

Contaminants in Fish and Shellfish in the Stillaguamish River and Port Susan Marine Areas, Washington

The greater Port Susan area of Central Puget Sound, Washington, is home to some of the Stillaguamish Tribe's fishing, hunting, and gathering areas since time immemorial. It is also a popular sport and commercial fishing area for the public. Large shellfish beds lie in the Port Susan and Stillaguamish estuary and several Pacific salmon species return to the Stillaguamish River and Tulalip fishery every year. Clams and salmon are a local and consumable resource for Tribal members and the public. The health and abundance of these salmon and shellfish are a concern for the public and the tribe and these resources are tightly woven into cultural knowledge, traditions, and Tribal culture and history.

As urbanization has increased, which is predicted to continue in western Washington, concern over pollution (mercury, polychlorinated biphenyls [PCBs] and organochlorine insecticides) impacts to fish and shellfish have grown. From 2016 to 2019, the Stillaguamish Tribe, in partnership with the U.S. Geological Survey (USGS) and the Washington Department of Health (DOH), reviewed existing data to determine the risk, if

any, to human health from consuming locally caught Pacific Chinook salmon (*Oncorhynchus tshawytscha*) and Eastern softshell clams (*Mya arenaria*) harvested from Port Susan Bay.

The Stillaguamish Tribe, Snohomish County, the Tulalip Tribes, the USGS, and others have conducted baseline monitoring in the Stillaguamish watershed and the Port Susan estuary for several years. However, data are limited on the occurrence of contaminants in the foods harvested in this area. The Stillaguamish River and watershed are considered a relatively undeveloped area, with primarily forest and agricultural land uses, and has low but measurable levels of contaminants reported (Wagner and others, 2014). Contaminants, often from historical sources, can accumulate in the Pacific Ocean and may pose a risk to Tribal members or the public from harvest of local seafood. This fact sheet summarizes the concentrations and risks associated with PCBs and other contaminants, such as total chlordanes and DDT (both pesticides) and mercury, in tissues of adult, returning Pacific Chinook salmon and Eastern softshell clams collected from 2016 to 2018 (U.S. Fish and Wildlife [USFWS], 2020).

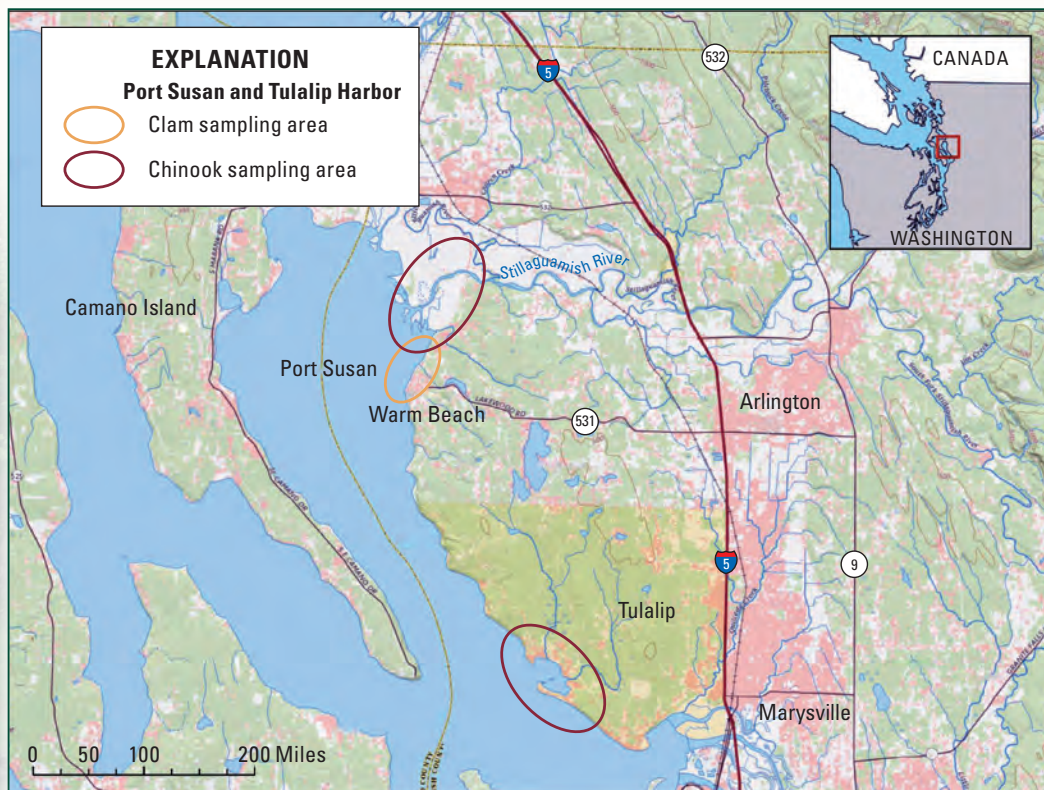


Figure 1. Location of clam and Chinook salmon sampling collections as part of study done in the Port Susan area of Puget Sound, Washington. The Stillaguamish Tribe is headquartered in Arlington, Washington.

Where do these pollutants come from?

The chemicals evaluated here (organochlorine pesticides, PCBs, and mercury) primarily come from agricultural and industrial activities that release them into the air or water. Organochlorine pesticides are an older class of pesticides that are mostly banned in the United States. They were used to control pests in agriculture or, in the case of DDT, were used to control pests such as mosquitos in urban areas. PCBs were used in hydraulic fluids, electrical devices, and in paints and dyes. Mercury is a naturally occurring element, often released from volcanoes or certain minerals, and a major contaminant from combustion of coal and waste streams. These three pollutant groups have some common chemical properties that give them persistence in the environment and a tendency to bioaccumulate, and are known to be toxic to animals, including humans and killer whales (*Orcinus orca*). Although there has been a history of control and regulation to remove or decrease these current pollution sources, they are still present and released into the air or water. These three pollutant groups also have a global distribution in the atmosphere; they can be transported atmospherically long distances to Puget Sound.

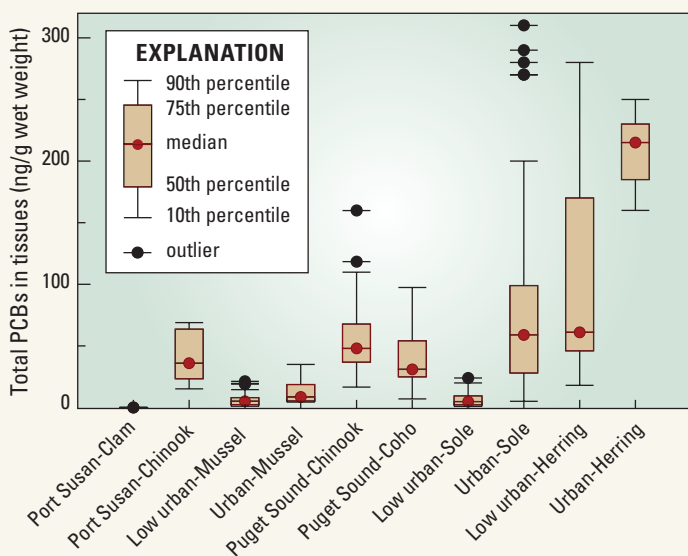


Figure 2. Comparison of polychlorinated biphenyls (PCBs) in tissues in Puget Sound, Washington. Data from West and others (2017), WADOE (2018), and USFWS (2020).

Why should we worry about pollutants in seafood?

Each of these pollutant groups—organochlorine pesticides, PCBs, and mercury—are known to have adverse health effects when larger quantities of them are consumed. Effects are more common from long-term, repeated exposures to low or moderate levels of these chemicals. Those persons most at risk are fetal and newborn children who receive, relative to adults, a higher dose per body weight than adult consumers. Exposure to high levels of mercury in the diet is known to cause neurological and immune system disorders (U.S. Environmental Protection Agency, 1997). Total chlordanes (which are a group of banned organochlorine pesticides) are known immune suppressants (Rought, 1999; Tryphonas and others, 2003) and DDT breakdown products are known endocrine disruptors (Bouwman and others, 2011). Much of the literature on PCB toxicity describes its effects on the immune system.

Are organochlorines in our diet a concern?

Like mercury and PCBs, organochlorine pesticides such as chlordanes and DDT are known to have adverse health effects at sufficiently high doses. They were used as pesticides for agriculture and termite control (chlordane), and for mosquito control (DDT) in the United States until 1988 and 1973, respectively. Organochlorine pesticides “bioaccumulate” through the marine food web and can reach high concentrations in some marine organisms. Chlordane has known human health effects and is classified as a Class 2 human carcinogen (Agency for Toxic Substances and Disease Registry [ATSDR], 2018). Although the human toxicology data on DDT is more limited than for chlordane, DDT generally is considered less toxic than chlordane and is classified as a “Probable” human carcinogen (ATSDR, 2002). These two pesticides were evaluated as a part of routine testing of tissues. Concentrations of measured pesticides (USFWS, 2020) were well below levels where consumption advisories would be warranted (table 1).

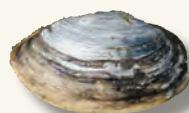
Table 1. Concentrations of contaminants in seafood from the Port Susan area, Washington.

[All units are in parts per billion wet weight. Calculated consumption guideline shown in **bold**. Data from U.S. Fish and Wildlife Service (2020). Abbreviations: DDx's, sum of DDT, DDE, and DDD pesticides; ND, not detected; NM; not measured in laboratory; PCBs, polychlorinated biphenyls; ppb, parts per billion; ±, plus or minus]

	Total chlordanes	Total DDx's	Total PCBs	Total mercury
Eastern softshell clams				
Maximum	ND	ND	ND	30
Minimum	ND	ND	ND	16
Median	ND	ND	ND	24
Chinook salmon fillet				
Maximum	5.92	33.03	68.9	NM
Minimum	0.76	7.34	15.2	NM
Median	3.19	18.17	35.9	NM
Overall				
Median in ppb	3.19	18.17	35.9	20
±95-percent confidence interval	0.94	5.21	13.8	11.1
Guideline concentration for 8 meals a month	600	600	22.5	115



Tribal fishermen with a Chinook salmon from the Stillaguamish River, Washington.



Eastern softshell clam



Chinook salmon fillet

Summary of Findings

Contaminant concentrations were low in all samples that were reviewed here. The concentrations measured were consistent with those of other reports of fish tissue concentrations from the Puget Sound region (West and others, 2017). The total concentrations of the major chemical groups (that is, the sum of chlordanes, total DDTs, total PCBs and mercury), while often present, were below levels that warrant new consumption advisories beyond those already in place. Current consumption advisories for Chinook salmon in Puget Sound are available at www.doh.wa.gov/CommunityandEnvironment/Food/Fish, with a recommended limit of two meals per month for Blackmouth salmon (resident Chinook that have spent most of their life in Puget Sound) and four meals per month for mature Chinook salmon returning from the open ocean. The measurement of 180 PCB chemicals (that is, congeners) was unique to USFWS (2020). One of these PCB chemicals, PCB 126, is particularly potent in its dioxin-like toxicity. PCB 126, detected in 7 of the 15 Chinook fillets but not in the clams, has the potential to elevate the risk of dioxin-related disease in consumers (see p. 4).

The DOH works to protect and improve the health of people in Washington State. Part of this mission is to reduce or eliminate exposures to health hazards in the environment. The DOH Office of Environmental Public Health Sciences (OEPHS) evaluates chemical hazards in the environment, develops strategies to reduce exposure to environmental contaminants, and provides education and outreach to communities to help minimize effects on the public. One focus of OEPHS is on the human health effects of the consumption of contaminated seafood.

Chinook salmon and clam tissues were evaluated for organochlorine pesticides, PCBs, and mercury. In general, PCBs were analyzed by measuring all 209 congeners including the

dozen dioxin-like PCBs (USFWS, 2020). To determine whether Chinook salmon and softshell clams are safe to consume, DOH compared contaminant concentrations found in the tissue of these two species with health-based screening levels established by DOH. Screening levels for the general population and high consumers were used for comparison based on eight and twenty-three 8-ounce meals per month, respectively. Allowable meal consumption rates also were calculated to provide safe meal limits to Chinook salmon and softshell clam consumers. Based on cultural considerations as Chinook salmon are consumed with skin on fillets, no reductions in contaminants were calculated to account for reductions of contaminants by cleaning and cooking techniques. Similarly, reductions in contaminants were not considered for softshell clam tissue samples (USFWS, 2020).

Softshell Clam Results

Partly because of the relatively low amount of fat in the tissue of shellfish, the concentrations of organic compounds including organochlorine pesticides, PCBs, and mercury were not detected above levels of concern. Most of the time, PCBs and organochlorine pesticides were not detected in shellfish.

Calculated safe meal limits for all organochlorine pesticide contaminants were greater than 500 meals per month, indicating the very low concentrations in clam tissue. Total PCB concentrations were less than 1 part per billion, allowing for more than 200, 8-ounce meals per month. Mercury concentrations allowed for 47 meals per month, well above DOH limit-of 8 meals per month when issuing an advisory to the general public, or 23 meals per month for high-consumption populations.

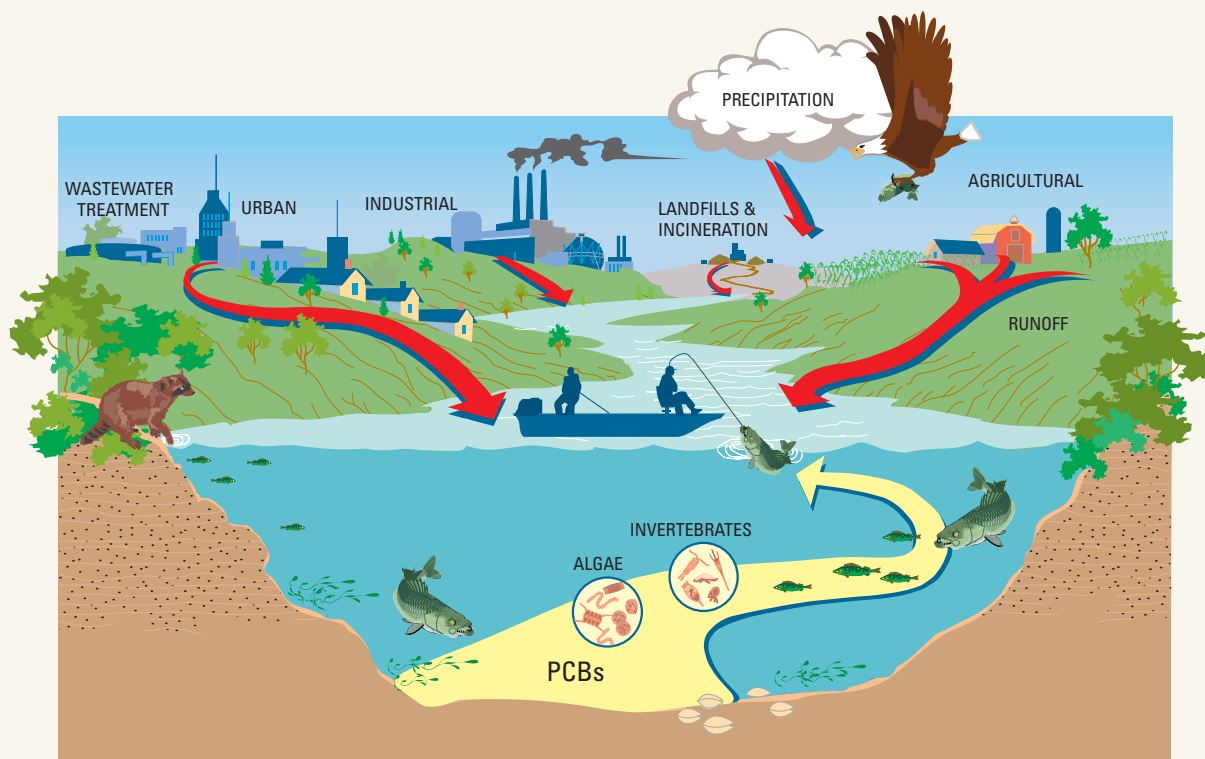


Figure 3. Diagram showing the polychlorinated biphenyl (PCB) cycle.

Chinook Salmon Results

While contaminant levels for all organochlorine pesticides in Chinook salmon were higher than those seen in the clam tissues, concentrations did not exceed screening levels based on general population or high consumer consumption rates. With the exception of total DDT, organochlorine pesticide concentrations allow for greater than 500 meals per month. DDT concentrations were also low and resulted in calculated meal limits of more than 200 meals per month. Total PCB concentrations (average of 47 ppb) from fillets are slightly lower than PCB concentrations previously reported in Puget Sound Chinook salmon (average of 54 ppb) but slightly higher than coastal Chinook from the Pacific Northwest. **Calculated meal limits allow for 4 meals per month**, consistent with the current consumption advisory of 4 meals per month for non-resident Chinook salmon in Puget Sound. Removing skin and belly fat and cooking to reduce fats can reduce PCB concentrations, allowing for 8 meals per month. Mercury was not measured in Chinook salmon tissue; however, previous analysis of mercury in Puget Sound salmon would suggest that it is not of concern as well.

For more information on the Department of Health's fish advisories for Puget Sound, visit: www.doh.wa.gov/fishmap

Future Assessment

DOH, in consultation with the Washington State Department of Fish and Wildlife and the Washington State Department of Ecology, will evaluate the results of the dioxin-like PCB concentrations to determine if any further advice is warranted.

Eat Fish, be Smart, Choose Wisely

DOH encourages all Washingtonians to eat at least two fish meals per week as part of a heart healthy diet in accordance with American Heart Association (AHA) recommendations. People may eat fish more than two times weekly, but such frequent consumers should take steps to reduce exposure to contaminants in the fish that they eat by following some general advice.

- Eat a variety of fish that are low in contaminants according to guidance provided on the DOH website at <http://www.doh.wa.gov/fish/>.
- Follow advice provided by DOH and other local health agencies on water bodies to fish.
- Young children and small adults should eat proportionally smaller meal sizes.
- Eat fillets without the skin.
- Consume younger, smaller fish (within legal limits). These fish typically contain lower levels of accumulative contaminants like PCBs and mercury than older, larger fish.
- When cleaning fish, remove the skin, fat, and internal organs before cooking; this will help to reduce the amount of some contaminants.
- Grill, bake, or broil fish so that fat drips off while cooking.
- Smoking fish greatly increases the cancer risk due to the introduction of a large dose of polycyclic aromatic hydrocarbons (PAHs) during smoking.

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Project web page at: <https://www.doh.wa.gov/DataandStatisticalReports/HealthDataVisualization/fishadvisory>

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