Project Design and Implementation: Bioaccumulative Toxics in Native American Shellfish

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Abstract

The Swinomish Indian Tribal Community (Tribe) launched the Bioaccumulative Toxics in Native American Shellfish Project (BTNAS) to address the potential human health risks associated with chemical contamination of water resources. BTNAS is a four-year interdisciplinary project involving sample collection and analysis, consumption risk modeling, education and outreach, and mitigation planning. The principal goal of the project is to ascertain whether the Swinomish people who consume subsistence-harvested clams and crabs are exposed to bioaccumulative toxics to a degree that poses chronic and acute health risks. Secondary goals are to effectively communicate and educate the community about identified risks in a culturally appropriate manner, and to develop mitigation measures. Project advisory groups have been established to discuss the project and disseminate findings with other potentially affected Puget Sound area Tribes, local, State, and federal government agencies, academic institutions and community groups. The analytical results and subsistence shellfish consumption rates specific to Puget Sound area Tribes will be used when performing Tribal health risk assessments. The risk assessments will also incorporate cultural risks such as potential loss of shellfish used in traditional ceremonies.

The Tribe is a federally recognized Indian Tribe located 65 miles north of Seattle, Washington. The Swinomish Reservation comprises the southeastern lobe of Fidalgo Island and includes approximately 3000 acres of tidelands that ring the Reservation. These tidelands represent an important facet of the spiritual, subsistence, environmental and economic Swinomish culture. Several published reports demonstrate the presence of chemical contamination in the water bodies and tidelands surrounding the Reservation, as well as in off-Reservation usual and accustomed hunting and gathering areas. Swinomish Tribal members commonly practice subsistence harvesting of shellfish in these areas. Previous health risk analyses determining exposure to bioaccumulative toxics relied on a consumption rate of 6.5 grams per day for fish and shellfish (approximately one fish meal per month), completely overlooking Native American subsistence harvesting and consumption issues.

Background

The Treaty of Point Elliot established the Swinomish Indian Tribal Community, located near La Conner, Washington, in 1855. The Treaty set aside the peninsula at the southern end of Fidalgo Island, formally called Shais-quihl, as a permanent homeland for the peoples of the Skagit River Valley. Today the Reservation encompasses approximately 7,344 acres of land area and approximately 2,900 acres of tribally owned tidelands (Figure 1).

The members of the Swinomish Indian Tribal Community (Tribe) are descendants of the tribes and bands of the Skagit, Kikiallus, Swinamish, and Samish peoples. Today approximately 1,000 Native Americans live on the reservation, of which 800 are enrolled Swinomish members. The Tribe is federally recognized and operates under the Constitution and Bylaws adopted in 1936 pursuant to the Indian Reorganization Act of 1934.

The 1855 treaty also established Usual and Accustomed (U/A) areas—parcels of land and water outside the formal boundary of the Reservation designated as areas that Native Americans have traditionally employed for subsistence purposes. Continued access to these U/A areas was promised under the authority of the treaty compromise.

The rich marine environment adjacent to the Reservation, located both within Reservation boundaries and within the U/A area, supports more than 58 species of fish from 26 families and numerous species of shellfish. Fourteen species of crab, including Dungeness crab, Japanese oysters, bay mussels, and several clam species, including heart or cockle basket, Macoma, native littleneck, butter, manila, horse, and the eastern soft-shell clams (Swinomish Land Use Advisory Board 1996) can all be found within the adjacent tidelands. The shellfish in these tidelands represent a vital subsistence and commercial resource for the Tribe, as well as an important point of cultural association for the Tribe's identity. Shellfish are employed in cultural ceremonies, incorporated in the common diet, and sold to support families on the Reservation.

Figure 1. Regional Map of Swinomish Indian Reservation

Possible Sources of Contamination

Numerous potential sources of bioaccumulative pollutants are located on or adjacent to the Swinomish Reservation. Two petrochemical refineries, historic unregulated landfills, underground storage tanks, agricultural run-off, a historic wood mill, non-point suburban run-off, heavy boat traffic, and atmospheric deposition from other industries in the airshed may all contribute to the contamination.

Sediment studies performed by the Washington Department of Ecology (Ecology) in Padilla Bay document the presence of several bioaccumulative toxics. In 1999, Ecology issued a report citing the presence of several toxics as well as a high toxicity in the echinoderm bioassay were found. Reported iron concentrations are at potentially toxic levels and a PCB congener approached the chronic water quality criterion for marine waters. Several methylphenols exceeded DWOE's sediment management standards (SMS). PAHs, phthalates, dioxins, and furans also exhibited elevated levels (Johnson 1999). Reported finding applied only to wildlife; no calculations for possible human health consequences were performed.

PCBs, phenols, and PAHs were also found in a 1997 Ecology study of Fidalgo Bay. Of particular concern were the high molecular weight PAHs, which exceeded sediment quality standards and showed concentrations two to four times higher in Fidalgo bay than from reported reference areas (Johnson et al 1997). A more recent report focusing on the west half of Fidalgo Bay found 21 semi-volatile organics, 16 of which were PAHs. Methylphenol and dibenzofuran were also present (Johnson 2000a).

PAHs appear in every report issued on Padilla Bay and surrounding waters. A National Oceanic and Atmospheric Administration (NOAA) report determined that the PAH concentrations found exceeded NOAA's sediment concentration standards. Moreover, the report stated that, "among 100 sampling stations [throughout Puget Sound, from the Port Gardner Bay in the south to the US/Canadian boarder in the north], there were 18 locations, including Padilla Bay and Fidalgo Bay…in which at least one chemical concentration exceeded a guideline value, at least one of the toxicity tests indicated highly toxic conditions, and several indices of benthic community structure showed reduced infaunal diversity and abundance" (Long et al 1999).

In 1998, Ecology tested the wastewater effluent of one of the oil refineries located on March Point for dioxins. Regeneration of catalytic reformers in the refineries can potentially generate dioxins several times a year. High concentrations of the dioxins 2,3,7,8-TCDD and 2,3,7,8-TCDF were found in the wastewaters of that refinery (Yake et al 1998).

A recently completed preliminary screening of shellfish beds located on Swinomish tideland and U/A areas, performed by Ecolgy at the request of the Tribe, found the presence of several chemicals including lead and PAHs. Levels of arsenic and 2,3,7,8-tetrachlorodibenzofuran exceeding Washington State Department of Health (Health) standards were found (Johnson 2000b).

Environmental watch-dog groups tracking the petrochemical facilities' compliance with discharge permits, issued under the National Pollutant Discharge Elimination System (NPDES) as established under Clean Water Act guidelines, have noted numerous past violations of the permits by the petro-chemical industries. The industries are also required to publish monthly discharge monitoring reports and quarterly wastewater characterizations, cataloging what contaminants remain in the effluent. Previous testing discovered levels of cyanide, copper, mercury, ammonia, cadmium, chlorine, lead, nickel, selenium, and zinc all exceeded water quality standards in the waste water reports one or more times (Kent 1996).

Reports detailing the industrial effluents released into the air are required by the Northwest Air Pollution Authority (NWAPA), as determined by standards set forth by the federal Clean Air Act. Often much greater amounts of toxics are released into the air than into the water. However, air emissions and deposition of possible contaminants are much harder to track and measure than water effluent from sewer outfalls, so little is known about air permit violations and the consequences of those violations. Moreover, disclosure of several chemicals not specifically listed by NWAPA is voluntary, so public information on emissions of some chemicals and their concentrations is not available. Predominant wind patterns dictate that a portion of air effluents from industries located in the airshed settle within Reservation boundaries (Juras 2003).

Overlooked Native American Concerns

Some of the emitted chemicals are bioaccumulative toxics, subjecting the Swinomish people to low level, chronic exposure, which may be causing some of the outstanding health problems in the community. Exposure through consumption of subsistence-harvested foods such as shellfish may in part be perpetuating the abnormally high incidences of health-related problems reported on Native American reservations, such as learning disorders and liver diseases. Little research has been completed on the possible connections between low level, chronic exposure through the consumption of shellfish and its resulting effects on the health of the Native American peoples who depend on that food source. Moreover, current standards of acceptable exposure may not address all of the tribal issues of concern, such as cultural risks associated with the loss of harvesting and consuming subsistence foods.

The prevalence of shellfish contamination is highlighted by the 25% decrease in commercial acreage available for shellfish harvest since 1980 as a result of poor conditions determined by Health. Health has named PCBs, PAHs, and dioxins as of particular concern in Puget Sound (Puget Sound Water Quality Action Team 2000). Meanwhile, Swinomish tribal members rely more heavily each year on shellfish harvests for economic survival due to the rapid declines in the traditionally plentiful salmon runs. Swinomish member Janie Beasley recalls a time only a few decades ago when fishing boats dominated the Tribal docks. Now many Tribal members have sold or traded their fishing equipment for crab pots. She believes that more Swinomish members crab commercially now than in the past in order to provide enough income to sustain their families. In addition, digging for clams has often times replaced fishing when members practice subsistence harvesting (Beasley 2000). The compounding effects of a dwindling supply of uncontaminated shellfish added to the marked decrease in fish returns have threatened the cultural tradition of subsistence harvesting for Swinomish fishers, as well as their economic livelihood and their health.

In an effort to mitigate the health risks associated with contaminated fish and shellfish, the U.S Environmental Protection Agency (EPA) established ambient water quality criteria (AWQC) in the Clean Water Act, section 304(a). The AWQC recommends a fish consumption rate (FCR) of fish and shellfish from estuarine and fresh water for an "average American" to be 6.5 grams per day (g/day) (USEPA 1980). The rate originates from a mean per capita consumption rate study for both consumers and non-consumers of fish published in the 1973-1974 National Purchase Diary Survey (Javitz 1980). This FCR is used when determining the health risk to humans when target chemicals are present in fish and shellfish. This rate equals approximately one fish meal per month. Thus, the EPA standard enacted to limit exposure to toxics through fish and shellfish consumption utterly ignores significant evidence from Native American communities demonstrating that many Native peoples eat one or more fish meals per day (Columbia River Inter-Tribal Fish Commission 1994; Toy et al 1996; Suquamish Tribe 2000).

Washington's Model Toxic Control Act, acknowledging the need for more stringent standards, assumes a FCR of 23 g/day (after the application of a 0.5 diet fraction), falls far below documented Native consumption levels and does not specifically address shellfish standards (*Washington's Model Toxic Control Act 1999*). Ecology, in a 1999 draft report, recommended a statewide default FCR of 177 g/day for fish and 68g/day for shellfish based on two fish consumption surveys conducted in Washington State by Native American groups: the Columbia River Intertribal Fish Commission and the Tulalip Tribe (Keill and Kissinger 1999). The Suquamish Tribe's study documented consumption rates of more than twice the proposed Ecology rate (Suquamish Tribe 2000).

Recently the EPA has moved to increase the FCR and create two separate rates, one for the general adult population and one for subsistence fishers (USEPA 1998) but the proposed increase remains far below the recognized FCR for Native Americans in Washington State. The revisions call for a tiered approach in the application of a FCR, with first preference given to local or regional seafood intake surveys. This project will employ the EPA's revision approach by using an averaged fish consumption rate from two Puget Sound studies done by Native American Tribes since the data qualifies as first preference according to the proposed EPA revisions. The Tulalip study (Toy et al 1996) and the Suquamish study (Suquamish Tribe 2000) both calculated separate consumption rates for fish and shellfish, and their geographic proximity to the Swinomish Tribe will provide a more accurate comparison to the Swinomish Tribe than the Columbia River Intertribal fish Commission study's rates, which looked at an inland Tribe on the Columbia River who do not consume saltwater shellfish.

Little documentation exists on the effects of chemical exposure to tribal cultural health. However, cultural risk is an essential part of tribal risk assessments because natural resources are cultural resources. Traditional tribal lifestyles are inextricably linked with the natural environment; therefore, contamination affecting human health and the environment also degrades the tribal lifestyle. Moreover, the traditional subsistence-based lifestyle is not a preference, but a guaranteed Treaty right that continues to be widely practiced today. Impacts to cultural health from contaminated shellfish may include lost ceremonial use, lost identity and religion, lost educational opportunity, and broken Treaties and trust responsibility (Harris and Harper 2000).

Based on the overwhelming evidence that cultural elements are an important risk factor to address, the risk assessment for this project will incorporate a tribal cultural risk component. Factors such as high environmental exposures, longer exposure duration, native diets, and body burdens will be assessed.

Research Design And Methods

The project can be broadly organized by four specific aims. These include: first, to determine whether Swinomish people who eat shellfish harvested from the Reservation or U/A areas are exposed to bioaccumulative toxics by testing sediment, clams, and crabs; second, if health risks are identified, to effectively communicate those risks to the community in a culturally appropriate manner; third, to develop mitigation measures; and fourth, to catalog major health problems on the Reservation that may be related to eating contaminated shellfish, and develop hypotheses between the health problems and toxics found.

The first of the aims is addressed by collecting and analyzing shellfish tissue and sediment samples from on-Reservation locations and in some U/A areas. The target sample species are Dungeness crabs (*Cancer magister*), butter clams (*Saxidomus giganteus*), and native littleneck steamer clams (*Prototheca staminea*). During early June 2002, clam samples were collected in conjunction with sediment samples from the clam dig sites. Crab sampling is scheduled for late May 2003. Sample collection events occur in late spring to coincide with the high lipid concentrations found in shellfish during the spawning season.

For the clam and sediment samples, 16 composite samples of each clam species and associated sediment were taken from 15 sample sites (the 16th sample being a duplicate sample). For the collection of the crab samples, three to four crab pots will be grouped together within five general areas. The sampling sites for both the crab and clam collection events are clumped in geographic location within each water body to allow for statistical analysis both between sites and within sites (Figure 2). The waterbodies included in this study are Padilla Bay, Fidalgo Bay, Similk Bay, Kiket Bay, and Samish Bay. Sampling site locations were chosen based on the harvest frequency by Tribal members, both presently and historically, the proximity of the area to potential contamination sources, accessibility, and relative abundance of the target sample species.

Tribal members who work for the Swinomish Water Resources Program participated in the digs. Clams were excavated in the traditional method—using pitchforks—with additional collection protocols to prevent contamination from sampling equipment and other sample sites. Sampling protocol followed guidelines established by the Puget Sound Estuary Program (PSEP 1997a, 1997b, 1997c, 1997d). These comprehensive guidelines are used in data generation for State programs including the Puget Sound Dredged Disposal Analysis, Puget Sound Ambient Monitoring Program, and Ecology's Sediment Management Standards. State protocol is favored over federal procedures because the methodology used by Washington State is substantially based on federal methodology with additional measures added to suit specific environmental issues in Washington State. Puget Sound Estuary Program protocol employs the State's more comprehensive regulations on water quality. By employing State methodology results from additional studies performed by other Puget Sound area Tribes, results ? will be comparable.

To determine which chemicals to analyze, this project considered any bioaccumulative contaminants found in previous studies as well as chemicals associated with potential pollution sources. A list of chemicals analyzed in two species of clams, one species of crabs and sediments may be found in Table 1. Four of these chemical groups are listed on Persistent, Bioaccumulative, and Toxic (PBT) lists for the EPA and ECOLOGY: benzo(a)pyrene, dioxins/furans, mercury, and PCBs. Ecology's Manchester Laboratory in Port Orchard, Washington, will provide analyses for poly-chlorinated biphenyl aroclors, heavy metals, organotins, chlorinated pesticides, and poly-aromatic hydrocarbons. The AXYS Analytical Services Group in Sidney, British Columbia, will analyze the poly-chlorinated biphenyl congeners and the dioxins/-furans.

The health risk assessments will be performed using the analytical data received from the laboratories, with the inclusion of cultural considerations specific to the Tribe. Factors such as high environmental exposures, longer exposure duration, native diets, and body burdens will be included. The second project aim—to communicate and educate the community—will be addressed via three methods. Each method was designed with Swinomish-specific cultural considerations in mind.

The first method is the use of the "Tox in a Box" educational kit for use in presentations to the local schools. The hands-on learning tool, developed by the University of Washington's (UW) School of Public Health and Community Medicine, introduces the principles of toxicology and environmental health. It is useful when working with grades kindergarten through 12, and is easily tailored to provide information specific to the audience, such as where particular chemicals may

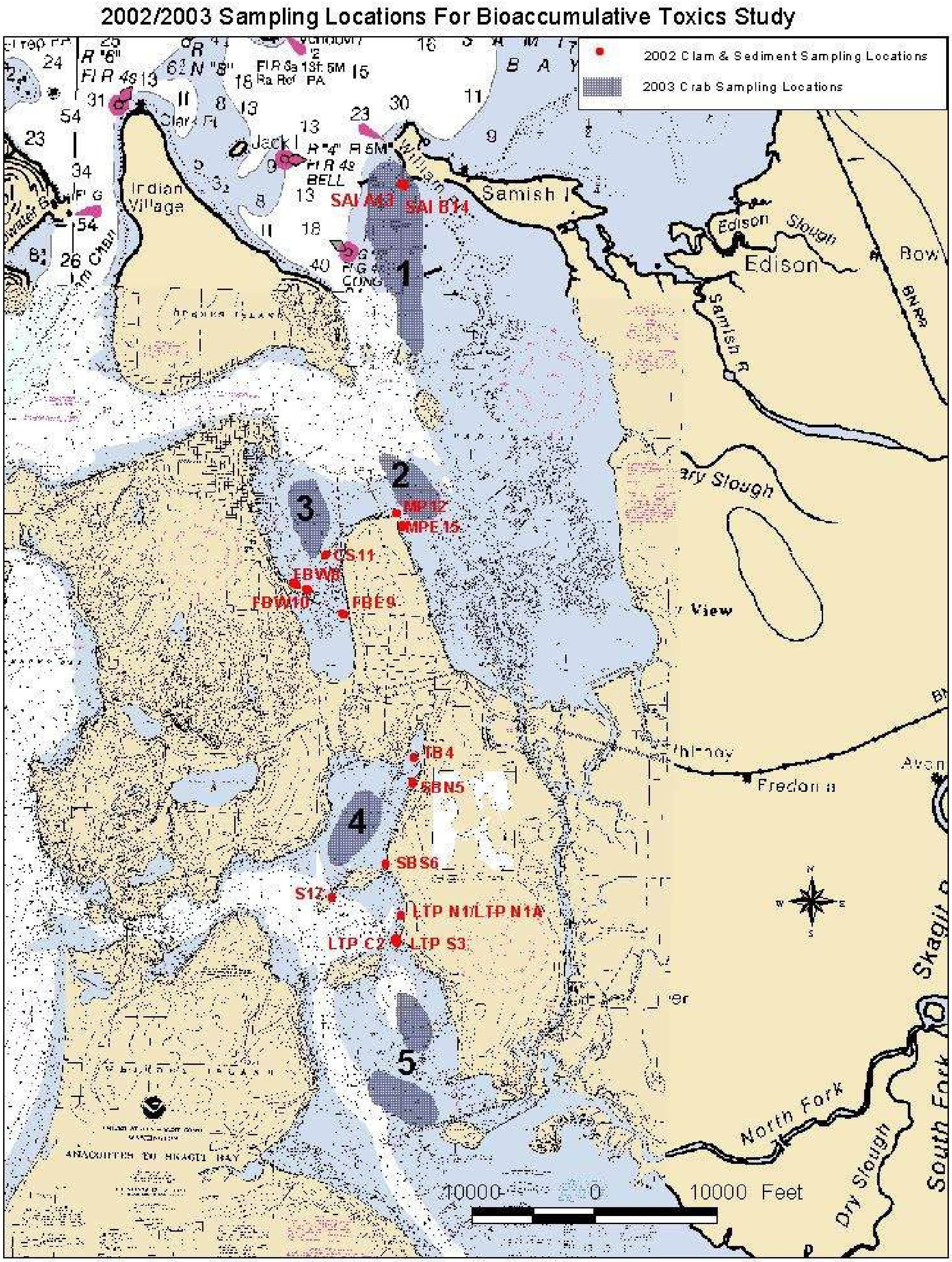

Figure 2. Sampling sites for the BTNAS project

originate in and around the Swinomish community. The five main topics are: Living in the Chemical World; Dose Makes the Poison; Toxicology (application of basic science); Risks vs. Benefits (assessing your options); and Tox Tales (a real life component). Since community students are much more likely to respect and listen to a presentation by a familiar fellow Tribal member, a Swinomish Tribal member will be trained by the UW community outreach coordinator to give the presentations to students.

The second form of education and risk communication is through community gatherings. Community gatherings represent a traditional method of information dissemination in the Swinomish Community. Centered on food, these meetings usually take place in the late afternoon or early evening at a central gathering location in the Swinomish Village. A Swinomish Tribal member familiar with the project will speak at these meetings in order to leverage the sense of familiarity and trust within the Community.

The third form of communication and education will occur via the Swinomish cable channel. Frank Dunn, head of media resources and outreach for the Swinomish Indian Tribal Community, believes that television constitutes one of the most widely used forms of news acquisition and entertainment by Tribal members. He states that television is a high priority among Tribal members, with cable access often purchased before more basic items. Televisions are found in every house on the Reservation, often with more than one per home (Dunn 2000). With this in mind, one of the chosen avenues for educating the Swinomish community is through television programming on the newly installed Swinomish cable access channel. Mr. Dunn has initiated filming of all aspects of the project—from field prep and sample collection, to personnel meetings and even a visit to AXYS labs in Sidney, British Columbia, where the PCB congeners and dioxins/-furans analyses are performed.

The footage may be edited into several different pieces. One could be a flashy public service announcement to catch the attention of the viewers. Another may be a short documentary to air on the cable channel with the purpose of informing the community about the project and its findings. And a possible third project could be a full-length documentary as a visual record of the project, detailing all aspects of the project for the purpose of informing other organizations interested in initiating similar projects.

Mr. Dunn will be working with an intern to edit the footage, thus giving a young adult from the community an opportunity to gain hands on skills in a potential job field.

The third specific aim is to develop mitigation measures. Once the health risk assessments are completed, project members will explore mitigation options, if necessary, and present them to the community. Selected measures will be then be further developed and refined, based on community input. In this component of the project careful consideration will be given to the chosen options to ensure that they will be beneficial to the Tribe, not detrimental. For example, a self-imposed advisory or beach closure negates Treaty-established rights to harvest on tidelands; therefore, this is not an acceptable solution. Beach closures also imply that it is acceptable to gather and eat less traditional foods such as shellfish, which is not acceptable. Alternatives to beach closures will be explored.

The fourth and final aim of the BTNAS project is to catalog major health problems on the Reservation that may be related to eating contaminated shellfish, and develop hypotheses on the relationship between the health problems and the toxics present. This goal will be achieved by working with the primary care physician at the Swinomish Health Clinic to review prevalent health problems. A literature review of peer-reviewed published data establishing the chemical pathway between contaminated food and identified health problems will be employed to develop hypotheses between toxics found in this project and reported health problems on the Reservation.

An important aspect of the BTNAS project is disseminating project information to other Tribes who may be experiencing similar risks from the consumption of subsistence-harvested shellfish. Puget Sound area Tribes have been invited to participate by forming a tribal advisory committee. Annual committee meetings will be held, providing an open forum for discussion of the methods, results, communication/ education tactics, and mitigation options of the BTNAS project and assistance to Tribes who wish to initiate their own projects.

Subsistence harvesting of traditional foods such as shellfish is an integral part of the Swinomish lifestyle. Chemical contamination of these traditional foods imperils the Tribe's cultural, social, spiritual, natural, and economic resources, as well as posing serious human health risks. The Bioaccumulative Toxics in Native American Shellfish study will address the Tribe's concern of possible contamination of subsistence harvested shellfish and related risks.

Table 1. Chemicals Analyzed in Bioaccumulative Toxics in Native American Shellfish Project

CAS No.	CHEMICAL NAME
Polyaromatic Hydrocarbons	
50328	Benzo(a)pyrene
53703	Dibenzo(a,h)anthracene
56553	Benzo(a)anthracene
83329	Acenaphthene
85018	Phenanthrene
86737	Fluorene
1730376	9H-Fluorene, 1-methyl-
90120	1-Methylnaphthalene
91203	Naphthalene
91576	2-Methylnaphthalene
91587	2-Chloronaphthalene
92524	1,1'-Biphenyl
120127	Anthracene
129000	Pyrene
132649	Dibenzofuran
132650	Dibenzothiophene
191242	Benzo(ghi)perylene
192972	Benzo[e]pyrene
193395	Indeno(1,2,3-cd)pyrene
198550	Perylene
205992	Benzo(b)fluoranthene
206440	Fluoranthene
207089	Benzo(k)fluoranthene
--	2-Methylfluoranthene
3698243	Chrysene, 5-methyl-
208968	Acenaphthylene
218019	Chrysene
483658	Retene
581420	2,6-Dimethylnaphthalene
832699	1-Methylphenanthrene
2245387	1,6,7-Trimethylnaphthalen
2531842	2-Methylphenanthrene
86748	Carbazole
85018	Phenanthrene, 3,6-dimethyl-
--	4,6-Dimethyldibenzothiophene
Heavy metals	
22967926	Mercury
7439921	Lead
7440508	Copper
7440382+	Arsenic
7440439	Cadmium
7782492	Selenium
4440666	Zinc
7440020	Nickel
Chlorinated Pesticides	
309002	Aldrin
56534022	Cis-Chlordane (alpha)
56534033	Trans-Chlordane (gamma)
60571	Dieldrin
76448	Heptachlor
1024573	Heptachlor epoxide
72435	Methoxychlor
5103731	cis-nonachlor
39765805	trans-nonachlor
27304138	Oxychlordane

CAS No.	CHEMICAL NAME
Polychlorinated Biphenyls Aroclors	
11096825	PCB-1260
11097691	PCB-1254
11104282	PCB-1221
53469219	PCB-1242
12672296	PCB-1248
12674112	PCB-1016
Polychlorinated Biphenyls Congeners	
32598133	77
70362504	81
32598144	105
74472370	114
31508006	118
65510443	123
57465288	126
38380084	156
69782907	157
52663726	167
32774166	169
35065306	170
35065293	180
39635319	189
Dibenzofurans	
51207319	2,3,7,8-TCDF
57117416	1,2,3,7,8-PeCDF
57117314	2,3,4,7,8-PeCDF
70648269	1,2,3,4,7,8-HxCDF
57117449	1,2,3,6,7,8-HxCDF
60851345	2,3,4,6,7,8-HxCDF
72918219	1,2,3,7,8,9-HxCDF
67562394	1,2,3,4,6,7,8-HpCDF
55673897	1,2,3,4,7,8,9-HpCDF
39001020	OCDF
55722275	Total TCDF
30402154	Total PeCDF
55684941	Total HxCDF
38998753	Total HpCDF
Dibenzo-p-dioxins	
1746016	2,3,7,8-TCDD
40321764	1,2,3,7,8-PeCDD
39227286	1,2,3,4,7,8-HxCDD
57652857	1,2,3,6,7,8-HxCDD
19408743	1,2,3,7,8,9-HxCDD
35822469	1,2,3,4,6,7,8-HpCDD
3268879	OCDD
41903575	Total TCDD
37871004	Total HpCDD
36088229	Total PeCDD
34465468	Total HxCDD
Extended PAHs	
3001950	C1-Napthalenes
3001951	C2-Napthalenes
3001952	C3-Napthalenes
3001953	C4-Napthalenes
3001954	C1-Fluorenes

Chlorinated Pesticides, continued		**Extended PAHs,** continued	
8001352	Toxaphene	3001955	C2-Fluorenes
789026	o,p'DDT	3001956	C3-Fluorenes
50293	p,p'DDT	3001957	C1-Dibenzothiophenes
72548	p,p'DDD	3001958	C2-Dibenzothiophenes
53190	o,p'DDD	3001959	C3-Dibenzothiophenes
72559	p,p'DDE	3001960	C1-Phenanthrenes/Anthracenes
3424826	o,p'DDE	3001961	C2-Phenanthrenes/Anthracenes
58899	gamma-BHC (lindane)	3001962	C3-Phenanthrenes/Anthracenes
319846	alpha-BHC	3001963	C4-Phenanthrenes/Anthracenes
319857	beta-BHC	3001964	C1-Fluoranthene/Pyrene
319868	delta-BHC	3001965	C1-Chrysenes
1825214	pentachloroanisol	3001966	C2-Chrysenes
2921882	chloryiphos	3001967	C3-Chrysenes
118741	hexachlorobenzene	3001968	C4-Chrysenes
2385855	Mirex		
72208	Endrin		
7421934	Endrin Aldehyde	**Organotins**	
53494705	Endrin Ketone	56573854	Tributyltin
959988	Endosulfan I	1461252	Tetrabutyltin
1031078	Endosulfan Sulfate	1002535	Dibutyltin
33213659	Endosulfan II	78763549	Monobutyltin

References

Beasley, J., July 25, 2000, personal communication with enrolled Swinomish Indian Tribal Community member.

Columbia River Inter-Tribal Fish Commission, 1994, *A Fish Consumption Survey of the Umatilla, Nez Perce, Yakama, and Warm Springs Tribes of the Columbia River Basin,* CRITFC Technical Report No. 94-3, Portland, Oregon.

Dunn, F., July 31, 2000, personal communication with media resources coordinator for the Swinomish Indian Tribal Community.

Harper, B., and S. Harris, 2000, Using Eco-Cultural Dependency Webs in Risk Assessment and Characterization of Risks to Tribal Health and Cultures, *Environ. Sci. & Pollut. Res.,* 2: 91-100.

Javitz, H., 1980, *Seafood Consumption Data Analysis,* Prepared by SRI International for the Office of Water Regulations and Standards, EPA Contract 68-01-3887, Washington, D.C.

Johnson, A., 1999, *Investigation of Chemical Contamination at Whitmarsh Landfill and Padilla Bay Lagoon,* Washington State Dept. of Ecology, Olympia, WA.

Johnson, A., D. Serdar, and D. Davis, 1997*, Survey for Petroleum and Other Chemical Contaminants in the Sediments of Fidalgo Bay,* Washington Department of Ecology, Olympia, WA.

Johnson, A., 2000a*, Sediment Quality on the West Side of Inner Fidalgo Bay,* Washington State Department of Ecology, Olympia, WA.

Johnson, A., 2000b, *Results of a Screening Analysis for Metals and Organic Compounds in Shellfish from Padilla Bay and Vicinity,* Washington State Dept. of Ecology, Olympia, WA.

Juras, M., 2003, analysis of Toxic Release Inventory data releases in 50 kilometer radius airshed around Swinomish Indian Reservation using Risk Screening Environmental Indicators tool, Bureau of Air Quality, Columbia, SC.

Keill, L. and L. Kissinger, 1999*, Draft Analysis and Selection of Fish Consumption Rates for Washington State Risk Assessments and Risk-Based Standards,* Washington Dept. of Ecology Pub. No. 99-200, Olympia, WA.

Kent, M., 1996*, Toxic Soup,* People for Puget Sound, Seattle, WA.

Long, E., J. Hameedi, A. Robertson, M. Dutch, S. Aasen, C. Ricci, K. Welch, W. Kammin, R.S. Carr, T. Johnson, J. Biedenbach, K.J. Scott, C. Mueller, and J. Anderson, 1999, *Sediment Quality in Puget Sound,* U.S. Dept. of Commerce, National Oceanic and Atmospheric Adm., Silver Spring, MD and Washington State Department of Ecology, Olympia, WA.

Puget Sound Estuary Program (PSEP), 1997a, *Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound* Draft Report, Prepared for the USEPA Region X, Office of Puget Sound, Seattle, WA.

Puget Sound Estuary Program (PSEP), 1997b, *Recommended Guidelines for Measuring Organic Compounds in Puget Sound Marine Sediment, Water Column, and Tissue in Puget Sound*, Prepared for the USEPA Region X, Office of Puget Sound, Seattle, WA.

Puget Sound Estuary Program (PSEP), 1997c, *Recommended Guidelines for Measuring Metals in Puget Sound Marine Sediment, Water Column, and Tissue in Puget Sound*, Prepared for the USEPA Region X, Office of Puget Sound, Seattle, WA.

Puget Sound Estuary Program (PSEP), 1997d, *Recommended Quality Assurance and Quality Control Guidelines for the Collection of Environmental Data in Puget Sound*, Prepared for the USEPA Region X, Office of Puget Sound, Seattle, WA.

Puget Sound Water Quality Action Team, 2000, *Puget Sound's Health 2000*, Olympia, WA.

Suquamish Tribe, 2000, *Fish Consumption Survey of the Suquamish Indian Tribe of the Port Madison Indian Reservation, Puget Sound Region,* The Suquamish Tribe, Suquamish, WA.

Swinomish Land Use Advisory Board, 1996, *The Swinomish Comprehensive Plan,* Swinomish Indian Tribal Community, La Conner, WA.

Toy, K.A., N.L. Polissar, S. Liao, and G.D. Gawne- Mittelstaedt, 1996*, A Fish Consumption Survey of the Tulalip and Squaxin Island Tribes of the Puget Sound Region,* Tulalip Tribes, Department of Environment, Marysville, WA.

USEPA, 1980, *Food and Nutrient Intakes if Individuals in One Day in the United States: Spring 1977,* National Food Consumption Survey 1977-1978, Preliminary Report No. 2, Washington, D.C.

USEPA, 1998, *Draft Water Quality Criteria Methodology Revisions: Human Health.* 63 Fed. Reg. 43,756, Washington, D.C.

Washington's Model Toxic Control Act, 1999, Wash. Admin. Code 173-340-730 (3)(iii)(B), Olympia, WA.

Yake, B., S. Singleton, and K. Erickson, 1998, *Washington State Dioxin Source Assessment,* Washington State Department of Ecology, Olympia, WA.