/kg)	Max (mg/kg)	Stnd Deviation (mg/kg)
Body w/o Shell	7	7	PCB Congeners (total)	0.03	0.006	0.11	0.04
	7	7	Mercury	0.004	0.002	0.006	0.001
	7	7	Dioxin/Furan TEQs (total)	3.18	0.0000001	0.0000005	0.00000013
	7	7	Arsenic	0.385	0.224	0.616	0.123

Excluded data: PCB Aroclor data was excluded since there was sufficient total PCB congener data to use for meal consumption calculations. Total PCB congeners are preferred over Aroclors when calculating meal recommendations

Proposed fish and shellfish advisory for the Lower Willamette River

Fish Advisory Program staff set maximum meal recommendations using the calculations in OHA's Standard Operating Guidance (SOG). OHA's SOG and the calculations used were adapted from EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2, Risk Assessment and Fish Consumption Limits, Third Edition (Nov 2000). In this guidance, EPA allows for flexibility in how states calculate meal recommendations when dealing with cancer risk.

Standard mathematical models to predict cancer risk are an inappropriate basis for fish consumption recommendations for several reasons[1]. They are based on extremely low thresholds for lifetime excess cancer risk (1 in 10,000 to 1 in

[1] Stone D, Hope BK, 2009, Carcinogenic Risk as the Basis for Fish Advisories: A Critique. Integrated Environmental Assessment and Management. Vol. 6, No. 1

1,000,000) yet do not consider the health benefits gained from eating fish, which are well established and much more likely to affect most people. Thus, relying on carcinogenic risk models for fish advisories would overemphasize a slight excess risk of cancer while ignoring significant benefits of fish consumption in reducing other diseases. This in turn could result in an overall decline in fish consumption and potentially worse health outcomes of the population overall.

As a state public health agency, OHA balances the risks of consuming fish with contaminants against the known health benefits of eating fish high in omega–3 fatty acids and other nutrients that benefit the heart and brain. Fish consumption advisories are a protective action taken by OHA to enable people to consume fish at safe levels until clean-up actions are completed, which can take years to decades.

Calculations were performed using non-carcinogenic risk for the following reasons:

- There is strong evidence that a diet rich in fish has many health benefits across broad and diverse populations. Eating fish decreases the risk of heart disease, a leading cause of death in Oregon.
- Noncancer health effects, such as lifelong reduced IQ, low birth weight, liver impairment, alterations in thyroid function, immune system suppression, heart disease, liver dysfunction and diabetes are more likely and, in some cases, more severe than a small increase in a person's lifetime cancer risk. Meal calculations protect against significant health risks that are more likely to occur at low doses. At these low doses, the cancer risk is small.
- For PCBs and other contaminants, meal recommendations calculated based on noncancer health effects also protect against cancer within the acceptable range established by EPA. EPA's acceptable range is 1 in 10,000 to 1 in 1,000,000.
- Calculating fish meal recommendations based on a very low and theoretical likelihood of developing cancer would mean unnecessarily forgoing the much more likely and well documented health benefits of eating fish.
- Simply put: the health *benefits* of eating moderate amounts of fish from the Lower Willamette River are much more likely than a health *risk* from cancer.
- Most states calculate fish advisory meal recommendations, related to PCBs, based on noncancer risk for the same reasons Oregon does.

It should be noted, that calculations are performed assuming people will eat the fillet and not the whole fish. In fact, OHA communications include recommendations on ways to clean, prepare and cook fish in ways that reduce a person's exposure to contaminants, especially those that are lipophilic (fat loving) such as PCBs. This means discarding much of the fish that may be eaten in stews and soups by Tribal members and subsistence fishers.

When fish tissue data was reported as whole body instead of fillet, OHA converted this information into equivalent fillet data by dividing by two. Those individuals who eat the entire fish should reduce the recommended meals for a particular species by two. This means that for black crappie, the meal allowance for whole fish would be two 8 ounce meals instead of four 8 ounce meals per month.

OHA's SOG can be found on the fish advisory webpage here: http://www.oregon.gov/oha/ph/HealthyEnvironments/Recreation/FishConsumption/Pages/fishadvisories.aspx

OHA's maximum meal recommendations for fish and shellfish are listed in Tables 8 and 9 below. Consistent with other sediment cleanup sites, EPA and DEQ anticipate a temporary increase in contaminant concentrations in fish tissue once certain cleanup activities start in the Harbor due to disturbance of contaminated sediment. OHA will update the advisory at onset of cleanup activities. At that time, the advisory meal recommendations will be updated to zero meals per month for all resident fish and shellfish species. This would ensure that the public, especially the most vulnerable populations, would be as protected as possible during and for some duration immediately following the cleanup phase, when there will be spikes in the amount of contaminants fish and shellfish are exposed to. The cleanup plan for Portland Harbor includes ongoing fish tissue sampling to monitor the recovery of the river. As the data from this monitoring become available, OHA will evaluate them and update the fish advisory as warranted by the data.

Support for the cleanup of Portland Harbor

OHA supports the cleanup efforts being required in Portland Harbor. Based on an evaluation of tissue contaminant data for all available species in Portland Harbor, OHA is confident that any reductions in PCB levels and other contaminants of concern in fish tissue will result in less restrictive fish advisories in the future (i.e. OHA will be able to recommend more fish meals per month). Mercury is a common contaminant in the tissues of bass and other long-lived predatory fish statewide. This mercury comes from a combination of sources, some natural, some from deposition of atmospherically transported global mercury emissions, and some from upstream industrial or past mining operations. Because of these sources of mercury that are unrelated to Portland Harbor contamination, it is unlikely that the number of recommended fish meals in Portland Harbor will ever be unlimited.

Rounding of meals for resident fish and shellfish within the advisory boundary

Due to the extent of contamination, and because OHA will reduce meal recommendations for all resident fish and shellfish to zero during, and for some time after clean-up activities, management and staff decided to modify our standard operating procedures for this advisory as follows: Meals per month calculated at less than one would round to zero. This was done as a precautionary measure, and to provide consistency and ease of messaging to the public.

This approach was applied to smallmouth bass, brown bullhead, and clams. OHA is considering an update to its SOG to reflect this principle more generally as conditions warrant.

Inclusion of clams, mussels and crayfish

Shellfish, specifically clams, mussels and crayfish, are included in this advisory. This is because these species are present in localized areas in the Willamette and Portland Harbor.

As mentioned earlier, under state rules enforced by the Oregon Department of Fish and Wildlife, it is illegal to harvest or posess clams and mussels from freshwater sources in Oregon. This advisory will specifically state this, however, meal recommendations are being published so that individuals who are harvesting and eating these invertebrates illegally will know that they are at risk.

Future advisories

Sturgeon

OHA is developing a separate technical report in support of a health advisory related to consumption of sturgeon. That report, and the meal recommendations for sturgeon, will be separate from this advisory because it will likely target a much larger geographical area, and because sturgeon are exposed to contaminants at locations throughout this area, not just the vicinity of Portland Harbor.

Lamprey

As with sturgeon, a separate advisory is being developed for lamprey. Lamprey are considered anadromous species (i.e., they have migration patterns like salmon, spawning in freshwater and migrating to the ocean to grow into adulthood), so the boundary for a lamprey advisory will be for a much larger geographic area. It is illegal for any non-tribal member of the public to harvest lamprey from the Willamette or Columbia rivers, unless they possess a 'non-tribal' personal use collection permit. The lamprey advisory will specifically state that this practice for the general public is illegal unless the appropriate collection permit is issued. As for shellfish, meal recommendations are being published for lamprey so that individuals who are harvesting and eating lamprey illegally will know that they are at risk.

Maximum meal recommendations — All fish and shellfish

When using these meal recommendations: If you eat the maximum amount of recommended fish or shellfish meals in a month, do not consume any other resident fish or shellfish during that month. You can also average the recommended fish meals per month across several weeks. For example, if you eat a lot of fish one week, you can cut back for the next week or two. These meal recommendations were calculated for resident fish only. Migratory fish* like salmon, steelhead and trout are not considered resident fish and are not covered by this advisory. Therefore, these and other migratory fish are considered a healthy choice when looking for additional fish meals to consume.

For advice on the types of fish to consume to reduce your exposure to contaminants in fish, refer to EPA's "Choose Fish and Shellfish Wisely" webpage here: http://water.epa.gov/scitech/swguidance/fishshellfish/outreach/advice_index.cfm

* Migratory fish spend most of their lives in other places beyond the advisory area. Some traveling to and from the ocean, and others moving in and out of the river via several of the tributaries on the Willamette.

Although OHA's maximum meal recommendations in Table 8 cover the species of fish for which data was available, protocol dictates that the same meal recommendations be followed for fish at the same trophic level, and in the same habitat as these. The trophic level of an organism is the position it occupies in a food chain. This means that the meal allowances listed in Table 8 should be followed for fish that exhibit the same characteristics as bass, carp, and bullhead, because their predatory nature and food preferences are similar. Examples of similar types of predatory fish are northern pike minnow, yellow perch, walleye and big mouth bass.

Note that the meal recommendations in Table 8 are for all populations (vulnerable and general). Meal recommendations for vulnerable populations are always calculated for PCBs and mercury. For this update, the number of meals calculated for each group were the same. This is because all populations are especially vulnerable to the health effects of PCBs, the contaminant of greatest concern in fish from the Lower Willamette River.

Table 8. Recommended meals per month for resident fish

River Zone	Fish Species	Meals/Month Recommended Consumption Rates	Risk-Driving Contaminant	Comments
Sellwood Bridge to confluence with Columbia River, including Multnomah Channel to Sauvie Island Bridge	Bass	0	**PCBs**	Meal recommendations are for ALL populations
	Carp	0		
	Brown bullhead	0		
	Black crappie*	2¥		

* Although crappie is a resident species, it is not as long lived as bass and is not considered a predatory fish. Short lived, non-predatory species accumulate lower concentrations of contaminants than longer lived, predatory fish such as bass. Unlike carp and bullhead, crappie do not spend the majority of their time near the river bottom or eat clams from the sediment where most of the contamination is found.

¥ 4 meals per month of Black crappie can be eaten if only the fillet is eaten

Table 9. Recommended meals per month for shellfish

River Zone	Fish Species	Meals/Month Recommended Consumption Rates	Risk-Driving Contaminant	Comments
Sellwood Bridge to confluence with Columbia River, including Multnomah Channel to Sauvie Island Bridge	Clams	0	**PCBs**	Meal recommendations are for ALL
	Crayfish	2		
	Mussels	7		

Discussion

Based on the available data, the advisory outlined in Tables 8 and 9 above represents the most consistent health protective approach possible while encouraging people to eat fish for its health benefits. As more fish tissue data from Portland Harbor and the Willamette become available in the future, OHA will evaluate those data and update this advisory as warranted. This includes any changes to the advisory once data are collected at the end of the cleanup period which is scheduled to last for approximately 13 years.

The meal recommendations in Tables 8 and 9 will stay in effect until the onset of cleanup activities. Cleanup activities will include extensive dredging that is expected to start within the next three to five years.

Once this technical report is approved, staff will begin developing communication and outreach plans and materials to promote public awareness of the advisory.

Limitations

As in any scientific process there are some uncertainties. Our use of the arithmetic mean to calculate meal recommendations assumes that fishers, over a lifetime, will catch a random distribution of fish across an entire waterbody covered by an advisory, and therefore consume fish with differing levels of a given contaminant. This may or may not reflect the actual practice of fishers on a given waterbody, especially subsistence fishers who may be relegated to a particular area of the river because they do not have the means to fish elsewhere. It is possible that a fisher consistently fishing in one particular spot over a lifetime could get fish that have consistently higher or lower contaminant concentrations than the mean used to calculate this advisory.

For black crappie and brown bullhead, the number of fish tissue samples was four, lower than the samples collected for bass and carp. Although a higher number of fish tissue samples is desirable, the number of black crappie samples is sufficient for purposes of determining meal recommendations.

Oregon Health Authority
PUBLIC HEALTH DIVISION
Environmental Public Health
Phone: 971-673-0482
FAX: 971-673-0979

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