



Puget Sound Ecosystem Monitoring Program (PSEMP)

Mussel Watch Pilot Expansion 2012/2013: a study of toxic contaminants in blue mussels (*Mytilus trossulus*) from Puget Sound Washington, USA

**Field Sample Summary and Progress Report
February 19, 2013**

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This study would not have been possible without the enormous effort provided by sponsoring partners and citizen science volunteers groups. These partners and volunteers helped measure and bag thousands of mussels prior to deployment, deployed and retrieved mussels at 108 sites throughout the greater Puget Sound, and helped process the mussels in the laboratory after retrieval. We recognize the following organizations, their staff and volunteers for their assistance with this project: Bainbridge Beach Naturalists, City of Bellingham, Evergreen State College, Harbor Wildwatch, Highline Community College – Marine Science and Technology Center, King County, Kitsap County Public Works, Lummi Nation, Nisqually Reach Nature Center, Padilla Bay National Estuarine Research Preserve, Penn Cove Shellfish, Port Gamble S’Klallam Tribe, Port Madison Suquamish Tribe, Puget Creek Restoration Society, Puget Sound Partnership, Puget Soundkeeper Alliance, Samish Indian Nation, San Juan County Marine Resources Committee (MRC), Seattle Aquarium, Skagit County MRC, Snohomish County MRC, SSA Marine, Stillaguamish River Clean Water District, Stillaguamish Tribe, Tacoma-Pierce County Health Department, Tulalip Tribes, United States Navy – NW Space and Naval Warfare Systems Center, University of Puget Sound, University of Washington-Tacoma, Washington Conservation Corps – Puget SoundCorps, Whatcom County MRC, Washington Department of Ecology, Washington Department of Fish and Wildlife’s Oil Spill Response Team, Washington Department of Natural Resources (DNR) Aquatic Reserves Program, DNR Nearshore Habitat Program, Washington State University (WSU) Island County Beach Watchers, WSU Kitsap County Beach Watchers, WSU Skagit County Beach Watchers, and WSU Snohomish County Beach Watchers.

Table of Contents

1.0 ABSTRACT	5
2.0 INTRODUCTION	5
3.0 SITE RECONNAISSANCE AND PERMITS	5
4.0 METHODS OVERVIEW	6
4.1 Mussel Preparation Prior to Deployment	6
4.2 Mussel Cage Deployment	11
4.2.1 Baseline Mussels.....	11
4.2.2 Reference Mussels.....	17
4.2.3 Mid-Study Mussel Cage Check.....	17
4.3 Mussel Cage Retrieval	17
4.3.1 Sediment Collection.....	18
4.3.2 Native Mussel Collection	19
4.4 Laboratory Processing	19
4.4.1 Laboratory Processing of Naturally Occurring Mussels	24
4.4.2 Laboratory Processing of Reference Mussels	24
4.5 Data Records	24
5.0 PRELIMINARY RESULTS	24
5.1 Baseline and Reference Mussels	25
6.0 RECOMMENDATIONS	25
6.1 Reconnaissance and Permit Gathering	28
6.2 Sponsor Payments (Partner Contracts).....	29
6.3 Purchasing	29
6.4 Laboratory back-log during retrieval week	30
APPENDIX A.....	31
APPENDIX B.....	37

List of Tables

Table 1. Mussel cage locations, deployment, and retrieval dates.....	7
Table 2. Mussel monitoring sites with predators present inside the cage at the time of retrieval.	18
Table 3. Survival of mussels and sites where sediment was collected.....	25

List of Figures

Figure 1. Penn Cove Shellfish’s mussel harvesting platform with debyssing machine.....	10
Figure 2. Separated and cleaned mussels.	10
Figure 3. Citizen science volunteers assessing mussel health and sorting mussels.	12
Figure 4. WDFW staff measuring total shell length with digital calipers.....	12
Figure 5. Four heavy-duty mesh polyethylene grow-out bags.....	13
Figure 6. Penn Cove Shellfish manager hanging a line of mussel bags.....	13
Figure 7. A line of mussel bags hanging from the aquaculture raft.....	14
Figure 8. Multiple lines of mussel bags hanging from the aquaculture raft at Penn Cove Shellfish.	14
Figure 9. Locations of 108 mussel cages placed throughout the greater Puget Sound.	15
Figure 10. Mussel bags attached to a cage prior to deployment.	16
Figure 11. Study partner deploying a mussel cage at March Point.	16
Note vertical rebar stakes inside and outside of cage.	16
Figure 12. Mussels being removed from their bag prior to sorting.....	20
Figure 13. Mussels being separated from each other prior to sorting.....	20
Figure 14. One site of mussels (four bags) undergoing the sorting process.....	21
Figure 15. Mussels being rinsed with cold tap water.	21
Figure 16. Mussels from one site.....	22
Figure 17. Condition index mussel and aluminum weigh-tin.	22
Figure 18. Mussel soft tissue from one site processed for condition index and ready for drying.	23
Figure 19. Trays of mussel soft tissue processed for condition index in the drying oven.....	23
Figure 20. Mussel soft tissue after drying in a 120° C oven for a minimum of 18 hours.....	24

List of Appendices

APPENDIX A

Figure A.1. Bagged Mussel Length (mm)	31
Figure A.2. Deployment Chain of Custody	32
Figure A.3. Deployment Data Sheet.....	33
Figure A.4. Retrieval Chain of Custody.....	34
Figure A.5. Retrieval Data Sheet	35
Figure A.6. Condition Index Log	36

APPENDIX B

Figure B.1 WDFW Shellfish Transfer Permit (permit #12-1081).....	37
Figure B.2 WDFW Hydraulic Project Approval (permit #128221-1).....	38
Figure B.3 Washington State Parks Scientific Research Permit (permit # 120901).....	43
Figure B.4 Memorandum of Understanding with the Washington Department of Natural Resources.....	48

1.0 ABSTRACT

Washington Department of Fish and Wildlife - Puget Sound Ecosystem Monitoring Program's Toxics in Biota staff, together with 38 partner groups and many citizen science volunteers, carried out a study to evaluate the geographic extent and magnitude of nearshore contamination in Puget Sound biota during the late fall and early winter of 2012/13. This study was called the Mussel Watch Pilot Expansion project and was funded by the U.S. Environmental Protection Agency's National Estuary Program. WDFW staff held three workshops during the summer of 2012 to gauge interest and recruit partners and volunteers to help in the field portion of this study. As a result, 12 organizations signed on to sponsor 48 sites, in addition to the 60 original sites, and a number of other groups (citizen science volunteers) signed up to help manage the field work.

During the field portion of this study 9,040 Pacific blue mussels (*Mytilus trossulus*) harvested from a Penn Cove Shellfish aquaculture facility were placed in predator-exclusion cages at 108 study sites throughout the greater Puget Sound region. The mussels were left to feed for two months (November – January) and only three cages were lost during the study. At the time of mussel cage retrieval, mussel survival ranged from 63 – 97% at all sites. Subsets of mussels from each site have been assessed for fitness (Condition Index) and composites of mussel tissue from each site are being prepared for contaminant analysis.

A study of this magnitude would not have been possible without the assistance of the many volunteers and partners who signed on to help. Much was learned during the field sampling process and we make recommendations for field management of future mussel monitoring studies in Washington State.

2.0 INTRODUCTION

The Washington State Department of Fish and Wildlife (WDFW) is a member of the Puget Sound Ecosystem Monitoring Program (PSEMP), a multi-agency effort to monitor the health of Puget Sound. The WDFW-[PSEMP Toxics in Biota team](#) conducts regular contaminant surveys on selected fish and invertebrate species to assess the status and trends of the Puget Sound food web. Contamination of nearshore biota, especially from terrestrial sources including stormwater has long been a gap in toxics monitoring in Puget Sound. The current 2012/13 Mussel Watch Phase 2 study (Mussel Watch Pilot Expansion) represents the first effort to provide a single synoptic, spatially comprehensive overview of contaminants in a common nearshore organism in Puget Sound. This project is an expansion of and uses some of the standard operating procedures developed by the nationwide NOAA Mussel Watch program. The main objective of this study is to use native Pacific blue mussels (*Mytilus trossulus*) to evaluate the geographic extent and magnitude of nearshore biota contamination in the greater Puget Sound area. This report documents progress including (1) field activities (2) site locations, (3) deployment and retrieval methods, (4) timeframe, (5) laboratory processing, and (6) recommendations for future work.

3.0 SITE RECONNAISSANCE AND PERMITS

The success of a large scale mussel sampling effort depends on the participation of a large number of volunteers to cover the necessary geographic scope over a short period. Three 4-hour workshops were held during June-July 2012 to inform the public and various interest groups about plans for the 2012/13 Mussel Watch Pilot Expansion study and to solicit help from volunteers and partnerships with local entities. As a result over 30

government agencies, tribes, universities and colleges, citizen science groups (including Beachwatchers, Beach Naturalists, and Marine Resource Committees), and businesses signed on to volunteer their time and/or sponsor additional sites for this study (Table 1). Many of these groups provided valuable input during the site select phase of this study.

Partner groups helped during the site selection phase of the study by providing information about potential monitoring locations near them (i.e. local knowledge) and by sending volunteers out to scout local beaches during daytime low tides. Some of the important information gathered during these scouting activities included shoreline ownership and accessibility, habitat and substrate type, exposure conditions (i.e. high or low surf), potential contaminant sources nearby, GPS coordinates, and photos of the site. In addition, partners/volunteers obtained permission from various private property owners to access their shorelines during the deployment and retrieval portions of the study.

A number of permits (Appendix B) were gathered to allow the field portion of this study to move forward. Major permits granted included a WDFW Hydraulic Project Approval (permit #128221-1), a WDFW Shellfish Transfer Permit (permit #12-1081), a Washington State Parks Scientific Research Permit (permit #120901), and a Memorandum of Understanding with the Washington Department of Natural Resources (DNR) to access Aquatic Reserves and other state-owned aquatic lands (MOU #13-191). In addition, WDFW entered into site access agreements with the Port of Olympia, City of Tacoma and Port of Seattle. Permission to access shoreline property was also granted from Seattle Parks and Recreation, Metro Parks and Recreation Tacoma, City of Des Moines Parks and Recreation, City of Steilacoom, City of Burien, City of Bellingham, City of Allyn, City of Anacortes, Port of Coupeville, Kitsap County Parks, Mukilteo Water and Wastewater District, Washington State Ferries, Padilla Bay National Estuary, and the US Navy. Permission to access tribal shorelines was granted from the Lummi Nation, Samish Indian Nation, Stillaguamish Tribe, Port Gamble S'Klallam Tribe, and the Port Madison Suquamish Tribe.

4.0 METHODS OVERVIEW

4.1 Mussel Preparation Prior to Deployment

For this study we used the Puget Sound native Pacific blue mussel (*Mytilus trossulus*). All the *M. trossulus* were donated by [Penn Cove Shellfish](#) and came from their commercial shellfish aquaculture facility on Whidbey Island near Coupeville, Washington. From October 22 – 29, 2012, the WDFW-PSEMP team and citizen science volunteers prepared live mussels, provided from the daily harvest routine of Penn Cove Shellfish, for field deployment. Mussels growing on ropes hanging from aquaculture rafts were removed from the water and placed into a debussing machine on Penn Cove Shellfish's harvesting platform (Figures 1 and 2). The debussing machine separates the mussels from their aquaculture ropes and from one another, and shaves off their byssal threads. WDFW staff received buckets of partially processed *M. trossulus* mussels from the harvesting platform. The mussels had undergone separation from the aquaculture ropes and one another in the rolling-brush portion of the debusser machine, but

Table 1. Mussel cage locations, deployment, and retrieval dates.

Site Name	County	Site Coordinates		Deployment Date	Retrieval Date
		Latitude	Longitude		
*Protection Island Aquatic Reserve, Thompson Spit	Clallam	48.0967	-122.9394	11/13/2012	1/9/2013
*Smith and Minor Islands Aquatic Reserve, Joseph Whidbey State Park ^a	Island	48.3136	-122.7106	11/13/2012	NA
Coupeville Wharf, Toby's Tavern	Island	48.2219	-122.6863	11/14/2012	1/8/2013
Ala Spit County Park	Island	48.3928	-122.5866	11/12/2012	1/10/2013
Deception Pass State Park, Cornet Bay	Island	48.4022	-122.6212	11/12/2012	1/10/2013
Holmes Harbor, Rocky Point, Baby Island	Island	48.0959	-122.5270	11/13/2012	1/10/2013
Maxwelton, Dave Mackie County Park	Island	47.9400	-122.4470	11/12/2012	1/10/2013
Oak Harbor, Crescent Harbor	Island	48.2776	-122.6595	11/14/2012	1/8/2013
*Cavalero Beach County Park	Island	48.1753	-122.4784	11/14/2012	1/7/2013
*Triangle Cove	Island	48.1985	-122.4646	11/14/2012	1/7/2013
Penn Cove (Baseline)	Island	48.2176	-122.7086	NA	NA
Penn Cove (Reference)	Island	48.2176	-122.7086	NA	1/8/2013
*Maury Island Aquatic Reserve, Old Marine Park	King	47.3800	-122.4017	11/14/2012	1/10/2013
Richmond Highlands Beach	King	47.7295	-122.3737	11/15/2012	1/9/2013
Des Moines Marina City Beach Park	King	47.4031	-122.3292	11/14/2012	1/9/2013
Dumas Bay	King	47.3290	-122.3905	11/14/2012	1/10/2013
Seahurst County Park	King	47.4845	-122.3618	11/14/2012	1/9/2013
*Fautleroy ^b	King	47.5237	-122.3946	11/12/2012	1/9/2013
Lincoln Park	King	47.5309	-122.4015	11/12/2012	1/9/2013
*Carkeek Park	King	47.7133	-122.3806	11/11/2012	1/9/2013
Discovery Park, West Point	King	47.6623	-122.4360	11/12/2012	1/9/2013
Elliott Bay, Four-Mile Rock	King	47.6385	-122.4122	11/12/2012	1/9/2013
*Salmon Bay	King	47.6663	-122.4018	11/12/2012	1/9/2013
*Smith Cove	King	47.6312	-122.3857	11/12/2012	1/9/2013
Elliott Bay, Alki-Duwamish Head	King	47.5893	-122.3953	11/12/2012	1/9/2013
Elliott Bay, Seattle Aquarium, Pier 59	King	47.6074	-122.3425	11/12/2012	1/9/2013
Elliott Bay, Harbor Island, Pier 17	King	47.5877	-122.3507	11/12/2012	1/7/2013
Elliott Bay, Myrtle Edwards	King	47.6187	-122.3612	11/12/2012	1/7/2013
Quartermaster Harbor	King	47.4050	-122.4407	11/12/2012	1/9/2013
Vashon Ferry, N. End Boat Ramp	King	47.5091	-122.4633	11/13/2012	1/9/2013
Eagle Harbor, Bainbridge Ferry Terminal	Kitsap	47.6227	-122.5101	11/13/2012	1/10/2013
Port Madison, Hidden Cove	Kitsap	47.6941	-122.5454	11/13/2012	1/10/2013
West Bainbridge, Westwood	Kitsap	47.6269	-122.5778	11/13/2012	1/10/2013
Colvos Passage, Olalla, Prospect Point Beach	Kitsap	47.4233	-122.5365	11/14/2012	1/8/2013
Liberty Bay-Poulsbo	Kitsap	47.7192	-122.6267	11/13/2012	1/10/2013
Sinclair Inlet, Sinclair Marina	Kitsap	47.5407	-122.6420	11/13/2013	1/9/2013
Sinclair Inlet, Waterman Point	Kitsap	47.5847	-122.5705	11/13/2012	1/9/2013
*Hood Canal, Holly	Kitsap	47.5706	-122.9715	11/14/2012	1/11/2013
*Illahee Creek	Kitsap	47.6159	-122.5950	11/13/2012	1/8/2013
*Manchester, Stormwater Outfall	Kitsap	47.5562	-122.5428	11/13/2012	1/8/2013
*Silverdale, Dyes Inlet	Kitsap	47.6428	-122.6967	11/13/2012	1/8/2013
*Suquamish, Stormwater Outfall	Kitsap	47.7296	-122.5506	11/13/2012	1/8/2013
Bremerton Shipyard-Charleston Beach	Kitsap	47.5515	-122.6609	11/14/2012	1/8/2013
*Bremerton Shipyard-Ferry Terminal	Kitsap	47.5604	-122.6278	11/14/2012	1/9/2013
*Keyport, Liberty Bay	Kitsap	47.6972	-122.6174	11/14/2012	1/8/2013

Site Name	County	Site Coordinates		Deployment	Retrieval
Point No Point	Kitsap	47.9086	-122.5267	11/13/2012	1/8/2013
*Port Gamble, Point Julia	Kitsap	47.8534	-122.5743	11/13/2012	1/8/2013
*Port Gamble, West	Kitsap	47.8421	-122.5851	11/13/2012	1/8/2013
Point Bolin	Kitsap	47.6937	-122.5947	11/13/2012	1/10/2013
Point Jefferson	Kitsap	47.7797	-122.4823	11/13/2012	1/10/2013
Case Inlet-Allyn	Mason	47.3837	-122.8262	11/15/2012	1/12/2013
Totten Inlet	Mason	47.1327	-123.0216	11/14/2012	1/7/2013
Shelton, Oak Bay Marina	Mason	47.2142	-123.0864	11/12/2012	1/7/2013
*Nisqually Reach Aquatic Reserve, Anderson Island	Pierce	47.1494	-122.6764	11/14/2012	1/7/2013
Gig Harbor, Narrows Passage	Pierce	47.3255	-122.5762	11/14/2012	1/8/2013
Kopachuck State Park	Pierce	47.3103	-122.6880	11/14/2012	1/8/2013
Commencement Bay-Skookum Wulge	Pierce	47.2898	-122.4099	11/13/2012	1/9/2013
Thea Foss Waterway	Pierce	47.2593	-122.4348	11/13/2012	1/9/2013
Tacoma Ruston Way Puget Creek	Pierce	47.2811	-122.4771	11/13/2012	1/9/2013
Fox, Tanglewood Island	Pierce	47.2646	-122.6444	11/12/2012	1/9/2013
Point Defiance Park	Pierce	47.3132	-122.5280	11/12/2012	1/9/2013
Steilacoom, Sunnyside Beach Park	Pierce	47.1807	-122.5903	11/12/2012	1/8/2013
*Hylebos Waterway 1	Pierce	47.2704	-122.3772	11/14/2012	1/9/2013
*Hylebos Waterway 2	Pierce	47.2699	-122.3764	11/14/2012	1/9/2013
*Hylebos Waterway 3	Pierce	47.2692	-122.3751	11/14/2012	1/9/2013
*Hylebos Waterway 4	Pierce	47.2685	-122.3740	11/14/2012	1/9/2013
*Hylebos Waterway 5	Pierce	47.2680	-122.3732	11/14/2012	1/9/2013
*Hylebos Waterway 6	Pierce	47.2675	-122.3723	11/14/2012	1/9/2013
*Hylebos Waterway 7	Pierce	47.2668	-122.3712	11/14/2012	1/9/2013
*Hylebos Waterway 8	Pierce	47.2661	-122.3701	11/14/2012	1/9/2013
*Hylebos Waterway 9	Pierce	47.2653	-122.3689	11/14/2012	1/9/2013
*Tacoma Ruston Waterfront 1	Pierce	47.2809	-122.4766	11/13/2012	1/9/2013
*Tacoma Ruston Waterfront 2	Pierce	47.2806	-122.4759	11/14/2012	1/9/2013
*Tacoma Ruston Waterfront 3	Pierce	47.2795	-122.4743	11/13/2012	1/9/2013
*Tacoma Ruston Waterfront 4	Pierce	47.2791	-122.4737	11/13/2012	1/9/2013
*Tacoma Ruston Waterfront 5	Pierce	47.2785	-122.4727	11/13/2012	1/9/2013
*Tacoma Ruston Waterfront 6	Pierce	47.2783	-122.4721	11/13/2012	1/9/2013
*Tacoma Ruston Waterfront 7	Pierce	47.2779	-122.4712	11/13/2012	1/9/2013
*Tacoma Ruston Waterfront 8	Pierce	47.2775	-122.4687	11/13/2012	1/9/2013
*Tacoma Ruston Waterfront 9	Pierce	47.2770	-122.4684	11/13/2012	1/9/2013
*Fisherman's Bay, Weeks Wetland, Lopez Island	San Juan	48.5188	-122.9169	11/13/2012	1/9/2013
*Friday Harbor Labs, San Juan Island	San Juan	48.5453	-123.0132	11/13/2012	1/9/2013
*North Shore, Orcas Island	San Juan	48.7110	-122.9292	11/13/2012	1/9/2013
*Cypress Island Aquatic Reserve, Secret Harbor	Skagit	48.5539	-122.6881	11/13/2012	1/15/2013
*Cypress Island Aquatic Reserve, Strawberry Bay	Skagit	48.5637	-122.7222	11/13/2012	1/14/2013
March Point	Skagit	48.4996	-122.5675	11/13/2012	1/8/2013
Larrabee State Park	Skagit	48.6422	-122.4857	11/13/2012	1/9/2013
Padilla Bay	Skagit	48.4924	-122.4866	11/13/2012	1/9/2013
Anacortes, Guemes Ferry	Skagit	48.5186	-122.6243	11/14/2012	1/8/2013
*Fidalgo Bay Aquatic Reserve, Weaverling Spit	Skagit	48.4824	-122.5839	11/14/2012	1/8/2013
Skagit River Delta	Skagit	48.3339	-122.4368	11/12/2012	1/9/2013
Everett Harbor	Snohomish	47.9721	-122.2316	11/14/2012	1/7/2013
Kayak Point	Snohomish	48.1337	-122.3657	11/14/2012	1/7/2013
Puget Sound, Edmonds Ferry	Snohomish	47.8142	-122.3822	11/14/2012	1/7/2013

Site Name	County	Site Coordinates		Deployment	Retrieval
Mukilteo WWTP, Big Gulch	Snohomish	47.9107	-122.3222	11/12/2012	1/8/2013
*Port Susan, Warm Beach	Snohomish	48.1705	-122.3669	11/14/2012	1/7/2013
Hermosa Point	Snohomish	48.0618	-122.2929	11/14/2012	1/7/2013
Tolmie State Park	Thurston	47.1220	-122.7729	11/12/2012	1/8/2013
Johnson Point	Thurston	47.1783	-122.8155	11/13/2012	1/11/2013
Olympia, Budd Inlet, North Point	Thurston	47.0605	-122.9055	11/13/2012	1/11/2013
*Bellingham Bay, Little Squalicum Creek	Whatcom	48.7639	-122.5175	11/13/2012	1/8/2013
Bellingham Bay, Post Point	Whatcom	48.7194	-122.5167	11/13/2012	1/8/2013
Bellingham Bay, Squalicum Harbor	Whatcom	48.7533	-122.4993	11/13/2012	1/8/2013
*Cherry Point Aquatic Reserve, 1 Alcoa-BP	Whatcom	48.8584	-122.7407	11/14/2012	1/9/2013
*Cherry Point Aquatic Reserve, 2 Alcoa-BP ^c	Whatcom	48.8568	-122.7358	11/14/2012	NA
*Cherry Point Aquatic Reserve, 3 Alcoa-BP	Whatcom	48.8546	-122.7273	11/14/2012	1/9/2013
*Cherry Point Aquatic Reserve, 4, Conoco Phillips	Whatcom	48.8208	-122.7101	11/14/2012	1/9/2013
West Bellingham Bay, Lummi Nation	Whatcom	48.7510	-122.6193	11/13/2012	1/8/2013
Birch Point	Whatcom	48.9390	-122.8200	11/13/2012	1/8/2013
*Cherry Point Aquatic Reserve, Birch Bay	Whatcom	48.8962	-122.7854	11/13/2012	1/8/2013

* Mussel monitoring sites sponsored by partner groups.

^a No mussels recovered – the cage with the screw anchor attached was found at the high tide line of Joseph Whidbey State Park, Rocky Point parking lot

^b No mussels recovered – upon arrival for retrieval, the cage was found completely buried in sand from a storm surge in the previous weeks

^c No mussels recovered – the cage was found high in the intertidal zone during the mid-study mussel cage check

Figure 1. Penn Cove Shellfish's mussel harvesting platform with debyssing machine.



Figure 2. Separated and cleaned mussels.



had not yet run across the debussing conveyer belt. As a result, the mussels were separated and washed, but still had their byssal threads attached.

At a sorting station on shore, WDFW staff and volunteers inspected each live mussel for shell damage, sorted out mussels of the desired size, and measured each mussel (Figures 3 and 4). Only living mussels (i.e., able to close their shells upon stimulation) with intact shells that measured between 50 – 60 mm in length were used in this study. A total of 9,040 mussels were placed into 565 tubular polyethylene mesh grow-out bags. Two groups of eight mussels (16 total) were placed into each bag, which was subsequently labeled with a unique bag ID number (Figure 5). The shell lengths of all mussels placed into each bag and the corresponding bag ID number were recorded on a Bagged Mussel Lengths datasheet (Appendix A.1). The bags of mussels were attached approximately 20 cm apart to grow-out lines that were hung from an aquaculture raft in Penn Cove for 10 days. The 10 day period was intended to allow the bagged mussels time to reattach their byssal threads and recover from the stress of handling (Figures 6 – 8) prior to deployment.

4.2 Mussel Cage Deployment

Mussel bags were deployed in cubic, wire mesh predator-exclusion cages (40.6 cm [16"] per side), during a period of night-time negative tides from November 12 – 15, 2012. Mussel bags were removed from Penn Cove Shellfish aquaculture rafts and delivered to citizen science volunteers and WDFW-PSEMP employees (deployers) in the later afternoon of each day for deployment that same evening. All mussels were transported in sealed Ziploc bags nested on top of bagged ice in coolers. Chain of Custody forms (Appendix A.2) were filled out by all deployers. Mussels were deployed to 108 sites throughout the greater Puget Sound (Figure 9; Table 1) during these four nights of low tides.

At each site four mussel bags were suspended horizontally inside the top one-third of the wire-mesh cage, using zip ties to affix the ends of the bags to the sides of the cage (Figure 5). The cages were then anchored into the substrate using a combination of helical (screw) anchors, rebar stakes and/or concrete cinder blocks (Figure 10 and 11), depending on substrate type. GPS coordinates, tide height, anchoring method, and a number of other observations were recorded on a Deployment Data Sheet (Appendix A.3).

4.2.1 Baseline Mussels

Twenty bags (containing 320 total mussels) were removed from the Penn Cove Shellfish aquaculture raft on November 15, 2012 and saved to allow for determination of the condition index (CI) and tissue contaminant residue of mussels prior to deployment (i.e. initial contaminant condition). The day after removal from Penn Cove, 100 of these mussels were taken from their bags, inspected, rinsed with tap and deionized water, and processed immediately to determine their CI at WDFW's Marine Resources Laboratory in Olympia. To determine CI, individual mussels were assigned a unique Fish Identification (FishID) number and their total shell length (TSL) was measured using digital calipers. Mussels were then opened using a scalpel blade inserted between the two valves to reveal the soft tissue. Any remaining byssal fibers were cut from the byssal gland and discarded. All soft tissue was scraped from the shells into a pre-weighed aluminum drying pan and weighed to the nearest tenth of a gram (0.1 g)

Figure 3. Citizen science volunteers assessing mussel health and sorting mussels.



Figure 4. WDFW staff measuring total shell length with digital calipers.

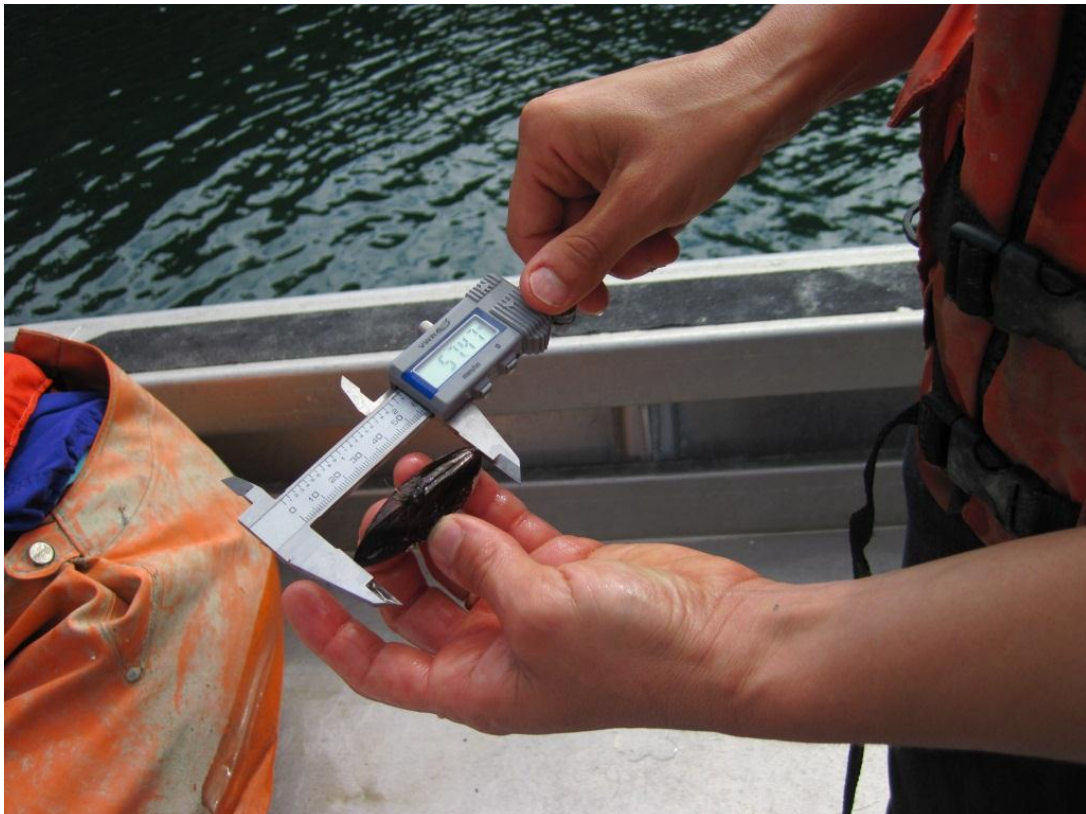


Figure 5. Four heavy-duty mesh polyethylene grow-out bags (each with 16 mussels) with Bag ID numbers attached.



Figure 6. Penn Cove Shellfish manager hanging a line of mussel bags from an aquaculture raft in Penn Cove, Whidbey Island.



Figure 7. A line of mussel bags hanging from the aquaculture raft.



Figure 8. Multiple lines of mussel bags hanging from the aquaculture raft at Penn Cove Shellfish.



Figure 9. Locations of 108 mussel cages placed throughout the greater Puget Sound.

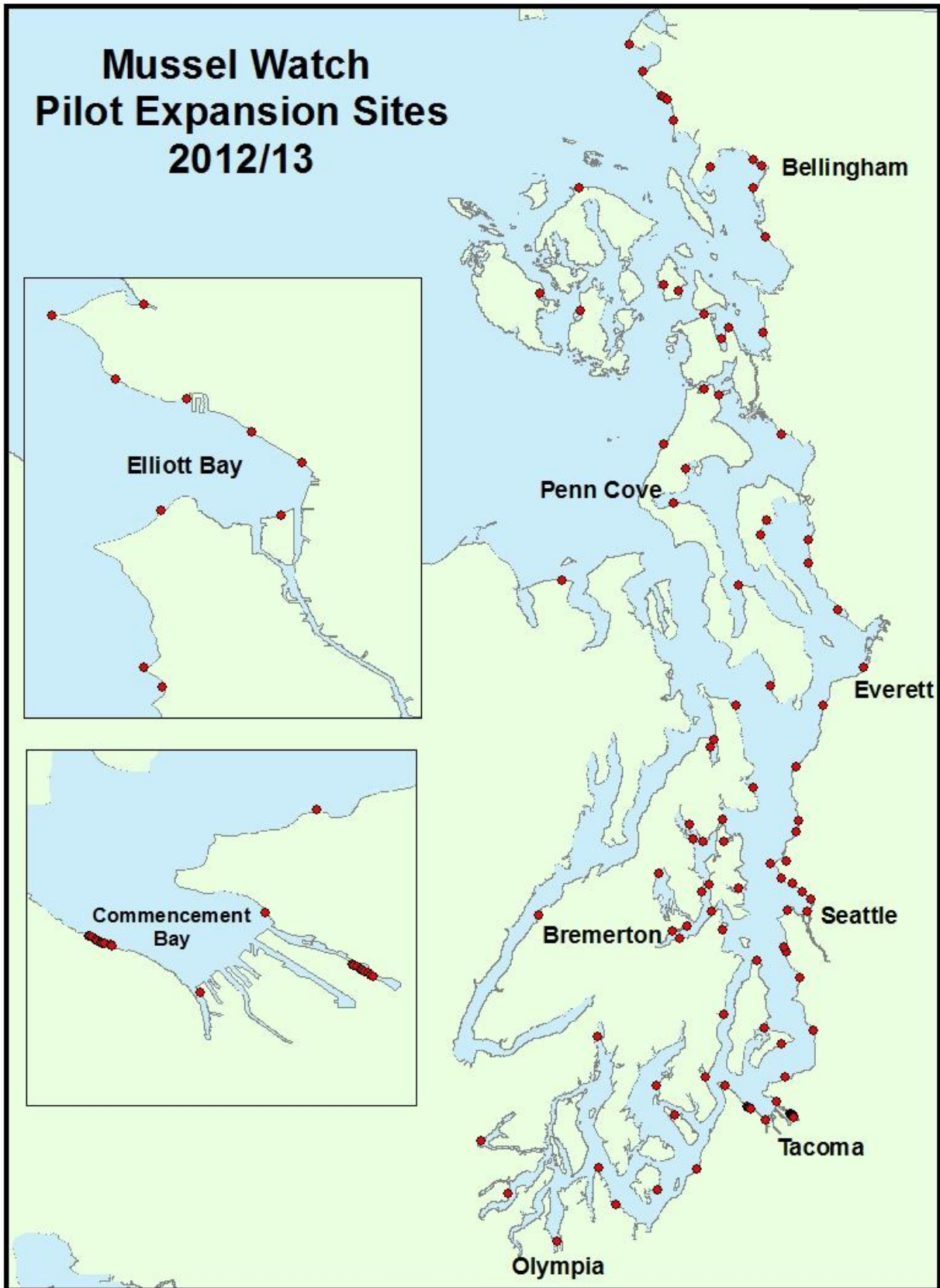


Figure 10. Mussel bags attached to a cage prior to deployment.



Figure 11. Study partner deploying a mussel cage at March Point.
Note vertical rebar stakes inside (left) and outside (right) of cage.



using a bench scale. The soft tissue was then placed directly into a 120° C oven for a minimum of 18 hours to attain a constant dry weight. Once drying was complete, the tissue was allowed to cool and then weighed to the nearest tenth of a gram using a bench scale. The remaining 220 mussels (enough for 6 composites of tissue) were placed into the Marine Resource Laboratory's walk-in freezer and held at -20° C. Those mussels will be processed for contaminant analysis with the rest of the mussels at the end of the field phase of this study

4.2.2 Reference Mussels

Thirty-one bags of mussels were left hanging on lines at the Penn Cove Shellfish aquaculture facility after deployment of all other mussel bags to their designated sites. These mussels were retained as potential replacements if deployed mussels were lost, and as a control for growth effects from the caging and translocation process.

4.2.3 Mid-Study Mussel Cage Check

During the two low tide cycles following deployment, approximately one month later, deployment teams checked on their mussel cages and reported back to WDFW whether cages were damaged, lost, or experienced predation. It was during this checking period that the Cherry Point Aquatic Reserve #2, Alcoa-BP cage was found washed up in the high intertidal area. The mussels from this cage were all dead when the cage was discovered. It was also during this time that sunflower sea stars (*Pycnopodia helianthoides*) were found in three of the cages: Eagle Harbor – Bainbridge ferry terminal, Steilacoom – Sunnyside Beach Park, and North Shore – Orcas Island. Small *P. helianthoides* (approx. 15 cm diameter) were apparently able to squeeze through the mesh of the cages, but seemed to avoid crawling up the cage side walls. Of the three cages where in *P. helianthoides* were observed, mussel survival was 63, 80, and 77% respectively, at the end of the study (cage retrieval). Volunteers were asked to remove any sea stars or other organisms found in the mussel cages. Predation was also noted at time of mussel cage retrieval and will be described in more detail in section 4.3.

4.3 Mussel Cage Retrieval

Approximately two months after deployment, during night-time low tides from January 7 – 12, 2013, mussel cages from 107 of the sites were retrieved by citizen science volunteers and WDFW-PSEMP employees (Table 1). During this time two more mussel monitoring sites were lost; one mussel cage was reported as missing (Smith and Minor Islands Aquatic Reserve, Joseph Whidbey State Park) and one cage was retrieved with dead mussels (Fauntleroy). The mussel cage located at Smith and Minor Islands Aquatic Reserve, Joseph Whidbey State Park site was not found during the retrieval period. However it was discovered with its screw anchor still attached by members of the public during the weekend of January 19 – 20th, 2013. It was washed ashore at the high tide line at the Rocky Point parking lot in Joseph Whidbey State Park, south of its original deployment location. The cage at the Fauntleroy site was found during the retrieval period completely buried in sand, likely as a result of a large storm surge that moved sand along the shoreline in previous weeks. The mussels from the Smith and Minor Islands Aquatic Reserve and Fauntleroy cages were all dead.

All mussel cage retrievers filled out Retrieval Chain of Custody forms (Appendix A.4) and Retrieval Data Sheet forms (Appendix A.5). For the majority of sites, all equipment and mussels were transported to the DFW Marine Resources Laboratory in Olympia the morning after retrieval. The only exception was the Protection Island Aquatic Reserve, Thompson Spit site which was returned to the lab two days after retrieval. All mussels were held in bags nested on ice until they were delivered to the WDFW-PSEMP team.

At time of mussel cage retrieval, citizen science volunteers and WDFW PSEMP staff noted the presence of sea stars, including sunflower sea stars (*P. helianthoides*) and crabs, including Northern kelp crabs (*Pugettia producta*), inside the mussel cages at 11 sites (Table 2). In addition, the volunteers that collected the Eagle Harbor – Bainbridge Ferry Terminal cage made note that although no predators were found in the cage at time of retrieval some mussels appeared to have been eaten (i.e., empty shells found in cage). As mentioned previously, this was a site that had contained *P. helianthoides* inside the cage at the time of the mid-study mussel cage check in December 2012.

Table 2. Mussel monitoring sites with predators present inside the cage at the time of retrieval.

Site	Predator	Survival (%)
Des Moines Marina City Beach Park	<i>Pycnopodia helianthoides</i>	87
Manchester, Stormwater Outfall	<i>Pugettia producta</i>	94
Suquamish, Stormwater Outfall	2 sea star, 1 crab	73
Nisqually Reach Aquatic Reserve, Anderson Island	crabs	88
Gig Harbor, Narrows Passage	<i>P. helianthoides</i>	87
Tacoma Ruston Waterfront 1	2 sea star	73
Tacoma Ruston Waterfront 5	1 <i>P. producta</i>	89
Tacoma Ruston Waterfront 8	1 <i>P. producta</i> , 1 <i>P. helianthoides</i>	84
Cypress Island Aquatic Reserve, Strawberry Bay	1 sea star	92
Johnson Point	3 – 4 <i>P. helianthoides</i>	84
Cherry Point Aquatic Reserve, 3 Alcoa-BP	sea star and crabs	94

After checking that all supplies and mussels were returned to the lab, the mussels were held in the cold room (5° C) in the Marine Resources Laboratory for immediate processing.

4.3.1 Sediment Collection

Surface sediment samples were collected from select sites to accommodate an ancillary study conducted and funded by one of the study partners, Dr. James Gawel from the University of Washington - Tacoma. Using Dr. Gawel's protocol, at the time of mussel cage retrieval volunteers collected a sediment sample from the top 2 cm of substrate at or near the mussel cage location. Sediment samples were collected from the majority of sites (Table 3) with the exceptions of; Richmond Highlands Beach, Elliot Bay – Seattle Aquarium, Elliot Bay – Harbor Island/Pier 17, Hood Canal – Holly, Everett Harbor, Kayak Point, Cherry Point Aquatic Reserve 1, West Bellingham Bay – Lummi Nation, and Hylebos Waterway sites 3 through 9. The sediment samples were held in the - 20° C freezer as they arrived but were later transferred to the 5° C cold room. These samples were stored

in the cold room until they were delivered to Dr. Gawel at the University of Washington, Tacoma on January 31, 2013 for analysis.

4.3.2 Native Mussel Collection

Several partner groups expressed interest in sponsoring a comparison of contaminant concentrations between the caged mussels at a site and mussels that naturally occurred nearby. A protocol for collecting native mussels near caged mussels was developed for those sponsoring organizations. Sponsors collected native mussels, along with their caged mussels, during the retrieval period at the following six sites; Cavalero Beach County Park, Hylebos Waterway (mussels were collected along a transect between site 1 and site 2), Everett Harbor, Kayak Point, Puget Sound – Edmond’s Ferry, and Hermosa Point.

4.4 Laboratory Processing

Mussels from all sites (caged and naturally occurring) were assessed for mortality, sorted, and rinsed within 24 hours of arriving at the Marine Resources Laboratory in Olympia. Mussels from each site were removed from their individual bags (Figure 12), retaining their bag numbers, and placed in a solvent-cleaned stainless steel colander where they were counted and examined for empty, rotten, gaping or cracked shells (Figures 13 and 14). Mussels with any of these four characteristics were discarded. The exception to this rule occurred in cases where high mortality was evident at a site. In this case living mussels with cracked shells were sometimes retained for use in CI assessment. Using the cracked but live mussels in these cases allowed us to save enough uncompromised mussels for contaminant analysis. All living mussels were rinsed first with tap water and then with deionized water (Figure 15). Three mussels were then randomly chosen from each of the four bags (12 total) to be used for CI. The remaining mussels were placed in Ziploc bags labeled with the site name and bag number and frozen in the -20° C freezer for future resection and contaminant analysis (Figure 16).

For determination of CI, an individual mussel was assigned a unique FishID number and its total shell length was measured using digital calipers. The mussel was then opened using a scalpel blade inserted between the two valves to reveal the soft tissue (Figure 17). The remaining byssal fibers were then cut from the byssal gland and discarded. All soft tissue was scraped from the shells into a pre-weighed aluminum drying pan and weighed to the nearest tenth of a gram (0.1 g) using a bench scale.

After laboratory processing of the first mussel monitoring site, lab staff noted that the gonads of some mussels were enlarged, indicating potential gametogenesis. Presence (+G) or absence of gametes (-G), and questionable gametes (G?) were noted in the comment section of the Condition Index Log form (Appendix A.6) for all mussels thereafter.

After mussels from an entire site were processed for CI, a photograph of all the shucked mussels and the data sheet was taken using a digital camera (Figure 18). Trays containing mussel soft tissue in pans were then placed directly into a 120° C oven, or were stored in the cold room until space was available in the oven (Figure 19). Any mussel tissues placed in the cold room remained there for less than 48 hours prior to drying and all were dried in the oven for a minimum of 18 hours. Alternatively, some samples began the drying process in a 60° C oven and were then moved to the 120 °C oven when space allowed. Once drying was complete, the mussel tissues were removed from the ovens, allowed to cool, and then weighed to the nearest tenth of a gram using a bench scale (Figure 20). All measurements were recorded on the ‘Condition Index Log’ form (Appendix A.6).

Figure 12. Mussels being removed from their bag prior to sorting.



Figure 13. Mussels being separated from each other prior to sorting.



Figure 14. One site of mussels (four bags) undergoing the sorting process.



Figure 15. Mussels being rinsed with cold tap water.



Figure 16. Mussels from one site that have been sorted, rinsed, and bagged for condition index (bags with orange tags on right) and future resection for contaminant analysis (on left).



Figure 17. Condition index mussel and aluminum weigh-ten (FishID visible).



Figure 18. Mussel soft tissue from one site processed for condition index and ready for drying.

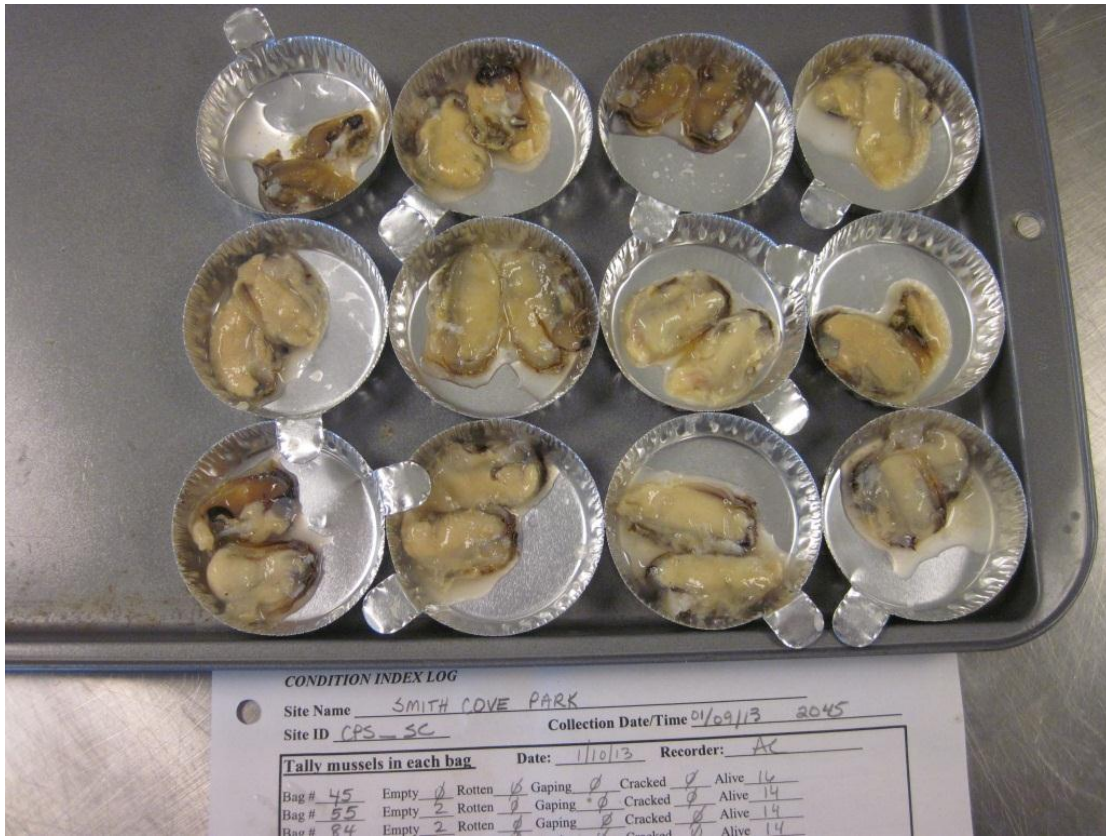


Figure 19. Trays of mussel soft tissue processed for condition index in the drying oven.



Figure 20. Mussel soft tissue after drying in a 120° C oven for a minimum of 18 hours.



4.4.1 Laboratory Processing of Naturally Occurring Mussels

Naturally occurring mussel samples were rinsed with tap and deionized water following the standard protocol described above. These mussels were then measured and sorted according to length (size range was approximately 20 – 60 mm) and 44 of the longest mussels were then selected for processing. Of these 44 naturally occurring mussels, 12 were processed for CI and 32 were stored in the -20° C freezer for future resection and contaminant analysis.

4.4.2 Laboratory Processing of Reference Mussels

Mussels that were not deployed in November but left hanging at the Penn Cove aquaculture rafts were also retrieved during the week of cage retrieval and processed as a control sample. Twenty-one bags of these reference mussels underwent sorting and rinsing following the protocols outlined above. Five mussels from each bag (100 mussels total) were set aside for determination of CI. The remaining mussels were frozen for future resection and contaminant analysis.

4.5 Data Records

Project staff and citizen science volunteers used the following forms to record field and laboratory data: Bagged Mussel Lengths (mm), Deployment Chain of Custody, Deployment Data Sheet, Retrieval Chain of Custody, Retrieval Data Sheet, and Condition Index Log. Examples of each form are located in the Appendix section. Original data sheets were retained in a three-ring binder and electronic copies (PDFs) of each data sheet were produced.

5.0 PRELIMINARY RESULTS

After about two months of exposure to the nearshore marine waters of greater Puget Sound, mussels from 105 of the 108 original sites (97%) were successfully retrieved and returned for processing and contaminant analysis. As mentioned, mussels from two sites (Smith and Minor Island Aquatic Reserve and Cherry Point Aquatic Site

#2) were displaced and mussels from one site (Fautleroy) were buried. In addition, sponsorship of two sites (Bremerton Shipyard – Charleston Beach and Liberty Bay – Keyport) fell through. Therefore mussels from those sites will not be analyzed for contaminants in this study, but will instead be archived for potential future use.

Based on the number of mussels alive at each site at the end of the experiment, not counting the three lost sites, mussel survival ranged from 63 – 97% (Table 3). Dead mussels were sorted into four

categories; 1) empty, 2) rotten, 3) gaping and 4) cracked. Descriptions of the four categories are as follows: 1) empty - mussels or shell fragments contained no living tissue, 2) rotten – mussels with putrid or rotting tissue, 3) gaping – open mussels were considered dead if they did not respond to stimulation, and 4) cracked - mussels had cracks or holes in their shell. Of the total 7,023 mussels that were returned and counted, 798 (11%) were empty, 22 (0.3%) were rotten, 27 (0.4%) were gaping, 34 (0.5%) had cracked shells, and 6,142 (87%) were alive and intact. Predation was noted in mussels from 12 sites during the sorting process. Predation was identified by the presence of drill holes in the shells, possibly from Japanese oyster drills (*Ceratostoma inornatum*).

If no empty shell valves or fragments were found in a bag and the total number of mussels in that bag was less than 16, then we speculated that either the original number of mussels in the bag was miscounted or mussels were removed from the bag by a predator. Thus in bags with fewer than 16 mussels we used the total number of mussels available in each bag, minus any dead mussels, to calculate survival for that bag.

At this date, all mussel soft tissue to be used for CI has been dried and weighed and all the remaining mussels are in the freezer awaiting tissue resection for future contaminant analysis. Digitization and quality control (QC) checking of total shell length and soft tissue wet and dry weight data is currently underway but not yet completed. Tissue resection for contaminant analysis is currently underway.

5.1 Baseline and Reference Mussels

The bags of mussels taken from Penn Cove Shellfish during the deployment period (baseline) had a total of 18 dead and 318 living mussels (95% survival rate). The reference mussels taken from Penn Cove Shellfish during the retrieval period had a total of 22 dead (i.e. empty) and 310 living mussels (93% survival rate).

6.0 RECOMMENDATIONS

There were a number of factors that contributed to the overall success of the field and laboratory phases of this study. Partner group sponsorship of sites contributed greatly to the scope of the study’s geographic coverage and a large volunteer component allowed for simultaneous deployment and retrieval at all the monitoring sites. Below we share some lessons learned throughout the course of this study and make recommendations for future projects of this type.

Table 3. Survival of mussels and sites where sediment was collected as part of an ancillary study conducted by the University of Washington – Tacoma.

Site	% Survival	Sediment
Protection Island Aquatic Reserve, Thompson Spit	97	X
Smith and Minor Islands Aquatic Reserve, Joseph Whidbey State Park ^a	NA	
Coupeville Wharf, Toby's Tavern	86	X

Site	% Survival	Sediment
Ala Spit County Park	84	X
Deception Pass State Park, Cornet Bay	92	X
Holmes Harbor, Rocky Point, Baby Island	94	X
Maxwelton, Dave Mackie County Park	89	X
Oak Harbor, Crescent Harbor	94	X
Cavalero Beach County Park	92	X
Triangle Cove	83	X
Penn Cove Baseline	95	
Penn Cove Reference	93	
Maury Island Aquatic Reserve, Old Marine Park	92	X
Richmond Highlands Beach	89	
Des Moines Marina City Beach Park	87	X
Dumas Bay	88	X
Seahurst County Park	94	X
Fauntleroy ^b	NA	X
Lincoln Park	90	X
Carkeek Park	80	X
Discovery Park, West Point	84	X
Elliott Bay, Four-Mile Rock	84	X
Salmon Bay	92	X
Smith Cove	91	X
Elliott Bay, Alki-Duwamish Head	84	X
Elliott Bay, Seattle Aquarium, Pier 59	81	
Elliott Bay, Harbor Island, Pier 17	74 ^c	
Elliott Bay, Myrtle Edwards	91	X
Quartermaster Harbor	84	X
Vashon Ferry, North End Boat Ramp	83	X
Eagle Harbor, Bainbridge Ferry Terminal	63 ^c	X
Port Madison, Hidden Cove	89	X
West Bainbridge, Westwood	95	X
Colvos Passage, Olalla, Prospect Point Beach	88	X
Liberty Bay-Poulsbo	81	X
Sinclair Inlet, Sinclair Marina	80	X
Sinclair Inlet, Waterman Point	83	X
Hood Canal, Holly	95	
Illahee Creek	86	X
Manchester, Stormwater Outfall	94 ^c	X
Silverdale, Dyes Inlet	91	X

Site	% Survival	Sediment
Suquamish, Stormwater Outfall	73	X
Bremerton Shipyard-Charleston Beach	91	X
Bremerton Shipyard-Ferry Terminal	89	X
Keyport, Liberty Bay	86	X
Point No Point	94	X
Port Gamble, Point Julia	91	X
Port Gamble, West	91	X
Point Bolin	95	X
Point Jefferson	89	X
Case Inlet-Allyn	89	X
Totten Inlet	94	X
Shelton, Oak Bay Marina	94	X
Nisqually Reach Aquatic Reserve, Anderson Island	88	X
Gig Harbor, Narrows Passage	87	X
Kopachuck State Park	95	X
Commencement Bay-Skookum Wulge	72 ^c	X
Thea Foss Waterway	89	X
Tacoma Ruston Way Puget Creek	78	X
Fox, Tanglewood Island	84	X
Point Defiance Park	81	X
Steilacoom, Sunnyside Beach Park	80	X
Hylebos Waterway 1	84 ^c	X
Hylebos Waterway 2	88	X
Hylebos Waterway 3	84	X
Hylebos Waterway 4	88	X
Hylebos Waterway 5	80	X
Hylebos Waterway 6	81	X
Hylebos Waterway 7	86	X
Hylebos Waterway 8	91	X
Hylebos Waterway 9	77	X
Tacoma Ruston Waterfront 1	73	X
Tacoma Ruston Waterfront 2	81	X
Tacoma Ruston Waterfront 3	75	X
Tacoma Ruston Waterfront 4	92	X
Tacoma Ruston Waterfront 5	89	X
Tacoma Ruston Waterfront 6	81	X
Tacoma Ruston Waterfront 7	90	X
Tacoma Ruston Waterfront 8	84	X

Site	% Survival	Sediment
Tacoma Ruston Waterfront 9	88	X
Fisherman's Bay, Weeks Wetland, Lopez Island	94	X
Friday Harbor Labs, San Juan Island	84	X
North Shore, Orcas Island	77 ^c	X
Cypress Island Aquatic Reserve, Secret Harbor	88 ^c	X
Cypress Island Aquatic Reserve, Strawberry Bay	92 ^c	X
March Point	91	X
Larrabee State Park	88	X
Padilla Bay	95	X
Anacortes, Guemes Ferry	86	X
Fidalgo Bay Aquatic Reserve, Weaverling Spit	94	X
Skagit River Delta	92	X
Everett Harbor	89	
Kayak Point	86	X
Puget Sound, Edmonds Ferry	86 ^c	X
Mukilteo WWTP, Big Gulch	92	X
Port Susan, Warm Beach	92	X
Hermosa Point	92	X
Tolmie State Park	67 ^c	X
Johnson Point	84	X
Olympia, Budd Inlet, North Point	92	X
Bellingham Bay, Little Squalicum Creek	88	X
Bellingham Bay, Post Point	84	X
Bellingham Bay, Squalicum Harbor	89	X
Cherry Point Aquatic Reserve, 1 Alcoa-BP	95	
Cherry Point Aquatic Reserve, 2 Alcoa-BP ^a	NA	
Cherry Point Aquatic Reserve, 3 Alcoa-BP	94	X
Cherry Point Aquatic Reserve 4, Conoco Phillips	81	X
West Bellingham Bay, Lummi Nation	92	
Birch Point	89 ^c	X
Cherry Point Aquatic Reserve, Birch Bay South	91	X

^a No mussels were recovered from this site due to lost cage

^b No mussels were recovered from this site because the cage was buried in sediment

^c Predation suspected based on observations made during the sorting process

6.1 Reconnaissance and Permit Gathering

The time needed to identify and bring in volunteer groups and partners, select sample locations, perform site reconnaissance, acquire permits, and get permission to access private and government-owned shorelines was considerable. For future winter-time mussel monitoring, we recommend starting the site selection process early

in the spring months prior to monitoring. This will allow time for partners and volunteers to visit potential sites during *daytime* low tides and report back. In addition, attaining necessary permits (HPA) and permission to access private and government-owned shorelines, especially those that require site access agreement contracts, is a time consuming and lengthy process; it is best to start that process as early as possible to ensure legal access to all sites at the time of deployment.

6.2 Sponsor Payments (Partner Contracts)

The number of outside groups sponsoring additional mussel monitoring sites greatly expanded the geographic coverage and scope of this study. The original EPA-National Estuary Program grant awarded for this study provided enough funding to place mussel monitoring cages at 60 sites. Sponsorship by outside groups added 48 more sites to the study design. Although the addition of these 48 sites was very valuable to the study, the extra work involved in setting up and managing separate WDFW contracts for each sponsoring group has been considerable. For this study WDFW will be entering into 13 separate contracts to handle payment of sponsored sites. In the future we recommend creating a simplified payment system (i.e. an umbrella contract) under which interested partners can contribute funds to pay WDFW for the supplies, staff time and analysis costs involved in sponsoring a site(s).

6.3 Purchasing

Site selection and addition of sponsored sites occurred from July through October, 2012. During this period a number of partners and volunteer organizations signed up, or asked for additional meetings with us to consider signing up, to participate in our project. Ultimately most of these groups ended up sponsoring and/or adopting management of one or more mussel monitoring site(s). However, sponsoring groups continued to come forward and the final number of sites was not static until November 1, 2012. For planning and purchasing purposes WDFW staff communicated on a weekly basis the current number of sites added to the study and projecting above that number by 15% when it came time to purchase the bulk of the cages, which required several weeks of lead time to produce. At the end of October staff estimated that equipment for approximately 120 – 126 sites would be needed to cover any additional sites that may be sponsored at the last minute, and to cover the loss of any cages at the mid-study check. The final number of sites was not determined until the day of mussel bagging (October 22nd), only 10 days prior to deployment. If this study is repeated, the final number of study sites should be determined well in advance of the beginning of field work to allow ample time for equipment and supply purchasing, and equipment assembly and packaging.

The anti-predator cages were the most expensive and time consuming equipment to manufacture (2 weeks) for this study. We had the manufacturer make two prototypes (16" and 18" cubes) and deployed and retrieved mussels in both cages to determine the best model for this study. A total of 120 of the 18" cube cages were purchased, but the ordering happened in two increments; first 90 cages were ordered based on early estimates in August, then another 30 cages were ordered a month later to meet the expanding site list and ensure we had enough to replace cages at about 15% of the sites, if necessary.

After reconnaissance at most of the monitoring sites it was determined that several anchoring systems were needed to secure the mussel cages to the various kinds of beach substrate encountered. For most sites a 30-inch screw anchor and two 4-foot, bent-tipped rebar stakes (standard anchor system) secured to the cage with heavy duty (75 lb. tensile strength) 11-inch cable ties were considered adequate to secure a single cage.

However, if the site was made up of soft mud or very rocky substrate, where a screw anchor would not hold or could not be installed, or was exposed to unusually high surf, we purchased alternate equipment including extra-long cable ties and/or cinder blocks to secure the cage.

During the week of deployment, screw anchors were inadvertently provided to nearly all sites, even to those sites designated to receive alternate anchoring gear. This resulted in a shortage of screw anchors that was remedied by our partners at the DNR who loaned us several of their own. In the future, we recommend careful tracking and documentation of anchor needs at each site during the reconnaissance phase of the study, and development of a site-specific list of anchor gear to be consulted during equipment hand-out on the evenings of cage deployment. Considering the relatively low number of cages lost during the study, it appears that deploying both screw anchors and rebar stakes in addition to the alternate anchors, especially at high energy sites, may have added to our recovery success. Thus, we also recommend deploying multiple types of anchors at high energy sites.

A last-minute addition to our cage set-up that greatly increased the visibility of cages during retrieval was Velcro leg reflectors (the kind worn by bicyclists at night), which were placed on the upper portion of the cages. Various retrievers noted that the Velcro reflectors were visible hundreds of meters away and flashed as they swept a flashlight across the intertidal area. This enabled retrievers to quickly locate the cages at night in the dark. Thus we recommend placing reflectors on cages to aid in night-time retrieval.

6.4 Laboratory back-log during retrieval week

Nearly all of the mussel cages were retrieved over the course of four nights in early January, 2013. Cages and mussels were delivered to the Marine Resource's Laboratory the morning following delivery. The large volume of mussel bags (565) received over the course of only four days made it very difficult to process the mussels in a timely fashion.

Once it was determined that the number of mussels being delivered was more than lab staff could process in one day using the initial plan, which was to process mussels from each site immediately for mortality and condition index (CI) and freeze the remaining mussels for contaminant analysis, an alternate plan went into effect. To compensate for the backlog, upon arrival at the lab each site was immediately assessed for mortality, then mussels to be processed for CI were *set aside* in the walk-in refrigerator, to await processing within 24 – 72 hours. Then mussels to be used for tissue chemistry analysis were immediately labeled and placed in the freezer to await processing at a later date (not to exceed three months). We noted that no mussels held in the cold room for CI processing were found dead or gaping at the time processing.

In the future, we recommend spacing mussel cage retrieval, and subsequent delivery to the laboratory, over a longer period of time (five to six nights) and staggering the retrieval so that a set number of cages are delivered to the lab each day. This will allow samples to be processed in a timely manner with a limited backlog. If four to five staff are available to process samples in the laboratory, then we recommend 25 cages be delivered per day. We also recommend scheduling a number of laboratory-competent volunteers to help in the lab on the days of retrieval processing.

APPENDIX A

Examples of all Data Records used to date.

Figure A.1. Example of Bagged Mussel Lengths record.


Rope 997

Date 10/24/2012 Bagged Mussel Lengths(mm) Page 1 of

Mussel Bag Serial Number	121 ^①	122 ^①	123 ^②	124 ^①	125 ^②
1	51	55	53	55	54
2	58	58	55 60	54	54
3	53	53	60	50	55 53
4	53	54	57 57	56	60
5	58	58	57	54	57
6	52	56	53	56	55
7	58	57	51	54	51
8	57	60	55 52	50	60
9	57	58	55	60	52
10	52	53	56	53	56
11	58	56	60	56	55
12	52	59	53	58	55
13	57	57 59	54	57 58	56
14	60	55	56	60	53
15	52	54	51	53	52 54
16	54	56	57	54	52
Recorder:	80	80	80	80	80

Mussel Bag Serial Number	126 ^①	127 ^①	128 ^②	129 ^②	130 ^③
1	58	✓56	52	55	50
2	53	✓52	56	54	55
3	53	54 57	51	60	55
4	53	59	58	58	50
5	54	✓59	51	60	50
6	57	✓55 57	50	58	55
7	52	✓60	60	52	57 58
8	57	✓56	52	54	56
9	57	60	57	60	52
10	57	58	53	55	54
11	53	60 59	52	54	55
12	54	✓57	59	54	55
13	56	51	54	60	53
14	56	59	59	56	54
15	53	✓60	52	56	53
16	60	✓55	56	57	59
Recorder:	80	80	80	80	80

Figure A.2. Example of Deployment Chain of Custody record.



DEPLOYMENT CHAIN OF CUSTODY
MUSSEL WATCH PILOT EXPANSION STUDY

<p>Relinquished by: (release of mussel bags from Penn Cove, please record bag numbers)</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="font-size: small;">Print and Sign NAME</th> <th style="font-size: small;">DATE</th> <th style="font-size: small;">TIME</th> </tr> </thead> <tbody> <tr> <td>Karen Peabody - Eastridge <i>Karen Peabody - Eastridge</i></td> <td>11/13/12</td> <td>1700</td> </tr> <tr> <td colspan="3">(191, 196, 280, 275) (224, 205, 255, 268) (179, 279, 194, 190)</td> </tr> <tr> <td colspan="3">(269, 259, 263, 260) (264, 276, 273, 277) (278, 272, 271, 274)</td> </tr> </tbody> </table>	Print and Sign NAME	DATE	TIME	Karen Peabody - Eastridge <i>Karen Peabody - Eastridge</i>	11/13/12	1700	(191, 196, 280, 275) (224, 205, 255, 268) (179, 279, 194, 190)			(269, 259, 263, 260) (264, 276, 273, 277) (278, 272, 271, 274)					
Print and Sign NAME	DATE	TIME														
Karen Peabody - Eastridge <i>Karen Peabody - Eastridge</i>	11/13/12	1700														
(191, 196, 280, 275) (224, 205, 255, 268) (179, 279, 194, 190)																
(269, 259, 263, 260) (264, 276, 273, 277) (278, 272, 271, 274)																
<p>Received by: (Primary mussel possession, please record bag numbers)</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="font-size: small;">Print and Sign NAME</th> <th style="font-size: small;">DATE</th> <th style="font-size: small;">TIME</th> </tr> </thead> <tbody> <tr> <td>Melissa Roberts <i>Melissa Roberts</i></td> <td>11/12/12</td> <td>1656</td> </tr> <tr> <td colspan="3" style="text-align: center;">All the above serial numbers taken</td> </tr> </tbody> </table>	Print and Sign NAME	DATE	TIME	Melissa Roberts <i>Melissa Roberts</i>	11/12/12	1656	All the above serial numbers taken								
Print and Sign NAME	DATE	TIME														
Melissa Roberts <i>Melissa Roberts</i>	11/12/12	1656														
All the above serial numbers taken																
<p>Received by: (Secondary mussel possession, record the bag numbers)</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="font-size: small;">Print and Sign NAME</th> <th style="font-size: small;">DATE</th> <th style="font-size: small;">TIME</th> </tr> </thead> <tbody> <tr> <td>Alan Chapman <i>Alan Chapman</i></td> <td>11/13/12</td> <td>1935</td> </tr> <tr> <td colspan="3">(205, 255, 224, 268)</td> </tr> </tbody> </table>	Print and Sign NAME	DATE	TIME	Alan Chapman <i>Alan Chapman</i>	11/13/12	1935	(205, 255, 224, 268)								
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Print and Sign NAME	DATE	TIME														
Elizabeth Anderson <i>Elizabeth Anderson</i>	11-13-12	2009														
(190, 179, 279, 194)																
(278, 272, 271, 274)																
(276, 264, 277, 273)																
<p>Received by: (Secondary mussel possession, record the bag numbers)</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="font-size: small;">Print and Sign NAME</th> <th style="font-size: small;">DATE</th> <th style="font-size: small;">TIME</th> </tr> </thead> <tbody> <tr> <td>April Markiewicz <i>April Markiewicz</i></td> <td>11/13/2012</td> <td>8:39 pm</td> </tr> <tr> <td colspan="3">(269, 259, 263, 260)</td> </tr> </tbody> </table>	Print and Sign NAME	DATE	TIME	April Markiewicz <i>April Markiewicz</i>	11/13/2012	8:39 pm	(269, 259, 263, 260)								
Print and Sign NAME	DATE	TIME														
April Markiewicz <i>April Markiewicz</i>	11/13/2012	8:39 pm														
(269, 259, 263, 260)																

Page 1 of 1

Figure A.3. Example of Deployment Data Sheet record.



DEPLOYMENT DATA SHEET		MUSSEL WATCH PILOT EXPANSION STUDY	
Site Name: <u>EBDH Duwamish Head</u>	Bag #'s: <u>97 77 12 56</u>	Date: <u>11/12/12</u>	
Cage & Mussel Deployer(s) - please print: <u>Janice Mathisen Anna Wilson John Applegate Norm Lau</u>			
Data Recorder - please print: <u>Janice Mathisen</u>			
GPS Make/Model (set to Datum NAD83): <u>Garmin eTrex set to Datum NAD83</u>			
Latitude: <u>47.58934</u>	Longitude: <u>-122.39533</u>	Accuracy: <u>± 4 m</u> (± feet)	
Deployment Details			
Time cage was anchored: <u>9:03 PM</u> Cable ties extremely brittle. When we tried to mangle they broke off.			
Cage Elevation - approximate the distance from cage bottom to water surface in one of the two scenarios: depth of water on cage <u>—</u> (inches) OR distance to water line <u>0</u> (feet). - at water line (-1.8 @ 9:03 PM)			
Anchoring method(s): No. of Rebar Used <u>2</u> Screw Anchor: (circle one) <input checked="" type="radio"/> Yes <input type="radio"/> No			
Comments regarding deployment: <u>Sandy patch found in eelgrass bed. Cage is lined up with light pole between large tree and stair access to beach. It is lined up with light pole north of stairs (from beach to left of stairs)</u>			
⇒ We moved the site southwest of the original Duwamish Head site due to a seal hauled out on the beach @ original site)			
Conditions at Deployment Site			
Time of low tide: <u>9:30 PM</u> Height of Low Tide in Feet (MLLW): <u>-1.96</u>			
Eelgrass present (circle one): <input checked="" type="radio"/> Yes <input type="radio"/> No Substrate: <u>Sand, shell debris</u>			
Wild mussels present (circle one): <input checked="" type="radio"/> Yes <input type="radio"/> No Average size (approximate in inches): <u>1"-2" on lower concrete steps - either side</u>			
What else is present around the area of the cage? (Bulkheads, stream, docks, etc....) <u>Seawall riprap concrete stairs steps</u>			
Obvious sources of pollution? (oil slicks, pilings, seeps, derelict boats or pipes, etc...) <u>None other than proximity to Alki Ave SW</u>			
Other observations: <u>Eelgrass beds, some dense, some sparse. Sand and shell debris at wrack line. Evidence of Macoma clams (shells), Little neck (Venerupis sp), Mytilus sp. Found purple star (Pisaster), sea pen, gurnard, crab molts (gracful cancer + dungereass) hermit crabs. Some sea lettuce present. Found Rained lightly o' times Lacuna snails + Lacuna eggs on eelgrass</u>			

Figure A.4. Example of Retrieval Chain of Custody record.



RETRIEVAL CHAIN OF CUSTODY
MUSSEL WATCH PILOT EXPANSION STUDY

Instructions: Remove mussel bags from cage. Do not open the mesh bags. Place whole mussel bags in prelabelled Ziploc storage bag, seal, and put on ice in a cooler for overnight. DO NOT FREEZE! Remove cage, anchoring devices and sample debris from site. Deliver mussels and gear to the WDFW Marine Lab on the 6th floor of the Natural Resources Building (1111 Washington St. SE, Olympia, WA 98501) the following morning after retrieval.

SITE NAME: Hylebos I CPS - HY W1				
BAG ID NUMBERS:	# 316	# 238	# 295	# 288

Retriever Took Possession: Janice Jensen *Janice Jensen* 1/9/13 9:00pm
Print and Sign NAME DATE TIME

Observations or Comments:

Retriever Relinquished Possession: Janice Jensen *Janice Jensen* 1/10/13 8:00am
Print and Sign NAME DATE TIME

Observations or Comments:

WDFW Lab Took Possession: Karen Peabody-Eastidge *Ka Peabody Eastidge* 1/10/13 0900
Print and Sign NAME DATE TIME

Observations or Comments:

Figure A.5. Example of Retrieval Data Sheet record.



RETRIEVAL DATA SHEET <i>SJF-PIAR</i>		MUSSEL WATCH PILOT EXPANSION STUDY	
Site Name: <u>Thompson Spit</u>	Bag #'s: <u>221 227 240 228</u>	Date: <u>9 Jan 2013</u>	
Cage & Mussel Retriever(s) - please print: <u>Lisa LaBuddo, Caitan Murray, Dion Jamieson, Geoffrey Mayhew</u>			
Data Recorder - please print: <u>Lisa LaBuddo</u>			
GPS Make/Model (set to Datum NAD83): <u>Garmin map 62s</u>			
Latitude: <u>48.09669°</u>	Longitude: <u>122.93942°</u>	Accuracy: <u>5</u>	(± feet)
Retrieval Details			
Time cage was removed: <u>17:16</u>			
Cage Elevation - approximate the distance from cage bottom to water surface in one of the two scenarios: depth of water on cage <u>12</u> (inches) OR distance to water line _____ (feet).			
Comments regarding retrieval: <u>one of the bag numbers was missing, but found in bottom of cage; cage was removed easily and it was intact.</u>			
Conditions at Retrieval Site			
Time of low tide: <u>17:20</u>		Height of Low Tide in Feet (MLLW): <u>0.9 ft</u>	
Eelgrass present (circle one): <input checked="" type="radio"/> Yes <input type="radio"/> No		Substrate: <u>Cobble with sand base</u>	
Wild mussels present (circle one): Yes <input type="radio"/> No <input checked="" type="radio"/>		Average size (approximate in inches): <u>n/a</u>	
What else is present around the area of the cage? (Bulkheads, stream, docks, etc....) <u>none upland housing in distance (looks abandoned)</u>			
Obvious sources of pollution? (oil slicks, pilings, seeps, derelict boats or pipes, etc...) <u>none present other than upland housing</u>			
Other observations: <u>Nothing out of the ordinary in the cage (no other organisms) or around it</u>			
	Please take photos of cage before retrieval.		

Figure A.6. Example of Condition Index Log record.

Mussel Watch Pilot Expansion Study Page 1 of 2 (SEE BACK)
CONDITION INDEX LOG

Site Name ORCAS NORTH SIDE
 Site ID SSI-ONES Collection Date/Time 1/9/13 8:55 pm

Tally mussels in each bag Date: 1/10/13 Recorder: _____

Bag # <u>41</u>	Empty <u>2</u>	Rotten <u>0</u>	Gaping <u>0</u>	Cracked <u>0</u>	Alive <u>14</u>
Bag # <u>57</u>	Empty <u>8</u>	Rotten <u>0</u>	Gaping <u>0</u>	Cracked <u>0</u>	Alive <u>8</u>
Bag # <u>60</u>	Empty <u>2</u>	Rotten <u>0</u>	Gaping <u>0</u>	Cracked <u>0</u>	Alive <u>14</u>
Bag # <u>69</u>	Empty <u>3</u>	Rotten <u>0</u>	Gaping <u>0</u>	Cracked <u>0</u>	Alive <u>13</u>
TOTALS:	Empty <u>15</u>	Rotten <u>0</u>	Gaping <u>0</u>	Cracked <u>0</u>	Alive <u>49</u>

Comments (specifically, note if a gaping or cracked mussel was used for the CI):
57- 8 empty predation

CONDITION INDEX Fish ID# Range: 137505 to 137516

Date: <u>1/11/13</u>		Date: <u>1/14/13</u>		Observations	
Recorder: <u>AC</u>		Recorder: <u>SO</u>			
Fish ID#	Bag #	Shell Length 0.1 mm	Wet Tissue Weight plus Pan 0.1 g		Dry Tissue Weight plus pan 0.1 g
137505	41	55.89	10.0	3.1	+G
137506	41	60.74	10.0	2.9	+G
137507	41	56.44	10.1	3.3	+G
137508	57	10.0 57.02	8.4	2.5	+G
137509	57	56.97	8.5	2.6	+G
137510	57	51.32	7.5	2.5	+G
137511	60	57.66	9.4	2.7	+G
137512	60	53.97	7.4	2.1	+G
137513	60	58.49	8.5	2.5	+G
137514	69	50.32	4.3	1.6	-G
137515	69	54.89	8.0	2.6	+G
137516	69	52.66	5.3	1.7	G?

Date & Time In Oven: <u>1/11/13 1700 LN</u>	Date & Time Out: <u>1/14/13 0900</u>	Pan Weight: <u>1.3 g</u>
--	---	-----------------------------

Comments: @ 120°C

Created: LAN 12/2012

APPENDIX B

Permits attained for the Mussel Watch Pilot Expansion study.

Cc: Enforcement
Willapa Lab

STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE

NEW X
RENEW
Prev. permit #

SHELLFISH TRANSFER PERMIT NO. 12-1081

Company Name: **Washington Dept. of Fish and Wildlife-Puget Sound Ecosystem Monitoring Program**
Applicant: **James E. West**
Address: **600 Capitol Way N**
City, State, Zip: **Olympia WA 98501**
Telephone No. **360-902-2842**

Transfer is for (species and life stage): **Blue mussels; Mytilus trossulus; adults**

Equipment type used in transfer: **NA**

FROM: Property from which applicant will make transfer:
General Area: **Penn Cove** Specific Area: **Penn Cove Mussel**

Pest or Disease Classification: RESTRICTED UNRESTRICTED UNDESIGNATED X

TO: Property to which applicant will make transfer:
General Area: **Puget Sound** Specific Area: **Multiple sites; specific site locations maintained on file by Brady Blake**

Pest or Disease Classification: RESTRICTED UNRESTRICTED UNDESIGNATED X

Conditions of Transfer: **Copy of this permit to accompany all transfers of mussels.**

THIS PERMIT IS VALID FROM: **18 July 2012 TO: 31 January 2013**
IT SHALL BE THE RESPONSIBILITY OF THE PERMIT HOLDER TO HAVE OBTAINED THE LEGAL RIGHT TO POSSESS AND TRANSFER THE SHELLFISH COVERED BY THIS PERMIT. ONE COPY OF THIS PERMIT MUST BE CARRIED ON EACH CONVEYANCE USED. FAILURE TO COMPLY WITH THE TERMS OF THIS PERMIT, IN WHOLE OR PART, SHALL BE CONSIDERED TO CONSTITUTE A SIGNIFICANT THREAT TO THE STATES' SHELLFISH INDUSTRY AND STOCKS. BECAUSE OF THE THREAT REPRESENTED TO THE PUBLIC HEALTH, SAFETY, OR WELFARE, THIS PERMIT WILL BE SUMMARILY SUSPENDED IF THE HOLDER FAILS TO COMPLY WITH ITS TERMS, IN WHOLE OR PART, SUBJECT TO THE OPPORTUNITY AFFORDED BY THE ADMINISTRATIVE PROCEDURES ACT (Chapter 34.05, RCW) FOR THE HOLDER TO CONTEST THIS ACTION. IF THE HOLDER REQUESTS REVIEW OF THIS SUSPENSION OF THIS PERMIT, A PROCEEDING TO DO SO SHALL BE PROMPTLY INSTITUTED AND THE VALIDITY OF THE SUSPENSION DETERMINED. IF REVIEW IS NOT REQUESTED, SUSPENSION OF THIS PERMIT SHALL BE CONSIDERED FINAL AND IRREVOCABLE. THIS PERMIT DOES NOT AUTHORIZE RELAY OF SHELLFISH UNDER CHAPTER 69.30 RCW RELATING TO HUMAN HEALTH AND SAFETY. AUTHORIZATION TO RELAY SHELLFISH MUST BE OBTAINED FROM THE WASHINGTON DEPARTMENT OF HEALTH (CONTACT BILL CLELAND, (360) 236-3306).

FOR ALL TRANSFERS EXCEPT PLACING CULTCH
IN DABOB BAY:

Approved for the Director of Fish and Wildlife

By: _____
Brady Blake, Fish and Wildlife Biologist



Date: **18 July 2012**

RCW 77.80.060 and WAC 220-72-073 require all transfers to be accompanied by a permit issued by the Director of Fish and Wildlife or his agent.



HYDRAULIC PROJECT APPROVAL

RCW 77.55.021 - See appeal process at end of HPA

Statewide
600 Capitol Way N
Olympia, WA 98501-1091
(360) 902-2200

Issue Date: November 01, 2012

Control Number: 128221-1

Project Expiration Date: October 31, 2013

FPA/Public Notice #: N/A

PERMITTEE

Washington Department of Fish and Wildlife
ATTENTION: Jennifer Lanksbury
600 Capitol Way N MS 43150
Olympia, WA 98501
360-902-2820
Fax: 360-302-2183

AUTHORIZED AGENT OR CONTRACTOR

Project Name: WDFW Mussel Watch Pilot Expansion Project

Project Description: Mussels will be distributed in cages (50 mussels per cage) placed at approximately 107 sites within the Salish Sea Archipelago (one cage per site) for a period of 8 to 12 weeks. Cages will be anchored at each site between +1 and -1 foot MLLW tidal elevation using metal rebar stakes driven into the substrate or secured to fixed pilings or other secure structures already on site.

PROVISIONS

1. This HPA authorizes the placement of mussel cages within the intertidal zone of Puget Sound (Salish Sea) to evaluate geographic extent and magnitude of chemical contamination in nearshore biota of Washington State at a comprehensive multi-site project planned for fall and winter of 2012-13.
2. The project may begin immediately and shall be completed by October 31, 2013.
3. NOTIFICATION REQUIREMENT: The Area Habitat Biologist (AHB) listed below shall receive written notification (FAX or mail) from the person to whom this Hydraulic Project Approval (HPA) is issued (permittee) or the agent/contractor no less than three working days prior to the start of construction activities. The notification shall include the permittee's name, project location, starting date for work, and the control number for this HPA.
4. Work shall be accomplished per plans and specifications approved by the Washington Department of Fish and Wildlife entitled JARPA and dated August 2, 2012, except as modified by this Hydraulic Project Approval. A copy of these plans shall be available on site during construction.
5. Mussel cages (12- or 16-inch cube, vinyl coated, wire mesh) shall be staked in the low intertidal zone at each site between the -1 and +1 foot MLLW tidal elevation using rebar metal stakes or secured to fixed pilings or other secure structures already on site.
6. The permittee shall submit a report of the Mussel Watch Pilot Expansion Project by December 31, 2013. Report shall be submitted to the AHB listed below and to the Habitat Program at HPAapplications@dfw.wa.gov or by mail to WDFW Habitat Program, 600 capitol Way N. Olympia,



Issue Date: November 01, 2012

Control Number: 128221-1

Project Expiration Date: October 31, 2013

FPA/Public Notice #: N/A

WA 98501.

The report shall include:

- a. HPA control number, permittee, contact person, address, telephone number, date of report, time period.
- b. Total number of projects completed, and results of the study.
- c. Problem(s) encountered, such as: Inability to comply with provisions, lack of notification to WDFW, any impacts to fish habitat or water quality, any corrective actions taken to rectify these problems.
- d. Recommendations for improvement to provisions and mitigation.

HABITAT FEATURES

7. Eelgrass and kelp shall not be adversely impacted due to any project activities (e.g., equipment shall not operate, and other project activities shall not occur in eelgrass and kelp).
8. Removal or destruction of overhanging bankline vegetation shall be limited to that necessary for the construction of the project.
9. Intertidal wetland vascular plants shall not be adversely impacted due to project activities (e.g., equipment shall not operate, and other activities shall not occur in intertidal wetland vascular plants).
10. All natural habitat features on the beach larger than 12 inches in diameter, including trees, stumps, logs, and large rocks, shall be retained on the beach following construction. These habitat features may be moved during construction if necessary.

WATER QUALITY MEASURES

11. Project activities shall be conducted to minimize siltation of the beach area and bed.
12. All debris or deleterious material resulting from construction shall be removed from the beach area and bed and prevented from entering waters of the state.
13. No petroleum products or other deleterious materials shall enter surface waters.
14. Project activities shall not degrade water quality to the detriment of fish life.
15. If at any time, as a result of project activities, fish are observed in distress, a fish kill occurs, or water quality problems develop (including equipment leaks or spills), immediate notification shall be made to the Washington Military Department's Emergency Management Division at 1-800-258-5990, and to the Area Habitat Biologist listed below.



HYDRAULIC PROJECT APPROVAL

RCW 77.55.021 - See appeal process at end of HPA

Statewide
600 Capitol Way N
Olympia, WA 98501-1091
(360) 902-2200

Issue Date: November 01, 2012

Control Number: 128221-1

Project Expiration Date: October 31, 2013

FPA/Public Notice #: N/A

PROJECT LOCATIONS

Location #1 Puget Sound

WORK START: November 01, 2012				WORK END: October 31, 2013		
WRIA: 99.0000		Waterbody: Various		Tributary to: Statewide		
1/4 SEC: All	Section: 01	Township: 99	Range: 99	Latitude: N	Longitude:	County: Multiple
Location #1 Driving Directions						
Multiple sites and WRIAs see attached list.						

APPLY TO ALL HYDRAULIC PROJECT APPROVALS

This Hydraulic Project Approval pertains only to those requirements of the Washington State Hydraulic Code, specifically Chapter 77.55 RCW (formerly RCW 77.20). Additional authorization from other public agencies may be necessary for this project. The person(s) to whom this Hydraulic Project Approval is issued is responsible for applying for and obtaining any additional authorization from other public agencies (local, state and/or federal) that may be necessary for this project.

This Hydraulic Project Approval shall be available on the job site at all times and all its provisions followed by the person(s) to whom this Hydraulic Project Approval is issued and operator(s) performing the work.

This Hydraulic Project Approval does not authorize trespass.

The person(s) to whom this Hydraulic Project Approval is issued and operator(s) performing the work may be held liable for any loss or damage to fish life or fish habitat that results from failure to comply with the provisions of this Hydraulic Project Approval.

Failure to comply with the provisions of this Hydraulic Project Approval could result in a civil penalty of up to one hundred dollars per day and/or a gross misdemeanor charge, possibly punishable by fine and/or imprisonment.

All Hydraulic Project Approvals issued under RCW 77.55.021 are subject to additional restrictions, conditions, or revocation if the Department of Fish and Wildlife determines that changed conditions require such action. The person(s) to whom this Hydraulic Project Approval is issued has the right to appeal those decisions. Procedures for filing appeals are listed below.

NOTE: You may request changes to this HPA. If you paid an application fee for your original HPA you must include payment of \$150 with your written request or request billing to an account previously established with Washington Department of Fish and Wildlife. If you did not pay an application fee for the original HPA, no fee is required for a change to it. Requests for changes must include the HPA number, check number or billing account number, and a description of the requested change. Send your written requests and payment, if applicable, by mail to: Washington Department of Fish and Wildlife, PO Box 43234, Olympia, Washington 98504-3234. If you are charging the fee to a billing account number or you are not subject to the fee, you may email your request to HPAapplications@dfw.wa.gov.



HYDRAULIC PROJECT APPROVAL

RCW 77.55.021 - See appeal process at end of HPA

Statewide
600 Capitol Way N
Olympia, WA 98501-1091
(360) 902-2200

Issue Date: November 01, 2012

Control Number: 128221-1

Project Expiration Date: October 31, 2013

FPA/Public Notice #: N/A

APPEALS INFORMATION

If you wish to appeal the issuance, denial, conditioning, or modification of a Hydraulic Project Approval (HPA), Washington Department of Fish and Wildlife (WDFW) recommends that you first contact the department employee who issued or denied the HPA to discuss your concerns. Such a discussion may resolve your concerns without the need for further appeal action. If you proceed with an appeal, you may request an informal or formal appeal. WDFW encourages you to take advantage of the informal appeal process before initiating a formal appeal. The informal appeal process includes a review by department management of the HPA or denial and often resolves issues faster and with less legal complexity than the formal appeal process. If the informal appeal process does not resolve your concerns, you may advance your appeal to the formal process. You may contact the HPA Appeals Coordinator at (360) 902-2534 for more information.

A. INFORMAL APPEALS: WAC 220-110-340 is the rule describing how to request an informal appeal of WDFW actions taken under Chapter 77.55 RCW. Please refer to that rule for complete informal appeal procedures. The following information summarizes that rule.

A person who is aggrieved by the issuance, denial, conditioning, or modification of an HPA may request an informal appeal of that action. You must send your request to WDFW by mail to the Washington Department of Fish and Wildlife HPA Appeals Coordinator, 600 Capitol Way North, Olympia, Washington 98501-1091; e-mail to HPAapplications@dfw.wa.gov; fax to (360) 902-2946; or hand-delivery to the Natural Resources Building, 1111 Washington St SE, Habitat Program, Fifth floor. WDFW must receive your request within 30 days from the date you receive notice of the decision. If you agree, and you applied for the HPA, resolution of the appeal may be facilitated through an informal conference with the WDFW employee responsible for the decision and a supervisor. If a resolution is not reached through the informal conference, or you are not the person who applied for the HPA, the HPA Appeals Coordinator or designee will conduct an informal hearing and recommend a decision to the Director or designee. If you are not satisfied with the results of the informal appeal, you may file a request for a formal appeal.

B. FORMAL APPEALS: WAC 220-110-350 is the rule describing how to request a formal appeal of WDFW actions taken under Chapter 77.55 RCW. Please refer to that rule for complete formal appeal procedures. The following information summarizes that rule.

A person who is aggrieved by the issuance, denial, conditioning, or modification of an HPA may request a formal appeal of that action. You must send your request for a formal appeal to the clerk of the Pollution Control Hearings Boards and serve a copy on WDFW within 30 days from the date you receive notice of the decision. You may serve WDFW by mail to the Washington Department of Fish and Wildlife HPA Appeals Coordinator, 600 Capitol Way North, Olympia, Washington 98501-1091; e-mail to HPAapplications@dfw.wa.gov; fax to (360) 902-2946; or hand-delivery to the Natural Resources Building, 1111 Washington St SE, Habitat Program, Fifth floor. The time period for requesting a formal appeal is suspended during consideration of a timely informal appeal. If there has been an informal appeal, you may request a formal appeal within 30 days from the date you receive the Director's or designee's written decision in response to the informal appeal.

C. FAILURE TO APPEAL WITHIN THE REQUIRED TIME PERIODS: If there is no timely request for an appeal, the WDFW action shall be final and unappealable.

ENFORCEMENT: Sergeant Klein (112) P3

Habitat Biologist Doug Thompson	360-466-4345		for Director WDFW
------------------------------------	--------------	--	----------------------

CC: Washington Department of Fish and Wildlife
West, James
600 Capitol Way N MS 43150



HYDRAULIC PROJECT APPROVAL

RCW 77.55.021 - See appeal process at end of HPA

Statewide
600 Capitol Way N
Olympia, WA 98501-1091
(360) 902-2200

Issue Date: November 01, 2012

Control Number: 128221-1

Project Expiration Date: October 31, 2013

FPA/Public Notice #: N/A

Olympia, WA 98501

Don Hoch
Director



STATE OF WASHINGTON

WASHINGTON STATE PARKS AND RECREATION COMMISSION

1111 Israel Road SW • P.O. Box 42650 • Olympia, Washington 98504-2650
(360) 902-8500 • Washington Telecommunications Relay Service at (800) 833-6388
www.parks.wa.gov

October 8, 2012

Jennifer A. Lanksbury
James E. West
600 Capitol Way N, MS: 43150
Olympia, WA 98501

RE: Scientific Research Permit – Birch Bay, Dugalla Bay, Larrabee, Deception Pass, Tolmie, Kopachuck and Possession Point State Parks – SRP #120901

Dear Ms. Lanksbury

Enclosed please find two (2) copies of the research permit you requested. Please sign both copies and return one original to me for our files. You should retain the other original. Please contact me if you desire any changes in permit stipulations.

Please note the condition that you or your designees contact Park staff 10 days before the beginning research activities to assure good communication and field staff availability. The permit also requires a copy of the permit be carried by the researchers to protect them should their activities be challenged by any party.

Please note the enclosed Scientific Research Permit Fee Notice. The \$128.75 application fee has been waived. However, fees may be applicable should an amendment be requested.

I know you will find our staff appreciative of your working with them to minimize any impact your research may have on the park and the park patrons. Should you have any questions or need additional information, please contact Cortney Melton in Olympia at (360) 902-8623.

Sincerely,

A handwritten signature in black ink, appearing to read "Rob Fimbel", written over a horizontal line.

Rob Fimbel
Stewardship Program

Enclosure - Permit (2)
Scientific Research Permit Fee Notice

Don Hoch
Director



STATE OF WASHINGTON
WASHINGTON STATE PARKS AND RECREATION COMMISSION

1111 Israel Road SW • P.O. Box 42650 • Olympia, Washington 98504-2650
(360) 902-8500 • Washington Telecommunications Relay Service at (800) 833-6388
www.parks.wa.gov

SCIENTIFIC RESEARCH PERMIT

Permit# 120901

Birch Bay, Dugualla Bay, Larrabee, Deception Pass, Tolmie, Kopachuck and Possession Point State Parks

This scientific research permit is made and entered into, by and between the Washington State Parks and Recreation Commission, hereinafter referred to as the "COMMISSION", and Jennifer A. Lanksbury and James E. West, hereinafter referred to as the "PERMITTEE".

WHEREAS, the PERMITTEE requests a permit for scientific research to monitor and evaluate the geographic extent and magnitude of chemical contamination in nearshore biota of Washington State, using native mussels as per the original scientific research permit application dated September 24, 2012,;

WHEREAS, PERMITTEE is a representative of Washington Department of Fish and Wildlife and;

WHEREAS, the COMMISSION has Waived the application fee of \$128.75, and all other applicable fees because the requested action will be of benefit to the general public, and;

WHEREAS, the requested data collection is exempt from SEPA by WAC 197-11-800 (17), and;

WHEREAS, PERMITTEE will obtain all necessary state and federal permits, if any, for this study;

NOW THEREFORE, COMMISSION hereby grants PERMITTEE a permit and right of entry to Birch Bay, Dugualla Bay, Larrabee, Deception Pass, Tolmie, Kopachuck and Possession Point State Parks beginning on November 1, 2012 and terminating on March 1, 2013 upon the following terms and conditions:

1. COMMISSION hereby grants to PERMITTEE a revocable right to enter the above-mentioned park at such times as are mutually agreeable to PERMITTEE and PARK MANAGER to perform the following tasks as described in the original letter of request dated September 24, 2012:
 - a. However, the PERMITTEE will need to contact the PARK **ten days** before the deployment and retrieval dates.

2. PERMITTEE shall notify and coordinate visits and research site locations in advance with park manager at the following park:

Kopachuck, Janet Shonk, Area Manager
321 158th Ave KP S
Lakebay, WA 98349-9680
Phone: (253) 265-3606
Email: Janet.Shonk@PARKS.WA.GOV

Tolmie, Tom Pew, Area Manager
12245 Tilley Rd S
Olympia, WA 98512-9167
Phone: (360) 753-1519
Email: Tom.Pew@PARKS.WA.GOV

Deception Pass & Duguala, Jack Hartt, Area Manager
41020 State Route 20
Oak Harbor, WA 98277
Phone: (360) 675-3767
Email: Jack.Hartt@PARKS.WA.GOV

Larrabee, Paul McEvers, Area Manager
245 Chuckanut Drive
Bellingham, WA 98229
Phone: (360) 676-2093
Email: Paul.McEvers@PARKS.WA.GOV

Possession Point, John Crimmims, Area Manager
1280 Engle Road
Coupeville, WA 98239
Phone: (360) 678-4519
Email: John.Crimmims@PARKS.WA.GOV

3. Any materials approved under this permit for removal from Commission owned properties will become the property of the PERMITTEE unless otherwise stipulated.
4. All tools, equipment, and other property owned by PERMITTEE shall remain the property of PERMITTEE and are to be removed from the park by PERMITTEE prior to the expiration of this permit, or within 30 days following revocation.
5. PERMITTEE will be responsible for damages arising from any activities of PERMITTEE, its officers, agents, employees or representatives on said land, in the exercise of rights under this permit and hereby agrees to indemnify and hold COMMISSION harmless from any such damages.


6. COMMISSION shall not be responsible in any manner for the tools, equipment or other property owned by PERMITTEE.
7. PERMITTEE shall keep a copy of this permit on his or her person at all times research is being conducted on park land. PERMITTEE shall exhibit the permit if requested to do so by COMMISSION staff or other law enforcement personnel.
8. PERMITTEE shall provide a report to COMMISSION, in electronic form, detailing work completed under this permit within 60 days of permit expiration. And no later than six months after research is completed, PERMITTEE shall provide COMMISSION a report detailing the findings and conclusions of the research conducted. PERMITTEE will also provide a complimentary copy to COMMISSION of any scientific publications resulting from this study.
9. Stipulations:
 - a. PERMITTEE must contact park staff prior to entering the park to conduct research as outlined in this permit.
 - b. PERMITTEE shall explain research activities to the public if asked.
 - c. In the event archaeological resources are found or unearthed during the work allowed by this permit, PERMITTEE shall cease work immediately and contact State Parks Archaeologist, Daniel Meatte at (360) 902-8637. If cultural resources are discovered, the PERMITTEE shall comply with provisions of Chapter 27.44 RCW, Chapter 27.53 RCW and the rules and regulations of the office of Archaeology and Historic Preservation, including compliance with all archaeological excavation permit requirements.
 - d. PERMITTEE shall not harm flora or fauna while conducting research at Birch Bay, Dugualla Bay, Larrabee, Deception Pass, Tolmie, Kopachuck and Possession Point State Parks except as necessary for research activities regulated by this permit.
 - e. PERMITTEE shall obtain a wildlife collection permit from the Department of Fish and Wildlife before beginning sampling activities that involve wildlife specimens, and shall keep a copy of the permit with researchers when conducting activities covered by this scientific research permit.
 - f. PERMITTEE shall leave research sites as undisturbed as possible to protect the natural wildlife.
10. This permit shall expire March 1, 2013 unless otherwise mutually agreed by both parties--except that PARKS may revoke said permit for any cause. Any request for extension of this permit must be made in writing as an addendum.

DATED: 8 Oct 2012

DATED: _____

COMMISSION

PERMITTEE

By 
Rob Fimbel
Stewardship Program

By _____
Jennifer A. Lanksbury

APPROVED AS TO FORM ONLY:
Jessica Fogel, AAG 5/12/10
Office of the Attorney General

BY _____
James E. West



WASHINGTON STATE DEPARTMENT OF
Natural Resources
PETER GOLDMARK - Commissioner of Public Lands

MEMORANDUM OF UNDERSTANDING

MOU No. 13-191

WDFW CAPs ID #12-1798

This Memorandum of Understanding (MOU) is between the Aquatic Division, Department of Natural Resources, referred to as DNR, and the Washington Department of Fish and Wildlife, referred to as WDFW.

Background

The DNR is the trustee and steward of 2.6 million acres of state-owned aquatic lands. DNR manages the bedlands and certain tidelands under Puget Sound, and the coast, and most of the navigable rivers, streams, and lakes to ensure protection for aquatic habitat, and to facilitate navigation, commerce, and public access. These DNR managed aquatic lands are commonly referred to as state-owned aquatic land (SOAL).

The Puget Sound Ecosystem Monitoring Program (PSEMP, formerly the Puget Sound Assessment Monitoring Program) has provided essential science for conservation, recovery, and management of the Puget Sound Ecosystem since 1989. PSEMP is currently a legislatively mandated program under the Puget Sound Partnership. PSEMP is a critical component of the PSP science panel, developing a monitoring program for the Puget Sound Partnership, in addition to continuing the Puget Sound Ecosystem Monitoring Program.

Washington Department of Fish and Wildlife's (WDFW) *Toxics in Biota Program* has played a central role in evaluating the status and trends of toxic contaminants in the Puget Sound ecosystem since 1989. Numerous WDFW employees are recognized as regional leaders in designing and conducting long-term assessment and monitoring programs to track and report on toxic contaminants in biota. As a participant in the PSEMP, WDFW staff track contaminants of concern in key species in the ecosystem, identifying where harm to biota has occurred, the extent and magnitude of contaminant-related problems, and whether conditions are improving or degrading. Data generated from PSEMP's *Toxics in Biota Program* studies have been providing essential science for conservation, recovery and management of the Puget Sound ecosystem for over 20 years.

Tracking toxic contamination in fish (Toxics in Fish) is one of a set of Puget Sound recovery indicators recently adopted by the Puget Sound Partnership (PSP). The PSEMP is a critical component of the PSP Science Panel, helping to develop a monitoring program for the Partnership. A key institutional linkage between DNR and PSEMP is that both are represented on the PSP's Scientific Panel. It is beneficial to DNR to support activities that fulfill the critical research needs, and further the scientific understanding of various environmental attributes of Puget Sound.

Purpose

This MOU formally recognizes the connection between long-term monitoring of environmental parameters that measure habitat function and quality, and the use of the state-owned aquatic lands of Puget Sound from the Canadian border south to Budd Inlet and west to Oakland Bay, including the eastern Strait of Juan de Fuca to Port Angeles and Hood Canal. Execution of this MOU strengthens the coordination between the DNR Aquatic Resources Program and WDFW PSEMP. This MOU defines a streamlined process for DNR to authorize and re-authorize WDFW PSEMP's shellfish monitoring program on state-owned aquatic lands for the purposes of sampling toxic contaminants. This increased coordination and streamlined process will result in better environmental protection of SOAL at a cost savings to the state.

The DNR and WDFW agree to the provisions and statements outlined below.

1.01 Definitions:

Department of Natural Resources - an agency of the state of Washington.

Department of Fish and Wildlife – an agency of the state of Washington

Puget Sound Ecosystem Monitoring Program (PSEMP) – a program under the authority of the Puget Sound Partnership, the various components (fish and shellfish, sediment, and water column monitoring, etc.) of which are delegated to various natural resource agencies (e.g., WDFW, Ecology, DNR, etc.).

Memorandum of Understanding - The Department of Natural Resources enters into memoranda of understanding, in good faith, with public and private agencies to collaborate on and/or coordinate programs, and to define institutional linkages along broad areas of concern. Memoranda of understanding are not legal contracts and do not strictly obligate the resources of the Department.

Access to SOAL – Access to State Owned Aquatic Lands managed by the Washington Department of Natural Resources for purposes of toxics sampling.

2.01 Objectives:

- Create a formal cooperative agreement between DNR and WDFW that encourages joint planning and operations in support of the PSEMP toxics monitoring and data collection program.
- Create a streamlined process to grant WDFW access to SOAL for the purpose of deploying, monitoring and removing mussel cages to monitor for toxic contaminants.
- Build collaboration between DNR and WDFW that sets priorities and coordinates efforts to accomplish priority management actions in support of toxics monitoring and data collection actions in support of the Puget Sound Partnership's Action Agenda.
- Coordinate and communicate regarding concerns related to toxic contaminants, relative to resource protection activities such as restoration or protection of key habitats that involve state-owned aquatic lands.

3.01 Work Activit(ies):

- Shellfish monitoring will be conducted using native Washington mussels (*Mytilus trossulus*) transplanted from an aquaculture farm into wire mesh cages at sites around the greater Puget Sound (Attachment A).
- Regions to be monitored include the whole Puget Sound, Whidbey Basin, Bellingham Basin, and Strait of Georgia. Additional sites may occur in the San Juan Archipelago, Admiralty Inlet, Hood Canal, and Strait of Juan de Fuca.
- Up to 7360 mussels will be distributed among up to 115 cages (~64 per cage) distributed over more than 1000 miles of Washington shoreline.
- The mussels will be placed in 16Lx16Wx16H inch vinyl-coated, wire mesh cages to reduce loss from predation.
- At each monitoring site a mussel cage will be placed in the intertidal zone between tidal heights of +1 to -1.5 foot mean lower low water (MLLW).
- The mussel cages will be anchored to the substrate with metal stakes or they will be secured to fixed pilings or other appropriate structures already on site, when available.

- The mussel cages will be put in place by WDFW staff and/or volunteers during night-time low tide windows in November, 2012, left on site for 8 to 12 weeks, and then removed completely in January, 2013.
- After removal the mussels will be tested for toxic contamination.

4.01 Functions/Roles/Tasks of Agencies/Parties:

DNR shall:

- Review WDFW proposed monitoring locations for potential conflict with management and use of state owned aquatic lands, such as interference with public access, navigation, or habitat stewardship goals.
- Provide written notification to WDFW describing if an area is open or closed for deployment of mussel cages. The notification will be in the form of a template letter signed by the Project Coordinator with the location and dates, and incorporate by reference this MOU. Written notification will be provided within 15 working days of receipt of notice of any proposed work.
- In authorizing access to WDFW for this specific purpose, DNR conveys no rights in property. Access to SOAL may be revoked by DNR with 30 days notice to WDFW.
- Maintain communication with WDFW staff regarding monitoring results and potential management activities on SOAL.

WDFW PSEMP shall:

- Contact DNR before beginning deployment of any mussel cages and provide a description of the location of the proposed work. WDFW will not proceed until receiving written confirmation from the DNR project coordinator that the area is open for deployment of mussel cages.
- If the cage is deployed in a location different than that initially provided to DNR, WDFW will provide the latitude and longitude to DNR after deployment.
- Include in the description of proposed work any details on the anchoring of cages, and describe how the encumbrances will be removed from SOAL.

- Satisfy all procedural requirements, including regulatory permits, triggered by this type of work (e.g., coordinate with counties, if necessary)
- WDFW will ensure the locations of all cages avoid any identified or obvious conflicts with DNR management and stewardship goals.
- Maintain communication with DNR regarding monitoring results and implications to potential management activities on SOAL.

5.01 Terms and Conditions:

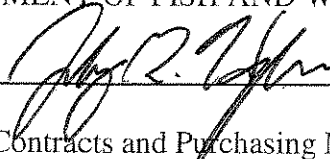
- (1) Effective Dates. This MOU is effective between November 1 2012 and July 31 2013. This agreement will be re-visited if funding extends the effectiveness date.
- (2) Amendments. This MOU shall be amended only by written mutual consent of the parties.
- (3) Termination. Either party may terminate this MOU by notifying the other party, at the addresses given, of the termination and specifying the termination date. The terminating party shall deliver the notice at least 30 days prior to the termination date.

6.01 Project Coordinators:

- (1) The Project Coordinator for the DNR is Kyle Murphy, Aquatic Reserve Manager, 360-902-1073
- (2) The Project Coordinator for the WDFW is James West, 360-902-2842 or 206-302-2427

STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE

Dated: 11/6, 2012

By: 

Title: Contracts and Purchasing Manager

Address: 600 Capitol Way N., MS: 43153
Olympia, WA 98501

Phone: (360) 902-2230

STATE OF WASHINGTON
DEPARTMENT OF NATURAL RESOURCES

Dated: 11/2, 2012

By: 

Title: Aquatic Resource Division Manger

Address: 1111 Washington St SE
P.O. Box 47027
Olympia, WA 98504-7027

Phone: (360) 902 - 1100

WORK ACTIVITIES

A detailed description of the program design and all work activities for WDFW/PSEMP's Mussel Watch Pilot Expansion is provided in the program's Quality Assurance Project Plan (West et al, 2012). Work activities in the SOAL include deployment and retrieval of native mussels (*Mytilus trossulus*) in cages in the marine intertidal zone, and associated field measurements. Procedures include the following:

Mussel Deployment

The native mussels (*Mytilus trossulus*) used for this study will come from an aquaculture farm in Penn Cove off Whidbey Island (Penn Cove Shellfish). Up to 7360 mussel (~64 per cage) will be temporarily transplanted at up to 115 intertidal sites distributed over more than 1000 miles of Washington shoreline in with winter of 2012-2012. The study period will occur during the non-spawning period for *M. trossulus*. Site locations will be finalized in October, 2012 and a map and table (including latitudes and longitudes) of the specific locations will be provided to DNR for consideration.

The mussels will be placed in knitted shellfish bags, which will be hung inside -16Lx16Wx16H inch cubic vinyl-coated, wire mesh cages. These cages are similar in construction to those used by the Washington Department of Health for their Biotoxin Program. The mussel cages will be placed in the marine intertidal zone at a tidal height of approximately +1 to -1.5 feet mean lower low water (MLLW). Cages will be anchored to the substrate with metal stakes, or they will be secured to fixed pilings or other appropriate structures already on site, when available.

Cages will be put in place by WDFW staff and/or volunteers during night-time low tide windows in November, 2012. If a cage is observed to be missing during the low tidal cycle following deployment, that cage may be replaced with a new cage. Each mussel cages will be left on site for 8 to 12 weeks and then removed completely in January, 2013. After removal the mussels will be taken to a WDFW laboratory where they will be measured and processed for toxic contaminant testing.

Field Measurements

WDFW staff and/or volunteers will record site specific characteristics including, but not limited to:

- Coordinates (latitude/longitude) of cage
- Station description, including digital photos
- Site conditions (including obvious sources of pollutants)
- Ecosystem description (plants and/or animals in vicinity of cage)
- Substrate type
- Method of anchorage

- Tidal height
- Weather

After satisfying all procedural requirements triggered by this type of work, the WDFW project coordinator will provide a description of the proposed location of mussel cage deployment to the DNR project coordinator. The DNR project coordinator (with DNR Aquatic District support) will review these proposed locations for potential conflict with existing aquatic leases and habitat stewardship goals and provide written notification to the Ecology project coordinator granting access to SOAL for the sole purpose of deployment, monitoring or retrieval of said mussel cages. Written notification will be provided by DNR within 15 working days of receipt of notice of proposed work.

(Reference for West et al, 2012: West, J.E., J. Lanksbury, and L. Niewolny. 2012. Quality Assurance Project Plan: Mussel Watch Pilot Expansion Project. Washington Department of Ecology Publication)