Washington State 2009/10 Mussel Watch Pilot Project

A Collaboration between National, State and Local Partners

Washington Department of FISH and WILDLIFE

Snohomish County Public Works Surface Water Management

Sea Grant Washington

NOAA

SNOHOMISH COUNTY MARINE RESOURCES COMMITTEE

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Publication Information

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Executive Summary

NOAA's National Mussel Watch Program has monitored the status and trends of toxic contaminants in our nation's Great Lakes and marine coastal waters, including Puget Sound, since 1986. This project represents first steps towards adapting NOAA's large-scale program to address toxics monitoring and needs at the Puget Sound scale. As such, the Washington Department of Fish and Wildlife's (WDFW) Puget Sound Assessment and Monitoring Program (PSAMP) teamed with Snohomish County Marine Resources Committee (MRC), Snohomish County Public Works-Surface Water Management, Washington Sea Grant, and NOAA's Mussel Watch team to (a) conduct field-sampling for the 2009/10 Mussel Watch season in Washington waters, (b) evaluate the possibility of merging field sampling with existing toxic contaminant monitoring in Puget Sound (c) demonstrate and evaluate the use citizen scientists as a primary resource for conducting field work and (d) investigate the feasibility of Mussel Watch as a monitoring tool in Puget Sound.

PSAMP staff coordinated with Snohomish County and Washington Sea Grant staff to identify which of the 26 core Mussel Watch locations would be sampled by volunteer teams, and which would be sampled by PSAMP staff, to identify appropriate local volunteer groups for volunteer sampling, and to develop volunteer materials based on the NOAA Mussel Watch protocol. Snohomish County staff coordinated with local volunteer groups to organize five volunteer training sessions, and trained all of the volunteers (including Site Leads) who then successfully sampled mussels from each of their assigned Mussel Watch sites. Washington Sea Grant staff helped to organize the project and coordinate the volunteer activities. NOAA Mussel Watch sent a representative from Silver Spring, MD to assist in implementing the project, including field work for two sampling locations. Volunteers sampled 14 sites while PSAMP staff sampled six sites and assisted with some of the logistics for the volunteer-locations.

All Mussel Watch locations were successfully sampled using adapted NOAA protocols by either PSAMP staff or a citizen scientist team, except for five sites where mussels were unavailable and one where it was determined that conditions were too hazardous to continue the site. Specific sampling locations for several other sites were shifted to overcome some of these issues, with careful attention paid to selecting new sampling locations that were still close enough and with conditions similar to originally designated Site Centers. A review of field reports from previous years indicated that some previous Mussel Watch sampling had been made at locations that were substantially different from intended Site Centers, so we concluded that a careful matching of actual historical sampling locations with Mussel Watch pollutant data is needed for future data analyses of historic data. In at least one case an ambient station had been shifted to a marina, wherein previously unexplained high contaminant values had been observed.

Three new pilot locations were sampled on a one-time basis to either evaluate contaminant loads in mussels from a highly contaminated site, or to coordinate with other existing PSAMP sampling efforts. These sites may provide information that will be useful in helping to design future expansion efforts of Mussel Watch in Puget Sound.

All mussel samples were shipped to labs and arrived in excellent condition for chemical analysis and histopathological determination of reproductive condition. We have since been informed

that chemical analysis of tissues by the contract lab in Texas may be substantially delayed because of the large number of high-priority samples being handled by that lab from the Deepwater Horizon oil spill. As of this writing we have no estimate of the timing for receiving data.

Training workshops and materials developed for the citizen scientists were successful and demonstrated the proof-of-concept for using volunteers to implement a monitoring study such as Mussel Watch. More than 65 volunteers contributed over 500 hours to sampling mussels in this project, with a value of more than $10,000. Volunteers significantly reduced the amount of time professional staff were needed in the field, provided staff scientists with valuable local knowledge and natural history, and engaged citizens' desire to become involved in Puget Sound's recovery. A post-project survey indicated a high degree of satisfaction among the volunteers, an increased personal connection with their local environment and the research and monitoring community conducting these studies. Ninety percent of participants indicated a desire to participate again in the program and expressed an interest in expanding Mussel Watch coverage in their region to answer local pollution questions.

Recommendations and next steps for adapting Mussel Watch to Puget Sound needs are to:

- Identify goals of an expanded Mussel Watch program, particularly relative to the Puget Sound Partnership's Action Agenda and other existing related studies
- Engage and coordinate existing participants with interested potential partners such as Marine Resource Committees, Stormwater Work Group, local governments, tribes, and non governmental groups
- design the expansion to address Puget Sound goals
- Identify and inventory the availability of mussels in Puget Sound for expanding sampling
- Evaluate the uses and limitations of mussels for monitoring pollution based on their distribution and life history characteristics

Successful adaptation of the National Mussel Watch program to the Puget Sound level will require sufficient and consistent funding to conduct adequate pilot studies, establish more sampling locations than currently exist, add seasonal sampling where necessary, and establish a well-tended wide-ranging network of committed volunteers and volunteer organizations.

Table of Contents

List of Figures

List of Tables

Project Overview and Goals

NOAA's Mussel Watch[1] is one of the nation's longest running continuous contaminant monitoring programs. It was designed to assess the status of toxic contaminants in estuarine, nearshore marine and Great Lakes waters and track changes in contamination through time. Mussel Watch efforts in Washington State are focused on mussels from the genus *Mytilus* and the program currently samples 26 stations in the State every two years. Monitoring stations are located throughout the Puget Sound, Hood Canal, the Straits of Juan de Fuca and Georgia, the Pacific Coast, coastal estuaries, and the mouth of the Columba River.

NOAA's Mussel Watch program has been tracking contaminants in US coastal and Great Lakes waters since 1986. In recent years NOAA has begun to seek sampling partnerships with State and local entities to promote the relevance of its program at regional levels and help ensure its long-term viability. NOAA supports the concept of expanding spatial and temporal coverage of Mussel Watch sampling to help address local issues such as those identified as ecosystem recovery goals in the Puget Sound Partnership's Action Agenda, while maintaining pre-existing long-term Mussel Watch stations to ensure compatibility with its National Status and Trends monitoring. Such State/Federal partnerships are developing in other coastal areas, and it is the purpose of the current project to take the first steps towards identifying a potential partnership framework between NOAA's Mussel Watch and Washington State.

Mussel Watch has been an important complement to ongoing contaminant monitoring efforts already underway in Washington State's marine and estuarine waters. Washington Department of Fish and Wildlife's Puget Sound Assessment and Monitoring Program (PSAMP) has long reported Mussel Watch data and results along with status and trends information from its own sentinel species, primarily finfish, to present a more complete contaminant status and trends story for Washington State. PSAMP scientists have placed a high value on the utility of Mussel Watch for regional contaminant assessments, but also recognize the need to adapt the program to better answer regional questions. The Snohomish County Marine Resources Committee (MRC) has already taken these steps by partnering with Mussel Watch beginning in 2007 to augment local monitoring coverage, with the aim of increasing their ability to track local water quality. They facilitated the addition of seven Mussel Watch stations in Snohomish County, in addition to the historical stations already located there, and organized a network of local volunteers to perform semi-annual mussel collections and water quality sampling.

The current project is a collaboration between WDFW's PSAMP, the Snohomish County MRC, Snohomish County Public Works-Surface Water Management, and Washington Sea Grant. It was funded by the Puget Sound Partnership to take the first steps towards developing a NOAA/Washington State Mussel Watch partnership by: (1) evaluating the feasibility of adding Mussel Watch field sampling (starting with the 2009/10 field season) to WDFW's existing PSAMP and (2) demonstrating as a proof-of-concept the use of local citizen scientists for field sampling for a subset of locations. The longer-term goal of establishing a stable and secure partnership between the National Mussel Watch Program and Washington State and local

[1] http://ccma.nos.noaa.gov/about/coast/nsandt/musselwatch.html

partners will rely on results from our current study along with an evaluation of Mussel Watch in the context of the Partnership's Action Agenda and identification of a stable, long-term funding source .

Summary of the National Mussel Watch Program

History

The National Mussel Watch Program is now in its 24th year of sampling. The program was established in 1986 by the National Oceanic and Atmospheric Administration (NOAA), in response to the Marine Protection, Research and Sanctuaries Act (MPRSA – 33 USC 1442) legislation which called on the US Secretary of Commerce to initiate a continuous monitoring program "to assess the health of the marine environment, including monitoring of contaminant levels in biota, sediment and the water column." The program goal of Mussel Watch is, "to support ecosystem-based management through an integrated nationwide program of environmental monitoring, assessment and research to describe the status and trends of our nation's estuaries and coasts" (Kimbrough et al., 2008).

The Mussel Watch program monitors the status and trends of chemical contaminants in US coastal waters through annual or semi-annual collection and analysis of oysters and/or mussels, depending on their availability and location. These bivalves are permanently attached or established (i.e., sessile) filter-feeding organisms that can concentrate pollutants from their food and from seawater. The contaminant levels in their tissues change in response to ambient environmental levels (Burns and Smith, 1981; Regoli and Principato, 1995; Gustafsson et al., 1999). In addition, many contaminants that accumulate in their tissues undergo minimal metabolic transformation (Roesijadi et al., 1984; Moore et al., 1989; Widdows and Donkin, 1991). These characteristics combined with targeted sampling of young individuals, provide a good indicator of recent local contamination. Mussel Watch measures the levels of over 140 chemical contaminants, many of which are listed as Environmental Protection Agency (EPA) Priority Pollutants, in the tissue of these bivalves (Kimbrough et al., 2008). Most of these contaminants are toxic to aquatic organisms and are considered persistent organic pollutants. Many bioaccumulate and can biomagnify through food chains to upper trophic level organisms such as salmon, seals, sea lions, killer whales and humans.

Mussel Watch sampled 145 sites around the country in its inaugural year 1986. Today Mussel Watch occupies nearly 300 monitoring sites (Figure 1), many of which coincide with sites from a 1976-1978 EPA Mussel Watch study, potentially stretching the data record back further in many states. Mussel Watch sites were originally selected in consultation with state officials and academic professionals to represent large coastal areas, providing an assessment of the overall ambient conditions nationwide (Kimbrough et al., 2008). Many sites are located in or near National Estuarine Research Reserves and National Marine Sanctuaries, such as the *Olympic Coast National Marine Sanctuary* in Washington State.

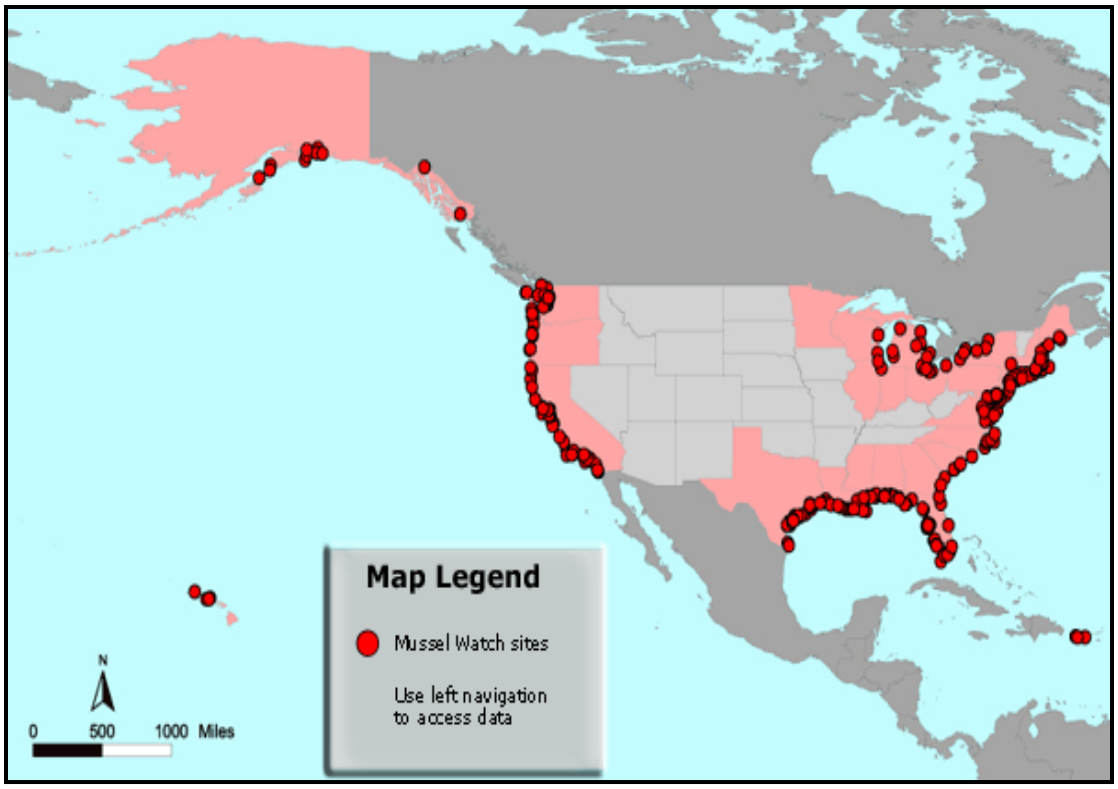

Figure 1. Map of NOAA's National Mussel Watch Program sampling sites in the United States and Puerto Rico. From: http://www8.nos.noaa.gov/cit/nsandt/download/mw_monitoring.aspx

Mussel Watch monitoring in Washington State has been used to assess the status and trends of pollutants throughout the Puget Sound, Hood Canal, the Straits of Juan de Fuca and Georgia, the Pacific Coast, and the mouth of the Columba River. In addition, the Mussel Watch program initiated a special event assessment of the Point Wells Oil Spill, a 4,800 gallon bunker-fuel spill that occurred on December 31st, 2003 (Fay, 2005). Mussel Watch has provided valuable baseline data for comparison during other oil spills around the country; currently NOAA's Mussel Watch staff are heavily engaged in focused research efforts in the Gulf of Mexico, to help assess the impacts of the ongoing Deepwater Horizon Oil Spill.

Sampling Design

A variety of bivalve species are targeted by Mussel Watch in different coastal regions since no single species of oyster or mussel is common to all states. Mussels (*Mytilus* spp.) are collected from the Pacific and North Atlantic coasts, while oysters (*Crassostrea virginica*) are collected from the mid-Atlantic southward and along the Gulf Coast. Zebra mussels (*Dreissena* spp.), an invasive species, are collected from the Great Lakes. Mussels are the only bivalves collected in Washington State and typically include *Mytilus edulis/trossullus* and *M. californianus* (Figure 2).

Figure 2. ***Mytilus edulis/trossullus*** **(top) and** ***Mytilus californianus*** **(bottom). Photo courtesy of National Mussel Watch Program unpublished report.**

Mussel Watch sites are typically located 10 - 100 km apart along US coastlines, in shellfish beds large enough to sustain repeated sampling. Monitoring sites are selected to provide an assessment of the ambient conditions over broad coastal areas, to allow comparison among very large water bodies. Hence municipal sewage outfalls, industrial effluents, and other known point pollution sources are avoided. In addition, only naturally occurring bivalves are collected from natural substrates or concrete; creosote- or other treated pilings are avoided. The distribution of bivalves is not manipulated with transplantation.

Mussel Watch ambient data have also been used for characterizing the environmental impact of new and emerging contaminants, extreme events (hurricanes and oil spills) and for assessing the effectiveness of legislation, management decisions and remediation of coastal contamination levels (Kimbrough et al., 2008). Historical Mussel Watch data have been utilized to assess the environmental impacts of several catastrophic events, including the San Francisco Cosco Busan oil spill, the Delaware Bay Athos 1 oil spill, Gulf Coast hurricanes Katrina and Rita, and the attack on the World Trade Center.

Mussels and oysters are sampled during their reproductively quiescent winter months, (prior to their spawning season) to avoid variability in contaminant tissue residues related to reproduction. They are collected from intertidal zones either by hand or with a clam rake or dredge, and removed from their substrates by cutting their byssal threads. The collected bivalves are then rinsed, using water from the collection site, brushed clean and immediately packed in ice to keep the samples alive until they reach the laboratory. Samples are shipped within two days of

collection to analytical laboratories for analysis of chemical contaminants and for assessment of gonadal index and histopathology. The gonadal index/ histopathology component verifies reproductive state and measures the prevalence of nearly 70 diseases and parasites.

Of the more than 140 organic compounds and metals included in Mussel Watch analyses, approximately 17 are toxic trace elements, including metals and metalloids (elements with metal-like properties e.g. antimony, arsenic and silicon). The organic compounds regularly quantified by the program include polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), dichloro-diphenyl-trichloro-ethane (DDT) and its metabolites, organo-tins, chlordanes, Dieldrin and its related compounds, hexachlorocyclohexanes (HCHs), and various other chlorinated pesticides (Appendix A). Recently the National Mussel Watch program also undertook a special assessment of polybrominated diphenyl ethers (PBDEs) in the US coastal zone (Kimbrough et al., 2009). Most of the organic contaminants analyzed by the Mussel Watch Program are regulated by federal and/or state laws. Many of these same pollutants are also tracked by the Snohomish County MRC in their own Mussel Watch collections. In addition, PSAMP tracks many of the same pollutants, as well as some others, in Puget Sound fish (Appendix A).

Detailed descriptions of the National Mussel Watch Program sampling and analytical protocols can be found at the "Mussel Watch Contaminant Monitoring: Methods Documents" website: http://ccma.nos.noaa.gov/about/coast/nsandt/musselmethods.html. We adapted this sampling protocol to meet the needs of our Washington State Mussel Watch pilot effort, including modifications made to support training of volunteers (see *Appendix B.1 - Training manual template for Mussel Watch volunteers in Washington State*.

Previous Mussel Watch Sampling in Washington State

Twenty six National Mussel Watch Program sites have been established for Washington State (Table 1 and Figure 4). Prior to 2009/10 the majority of Mussel Watch sites in Washington State were sampled by contractors hired directly by NOAA. However, Snohomish County Marine Resources Committee (MRC) volunteers, with the assistance of the Stillaguamish and Tulalip Tribes, have surveyed an expanded number of Mussel Watch sites in Snohomish and Island Counties since 2007.

The Snohomish County MRC is a group of volunteers from local and tribal governments, recreational, economic, and environmental interests which functions as an advisory group to Snohomish County on marine related issues. With support from the Northwest Straits Commission (NWSC) and Snohomish County Surface Water Management (SWM), the MRC also conducts a variety of projects that meet NWSC Benchmarks, including benefits to marine life, habitat, water quality, science, and education and outreach.

In 2007, the MRC began a partnership with NOAA to conduct Mussel Watch sampling utilizing citizen scientists at the three national sites within Snohomish County - Puget Sound Everett Harbor (PSEH), Puget Sound Edmonds Ferry (PSEF), and Puget Sound Mukilteo Ferry (PSMF). Additionally, the MRC expanded coverage of Snohomish County waters monitored by the project after a site was established at Eide Road (PSER) on Port Susan. The same year, the MRC

worked with wildlife biologists from the Stillaguamish Tribe, who independently established sites at Kayak Point Regional Park (PSKP) in Snohomish County and Cavalero County Park (PSCC) in Island County. The sampling schedule was also augmented to include a summer sampling effort in order to assess the effects of surface water runoff between wet and dry months, rather than simply during the winter months every two years.

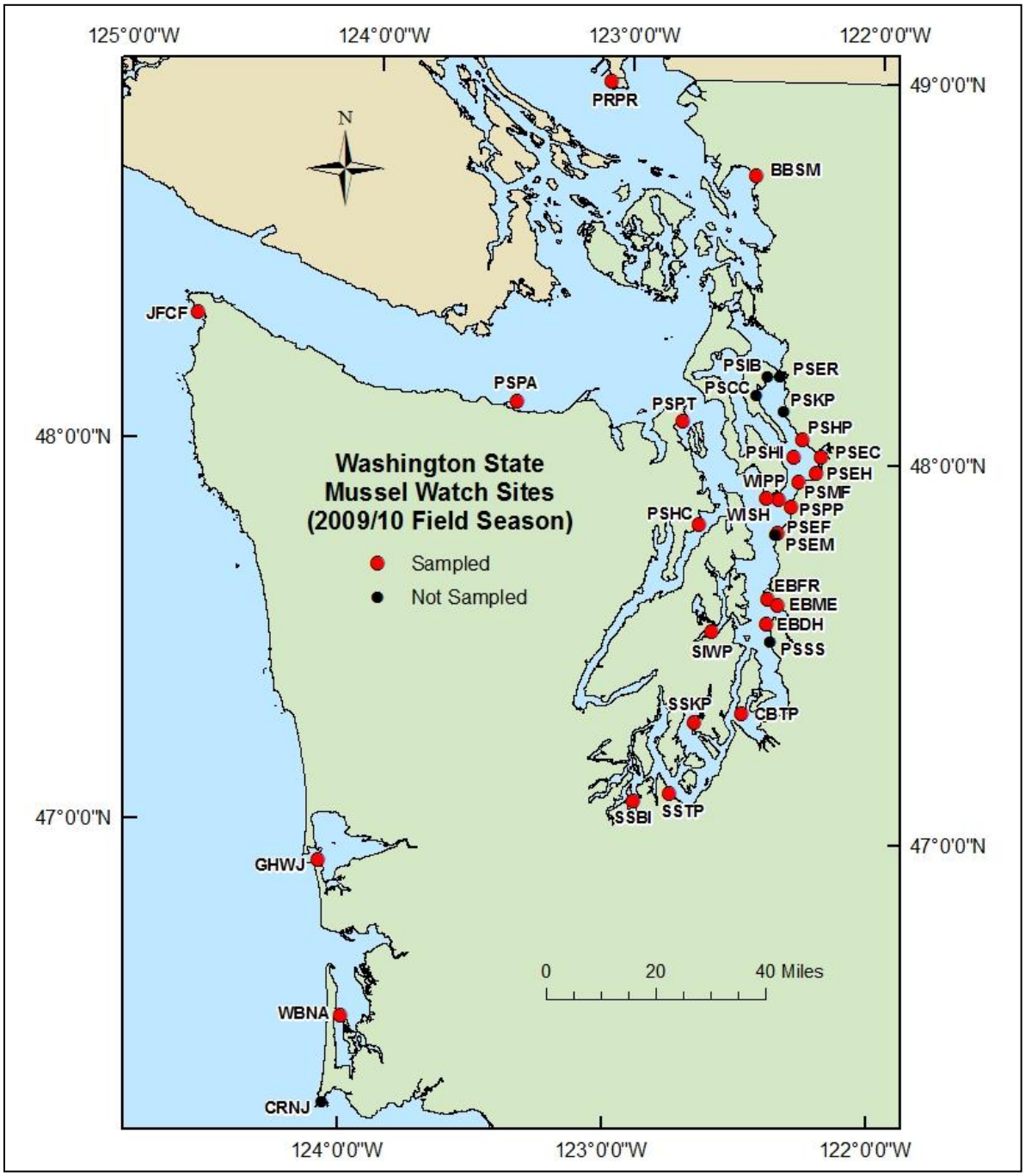

Figure 3. Distribution of Mussel Watch sites in Washington State. See Table 1 for definition of site acronyms. For description of 'Sampled' sites see Appendix C; 'Not Sampled' sites see Appendix D

Over the next three years, the MRC added five more sites throughout Snohomish County. These sites were established in areas where spatial gaps existed, including rural areas, suburban areas along the railroad, and near marinas. Data from this expanded network of sites will provide a useful and meaningful comparison to water quality data collected by the Washington State Department of Ecology at the mouths of the Stillaguamish and Snohomish Rivers in 2009 and 2010, where the same parameters were analyzed.

All Snohomish County sites were sampled semi-annually until winter 2010 by MRC members, staff, and volunteers from partner organizations including the Tulalip Tribes, the Washington State University (WSU) Snohomish County Extension Beach Watchers, and the Ocean Research College Academy (ORCA) at Everett Community College. The MRC will not sample in summer 2010, and will assess the utility and cost of continuing summer sampling in the future.

Within the semi-annual sampling scheme, NOAA has paid for wet season (winter) sample analyses at nationally recognized sites every other year (even-numbered years). Snohomish County MRC has used grant funding to pay for additional sample analyses in odd-numbered years at the nationally recognized sites, as well as all sampling efforts at locally established sites. The MRC has also been responsible for the cost of shipping, coordinating volunteers and site logistics for all sites and sampling efforts.

Review of Historic Mussel Watch Data: a case study

Although a full review of historical National Mussel Watch Program contaminant data for Washington State is beyond the scope and purpose of this report, we have included here a brief discussion of Mussel Watch data for examining the spatial extent and magnitude of, and temporal changes in, contaminants in Washington State mussels. This discussion focuses on PAHs as an example, because this contaminant class is particularly relevant to biota health and to current efforts regarding stormwater analysis and control in Washington State. In addition it provides a perspective on the limitations of the ambient design for answering regional questions. Data for all Mussel Watch sites and contaminants analyzed are available at the National Status & Trends Mussel Watch Data Portal website: http://www8.nos.noaa.gov/cit/nsandt/download/mw_monitoring.aspx.

Mussel Watch data have been used to characterize Puget Sound as one of the nation's hot spots for PAHs with concentrations similar to some of the nation's most polluted urban harbors (Figure 4), Mussels sampled outside Elliott Bay in Central Puget Sound had similar PAH levels as those sampled from Los Angeles harbor in 2001/02 (Figure 5). Of particular note here is the near-Elliott Bay site (4-Mile Rock, EBFR on Figure 3), which is situated well outside Elliott Bay, away from direct pollution sources that are tracked with sediment and fish sampling in the inner Elliott Bay. It is expected that expanding spatial coverage into Elliott Bay should capture some of the greatest biota-exposures to PAHs in the Sound, and the gradient of pollution in biota from the known urban sources to more distant locations.

Table 1. NOAA's Mussel Watch Program (NOAA), Snohomish County Marine Resources Committee (SCMRC), and Puget Sound Assessment and Monitoring Program (PSAMP) sites sampled (bold) and various sites not sampled (italics) during the 2009/10 field season.

SiteAcronym	Site Name	Site Affiliation	Samplers
BBSM	**Bellingham Bay-Squalicum Marina Jetty**	**NOAA**	**Whatcom County MRC volunteers**
CBTP	**Commencement Bay-Tahlequah Point**	**NOAA**	**PSAMP**
EBDH	**Elliott Bay-Duwamish Head**	**NOAA**	**Seattle Aquarium volunteers**
EBFR	**Elliott Bay-Four-Mile Rock**	**NOAA**	**PSAMP, SCMRC, Sea Grant, Seattle Aquarium volunteer**
GHWJ	**Grays Harbor-Westport Jetty**	**NOAA**	**Grays Harbor County MRC volunteers**
JFCF*	**Juan de Fuca Strait-Cape Flattery**	**NOAA**	**PSAMP, OCNMS and Makah Tribe collaborators**
PRPR	**Point Roberts-Point Roberts**	**NOAA**	**PSAMP and Island County Beach Watchers volunteers**
PSEC	**Puget Sound-Everett Cemex**	**NOAA/SCMRC**	**SCMRC volunteers**
PSEF	**Puget Sound-Edmonds Ferry**	**NOAA**	**SCMRC volunteers**
PSEH	**Puget Sound-Everett Harbor**	**NOAA**	**SCMRC volunteers**
PSHC	**Puget Sound-Hood Canal**	**NOAA**	**Port Townsend Marine Science Center volunteers**
PSHI	**Puget Sound-Hat Island**	**NOAA/SCMRC**	**SCMRC volunteers**
PSHP	**Puget Sound-Hermosa Point**	**NOAA/SCMRC**	**SCMRC volunteers**
PSMF	**Puget Sound-Mukilteo Ferry**	**NOAA**	**SCMRC volunteers**
PSPA	**Puget Sound-Port Angeles**	**NOAA**	**OCNMS collaborators**
PSPT	**Puget Sound-Port Townsend**	**NOAA**	**Port Townsend Marine Science Center volunteers**
SIWP	**Sinclair Inlet-Waterman Point**	**NOAA**	**PSAMP and ENVVEST collaborators**
SSBI	**South Puget Sound-Budd Inlet**	**NOAA**	**PSAMP**
WBNA	**Willapa Bay-Nahcotta**	**NOAA**	**Pacific County MRC volunteers**
WIPP	**Whidbey Island-Possession Point**	**NOAA**	**PSAMP**
PSPP	**Puget Sound-Picnic Point**	**SCMRC-alternate**	**SCMRC Volunteers**
EBME	**Elliott Bay-Myrtle Edwards**	**PSAMP-pilot site**	**PSAMP and Seattle Aquarium volunteers**
SSKP	**South Puget Sound-Kopachuck Park**	**PSAMP-pilot site**	**PSAMP**
SSTP	**South Puget Sound-Tolmie Park**	**PSAMP-pilot site**	**PSAMP**
WISH**	Whidbey Island-Scatchet Head	Alternate to WIPP site	PSAMP and WSU Beach Watchers volunteers
CRNJ	*Columbia River-North Jetty*	*NOAA*	*Not Sampled*
PSKP	*Puget Sound-Kayak Point*	*NOAA*	*Not Sampled*
PSCC	*Puget Sound-Cavalero County Park*	*NOAA*	*Not Sampled*
PSEM	*Puget Sound-Edmonds Marina*	*NOAA/SCMRC*	*Not Sampled*
PSER	*Puget Sound-Eide Road*	*NOAA/SCMRC*	*Not Sampled*
PSSS	*Puget Sound-South Seattle*	*NOAA*	*Not Sampled*

* Due to dangerous conditions at original site, sampling occurred at nearby alternate location; Wa'atch Point (Appendix C.7)

** Alternate location that was sampled but not analyzed due to later discovery of mussels at original WIPP site (Appendix C.25)

Although such fine (local) scale data are lacking, Mussel Watch data can be used to gain some sense of the ambient conditions within broad-scale regions of Washington State (Figure 6). Oceanic and non-urban locations exhibited the lowest exposures to PAHs which increased with proximity to the more urbanized Central and Southern Puget Sound basins. Data from 2006 showed a high level of PAHs at the Port Townsend site (more than 11,000 ppb dry weight). A careful review of sampling records showed that the sampling site for that year had been located unusually near to the Port Townsend marina and ferry terminal. In this case, the Port Townsend site likely represented a local source of contamination rather than ambient conditions for the region.

The long-term nature of the Mussel Watch dataset is useful for tracking temporal changes in pollutants. For instance, Mussel Watch data allow us to see whether the levels of PAHs in the various oceanographic basins in Washington are trending up or down, as compared to the rest of the nation (Figure 7). A time series of data from 1985-2004 showed that PAH levels at Washington sites tended to be higher than the national average and overall, levels were relatively stable throughout this time period for the sites included.

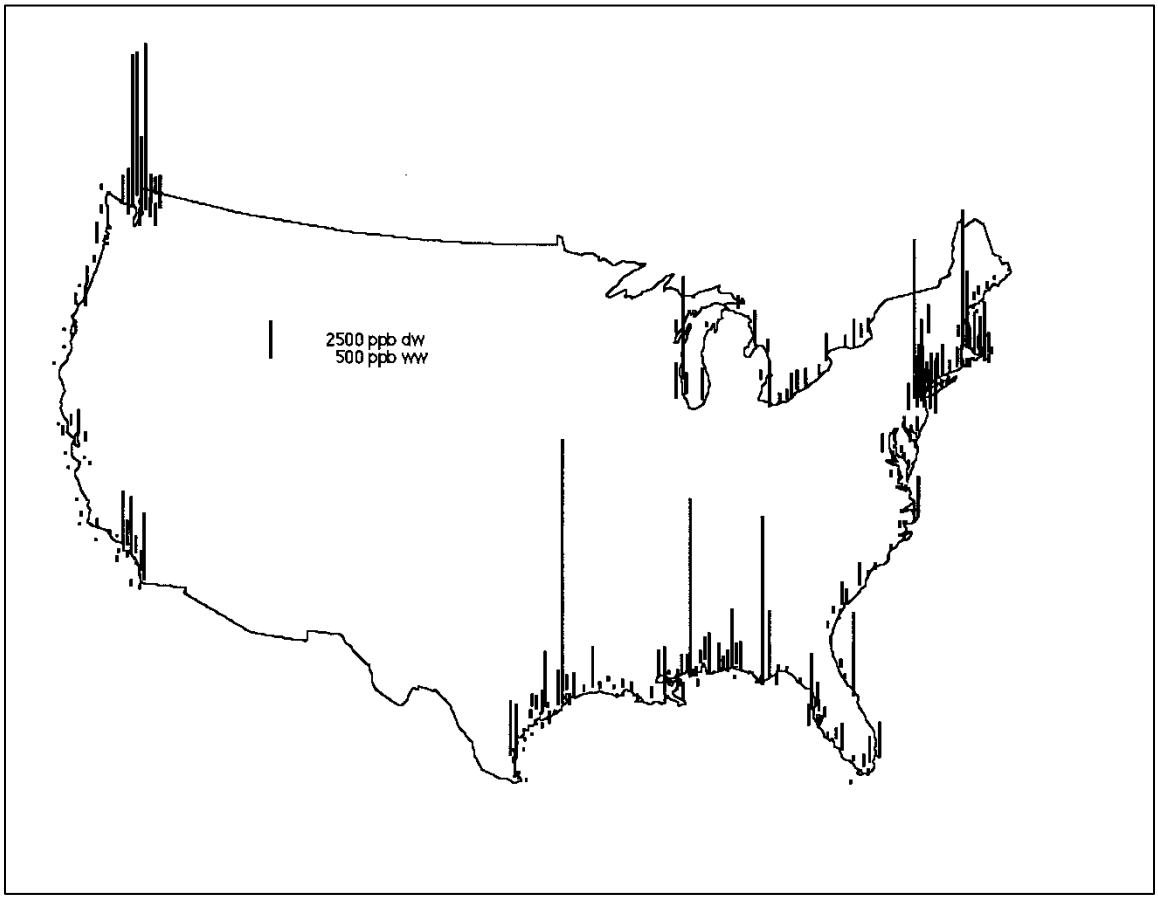

Figure 4. Total PAHs in mussels and oysters, from national Mussel Watch sites. Data from National Status & Trends Mussel Watch Program (1995/1996), courtesy of Alan Mearns.

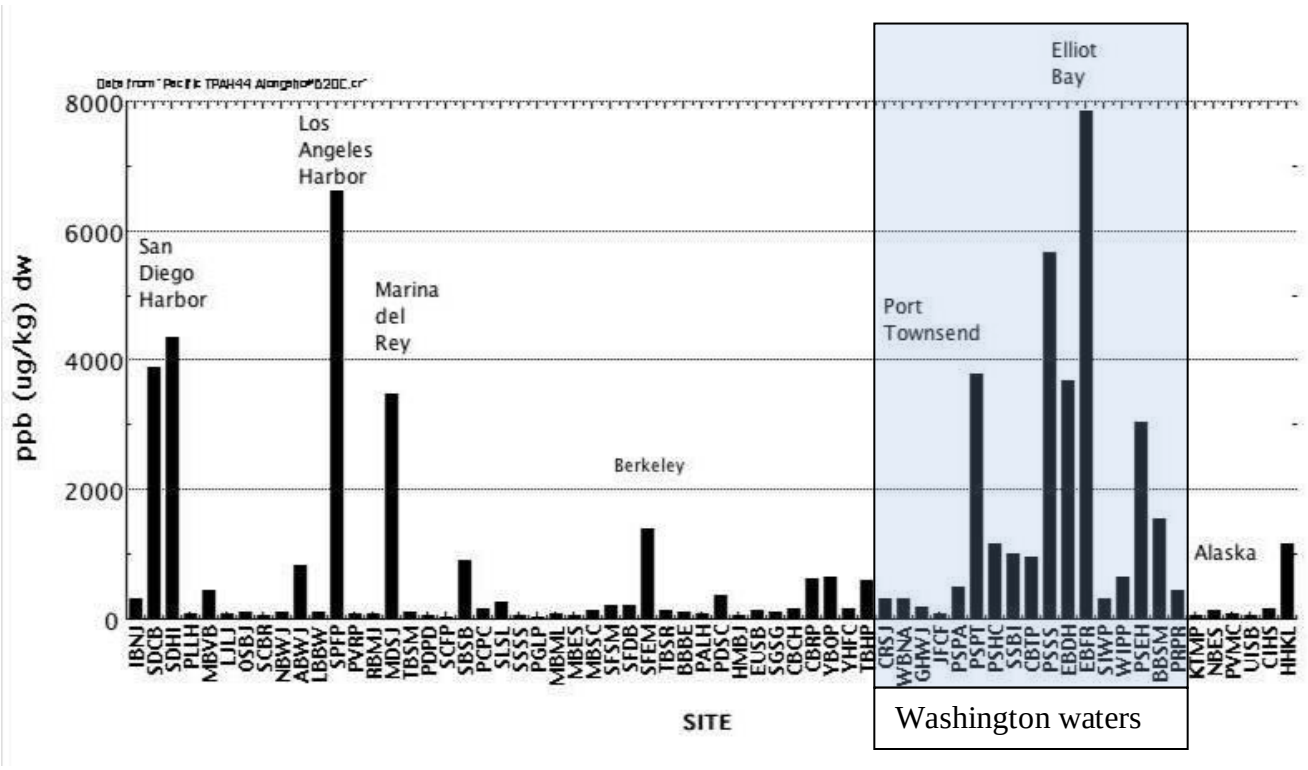

Figure 5. Total PAHs along the Pacific Coast. Adapted from National Status & Trends Mussel Watch Program (2001/2002), figure courtesy of Alan Mearns.

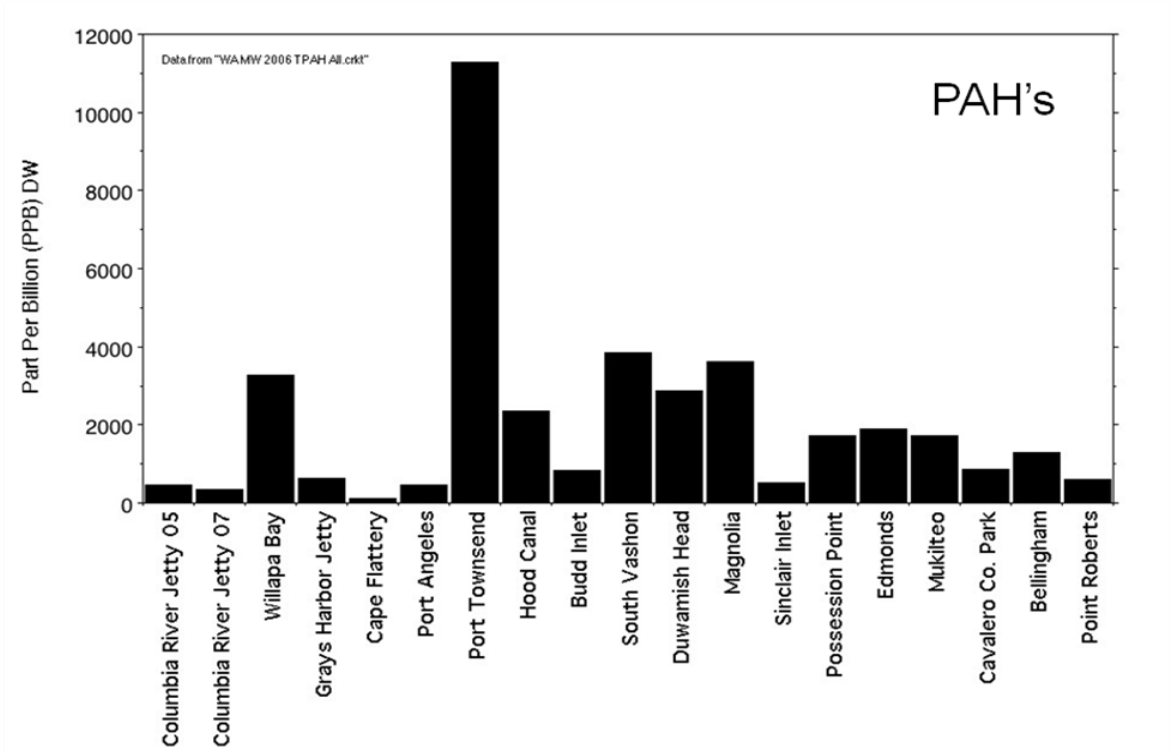

Figure 6. Total PAHs from select Washington State Mussel Watch sites. Data from National Status & Trends Mussel Watch Program (2006), courtesy of Alan Mearns.

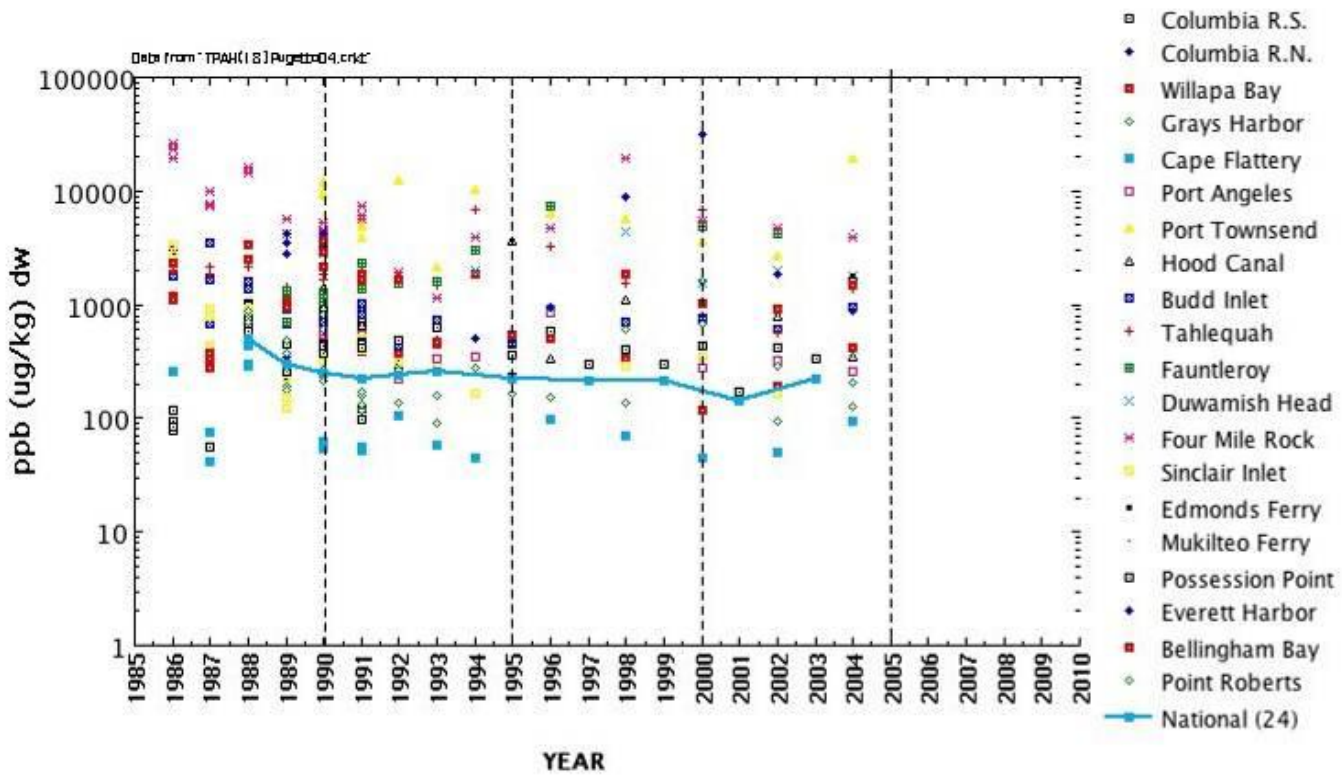

Figure 7. Total PAHs from 1985-2004 at select Washington State Mussel Watch sites. Note log scale. Data from National Status & Trends Mussel Watch Program, courtesy of Alan Mearns.

Snohomish County's Mussel Watch program has expanded spatial coverage of their sampling sites and conducted sampling across two seasons to move towards sufficient Mussel Watch coverage to answer questions about distribution and timing of pollutant loads to Snohomish County marine waters. Their additional sites suggest local sources of contamination from PAHs and other contaminants, and illustrate urban-to-rural gradients within Snohomish County waters (Figure 8). In addition, the Snohomish County MRC initiated a pilot-project to assess differences in chemical concentrations between winter (wet season) and summer (dry season) (Figure 9). Projects such as this one provide valuable knowledge to local managers dealing with issues of stormwater runoff.

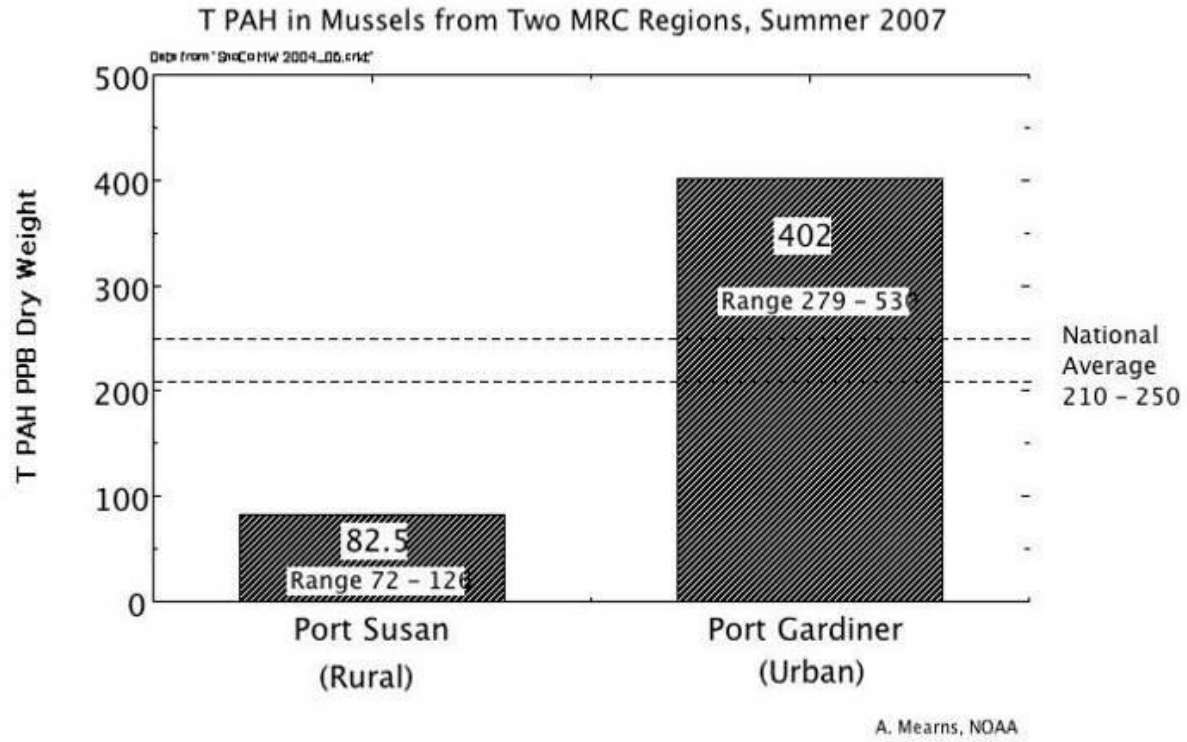

Figure 8. Comparison of Total PAH concentrations in mussels between an urban and rural site in Snohomish County waters . Data from National Status & Trends Mussel Watch Program and the Snohomish County Marine Resources Committee, courtesy of Alan Mearns

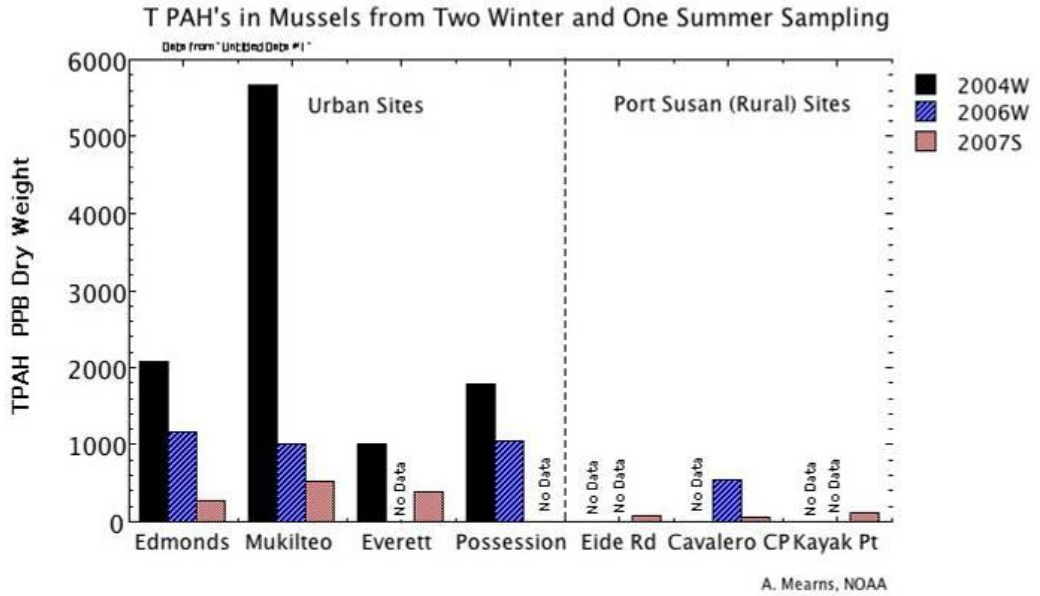

Figure 9. Total PAHs in mussels between wet (winter = W) and dry (summer = S) seasons at select Snohomish County Mussel Watch sites. Data from National Status & Trends Mussel Watch Program and the Snohomish County Marine Resources Committee, courtesy Alan Mearns

Details of Mussel Watch Collection in 2009/10

Participants and Goals

Collection of mussels in Washington State during the 2009/10 field season was successful because of the mutual efforts of State and County agencies, several tribes and local volunteer groups, with funding provided by the Puget Sound Partnership. Leadership for this effort came from collaboration between WDFW's PSAMP, the Snohomish County MRC and Surface Water Management and Washington Sea Grant Program. Our goal was to begin the process of adapting the Mussel Watch sampling plan from the national to the state/local level. To that end we planned to sample all core Mussel Watch station samples for the 2009/10 field season and demonstrate the utility and benefits of partnering with local volunteer groups for scientific sampling.

Volunteers collecting mussels at the Puget Sound – Edmonds Ferry (PSEF) site, under the leadership of the Snohomish County MRC.

Site Evaluation

To begin the process of adapting Mussel Watch sampling to State and local partners, we evaluated the current Mussel Watch sites in Washington State for their suitability for volunteer sampling. Evaluation of the Mussel Watch sites included an assessment of 1) site location, including remoteness and proximity to potential volunteer groups; 2) accessibility, including the need for an access permit or permission, special vehicle/vessel requirement, and difficult access features such as long trails or climbing required; and 3) local hazards such as high surf conditions or steeply inclined shorelines.

Local Volunteer Organization Partners

We partnered with the following local volunteer organizations to conduct sampling at suitable Mussel Watch sampling sites:

- Feiro Marine Life Center
- Grays Harbor County Marine Resources Committee
- Olympic Coast National Marine Sanctuary
- Pacific County Marine Resources Committee
- Port Townsend Marine Science Center
- Seattle Aquarium
- Whatcom County Marine Resources Committee

In addition, the Snohomish County MRC coordinated volunteers for sampling at Snohomish County sites as in previous years with separate funding from the Northwest Straits Commission.

Staff from our project contacted local volunteer organizations and recruited an experienced volunteer for each group to act as a Site Lead. Site Leads and project staff identified suitable volunteers and organized training sessions. Each local volunteer organization took responsibility for sampling at one or two Mussel Watch sites. All participants coordinated with PSAMP scientists to choose an appropriate sampling date and time, based on historical sampling date and the tide schedule. Each volunteer organization received a modest compensation (approximately $500) directly from the Partnership to foster the volunteer activities.

Volunteer Education and Training

Five training sessions were held for 46 volunteers[2] representing seven organizations (Table 2). Training locations and logistics were coordinated by staff from the local volunteer organizations and Snohomish County MRC staff. Local volunteer organization staff were responsible for recruiting and coordinating volunteers for their sites and informing them of training dates, times, and locations. Training sessions were presented and facilitated by Amy Johnson (a project Contractor) and Snohomish County MRC staff. PSAMP staff ensured that sampling materials were delivered to volunteer groups and assured appropriate sampling protocols and timing.

We developed a *Washington State Mussel Watch Program Training Manual*, based on the *NOAA Mussel Watch Program Procedures and Sampling Protocol*, with additions and clarifications specific to a volunteer audience (Appendix B.1). The training manual was customized for each volunteer training session to include information about the local Mussel Watch sites. We also developed a Site Lead Supplemental manual that included additional details for Site Leads (Appendix B.2).

Volunteer training sessions consisted of a classroom component and field practicum to ensure the training protocols were understood and could be applied in the field (Appendix B). The classroom portion of the training provided background on the National Mussel Watch Program, as well as the regional expansion of the project. It introduced volunteers to the history of the Mussel Watch site(s) where they would be sampling and provided selected data trends for the

[2] 19 volunteers had already been trained for Snohomish County sampling

area. Volunteers learned how to select stations at their site, proper sampling and packing procedures, a protocol for unforeseen logistical circumstances, and appropriate contacts for any questions they had after training or during sampling. See the training manual for details on the content of this training (Appendix B.1).

Table 2. Volunteer groups trained, training location/date, and number of volunteers in attendance. PTMSC - Port Townsend Marine Science Center; OCNMS - Olympic Coast National Marine Sanctuary; FMLC - Feiro Marine Life Center; WCMRC - Whatcom County Marine Resources Committee (MRC); SA - Seattle Aquarium; PSMRC - Pacific County MRC; GHMRC - Grays Harbor County MRC.

Group(s)	Training Location	Training Date	Attendance
PTMSC, OCNMS, FMLC	Port Townsend Marine Science Center	January 8, 2010	12
WCMRC	Whatcom County Civic Center Building	January 22, 2010	8
SA	Seattle Aquarium	January 23, 2010	14
PSMRC	Pacific County Administration Building	February 19, 2010	5
GHMRC	Westport Maritime Museum	February 20, 2010	7
Total Number Volunteers Trained			**46**

The field practicum followed the classroom component and enabled volunteers to visit the local Mussel Watch site and practice sampling procedures learned in the classroom. Volunteers practiced locating and establishing stations, identifying the appropriate size and number of mussels required for analysis, and techniques for properly cutting mussels from their substrate. They were also able to assess the site during daylight hours, as low tide on most sampling dates fell during hours of darkness. Common questions related to how far from site center samples could be taken, the variable nature of mussel population sizes and extent at sites, and appropriate site access points.

Following the field practicum, there was an additional short classroom training for Site Leads. This portion of the training ensured that the Site Leads were provided with the background knowledge needed to coordinate any future Mussel Watch sampling opportunities. See the Site Lead supplemental for details on content of this training (Appendix B.2).

Volunteer training sessions also provided the opportunity for volunteers to share local knowledge about the local Mussel Watch sites, including anecdotal information about potential sources of contamination and important site access information. This information was collated by PSAMP staff and integrated into the site histories for this report (Appendix C). This ability to incorporate local knowledge further highlights the value of engaging local citizen scientists.

Classroom training for volunteers at Port Townsend Marine Science Center.

Seattle Aquarium volunteers at Elliott Bay Duwamish Head (EBDH) for field practicum.

Mussel Watch Contractor Amy Johnson teaching Whatcom County MRC volunteers during field practicum at Bellingham Bay Squalicum Marina Jetty (BBSM).

Summary of Collaborative Sampling in 2009/10

Project Coordination and Sampling

PSAMP, Snohomish County MRC members and staff in partnership with the Snohomish County Public Works Surface Water Management, and Washington Sea Grant provided overall coordination for Washington Mussel Watch sampling during the 2009/10 field season. Mussel Watch sampling was performed by PSAMP staff, Snohomish County MRC staff and volunteers, and other local volunteer groups, including the Grays Harbor County MRC, Pacific County MRC, Port Townsend Marine Science Center, Seattle Aquarium, and Whatcom County MRC. Because of local Mussel Watch site sampling constraints, volunteers from the Feiro Marine Life Center did not participate in Mussel Watch sampling this year, even though they were trained. Assistance with sampling was provided by the Ocean Research College Academy (ORCA) at Everett Community College, Olympic Coastal National Marine Sanctuary, WSU Beach Watchers, Makah and Tulalip Tribes, and US Navy. Funding support for Mussel Watch sampling in 2009/10 was received from the Puget Sound Partnership and in-kind contributions from PSAMP, the Snohomish County MRC, Washington Sea Grant, and several volunteer groups. In addition, sampling of Snohomish County sites was funded through a grant from the Northwest Straits Commission.

On the day of sampling, Site Leads were responsible for coordinating the arrival of all volunteers at the site and ensuring that proper sampling techniques were followed during collection.

Though a brief sampling summary is provided here, details of the full volunteer sampling protocol are presented in Appendix B.1. Once the Site Center was identified the Mussel Watch volunteers collected between 80-160 mussels from each of three Stations which were established around the Site Center. In accordance with protocol, the samplers wore laboratory gloves during mussel collection and rinsed all mussels in seawater collected at the Site to prevent outside contamination of the samples. In addition to collecting mussels, Site Leads and volunteers collected additional data, including water temperature, salinity, Station GPS coordinates, descriptions of substrate type, the overall Site conditions and/or potential pollutant sources observed, and any other observations pertinent to the Site. Volunteers were also encouraged to write a narrative log to describe their activities in their own words. Site Leads were also responsible for proper packing and timely shipment of the mussels (within two days of collection) to two different out-of-state analytical laboratories. PSAMP staff were available via cellular phone during all sampling periods to answer any questions and/or address problems that volunteers had in accessing or sampling at the site.

Site Sampling Summary

Washington State collaborators successfully sampled 20 of the 26 sites listed in the National Mussel Watch Program manual for Washington State including Snohomish County's expanded sites (Table 1). One site (CBNJ) was dropped in advance by NOAA's Mussel Watch program headquarters staff, who advised that the site was too dangerous to sample. The remaining five sites lacked sufficient mussels for collection, based on evaluating each site in the field. In addition to these 20 sampled sites, two alternate sites (PSPP and WISH) and three new pilot sites (EBME, PSKP and PSTP) were successfully sampled, bringing the total of sampled sites in the 2009/10 field season up to 25. Sampling efforts took place over three months; from December 12th, 2009 through March 3rd, 2010. Specific notes on sampling efforts for individual sites are listed in Appendices C.1 - C.25 and D.1 - D.6.

Photo: © Kathy Greer 2010

Volunteers sampling from jetty riprap at the Gray's Harbor – Westport Jetty (GHWJ) site.

Site Lead recording data at the Bellingham Bay - Squalicum Marina Jetty (BBSM) site.

Volunteer Sampling

More than 65 volunteers contributed more than 500 hours to Mussel Watch sampling in the 2009/10 field season (a value of more than $10,000 in volunteer time), and they completed sampling at 14 Mussel Watch sites. Volunteer participation significantly reduced the time and travel required by PSAMP staff to complete Mussel Watch sampling in the state, engaged local community members in learning more about their local environment, and resulted in the delivery of high quality samples to the lab for testing. By successfully partnering with local volunteer organizations in 2009/10, we have created the base of a network of trained volunteers around the state eager to conduct Mussel Watch sampling in the future.

Volunteers from the Seattle Aquarium determining seawater salinity at the Elliott Bay - Duwamish Head (EBDH) site.

Photo: © Kathy Greer 2010

Volunteer counting mussels before bagging at the Gray's Harbor – Westport Jetty (GHWJ) site.

Volunteer Evaluation

A project evaluation was distributed to 43 participants following completion of the project sampling period (Snohomish County MRC volunteers were not included in this evaluation). Forty-one participants were sent a link to an online survey via email and two additional participants were sent a mail copy of the same survey. The online survey was completed by 56% of recipients (24 people). This report includes a short summary of evaluation results. Full evaluation information is available upon request.

Overall, participant evaluations were very positive. More than 65% of survey respondents were extremely satisfied or very satisfied with their experience participating in Mussel Watch sampling in 2009/10 and an additional 25% were satisfied. Volunteers reported learning about local marine environmental issues and the scientific method, and increasing their personal connection to the local environment and local community through participation in the project (Figures 10 and 11). More than 80% of survey respondents reported learning about mussels and the intertidal ecosystem, contaminants in the marine environment, and water quality issues through their participation in Mussel Watch (Figure 10). Similarly, more than 80% of survey respondents reported gaining an increased connection to their local environment, other people in their community with similar interests in the local environment, and the research community (Figure 11). While only 74% of respondents reported an increased connection to the local organization coordinating their sampling effort, those who did not had each reported a very strong connection prior to participation in this project.

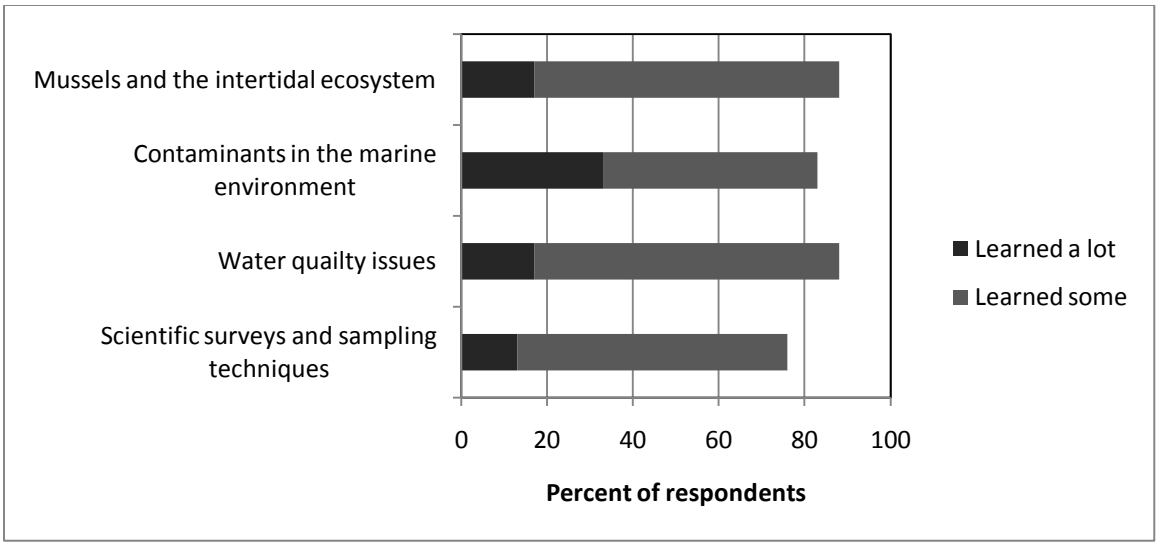

Figure 10. Evaluation of Mussel Watch participants—percent of respondents who reported learning about various topics through participation in the project.

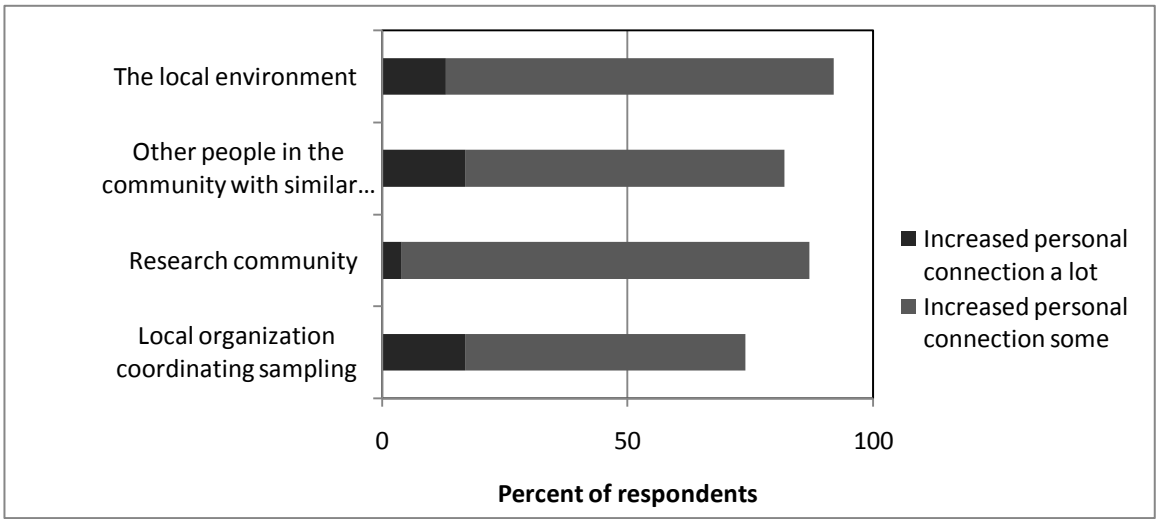

Figure 11. Evaluation of Mussel Watch participants—percent of respondents who reported an increased personal connection to the environment and others as a result of participation in the project.

More than 90% of respondents would be interested in participating in Mussel Watch sampling in the future and some indicated a desire for more sampling locations. The following selection of volunteer comments provides a window into the overall volunteer appreciation of the project:

- "Thanks much for the opportunity to broaden the network of people working towards a better informed general public."
- "Engagement of the volunteer samplers may have more value than the actual results of the sampling. Ultimately doing something about environmental pollution will require public engagement and public understanding."

- "Thanks for the opportunity to do this! I had fun and learned quite a bit in the process."
- "I was heartened to learn of this program, and glad to participate."

Problematic Sites

Although overall sampling in the 2009/10 field season went very well, a few problems were encountered. Most of the problems related to difficult or dangerous conditions at sampling sites. For instance steep cliffs, high surf conditions, long trails, and the potential for encounters with cougars or bears made sampling at Juan de Fuca-Cape Flattery (JFCF - Appendix C.7) potentially dangerous and inappropriate for volunteer assistance in this initial year of collaborative sampling. Difficulties encountered at this site led to the eventual relocation of sampling to a safer site, with more abundant and larger mussels, at Wa'atch Point approximately 3.6 miles to the south. In addition, National Mussel Watch Program staff advised against sampling at the Columbia River-North Jetty (CBNJ – Appendix D.1) site due to its history of dangerous conditions and remote location.

Bellingham Bay-Squalicum Marina Jetty (BBSM - Appendix C.1) posed some difficulties in sampling due to the necessity of climbing on large riprap boulders along a jetty. Dangers there included risk of injury by falling and/or landing in the water. Thus, personal flotation devices were a necessity for the volunteers who sampled BBSM. Point Roberts-Point Roberts (PRPR - Appendix C.8), required an entire day of travel via car and required international border crossings. The Puget Sound-Hat Island (PSHI – Appendix C.13) site can be reached only by boat and required the assistance of the Snohomish County Sheriff Department's Marine Services Section for access. Puget Sound-Port Angeles (PSPA – Appendix C.16) also required the use of a boat to reach mussels from aquaculture net pens, and the collaborator who helped sample that site (manager of the salmon-rearing facility) used SCUBA to sample mussels.

In addition, several sites were difficult due to the very small size of mussels, difficulty in removing them, or insufficient population size for sampling. This situation was encountered at Sinclair Inlet-Waterman Point (SIWP – Appendix C.19), where mussels were very small in size thus requiring the collection of many individuals for a sample. At Willapa Bay-Nahcotta (WBNA – Appendix C.23) the mussels were small and also wedged tightly among sharp-edged oysters, making them difficult to collect. A lack of sufficient mussels at some locations led to cancellation of sampling at the following sites: Puget Sound-South Seattle (PSSS – Appendix D.6), Puget Sound-Cavalero County Park (PSCC – Appendix D.2), Puget Sound-Edmonds Marina (PSEM – Appendix D.3), and Puget Sound-Kayak Point (PSKP – Appendix D.4).

Finally, several sites required prior permission from private landowners and/or state or county business facilities to access. This was the case at Bellingham Bay-Squalicum Marina Jetty (BBSM), Commencement Bay-Tahlequah Point (CBTP – Appendix C.2), Puget Sound-Everett Cemex (PSEC – Appendix C.9), Sinclair Inlet-Waterman Point (SIWP), South Puget Sound-Budd Inlet (SSBI – Appendix C.20) and several other sites.

Recommended Re-evaluation of Some Mussel Watch Sites

Whidbey Island – Possession Point

Due to irregularities in sampling location over the past decade, we recommend a re-evaluation of the Whidbey Island – Possession Point (WIPP – Appendix C.24) site. A review of notes from previous years revealed that in 2002 no mussels were found at the original WIPP site and in 2004 sampling for the WIPP site changed to a new location. Although this new location was relatively close geographically, it differed substantially in oceanography, bathymetry and nearby land-use from the original WIPP site. The original WIPP site is situated at the end of Possession Point along an exposed, open-water shoreline, and the bathymetry is fairly steep along the shore. (Figure 11, red pin, southeast quadrant). In 2004, mussels were sampled from "floating docks to the south and 'around the corner' from the original site in a small embayment called Sandy Hook" (Fay, 2005). From 2004 until this year, WIPP mussels were collected at this Sandy Hook location. Notes from 2004/05 indicate that "large *Mytilus* [sp.] were collected from the dock floats at Sandy Hook" (Fay, 2005). However, the water body at this Sandy Hook "alternate" location does not conform to that of the original WIPP site. The alternate site is situated within Cultus Bay, on the marina side of the Sandy Hook inlet. Water flow is likely very restricted through this portion of the relatively shallow Cultus Bay, and the floating docks that line this Hook are populated with private marine vessels (Figure 11, yellow pin, northwest quadrant).

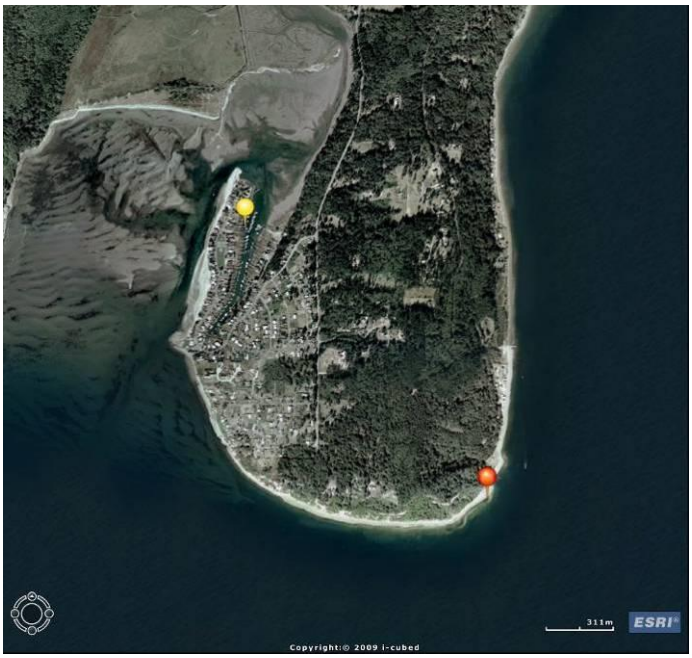

Figure 12. Original WIPP site center (red pin, southeast quadrant) and alternate "WIPP" site center (yellow pin, northwest quadrant) at the dock floats in a marina in Cultus Bay).

As such, the conditions at this "alternate" location—a shallow marina with restricted flow—do not represent the open water conditions present at the original WIPP site. The name of this site was never changed -- the data collected from Cultus Bay/Sandy Hook were classified as WIPP site data. Comments from Lincoln Loehr, an oceanographer and Snohomish County MRC volunteer, illustrate the necessity of a re-evaluation of the WIPP site data:

> "An interesting thing about the Possession Point station is that of all the stations in Possession Sound, Port Gardner and Port Susan, the Possession Point station had the highest tributyltin concentrations. I think that the concentrations were not high compared to the national data, but nevertheless, they were substantially higher than the rest of the stations in the area, and it is nowhere near any shipyard, naval base, boat harbor, etc." (L. Loehr personal communication).

Since mussel samples taken from Cultus Bay/Sandy Hook were sampled from docks that had boats tied to them, it is reasonable to suspect that the high tributyltin levels observed in previous years may be related to antifouling marine paint from boats in the marina. A full re-evaluation of the WIPP/Cultus Bay site data is needed to determine whether or how the changing trends in contaminant data at this site may be tied to their actual location.

South Puget Sound – Budd Inlet

The National Mussel Watch Program site description for South Puget Sound – Budd Inlet (SSBI – Appendix C.20) reads as follows:

> "The site center is the landward end of the marine laboratory pier. The three discrete collection stations were as follows: 1) the rip-rap at the base of the pier, 2) the first pair of pilings from shore, and 3) a set of unattached pilings 10 m north of the pier."

During sampling this year, PSAMP staff noted that the pilings at Stations 2 and 3 were likely made from creosote-treated wood. The National Mussel Watch Program protocol instructs to avoid collecting mussels from creosote-treated wood, so we did not sample mussels from these pier pilings this year. We suggest a re-evaluation of the historical PAH data from the SSBI site.

Juan de Fuca-Cape Flattery

As described above in the "Summary of Collaborative Sampling in 2009/10: Problematic Sites" section, the Juan de Fuca-Cape Flattery (JFCF – Appendix C.7) site proved both difficult and dangerous to sample. Specifically, the steep cliffs and high surf conditions made sampling at the original JFCF site extremely dangerous. These difficulties lead to the eventual relocation of sampling to a much safer site at Wa'atch Point, approximately 3.6 miles to the south of JFCF. Not only was this site much safer to sample, the mussels there were much larger and more abundant. Although we believe that this new site has environmental conditions similar to the original JFCF site, there may be an influence from the Wa'atch River into Makah Bay, of which Wa'atch Point is the northern most point. Thus, we recommend evaluation of data from this year compared to previous years for this site.

Pilot-Study Sites for Washington State in 2009/10 Mussel Watch Season

A pilot-study Mussel Watch site at Elliott Bay – Myrtle Edwards (EBME – Appendix C.5) was added in the 2009/10 field season as a replacement for the abandoned Puget Sound – South Seattle (PSSS – Appendix D.6) site. Previous records revealed that PSSS had been abandoned since 2004 due to lack of mussels for collection, and a search of this site turned up no mussels for sampling again this year. In addition, although PSAMP and National Mussel Watch Program staff searched along the central Puget Sound waterfront to the north and south of PSSS, no suitable mussel populations were identified as a replacement. Since funds from the PSSS mussel analysis were left available, PSAMP staff proposed sampling at a new site inside Elliott Bay for the 2009/10 sampling year to provide a preliminary evaluation of one of Puget Sound's worst-case contaminant scenarios, and an illustration of a possible urban-to-non-urban gradient between inner Elliott Bay and two Mussel Watch ambient stations that bracket the bay (Four-Mile Rock (EBFR) and Duwamish Head (EBDH)). This pilot Mussel Watch site was also co-located with another long-term monitoring site along the Seattle waterfront, where PSAMP has been tracking contaminants in bottom fish since 1991 and where King County Department of Parks and Natural Resources have been monitoring contaminants in sediments.

Similarly, two South Puget Sound sites – Kopachuck Park (SSKP – Appendix C.21) and South Puget Sound – Tolmie Park (SSTP – Appendix C.22) were added as pilot-project sites during the 2009/10 field season by PSAMP staff. These sites were co-located near stations where plankton were sampled for a focus study on toxics in primary producers and consumers during that year, and near PSAMP long-term bottomfish monitoring stations in Carr Inlet (SSKP) and the Nisqually Reach (SSTP). It was agreed that funds from the National Program would be used, on a one-time basis, to pay for sample analyses from these additional sites in 2010.

Recommendations and Future Steps for Mussel Watch in Washington State

The National Mussel Watch program is an important tool that supports our country's monitoring and evaluation of the health and quality of its estuarine, nearshore marine and Great Lakes waters. Its goal is to evaluate ambient pollution conditions in our nation's large water bodies including Puget Sound, and as such its sampling program was designed to answer questions on a large spatial scale. In order to develop this program to meet regional or local needs, an evaluation and expansion of the program is required for Puget Sound.

Mussels (*Mytilus* spp.) can be used as a biological indicator to assess and monitor Puget Sound water quality and biota health as part of the Governor's goal of a fishable/swimmable/diggable Puget Sound. These species could potentially fill data gaps not covered by existing monitoring and assessment programs. In particular, they are potentially useful as sentinel species for inputs of toxic contaminants to Puget Sound's nearshore waters, especially from stormwater or other shoreline discharges. In addition, they have been used for evaluating background conditions of

oil and other fossil-fuel compounds and to measure ecosystem damage resulting from spills. Results from our current project suggest that a Mussel Watch-type program may contribute significantly to meeting the Action Agenda's goals, and we offer a number of recommendations below based on the results of our study to meet that end.

Any expansion of Mussel Watch in Puget Sound would necessitate answering several logistical questions before implementation plans can be designed. The issue of mussel distribution in Puget Sound is perhaps the most significant factor in determining the extent to which mussels could be a useful tool in an expanded program. Some of the core national Mussel Watch locations were chronically under-sampled because of small population sizes. We encountered long stretches of shoreline in Puget Sound that lacked mussels or habitat suitable for mussels. Related to abundance and distribution of mussels in Puget Sound we need to know:

- What is the existing distribution of suitable mussel populations in Puget Sound?
- Which mussel populations are robust enough to withstand repeated sampling?
- Can other abundant bivalve species be substituted for mussels (e.g., oysters or hard shell clams)?
- Can mussels or other bivalves be temporarily redistributed to locations where they do not normally occur?
- What is the smallest sample size and number of mussels per composite required to address specific hypotheses?

Some of these questions can be approached using existing information. Satellite imagery, such as provided by Google Earth or ArcExplorer©, were valuable to us in previewing shorelines and they seemed to provide accurate views of potential mussel habitat in our searches and sampling preparations. Shoreline photos or existing shoreline habitat inventories could also be used to preview shorelines for mussel habitat. Power analyses can be conducted using existing Mussel Watch data to estimate the minimum sample size required to capture expected changes or patterns in tissue residues. Other questions may require significant resources to ground-truth mussel inventories, collect and analyze other bivalve species, and analyze data.

The same benefits that distinguished sessile shoreline bivalves for the national Mussel Watch program make them desirable as indicator species in Puget Sound. Their sessile and accessible nature make them easy to sample and because of this, sampling can be carried out by trained volunteers. We think the success of a large-scale expansion of Mussel Watch in Puget Sound will rely on developing a network of citizen scientists who could conduct sampling with supervision from Site Leads. This would reduce the number of full-time, paid Agency or professional staff from several to perhaps one or two. Such a Mussel Watch Program Manager or Principal Investigator would organize, coordinate and train volunteers, manage implementation logistics, analyze data, write reports and further develop the program. Sharing staff and resources with existing biota monitoring programs could reduce startup costs in terms of database design, sampling equipment, and experience, and increase overall efficiency.

We observed a wide range of interest and enthusiasm among volunteers, and there were often individuals who were knowledgeable regarding local conditions, shoreline habitats, ecology, and potential pollution sources. Many volunteers expressed a desire to help recover the Puget Sound,

as well as satisfaction from having participated in Mussel Watch activity. Establishing formal, predictable working relationships with a network of such volunteers would not only significantly increase the efficiency of a Mussel Watch program, but also help to fulfill the Partnership's goal of engaging the public and fostering citizen-science volunteers. In addition, a Mussel Watch volunteer network could serve other programs that may rely on citizen-scientists, such as oil spill preparedness and response, and monitoring for invasive aquatic species.

Coordination of citizen-science volunteers in this project relied on help and participation from local entities such as Marine Resource Committees, local research stations, and schools. The Snohomish County MRC has now supported a Mussel Watch expansion in that county for several years, which provided the expertise for our volunteer training, and which could be used as a model for participation from other MRCs. In addition, other Mussel Watch-type work has been conducted by groups in Puget Sound such as Environmental Investment (ENVVEST), a collaborative project between US-EPA, the Puget Sound Naval Shipyard, Washington Department of Ecology and local stakeholders, designed to meet local clean water objectives. A successful expansion of Mussel Watch would formally engage such potential collaborators for long-term participation.

As of this writing the funding model proposed by NOAA for Washington State Mussel Watch sampling involves NOAA continuing to pay for chemical and histopathological analyses of their existing 20 core Mussel Watch stations, while other sources (e.g., PSAMP) take on the cost of field collections for these 20 stations in Washington State, as well as field collections and chemical analysis of any added locations. Virtually any expanded Mussel Watch program in Washington would include adding a significant number of new sampling locations to cover obvious gaps in coverage, as the program evolves from its current ambient sampling design to one that addresses site- and time-specific regional needs. In addition, two analysis issues need to be addressed. Firstly a number of chemicals not currently monitored by Mussel Watch would need to be considered for Puget Sound, including brominated flame retardants, current-use pesticides, pharmaceuticals and personal care products. Secondly, turnaround time for chemical analyses is currently approximately one year. Such a time frame would probably be too long for the type of monitoring that might be proposed for the Puget Sound expansion, especially including compliance or effectiveness monitoring. Future discussions with NOAA should address this issue to determine whether this time can be shortened or other analytical labs could be considered to process samples.

Specific questions that might be addressed by an expanded Mussel Watch program for Puget Sound could include:

- What are the chemicals that nearshore biota are exposed to?
- What is the extent and magnitude of such exposure?
- Are there health effects to biota from such exposures?
- What is the timing of contaminant inputs to shoreline habitats?
- What are the major sources of contaminants to the nearshore and how do they vary in both time and space including:
    - stormwater outfalls
    - non-point runoff
    - wastewater treatment outfalls, and

- combined sewer overflows?

We anticipate the need for several workshops or meetings to gather potential partners and develop some of the ideas mentioned above. In particular, the Puget Sound Stormwater Work Group has identified Mussel Watch as a primary tool for assessing bioaccumulation toxicity of stormwater-related toxics, and has proposed implementation of monitoring at 30 new (as yet unnamed) locations that would be co-located with existing stormwater or other non point or point sources of pollution[3]. We need to coordinate with the Stormwater Work Group's proposal and with related efforts such as Ecology's Toxics Reduction Strategy and other existing monitoring and assessment programs (e.g., PSAMP and Snohomish County), to identify common goals and objectives. Existing state- or local-level Mussel Watch efforts (e.g., Snohomish County and ENVVEST) and California's programs including Southern California Coastal Water Research Project[4] and Surface Water Ambient Monitoring Program[5], could serve as models for Washington.

[3] http://www.ecy.wa.gov/programs/wq/psmonitoring/swworkgroup.html

[4] http://www.sccwrp.org/ResearchAreas/Contaminants/ContaminantsOfEmergingConcern/SouthernCaliforniaMusselWatch.aspx

[5] http://www.waterboards.ca.gov/water_issues/programs/swamp/mussel_watch.shtml

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Appendix A. Contaminants monitored in bivalve molluscs by NOAA's Mussel Watch and Snohomish County Mussel Watch programs, and in a number of fish and invertebrates by the Puget Sound Assessment and Monitoring Program's (PSAMP) Toxics in Biota Component

				PSAMP Multi-species	
Chemical Class	**Compound**	**NOAA Mussel Watch**	**Snohomish Co. Mussel Watch**	**Regular**	**Intermittent**
Low Molecular Weight PAHs (Polycyclic Aromatic Hydrocarbons)	Biphenyl	X	X		X
	1,6,7-Trimethylnaphthalene	X	X		X
	1-Methyl-9H-fluorene				X
	1-Methylnaphthalene	X	X		X
	1-Methylphenanthrene	X	X		X
	2,6-Dimethylnaphthalene	X	X		X
	2-Chloronaphthalene				X
	2-Methylnaphthalene	X	X		X
	2-Methylphenanthrene				X
	4,6-Dimethyldibenzothiophene				X
	9(H)-carbazole				X
	Acenaphthene	X	X		X
	Acenaphthylene	X	X		X
	Anthracene	X	X		X
	Benzothiophene		X		
	C1-Benzothiophene		X		
	C2-Benzothiophene		X		
	C3-Benzothiophene		X		
	Decalin		X		
	C1-Decalin		X		
	C2-Decalin		X		
	C3-Decalin		X		
	C4-Decalin		X		
	Dibenzothiophene		X		X
	C1-Dibenzothiophenes	X	X		X
	C2-Dibenzothiophenes	X	X		X
	C3-Dibenzothiophenes	X	X		X
	Fluorene	X	X		X
	C1-Fluorenes	X	X		X
	C2-Fluorenes	X	X		X
	C3-Fluorenes	X	X		X
	Naphthalene	X	X		X
	C1-Naphthalenes	X	X		X
	C2-Naphthalenes	X	X		X
	C3-Naphthalenes	X	X		X
	C4-Naphthalenes	X	X		X
	Naphthobenzothiophene		X		
	C1-Naphthobenzothiophene		X		
	C2-Naphthobenzothiophene		X		
	C3-Naphthobenzothiophene		X		
	C1-Phenanthrenes/Anthracenes	X	X		X
	C2-Phenanthrenes/Anthracenes	X	X		X
	C3-Phenanthrenes/Anthracenes	X	X		X
	C4-Phenanthrenes/Anthracenes	X	X		X
	Carbazole				X
	Dibenzofuran		X		X
	Phenanthrene	X	X		X
	Phenanthrene,3,6-dimethyl-				X
cont'd….					

				PSAMP Multi-species	
Chemical Class	Compound	NOAA Mussel Watch	Snohomish Co. Mussel Watch	Regular	Intermittent
High Molecular Weight PAHs (Polycyclic Aromatic Hydrocarbons)	2-Methylfluoranthene				X
	Benzo(a)anthracene	X	X		X
	Benzo(a)pyrene	X	X		X
	Benzo(b)fluoranthene	X	X		X
	Benzo(e)pyrene	X	X		X
	Benzo(g,h,i)perylene	X	X		X
	Benzo(k)fluoranthene	X	X		X
	fluoranthene	X	X		X
	C1-Fluoranthene/Pyrene	X	X		X
	C2-Fluoranthene/Pyrene		X		
	C3-Fluoranthene/Pyrene		X		
	Chrysene	X	X		X
	C1-Chrysenes	X	X		X
	C2-Chrysenes	X	X		X
	C3-Chrysenes	X	X		X
	C4-Chrysenes	X	X		X
	Dibenzo(a,h)anthracene	X	X		X
	C1-Dibenzo(a,h)anthracene		X		
	C2-Dibenzo(a,h)anthracene		X		
	C3-Dibenzo(a,h)anthracene		X		
	indeno(1,2,3-c,d)pyrene	X	X		X
	Perylene	X	X		X
	Pyrene	X	X		X
	Retene				X
PAH metabolites	benzo(a)pyrene_FAC			X	
	naphthalene_FAC			X	
	phenanthrene_FAC			X	
DDTs	2,4'-DDD	X	X	X	
	2,4'-DDE	X	X	X	
	2,4'-DDT	X	X	X	
	4,4'-DDD	X	X	X	
	4,4'DDE	X	X	X	
	4,4'-DDT	X	X	X	
Butyltins	Monobutyltin trichloride	X	X		X
	Dibutyltin dichloride	X	X		X
	Tributyltin chloride	X	X		X
	Tetrabutyltin	X	X		X
Chlordanes	α-Chlordane	X	X	X	
	γ-Chlordane	X	X	X	
	cis-Chlordane	X			
	trans-Chlordane				X
	Heptachlor	X	X	X	
	Heptachlor-Epoxide	X	X	X	
	cis-Nonachlor		X		X
	trans-Nonachlor	X	X	X	
	Nonachlor III			X	
HCHs	α-HCH (hexachlorocyclohexane)		X	X	
	β-HCH (hexachlorocyclohexane)		X	X	
	δ-HCH (hexachlorocyclohexane)		X	X	
	γ-HCH (Lindane)	X	X	X	
Benzenes	1,2-dichlorobenzene			X	
	1,2,4-trichlorobenzene			X	
	1,3-dichlorobenzene			X	
	1,4-dichlorobenzene			X	
	1,2,3,4-tetrachlorbenzene		X		X
	1,2,3,5/1,2,4,5-tetrachlorbenzene				X
	1,2,4,5-tetrachlorbenzene		X		
	pentachlorbenzene				X
	hexachlorbenzene	X	X	X	X

				PSAMP Multi-species	
Chemical Class	**Compound**	**NOAA Mussel Watch**	**Snohomish Co. Mussel Watch**	**Regular**	**Intermittent**
Endosulfans	α-endosulfan		X	X	
	β-endosulfan		X	X	
	endosulfan sulfate		X	X	
Dieldrin-related compounds	Dieldrin	X	X	X	
	Aldrin	X	X	X	
	Endrin	X	X		
	Endrin aldehyde				X
	Endrin ketone				X
Other Organo-chlorine Pesticides	Mirex	X	X	X	
	Toxaphene			X	
	Methoxychlor			X	
	Oxychlordane		X	X	
	Octachlorostyrene				X
	Chlorpyrifos		X		
	Pentachlorobenzene		X		
	Pentachloroanisole		X		
Metals & Metalloids	Aluminum (Al)	X	X		
	Antimony (Sb)	X			
	Arsenic (As) (total)	X	X	X	
	Cadmium (Cd)	X	X		X
	Chromium (Cr)	X	X		
	Copper (Cu)	X	X	X	
	Iron (Fe)	X	X		
	Lead (Pb)	X	X	X	
	Manganese (Mn)	X	X		
	Mercury (Hg)(total)	X	X	X	
	Monomethylmercury				X
	Nickel (Ni)	X	X		
	Selenium (Se)	X	X		X
	Silicon (Si)	X			
	Silver (Ag)	X	X		
	Thallium (Tl)	X			
	Tin (Sn)	X	X		X
	Zinc (Zn)	X	X		
Polychlorinated biphenyls (PCBs)	PCB 001				
	PCB 002				
	PCB 003				
	PCB 004				X
	PCB 005				
	PCB 005/008		X		X
	PCB 006				X
	PCB 007				
	PCB 007/009				X
	PCB 008				
	PCB 008/005	X			
	PCB 009				
	PCB 010				X
	PCB 011				X
	PCB 012/013				X
	PCB 014				X
	PCB 015				X
	PCB 016				
	PCB 016/032				X
	PCB 017			X	X
	PCB 018	X	X	X	X
	PCB 018/030				
	PCB 019				X
	PCB 020				X
	PCB 020/028				

				PSAMP Multi-species	
Chemical Class	Compound	NOAA Mussel Watch	Snohomish Co. Mussel Watch	Regular	Intermittent
	PCB 021				X
	PCB 021/033				
	PCB 022				X
	PCB 023				
	PCB 023/024				X
	PCB 024				X
	PCB 025				X
	PCB 026				X
	PCB 026/029				
	PCB 027				X
	PCB 028	X	X	X	X
	PCB 029		X		X
	PCB 030				X
	PCB 031		X	X	X
	PCB 032				
	PCB 033			X	X
	PCB 034				
	PCB 035				X
	PCB 036				X
	PCB 037				X
	PCB 038				X
	PCB 039				X
	PCB 040				X
	PCB 040/041/071				
	PCB 041				X
	PCB 042				
	PCB 042/068				X
	PCB 043				
	PCB 043/049				X
	PCB 044	X	X	X	X
	PCB 044/047/065				
	PCB 045		X		X
	PCB 045/051				
	PCB 046				X
	PCB 047/048/075				X
	PCB 048				
	PCB 049		X	X	
	PCB 049/069				
	PCB 050				X
	PCB 050/053				
	PCB 051				X
	PCB 052	X	X	X	X
	PCB 053				X
	PCB 054				X
	PCB 055				X
	PCB 056				X
	PCB 056/60		X		
	PCB 057				X
	PCB 058				X
	PCB 059				X
	PCB 059/062/075				
	PCB 060				X
	PCB 061				X
	PCB 061/070/074/076				
	PCB 062				X
	PCB 063				X
	PCB 064				
	PCB 064/071				X
	PCB 065				X

				PSAMP Multi-species	
Chemical Class	Compound	NOAA Mussel Watch	Snohomish Co. Mussel Watch	Regular	Intermittent
	PCB 066	X	X	X	X
	PCB 067				X
	PCB 068				X
	PCB 069				X
	PCB 070		X	X	
	PCB 070/076				X
	PCB 072				X
	PCB 073				X
	PCB 074			X	X
	PCB 074/61		X		
	PCB 077	X			X
	PCB 078				X
	PCB 079				X
	PCB 080				X
	PCB 081				X
	PCB 082			X	X
	PCB 083				X
	PCB 083/099				
	PCB 084				X
	PCB 085				X
	PCB 085/116/117				
	PCB 086/097				X
	PCB 086/087/097/108/119/125				
	PCB 087			X	X
	PCB 087/115		X		
	PCB 088				X
	PCB 088/091				
	PCB 089				X
	PCB 090				X
	PCB 090/101/113				
	PBC 091				X
	PCB 092				X
	PCB 093				X
	PCB 093/095/098/100/102				
	PCB 094				X
	PCB 095		X	X	X
	PCB 096				X
	PCB 098/102				X
	PCB 099		X	X	X
	PCB 100				X
	PCB 101			X	X
	PCB 101/090	X	X		
	PCB 103				X
	PCB 104				X
	PCB 105	X	X	X	X
	PCB 106				X
	PCB 107/108				X
	PCB 107/124				
	PCB 109				X
	PCB 110			X	X
	PCB 110/115				
	PCB 110/77		X		
	PCB 111				
	PCB 111/115				X
	PCB 112				X
	PCB 113				X
	PCB 114				X
	PCB 116/117				X
	PCB 118	X	X	X	X

				PSAMP Multi-species	
Chemical Class	Compound	NOAA Mussel Watch	Snohomish Co. Mussel Watch	Regular	Intermittent
	PCB 119				X
	PCB 120				X
	PCB 121				X
	PCB 122				X
	PCB 123				X
	PCB 124				X
	PCB 125				X
	PCB 126	X			X
	PCB 127				X
	PCB 128	X	X	X	X
	PCB 128/166				
	PCB 129				X
	PCB 129/138/160/163				
	PCB 130				X
	PCB 131				
	PCB 131/142				X
	PCB 132				X
	PCB 133				X
	PCB 134/143				X
	PCB 135				X
	PCB 135/151/154				
	PCB 136				X
	PCB 137				X
	PCB 138	X		X	
	PCB 138/160		X		
	PCB 138/163/164				X
	PCB 139				X
	PCB 139/140				
	PCB 140				X
	PCB 141				X
	PCB 142				
	PCB 144				X
	PCB 145				X
	PCB 146		X		X
	PCB 147				X
	PCB 147/149				
	PCB 148				X
	PCB 149			X	X
	PCB 149/123		X		
	PCB 150				X
	PCB 151		X	X	X
	PCB 152				X
	PCB 153			X	X
	PCB 153/132		X		
	PCB 153/168				
	PCB 153/132/168	X			
	PCB 154				X
	PCB 155				X
	PCB 156			X	X
	PCB 156/157				
	PCB 156/171/202		X		
	PCB 157				X
	PCB 158		X	X	
	PCB 158/160				X
	PCB 159				X
	PCB 161				X
	PCB 162				X
	PCB 164				
	PCB 165				X

				PSAMP Multi-species	
Chemical Class	**Compound**	**NOAA Mussel Watch**	**Snohomish Co. Mussel Watch**	**Regular**	**Intermittent**
	PCB 166				X
	PCB 167				X
	PCB 168				X
	PCB 169				X
	PCB 170			X	
	PCB 170/190	X	X		X
	PCB 170/194				
	PCB 171			X	X
	PCB 171/173				
	PCB 172				
	PCB 172/192				X
	PCB 173				X
	PCB 174		X		X
	PCB 175				X
	PCB 176				X
	PCB 177			X	X
	PCB 178				X
	PCB 179				X
	PCB 180	X	X	X	X
	PCB 180/193				
	PCB 181				X
	PCB 182				X
	PCB 183		X	X	X
	PCB 183/185				
	PCB 184				X
	PCB 185				X
	PCB 186				X
	PCB 187	X	X	X	X
	PCB 189				X
	PCB 190				
	PCB 191			X	X
	PCB 193				X
	PCB 194		X	X	X
	PCB 195			X	X
	PCB 195/208	X	X		
	PCB 196/203				X
	PCB 197				X
	PCB 198				X
	PCB 199			X	X
	PCB 200				X
	PCB 201				X
	PCB 201/157/173		X		
	PCB 202				X
	PCB 204				X
	PCB 205			X	X
	PCB 206	X	X	X	X
	PCB 207				X
	PCB 208			X	X
	PCB 209	X	X	X	X
cont'd….					

				PSAMP Multi-species	
Chemical Class	Compound	NOAA Mussel Watch	Snohomish Co. Mussel Watch	Regular	Intermittent
Polybrominated diphenyl ethers (PBDE)s	PBDE 001	X*			
	PBDE 002	X*			
	PBDE 003	X*			
	PBDE 007	X*			X
	PBDE 008	X*			
	PBDE 008/011				X
	PBDE 010	X*			X
	PBDE 011	X*			
	PBDE 012	X*			X
	PBDE 012/013				
	PBDE 013	X*			X
	PBDE 015	X*			X
	PBDE 017	X*			X
	PBDE 017/025				
	PBDE 025	X*			X
	PBDE 028	X*		X	
	PBDE 028/033				X
	PBDE 030	X*			X
	PBDE 032	X*			X
	PBDE 033	X*			
	PBDE 035	X*			X
	PBDE 037	X*			X
	PBDE 047	X*		X	X
	PBDE 049	X*		X	X
	PBDE 051				
	PBDE 066	X*		X	X
	PBDE 071				X
	PBDE 075	X*			X
	PBDE 077	X*			X
	PBDE 079				
	PBDE 085	X*		X	X
	PBDE 099	X*		X	X
	PBDE 100	X*		X	X
	PBDE 105				X
	PBDE 116	X*			X
	PBDE 118	X*			
	PBDE 119	X*			X
	PBDE 119/120				
	PBDE 126	X*			
	PBDE 128				
	PBDE 138	X*			
	PBDE 138/166				X
	PBDE 139				X
	PBDE 140				X
	PBDE 153	X*		X	X
	PBDE 154	X*		X	X
	PBDE 155	X*			X
	PBDE 156/169				X
	PBDE 166	X*			
	PBDE 180				X
	PBDE 181	X*			X
	PBDE 183	X*		X	X
	PBDE 184				X
	PBDE 190	X*			
	PBDE 190/171				X
	PBDE 191				X
	PBDE 194				X
	PBDE 195				X
	PBDE 196				X

				PSAMP Multi-species	
Chemical Class	**Compound**	**NOAA Mussel Watch**	**Snohomish Co. Mussel Watch**	**Regular**	**Intermittent**
	PBDE 200/203/198				X
	PBDE 201				X
	PBDE 202				X
	PBDE 203				
	PBDE 204/197/199				X
	PBDE 205				X
	PBDE 206				X
	PBDE 207				X
	PBDE 208				X
	PBDE 209				X
X* - measured only in samples from 1996 and 2004-2007					

Appendix B. Overview of Training Documents

Washington Mussel Watch training documents include:

- *Washington State Mussel Watch Program Training Manual*
- *Washington State Mussel Watch Program Site Lead Supplemental*
- *Washington State Mussel Watch Program Background and Results training presentation*

The *Washington State Mussel Watch Program Training Manual* was customized for each volunteer training session to include information specific to the local MW sample site(s) and local site descriptions. A template of this training manual is included here. A complete training manual, with information for all Washington MW sites is available upon request.

Similarly, the Washington State Mussel Watch Program Background and Results training presentation was customized for each volunteer training session to include information and results most specific to the local MW sampling locations. A template training presentation is included here. The full suite of slides is available upon request.

In future years, all MW training documents should be updated to incorporate data and information from the most recent sampling effort, and current contact information for MW staff and volunteer groups.

WASHINGTON STATE MUSSEL WATCH PROGRAM TRAINING

Volunteer Site Lead Organization

Date of Training

SNOHOMISH COUNTY MARINE RESOURCES COMMITTEE

PugetSoundPartnership
our sound, our community, our chance

Sea Grant Washington

NOAA
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Washington Department of FISH and WILDLIFE

Table of Contents

Volunteer Information

Dear Volunteer,

Thank you so much for your interest and commitment as a volunteer for the Mussel Watch Program! You are here at an exciting time, as we move a nationally-led program to state responsibility, and incorporate citizen science as a vital component of our sampling efforts, where YOU, the volunteer, are CRUCIAL!

As a volunteer, we consider you a highly valued and important member of our Mussel Watch Program Team. Volunteers are essential in the success of the sampling efforts all across the state. As a member of our team, we ask you to be completely invested in this "discovery" phase, where we ourselves are working out the uncertainties, and "kinks" inherent in developing new programs. We ask for your help in seeking out local knowledge of the sites, request that you remain consistent with the protocols, and encourage your patience when the unexpected arises. We are counting on you to provide honest feedback so we can continue to improve this program in the future.

Included in this training packet is all the information you will need to be successful in this program. The training today will cover topics such as the history of the Mussel Watch Program, local Washington State data findings, as well as the sampling procedures and protocols, and important contact information.

We hope you enjoy your experience working with the Mussel Watch Program!

Thank you, again, for all your hard work!

Sincerely,

Amy Johnson
Mussel Watch Training Coordinator

Jennifer Lanksbury
Washington Department of Fish and Wildlife
Mussel Watch Project Leader

Kathleen Herrman
Snohomish County Mussel Watch Project Leader

Andrea Hennings
Snohomish County Mussel Watch Project Assistant

Jim West
Research Scientist, Washington Department of Fish and Wildlife

Kate Litle
Citizen Science Specialist, Washington Sea Grant

Introduction and Background

The National Mussel Watch Program is the longest continuous contaminant program in the United States coastal waters. The program, which is within the National Status and Trends Program of the National Oceanic and Atmospheric Administration (NOAA), has been in existence since 1986. At more than 300 sites, Mussel Watch utilizes mussels and oysters to "monitor spatial distributions and temporal trends of chemical concentrations in coastal and estuarine regions of the US," (O'Conner & Lauenstein, 2006, pg. 2).

Bivalve mollusks feed by filtering large amounts of water and are valuable indicators of contaminants in marine ecosystems. Their tissues metabolize the contaminants within 30 days, providing researchers with a snapshot of water quality during recent exposures. Although widely distributed, there is no single species of mollusk found in all coastal waters of the United States; on the west coast, *Mytilus edulis* (blue mussel), and *Mytilus californianus* (California sea mussel, rock mussel, big mussel) are used for Mussel Watch.

During the winter sampling season volunteers collect mussels in the field at low-tide. The samples are then shipped to the Rutgers Haskin Shellfish Laboratory for assessment of disease and/or parasites (histology analysis) and determination of reproductive status (gonadal indexing to determine the stage of egg and sperm development), and to B&B Laboratories for chemical analysis.

The chemical analysis of mussel soft tissue includes assays for over 100 chemical contaminants, including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, persistent organic pollutants (POPs), and trace metals. Concentrations of these chemicals, increased by human activity, pose a risk to human health and wildlife. Contaminant sources include point sources (wastewater treatment plants, industry), surface water run-off, spills, historical input and atmospheric deposition.

Throughout the United States the concentrations of some of these chemicals have shown decreasing trends (particularly for banned chemicals such as DDT, etc). However, at some sites high concentrations of specific chemicals indicate potential hot spots that remain areas of interest. Continual monitoring of chemical contaminants at these sites is necessary to detect spatial and temporal trends, and identify areas of concern.

There are 26 National Mussel Watch sites in Washington, surveyed biennially during the winter season. Of these national program sites, Snohomish County Marine Resource Committee (MRC) volunteers, with the assistance of the Stillaguamish and Tulalip Tribes, are responsible for surveying eight sites in Snohomish County and one site in Island County. The Snohomich County MRC sites are surveyed twice a year, during the winter (wet) and summer (dry) seasons.

Based on the success of the Snohomish County MRC citizen science model, a statewide group has teamed up to replicate this program throughout the State of Washington, beginning in winter 2009-2010. This leadership team includes Snohomish County, Washington Sea Grant, and Washington Department of Fish and Wildlife, with funding provided by the Puget Sound Partnership. This collaborative partnership is working to provide the training and materials to local volunteers to continue the Mussel Watch sampling through volunteer efforts.

Local volunteer organizations include the Feiro Marine Life Center, Olympic Coast National Marine Sanctuary, Port Townsend Marine Science Center, Seattle Aquarium, the Grays Harbor County, Pacific County, Snohomish County, and Whatcom County Marine Resource Committees, the Stillaguamish Tribe, and the Tulalip Tribes. Plans for expanding the Mussel Watch Program in Washington State are currently being explored.

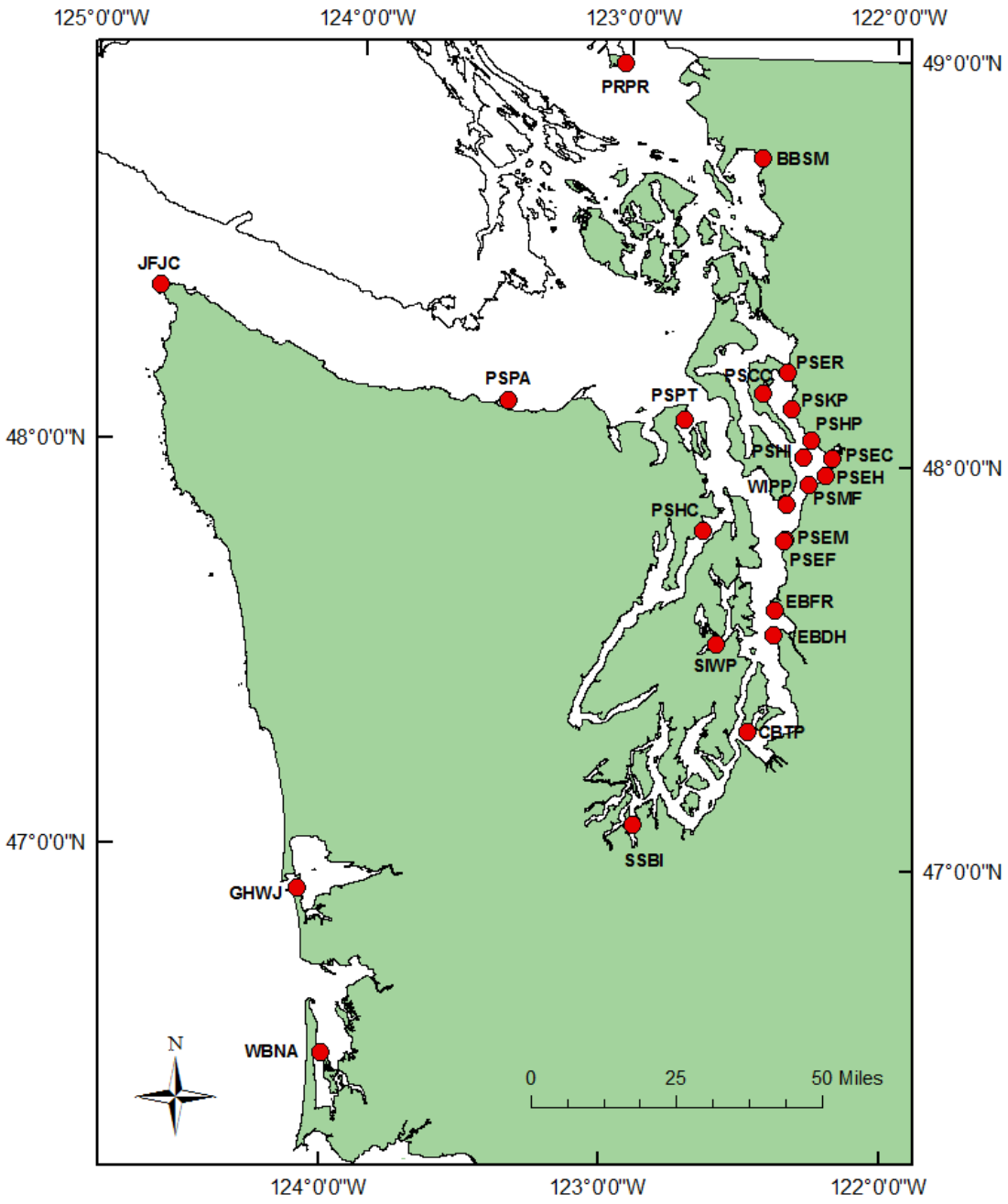
For more information about the National Mussel Watch program and results to date, please see the following publications:

Kimbrough, K.L., W.E. Johnson, G.G. Lauenstein, J.D. Christensen and D.A. Apeti. 2009. An Assessment of Polybrominated Diphenyl Ethers (PBDEs) in Sediments and Bivalves of the U.S. Coastal Zone. Silver Spring, MD. NOAA Technical Memorandum NOS NCCOS 94. 97 pp.

Kimbrough, K.L., W.E. Johnson, G.G. Lauenstein, J.D. Christensen and D.A. Apeti. 2008. An Assessment of Two Decades of Contaminant Monitoring in the Nation's Coastal Zone. Silver Spring, MD. NOAA Technical Memorandum NOS NCCOS 74. 105 pp.

O'Connor, T.P. and G.G. Lauenstein. 2006. Trends in chemical concentrations in mussels and oysters collected along the US coast: Update to 2003. Marine Environmental Research, 62, 261-285. http://www8.nos.noaa.gov/cit/nsandt/download/mw_monitoring.aspx

Washington State Mussel Watch Sites 2009-2010



Local Site Descriptions

In this section, include the site descriptions for each site the volunteer organization will be responsible for. Include pictures and maps for visual reference.

Mussel Watch Program Sampling Supplies

Sampling Supply List for ONE SITE:

General Site Materials

- Directions to Site Center and Contacts list
- Flashlights and/or headlamps
- Propane lantern(s), propane, and matches (useful, but optional)
- 1 GPS unit
- Cell phone(s)

Mussel Sampling Materials

- 3 plastic containers or buckets (for washing mussels in)
- 1 small cooler with ice (to carry collected mussels)
- 3 scrub brushes
- 3 knives (preferably curved)
- 1 bag medium disposable laboratory gloves (nitrile or latex)
- 1 bag large disposable laboratory gloves (nitrile or latex)
- Glove liners or knit gloves (worn under laboratory gloves to keep hands warm)

Mussel Bagging Materials

- 3 1-quart pre-labeled Ziploc bags (1 for each Station – histology)
- 7 1-gallon pre-labeled Ziploc bags (3 *double bags* for each Station - chemistry; 1 to contain all 3 histology quart bags)
- 6 bag tags* (3 for chemistry; 3 for histology – one tag to be placed *inside* each sample bag containing mussels)
- 1 garbage bag

Water Quality Materials

- 1 refractometer
- 1 thermometer

Documentation and Recording Materials

- 1 clipboard

- Data sheets*
- Pencils
- Sharpies (for labeling bags)
- 1 digital camera (helpful if waterproof)
- Volunteer forms (must be on file before volunteers can participate)

Miscellaneous Materials

- Extra bags, gloves, pens and pencils, and batteries
- Paper towels
- Life jackets (if sampling in dangerous area)

Shipping Supplies

- 16 qt Cooler (for shipping histology mussels to Rutgers Haskin Shellfish Lab)
- 28 qt Cooler (for shipping chemistry mussels to B&B Laboratories)
- 48 qt Cooler (for holding mussels overnight or weekend)
- Ice
- Chain-of-Custody forms (one for each cooler)
- FedEx Priority Overnight mailing labels (prefilled out, WDFW tracking number noted)
- Nylon reinforced packing tape
- Directions for packing & shipping mussels

* NOTE: <u>All bag tags and data sheets must be printed on Rite-in-the-Rain paper. You must use a pencil on Rite-in-the-Rain paper—pen will run and become illegible if the paper gets wet.</u>

Mussel Watch Program Sampling Protocol

Overview

On the sampling day, volunteers will meet at their assigned site to begin sampling. Sampling generally takes about two hours, and begins at the time in which the tide is low enough for mussel access. This will differ depending on the site location.

Safety Information

Field work, particularly in coastal environments, has an inherent risk of danger and can often be unpredictable. It is essential that you exercise due caution whenever you are conducting field sampling. Here are some safety guidelines to follow:

- Do not sample alone. Use a minimum of two people; more is preferable.
- Wear appropriate clothing for thermal and water protection.
- Be alert to breaking waves; wear a life jacket if appropriate.
- Avoid falls; wet rocks and logs are slippery.
- Wear gloves: protect hands from cuts and samples from contamination.

Field teams should use good judgment and not risk their personal safety when conditions pose undue risk - abandon the site and return when conditions improve.

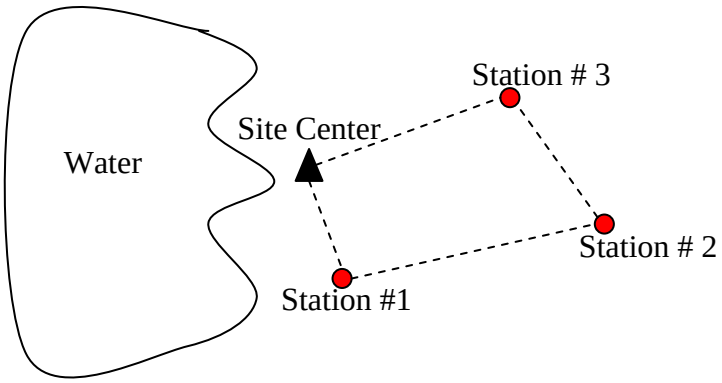
Sampling Methods

1) Find the established Site Center as indicated in the Local Site Description using a GPS unit:

a) Record the latitude and longitude at the Site Center, or as close as you can get to it (may be offshore a bit).
b) Record the date, time of arrival, weather conditions, and mussel watch collectors and data recorder on data sheet.
c) Collect water temperature using a thermometer and salinity data using a refractometer as near to the Site Center as possible at an approximate depth of one foot.
d) Record site conditions and description, noting any sources of contamination, on back of data sheet.
e) Record any additional observations, notes or comments in the space provided.
f) Take photos of the Site Center.

2) Establish three distinct Stations for mussel collection around, or to either side, of the Site Center:

a) Site Center can serve as Station #1 if mussels are available there.
b) Try spacing stations between 25 – 250 meters (82 – 820 feet) from one another, if possible.
c) If no mussels are found near the Site Center then search for mussels can proceed up to 800 meters (~ 3000 feet or ½ mile) from the Site Center in either direction, as long as the habitat remains consistent:
    - IMPORTANT: The search for mussels should stop if the habitat characteristics change significantly from the Site Center. <u>Do not proceed onto substantially different substrates or environments (e.g., if the Site Center is in marina, do not leave the marina, and vice versa).</u>
      Feel free to call sampling contacts if unsure.



NOTE: If it is not possible to delimit three separate stations (i.e., not enough mussels)* then collection can be spread out along the shoreline:

- Clearly note change in sampling technique on data sheet.
- Note latitude and longitude of starting and ending points of the line sampled (see Step #3 below).
- Mussels should still be separated into the three Station bags (see Step #4 below) based on relative spatial distance, to avoid sampling a single non-representative "clump", by following along the shoreline and filling bags (see figure below).

***Only choose this option if absolutely necessary.**

3) At each Station:

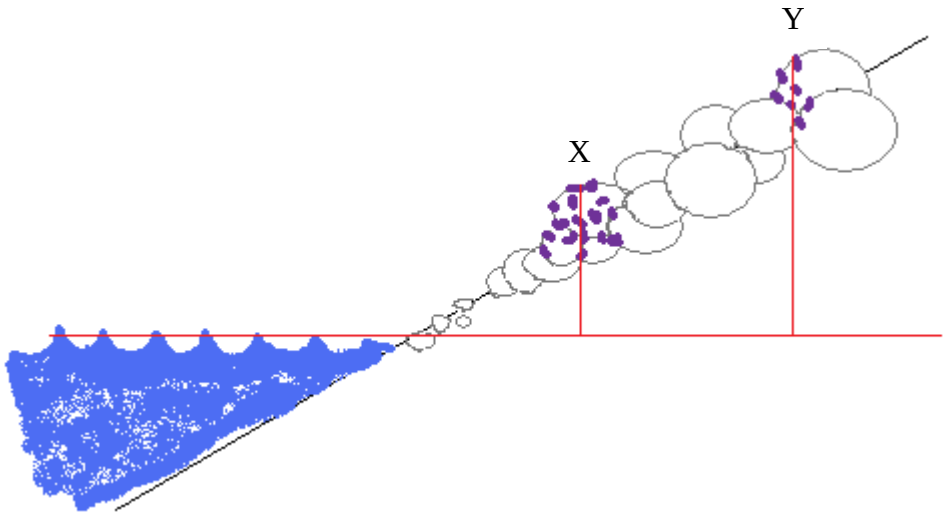
a) Record GPS coordinates and start time.

b) Write a description of the Station, including, for instance, its location relative to the Site Center or other landscape features, and the type of intertidal habitat in that area.

c) Describe the substrate to which mussels are attached (e.g., boulder, cement, pilings, sand, cobble, etc). *Be as descriptive as possible.*

- **Note: DO NOT collect from creosote-treated wood.**

d) Estimate and record the height of mussels collected, relative to the height of seawater at the time of collection ("Height of Collection" on the data sheet) and the highest overall distribution of mussels available, even if none are collected there ("Highest Distribution of Mussels" on the data sheet). See figure below. (Note: the Height of Collection and Highest Distribution of Mussels may be the same if you are collecting mussels from the highest area in which they occur.)



X = Height of Collection (where you are sampling)
Y = Highest Distribution of Mussels (further up the shore)

e) Take photos of the Station, its surroundings, and the substrate.

f) Collect mussels.

4) To collect mussels:

a) ALWAYS wear disposable laboratory gloves when handling mussels, bags, and bag tags.

b) At each Station mussels need to be collected and placed into two (2) different bags for the two (2) separate analyses:

1. Use pre-labeled **gallon** Ziploc bags for mussels for **chemical analysis. At each Station, collect between 60 – 140 mussels,** depending on size.

- 2 inch – 3 inch long mussels (ideal size): collect 60 mussels
- ½ inch – 2 inch mussels: collect 100 – 120 mussels
- Less than ½ inch mussels: collect 140 mussels

2. Use pre-labeled **quart** Ziploc bags for mussels for **histology analysis**. **At each station collect exactly 20 mussels**, independent of size.

Be sure to use the appropriately labeled bag for collections at each station. All Ziploc bags should have WA Mussel Watch, the Site Name and Acronym, the Date, and Station # written on the outside with a Sharpie. The appropriate Rite-in-the-Rain bag tag should be placed inside each bag.

c) To collect mussels cut their byssal threads (do not tear off substrate), brush off sediment and rinse in a bucket of marine water collected near each Station.
   - Be sure to change bucket of seawater between Stations.

d) Double bag the mussels to prevent ice melt leakage from contacting the mussels.
   - Each gallon Ziplock bag with mussels goes into another gallon bag – so chemistry bag from each Station gets double bagged by itself.
   - All three quart Ziplock bags go into a single gallon bag – so histology bags from all three Stations get double bagged *together* into one gallon bag.
   - Place ALL sealed bags into a plastic garbage bag and immediately place on ice in a cooler. **Remember to always use gloves when handling mussels, labels, and bags.**

5) After sampling is complete, record the time on the data sheet ("Time Leave").

6) Be sure to note on the Chain-of-Custody form if the final collection of mussels changes hands between collection and shipping (i.e. if someone other than Site Lead keeps the mussels overnight before shipping).

7) Package the samples in two separate coolers for shipping to B&B Laboratories (chemistry) and Rutgers Haskin Shellfish Lab (histology):

a) If necessary, samples can be placed in a refrigerator on ice overnight(s) – **Do not allow samples to freeze!** Mussels must arrive alive at the laboratories.

b) Ship coolers via FedEx *Priority Overnight* as soon as possible; they will arrive the next business day.
   - Avoid shipping to arrive on a weekend - if sampling on a Friday or Saturday, hold mussels on ice until Monday morning.

c) See below for illustrated directions on packing mussel samples for shipping - note that a *copy* of the MW datasheet and the *original* Chain-of-Custody form go in a Ziploc bag at the top of the cooler:

1) Place a layer of bagged ice into the bottom of the cooler.

2) Place bagged mussel samples on top of the ice layer.

3) Continue alternating bags of mussels with bags of ice, filling the voids with remaining ice. Place a *copy* of the MW datasheet and the *original* Chain-of-Custody form into a Ziplock bag at the top of the cooler.

4) Attach the FedEx packing label to the top of the cooler using sticker backing. Use at least two bands of nylon fiber tape to secure sides of label and seal cooler (yellow arrow). Wrap bands of clear tape around the lip of the cooler (helps seal in coldness) as well as around its width.

Important Contacts

Questions during sampling? - Call in this order:

- 1st – Jennifer Lanksbury (WDFW staff): (253) 312-1119 (cell)
- 2nd – Jim West (WDFW staff): (206) 718-4787 (cell)
- 3rd – NS&T Mussel Watch Program, 24/7 Field Crew Cell Phone: (240) 687-3075

NOAA Contacts

- Dennis Apeti, PhD., NOAA Mussel Watch Program, (301) 713-3028; dennis.apeti@noaa.gov
- Ed Johnson, PhD., NOAA Mussel Watch Program, (301) 713-3028; ed.johnson@noaa.gov
- Kimani Kimbrough, PhD., NOAA Mussel Watch Program, (301) 713-3028; kimani.kimbrough@noaa.gov

Volunteer Organization Contact

- Enter the local volunteer site lead organization's contact information here.

Training/Regional Program Contacts

- Amy Johnson, Training Coordinator, (425) 780-9351; psamyhj@gmail.com
- Jennifer Lanksbury, WA Dept. of Fish & Wildlife, (360) 902-2820 (wk); (253) 312-1119 (cell), jennifer.lanksbury@dfw.wa.gov
- Kathleen Herrmann, Snohomish County MRC, (425) 388-6414 (wk); (425) 754-5731 (cell) kathleen.herrmann@co.snohomish.wa.us
- Andrea Hennings, Snohomish County MRC, (425) 388-3464x4573; andrea.hennings@co.snohomish.wa.us

Glossary

Assay - a procedure for testing and/or measuring the amount of a substance, such as a contaminant, in an organism or organic sample.

Chain-of-Custody Form - documentation of custody and transfer of samples. After mussel collection, this form should be filled out and signed when the mussels change hands. The *original* Chain-of-Custody form should be included in the cooler when the mussels are sent to the labs for processing, as the receiving labs will be the last group to sign these forms.

Gonadal Index - a measure of sperm and egg development. This analysis is performed by the Rutgers Haskin Shellfish Laboratory and allows the National Mussel Watch program to determine whether mussels were in pre- or post-spawning (reproductive) state when they were collected. This determination is essential to ensure accurate interpretation of mussel contaminant results, as mussels "dump" contaminants into their sperm and eggs and are thus expected to have lower contaminant levels after spawning.

Height of Collection - height above water level (at time of collection) where mussels are actually collected. This measurement is made at each Station and may vary between Stations.

Highest Distribution of Mussels - height above water level (at time of collection) of the highest distribution of mussels at each Station. *(Comparison of the above two values gives the National Mussel Watch program an estimate of where within the intertidal zone mussels were collected.)*

Histology Analysis - analysis of mussel soft tissue to assess disease and the presence of parasites.

MLLW - mean lower-low water

Persistent Organic Pollutants (POPs) - organic compounds that are resistant to environmental degradation. POPs are sometimes used in pesticides, industrial processes, and the production of some solvents, pharmaceuticals, and other goods. Because they do not degrade, POPs bioaccumulate in animal tissues and can increase in concentration up the food chain. Health concerns from exposure to POPs include the

disruption of endocrine, reproductive, and immune systems, neurological problems, and cancers.

Polycyclic Aromatic Hydrocarbons (PAHs) - chemical compounds that occur in oil, coal, and tar deposits and are also formed by the incomplete combustion of carbon-containing fuels (e.g., wood, oil, coal, etc.). PAHs are known to be carcinogenic (cancer-causing).

Polychlorinated Biphenyles (PCBs) - a specific type of POP historically used as a coolant, in pesticides, in industrial process fluids and oils, and in paints and adhesives. PCB production was banned in the U.S. in 1976 and internationally through a convention in 2001. Despite the end to production more than 30 years ago, PCBs are still present in the environment.

Refractometer – an instrument used to measure the concentration or refractive index of liquids. It measures how much the speed of light is reduced when it passes through a liquid (in this case, seawater) and projects the result onto a salinity scale set to read in parts per thousand ($^0/_{00}$, ppt). (Seawater typically measures around 35 ppt, which is roughly equivalent to 35 pounds of salt per 1,000 pounds of seawater.)

Site Center - the designated site location as provided by the National Mussel Watch program in the Local Site Description. The Site Center location will be given in Degrees : Decimal Minutes.

Station - the specific location(s) of mussel collections at each Site. Mussels are collected at three (3) Stations near the Site Center. Stations should be spaced between 25 - 250 meters (82 - 820 feet) apart. Mussels are collected at three separate Stations to spread out collections and avoid sampling a single, non-representative "clump" of mussels at any Site.

Trace Metals - metals such as iron, magnesium, lithium, zinc, copper, chromium, nickel, cobalt, arsenic, and selenium, which are typically present in the environment in extremely small quantities.

WASHINGTON STATE

MUSSEL WATCH PROGRAM TRAINING

Site Lead Supplemental

Volunteer Site Lead Organization

Date of Training

Table of Contents

Partner Organizations

As we begin to transfer the Mussel Watch Program for Washington State from a federally-implemented program, to a state citizen science program, your participation is crucial. We cannot thank you enough for the time and effort you are investing in coordinating regional sampling. This project would not be possible without the assistance of all partners:

- National Oceanic and Atmospheric Administration
- Washington Department of Fish and Wildlife
- Puget Sound Partnership
- Snohomish County Marine Resources Committee
- Stillaguamish Tribe
- Tulalip Tribes
- Washington Sea Grant
- Feiro Marine Life Center
- Grays Harbor County Marine Resources Committee
- Olympic Coast National Marine Sanctuary
- Pacific County Marine Resources Committee
- Port Townsend Marine Science Center
- Seattle Aquarium
- Whatcom County Marine Resources Committee

Volunteers

Volunteer Waiver Forms

All volunteers, as well as volunteer site leads, are considered to be volunteering for Washington Department of Fish and Wildlife. This eliminates the need for a scientific collection permit for each site, but it does mean the volunteers need a waiver form on file. Waiver forms should be sent to Jennifer Lanksbury, at WDFW – see address in contacts list.

Training

As with any volunteer management and citizen science program, training for volunteers is essential to maintain accuracy and consistency for collection methods. Each new volunteer should receive proper training, both in field and in classroom, while former volunteers should simply get a refresher of methods. Initial training will be provided as part of this workshop, but any future volunteers will need to be trained by you. This training packet can be used as a model for your own training sessions.

Coordinating

In order to ensure efficient collection, there is a limit on the number of volunteers needed at a Site. For land-based Sites, volunteer numbers should be limited to seven individuals, including the Site Lead. If there is space, additional volunteers can join for passive observations and photo documentation. If the Site can be accessed only by boat, or is space-limited for other reasons, the number of volunteers should not exceed 4-5 individuals.

Generally, logistics work well with two volunteers at each sampling Station (there are three Stations per Site), with one overall data recorder and water quality sampler. Having too many volunteers can hinder the efficiency and effectiveness of collecting within the tidal timeframe.

Once the volunteers are chosen, keep in regular contact with them to ensure they are aware of the sampling day logistics, and have them alert you if anything in their schedule changes. Create a plan for the day, as well as a back-up plan for any unexpected occurrences. It is important to be prepared for the unexpected; flexibility is a must.

Pre-sample Preparation

Pre-sample preparations begin at least 4-8 weeks in advance of your intended sampling date to ensure all items are in line for a successful sampling. Staff at WDFW will provide the directions to, and equipment and supplies needed, for most Sites. Contact Jennifer Lanksbury before sampling to ensure all preparations are in order.

Sampling Dates and Tides

Sampling dates should be chosen within a 3-week window on either side of NOAA's targeted sampling dates for each Site. For example, if NOAA's target sampling date is January 19th, you can choose your sample date between December 29th and February 9th, depending on when tide height is good for mussel access and volunteer safety. Check height of mussel access for each Site on the Site description, and match with a tide chart.

During the winter, low tides are generally in the evening, which poses a unique set of circumstances for volunteers. It is important that your volunteers are capable and comfortable with climbing over slippery rocks to access mussels in the dark, using flashlights, headlamps, and/or propane lanterns.

Choosing a low-tide that corresponds with a full moon will alleviate some of the darkness issue given, of course, the weather cooperates.

Notification of Sampling and Site Access

Once a date and time has been decided, notify WDFW staff (via the contacts list provided) of your intended schedule. If any special access is required for sampling (indicated in the site

description), contact the relevant land owners and/or agencies to obtain permission or permits, allowing you to sample the mussels from the Site.

Review Site Descriptions and Sampling Equipment

While not absolutely necessary, conducting a Site visit prior to sampling, assessing mussel abundance for sampling will allow more time to determine a new Site location, if needed. It is also important to review the Site description to ensure adequate understanding of the Site prior to bringing volunteers on board for sampling.

Sampling supplies will need to be inventoried to ensure all supplies are stocked and in working condition. Contact WDFW staff and/or order additional supplies if necessary.

Pre-labeling Bags

It is important to pre-label the bags and bag tags before entering the field to ensure a more efficient sampling session. Here are the instructions for proper bag and bag tag labeling:

- Gallon Ziploc bags – are used to collect mussels for chemical analysis. There are three different gallon bags that will be labeled corresponding with each Station.
    - On the outside of each bag use permanent marker to write –
        - "WA Mussel Watch", Site Name, Site Acronym, Station #, Sample Date
        - Example: ***WA Mussel Watch***
            - ***Puget Sound - Port Townsend***
            - ***PSPT***
            - ***Station #1***
            - ***2/17/2010***
    - On the inside of each bag place a bag tag printed in Rite-in-the-Rain paper with the same information as listed above, but written in pencil.
- Quart Ziploc bags – are used to collect mussels for histology analysis. Label three quart bags to correspond to the three Stations you will sample, listing the same information on the labels as described above.

Flexibility of Sampling Protocols

Deviations from the mussel watch protocols are sometimes necessary, but approval from Mussel Watch staff (via the WDFW contacts) should be obtained prior to sampling. If prior approval is not possible, notification of Program staff should be done as soon as possible. In every case, changes in sampling procedures or location must be clearly documented by the field crew on the data sheet.

Sampling Day

Volunteer Site Lead Role

As a Site Lead, your role on the sampling day is to coordinate the volunteers and ensure the process runs smoothly. It is up to the Site Lead to designate samplers, ensure proper protocols are being followed, and maintain accuracy in data collection and reporting. Site Leads are also encouraged to obtain SALINITY and TEMPERATURE data themselves (Appendix 1 and 2). Site Leads will then be responsible for maintaining the chain-of-custody and secure samples prior to shipment.

Shipping Samples

After collecting the mussels, they need to be properly packaged and shipped in heavy-duty coolers. Depending on the number of Sites sampled, the procedure for preparing samples for shipping will take approximately one hour.

Shipping Checklist

- Check that all bag labels and sample data sheets are properly filled out, and included in the shipment.
- Pack the mussels into the cooler by alternating layers of bagged ice and bagged mussels (see training packet with illustrations).
- Make *copies* of the sampling data sheet and place one copy inside a Ziploc bag in each of the coolers (originals kept with Site Lead organization).
- Fill out Chain of Custody form for each cooler and place *original* in Ziploc bag with the *copied* data sheet. (copies of the Chain of Custody form kept with Site Lead organization).
- Tape coolers closed with nylon fiber packing tape. If possible, use tape to seal crack at lip of cooler, then wrap tape around both the depth and width of the cooler.
- Fill out the date of shipping and record the weight of each cooler on the WDFW FedEx mailing label, and take the coolers to the nearest FedEx store. **Important note: DO NOT inform FedEx employees that there are live animals in the coolers. Instead, use the term "water quality samples."**

If samples need to be held overnight, or over the weekend, store the packed coolers in a refrigerator, repacking with ice each day, until overnight shipping is available. Do not ship samples so that they will arrive over the weekend. If sampling occurs on a Friday, hold the mussels as described above until Monday morning for shipping.

Data Retrieval and Analysis

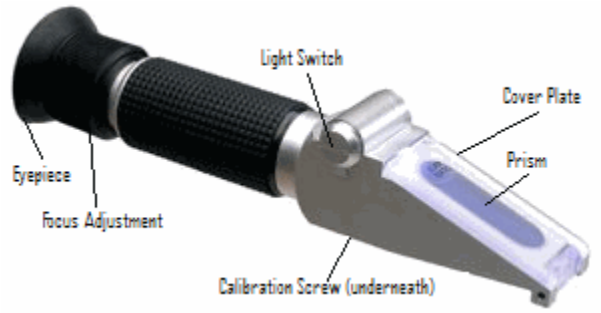
Data from TDI Brooks takes about 6-8 months to process, after which, the results will be sent to the NOAA Mussel Watch Program team. Results will be provided to each organization by Mussel Watch Program Staff (via WDFW) as soon as it becomes available.

Data Synthesis and Outreach

Completing the sampling, and sending in the mussels is just the first step of this program. Volunteers can assist in many other ways, through data synthesis, or through providing outreach and dissemination to the community about the results so far. Answering questions such as "What's the health of our local area?" or "What can I do to get involved and make a difference?" are just a few of the important questions to address with your community.

APPENDIX 1 – Measuring Salinity of Seawater using a Refractometer

Refractometer Parts

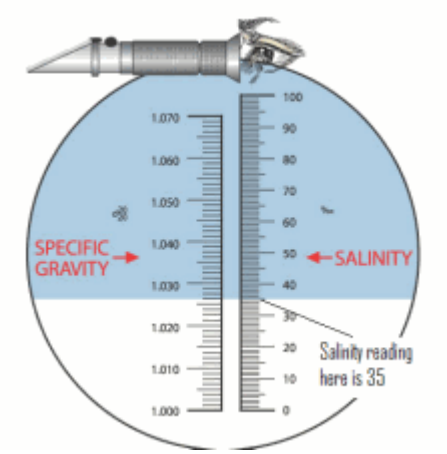


1. Verify that the refractometer has been calibrated by testing to see if distilled water reads as zero (0) - see calibration instructions below.
2. Open cover plate, use dropper from case to place several drops of seawater* on clean prism surface, gently close cover plate and press lightly so seawater spreads across entire surface of prism without air bubbles or dry spots.

   *Obtain seawater from middle of water column (not at surface) in as deep water as your boots allow you to wade (i.e., 1 – 2 feet of water).

3. Allow seawater to remain on prism for approximately 30 seconds, keeping refractometer level so as not to drain seawater away.
4. Turn on light switch to illuminate prism and look into the eyepiece. Note on the RIGHT side of the scale (o/oo PPT - Salinity) where the white and blue boundary lies. This value is the salinity reading that should be recorded in the "Salinity" field in the Site Water Parameters section of the data sheet.

- Focus using the focus adjustment just in front of the eyepiece.



5. After measurement, clean away the seawater on the surface of the prism and cover plate using a cloth or paper towel. Put it back into its case after it is dry and store in safe location.

Calibration Instructions for Refractometer:

1. Obtain distilled water in a closed vial and place in a seawater bath to bring distilled water to approximately the same temperature as the seawater you will be measuring…should take ~ 3-5 minutes.
2. Removed distilled water vial from seawater bath and wipe outside of vial dry, so as not to contaminate with seawater droplets.
3. Open refractometer cover plate, use dropper from case to place several drops of DISTILLED water on clean prism surface, gently close cover plate and press lightly so water spreads across entire surface of prism without air bubbles or dry spots.
4. Allow distilled water to remain on prism for approximately 30 seconds, keeping refractometer level so as not to drain water away.
5. Turn on light switch to illuminate prism, look into eyepiece and find where the white and blue boundary lies.

a. Focus the scale using the focus adjustment near the eyepiece.

6. Use small screwdriver in refractometer case to adjust calibration screw under prism until the white and blue boundary is just on the zero (0) mark on the RIGHT side of the scale.
7. After calibration, clean away the water on the surface of the prism and cover plate using a cloth or paper towel. You are now ready to take a salinity reading of seawater…follow directions above.

APPENDIX 2 – Measuring Temperature of Seawater

1. Wade into the seawater as deep as your boots will allow.

2. Place entire thermometer into water as deep as your clothing will allow (near middle of water column is better than at surface).
3. Wait approximately 2 - 4 minutes until thermometer reading stabilizes.
4. Read and record temperature in degrees Celsius (°C) in the “Water Temperature” field in the Site Water Parameters section of the data sheet.
5. Dry off thermometer and store in safe place.

Washington State Mussel Watch Program Background and Results

By Amy Johnson
Mussel Watch Coordinator

DATE OF TRAINING

VOLUNTEER SITE LEAD ORGANIZATION

SNOHOMISH COUNTY MARINE RESOURCES COMMITTEE

Sea Grant Washington

PugetSoundPartnership
our sound, our community, our chance

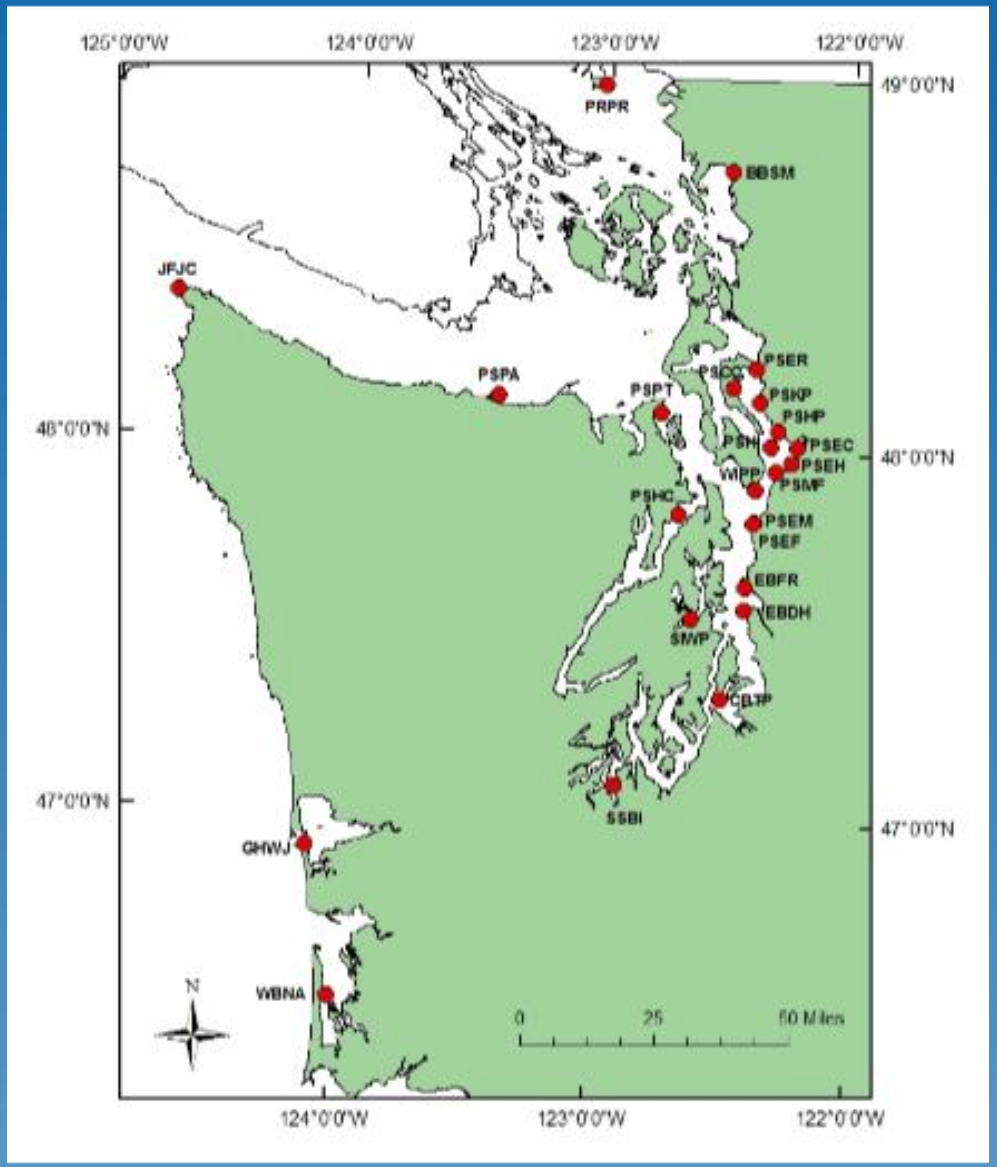
NOAA

Washington Department of FISH and WILDLIFE

What Is It?

- NOAA's National Status and Trends Mussel Watch (MW) Program is the longest continuous contaminant monitoring program in U.S. coastal waters.
- The program has sampled mussels and oysters biennially from 300 sites since 1986, 26 of which are in Washington – 5 on the coast; 2 in the "Straits" and 19 in the main basin.

Mussel Watch Map



Why Is It Important?

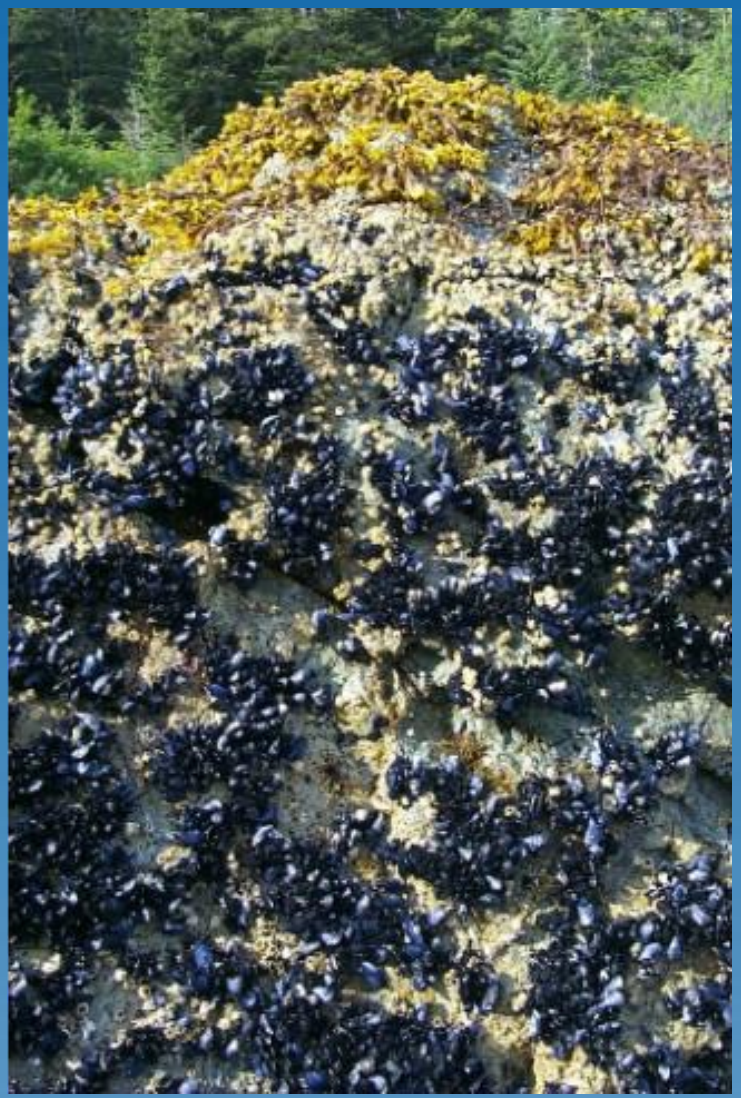
- As we shift responsibility from a federally implemented program (NOAA) to a state-run citizen science program (WDFW), the role of community partner organizations and volunteers is crucial.

Project Goals

Goals:

- Assess overall water quality across the marine waters of Washington state.
- Compare wet and dry season chemical concentrations.
- Review trends and compare to water quality results from across the nation

Why monitor Mussels (and oysters)?

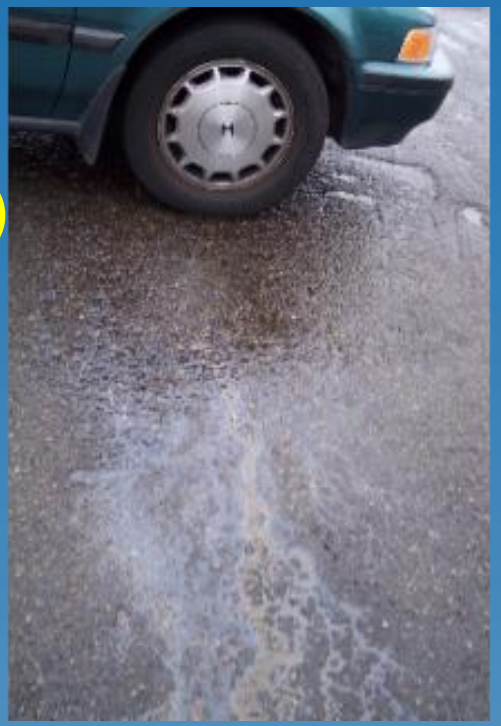


- Stationary filter-feeders
- Abundant (usually!)
- Wide geographic distribution
- Don’t metabolize PAHs, organic compounds
- Reflect recent concentrations in the water

What Pollutants Are Tested?

Tests for over 100 pollutants including:

- Trace elements (14, As to Zn)
- Organotin compounds (5)
- PAH's (18, then 24, then 46)
- PCB's (chlorination no., then 18+ congeners)
- Organochlorine pesticides (24+, eg 6 DDT's,)
- Current-use pesticide (chlorpyrifos)
- Chlorinated benzenes (3)
- PBDE's (38)
- Lipid and water content
- Pathogens



= 150 Separate Chemicals

Mussel Watch Sampling

- Train

- Travel to Sample Sites

- Write Site Descriptions

- Measure Water Quality (Temp and Salinity)

- Collect Mussels







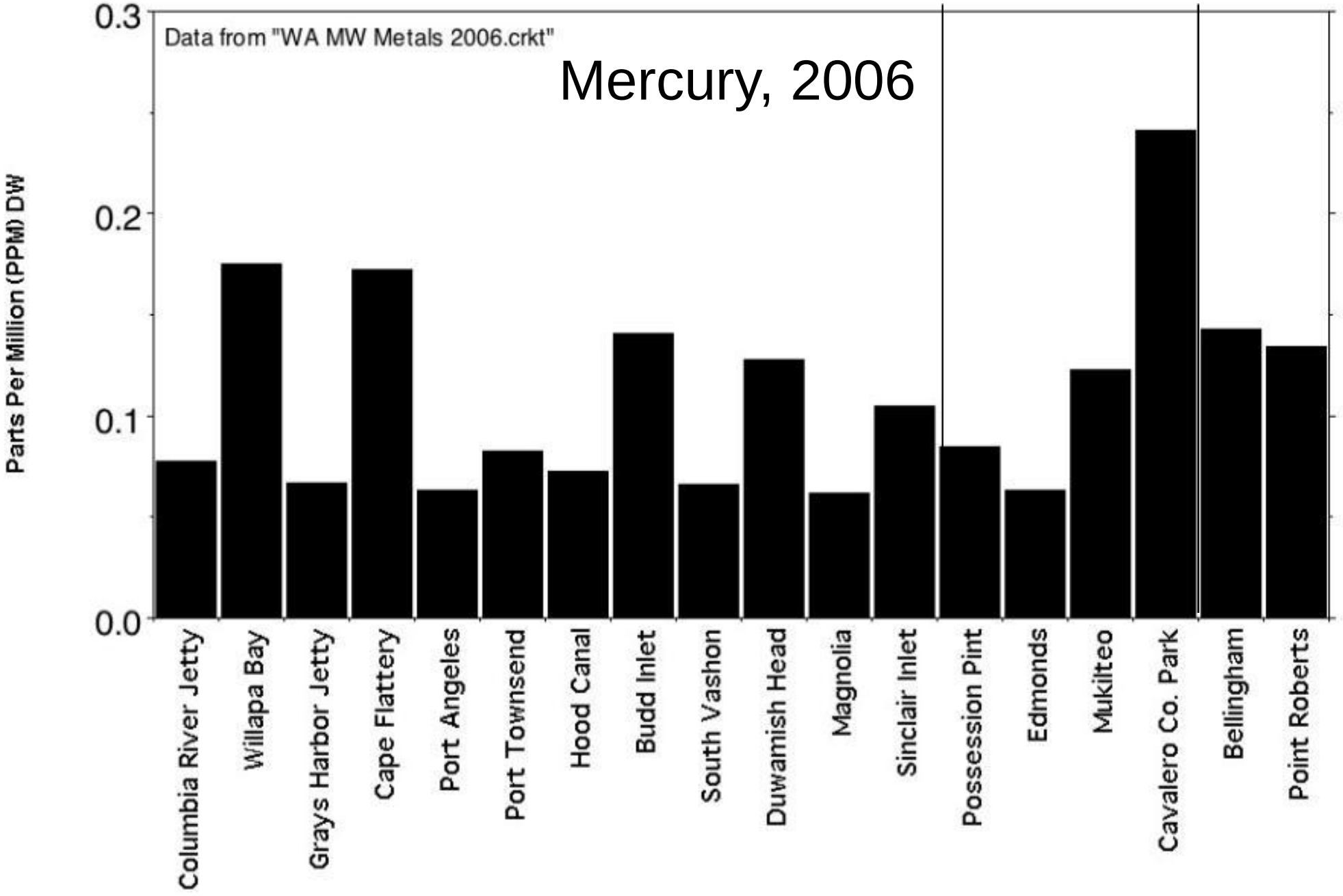



Results
What are We Learning?

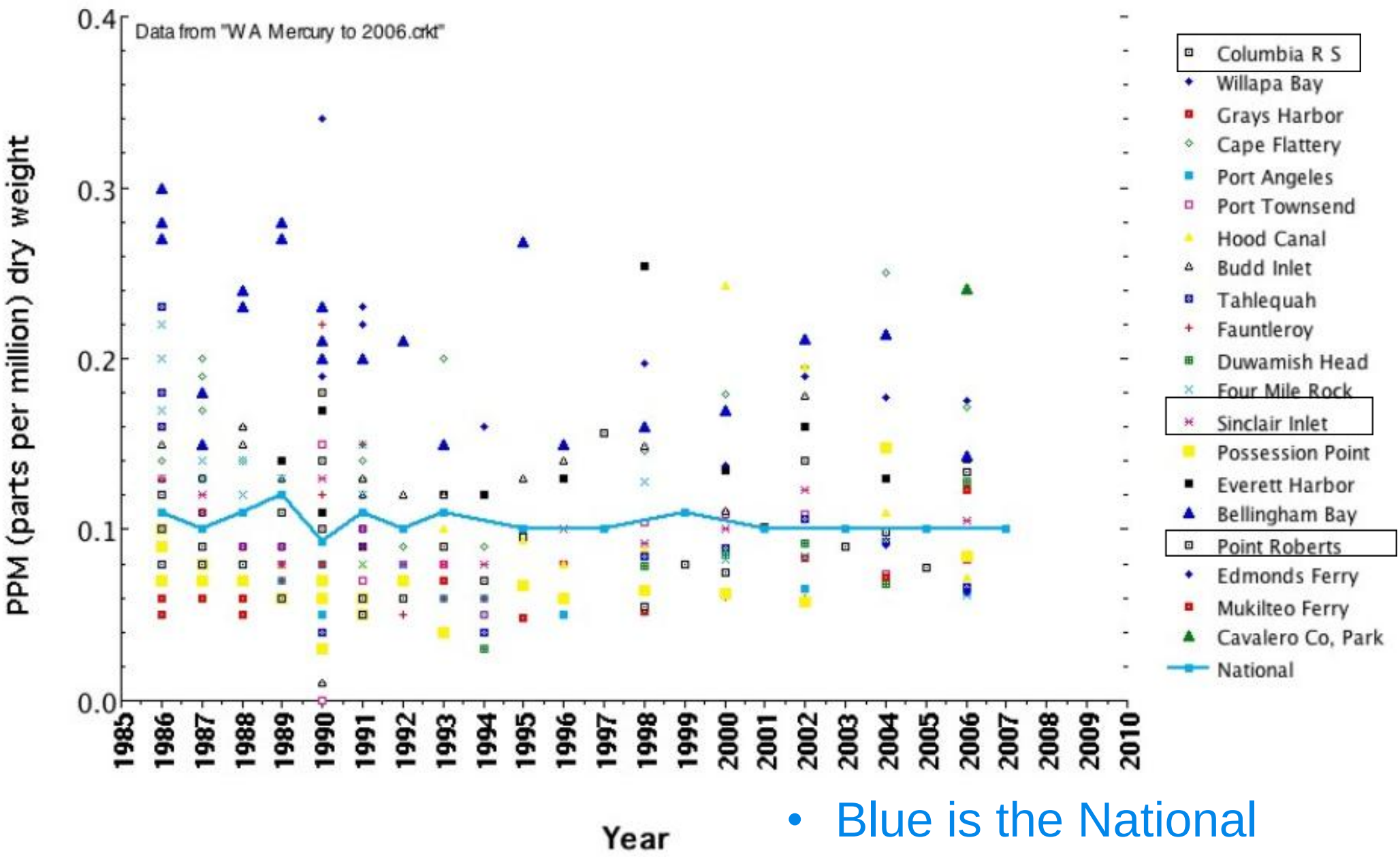
Instructional Slide

For the following graphs and charts, place dots ( ) over the values for each site to guide audiences' focus on their specific area.

(Delete before presentation)

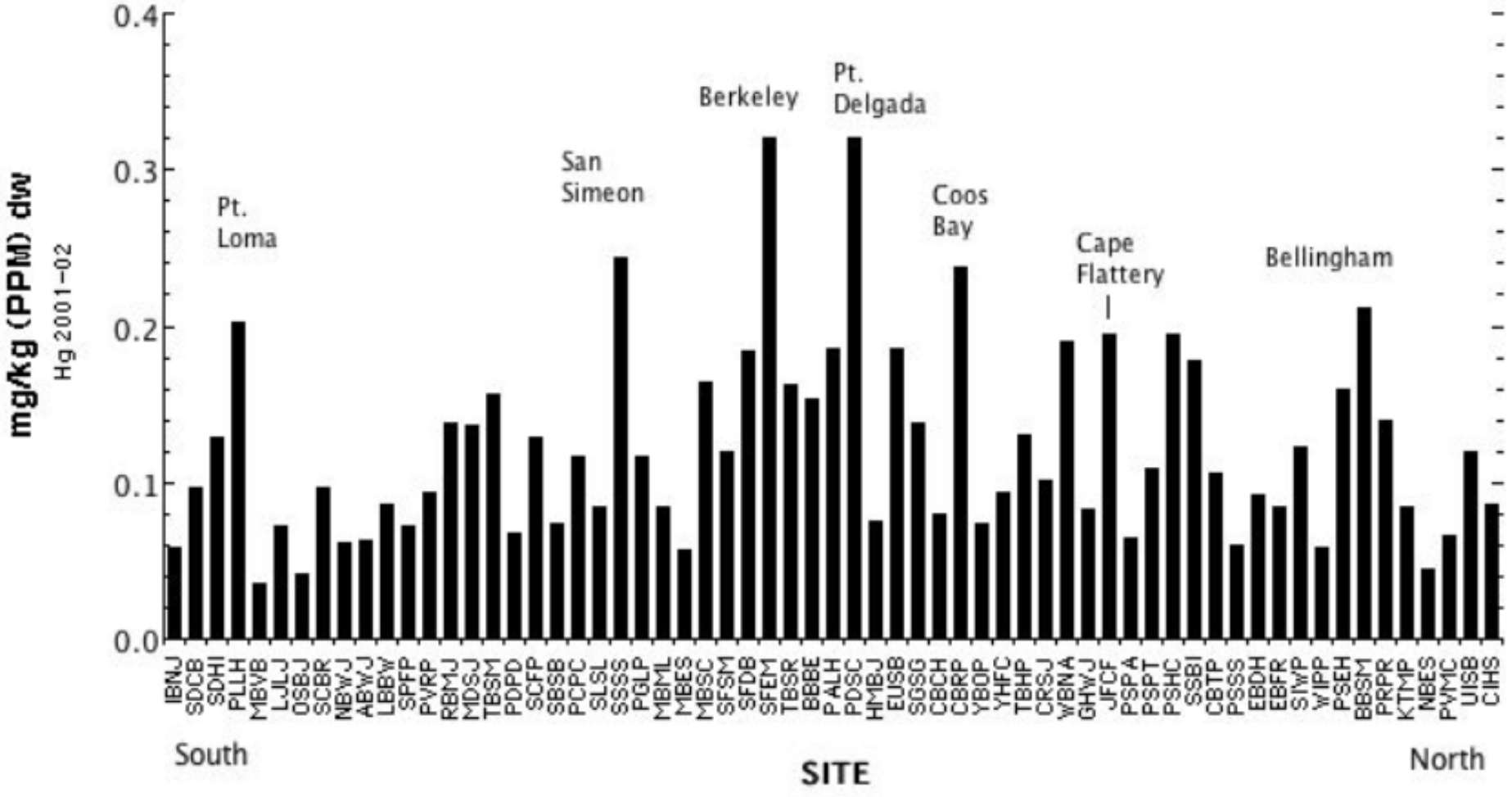

Data from "WA MW Metals 2006.crkt"
Mercury, 2006
Parts Per Million (PPM) DW
0.3
0.2
0.1
0.0
Columbia River Jetty
Willapa Bay
Grays Harbor Jetty
Cape Flattery
Port Angeles
Port Townsend
Hood Canal
Budd Inlet
South Vashon
Duwamish Head
Magnolia
Sinclair Inlet
Possession Pint
Edmonds
Mukilteo
Cavalero Co. Park
Bellingham
Point Roberts

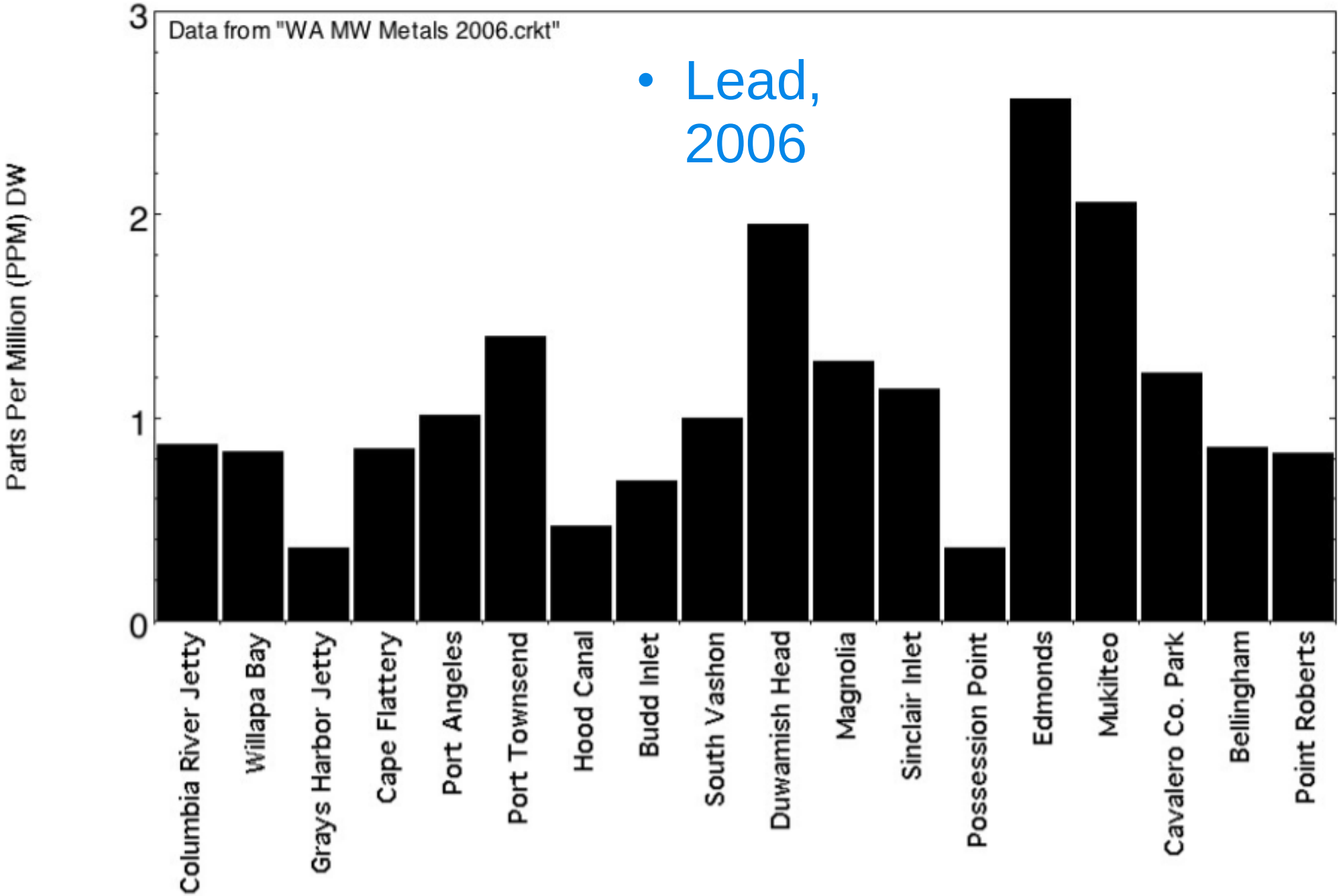
Puget Trends for Mercury (Hg)



- Blue is the National Average

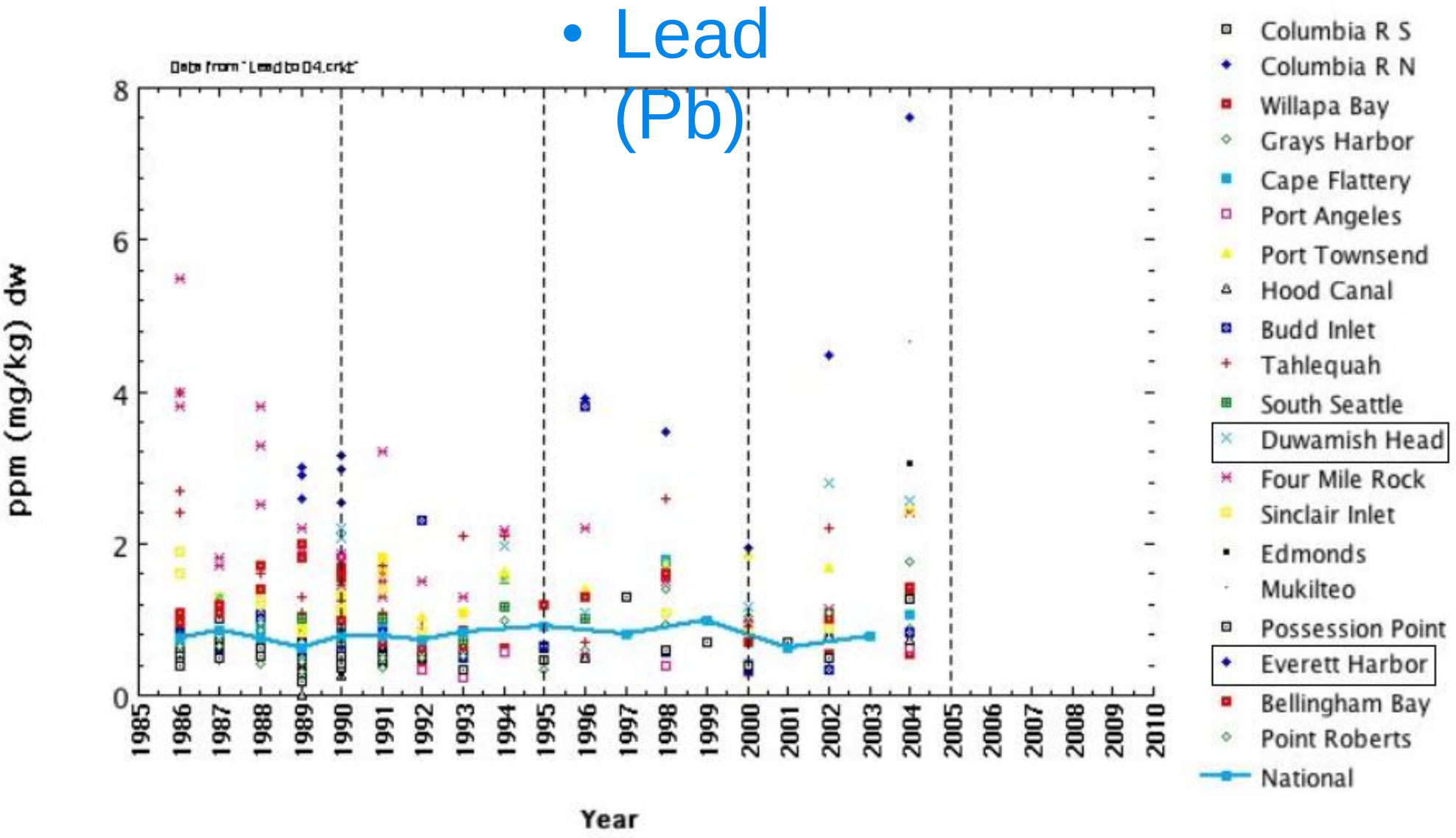
- Mercury Along Pacific Coast 2001-02



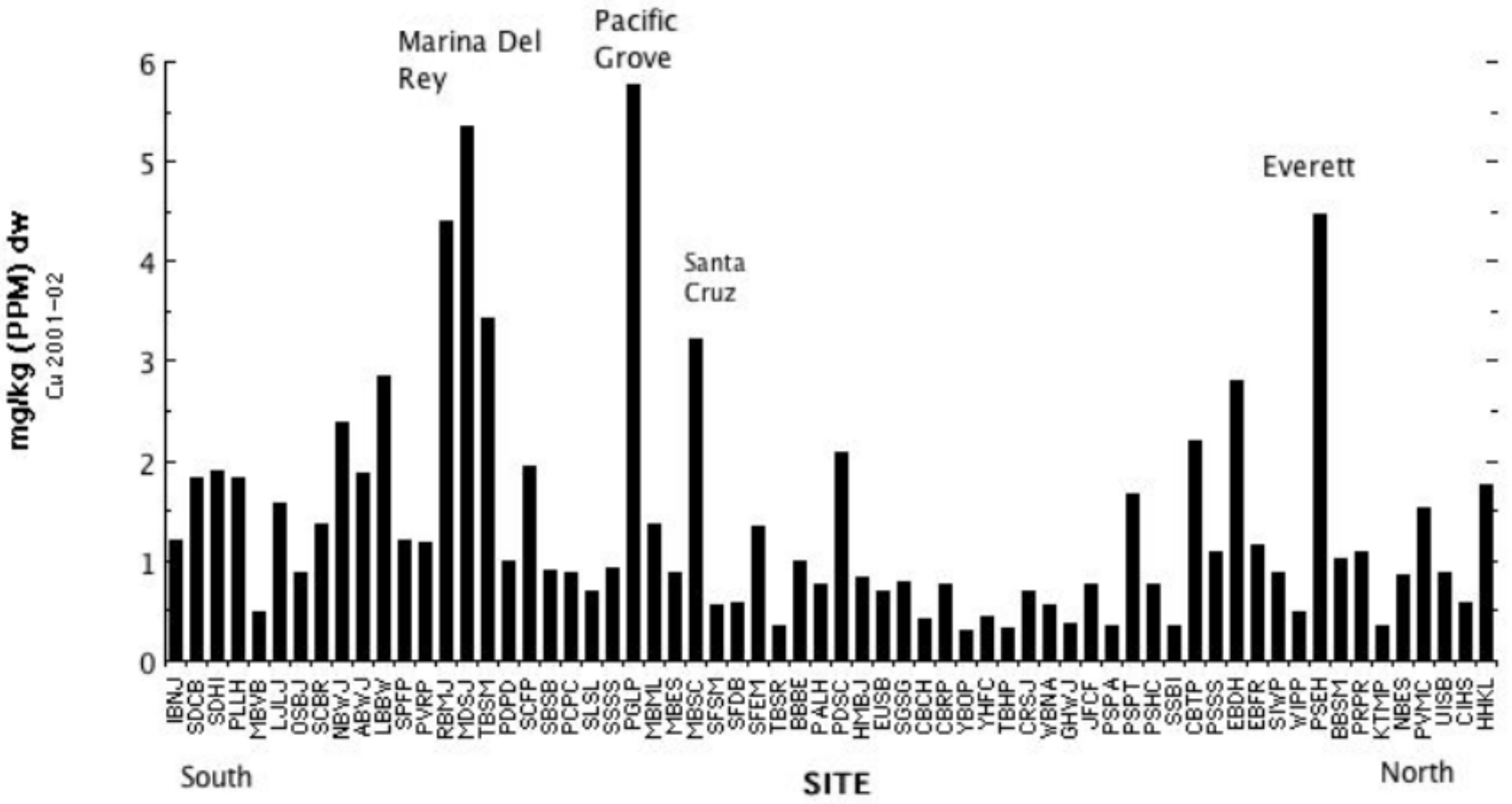

Data from "WA MW Metals 2006.crkt"
Parts Per Million (PPM) DW
0
1
2
3
Columbia River Jetty
Willapa Bay
Grays Harbor Jetty
Cape Flattery
Port Angeles
Port Townsend
Hood Canal
Budd Inlet
South Vashon
Duwamish Head
Magnolia
Sinclair Inlet
Possession Point
Edmonds
Mukilteo
Cavalero Co. Park
Bellingham
Point Roberts

- Lead, 2006

- Lead (Pb)


Data from "Lead to 04.crkt"
ppm (mg/kg) dw
Year
0
2
4
6
8
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Columbia R S
Columbia R N
Willapa Bay
Grays Harbor
Cape Flattery
Port Angeles
Port Townsend
Hood Canal
Budd Inlet
Tahlequah
South Seattle
Duwamish Head
Four Mile Rock
Sinclair Inlet
Edmonds
Mukilteo
Possession Point
Everett Harbor
Bellingham Bay
Point Roberts
National

- Lead Along Pacific Coast



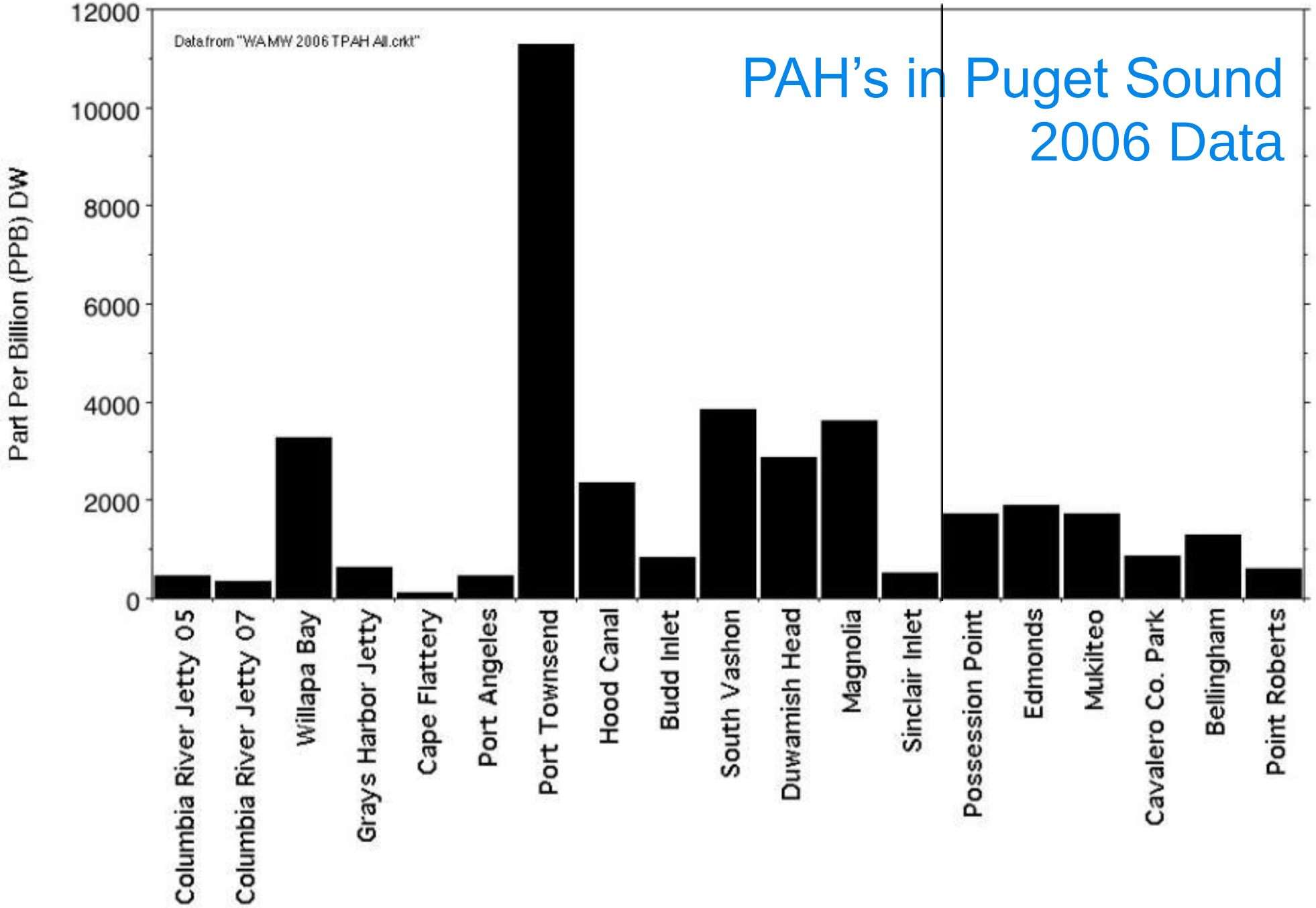
PAH’s

Polycyclic Aromatic Hydrocarbons
(Think oil spills and storm runoff)

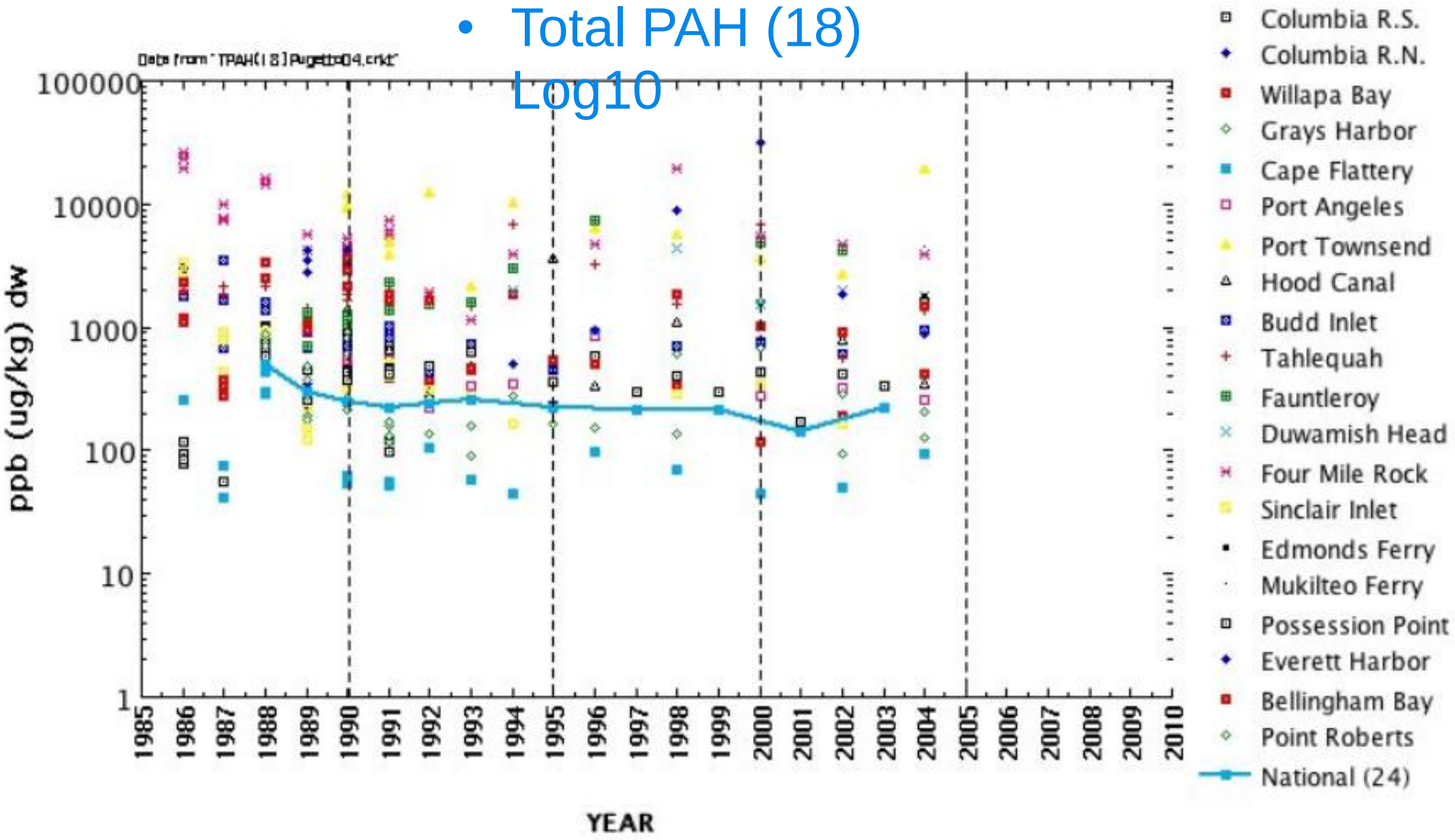
PAH's and Hydrocarbons

PAH's are the primary hydrocarbons of ecological concern in Puget Sound

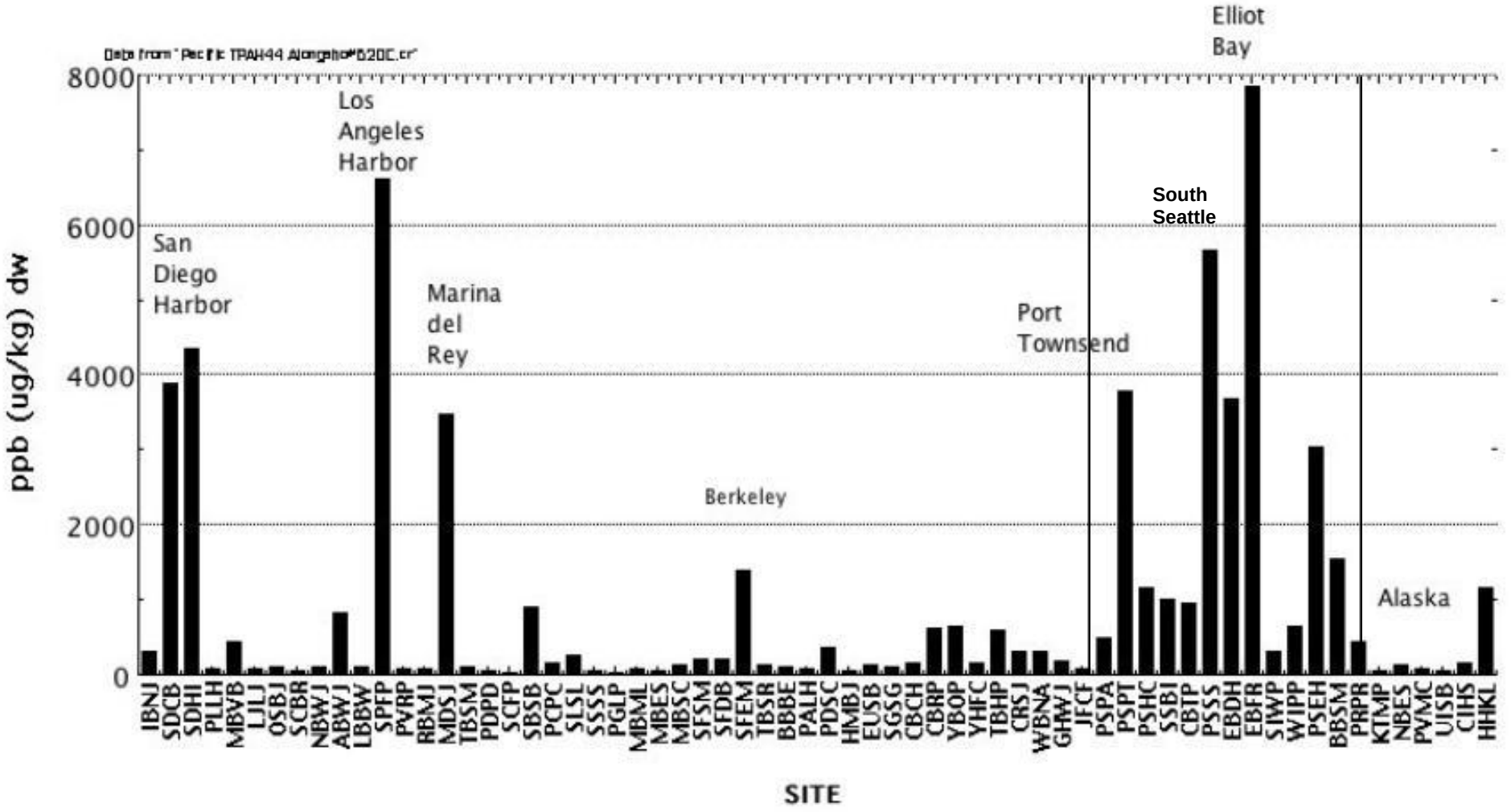
PAH's in Puget Sound 2006 Data



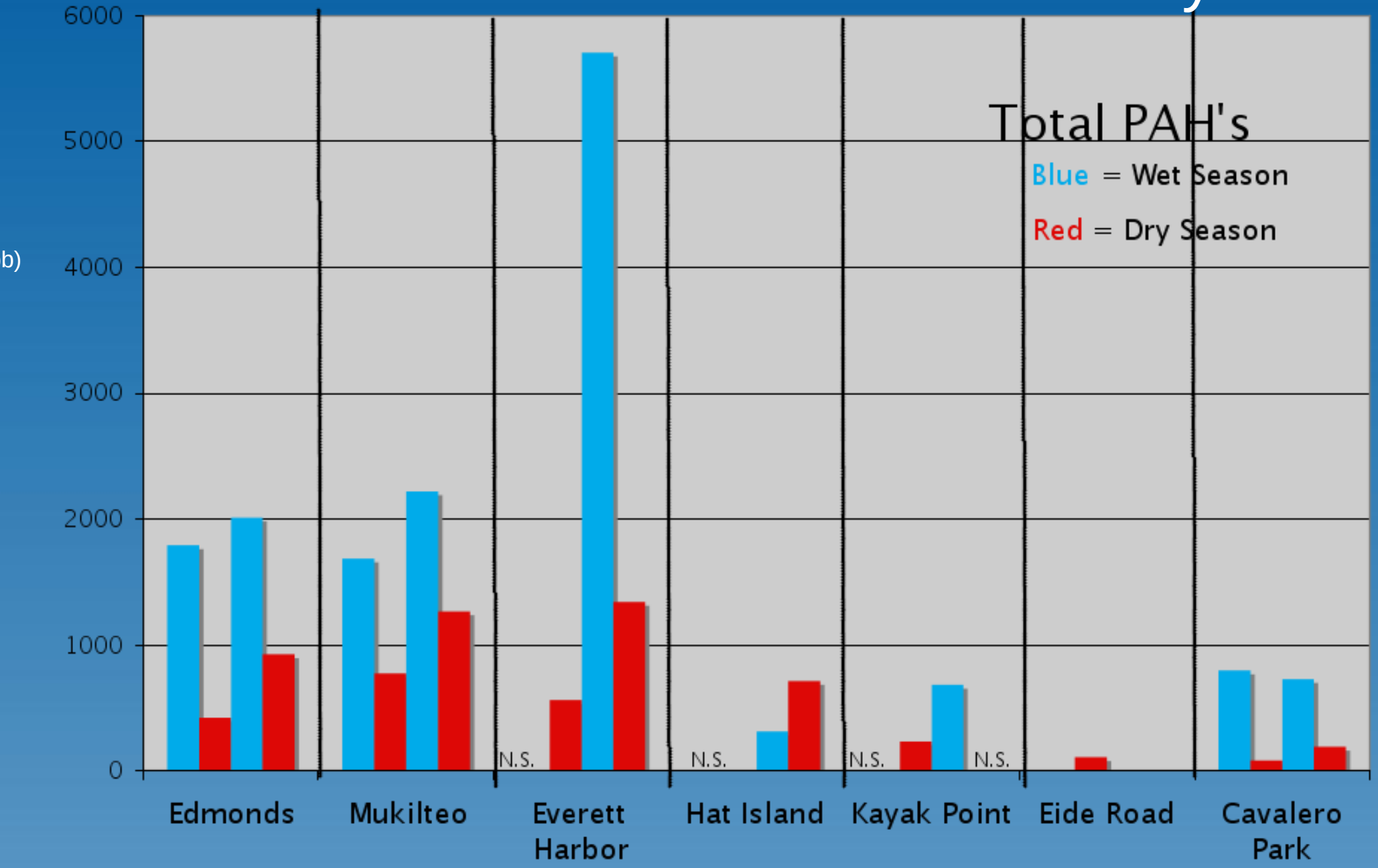
- Total PAH (18) Log10



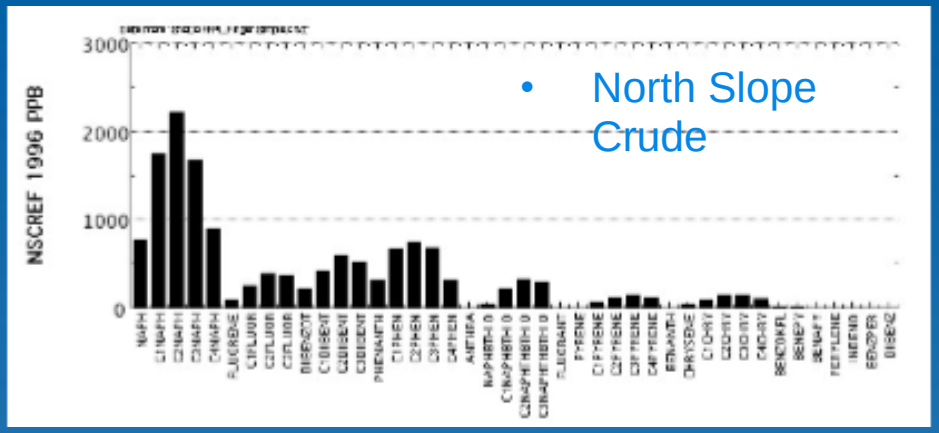
- Total PAH Along Pacific Coast 2001-02



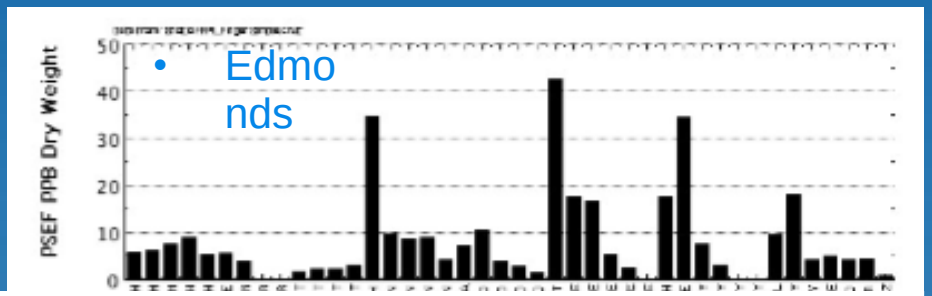
2008 Results for Snohomish County



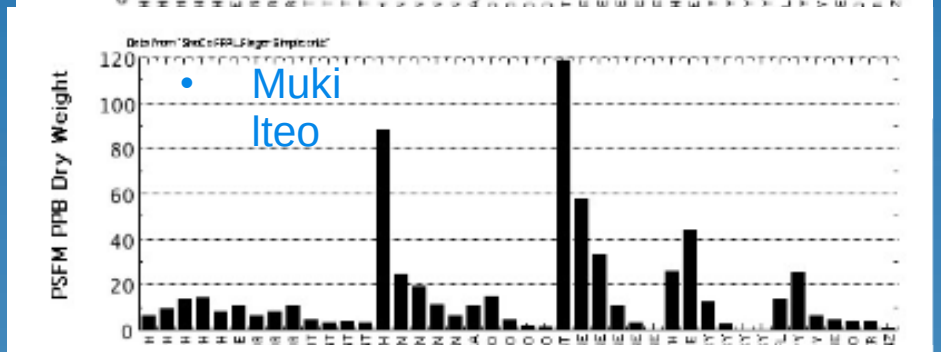
Fingerprinting to Identify Sources



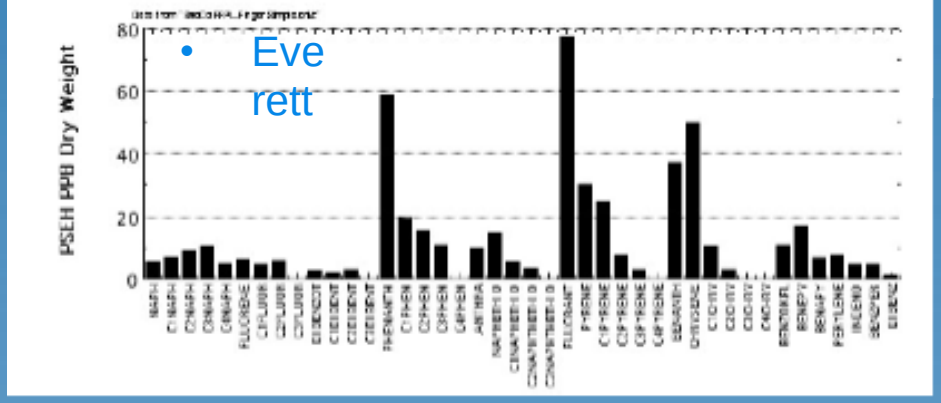
- North Slope Crude



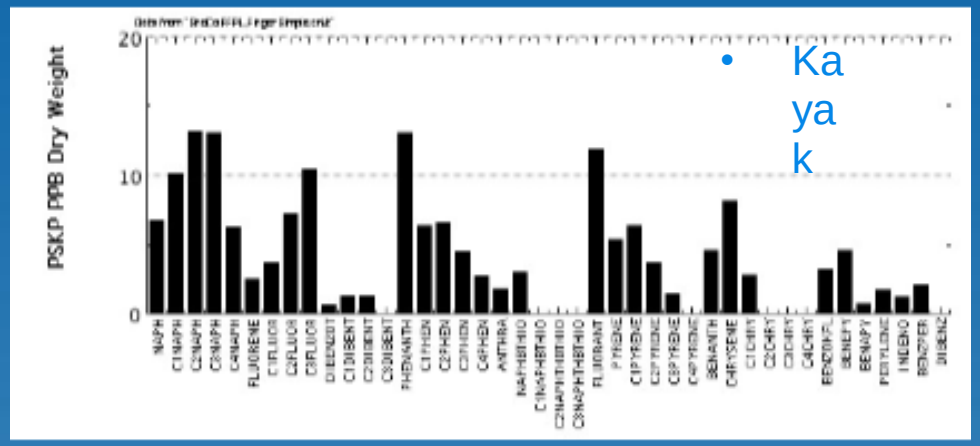
- Edmonds



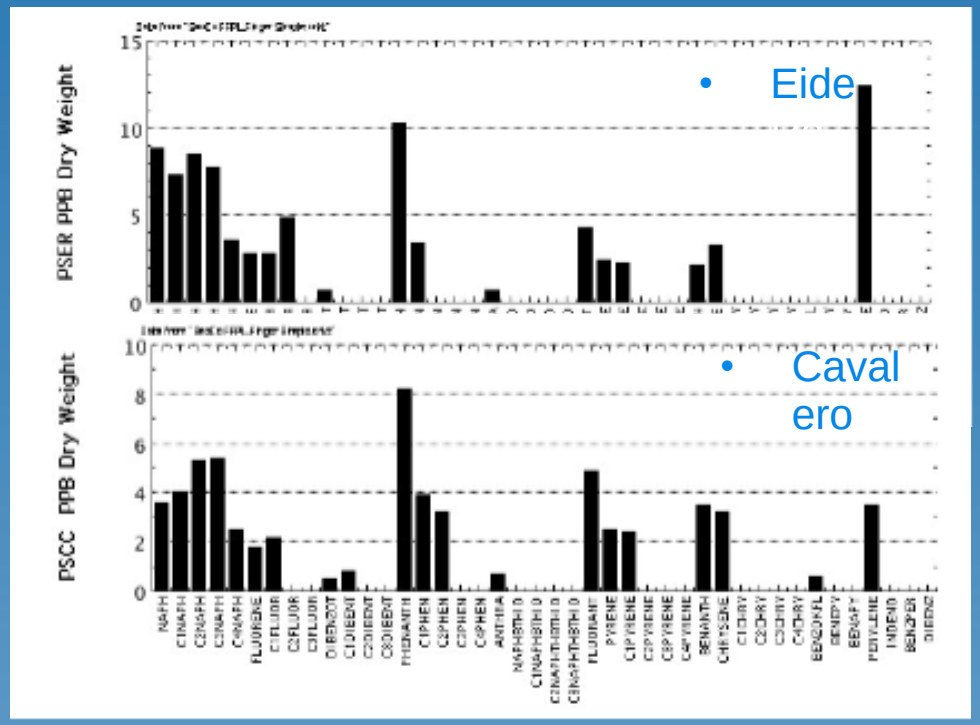
- Mukilteo



- Everett



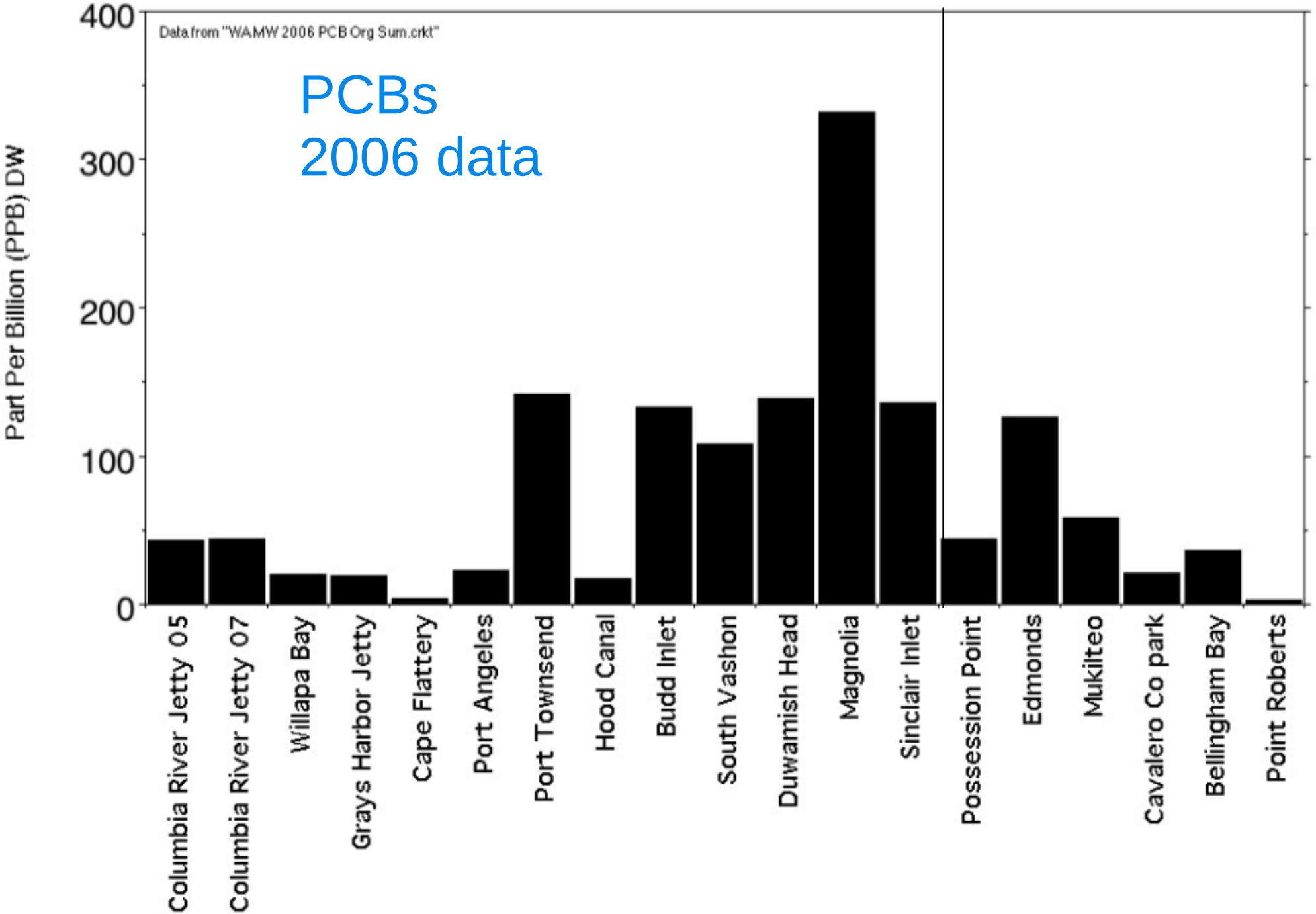
- Kayak



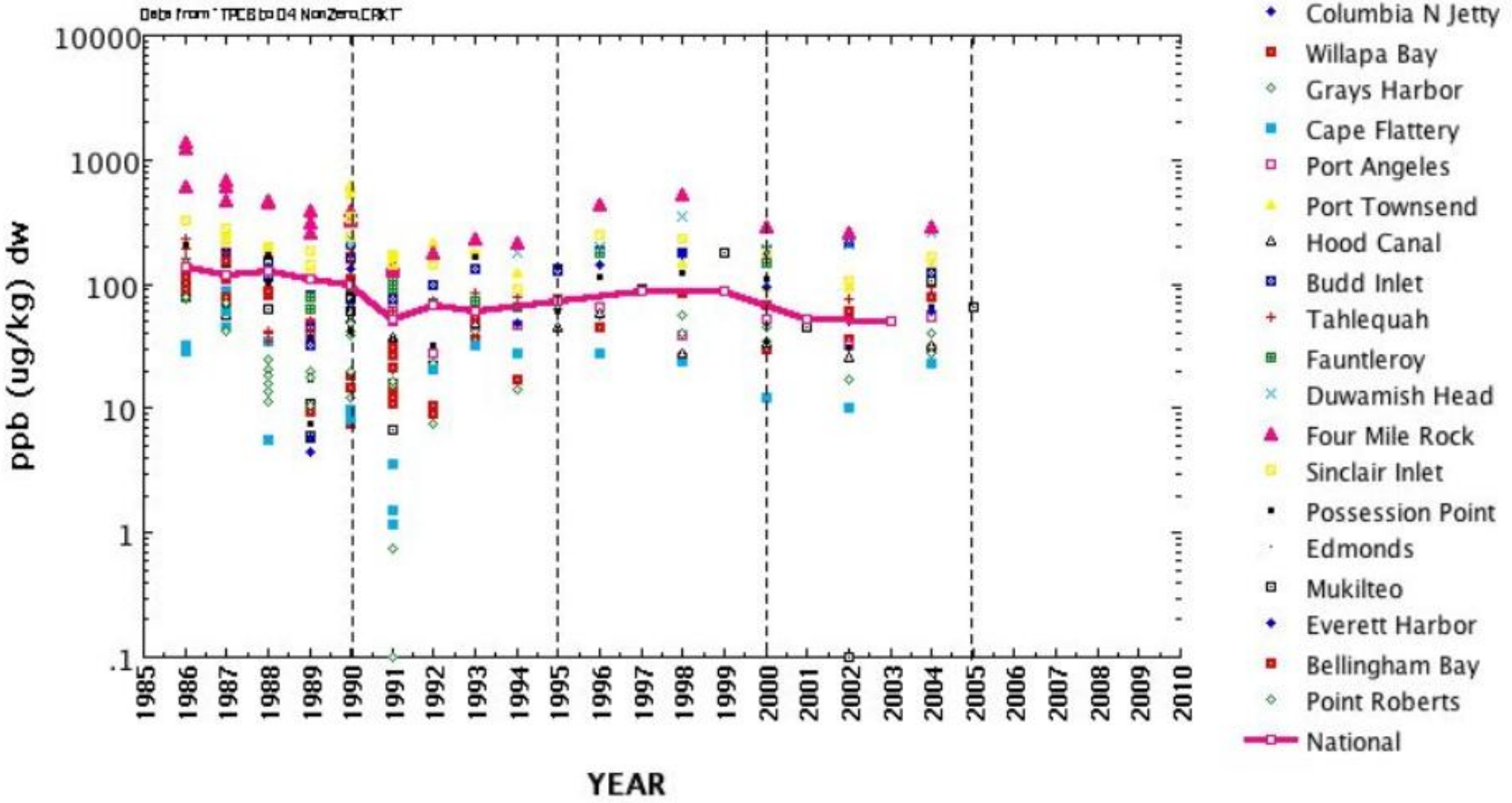
- Eide
- Cavalero

PCB’s

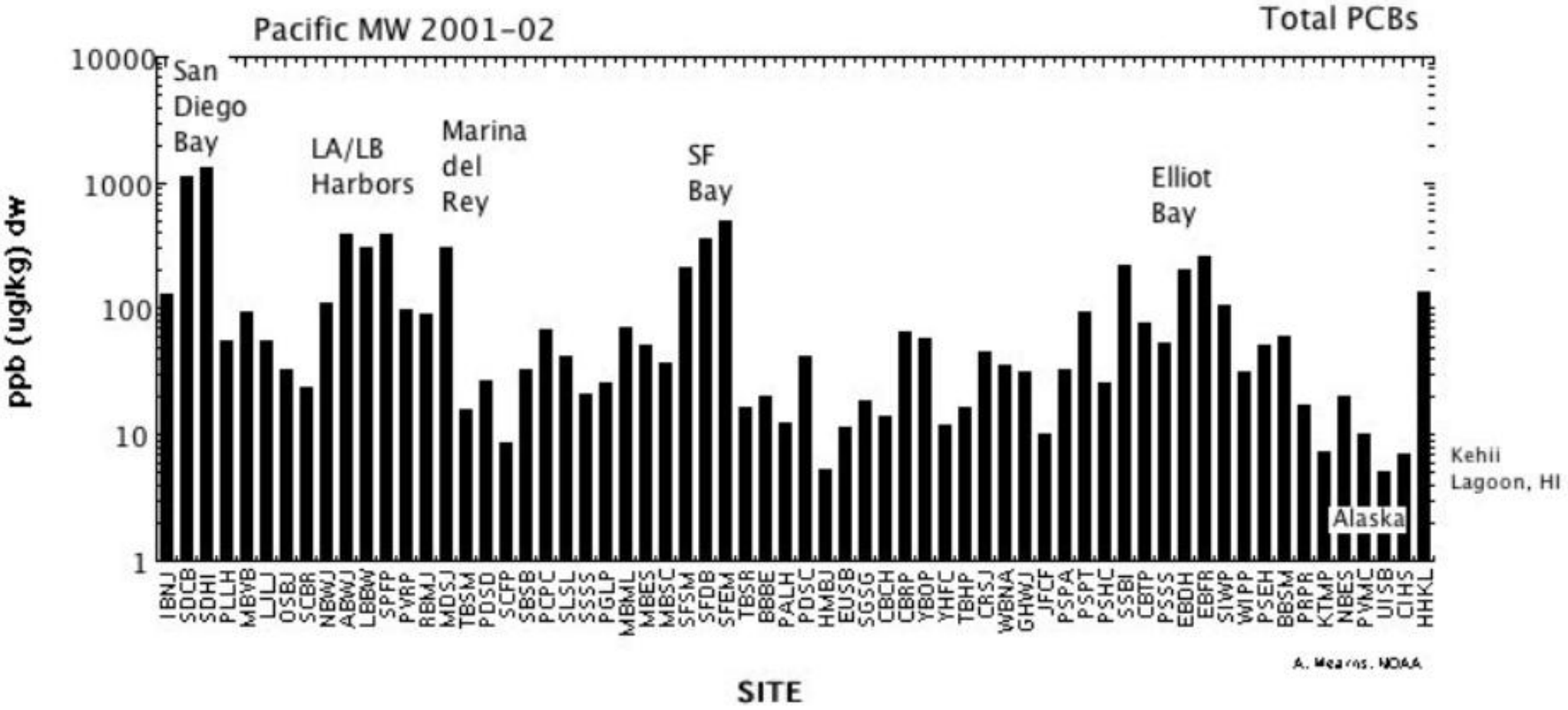
Polychlorinated Biphenyls


Data from "WAMW 2006 PCB Org Sum.crkt"
PCBs
2006 data
Part Per Billion (PPB) DW
400
300
200
100
0
Columbia River Jetty 05
Columbia River Jetty 07
Willapa Bay
Grays Harbor Jetty
Cape Flattery
Port Angeles
Port Townsend
Hood Canal
Budd Inlet
South Vashon
Duwamish Head
Magnolia
Sinclair Inlet
Possession Point
Edmonds
Mukilteo
Cavalero Co park
Bellingham Bay
Point Roberts

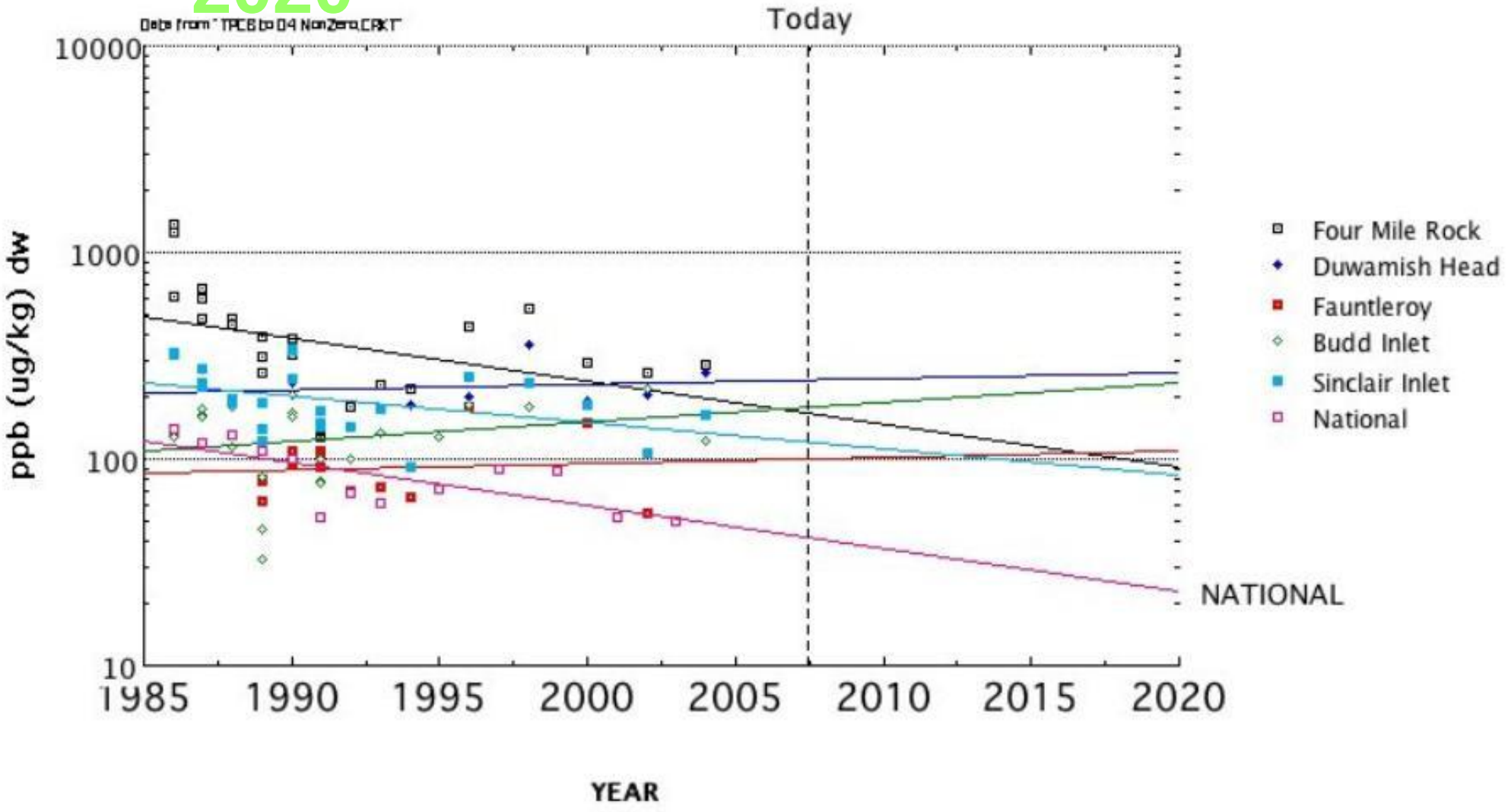
- **Total PCB's Log**



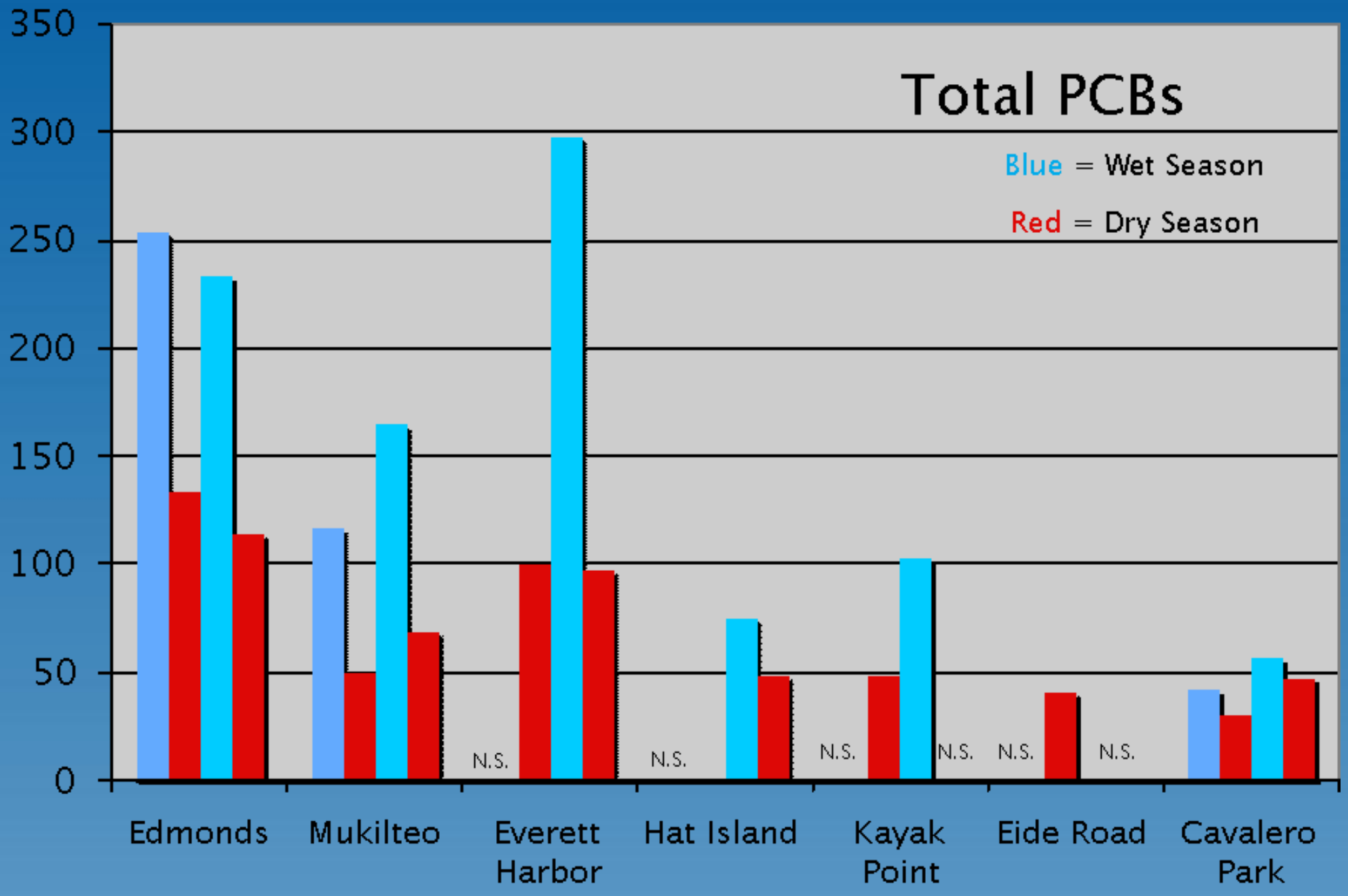
- **Total PCB's 2001-02 Log**



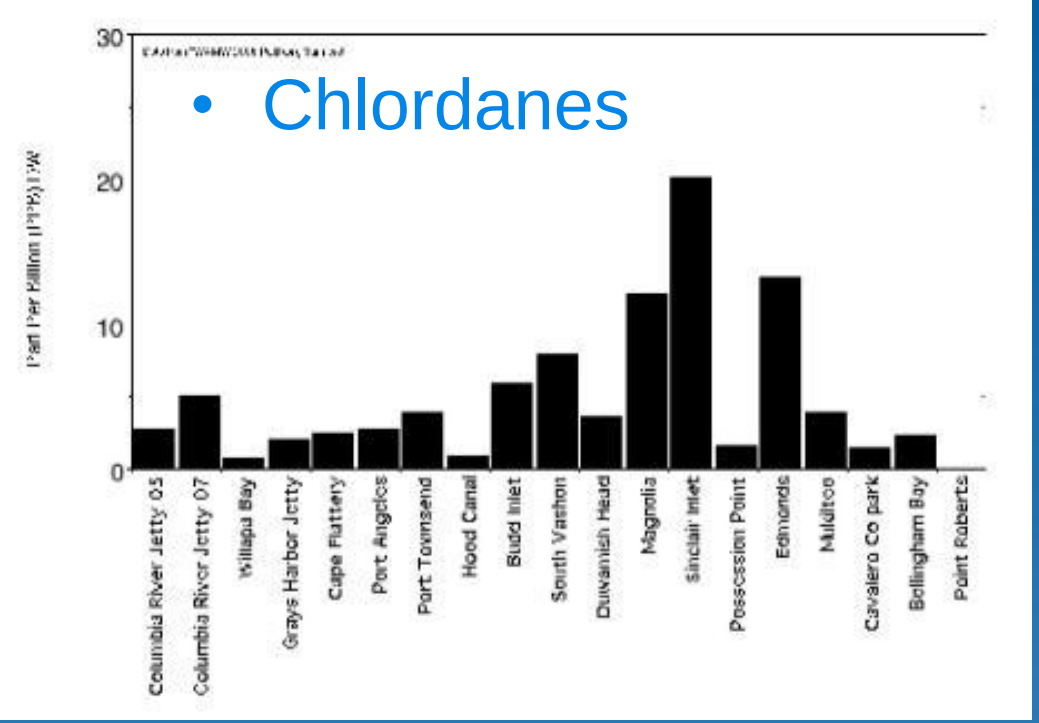
- **Total PCB's to 2020**



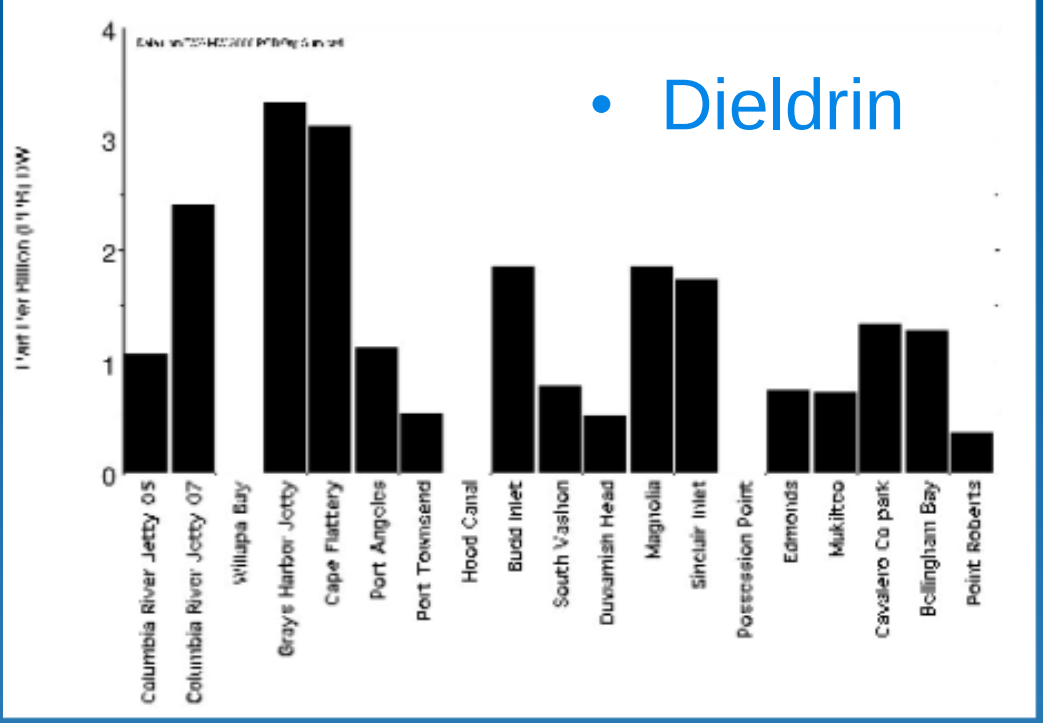
2008 Results for Snohomish County



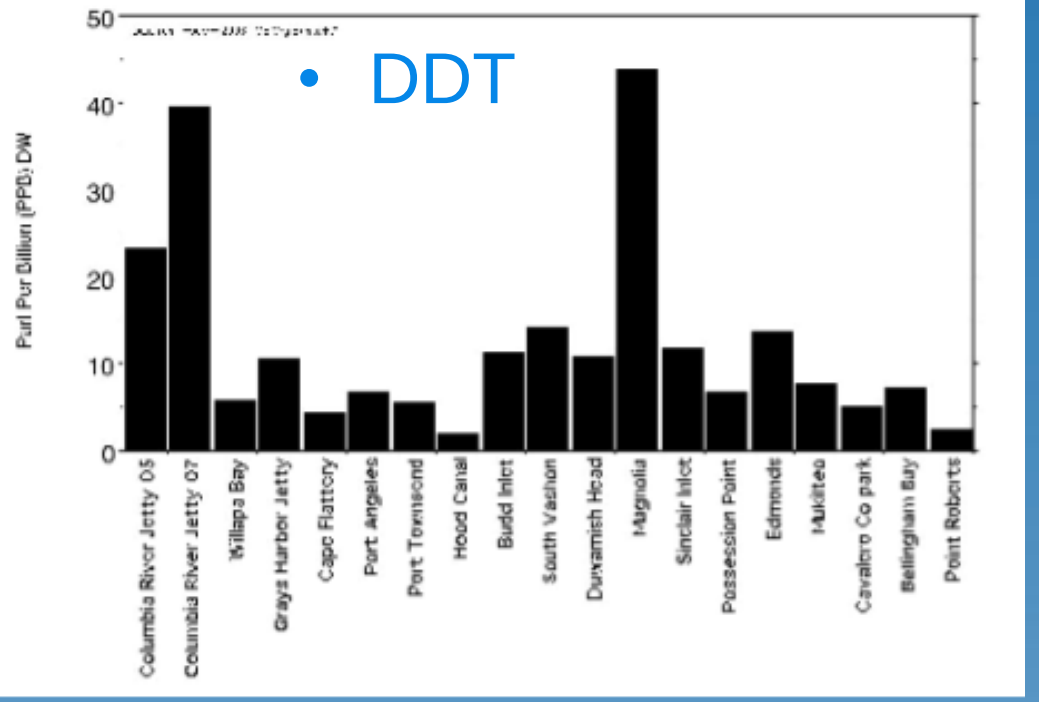
- Chlordanes



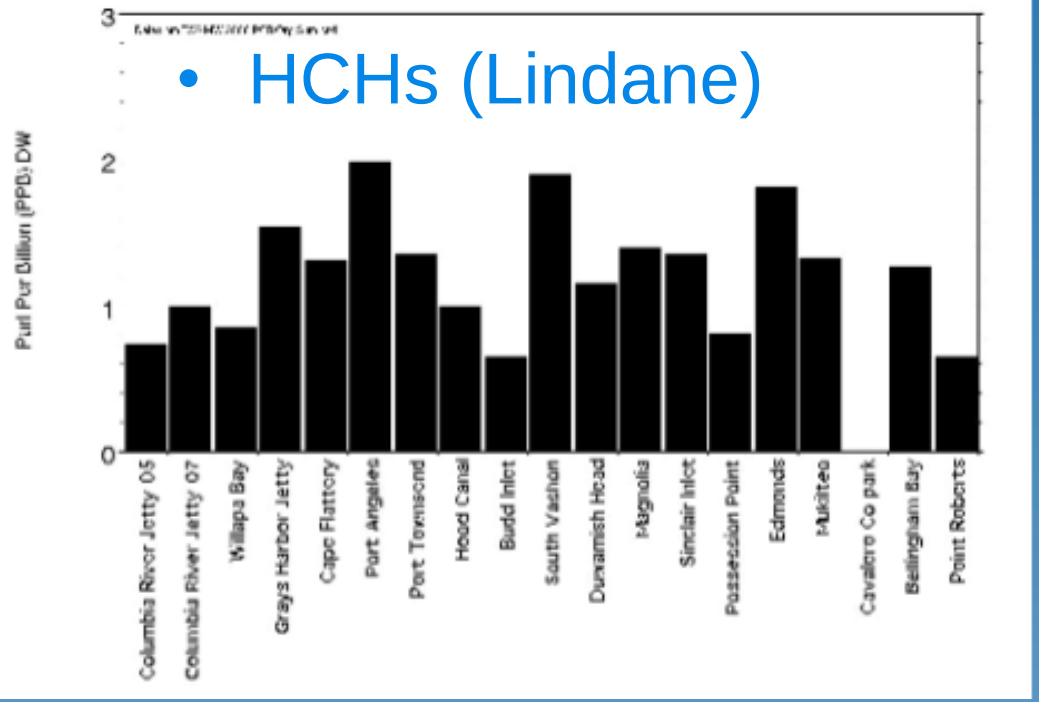
- Dieldrin



- DDT

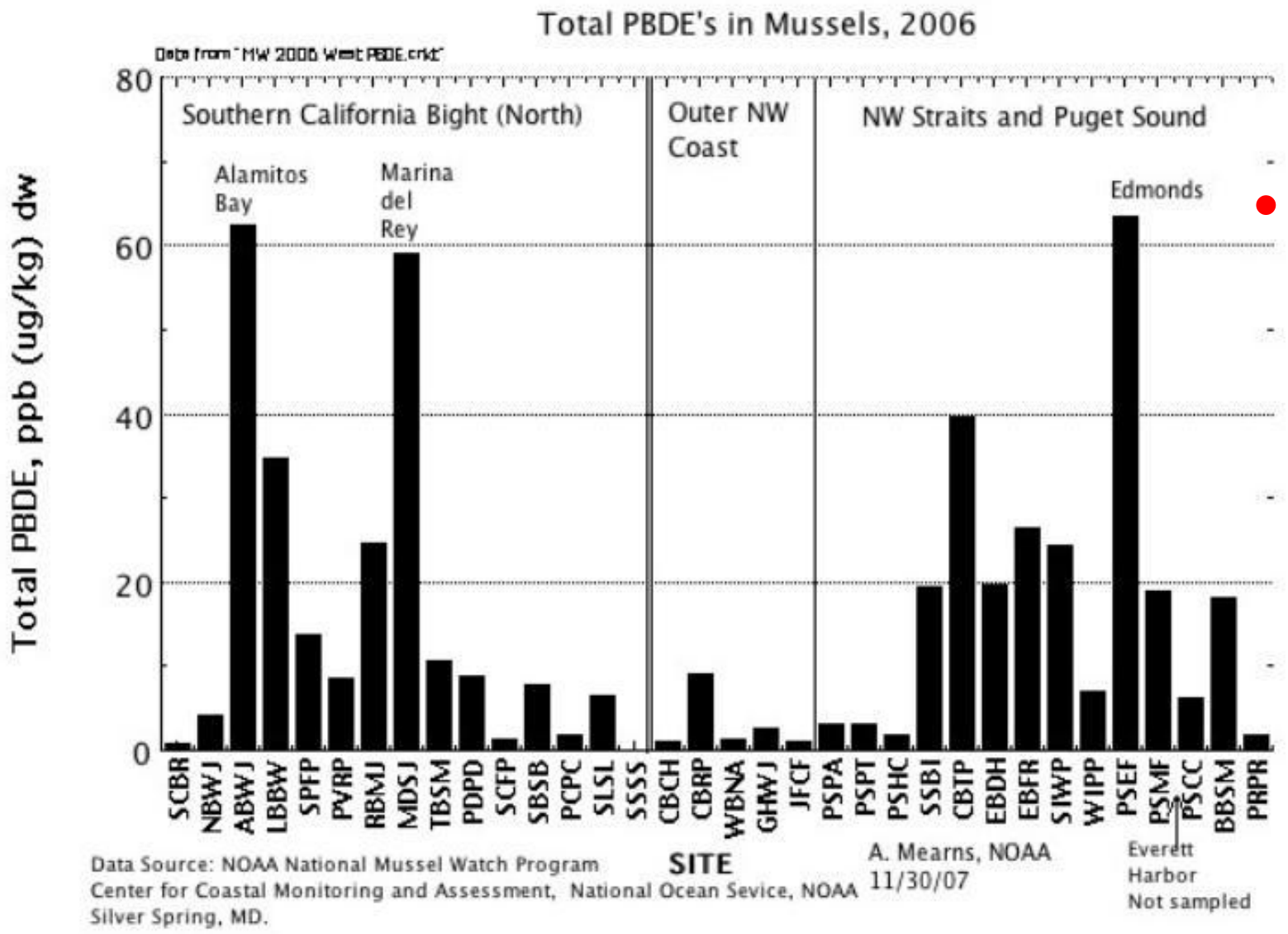


- HCHs (Lindane)



PBDEs – Polybrominated diphenyl ethers (Flame retardants)

- **PBDEs … Emerging Contaminants**



- Yikes!!!

The Future

1. Stormwater Runoff: How Important? Very!!!

2. Are these levels of contamination of significance to the marine and wildlife?

- 3. How clean is “clean enough?”
- 4. What are the sources anyway?

THANK YOU, VOLUNTEERS!

Any questions?

ACKNOWLEDGEMENTS

Data analysis, synthesis, and graphics courtesy of Alan Mearns, NOAA

Appendix C. Overview of Washington State Mussel Watch Sites Sampled in 2009/10

Included in Appendices C.1 – C.25 are detailed descriptions of each of the Mussel Watch sites in Washington State that were successfully sampled during the 2009/10 field season. Each Appendix begins with a brief summary of sampling at the particular site. Immediately following is an overall description of the site as provided by the National Mussel Watch Program, including some historical data regarding sampling success (or not) at that site. Following that description are the 2009/10 field season sampling notes for each site, as collected and transcribed by the Washington State collaborators. Photos of sampling efforts and/or site particulars in 2009/10 are included, where appropriate.

The initial information and descriptions of each Site were taken directly from an unpublished document entitled, "National Status and Trends Mussel Watch Program: Mussel Watch Site Descriptions for Washington State", given to the Washington State collaborators by National Mussel Watch Program staff at the onset of this project. The descriptions include the Site name and acronym (in parenthesis), the National Program Site number, the nominal Site Center (i.e. the target latitude and longitude), the NOAA chart number where the Site can be located, and directions to the Site, including maps. Also included is a general Site description with sufficient information to allow samplers to easily locate the Site and/or find a suitable boat ramp, where appropriate. Bivalve and sediment collection comments are also given. These comments include sampling methods from previous years, ideal water depths (i.e., ideal tidal level) for collection, and any pertinent aspects of the sampling or the sampling area. Information regarding probable contaminants affecting each site is also included. Although the Site description documentation from the National Mussel Watch Program generally contained collection notes from 1995-2000, another document supplied by the Program contained additional sampling notes (2002-2005) from select sites (Fay, 2005). Where appropriate these additional notes were added into the National Program description for each site, with a citation.

A section containing the Washington State collaborators with details regarding mussel collection efforts for the 2009-10 field season follows the National Mussel Watch Program description for each Site. Washington State collaborators notes include the date and time of sampling, the location of the Site Center, and the water temperature and salinity readings taken at the Site. Included is information about who sampled the site (collaborators and/or volunteers), and the Site Lead is identified. Details of site access, including whether permission from private land owners was required, are described. Also included are site descriptions, observations and general notes, often transcribed directly from sampling data sheets (see Appendix E for data sheet template), as well as photographs of site details and/or sampling efforts. In addition, any potential sources of pollution noted by samplers are included there. Following the Washington State collaborators details of sampling is a copy of the front and back sections of the Washington Mussel Watch Program Data Sheet, as filled out by samplers at the time of collection.

Appendix C.1 Bellingham Bay – Squalicum Marina Jetty

The Bellingham Bay - Squalicum Marina Jetty site was successfully sampled by volunteers from the Whatcom County Marine Resources Committee on Tuesday the 26th of January, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Bellingham Bay, Squalicum Marina Jetty (BBSM)

TARGET SPECIES - *Mytilus species* SITE NUMBER - 283

NOMINAL SITE CENTER - 48° 45.130' N 122° 29.870' W

LOCATED ON NOAA CHART - 18424

SITE ACCESS - This site is located on the jetty adjacent to the Squalicum Marina in Bellingham. From U.S. Highway 5 in Bellingham, take Exit 255 west onto Sunset Drive. Proceed on through town, Sunset Drive then turns into Broadway. At the intersection at the end of Broadway, turn left onto West Holly Street. Proceed along West Holly Street to F Street and make a left onto F Street. Drive down F Street and make a right onto Roeder Avenue. Continue down Roeder Avenue, then turn left onto Coho Way and drive into the Marina complex. Wind around the marina, bearing left and park next to the parking lot adjacent to the jetty at the end. If sediments are to be collected, a small boat is necessary. There is a good boat ramp next to the U.S. Coast Guard Station on Glenn Drive, which exits off Marine Drive.

SITE DESCRIPTION - The nominal site center is approximately 2/3 of the way down the rock jetty from the parking lot, on the bay side of the jetty. Discrete collection stations included the site center and two other stations approximately 10 m away, on either side of the nominal site center.

BIVALVE COLLECTIONS

1995 *Mytilus sp.* was moderately abundant on the rocks of the jetty, although the population was comprised of fairly small individuals rather cryptically located on the sides and bottoms of the jetty's rocks. Collected organisms ranged from approximately 2.5 cm to 4.0 cm in shell length. The organisms which were collected at this site shared some external shell characteristics with *Mytilus sp.* making it difficult to know with certainty that only *Mytilus sp.* was collected until laboratory examination was completed.

1996 The site was sampled just after a severe winter storm. The breakwater was being subjected to high seas, so the site was moved to the inside of the breakwater. The discrete stations were as follows: Station 1 was at the base of the breakwater, Station 2 ten meters further out (southeast) and Station 3 another 10 m out along the wall. There was a good population of small *Mytilus sp.* mussels growing along the breakwater. Collected mussels ranged from 3.0 cm to 4.4 cm in shell length. The average shell length was 3.8 cm with a standard deviation of 0.3 cm for 36 collected individuals.

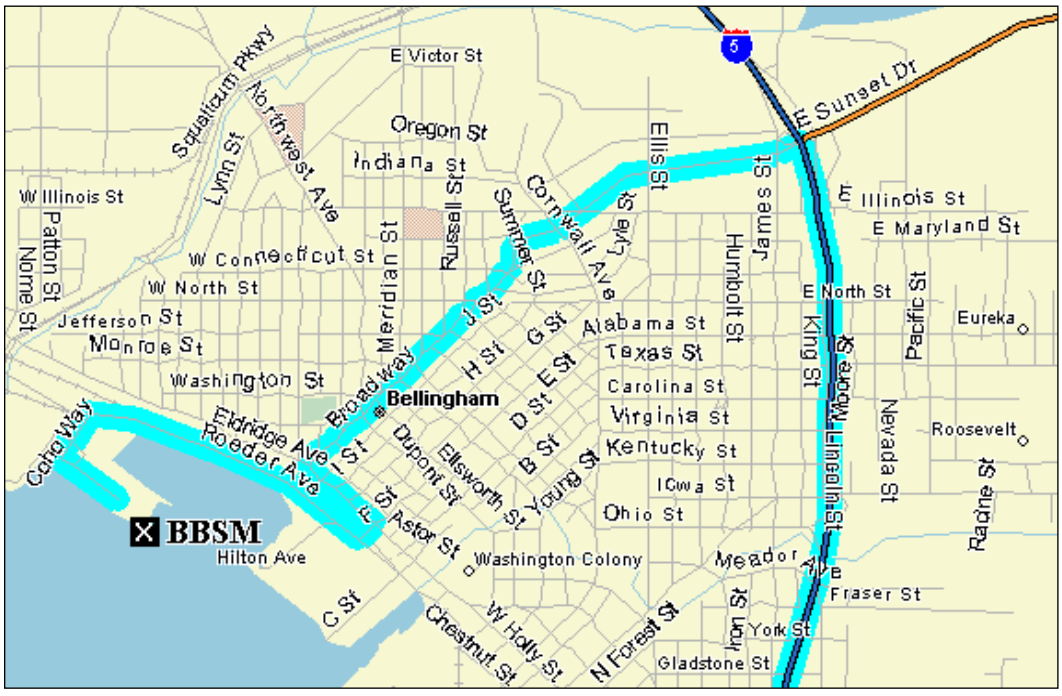
1997 No collection.
1998 Small sized individuals of *Mytilus sp.* mussels were abundant on the rocks of the jetty. Collected mussels ranged from 1.4 cm to 4.0 cm in shell length. The average shell length was 2.7 cm with a standard deviation of 0.5 cm for 160 collected individuals.
1999 No collection.
2000 Abundant medium to large sized *Mytilus sp.* mussles were present at Station1 with larger mussels being found at Stations 2 and 3.

SEDIMENT COLLECTIONS
1995 No collection.
1996 The sediment sample was collected from the nominal site center about 0.5 mile to the southwest of the bivalve site. The location was 48° 44.75' N and 122° 30.70' W in about 11 meters of water.
1997 No collection.
1998 No collection.
1999 No collection.
2000 No collection.

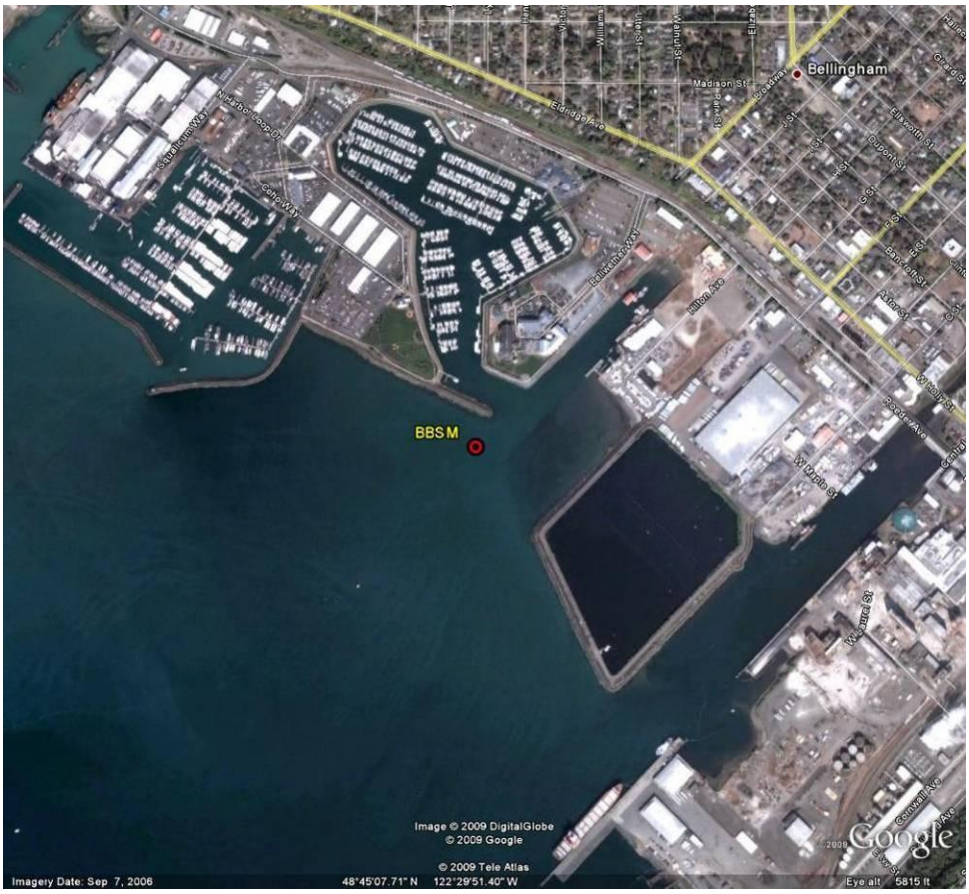
SAMPLING METHODS
Bivalves - hand
Sediments - stainless steel sediment grab and stainless steel scoop

WATER DEPTH - intertidal, +0.25 m MLLW.

POSSIBLE CONTAMINANTS – Potential sources of contamination include urban runoff from this heavily industrialized area including a large fishing, timber and pulp and paper industries.



Map of access route to BBSM site.



Aerial view of location of BBSM nominal site center.

Washington State collaborators notes on

Bellingham Bay, Squalicum Marina Jetty (BBSM)

Date sampled: January 26th, 2010 starting at 5:00 pm
Site Center coordinates: 48° 45.179' N, 122° 29.895' W
Water temperature: 7° C
Salinity: 21 $^{o}/_{oo}$

Sampler Information - Eight volunteers from the Whatcom County MRC sampled BBSM.

Volunteer Site Lead - Melissa Roberts
Title: Planner I - Natural Resources
Whatcom County Public Works
322 N. Commercial St., Ste. 110
Bellingham, WA 98225
(360) 676-6876 ext. 50259

MRoberts@co.whatcom.wa.us

Melissa also represents the Whatcom County MRC and suggested additional volunteers for assisting at the remote Whatcom County, Point Roberts-Point Roberts (PRPR) site (see Appendix C.8).

All volunteers attended a Mussel Watch training on Friday, January 22nd from 12:30 – 5:30 pm at the Bellingham Civic Center Building; 322 N. Commercial St, Bellingham.

Special note for volunteer recruitment - because vigorous climbing on large boulders was required to access the jetty, this site may be difficult for volunteers who have trouble with climbing and/or balance.

Volunteers accessing BBSM site; climbing required over substrate made up of large boulders.

Potential future contact source for volunteers (not contacted for this field season):
Wendy Steffensen - North Sound Baykeepers
(360) 733-830
waters@re-sources.org

Site Access - During the field portion of Mussel Watch Volunteer Training, volunteers alerted PSAMP staff that a large sign on Squalicum Harbor marina jetty read, "**Closed to Public Access**". PSAMP staff called the Bellingham Bay Harbor Master the following day and obtained permission for Mussel Watch volunteers to access the jetty on their scheduled date for sampling. Mike Endsley (the current Harbor Master) indicated that the Bay authorities would allow volunteer samplers only after assurances that WDFW would cover "L&I" for all volunteers: the Bay authorities did not want to be held liable for any accidents volunteers may have suffered while on the jetty. To address this issue, we assured Mike Endsley that each Mussel Watch volunteer had filled out a WDFW Volunteer Registration Form, which includes L&I coverage for the volunteer while performing work for WDFW.

Mike Endsley, Bellingham Bay Harbor Master
360-676-2542, ext 370

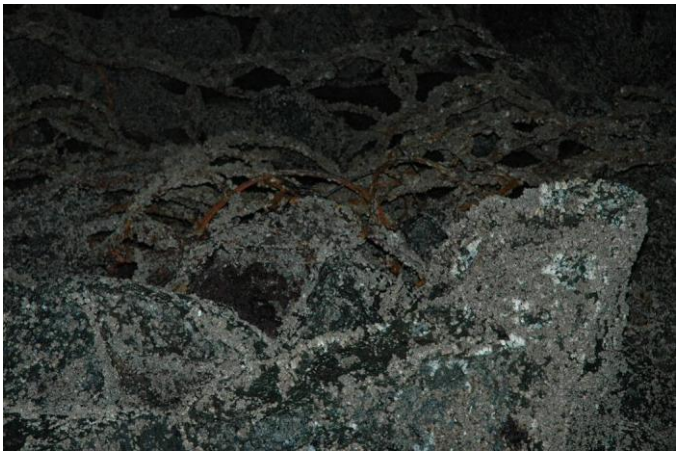
mikee@portofbellingham.com

Site Description, Observations and General Notes – Volunteers sampled on the exposed side of the jetty, i.e., not on the marina side. About five boats were seen coming and going during sampling. Large greywacke boulders (sedimentary rock) made up jetty. Lots of limpets were noted high on the rocks. There was a patchy distribution of small (<1 inch) mussels growing in the rock crevasses, but no large mussels were found. Barnacles covered most of the exposed surfaces and were also very small.

Volunteers rinsing, counting, and bagging mussels collected at BBSM site.

Substrate description for all stations was noted as "large boulders with barnacles".

Potential Sources of Contamination Noted – One creosote pile was noted approximately 20 feet from the shore in between stations two and three. Some pieces of old nets were twisted and wedged in the rocks. A matrix of rusty steel cables was mixed in with the rocks and boulders of the jetty. Driftwood also seen wedged in between the rocks.



Matrix of rusty steel cables mixed in with rocks and boulders at BBSM site.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Bellingham Bay – Squalicum Marina Site Code: BBSM

Date: 1-26-2010 Time Arrive: 1700 Time Leave: 1843

Latitude: 48°45.179' Longitude: 122°29.895'

Weather: party cloudy, ~40s, no precip in last 24 hours

Mussel Collectors: Ruth Solfield, Doug Stark, Bonnie Blalock, Emily Duncanson, Brittney Hanisch

Data Recorder: Melissa Roberts GPS Make/Model: etrex Venture Garmin Elizabeth Kilanowski, Bert Rubash

SITE WATER PARAMETERS

Water Temperature (°C): 7.0°C Salinity (ppt): 21‰

Tidal Station: Bellingham Bay

Time of Low Tide: 8:02PM Height of Low Tide: -1.3 ft. [X] m. [ ]

STATION DESCRIPTIONS

STATION 1

Latitude: 48°45.175' Longitude: 122°29.873' Start Time: 1748

Station Description: large boulders, rock jetty, mussels growing within and on barnacle layer

Substrate: large boulders w/barnacles Height of Collection: 10' ft. [X] m. [ ]

Highest Distribution of Mussels *(compared to water level at time of collection)*: 12'

STATION 2

Latitude: 48°45.179' Longitude: 122°29.895 Start Time: 1740

Station Description: large boulder rock jetty, mussels growing within barnacles, ~~density~~ densely packed but very small sizes

Substrate: large boulders w/ barnacles Height of Collection: 16' ft. [X] m. [ ]

Highest Distribution of Mussels *(compared to water level at time of collection)*: ~~15'~~ NR 10'

STATION 3

Latitude: 48°45.193' Longitude: 122°29.937' Start Time: 1728

Station Description: large boulder rock jetty, mussels growing on rock + each other, in amongst barnacles

Substrate: large boulders w/ barnacles Height of Collection: 14', 12' ft. [X] m. [ ]

Highest Distribution of Mussels *(compared to water level at time of collection)*: 15'

Version 4 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
✓	Creosote	1 creosote pile approx. 20 ft. from shore in between station 2 and 3
	Oil on water	
	Oil on beach	
✓	Garbage	pieces of old nets twisted + wedged in rocks
✓	rusty steel cables	matrix of rusty steel cables mixed in w/ rocks + boulders of jetty
✓	driftwood	driftwood wedged in between rocks

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

exposed side of the jetty, boats coming + going (~5)
lots of limpets higher on rocks
large graywacke boulders (sedimentary rock)
patchy distribution of small (<1 inch) mussels growing in rock crevasses, no large mussels found, barnacles covered most exposed surfaces + were also very small

Washington State Mussel Watch data sheet (front and back) from the BBSM site.

Appendix C.2 Commencement Bay – Tahlequah Point

The Commencement Bay - Tahlequah Point site was successfully sampled by PSAMP staff on Monday, December 28th, 2009. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Commencement Bay, Tahlequah Point (CBTP)

TARGET SPECIES - *Mytilus species* SITE NUMBER -275

NOMINAL SITE CENTER - 47°19.855' N 122°30.262' W

LOCATED ON NOAA CHART – 18474_1

SITE ACCESS - This site is a walk-up, and is easily accessible. From Tacoma, cross over the Dalco Passage to Vashon Island, on the Point Defiance - Tahlaquah Ferry.

SITE DESCRIPTION - The site is located about 150 m to the east of the Tahlequah Ferry dock. There are the remains of an old wooden jetty structure on the beach at Tahlequah Point.

BIVALVE COLLECTIONS

1995 No collection.

1996 There was a very sparse population of small *Mytilus sp.* mussels growing on the rocks and pebble beach at the MLLW mark. The mussels were all encrusted with a heavy marine growth, and there was a good population of Rock Crabs and starfish. Collected mussels ranged from 3.2 cm to 4.5 cm in shell length. The average shell length was 3.8 cm with a standard deviation of 0.3 cm for 51 collected individuals

1997 No collection.

1998 There were numerous small *Mytilus sp.* mussels under rocks above the water line, approximately 3 feet above MLLW, and on the ferry pier pilings. *Mytilus sp.* was the prevalent species present at this site. Starfish were noted all over pilings eating barnacles. Collected mussels ranged from 1.3 cm to 3.1 cm in shell length. The average shell length was 1.7 cm with a standard deviation of 0.3 cm for 144 collected individuals.

1999 No collection.

2000 Small to medium sized *Mytilus sp.* mussels were very rare at this site. The whole area was searched for mussels all along the cobble beach approximately 100 meters east of the old pier (east of the ferry terminal) to the ferry terminal. Sufficient mussels were collected to provide only one composite sample. There appeared to be strong predation pressure on the mussels as the ones that were found were predominantly located between closely packed barnacles.

2004 Access beach via small steep path on east side of ferry ramp. Position logged is nominal as 300 yards of beach to east of and beneath ferry dock were searched and scavenged for the few mussels (Fay, 2005).

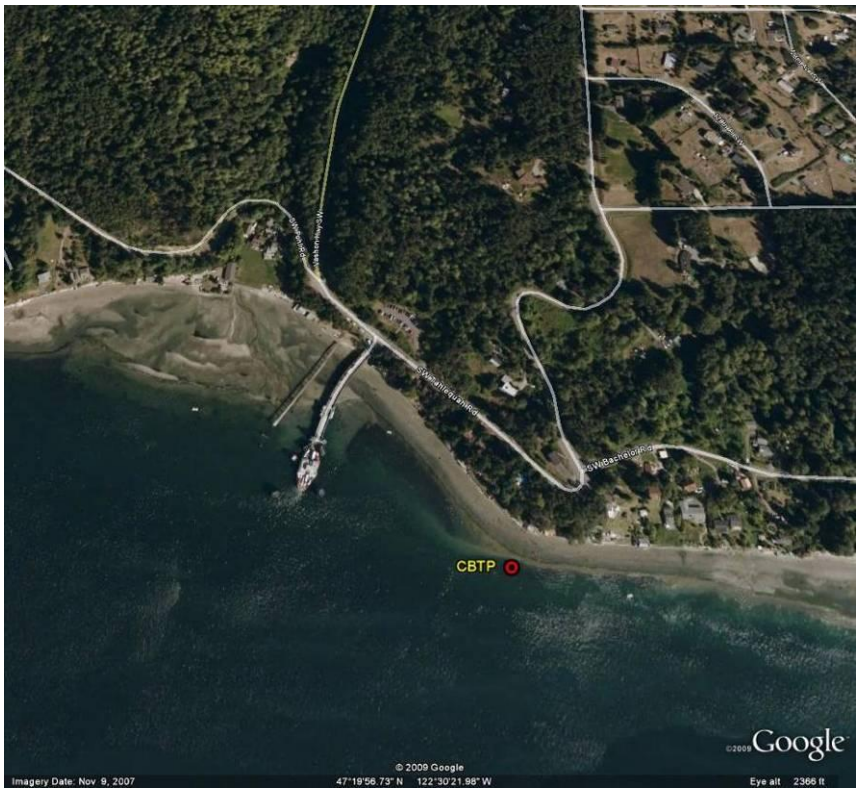
SEDIMENT COLLECTIONS
None, the sediment site is at Browns Point (CBBP).

SAMPLING METHODS
Bivalves - hand
Sediments - N/A

WATER DEPTH - intertidal, +0.5 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination aside from the ferry operations near the site.

Map of access route to CBTP site.



Aerial view of location of CBTP nominal site center.

Washington State collaborators notes on

Commencement Bay, Tahlequah Point (CBTP)

Date sampled: December 28th, 2009, starting 5:30 pm
Site Center coordinates: 47° 19.855' N, 122° 30.262' W
Temperature: 8.9° C
Salinity: $35^{o}/_{oo}$

Sampler Information – Three PSAMP staff sampled CBTP.

Site Lead - Jennifer Lanksbury
Fish & Wildlife Biologist
Puget Sound Assessment and Monitoring Program
Washington Department of Fish & Wildlife
600 Capitol Way N
Olympia, WA 98501-1091
360-902-2820
Jennifer.Lanksbury@dfw.wa.gov

Site access - Easy access to the site occurred via a path to the west of the Point Defiance - Tahlequah Ferry terminal entrance (look for large cement barriers). We walked under the ferry terminal and found the nominal site center after about a five minute walk along the beach to the east of the current ferry terminal.

Convenient beach access point situated between large cement barriers to the west of the Point Defiance-Tahlequah ferry terminal.

Site description, Observations and General Notes - Most mussels were found among large boulders near the high tide line at the old lighthouse/ferry terminal. Substrate included boulders, large cobble mixed with some sand, and concrete walls.

Old light house/ferry terminal near nominal site center for CBTP. Creosote construction noted here.

Potential Sources of Contamination Noted – The old pilings of former ferry terminal found on the beach were creosote, there were also some creosote retaining walls on the beachfront homes there. Some retaining walls were also made of concrete. We found a dead harbor seal just below the current ferry terminal dock, which was about a five minute walk west of the site center.

Concrete and natural rock construction of some retaining walls at sampling stations for CBTP site; creosote retaining walls not shown.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Commencement Bay-Tahlequah Point Site Code: CBTP

Date: 12/28/2009 Time Arrive: 5:30 pm Time Leave: 7:00pm

Latitude: 47° 19.855' N Longitude: 122° 30.262' W

Weather: Clear

Mussel Collectors: J. Lanksbury, S. Quinnell, S. Orlaineta

Data Recorder: ~~SO~~ S. Orlaineta

SITE WATER PARAMETERS

Water Temperature (°C): 48° Salinity (ppt): ~~35~~ ppt

Tidal Station: Tahlequah, Neil Pt., Dalco Passage, Vashon I.

Time of Low Tide: 8:14PM Height of Low Tide: -0.4 ft. ☐ m. ☒

STATION DESCRIPTIONS

STATION 1

Latitude: 47.33130 Longitude: 122.50494 Start Time: 5:31pm

Station Description: facing water, just to the right of old ferry pilings on big boulders, old abandoned light house behind ~ 62m

Substrate: Cobbel / Bolder Height of Collection: 3-4 ft. ☑ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: "

STATION 2

Latitude: 47.33149 Longitude: 122.50548 Start Time: 6:00

Station Description: Long concrete wall w/ large boulders infront. WSW of site center ~ 170m

Substrate: Boulders / cobbel Height of Collection: 3-4 ft. ☑ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: "

STATION 3

Latitude: 47.33105 Longitude: 122.50275 Start Time: ~~6:35~~ 6:37

Station Description: In front of stone stairway east of site center ~ 122 m away from site ctr.

Substrate: Sand / boulders Height of Collection: 3-4 ft. ☑ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: "

Version 3 – 2009

Check Boxes for Site Conditions:

✔	Condition	Description
✓	Creosote	Old pilings of former ferry terminal on beach also some retaining walls of shoreline homes
	Oil on water	
	Oil on beach	
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Dead harbor seal just below ferry dock (near current ferry terminal west of site).

Washington State Mussel Watch data sheet (front and back) from the CBTP site.

Appendix C.3 Elliott Bay – Duwamish Head

The Elliott Bay - Duwamish Head site was successfully sampled by volunteers from the Seattle Aquarium on Tuesday, January 26th, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Elliott Bay, Duwamish Head (EBDH)

TARGET SPECIES - *Mytilus species* SITE NUMBER -279

NOMINAL SITE CENTER - 47° 35.750' N 122° 23.300' W

LOCATED ON NOAA CHART - 18449

SITE ACCESS - This site is a walk-up, and is easily accessible. From U.S. Highway 5 in Seattle, take Exit 163 west onto the West Seattle Freeway. Then take the exit north onto Harbor Ave. SW and continue on to Duwamish Head. A small boat is needed if sediment samples are to be collected. There is a good public boat at Armeni Park.

SITE DESCRIPTION - The site is located just to the southeast of Duwamish Head, on Harbor Ave. SW at the Luna Park. The three discrete stations are located on the east, north and west sides of the stone seawall that form the three sides to the park.

BIVALVE COLLECTIONS

1995 No collection.

1996 There was a good population of small *Mytilus sp.* mussels growing on the rock seawall, below the Luna Park. The mussels were all encrusted with barnacles. Collected mussels ranged from 3.5 cm to 4.9 cm in shell length. The average shell length was 4.2 cm with a standard deviation of 0.3 cm for 36 collected individuals.

1997 No collection.

1998 Small to medium *Mytilus sp.* mussels were abundant growing on the north and west sides of the seawall. The east wall was not sampled as it was being reinforced at the time of collection (no mussels were present as a result). Collected mussels ranged from 2.9 cm to 7.5 cm in shell length. The average shell length was 4.1 cm with a standard deviation of 0.7 cm for 92 collected individuals.

1999 No collection.

2000 Medium sized *Mytilus sp.* mussels were abundant growing on the north, east, and west sides of the seawall. The mussels were encrusted with barnacles.

2004 Collected from the rocks at the mud line of flats surrounding the park bulkhead. Small scattered mytilus were found all around the park on the vertical walls, but heavily interspersed with barnacles (Fay, 2005).

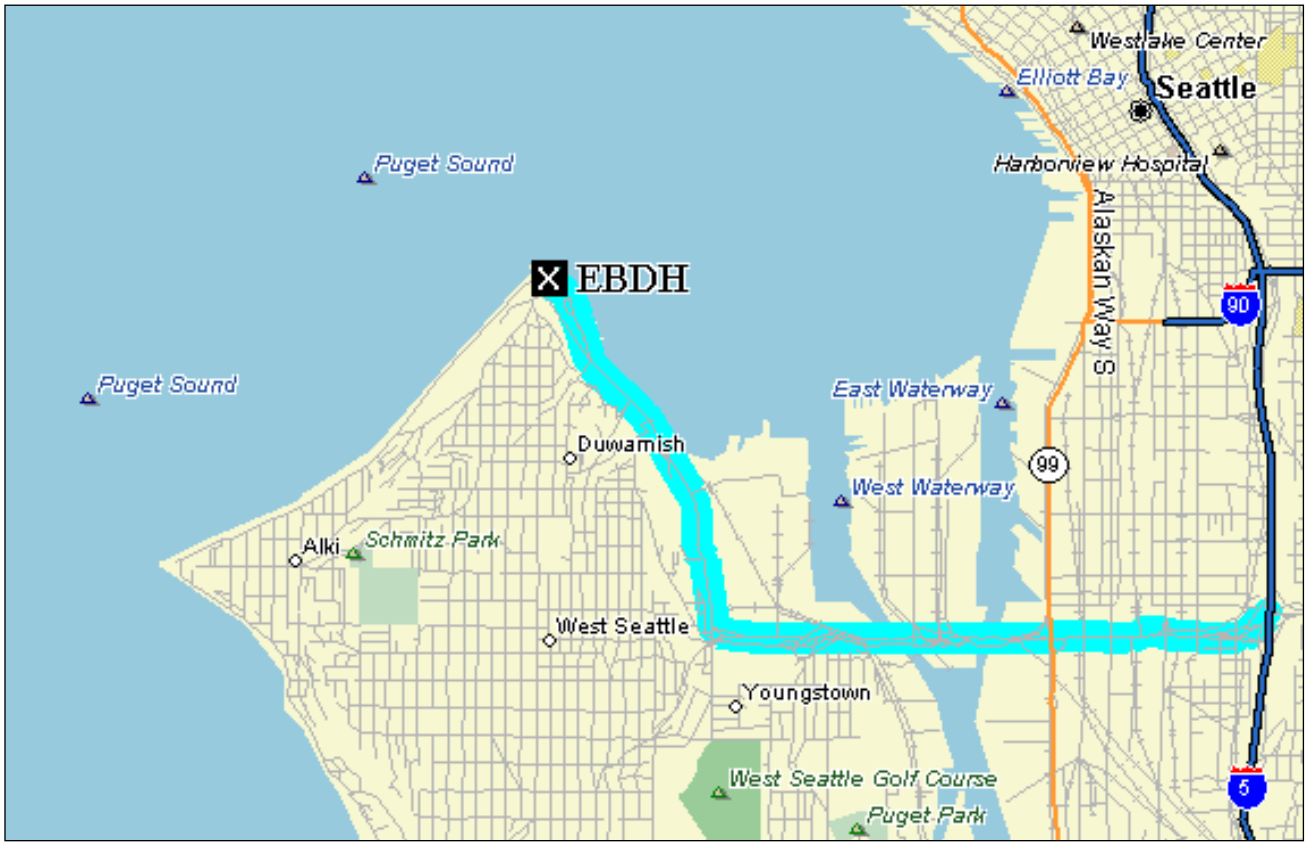
SEDIMENT COLLECTIONS

1995 No collection.
1996 The sediment sample was collected near the nominal site center, about 0.5 mile to the north of the bivalve site in Elliott Bay, in about 100 m of water.
1997 No collection.
1998 No collection.
1999 No collection.
2000 No collection.

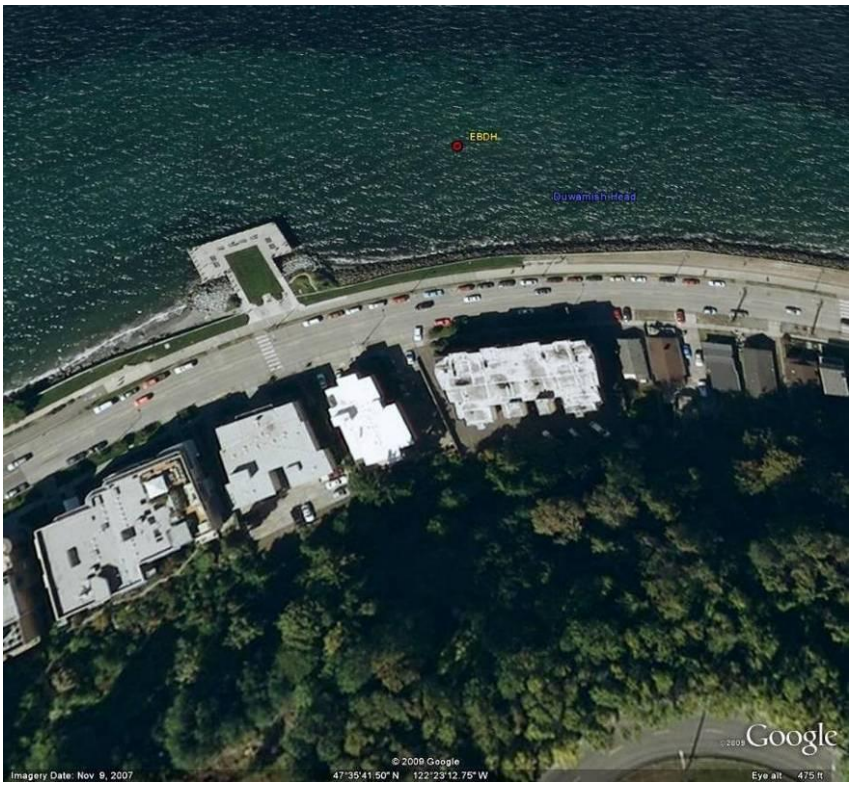
SAMPLING METHODS
Bivalves - hand
Sediments - stainless steel sediment grab and stainless steel scoop

WATER DEPTH - intertidal, +1.5 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination.



Map of access route to EBDH site.



Aerial view of location of EBDH nominal site center.

Washington State collaborators notes on

Elliott Bay, Duwamish Head (EBDH)

Date sampled: January 26th, 2010 starting at 8:25 pm
Site Center coordinates: 47º 35.728' N, 122 º 23.261' W
Temperature: 9° C
Salinity: $30^{o}/_{oo}$

Sampler Information – Fourteen volunteers sampled EBDH.

Volunteer Site Lead - Janice Mathisen
Community Outreach Coordinator
Seattle Aquarium
1483 Alaskan Way
Seattle, WA 98101
(206) 386-4365
Janice.Mathisen@seattle.gov

All volunteers attended a Mussel Watch training on Saturday, January 23rd from 12:30 to 5:30 pm at the Seattle Aquarium, 1483, Alaskan Way, Seattle, WA.

Site Access – The Volunteer Site Lead went to the EBDH site earlier in the day (well in advance of sampling) to photograph site access. On the date of sampling some broken glass was noted on the beach.

Site Description, Observations and General Notes – The substrate was noted as mostly sand and large rocks which formed a riprap wall. Volunteers found limpets, fucus, aggregating anemones, periwinkles, eelgrass, shaggy mouse nudibranch eggs, a variety of chitons, mottled sea stars, and many juvenile sea stars at the site.

Volunteers using refractometer to obtain salinity data at EBDH site.

Volunteers collecting, rinsing and bagging mussels, and recording data at EBDH site.

Volunteers at EBDH did not have a GPS unit available to them for recording Site Center and Station coordinates on the evening of sampling. To mitigate this problem the volunteers pinpointed Site Center and three Station locations on a close-up satellite photograph of the

location (Figure 1). The coordinates for each location were then estimated using matching satellite imagery and a coordinate locator available on the ArcGIS Explorer program. Volunteers noted that the Site Center was located at the seaward, middle piling of a 91 foot wide concrete platform that extended over the beach below the seawall (Figure 1). Station one was under the concrete platform among riprap backing up to the base of seawall.

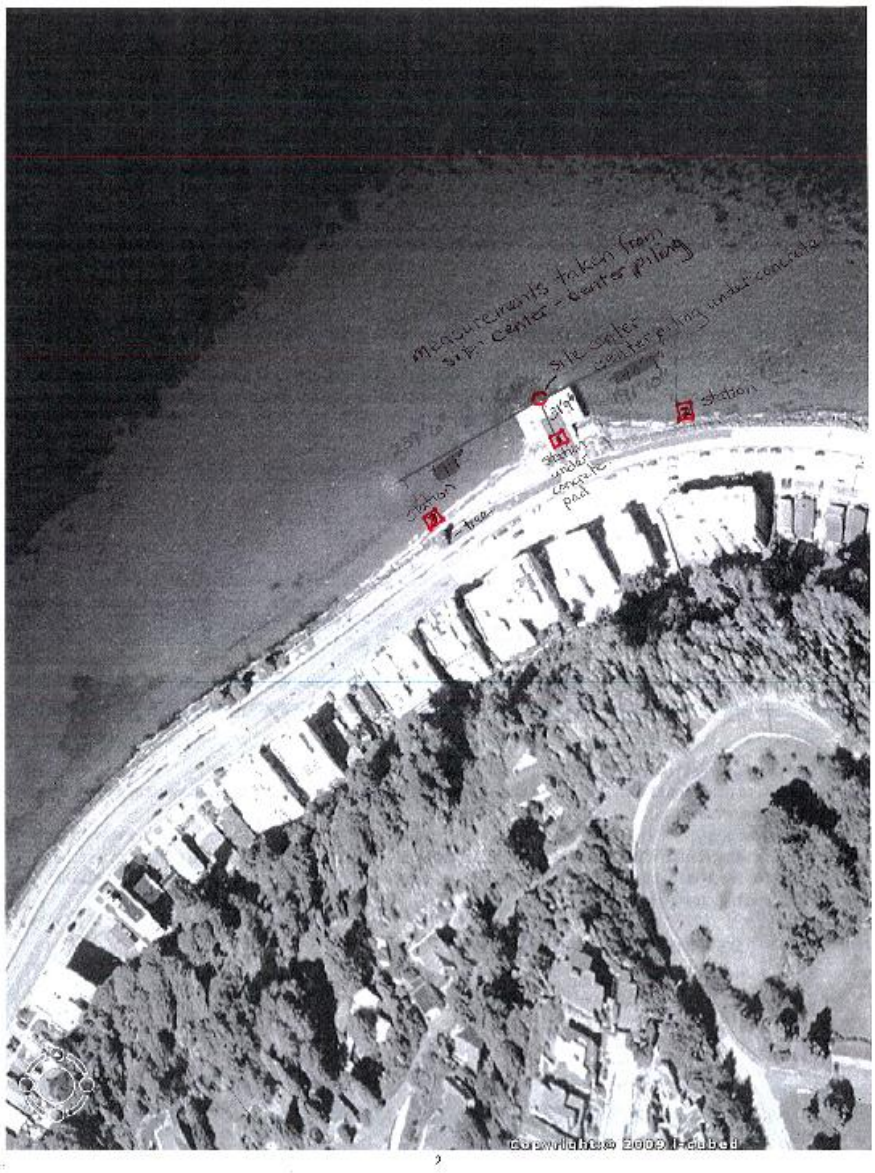


Figure 1. Satellite map used by volunteers to indicate EBDH Site Center and Station locations, which are indicated in red.

Potential Sources of Contamination Noted – A small run-off outflow pipe was noted at the base of the sea wall near station three.

Run-off outlflow pipe noted near Station three of EBDH. Photo taken prior to low tide sampling window.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Elliott Bay – Duwamish Head Site Code: EBDH

Date: 1-26-2010 Time Arrive: 18:25 Time Leave:

Latitude: will figure from map (per J. Lanksbury WDFW) Longitude: Station 1 19:05 Station 2 19:15 Station 3 19:27

Weather: clear, calm, air temp mid 40s° F

Mussel Collectors: Charlotte Spang, Marci Greenberg, Bob Brenner, Erin Richmond, Jenny East, Kathleen Ryan, Gretchen Frankenstein, Derek Ttermsen, David Todd, Stacey Panek Noelle Congdon,

Data Recorder: Janice Mathisen GPS Make/Model:

SITE WATER PARAMETERS

Water Temperature (°C): 9°C Salinity (ppt): 30 ppt

Tidal Station: Elliott Bay

Time of Low Tide: 7:43PM Height of Low Tide: -1.2 ft. [X] m. [ ]

STATION DESCRIPTIONS

STATION 1

Latitude: Longitude: Start Time: 18:25

Station Description: From site center (site center: sea ward center piling under concrete platform) 31'9" south toward sea wall under concrete platform to large rocks making up rip rap backing up to base of sea wall

Substrate: sand, large rock rip rap Height of Collection: +4.5 ft. [X] m. [ ]

Highest Distribution of Mussels *(compared to water level at time of collection)*: +5'

STATION 2

Latitude: Longitude: Start Time: 18:00

Station Description: 191'10" east of site center, then south to rip rap at base of sea wall. Large boulder rip rap on sand, rip rap backs up to sea wall. Shallow slope

Substrate: sand, large rocks forming rip rap Height of Collection: + 6 ft. [X] m. [ ]

Highest Distribution of Mussels *(compared to water level at time of collection)*: 10'

STATION 3

Latitude: Longitude: Start Time: 18:21

Station Description: From site center, 239'6" west, then turn south to rip rap. Station is below a large pine tree at top of seawall. Large boulders, part of rip rap along seawall (fucus, barnacles, mussels, anemones). Small run-off outflow pipe at base of sea wall

Substrate: Sand, large rocks forming rip rap Height of Collection: +8 ft. [X] m. [ ]

Highest Distribution of Mussels *(compared to water level at time of collection)*: + 10 ft

Version 4 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
✓	Garbage	some broken glass

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Sand substrate, large boulders making up rip rap that back up to the sea wall. Concrete platform 91' wide extends over the beach below the sea wall. Site center is the seaward, middle piling. See map for exact placement.

We found limpets, Fucus, aggregating anemones, periwinkles, eel grass, shaggy mouse nudibranch eggs, a variety of chitons, mottle sea stars, many juvenile sea stars

Washington State Mussel Watch data sheet (front and back) from the EBDH site.

Appendix C.4 Elliott Bay – Four-Mile Rock

The Elliott Bay – Four-Mile Rock site was successfully sampled by a group of Mussel Watch collaborators and volunteers on Monday, December 14th, 2009. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Elliott Bay, Four-Mile Rock (EBFR)

TARGET SPECIES - *Mytilus species* SITE NUMBER -280

NOMINAL SITE CENTER - 47° 38.330' N 122° 24.830' W

LOCATED ON NOAA CHART - 18449

SITE ACCESS - This is a walk-up site that is easily accessible at low tide. Take Exit 166 on U.S. Highway 5 in Seattle, and head west down Denny Way. At the end of Denny Way, turn right (north) onto Western Ave. which goes into Elliott Ave. West. Continue on and take the right exit go over the Magnolia Bridge and up the hill onto Magnolia Way West. At the stop sign, turn left onto W. Howe St. and cross the bridge, and turn left again onto Magnolia Blvd. Turn left again onto W. Raye St. and drive down the hill to the bottom. Take a left on Perkins Lane. Look for a 6' high yellow picket fence on the right, that spans the width of two properties with no buildings. This land is owned by the City Council, and lies directly above Four-Mile Rock. A small boat is necessary if sediments are to be sampled. There is a good small boat ramp at Duwamish Head, a few miles away to the south across Elliott Bay.

SITE DESCRIPTION - The site is located at Four-Mile Rock, a five meter high boulder lying just offshore and below Magnolia Bluff. The rock has a green navigation marker/light built on top of it. The discrete stations are located around the rock. Station 1 lies to the northeast on the pebble beach, Station 2 lies to the northwest and Station 3 lies to the southeast.

BIVALVE COLLECTIONS

1995 No collection.

1996 There was a very sparse population of small to medium sized *Mytilus sp.* mussels growing on Four-Mile Rock and the surrounding pebble beach area. All of the mussels were heavily encrusted with marine growth and barnacles. Collected mussels ranged from 3.2 cm to 5.0 cm in shell length. The average shell length was 3.9 cm with a standard deviation of 0.4 cm for 53 collected individuals.

1997 No collection.

1998 No mussels were present on Four Mile Rock. Sampled southeast of the rock where both *Mytilus sp.* and *Mytilus sp.* were present in a discrete zonation pattern with *Mytilus sp.* present in the more exposed upper zone and *Mytilus sp.* in the lower zone. The nominal site center was below flag pole at 47° 38.378' N, 122° 24.736' W. *Mytilus sp.* was small sized and rather scarce the sampling location. Collected mussels ranged from 1.8 cm to

7.5 cm in shell length. The average shell length was 2.6 cm with a standard deviation of 0.8 cm for 67 collected individuals.

1999 No collection.

2000 Mussels were very rare on Four Mile Rock. Collected samples on boulders that were located slightly southeast of Four Mile Rock. There were very large numbers of very small mussels at this site. Both *Mytilus sp.* and *Mytilus sp.* were abundant with small to medium sized *Mytilus sp.* mussels collected at three stations on the boulders along the beach. Station 2 was the site center with Stations 1 and 3 being approximately 25 meters on either side of the center station. The hillsides in the general vicinity (towards Seattle) have slumped into the sound and several buildings have been condemned within sight of the site.

2004 Mussels were abundant on the rock up to a height of 6 feet and on the rocks and debris of the beach. Access is possible by safe wading 1- 2 feet above this tide level (Fay, 2005).

SEDIMENT COLLECTIONS

1995 No collection.

1996 Fine grained sediments were collected near the nominal site center, at 47° 37.68' N and 122° 24.33' W in about 45 meters of water.

1997 No collection.

1998 No collection.

1999 No collection.

2000 No collection.

SAMPLING METHODS

Bivalves - hand

Sediments - stainless steel sediment grab and stainless steel scoop

WATER DEPTH - intertidal, +0.5 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination.

Map indicating location of EBFR site.

Aerial view of location of EBFR nominal site center.

Washington State collaborators notes on

Elliott Bay, Four-Mile Rock (EBFR)

Date sampled: December 14th, 2009, starting at 7:40 pm
Site center coordinates: 47º 38.350' N, 122º 24.738' W
Temperature: 7.2° C
Salinity: $30^{o}/_{oo}$

Sampler Information – Ten collaborators from the National Mussel Watch program (1), PSAMP (3), SCMRC (4), Washington Sea Grant (1) and Seattle Aquarium (1) helped to sample at the EBFR site. Since this was the first Mussel Watch site in Washington to be sampled in the 2009/10 field season, it was attended by a representative for the National Mussel Watch program and most of the Washington State collaborators involved.

Site Lead - Jennifer Lanksbury
Fish & Wildlife Biologist
Puget Sound Assessment and Monitoring Program
Washington Department of Fish & Wildlife
600 Capitol Way N
Olympia, WA 98501-1091
360-902-2820
Jennifer.Lanksbury@dfw.wa.gov

Site Access – Directions to site were adequate, though the yellow color of the picket fence marking the site entrance was difficult to see at night and in the rain. We also note that parking was limited along the side of the narrow road near the beach access point and turning the vehicles around to leave after sampling was difficult. There was a moderately steep trail leading from the opening in the fence to the beach below.

Site Description, Observations and General Notes – The beach was made up of cobble, rip-rap and large boulders. We noted abundant, though relatively small, mussels. Mussels were sampled from the landward side of Four-Mile Rock below Magnolia Bluff, and from large the rip-rap boulders around it.

Collaborators sampling mussels from riprap and recording data at EBFR site.

Potential Sources of Contamination Noted – No obvious sources of contamination were evident. The day following sampling there was a news story of a sewage spill from the West Point Sewage Treatment Plant, just to the north of the EBDH, that occurred on the night of our sampling. However, one of the collaborators (Lincoln Loehr, a former Oceanographer affiliated with the SCMRC) noted the following information in an e-mail reply (dated 12/15/2009) to the concerned collaborators:

> "The [sewage] spill happened last night, resulting in a release on the north side of West Point between 10 pm and 1 am. We were on the south side of West Point, about a mile away, with the wind blowing to the north, and the ebb currents going towards West Point. We were out of there before 10:00 pm. So, both in time, space, and direction of water movement, we had no exposure to the sewage spill at West Point."

Thus we felt confident keeping the mussels collected at EBFR on the night of 12/14/2009 and sending them to their respective laboratories for analysis.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Elliot BAY 4 MILE Rock Site Code: EBFR

Date: 12-14-09 Time: 7:40 PM Map Datum: NAD83

Latitude: 47.63917 Longitude: -122.41230

Weather: Mediun Rain ~ 32° F, Dark & Cloudy, wind 10 to 20 kts

Site Condition: Cobble beach, rip-rap & a large boulder lots of Fmussels - but small

SITE WATER PARAMETERS

Water Temperature (°C): 45° F

Salinity (ppt): 30

Tide: Shilshoal Bay Marina Lowest Tide 9:28 PM

STATION DESCRIPTIONS

STATION 1

Latitude: 47.63900 Longitude: 122.41349

Description: Landward side of 4 mile rock w/ Lighthouse on it's top 8:10

Collectors: Amy Johnson Steve Quinnell Andrea Hennings Same as Sta 2. Height of Collection (m): 5-6 ft

STATION 2

Latitude: N47.63877 Longitude: W 122.41275

Description: large rip-rap by shore, about ~~100~~ 70 m To The east of 4 mile rock

Collectors: A. Johnson, S. Quinnell, A. Hennings, K. Herrmann, K. Little J. Matheson, J. West. Height of Collection (m): 5-6 ft.

STATION 3

Latitude: N 47.63851 Longitude: W 122.41242

Description: large rip rap about 100 m To The east of 4 mile rock

Collectors: Same as Sta 2 Height of Collection (m): 5-6 ft

Version 2 – 2009

Site	Site Code
Puget Sound, South Seattle	PSSS
Elliott Bay, Four-Mile Rock	EBFR
Commencement Bay, Tahlequah Point	CBTP
Whidbey Island, Possession Point	WIPP
Sinclair Inlet, Waterman Point	SIWP
Whidbey Basin, Eide Road	PSER
Puget Sound, Hermosa Point	PSHP
Whidbey Basin, Kayak Point	PSKP
Puget Sound, Mukilteo Ferry**	PSMF
Whidbey Basin, Cavalero County Park	PSCC
Puget Sound, Everett Cemex	PSEC
Puget Sound, Edmonds Marina	
Puget Sound, Edmonds Ferry**	PSEF
Whidbey Basin, Hat Island	PSHI
Puget Sound, Everett Harbor**	PSEH
South Puget Sound, Budd Inlet	SSBI
Puget Sound, Hood Canal	PSHC
Puget Sound, Port Angeles	PSPA
Elliott Bay, Duwamish Head	EBDH
Puget Sound, Port Townsend	PSPT
Point Roberts, Point Roberts	PRPR
Bellingham Bay, Squalicum Marina Jetty	BBSM
Willapa Bay, Nahcotta	WBNA
Columbia River, North Jetty	CRNJ
Grays Harbor, Westport Jetty	GHWJ
Juan de Fuca Strait, Cape Flattery	JFCF

Shaded sites to be samples by SCMRC

Washington State Mussel Watch data sheet (front and back) from the EBFR site. This was an early proto-type version of the Washington State Mussel Watch data sheet, which was later updated to include space for writing on the back (see data sheets from other sites).

Appendix C.5 Elliott Bay – Myrtle Edwards

The Elliott Bay – Myrtle Edwards (EBME) site was was added for the 2009/10 field season by PSAMP staff as a replacement for the abandoned Puget Sound – South Seattle (PSSS) site (see Appendix D.6). Because the PSSS site had no mussels available for collection, and previous records revealed that it had already been "abandoned" since 2004, PSAMP staff proposed sampling be relocated to a site inside Elliott Bay, along the Seattle waterfront, for this sampling year. This urban EBME site was co-located near long-term PSAMP sites where bottom fish (English sole) and pelagic species (fish and plankton) are already monitored for contaminants. The addition of a Mussel Watch site located within Elliott Bay will help to illustrate the urban-to-non-urban gradient between Puget Sound's most contaminated embayment, and the two Mussel Watch stations that bracket the bay, i.e. Four-Mile Rock (EBFR) and Duwamish Head (EBDH). National Mussel Watch Program funds from the PSSS site will be reallocated, on a one-time basis, to pay for EBME analysis in 2010. Further discussion is needed as to whether Mussel Watch and/or the Washington State collaborators should establish an additional Central Puget Sound site to replace PSSS in future years.

The EBME site was successfully sampled by a member of the PSAMP staff and volunteers on Monday, February 22nd, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

Washington State collaborators notes on

Elliott Bay, Myrtle Edwards (EBME)

TARGET SPECIES - *Mytilus species* SITE NUMBER – NA (PSAMP pilot site)

NOMINAL SITE CENTER – 47.62583 -122.37273

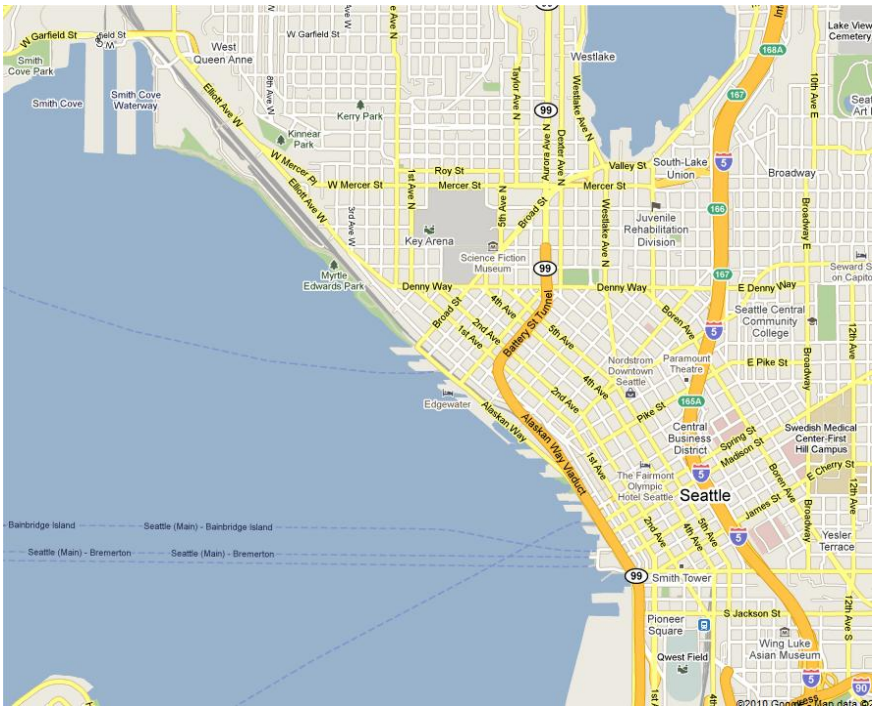
SITE ACCESS - This site is located just north of Myrtle Edwards Park, near the Elliott Bay Fishing Pier on the Seattle waterfront. From I-5 in Seattle take Exit 165 (left side exit) and immediately turn right onto 6th Ave. Go four blocks and turn left onto Pine St. Turn right on 1st Ave, drive for many blocks then turn left onto Denny Way. Bear right onto Western Ave W, which becomes Elliott Ave W. Pass the intersection with W Mercer Place. After passing W Prospect St and W Lee St, turn right onto the on-ramp and follow it around to the left over Elliot Ave W and the railroad tracks. At end of ramp turn right onto W Garfield St, which quickly becomes Alaskan Way W. Follow Alaska Way W past a genetics research facility (Amgen) to the right, past the "Helix" Bridge to the left, going towards the large, gray grain elevators. When you see a sign that says "Public Access – Park and Bike Path" follow it to a small parking lot to the right.

SITE DESCRIPTION - The site is located along the riprap wall between the Elliott Bay Fishing Pier and the filling station/loading dock for the large grain elevator. Mussels are found in small groups on the riprap. Due to sparse abundance of mussels, this site is best sampled along a transect line instead of at discrete stations.

SAMPLING METHOD
Bivalves - hand

WATER DEPTH - intertidal, +0.4 m MLLW.

POSSIBLE CONTAMINANTS – Grain elevator loading dock pilings at south end of transect appeared to be creosote-treated. Elliott Bay Fishing Pier pilings appeared to be concrete. Some garbage noted along top of riprap wall. Heavy ferry and commercial boat traffic in Elliott Bay. The Duwamish River empties into Elliott Bay and flows past this site.



Map of access route to Mrytle Edwards park area (south of Site Center).

Satellite image of Site Center between public fishing pier and cargo loading dock of grain elevator.

Sign pointing to public parking next to grain elevator near EBME site.

Seattle Fishing Pier on north side of sampling transect and grain elevator loading dock with barge on south side of sampling transect. Riprap wall in foreground was sampled for mussels.

Date sampled: February 22nd, 2010, starting at 3:30 pm
Site Center coordinates: 47º 37.550' N, 122 º 22.364' W
Temperature: 8.2° C
Salinity: 28$^{o}/_{oo}$

Sampler Information – One PSAMP staff and four Seattle Aquarium volunteers sampled the EBME site.

Site Lead - Jennifer Lanksbury
Fish & Wildlife Biologist
Puget Sound Assessment and Monitoring Program
Washington Department of Fish & Wildlife
600 Capitol Way N
Olympia, WA 98501-1091
360-902-2820
Jennifer.Lanksbury@dfw.wa.gov

The volunteers had already attended a Mussel Watch training on Saturday, January 23rd from 12:30 to 5:30 pm at the Seattle Aquarium in preparation for sampling previously at the EBDH site. EBME was the second Mussel Watch site at which these volunteers assisted in collections.

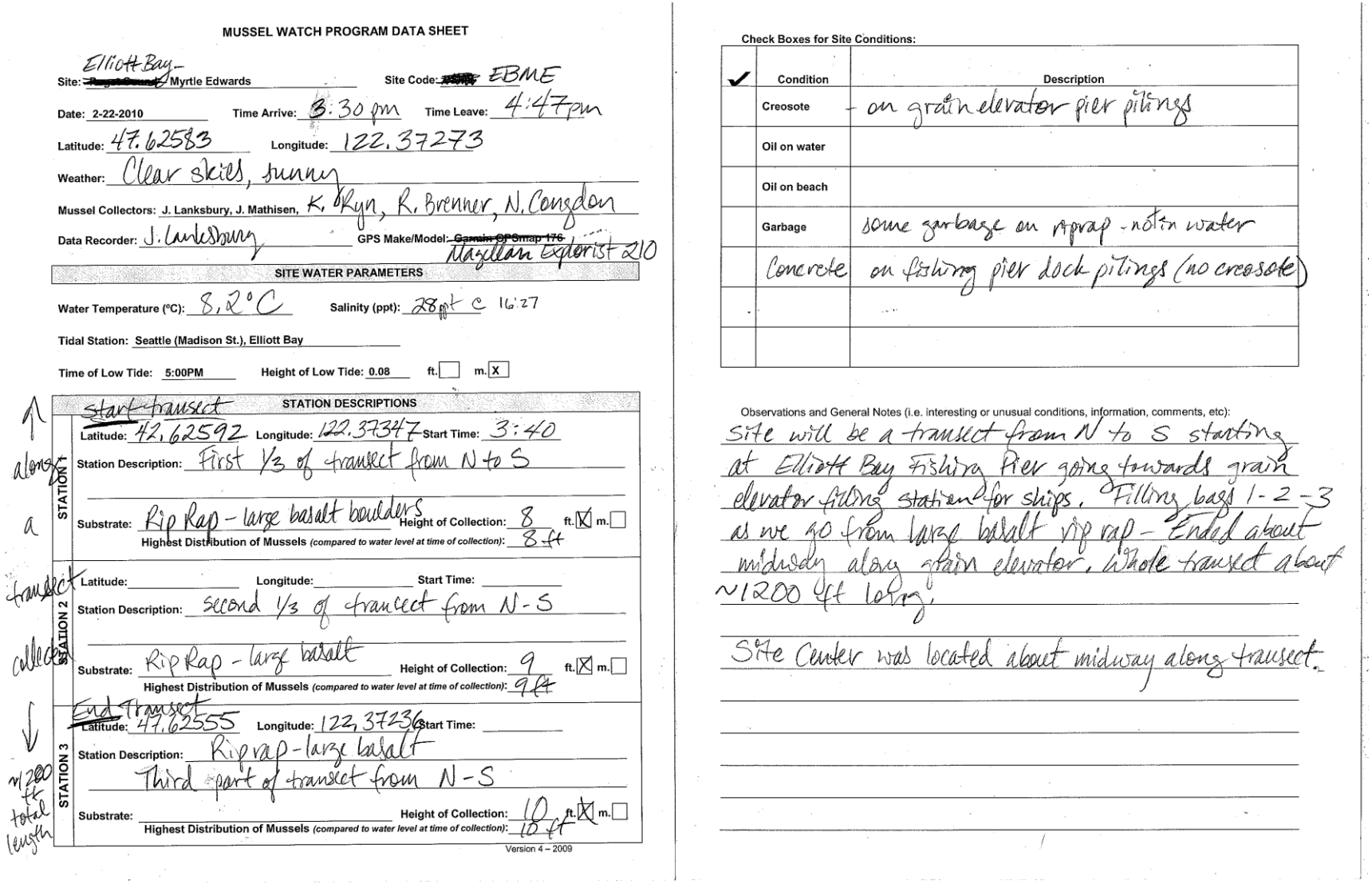
Site Access – see description above.

Site Description, Observations and General Notes – Due to a low abundance of mussels at any one location or boulder, this site was sampled in a transect from north to south starting at the Elliott Bay Fishing Pier and moving towards the grain elevator filling station. Station sample bags were filled with mussels in order (i.e. station 1 bag was filled along first 1/3 of transect, station 2 along second 1/3, and station 3 along third part of transect) as we moved along a line on the basalt riprap. The Site Center was located about midway along the sampling transect, at the

top of riprap wall and the entire transect was estimated to be about 1200 ft long. The substrate appeared to be basalt riprap boulders.

Volunteers searching riprap for mussels at EBME site; patchy abundance of mussels was noted.

Potential Sources of Contamination Noted – As noted above, creosote pilings made up part of the grain elevator filling station to south of site. The Elliott Bay Fishing Pier to north of the Site Center appeared to have concrete pilings. Some garbage was noted above the water line, among the rocks that made up riprap wall.



MUSSEL WATCH PROGRAM DATA SHEET

Site: Elliott Bay – Myrtle Edwards Site Code: EBME

Date: 2-22-2010 Time Arrive: 3:30 pm Time Leave: 4:47pm

Latitude: 47.62583 Longitude: 122.37273

Weather: Clear skies, sunny

Mussel Collectors: J. Lanksbury, J. Mathisen, K. O'Kyn, R. Brenner, N. Congdon

Data Recorder: J. Lanksbury GPS Make/Model: ~~Garmin GPSmap 176~~ Magellan Explorist 210

SITE WATER PARAMETERS

Water Temperature (°C): 8.2°C Salinity (ppt): 28 ppt @ 16:27

Tidal Station: Seattle (Madison St.), Elliott Bay

Time of Low Tide: 5:00PM Height of Low Tide: 0.08 ft. ☐ m. ☒

STATION DESCRIPTIONS

STATION 1

Start transect

Latitude: 42.62592 Longitude: 122.37347 Start Time: 3:40

Station Description: First 1/3 of transect from N to S

Substrate: Rip Rap – large basalt boulders Height of Collection: 8 ft. ☒ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): 8 ft

STATION 2

Latitude: Longitude: Start Time:

Station Description: second 1/3 of transect from N-S

Substrate: Rip Rap – large basalt Height of Collection: 9 ft. ☒ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): 9ft

STATION 3

End transect

Latitude: 47.62555 Longitude: 122.37236 Start Time:

Station Description: Riprap – large basalt

Third part of transect from N-S

Substrate: Height of Collection: 10 ft. ☒ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): 10 ft

Version 4 – 2009

↑ along a transect collected ↓ ~1200 ft total length

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	– on grain elevator pier pilings
	Oil on water	
	Oil on beach	
	Garbage	some garbage on riprap – not in water
	Concrete	on fishing pier dock pilings (no creosote)

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Site will be a transect from N to S starting at Elliott Bay Fishing Pier going towards grain elevator filling station for ships. Filling bags 1-2-3 as we go from large basalt rip rap – Ended about midway along grain elevator. Whole transect about ~1200 ft long.

Site Center was located about midway along transect.

Washington State Mussel Watch data sheet (front and back) from the EBME site.

Appendix C.6 Grays Harbor – Westport Jetty

The Grays Harbor – Westport Jetty (GHWJ) site was successfully sampled by volunteers on Sunday, February 28th, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Grays Harbor, Westport Jetty (GHWJ)

TARGET SPECIES - *Mytilus species* SITE NUMBER - 268

NOMINAL SITE CENTER - 46° 54.747' N 124° 7.047' W

LOCATED ON NOAA CHART - 18502

SITE ACCESS - This site is located on the seawall at the base of the jetty in Westport, on Gray's Harbor. Take Highway 105 into Westport, turn right onto Dock Ave. and then left onto Westhaven Drive at the stop sign. Locate the tall blue and white observation tower next to the Islander Restaurant/Motel. The collection site is on the seawall, just to the north of the observation tower.

SITE DESCRIPTION - The site center is on the bayward side of the seawall, north-northeast of the observation tower. Mussels were collected from the nominal site center and two other discrete stations separated by 15 m on either side of the site center.

BIVALVE COLLECTIONS

1995 *Mytilus sp.* was abundant. Collected organisms ranged from approximately 4.0 cm to 8.0 cm in shell length.

1996 There was a good population of small to medium sized *Mytilus sp.* mussels throughout the area. The mussels were generally located on the protected underside of the rocks, on the breakwater/seawall. Collected mussels ranged from 3.9 cm to 6.5 cm in shell length. The average shell length was 5.1 cm with a standard deviation of 0.7 cm for 54 collected individuals.

1997 No collection.

1998 Medium sized *Mytilus sp.* mussels were abundant at this site. Collected mussels ranged from 2.0 cm to 9.3 cm in shell length. The average shell length was 5.7 cm with a standard deviation of 1.4 cm for 42 collected individuals.

1999 No collection.

2000 A mixture of Blue and California Mussels were present. Care was taken to only collect *Mytilus sp.* mussels which were abundant and medium to large sized. *Mytilus sp.* mussels were found higher up in the intertidal zone when compared to *Mytilus sp.*.

2004 Mussels were abundant in large masses on tidally exposed rock jetty. (Fay, 2005)

SEDIMENT COLLECTIONS

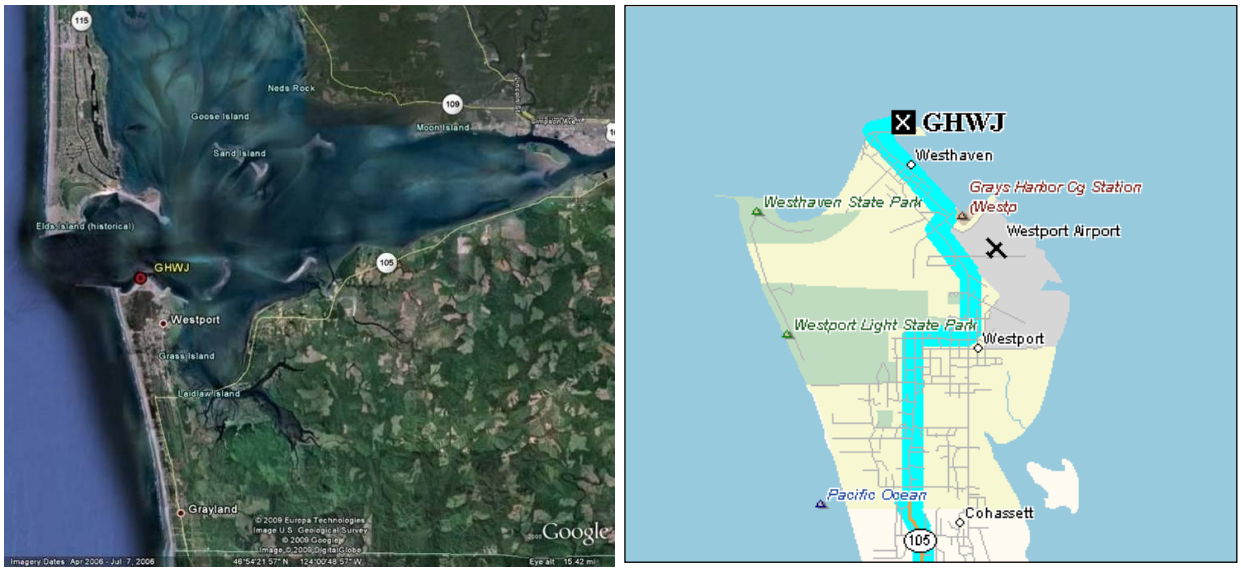
1995 No collection.

1996 No collection.
1997 No collection.
1998 No collection.
1999 No collection.
2000 No collection.

SAMPLING METHODS
Bivalves - hand
Sediments - N/A

WATER DEPTH - intertidal, +0.5 m MLLW.

POSSIBLE CONTAMINANTS – Potential sources include fishing, timber, and shipping industries located in the vicinity of the site.



Satellite image and road map of location of GHWJ site.

Close-up satellite image of GHWJ site.

Washington State collaborators notes on

Grays Harbor, Westport Jetty (GHWJ)

Date sampled: February 28th, 2010, starting at approximately 4:15 pm
Site Center = 46° 54.733'N, 124° 7.054' W
Water temp = 11.5° C
Salinity = 30 $^{o}/_{oo}$

Sampler Information – Eight volunteers from the Grays Harbor Marine Resource Committee sampled the GHWJ site.

Site Lead - Kathy Greer
Washington Pacific Coast Coordinator, Surfrider Foundation
PO Box 2293
Westport, Washington 98595
360-581-7060
kgreer@surfrider.org
http://www.surfrider.org/

All volunteers attended a Mussel Watch training on Saturday, February 20th from 12:30 – 4:30 pm at the Westport Maritime Museum, 2201 Westhaven Drive, Westport, WA.

Photo: © Kathy Greer 2010

Volunteers sampling along one side of the jetty at the GHWJ site.

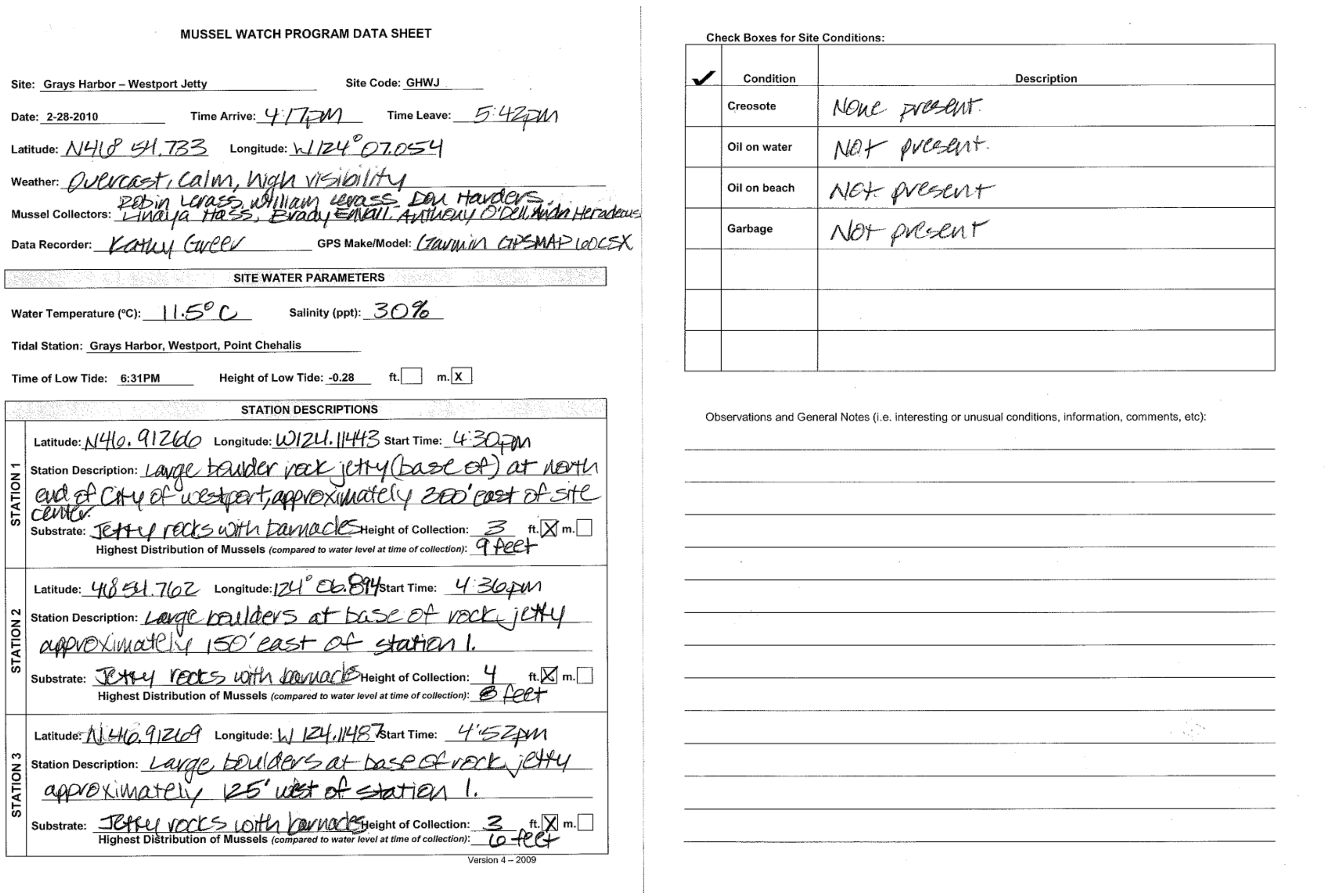
Photos: © Kathy Greer 2010

Volunteers sampling along the other side of the jetty at the GHWJ site.

Site Access – No problems noted.

Site Description, Observations and General Notes – Substrate description for all stations was, "large boulders with barnacles at base of jetty".

Potential Sources of Contamination Noted – No creosote, oil on water or beach, or garbage seen.



MUSSEL WATCH PROGRAM DATA SHEET

Site: Grays Harbor – Westport Jetty   Site Code: GHWJ

Date: 2-28-2010   Time Arrive: 4:17PM   Time Leave: 5:42PM

Latitude: N46° 54.733   Longitude: W124° 07.054

Weather: Overcast, calm, high visibility

Mussel Collectors: Robin Lerass, William Lerass, Dan Harders, Lindya Hass, Brady Enall, Anthony O'Dell, Alan Heradeus

Data Recorder: Kathy Greer   GPS Make/Model: Garmin GPSMAP 60CSX

SITE WATER PARAMETERS

Water Temperature (°C): 11.5°C   Salinity (ppt): 30%

Tidal Station: Grays Harbor, Westport, Point Chehalis

Time of Low Tide: 6:31PM   Height of Low Tide: -0.28   ft. ☐   m. ☒

STATION DESCRIPTIONS

STATION 1

Latitude: N46.91266   Longitude: W124.11443   Start Time: 4:30pm

Station Description: Large boulder rock jetty (base of) at north end of City of Westport, approximately 300' east of site center.

Substrate: Jetty rocks with barnacles   Height of Collection: 3   ft. ☒   m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: 9 feet

STATION 2

Latitude: 46 54.762   Longitude: 124° 06.894   Start Time: 4:36pm

Station Description: Large boulders at base of rock jetty approximately 150' east of station 1.

Substrate: Jetty rocks with barnacles   Height of Collection: 4   ft. ☒   m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: 8 feet

STATION 3

Latitude: N46.91269   Longitude: W 124.1487   Start Time: 4:52pm

Station Description: Large boulders at base of rock jetty approximately 125' west of station 1.

Substrate: Jetty rocks with barnacles   Height of Collection: 3   ft. ☒   m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: 6 feet

Version 4 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	None present.
	Oil on water	Not present.
	Oil on beach	Not present
	Garbage	Not present

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Washington State Mussel Watch data sheet (front and back) from the GHWJ site.

Appendix C.7 Strait of Juan de Fuca – Cape Flattery

An alternate Strait of Juan de Fuca – Cape Flattery (JFCF) site, located at Wa'atch Point (~3.5 miles southeast of the original site center), was successfully sampled by PSAMP, Olympic Coast National Marine Sanctuary, and Makah Tribal staff on Thursday, March 3rd, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Strait of Juan de Fuca, Cape Flattery (JFCF)

TARGET SPECIES - *Mytilus species* SITE NUMBER - 269

NOMINAL SITE CENTER - 48° 23.043' N 124° 43.598' W

LOCATED ON NOAA CHART - 18485

SITE ACCESS - This site is remote and should not be attempted alone. The Fisheries Office is in the old Makah Air Force Station. To access the site, follow the signs from Neah Bay to Cape Flattery. Drive past the old Makah Air Force Station, now the Makah Indian Reservation Tribal Council Offices, and out to the parking area for the Cape Flattery Trail. Access from here is via narrow footpaths and game trails. A 200' length of 1/2" rope is necessary to descend the cliff above the site. There are bear and cougars present in this wilderness area, it would be prudent to inform the police prior to sampling. Highway 112 west from Port Angeles via Sekiu is often subject to closure during the winter months, as a result of heavy snowfall and/or rock/mud slides.

SITE DESCRIPTION - The site lies just to the north of Hole in the Wall Cove. This is an extremely high surf area, and sampling should only be undertaken at minus tides on calm days. This site should not be attempted at night, or in wet weather - as the path is very slippery and dangerously close to the edge of the cliff. The three discrete stations are located 250 to 25 m apart, around the nominal site center.

BIVALVE COLLECTIONS

1995 No collection.

1996 There was a very good population of *Mytilus sp.* mussels at the site. Collected mussels ranged from 4.4 cm to 7.8 cm in shell length. The average shell length was 5.7 cm with a standard deviation of 0.8 cm for 54 collected individuals.

1997 No collection.

1998 Medium to large sized *Mytilus sp.* mussels were abundant at this site. Collected mussels ranged from 5.7 cm to 8.6 cm in shell length. The average shell length was 7.1 cm with a standard deviation of 0.7 cm for 36 collected individuals.

1999 No collection.

2000 Abundant medium to large sized *Mytilus sp.* mussels were present at all stations at this site. The rocks were covered with algae with the mussels being more abundant in crevasses and less exposed surfaces of the rocks. The access to the site required a ladder

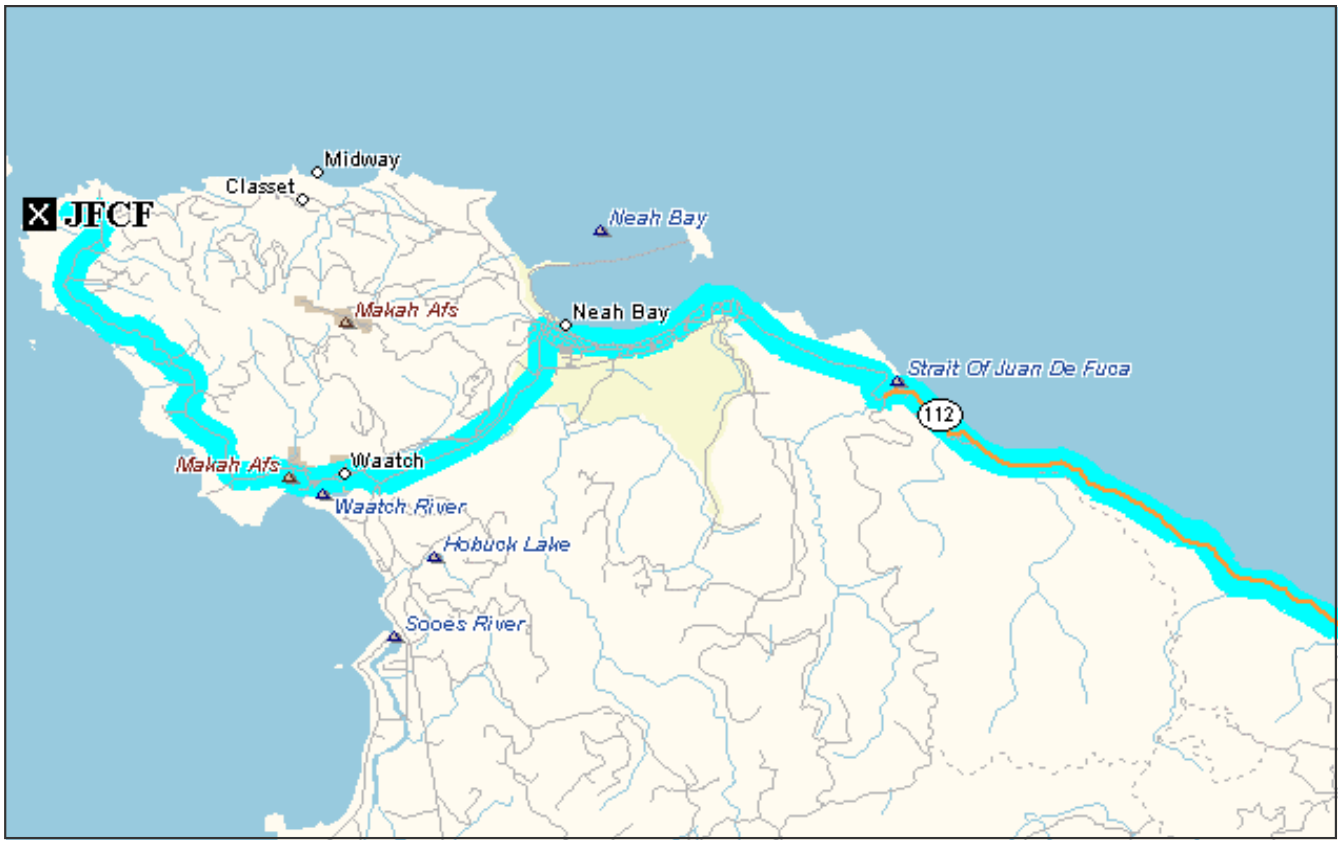
to descend to the ledge that leads to a very steep trail down to the sampling site. Cougars were active in this area as a paw print overprinted the tracks made while going to the site.

SEDIMENT COLLECTIONS
None, the sediment site is at Neah Bay (JFNB).

SAMPLING METHODS
Bivalves - hand
Sediments - N/A

WATER DEPTH - intertidal, +0.5 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination.



Map indicating location of EBFR site.

Satellite image of JFCF site location, in "Hole in the Wall Cove".

Washington State collaborators notes on

Strait of Juan de Fuca, Cape Flattery (JFCF)

Date sampled: March 3rd, 2010, starting at 9:30 am
Site center coordinates: 48° 20.299' N, 124° 41.081' W (*not the original site location*)
Temperature: 9.5° C
Salinity: $35^{o}/_{oo}$

Sampler Information – Two PSAMP staff, Ed Bowlby, a Research Coordinator from the Olympic Coast National Marine Sanctuary (OCNMS), and Andrew Winck, a Biologist from the Makah Tribe, helped to sample the JFCF site.

Site Lead - Jennifer Lanksbury
Fish & Wildlife Biologist
Puget Sound Assessment and Monitoring Program
Washington Department of Fish & Wildlife
600 Capitol Way N
Olympia, WA 98501-1091
360-902-2820
Jennifer.Lanksbury@dfw.wa.gov

Additional Contact Information - Steve Pendleton, the Makah Tribe *Environmental Program Manager*, granted us permission to take mussel samples from Wa'atch Point, a tribal subsistence

area on Hobuck Beach at the northern end of Makah Bay (see Alternate Site 2 – Wa'atch Point below).

Site Access – <u>Original Site</u>: This site is very remote. It takes one full day of travel by car to reach the Cape Flattery trailhead from the state capitol of Olympia. Then it takes about a half hour of hiking to reach the cliffs at the end of the trail. We traveled to Cape Flattery a day in advance of the planned sampling date to do some reconnaissance on the original nominal site center at "Hole in the Wall Cove". We hiked the Cape Flattery Trail to the proper location, however, upon arrival at the sheer cliffs above the original JFCF site center, it was quickly determined that descending to the surf area with our sampling gear, even with rope, was too dangerous to attempt.

Cliff walls at nominal site center for JFCF site.

<u>Alternate Site 1</u>: In the previous sampling year (2008), OCNMS staff had collaborated directly with the National Mussel Watch Program to sample the JFCF. However, the data sheet from that sampling excursion (and later discussions with the OCNMS staff who sampled that year) revealed that they were unable to find the original JFCF nominal site center coordinates in 2008 and instead sampled a new location some miles to the northeast of the site center (Figure 1).

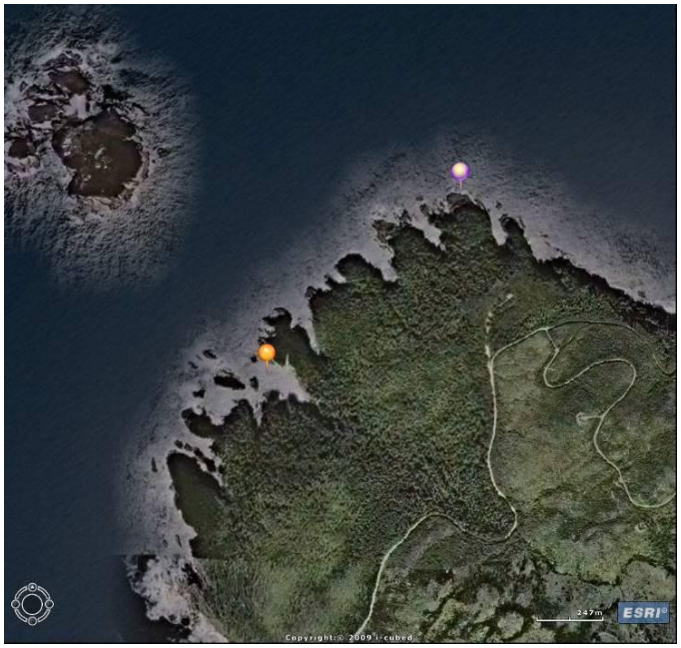


Figure 1. Original JFCF site (orange pin) at "Hole in the Wall" cove and alternate JFCF site (purple pin to the northeast) sampled by OCNMS staff in 2008.

So after determining that the original JFCF site was too dangerous to sample, we hiked to the alternative site sampled in 2008. This alternate site was accessed via an unmarked trail, recognized by the OCNMS staff member traveling with us, which branched off the Cape Flattery Trail. However, once we arrived at the alternative site it was determined that though the climb down was less precipitous, the slippery conditions and relatively high surf crashing over the rocks to be sampled presented too great a danger to warrant sampling mussels there.

Steep and slippery rock face access to alternate JFCF site and high surf conditions on date of reconnaissance.

<u>Alternate Site 2 – Wa'atch Point</u>: Once it was determined that neither the original nor the alternate JFCF site could be sampled, we did further reconnaissance along the western side of Cape Flattery to look for another potential alternate Mussel Watch site. At the southern end of the Cape, near Wa'atch Point, we discovered a beach with an abundant population of large mussels. The site was located on a tribal subsistence area at the northern end of Makah Bay, called Hobuck Beach (see Figure 2 and Site Description, Observations and General Notes for details of permission required to access).

Super-abundant and large mussels sampled at Wa'atch Point. This site was used as alternate location to the original JFCF site, which was too dangerous to sample.

Directions to Wa'atch Point - From Neah Bay travel west on Bay View Ave (main road) towards Cape Flattery. Following the signs towards the Cape Flattery Trail, turn left on Fort Street, then right on 3rd Ave, then left on Cape Flattery Rd. Pass Hobuck Rd and the Makah Tribal Center, then turn left on Wa'atch Beach Dr. Go through the neighborhood to the end of the cul-de-sac and park in the center of the cul-de-sac on the grass. To get to the beach you must go on private property, between a house and garage that boarders the beach, it is the house with a pole in the front yard that reads "230-232"). The Site Center is about a half mile (~20 minute) walk from this beach access house, walking towards the north and Wa'atch Point.

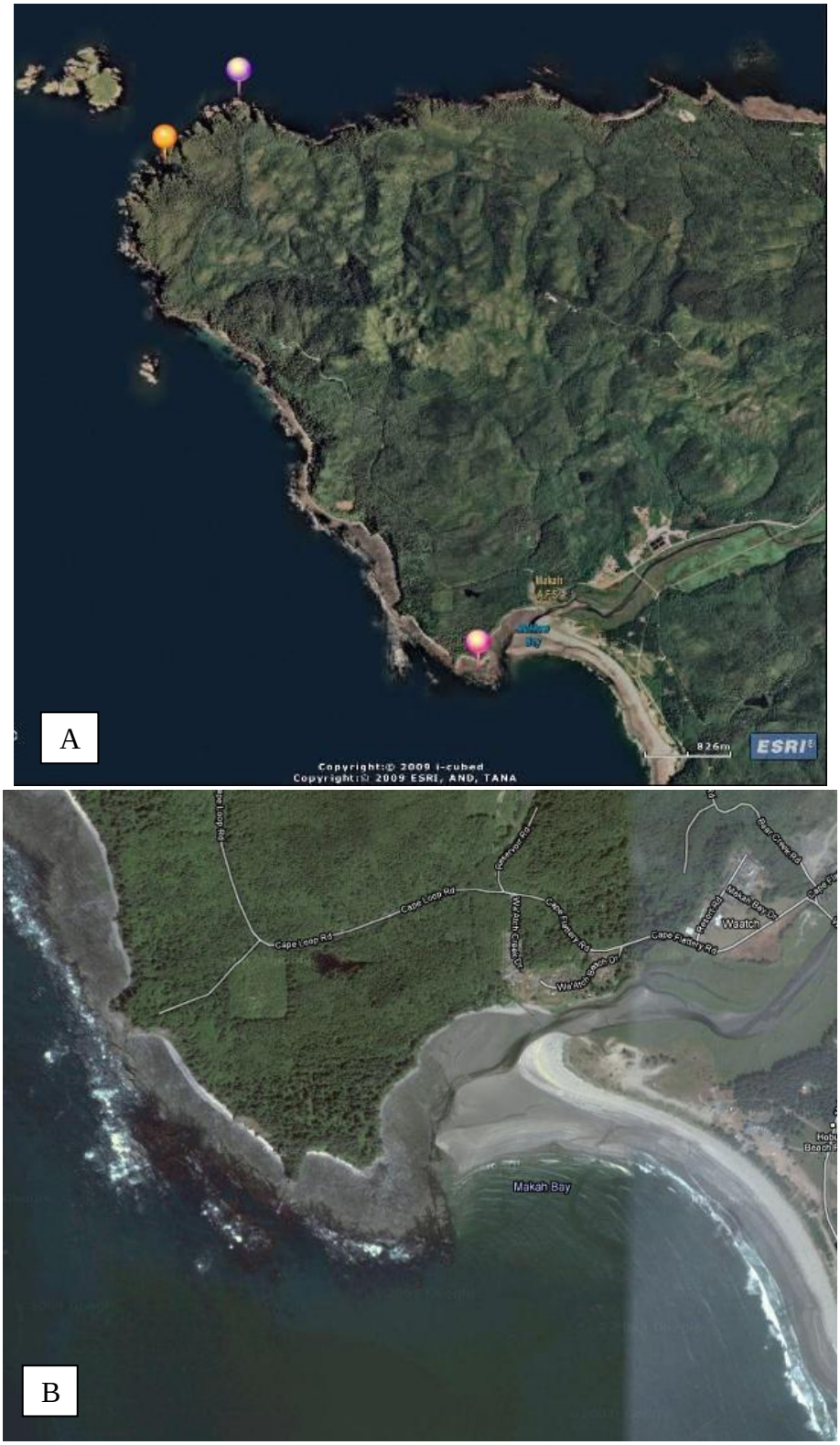


Figure 2. A) Wa'atch Point (pink pin near bottom of map) is about 3.6 miles southeast of the original JFCF site center (orange pin). B) Close-up of Wa'atch Point on the north end of Makah Bay; dark purple discoloration shale bedrock surrounding point is from intertidal flora/fauna.

Site Description, Observations and General Notes - Because this beach is on Makah Tribal land and is a subsistence area, we asked the permission of the Makah Tribe to sample mussels there. Steve Pendleton, the Makah Environmental Program Manager, granted us permission to take samples from the beach and sent one of his Tribal Biologists along to assist. We restricted our sampling to the far northern end of the beach near Wa'atch Point. The substrate was sedimentary bedrock (shale) with some cobble mixed in. There was lots of fucus and surf grass near the Site Center. We accessed the very abundant beds of large mussels at about -0.05 meter MLLW.

Potential Sources of Contamination Noted – No obvious signs of contamination noted except houses that were located at the head of Hobuck Beach.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Juan de Fuca – Cape Flattery (Wáatch Point) Site Code: JFCF

Date: 3-3-2010 Time Arrive: 8:39 AM Time Leave: 9:30 AM

Latitude: 48 20.299 Longitude: 124 41.081

Weather: Sunny, cloudless

Mussel Collectors: J. Lanksbury, A. Marshall, E. Bowlby, Andrew Winck (Makah Biologist)

Data Recorder: J. Lanksbury GPS Make/Model: Garmin [redacted] → Oregon 550

SITE WATER PARAMETERS

Water Temperature (°C): 9.5°C Salinity (ppt): 35 ppt

Tidal Station: Tatoosh Island, Cape Flattery

Time of Low Tide: 8:30AM Height of Low Tide: -0.06 ft. ☐ m. ☒

STATION DESCRIPTIONS

STATION 1

Latitude: 48 20.299 Longitude: 124 41.081 Start Time: 8:41 AM

Station Description: Rocky intertidal area on far north side of beach of Makah Bay (Hobuck beach - near 1st cliff of Cape Flattery

Substrate: sedimentary rock/shale w/ some cobble Height of Collection: 2 4ft ft. ☒ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection):

STATION 2

Latitude: 48 20.272 Longitude: 124 41.117 Start Time: 8:58

Station Description: closer to water line about 40 ft from St. 1 - large patch o mussels

Substrate: bd. rock/shale, ~~sand~~ gravel Height of Collection: 3 ft. ☒ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): 5 ft

STATION 3

Latitude: 48 20.263 Longitude: 124 41.058 Start Time: 9:10 AM → 9:18 end

Station Description: bunch of rock surrounded by shallow tide pools; near tide surf zone, some surf grass in small channels

Substrate: same shale as site 2 Height of Collection: ~2 ft. ☑ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection):

Version 4 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	no signs of contamination (house at head of beach only)
	Oil on water	
	Oil on beach	
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Original JFCF site too dangerous to sample - steep cliffs & high surf. Recon of Cape Flattery area revealed large & abundant mussels at local Makah Tribe subsistence beach at south end of Cape called Wáatch Point, at north end of Makah Bay. Sampled there with permission from Makah Env. Prog. Mngr Steve Pendleton. Directions: Bay View Ave (main road in Neah Bay), towards Cape Flattery, L on Fort St, R on 3rd Ave, L on Cape Flattery Rd (following signs to Cape Flattery trail). Pass Hobuck Rd & Tribal Center, L on Wáatch Beach Dr. Through neighborhood, park in center of cde sac. Go through yard between houses 230-232 to access beach.

Site Center is about half mile (~20 min) walk from beach access house, towards the north and Wáatch Point.

Steve Pendleton - Makah Env. Program Mngr (360) 640-2165

Washington State Mussel Watch data sheet (front and back) from the JFCF site.

Appendix C.8 Point Roberts – Point Roberts

The Point Roberts – Point Roberts (PRPR) site was successfully sampled by PSAMP, and two volunteers on Monday, January 25th, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Point Roberts, Point Roberts (PRPR)

TARGET SPECIES - *Mytilus species* SITE NUMBER - 284

NOMINAL SITE CENTER - 48° 59.420' N 123° 05.300' W

LOCATED ON NOAA CHART - 18421

SITE ACCESS - This site is a walk-up, and is easily accessible. To reach this site, one has to travel into Canadian Territory and then back again into the United States. Follow U.S. Highway 5 north to the Canadian border and cross over, then follow Highway 99 north towards Vancouver. At Delta, take Highway 17 south to Tsawwassen. In Tsawwassen, turn left (south) onto 56th St. and follow the signs to the U. S. border and Point Roberts. South of the border, the main road is called Tyee Drive. At the gas station and stop sign, turn right onto Gulf Rd. and drive to the end. Park in the parking lot next to Breaker's Bar, which is on the beach. If sediments are to be collected, a small boat is necessary. There is a small boat ramp on the beach at Lighthouse Point County Park, in Point Roberts. This ramp can only be used in good weather, as there is no protection from the wind and waves.

SITE DESCRIPTION - The western site is located about 0.35 miles to the north of the old dock pilings on the beach at Breaker's bar. The site is on the rocks in the intertidal area, below a small bluff. Due to the poor survival rate of the mussels at this site, there is an alternate site on the eastern side of Point Roberts. From the stop sign intersection, continue straight on and then turn left onto A.P.A. Rd. Continue on for about 1.5 miles until the road surface ends and it becomes a dirt road. Go through the gate and on to the end of the road at the beach. Go down the stairs and onto the beach, and the site is about 0.5 miles to the south at the large rock. The nominal site center for this eastern site is 48° 58.90' N and 123° 01.30' W.

BIVALVE COLLECTIONS

1995 No collection.

1996 No live *Mytilus sp.* mussels were found at either the east or the west sites.

1997 No collection.

1998 *Mytilus sp.* was scarce and small sized at this location. The mussels were found in small patches around the base of boulders scattered on the gravel beach. Collected mussels ranged from 1.5 cm to 2.9 cm in shell length. The average shell length was 2.0 cm with a standard deviation of 0.3 cm for 193 collected individuals.

1999 No collection.

2000 *Mytilus sp.* was very scarce and small sized at this location. The mussels were found in small patches in crevices and the undersides of shoreward facing base of boulders scattered on the gravel beach.

2004 Mussels were attached to the buried margins of rocks in10 to 50-pound size. Must overturn the rocks even to see the mussels. Many large oysters (singly attached to rocks and in the shelly sand) were present. Not accessible until this tide level at 18:00 1/1/2004. (Fay, 2005)

SEDIMENT COLLECTIONS

1995 No collection.

1996 The sediment sample was collected from near the nominal site center, southwest from the Red "4" Bell. The location was 48° 56.52' N and 123° 00.41' W, in about 63 m of water.

1997 No collection.

1998 No collection.

1999 No collection.

2000 No collection.

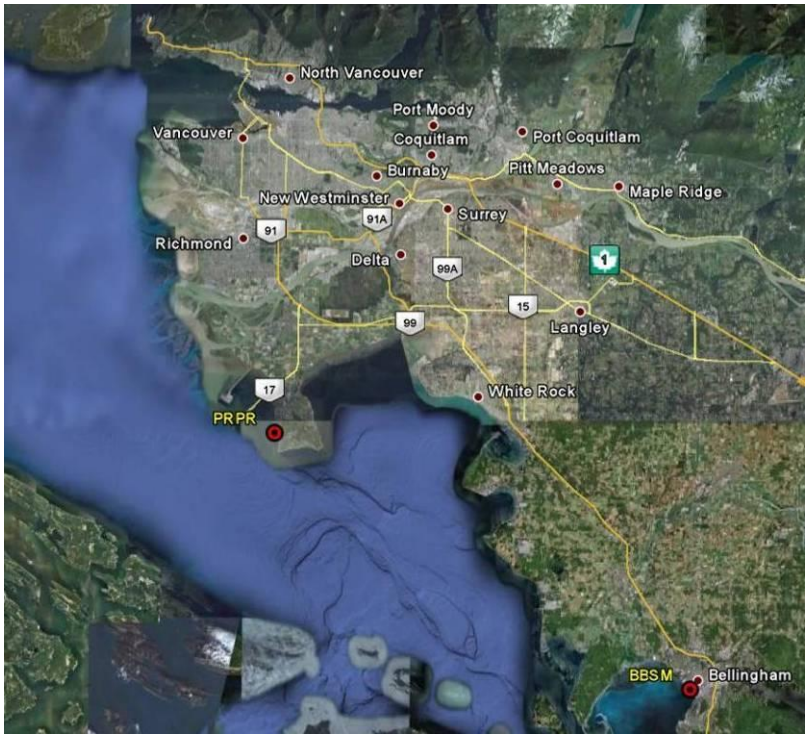
SAMPLING METHODS

Bivalves - hand

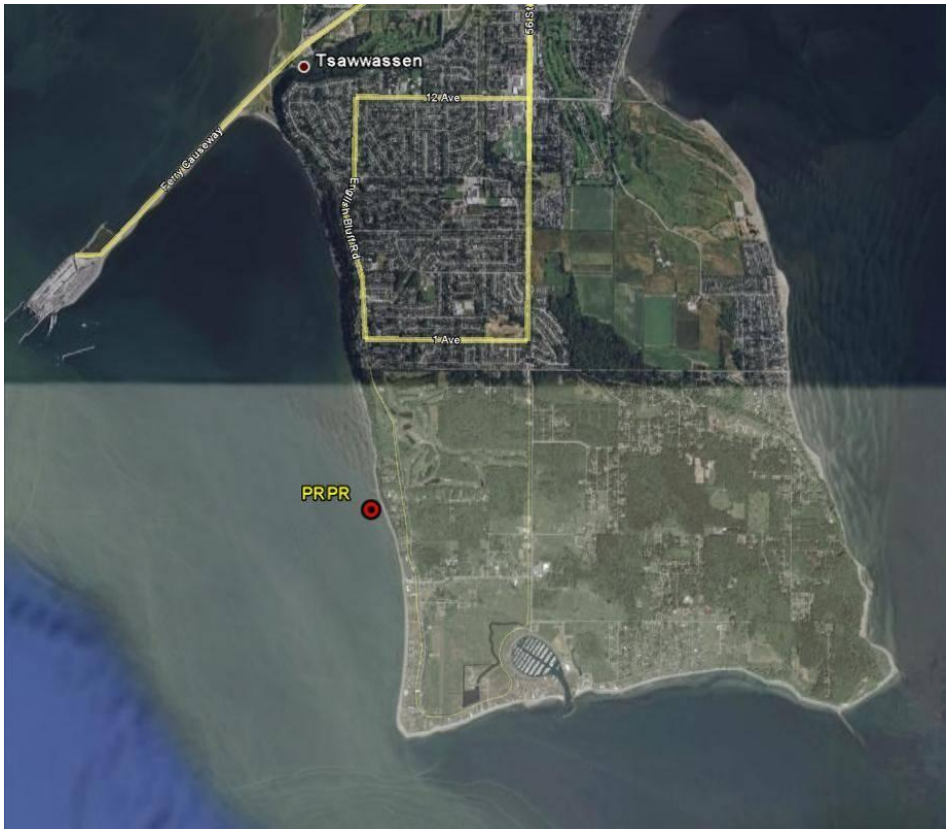
Sediments - stainless steel sediment grab and stainless steel scoop

WATER DEPTH - intertidal, +0.5 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination.



Location of PRPR site, on US peninsula, and route through Canada to access site.



Close-up of PRPR site center (western site only).

Washington State collaborators notes on

Point Roberts, Point Roberts (PRPR)

Date sampled: January 25th, 2010 starting at 5:00 pm
Site center coordinates: 48º 59.4564' N, 123º 5.2686' W
Temperature: 8° C
Salinity: 30 $^{o}/_{oo}$

Sampler Information – Two PSAMP staff and two volunteers sampled PRPR.

Site Lead - Jennifer Lanksbury
Fish & Wildlife Biologist
Puget Sound Assessment and Monitoring Program
Washington Department of Fish & Wildlife
600 Capitol Way N
Olympia, WA 98501-1091
360-902-2820
Jennifer.Lanksbury@dfw.wa.gov

Due to the low number of volunteers at this site, no training was held at Point Roberts. Instead, volunteers were sent the sampling manual in advance (via email) and received training on-site at the time of collection.

Site Access – This was a very remote site and took a full day of traveling by car to reach. Accessing the small, isolated Point Roberts peninsula required traveling through Canada. The sampling site was located about a half mile walk north along the beach from the parking lot at a bar/restaurant called "Breakers." The Site Center was near a low bluff where boulders and large rocks reached out from the upper beach into a lower intertidal area.

Approaching PRPR collection site; note lights offshore on Canadian side of water (see Potential Contaminants Noted section).

Site Description, Observations and General Notes – The substrate was made up of sandy beach populated with boulders, cobbles and pebbles. We collected mussels from large (5ft x 5ft) boulders as well as from areas scattered among large cobbles and smaller-sized boulders.

Large boulder with mussels at center of PRPR site.

Potential Sources of Contamination Noted – No notable sources of contamination were documented at the time of sampling, though many lights indicating some kind of industrial area were seen some distance across the water on the Canadian side. It was later noted on a map that a Canadian ferry terminal (at the end of highway 17) and large shipping container and gravel yard were located northwest of the Site Center, on points offshore connected via long land bridges on the Canadian side.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Point Roberts – Point Roberts Site Code: PRPR

Date: 1-25-2010 Time Arrive: 5:00 PM Time Leave: 6:45PM

Latitude: 48.99094 Longitude: 123.08781

Weather: Cloudy w/ Light Rain

Mussel Collectors: J. Lanksbury, S. Orlaineta, Gonzalo & Catalina Valdes

Data Recorder: S. Orlaineta GPS Make/Model: Garmin GPSmap 176

SITE WATER PARAMETERS

Water Temperature (°C): 46°F / 8°C Salinity (ppt): 30

Tidal Station: Strait of Georgia, Blaine, Semiahmoo Bay

Time of Low Tide: 7:26PM Height of Low Tide: -0.17 ft. ☐ m. ☒

STATION DESCRIPTIONS

STATION 1

Latitude: 48.99059 Longitude: 123.08761 Start Time: 5:09 PM

Station Description: ~ 1/2 mile N of old pier pilings. Mussels on Large boulder 5ft X5ft @base of bluff

Substrate: Sand/Pebble/cobble/boulder Height of Collection: ~4ft ft. ☒ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): 4 ft.

STATION 2

Latitude: 48.99118 Longitude: 123.08785 Start Time: 5:25

Station Description: ~ 300 ft NW of station #1 mussels scattered about

Substrate: Large cobel/boulder Height of Collection: 1 ft ft. ☒ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): 3ft

STATION 3

Latitude: 48.99195 Longitude: 123.08800 Start Time: 5:52 PM

Station Description: ~ 300 ft N of station #2 Big Large boulder 5x5ft

Substrate: Large cobbel/boulder Height of Collection: 3 ft. ☒ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): 5

Version 4 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Site center ~ 1/2 mile N of parking at Breaker - end of Gulf road

Washington State Mussel Watch data sheet (front and back) from the PRPR site.

Appendix C.9 Puget Sound – Everett Cemex

The Puget Sound – Everett Cemex (PSEC) site was successfully sampled by Snohomish County Marine Resources Committee volunteers on Monday, January 25th, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Puget Sound, Everett Cemex (PSEC)

TARGET SPECIES- *Mytilus species*

NOMINAL SITE CENTER – 47.94968 N; -122.30158 W

LOCATED ON NOS CHART # - 18444

SITE ACCESS - The site is located at 222 W Marine View Dr., Everett, WA
From I-5 northbound
Take exit 195 for E. Marine View Dr. Turn left at E. Grand Ave. East Grand Ave turns slightly right and becomes E. Marine View Drive. Follow that around the north end of Everett where it becomes W Marine View Drive. Turn right at the gated driveway entrance by the Cemex sign. It's currently the first business you see as you start turning south.

From I-5 southbound
Take exit 198 to merge onto WA-529 toward N Broadway. Take the ramp to E. Marine View Drive. Turn right at E. Marine View Drive. Turn right at the gated driveway entrance by the Cemex sign. It's currently the first business you see after you start heading south.

Park vehicles along the south fence along the driveway about 50 feet before the 2nd gate. Large vehicles with wide turning movements will be coming through the 2nd gate and need plenty of room. Collectors must get into 1 or 2 vehicles which can enter the site and park in the southwest corner of the site. **All collectors/volunteers must have hard hats, orange vests, and safety glasses** (regular eye glasses and sun glasses are OK).

Contact office when entering site (inside the building) – Jay Harmon at 425-252-8600
Contact to schedule site visit – David McCauley, Cemex, 425-754-9246.

SITE DESCRIPTION - The site is on property owned by Jeld-Wen and leased to Cemex for a barge off-loading facility for cement, concrete, and asphalt operation. The entire Jeld-Wen property is about 33 acres, with the western 6.1 acres leased to Cemex. The upland site is primarily composed of fill material deposited onto the original Snohomish River delta to create upland for industrial and commercial uses. The fill occurred primarily between 1921 and 1945. The site is surrounded by the Snohomish River on the north, west and south sides, and has a pier for barge operations on the west side. The south side abuts Maulsby Mudflat, an area of historic log-rafting.

The bank has riprap/rock armoring. Along the south side logs have been chained near the shore by pilings. The logs and rock bank on the southwest corner contain abundant mussel populations, with some mussels extending into the mud along the rock edge. Mud is also interspersed between the rock in many areas. The metal pilings on the west side also contain significant mussel populations. Because the site access is difficult due to business activity and controlled access to the site, mussels are generally protected from public collection. The site is near the mouth of the Snohomish River and will have a wide range of salinity.

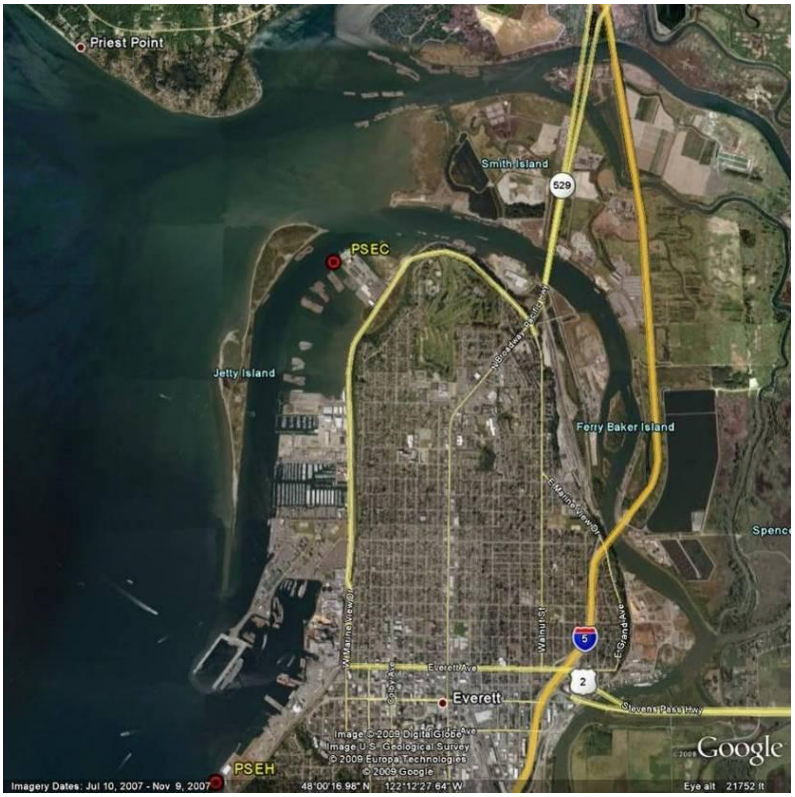
BIVALVE COLLECTIONS
Mussels were collected at the southwest corner of the site, with site 1 on the south side, site 2 at the point, and site 3 on the west side. The mussels were large and plentiful.

SEDIMENT COLLECTIONS
None were collected.

SAMPLING METHODS
Mussels – by hand.

DEPTH OF SAMPLE COLLECTION
Mussels – intertidal, essentially all at the waterline.

POSSIBLE CONTAMINANTS
Unknown. A stormwater outfall was located approximately 20 feet from Station 3, between Stations 2 and 3. This site was selected to evaluate the effect of the river on contaminants.



Location and access route for PSEC site.

Close-up satellite view of PSEC site.

Washington State collaborators notes on

Puget Sound, Everett Cemex (PSEC)

Date sampled: January 25th, 2010 starting at 5:03 pm
Site Center coordinates: 48° 01.016' N, 122° 12.969' W
Water temperature: 7.5° C
Salinity: 13 °/oo

Sampler Information – Nine volunteers from the Snohomish County Marine Resources Committee (SCMRC) and the Washington State University (WSU) Beach Watchers sampled PSEC.

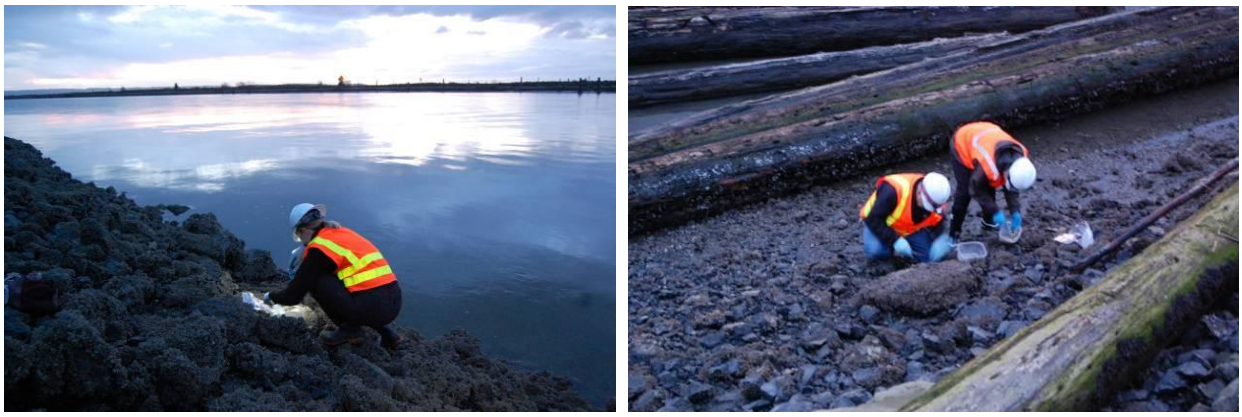
Site Lead - Mary Cunningham
SCMRC member
3000 Rockefeller Ave, M/S 607
Everett, WA 98201
(425) 257-7131
mcunningham@ci.everett.wa.us

Volunteers had been trained previously by the Snohomish County MRC.

Site Access – The property is owned by Jeld-Wen and leased by Cemex. Prior permission and coordination with Cemex is needed to access site. Contact David McCauley (425-754-9246) to schedule a site visit or sampling. Mr. McCauley will facilitate site access for the day of sampling. All volunteers are required to wear hard hats and reflective neon vests. Eye protection, which may include eye or sun glasses, is required if the machinery at the site is in use.

Enter at the northern end of the property by the Cemex sign and park on the south side of the driveway, approximately 50 feet before the second of the two gates. Site restrictions allow no more than two vehicles to enter. When the gate is opened, proceed along the drive, which will turn to the south. Parking is available at the southwestern tip of the property just above the sampling site. The site is located on riprap boulders and requires moderate scrambling and climbing to access.

Site Description, Observations and General Notes - Mussels were large and abundant along the boulder faces within the tide line. The substrate between the boulders was a silty deposit from the discharge of the Snohomish River.



Volunteers sampling mussels at the PSEC site.

Potential Sources of Contamination Noted – A few cans were found between the riprap boulders. Tar was not seen at the site, but was present on a sampler's boots after collection. The site smelled of mud and decay, though one sampler noting a possible sewage smell. Samplers noted presence of creosote logs and a stormwater outfall pipe with outflow onto the riprap boulders.

The Cemex is an off-loading site located between the Port of Everett and Snohomish River delta for a concrete, asphalt, and cement operation at the mouth of the Snohomish River. The area has been dredged historically. A span of water separates the site from Jetty Island, which is composed of dredged materials from the Snohomish River.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Puget Sound Everett Cemex Site Code: PSEC

Date: 01-25-10 Time Arrive: 5:03 Time Leave: 5:45

Latitude: N 48.01024 Longitude: 122.12.969 1st team done @ 5:15

Weather: overcast, balmy for January no rain

Mussel Collectors: Andrea Hennings, Kathleen Herrmann, Lincoln Loehr, Dena Peel, Craig Wollam, Jim O'Neill, Mauricio Calderon

Data Recorder: Mary Cunningham

SITE WATER PARAMETERS

Water Temperature (°C): 7.5°C Salinity (ppt): ~~2~~ 13

Tidal Station: Everett

Time of Low Tide: 6:46 Height of Low Tide: -0.3" ft. [X] m. [ ]

STATION DESCRIPTIONS

STATION 1

Latitude: 48.01.001 Longitude: W 122.12.944 Start Time: 5:08

Station Description: Riprap w silt south side ~ 50 yards from point

Substrate: Riprap w/silt Height of Collection: 1' ft. [X] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 3'

STATION 2

Latitude: 48 01 024 Longitude: 122.12.969 Start Time: 5:08

Station Description: point

Substrate: Rocky riprap / silty Height of Collection: water line to 2' ft. [X] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 5'

STATION 3

Latitude: 48 01 084 Longitude: 122 12.953 Start Time: 5:08

Station Description: 100' N of point

Substrate: rocky riprap Height of Collection: 2.4' ft. [X] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 6' +

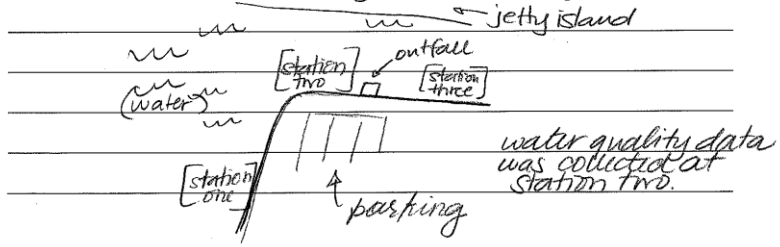
Version 3 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	Couple cans by Station 3
		Organicy smell - mud, sewagy
✓	tar	found on the bottom of a wampless boots - not certain of source

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

- more mussels than needed were sampled from station one
- site was accessed over edge of parking lot → composed of rock riprap, interspersed with silty soil
- in general, mussels were large (~2 inches), although the population across the entire site was well stratified by size (and age).



Washington State Mussel Watch data sheet (front and back) from the PSEC site.

Appendix C.10 Puget Sound – Edmonds Ferry

The Puget Sound – Edmonds Ferry (PSEF) site was successfully sampled by collaborators and volunteers from NOAA, the Ocean Research College Academy (ORCA) at Everett Community College, the SCMRC, and WSU Beach Watchers on Tuesday, January 26th, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Puget Sound, Edmonds Ferry (PSEF)

TARGET SPECIES: *Mytilus species*

NOMINAL SITE CENTER- 47°48.839'N 122°22.937W

LOCATED ON NOS CHART #: 18446_1

SITE ACCESS - From I−5, take WA−104 (Exit 177) west to Edmonds ferry landing. On the right, just after crossing the railroad tracks, is Brackett's Landing Park. The site is on the south side of the jetty north of the parking lot. Walk north from the parking lot to the beach to access the sample sites.

SITE DESCRIPTION - Site is located on the south side of the jetty at Brackett's Landing Park north of the ferry terminal in downtown Edmonds. Mussels are very abundant and easily accessible at any low tide (less than +1 feet).

"In 2004 this site was established to replace the abandoned site at PSSS and to respond to the oil spill that occurred in December 2003, and to prepare for a possible loss of the site at Everett Harbor in the near future" (Fay, 2005).

BIVALVE COLLECTIONS
2004 Mussels were abundant in small patches at and half a foot above this water level. This is earliest level available, with waterline about the base of the jetty where mussels begin. Mussels encrusted with barnacles. South side of jetty in Bracketts Landing park. Park gate closes at 10 pm (Fay, 2005).

SEDIMENT COLLECTIONS
No sediments were collected.

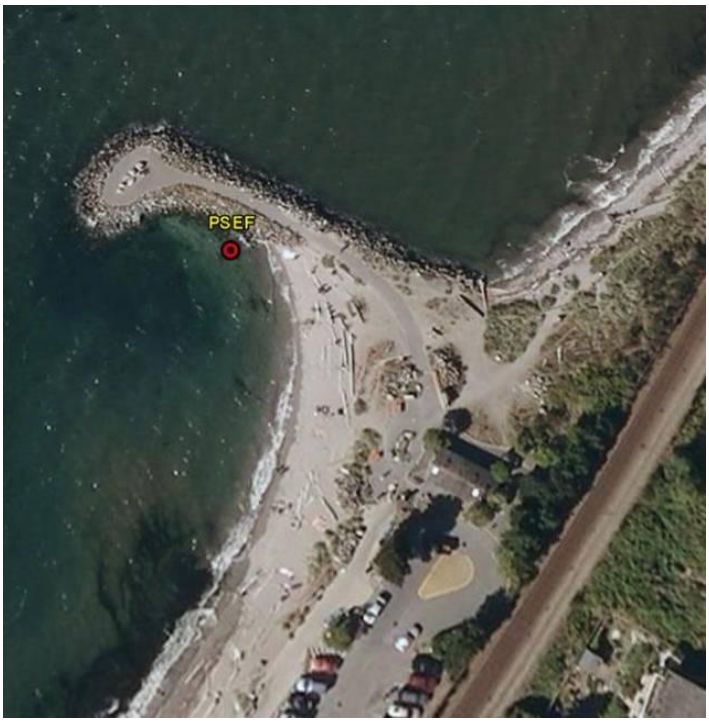
SAMPLING METHODS
Mussels – by hand.
Sediments – None collected, but no mud areas were likely in the vicinity.

DEPTH OF SAMPLE COLLECTION
Mussels – Intertidal.

POSSIBLE CONTAMINANTS

The site was established in early January 2004 following the fuel oil spill in late December at Wells Point, just two miles to the south of the ferry landing. Thus the most likely contaminant to appear in the initial sampling would be residues from this spill.

Location and route to PSEF site (upper right corner).



Close-up satellite view of PSEF site.

Washington State collaborators notes on

Puget Sound, Edmonds Ferry (PSEF)

Date sampled: January, 26th, 2010 starting at 4:05 pm
Site center coordinates: 47° 48.839’ N, 122° 22.937’ W
Water temperature: 8.5° C
Salinity: 30 °/$_{oo}$

Sampler Information – Seven collaborators and volunteers including staff from NOAA, student volunteers from the Ocean Research College Academy (ORCA) at Everett Community College, and volunteers from the SCMRC and WSU Beach Watchers sampled at the PSEF site.

Site Lead - Alan Mearns
Senior Staff Scientist
Emergency Response Division
National Oceanic and Atmospheric Administration
7600 Sand Point Way NE
Seattle, WA 98115
206-526-6336
alan.mearns@noaa.gov

Volunteers had been trained previously by the Snohomish County MRC.

Site Access - Edmonds Marine Sanctuary requires a separate permit for sampling. Contact Sally Lider at Edmonds Parks, Recreation, and Cultural Services prior to sampling to inform her of sampling dates and updated permit, if needed. The permit stipulates use of signage and/or handout available to the public during the sampling, to explain the project. Easiest access to the sampling site on the beach is from the Brackett's Landing parking lot.

Site Description, Observations and General Notes – The site is located on the southeast side of Brackett's Landing jetty. Mussels were available on large boulders and the substrate surrounding the jetty is fine-grain sand. Mussel density was highest within the bend of the jetty and decreased in both directions along the sides of the boulders facing the water. Mussel size increased as the sampling team proceeded west along the jetty.

Population numbers were noted as being lower than six weeks prior, when the site was checked by Site Lead, Alan Mearns, on December 12th, 2009. Some mussel shells were found at the base of the jetty with small (1-2 mm) drill holes, suggesting predation by whelks.

Volunteers sampling at the PSEF site.

Potential Sources of Contamination Noted – The ferry and its associated dock are south of jetty. A concrete outfall pipe to the beach from an unidentified source was noted. There is a parking lot and restroom to the east of the site. Edmonds Underwater Dive Park is located outside the jetty arm to the west and contains sunken vessels, concrete blocks, tractor tires, PVC pipes, navigation buoys, pieces of a decommissioned floating bridge, and vehicle bodies.

Ferry landing at terminal near PSEF site during sampling.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Puget Sound Edmonds Ferry Site Code: PSEF

Date: 01-26-10 Time Arrive: 16:06 Time Leave: 17:10

Latitude: N 47° 48.844 Longitude: W 122° 22.950

Weather: Partly cloudy, ~50°F at beginning of sampling

Mussel Collectors: Alan Mearns, Deborah Simecek-Beatty, Jenny Hartwell, Nancy McDonald, Andrea Hennings, Matt Hward, Jim O'Neill

Data Recorder: Andrea Hennings

SITE WATER PARAMETERS

Water Temperature (°C): 8.5°C Salinity (ppt): 30

Tidal Station: Everett, WA

Time of Low Tide: 19:31 Height of Low Tide: -1'2" ft. [X] m. [ ]

STATION DESCRIPTIONS

STATION 1

Latitude: N47°48.843' Longitude: W122°22.944' Start Time: 16:20

Station Description: large boulders - first station as you walk toward riprap jetty (mussels were relatively spause)

Substrate: large boulders (riprap), barnacles Height of Collection: +2 ft. [X] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): +2

STATION 2

Latitude: N47°48.842' Longitude: W122°22.952' Start Time: 16:20

Station Description: riprap jetty boulders - midway between station 1 & 3 at bend of jetty (medium size mussels ~1½ inches)

Substrate: large boulders, barnacles Height of Collection: +2 ft. [X] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): +2

STATION 3

Latitude: N 47°48.840' Longitude: W122°22.959' Start Time: 16:40

Station Description: riprap jetty - at point (mussels were ~2 inches larger here, but more sparse) very large barnacles, seaweed

Substrate: large boulders, barnacles Height of Collection: +2 ft. [X] m. [ ]

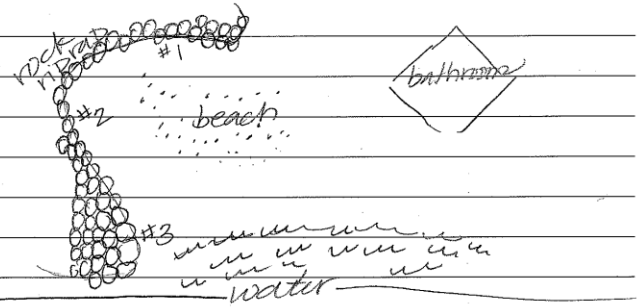
Highest Distribution of Mussels (compared to water level at time of collection): +6

Version 3 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	
		no contaminents noted (other than ferry)

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):



- water was clear, ~~4~~ ferries left/arrived during sampling
- some dead mussels - whelks? freeze?

snails were present
some mussels shells were found with small drill holes

mussels had been more abundant

Washington State Mussel Watch data sheet (front and back) from the PSEF site.

Appendix C.11 Puget Sound – Everett Harbor

The Puget Sound – Everett Harbor (PSEH) site was successfully sampled by collaborators and volunteers from the Snohomish County Marine Resources Committee (SCMRC), the Ocean Research College Academy (ORCA) at Everett Community College, and the WSU Beach Watchers on Tuesday, January 26th, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Puget Sound, Everett Harbor (PSEH)

TARGET SPECIES - *Mytilus species* SITE NUMBER - 282

NOMINAL SITE CENTER - 47° 58.360' N 122° 13.820' W

LOCATED ON NOAA CHART - 18444

SITE ACCESS - This site is a walk-up, and is easily accessible on foot. Prior permission has to be obtained from the Everett Port Authority, as access is needed to the site across their property. Take Exit 192 on U.S. Highway 5 in Everett, and go west on Mukilteo Blvd. Turn right (north) onto Rucker Ave. and then left (west) onto California St. Go under the railroad bridge and turn left (south) onto Terminal Ave. and into the Port area. Park next to the Maintenance Shop near Pier 1, and obtain the key to the corner gate through the fence to the seawall. A small boat is needed if sediments are to be collected. There is a good public ramp on 13th St., which is farther north off Marine View Drive. The ramp is on the Snohomish River, and inside the Everett Harbor Breakwater.

SITE DESCRIPTION - The site is located on the rocks of the breakwater and tidal flat below the Port Authority Maintenance Shop. The discrete stations on the breakwater are as follows: Station 1 is on the corner below the gate, Station 2 is about 15 m to the north and Station 3 is about 15 m east of Station 1.

BIVALVE COLLECTIONS

1995 No collection.

1996 There was a good population of small *Mytilus sp.* mussels growing on the rock seawall. There was also a good crop of spat, and no seastars were observed in the immediate area. Collected mussels ranged from 3.1 cm to 4.4 cm in shell length. The average shell length was 3.6 cm with a standard deviation of 0.3 cm for 36 collected individuals.

1997 No collection.

1998 There were abundant small *Mytilus sp.* mussels present at this site. The mussels were heavily encrusted with barnacles. Collected mussels ranged from 2.0 cm to 3.9 cm in shell length. The average shell length was 3.9 cm with a standard deviation of 0.7 cm for 54 collected individuals.

1999 No collection.

2000 There were abundant medium to large sized *Mytilus sp.* mussels present at this site. The mussels were heavily encrusted with barnacles.

2004 *M. edulis* is abundant but not particularly densely distributed on the rock margins in the sand. Found near the mud line which is very soft. Larger specimens were found further from the access gate. New construction, pilings being driven to south of site as part of harbor rocks overturned. Must get security to open the locked gates. California Street no longer goes thru. Continue north on Rucker to Everett and take the new overpass to the port. (Fay, 2005)

SEDIMENT COLLECTIONS

1995 No collection.

1996 Fine grained sediments were collected from 47° 58.45' N and 122° 14.23' W, in about 86 m of water.

1997 No collection.

1998 No collection.

1999 No collection.

2000 No collection.

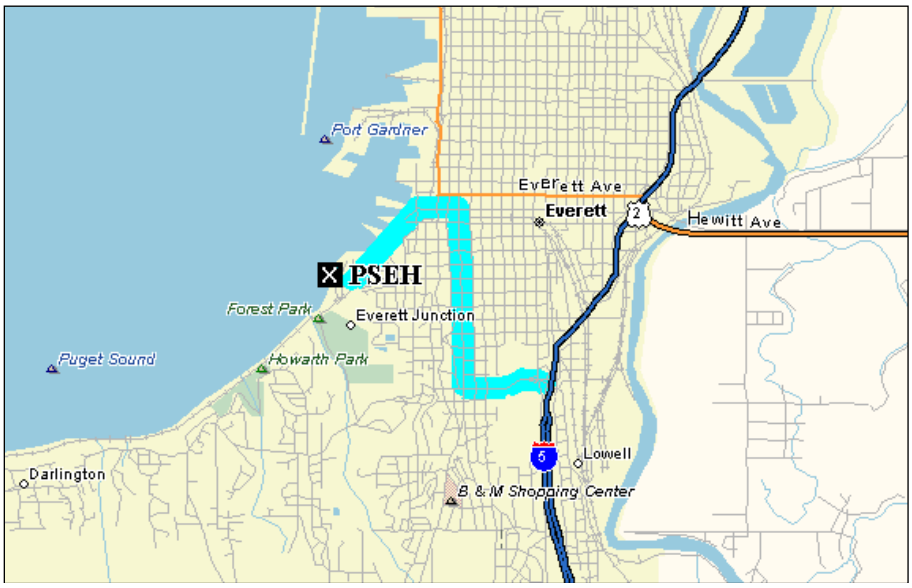
SAMPLING METHODS

Bivalves - hand

Sediments - stainless steel sediment grab and stainless steel scoop

WATER DEPTH - intertidal, +0.25-0.5 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination except runoff from maintenance facility.



Map showing access route to PSEH site.

Satellite image of PSEH site location.

Washington State collaborators notes on

Puget Sound, Everett Harbor (PSEH)

Date sampled: January 26th, 2010 starting at 4:30 pm
Site center coordinates: 47° 58.360' N, -122° 13.820' W
Water temperature: 10° C
Salinity: 30 °/oo

Sampler Information – Six collaborators and volunteers, two from the SCMRC, two from ORCA/Everett Community College, and two from WSU Beach Watchers, helped sample the PSEH site.

Site Lead - Mary Cunningham
SCMRC Member
3000 Rockefeller Ave, M/S 607
Everett, WA 98201
425-257-7131
mcunningham@ci.everett.wa.us

Volunteers had been trained previously by the Snohomish County MRC.

Site Access – The property is owned by the Port of Everett, and prior permission and coordination is needed to access the site. Contact Ed Madura, (425) 259-5428, to schedule a site visit or sampling, and call the Guard Gate cellular phone, (425) 754-8421, the day of sampling for access to the property.

Samplers should meet off the site to assemble in fewer than five cars. Drive to Gate S2 and call the guard for entry. Follow the guard through the property and a second gate to the parking area just south of the sampling site. The second gate will be left unlocked in case of an emergency. After sampling has finished, call the guard to escort the group back through the property. The site is located on riprap boulders and requires moderate scrambling and climbing.

Site description, Observations and General Notes - Mussels were located within the tide line on the lower riprap boulders and large cobble on the beach face.

Volunteers sampling mussels at the PSEH site.

Potential Sources of Contamination Noted – The Port of Everett contains many industrial operations. The Site Center is north and west of a railroad. A parking area lies to the south of site. Creosote pilings are present at the site and there is an outfall from the Port property within site.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Puget Sound Everett Harbor Site Code: PSEH

Date: 01-26-10 Time Arrive: 4:30 Time Leave: 5:25

Latitude: N47°58.356 Longitude: W122°13.786

Weather: Mostly sunny 12°C

Mussel Collectors: Kathleen Herrmann, Craig Wollam, Tony Whitmire ~~Sawyer Henderson, Mauricio Calderon~~

Data Recorder: Mary Cunningham

SITE WATER PARAMETERS

Water Temperature (°C): 10°C Salinity (ppt): 30

Tidal Station: Everett

Time of Low Tide: 7:42 PM Height of Low Tide: -1.2 ft. ☒ m. ☐

STATION DESCRIPTIONS

STATION 1

Latitude: N47°58.336 Longitude: W122°13.769 Start Time: 4:35

Station Description: Furthest south — from outfall to S about 30', starts about even w/ stipg Maintenance building

Substrate: Rocky/riprap Height of Collection: 0-3 ft. ☒ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: 3'

STATION 2

Latitude: N47.58.356 Longitude: W122°13.786 Start Time: 4:35

Station Description: Site center

Substrate: Rocky riprap Height of Collection: 1-2 ft. ☒ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: 4 feet

STATION 3

Latitude: 47°58.370 Longitude: W122°13.778 Start Time: 4:40

Station Description: Station furthest North (closest to dock, below where wood piling starts

Substrate: Rocky / riprap Height of Collection: water line ft. ☒ m. ☐

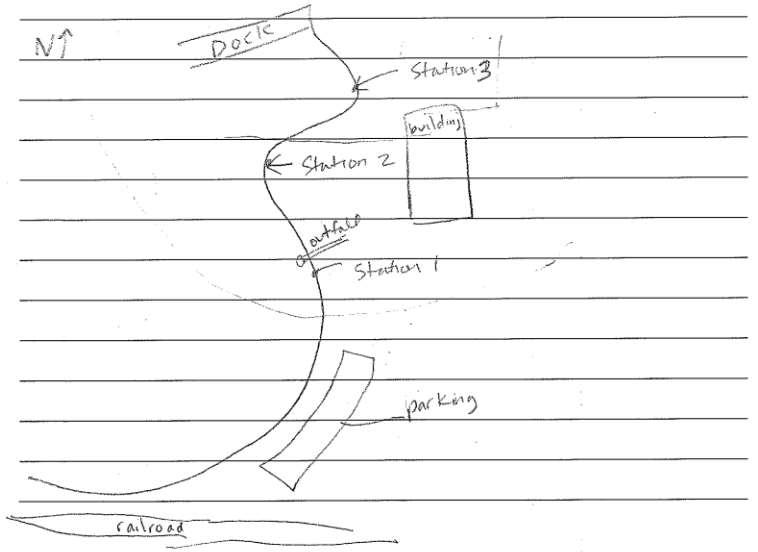
Highest Distribution of Mussels *(compared to water level at time of collection)*: 3.5 feet

Version 3 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):



Washington State Mussel Watch data sheet (front and back) from the PSEH site.

Appendix C.12 Puget Sound – Hood Canal

The Puget Sound – Hood Canal (PSHC) site was successfully sampled by Port Townsend Marine Science Center volunteers on Saturday, January 23rd, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Puget Sound, Hood Canal (PSHC)

TARGET SPECIES - *Mytilus species* SITE NUMBER - 273

NOMINAL SITE CENTER - 47° 49.91' N 122° 41.30' W

LOCATED ON NOAA CHART - 18473

SITE ACCESS - The bivalve site is located at the abandoned Southpoint Ferry Terminal in Bridgehaven, just to the southwest of the Hood Canal Floating Bridge. From Highway 104 several miles west of the Hood Canal Floating Bridge, turn south onto Southpoint Rd., which runs between Highway 104 and the abandoned ferry terminal. Proceed to the end of Southpoint Rd. Park near the pilings of the abandoned ferry terminal. The site is now in private hands and is in the process of being developed, it is imperative to get permission to sample prior to sampling. A boat is necessary if sediments are to be collected. There is a good ramp under the west end of the Hood Canal Floating Bridge, on the north side at Termination Point. There is a second ramp on the east side of the bridge, near Salsbury Point.

SITE DESCRIPTION - The site center is the northeast corner of the parking lot at the abandoned ferry terminal. The only observed mussel habitat was the pilings of the abandoned ferry terminal, approximately 25 m north of the site center. This is a rather small site, so discrete collection stations were not designated.

BIVALVE COLLECTIONS

1995 *Mytilus sp.* was rare and in fact, the majority of the collected mussels were growing on a rope hanging down amongst the pilings. Collected organisms ranged in size from approximately 2.0 cm to 5.0 cm in shell length. There were many sea stars (*Pycnopodia* sp.) present during the collection, indicating that predation may account for the rarity of mussels at this site.

1996 There was a fairly good population of small to medium sized *Mytilus sp.* mussels growing on the creosote pilings of the old ferry dock. These were the only mussels to be found in the area, and they were all located some 2 to 2.5 m above MLLW in a narrow dense band on the pilings. Unfortunately, there was no alternative location that was a natural substrate on which mussels could be found. Collected mussels ranged from 4.3 cm to 6.2 cm in shell length. The average shell length was 5.0 cm with a standard deviation of 0.4 cm for 30 collected individuals.

1997 No collection.

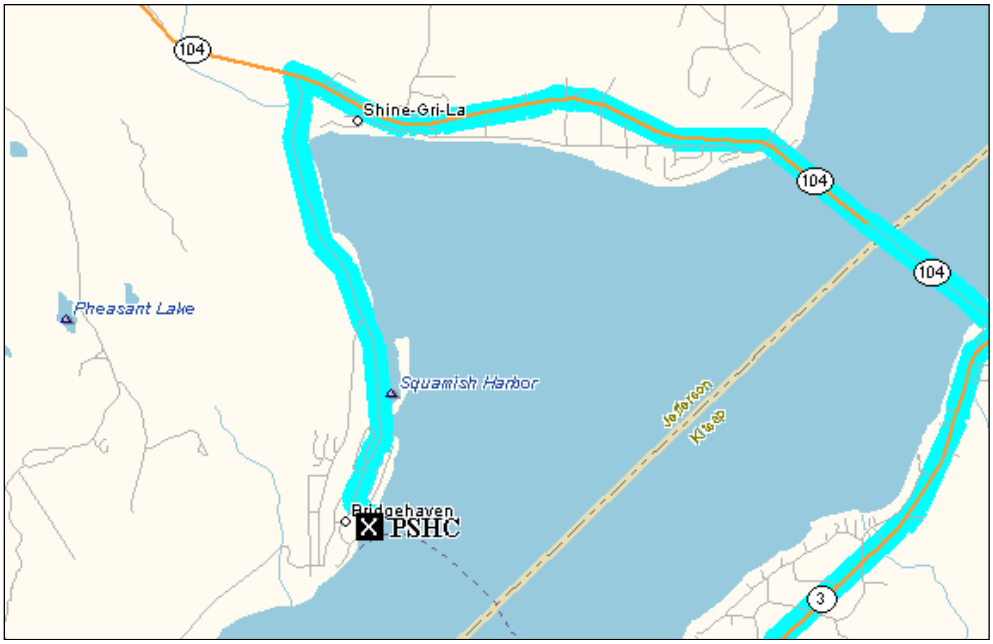
1998 There were abundant small sized *Mytilus sp.* growing on the rocks. Care was taken to avoid sampling any mussels from the old creosote pilings of the old ferry dock. Abundant oysters were also present on the pilings and the rocks. Collected mussels ranged from 2.0 cm to 4.5 cm in shell length. The average shell length was 3.1 cm with a standard deviation of 0.6 cm for 103 collected individuals.
1999 No collection.
2000 There were small to medium mussels present in adequate numbers, but somewhat hard to find. No mussels were taken from the old creosote pilings of the old ferry dock.
2004 Mussels were not as abundant as two years ago, and were heavily encrusted with barnacles. Available at this tide level, not earlier. Water was about 1 foot deep surrounding the riprap at this time. Area is posted no trespassing by Washington DOT, former ferry landing and parking, but not fenced. Appears to notify beach partiers (Fay, 2005).

SEDIMENT COLLECTIONS
1995 No collection.
1996 The soft olive-brown silty sediment sample was collected from 47° 50.31' N and 122° 38.92' W, in about 65 m of water.
1997 No collection.
1998 No collection.
1999 No collection.
2000 No collection.

SAMPLING METHODS
Bivalves - hand
Sediments - stainless steel sediment grab and stainless steel scoop

WATER DEPTH - intertidal, +2.5 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination, however the piling of the ferry terminal are heavily coated with creosote and should be avoided.



Map indicating location of PSHC site.

Close-up satellite view of PSHC site.

Washington State collaborators notes on

Puget Sound, Hood Canal (PSHC)

Date sampled: January 23rd, 2010 at 3:45 pm
Site center coordinates: 47° 49.943' N, 122° 41.248' W
Temperature: 8° C
Salinity: 27 $^{o}/_{oo}$

Sampler Information – Nine volunteers sampled the PSHC site.

Site Lead - Valerie Lindborg
Citizen Science Monitoring Coordinator
Port Townsend Marine Science Center
Fort Worden State Park
532 Battery Way,
Port Townsend, WA 98368
(360) 385-5582 x 110
vlindborg@ptmsc.org

All volunteers attended a five-hour Mussel Watch training on Friday, January 8th at the Port Townsend Marine Science Center.

Site Access – The original Site Center was located on private property. Although PSAMP staff initially gained permission from the property owners to sample on their beach, the owners later asked that all Mussel Watch volunteers sign legal paperwork (drawn up by their lawyer) absolving the owners of liability for injury. To simplify the sampling effort the site was relocated slightly to the northeast onto neighboring Department of Transportation (DOT) property. Although there was a "do not trespass" warning sign present at the beach access point onto the DOT land, there was no lock on the gate leading to the beach and volunteers easily accessed the shore. However, PSAMP recommends future sampling efforts be cleared through DOT in advance of sampling.

Volunteers noted that the site could be sampled earlier in the low tide (i.e., at a higher tide level) than indicated by the NOAA manual. Volunteers also illustrated the site layout on the back of the sample data sheet.

Site Description, Observations and General Notes – Substrate was made up of large rocks on sand, near old creosote ferry dock pilings. Mussels were not sampled from pilings, only from rocks. Mussels were small to medium in size and pretty abundant on large rocks with barnacles.

Port Townsend Marine Science Center volunteers sampling at the PSHC site.

Potential Sources of Contamination Noted – Creosote was noted on the surrounding dock pilings from an old ferry terminal located on the DOT land. Mussels were not sampled from the dock pilings, but they did have mussels present on them. There were also several beachfront houses to the south of the site, but no other signs of contamination.

Creosote pilings of old ferry terminal and cement retaining near PSHC site.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Puget Sound – Hood Canal Site Code: PSHC

Date: 1-23-2010 Time Arrive: 3:45 Time Leave: 5:00

Latitude: N 47°49.943 Longitude: W 122° 41.248

Weather: partly cloudy, calm, some sun breaks,

Mussel Collectors: Dan + Soozie Darrow, Susan + Stan Kriegel

Data Recorder: Valerie Lindberg (site lead) GPS Make/Model: Garmin

360-385-5582 (H)

SITE WATER PARAMETERS

Water Temperature (°C): 8°C Salinity (ppt): 27 ppt

Tidal Station: Lofall low tide

Time of Low Tide: 4:25 PM Height of Low Tide: +1.2 ft. [X] m. [ ]

STATION DESCRIPTIONS

STATION 1

Latitude: 47°49.951 Longitude: 122°41.249 Start Time: 3:55

Station Description: On large rocks right next to old ferry dock but not collecting from creosote pilings

Substrate: sand + large rocks Height of Collection: ≈21 ft. [X] m. [ ]

Highest Distribution of Mussels *(compared to water level at time of collection)*: ≈24 ft

STATION 2

largest + highest cont. of mussels

Latitude: N 47°49.947 Longitude: 122° Start Time: 4:25

Station Description: Right in front of the second dock in the water

Substrate: Sand mussels were pulled off large rocks Height of Collection: 22 ft. [X] m. [ ]

Highest Distribution of Mussels *(compared to water level at time of collection)*: 24

STATION 3

tiny mussels + sparse

Latitude: N 47°49.942 Longitude: W 122°41.251 Start Time: 3:55

Station Description: On the beach right in front of large wooden pilings in the water

Substrate: Sand large rocks Height of Collection: 22 ft. [X] m. [ ]

Highest Distribution of Mussels *(compared to water level at time of collection)*: 23 ft on wall

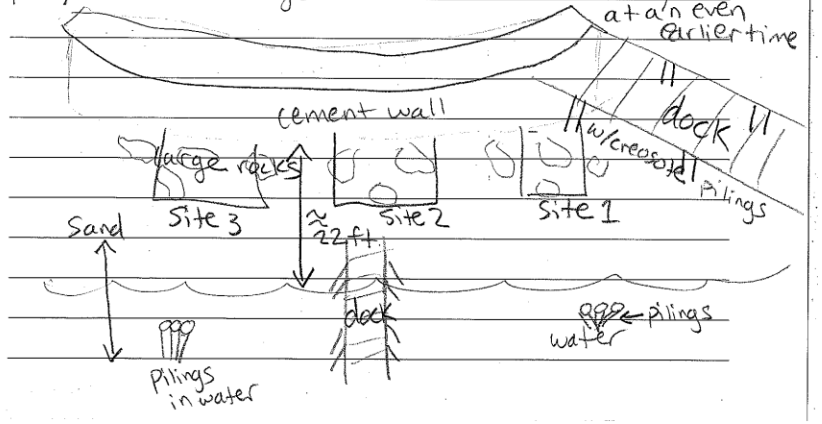
Version 4 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	On surrounding dock pilings, these were not sampled from but did have mussels on them
	Oil on water	None
	Oil on beach	None
	Garbage	None

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Original site Center was on private property so it was changed, Jennifer OK'd this. DOT warnings present at beach access points. Mussels were small → medium + pretty abundant on large rocks w/ barnacles. Easily accessed at a an even earlier time



Washington State Mussel Watch data sheet (front and back) from the PSHC site.

Appendix C.13 Puget Sound – Hat Island

The Puget Sound – Hat Island (PSHI) site was successfully sampled by Mussel Watch collaborators and volunteers on Monday, January 25th, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Puget Sound, Hat Island (PSHI)

TARGET SPECIES: Mytilus species (M. trossulus)

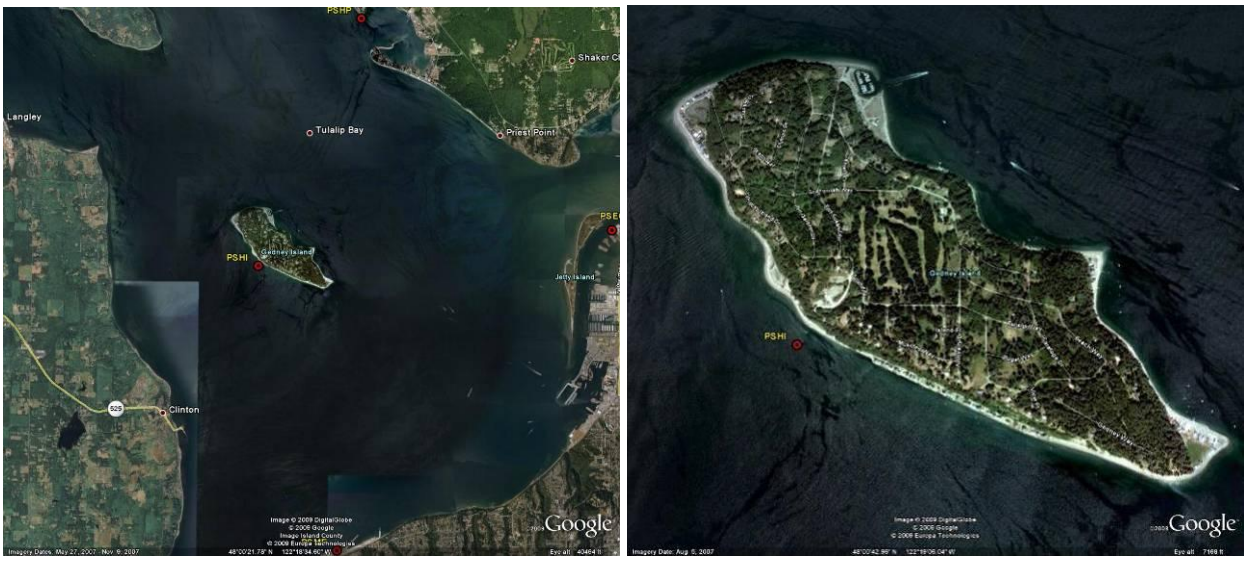
NOMINAL SITE CENTER- 48° 34.360' N 122° 19.330' W

LOCATED ON NOS CHART #: 18443_1

SITE DESCRIPTION - Site consists of remnants of an old pier structure with 20+ pilings and a cement structure on Hat Island (Gedney Island). Two populations of *Mytilus species* (*M. trossulus*) were located in sufficient numbers. One was located on non‐creosote* pilings from the old pier structure. A second population is located on the cement structure with mussels measuring 1/2" or less, and can potentially be large enough for collection in winter 2009. Mussels on pilings are of suitable size (>1") and numbers for collection. Mussels are located 12 feet from the seafloor, and are not accessible by land. Mussel collectors must have boat transport to access the island and to sample the mussels.

*Original October 2007 site visit determined the pilings to be non- creosote. In March 2008, during sampling, potential creosote oozing was discovered. Confirmation will be made following lab analysis of piling sample collected Summer 2008.

SITE ACCESS - Piling samples can only be accessed by boat. Snohomish County Sheriff's Office is willing to transport staff and volunteers to island for sampling, and can use any of their boats, as long as the boat can be tied off to the pilings in order to sample. Options include: 33′ boat, with or without a zodiac, or their two 20′ boats. The Sheriffs will meet staff and volunteers at 10th Street Boat Launch or 14th Street Boat Launch on the Everett Waterfront (depending on the boat used).



Satellite view of Hat Island and PSHI site.

Aerial view of west side of Hat Island. Old pier structure consisting of 20+ pilings and cement structure in lower right corner.

Washington State collaborators notes on

Puget Sound, Hat Island (PSHI)

Date sampled: January 25th, 2010 starting at 3:00 pm
Site Center coordinates: 48° 00.594' N, 122° 19.553' W
Temperature: 7° C
Salinity: 29 °/oo

Sampler Information – Four collaborators and volunteers from the SCMRC and the WSU Beach Watchers helped to sample the PSHI site.

Site Lead:
Lincoln Loehr
SCMRC Member
3000 Rockefeller Ave, M/S 607
Everett, WA 98201

Volunteers had been trained previously by the Snohomish County MRC.

Site Access - Hat Island (common name for Gedney Island) is a private island only accessible by ferry or personal watercraft. Notify Hat Island Manager, Chuck Motson (360) 444-6611, of sampling date. Access to site was provided by the Snohomish County Sheriff's Office. Contact Lt. Rodney Rochon at (425) 388-5255 to schedule a boat and crew for the sampling date. Communication will then transfer to the scheduled Captain of the boat for further logistical planning. For ease of site access and sampling, confirm the use and availability of the Sheriff's Zodiac boat.

Concrete structure near PSHI site center.

Snohomish County MRC collaborator sampling mussels at PSHI site.

Site Description, Observations and General Notes - Previous samplings obtained mussels from creosote pilings. Winter 2010 samples were obtained from a concrete structure just beachward of the previous site location. Mussels were generally large and covered the surface of the structure within the upper and inter tidal.

Potential Sources of Contamination Noted – Creosote pilings are located near the site; a portion of the sample for station three was obtained by a sampler not wearing gloves.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Puget Sound Hat Island Site Code: PSHI

Date: 01-25-10 Time Arrive: 3 PM Time Leave: ~~3:34~~ 3:48 PM

Latitude: ~~N 48° 00.594~~ 48° 00.598 Longitude: W 122° 19.553 / 122, 19.547

Weather: Partly cloudy, windy, waves 2-4 ft

Mussel Collectors: KATHLEEN KERRIGAN WNCohN Lab, Maureen Hoban

Data Recorder: THOMAS HOBAN/Kathleen

SITE WATER PARAMETERS

Water Temperature (°C): 44.8°F Salinity (ppt): ~~29~~

Tidal Station: PSHI - Hat Island

Time of Low Tide: 6:47 pm Height of Low Tide: -0'3" ft. [X] m. [ ]

STATION DESCRIPTIONS

STATION 1

Latitude: N 48° 00.598 Longitude: W 122° 19.553 Start Time: 3:00 pm

Station Description: Behind old dock on concrete bunker

Substrate: Concrete bunker Height of Collection: +1 ft. [X] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 3-0 ft above water level

STATION 2

Latitude: N 48° 00.598 Longitude: W 122° 19.553 Start Time: 3:00 pm

Station Description: Behind old dock on concrete bunker

Substrate: Concrete bunker Height of Collection: +1 ft ft. [X] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 3ft above water level

STATION 3

Latitude: N 48° 00.598 Longitude: W 122° 19.553 Start Time: 3:00 pm

Station Description: Behind old dock on concrete bunker

Substrate: Concrete bunker Height of Collection: +1 ft ft. [X] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 3ft above water level

Version 3 – 2009

Check Boxes for Site Conditions:

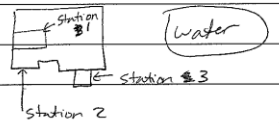
✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	

o o o o o o > old pilings

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Sampled from Concrete Bunker - 3 stations

took GPS Point



Shore

- Site was accessed by Sheriff department's boat (hard shell river boat)
- 2-4 ft waves
- Important to have zodiac in future
- One handful of mussels taken from Station 3 without gloves on

Washington State Mussel Watch data sheet (front and back) from the PSHI site.

Appendix C.14 Puget Sound – Hermosa Point

The Puget Sound – Hermosa Point (PSHP) site was successfully sampled by Mussel Watch collaborators and volunteers, including members of the Tulalip Tribes, on Tuesday, January 26th, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Puget Sound, Hermosa Point (PSHP*)

TARGET SPECIES- *Mytilus species*

NOMINAL SITE CENTER – 48° 03.688' N 122° 17.612' W

LOCATED ON NOS CHART # 18443_1

SITE ACCESS - From I-5 heading North take exit 199 for WA-528 towards Marysville. Stay in the left (west) exit lane and proceed west at stop light onto 4th St/WA 528 back under I-5 and cross onto the Tulalip Indian Reservation.
From I-5 heading Southbound, also take exit 199 and turn right (west) onto 4th St/WA 528. 4th St/WA528 becomes Marine Dr. NE. Continue for roughly 6.6 miles until Hermosa Beach Road. Hermosa Beach Road will be on your left just after you go under a large concrete foot bridge and pass the Tulalip Boys and Girls Club. Proceed along Hermosa Beach Road. Parking is available along the beach at the boat launch south and across the street from 7598 Hermosa Beach Road. The site is a five minute or less walk to Hermosa Point – north along Tulalip Bay.

SITE DESCRIPTION - The site is located just outside of Tulalip Bay at Hermosa Point and northwest of the point. The site is on the Tulalip Indian Reservation. The substrate is sand and cobble.

BIVALVE COLLECTIONS
Mussels were collected at the point (site 1), and northwest of the point (sites 2 and 3). The mussels were medium-sized

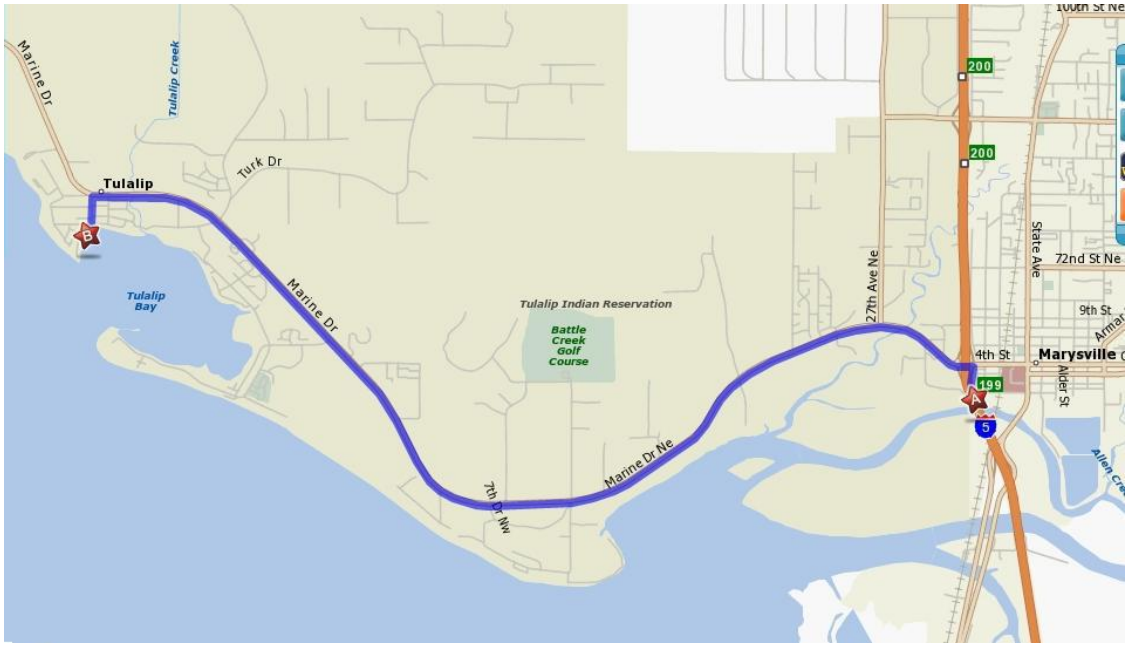
SEDIMENT COLLECTIONS
None were collected.

SAMPLING METHODS
Mussels – by hand

DEPTH OF SAMPLE COLLECTION
Mussels – intertidal

POSSIBLE CONTAMINANTS
Unknown

* This site was originally called PSTB / Puget Sound, Tulalip Bay. The name was changed to PSHP.



Map of route to PSHP site.

Aerial view of PSHP site location.
Washington State collaborators notes on

Puget Sound, Hermosa Point (PSHP)

Date sampled: January 26th, 2010 starting at 3:20 pm
Site Center coordinates: 48° 06.163' N, 122° 29.348' W
Temperature: 8° C
Salinity: 22 °/oo

Sampler Information – Five collaborators and volunteers from the SCMRC, Tulalip Tribes and WSU Beach Watchers sampled at the PSHP site.

Site Lead - Lincoln Loehr
SCMRC Member
3000 Rockefeller Ave, M/S 607
Everett, WA 98201

Volunteers had been trained previously by the Snohomish County MRC.

Site Access – The site was located on Hermosa Point, on the Tulalip Tribes reservation. Sampling should be planned and take place with Cathy Stanley, Tulalip Tribes shellfish biologist, (360) 716-4628, and/or Mike McHugh, Tulalip Tribes shellfish manager, (360) 716-4615).

Parking is available along the street near the beach, which permits easy access.

Site Description, Observations and General Notes - Mussels of various sizes were available within the tide line on large cobble rocks.

Collaborators and volunteers sampling mussels at the PSHP site.

Potential Sources of Contamination Noted – The beach to north is bordered by houses and a small marina in located within Tulalip Bay.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Puget Sound Hermosa Point Site Code: PSHP

Date: 01-26-10 Time Arrive: ~~@~~ 15:20 Time Leave: 1655

Latitude: 48.06163°N Longitude: 122.29348°W

Weather: balmy Temperature

Mussel Collectors: Tom Hoban, Maureen Hoban, Lincoln Loehr, Mike McHugh

Data Recorder: Lincoln Loehr

SITE WATER PARAMETERS

Water Temperature (°C): 8°C Salinity (ppt): 22 ‰

Tidal Station: Tulalip

Time of Low Tide: 1948 Height of Low Tide: -1.1 ft. ☒ m. ☐

STATION DESCRIPTIONS

STATION 1

Latitude: 48.06163°N Longitude: 122.29348°W Start Time: 1610

Station Description: West Side of Hermosa Point

Substrate: Cobble Height of Collection: 1/2 ft. ☒ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: 1 ½ ft

STATION 2

Latitude: 48.06179°N Longitude: 122.29353°W Start Time: 1620

Station Description: about 80' NNW of Sta 1

Substrate: Cobble Height of Collection: 1' ft. ☒ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: 3'

STATION 3

Latitude: 48.06148°N Longitude: 122.29317°W Start Time: 1630

Station Description: ~~@~~ about 80' SSE of Sta 1

This station is on the end of the Point

Substrate: Cobble Height of Collection: +1' ft. ☒ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: 4'

Version 3 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Washington State Mussel Watch data sheet (front and back) from the PSHP site.

Appendix C.15 Puget Sound – Mukilteo Ferry

The Puget Sound – Mukilteo Ferry (PSMF) was successfully sampled by collaborators and volunteers from the SCMRC, the Ocean Research College Academy (ORCA) at Everett Community College, and WSU Beach Watchers on Tuesday, January 26th, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Puget Sound, Mukilteo Ferry (PSMF)

TARGET SPECIES- *Mytilus species*

NOMINAL SITE CENTER – 47° 56.981' N 122° 18.095' W

LOCATED ON NOS CHART # - 18473-1

This new site was added in 2004 (like PSEF) in response to the oil spill at Wells Point, and was reported to have a robust mussel population attached to the floating docks at the public boat ramp. However, a winter storm the previous year had wiped out the docks (and many businesses were still closed from the damage) thus the substratum and mussels were not there this year. Collection was made among the intertidal rocks that border the government property adjacent to the Silver Cloud Hotel, though the entire rocky shoreline from the launch ramp, past the ferry landing to the hotel was searched without finding mussels.

SITE ACCESS - From I-5 take exit 189 and go east on Hwy 526 past Snohomish County airport (where Boeing assembles the 747 and 757 aircraft) to Hwy 525 at Nelson's Corner. Turn right on 525 and follow signs indicating "To Mukilteo Ferry". Approaching the ferry landing go right and park at the Silver Cloud Inn or left to the boat ramp and large public parking area to access the shoreline at either point.

SITE DESCRIPTION - The entire shoreline from southwest of the ferry (at the boat ramp) to east of the ferry into the fenced former military facility is comprised of rock riprap suitable for mussel habitat. The site had received a recommendation as a collecting location due to the abundance of mussels attached to the floating docks at the boat ramp. However, the floating docks were gone along with their mussels. A severe storm in the previous year reportedly took out the docks, and probably the resident mussel population on the rocky shoreline. The severity of the storm was such that several businesses at the waterfront remained closed and were still rebuilding from the storm damage. The site is well protected and easily accessed at any time of night or day and in essentially in any weather for which the tides are favorable.

BIVALVE COLLECTIONS

2004 Mussels are very rare and small. Found as singles both at the sand interface and as isolated individuals attached to rocks. Reported mussels on boat launch floats were not found as floats were gone, possibly due to storm damage. Both lighthouse park and the riprap North of the

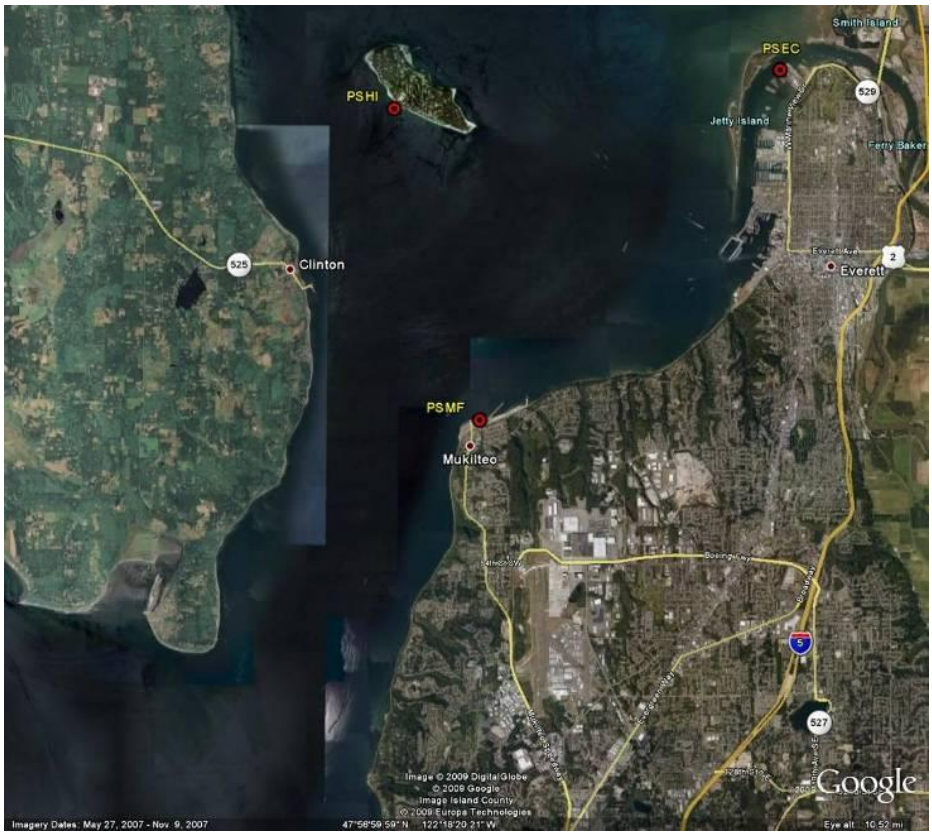
Silver Cloud motel were searched for mussels, as well as steel and concrete pilings at the motel and ferry landing. Mussels were essentially absent. Further south there is no more habitat, to the north access is limited by the former Air Force facility, now a NOAA field station (Fay, 2005).

SEDIMENT COLLECTIONS
None were collected.

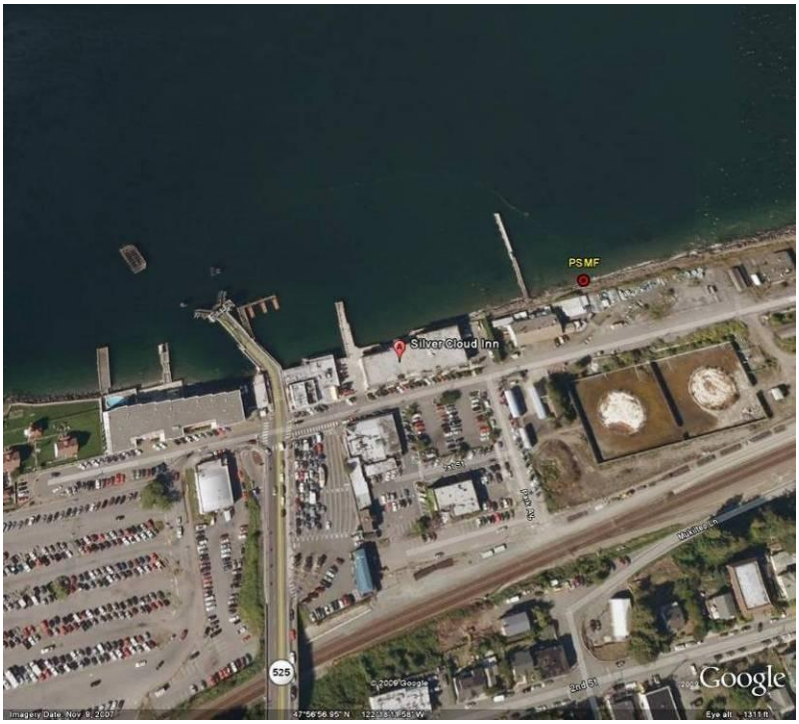
SAMPLING METHODS
Mussels – by hand

DEPTH OF SAMPLE COLLECTION
Mussels – intertidal, essentially all at the waterline

POSSIBLE CONTAMINANTS
Unknown. Apart from the oil spill at Wells Point the preceding week, little could be ascertained about the site environs at the time of collection (in the heaviest snow storm in 10 years). The port of Everett is but 4 miles to the north, and the spill at Point Wells was 12 miles to the south.



Satellite view of PSMF site and access route.



Aerial view of PSMF site center.

Washington State collaborators notes on

Puget Sound, Mukilteo Ferry (PSMF)

Date sampled: January 26th, 2010 starting at 6:10 pm
Site Center coordinates: 47° 94.968’ N, -122° 30.205’ W
Temperature: 7.5° C
Salinity: 20 °/oo

Sampler Information – Eight collaborators and volunteers from the SCMRC, the Ocean Research College Academy (ORCA) at Everett Community College, and WSU Beach Watchers helped to sample the PSMF site.

Site Lead - Mary Cunningham
SC MRC member
3000 Rockefeller Ave, M/S 607
Everett, WA 98201
(425) 257-7131
mcunningham@ci.everett.wa.us

Volunteers had been trained previously by the Snohomish County MRC.

Site Access - Public parking near the site center was available east of the Silver Cloud Inn, between the hotel and the NOAA Mukilteo Research Station. The beach is easily accessed by a set of stairs from the parking area.

Site Description, Observations and General Notes - Mussels were found interspersed with the cobble on the beach, along metal boat launch tracks, and on old bricks and concrete within the tide line.

Volnteers sampling mussels at the PSMF site.

Fewer mussels than expected were at the site. Mussel and barnacle shell debris was present in large amounts at the site, especially lower within the tide line. Lincoln Loehr, of the SCMRC, noted mussel populations were larger on a site visit on January 1st, 2010. On the same day, he photographed a large flock of surf scoters at the Mukilteo Ferry dock feeding on the barnacles attached to the pier.

Large flock of surf scoters at the Mukilteo Ferry dock several weeks prior to sampling at the PSMF site. Scoter predation on mussels may have reduced sampling population at this site.

Potential Sources of Contamination Noted – Some pier remnants at the site were creosote. The ferry, ferry parking and associated dock are to the south of the site. A hotel and NOAA research labs border the site to the east. A stormwater culvert and local creek culvert are located at the site. Train tracks with significant train traffic are located to the east of the site.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Puget Sound Mukilteo Ferry Site Code: PSMF

Date: 01-26-10 Time Arrive: 6:10 Time Leave: 7:10

Latitude: N47°34.968 Longitude: W122°30.205

Weather: Mostly Sunny, dry

Mussel Collectors: Mary Cunningham, Kathleen Herrmann, Craig Wollam, Tony Lukhmire, Lincoln Loehr, Sawyer Henderson, Mauricio Calderon

Data Recorder: Mary Cunningham

SITE WATER PARAMETERS

Water Temperature (°C): 7.5 Salinity (ppt): 20

Tidal Station: Everett

Time of Low Tide: 7:42 pm. Height of Low Tide: -1.2 ft. ☒ m. ☐

STATION DESCRIPTIONS

STATION 1

Latitude: 47.94935N Longitude: 122.30367 Start Time: 6:26

Station Description: Pier by Silver Cloud

Substrate: Concrete piling Height of Collection: 6 ft. ☒ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): 8 feet

STATION 2

Latitude: 47.94.968 N Longitude: 122.30.205 W Start Time: 6:30

Station Description: Metal Boat launch rails

Substrate: Metal - iron rail Height of Collection: 2-5 ft. ☒ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): 5'

STATION 3

Latitude: 47.95005°N Longitude: 122.30097°W Start Time: 6:25

Station Description: Near eastern (northern) end of NOAA facility

Maybe old pier debris

Substrate: Rocks, rocks Concrete/brick stub fragments Height of Collection: ft. ☒ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): 6'

Version 3 – 2009

These are all oriented N/S / long

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

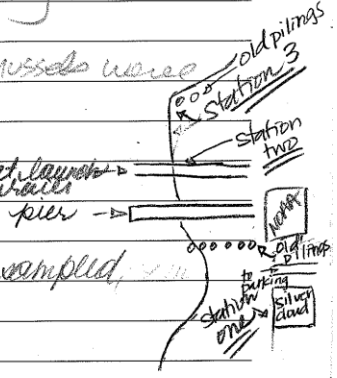
Large kill of mussels - Lots of mussel debris

Barnacles & mussels dead along lower elevations

Volunteer noticed these mussels were alive 2 weeks ago.

Signs of predation

mussels at station 2 were sampled from old boat launch rails



Washington State Mussel Watch data sheet (front and back) from the PSMF site.

Appendix C.16 Puget Sound – Port Angeles

The Puget Sound – Port Angeles (PSPA) site was successfully sampled by the manager of the floating salmon pens (owned by American Gold Seafoods/Icicle Seafoods) at Ediz Hook in Port Angeles, and a collaborator from the Olympic Coast National Marine Sanctuary (OCNMS) on Tuesday, January 12th, 2010. Mussel samples were shipped for chemical and histopathology analysis the same day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Puget Sound, Port Angeles (PSPA)

TARGET SPECIES - *Mytilus species* SITE NUMBER - 271

NOMINAL SITE CENTER - 48° 08.38' N 123° 25.21' W

LOCATED ON NOAA CHART - 18468

SITE ACCESS - The sampling site is located at the salmon pens in Port Angeles Harbor, and can only be accessed by boat. Permission is required to sample at the salmon pens. Follow Highway 101 north out to the Olympic Peninsula, through Sequim and on to Port Angeles. Follow the signs out to Ediz Hook, where there is a good boat ramp just short of the U.S. Coast Guard Station entrance and the Pilot Station.

SITE DESCRIPTION - The salmon pens are located just to the southeast of the boat ramp, and west of the Coast Guard Station on the Point of Ediz Hook. The discrete sampling stations are located 20 to 25 m apart, around the nominal site center.

BIVALVE COLLECTIONS

1995 No collection.

1996 There was a good population of small to medium sized *Mytilus sp.* mussels growing on the floats and buoys around the salmon pens. The mussels were all subtidal, as the salmon pens float on the surface of the water. Collected mussels ranged from 4.5 cm to 8.7 cm in shell length. The average shell length was 5.4 cm with a standard deviation of 0.7 cm for 36 collected individuals.

1997 No collection.

1998 There was a good population of small *Mytilus sp.* mussels growing on the salmon pen floats. Collected mussels ranged from 2.3 cm to 7.6 cm in shell length. The average shell length was 3.7 cm with a standard deviation of 0.7 cm for 97 collected individuals.

1999 No collection.

2000 There were abundant medium to large sized *Mytilus sp.* mussels growing on the salmon pen floats.

2004 Collected from floats at salmon farm by R. Hodgin, manager of the farm (Fay, 2005)

SEDIMENT COLLECTIONS

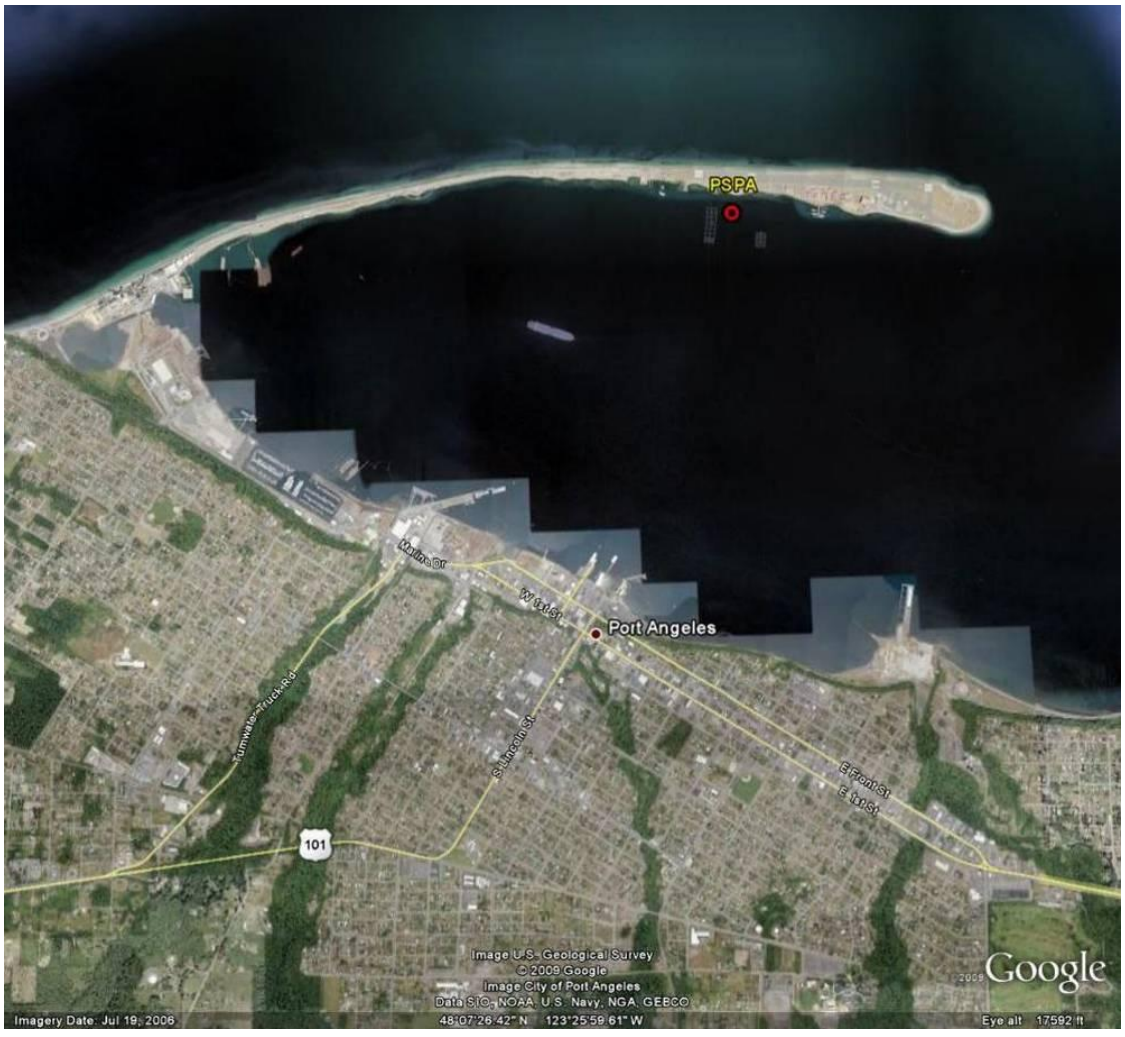
1995 No collection.

1996 Fine grained sediments were collected from an area to the southeast of the salmon pens, at 48° 06.18' N and 122° 45.90' W.
1997 No collection.
1998 No collection.
1999 No collection.
2000 No collection.

SAMPLING METHODS
Bivalves - hand
Sediments - stainless steel sediment grab and stainless steel scoop

WATER DEPTH - subtidal, 0-0.5 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination



Satellite image of PSPA site on Ediz Hook, Port Angeles.

Aerial view of PSPA site at floating salmon pens.

Washington State collaborators notes on

Puget Sound, Port Angeles (PSPA)

Date sampled: January 12th, 2010
Site center coordinates: 48° 8.38' N, 123° 25.21' W
Temperature: 8.1° C
Salinity: $30^{o}/_{oo}$

Sampler Information – The manager of the floating salmon pens, owned by American Gold Seafoods/Icicle Seafoods, sampled mussels at PSPA and gave them to a collaborator from the OCNMS, who also collected data on physical measurements of the site.

Site Lead - Mary Sue Brancato
Resource Protection Specialist
Olympic Coast National Marine Sanctuary
115 East Railroad Ave., Suite 301
Port Angeles, WA 98382
(360) 457-6622, ext 20
Mary.Sue.Brancato@noaa.gov

Site Access – PSAMP staff contacted the manager of the floating salmon pens, Randy Hodgins, to ask permission to sample mussels from the floating salmon pens. Randy indicated that in years prior he has collected and delivered mussels to the Mussel Watch sampler (i.e., a contractor for the national program) from the pens himself. Due to restrictions from the property owner on access to the floating pens, it was agreed that Randy would collect mussels for the program again

this year, following protocol specified in a letter. Below is a copy of the letter sent to Randy describing mussel collection protocol and thanking him for his participation in the Mussel Watch program:

Jennifer A. Lanksbury
Fish & Wildlife Biologist
Puget Sound Assessment and Monitoring Program
Washington Department of Fish & Wildlife

Randy Hodgins
American Gold Seafoods/Icicle Seafoods
670 Ediz Hook Road
Port Angeles, WA 98362

January 5, 2010

Dear Randy,

Thanks again for agreeing to collect mussels this year for the National Mussel Watch Program (Mussel Watch). In this package I have included a Mussel Watch brochure and the gloves and pre-labeled bags (small and large) you will need to collect the mussels.

Below are the protocols we ask that you follow when collecting:

1) Collect from at least 3 separate locations around the pens, preferably as far away from each other as possible. This ensures mussels are not sampled from a single clump.

2) **Place the mussels into the pre-labeled bags provided.** You will see that there is a small and large bag labeled for each location, called: Station 1, Station 2 and Station 3.

   - For each station put the first 20 mussels you find into the corresponding smaller bag, then put the rest of the mussels into the larger bag.
   - FYI - the small bags go for histopathology analysis, the larger bags go for chemistry analysis.

3) Please collect the largest mussels you find. We need a total of 80 (large mussels, 2 - 3 inches long) to 130 (smaller ones, <½ inch) from each of the 3 locations. Remember that the first 20 always go in the smaller bags. If the mussels fall somewhere in between the sizes listed above, then a good rule of thumb is to collect about 100 from each location.

4) **Wear the blue Nitrile gloves provided when collecting the mussels**. I have sent several pairs so you can replace them if you get rips in your gloves as you're collecting.

5) Please use a knife to cut the threads connecting the mussels to the floats. Ripping them off hurts the mussels and they die sooner. They can stay in clumps if they are stuck together though.

PLEASE FEEL FREE TO CALL ME DURING YOUR SAMPLING IF YOU HAVE ANY QUESTIONS.

MY CELL NUMBER IS (XXX) XXX-XXXX. MY WORK NUMBER IS (360) 902-2820.

On behalf of the Washington Department of Fish & Wildlife and the National Mussel Watch Program I thank you for helping to continue these valuable monitoring efforts in Washington State.

Be safe and remember to wear a life jacket out there!
Sincerely,

Jennifer Lanksbury

Description, Observations and General Notes – OCNMS staff noted that Randy collected the mussels from the salmon pens via SCUBA diving, not from a boat as expected. Water measurements (salinity and temperature) took place from the end of the dock at the nearby boat launch on Ediz Hook.

Potential Sources of Contamination Noted – Although the sample collector was provided with nitrile gloves to use while sampling, it was unconfirmed whether he used them or his own dive gloves when collecting the mussels. The Port Angeles Coast Guard Air Station is located directly to the west of the PSPA site. On the other side of Port Angeles Harbor, across from the sampling site, there is a ferry terminal and a marina.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Puget Sound, Port Angeles Site Code: PSPA

Date: 1/12/2010 Time Arrive: 12:00 Time Leave: 12:30

Latitude: 48.13967 Longitude: -123.4168

Weather: Sunny, calm; heavy rain for previous 24 hours 9.6°C

Mussel Collectors: Randy Hodgins, manager salmon pens

Data Recorder: Mary Sue Brancato

SITE WATER PARAMETERS

Water Temperature (°C): 8.1°C Salinity (ppt): 30

Tidal Station: Ediz Hook, Port Angeles

Time of Low Tide: Not applicable Height of Low Tide: Not appl. ft. ☐ m. ☐

STATION DESCRIPTIONS

STATION 1

Latitude: 48°08.38' N Longitude: 123° 25.21' W Start Time: 11:00 AM

Station Description:

Substrate: Height of Collection: NA ft. ☐ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*:

STATION 2

Latitude: Longitude: Start Time:

Station Description:

Substrate: Height of Collection: NA ft. ☐ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*:

STATION 3

Latitude: Longitude: Start Time:

Station Description:

Substrate: Height of Collection: NA ft. ☐ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*:

Version 3 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Mussels sampled by boat from floats of salmon pen owned by American Gold Seafoods - Icicle Seafoods.

Water sampling from end of float at boat launch on Ediz Hook.

Washington State Mussel Watch data sheet (front and back) from the PSPA site.

Appendix C.17 Puget Sound – Picnic Point

The Puget Sound – Picnic Point (PSPP) site was not an original National Mussel Watch Program site, but was added for the 2009/10 field season by SCMRC staff as a replacement for the abandoned Puget Sound – Edmonds Marina (PSEM – Appendix D.3) and Puget Sound – Kayak Point (PSKP – Appendix D.4) sites. Because the latter two sites had no mussels available for collection, Snohomish County MRC staff scoped out possible substitute sample locations nearby. It was determined that the beach at Picnic Point had a sufficiently large mussel population to warrant sampling.

The PSPP site was successfully sampled by a member of the Snohomish County MRC staff and a volunteer on Thursday, March 18th, 2010. Mussel samples were shipped for chemical and histopathology analysis the same day and arrived in good condition at both receiving laboratories.

Washington State collaborators notes on

Puget Sound, Picnic Point (PSPP)

Date sampled: March 18th, 2010 starting at 11:00 am
Site Center coordinates: 47° 53.026' N, 122° 19.911' W
Temperature: 10° C
Salinity: 30 °/$_{oo}$

Sampler Information – Two people, a Snohomish County MRC collaborator and a volunteer, sampled PSPP.

Site Lead - Lincoln Loehr
SCMRC member
3000 Rockefeller Ave, M/S 607
Everett, WA 98201

Volunteers had been trained previously by the Snohomish County MRC.

Site Access – Site access: This site is within the Snohomish County Park, Picnic Point and is easily accessible by foot at most low tides. Inform Doug Dailer (425-745-5111), Snohomish County Park Ranger, of the sampling date. From Interstate 5, take exit 186 and head west on 128th St SW. Continue on Airport Road, turn left at Evergreen Way, turn right at Shelby Road, continue on 140th St SW, and then turn right onto Picnic Point Road. Parking is available in the Picnic Point Park's parking lot. Access the beach from the pedestrian overpass and head north approximately 500 yards along the railroad riprap to arrive at the site. Do not proceed past Park boundaries, as the area to the north is a No Trespassing Zone.

Samplers informed the Snohomish County Park Ranger, Doug Dailer (425) 745-5111, of the sampling date. Parking was available in the park's associated lot. Sampling site was easy to

access from the Picnic Point County Park beach. Samplers walked north along the riprap to arrive at the site. It is advised not to proceed past the park boundaries, as the area to the north is a "No Trespassing Zone".

Site Description, Observations and General Notes - Mussels were present on the large boulders that make up the riprap for the railroad. The beach face substrate was sand and shell.

Rocks covered with mussels and barnacles at PSPP site.

Potential Sources of Contamination Noted – A railroad borders the site to the east. The "No Trespassing Zone" to the north of the site contains a large derelict wooden barge wrecked, or perhaps intentionally grounded, on the shore, which has promoted accumulation of beach sediments.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Puget Sound Picnic Point Site Code: PSPP

Date: 03-18-10 Time Arrive: 11:00 Time Leave: 12:50

Latitude: N47°53.026 Longitude: W 122°19.911 12°C

Weather: Sunny, light wind, air temp ~~10°C~~

Mussel Collectors: Lincoln Loehr, Janet Loehr

Data Recorder: Lincoln Loehr

SITE WATER PARAMETERS

Water Temperature (°C): 10°C Salinity (ppt): 30 ‰

Tidal Station: Seattle

Time of Low Tide: 13 23 Height of Low Tide: 0.5 ft.☒ m.☐

STATION DESCRIPTIONS

STATION 1

Latitude: N 47°53.026' Longitude: W 122°19.911' Start Time: 11:20

Station Description: =site center

Substrate: rip rap Height of Collection: 2 ft.☒ m.☐

Highest Distribution of Mussels *(compared to water level at time of collection)*:

STATION 2

Latitude: N 47°53.013' Longitude: W122°19.917' Start Time: ~~11:40~~ 1150

Station Description: = about 30m South of Sta 1

Substrate: rip rap Height of Collection: 3 ft.☒ m.☐

Highest Distribution of Mussels *(compared to water level at time of collection)*:

STATION 3

Latitude: N 47°53.042' Longitude: W 122°19.904' Start Time: 1225

Station Description: =about 30m North of Sta 1

Substrate: rip rap Height of Collection: 4 ft.☒ m.☐

Highest Distribution of Mussels *(compared to water level at time of collection)*:

Water level dropped 2 ft by 1250

Version 3 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

none

Washington State Mussel Watch data sheet (front and back) from the PSPP site.

Appendix C.18 Puget Sound – Port Townsend

The Puget Sound – Port Townsend (PSPT) site was successfully sampled by volunteers from the Port Townsend Marine Science Center (PTMSC) on Tuesday, January 12th, 2010. Mussel samples were shipped for chemical and histopathology analysis the next day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Puget Sound, Port Townsend (PSPT)

TARGET SPECIES - *Mytilus species* SITE NUMBER - 272

NOMINAL SITE CENTER - 48° 06.28' N 122° 46.68' W

LOCATED ON NOAA CHART - 18464

SITE ACCESS - This sampling site is an easy walk-up from the shore. Follow Highway 101 north out to the Olympic Peninsula, and then turn right (east) on Highway 20 and drive to Port Townsend. A boat is necessary if sediments are to be collected. There is a good small boat ramp at the Port Townsend Marina - right next to the bivalve site.

SITE DESCRIPTION - The site is located at the southwest corner of the Port Townsend Marina breakwater, next to the abandoned railroad ferry terminal. Station 1 is located at the nominal site center, the southwest corner of the rock breakwater, Station 2 is 10 m to the northwest and Station 3 is a further 30 m along the northwest breakwater.

BIVALVE COLLECTIONS

1995 No collection.

1996 There was a small population of small *Mytilus species* mussels growing in between and under the rocks on the marina breakwater. There were lots of barnacles and also a few small Olympia Oysters. Collected mussels ranged from 2.4 cm to 3.5 cm in shell length. The average shell length was 3.0 cm with a standard deviation of 0.3 cm for 59 collected individuals.

1997 No collection.

1998 There were abundant small *Mytilus species* present along the breakwater. Gastropod predation on the mussels was evident at this site. Oysters were also present at this site. There was construction of a new pier adjacent to the sampling site. Collected mussels ranged from 2.2 cm to 4.1 cm in shell length. The average shell length was 3.1 cm with a standard deviation of 0.3 cm for 120 collected individuals.

1999 No collection.

2000 The mussels were extremely rare and very small sized. There were a lot of barnacles and gastropods present at the site. Many of the rocks of the breakwater had absolutely no mussels present, those with mussels had many gastropods feeding on the mussels. The mussels that were collected were extremely difficult to collect as they were all lodged between barnacles presumably avoiding predation by the gastropods.

2002 Mussels were abundant on the muddy tidal flat adjacent to the breakwater when the tide went out (Fay, 2005)

2004 No mussels were found on the mud flat, on the rocks of jetty or around the rocks in sand flat. Numerous large oysters were present on the rock and collected in lieu of missing mussels. Highest oyster access is at the foot of the jetty and about a foot up the lowest level of rocks. Area is posted prohibiting shellfish consumption due to contamination (Fay, 2005).

SEDIMENT COLLECTIONS

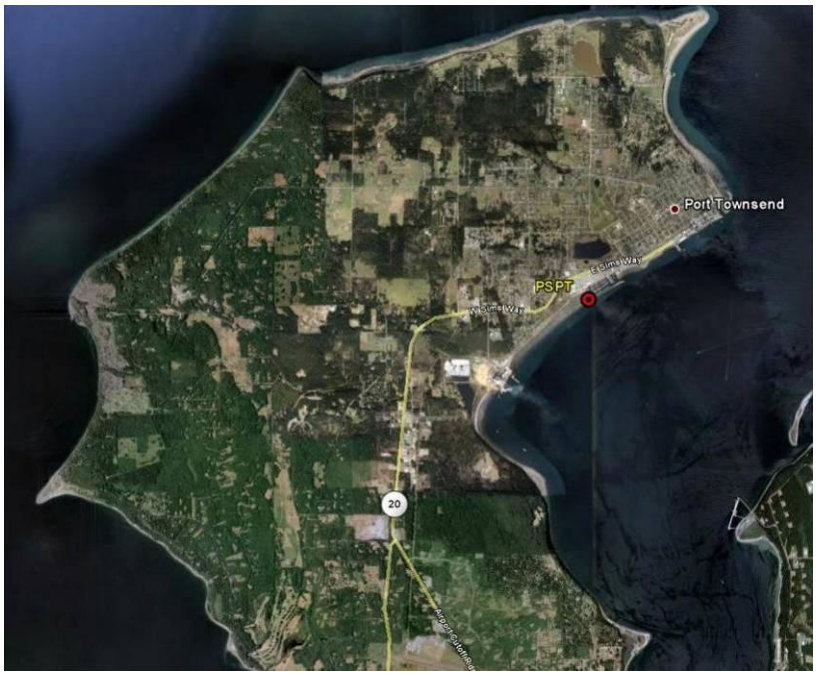
1995 No collection.
1996 Sediment sample was collected just off the nominal site center, in ~20 meters of water.
1997 No collection.
1998 No collection.
1999 No collection.
2000 No collection.

SAMPLING METHODS

Bivalves - hand
Sediments - stainless steel sediment grab and stainless steel scoop

WATER DEPTH - intertidal, +0.5 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination.



Satellite map indicating location of PSPT site.

Aerial view of PSPT site on outside of marina jetty wall.

Washington State collaborators notes on

Puget Sound, Port Townsend (PSPT)

Sample date: January 12th, 2010 starting at 7:30 pm
Site center coordinates: 48° 6.285' N, 122° 46.678' W
Temperature: 8.2° C
Salinity: 35$^{o}/_{oo}$

Sampler Information – Eight volunteers from the PTMSC sampled the PSPT site.

Site Lead - Jean Walat
Volunteer and Citizen Science Coordinator
Port Townsend Marine Science Center
Fort Worden State Park
532 Battery Way,
Port Townsend, WA 98368
(360) 385-5582 x 112
jwalat@ptmsc.org

All volunteers attended a five-hour Mussel Watch training on Friday, January 8th at the Port Townsend Marine Science Center.

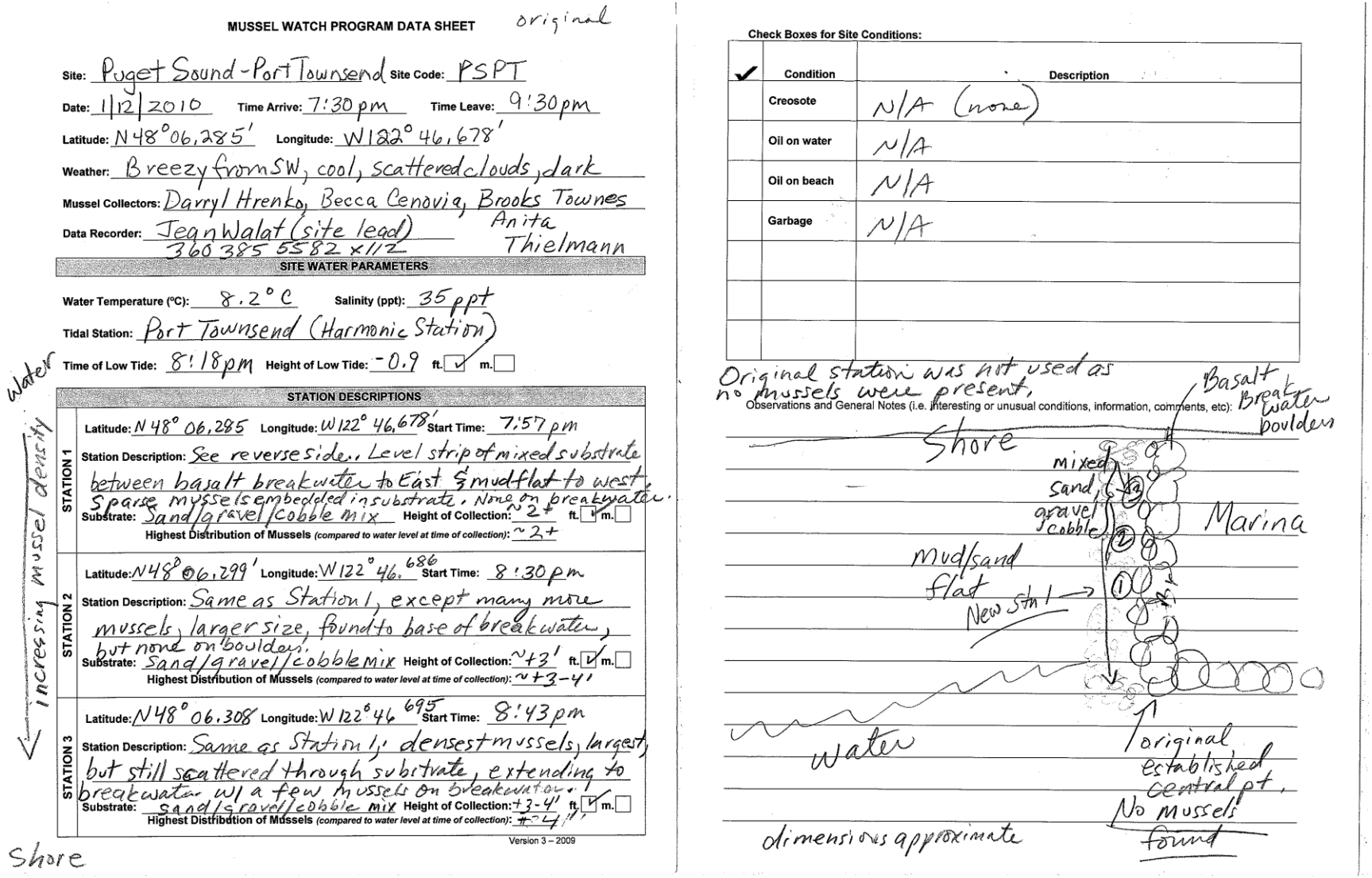
PTMSC volunteers sampling, rinsing and bagging mussels at the PSPT site.

Site Access – Nothing was noted by the volunteers regarding site access.

Site Description, Observations and General Notes - The original station was not used, as no mussels were present there. Volunteers provided a drawing of the station locations on the back of the Washington State Mussel Watch Datasheet. Mussels were found embedded in a substrate of mixed cobble, gravel and sand in a strip between the outside edge of the basalt boulder breakwater of the marina (to east) and the mudflat to the west. Some mussels were found at the base of, and on, the breakwater for stations.

Example of substrate with embedded mussels at PSPT site.

Potential Sources of Contamination Noted – No contaminants were observed or recorded on the datasheet, however this site is located on the outside wall of a marina jetty.



MUSSEL WATCH PROGRAM DATA SHEET original

Site: Puget Sound - Port Townsend Site Code: PSPT

Date: 1/12/2010 Time Arrive: 7:30 pm Time Leave: 9:30 pm

Latitude: N 48° 06.285' Longitude: W 122° 46.678'

Weather: Breezy from SW, cool, scattered clouds, dark

Mussel Collectors: Darryl Hrenko, Becca Cenovia, Brooks Townes

Data Recorder: Jean Walat (site lead) 360 385 5582 x112 Anita Thielmann

SITE WATER PARAMETERS

Water Temperature (°C): 8.2° C Salinity (ppt): 35 ppt

Tidal Station: Port Townsend (Harmonic Station)

Time of Low Tide: 8:18 pm Height of Low Tide: -0.9 ft. ☑ m. ☐

STATION DESCRIPTIONS

STATION 1

Latitude: N 48° 06.285 Longitude: W 122° 46.678' Start Time: 7:57 pm

Station Description: See reverse side. Level strip of mixed substrate between basalt breakwater to East & mudflat to west. Sparse mussels embedded in substrate. None on breakwater.

Substrate: Sand/gravel/cobble mix Height of Collection: ~2+ ft. ☐ m. ☑

Highest Distribution of Mussels (compared to water level at time of collection): ~2+

STATION 2

Latitude: N 48° 06.299' Longitude: W 122° 46.686' Start Time: 8:30 pm

Station Description: Same as Station 1, except many more mussels, larger size, found to base of breakwater, but none on boulders.

Substrate: Sand/gravel/cobble mix Height of Collection: ~+3' ft. ☑ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): ~+3-4'

STATION 3

Latitude: N 48° 06.308 Longitude: W 122° 46.695 Start Time: 8:43 pm

Station Description: Same as Station 1, densest mussels, largest, but still scattered through substrate, extending to breakwater w/ a few mussels on breakwater.

Substrate: Sand/gravel/cobble mix Height of Collection: +3-4' ft. ☑ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): +-4'

Version 3 – 2009

Water

increasing mussel density

Shore

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	N/A (none)
	Oil on water	N/A
	Oil on beach	N/A
	Garbage	N/A

Original station was not used as no mussels were present.

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Basalt Breakwater boulders

Shore

mixed sand, gravel, cobble

Marina

mud/sand flat

New Stn 1

Water

original established central pt. No mussels found

dimensions approximate

Washington State Mussel Watch data sheet (front and back) from the PSPT site.

Appendix C.19 Sinclair Inlet – Waterman Point

The Sinclair Inlet – Waterman Point (SIWP) site was successfully sampled by collaborators from PSAMP and the US Navy (Naval Base Kitsap-Bremerton) on Friday, January 8th, 2010. Mussel samples were shipped for chemical and histopathology analysis the following Monday and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Sinclair Inlet, Waterman Point (SIWP)

TARGET SPECIES - *Mytilus species* SITE NUMBER - 278

NOMINAL SITE CENTER - 47° 35.110' N 122° 34.250' W

LOCATED ON NOAA CHART - 18449

SITE ACCESS - This site is a walk-up and is easily accessible. From U.S. Highway 5 in Tacoma, take Highway 16 north towards Bremerton, then turn right onto Highway 160 and proceed into Port Orchard. At the intersection of Highway 166, turn left and go north, then turn right onto Beach Drive. This road runs parallel to the east side of Sinclair Inlet. Turn left onto Lighthouse Rd. and park at the end. Access to the site is through private property. A small boat is needed if sediment samples are to be collected. There are two good boat ramps located to the south in Port Orchard.

SITE DESCRIPTION - The sampling site is located at the Waterman Point Light, in Sinclair Inlet. The discrete stations are located about 25 m apart, on the rocks around the base of the light.

BIVALVE COLLECTIONS

1995 No collection.

1996 There was a good population of small to medium sized *Mytilus sp.* mussels growing in crevices and under the rocks around the navigational light. All of the mussels were heavily encrusted with marine growth and barnacles, that may have provided some additional protection from the numerous large starfish in the area. Collected mussels ranged from 3.7 cm to 5.1 cm in shell length. The average shell length was 4.5 cm with a standard deviation of 0.3 cm for 51 collected individuals

1997 No collection.

1998 There was an excellent population of both small to medium sized *Mytilus sp.* mussels and *Mytilus sp.* around the green navigation light. Great care was taken to collect only the target species at this site. Collected mussels ranged from 2.8 cm to 5.7 cm in shell length. The average shell length was 3.7 cm with a standard deviation of 0.5 cm for 61 collected individuals.

1999 No collection.

2000 Both *Mytilus sp.* mussels and *Mytilus sp.* mussels were small to medium sized and abundant around the green navigation light. Care was taken to only collect the blue

mussel at this site. There were a large number of starfish present all around the sampling site apparently cropping the mussel population.

2004 Dense aggregations of small mussels on navigation marker were gone. Individuals of moderate size were found as singles buried in sand shoreward of nav marker. Some small mussels seen attached to rocks but infrequently. Adjacent beaches and entrance to community marked as private, no trespass. Get homeowner permission to access via yard and steps to beach (Fay, 2005).

SEDIMENT COLLECTIONS

1995 No collection.

1996 Fine grained sediments were collected near the "L2" barge mooring, at 47° 33.04' N and 122° 37.61' W in about 12 m of water. The "L3" mooring had been removed prior to sampling the site.

1997 No collection.

1998 No collection.

1999 No collection.

2000 No collection.

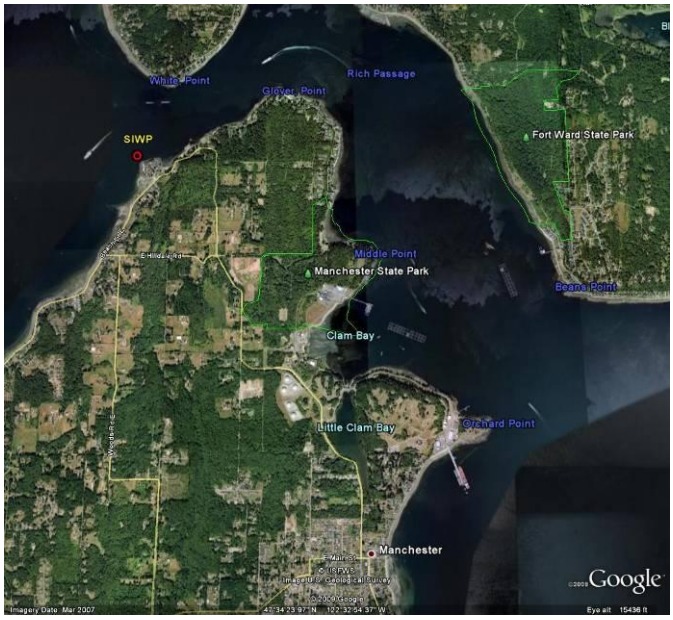
SAMPLING METHODS

Bivalves - hand

Sediments - stainless steel sediment grab and stainless steel scoop

WATER DEPTH - intertidal, +0.5 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination.



Satellite view of SIWP site.

Aerial view of SIWP site.

Washington State collaborators notes on

Sinclair Inlet, Waterman Point (SIWP)

Date sampled: January 8th, 2010 starting at 5:05 pm
Site center coordinates: 47º 35.068' N, 122 º 34.223' W
Temperature: 8.9° C
Salinity: $33^{o}/_{oo}$

Sampler Information – Four PSAMP staff and two US Navy civilian staff, lead by Robert Johnston, sampled the SIWP site.

Site Lead - Jennifer Lanksbury
Fish & Wildlife Biologist
Puget Sound Assessment and Monitoring Program
Washington Department of Fish & Wildlife
600 Capitol Way N
Olympia, WA 98501-1091
360-902-2820
Jennifer.Lanksbury@dfw.wa.gov

- Future contact for sampling help and general interest:
  Doris Small - Watershed Steward/Fish Habitat Biologist
  Washington Department of Fish & Wildlife
  502 High St, Suite 112

Port Orchard, WA 98366
360.895.4756 wk, 360.710.1215 cell

Site Access – PSAMP called in advance and obtained permission from Milton & Shirley Utas of 5606 Lighthouse Dr E, Port Orchard, (360) 871-1488, to access the beach via their private property. They had stone steps in their back yard leading down to the beach.

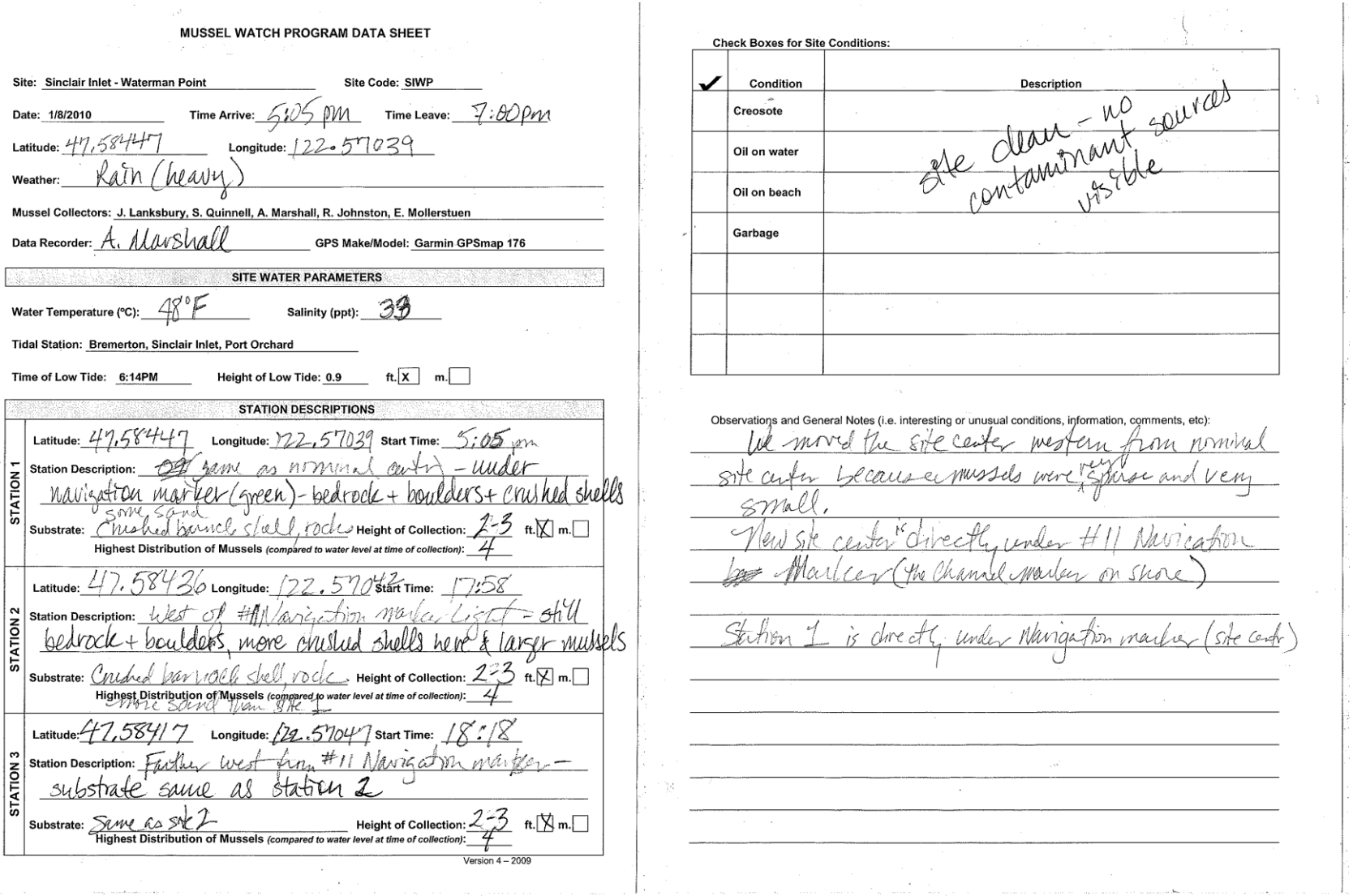
Site Description, Observations and General Notes - We moved the Site Center to the west of the National Program nominal site center, which was near the beach steps at the Utas property, because mussels were very sparse and small at that location. The new Site Center lay directly under the large navigation/channel marker (#11) on the opposite side of Waterman Point; station one was directly under the navigation marker. All mussels at this site were relatively small (<1 inch, mostly). The substrate base was striated bedrock, with boulders and cobbles and patches of crushed barnacle shells mixed with sand.

Navigation/channel marker (#11) at new Site Center of SIWP site.

We also helped Robert Johnston and his staff to sample their own mussel sites at the nearby Manchester Laboratory pier and at another site on Sinclair Inlet called Ross Point. Together we helped them collected enough mussel samples for their ENVVEST (Puget Sound Naval Shipyard, Intermediate Maintenance Facility, and Naval Base Kitsap-Bremerton Environmental Investment) program needs, as well as the needs of the National Mussel Watch program.

US Navy collaborators assisting with mussel collection at SIWP site.

Potential Sources of Contamination Noted – No obvious sources of contamination were noted at this site. However, the authors note that Naval Base Kitsap-Bremerton lies across the inlet, and the Seattle-Bremerton ferry passes Waterman Point multiple times on a daily basis.



MUSSEL WATCH PROGRAM DATA SHEET

Site: Sinclair Inlet - Waterman Point Site Code: SIWP

Date: 1/8/2010 Time Arrive: 5:05 pm Time Leave: 7:00pm

Latitude: 47.58447 Longitude: 122.57039

Weather: Rain (heavy)

Mussel Collectors: J. Lanksbury, S. Quinnell, A. Marshall, R. Johnston, E. Mollerstuen

Data Recorder: A. Marshall GPS Make/Model: Garmin GPSmap 176

SITE WATER PARAMETERS

Water Temperature (°C): 48°F Salinity (ppt): 33

Tidal Station: Bremerton, Sinclair Inlet, Port Orchard

Time of Low Tide: 6:14PM Height of Low Tide: 0.9 ft. [X] m. [ ]

STATION DESCRIPTIONS

STATION 1

Latitude: 47.58447 Longitude: 122.57039 Start Time: 5:05 pm

Station Description: ~~Off~~ same as normal entry - under navigation marker (green) - bedrock + boulders + crushed shells

Substrate: some sand Crushed barnacle, shell, rocks Height of Collection: 2-3 ft. [X] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 4

STATION 2

Latitude: 47.58436 Longitude: 122.57042 Start Time: 17:58

Station Description: West of #11 Navigation marker Light - still bedrock + boulders, more crushed shells here & larger mussels

Substrate: Crushed barnacle shell, rocks Height of Collection: 2-3 ft. [X] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 4

more sand than site 1

STATION 3

Latitude: 47.58417 Longitude: 122.57047 Start Time: 18:18

Station Description: Further west from #11 Navigation marker - substrate same as station 2

Substrate: Same as sit 2 Height of Collection: 2-3 ft. [X] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 4

Version 4 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	site clean - no contaminant sources visible
	Oil on water	
	Oil on beach	
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

We moved the site center western from nominal site center because mussels were very sparse and very small.

New site center is directly under #11 Navigation ~~bo~~ Marker (the Channel marker on shore)

Station 1 is directly under Navigation marker (site center)

Washington State Mussel Watch data sheet (front and back) from the PSPT site.

Appendix C.20 South Puget Sound – Budd Inlet

The South Puget Sound – Budd Inlet (SSBI) site was successfully sampled by PSAMP staff on Monday, January 11th, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

South Puget Sound, Budd Inlet (SSBI)

TARGET SPECIES - *Mytilus species* SITE NUMBER -274

NOMINAL SITE CENTER - 47° 5.952' N 122° 53.685' W

LOCATED ON NOAA CHART – 18456_1

SITE ACCESS - This site is located adjacent to the abandoned Washington State Department of Natural Resources Marine Research and Development Center Laboratory, near Olympia. From downtown Olympia, drive north on East Bay Drive, which turns into Boston Harbor Rd. From Boston Harbor Rd., turn left onto 47th Ave. SW and proceed to the Washington State Department of Natural Resources Marine Research and Development Center Laboratory (WSDNR). This facility has been abandoned because of leaking fuel storage tanks, so permission is required to access this site across State property. Alternatively, the site can be accessed through a trailer park just north of the laboratory property. The trailer park information is as follows: Sea Shore Villa Trailer Park, 4805 Cushman Rd., Olympia, WA. From 47th Ave. SW, which is located just after the Lutheran Church on the right hand side of Boston Harbor Rd., turn right on Cushman Rd. and proceed to the trailer park. Find the road to the beach on the left (south) side of the trailer park, and drive down to the beach. A small boat is necessary if sediments are to be collected. There is a good boat ramp at the East Bay Marina, just off Marina Access Rd.

SITE DESCRIPTION - The site center is the landward end of the marine laboratory pier. The three discrete collection stations were as follows: 1) the rip-rap at the base of the pier, 2) the first pair of pilings from shore, and 3) a set of unattached pilings 10 m north of the pier.

BIVALVE COLLECTIONS

1995 *Mytilus sp.* was abundant. Oysters (*Crassostrea gigas*), and clams (*Tapes*, *Saxidomus*, etc.) were also abundant at this site. Collected mussels ranged from 2.6 cm to 6.5 cm in shell length. The average shell length was 5.2 cm with a standard deviation of 0.7 cm for 42 collected individuals.

1996 There was a fair population of small to medium sized *Mytilus sp.* mussels at the site. Collected mussels ranged from 3.4 cm to 7.6 cm in shell length. The average shell length was 4.8 cm with a standard deviation of 1.3 cm for 49 collected individuals

1997 No collection.

1998 There were abundant small sized *Mytilus sp.* at this site. Mussels were collected on the rocks to the north of the pier. A seawall was being constructed approximately 100 m to

the north of the nominal site center. Collected mussels ranged from 2.0 cm to 7.9 cm in shell length. The average shell length was 4.9 cm with a standard deviation of 1.3 cm for 58 collected individuals.

1999 No collection.

2000 Medium to large sized *Mytilus sp.* mussels were abundant at all three stations at this site. Some of the mussels were encrusted with barnacles.

2004 Collected from upper range of tidal range on rocks from corner of bulwarks adjacent to beach. Mussels are larger and more abundant deeper in the intertidal. Trailer park manager adamant about getting permission to access the beach thru his property. Old state facility locked and former resident apparently no longer there. No one home. (Fay, 2005)

SEDIMENT COLLECTIONS

1995 No collection.

1996 The soft olive-brown silty sediment sample contained some shell, and was collected from 47° 06.04' N and 122° 54.74' W in about 25 m of water.

1997 No collection.

1998 No collection.

1999 No collection.

2000 No collection.

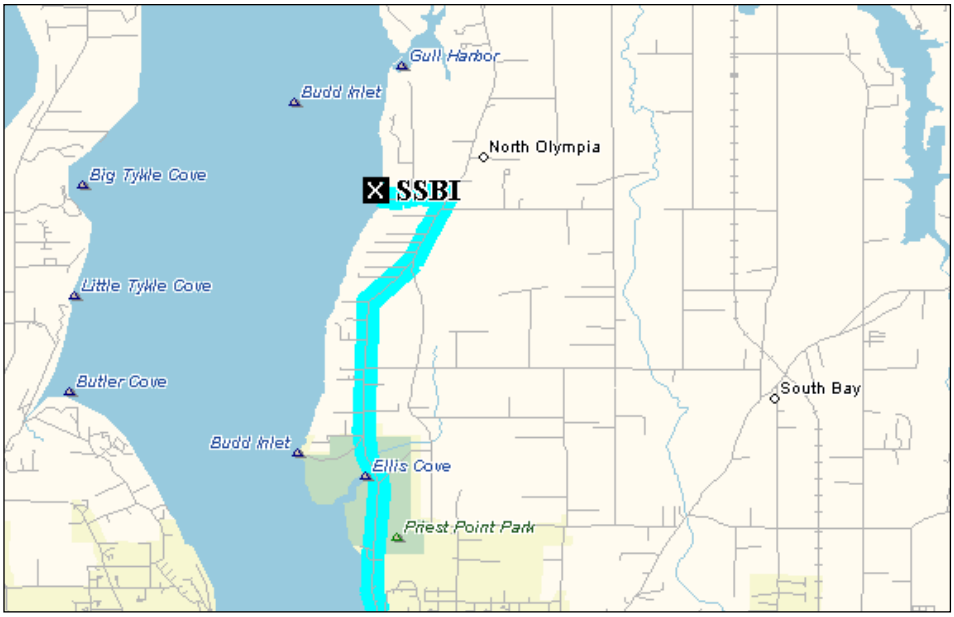
SAMPLING METHODS

Bivalves - hand

Sediments - stainless steel sediment grab and stainless steel scoop

WATER DEPTH - intertidal, +0.5 m MLLW.

POSSIBLE CONTAMINANTS – This site is only a few miles from Olympia so potential contaminants may include urban runoff, as well as input from the timber and fishing industries. The U.S. Navy also had some underwater dump sites nearby. This site was abandoned by the WSDNR due to leaking fuel tanks on the adjacent property.



Map of access route to SSBI site.

Aerial view of SSBI site.

Washington State collaborators notes on

South Puget Sound, Budd Inlet (SSBI)

Date sampled: January 11th, 2010 starting at 7:50 pm
Site center coordinates: 47° 5.952' N, 122° 53.685' W
Temperature: 9.5° C
Salinity: $20^{o}/_{oo}$

Sampler Information – Four PSAMP staff sampled at the SSBI site.

Site Lead - Jennifer Lanksbury
Fish & Wildlife Biologist
Puget Sound Assessment and Monitoring Program
Washington Department of Fish & Wildlife
600 Capitol Way N
Olympia, WA 98501-1091
360-902-2820
Jennifer.Lanksbury@dfw.wa.gov

Site Access – We gained permission from the Washington State Department of Natural Resources (DNR), through Mike Chevalier (360) 902-1063 (though Mike noted that we could also have contacted a man named Blaine at (360) 902-1731 for access), to access their Marine Land Management Research and Development Center at the end of 47th Ave SW. Contrary to the National Mussel Watch Program site access notes on SSBI, this facility not abandoned and is still very much in use.

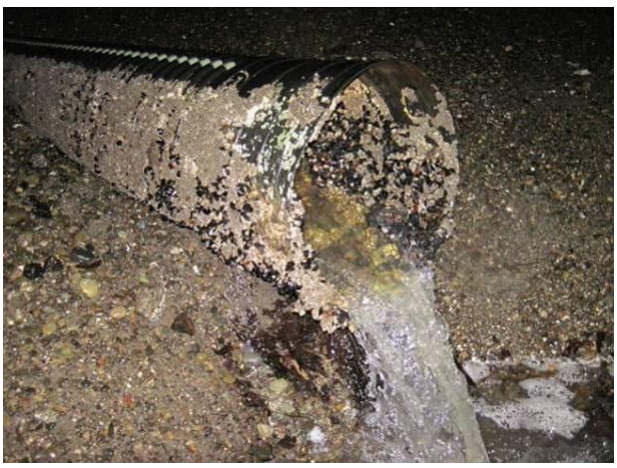
Because we accessed their location after normal work hours the DNR staff left us a hidden key, which unlocked the front gate to the facility parking lot. Access to this lot worked well for parking, however we quickly realized that the facility lot is completely fenced off from the beach. We found a large gate in the back of the parking lot fence that lead to the beach, however we did not have a key to unlock that gate. Thus although we parked near the beach in the facility's lot, we had to walk back out of the lot to a narrow path that skirted the east and south side of the fence, in order to reach the beach. This was not convenient; the fence was surrounded by thick undergrowth and topped with low barbed wire, which was near our heads. Next time this site is accessed, the samplers should *ask for a key to access the beach from parking lot, i.e., the gate on south side of the fence*.


Locked gate in parking lot (view from outside) that would have allowed quick and easy access to the beach outside the DNR Center, and the difficult path around the outside of the parking lot fence (awkward to manage with equipment).

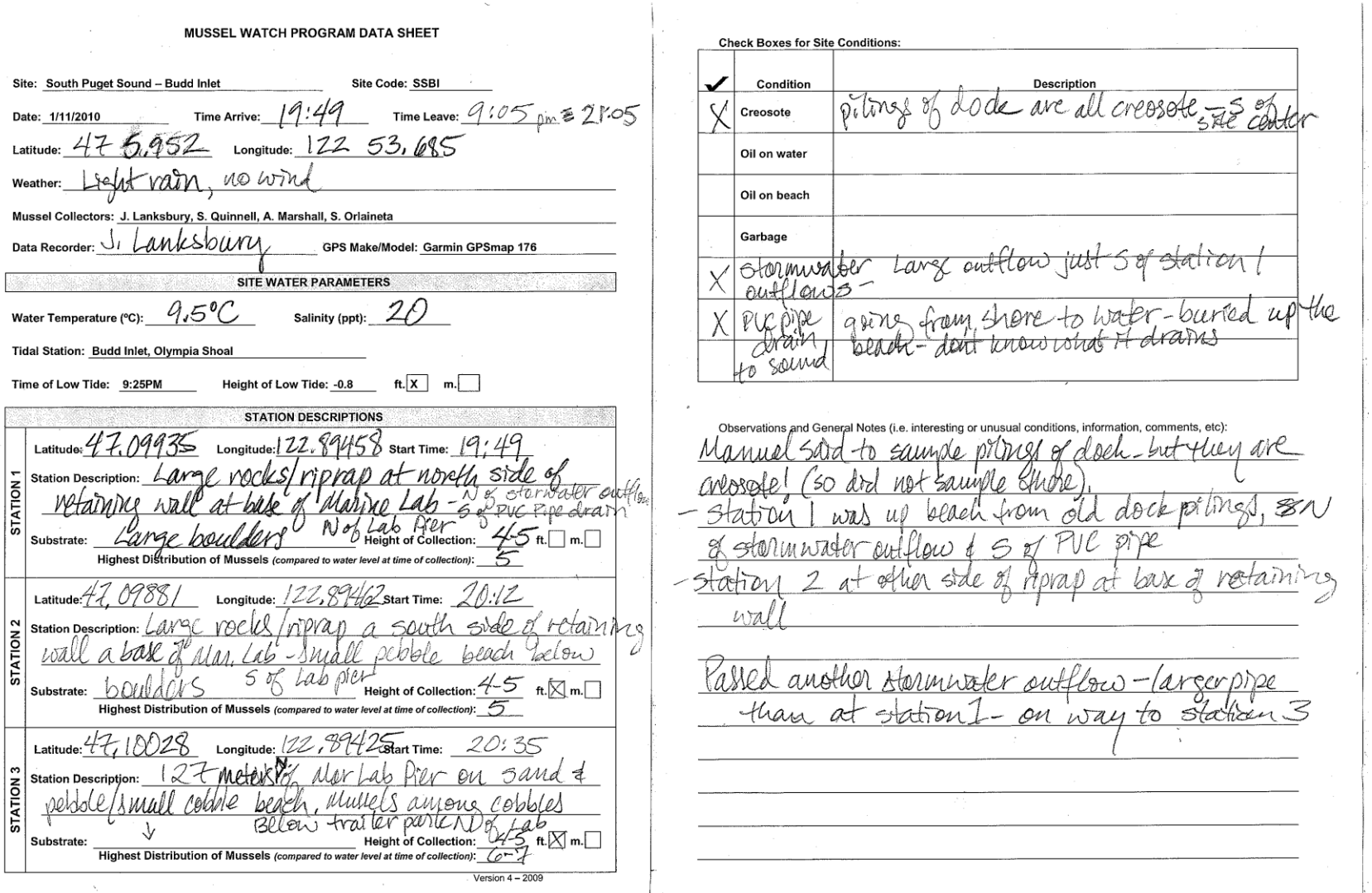
Site Description, Observations and General Notes - The Mussel Watch manual said to sample mussels from the dock pilings; perhaps this had been done that in the past. However, we did not sample from the creosote pilings because the Mussel Watch protocol specifically states not to sample on creosote. Instead we sampled the large rock boulder riprap along the DNR Center's concrete retaining wall to the south and north of the docks and from a cobble beach area, under a bluff with a trailer park located on it, about 130 meters to the north of the Site Center.


PSAMP staff sampling the boulders and cobble beach locations at the SSBI site.

Potential Sources of Contamination Noted – The dock currently in front of the DNR Center is made up of creosote pilings, this was directly in front of the Site Center. There were also old creosote dock pilings (once a dock) adjacent to the current dock. We noted two stormwater outflows near the collection locations, as well as a narrow PVC pipe leading from the north side of the building (buried under sand) into the Inlet. We do not know what that PVC pipe drains, if anything.




Stormwater outflow and PVC drain pipe running out of a buried location on upper beach and into the marine water near sampling location at SSBI site.



MUSSEL WATCH PROGRAM DATA SHEET

Site: South Puget Sound – Budd Inlet Site Code: SSBI

Date: 1/11/2010 Time Arrive: 19:49 Time Leave: 9:05 pm = 21:05

Latitude: 47 5.952 Longitude: 122 53.685

Weather: Light rain, no wind

Mussel Collectors: J. Lanksbury, S. Quinnell, A. Marshall, S. Orlaineta

Data Recorder: J. Lanksbury GPS Make/Model: Garmin GPSmap 176

SITE WATER PARAMETERS

Water Temperature (°C): 9.5°C Salinity (ppt): 20

Tidal Station: Budd Inlet, Olympia Shoal

Time of Low Tide: 9:25PM Height of Low Tide: -0.8 ft. [X] m. [ ]

STATION DESCRIPTIONS

STATION 1

Latitude: 47.09935 Longitude: 122.89458 Start Time: 19:49

Station Description: Large rocks/riprap at north side of retaining wall at base of Marine Lab – N of stormwater outflow – S of PVC Pipe drain – N of Lab Pier

Substrate: Large boulders Height of Collection: 4-5 ft. [ ] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 5

STATION 2

Latitude: 47.09881 Longitude: 122.89462 Start Time: 20:12

Station Description: Large rocks/riprap a south side of retaining wall a base of Mar. Lab - small pebble beach below – S of lab pier

Substrate: boulders Height of Collection: 4-5 ft. [X] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 5

STATION 3

Latitude: 47.10028 Longitude: 122.89425 Start Time: 20:35

Station Description: 127 meters N of Mar Lab Pier on sand & pebble/small cobble beach. Mussels among cobbles Below trailer park N of lab

Substrate: ↓ Height of Collection: 4-5 ft. [X] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 6-7

Version 4 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
X	Creosote	pilings of dock are all creosote – S of station 1
	Oil on water	
	Oil on beach	
	Garbage	
X	stormwater outflow	Large outflow just S of station 1
X	PVC pipe drain to sound	going from shore to water – buried up the beach – don't know what it drains

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Manuel said to sample pilings of dock – but they are creosote! (so did not sample there).

– Station 1 was up beach from old dock pilings, S of stormwater outflow & S of PVC pipe

– Station 2 at other side of riprap at base of retaining wall

Passed another stormwater outflow – larger pipe than at station 1 – on way to station 3

Washington State Mussel Watch data sheet (front and back) from the SSBI site.

Appendix C.21 South Puget Sound – Kopachuck Park

The South Puget Sound – Kopachuck Park (SSKP) site was not an original National Mussel Watch Program site, but was added for the 2009/10 field season by PSAMP staff. This site was purposefully co-located near a long-term PSAMP monitoring site in Carr Inlet, where bottom fish (English sole) and pelagic species (fish and plankton) have been sampled for contaminants in the past. PSAMP staff believes this site, as well as another pilot site within the Nisqually Reach (delta) region (SSTP –Appendix C.22), will provide valuable information on contaminants in the southern part of the Puget Sound, which has limited coverage under the current National Mussel Watch Program. Funds from the National Program will be used, on a one-time basis, to pay for this new SSKP site analysis in 2010. PSAMP staff considers SSKP one in a list of potential "expanded" sites that Mussel Watch and/or the Washington State collaborators should continue to monitor in future sampling years.

The SSKP site was successfully sampled by PSAMP staff Friday, February 5th, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

Washington State collaborators notes on

South Puget Sound, Kopachuck Park (SSKP)

TARGET SPECIES - *Mytilus* species SITE NUMBER - None

NOMINAL SITE CENTER - 47° 18.654' N 122° 41.234' W

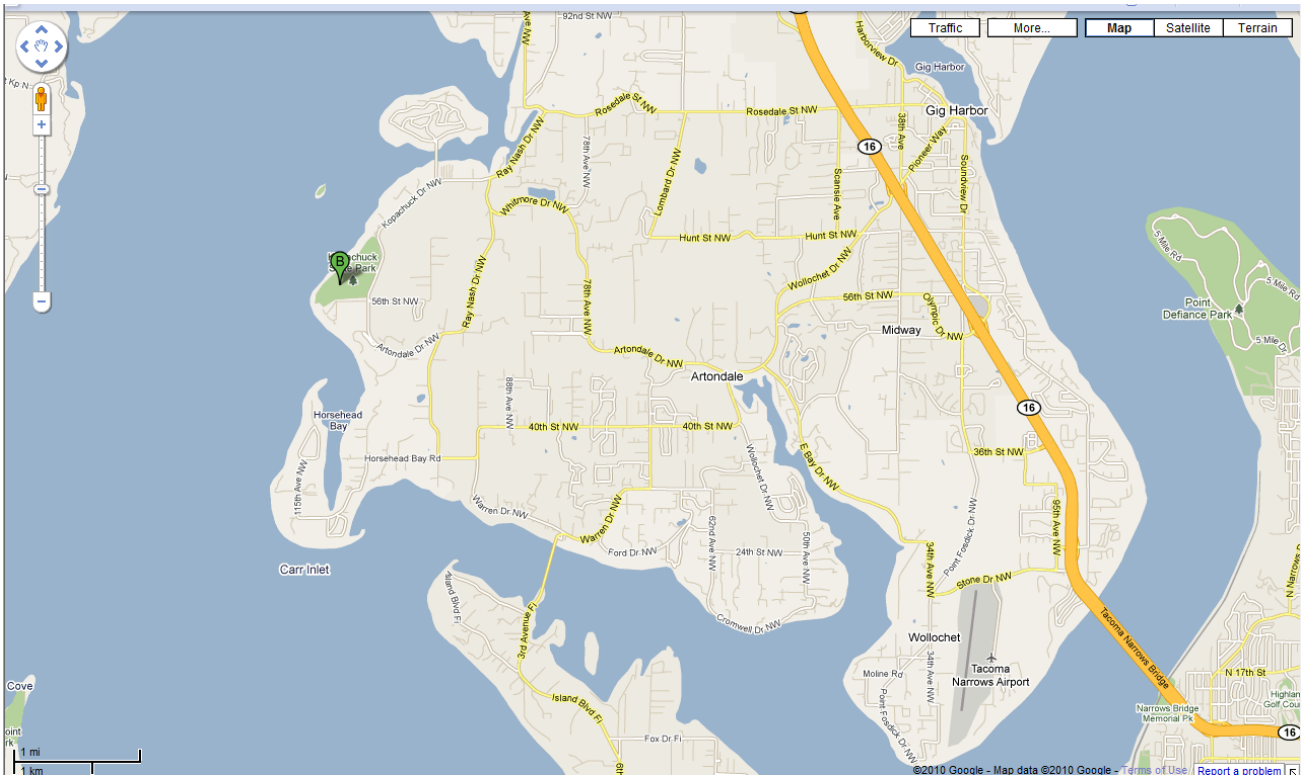
SITE ACCESS – Kopachuck State Park, 11101 56th Street NW, Gig Harbor, WA, 98335. From I-5 take Hwy 16 towards Gig Harbor and cross the Tacoma Narrows Bridge. Take the 3rd exit after the bridge (Exit #10) and turn left (west) onto Olympic Dr NW. Look for signs to Kopachuck State Park. Follow Olympic, it becomes 56th St NW, then becomes Fillmore Dr NW. Turn right on Wollochet Dr NW, then left onto Hunt St NW. Turn right on Scansie Ave, then take a left onto Rosedale St NW. Follow for a while and take a left onto Ray Nash Dr NW. When Ray Nash Dr splits, veer right onto Kopachuck Dr NW. Follow Kopachuck Dr for a while, then take a right onto 56th St NW, which leads into the park. 56th St NW divides the park, look for signs for the beach and day use area, which should be the 2nd right inside the park. The gated road to the beach is off the day use area parking lot, to the right side, and is LOCKED. You must get the Park Ranger (Mathew Smith, 253-265-3606) to unlock the gate. He lives in the ranger's house towards the park entrance.

SITE DESCRIPTION – The site center is on the north side of the point at Kopachuck State Park beach, straight down from a set of stairs to the beach near some picnic tables. There was a short, flat, yellow post in the intertidal area that we used to locate the site center. Stations 1 and 2 were to the north of the site center, located on separate downed trees that fell near the northern border of the park. Station 3 was on a log to the south of the site center, though we also collected some mussels from the cobble near that tree.

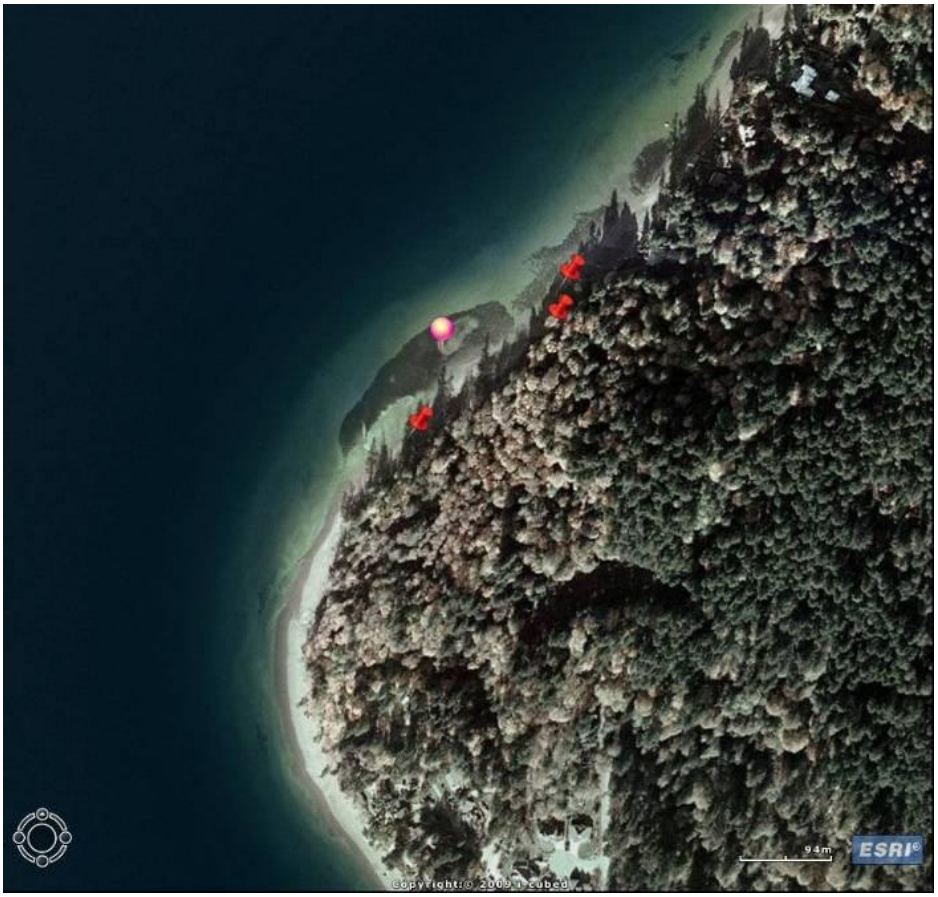
SAMPLING METHODS
Bivalves - hand

WATER DEPTH - intertidal, +2.5 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination other than houses along the beach on either side of the State Park.



Map of Kopachuck State Park on south side of Key Peninsula.



Site center (pink pin) and stations (red pins) sampled on north side of the point at Kopachuck State Park.

Gate that provides access from the day-use area parking lot to the beach. This gate can only be unlocked by the Park Ranger.

Date sampled: February 5th, 2010 starting at 4:20 pm
Site center coordinates: 47° 18.654' N, 122° 41.234'W
Temperature: 10° C
Salinity: $31^{o}/_{oo}$

Sampler Information – Four PSAMP staff sampled at the SSKP site.

Site Lead - Jennifer Lanksbury
Fish & Wildlife Biologist
Puget Sound Assessment and Monitoring Program
Washington Department of Fish & Wildlife
600 Capitol Way N
Olympia, WA 98501-1091
360-902-2820
Jennifer.Lanksbury@dfw.wa.gov

Site Access - The Park Ranger, Mathew Smith, let us into the gated road that led down to the beach. We noted that due to the shallow grade of the beach, sampling at this site can probably occur earlier in the lower low tide (at +2ft or more).

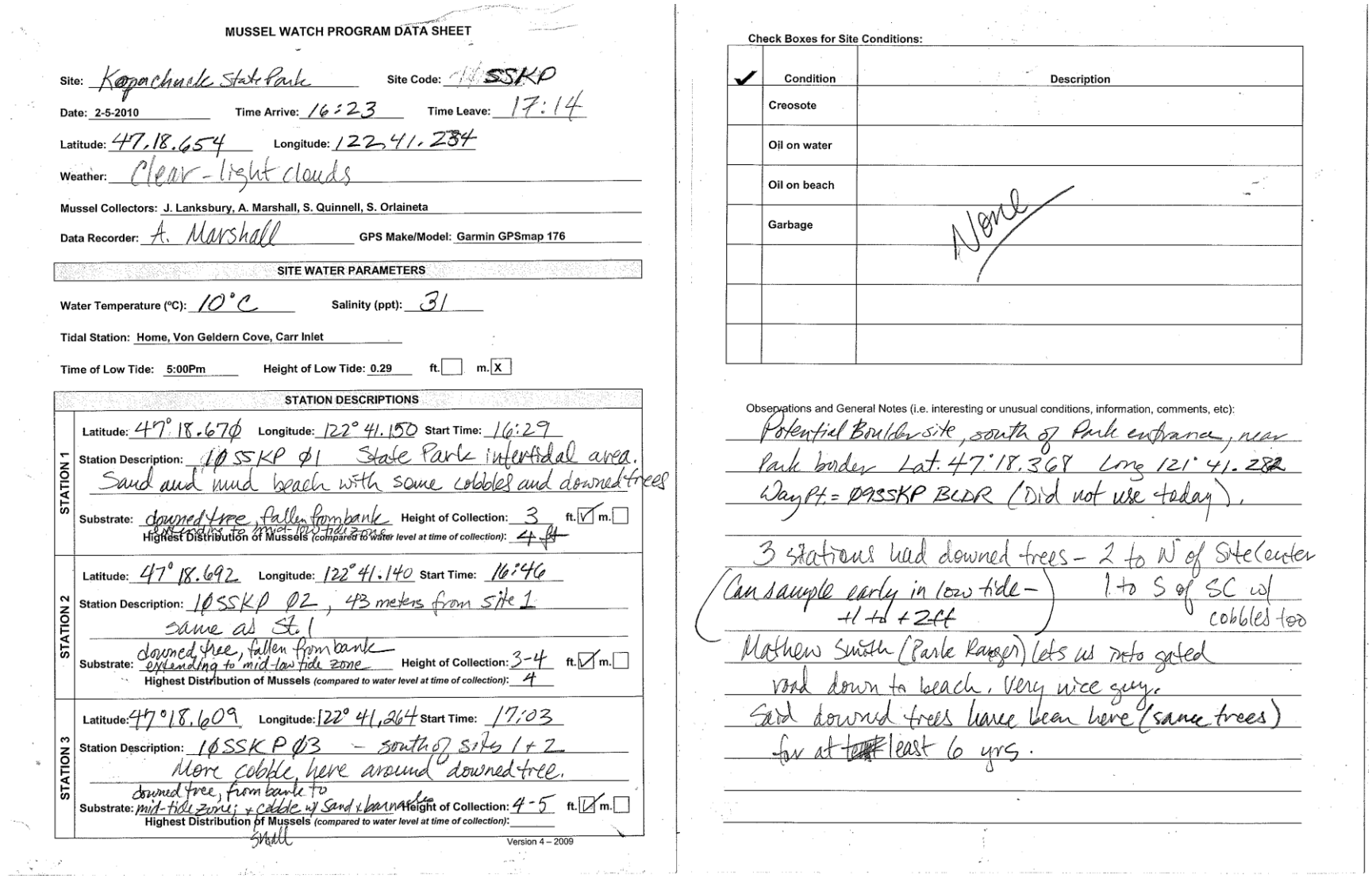
Site Description, Observations and General Notes - The beach was made up of sand and mud, with some cobbles and barnacles. There were several downed trees that had fallen from the bordering forest bank onto the beach. These trees extended perpendicular to the waterline into the mid- to low intertidal zone and were encrusted with mussels and barnacles. We sampled mussels from several of these downed trees, as well as from some cobbles that were around one of the downed trees. The Park Ranger noted that those downed trees have been on the beach for at least six years.


Sampling mussels from downed trees at SSKP site.

We noted a decently sized mussel population on a large boulder at the southern border of the park beach (at 47° 18.368' N, 121° 41.282' W) as well, though we did not sample that site.

Many sand dollars were also noted in large groups, half buried in sandy mud, in the lower intertidal zone.

Potential Sources of Contamination Noted - No obvious sources of contamination were noted.



MUSSEL WATCH PROGRAM DATA SHEET

Site: Kopachuck State Park Site Code: SSKP

Date: 2-5-2010 Time Arrive: 16:23 Time Leave: 17:14

Latitude: 47.18.654 Longitude: 122.41.284

Weather: Clear - light clouds

Mussel Collectors: J. Lanksbury, A. Marshall, S. Quinnell, S. Orlaineta

Data Recorder: A. Marshall GPS Make/Model: Garmin GPSmap 176

SITE WATER PARAMETERS

Water Temperature (°C): 10°C Salinity (ppt): 31

Tidal Station: Home, Von Geldern Cove, Carr Inlet

Time of Low Tide: 5:00Pm Height of Low Tide: 0.29 ft. ☐ m. ☒

STATION DESCRIPTIONS

STATION 1

Latitude: 47° 18.670 Longitude: 122° 41.150 Start Time: 16:29

Station Description: 10SSKP 01 State Park intertidal area. Sand and mud beach with some cobbles and downed trees

Substrate: downed tree, fallen from bank extending to mid-low tide zone Height of Collection: 3 ft. ☑ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): 4 ft

STATION 2

Latitude: 47° 18.692 Longitude: 122° 41.140 Start Time: 16:46

Station Description: 10SSKP 02, 43 meters from site 1 same as St. 1

Substrate: downed tree, fallen from bank extending to mid-low tide zone Height of Collection: 3-4 ft. ☑ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): 4

STATION 3

Latitude: 47°18.609 Longitude: 122° 41.264 Start Time: 17:03

Station Description: 10SSKP 03 - south of sites 1 + 2 More cobble here around downed tree.

Substrate: downed tree, from bank to mid-tide zone; + cobble w/ sand + barnacles Height of Collection: 4-5 ft. ☑ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): Small

Version 4 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	None

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Potential Boulder site, south of Park entrance, near Park border Lat. 47°18.368 Long 121° 41.282 Way Pt. = 093SSKP BLDR (Did not use today).

3 stations had downed trees - 2 to N of Site center (Can sample early in low tide - +1 to +2 ft) 1 to S of SC w/ cobbles too

Mathew Smith (Park Ranger) lets us into gated road down to beach, Very nice guy. Said downed trees have been here (same trees) for at least 6 yrs.

Washington State Mussel Watch data sheet (front and back) from the SSKP site.

Appendix C.22 South Puget Sound – Tolmie Park

The South Puget Sound – Tolmie Park (SSTP) site was not an original National Mussel Watch Program site, but was added for the 2009/10 field season by PSAMP staff. This site was purposefully co-located near a long-term PSAMP monitoring site in the Nisqually Reach (delta) area, where bottom fish (English sole) and pelagic species (fish and plankton) have been sampled for contaminants in the past. This site, as well as another pilot site within Carr Inlet (SSKP – Appendix C.21), will provide valuable information on contaminants in the southern part of the Puget Sound, which has limited coverage under the current National Mussel Watch Program. Funds from the National Program will be used, on a one-time basis, to pay for this new SSTP site analysis in 2010. PSAMP staff considers SSTP one in a list of potential "expanded" sites that Mussel Watch and/or the Washington State collaborators should continue to monitor in future sampling years.

The SSTP site was successfully sampled by a PSAMP staff member and several volunteers on Sunday, February 5th, 2010. Mussel samples were shipped for chemical and histopathology analysis the following day and arrived in good condition at both receiving laboratories.

Washington State collaborators notes on

South Puget Sound, Tolmie Park (SSTP)

TARGET SPECIES - *Mytilus* species SITE NUMBER – None

NOMINAL SITE CENTER - 47° 7.252' N 122° 46.518' W

SITE ACCESS – Tolmie State Park is located at 7730 61st Ave NE, Olympia, WA 98506. From I-5 near Lacey take the Marvin Road exit (Exit 111) and turn north onto Marvin Rd NE. Look for signs for Tolmie State Park. Follow Marvin Rd through several traffic circles and eventually turn right onto 56th Ave NE. 56th Ave NE veers left and becomes Hill Rd NE. From Hill Rd turn left onto 61st Ave NE. Follow 61st all the way to end at Tolmie State Park. The gated beach access road is to the right as you enter the park, Look for signs. The road leads veers down steeply to the beach parking lot. There is a short path to the beach on the right side, as you face the shoreline. The park stays open only until dusk, so contact the Park Ranger (Robert Sterling, (360) 456-6464) in advance to have the gate at the top of the beach access road left unlocked for nighttime sampling. Special note: give the Park Ranger a few days advanced warning so he/she can hear the message and call back, since this number usually gets no answer.

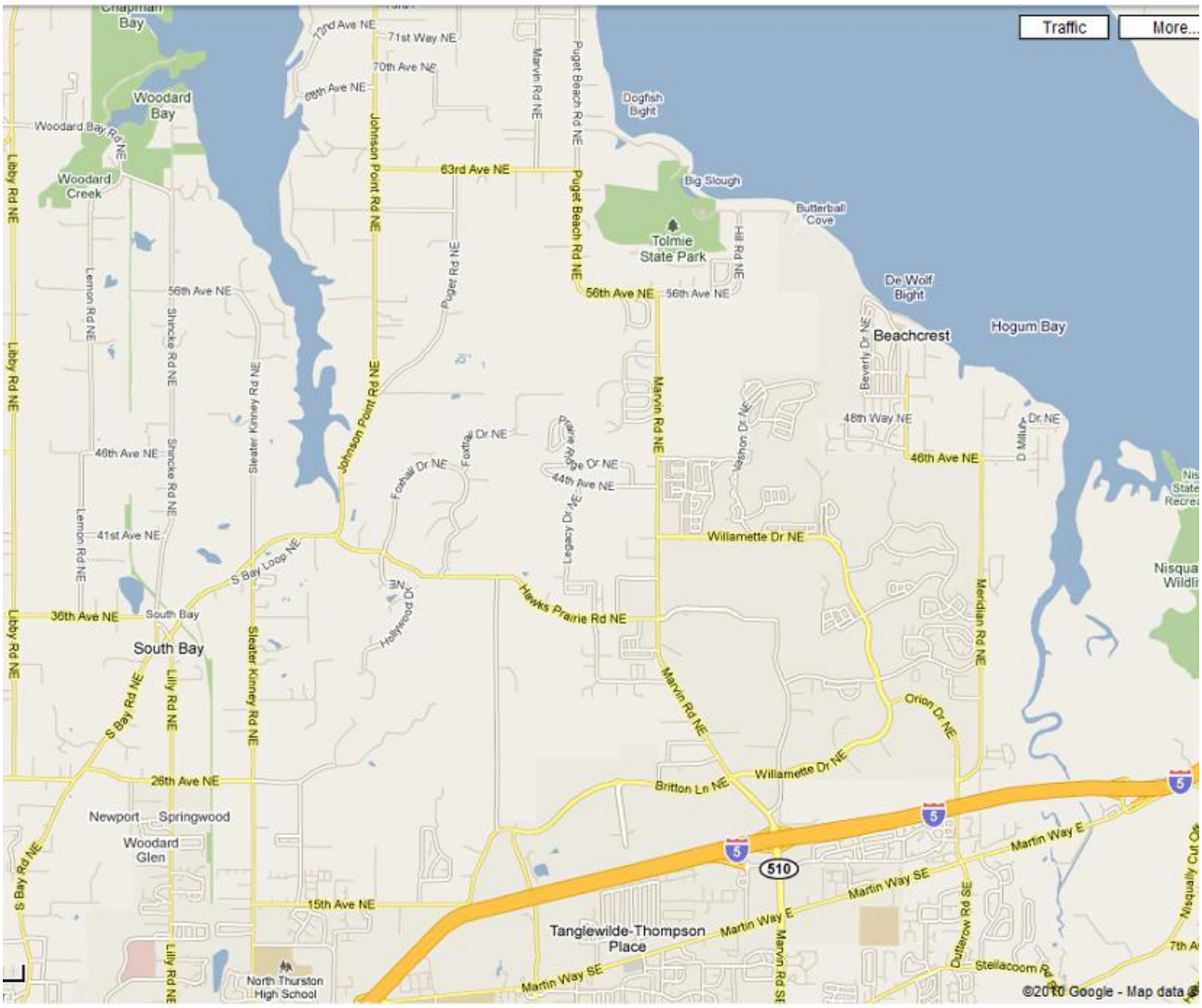
SITE DESCRIPTION – Tolmie State Park lies within the Nisqually Reach and has about 1,800 feet of very shallow saltwater shoreline. There is a creek that drains from upland into the park tidelands, and some saltwater marsh habitat and an underwater park built by scuba divers off the shore as well. During low tide the tidal flats are extensive and one can walk out into the water quite a distance before it gets deeper than rubber boots. There are a lot of clams, polychaetes and sand dollars, as well as *Ulva* sp. (sea lettuce) on the exposed beach at low tide. However, mussels are high in the intertidal area, buried among the small cobbles and on some branches of

downed trees that lie perpendicular to the water line. Most of the mussels are located in the cobble just in front of the beach entrance trail and to either side of it.

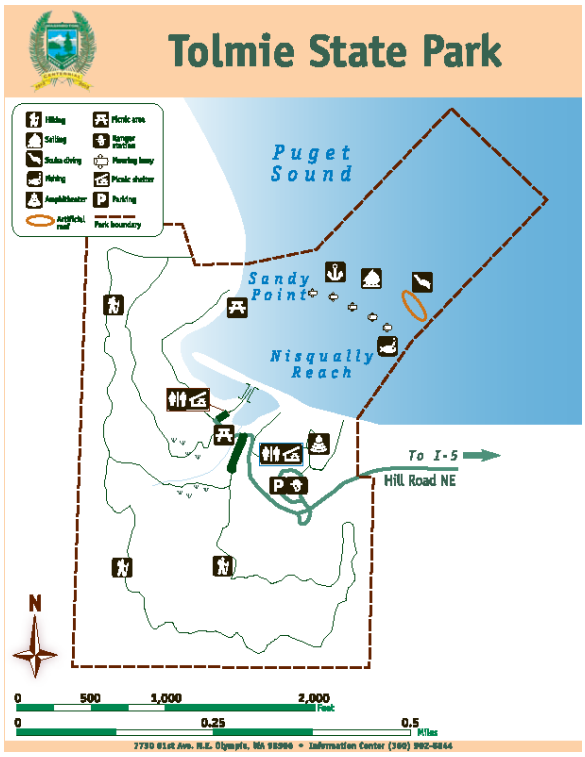
SAMPLING METHODS
Bivalves – hand

WATER DEPTH - intertidal, +2.5 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination. There are houses along the beach on either side of State Park borders.



Map showing location of Tolmie State Park (upper middle portion of map).



Washington State Parks map of Tolmie State Park.

Date sampled: February 7th, 2010 starting at 5:45 pm
Site center coordinates: 47° 7.252' N, 122° 46.518' W
Temperature: 9° C
Salinity: 30$^{o}/_{oo}$

Sampler Information – One PSAMP staff and four volunteers sampled mussels at the SSTP site.

Site Lead - Jennifer Lanksbury
Fish & Wildlife Biologist
Puget Sound Assessment and Monitoring Program
Washington Department of Fish & Wildlife
600 Capitol Way N
Olympia, WA 98501-1091
360-902-2820
Jennifer.Lanksbury@dfw.wa.gov

Due to the small number of volunteers, a brief training on protocols of Mussel Watch collection was conducted at the site just prior to sampling.

Site Access – The beach slope was very mild here and the intertidal area very extensive. Sampling at this beach can probably occur earlier during lower low tide, probably above 2 ft.

Site Description, Observations and General Notes - The beach was composed mostly of fine sand mixed with mud at the lower intertidal area, with cobble dominating the upper portion of the beach. There were significant signs of clams, *Ulva* sp. (seaweed) present, and aggregations of sand dollars in the lower intertidal. Mussels were sampled from a downed tree, likely a Pacific Madrone (*Arbutus menziesii*), that lay perpendicular to water line in the lower intertidal area. Mussels were also collected in the upper intertidal area, embedded among the cobbles and sand.

Downed tree with mussels at SSTP site and volunteers sampling mussels from cobble and sand substrate.

Potential Sources of Contamination Noted – We noted houses on either side of the beach, beyond the state park borders; otherwise there were no obvious sources of contamination.

Volunteers sampling mussels from a downed tree at the SSTP site.

MUSSEL WATCH PROGRAM DATA SHEET

Site: South Puget Sound – Tolmie Park Site Code: SSTP

Date: 2-7-2010 Time Arrive: 5:45PM Time Leave: 7:00 PM

Latitude: 47 7.252 Longitude: 122 46.518

Weather: Cloudy – no rain, but rained earlier during day.

Mussel Collectors: J. Lanksbury, S. Lanksbury, M. Lanksbury, Ann & Nigel Blakely

Data Recorder: Sean and Jennifer Lanksbury GPS Make/Model: Garmin GPSmap 176

SITE WATER PARAMETERS

Water Temperature (°C): 9 °C Salinity (ppt): 30 ‰

Tidal Station: Dupont Wharf, Nisqually Reach

Time of Low Tide: 7:00PM Height of Low Tide: 0.18 ft. ☐ m. ☒

STATION DESCRIPTIONS

STATION 1

Latitude: 47 7.252 Longitude: 122 46.438 Start Time: 5:50

Station Description: Downed Tree with mussel growing on upper branches – likely Madrona, roots still in upper beach

Substrate: Tree branches over sand Height of Collection: 2ft ft. ☒ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: 3ft

STATION 2

Latitude: 47 7.267 Longitude: 122.46.490 Start Time: 6:10

Station Description: Beach w/ sand & cobbles some clams barnacles & mussels embedded

Substrate: Small Cobbles in Sand Height of Collection: 2ft ft. ☒ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: 3ft

STATION 3

Latitude: 47 7.252 Longitude: 122 46.518 Start Time: 6:35

Station Description: Same as St. 2 – relatively more cobble & less sand

Substrate: cobble & sand Height of Collection: 3ft ft. ☒ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: 3ft

Version 4 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	None
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Very mild slope to beach – intertidal area very extensive due to almost flat beach. Beach mostly fine sand mixed with mud. Lots of clam siphons, Ulva sp. seaweed and many aggregations of sand dollars.

Mussels high in intertidal zone at cobble areas and downed tree. Can collect early during low tide – probably at +1 or +2 ft.

Houses on either side of beach beyond State Park boarders, otherwise no obvious source of contaminants.

Washington State Mussel Watch data sheet (front and back) from the SSTP site.

Appendix C.23 Willapa Bay – Nahcotta

The Willapa Bay – Nahcotta (WBNA) site was successfully sampled by volunteers from the Pacific County Marine Resources Committee (MRC) on Tuesday, March 2nd, 2010. Mussel samples were shipped for chemical and histopathology analysis the same day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Willapa Bay, Nahcotta (WBNA)

TARGET SPECIES - *Mytilus species* SITE NUMBER - 267

NOMINAL SITE CENTER - 46° 29.95' N 124° 01.63' W

LOCATED ON NOAA CHART - 18504

SITE ACCESS - Follow Highway 101 out to the North Beach peninsula, and drive into Seaview. Take Highway 103 north through Ocean Park to Nahcotta. In Nahcotta, take a right onto 273rd Street and drive down to the breakwater and the Jolly Roger Seafood Plant. There is a small boat basin present, along with a boat ramp.

SITE DESCRIPTION - The site is located just to the south of the breakwater, on the oyster farming racks owned by the State of Washington Oyster Laboratory in Nahcotta. The surrounding area is a large intertidal mud flat.

BIVALVE COLLECTIONS

1995 No collection.

1996 No collection because no mussels (*Mytilus sp.*) were found. Nahcotta is an important commercial oyster farming area, where the Giant Pacific Oyster, *Ostrea gigas*, is cultivated and grown. The entire shoreline is littered with dead oyster shells, and the area has a dense growth of live oysters.

1997 No collection.

1998 Small to medium *Mytilus sp.* mussels collected on private oyster poles (Larry's) associated with the commercial oyster farming. Collected mussels ranged from 1.7 cm to 4.0 cm in shell length. The average shell length was 2.7 cm with a standard deviation of 0.5 cm for 111 collected individuals.

1999 No collection.

2000 Collected samples off the only public oyster grounds in Washington State. Access to the sampling site was through the Nahcotta Tidelands Interpretive Park adjacent to the Washington Department of Fish and Game Laboratory. Medium sized *Mytilus sp.* were only found attached to poles and other substrates protruding from the mudflat. The Pacific Oyster was the dominant bivalve in this area.

2004 Mussels were mostly small but abundant on the oyster stakes (Fay, 2005)

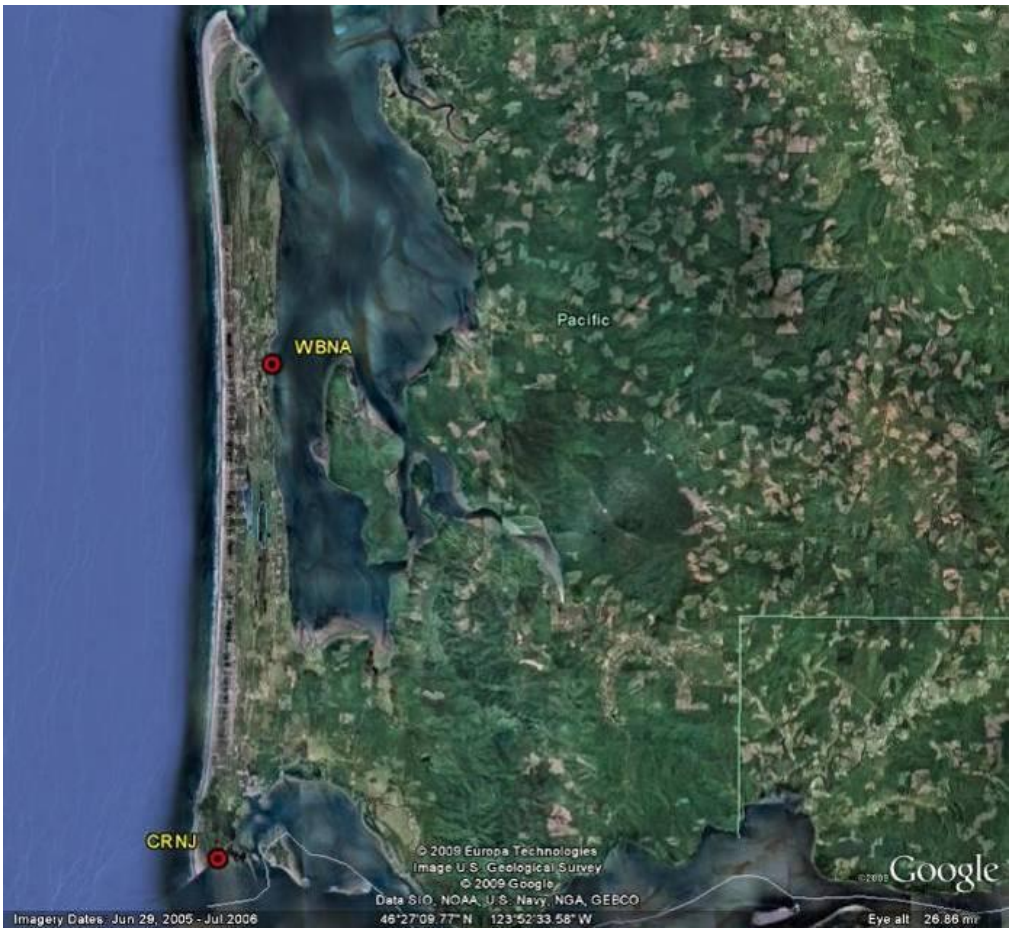
SEDIMENT COLLECTIONS

1995 No collection.
1996 The sediment sample was collected from the nominal site center, and was comprised of soft light brown silty sands.
1997 No collection.
1998 No collection.
1999 No collection.
2000 No collection.

SAMPLING METHOD
Bivalves - hand
Sediments - hand held stainless steel scoop

WATER DEPTH - intertidal, 0 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination.



Satellite view of WBNA site on the North Beach peninsula.

Close-up aerial view of WBNA site.

Washington State collaborators notes on

Willapa Bay, Nahcotta (WBNA)

Date sampled: March 2nd, 2010 starting at 7:15 am
Site center coordinates: 46° 29.95' N, 124° 01.63' W
Temperature: 10° C
Salinity: $21^{o}/_{oo}$

Sampler Information – Five volunteers from the Pacific County MRC sampled mussels at the WBNA site.

Site Lead - Mike Nordin
Pacific Conservation District, PCMRC
plutroll@willapabay.org
(360) 875-9424
(360) 208.4451

All volunteers attended a Mussel Watch training on Friday, February 19th from 12:30 – 4:30 pm at the Pacific County Administration Building, 7013 Sandridge Road, Long Beach, WA.

Site Access – Due to the difficulty in sampling at this site (see volunteer description below), future Mussel Watch efforts at WBNA may be improved by searching for nearby, alternate locations with more suitable mussel populations.

Site Description, Observations and General Notes – The substrate at this site consisted of mud, wooden oyster stakes and Japanese oysters, and very minimal eelgrass. The mussels were mixed in with Japanese oyster shells. Volunteers reported that this site was hard to sample due to the difficulty of getting mussels out from between the oysters (one volunteer cut their hand on an oyster shell trying to get a mussel out) and because the mussels were very small. "Potato bugs" were noted on some of the wooden oyster stakes, as were three ammocetes (larval lamprey), which were found beneath oyster shells.

Oyster farm stakes and muddy substrate at WBNA site. Note: date/time stamp on photos are incorrect, sampling occurred on 3/2/2010.

Pacific County MRC volunteers sampling mussels at WBNA site. Note: date/time stamp on photo is incorrect, sampling occurred on 3/2/2010.

Potential Sources of Contamination Noted - Volunteers noted a minute amount of oil running off the mud flat.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Willapa Bay - Nahcotta Site Code: WBNA

Date: ~~2-28-2011~~ 3/2/10 Time Arrive: 0715 Time Leave: 0915

Latitude: _____ Longitude: _____

Weather: Rain

Mussel Collectors: Mk Nordin, Doug Ross, Ted Lailer, Mike Johnson

Data Recorder: Mk Nordin GPS Make/Model: _____

SITE WATER PARAMETERS

Water Temperature (°C): 50°F Salinity (ppt): 21 ppt

Tidal Station: Nahcotta, Willapa Bay, Washington

Time of Low Tide: ~~7:19PM~~ 0830 AM MJ Height of Low Tide: ~~-0.33~~ ft. ☐ m. ☒

STATION DESCRIPTIONS

STATION 1

Latitude: _____ Longitude: _____ Start Time: 0715

Station Description: Mud substrate / oyster stakes / very minimal eel grass / Mussels Mixed in with Japanese Oysters

Substrate: Mud / oyster shell Height of Collection: 1'-2' ft. ☒ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: 2'

STATION 2

Latitude: _____ Longitude: _____ Start Time: 0745

Station Description: Mud substrate / oyster stakes / minimal eel grass / Mussels mixed with Japanese oysters - shells

Substrate: Mud / oyster shell Height of Collection: 1'-2' ft. ☒ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: 2'

STATION 3

Latitude: _____ Longitude: _____ Start Time: 0830

Station Description: Mud substrate / oyster stakes / light eel grass / Mussels mixed in with Japanese Oysters and shell.

Substrate: Mud / oyster shells Height of Collection: 1-2' ft. ☒ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: 2'

Version 4 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
✓	Oil on beach	Minor oil running off mud flat
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Arrival at site at 0700, started survey at 0715. Day was dominated by overcast skies and rain. The site(s) were primarily mud flats and sampling took place on oyster stakes. Mussels were interwined with Japanese Oysters and oyster shells. There were also Potato bugs on some of the wooden stakes, this was somewhat surprising. Observed Ammocetes (3) on mud flat beneath oyster shell.

Washington State Mussel Watch data sheet (front and back) from the WBNA site.

Appendix C.24 Whidbey Island – Possession Point

The Whidbey Island – Possession Point (WIPP) site was almost not sampled in 2009/10 due to irregularities identified by PSAMP staff in the location of previous WIPP sampling.

Notes from previous years of Mussel Watch sampling in Washington State indicated that during the 2002 sampling season the sampling contractor found a virtual absence of mussels at the WIPP site. A subsequent summer-time investigation during a day time extreme low tide, "confirmed a total absence of mussels at the WIPP site." "An alternate [WIPP site] was sought in 2004. Nothing was found along the shoreline to the north of Possession Point, but a good population was found attached to floating docks to the south and 'around the corner' from the original site in a small embayment called Sandy Hook. Sampling was done [there] beginning in 2004." In addition, notes from the 2005 sampling indicate that "large *mytilus* were collected from the dock floats at Sandy Hook. None were observed on the beach at [the] designated [WIPP] site. Designated site had neither mussels nor any suitable habitat. North of the site at Possession Park also had no habitat or mussels. Around the corner to the west was a small spit of land called Sandy Hook. Mussels were abundant on the dock floats in the inlet of Sandy Hook."

This alternate location at the inlet of Sandy Hook, called Cultus Bay, is basically a marina. Conditions inside a marina likely do not represent the open water conditions present at the original WIPP site and may thus confuse data analysis (Figure 1). We note that the site location name of WIPP was never changed when sampling began at Cultus Bay.

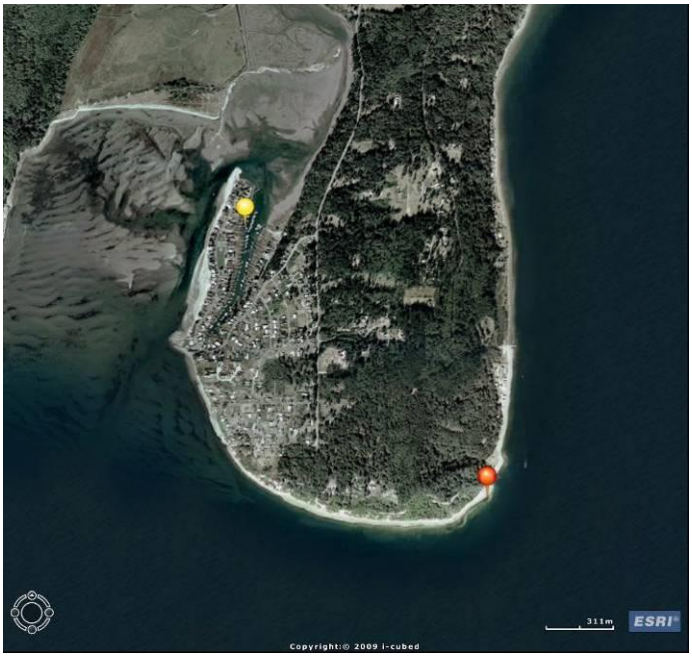


Figure 1. Original WIPP site center (red pin) and alternate "WIPP" site center (yellow pin) at the dock floats in the inlet of Sandy Hook (i.e., a marina in Cultus Bay).

After discussions with National Mussel Watch staff, PSAMP identified another alternate site to WIPP at Scatchet Head (WISH - Appendix C.25). It was felt that this open-water alternate much more closely approximated the open water conditions at the original WIPP site.

However on the night of sampling the alternate WISH site, following a request from the National Mussel Watch Program staff, PSAMP staff investigated conditions at the original WIPP site and discovered that an abundant mussel population residing there. Thus, the WIPP site was successfully sampled by PSAMP staff on Tuesday, December 29th, 2009. Mussel samples were shipped for chemical and histopathology analysis the next day and arrived in good condition at both receiving laboratories.

National Status & Trends Program description of

Whidbey Island, Possession Point (WIPP)

TARGET SPECIES - *Mytilus* species SITE NUMBER - 281

NOMINAL SITE CENTER - 47° 54.320' N 122° 22.620' W

LOCATED ON NOAA CHART - 18473

SITE ACCESS - This site is on the east side of Possession Point, at the south end of Whidbey Island. It is most easily accessed via private property, and prior permission must be obtained for collections. Take the ferry from Mukilteo to Clinton. Exit the ferry terminal and turn left at the first intersection onto Humphrey Rd. Proceed south to Glendale Rd., then turn left onto Jewett Rd., which turns into Possession Point Rd. From Possession Point Rd., turn right onto South Franklin Rd. and proceed to the end of the road. At the end of the road, access is gained to the shore across private property. The site is the cobble beach just to the south of the private residence.

SITE DESCRIPTION - The site center is on the beach approximately 150 m south of the retaining wall between the private property and top of the beach. Discrete collection stations were not established because mussels were extremely rare. This site is a cobble beach with widely scattered boulders. Mussels were found attached to the undersides of a few of the larger boulders that could be turned over.

BIVALVE COLLECTIONS

1995 *Mytilus sp.* was rare at this site and specimens were small. The presence of many sea stars (*Pisaster* sp.) suggested that predation may partially explain the low densities of mussels at this site. Collected mussels ranged from 1.5 cm to 4.0 cm in shell length. The average shell length was 2.7 cm with a standard deviation of 0.5 cm for 70 collected individuals.

1996 There was only one small population of small *Mytilus sp.* mussels found growing in the cobble beach. There is a single large 2 m high boulder at the base of the bluff, with a small brass U.S. Geodetic Survey marker on top. This was the only area that had any live mussels. Discrete stations were not possible, as there were only a few mussels on the one rock. One composite mussel sample was collected. Collected mussels ranged from 1.0 cm

to 3.2 cm in shell length. The average shell length was 2.1 cm with a standard deviation of 0.6 cm for 91 collected individuals.

1997 No collection.

1998 *Mytilus sp.* was abundant approximately 5 feet above MLLW, out of the reach of the starfishes also present at this location. Collected mussels ranged from 2.3 cm to 4.9 cm in shell length. The average shell length was 3.6 cm with a standard deviation of 0.6 cm for 59 collected individuals.

1999 No collection.

2000 Both *Mytilus sp.* and *Mytilus sp.* mussels were abundant growing between barnacles on the large boulders located off Possession Point. Care was taken to only collect *Mytilus sp.*, which were small to medium sized at this site.

2004 Large mytilus were collected from the dock floats at Sandy Hook. Sub-tidal depth of 0.5 foot. None were observed on the beach at designated site. Designated site had neither mussels nor any suitable habitat. North of the site at Possession Park also had no habitat or mussels. Around the corner to the west was a small spit of land called Sandy Hook. Mussels were abundant on the dock floats in the inlet of Sandy Hook (Fay, 2005). See description from Fay (2205) below for Site relocation.

SEDIMENT COLLECTIONS

1995 No collection.

1996 Fine grained sediments were collected from 47° 54.44' N and 122° 22.19' W, in about 185 m of water.

1997 No collection.

1998 No collection.

1999 No collection.

2000 No collection.

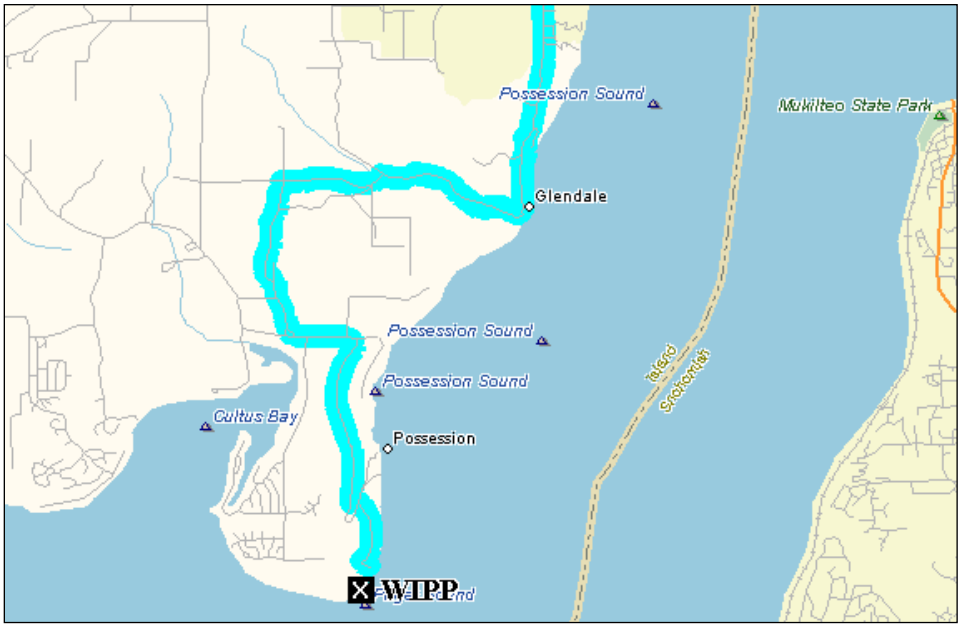
SAMPLING METHODS

Bivalves - hand

Sediments - stainless steel sediment grab and stainless steel scoop

WATER DEPTH - intertidal, +1.0 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination.



Map to original WIPP site.

Notes from National Mussel Watch Program Report regarding relocation of WIPP site, under "New Sites" section (Fay, 2005):

WHIDBY ISLAND, POSSESSION POINT– WIPP

TARGET SPECIES- *Mytilus edulis*

NOMINAL SITE CENTER –47.91717 N; 122.39254 W

LOCATED ON NOS CHART # - 18473

SITE ACCESS - From the ferry landing at Clinton take Humphrey Road south to Glendale. Go right (west) on Glendale Road to Jewett Road, and turn left. Proceed south on Jewett Road to where it joins Cultus Bay Road and go left. Then take the first right as Cultus Bay Road goes south. Turn right on East Scatchet View Drive and proceed down to the spit of land in Cultus Bay. At the "community center" go right on Sandy Hook Terrace and out on the spit to the boat harbor and floating docks. Temporary parking is at the pier leading out into the slough.

SITE DESCRIPTION – In the 1996 sampling the site was reported as near devoid of mussels. In our first visit to the site in 2002, no mussels were found except for an isolated pocket of a very few small mussels attached inside the hollow of a log embedded in the gravel shoreline, very low in the intertidal zone. Inquiries of the resident park ranger indicated that mussels were unknown in the area. During summer 2003, a survey was made during daylight hours at the annual lowest tide period by the resident park ranger to confirm the absence of mussels on Possession Point. Inquiries were made of conservation groups and retired marine biology professors living on

Whidbey Island as to the likely presence of mussels suitable for monitoring in the Possession Point area. No viable suggestions of sites proximal to the existing WIPP were forthcoming. In the absence of mussels or suitable habitat, an effort was made to relocate the site within the vicinity of Possession Point.

The site was again visited in 2004 to confirm the absence and the area to the north where access could be gained to the shoreline and south to the tip of Possession Point were searched without finding habitat worth investigating. The search was extended to Cultus Bay, and though there was a rocky spit/jetty at the head of Sandy Hook, no mussels were found. The only intertidal mussels found in the area of Possession were inside the slough formed by Sandy Hook in Cultus Bay. Large masses of large mussels were ubiquitously distributed throughout the slough attached to virtually every floating surface and hard structure.

BIVALVE COLLECTIONS
Mussels were collected by hand from the floating boat docks (sub tidal, but just under the surface) at three locations on the expanse of docks.

SEDIMENT COLLECTIONS
None.

SAMPLING METHODS
Mussels – by hand.

DEPTH OF SAMPLE COLLECTION
Mussels were sub tidal (-0.1 meter) as they were attached to floating docks that rose and fell with the tide.

POSSIBLE CONTAMINANTS
The site was located in a small remote, residential and recreational home area. Undoubtedly sewage treatment was by septic systems. The area also served as a mooring for a number of recreational boats."

Washington State collaborators notes on

Whidbey Island, Possession Point (WIPP)

Date sampled: December 29th, 2009 starting at 7:10 pm
Site center coordinates: 47º 54.341' N, 122º 22.633' W
Temperature: 6.7° C
Salinity: $30^{o}/_{oo}$

Sampler Information – Due to a shortage of time available to coordinate the training of volunteers to sample WIPP, this site was sampled by three PSAMP staff.

Site Lead - Jennifer Lanksbury

Fish & Wildlife Biologist
Puget Sound Assessment and Monitoring Program
Washington Department of Fish & Wildlife
600 Capitol Way N
Olympia, WA 98501-1091
360-902-2820
Jennifer.Lanksbury@dfw.wa.gov

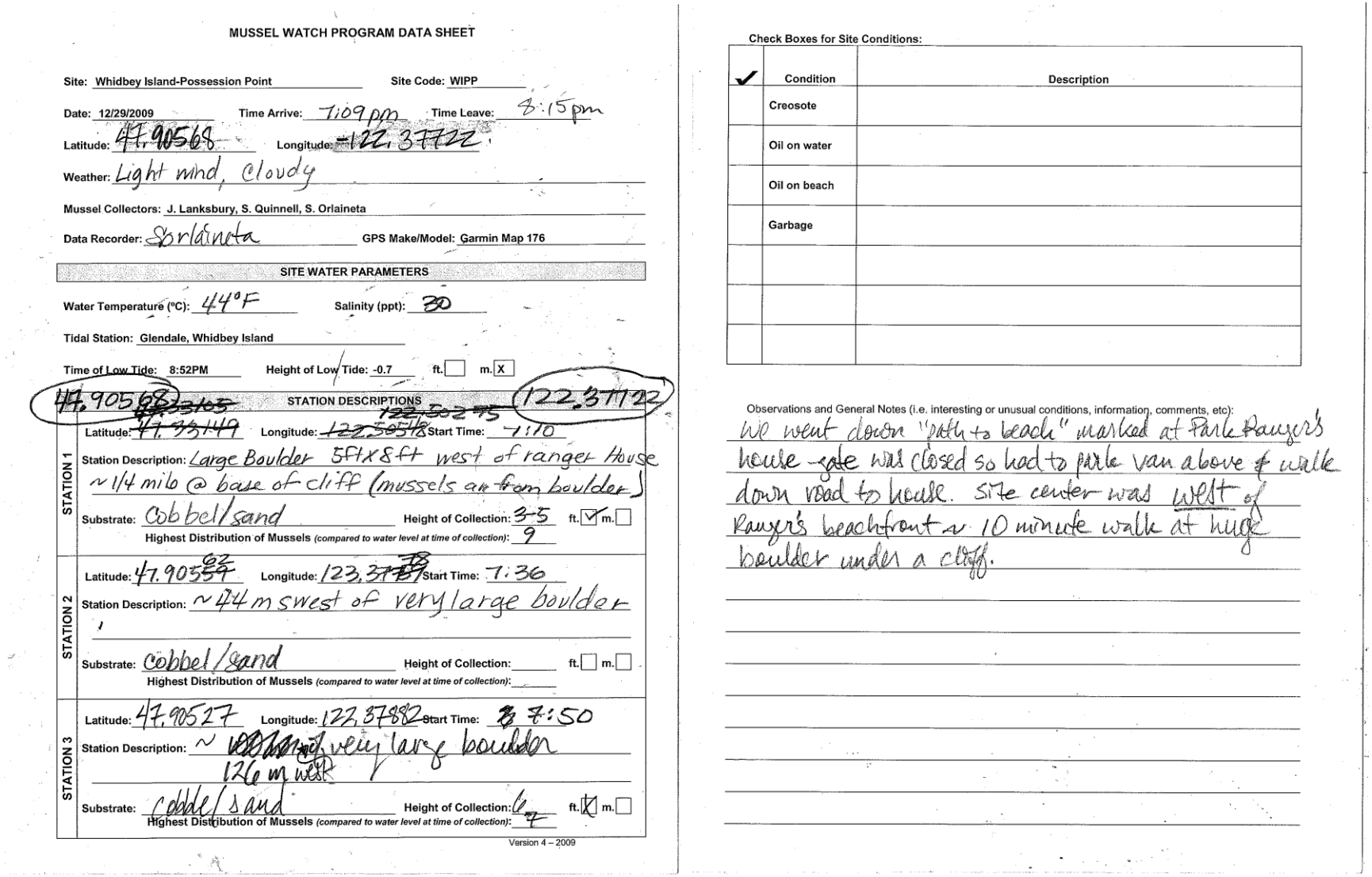
- WSU Beach Watchers may be good source of future volunteer help at this site.
  Contact - Sarah Woehrman
  WSU Beach Watchers Coordinator
  P.O. Box 5000
  Coupeville, WA 98239-5000
  (360) 679-7391
  sarah_martin@wsu.edu
  www.beachwatchers.wsu.edu/island

Site Access – After some confusion as to whether Possession Point is located on a County or State park, and several phone calls to the Washington State Parks service, PSAMP staff determined that this site is likely a part of what's called "South Whidbey Island State Park". However, we were not able to get a phone number for any Park Ranger for this site.

On the evening of sampling we parked on S. Franklin Road at a gate that was closed and locked. We then walked down the rest of the road (at this point a steep hill) to what appeared to be an occupied Park Ranger's house (though it was not marked as State property) at the end of the road. We knocked on the door but no one was home. On the right side of the property, next to a shed, was a path marked with a sign that read, "Path to Beach". We took this path, which led to the beach, visible directly behind the property.

Site Description, Observations and General Notes – The Site Center was about a ten minute (¼ mile) walk *west* of the house at the end of S. Franklin Rd. The center was near a very large boulder (~5 wide x 8 tall ft) at the bottom of a bluff/cliff. The substrate at WIPP consisted of the large boulder described above, and various cobbles among sand.

Potential Sources of Contamination Noted - No obvious signs of contamination were present.



MUSSEL WATCH PROGRAM DATA SHEET

Site: Whidbey Island-Possession Point Site Code: WIPP

Date: 12/29/2009 Time Arrive: 7:09 pm Time Leave: 8:15 pm

Latitude: 47.90568 Longitude: -122.37722

Weather: Light wind, cloudy

Mussel Collectors: J. Lanksbury, S. Quinnell, S. Orlaineta

Data Recorder: Sorlaineta GPS Make/Model: Garmin Map 176

SITE WATER PARAMETERS

Water Temperature (°C): 44°F Salinity (ppt): 30

Tidal Station: Glendale, Whidbey Island

Time of Low Tide: 8:52PM Height of Low Tide: -0.7 ft. ☐ m. ☒

47.90568 ~~47.93165~~ STATION DESCRIPTIONS ~~122.35275~~ 122.37722

STATION 1

Latitude: ~~47.93149~~ Longitude: ~~122.35578~~ Start Time: 7:10

Station Description: Large Boulder 5ft x 8ft west of ranger House ~1/4 mile @ base of cliff (mussels are from boulder)

Substrate: Cobbel/sand Height of Collection: 3-5 ft. ☑ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): 9

STATION 2

Latitude: 47.90559 Longitude: 122.37~~87~~ Start Time: 7:36

Station Description: ~44 m s west of very large boulder

Substrate: Cobbel/sand Height of Collection: ____ ft. ☐ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): ____

STATION 3

Latitude: 47.90527 Longitude: 122.37882 Start Time: ~~8~~ 7:50

Station Description: ~ ~~100~~ very large boulder 126 m west

Substrate: cobble/sand Height of Collection: 6 ft. ☒ m. ☐

Highest Distribution of Mussels (compared to water level at time of collection): 7

Version 4 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

We went down "path to beach" marked at Park Ranger's house - gate was closed so had to park van above & walk down road to house. Site center was west of Ranger's beachfront ~ 10 minute walk at huge boulder under a cliff.

Washington State Mussel Watch data sheet (front and back) from the WIPP site.

Appendix C.25 Whidbey Island – Scatchet Head

The Whidbey Island – Scatchet Head (WISH) site was not an original National Mussel Watch Program site, but was instead sampled in 2009/10 as a *new and improved* alternate site for WIPP (Appendix C.24). This was due to irregularities identified by PSAMP staff in the location of a previous alternate WIPP site, at Sandy Hook/Cultus Bay.

After discussions with National Mussel Watch staff, PSAMP identified WISH as a suitable alternate site to WIPP, which had not been successfully sampled for mussels in over eight years. It was felt that the WISH alternate site much more closely approximated the open water conditions at the original WIPP site than did the Sandy Hook/Cultus Bay site.

However on the night of sampling the alternate WISH site, following a request from the National Mussel Watch Program staff, PSAMP staff investigated conditions at the original WIPP site as well and discovered an abundant mussel population residing there. Thus, although the WISH site was the first to be successfully sampled by PSAMP staff on Tuesday, December 29th, 2009, the mussel samples were NOT shipped for chemical and histopathology analysis. They were instead saved in a -80º freezer at the PSAMP Headquarters in Olympia, WA. Mussels from the *original* WIPP site (second site sampled that night) were instead shipped for analysis. Nevertheless, we present the WISH sample notes here for future reference, in case the mussel population at the original WIPP site fails again and the WISH site is needed as an alternative.

Washington State collaborators notes on

Whidbey Island, Scatchet Head (WISH)

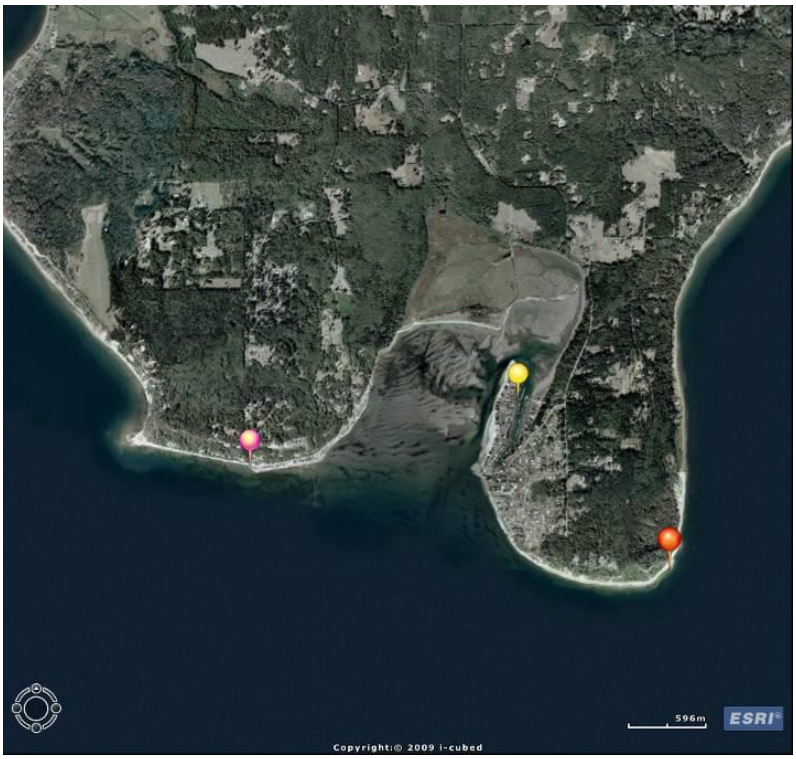
Date sampled: December 29th, 2009 starting at 5:20 pm
Site center coordinates: 47.91413, -122.41082
Temperature: 44° F (6.7° C)
Salinity: $30^{o}/_{oo}$

Sampler Information – Five collaborators and volunteers, three from PSAMP and two from WSU Beach Watchers, helped to sample mussels at the WISH site.

Site Lead - Jennifer Lanksbury
Fish & Wildlife Biologist
Puget Sound Assessment and Monitoring Program
Washington Department of Fish & Wildlife
600 Capitol Way N
Olympia, WA 98501-1091
360-902-2820
Jennifer.Lanksbury@dfw.wa.gov

Volunteers were trained in Mussel Watch sampling protocol on site.

Site Access – Take the Mukilteo/Clinton ferry to Whidbey Island. After getting off the ferry, drive about three miles to the stoplight and turn left onto Cultus Bay Rd. After about another three miles turn right onto Bailey Rd, then after about a half mile turn left onto Scatchet Head Rd. After another half mile veer right onto Swede Hill Rd, then turn left onto Blakely Ave (at the big Scatchet Head sign). In about another half mile turn left at the stop sign onto S George Dr. Follow S. George Dr down a hill and turn right onto Driftwood Dr. Parking is available on Driftwood Dr in a parking lot next to some tennis courts, near the Scatchet Head Community Building.



From right to left: *original* WIPP site (red pin), alternate WIPP site at Sandy Hook/Cultus Bay (yellow pin), and WISH site (pink pin). Although given its own site name, the WISH site was designed to be a second alternate to the WIPP site.

Since this is a private community, a parking permit is technically needed to legally park there, but we accessed the site late at night and there was no one around. We walked down a boat ramp near the tennis court to access the beach. Beach access was very near and easy from the parking lot.

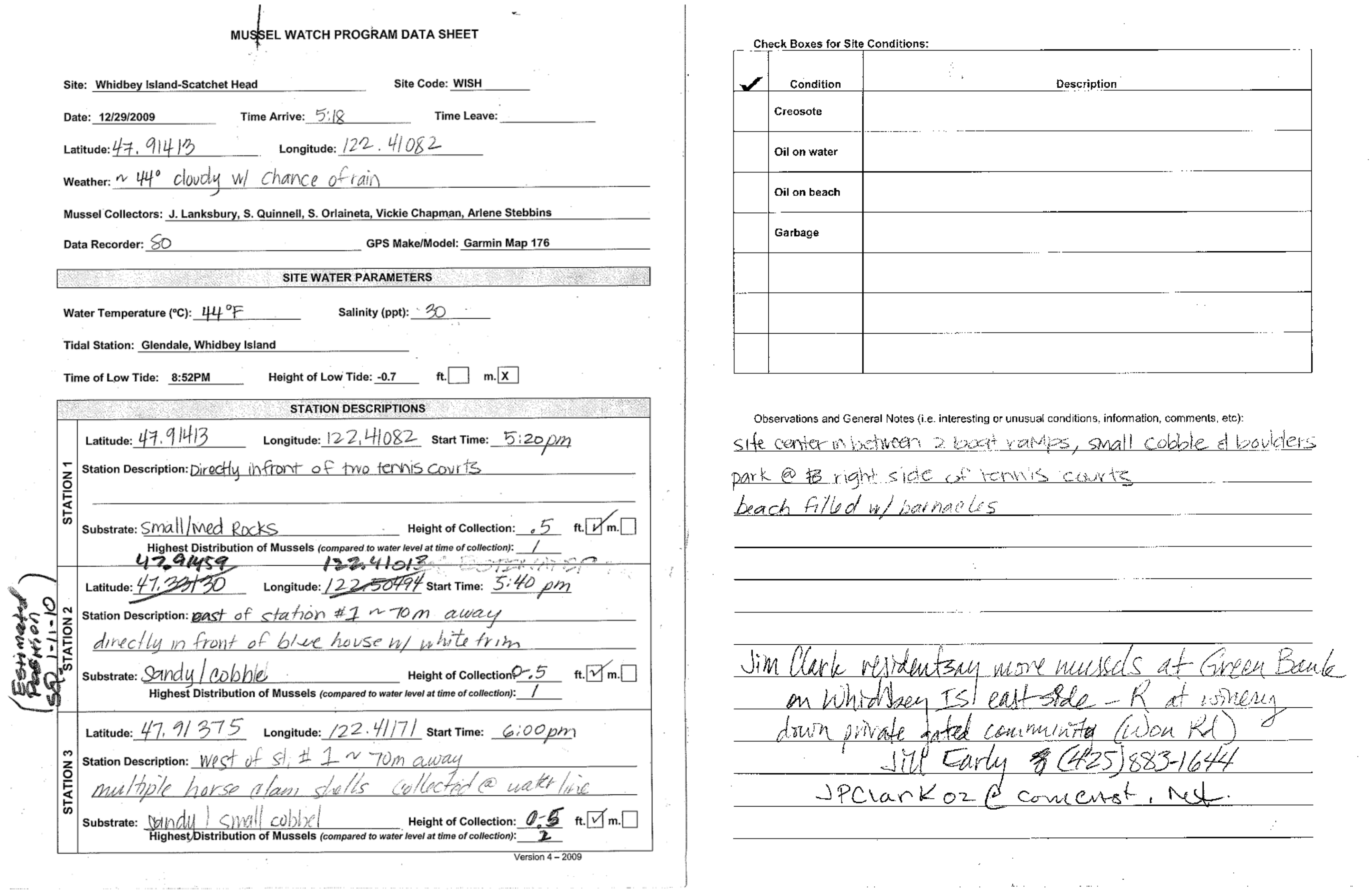
Site Description, Observations and General Notes - Cultus Bay is on the east side of Scatchet Head and there is a marina inside of Sandy Hook, which is on the opposite side of the Bay from Scatchet Head. Where we sampled off the south side of Scatchet Head faces the open Puget Sound. The substrate was mostly small to medium cobbles mixed with sand and ground up shells. The mussels were large and very abundant among the cobbles and sand and easy to remove. The beach was very shallow off Scatchet Head and we were able to walk far offshore at the low tide without getting water in our rubber boots. There were eel grass beds and many sand dollars in shallows.


Large and abundant mussels in lying in clumps and individually among the cobbles and sand at the WISH site.

We met local resident, with a house facing the beach, who came down to see what we were doing. He said there are many more mussels on the east side of Whidbey Island, on Green Bank at a winery down a private gated community (on Won Rd). He advised contacting Jim Early, (425) 883-1644, for access if we were interested in sampling there as well.

Potential Sources of Contamination Noted – There were no obvious signs of contamination. There are two boat ramps at Scatchet Head and houses all along the beach with concrete retaining walls. The site center was located between the two boat ramps.

Collaborators and volunteers collecting mussels in front of cement retaining wall at WISH site.



MUSSEL WATCH PROGRAM DATA SHEET

Site: Whidbey Island-Scatchet Head Site Code: WISH

Date: 12/29/2009 Time Arrive: 5:18 Time Leave:

Latitude: 47.91413 Longitude: 122.41082

Weather: ~ 44° cloudy w/ chance of rain

Mussel Collectors: J. Lanksbury, S. Quinnell, S. Orlaineta, Vickie Chapman, Arlene Stebbins

Data Recorder: SO GPS Make/Model: Garmin Map 176

SITE WATER PARAMETERS

Water Temperature (°C): 44°F Salinity (ppt): 30

Tidal Station: Glendale, Whidbey Island

Time of Low Tide: 8:52PM Height of Low Tide: -0.7 ft. [ ] m. [X]

STATION DESCRIPTIONS

STATION 1

Latitude: 47.91413 Longitude: 122.41082 Start Time: 5:20pm

Station Description: Directly infront of two tennis courts

Substrate: Small/med Rocks Height of Collection: .5 ft. [✓] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 1

STATION 2

Latitude: ~~47.33130~~ 47.91459 Longitude: ~~122.50494~~ 122.41013 Start Time: 5:40 pm

Station Description: east of station #1 ~ 70m away directly in front of blue house w/ white trim

Substrate: Sandy/cobble Height of Collection: 0.5 ft. [✓] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 1

(Estimated Position SQ 1-11-10)

STATION 3

Latitude: 47.91375 Longitude: 122.41171 Start Time: 6:00pm

Station Description: west of st. #1 ~ 70m away multiple horse clam shells collected @ water line

Substrate: sandy/small cobble Height of Collection: 0.5 ft. [✓] m. [ ]

Highest Distribution of Mussels (compared to water level at time of collection): 2

Version 4 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

site center in between 2 boat ramps, small cobble & boulders

park @ right side of tennis courts

beach filled w/ barnacles

Jim Clark residents say more mussels at Green Bank on Whidbey Isl east side – R at winery down private gated community (Wou Rd)

Jill Early (425)883-1644

JPClarK02 @ comcast.net

Washington State Mussel Watch data sheet (front and back) from the WIPP site.

Appendix D. Washington State Mussel Watch Sites NOT Sampled in 2009/10

Appendix D.1 – Columbia River – North Jetty

The Columbia River – North Jetty (CRNJ) site was not visited or sampled during the 2009/10 field season on advisement from National MW Program personnel. This was due to the fact that CRNJ had not been successfully sample for mussels in many years (see BIVALVE COLLECTIONS below). In addition, National MW staff indicated that this site posed significant risk to samplers due to wave exposure. There is a nearby Columbia River – South Jetty (CRSJ) site in Oregon.

National Status & Trends Program description of

Columbia River, North Jetty (CRNJ)

TARGET SPECIES - *Mytilus species* SITE NUMBER - 266

NOMINAL SITE CENTER - 46° 16.67' N 124° 03.73' W

SEDIMENT SITE CENTER - 46° 16.15' N 123° 59.92' W

LOCATED ON NOAA CHART - 18521

SITE ACCESS - Access is at the end of the road in Fort Canby State Park.

SITE DESCRIPTION - Mussels are collected on the rocks forming the north jetty located in the Fort Canby State Park camping area.

This sediment site is located in Baker's Bay on the north side of the Columbia River mouth. Access is by boat from the boat basin in Ilwaco. A sling launch is available year-round at the Port of Ilwaco facilities. From the boat basin, take the navigation channel south and enter the river mouth proper. Enter Baker's Bay from the south tip of Sand Island and locate the tower just inside the mouth of Baker's Bay. Note that entry to Baker's Bay must be made on a high and flooding tide due to the shallowness of the bay.

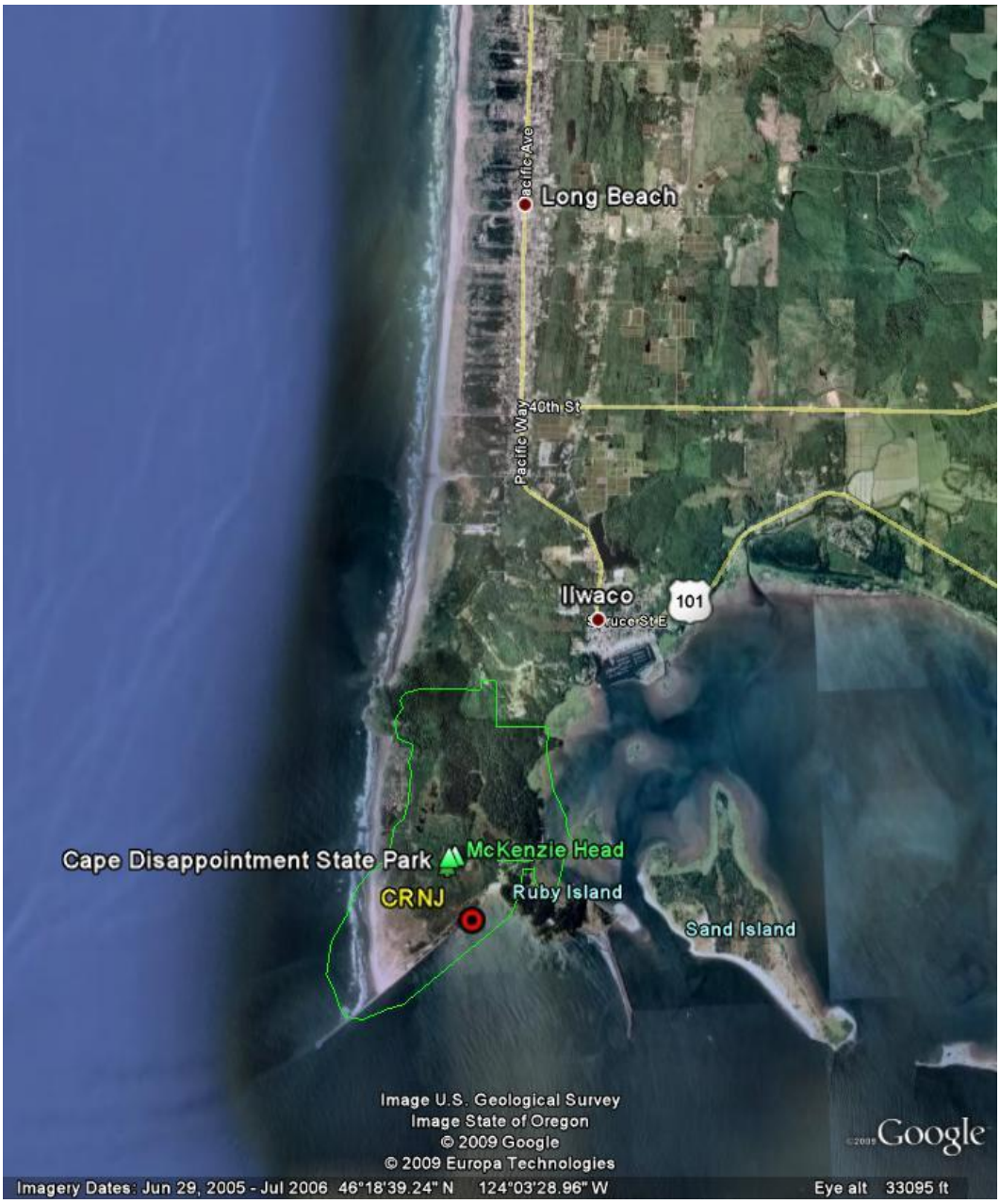
BIVALVE COLLECTIONS
1995 No collection.
1996 No collection.
1997 No collection.
1998 No collection.
1999 No collection.
2000 No collection.

SEDIMENT COLLECTIONS - N/A

SAMPLING METHODS
Bivalves - Intertidal, hand
Sediments - stainless steel grab and stainless steel scoop

WATER DEPTH - intertidal, +1.0 m MLLW; sediments, 2.5 m.

POSSIBLE CONTAMINANTS – The Columbia River watershed includes a vast area of rural/agricultural and urban/industrial areas.



Satellite map of Columbia River - North Jetty (CRNJ) site.

Aerial view of Columbia River - North Jetty (CRNJ) site.

Appendix D.2 – Puget Sound – Cavalero County Park

The Puget Sound - Cavalero County Park (PSCC) site was one of two sites (see also SSKP – Appendix D.4) established by the Stillaguamish Tribe, with the National MW Program, as a new site in 2007. However, though samplers from the Stillaguamish Tribe visited this site during times when the park was accessible, tide conditions prevented the collection of mussels there in the 2009/10 field season. In addition, samplers noted that the road to Cavalero County Park was sliding (i.e., unstable) and not accessible by vehicle, requiring a long walk to the Park.

National Status & Trends Program description of

Puget Sound, Cavalero County Park (PSCC)

TARGET SPECIES: *Mytilus species*

NOMINAL STATION CENTERS:
Station 1: 48° 10.514’ N -122° 28.701’ W
Station 2: 48° 10.512’ N -122° 28.712’ W
Station 3: 48° 10.512’ N -122° 28.687’ W

SITE ACCESS:
From I‑5, take exit #212 and turn left on West 532 towards Stanwood/Camano Island. Follow WA‑532 W approximately 10 miles, and take a slight left on NE Camano Drive, and follow this road for approximately 5 miles. Turn left on Cavalero Road, then another left on Simonson Place. Signs to County Boat Launch Park (located in residential community) can also be followed if necessary. Parking is located south of the boat launch, and site is accessed by walking north over the ramp to the beach.

SITE DESCRIPTION:
The PSCC site collection area is a 30 x 100 m cobble beach, with scattered boulders, centered about 100 m north northwest of the Cavalero County Park boat launch ramp and parking lot, Camano Island, Island County, Washington. Mussels are found in the intertidal zone on patchy boulders, and within cobble beaches. Stations 1 and 2 are 1‑2 meter sized boulders located 56 feet (19 m) apart. When standing north of the station 2 boulder these two boulders form a straight line‑of‑sight south to a house with a deck jutting over the beach. Station 3 is cobble only (no boulder) and located 33 meters to the southeast of the Station 1 boulder.

Satellite map of Puget Sound - Cavalero County Park (PSCC) site – left side.

Aerial view of Puget Sound - Cavalero County Park (PSCC) site.

Appendix D.3 – Puget Sound – Edmonds Marina

Although samplers found a few small mussels at the Puget Sound – Edmonds Marina (PSEM) site, population densities were not high enough to sample during the 2009/10 field season. See Site Description, Observations and General Notes below for a full description.

National Status & Trends Program description of

Puget Sound, Edmonds Marina (PSEM)

TARGET SPECIES- *Mytilus species*

NOMINAL SITE CENTER - 47° 48.665‘N 122° 23.288‘ W

LOCATED ON NOS CHART # - 18446

SITE ACCESS - From I-5 take exit 177 and go west. Proceed west about 5 miles following signs to Edmonds and Kingston Ferry. Prior to the ferry boat toll booth, turn left on West Dayton Street. Cross the railroad tracks and then turn into the parking lot on the right and park.

SITE DESCRIPTION - The site is the northern side of the breakwater for the Edmonds Marina. Station 2, the middle station, is reachable from the beach at low tide and is on the breakwater just below an art work consisting of metal salmon at the top of wooden poles. Station 3 is about 50 feet to the east of Station 2 and Station 1 is on the breakwater under the fishing pier walkway to the west of Station 2. Station 3 was also near a very narrow vertical gap in the breakwater. Although not near the entrance to the Marina, tidal driven currents are observed to flow through the porous rip-rap breakwater, and also through the narrow vertical gap. Therefore, the contaminant concentrations in the mussels are expected to be influenced by the marina. The marina also has an intertidal stormwater outfall that discharges inside the marina close to the breakwater.

The site is a short walk to the south from the ferry boat terminal. A long-term NOAA mussel watch site known as the Edmonds Ferry site (PSEF) is located at Beckett's Landing, on the north side of the ferry boat terminal. The Edmonds Ferry site had the highest level of PBDEs of any site on the west coast in the winter of 2006. The Edmonds Marina site was selected to compare the PBDEs and other parameters with same day sampled mussels from the Edmonds Ferry site. The Edmonds Marina site is close to the marina and also close to a secondary treated municipal sewage effluent discharged subtidally through two outfalls at depths of 58 and 66 feet below MLLW.

Stations 2 and 3 are well protected and easily accessed at any time of night or day and in essentially in any weather when the tides are favorable. Station 1 is more difficult to reach and work on and requires permission from the Port of Edmonds. Station 1 for future sampling should be moved closer to Station 2 and accessed from the shore.

BIVALVE COLLECTIONS

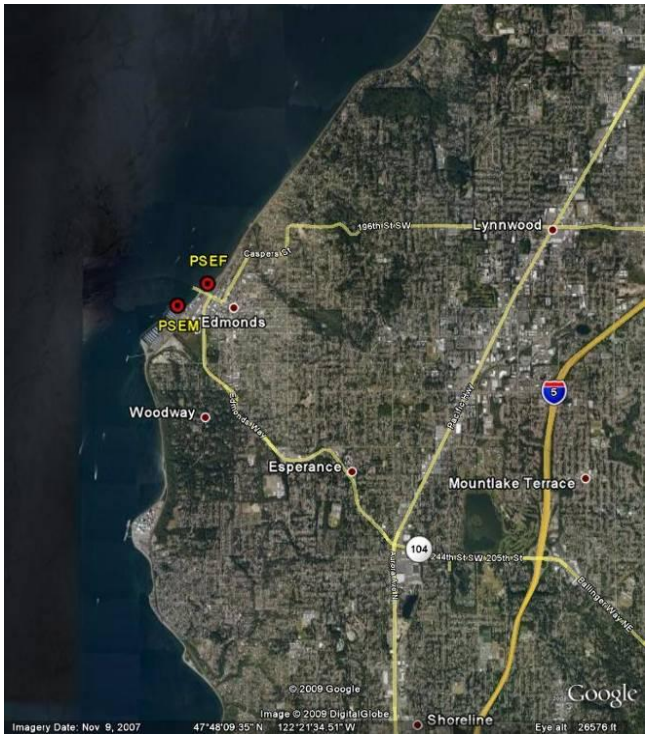
The original sampling plan was to be centered on the northern tip of the Edmonds Marina breakwater. The mussels near the tip of the breakwater (at Station 1) were very small, few in number and confined to difficult to reach areas in the breakwater. Because the mussels were sparse at the first station on the breakwater near the fishing pier overpass, and because this was a new site, the sample plan adjusted to sampling the other two stations closer to shore on the breakwater, accessed from shore instead of from the fishing pier. Mussels were medium size and abundant at Stations 2 and 3. The mussels for Stations 1 and 2 were on the rip-rap boulders of the breakwater. Mussels for Station 3 were on the concrete wall of the breakwater and the adjacent rip-rap boulders. None of the mussels collected were near the intertidal sediments.

SEDIMENT COLLECTIONS
None were collected.

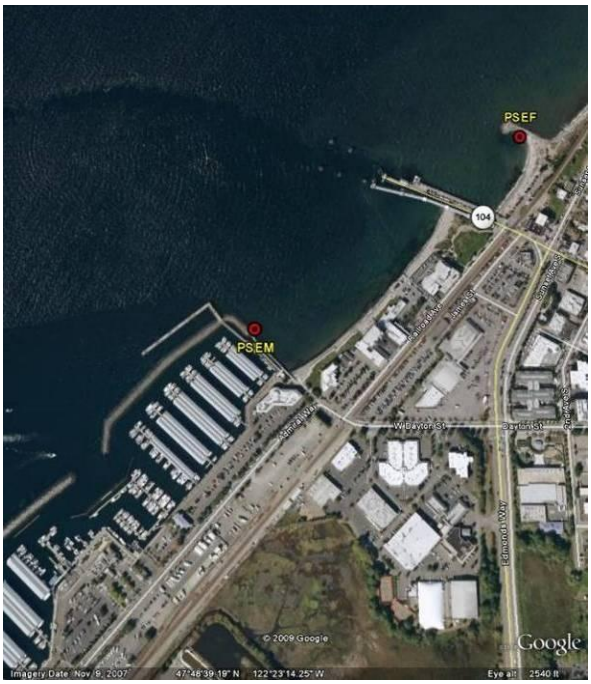
SAMPLING METHODS
Mussels – by hand.

DEPTH OF SAMPLE COLLECTION
Mussels – intertidal centered at about +5 or 6 feet above MLLW.

POSSIBLE CONTAMINANTS
PSEM probably will experience PAH and PBDE values comparable to other marina site in the NOAA National mussel watch program.



Satellite map of Puget Sound – Edmonds Marina (PSEM) site – lower of two sites shown.



Closer view of Puget Sound – Edmonds Marina (PSEM) site – lower of two sites shown.

Washington State collaborators notes on

Puget Sound, Edmonds Marina (PSEM)

Date visited: January 26th, 2010 starting at 5:30 pm
Site Center coordinates: 47° 48.665' N, 122° 23.288' W
Water temperature: Not collected
Salinity: Not collected

Sampler Information – Seven collaborators and volunteers from NOAA, ORCA/Everett Community College, WSU Beach Watchers, and the Snohomish county MRC attempted to sample at PSEM.

Site Lead - Alan Mearns
Senior Staff Scientist
Emergency Response Division
National Oceanic and Atmospheric
7600 Sand Point Way NE
Seattle, WA 98115
206-526-6336
alan.mearns@noaa.gov

Site Access – The Edmonds Marine Sanctuary requires a separate permit for sampling. Contact Sally Lider at Edmonds Parks, Recreation, and Cultural Services prior to sampling to inform her of sampling dates and to update permit, if needed. Permit stipulates use of signs and/or handouts

available to the public during the sampling to explain the project. Public parking is available east of the marina, in any of the parking lots.

The easiest access to this site is via the beach at low tide from Olympic Park. Although mussels are accessible higher within the tide line, traversing boulders with wave break from the ferry could be more dangerous, especially during hours of darkness.

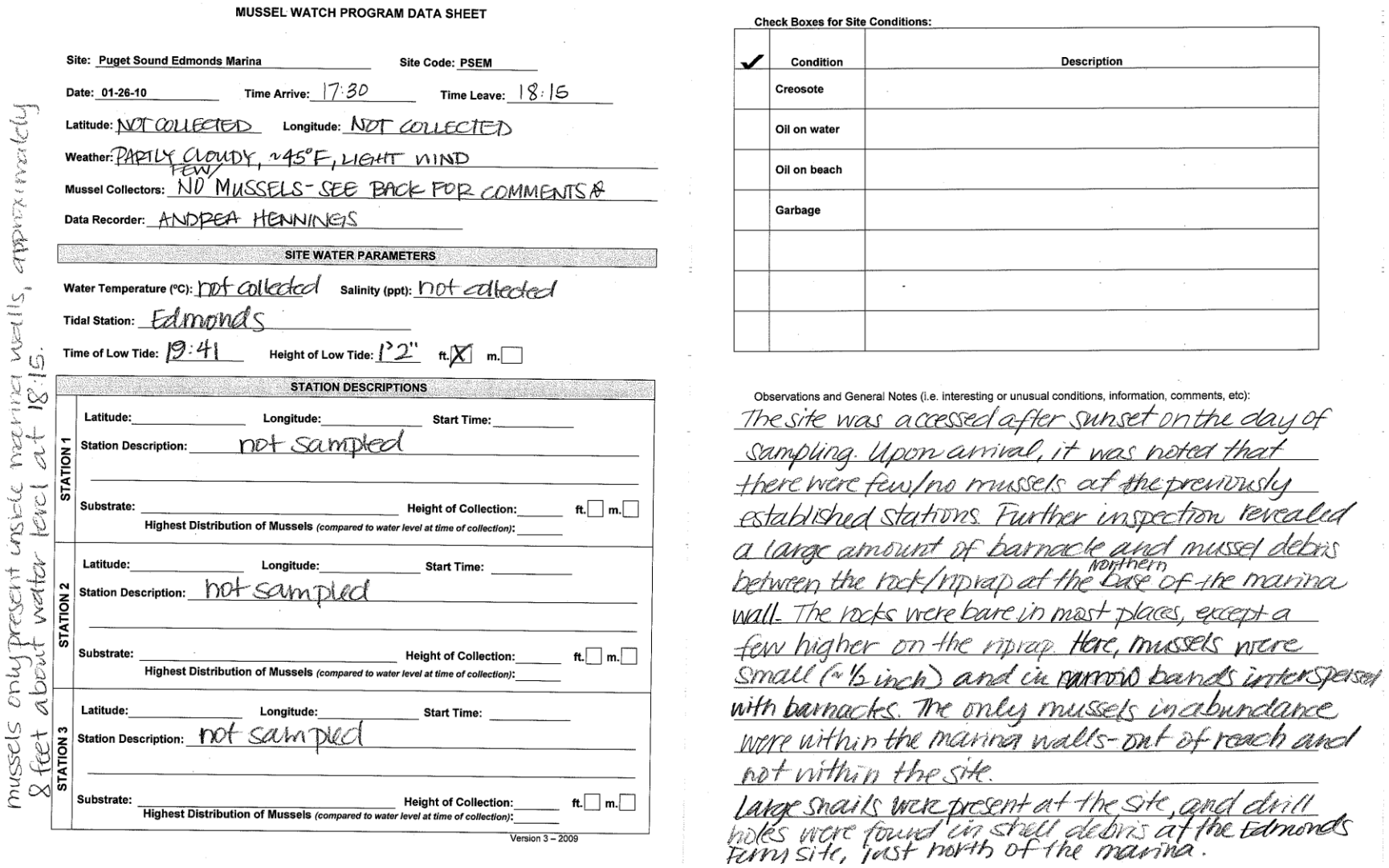
Site Description, Observations and General Notes – The site is located on the north/northeast side of Edmonds Marina wall, facing the ferry dock. The marina wall is metal and concrete with large boulders piled along the breakwater side. The beach face is sandy, with some areas of larger cobble. Mussels were found in small numbers on the boulders along the water-ward face (see below).

Mussels were previously found on large boulders along the northern breakwater of Edmonds Marina. However, on the sampling date the boulders were generally bare. Mussel and barnacle shell debris was found between the boulders and the base of the marina wall. Some small (approximately 0.5 inches) mussels were present approximately 8 feet above base of marina wall on boulders, although densities were not high enough to sample. Larger bands of small (approximately 0.5 inches) mussels were observed at the same height within the marina walls in a caged outflow area. This area was not accessible by reaching from boulders or ground, nor was it appropriate to sample due to the change in environment from the established site.

A large group (>75) of northern kelp crab (*Pugettia producta*) were present along the tide line. Fringed Dogwinkle (*Nucella lamellosa*), penpoint gunnel (*Apodichthys flavidus*), tidepool sculpin (*Oligocottus maculosus)*, and great blue heron (*Ardea herodias*) were also found.

Breakwater at Puget Sound – Edmonds Marina (PSEM) site. Photo taken August, 2009.

Potential Sources of Contamination Noted – Site is situated along a breakwater of the northern marina wall; the eastern beach face is dominated by large buildings and a parking lot. The ferry and associated dock are north of the marina.



MUSSEL WATCH PROGRAM DATA SHEET

Site: Puget Sound Edmonds Marina Site Code: PSEM

Date: 01-26-10 Time Arrive: 17:30 Time Leave: 18:15

Latitude: NOT COLLECTED Longitude: NOT COLLECTED

Weather: PARTLY CLOUDY, ~45°F, LIGHT WIND

Mussel Collectors: NO (FEW) MUSSELS - SEE BACK FOR COMMENTS &

Data Recorder: ANDREA HENNINGS

SITE WATER PARAMETERS

Water Temperature (°C): not collected Salinity (ppt): not collected

Tidal Station: Edmonds

Time of Low Tide: 19:41 Height of Low Tide: 1'2" ft. [X] m. [ ]

STATION DESCRIPTIONS

STATION 1
Latitude: Longitude: Start Time:
Station Description: not sampled
Substrate: Height of Collection: ft. [ ] m. [ ]
Highest Distribution of Mussels (compared to water level at time of collection):

STATION 2
Latitude: Longitude: Start Time:
Station Description: not sampled
Substrate: Height of Collection: ft. [ ] m. [ ]
Highest Distribution of Mussels (compared to water level at time of collection):

STATION 3
Latitude: Longitude: Start Time:
Station Description: not sampled
Substrate: Height of Collection: ft. [ ] m. [ ]
Highest Distribution of Mussels (compared to water level at time of collection):

Version 3 – 2009

mussels only present inside marina walls, approximately 8 feet about water level at 18:15.

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

The site was accessed after sunset on the day of sampling. Upon arrival, it was noted that there were few/no mussels at the previously established stations. Further inspection revealed a large amount of barnacle and mussel debris between the rock/riprap at the (Northern) base of the marina wall. The rocks were bare in most places, except a few higher on the riprap. Here, mussels were small (~½ inch) and in narrow bands interspersed with barnacles. The only mussels in abundance were within the marina walls - out of reach and not within the site.

Large snails were present at the site, and drill holes were found in shell debris at the Edmonds Farms site, just north of the marina.

MW Data Sheet for Puget Sound – Edmonds Marina (PSEM) site (front and back).

Appendix D.4 – Puget Sound – Kayak Point

The Puget Sound – Kayak Point (PSKP) site was one of two sites (see also PSCC – Appendix D.2) established by the Stillaguamish Tribe, with the National MW Program, as a new site in 2007. Although samplers from both the Stillaguamish Tribe and the Snohomish County MRC visited this site, there were little to no live mussels present. Thus they were unable to collect mussels at PSKP during the 2009/10 field season. See Site Description, Observations and General Notes below for a full description.

National Status & Trends Program description of

Puget Sound, Kayak Point (PSKP)

TARGET SPECIES- *Mytilus species*

NOMINAL SITE CENTER – 48° 8.205’ N 122° 22.037’ W

LOCATED ON NOS CHART # 18423_15

SITE ACCESS - Drive to Kayak Point State Regional Park (15610 Marine Drive Stanwood, WA 98292, 360-652-7992) and park at the north beach near the picnic enclosures.

SITE DESCRIPTION - A central point was established along the beach - north of the fishing pier. From the fourth picnic enclosure from the north end of the beach, it is 160 feet @ 274 degrees to station #1. From Station #1, station #2 is 134 feet @ 212 degrees. From Station #1, station #3 is 70 feet @ 43 degrees.

Satellite images of PSKP site.

Washington State collaborators notes on

Puget Sound, Kayak Point (PSKP)

Date visited: February 10th, 2010 starting at 7:00 pm
Site Center coordinates: 48° 8.205' N, 122° 22.037' W
Water temperature: Not collected
Salinity: Not collected

Sampler Information – Four collaborators and volunteers from the Snohomish County MRC, WSU Beach Watchers and the Washington Conservation Corps attempted to sample at PSKP.

Site Lead - Andrea Hennings
Marine Resources Program Assistant
Snohomish County Surface Water Management
3000 Rockefeller Ave, M/S 607
Everett, WA 98201
(425) 388-3464 ext. 4573
andrea.hennings@snoco.org

Note for volunteers – To access the samplers must walk down a road or on a trail system along a bluff. The hike along the trail system can be arduous, especially during hours of darkness.

Site Access – Day access to PSKP is available from the lower parking lot of Kayak Point Regional Park. However, access after dusk should be cleared with Park Rangers (360-652-

7992). Drive into the upper parking lot near the yurts, through park exit lane, which remains open year round. The beach must then be accessed either by walking down a road or on a trail system along a bluff. As stated above, the hike along the trail system can be arduous, especially during hours of darkness.

Site Description, Observations and General Notes – Mussels were previously found north of the jetty in a band running north to south from picnic shelters #3-8, interspersed with the cobble at a water height of approximately +1-4 ft MLLW. Upon arrival on sampling date, mussel shells were present, but most were dead.

Mussel shells were generally 1.5-2 inches in length. Most shell halves were separated completely, with the majority of those broken cleanly across one half of the face. Some mussels were still closed, but broken partially through the ligament, and no tissue was present inside.

A large population was still present on the creosote pilings of the pier in large bands, approximately 7-10 feet down from the top of the pilings. Mussels were also still present at the point south of the pier and to the east, although they were in very low numbers and interspersed with the cobble.

A sturgeon head was found upon arrival at the sampling site, and gray whales had been reported in Port Susan for the duration of the week. Shallow pits/impressions were also observed in the beach mud higher within the tide line and northwest of where the mussels had been present.

Potential Sources of Contamination Noted – Pilings of the pier were made of creosote. A boat ramp is located between the pier and the sampling site.

MUSSELS WERE PRESENT ON CREOSOTE PILINGS OF DOCK AND FEW WERE INTERSPERSED IN THE COBBLE ALONG THE BEACH FACE, APPROXIMATELY +2-3FT. MLLW.

MUSSEL WATCH PROGRAM DATA SHEET

Site: Puget Sound Kayak Point Site Code: PSKP

Date: 02-10-10 Time Arrive: 19:00 Time Leave: 20:30

Latitude: 48° 8' 16.02" Longitude: -122° 21' 58.00"

Weather: overcast, drizzly, no wind (sunset at 17:23)

Mussel Collectors: Jim O'Neill, ~~Corinna Frenzl~~, Stef Frenzl, Danielle Larsen – DID NOT COLLECT

Data Recorder: Andrea Hennings

SITE WATER PARAMETERS

Water Temperature (°C): n/a Salinity (ppt): n/a

Tidal Station: Kayak Point, WA

Time of Low Tide: 20:50 Height of Low Tide: 0.0 ft. [x] m. [ ]

STATION DESCRIPTIONS

STATION 1

Latitude: Longitude: Start Time:

Station Description: DID NOT COLLECT - SEE BACK

Substrate: Height of Collection: ft. [ ] m. [ ]

Highest Distribution of Mussels *(compared to water level at time of collection)*:

STATION 2

Latitude: Longitude: Start Time:

Station Description:

Substrate: Height of Collection: ft. [ ] m. [ ]

Highest Distribution of Mussels *(compared to water level at time of collection)*:

STATION 3

Latitude: Longitude: Start Time:

Station Description:

Substrate: Height of Collection: ft. [ ] m. [ ]

Highest Distribution of Mussels *(compared to water level at time of collection)*:

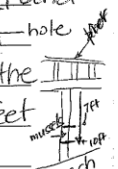
Version 3 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	
X		sturgeon head found on beach
X		pilings south of nominal center are creosote

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

The site was accessed after sunset on the sampling date. A band of mussels from the tideline to approximately one foot higher in elevation had been present north of the ~~dock~~ pier, west of the picnic huts (beginning along the beach just west of huts 3-8). Only shells were present. Most shell halves were separated completely, but most were broken cleanly across one half of the face, and some (still attached) were broken partially through the ligament. they were generally 1½-2" inches long. Mussels were found on the creosote pilings of the ~~dock~~ pier in large bands, approximately 7-10 feet from the top of the pilings. Mussels were also present on the point south of the pier and to the east, although they were in very low numbers and interspersed within the cobble. A sturgeon head was found when we arrived at the site. (PICTURES ARE AVAILABLE ON THE SNOHOMISH COUNTY SERVER OF ALL ITEMS NOTED).



MW Data Sheet for Puget Sound – Edmonds Marina (PSKP) site (front and back).

Appendix D.5 - Puget Sound – Point Jefferson

This site was not scheduled to be sampled in 2009/10 by the National MW Program and was thus not visited by the collaborators. However, we include it here for future reference.

"An attempt was made to establish a site at Point Jefferson as this was the area most directly impacted from the [Point Wells] oil spill in December 2003. The entire shoreline was searched (where accessible) from Indianola in the west all the way east past Point Jefferson and north up to Kingston. The only suitable habitat for intertidal mussels was at a private/community beach/pier at Point Jefferson (which at the time served as a major staging area for the oil spill cleanup effort). No mussels or trace of mussels were found on the rocks or pier area." (Fay, 2005)

National Status & Trends Program description of

Puget Sound, Point Jeffereson (PSPJ)

TARGET SPECIES- *Mytilus edulis*

NOMINAL SITE CENTER –47.74556 N; 122.47840W

LOCATED ON NOS CHART # - 18473-1

SITE ACCESS -From Highway 3 near Bremerton, take highway 305 east to 307. Left (north) on 307 to NE Gunderson Road. Go right (the only turn possible) on to Gunderson, and continue to where it joins Miller Bay Road NE (continue to your left). From Miller Bay road take the second left on to NE West Kingston Road (the name makes no sense) and continue to the "T". At the "T" take a right on to S Kingston Road NE, crossing a small inlet of the Sound, and continue in a southerly direction with Puget Sound on your left, and the Kingston Ferry landing behind you. When the road forks, take the left (east) on to NE Point Jefferson Road to near the end where two cul de sacs come off straight ahead and to the left. Take a right here, as NE Point Jefferson Road continues south. As the road veers more to the east it will join and become Klabord road for about one block before curving sharply right to become Jefferson Beach Road NE. Continue south and as the road bends to the right (west) look for the gated entrance (downhill) to the beach access. If the gate is missed, the road dead-ends in a short distance under the name of NE Marine View Drive, without a distinct point at which the moniker has changed.

SITE DESCRIPTION – The site was established in January 2004 in response to the oil spill at Wells Point a week earlier in late December 2003, and in an effort to substitute an alternate site for the abandoned PSSS site, which consistently has failed to produce mussels for lack of suitable habitat. The entire shoreline, where reasonable access could be attained from the roadway, was searched from Indianola (westernmost on the south shore) to Kingston (northernmost on the east shore) for suitable habitat for mussel attachment. No mussels or evidence of former populations were found in the intertidal. The most promising habitat was found on a rock bulkhead and pier at the south tip of Point Jefferson at a private beach access, boat ramp, and pier just off NE Marine View Drive. The pier was designated the nominal site.

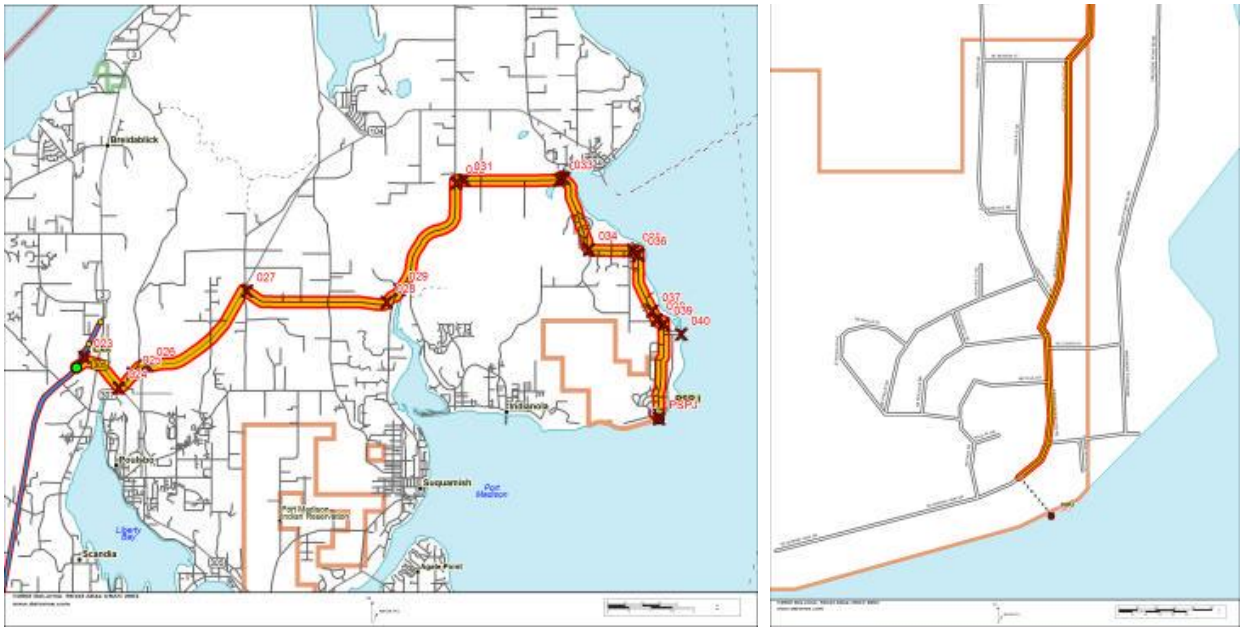
BIVALVE COLLECTIONS
No mussels were found or collected.

SEDIMENT COLLECTIONS
None collected, none sought.

SAMPLING METHODS
None, but would have been by hand.

DEPTH OF SAMPLE COLLECTION
Was to have been intertidal.

POSSIBLE CONTAMINANTS
An attempt was made to establish the site in early January 2004 following the fuel oil spill in late December at Wells Point, just five miles to the northeast of Point Jefferson and right on line with the trajectory of the spill. Thus the most likely contaminant to appear in the initial sampling would be residues from this spill.



Map to location of potential PSPJ site center.

Nominal PSPJ site access

Views to west (left) and east (right) of PSPJ site access dock.

Appendix D.6 - Puget Sound – South Seattle

This was the very first site the Washington State MW collaborators attempted to sample. Although the entire length of the beach at the Puget Sound – South Seattle (PSSS) site was searched, virtually no mussels were found to collect for the 2009/10 field season. Afterward, it was discovered, from a 2002-2005 National MW Program Field Collection Report, that PSSS had already been "abandoned" since 2004 (Fay, 2005). See Site Description, Observations and General Notes below for a full description. The funds for analysis for this site were reallocated to analyze samples from the new (pilot-project) Elliott Bay – Myrtle Edwards (EBME – Appendix C.5) site.

National Status & Trends Program description of

Puget Sound – South Seattle (PSSS)

TARGET SPECIES - *Mytilus species* SITE NUMBER -277

NOMINAL SITE CENTER - 47° 31.796' N 122° 24.094' W

LOCATED ON NOAA CHART - 18449

SITE ACCESS - The original sampling site is located at Point Williams, in Lincoln Park. From U.S. Highway 5, take Exit 163 west onto the West Seattle Freeway which goes into Fauntleroy Ave. Proceed south down Fauntleroy Ave. for about 3.5 miles to Lincoln Park, which will be on the right/west (Puget Sound) side of the road. Park the vehicle in the parking lot, and walk approximately 300 m through the park to the point. A boat is necessary if sediment samples are to be collected. There is a good boat ramp (the Armeni Boat Ramp) approximately 5 miles to the north at Duwamish Head.

SITE DESCRIPTION - The original site was located on the large cobble rocks at Point Williams.

BIVALVE COLLECTIONS

1995 No collection.

1996 The original site at Point Williams was extensively searched and no live *Mytilus sp.* mussels were discovered in the immediate area. The only live mussels found were growing on the pilings at the Fauntleroy Ferry dock, about 1/2 a mile to the southeast along the beach. Discrete sampling stations were not possible, as the population was small, sparse and in a limited area. Collected mussels ranged from 3.1 cm to 4.5 cm in shell length. The average shell length was 3.7 cm with a standard deviation of 0.3 cm for 53 collected individuals

1997 No collection.

1998 Dead site. No live mussels found at this site.

1999 No collection.

2000 *Mytilus sp.* mussels were medium to large sized and abundant on a log wedged into rocks and more sparse and smaller sized on concrete rubble and exposed rocks. Care was taken

to only collect target species. The three concrete pillars directly off Point Williams were totally devoid of any mussels.

2004 Not collected in 2004 because suitable habitat was found in 2002 to be gone and cannot supports mussels except on creosote pilings of ferry terminal and isolated occurrences of driftwood floating ashore from elsewhere.

SEDIMENT COLLECTIONS

1995 No collection.

1996 The gray-brown silty sand sediment sample contained some shell hash, and was collected from 47° 31.47' N and 122° 24.16' W, in about 41 m of water. The sediment site was moved from the original site (47° 31.55' N and 122° 25.08' W), as the sediments were unacceptable and contained only rocks, gravels and sands.

1997 No collection.

1998 No collection.

1999 No collection.

SAMPLING METHODS

Bivalves - hand

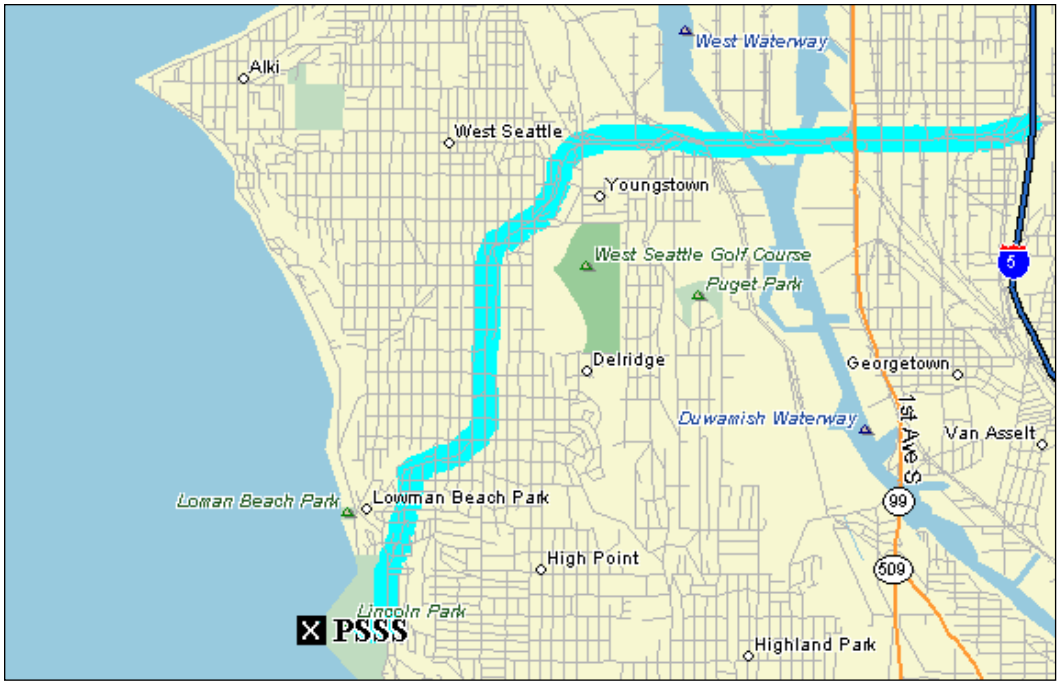
Sediments - stainless steel sediment grab and stainless steel scoop

WATER DEPTH - intertidal, +0.5 m MLLW.

POSSIBLE CONTAMINANTS – There is no obvious point source of contamination.

Notes from 2002-2005 National MW Report on sampling from 2002-05 (Fay, 2005):

For the complete lack of mussels or substratum observed in 2002, except for the creosote pilings of the ferry dock, and the previous mistaken sampling of mussels from expatriate driftwood on the shoreline, this site was abandoned for the 2004 season and beyond.



Map showing access to PSSS site.

Aerial view of PSSS site.

Washington State collaborators notes on

Puget Sound – South Seattle (PSSS)

Date visited: December 11th, 2009 starting at 5:30 pm
Site Center coordinates: 47° 31.796' N 122° 24.094' W
Water temperature: Not collected
Salinity: Not collected

Sampler Information – Six collaborators from PSAMP, the National MW Program, the Snohomish County MRC and a volunteer from the Seattle Aquarium attempted to sample mussels at PSSS.

Site Lead - Jennifer Lanksbury
Fish & Wildlife Biologist
Puget Sound Assessment and Monitoring Program
Washington Department of Fish & Wildlife
600 Capitol Way N
Olympia, WA 98501-1091
360-902-2820
Jennifer.Lanksbury@dfw.wa.gov

Site Access – See notes from National MW Program above.

Site Description, Observations and General Notes – It is noted here that the collaborators attempted to sample mussels at PSSS before the National MW Program provided Washington State with a 2002 – 2005 Field Collection Report of their sampling efforts during the 2002-2005 field seasons (Fay, 2005). Upon receiving this report, it was discovered that the "for the complete lack of mussels or substratum observed in 2002, except for the creosote pilings of the ferry dock, and the previous mistaken sampling of mussels from expatriate driftwood on the shoreline" the PSSS site had been "abandoned for the 2004 season and beyond" (Fay, 2005).

We searched the entire length of the Lincoln Park beach, in both directions, and found no mussels in enough quantity to collect. The substrate was medium - large cobbles. A few, very small mussels were found on three large concrete pillars (park pool cisterns) directly off Point Williams, but not enough to collect. Some sea stars (*Pisaster* sp.) were present, as were large breeding aggregations of whelks, with eggs attached to the cobbles.

Further reconnaissance of the area surrounding the PSSS site was undertaken in the following days. Two collaborators, PSAMP and National MW Program staff, searched from Lincoln Park to Seahurst Beach (6 km southward) but found not promising MW sites. Mussels found to the south, at the Fauntleroy Ferry terminal, were on creosote pilings. Consultation with National MW Program staff resulted in a decision to abandon this site for future sampling.

Potential Sources of Contamination Noted – See notes from National MW Program above.

No MW Datasheet was filled out for this site.

Appendix E. Example of Washington MW Program Data Sheet

MUSSEL WATCH PROGRAM DATA SHEET

Site: _____ Site Code: _____

Date: _____ Time Arrive: _____ Time Leave: _____

Latitude: _____ Longitude: _____

Weather: _____

Mussel Collectors: _____

Data Recorder: _____ GPS Make/Model: _____

SITE WATER PARAMETERS

Water Temperature (°C): _____ Salinity (ppt): _____

Tidal Station: _____

Time of Low Tide: _____ Height of Low Tide: _____ ft. ☐ m. ☐

STATION DESCRIPTIONS

STATION 1

Latitude: _____ Longitude: _____ Start Time: _____

Station Description: _____

_____

Substrate: _____ Height of Collection: _____ ft. ☐ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: _____

STATION 2

Latitude: _____ Longitude: _____ Start Time: _____

Station Description: _____

_____

Substrate: _____ Height of Collection: _____ ft. ☐ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: _____

STATION 3

Latitude: _____ Longitude: _____ Start Time: _____

Station Description: _____

_____

Substrate: _____ Height of Collection: _____ ft. ☐ m. ☐

Highest Distribution of Mussels *(compared to water level at time of collection)*: _____

Version 4 – 2009

Check Boxes for Site Conditions:

✓	Condition	Description
	Creosote	
	Oil on water	
	Oil on beach	
	Garbage	

Observations and General Notes (i.e. interesting or unusual conditions, information, comments, etc):

Appendix F. Example of Washington MW bag labels

Date: ____________ ______________

Station #: ________ ______________

____

NS&T Mussel Watch Site
Washington State | HISTOPATHOLOGY

Date: ____________ ______________

Station #: ________ ______________

____

NS&T Mussel Watch Site
Washington State | HISTOPATHOLOGY

Date: ____________ ______________

Station #: ________ ______________

____

NS&T Mussel Watch Site
Washington State | HISTOPATHOLOGY

Date: ____________ ______________

Station #: ________ ______________

____

NS&T Mussel Watch Site
Washington State | CHEMISTRY

Date: ____________ ______________

Station #: ________ ______________

____

NS&T Mussel Watch Site
Washington State | CHEMISTRY

Date: ____________ ______________

Station #: ________ ______________

____

NS&T Mussel Watch Site
Washington State | CHEMISTRY

INSTRUCTIONS

Please fill out the following sections on the front of this form, as directed below (**sections in bold are the most important**):

- Program – "NS&T Mussel Watch Year 25"
- State – "Washington State"
- Lab Contact – Amanda Fryer at B&B Laboratories
- Sampler signature – the sampler (should use the Site Lead's name here)
- **Sample ID = individually list each Site Center (acronym) & Station # (bag). Example: line 1 = PSHC, Station 1 line 2 = PSHC, Station 2**
- **Sample date – date samples were collected (not shipped)**
- **Sample time – if available from the MW datasheet**
- Sample Matrix = Tissue
- Preservative = Ice
- Container = Bag
- Analyses – leave these boxes blank
- Comments – list anything additional comments here
- **Total # of Containers – this is the total number of bags you include in the cooler (add up No. in cells from above)**
- **Relinquished by – signature of person actually shipping samples**
- Group Name – name of organization with which volunteers were associated
- **Date/Time – of when you packed up and shipped off samples via FedEx Priority Overnight shipping (using WDFW pre-filled labels)**

NOTE: If possible, make a photocopy of the front of this form (after it's all filled out) and keep it with the *original copy of MW data sheet.*
Original copy of MW data sheet should be kept; only photocopied versions of MW data sheet should be shipped to the labs.

Mussel Watch *Chemistry* Sample Collections
CHAIN OF CUSTODY RECORD

Program: NS&T Mussel Watch Year 25

State: Washington State

Lab Contact: Amanda Fryer at B & B Laboratories

Sampler Signature: _____

Analyses

Other Instructions

To be determined by NS&T Mussel Watch Program (NOAA)

Sample ID	Sample Date	Sample Time	Sample Matrix	Preservative	Containers Type	Containers No.							Comments
			Tissue	Ice	Bag								
			Tissue	Ice	Bag								
			Tissue	Ice	Bag								
					Total # of Containers								

Relinquished By	Group Name	Date	Time	Received By	Company Name	Date	Time
Printed Name:				Printed Name:			
Signature:				Signature:			
Printed Name:				Printed Name:			
Signature:				Signature:			

Matrix:

T=Tissue G=Gas
S=Soil/Sediment W=Waste
R=Rinseate HW=Hazardous Waste
P=Product W=Water

Sample Container: Vol/material

G=Glass C=Core
P=Plastic B=Bag

Appendix H. Washington MW Histology-Gonadal Index Sample Collections - Chain of Custody Form (front and back)

INSTRUCTIONS

Please fill out the following sections on the front of this form, as directed below (**sections in bold are the most important**):

- Program – "NS&T Mussel Watch Year 25"
- State – "Washington State"
- Lab Contact – Iris Burt at Rutgers Haskin Shellfish Lab
- Sampler signature – the sampler (should use the Site Lead's name here)
- **Sample ID = individually list each Site Center (acronym) & Station # (bag). Example: line 1 = PSHC, Station 1 line 2 = PSHC, Station 2**
- **Sample date – date samples were collected (not shipped)**
- **Sample time – if available from the MW datasheet**
- Sample Matrix = Tissue
- Preservative = Ice
- Container = Bag
- Analyses – leave these boxes blank
- Comments – list anything additional comments here
- **Total # of Containers – this is the total number of bags you include in the cooler (add up No. in cells from above)**
- **Relinquished by – signature of person actually shipping samples**
- Group Name – name of organization with which volunteers were associated
- **Date/Time – of when you packed up and shipped off samples via FedEx Priority Overnight shipping (using WDFW pre-filled labels)**

NOTE: If possible, make a photocopy of the front of this form (after it's all filled out) and keep it with the *original copy of MW data sheet.* Original copy of MW data sheet should be kept; only photocopied versions of MW data sheet should be shipped to the labs.

Mussel Watch *Histology-Gonadal Index* Sample Collections
CHAIN OF CUSTODY RECORD

Program: NS&T Mussel Watch Year 25

State: Washington State

Lab Contact: Iris Burt at Rutger Haskins Shellfish Laboratory

Sampler Signature:

Analyses

Other Instructions

To be determined by NS&T Mussel Watch Program (NOAA)

Sample ID	Sample Date	Sample Time	Sample Matrix	Preservative	Containers Type	Containers No.	Comments
			Tissue	Ice	Bag		
			Tissue	Ice	Bag		
			Tissue	Ice	Bag		

Total # of Containers

Relinquished By	Group Name	Date	Time	Received By	Company Name	Date	Time
Printed Name:				Printed Name:			
Signature:				Signature:			
Printed Name:				Printed Name:			
Signature:				Signature:			

Matrix:

T=Tissue G=Gas
S=Soil/Sediment W=Waste
R=Rinseate HW=Hazardous Waste
P=Product W=Water

Sample Container: Vol/material

G=Glass C=Core
P=Plastic B=Bag

Appendix I. Mussel Watch Program Sampling Supplies

Sampling Supply List for ONE SITE:

Site Access Materials

- Directions to Site Center and Contacts list
- GPS unit
- Flashlights and/or headlamps
- Propane lantern(s), propane, and matches (useful, but optional)
- Cell phone(s)

Mussel Sampling Materials

- 1 to 3 plastic containers or buckets (for washing mussels)
- 1 to 3 small coolers/ buckets with ice (to carry mussels while sampling)
- 3 scrub brushes
- 3 knives (or more, depending on number of samplers)
- Small/medium/large disposable laboratory gloves (Nitrile or latex)
- Glove liners or knit gloves (worn under laboratory gloves to keep hands warm)

Mussel Bagging Materials – note all samples are DOUBLE-BAGGED (for shipping)

- 7 – gallon-sized Ziploc bags:
  2 per each of 3 chemistry stations (i.e. double-bagged)
  1 to hold smaller histology bags during shipping (see below)
  Pre-labeling the bags works best
- 3 – quart-sized Ziploc bags:
  1 per each of 3 histology stations (all 3 fit into 1 gallon Ziplock for shipping)
  Pre-labeling the bags works best
- 6 bag labels (1 for each chemistry and histology bag)
  Place *inside* each sample bag, against side of bag for easy reading
  Use Rite-in-the-Rain paper
- 1 garbage bag

Water Quality Measurement Devices

- Refractometer + small amount of distilled water (for salinity reading)
- Thermometer (for temperature reading)

Documentation and Recording Materials

- Digital camera (helpful if waterproof)
- Clipboard
- Sharpies

- Pencils
- Data sheet - use Rite-in-the-Rain paper
- Volunteer forms (must be on file before volunteers can participate)

Miscellaneous Materials

- Extra bags, gloves, pens and pencils, and batteries just in case
- Paper towels
- Life jackets (if sampling in dangerous area)

Shipping Supplies – reminder: all samples are DOUBLE-BAGGED for shipping!

- 16 qt Cooler (to ship histology samples → Rutgers Haskin Shellfish Lab, NJ)
- 28 qt Cooler (to ship chemistry samples → B&B/TDI Brooks Lab, TX)
- 48 qt Cooler (for holding mussels overnight or weekend, if necessary)
- 4 garbage bags (1 for containing ice in top-half and bottom-half of each cooler)
- Ice (2-3 bags or more)
- Chain of Custody forms (one for each cooler) - use Rite-in-the-Rain paper
- FedEx *Priority Overnight* mailing labels (use WDFW tracking number)
- Nylon reinforced packing tape
- Directions for packing & shipping mussels

REMINDER: All internal bag labels and data sheets must be printed on Rite-in-the-Rain paper.