

Chapter 9. Nearshore Assessment: Nearshore water quality of the central and western Strait of Juan de Fuca

Anne Shaffer¹, Sue Nattinger², and Jenna Schilke¹

¹Washington Department of Fish and Wildlife 332 E. 5th Street Port Angeles, Wa. 98362
360.457.2634/shaffjas@dfw.wa.gov

² Clallam County Streamkeepers Port Angeles, Washington 98362.

Introduction

Water quality, a key element to habitat function for fish, is also a top factor for restoration and preservation actions for salmon recovery. The paucity of basic water quality data along the central and western Strait of Juan de Fuca makes meaningful nearshore restoration actions difficult to define, or prioritize. The goal of project is therefore to provide basic water quality information for priority nearshore areas of the central and western Strait, and recommendations for future nearshore water quality restoration and preservation actions. .

Methods and Materials

In this study we assessed five nearshore areas for basic water quality parameters identified as important to juvenile salmonids (Shaffer et al 2005). Basic water quality parameters: Dissolved oxygen (DO), salinity, temperature, and turbidity were assessed at standard sampling stations for Hoko, Clallam, Pysht, Twins, and Salt Creek (Figure 1). Nearshore areas of five sites: Clallam, Pysht, Twins, Hoko, and Salt Creek were sampled once a month during the same tide cycle. Monthly point sampling was initiated at the peak of a high neap tide of +6 feet MLLW and was completed within three hours. All sampling was done on foot from shore in from mid column in areas with depths of approximately 3'. Sites were sampled systematically from a west to east. During all sampling we began at the western most site (Hoko) and preceded systematically east concluding sampling at Salt Creek. To try and define the range in temperature over a tidal cycle

we sampled Salt Creek twice as the first and last sampling. The two samplings at Salt Creek were five hours apart. The second sampling was used for comparison with other nearshore areas. Streamkeepers of Clallam County provided water quality sampling equipment and sampling expertise. Equipment consisted of a YSI meter model 85 and turbidity meter model (HF scientific turbidimeter model HF-DRT-ISCE). Equipment was calibrated on site for DO and the turbidity meter zeroed and field checked against secondary reference standards before each use. The same sampling equipment were used for each sampling.

Results

Water quality of the five sites showed similar seasonal trends in temperature, DO, and turbidity. Temperature ranged from 5 degrees C in January to 15.5 degrees in July. Temperature peaks were observed in May-September. Lowest temperatures were observed from December-February (Figure 2). Over the course of the year Dissolved oxygen ranged from 4.5 mg/l to approximately 15 mg/l. DO was lowest during summer months (May-October (Figure 3). Turbidity was low at all sites from April to October, and increased during winter and early spring months (Figure 4). Trends in salinity and pH were more site specific (Figure 5).

Salt Creek nearshore had the highest seasonal temperature and lowest DO, but reached both in the late fall. Pysht nearshore also experienced high temperatures, and reached higher temperatures a full two months before all other sites. DO at the Pysht remained relatively high until later summer months. Overall the Hoko and Clallam River sites had the highest turbidity.

Salt Creek nearshore also had a up to a 4.5 degree difference in temperature between high and low tide sampling during April-June sampling. Temperatures were virtually the same between the two Salt Creek samplings during winter months (Figure 6). Turbidity was up to 3 NTU's higher at the lower tide sampling spring months.

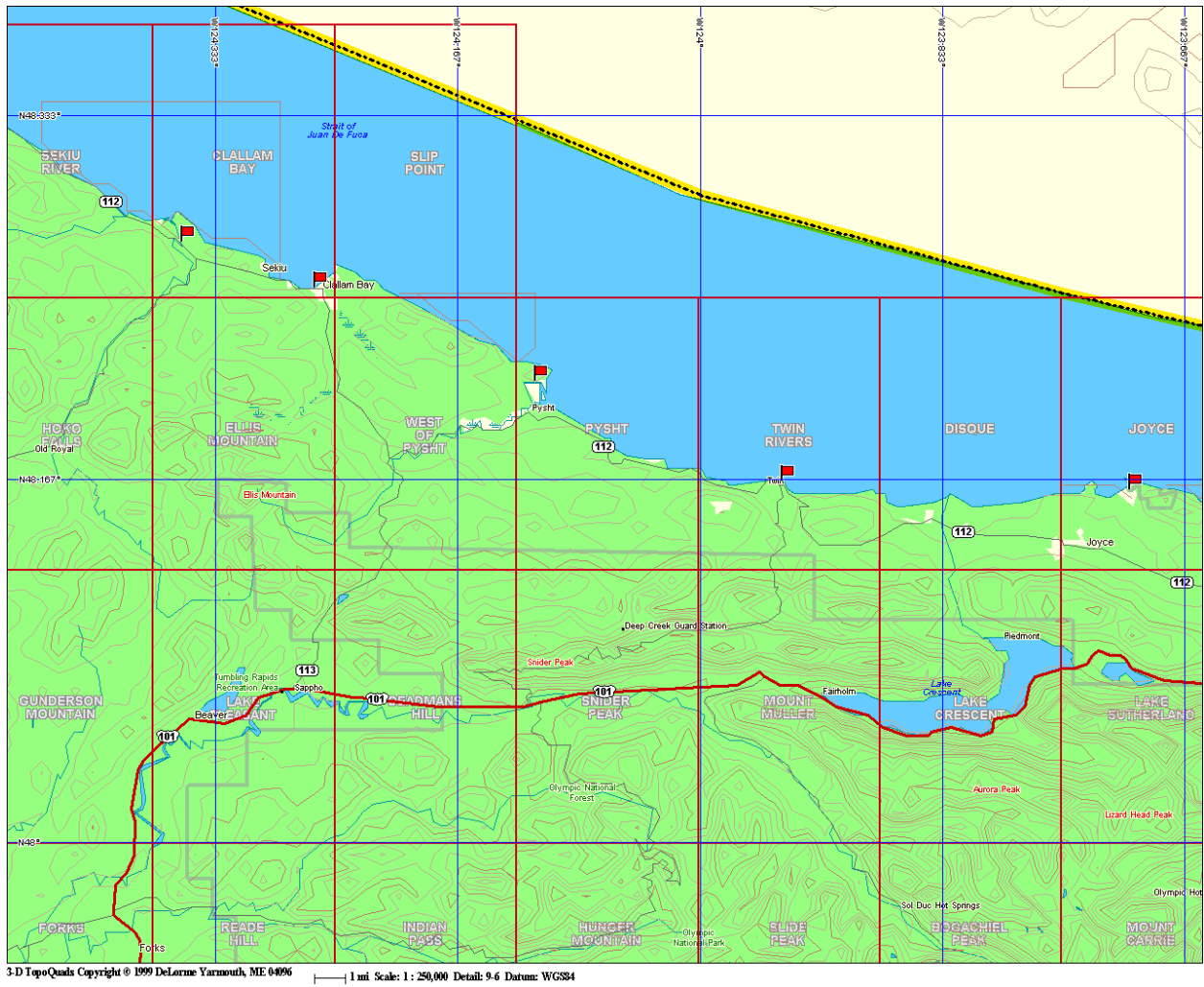


Figure 1. Sample sites, 2007 nearshore water quality study.

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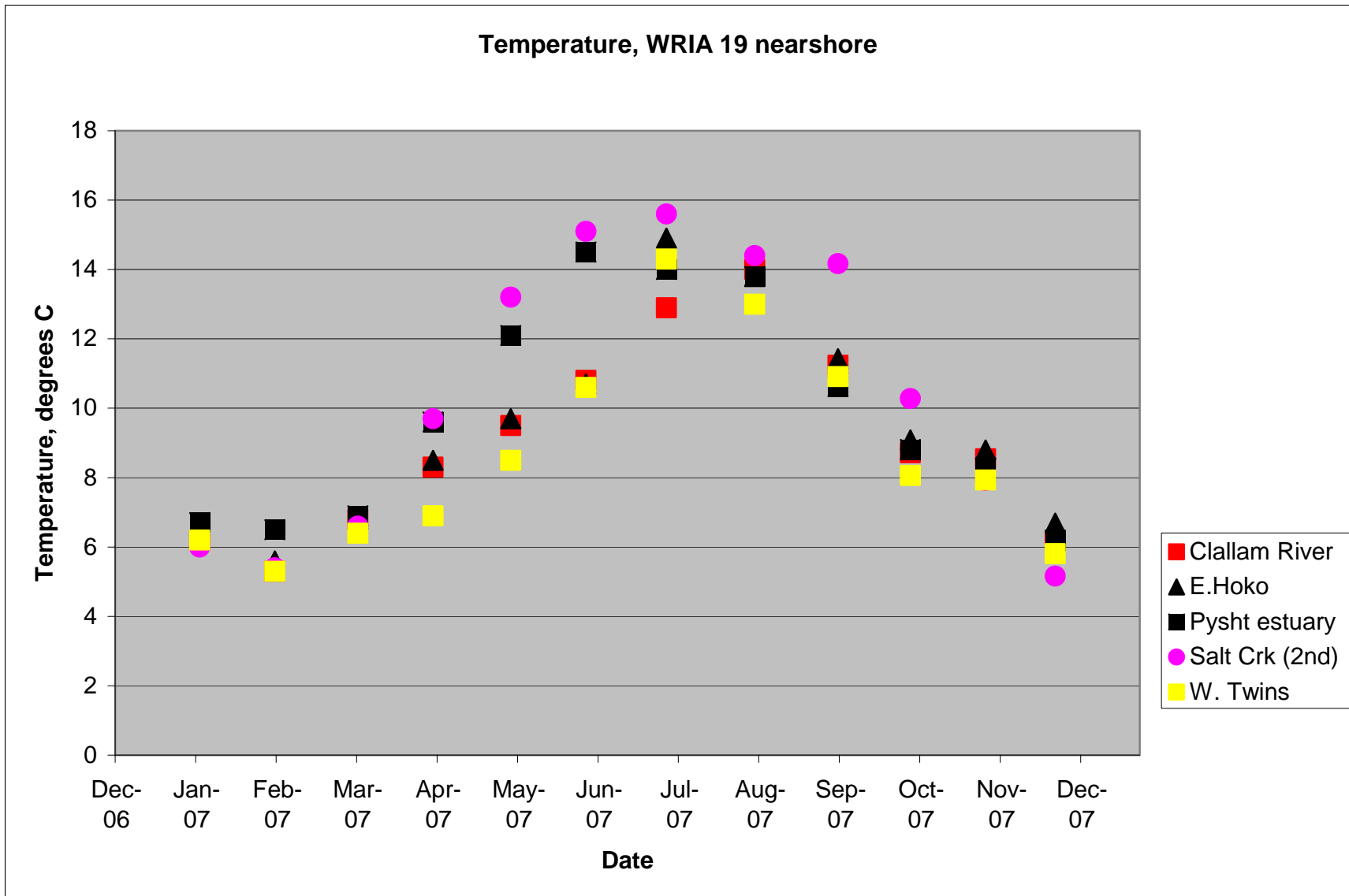


Figure 2. Temperature, select nearshore sites central and western Strait of Juan de Fuca, 2007

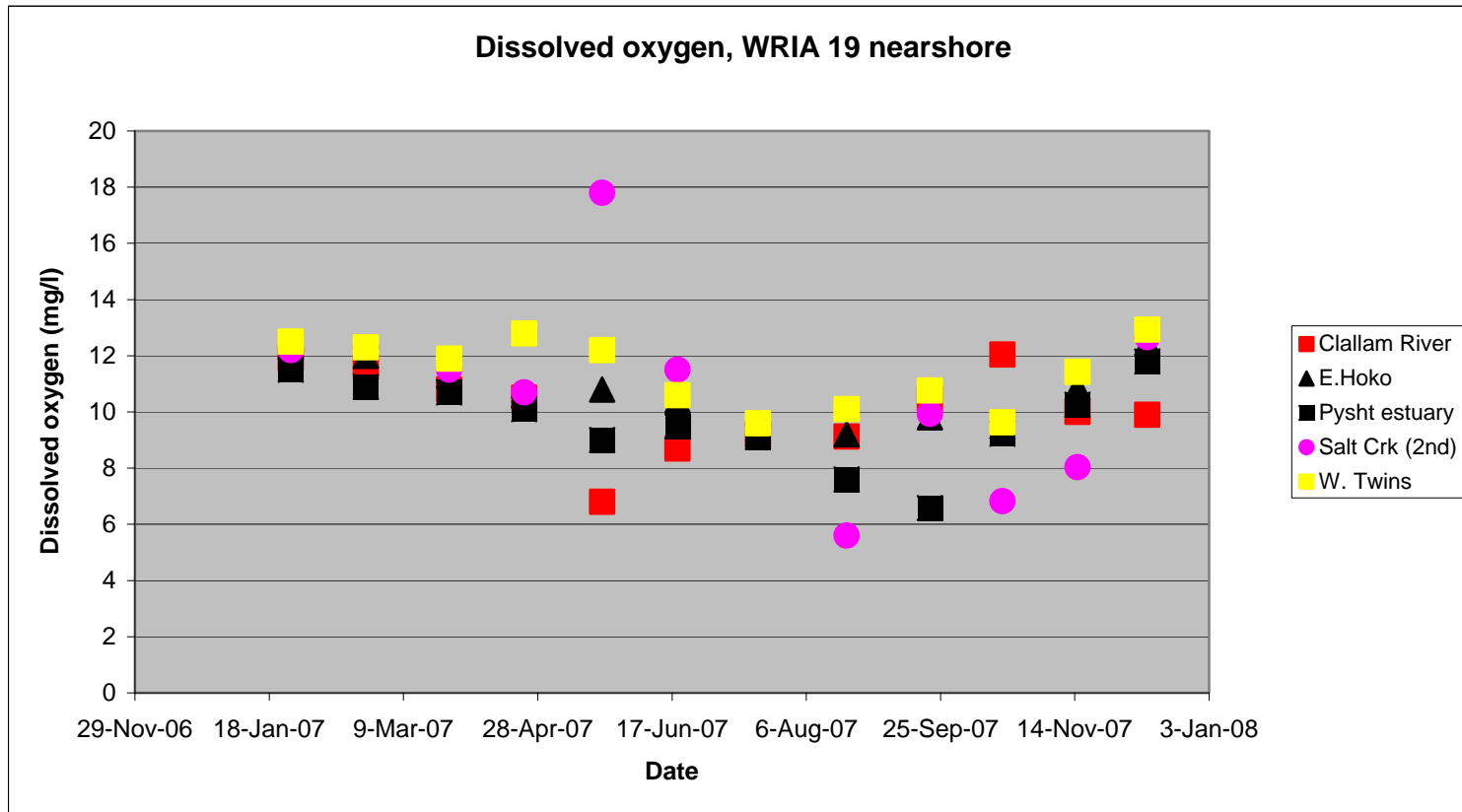


Figure 3 Dissolved oxygen select nearshore sites central and western Strait of Juan de Fuca, 2007

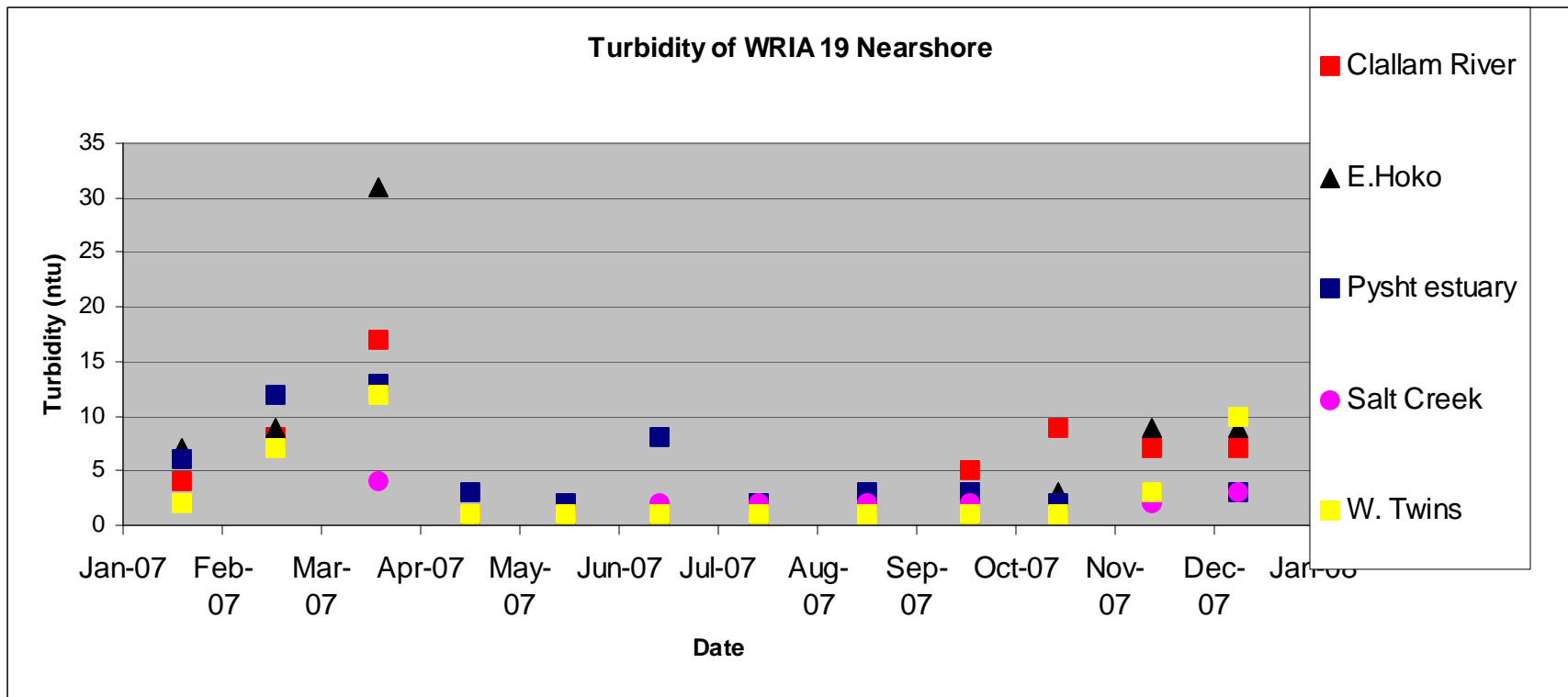


Figure 4. Turbidity, select nearshore sites central and western Strait of Juan de Fuca, 2007

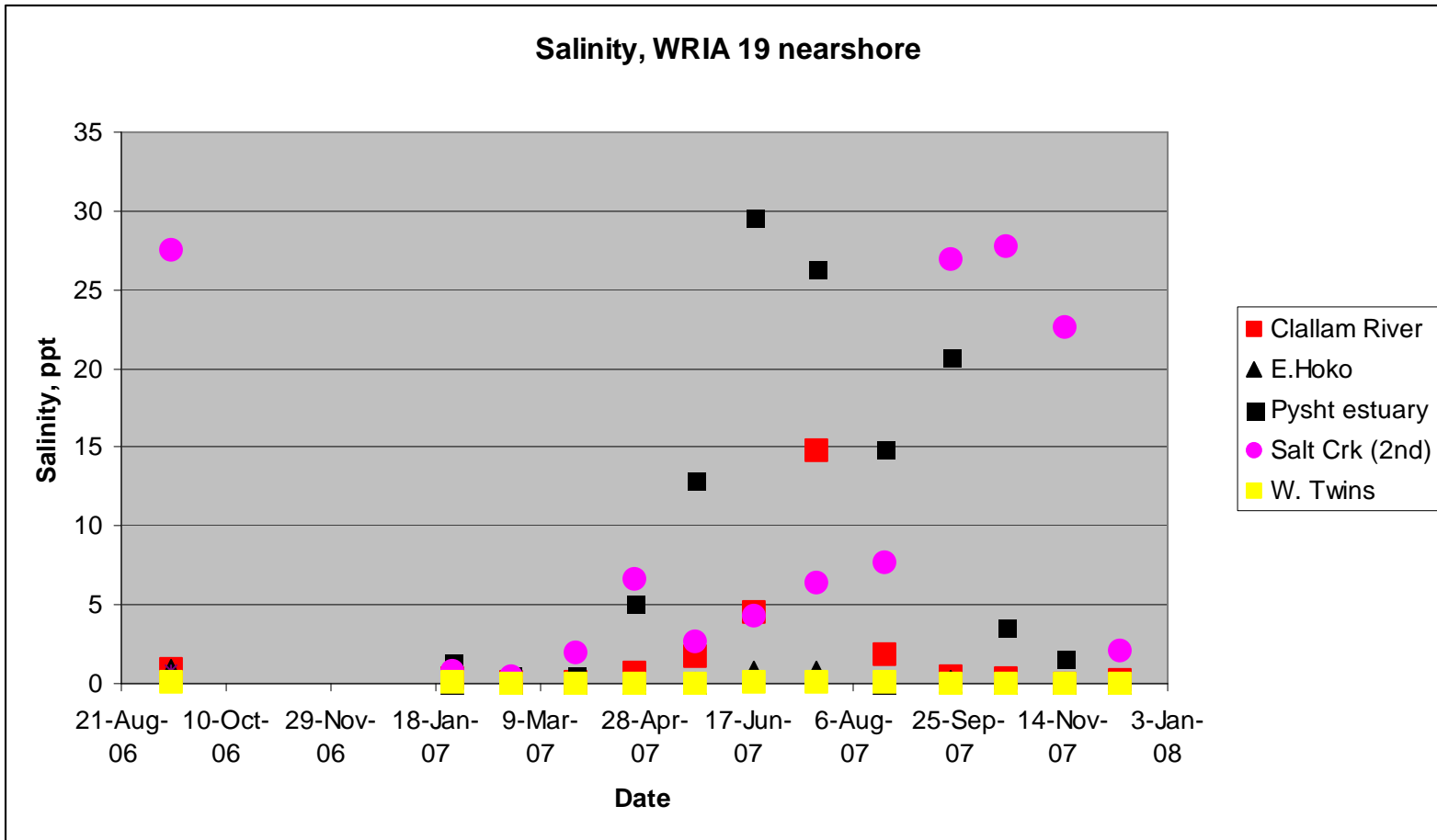


Figure 5. Salinity select nearshore sites central and western Strait of Juan de Fuca, 2007

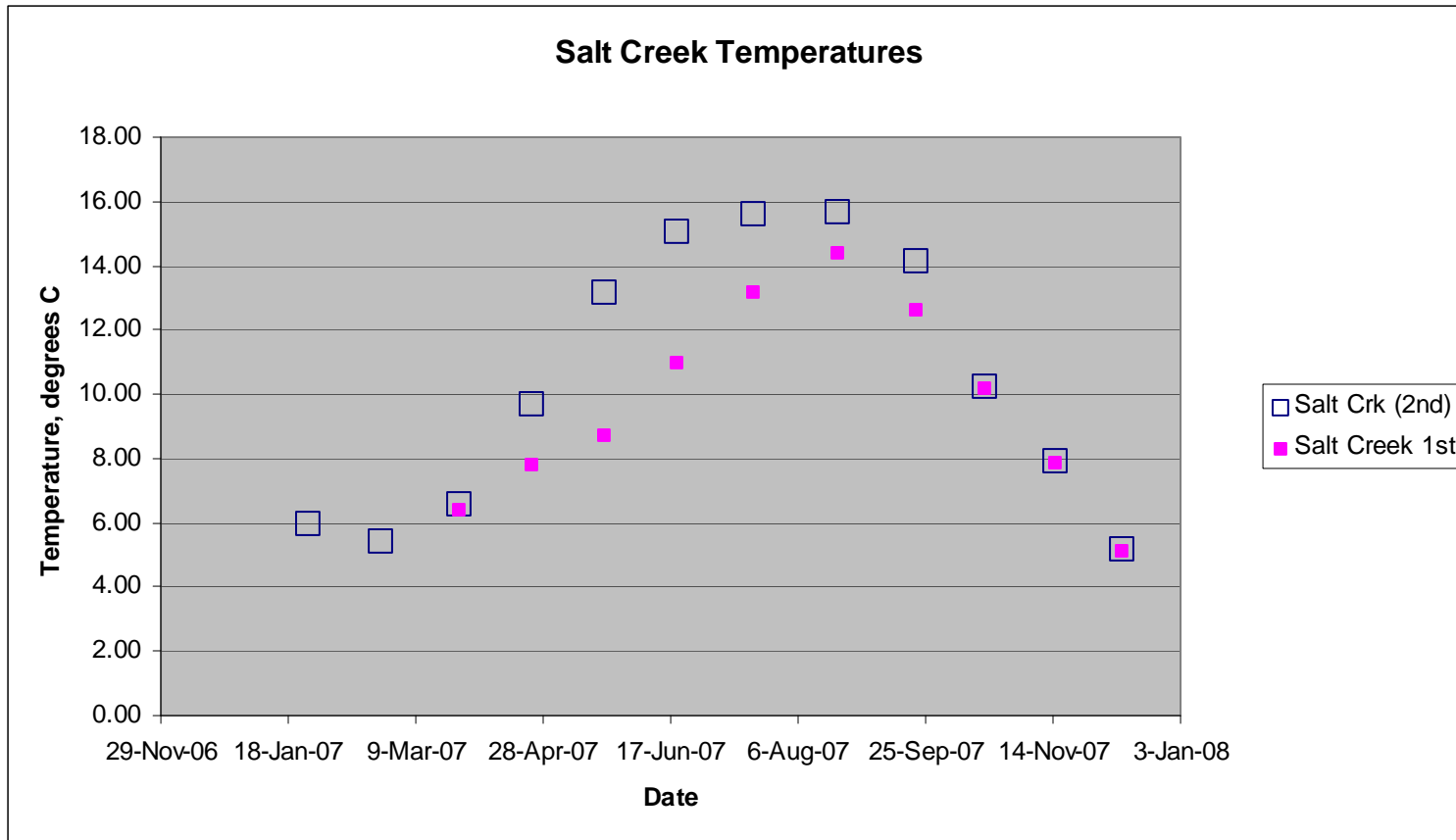


Figure 6 Temperature difference at first sampling (high tide) and second sampling (five hours after first sampling).

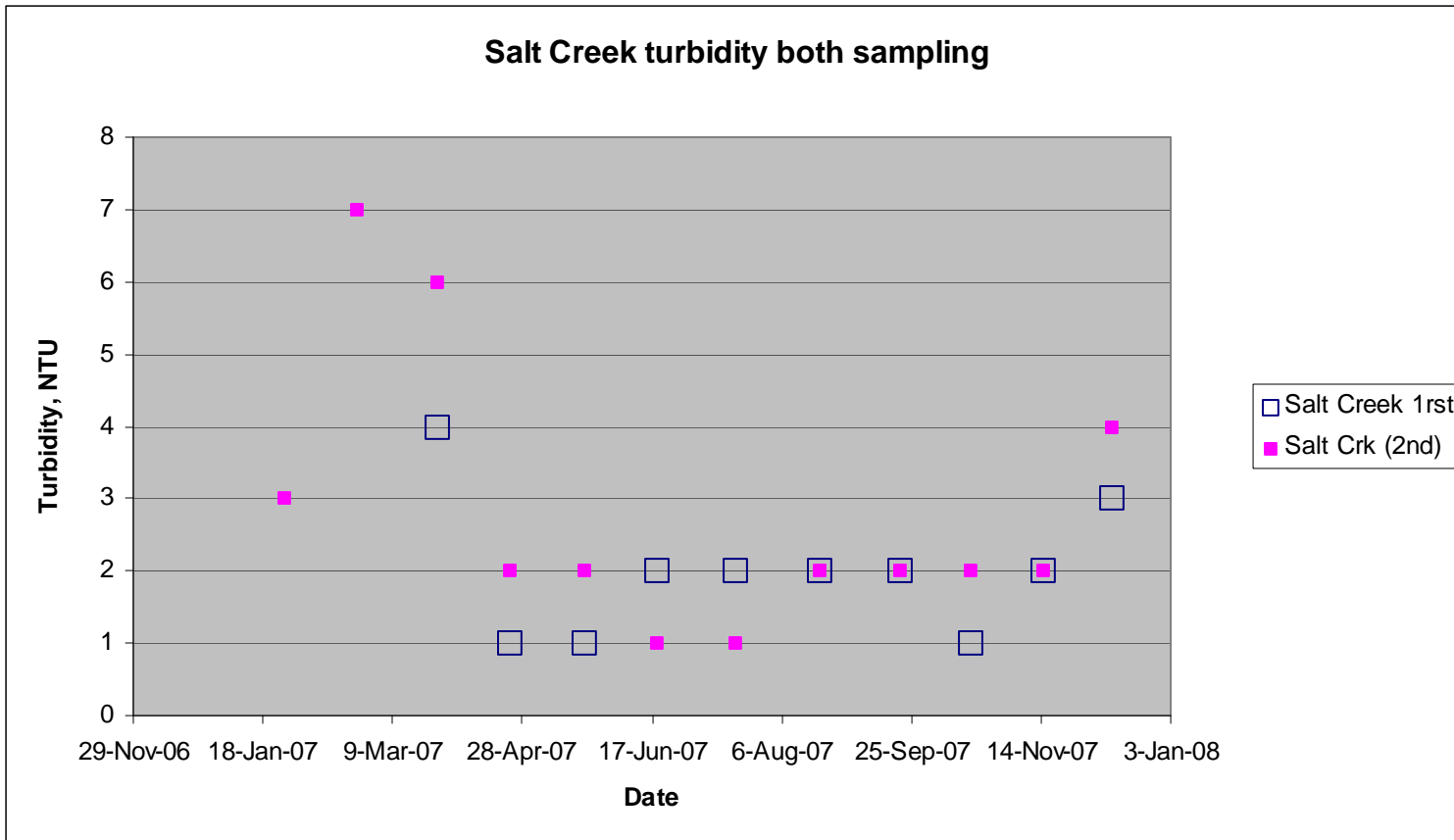


Figure 7. Turbidity at Salt Creek nearshore at first sampling (high tide) and second sampling (five hours after first sampling)

Discussion

The water quality parameters temperature and dissolved oxygen define adequacy of fish habitat. The Washington Department of Ecology standards specify marine water DO minimum levels of 5.0 mg/l to be good quality, and 7mg/l to be extraordinary quality. Temperature standards specify a marine water temperature (highest one day maximum) to be 22 degrees C to be fair quality, and 13 degrees C one day maximum to be extraordinary quality.

In freshwater systems temperatures above 60 degrees F (15.56 degrees C) affect fish growth and mortality (Washington. Department of Ecology). Temperatures above 17.5 degrees will impact fish migration and rearing. Temperatures above 15 degrees C will affect juvenile salmon use of the estuary (Fresh 2006). Sensitivity may be species specific and dependant on age of fish, and length of exposure. Hanson 1997 determined that juvenile Chinook salmon response varied with length of exposure to elevated temperatures and had significant mortalities, with different rates, at 18 degrees and higher. Chinook show marked avoidance of oxygen concentrations near 1.5, 3, and 4.5 mg/l in the summer at mean temperatures of 18.4 degrees C, but no avoidance to DO levels of 6 mg/l at lower temperatures of 11.8-13.2 degrees C. Coho optimum temperature for rearing juveniles (freshwater) is 12-14 degrees C. Temperatures above 26 degrees C can be lethal for rearing juvenile fish.

Juvenile salmon use the nearshore for outmigration from their natal streams, rearing, and shoreline migration. Water quality, and in particular temperature, DO, salinity, and turbidity plays a critical role in their habitat use including immigration, residence time, feeding, and emigration out of estuaries (California Department of Fish and Game 2004; Fresh 2006; Webster and Dill 2006). While present in the nearshore year round, juvenile salmon use of the nearshore has strong seasonal peaks. Juvenile chum are dominant in the central and western Strait nearshore from March-June. Coho and Chinook are prevalent from April thru October (Shaffer et al in prep). The majority of coho and Chinook are found along Salt Creek and Elwha nearshore areas. Far fewer were observed along the Pysht and Twins nearshore.

Overlapping juvenile salmon nearshore timing with water quality results of this study provides a few key elements for consideration. While the water quality observed in this study met or

exceeded the Washington Department of Ecology standards for good marine water quality there are a few potential warning signs. The temperatures at two sites, Pysht and Salt Creek, neared state water quality exceedance standards, and reached or exceeded threshold temperatures for juvenile salmon. Temperature at the Pysht reached threshold levels early in the season, and during the fish outmigration period. Salt Creek reached higher maximum temperatures, and lower dissolved oxygen, but did so much later in the salmon outmigration period.

The early onset of high temperatures may be an important determining factor in low Chinook and coho abundance in the Pysht estuary, and should be a high priority for restoration in the watershed. The delay in onset of high temperatures and low DO at Salt Creek may allow it to continue to support some of the highest coho densities of the central and western Strait nearshore (McHenry et al 2004; Shaffer et al in prep) and indicate that the Salt Creek estuary is at high risk for temperature problems. Riparian areas in the lower river, critical for mainlining healthy water quality, should be a top priority for preservation.

It is also interesting to note the seasonally high difference in Salt Creek nearshore water quality within one tidal cycle. Temperature and turbidity in the nearshore lower creek are clearly affected by tide. During spring and summer months temperatures may be much higher during the low part of the tidal cycle. Turbidity is also influenced by tide, with higher turbidity during low tide in the nearshore during late winter and spring months. Combined these observations are clear indications that watershed conditions can dominate nearshore water quality for at least portions of the day. It is therefore important to manage water quality in the watershed for nearshore considerations.

Maintaining and restoring healthy water quality in the nearshore is also important to preserving intact fish assemblages critical for a healthy ecosystem. For example, American shad, (*Alosa sapidissima*) an anadromous non-native fish nuisance species introduced to the Columbia river from the east coast in the 1870's, has displaced salmon in other systems in Washington (for example, over 4.0 million shad were recorded in the Columbia River in 1980 see WDFW 2002). American shad were collected from the shorelines and lower river of Salt Creek and shoreline of Pysht estuary during the WDFW lead 2007 nearshore assessment (see Chapters 1,3, and 6 of this report).

While thresholds are not documented, shad behavior is documented to be tied directly to water quality. Shad are observed to migrate in waters that exceed 11 degrees C and shad spawning is documented to be inhibited at *or below* 13.9 degrees C (Acolas et al 2006). The presence of this fish species at the Pysht and Salt Creek nearshore, the two sites with the highest water temperature, is a very strong warning signal to restore water temperatures at these systems as a precautionary measure to prevent establishment of this non-native and highly undesirable species.

The data provided in this basic water quality study begin to provide insight into the fundamental water quality parameters of the nearshore of key areas along the central and western Strait of Juan de Fuca. More detailed and long term monitoring of these and additional sites, is recommended to fully understand the physical parameters so important to habitat function and restoration.

Acknowledgements

Streamkeepers of Clallam County provided water quality equipment, protocols, and volunteer staff. Ed Chadd provided thoughtful manuscript review. Private land owners Merrill Ring Corporation and in particular Norm Schaff and Joe Murray provided property access and study support. Peninsula College provided intern support. Melanie Roed, Western Washington University, Dwight Berry, Peninsula College Center of Excellence, Sean Oden, and Jack Ganzhorn Peninsula College provided field assistance and technical support.

References

Acolas M. L., V. Véron, H. Jourdan, M.L. Bégout*, M.R. Sabatié and J.L. Baglinière 2006 Upstream migration and reproductive patterns of a population of allis shad in a small river (L'Aulne, Brittany, France). ICES Journal of Marine Science: Journal du Conseil 2006 63(3):476-484

California Department of Fish and Game. 2004. Recovery strategy for California coho salmon. Report to the California Fish and Game Commission. 594 pp. Copies/CDs available upon request from California Department of Fish and Game, Native Anadromous Fish and Watershed Branch, 1416 9th Street, Sacramento, CA 95814, or on-line: <http://www.dfg.ca.gov/nafwb.cohorecovery>

Fresh, K. 2006. Juvenile Pacific salmon in Puget Sound. Puget Sound Nearshore Partnership Report No. 2006-06. Published by the Seattle District, US Army Corps of Engineers. Seattle, Washington.

Hanson, C.H. 1997. Acute temperature tolerance of juvenile Chinook salmon from the Mokelumne river. Hanson Environmental, Walnut Creek, California.

McHenry, M., R. McCoy, and M. Haggerty. 2004. Salt Creek watershed: an assessment of habitat conditions, fish populations and opportunities for restoration. Lower Elwha Klallam Tribe, Port Angeles, Washington.

Shaffer, J.A. and T. Ritchie. In review. Fish use of the Salt Creek nearshore. Washington Department of Fish and Wildlife, Port Angeles, Washington.

Shaffer, J.A. J. Schilke, M. McHenry, and J. Murray, In review. Fish use and water quality of the Pysht nearshore. Washington Department of Fish and Wildlife, Port Angeles, Washington.

Washington Department of Fish and Wildlife 2002. Columbia River Fish Runs and Fisheries 1938-2000. Washington Department of Fish and Wildlife, Olympia, Washington.
<http://wdfw.wa.gov/fish/columbia/index.htm>

Washington Department of Ecology water quality statute effective 12/21/06. RCW 90.48.035. 06.23.117 (order 06-04) 173-201A-210.

Webster, S. J. and L.M. Dill 2006. The energetic equivalence of changing salinity and temperature to juvenile salmon. *Functional Ecology*. 20:621:629.

Appendix 1. Raw data. Note that there are data additional data provided: 1. There are data from three Pysht sample sites The Pysht estuary site was located at the old log dump (the side channel in front of Joe's house- these are data summarized in the report; Pysht Reed Creek (sampled at the request of Merrill Ring) was located at the mouth of Reed Creek; and the Pysht highway site (requested by WRIA 19 citizens) was located at the river intersection with the highway. The Pysht estuary site was the only site used in this summary. A more detailed discussion of Pysht water quality may be found in the Pysht nearshore fish use report (Chapter 5); 2. There are two Salt Creek measurements for each sampling date beginning in March 2007, when we began sampling Salt Creek at the beginning and end of the tide cycle). Only the second reading was used in the graphs of the data summary. The 16 September data were collected as a trial run and so not included in the graphs of the data summary.

Date	Location	Lat	Long	Time	mg/l DO	c Temp	ppt Salinity	ntu Turbidity	pH	% sat	microsiemens conductivity
14-Sep-06	E.Hoko	48.27343	124.35603	11:30	8.5	13.4	0.8	1	8.1	82	1161
14-Sep-06	Clallam R	48.25494	124.26209	12:00	9	12.3	0.9	1	7.9	85	1161
14-Sep-06	Pysht (hwy)	48.19561	124.12332	12:45	6.8	13.2	0.8	4	7.2	66	1253
14-Sep-06	W.Twin	48.16523	123.95267	13:15	10.4	11.7	0.1	1	7.6	95	225
14-Sep-06	Salt Crk	48.16161	123.70550	14:00	12.2	17	27.5	2	8.5	149	36000
15-Sep	Salt Crk	48.16161	123.70550	7:00	8.2	13	24.4	3	7.8	91	300000
26-Jan-07	E.Hoko	48.27342	124.35602	9:10	12.3	6.6	0	7	7.3	101	42
26-Jan-07	Clallam R	48.25477	124.26221	8:40	11.9	6.2	0.4	4	7.5	96	567
26-Jan-07	Pysht (hwy)	48.19033	124.14248	9:12	12.1	6.4	0	5	7.1	98	42
26-Jan-07	Pestuary (logyrd)sidechnl	48.21177	124.11052	9:40	11.5	6.7	1.4	6	7.3	95	1731
26-Jan-07	Preed crk	48.21009	124.12160	10:00	11.8	6.5	0	3	7	96	42
26-Jan-07	W.Twin	48.16535	123.95263	10:45	12.5	6.2	0.1	2	7.5	101	78
26-Jan-07	Salt Crk	48.16109	123.70580	11:22	12.2	6	0.8	3	7.3	99	965
23-Feb-07	E.Hoko	48.27335	123.35607	8:45	12	5.6	0	9	7.8	95	39
23-Feb-07	Clallam R	48.25477	124.26228	3:36	11.6	5.3	0.1	8	7.7	91	69
23-Feb-07	Pysht (hwy)	48.19032	124.14250	12:00	11.8	5.3	0	9	7.6	93	37
23-Feb-07	Pestuary (logyrd)sidechnl	48.21181	124.11039	3:36	10.9	6.5	0.6	12	7.2	89	822
23-Feb-07	Preed crk	48.21011	124.12163	8:24	11.8	5.7	0	3	7.7	94	38
23-Feb-07	W.Twin	48.16518	123.95268	3:36	12.3	5.3	0	7	7.7	97	49
23-Feb-07	Salt Crk	48.16107	123.70575	10:48	12.3	5.4	0.5	7	7.3	97	694
26-Mar-07	Salt Crk	48.16114	123.70569	7:15	11.5	6.4	1	4	8.2	94	1303

Date	Location	Lat	Long	Time	DO	Temp	Salinity	Turbidity	pH	% sat	conductivity
26-Mar-07	E.Hoko	48.27312	124.35647	8:30	11.3	6.8	0	31	7.9	93	37
26-Mar-07	Clallam R	48.25472	124.26226	8:51	10.8	6.8	0.1	17	7.8	89	95
26-Mar-07	Pysht (hwy)	48.1908	124.14256	9:30	11.5	6.4	0	18	7.6	93	36
26-Mar-07	Pestuary (logyrd)sidechnl	48.2174	124.11036	10:00	10.7	6.9	0.6	13	7	88	841
26-Mar-07	Preed crk	48.21021	124.12171	10:15	11	7	0	4	7.4	90	35
26-Mar-07	W.Twin	48.1654	123.95264	10:55	11.9	6.4	0	12	7.6	97	42
26-Mar-07	Salt Crk	48.16105	123.70557	11:30	11.5	6.6	0.2	6	7.4	94	253
23-Apr-07	Salt Crk	48.16112	123.70576	6:20	10	7.8	0.9	1	7.9	86	1155
23-Apr-07	E.Hoko	48.27338	124.35607	7:30	10.6	8.5	0	1	8.1	91	44
23-Apr-07	Clallam R	48.25461	124.26195	8:00	10.5	8.3	0.7	1	7.4	90	1011
23-Apr-07	Pysht (hwy)	48.19015	124.14251	8:30	11	7.9	0	1	7.7	93	46
23-Apr-07	Pestuary (logyrd)sidechnl	48.21178	124.11039	9:05	10.1	9.6	5.1	3	6.9	92	6380
23-Apr-07	Preed crk	48.21006	124.12169	9:20	11	7.9	3.3	2	7.3	95	4122
23-Apr-07	W.Twin	48.16536	123.95570	10:00	12.8	6.9	0	1	8.1	105	58
23-Apr-07	Salt Crk	48.16112	123.70578	10:30	10.7	9.7	6.8	2	7.2	98	8430
05/22/2007*	Salt Crk	48.10071	123.42600	6:20	9.8	8.7	1.7	1	7.4	85	2256
05/22/2007*	E.Hoko	48.16484	124.21366	7:55	10.8	9.7	0	1	7.2	96	48
05/22/2007*	Clallam R	48.15285	124.15735	8:20	10	9.5	1.7	2	7	89	2299
05/22/2007*	Pysht (hwy)	48.11413	124.08533	8:55	10.6	10	0	1	7	94	53
05/22/2007*	Pestuary (logyrd)sidechnl	48.12707	124.06635	9:19	9	12.1	13	2	7.2	91	16340
05/22/2007*	Preed crk	48.12609	124.07303	9:40	10.9	9.5	1.5	2	7.4	96	2032
05/22/2007*	W.Twin	48.09915	123.57153	10:14	12.2	8.5	0	1	7.4	105	67
05/22/2007*	Salt Crk	48.09664	123.42344	10:50	17.8	13.2	2.7	2	8.9	172	3901
06/19/2007*	Salt Crk	48.16112	123.70576	6:25	9.8	10.7	6.5	2	7.8	83	8300
06/19/2007*	E.Hoko	48.27338	124.35607	7:45	10.4	10.7	0.7	1	7.5	94	980000
06/19/2007*	Clallam R	48.25461	124.26195	8:09	9.9	10.8	4.6	1	7.4	92	606000
06/19/2007*	Pysht (hwy)	48.19015	124.14251	8:52	9.7	12	0	1	7.3	90	70
06/19/2007*	Pestuary (logyrd)sidechnl	48.21178	124.11039	9:18	9.5	14.5	29.6	8	7.8	112	36510
06/19/2007*	Preed crk	48.21006	124.12169	9:38	9.1	11.3	7.8	3	7.2	88	9960
06/19/2007*	W.Twin	48.16536	123.95570	10:19	10.6	10.6	0.1	1	7.5	96	126
06/19/2007*	Salt Crk	48.16112	123.70578	11:02	11.5	15.1	4.3	1	8.2	118	6300
07/19/07	Salt Crk	48.16108	123.70575	5:45	5.7	13.2	19.5	2	7.5	61	24250
07/19/07	E.Hoko	48.27334	124.35625	7:03	9.2	14.9	0.7	1	6.8	92	1073
07/19/07	Clallam R	48.25487	124.26238	7:30	6.8	12.9	14.8	2	6.8	71	18640
07/19/07	Pysht (hwy)	48.19031	124.14239	8:11	8.7	15.5	0.1	1	7.2	87	82
07/19/07	Pestuary (logyrd)sidechnl	48.21175	124.11072	8:38	9.1	14	26.4	2	7.7	103	35

Date	Location	Lat	Long	Time	DO	Temp	Salinity	Turbidity	pH	% sat	conductivity
07/19/07	Preed crk	48.21004	124.12141	9:00	7.4	14.1	14.9	3	7.1	79	19
07/19/07	W.Twin	48.16539	123.95256	9:39	9.6	14.3	0.1	1	7.4	94	114
07/19/07	Salt Crk	48.16115	123.70585	10:14	9.6	15.6	6.4	1	7.7	100	9150
08/21/07	Salt Crk	48.16107	123.70571	0717	5.6	14.4	7.7	2	7.5	58	10660
08/21/07	E.Hoko	48.27329	124.35608	0838	9.2	13.8	0	2	7.6	89	75
08/21/07	Clallam R	48.25465	124.26221	0906	8.7	14	1.9	2	7.4	85	2781
08/21/07	Pysht (hwy)	48.19024	124.14247	0937	9.1	14.4	0	1	7.3	89	72
08/21/07	Pestuary (logyrd)sidechnl	48.2483	124.11068	1001	7.6	13.8	14.9	3	7.3	81	19220
08/21/07	Preed crk	48.21001	124.12162	10:19	8.2	13.9	6.7	2	7.4	83	9260
08/21/07	W.Twin	48.16549	123.95258	10:58	10.1	13	0.1	1	7.3	96	80
08/21/07	Salt Crk	48.16107	123.70573	11:33	11.2	15.7	7.6	2	7.9	118	10770
09/21/07	Salt Crk	48.16106	123.70582	6:45	7.73	12.64	23.61	2	7.41	83.1	29948
09/21/07	E.Hoko	48.27338	124.35602	7:59	9.81	11.43	0.17	1	7.89	89.9	269
09/21/07	Clallam R	48.25474	124.26221	8:21	9.24	11.24	0.44	5	7.33	84.8	305
09/21/07	Pysht (hwy)	48.1903	124.14249	8:52	9.97	11.38	0.05	2	7.45	91.5	76
09/21/07	Pestuary (logyrd)sidechnl	48.2118	124.11039	9:05	6.58	10.62	20.82	3	7.16	67.3	24411
09/21/07	Preed crk	48.21009	124.12169	9:24	7.31	10.67	16.67	2	7.31	73.2	20015
09/21/07	W.Twin	48.16148	123.95257	10:00	10.76	10.91	0.05	1	7.39	96.8	73
09/21/07	Salt Crk	48.16109	123.70579	10:30	9.93	14.17	26.9	2	7.62	111.9	33590
10/18/07	Salt Crk	48.16108	123.70577	8:10	4.33	10.22	26.05	1	7.12	85.5	20335
10/18/07	E.Hoko	48.16102	124.70570	9:19	9.5	9.09	0.03	3	7.71	82.4	45
10/18/07	Clallam R	48.25477	124.26220	9:37	9.12	8.72	0.36	9	7.27	78.5	501
10/18/07	Pysht (hwy)	48.1902	124.14242	10:12	9.45	8.5	0.03	2	7.3	80.9	50
10/18/07	Pestuary (logyrd)sidechnl	48.212	124.11063	10:28	9.22	8.81	3.63	2	7.21	81.2	4578
10/18/07	Preed crk	48.21002	124.12177	10:42	8.84	8.58	0.13	2	7.03	75.8	175
10/18/07	W.Twin	48.16535	124.95255	11:09	9.63	8.06	0.04	1	7.04	81.5	56
10/18/07	Salt Crk	18.16108	124.70573	11:36	6.82	10.28	27.79	2	7.51	72.7	31142
11/15/07	Salt Crk	48.1611	123.70575	7:40	7.99	7.89	16.43	2	7.63	73.4	15070
11/15/07	E.Hoko	48.27321	124.35611	8:50	10.88	8.8	0.03	9	8.15	93.7	42
11/15/07	Clallam R	48.25465	123.26224	9:10	10.45	8.54	0.04	7	7.49	89.5	65
11/15/07	Pysht (hwy)			9:32	10.62	8.71	0.03	5	7.48	91	43
11/15/07	Pestuary (logyrd)sidechnl	48.21179	124.11065	9:52	10.26	8.28	1.66	3	7.15	88.5	2147
11/15/07	Preed crk	48.21022	124.12176	10:06	10.08	8.43	0.03	2	6.98	86	44
11/15/07	W.Twin	48.16533	123.95279	10:34	11.42	7.93	0.03	3	7.22	97	49
11/15/07	Salt Crk	48.16101	123.70577	11:05	8.04	7.92	22.58	2	7.15	77.5	23950

Date	Location	Lat	Long	Time	DO	Temp	Salinity	Turbidity	pH	% sat	conductivity
12/11/07	Salt Crk	48.16106	123.70573	7:40	12.01	5.13	3.47	3	7.52	97.6	4080
12/11/07	E.Hoko	48.27342	124.35515	8:54	12.46	6.69	0.03	9	7.68	101.7	38
12/11/07	Clallam R	48.25469	124.26214	9:12	12.04	6.16	0.2	7	7.44	96.9	271
12/11/07	Pysht (hwy)	48.19013	124.14248	9:38	12.93	6.2	0.03	6	7.67	103.8	42
12/11/07	Pestuary (logyrd)sidechnl	48.21206	124.11069	10:09	11.8	6.2	0.04	3	7.37	94.8	50
12/11/07	Preed crk	48.21178	124.11070	9:56	12.11	6.22	1.58	4	7.17	98.5	1948
12/11/07	W.Twin	48.16544	123.95265	10:37	12.93	5.81	0.04	10	7.32	102.7	56
12/11/07	Salt Crk	48.16105	123.70573	11:07	12.66	5.16	2.13	4	7.19	100.8	2490