Executive Summary: Nearshore function of the central Strait of Juan de Fuca for juvenile fish, including Puget Sound Chinook salmon.

Anne Shaffer and Tyler Ritchie, Washington Department of Fish and Wildlife, 332 E. 5th Street Port Angeles, Washington 98362

Pat Crain, Olympic National Park 6100 E. Park Avenue Port Angeles, Washington 98362;

Matt Beirne, Lower Elwha Klallam Tribe Fish Hatchery Road, Port Angeles, Washington 98362

Cathy Lear, Clallam County 223 E. 4th Street Port Angeles, Washington, 98362

Funding provided by Salmon Recovery Funding Board, Contract # 07-1046, Cheryl Baumann is NOPLE coordinator, Tara Galluska, RCO project manager, Clallam Marine Resources Committee, Washington Department of Fish and Wildlife. Partners: Lower Elwha Klallam Tribe, Peninsula College, United States Fish and Wildlife Service, Western Washington University, and Elwha Nearshore Consortium.

Executive summary

This report summarizes findings from the SRFB funded nearshore assessment of the central Strait of Juan de Fuca for the period of March 2007-March 2008. The goal of this study was to define current fish use in the central and western Strait nearshore as a baseline to define regional restoration actions and priorities, with an emphasis on the nearshore restoration response associated with the upcoming Elwha dam removals. Key areas of central and western Strait of Juan de Fuca, from Pysht to Dungeness Spit, were categorized by geomorphic habitat types, and then assessed fish use in these habitat types for migration, rearing, and spawning, over a year period. The study was structured to assess fish use both within the Elwha drift cell and in comparative areas. Individual reports are provided in Chapters 1-9, and data are in Appendix A-K. Key findings from this work include:

1. Ecological function in the nearshore is complex, and genetic work reveals that there is a strong cross regional element to fish use of the Strait nearshore.
2. Ecological function in the nearshore has a very strong seasonal variation both within and across geomorphic habitat type;
3. Different geomorphic habitat types of the nearshore function differently, but the function appears complex. Statistical analysis reveals a significant difference in ecological function at the drift cell scale but not at lower resolution within Elwha and comparative

drift cells. Nearshore restoration projects should therefore be based on restoration priorities that are defined at the drift cell scale if the intent is to restore ecosystem function.

4. Ecological function by geomorphic habitat type varies with site and so it is not possible to predict habitat function based solely on geomorphic habitat type. For example, though the main channel nearshore of both Twins and Salt Creek are important for wild coho, the Twins lower river and nearshore appears to function much differently than lower river's of Salt Creek for juvenile coho. Within specific drift cells it is important to understand how these specific habitats work, and how future restoration actions will effect this function. In particular Twins, Salt Creek, Pysht and Elwha specific nearshore will require long term monitoring. The Elwha nearshore, will require modeling of fish use physical processes to predict restoration response, and so priority.
5. A number of important findings within the Elwha nearshore, all of which strongly link sediment processes to habitat function
    a. The majority of the Elwha drift cell, and in particular the embayed shoreline, bluff, and spit habitats, functions lower ecologically than comparative drift cells.
    b. Despite lower ecological function, the Elwha nearshore, including the embayed, spit and bluff portion of the drift cell, support the highest density of juvenile salmon, and in particular Chinook salmon, than any other area in the study. This combination of low ecological function but high salmon use lead us to conclude that the restoration of the Elwha drift cell is a top priority for the central Strait.
    c. The Elwha west estuary consists of 20% of the entire 80+acres of the Elwha estuary, but for the duration of this study supported upwards of 90% of salmon, and over 94% of Chinook salmon collected from the entire estuary. Sediment processes are theorized to dictate fish use of the east and west connected portions of the estuary. Sediment processes in the lower river of the Elwha are dynamic, and will be more so with dam removal. Given the fish's ability to discern available habitat it is therefore a priority to provide the most habitat possible for their use. The impounded portion of the west estuary, which comprises approximately 9% of the total estuary, had 40% of all fish collected, but none of the salmon.

6. ESA listed stocks of Puget Sound and Columbia River stocks of Chinook were documented to utilize the western Strait, including the Pysht, Crescent Bay, and Freshwater Bay shorelines. Management and recovery plans for these species need to reflect this distribution as soon as possible. Additional research defining more clearly this use is recommended;
7. Forage fish spawn findings provide a number of restoration and management recommendations:
    a. Documentation of surf smelt spawning along active feeder bluffs within the Dungeness drift cell. This discovery provides new insight into the unique nature of Strait high energy shorelines, and provide strong justification for revising management of feeder bluffs at regional, state, and national scale;
    b. There appears to be a correlation between adult and juvenile smelt and spawn density. This indicates that observations of variability in spawning may have a functional base that should be further defined. This relationship may be useful for predicting forage fish spawning beaches;
    c. The illusive nature of sand lance spawning combined with high sand lance juvenile and adult numbers bears additional monitoring and more detailed analysis.
8. Water quality, and in particular temperature, may in fact be a limiting factor for the lower rivers and side channels of the nearshore central Strait. Nearshore areas with elevated temperatures (Pysht and Salt Creek) were documented to have shad, a warmer water non-native species that has annually has significant interactions with Columbia river salmon returns. The similarities in water quality trends in river and nearshore of Salt Creek and Twins indicate linkages between the two. More detailed assessment of nearshore water quality specific to habitat function for fish, and specifically linkages between freshwater and nearshore water quality/temperature would be very wise. In the absence of this scale of assessment, rivers should be managed to preserve and restore healthy nearshore water quality, and in particular temperature. Increasing LWD and riparian corridors along the rivering and nearshore portions of watersheds, including the nearshore, and preventing shoreline development both in the river and shoreline, are recommended.

9. Fish use of shorelines and of kelp beds appears to have very high interannual and geographic variation. Use also appears to be related to variation in physical processes, including depth, and kelp density, of kelp bed habitat and life history.

Nearshore Management and Restoration Recommendations

Ecological indices, densities of ESA listed salmon, and forage fish spawn documented over the last twelve months has led to the following nearshore restoration priorities, details of which can be found in respective chapters. These recommendations should be incorporated into the Clallam County Shoreline Management Plan, Puget Sound and Columbia River Chinook recovery plans, and Puget Sound Partnership regional action plans for recovery.

1. Elwha drift cell is ecologically degraded, but heavily used by ESA listed salmon stocks. Sediment is the dominant limiting factor of the Elwha drift cell. The river does provide a very much reduced sediment delivery to the nearshore, and work on sediment circulation within the Elwha nearshore indicate that shorelines proximal to the Elwha river mouth may be slightly less sediment starved than those further away. This theory is supported by documentation of surf smelt spawn only along the portion of the Elwha drift cell the beach immediately adjacent to the Elwha river mouth (Freshwater Bay). Restoration of the degraded Elwha drift cell, including the feeder bluffs and Ediz Hook is therefore a top priority. Restoration of feeder bluffs and Ediz Hook will require additional modeling of anticipated sediment processes to define actions appropriate to achieve the highest restoration response. This action is time sensitive and must occur prior to dam removal.
2. The Elwha west estuary is one of the highest functioning areas for ESA salmonid use in this study. Sediment dynamics in the oveall Elwha estuary are dynamic, and will continue to be so thru dam removal. Estuaries are well known bottle necks for salmon recovery. Restoring the Elwha estuary is therefore a top priority to achieve ecosystem restoration intended with dam removals. At a minimum, short term restoration of fish use via dike revision for fish passage is a high priority for action prior to dam removal in order to provide fish the highest estuary habitat opportunity during and after dam removals;
3. Preservation of Elwha west estuary and shoreline, including conservation easement and acquisition of private properties of the west estuary and Freshwater Bay shoreline, is a high priority that should begin immediately. This work can happen independent of the

dam removal timeline, but should begin immediately due to the increasing development along the shoreline, which is almost completely in private property status;

4. Crescent Bay and Salt Creek nearshore are some of the highest intact and ecologically functioning areas of nearshore in the study. Water quality, in particular temperature, is a concern for the Salt Creek nearshore. The Crescent Bay and lower Salt Creek are entirely privately owned, and so are at high risk for future degradation from development. Cresecent Bay and Salt Creek nearshore are therefore a priority for acquisition and restoration. Forage fish use of Crescent Bay for migration appears very high. In particular sand lance use of Crescent Bay indicates spawning-additional long term monitoring of this area is recommended.
5. The Twins nearshore appears to be function much differently for salmon than other nearshore areas of the central and western Strait. Understanding this function is critical for successful long term restoration and preservation of critical Twins salmon resources .is necessary to define fish use, and restoration needs of the Twins lower river. Continued long term monitoring of nearshore fish use of the Twins nearshore is needed.
6. The Twins shoreline has extremely high diversity and richness, and supports well documented forage fish spawning. The nearshore Twins appears to be functioning differently for salmonids than others nearshore areas of the central and western Strait. This difference in function may be due to nearshore alterations of the lower rivers and shoreline that have resulted in shifts in nearshore habitat function. Given the Twin's importance for coho, steelhead, and cutthroat restoration actions of acquisition and restoration of Twins nearshore (both estuary and shoreline)are a high priority, as well as further detailed assessment to understand salmon use of this nearshore area;
7. The similarities in water quality trends in river and nearshore of Salt Creek and Pysht indicate linkages between the watershed and nearshore water quality. More detailed assessment of nearshore water quality specific to habitat function for fish, and specifically linkages between freshwater and nearshore water quality/temperature would be very wise. In the absence of this scale of assessment, these rivers should be managed to preserve and restore healthy nearshore water quality, and in particular temperature. Increasing LWD and riparian corridors along the riverine and nearshore portions of

watersheds, including the nearshore, and preventing shoreline development both in the river and shoreline, are recommended.

8. Fish use of kelp beds appears to have very high interannual variation. Use also appears to be related to habitat type and variation in physical processes of kelp bed habitat. Continued long term monitoring of nearshore fish use of Strait of Juan de Fuca kelp beds, to better understand nearshore use, interannual variation and restoration response to restoration actions
9. Feeder bluffs throughout the inland waters of Puget Sound need to be managed for forage fish spawning. State wide management of feeder bluffs needs to be revised immediately assess feeder bluff beaches for forage fish spawning, and sediment management associated with feeder bluffs needs to be expanded to include not only volume of material provided, but the rate at which bluffs feed to the nearshore.
10. The feeder bluffs of the Dungeness drift cell are currently privately owned and at high risk of degredation. Their acquisition and preservation is a top priority;
11. Juvenile Puget Sound Chinook and numerous listed stocks of Columbia river juvenile Chinook have been documented to use the central and western Strait nearshore. Recovery plans boundaries for these species need to be revised to formally include these geographic areas.

Background and Introduction

The nearshore of the central Strait of Juan de Fuca is an important migratory corridor for many Puget Sound salmonid populations including Puget Sound Chinook, Strait of Juan de Fuca/Hood Canal Summer Chum, and sea run cutthroat, bull trout, as well as the forage fish on which they depend. Despite the critical importance of this area of Puget Sound, Strait nearshore habitat function including species, populations, and life history strategies of juvenile salmon and forage fish that use the nearshore, and the linkages with the wider Puget Sound are not understood, but necessary for defining nearshore restoration priorities.

Priority nearshore habitats within the Strait are theorized to be: lower rivers and estuaries, eelgrass and kelp beds, and sandy shorelines within 30 m MLLW. These areas are also the most degraded nearshore habitats. Sedimentation and hydrologic processes define nearshore Strait, and, due to diking and armoring of lower rivers and shorelines, in river dams, and overwater structures, are also the dominant limiting factors impeding salmon recovery

Course scale analysis of habitat use is an important tool for defining restoration actions in fresh and salt water systems (Airame, 2003; Steele et al 2004). This project defines fish use in each of these priority habitats and may provide the basis for prioritizing process based conservation/restoration actions within the central Strait nearshore. Restoration priorities defined by this course scale analysis will focus on restoring processes, and include removing or modifying structures in lower rivers, shorelines, and overwater structures. Data from this work will also provide basic fish use information for future quantitative course scale analysis that will be a collaborative effort of the WDFW, Elwha Tribe, NOAA, and USGS. The results of these modeling efforts will provide regional managers with tools to identify and prioritize salmon habitat preservation/restoration projects within the Strait of Juan de Fuca. This project is a stated priority for salmon recovery within the Elwha and Dungeness salmon recovery chapters of the Shared Strategy (Redman 2005) and the North Olympic Peninsula Lead Entity (NOPLE) nearshore restoration strategy (Barkhuis 2005) and follows nearshore restoration framework developed by Olympic Peninsula nearshore managers (Shaffer et al 2005).

The nearshore habitat, delineated by the physical features of tidal influence and light limitation, is generally defined as the area that extends from treeline to –30 meters (90 feet) Mean Low Low Water (MLLW). The nearshore is a critical component to marine ecosystems, and the nearshore Strait of Juan de Fuca, which offers 294 kilometers of shoreline, is a critical component of a functioning Puget Sound ecosystem. It is the conduit for species migrating to and from inland marine waters of Puget Sound and British Columbia.

Nearshore habitat forming process and function of the Strait of Juan de Fuca are diverse and complex (Carter and VanBaircom 1998; Miller et al 1980; Simenstad et al 1988; VanBlaircom and Chambers 2003;). In general, the nearshore Strait of Juan de Fuca provides critical feeding, refuge, and migration corridor for many species including three federally- and or state-listed salmon (Puget Sound Chinook, Strait of Juan de Fuca/ Hood Canal Summer Chum, and Bull Trout), as well as sockeye, pink, and chum salmon, sea run cutthroat and steelhead, many rockfish species (including copper, quillback, and black rockfish) and bottom fish, including halibut. Forage fish, including surf smelt, sand lance, and herring, use Strait shorelines heavily for spawning, feeding, and migration. This use depends on physical and biological features (Shaffer 2004,2001; Shaffer et al. 2003; VanBlaricom and Chambers 2003). Central Strait nearshore habitats theorized to be most critical for juvenile salmon survival are lower rivers and estuaries, eelgrass and kelp beds, and sandy shorelines.

Processes that define nearshore habitats of the Strait of Juan de Fuca are equally diverse. The Strait is high energy and has high variability in it's physical and biological features. Sedimentation is a defining process of the central Strait nearshore (Downing 1983). Along the central Strait of Juan de Fuca, coastal bluffs have been documented to contribute in excess of 70% of shoreline material (CoE 1971). Rivers provide the remaining amount. Hydrologic and sediment processes are the dominant limiting factors for central Strait nearshore (Barkhuis 2005). Habitats of highest priority are also those most degraded by these limiting factors.

Unfortunately we have little information on historic or current juvenile fish use of the central Strait nearshore areas; how this use compares to historic and future habitat conditions (Todd et al 2006) or the potential importance of each of these areas if restoration occurs**.**

We therefore need basic fish use information to develop a comprehensive and process based restoration plan for the nearshore. The upcoming dam removal and variable nature of our nearshore habitats makes this nearshore fish use assessment extremely time sensitive. If we don't act now we will lose an invaluable opportunity.

This project provides a basic fish use assessment that is process based and ecosystem focused. With it we can define current habitat use and, with collaborative physical and biological models defined by regional managers and scientist (Shaffer et al. 2005), predict future fish use. Based on these predictions, we will be able define areas of top priority for preservation and restoration

Without this fish use information it is impossible to build an informed nearshore restoration action plan.. Nearshore restoration will continue to be based on site specific interests and opportunities rather than nearshore ecological function. We also lose our ability to capitalize on additional potential restoration opportunities that may be associated with the upcoming dam removals

The objectives of this project therefore are to define fish use of habitats within the Strait of Juan de Fuca nearshore, for both the eastern and western-WRIA 18 and 19), including:

1. The species, populations, and life history strategies of juvenile salmon and forage fish and when they are present, and;
2. The distribution of juvenile salmon within areas by general habitat type and what are salmon doing within specific habitats.

This assessment of juvenile salmonid and forage fish use of the nearshore is based on a nearshore strategy developed by a nearshore workgroup (Shaffer et al. 2008) that includes both a conceptual and quantitative (analytical) model.

Approach and Methods.

The project follows the Salmon Recovery Funding Board (SRFB) guidelines for nearshore assessments (SRFB Steering Committee 2005). It addresses a priority data gap for both WRIA 18 and 19 identified in the NOPLE salmon strategy (Barkhuis 2005). The work is an identified priority in the Elwha River fish restoration plan section of the watershed recovery chapter of the Shared Stategy. This project also follows the multi-agency strategy to define nearshore restoration priorities (Shaffer et al 2005), as well as recommendations from the recent Clallam MRC 2004 report entitled ‘Nearshore restoration of the Central Strait of Juan de Fuca’. The project is ecosystem based.

Nearshore habitats were classified based on the geomorphic analysis developed by Mcbride and Beamer 2004 and specific study sites within each habitat type chosen based on primarily on information and data gaps. Sites for each sampling are provided in Table 3. Selected habitats function for fish use, including salmon populations, and in particular fish abundance and spawning activity, were defined by WDFW and Elwha professional staff through beach seine and forage fish spawning surveys at twleve sites. This field work was conducted collaboratively with Peninsula College and Western Washington University, and build partially upon telemetry work currently underway on the Elwha River and Twins system by WDFW, NOAA, Lower Elwha Klallam Tribe, and Jamestown S'Klallam Tribe. Surveys all employed PSAT and WDFW protocols and standard sampling methods (Figure 2).

Results

The field work began in March 2006, within two months of contract signing. It should be emphasized that Peninsula College Fisheries and Center for Excellence (REU) and Western Washington University students were the backbone of this project's field work, and that funding for these students was provided by both the Clallam Marine Resources Committee and SRFB.

Seining.

A total of 459 seines were sampled over the thirteen month period, over sixty three percent of which were conducted between March and September 2007. A total of 181 of these were from embayed (131 seines), spit (25 seines), and bluff (29 seines) sites, collectively called 'shoreline sites'. Challenging sampling conditions of swell and fog, combined with limited agency resources resulted in the majority of shoreline sampling occurring along sites that we could access by shore. Dungeness Bluffs, Dungeness Spit, Ediz Hook, and Elwha Bluffs, which are accessed by boat only, were sampled only from May-October 2007, and so at a lower proportion than other sites. For all fish caught from all sites, the catch per unit effort (CPUE) was 63% during spring and summer sampling; 32% for fall and winter.

The species richness varied seasonally by site and date (Figure4 A-D) Shorelines and lower rivers had the highest species diversity, bluffs and spits the lowest. Richness increased during spring and summer months across all sites except Freshwater Bay shoreline. Key findings of these data include the clear trend that shoreline, spit, and bluff habitats within the Elwha drift cell had consistently lower richness than comparative areas outside the Elwha drift cell. Overlapping this visually with eelgrass mapping conducted in 2007 by Norris et al indicates that the Elwha drift cell has very high fish use and habitat potential. In contrast, species richness in the Elwha side channel was highly variable, and for a number of sampling s had higher species richness than all other side channels, indicating its relative strong importance for juvenile fish, even in impaired state.

Community diversity also varied by habitat type (Figure 8a-d). Diversity was highest along shorelines and lower rivers, and lowest along feeder bluffs and spits. Habitats within the Elwha drift cell over all showed consistently lower diversity than those of comparative sites. Further, modified nearshore areas outside of the Elwha drift cell appear to have lower diversity than those that are unaltered comparable habitats (for example, diversity of the Pysht shoreline not only similar to that of Freshwater Bay, it is significantly lower than that of unaltered Crescent Bay and Twins shorelines).

Genetics analysis

Juvenile Chinook salmon collected during spring and summer 2007 seining were collected and analyzed by the WDFW genetics lab to determine stock identity. Results are provided in Table 5 (Kassler et al 2008). Key findings of this work include the presence of Elwha Chinook in the Pysht, Freshater Bay, and Crescent Bay. The current critical habitat boundary for Puget sound Chinook ends at the eastern edge of the Elwha river mouth. Documented use of western Strait shorelines by federally listed species supports the recommendation that the western boundary for this species should be moved to the entrance of the Strait of Juan de Fuca. Also of interest is the consistent use of Pysht and Crescent Bay nearshore by Columbia River and coastal stocks, including a number of federally listed coastal stocks.

Forage fish spawn surveys.

Sites within the Elwha and comparative drift cells were sampled for surf smelt and sand lance spawn during July-September 2007 and 2008, and November-January 2008, using standard forage fish spawn survey methodologies (see Moulten and Pentilla 2005). See the chapter on forage fish spawning for details.

Surf smelt spawning was documented along the embayment within the Elwha drift cell (Freshwater Bay) and along the feeder bluffs of the comparative Dungeness drift cell, called

Dungenness bluffs. These results provide, for the first time, a new and important identity to feeder bluffs and their role in the nearshore functional processes. The importance of active feeder bluffs for providing spawning material for distant fish spawning beaches is well accepted. Feeder bluffs however, are not currently managed as forage fish spawning beaches.

Given the very high energy of the Dungeness feeder bluff area we conclude that surf smelt spawning on feeder bluffs is dependant on the rate at which the bluffs feed material to the beach in order to maintain the relatively small material needed for spawning. This leads to the important conclusion that feeder bluffs must be managed for not only volume, but the rate at which they feed to the nearshore.

It also leads to the region specific recommendation for preserving the feeder bluffs of Dungeness drift cell, an extremely high energy area relative to other regions of Puget Sound.

Snorkeling surveys.

A total of 16 snorkeling surveys were conducted along the geomorphic habitat types of the Elwha and comparative drift cells. See the report on kelp snorkeling surveys. From these we conclude that kelp bed function for fish use is related to geomorphic habitat type, and that beds in the Elwha drift cell currently functions at a lower level than those in comparative areas. Strong differences in forage fish densities compared to surveys conducted seven years ago lead us to recommend long term surveys to better define long term trends in kelp bed use and response to upcoming restoration events.

Conclusions.

The reader is directed to both the executive summary and individual reports for specific discussions and important recommendations. The recommendations should be implemented as soon as possible.

Acknowledgments.

The study was sponsored by the WDFW Habitat Program, Science Division thru the North Olympic Lead Entity (NOPLE). The Clallam Marine Resources Committee (MRC) has funded

Peninsula College Fisheries and Western Washington University student participation interns including Jesse Charles, Chris DeSisto, Bryan Hara, Erica Hirsh, Keelan Hooper, Mario Laungayan, Romy Laungayan, Ross McDorman, Sean Oden, Tiffany Nabors, Rebecca Paradis, Jacob Ray, Tyler Ritchie, Melanie Roed, Justin Rondeau, Trista Simmons, Ben Warren, Karen Wilkie, Eric Wood, and Steve Wyall from WWU, REU, and PC. Their college supervisors were Ms.Nancy Bleuston-Johnson, Mr. Jack Ganzhorn, and Dr. Dwight Barry of WWU and Peninsula College. Chuck and Neva Novak and Ben and Irene Palzer continue to provide landowner access to the private beach at Crescent Bay. Malcom Dudley has provided invaluable private land owner support and access. Pam Lowry has provided access to forage fish spawn sampling locations in Freshwater Bay. Joe Murray and Merrill-Ring, continue to provide access to Pysht sampling sites. Charlie and Kendra Parks assisted with field sampling. Pam Sangunetti and Kevin Ryan (USFWS) continue to provide invaluable partnership and field support. Field and collaborative support provided by Mat Beirne, Rob Elofson, Mike McHenry, (Lower Elwha Klallam Tribe). The WSU Beach Watchers, Cathy Lear (Clallam County), Dave Parks (DNR), Pat Crain and Brian Winters (ONP), Ross Fuller, Mike Sharpf, Chris Byrnes, Roger Mosley, Dan Penttila, Dan Doty, and Tim Quinn (WDFW), Bruce McCarter (DFO), Jon Warrick, Jeff Duda (USGS), all of whom provided valuable technical assistance. Jenna Schilke lead much of the field work. Kurt Fresh and Anna Kagley (NOAA) provided a loaner net for seining, seining data sheet format, and vials and sample collection methodology for genetic sampling of juvenile Chinook. Todd Kassler and Dr. Ken Warheit, (WDFW), provide genetic analysis of the collected fish. Ed Chadd, Streamkeepers, provided review of the water quality report. Thank you to all.

References

Airame, S. 2003. Appling ecological criteria to marine reserve design: a case study. Ecol.App. v13 (1): 150-184

Barkhuis, S. 2005. North Olympic Peninsula Lead Entity Salmon Habitat Recovery Project Strategy. NOPLE Clallam County, Port Angeles, Washington.

Carter S.K. and G.R. VanBlaircom 1998. A survey of nearshore benthic habitats of the Strait of Juan de Fuca from Kydaka Point to Port Angeles. Final report to the WDFW. University of Washington, School of Fisheries, Seattle, Washington.

Draut, Amy E., Logan, Joshua B., McCoy, Randall E., McHenry, Michael, and Warrick, Jonathan A., 2008, Channel evolution on the lower Elwha River, Washington, 1939-2006: U.S. Geological Survey, Scientific Investigations Report 2008-5127, 26 p. [http://pubs.usgs.gov/sir/2008/5127/].

Downing, J. 1983. The coast of Puget Sound: Its processes and development. Washington SeaGrant, University of Washington Press, Seattle, Washington. 126 pages.

Haggerty, M. in prep. Water Resource Inventory Area 19 (Lyre-Hoko) Salmonid Restoration Plan. http://mhaggertyconsulting.com/uploads/ WRIA19RPDraft5_2 .pdf.

Haring, D. 1999. Salmon and steelhead habitat limiting factors, WRIA area 18. Washington Conservation Commission Final Report, Olympia, Washington.

McBride, A. and E. Beamer 2004. Geomorphic Classification for Estuaries and Shorelines Within Whidbey Basin. Skagit System Cooperative, La Conner, Washington.

Miller, B.S., C.A. Simenstad, J.N. Cross, K.L Fresh, and S.N. Steinfort. 1980. Nearshore fish and macroinvertebrate assemblages along the Strait of Juan de Fuca including food habits of the common nearshore fish. Final report of three years sampling 1976-1979.EPA No. D6-E693-EN.

Office of Environmental Engineering and technology office of Research and Development US EPA Washington DC.

Randle, T. J., J. Bountry, B. Jackson, and G. Smille. 2004. Elwha River restoration project draft sediment management and monitoring plan, based on recommendations of the Elwha River Physical Processes Monitoring Workshop, 13-17 August, 2001, Port Angeles, WA.
U.S. Department of the Interior, Bureau of Reclamation, Denver, CO and National Park Service, Fort Collins, CO.

Redman, S., D. Myers, D.Averill, K. Fresh, B. Graeber. 2005. Regional nearshore and marine aspects of slamon recovery in Puget Sound. Shared Stategy for Puget Sound, Seattle, Washington.

Shaffer, J.A, P. Crain, B. Winter, M. McHenry, C. Lear and T. Randle. 2008. Nearshore Restoration of the Elwha River Through Removal of the Elwha and Glines Canyon Dams: An Overview. Northwest Science. 82 (Special Issue).

Shaffer, J.A., L. Ward, P. Crain, B. Winter, K. Fresh, and C. Lear, 2005.. Elwha and Glines Canyon dam removals: nearshore restoration and salmon recovery of the central Strait of Juan de Fuca In. Proceedings Puget Sound Research 2005. Puget Sound Action Team, Olympia, Washington.

Shaffer, J.A. 2004. Nearshore mapping of the Strait of Juan de Fuca: II. Preferential use of nearshore kelp habitats by juvenile salmon and forage fish. in Proceedings, Puget Sound Research Conference 2003, Puget Sound Water Quality Action Team, Olympia Washington.

2000. Seasonal variation in understory kelp bed habitats of the Strait of Juan de Fuca. Journal of Coastal Research 16 (3) 768-778.

Shaffer, J.A., R. Moriarty, J. Sike and D. Penttila. 2003. Nearshore habitat mapping of the Strait of Juan de Fuca: Phase 2. Final report to the Northwest Straits Commission, Clallam Marine

Resources Committee, and Washington Department of Fish and Wildlife. WDFW, Olympia, Washington.

Simenstad, C..A.,R.M. Thom, K.A. Kuzis, J.R. Cordell, and D.K. Shreffler. 1988 Nearshore Community Studies of Neah Bay, Washington. University of Washington Fisheries Research Institute. FRI-UW-8811 Seattle, Wa.

Steele, E.A., B.E. Feist, D.W. Jensen, G.R. Pess, M.B. Sheer, J.B. Brauner and R.e. Bilby. 2004. Landscape models to understand steelhead (Oncorhynchus mykiss) distribution and help prioritize barrier removals in the Willamette basin, Oregon, USA. Can. J. Fish Aquat. Sci. 61: 999-1011.

Stolnack, S. and R. Naiman. 2005. Summary of Research and Education Activities in the Elwha River Watershed and Adjacent Coastal Zone. University of Washington, Seattle.
United States Army Corps of Engineers. 1971. Report on survey of Ediz Hook for beach erosion and related purposes.Part II. Seattle District Army Corps of Engineers, Seattle, Washington.

Todd, S., Fiztpatrick, N., Carter-Mortimer, A., and Weller, C. 2006. Historical changes to estuaries, spits, and associated tidal wetland habitats in the Hood Canal and Strait of Juan de Fuca regions of Washington State. Unpublished technical report, PNPTC TR 06-01, Kingston, Washington. 101 p. plus appendices.

Unites States Fish and Wildlife Service 1995. Marine Resources of the Elwha River Estuary. USFWS North Pacific Coast Ecoregion, Olympia, Washington

VanBlaricom, G. R. and M. D. Chambers 2003. Testing a charismatic paradigm: Consequences of a growing sea otter population for nearshore benthic communities along the south shore of the Strait of Juan de Fuca. Washington Cooperative Fish and Wildlife Research Unit Biological Resources Division, U.S. Geological Survey School of Aquatic and Fishery Sciences, University of Washington, Seattle, Washington

Warrick, J. A., G. R. Cochrane, Y. Sagy, and G. Gelfenbaum. 2008. Nearshore substrate and morphology offshore of the Elwha River. Northwest Science 82 (Special Issue):153-163.

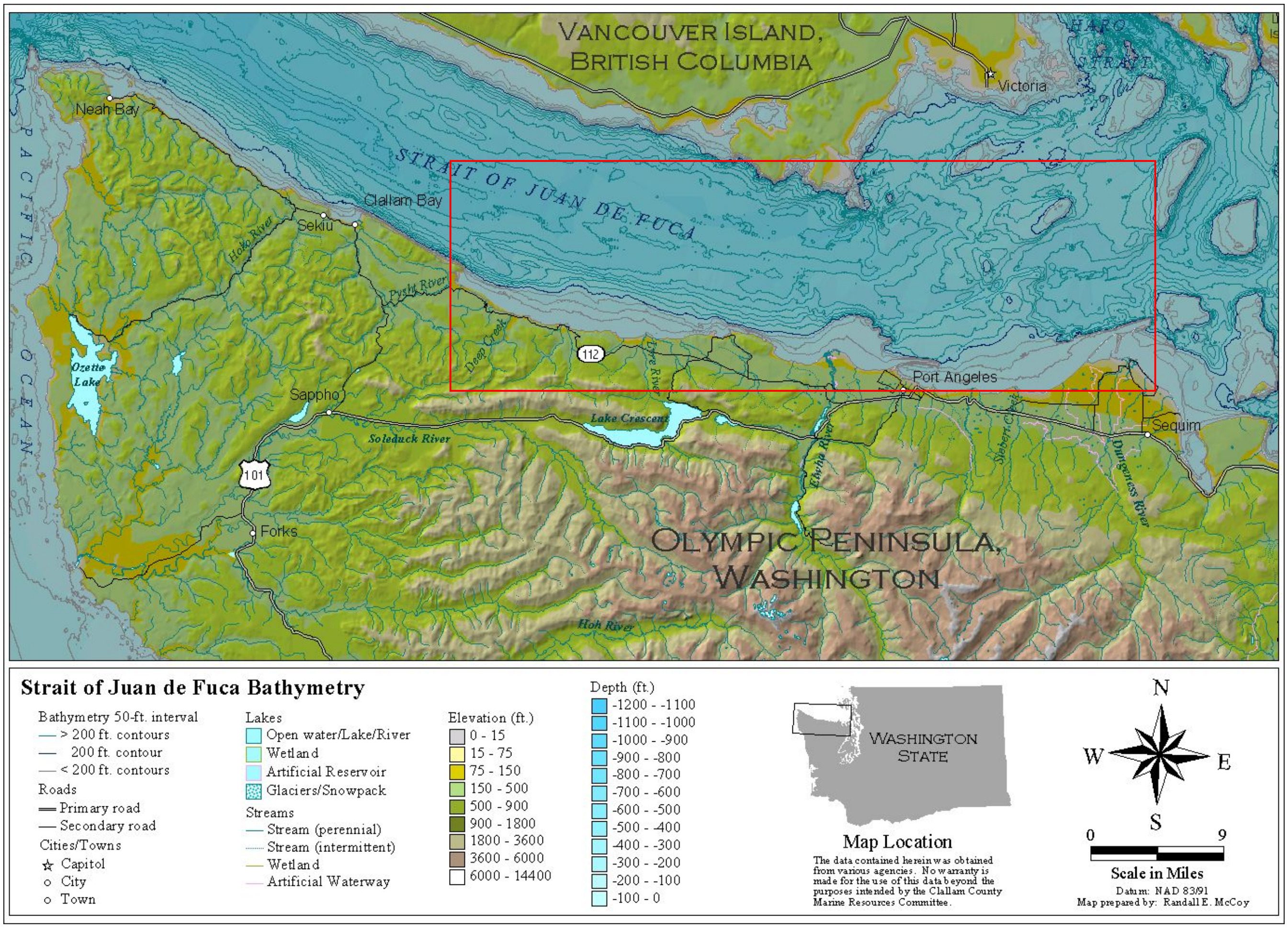
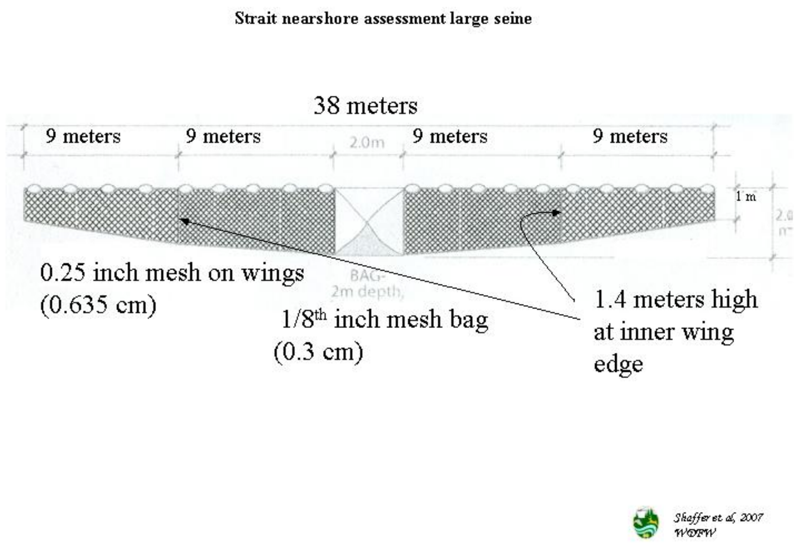


Figure 1. Strait of Juan de Fuca and central Strait of Juan de Fuca study area.



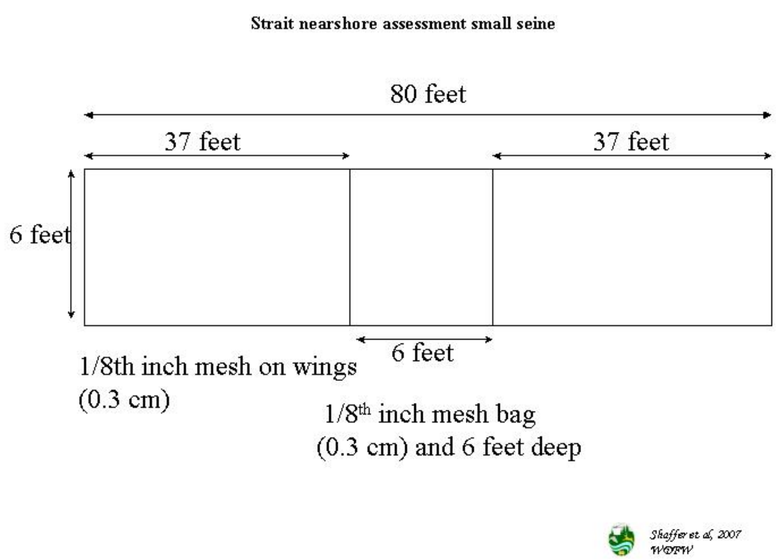


Figure 2. Beach seine design for nearshore assessment, Strait of Juan de Fuca. Built by Christensen nets.

Table 1. Nearshore central Strait sampling sites by geomorphic classification. Specific Elwha analysis site identification:. Red font indicates area within Elwha drift cell; blue font indicates comparative area outside of Elwha drift cell.

Site	Embayments	Lower river/Pocket Estuary	Spits	Bluffs
Pysht Lower River/Estuary		**X**		
Twins Lower River/Estuary		**X**		
Salt Creek Lower River/Estuary				
Elwha River mouth (Estuary)		**X**		
Pysht Bay	**X**			
Crescent Bay	**X**			
Freshwater Bay	**X**			
Twins Shoreline	**X**			
Elwha Bluffs				**X**
Dungeness Bluffs				**X**
Ediz Hook			**X**	
Dungeness Spit			**X**	

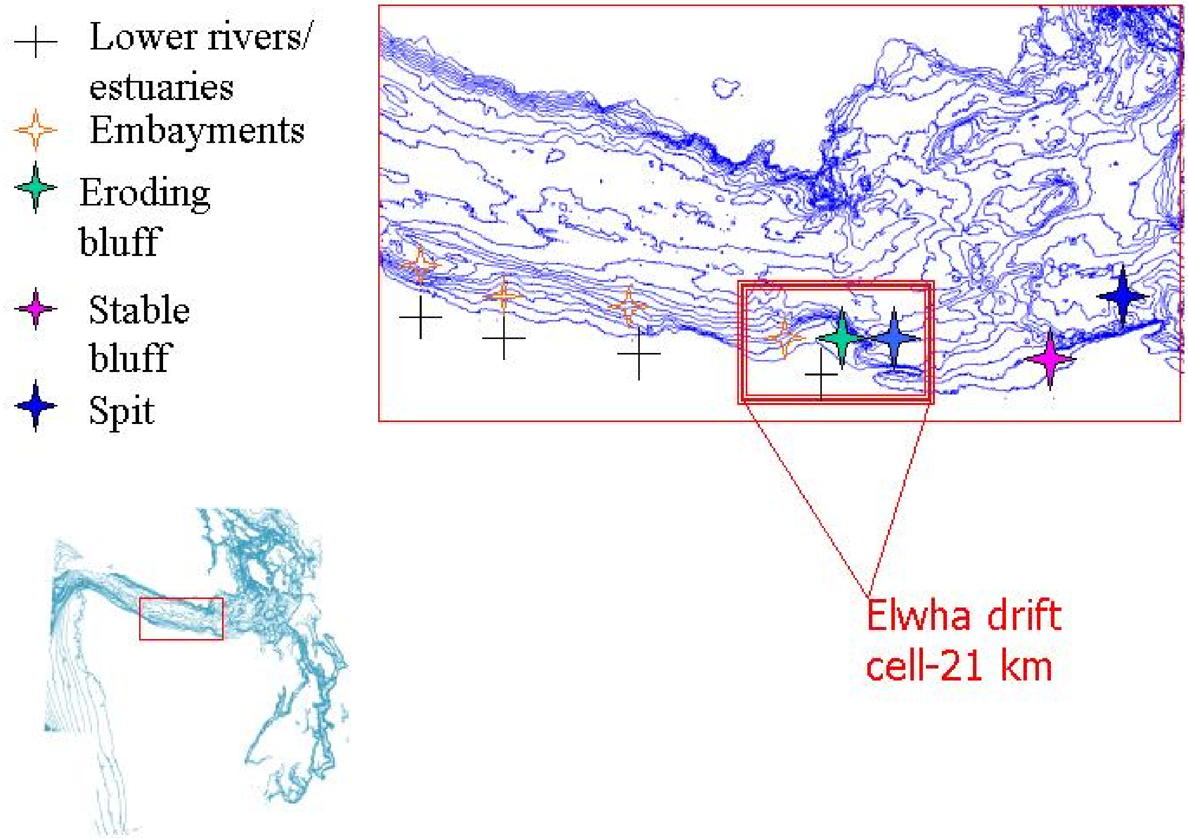


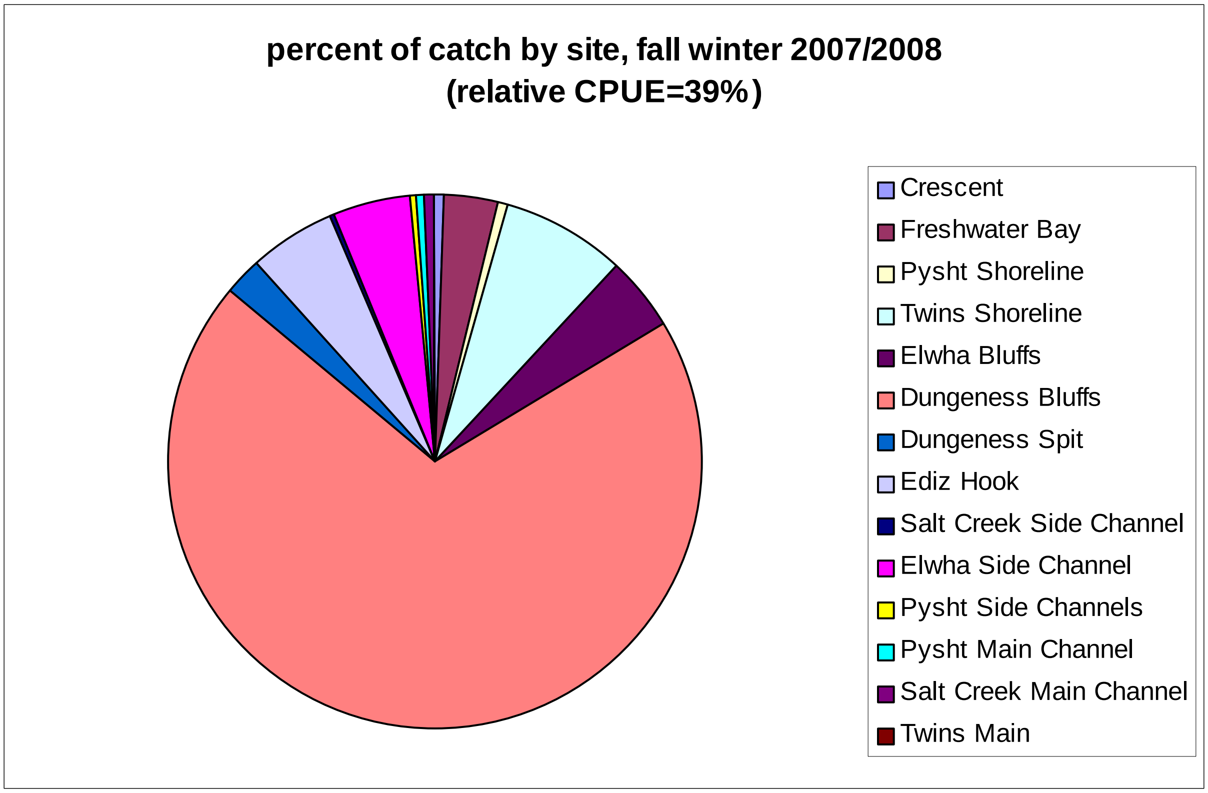
Figure 3. Sampling sites for Central Strait Nearshore Assessment

Table 2. Habitat structure and function documentation by geomorphic habitat type. FFS=forage fish survey; BS=Beach Seine; KS=Kelp snorkeling

Habitat Type ►	Sandy shore intertidal and shallow subtidal	Spit (intertidal and shallow subtidal)	Rocky Shore (intertidal and shallow subtidal	Pocket Estuary intertidal and shallow subtidal	*Stable bluff* Intertidal and shallow subtidal	Eroding bluff intertidal and shallow subtidal
Habitat Structure►	Unvegetated,& eelgrass bed)	Unvegetated & eelgrass beds	Kelp beds	Unvegetated & eelgrass beds	*Unvegetated & eelgrass beds*	Unvegetated & kelp beds
Habitat Function▼						
Forage fish spawning	**FFS**	**FFS**		**FFS**	**FFS**	**FFS**
Forage fish migration	**BS**	**BS**	**KS**	**BS**	**BS**	**BS**
Juvenile salmon migration	**BS**	**BS**	**KS**	**BS**	**BS**	**BS**

Table 3. Results. Percent of total fish and dominant species at each site, march 2007-march 2008.

Site	Total seines	Total Fish	% of all fish	Chinook	Coho	Chum	Smelt (adult = >120)	Smelt (juv = 50-120)	Smelt (pl = <50)	Herring (juv = 50-120)	Northern Anchovy	Sand lance (juv = 50-120)	3-Spine stickle back	Shiner perch	Stag horn scul pin	Cottids	Cutthr oat	Prickley Sculpin
Crescent Bay	41	11563	6	2	2	2	**42**	**14**	0	4	0	**21**	1	1	3	0	0	0
Dungeness Bluffs	16	24960	13	0	0	0	1	6	**90**	2	0	0	0	0	0	0	0	0
Dungeness Spit	12	5049	3	0	0	6	4	**54**	**14**	**11**	0	8	0	0	0	0	0	0
Ediz Hook	9	3101	2	6	0	3	5	**20**	1	**51**	0	**12**	0	0	0	0	0	0
Elwha Bluffs	13	5518	3	10	1	9	1	**43**	**15**	**20**	0	1	0	0	0	0	0	0
Elwha W Estuary	52	16258	9	**12**	2	1	0	0	0	0	0	0	**70**	0	4	5	0	1
Freshwater Bay	28	12259	6	4	0	1	**14**	6	9	**56**	1	7	0	1	0	0	0	0
Pysht Shoreline	30	31720	17	0	0	0	**11**	**79**	0	2	0	0	0	0	3	0	0	0
Pysht Main Channel	44	9553	5	0	1	1	0	7	0	0	0	0	1	0	7	**79**	0	0
Pysht Side Channels	36	15586	8	0	0	0	0	0	0	0	0	0	**49**	**26**	**19**	3	0	0
Salt Creek Main Channel	66	18731	10	0	2	3	0	0	0	0	0	0	5	**68**	**14**	6	0	0
Salt Creek Side Channel	52	13947	7	0	1	2	0	0	0	0	0	0	**12**	**54**	**22**	7	0	0
W.Twins River	26	1477	1	0	0	1	0	0	0	0	0	0	0	0	5	**48**	6	**33**
W. Twins Shoreline	32	19810	10	0	0	0	**10**	**17**	4	**19**	**30**	0	0	0	0	20	0	0
Total	459* *63% of which were March - September 07	189532	100															


percent of catch by site, fall winter 2007/2008
(relative CPUE=39%)
Crescent
Freshwater Bay
Pysht Shoreline
Twins Shoreline
Elwha Bluffs
Dungeness Bluffs
Dungeness Spit
Ediz Hook
Salt Creek Side Channel
Elwha Side Channel
Pysht Side Channels
Pysht Main Channel
Salt Creek Main Channel
Twins Main

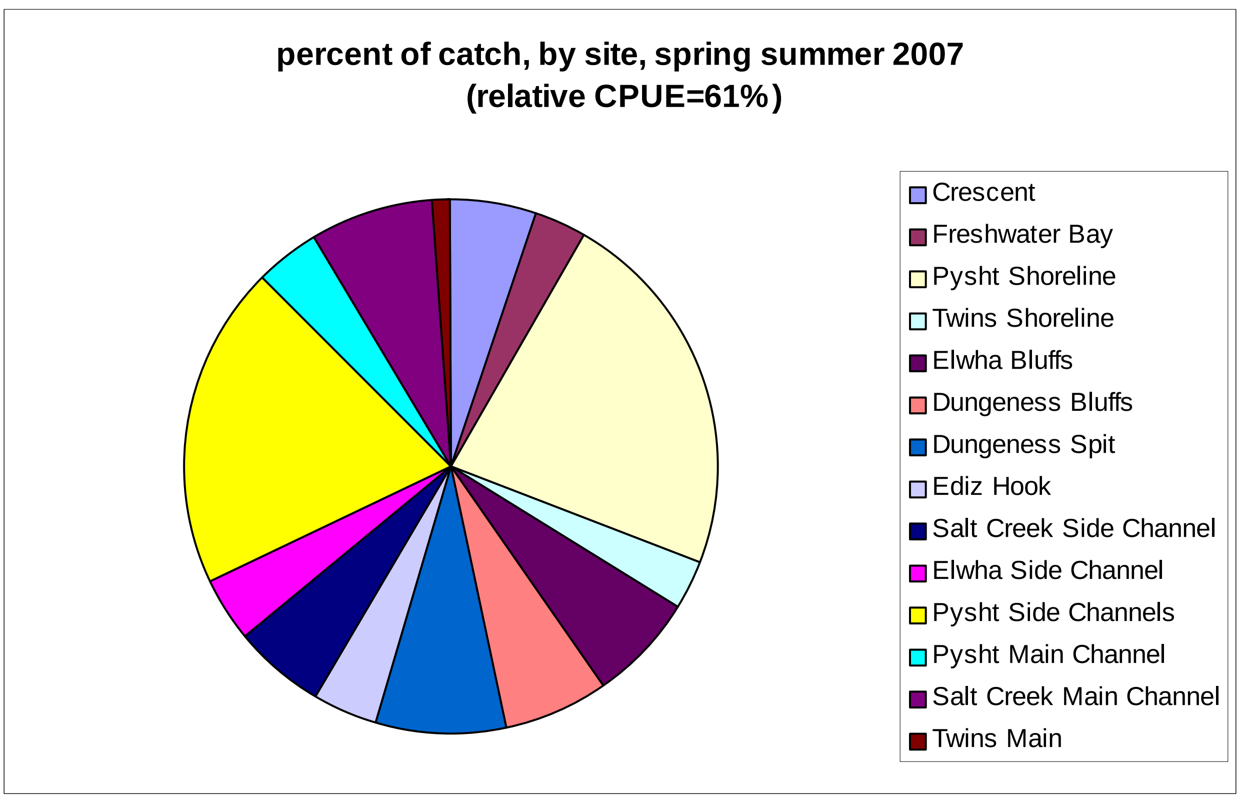

percent of catch, by site, spring summer 2007
(relative CPUE=61%)
Crescent
Freshwater Bay
Pysht Shoreline
Twins Shoreline
Elwha Bluffs
Dungeness Bluffs
Dungeness Spit
Ediz Hook
Salt Creek Side Channel
Elwha Side Channel
Pysht Side Channels
Pysht Main Channel
Salt Creek Main Channel
Twins Main

Figure 4. Composition of catch by season, Strait of Juan de Fuca.

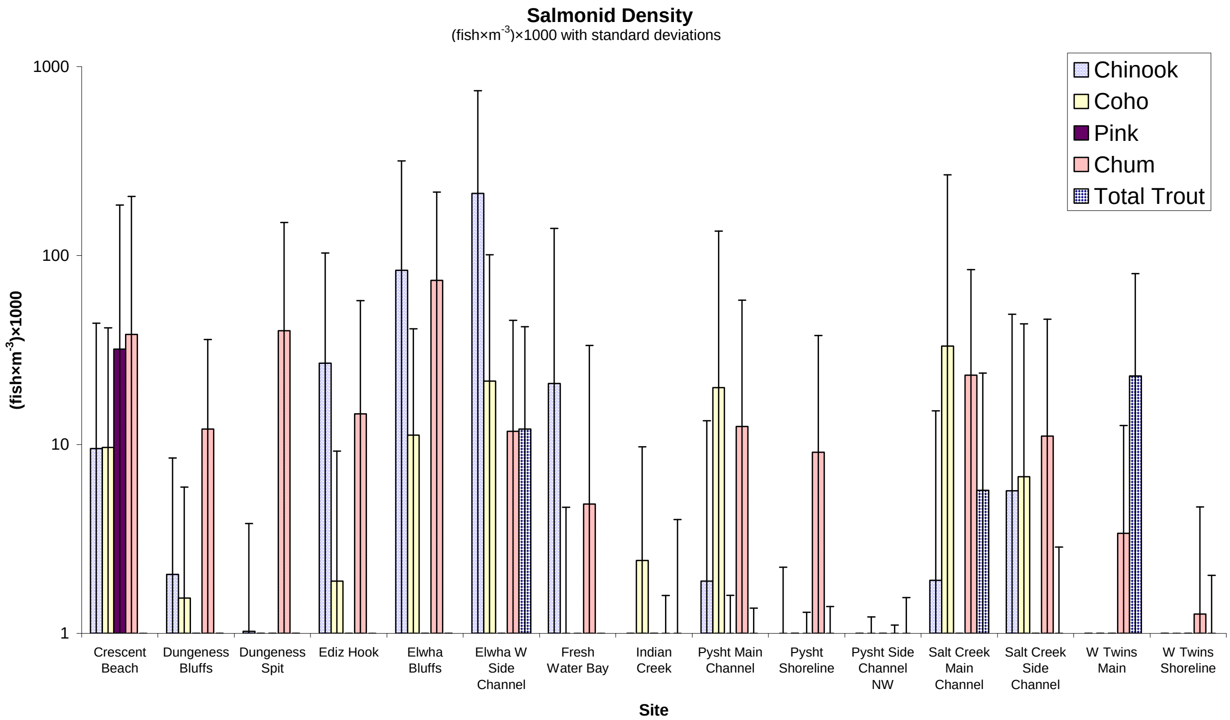


Figure 5. Salmon densities by geomorphic habitat type, central and western Strait of Juan de Fuca, March 2007-March 2008.

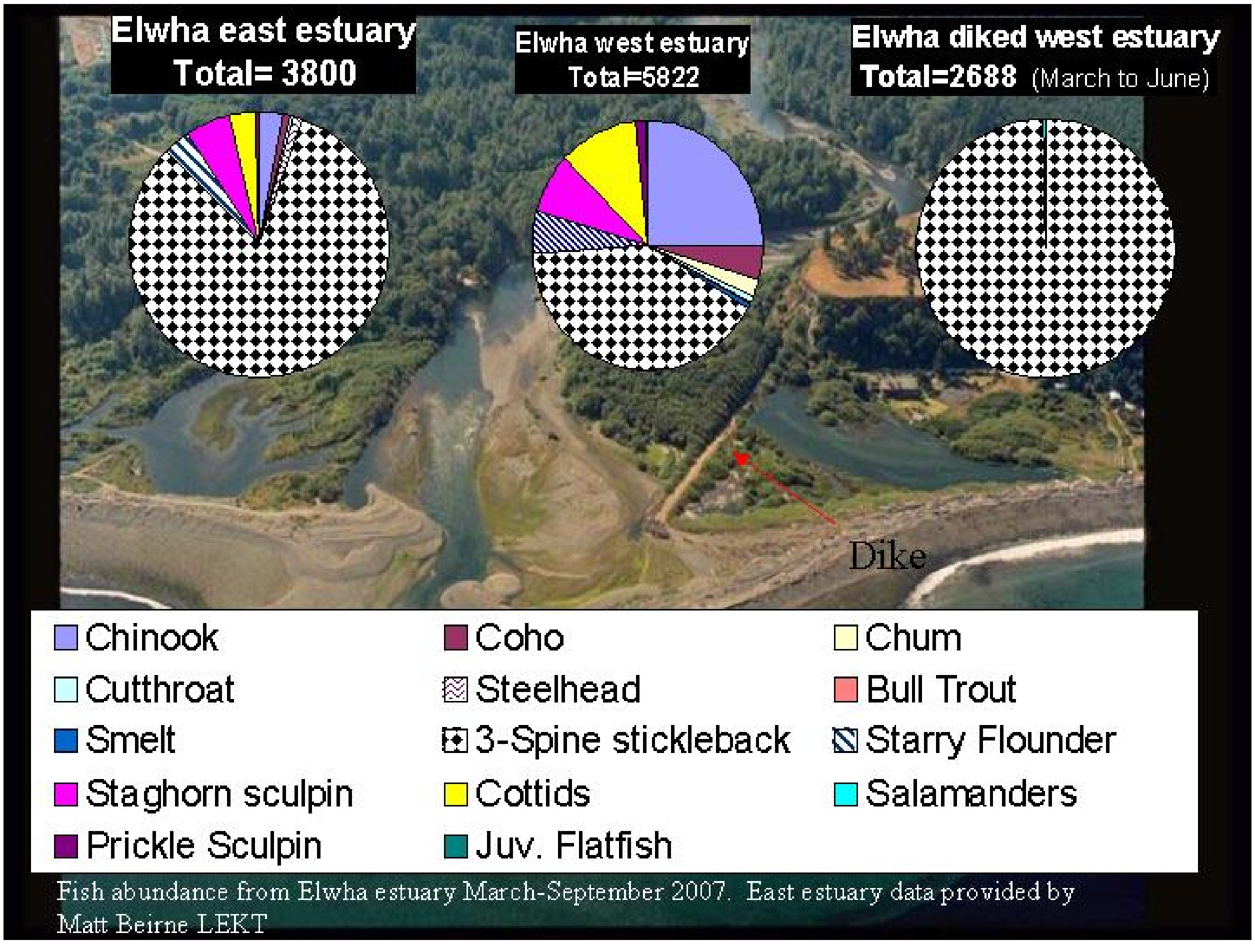
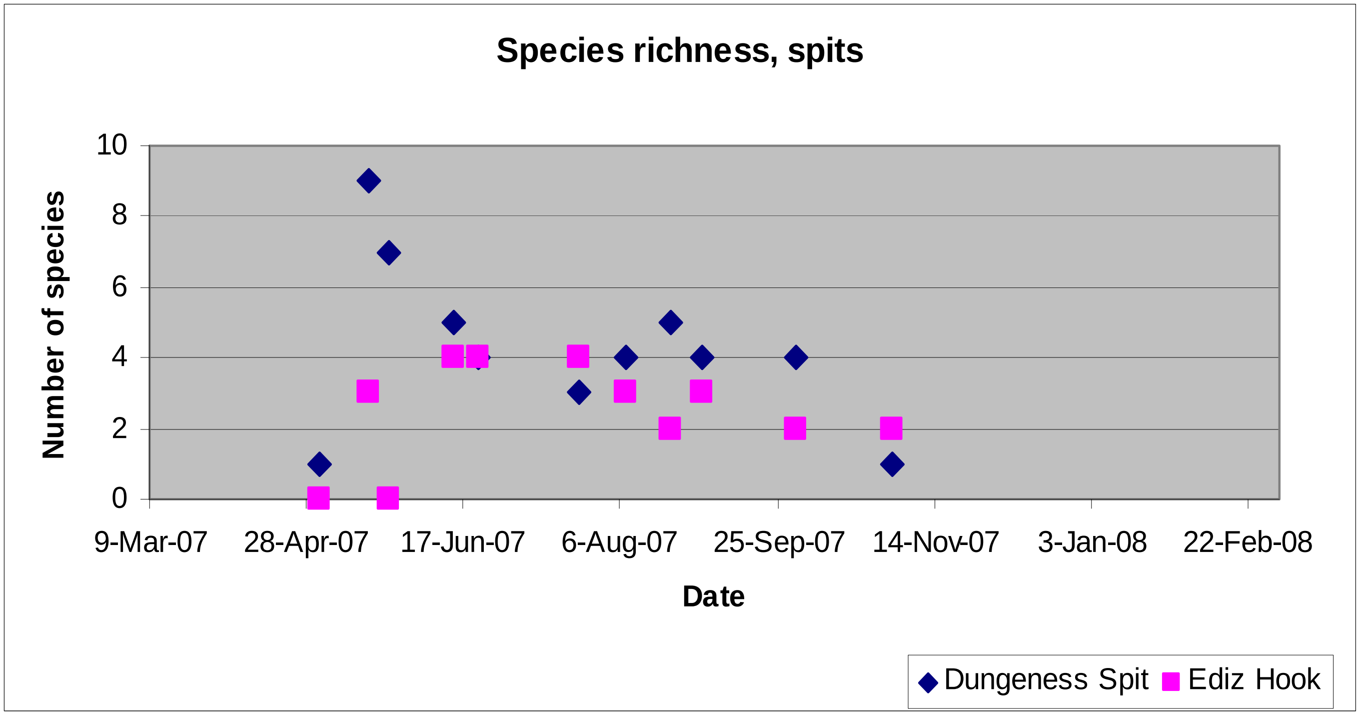


Figure 6. Fish abundance from Elwha estuary March-September 2007.


Species richness, spits
Number of species
10
8
6
4
2
0
9-Mar-07
28-Apr-07
17-Jun-07
6-Aug-07
25-Sep-07
14-Nov-07
3-Jan-08
22-Feb-08
Date
Dungeness Spit
Ediz Hook

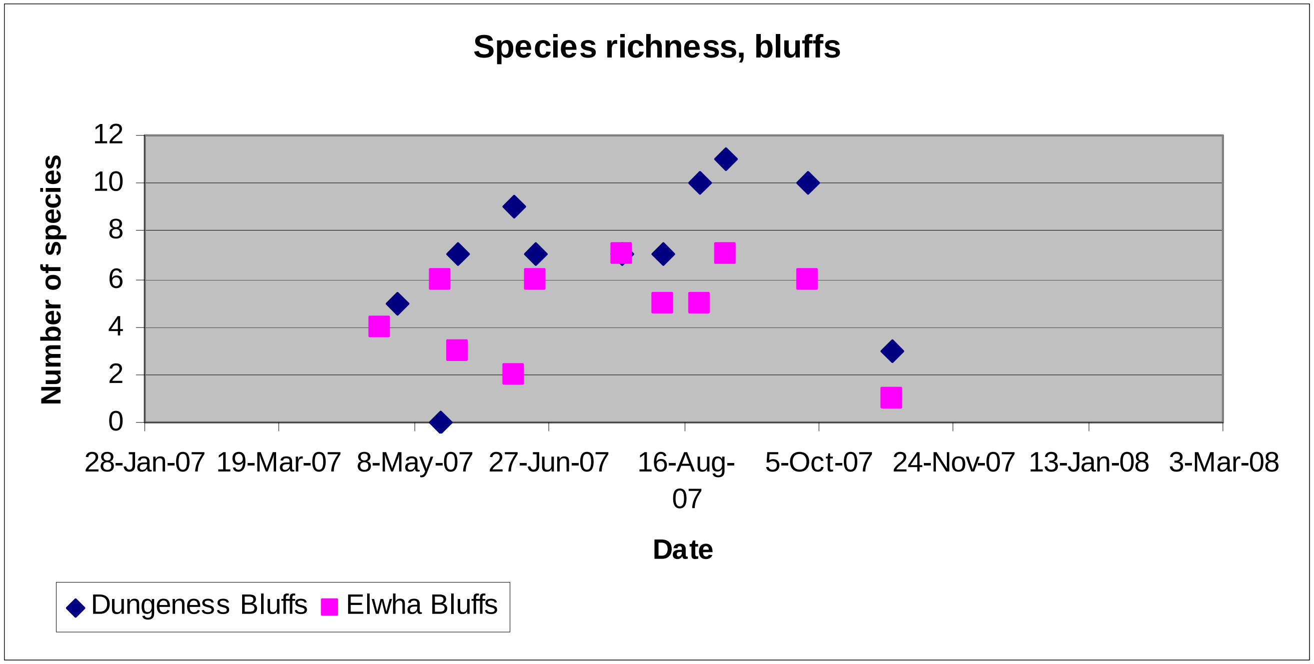


Figure 7a. Species richness spits and bluffs

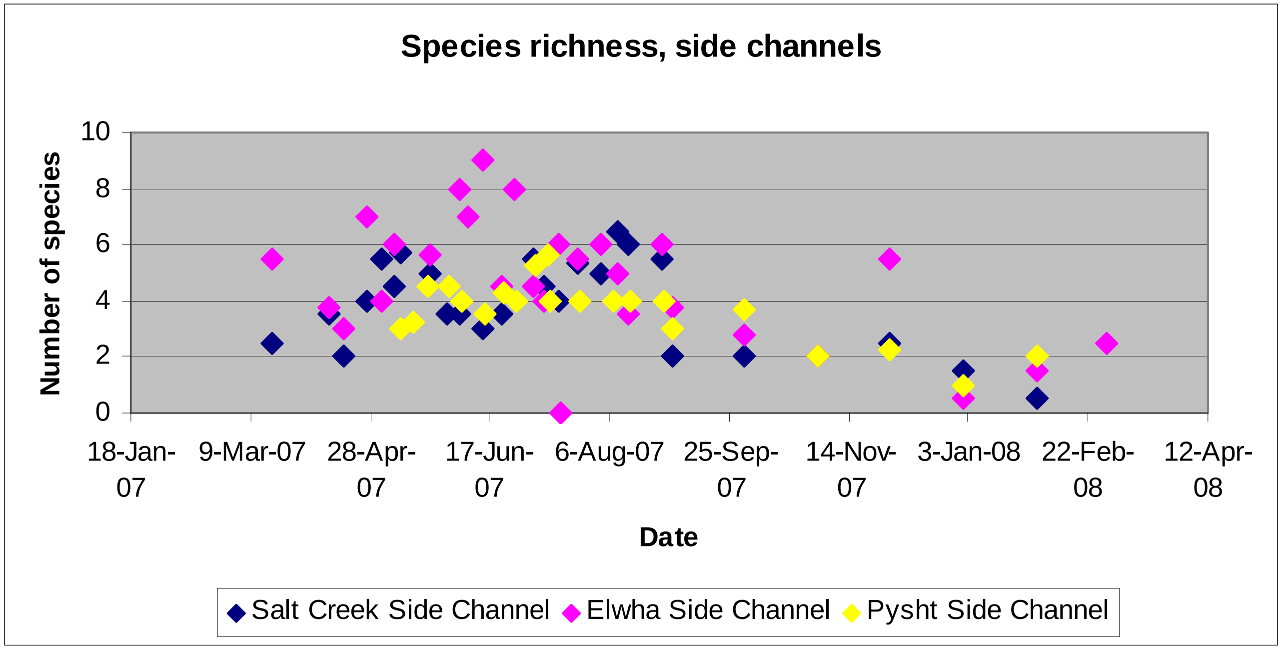


Figure 7b. Species richness side channels

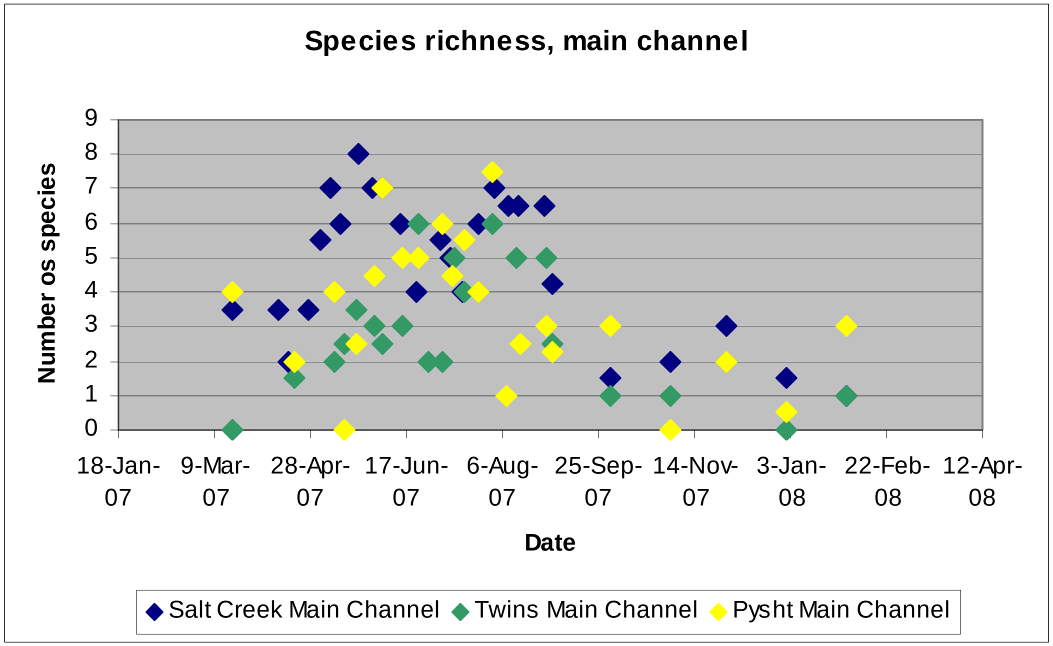


Figure 7c. Species richness for lower rivers main channel of central Strait of Juan de Fuca,

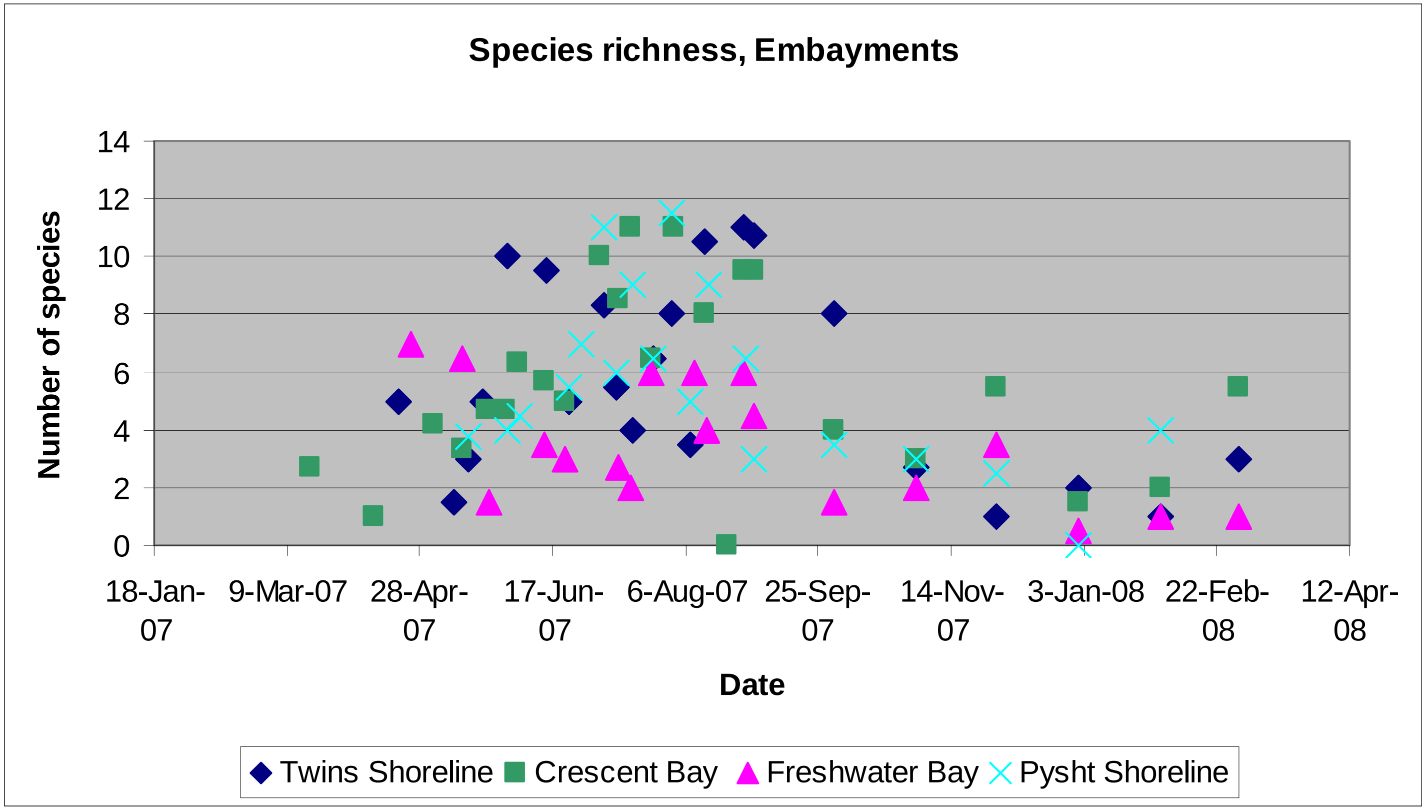


Figure 7d. Species richness for bays and shorelines of central Strait of Juan de Fuca,

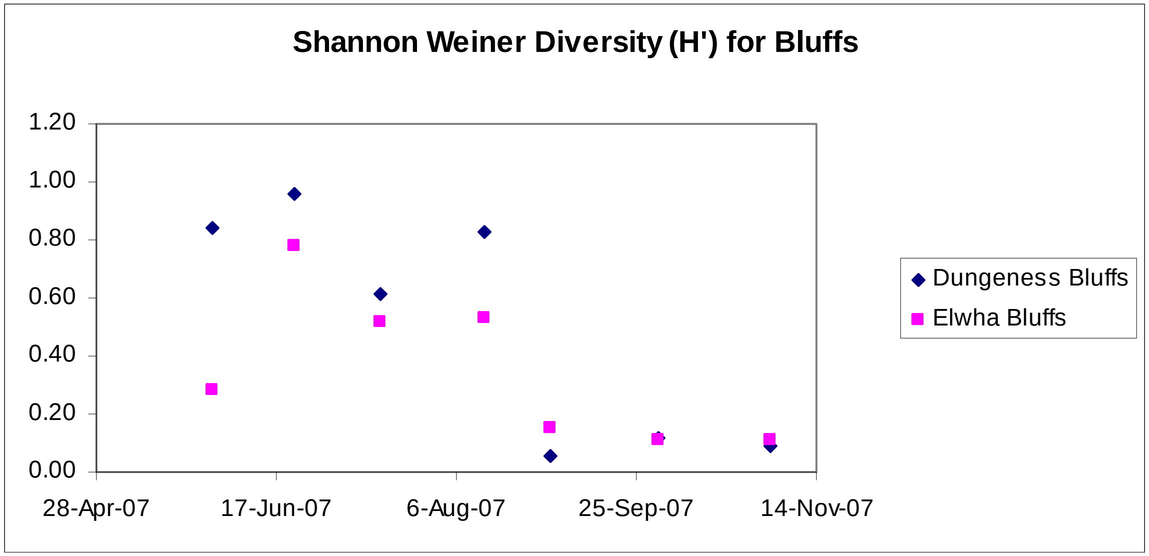


Figure 8 A. Species diversity for bluffs of central Strait of Juan de Fuca, March-October 2007.

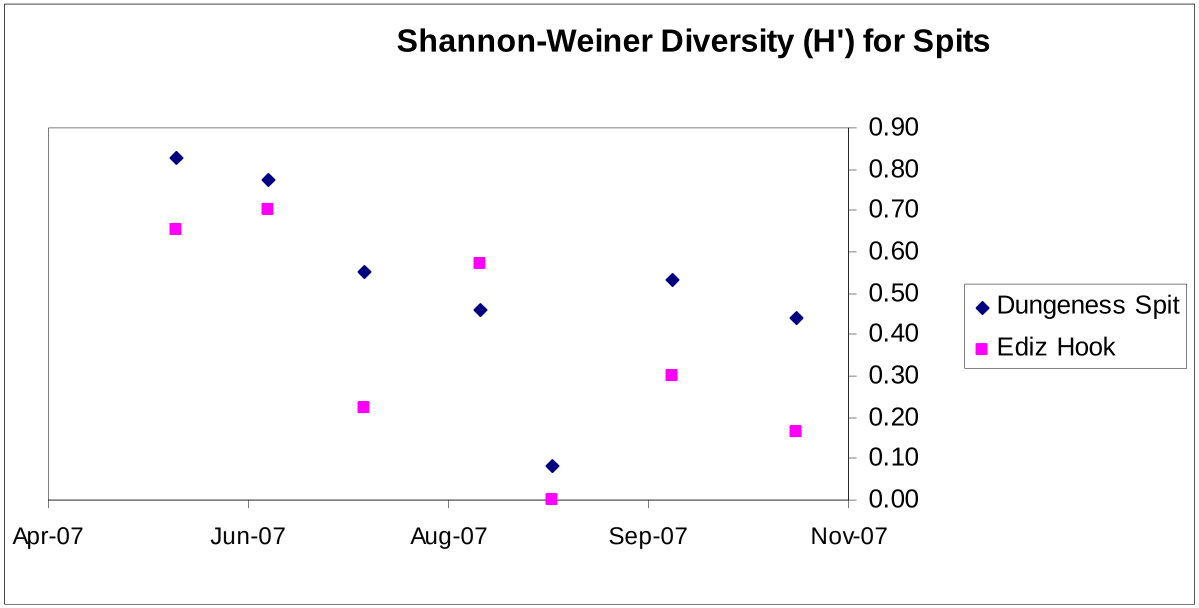


Figure 8 B. Species diversity for spits of central Strait of Juan de Fuca, March-October 2007 .

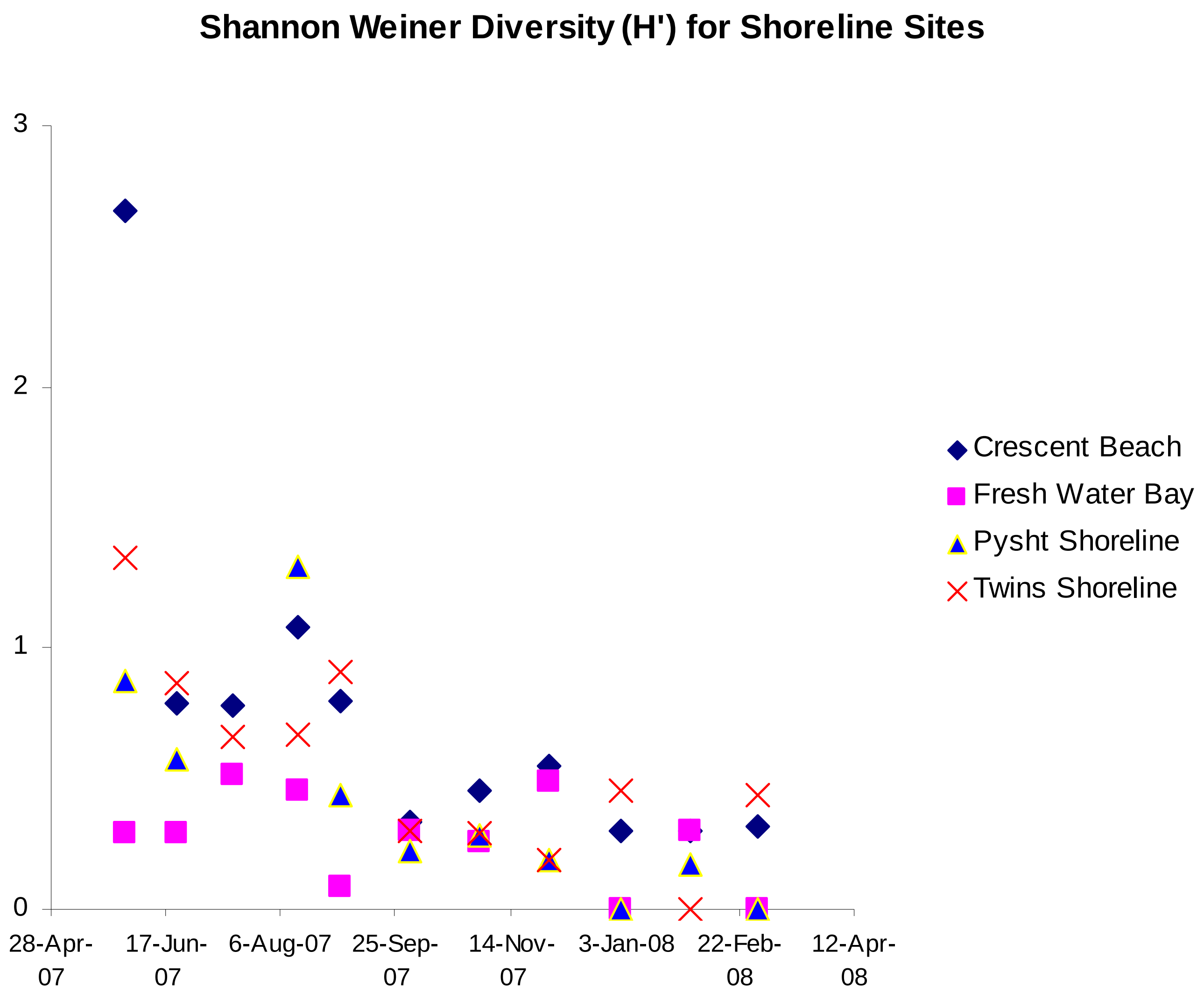
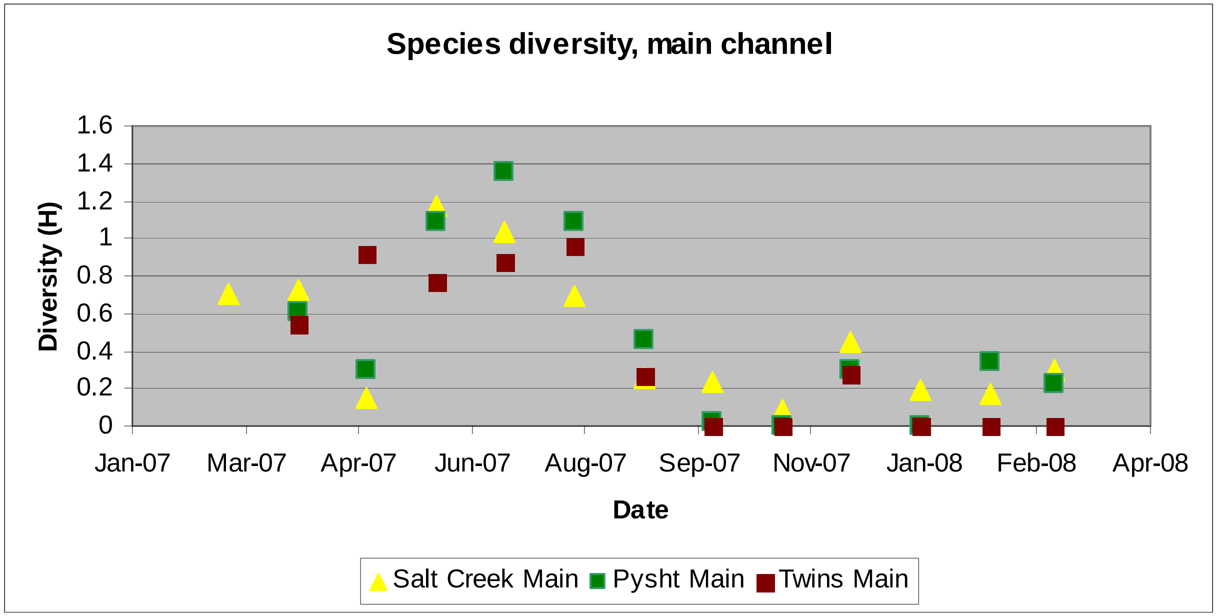


Figure 8 C. Species diversity for bay shorelines sites of central Strait of Juan de Fuca, March 2007- March 2008.


Species diversity, main channel
Diversity (H)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan-07
Mar-07
Apr-07
Jun-07
Aug-07
Sep-07
Nov-07
Jan-08
Feb-08
Apr-08
Date
Salt Creek Main
Pysht Main
Twins Main

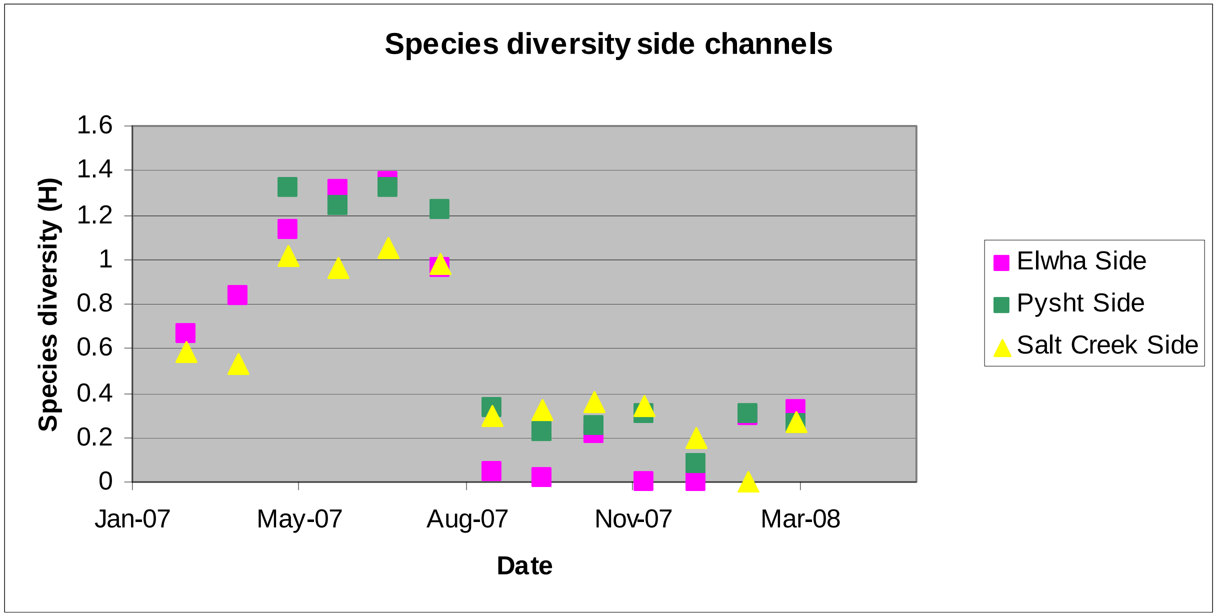


Figure 8 D. Species diversity for lower rivers and side channels of central Strait of Juan de Fuca, March 2007- March 2008.

Appendix A. Weekly densities, seining nearshore assessment

Appendix B. Species presence table, central Strait of Juan de Fuca

Chapter 1.Nearshore Fish use of embayment, spit, and bluff shoreline habitats of the central and western Strait of Juan de Fuca

Anne Shaffer and Tyler Ritchie, Washington Department of Fish and Wildlife, 332 E. 5th Street Port Angeles, Washington 98362

Introduction

This report provides a summary of beach seining results from March 2007-August 2008 for shorelines of embayment, spit, and bluff sites, collectively called ‘shoreline sites’, of nearshore central and western Strait of Juan de Fuca, and highlights of interannual long term monitoring results observed to date at two embayed shoreline sites. While this report provides a detailed discussion of results from this portion of the Strait nearshore, the reader is also referred to individual watershed chapters for Pysht, Twins, Salt Creek, as well as the Chinook genetic report, forage fish use, kelp snorkeling surveys, and nearshore water quality reports.

Methods and Materials.

Seining was conducted using the large Puget Sound Ambient Monitoring Protocols (PSAMP) protocol nets (Figure 1) deployed by boat from shore. Embayment, spit, and bluff sites were intended for sampling from March 2007-March 2008. Sites were to be sampled at a minimum of weekly from March-September 2007, and then monthly from October 2007 to March 2008. Two embayment sites, Freshwater Bay and Crescent Bay, continue to be sampled for long term monitoring, and have been sampled monthly from March-September 2008. On average two seines were conducted at each site and sampling day. For each seine all fish were identified to the lowest taxa possible, counted, and 25 of each species were measured to nearest mm. When observed, five Chinook were sampled for genetic analysis (see genetic report for methods). We opportunistically collected up to 100 fish of each forage fish species for biomass evaluation. These fish were preserved in 70 percent ethyl alcohol,returned to the lab, weighed, measured, and assessed for sexual maturity.

Fish densities were calculated to fish per cubic meter x 1000. Species richness and diversity were calculated for each site in the study.

Results

A total of 181 seines were sampled from all shoreline sites from March 2007-March 2008. Sixty three percent of these were conducted between March and September 2007. Chronically limited agency boat resources and challenging sampling conditions of swell and fog severely limited our ability to sample Dungeness Bluffs, Dungeness Spit, Ediz Hook, and Elwha Bluffs, which are accessed only by boat. These sites were therefore sampled only from May thru October 2007. Due to further constraints of run time only one seine was done at spit and bluff sites. Data are summarized in Appendix A and B.

The majority of seines were at embayed (131 seines) sites followed by bluff (29 seines) and spit (25 seines) sites Overall, shoreline sites had the highest percentage of total fish caught over the year sampling period. The one exception was Ediz Hook, which had the second lowest percent of fish collected of all sites sampled over the entire period (Table 1).

Forage fish, specifically smelt, anchovy, sand lance, and herring, were the most abundant fish collected along all the shoreline sites (Table 1), and comprised well over 40% of total fish collected during the year sampling period. Bluff and spits had the highest weekly averages of total smelt (the majority of which were surf smelt see appendix for individual species). Smelt did show strong seasonal variation in weekly densities for all live histories (adults, juveniles, and post larval stages Figure 3a-f).

Continued monitoring of Freshwater and Crescent bay indicates that there is strong interannual variation in smelt and lingcod density. Total smelt densities at each site decreased by over 80% in 2008 compared to 2007, and percent composition by life history shifted from adult smelt in 2007 to juvenile smelt in 2008. (Figure 3g-h; Table 2&3.) Length of mature adult smelt did not vary appreciably between site. Maturity and weight however did show site differences (Figure 3e). Adult herring were not as frequently encountered, and most adult herring were not sexually mature or gravid (Figure 3f). Only one site in the Dungeness drift cell was observed to have sexually mature herring throughout the 13 month study.

For salmonid use of the nearshore, salmon were present at all embayment, spit, and bluff sites. The Twins nearshore had the lowest density of salmon, with only two coho collected from the Twins nearshore in December 2007. The Elwha drift cell, including Freshwater Bay, Elwha Bluffs, and Ediz Hook, had the highest density of Chinook and coho salmon (Figure 4). Genetic analysis of juvenile Chinook salmon collected during this survey revealed that a significant proportion of juvenile Chinook were from ESA listed stocks of both Puget Sound and Columbia river (Shaffer et al in prep, See Chapter 6 of the nearshore assessment report; Figure 4.).

Discussion

Comparing diversity of shoreline sites, embayments, spits, and bluffs, indicates both trends and differences in ecological function. All sites had significant seasonal differences in diversity. Within embayments, Crescent Beach, Twins, and Pysht all have higher diversity than Freshwater Bay, which is degraded due to sediment starvation from Elwha river dams. Comparing between geomorphic habitat types of shoreline, the embayed sites had consistently higher diversity than spits and bluffs. Finally, the Elwha drift cell embayed, spit, and bluff sites had consistently lower diversity than comparative shoreline sites within the comparative Dungeness drift cell (Figure 5).

It is also important to note that, while the Elwha drift cell appears to be functioning at a lower level ecologically it is supporting the highest density of salmon, and in particular, Chinook salmon. In the genetic portion of this study we documented the majority of Chinook found along the central and western Strait shoreline to be from a number of listed stocks, including from Elwha Dungeness and Columbia river stocks (see Chapter 6 this report). Mapping of forage fish spawn from the Elwha drift cell has revealed that only Freshwater Bay supports surf smelt spawning.

Eelgrass mapping of the Elwha and comparative nearshore indicates remnant eelgrass beds in the Ediz Hook area, and extremely high use of understory kelp beds by juvenile forage fish (Norris et al 2007). This juxtaposition of current ecological fitness, current fish density and presence of numerous stocks of ESA listed priority recovery salmon species and forage fish spawning, leads us to conclude that the Elwha drift cell, including embayed, spit, and bluff sites, is a top priority for nearshore restoration.

Restoration of the Elwha drift cell will be complex and requires modeling analysis. The Elwha drift cell is defined as extending from the western edge of Freshwater Bay to the tip of Ediz Hook. Sediment processes are the dominant limiting factor for the Elwha nearshore, and have played a significant role in nearshore habitat form (Warrick et al 2008). Historically the feeder bluffs east of the river mouth provided over 70% of sediment to the Elwha littoral system (Randall et al 2004; Shaffer et al 2008). The Elwha river provided the rest. The feeder bluffs east of the river mouth of the Elwha have been bulkheaded for over 100 years. Feeder bluffs in the lower river have been actively feeding since the dams were installed (Draut et al 2008). We therefore hypothesize that nearshore sediment starvation, and concomitant functional impacts, increase in Elwha nearshore with distance from the river mouth. This is supported by the documentation of surf smelt spawning, which requires a fine sand gravel substrate, only along the Elwha drift cell in immediate proximity to the Elwha river mouth.

Upcoming dam removals, which will partially restore Elwha nearshore sediment delivery, will have two phases. The first is anticipated to deliver 10mcy of sediment to the nearshore within five years of dam removal (see Randle et al 2004; Stolnack and Naimann 2005; and Shaffer et al 2008). The second will be the post dam removal annual rate of sediment delivery, estimated to be approximately 200,00cy per year. Prior to shoreline armoring the sediment contribution from the feeder bluffs was estimated to be 70% of sediment to the Elwha drift cell. After shoreline armoring this contribution was estimated to have dropped to zero. Armoring will remain in place, so sediment contribution from feeder bluffs within the Elwha drift cell will continue to be disrupted. Every effort should therefore be made to optimize this high volume but short interval of upcoming sediment delivery to the Elwha bluffs and Ediz Hook.

Additional specific modeling to define sediment fate in the Elwha nearshore and anticipated habitat response, in particular for predicting the proportion and fate of grain size that will be suitable for forage fish spawning and eelgrass recolonization, will be needed if the restoration actions are to be the most effective and successful.

The high diversity and richness of the embayed shorelines, and Crescent Bay in particular, make it, Freshwater Bay, and the Twins shoreline top priorities for long term preservation. The majority of these properties are privately owned. Acquisition and conservation easements of Crescent Bay and Freshwater Bay are therefore the appropriate and top priority actions for shoreline restoration. Crescent Bay also supported the highest numbers of sand lance of any other nearshore areas within the study area, including Pysht, which is a documented sand lance spawning beach. These consistently high numbers of sand lance lead us to recommend Crescent Bay continue to be monitored for sand lance spawning.

The Twins shoreline is intriguing in that it has high diversity, but salmon use was not heavily documented in this study. This despite heavy salmon use of the watershed documented by Roni et al 2008. We theorize that salmon use of the Twins nearshore, both shoreline and lower river, is much different than other nearshore areas of the central and western Strait. Additional monitoring is recommended to understand salmonid use of the Twins nearshore. The high diversity and species richness of the area, and high smelt use for both spawning and migration, leads us to recommend the Twins as a priority for restoration and acquisition. The Twins is a mixture of private and public ownership. Acquisition/conservation easement of private properties is a priority.

The Pysht shoreline also exhibited high species diversity and richness, as well as salmon use, including both Puget Sound and Columbia river ESA listed stocks. This area is the site of a large conservation easement. Every effort should be made to keep the Pysht shoreline intact. All development of this shoreline should be avoided.

Finally, preliminary results from ongoing long term sampling of two of the embayed sites indicates a large seasonal and interannual variation in fish use of the nearshore central Strait, with large differences in both total numbers of fish, and fish distribution in the nearshore. For example, between 30-60% fewer smelt were observed in Crescent and Freshwater Bay shoreline sites in 2008 relative to 2007 sampling, and the life history composition of smelt changed dramatically with year. This strong interannual variation may reflect a cyclic nature for smelt use of the Strait, and partially explain large interannual differences in spawn that is characteristic of Strait smelt spawning beaches. Sand lance also had strong interannual differences in density. For both years, Crescent Bay had far more sand lance than Freshwater Bay. Also, in Crescent Bay 2008 we observed a strong and sustained recruitment of greenlings, primarily lingcod. This was not observed in 2007, but noted by WDFW biologists that worked in this area in the early 1980's (Doty, WDFW, pers comm.). This strong interannual variation makes it necessary to continue long term sampling of the nearshore central Strait so that we can clearly define current fish use of the nearshore, as well as changes in fish use that may occur due to restoration actions.

References

Norris, J, I. Ward**,** A. Shaffer and C. Lear 2007. Eelgrass mapping of the Elwha Nearshore. in Proceedings, Puget Sound Georgia Basin Conference , Puget Sound Water Quality Authority, Olympia Washington

Randle, T. J., J. Bountry, B. Jackson, and G. Smille. 2004. Elwha River restoration project draft sediment management and monitoring plan, based on recommendations of the Elwha River Physical Processes Monitoring Workshop, 13-17 August, 2001, Port Angeles, WA.
U.S. Department of the Interior, Bureau of Reclamation, Denver, CO and National Park Service, Fort Collins, CO.

Roni, P. R. Holland, T. Bennett, G. Pess and R. Moses. 2008. Straits intensively monitored watershed contract report: results of FY07 PIT tagging on east and west Twin rivers. Northwest Fisheries Science Center, NMFS, Seattle, Washington 98112.

Shaffer J.A., P. Crain, and Todd Kassler in prep. Juvenile Chinook use of the nearshore central and western Strait of Juan de Fuca. Washington department of fish and wildlife, Habitat program, science division.

Shaffer, J.A, P. Crain, B. Winter, M. McHenry, C. Lear and T. Randle. 2008. Nearshore Restoration of the Elwha River Through Removal of the Elwha and Glines Canyon Dams: An Overview. Northwest Science. 82 (Special Issue).

Stolnack, S. and R. Naiman. 2005. Summary of Research and Education Activities in the Elwha River Watershed and Adjacent Coastal Zone. University of Washington, Seattle.

U. S. Army Corps of Engineers. 1971. Report on survey of Ediz Hook for beach erosion and related purposes. Part II. Seattle District Army Corps of Engineers, Seattle, WA.

Warrick, J. A., G. R. Cochrane, Y. Sagy, and G. Gelfenbaum. 2008. Nearshore substrate and morphology offshore of the Elwha River. Northwest Science 82 (Special Issue):153-163.

Acknowlegements. The nearshore assessment project is sponsored by the North Olympic Peninsula Lead Entity and funded by the Salmon Recovery Funding Board (SRFB/RCO). Cheryl Baumann is the NOPLE coordinator, Tara Galuska is the RCE project manager. The Clallam Marine Resources Committee (MRC) provided important funding for college interns including Jesse Charles, Chris DeSisto, Bryan Hara, Erica Hirsh, John Kascirk, Mario Laungayan, Romy Laungayan, Ross McDorman, Tiffany Nabors, Sean Oden, Rebecca Paradis, Jacob Ray, Tyler Ritchie, Melanie Roed, Justin Rondeau, Trista Simmons, Ben Warren, Karen Wilkie, Eric Wood, and Steve Wyall from WWU, REU, and Peninsula College supervisors were Mr. Jack Ganzhorn and Dr. Dwight Barry of Peninsula College. Capt. Winn Miller and Phil Henry provided boat support and good will. Jenna Schilke, formerly with WDFW, supervised much of the field work. Dr. Jon Warrick, USGS, provided methods and the camera for photo analysis. The Clallam MRC continues to support student internships financially. Cathy Lear, Clallam County, is senior staff to the MRC. Dan Penttila, WDFW, provided report review.

REU is supported by the National Science Foundation's Research Experience for Undergraduates program under Grant DBI-0452328.

Chuck and Neva Novak and Ben and Irene Palzer continue to provide landowner access to the private beach at Crescent Bay. Malcolm Dudley has provided invaluable private land owner support and access. Pam Lowry has provided access to forage fish spawn sampling locations in Freshwater Bay. Pam Sangunetti and Kevin Ryan (USFWS) provided invaluable partnership and field support. Charlie and Kendra Parks, Port Angeles High School, and Andy Stevenson, provided field support and good will. Thank you all.

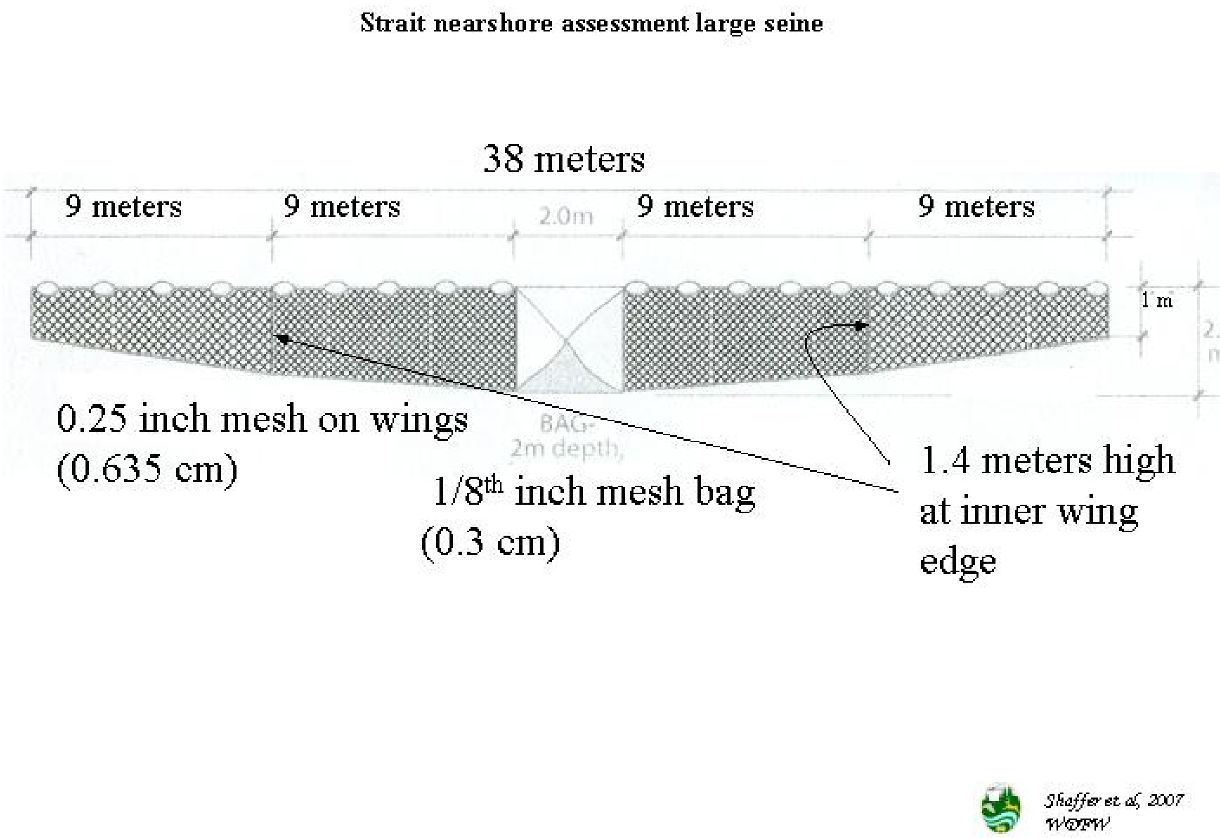
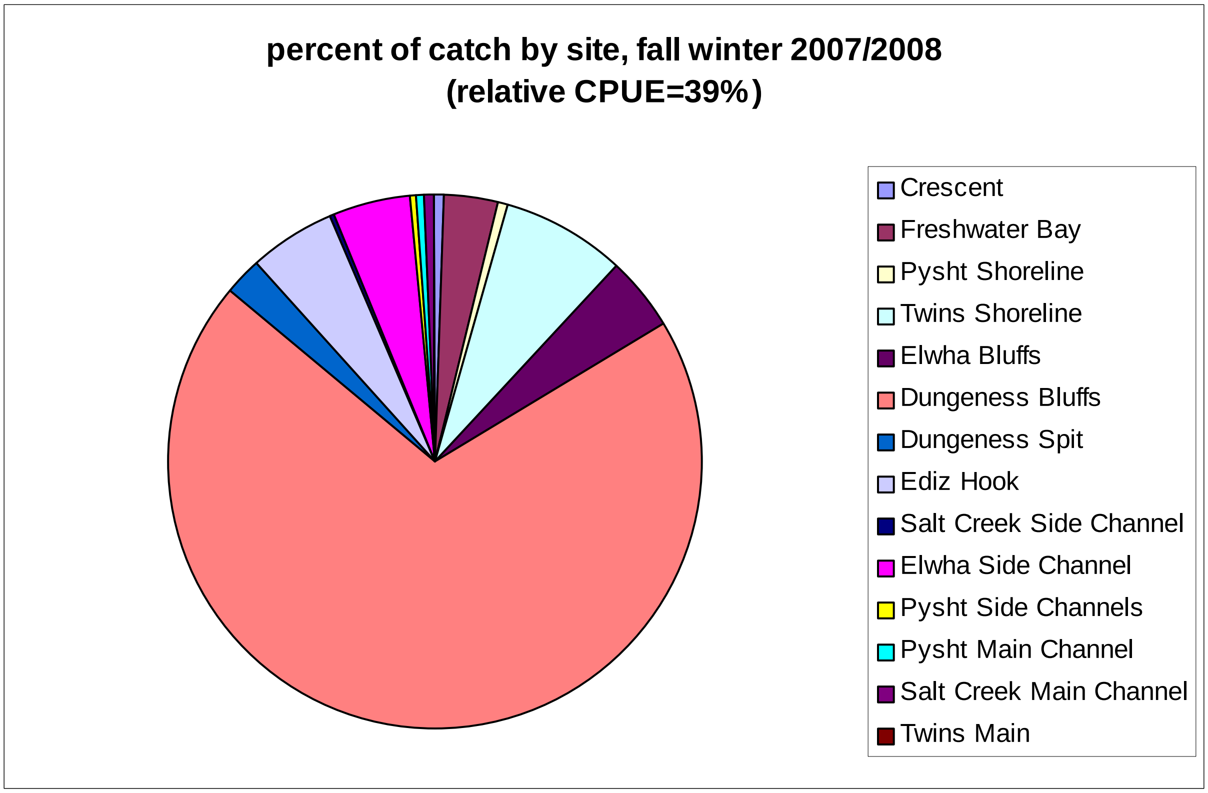


Figure 1. Strait nearshore assessment seine design provided by Christensen nets.

Table 1. Results. Percent of total fish and dominant species at each site, march 2007-march 2008.

Site	Total seines	Total Fish	% of all fish	Chinook	Coho	Chum	Smelt (adult = >120)	Smelt (juv = 50-120)	Smelt (pl = <50)	Herring (juv = 50-120)	Northern Anchovy	Sand lance (juv = 50-120)	3-Spine stickle back	Shiner perch	Stag horn scul pin	Cottids	Cutthroat	Prickley Sculpin
Crescent Bay	41	11563	6	2	2	2	**42**	**14**	0	4	0	**21**	1	1	3	0	0	0
Dungeness Bluffs	16	24960	13	0	0	0	1	6	**90**	2	0	0	0	0	0	0	0	0
Dungeness Spit	12	5049	3	0	0	6	4	**54**	**14**	**11**	0	8	0	0	0	0	0	0
Ediz Hook	9	3101	2	6	0	3	5	**20**	1	**51**	0	**12**	0	0	0	0	0	0
Elwha Bluffs	13	5518	3	10	1	9	1	**43**	**15**	**20**	0	1	0	0	0	0	0	0
Elwha W Estuary	52	16258	9	**12**	2	1	0	0	0	0	0	0	**70**	0	4	5	0	1
Freshwater Bay	28	12259	6	4	0	1	**14**	6	9	**56**	1	7	0	1	0	0	0	0
Pysht Shoreline	30	31720	17	0	0	0	**11**	**79**	0	2	0	0	0	0	3	0	0	0
Pysht Main Channel	44	9553	5	0	1	1	0	7	0	0	0	0	1	0	7	**79**	0	0
Pysht Side Channels	36	15586	8	0	0	0	0	0	0	0	0	0	**49**	**26**	**19**	3	0	0
Salt Creek Main Channel	66	18731	10	0	2	3	0	0	0	0	0	0	5	**68**	**14**	6	0	0
Salt Creek Side Channel	52	13947	7	0	1	2	0	0	0	0	0	0	**12**	**54**	**22**	7	0	0
W.Twins River	26	1477	1	0	0	1	0	0	0	0	0	0	0	0	5	**48**	6	**33**
W. Twins Shoreline	32	19810	10	0	0	0	**10**	**17**	4	**19**	**30**	0	0	0	0	20	0	0

Total	459* *63% of which were March - September 07	189532	100															


percent of catch by site, fall winter 2007/2008
(relative CPUE=39%)
Crescent
Freshwater Bay
Pysht Shoreline
Twins Shoreline
Elwha Bluffs
Dungeness Bluffs
Dungeness Spit
Ediz Hook
Salt Creek Side Channel
Elwha Side Channel
Pysht Side Channels
Pysht Main Channel
Salt Creek Main Channel
Twins Main

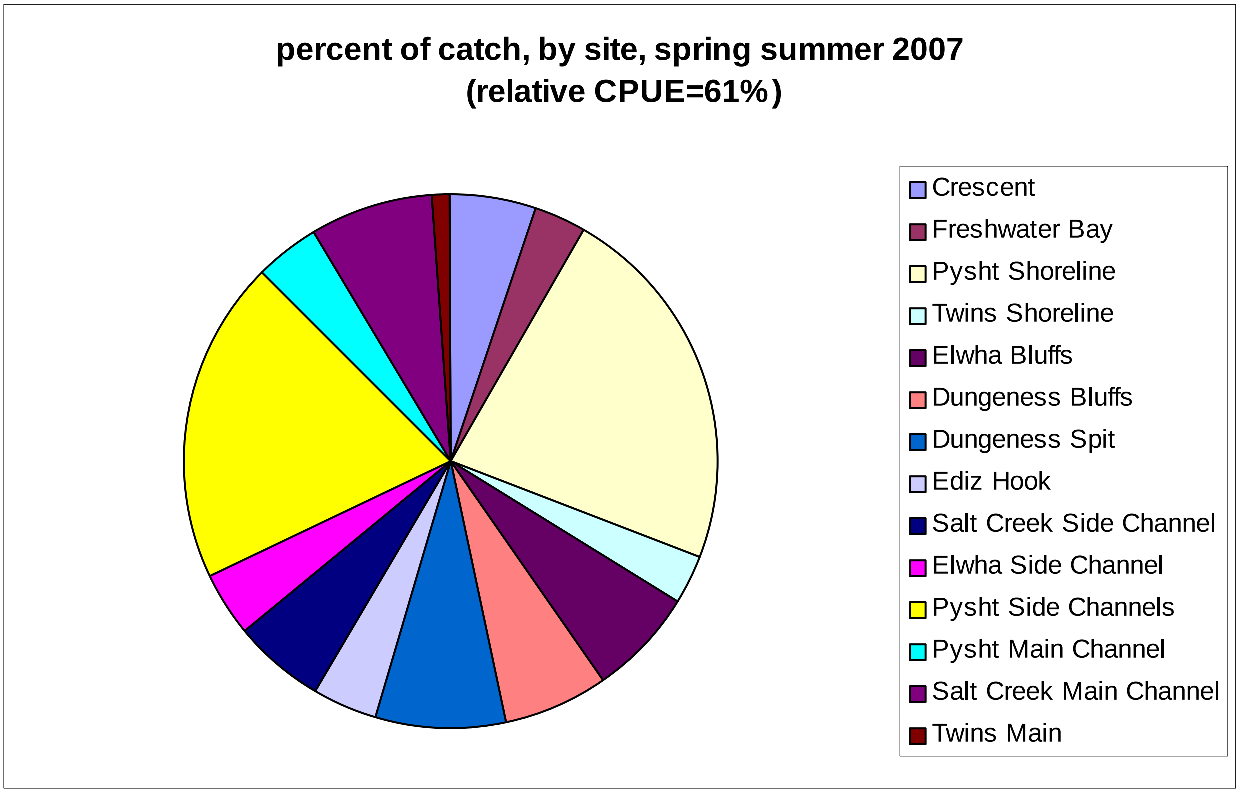


Figure 2 Percent of total fish collected by site by site for 2007-2008

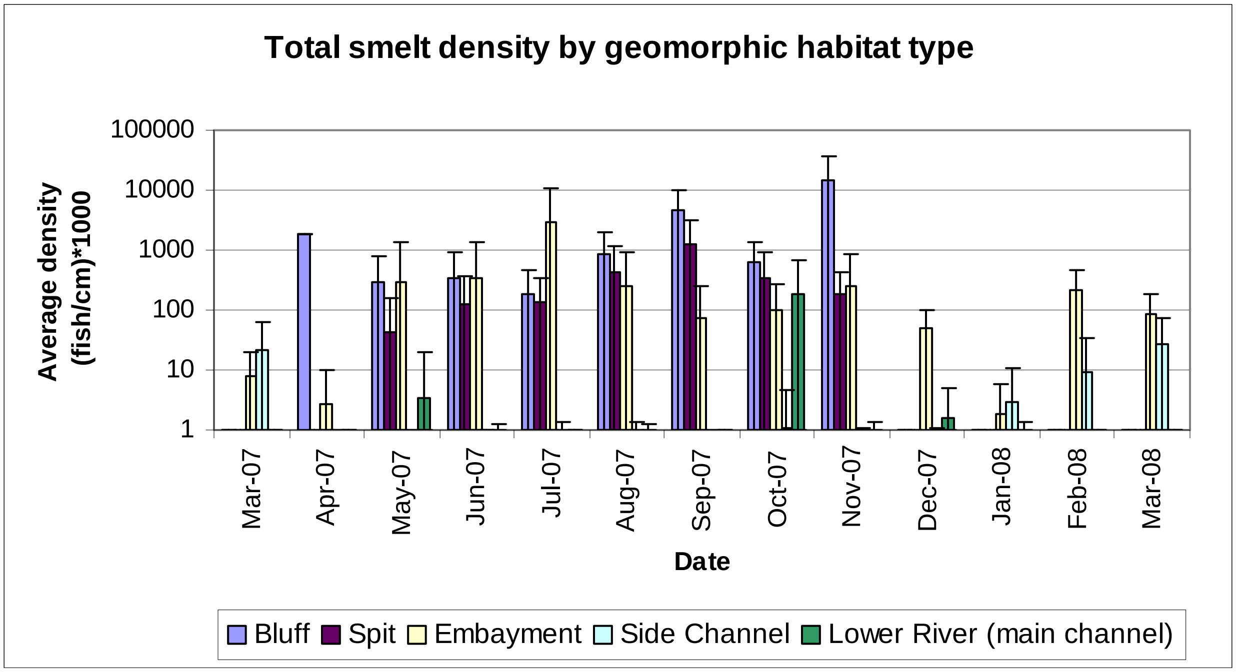


Figure 3a. Average weekly total smelt density by geomorphic habitat type (fish per cubic meter) x1000.

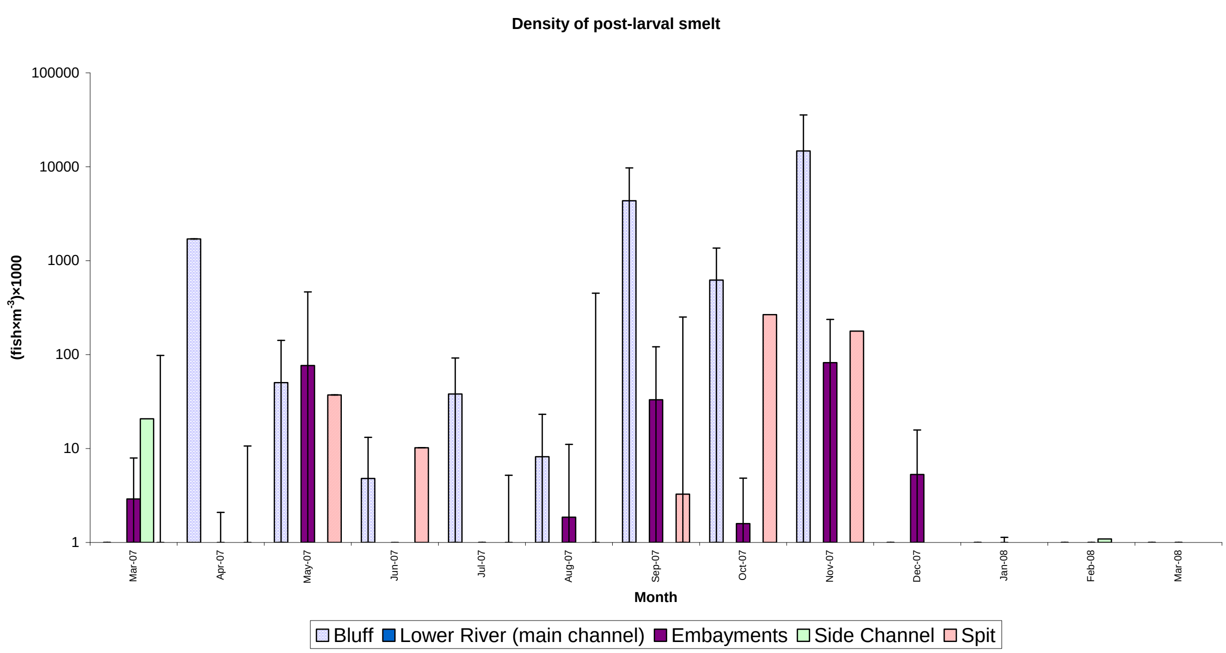


Figure 3b. Average weekly post larval smelt density by geomorphic habitat type (fish per cubic meter) x1000.

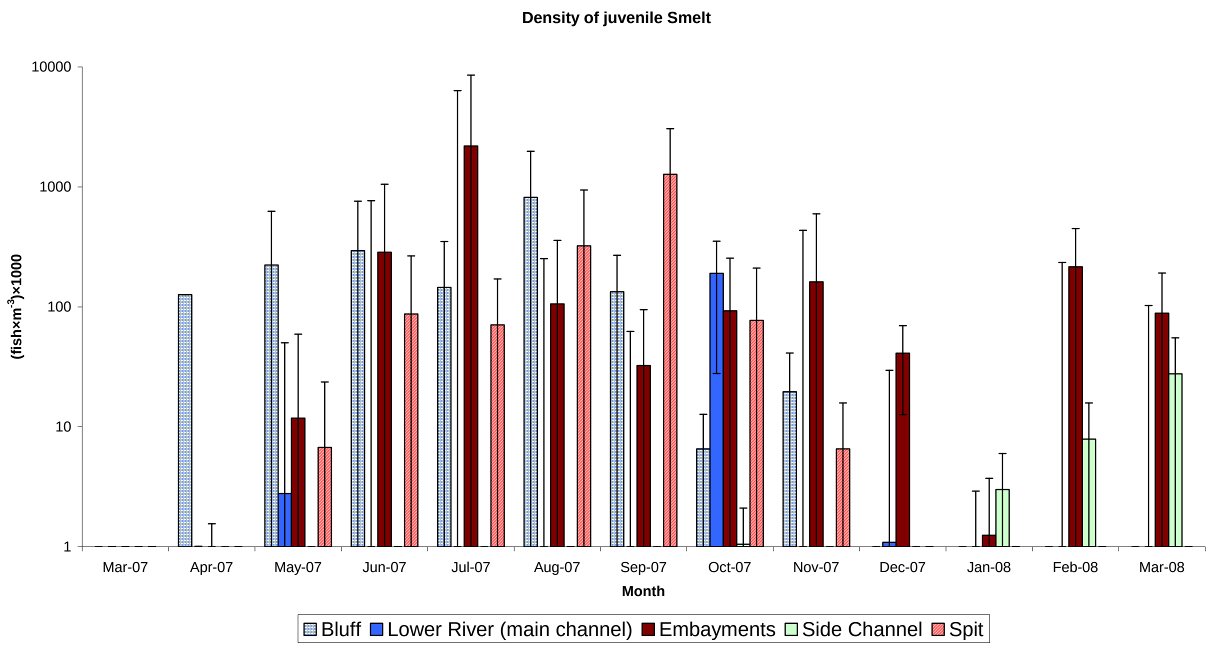


Figure 3c. Average weekly juvenile smelt density by geomorphic habitat type (fish per cubic meter) x1000.

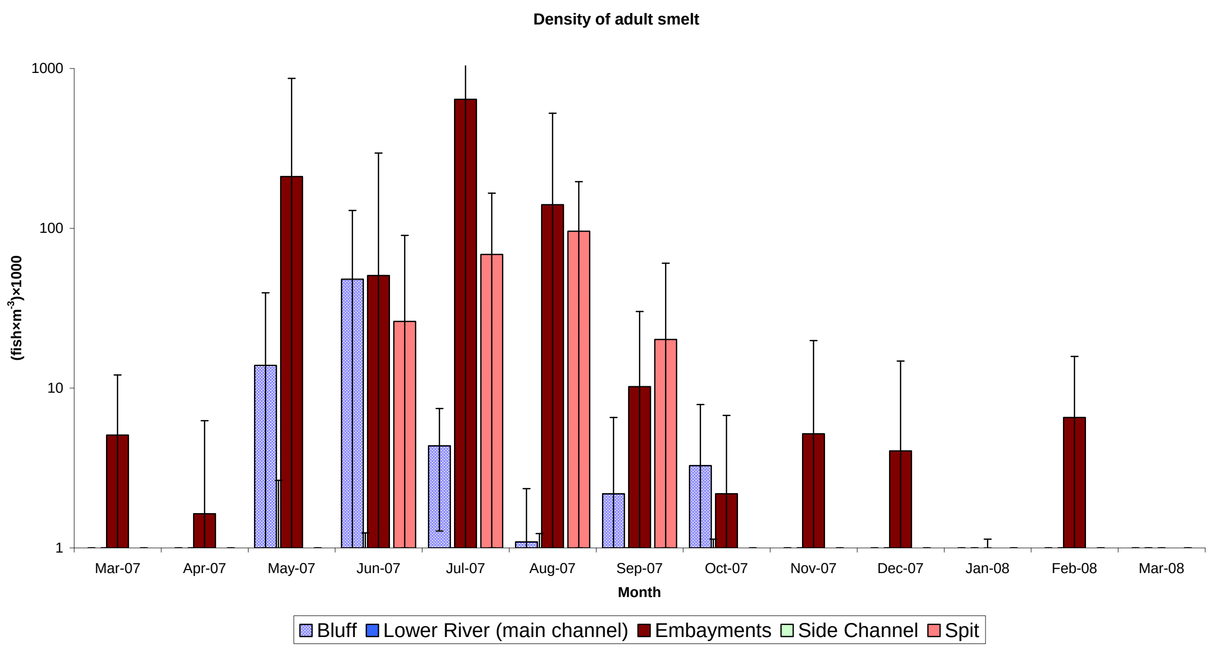


Figure 3d. Average weekly adult smelt density by geomorphic habitat type (fish per cubic meter) x1000.

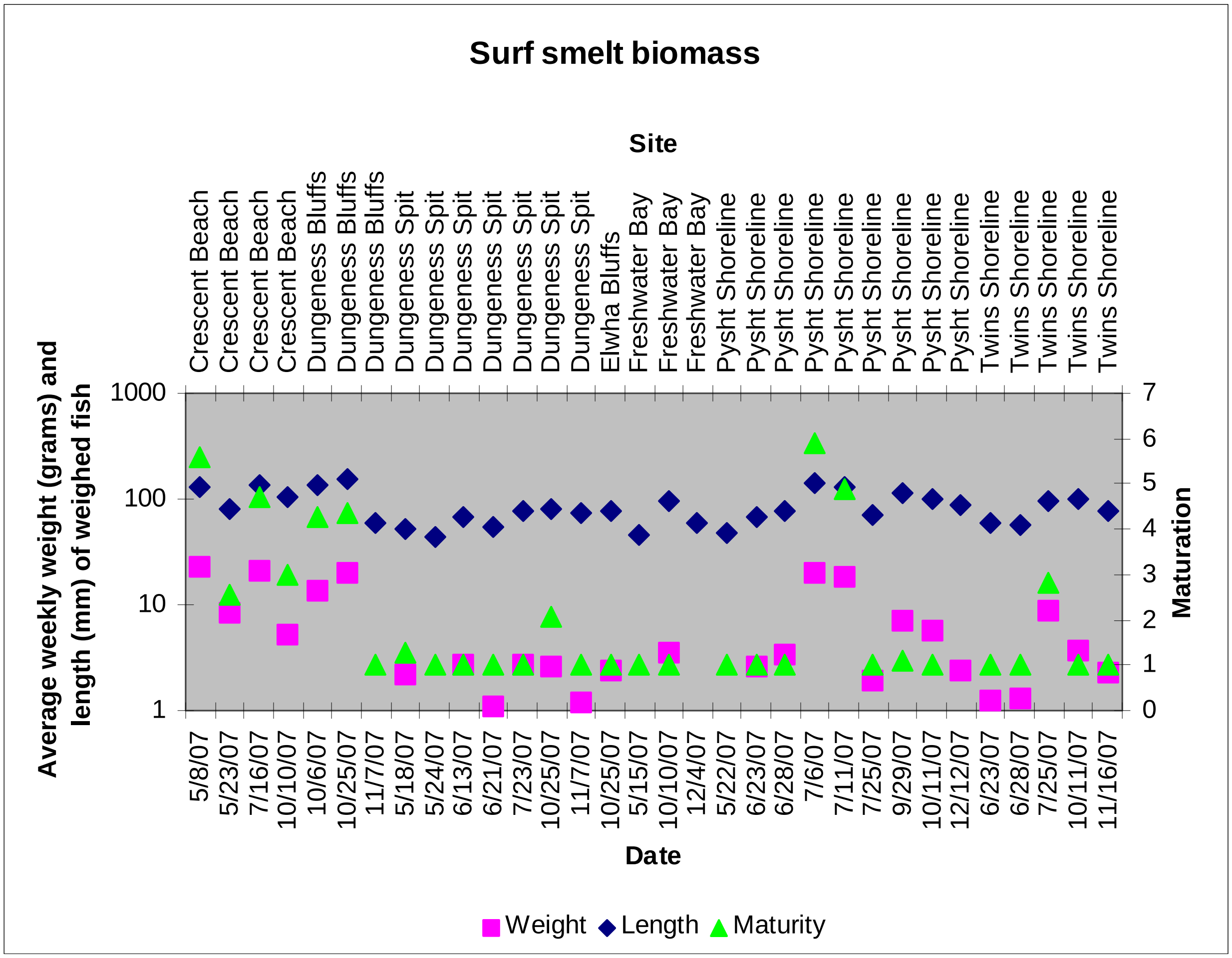


Figure 3e. Weight, length and maturity of weighed adult smelt collected from shoreline sites. Maturity 1=Immature, 2=Starting, 3=Developing, 4=Maturing, 5=Mature, 6=Ripe, 7=Spent, 8=Recovering, 0=Juvenile

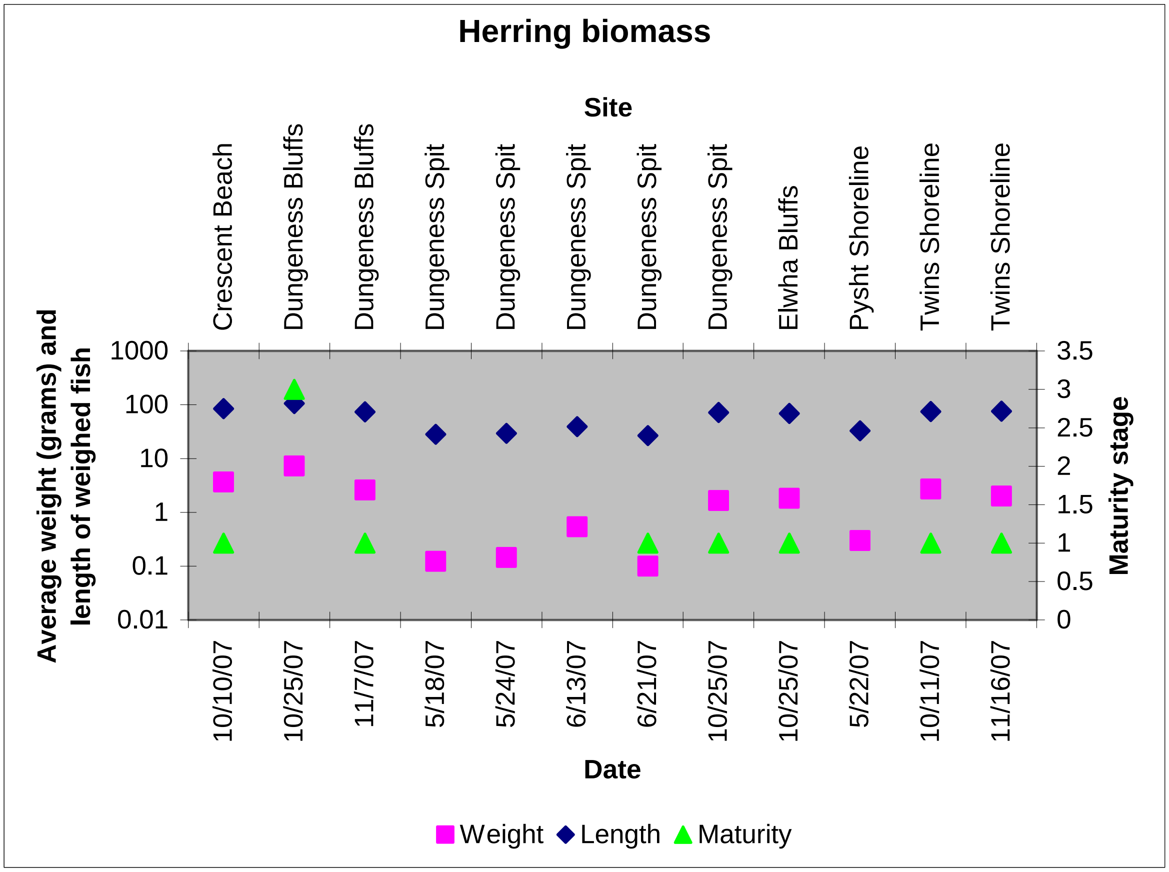
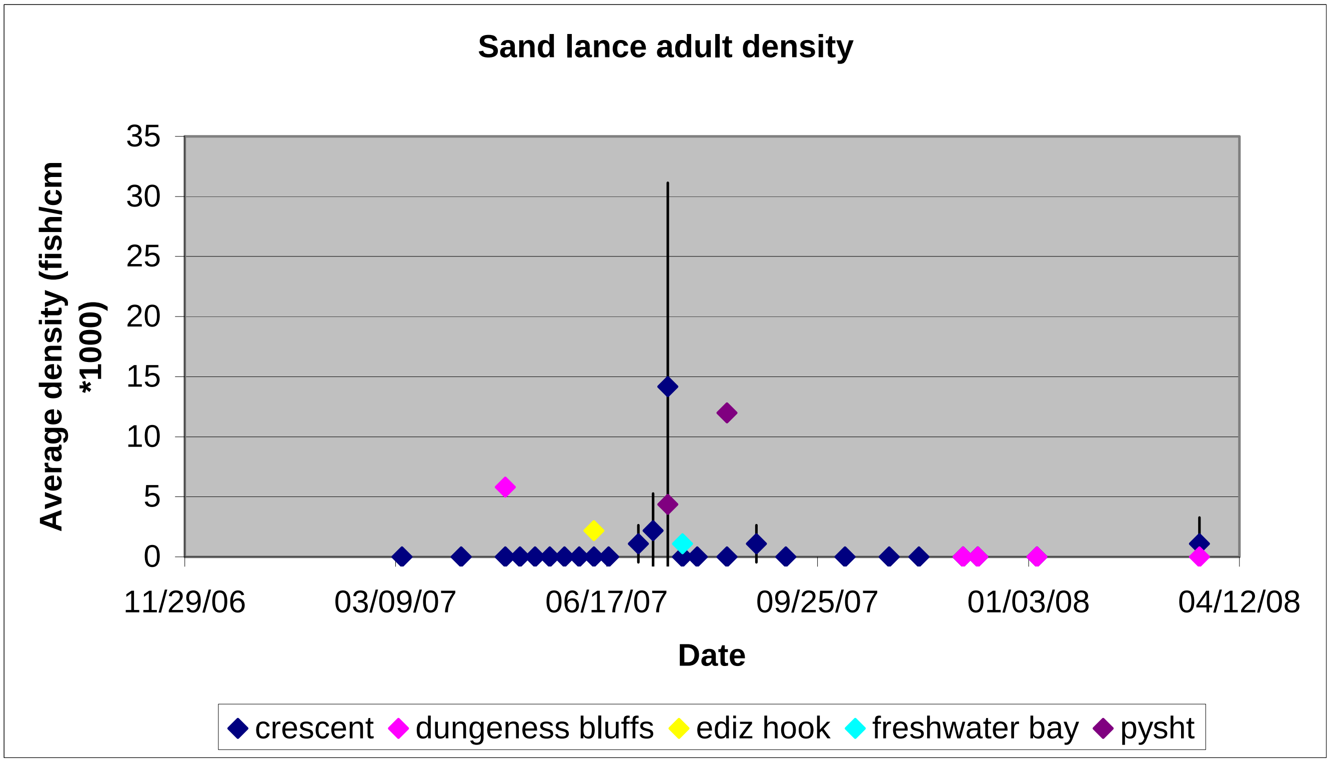
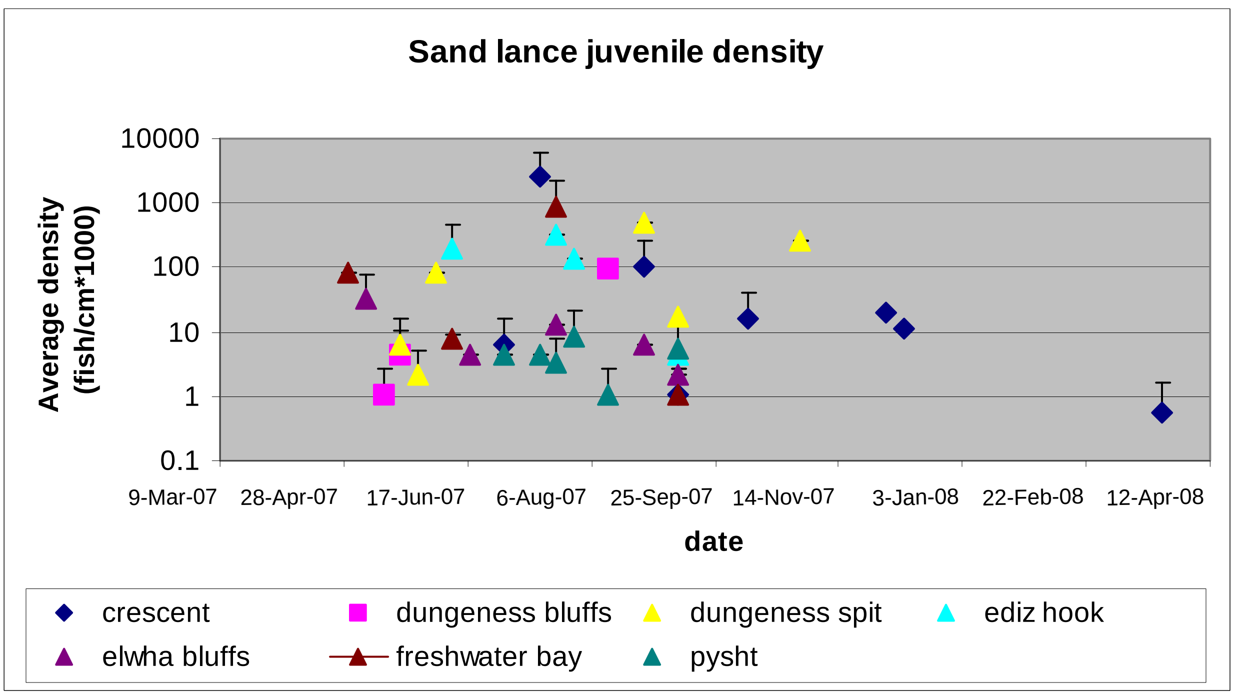


Figure 3f. Weight, length and maturity of weighed adult herring collected from shoreline sites. Maturity 1=Immature, 2=Starting, 3=Developing, 4=Maturing, 5=Mature, 6=Ripe, 7=Spent, 8=Recovering, 0=Juvenile


Sand lance adult density
Average density (fish/cm *1000)
35
30
25
20
15
10
5
0
11/29/06
03/09/07
06/17/07
09/25/07
01/03/08
04/12/08
Date
crescent
dungeness bluffs
ediz hook
freshwater bay
pysht


Sand lance juvenile density
Average density (fish/cm*1000)
10000
1000
100
10
1
0.1
9-Mar-07
28-Apr-07
17-Jun-07
6-Aug-07
25-Sep-07
14-Nov-07
3-Jan-08
22-Feb-08
12-Apr-08
date
crescent
dungeness bluffs
dungeness spit
ediz hook
elwha bluffs
freshwater bay
pysht

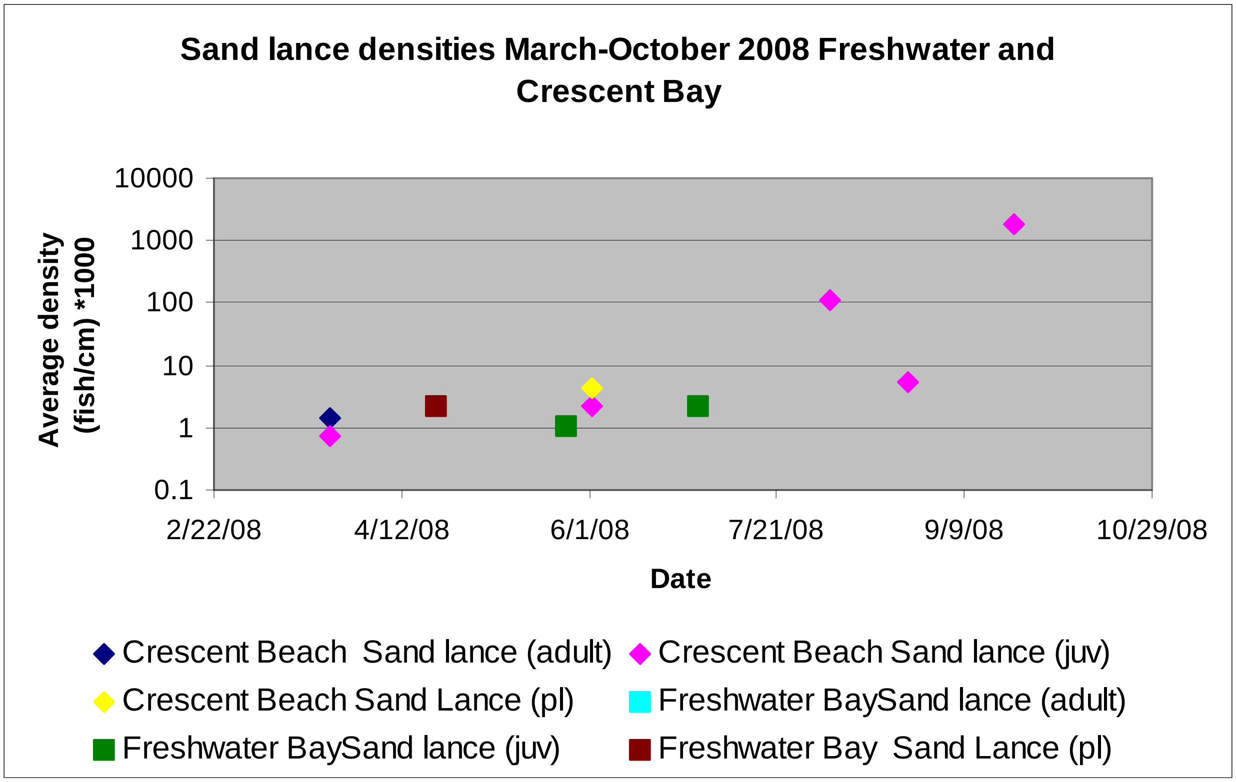


Figure 3g. Sand lance densities along shoreline sites.

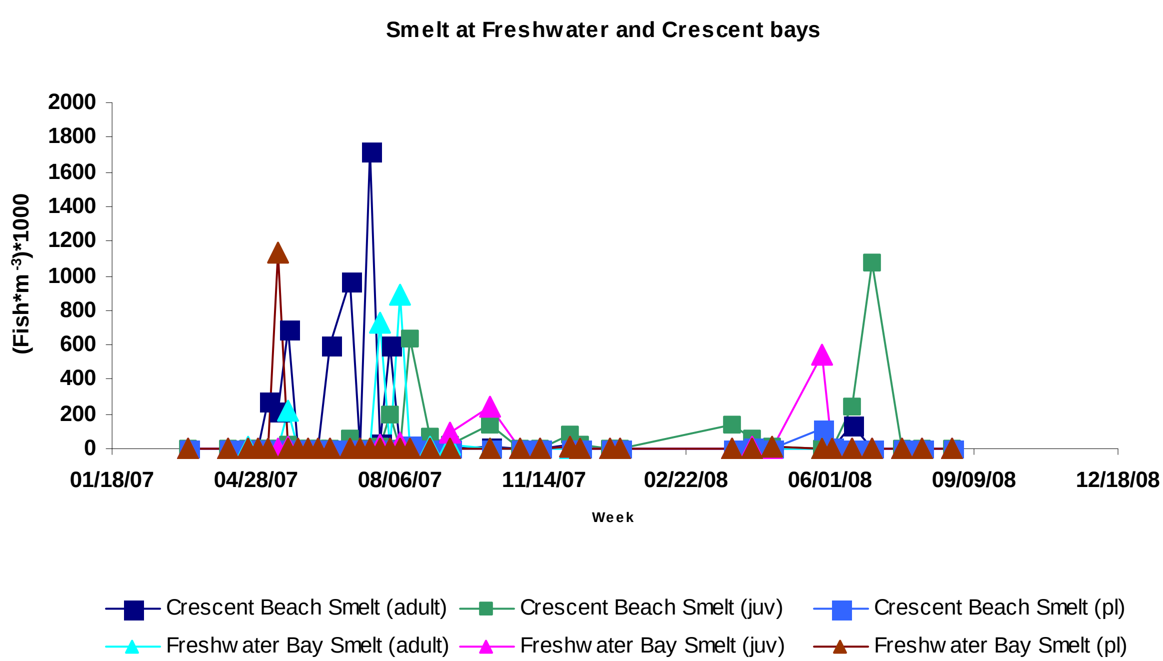


Figure 3g. Long term monitoring results for average smelt densities Freshwater and Crescent Bays.

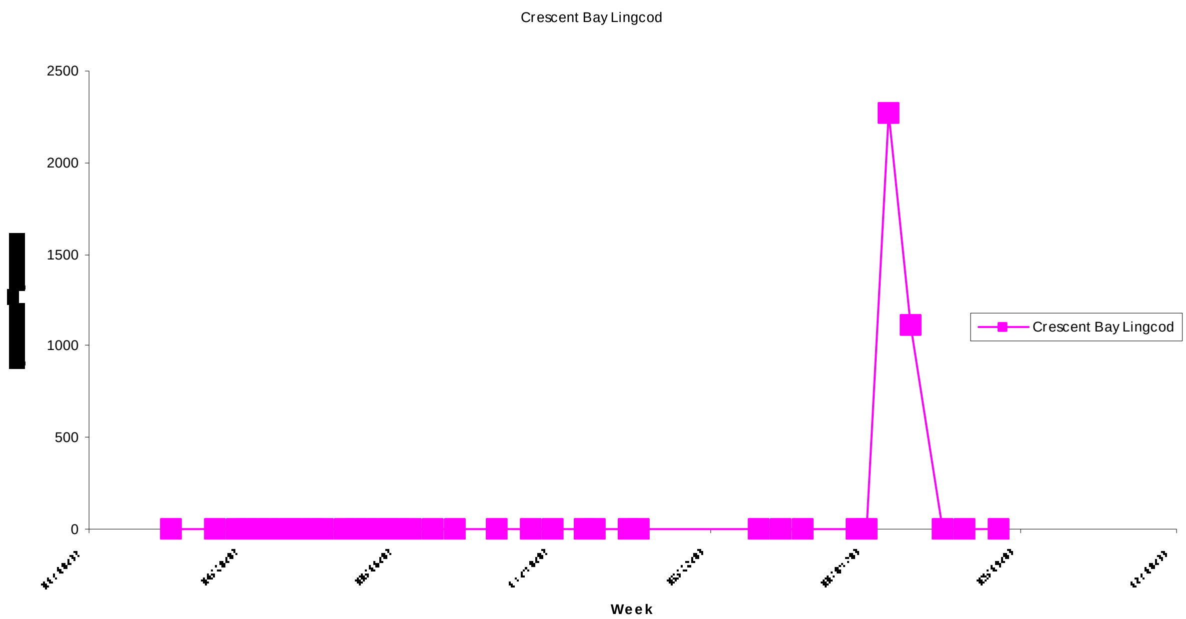


Figure 3h. Long term monitoring result, ling cod densities, Crescent Bay.

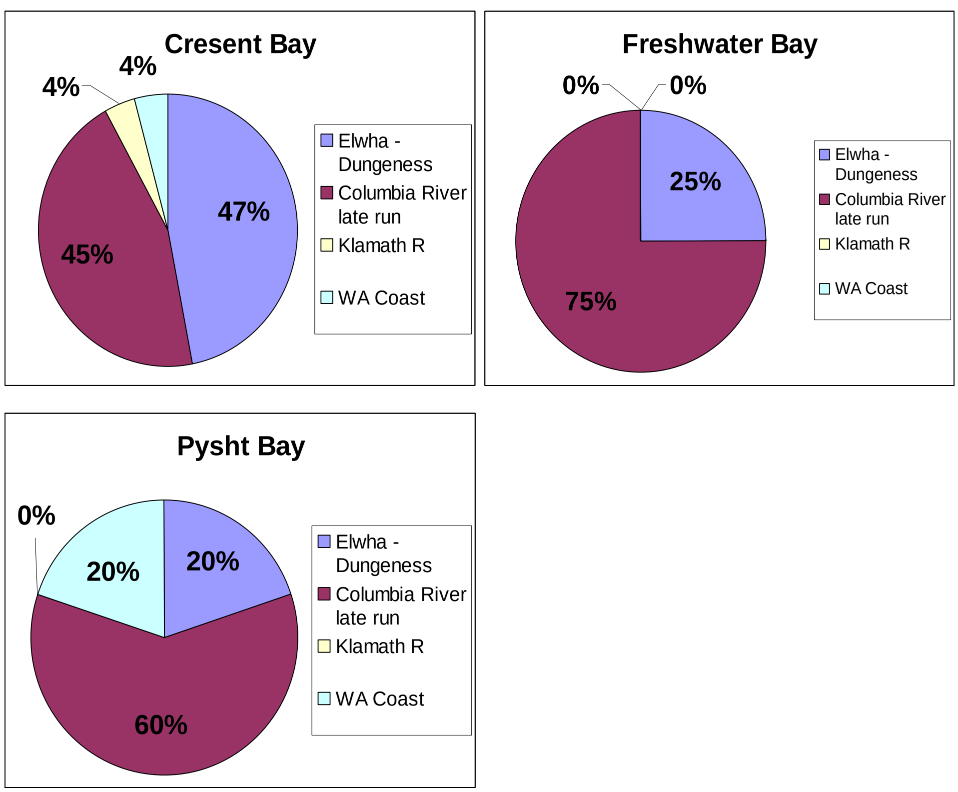


Figure 4. Chinook stock composition from embayment sites west of the Elwha river (Shaffer et al in prep, see accompanying Chapter 6 for additional details).

Table 2. Percent of total smelt for each year by life history. Total smelt % change based on CPUE.

Site	20007			2008			
	Adult	Juvenile	Post larval	Adult	Juvenile	Post larval	Percent Change in total smelt
Crescent	80	19	0	8	85	7	-32
Freshwater Bay	54	12	33	0	98	2	-60

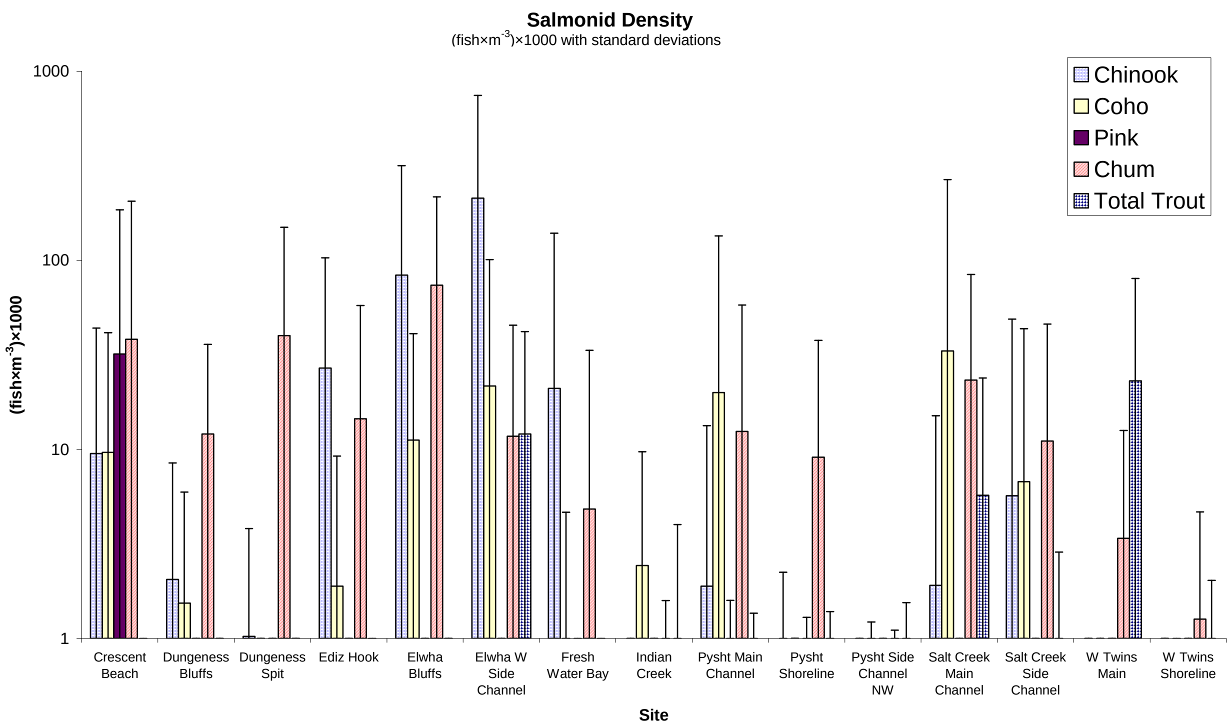
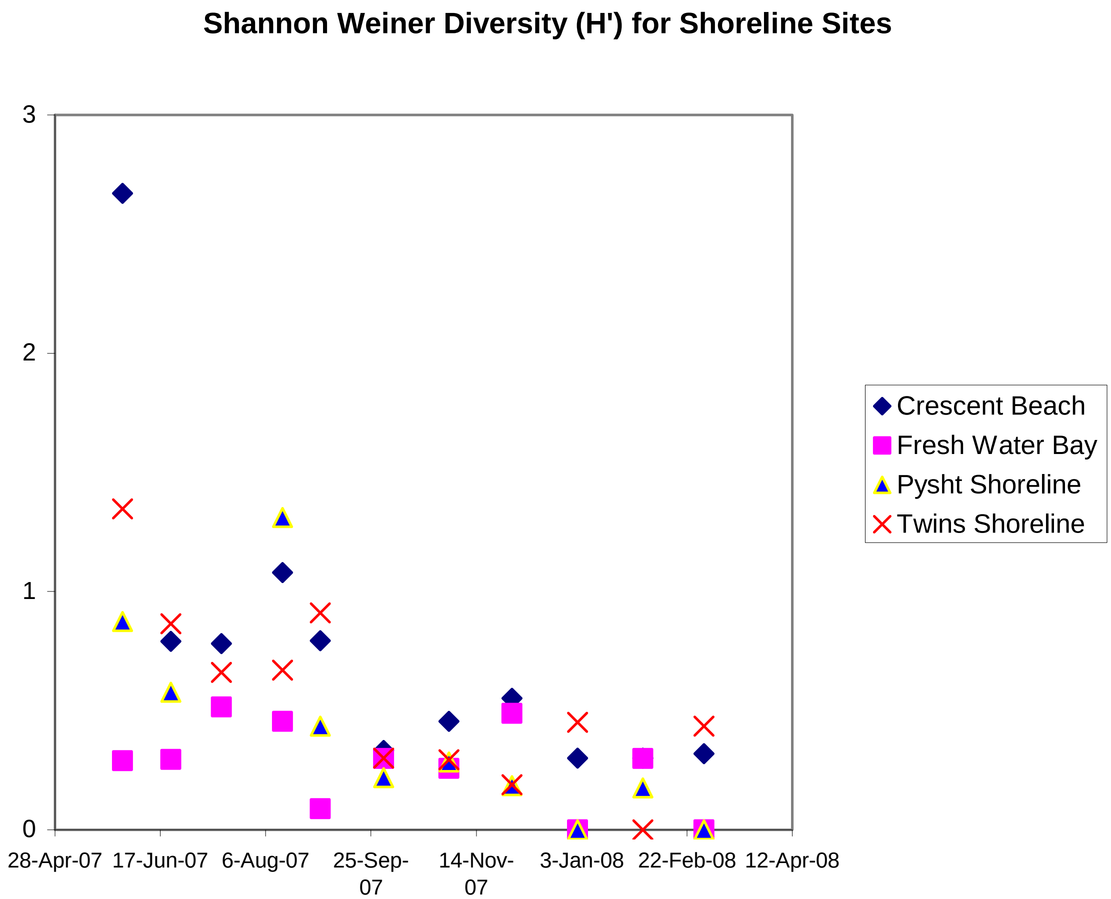
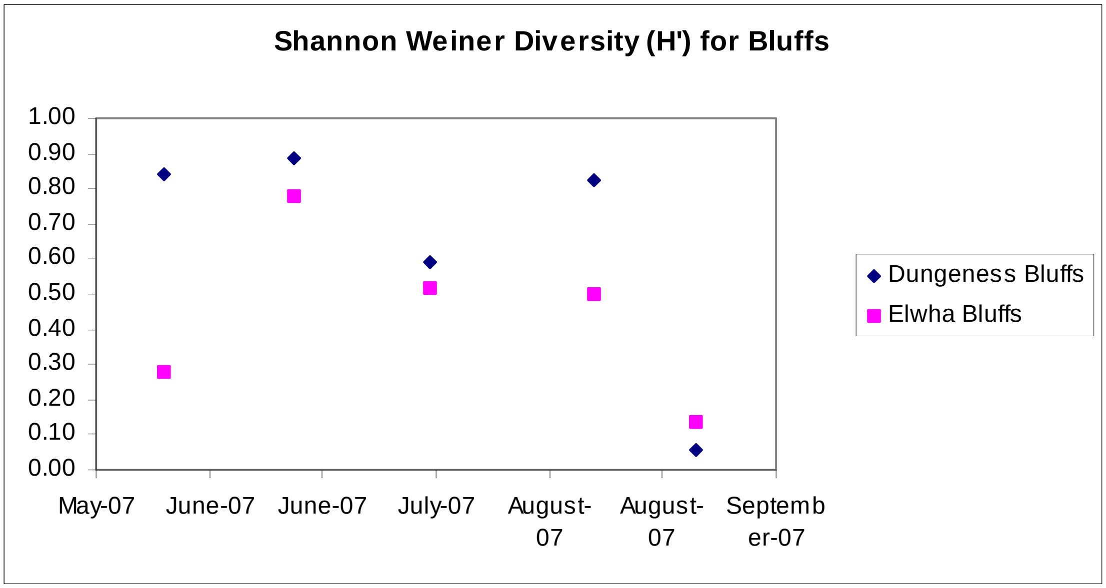


Figure 4. Salmon density by site and species, March-September 2007.


Shannon Weiner Diversity (H') for Shoreline Sites
3
2
1
0
28-Apr-07
17-Jun-07
6-Aug-07
25-Sep-07
14-Nov-07
3-Jan-08
22-Feb-08
12-Apr-08
Crescent Beach
Fresh Water Bay
Pysht Shoreline
Twins Shoreline



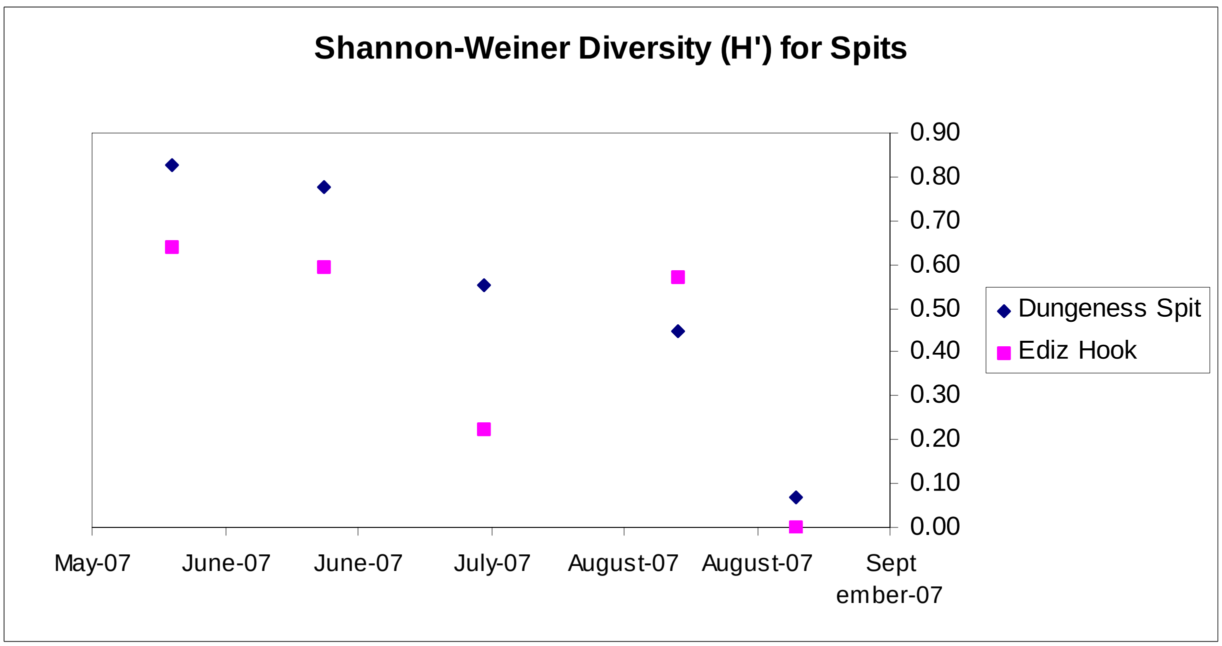


Figure 5. Ecological indices of Elwha and comparative sites by geomorphic habitat type.

Chapter 2. Nearshore Assessment: Fish use of the Elwha estuary

Shaffer[1], J. Anne, Matt. Beirne[2], J. Schilke[1], R. Paradis[3], D. Barry[3], and P. Crain[4]

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

[2] Lower Elwha Klallam Tribe Fish Hatchery Road, Port Angeles, Washington 98362. 360. 457. 4012 x14 mchenry@elwha.nsn.us.

[3] Western Washington University Huxley Program for the Peninsula, Port Angeles, Washington 90362.

[4] Olympic National Park. Olympic National Park 600 E. Park Avenue Port Angeles, WA 98362 patrick_crain@nps.gov

Abstract

We assessed fish use of three main areas (east, west, and impounded west sections) of the Elwha River estuary using standard beach seining techniques from March-September 2007. Species diversity, richness, and evenness were all highest in the connected section of the west estuary, which constitutes only 20% of the total Elwha estuary. Further, over 60% of total fish, 90% of salmonids, and 94% of juvenile Chinook salmon were collected from the connected west estuary. Species diversity and richness of the Elwha east estuary and impounded west estuary were very similar for months both were sampled. Juvenile salmon were the same size in the east and west connected estuary. We theorize that sediment processes closed off fish access to the majority of the east estuary. We hypothesize that migrating juvenile salmon responded to this closure by using the small proportion of west estuary left to them. These results indicate that: 1. Fish use of the Elwha estuary is complex and even fragments of connected estuary are critically important for migrating salmon; 2. Sediment processes in the Elwha estuary are dynamic, and; 3.Juvenile salmon appear to be able to respond to dynamic sediment environment. Projecting these

conclusions to the upcoming dam removal project lead us to recommend that increasing habitat options available for juvenile salmon in the Elwha estuary is a top priority for nearshore restoration This includes, at a minimum, modification of the west levee currently impounding portions of the west estuary to provide, at a minimum, fish passage, and optimally to provide at least partial ecosystem recovery. More detailed monitoring of fish migration in the Elwha estuary, including radio tracking of fish to better define fish use of this complex and dynamic estuarine habitat, is warranted and strongly recommended.

Introduction

The Elwha estuary, which connects the Elwha watershed with the Strait of Juan de Fuca, is critical habitat to a number of federally listed species and a complex, though not well understood, ecosystem. It includes approximately 88 acres of estuarine habitat that may be split into three sections: 1. The east estuary, located east of the river mouth and which includes approximately 63 acres (71 % of the total estuary) that are bordered to the east and south by rock dikes; 2. The west estuary, located on the west side of the river mouth, which in total is approximately 22 acres (29% of the total Elwha estuary) and includes approximately 18 acres of habitat that is bordered to the west by a earthen levee and connected directly to the west river mouth (19% of the total estuary), and; 3. The impounded west estuary which includes 9 acres (10% of total estuary) of impounded estuary, that is immediately west of, and separated from the rest of the west estuary by an earthen and rock dike along the west river channel. This west levee creates a total fish barrier between the river and the 9 acres of impounded estuary (Figure 1).

The Elwha estuary is limited by approximately 100 years of sediment starvation due to two dams installed in the watershed. The sediment starvation has resulted in loss of estuarine side channel habitat (Pess et al 2008). Dikes along the east and west estuary have also resulted in truncated and disconnected estuary.

The Elwha watershed will undergo a large scale restoration event with the removal of two large hydroelectric dams. Dam removal is slated to begin in 2012. Dam removal will result in the transport of approximately 10 million cubic yards of material from the upper river to be to the nearshore, including the Elwha estuary, within five years of dam removal (Randal et al 2004). Given the critical importance of estuarine systems for juvenile fish survival (Beamer et al 2003, 2005, Fresh et al 2006), understanding how the Elwha estuary functions is central to defining additional restoration necessary to achieve full ecosystem recovery (Shaffer et al 2008). The WDFW and LEKT, with numerous partners, have been monitoring the Elwha estuary for habitat function. This report summarizes findings of a one year study defining fish use of the Elwha estuary. Based on these observations we provide restoration and monitoring recommendations necessary to achieve the goal of understanding and promoting ecosystem function within the Elwha estuary.

Methods and Materials

The east, west, and impounded areas of the Elwha etuary, as well as the eastern shoreline of Freshwater Bay, were sampled using beach seines during the salmon outmigration period (March-September) 2007. The shoreline of Freshwater Bay was seined as well. Results of the Freshwater Bay sampling are provided in the companion shoreline report.

Large and small Puget Sound Protocol nets were used in the west estuary. Large PSP seine net was used in the east estuary. A total of 4-6 seines were conducted across three stations of the east estuary every other week. A total of 1-2 seines were conducted along the west estuary weekly. Two seines were conducted in the impounded estuary weekly. Large accumulations of green sea weed in the impounded estuary made the area unworkable. The impounded portion of the west estuary was therefore sampled only March-June.

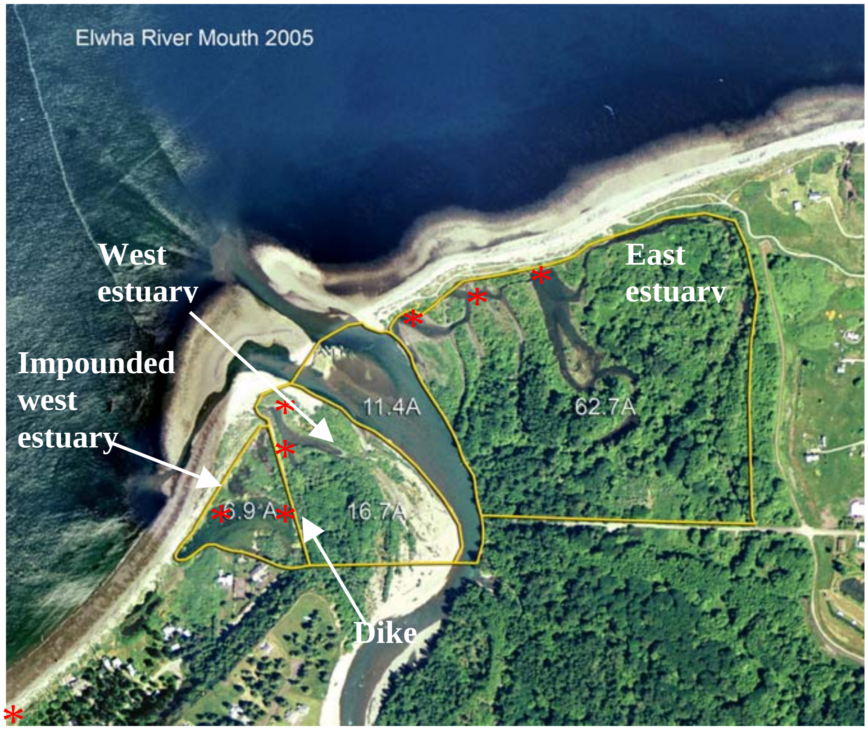


Figure 1. Sample locations east and west Elwha estuary with acreages. Asterisk indicates sample site.

Results

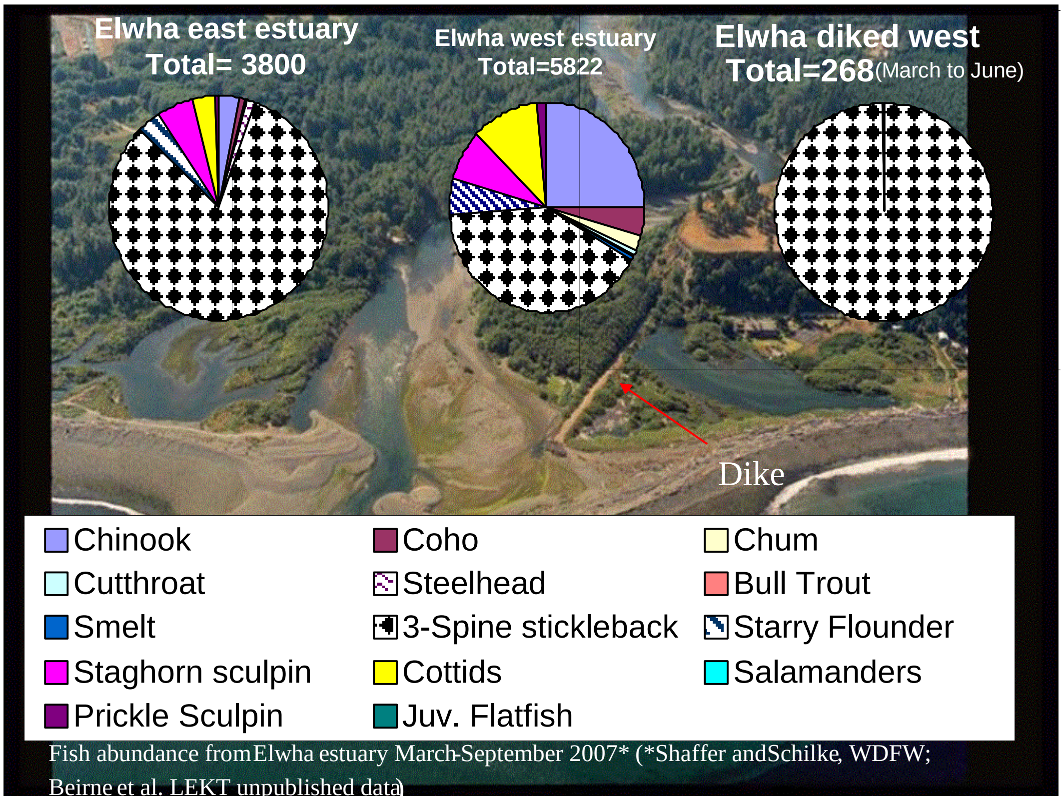
A total of 118 seines were conducted from March-September 2007 (Table1). Combining seining results from summer 2007 revealed a number of differences in fish use within the Elwha estuary. Species composition, diversity, and richness varied by each area (Figure 2-5).

Table 1. Seining summary Elwha estuary 2007. *=seining study lead by LEKT.

Date		Number of Seines by Site		
	East*	West	Impounded estuary	Total
March	10	2	2	14
April	12	6	6	24

May	15	6	10	31
June	8	6	na	14
July	10	8	na	18
August	4	5	na	9
Sept	4	4	na	8

Figure 2. Percent composition, by species, in each of the three sections of the Elwha estuary.



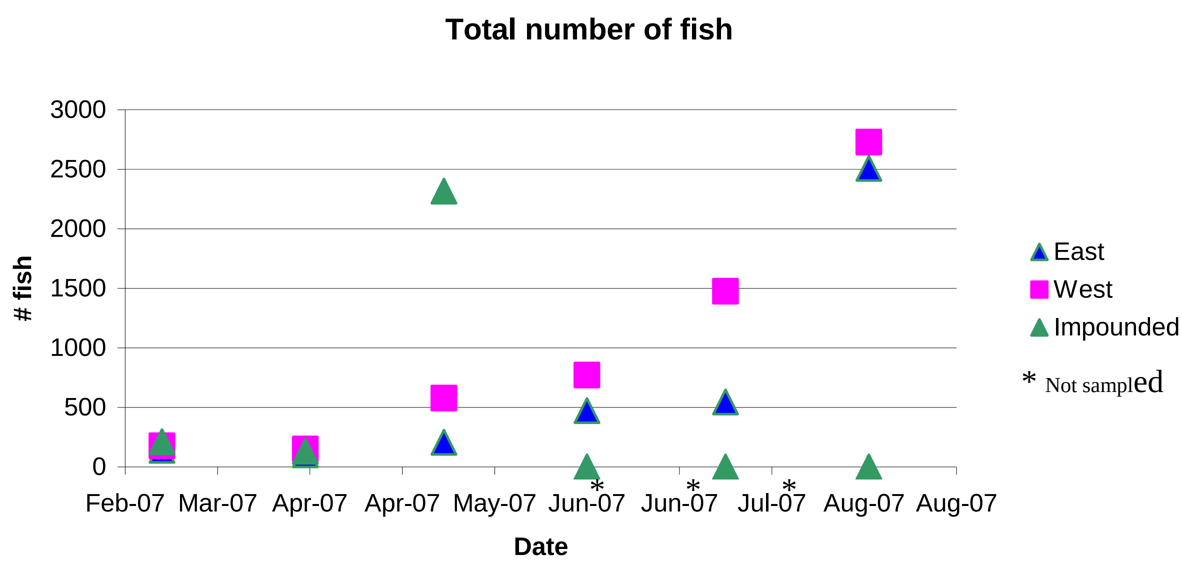


Figure 3. Total number of fish collected at each of the three sections of Elwha estuary March-September 2007, by month (Impounded area sampled March-June).

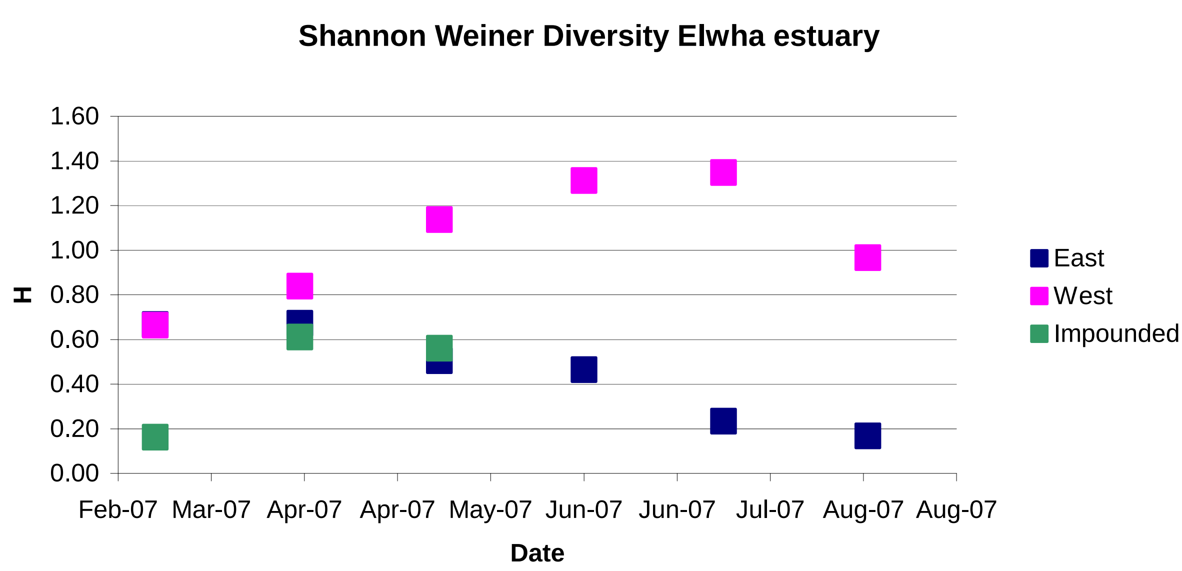


Figure 4. Shannon Weiner Diversity, Elwha estuary

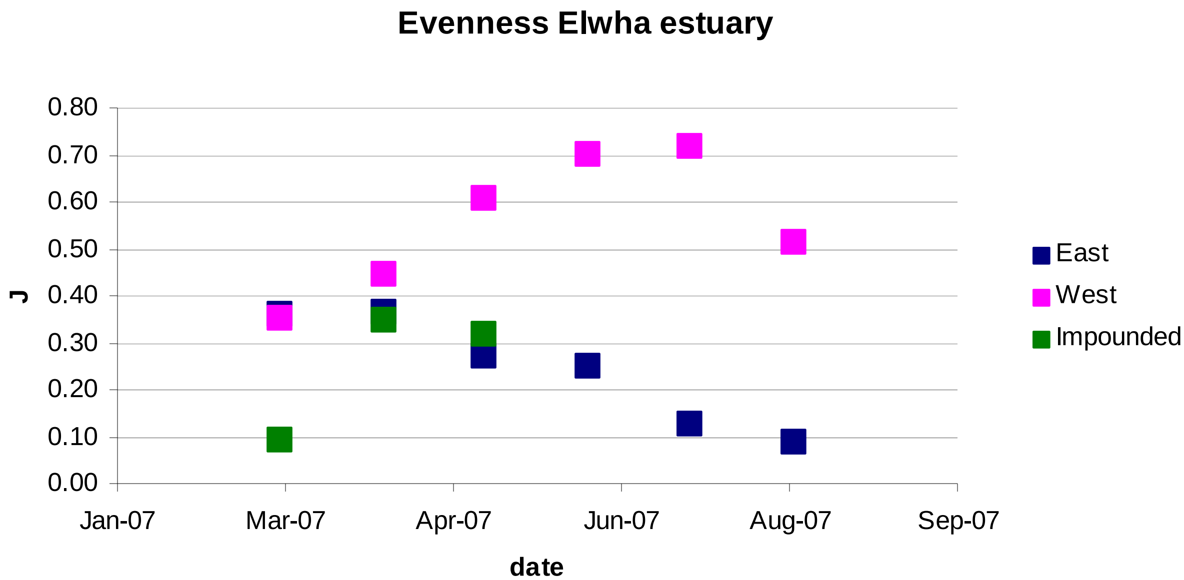


Figure 5. Evenness, Elwha estuary.

In total 47% of the fish were collected in 20% of the Elwha estuary (the west estuary). In addition, over 90 percent of combined juvenile salmonids and 94% of juvenile Chinook salmon were collected in the west estuary (Table 2). Densities of Chinook, coho, and chum salmon densities were all much higher in the west estuary than other areas of the Elwha estuary Figure 6-8). Fish size was similar across the estuary (Figure 9-13). Average juvenile Chinook size increased with time (Figure 14). Average coho size, on the other hand, initially increased and then decreased across the sampling season.

Table 2. Salmonid abundance summary Elwha estuary

		East estuary	**Connected west estuary**	**Impounded west estuary**	**Combined estuary**
Total salmon	Number	250	2527	3	2780
	Percent	9	91	0	100
Chinook	Number	130	1942	1	2073
	Percent	6	94	0	75
Coho	Number	37	335	0	372
	Percent	10	90	0	14
Chum					
	Number	37	180	0	217

	Percent	17	83	0	10
Cutthroat	Number	2	65	0	67
	Percent	3	97	0	2
Steelhead	Number	44	5	1	50
	Percent	88	10	2	2

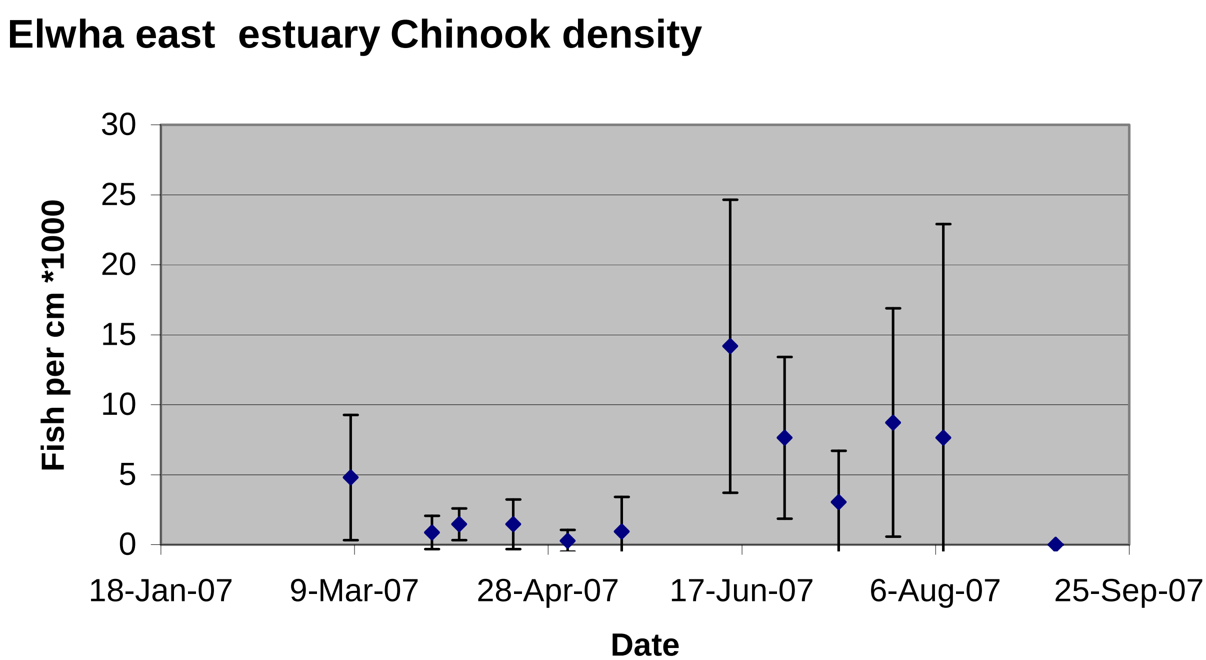


Figure 6. Chinook density, east estuary

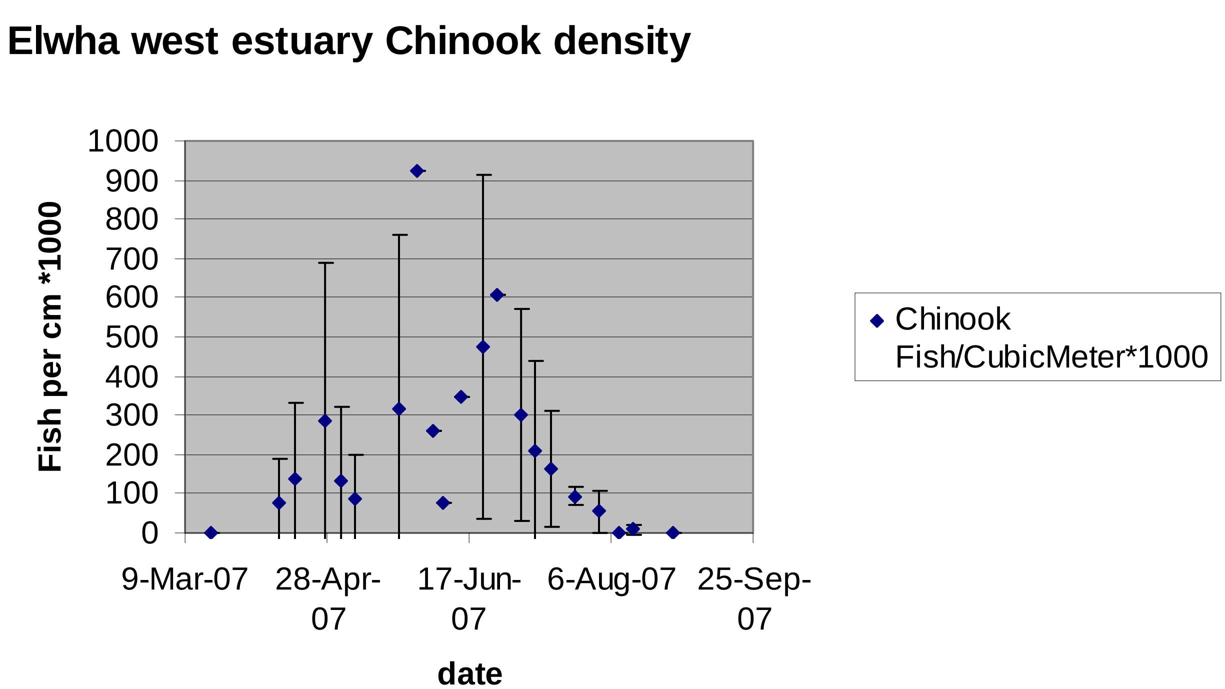


Figure 7. Chinook density, west estuary

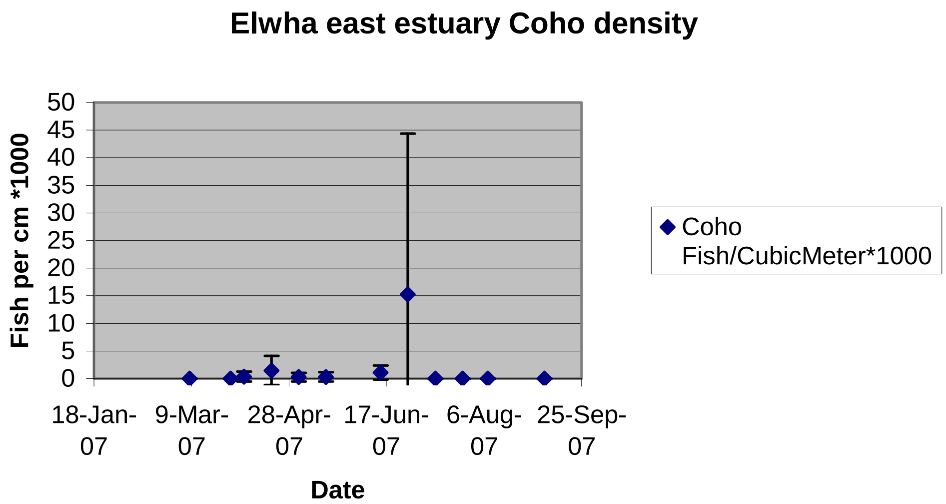


Figure 8. Coho density east estuary.

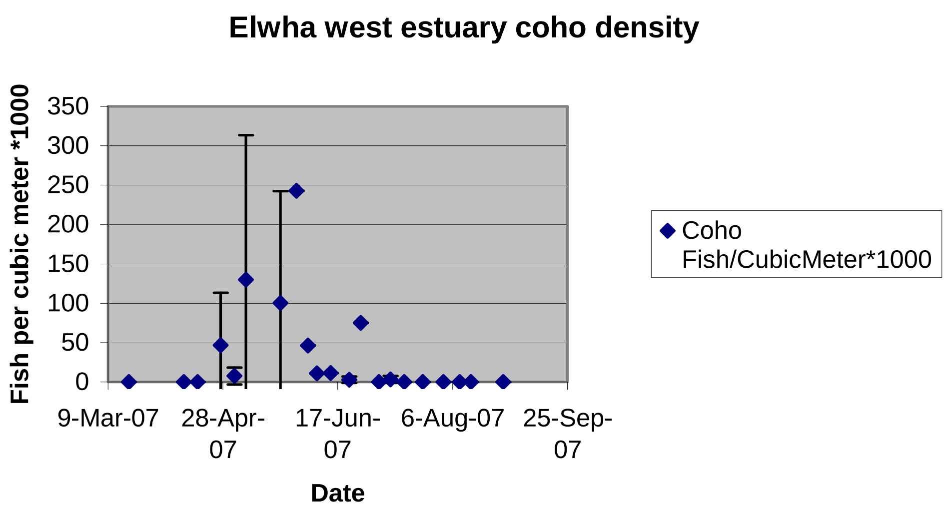


Figure 9. Coho density west estuary

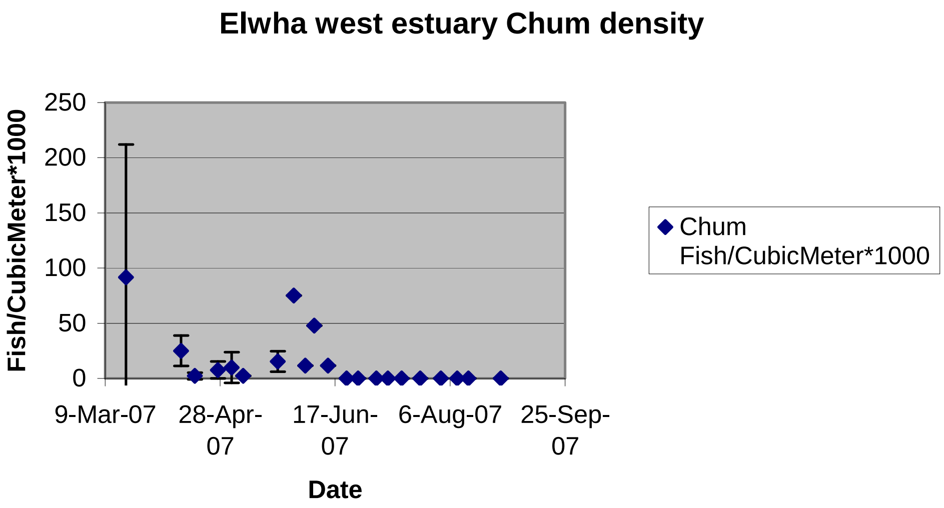


Figure 10. Chum density west estuary

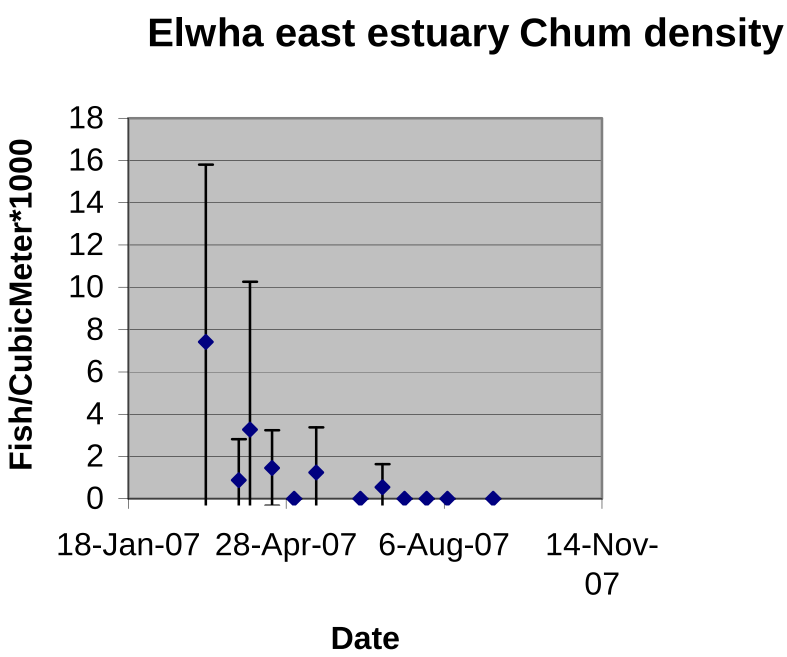
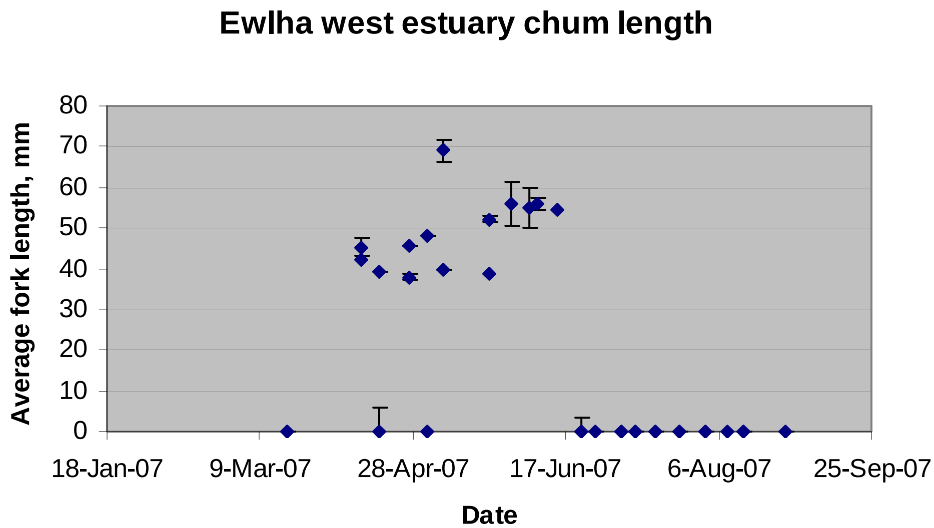
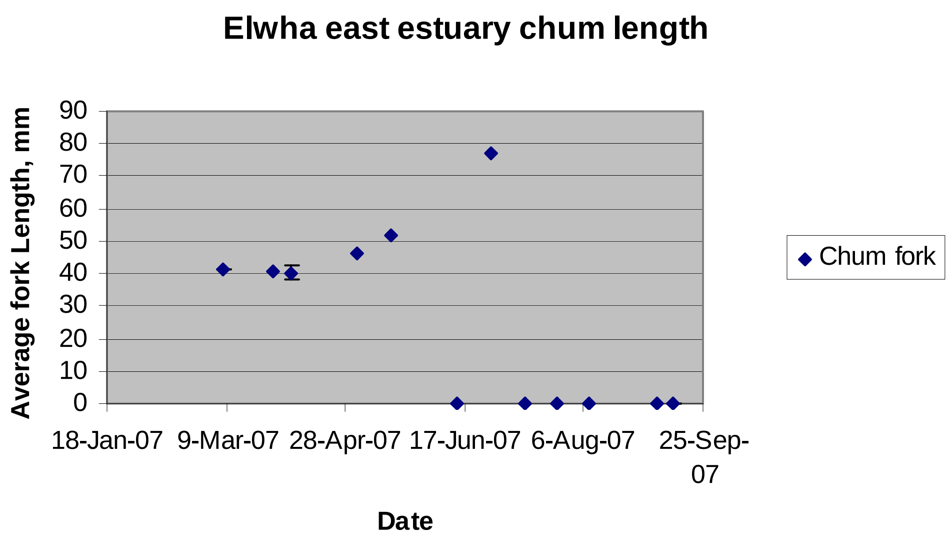


Figure 11. Chum density east estuary


Ewlha west estuary chum length
Average fork length, mm
80
70
60
50
40
30
20
10
0
18-Jan-07
9-Mar-07
28-Apr-07
17-Jun-07
6-Aug-07
25-Sep-07
Date


Elwha east estuary chum length
Average fork Length, mm
90
80
70
60
50
40
30
20
10
0
18-Jan-07
9-Mar-07
28-Apr-07
17-Jun-07
6-Aug-07
25-Sep-07
Date
Chum fork

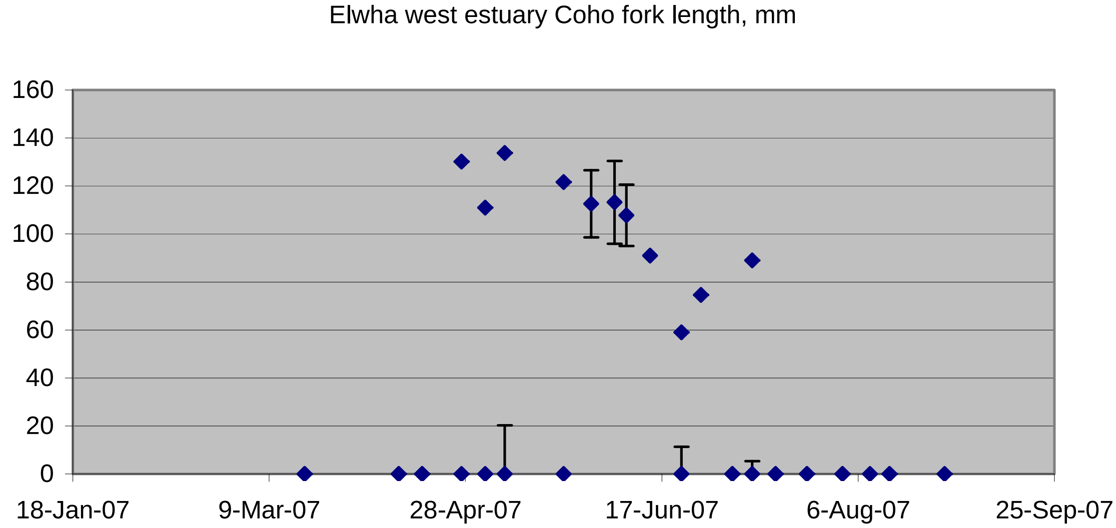


Figure 12. Coho fork length,.west estuary

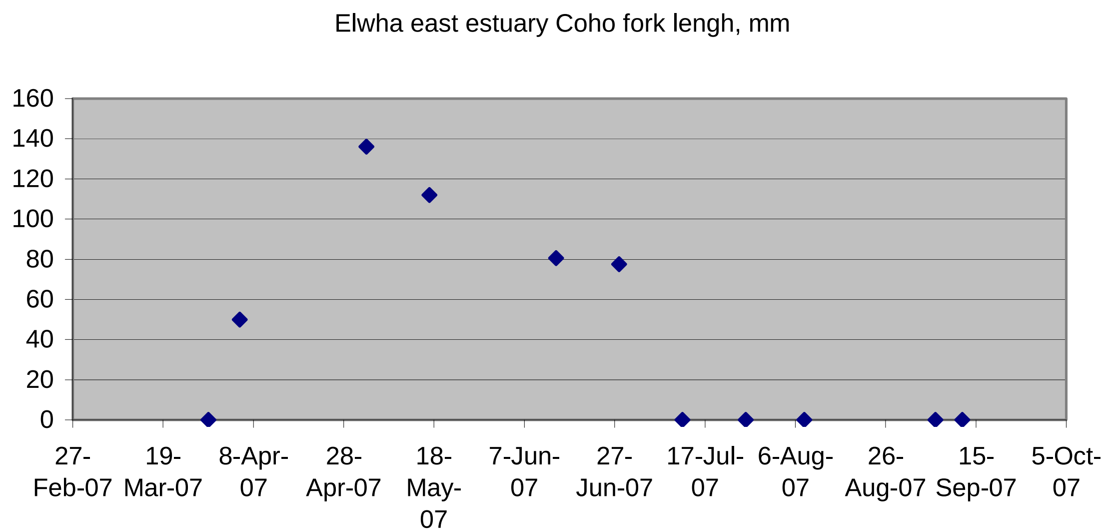


Figure 13. Coho fork length, mm. East estuary

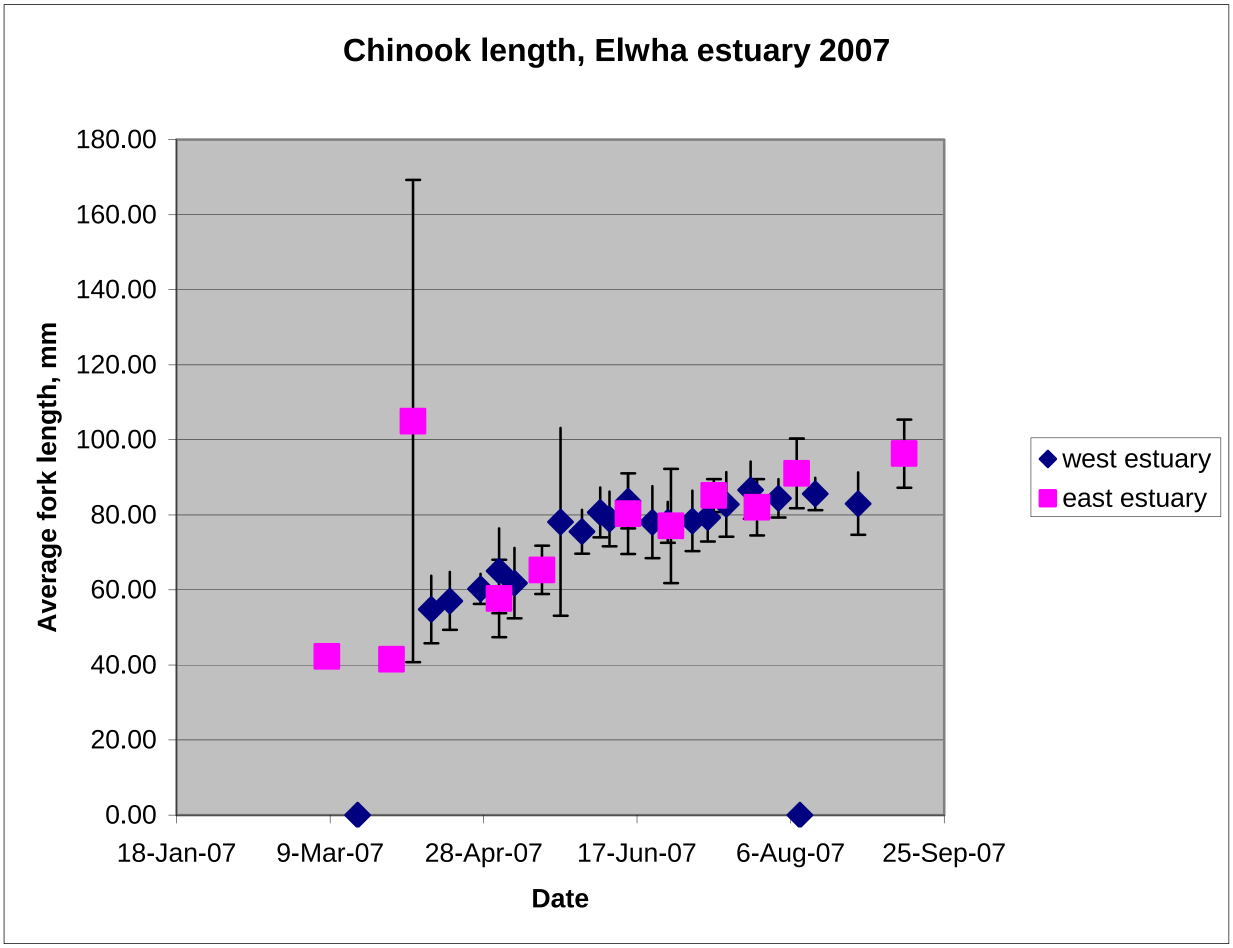


Figure 14. Chinook length Elwha estuary.

Discussion

Based on life history strategies published by Fresh 2006 and others, Chinook use of the Elwha estuary appears to be bimodal with delta fry migrates moving into the Elwha estuary in March and April, and parr migrants appearing in June. (see Beamer et al 2004). Chum use of the Elwha estuary begins in March and abruptly dropped off in June. This use is similar to chum use documented in other Puget Sound systems, where juvenile chum use the nearshore widely during outmigration (Fresh 2006; Brennan et al.2004). The abrupt decrease in chum densities in June is also consistent with life history of chum in other areas of Puget Sound and indicates that these fish are moving off to more neritic environments. (Fresh 2006).

Fish use of the Elwha estuary is complex and appears to be dictated by environmental factors. In this study we observed high fish use in a small area of the estuary that is bordered by a 40 plus year old dike that creates a total barrier to fish passage. The high total fish numbers in the impounded portion of the west estuary indicates that the impounded area is productive fish habitat provided fish can get to it. The low diversity and high evenness of the impounded portion of the west estuary, particularly compared to that of the connected west estuary just feet away, indicate that the structure is a significant limiting factor to the habitat function of the estuary.

The relative observations of the highest abundance of salmon and highest species diversity in the small west estuary are also intriguing. We've attributed the relative low use of the large east estuary to a sediment lens that is said to have formed off the entrance to the east estuary early in 2007 and persisted until late fall 2007/early winter 2008. One assumption is that, with the blockage of the east estuary entrance, the fish switched from the east to the west side of the river and used the only fragment of habitat left to them. This is based on the much lower fish numbers observed in the east estuary in 2007 compared to 2006 (Beirne, LEKT, unpublished data).

Alternatively, fish use of the Elwha west estuary may always be this high-and who knows what happened to the fish that would have used the east estuary in 2007. Another possibility is that there was some blockage at the connection of the west estuary to the main river, and that fish observed in the west estuary were simply resampled through the season, resulting in artificially inflated fish abundance observations for the west estuary. There are several observations to counter this theory. In particular: 1. If the fish numbers observed in the west estuary were a result of resampling we would have expected to see the same trends in total fish numbers on both sides of the estuary (since both were to be closed off). Instead we saw different trends in fish numbers on the east and west estuary. Only the numbers between the impounded west estuary (for the months sampled) and east estuary were similar-in fact almost identical-indicating that the east estuary and west impounded estuary function were driven by similar forces (blocking) and that those forces were different from those operating on the west connected estuary. Also, chum abundances increased steadily in the west estuary (but not the east estuary) indicating that the west estuary had regular fish access while the east estuary did not.

Sediment limitation has played a dominant role in Elwha lower river and nearshore habitat. Unconstrained, low gradient channel reaches in the lower Elwha River historically contained extensive side channels (Pess et al. 2008) and estuarine slack water habitats with suitable substrate for critical fish use including eulachon spawning. Truncation of sediment transport to the lower river, along with channelization, and the systematic removal of large woody debris (LWD), has caused channel incision and an increase in bed substrate size (Pohl 2004). Nearshore effects of this disruption likely include a significant reduction in side channel habitat and a reduction in suitable eulachon spawning habitat (Shaffer et al 2007).

Environmental factors have also been documented to dictate Chinook survival (Greene et al 2005). More specifically, sedimentation has been documented to define fish behavior and abundance in northwest estuaries. Gregory and Levings (1997) found sediment associated turbidity defined predation success by juvenile Chinook in the Fraser river.

Understanding current and future hydrodynamics in the lower Elwha river as well as a detailed understanding of fish movement in the lower river are therefore central to understanding estuarine habitat function during and after dam removal. In general we know that the sediment processes in the lower river are dynamic, and will continue to be so with dam removals (Randal et al 2004). In a longer horizon we need a more detailed model predicting upcoming sediment response in the estuary, as well as a detailed understanding of fish response. Combined, this information will allow us to define how, if at all, we expect to manage for sediment during the restoration process.

The fish use observed in 2007 may indicate that juvenile salmonids can respond fairly quickly to a dynamic sediment landscape. If this is correct, providing the fish the most options is the best alternative. The most obvious opportunity for providing more habitat is to provide fish access to the impounded west estuary currently blocked by the existing west levee. The dike, which is privately co-owned, is currently scheduled to be modified in place soley to provide current level of flood protection post dam removal-with no provision for fish passage. Clallam County is leading a SRFB funded project to provide fish passage in this structure. Clearly the Elwh nearshore is important habitat for fish, including federally listed salmonids. Detailed longer term monitoring of fish movement in the estuary as well as specific sediment mapping in the nearshore are warranted to define additional actions that might be appropriate for the Elwha nearshore.

Acknowledgements

This work was funded by the SRFB and EPA with in kind support by WDFW and the Lower Elwha Klallam Tribe. The Clallam Marine Resources Committee provided funding for two college interns. Student Interns were provided by Peninsula College Fisheries Program and Center of Excellence, and the Western Washington University REU program. Mr. Jack Ganzhorn and Dr. Dwight Barry provided student supervision. Nancy Bleustein Johnson provided student guidance. Interns that assisted in the project include Jesse Charles, Chris DeSisto, Bryan Hara, Erica Hirsh, Mario Laungayan, Romy Laungayan, Ross McDorman, Sean Oden, Tiffany Nabors, Jacob Ray, Tyler Ritchie, Melanie Roed, Justin Rondeau, Trista Simmons, Ben Warren, Karen Wilkie, Eric Wood, and Steve Wyall. Private property owners Pam Lowry and Malcom Dudley along with Chuck Janda provided site access. Project in kind partners in order of contribution included Cathy Lear (Clallam County), Dave Parks (DNR), Pat Crain and Brian Winters (ONP), Ross Fuller, Mike Sharpf, Chris Byrnes, Roger Mosley, Dan Penttila, Dan Doty, and Tim Quinn (WDFW), Bruce McCarter (DFO),Tim Randall (BoR) and Amy Draut (USGS). Kurt Fresh (NOAA) provided manuscript input. This material is based upon work supported in part by the National Science Foundation under REU Grant No.

0452328 awarded jointly to Peninsula College and Western Washington University. Any opinions, findings and conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

References

Beamer, E., R. Henderson, A. McBride and K.W. Wolf. 2003. The importance of non-natal pocket estuaries in Skagit Bay to wild Chinook salmon: an emerging priority for restoration. Skagit River System Cooperative, Research Department, La Connor. Washington. 10 p.

Beamer, E., A. McBride, C. Greene, R. Henderson, G. Hood, K. Wolf, K. Larsen, C. Rice and K. L. Fresh. 2005. Delta and nearshore restoration for the recovery of wild Skagit River Chinook salmon: linking estuary restoration to wild Chinook salmon populations. Supplement to Skagit Chinook Recovery Plan, Skagit River System Cooperative. La Conner, Washington.

Boehlert, G.W. and Mundy, B.C. (1988) Roles of behavioral and physical factors in larval and juvenile fish recruitment to estuarine nursery areas. American Fisheries Society Symposium 3, 51–67.

Bottom, D.L., Jones, K.K., Cornwell, T.J., Gray, A. and Simenstad, C.A. (2005) Patterns of Chinook salmon migration and residency in the Salmon River estuary (Oregon). Estuarine, Coastal and Shelf Science, 64, 79–93

Breine, J., Maes, J., Quataert, P., Van den Bergh, E., Simoens, I., Van Thuyne, G. and Belpaire, C. (2007) A fish-based assessment tool for the ecological quality of the brackish Schelde estuary in Flanders (Belgium). Hydrobiologia 575, 141–159.

Brennan, J.S., K.F. Higgins, J.R. Cordell and L.A. Stamatiou. 2004. Juvenile salmon composition, timing, distribution, and diet in marine nearshore waters of central Puget Sound in 2001-2002. King County, Department of Natural Resources and Parks, Seattle Washington. 164 p.

Fresh, K.L. 2006. Juvenile Pacific Salmon in Puget Sound. Puget Sound Nearshore Partnership Report No. 2006-06. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Franco, A., Franzoi, P., Malavasi, S., Riccato, F., Torricelli, P. and Mainardi, D. (2006) Use of shallow water habitats by fish assemblages in a Mediterranean coastal lagoon. Estuarine, Coastal and Shelf Science 66, 67–83.

Gray, A., C.A. Simenstad, D.L. Bottom and T.J. Cornwell. 2002. Contrasting functional performance of juvenile salmon habitat in recovering wetlands of the Salmon River Estuary, Oregon, U.S.A. Restoration Ecology 10:514-526.

Greene, C.M. and T.J. Beechie. 2004. Consequences of potential density-dependent mechanisms on recovery of ocean-type Chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences 61:590- 602.

rGreene, C.M., D. Jensen, G.R. Pess, E.M. Beamer and E.A. Steel. 2005. Effects of environmental conditions during stream, estuary, and ocean residency on Chinook salmon return rates in the Skagit River, Washington. Transactions of the American Fisheries Society 134:1562-1581.

Gregory RS, CD Levings. 1998 Turbidity Reduces Predation on Migrating Juvenile Pacific Salmon. Transactions of the American Fisheries Society: Vol. 127, No. 2 pp. 275–285.

rHarrison, T.D. and Whitfield, A.K. (1995) Fish Community Structure in Three Temporarily Open/Closed Estuaries on the Natal Coast. Ichthyological Bulletin of the J.L.B. Smith Institute of Ichthyology, Grahamstown, SouthAfrica. No. 64, 1–80.

rLevings, C.D., K. Conlin and B. Raymond. 1991. Intertidal habitats used by juvenile Chinook salmon (*Oncorhychus tshawytscha*) rearing in the North Arm of the Fraser River estuary. Marine Pollution Bulletin 22:20-26.

Marshall, S. and Elliott, M. (1998) Environmental influences on the fish assemblage of the Humber estuary, UK. Estuarine, Coastal and Shelf Science, 46, 175–184.

Miller, B.A. and S. Sadro. 2003. Residence time and seasonal movements of juvenile coho salmon in the ecotone and lower estuary of Winchester Creek, South Slough, Oregon. Transactions of the American Fisheries Society. 132:546-559.

Pess, G. R., M. L. McHenry, T. J. Beechie, and J. Davies. 2008. Biological impacts of the Elwha River dams and potential salmonid responses to dam removal. Northwest Science 82 Special Issue.

Pohl, M. 2004. Channel bed mobility downstream from the Elwha dams, Washington. The Professional Geographer 56:422-431.

Randle, T. J., J. Bountry, B. Jackson, and G. Smillie. 2004. Elwha river restoration draft sediment monitoring and management plan, U. S. Department of the Interior, Bureau of Reclamation and National Park Service, Port Angeles.

Pombo, L., Elliott, M. and Rebelo, J.E. (2002) Changes in the fish fauna of the Ria de Aveiro estuarine lagoon (Portugal) during the twentieth century. Journal of Fish Biology 61(Suppl. A), 167–181.

Potter, I.C. and Hyndes, G.A. (1999) Characteristics of the ichthyofaunas of southwestern Australian estuaries, including comparisons with holarctic estuaries and estuaries elsewhere in temperate Australia: a review. Australian Journal of Ecology, 24, 395–421.

Randle, T. J., J. Bountry, B. Jackson, and G. Smillie. 2004. Elwha river restoration draft sediment monitoring and management plan, U. S. Department of the Interior, Bureau of Reclamation and National Park Service, Port Angeles.

Shaffer, J.A. P. Crain, B. Winter, M. McHenry C. Lear and T. Randle 2008. Nearshore Restoration of the Elwha River Through Removal of the Elwha and Glines Canyon Dams: An Overview. Northwest Science 82 Special Issue.

Weinstein, M.P., Weiss, S.L., Hodson, R.G. and Gerry, L.R.(1980) Retention of three taxa of postlarval fishes in an intensively flushed tidal estuary, Cape Fear River, North Carolina. Fishery Bulletin US 78, 419–436.

Whitfield, A.K. and Elliott, M. (2002) Fishes as indicators of environmental and ecological changes within estuaries– a review of progress and some suggestions for the future. Journal of Fish Biology 61(Suppl. A), 229–250.

Chapter 3. Nearshore Assessment: Fish use of Salt Creek nearshore

Anne Shaffer and Tyler Ritchie, WDFW Habitat Program Science Division 332 E. 5th Street Port Angeles, Wa. 98362.

Introduction

Salt Creek nearshore is comprised of Crescent Bay and lower Salt Creek, and includes a number of highly functioning habitats including estuarine marsh, a sandy embayment, and a rocky shoreline, the later of which respectively support significant stands of eelgrass and kelp habitats (Figure 1).

The estuary is comprised of approximately 71 acres of estuarine salt march bisected by a 100 year old dike that effectively splits Salt Creek estuary in half and the acts as a significant fish passage barrier between the east and west estuary (Figure 1 and 2). Despite this barrier fish are present throughout the Salt Creek east and west estuary as well as in the main channel. The majority of the estuary east of the dike is intact and highly functioning (Tuffley et al 2004; McHenry et al 2004; Shaffer pers.obs). The estuary also includes the main channel and side channels of lower Salt Creek. The main channel is shallow, broad, low energy, and heavily tidally influenced for at least 4600 linear feet upstream from the mouth. The main channel is crossed by a county road approximately 1300' south of the creek mouth. The estuary south and west of the county bridge is in private ownership. North of the bridge is a mosaic of public and private property with the general public/private dividing line located in the center of the creek bed.

The mouth of Salt Creek opens directly into the eastern edge of Crescent Bay and experiences regular unimpeded tidal influence. The mouth does not close off seasonally, but the lower 500 feet or so of river channel migrates regularly. Fish, including smelt, gunnels, sculpins, flounder, sand lance and juvenile salmonids use the main channel and river mouth regularly (Shaffer et al

2002 and unpublished data). Eelgrass occurs in the main channel of the creek up to 2400 feet south from the mouth (Tuffley 2004). Juvenile salmon species composition and abundance varies significantly with sedge (estuarine type) and rose/Douglas fir (freshwater type) riparian areas of the lower creek (Tuffley 2004). Fish use of the impounded west estuary has not been quantified. Stickleback, and salmon have been observed in the wetted areas of the west estuary. Diking of the west estuary also causes significant ponding of the west estuary and as a result is the source of significant mosquito problems for the Salt Creek community (Shaffer et al 2006). Other anthropogenic impacts to the Salt Creek estuary include minor fill for a home site, and creosote piles supporting the county road that crosses the river near the mouth.

Crescent Bay is a highly productive and stable system. Approximately 4200 feet wide at its entrance and relatively shallow, Crescent Bay reaches an approximate maximum depth of 30 meters MLLW at its entrance. In addition to the creek mouth, the Crescent Bay shoreline includes a 1.3 mile long sandy beach that is separated from the marsh and creek by a natural, relatively intact sand spit (Figure 1 &2). This beach supports a healthy clam assemblage that includes native littleneck and cockles. Crescent Bay, and adjoining Agate Bay to the west, are noted as important for Tribal use, including harvest (Wray et al.2004). Net long shore transport in Crescent Bay is from west to the east (Schwartz et al 1991). The western end of the bay is dominated by dense eelgrass beds (DNR shorezone data 2001). The eastern end of Crescent Bay is bordered by a basalt reef that extends northwest approximately 1500 feet from shore to an approximate depth of 14 meters MLLW. This reef, which is located within a county park and an intertidal preserve, supports abundant and diverse rocky reef intertidal and shallow subtidal communities, including mixed *Nereocystis/Macrocystis* beds (Zeh et al 1981;. Clallam County Marine Resources Committee 2001). Subtidally, the nearshore of Salt Creek is documented to support some of the highest densities of sand lance, surf smelt, and juvenile salmon when compared to other central and western Strait nearshore and streams of similar size (Shaffer 2004). These high abundances are attributed in part to the intact lower creek and nearshore system.

Methods and Materials

The Salt Creek nearshore, including Crescent Bay shoreline and two small side channels, and the main channel of Salt Creek estuary were seined weekly using standard beach seining techniques from March-September 2007, and then monthly from October 2007-March 2008. A standard small Puget Sound Ambient Monitoring Protocol (PSAMP) net was used on the side channels throughout the study, and on the main channel from April-September. A standard large PSAMP net was used on the main channel and shoreline throughout the sample period. All fish collected were identified to species, counted, and measured. Water quality was assessed monthly as part of a basic water quality study for WRIA 19 nearshore. Crescent Bay shoreline sites also continue to be monitored monthly for long term trends in fish use. Ecological indices as well as individual species density and length averages were calculated and analyzed for trends along the central Strait. Restoration recommendations where generated for the Salt Creek nearshore (Note: a list of all recommendations for the central Strait nearshore can be found in the executive summary.)

Results

Number of seines by sample site are provided in Table 1.

Date	**Site**	**Number of seines**
March-Sept 2007	Crescent Beach	42
	Salt Creek Main Channel	43
	Salt Creek Side Channel	45
September 2007-March 2008	Crescent Bay	15
	Salt Creek Main Channel	15
	Salt Creek Side Channel	15

Table 1. Seine summary, Salt Creek nearshore.

Figure 1. 2007-2008 Sample locations, Salt Creek nearshore assessment

Species richness and diversity for Salt Creek nearshore are some of the highest observed in this study (Figure 1). Within the Salt Creek nearshore, all sites showed seasonal trends, with peaks both species diversity and richness during summer months, and lows during winter months.

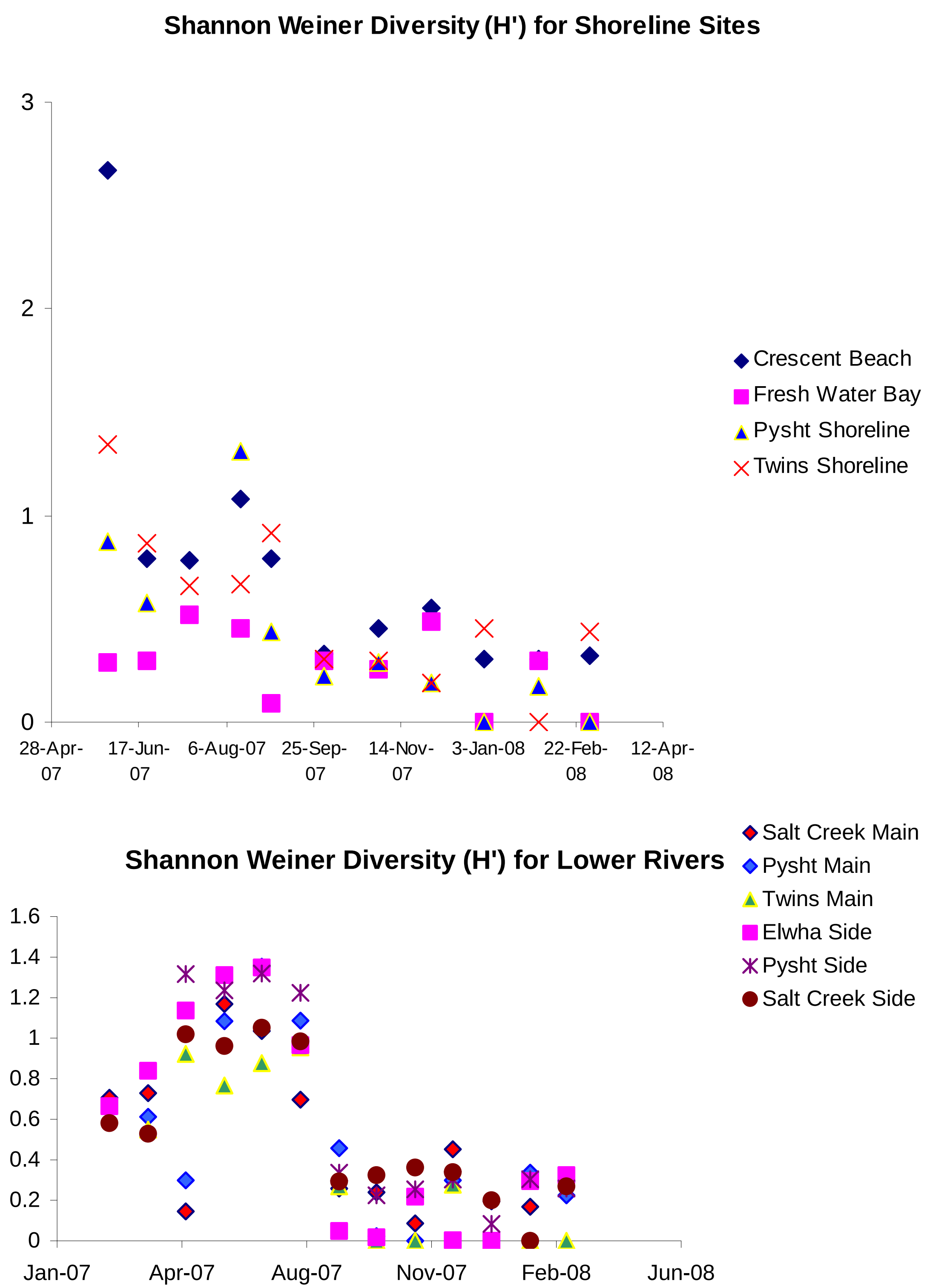
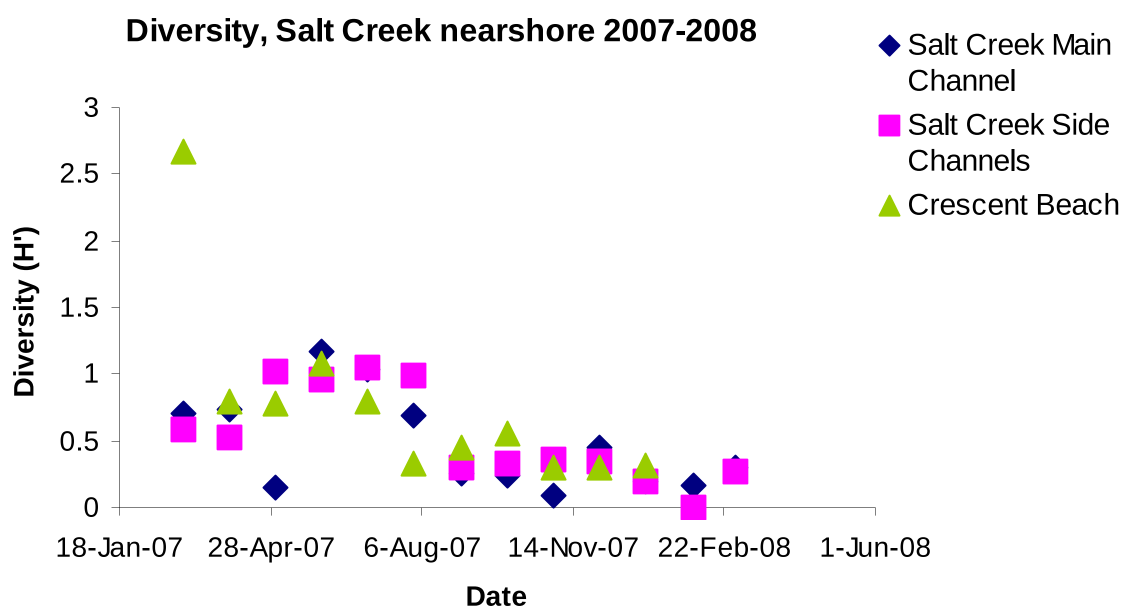


Figure 2. Species diversity for nearshore central and western Strait



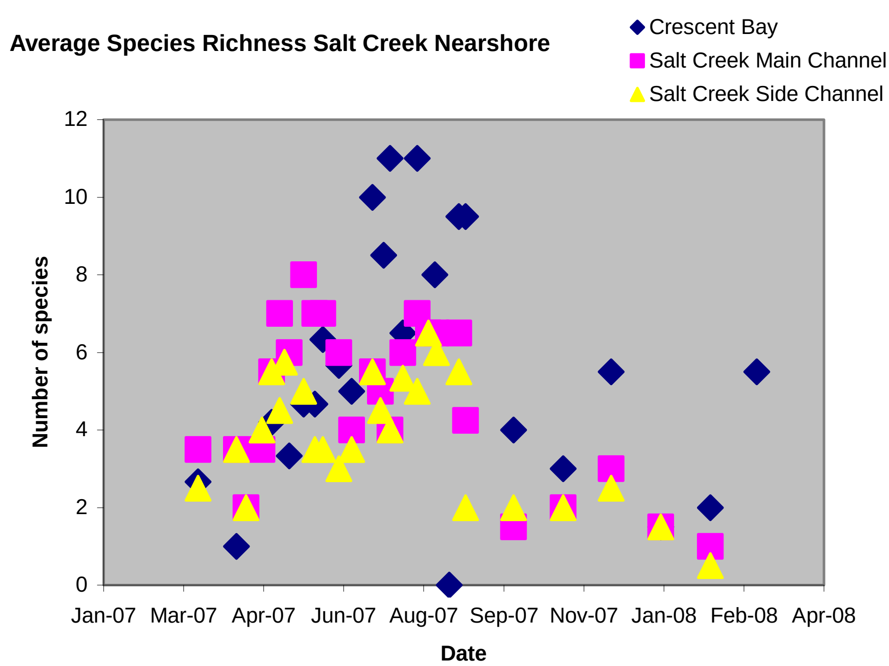


Figure 3. Species richness and diversity, Salt Creek nearshore.

There was a strong seasonal change in fish abundance at the Salt Creek site. In fall and winter far fewer fish were collected. From March-September 2007 over 43,000 fish were collected from the three nearshore habitat types of Salt Creek. From October 2007-March 2008, a total of just under two thousand fish were collected at Salt Creek. When corrected for net size, for spring and summer 2007, 44% of fish were collected from the main channel, 32 % from side channels, and 23 % from the shoreline sites. Just over 50% of all fish collected at Salt Creek during fall and winter months were found in the main channel, 35% were collected along the shoreline, and the remaining 15 % were collected from the side channels of the Salt Creek estuary. There is also a strong interannual variability in fish composition and density along the Crescent Bay estuary (Figure 7).

Percent of fish abundance of the dominant species is shown in Figure 4. Species varies somewhat by nearshore habitat type. Shiner perch, staghorn sculpin, and smelt were the dominant species overall. The majority of salmonids were collected during spring-summer 2007. Combined, Chinook, coho, and chum made up approximately 4% of all fish collected in the Salt Creek nearshore. Ninty one percent of Chinook were collected in the nearshore, 9% in the main channel of Salt Creek. Thirty percent of coho were collected along the shoreline; 50 % were collected along the main river channel, and 20% in the side channels of the estuary (see Appendix A). A subset of Chinook collected from the Salt Creek nearshore were analyzed for genetic composition. Of these, over 50% of Chinook analyzed from the Salt Creek nearshore were found to be from either Puget Sound (Elwha) or Columbia River stocks (Shaffer et al in review, see Chapter 6 for details). Also of interest is the observation of juvenile northern shad at Salt Creek over the study period. These made up less than 1% of the total catch but of which, over 99% collected were collected from the Salt Creek nearshore. Most were collected in fall months from the shoreline area.

Long term monitoring of the Crescent Beach shoreline reveals strong interannual variation in smelt abundance, as well as a strong interannual variation in recruitment of lingcod (Figure 8). Comparison of sand lance densities along shorelines of the central Strait reveals that Salt Creek supported some of the highest densities of sand lance (even higher than areas documented to support sand lance spawning).

Discussion

The Salt Creek nearshore is a very diverse area for fish use. Seasonally it had the highest diversity observed in this study. It also supports significant numbers of both adult and juvenile forage fish and, along with the Elwha nearshore, had the highest density of juvenile coho of all sites sampled. It also has very high lingcod recruitment, and, based on this and similar observations over a decade ago (Dan Doty, WDFW, pers comm.), is concluded to be an important lingcod nursery area. Our long term sampling indicates strong interanual variation in fish use of the Crescent Bay, and high sand lance densities may indicate that Crescent Bay is a sand lance spawning beach. The beach should be sampled for sand lance spawning.

While Chinook were present in lower numbers, the genetic results of this study are particularly important evidence that the Salt Creek nearshore is highly functioning for a number of critical species, including ESA listed salmon from Puget Sound and as far away as the Columbia River. Salt Creek nearshore is therefore recommended as a high priority for habitat preservation and restoration.

Salt Creek also has some functional warning signs, including elevated water temperatures, and the continued presence of juvenile shad. Shad are a non-native species capable of quickly overwhelming watersheds where they are present (WDFW 2002). Shad also are documented to be temperature dependant, and require warmer water for spawning and migration (Acolas et al 2006). Basic water quality monitoring indicates that Salt Creek seasonally experiences some of the warmest water temperatures observed along of central and western Strait of Juan de Fuca nearshore. Additional water quality monitoring of the Salt Creek nearshore is very important to accurately map the temperature of this nearshore. The potential for impact to existing healthy fish stocks in the creek via direct and indirect impacts from elevated water temperature make water quality as well as quantity a very important preservation and restoration parameter for Salt Creek.

The intact status of the nearshore, with the exception of the dike road that bisects the estuary, make both preservation in the form of acquisition and conservation easement, as well as restoration, of the Salt Creek estuary a top priority for the nearshore central Strait of Juan de Fuca.

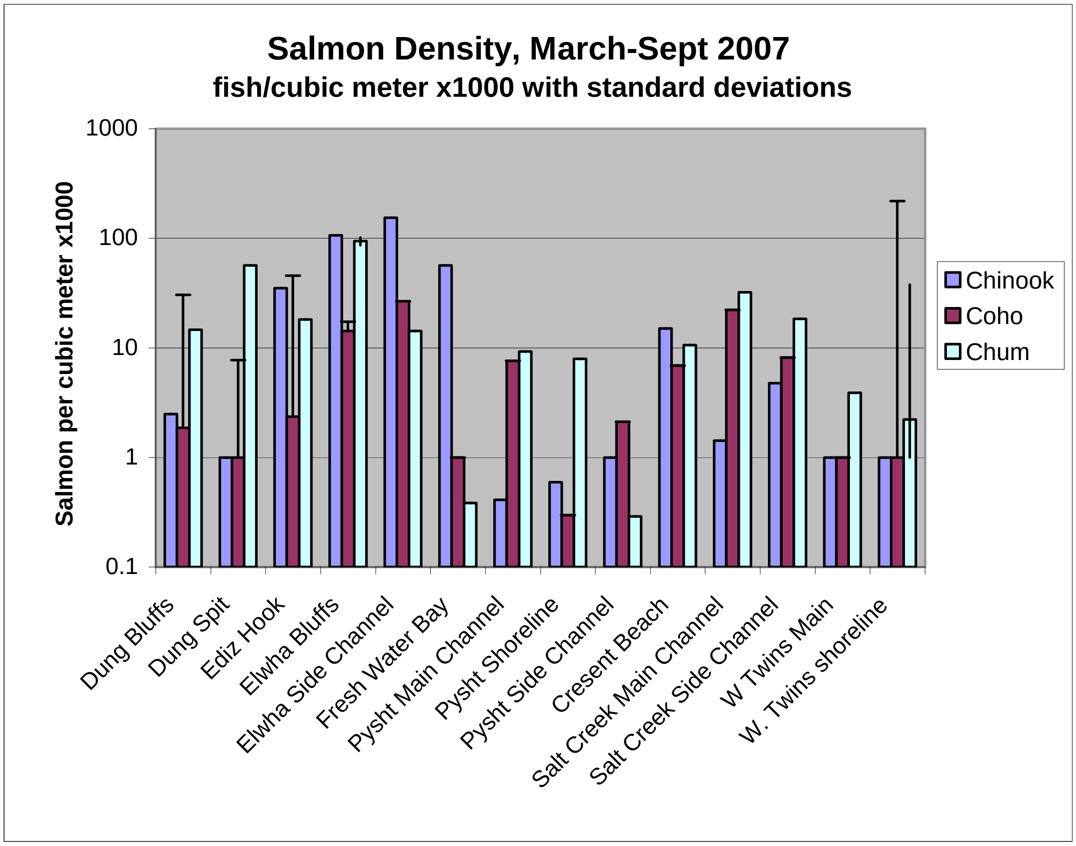
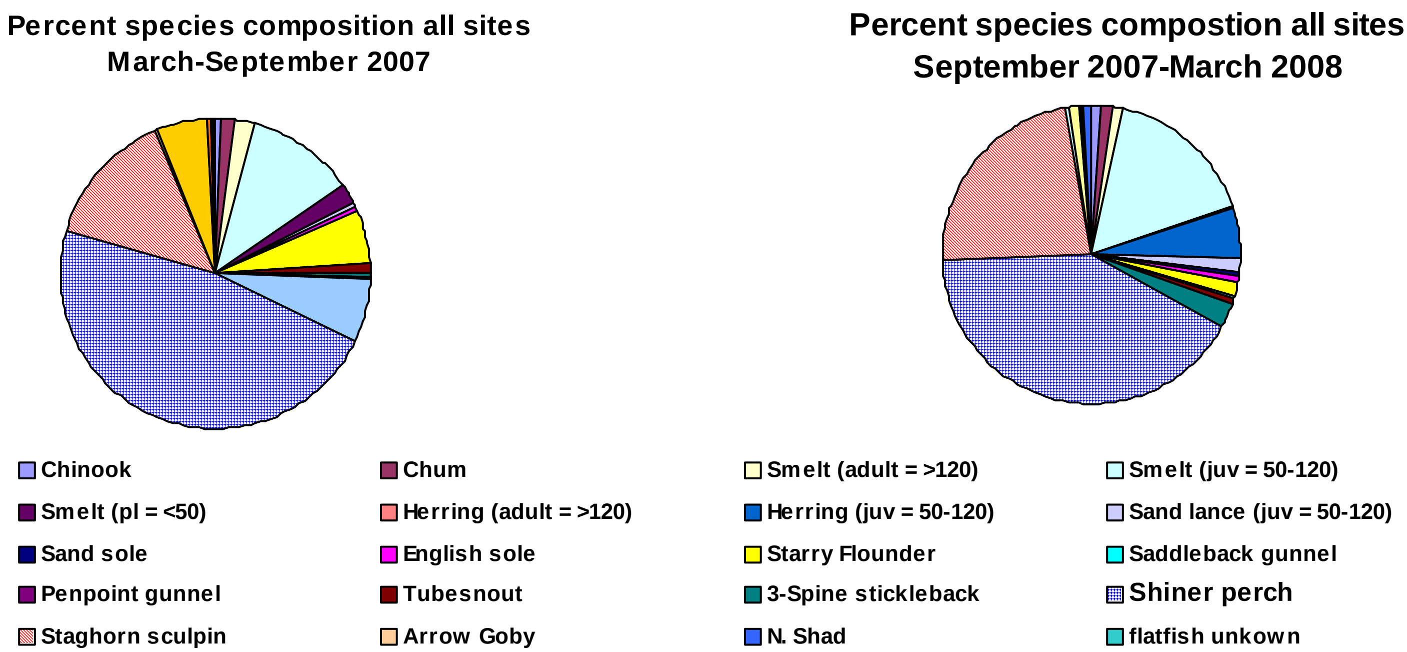


Figure 4. Salmonid abundance, Salt Creek nearshore.

Figure 5. Percent species composition, Salt Creek nearshore. A. March-September 2007; B. September 2007-March 2008.



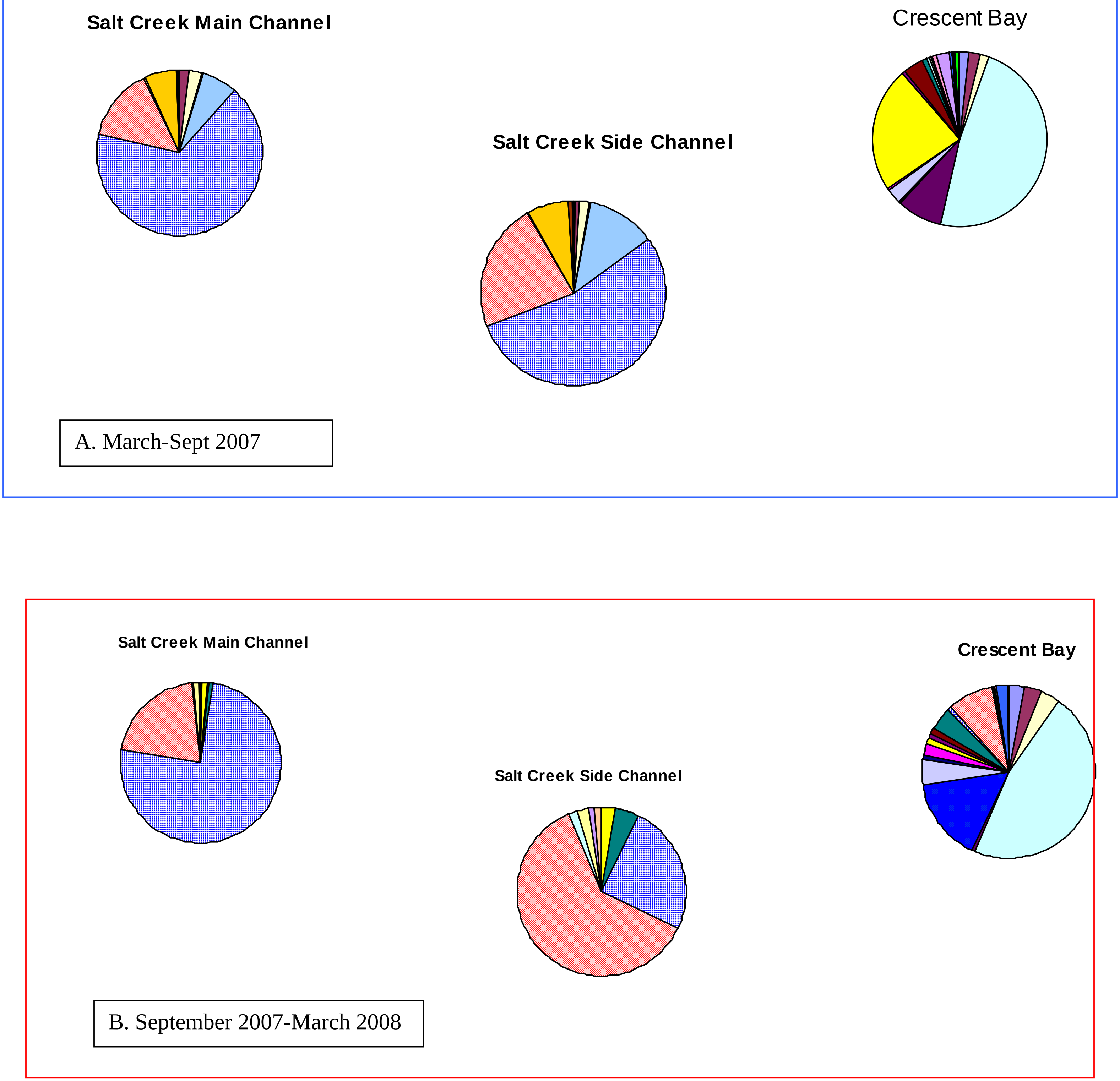


Figure 6. Species composition, percent, by habitat type, Salt Creek nearshore.

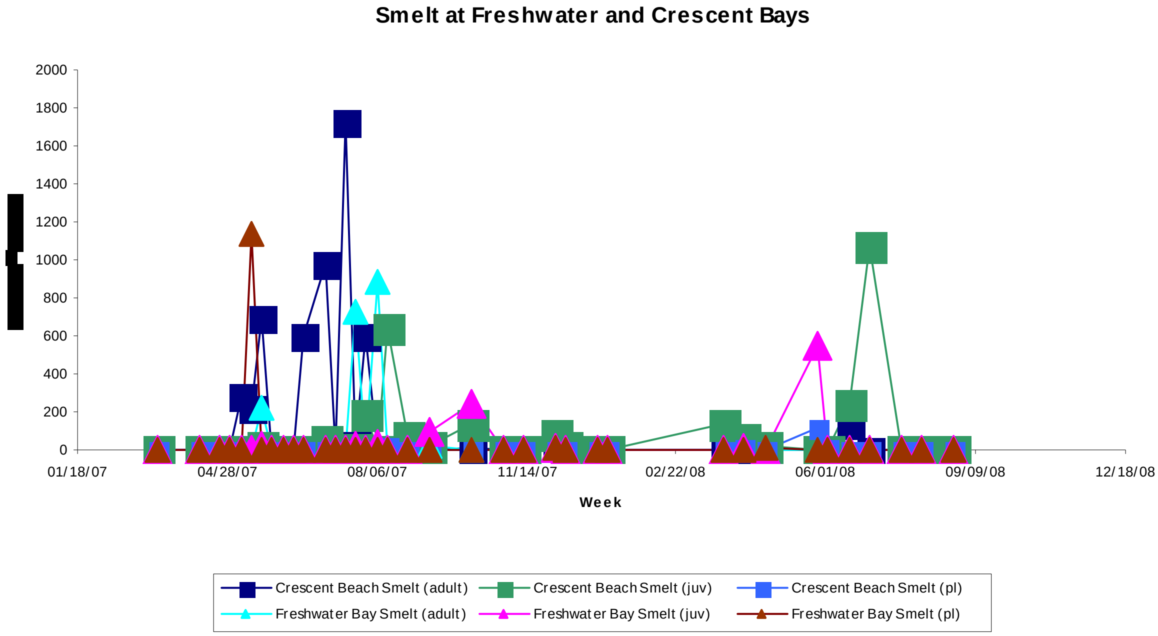


Figure 7. Smelt density Crescent Bay and Freshwater Bay shorelines.

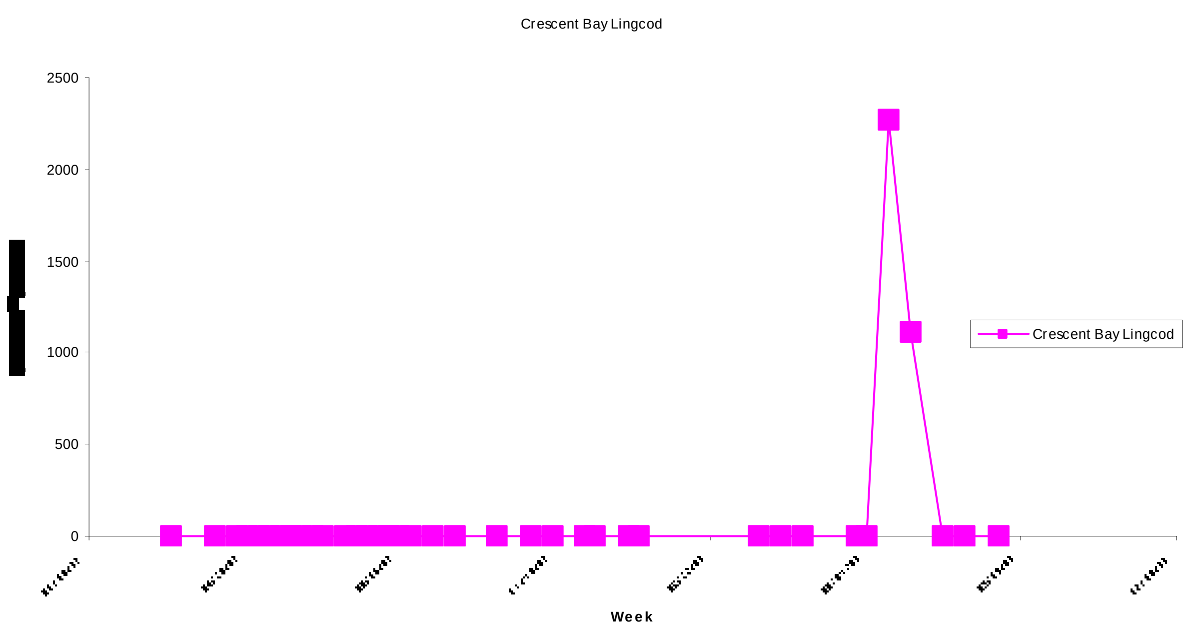
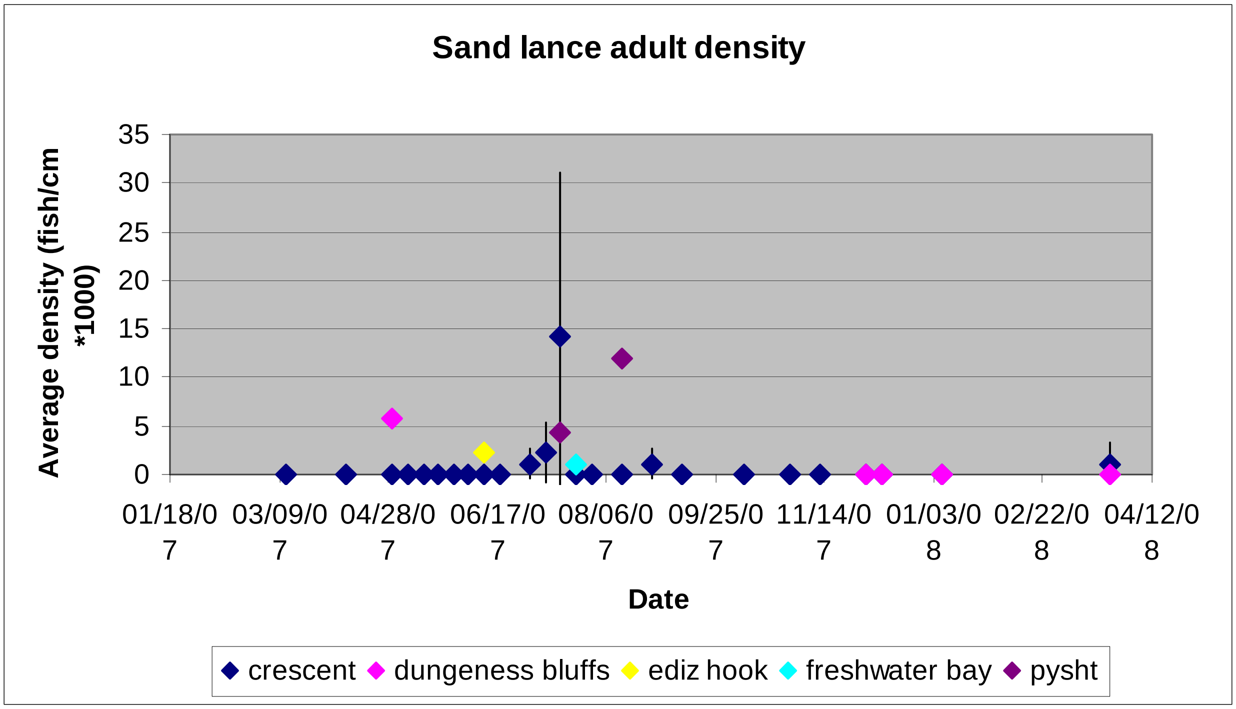
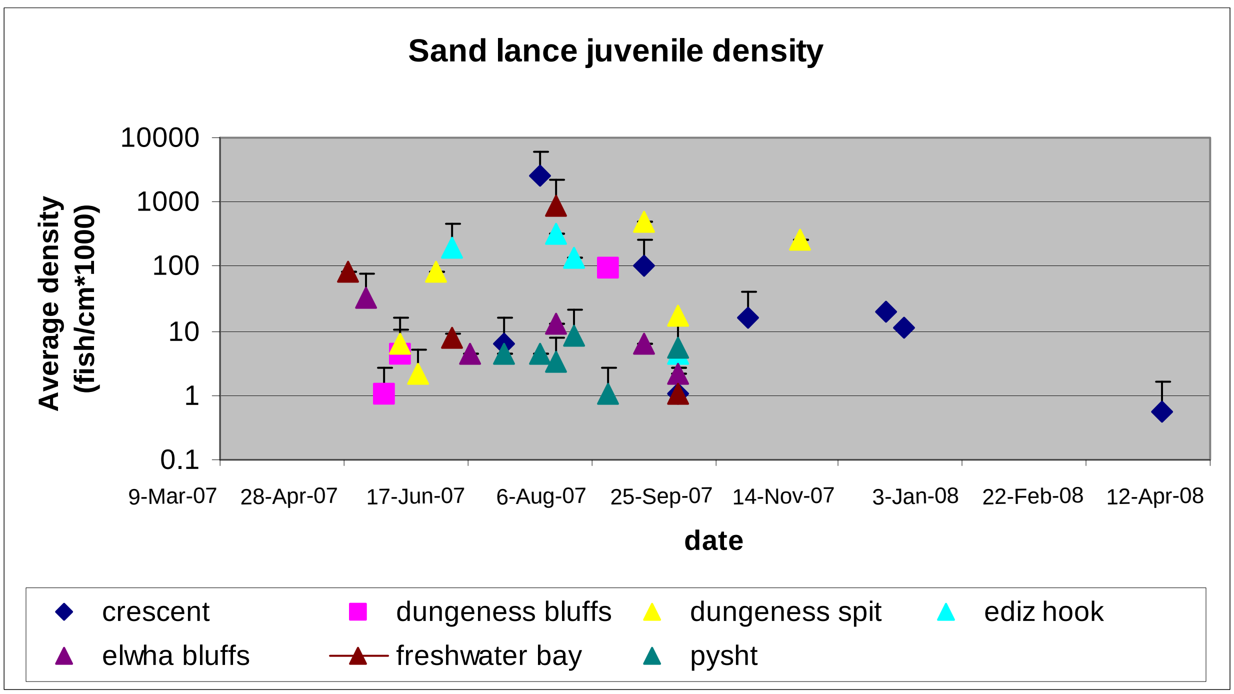


Figure 8. Juvenile lingcod densities, Crescent Bay.


Sand lance adult density
Average density (fish/cm *1000)
35
30
25
20
15
10
5
0
01/18/07
03/09/07
04/28/07
06/17/07
08/06/07
09/25/07
11/14/07
01/03/08
02/22/08
04/12/08
Date
crescent
dungeness bluffs
ediz hook
freshwater bay
pysht


Sand lance juvenile density
Average density (fish/cm*1000)
10000
1000
100
10
1
0.1
9-Mar-07
28-Apr-07
17-Jun-07
6-Aug-07
25-Sep-07
14-Nov-07
3-Jan-08
22-Feb-08
12-Apr-08
date
crescent
dungeness bluffs
dungeness spit
ediz hook
elwha bluffs
freshwater bay
pysht

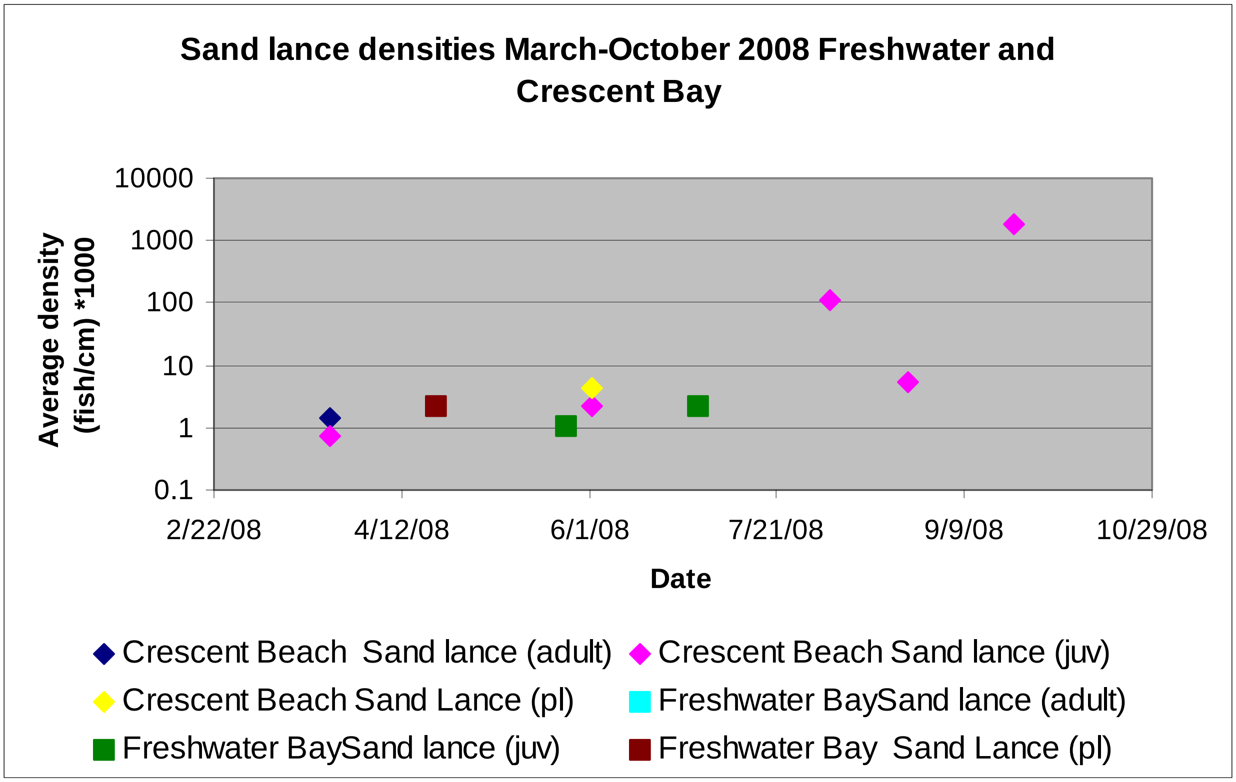


Figure 9. Sand lance densities, Crescent Bay compared to Freshwater Bay shorelines.

Acknowledgements

This work was sponsored by the NOPLE and funded by the SRFB/RCO with in kind support by WDFW and the Lower Elwha Klallam Tribe. Tara Galuska is the project manager RCO. The Clallam Marine Resources Committee provided funding for a number of college interns with Peninsula College Fisheries Program and Center of Excellence, and the Western Washington University REU program. Mr. Jack Ganzhorn and Dr. Dwight Barry provided student supervision. Nancy Bleustein Johnson provided student guidance. Jenna Schilke lead portions of the field work. Student interns that assisted in the project include Jesse Charles, Chris DeSisto, Bryan Hara, Erica Hirsh, Mario Laungayan, Romy Laungayan, Lili Muth, Ross McDorman, Tiffany Nabors, Sean Oden, Rebecca Paradis, Jacob Ray, Melanie Roed, Justin Rondeau, Trista Simmons, Ben Warren, Karen Wilkie, Eric Wood, and Steve Wyall. Private property owners and citizens Ben and Irene Palzer, Chuck and Niva Novak, Steve Wirth and Mariann Wahlen, and Bud Taggert provided much appreciated access and local knowledge. Project in kind partners in order of contribution included Cathy Lear (Clallam County), Pat Crain (ONP), Ross Fuller, Chris Byrnes, Roger Mosley, Dan Penttila, Dan Doty, and Tim Quinn (WDFW). Sue Nattinger, Streamkeepers, provided water quality sampling equipment and expertise.

Literature cited

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

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.Figure 4. Salmon density nearshore assessment, central Strait of Juan de Fuca March-Sept 2007.

Schwartz, M. et al. 1991. Net shore drift in Washington state: Volume 1, Pacific Ocean and Strait of Juan de Fuca. Shorelands and coastal zone management program, Washington Department of Ecology, Olympia, Washington.

Shaffer, A. 2004. Preferential use of nearshore kelp habitats by juvenile salmon and forage fish. In Proceeding, Puget Sound Research Conference 2002. Puget Sound Water Quality Action Team, Olympia, Wa.

Shaffer, A. D. Parks and D. Dafoe. 2006. Salt Creek dike road culvert repair for restored fish passage. Washington Department of Fish and Wildlife, Port Angeles, Washington.
Clallam County Marine Resources Committee 2001. Workshop Final Report: Marine Resource of the Strait of Juan de Fuca: how we interact. Clallam County, Port Angeles, Washington.

Tuffley, B. 2004. Salmonid usage of the lower Salt Creek Watershed. A final report for TFish 285. Peninsula College Fisheries Program, 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 State Department of Natural Resources 2001. Washington State Shorezone Inventory. WDNR, Olympia, Washington.

Wray, Jacilee et al. 2004. When the tide is out: Tribal use of nearshore. Olympic National Park. Port Angeles, Wa.

Zeh, J.E., J.P. Houghton, and D.C. Lees. 1981. Evaluation of existing marine intertidal and shallow subtidal biologic data. MESA report, EPA Interagency Agreement D6-E693-EN, EPA, Seattle, Washington.

Chapter 4. Nearshore Assessment: Fish use of the Twins nearshore

Anne Shaffer and Tyler Ritchie

Washington Department of Fish and Wildlife Science Program, Habitat Division, Washington Department of Fish and Wildlife 332 E. 5th Street Port Angeles, Washington 98362. 360.457.2634; shaffjas@dfw.wa.gov

Abstract

The nearshore fish assemblage of the east and west Twins rivers and shoreline was assessed via beach seining of the lower river and shoreline for over a year period. The key findings include: 1.Documentation of a strong seasonal variation in fish use of the Twins nearshore that was similar to other study areas of the central and western Strait; 2. The Twins shoreline was found to have some of the highest species diversity and richness of any of the study sites, while the lower river of the Twins was found to have among the lowest; 3. Juvenile steelhead and trout were observed in high abundance in the nearshore lower river; 4. Very low numbers of coho and Chinook were observed in the nearshore lower river and shoreline of the Twins; 5. Documentation of coho in the nearshore during winter months, and high trout numbers in the lower river during late summer and fall, and; 6.A seasonally high accumulation of macroalgae in the Twins lower river nearshore that was not observed at any of the other study sites. Based on these finding we conclude that the nearshore Twins is very important for steelhead, trout, and forage fish. While clearly important for salmon, the nearshore Twins functions differently for juvenile coho and Chinook than other areas on the nearshore Strait. Based on these findings we conclude that the Twins is a high priority for restoration, and recommend that: 1. Acquisition of nearshore private properties along the Twins shoreline should be a top nearshore restoration priority for this area; 2. Restoration of the Twins nearshore by removal of the 2.5 acre fill structure in the Twins nearshore should be completed as soon as possible; 3. Additional study to define the ecological function of the Twins nearshore for coho and Chinook, including the role lower river an shoreline alterations combined with apparently naturally occurring macroalagae blooms, may play in defining fish use in the nearshore Twins is a priority; 4. That habitat and

fish management revise provisions to better protect trout and salmon species in the nearshore during later summer, fall, and winter months, and; 5. These recommendations should be included in the revised Clallam County Shoreline Master Plan.

Introduction

The nearshore of the Twin Rivers is located on the western Strait of Juan de Fuca and extends from the area of tidal influence in the east and west Twin Rivers out to 30 m MLLW. It is geologically complex and includes both tectonic and glacial influences (Parks 2005). The Twin's nearshore drift cell includes approximately four linear miles of rocky and sandy shoreline. The shoreline is highly erosional. Parks (2005) concluded that there is no long-term net apparent sediment transport direction, but rather a high degree of inter-annual variability between east/west/ and north offshore across the shore platform, and that sediment transport may be impacted by shoreline modifications. The shoreline of the Twins nearshore is a mixture of private and state ownership. A significant portion of the Twins shoreline is owned and managed by the LaFarge Corporation. Todd et al. 2006 describes the Twins nearshore as a moderately impaired stream delta complex. There are a few obvious main impactors to the Twin nearshore. The first is the 2.4 acre pier structure associated with the La Farge Twin Rivers Clay Quarry, a 214-acre quarry site located immediately west of the west Twin Rivers. Elevation of the quarry ranges from 226 feet above mean sea level to mean high water. The quarry loading facility is a filled pier structure (locally termed a 'mole') that occupies approximately 2.4 acres of intertidal area directly north of the quarry. Elevation of the mole structure ranges from 33.2 feet to –2.2 feet below mean low water (Parks 2005).

The mole begins at mean high water and extends northward 250 to 300 feet into the intertidal zone to below mean low water. It includes approximately 63,000 cy of fill, 13,000 cy of riprap and 1300 linear feet of sheet and creosote treated piles. The mole is on state tidelands that are managed by the Washington DNR, and is leased by LaFarge Corporation.

Associated with the pier, a channel measuring approximately 150 feet wide by 550 feet long has been dredged on the east side of the mole structure from the mean high water elevation in the south, extending to approximately deep to the north to allow barge access for loading purposes. Dredging records suggest that 102,000 cubic yards (77994 m^3) of sediment were removed from the access channel between 1982 and 1985 (Parks 2005; WDOE, 1982).

In total the pier encompasses 2.5 acres of fill and significant dredging in nearshore Twins, including eelgrass beds. The pier is theorized to distrupt the fish migratory corridor, and displace forage fish spawning. The Twins pier has been the focus of collaborative but unsuccessful restoration proposals sponsored by the private landowner, state and tribal co-managers, and local citizens. See Shaffer et al. 2005 and Parks 2005 for a full description of the site and project.

Another potential impact to the Twins nearshore is the fill associated with the historic road grades, now the Hwy 112 road prism, and associated historic alteration of the area south of the highway and between the lower rivers of the east and west Twins. The 1926 US Coast and Geodetic Survey Map (Aslakson and Witherbee, 1926) shows the alignment of the "Pysht road" at or near the current Highway 112 alignment. The possibility of road fill being placed in low lying floodplain/wetland/back-beach areas between the two Twin river channels is very likely. Construction of the "old" Highway 9A road and the "new" Highway 112 alignment in the 1950's could have also been a factor in expanding fill material between the two river channels (Parks, pers comm.).. In addition to fill, alterations in this area include lower river clearing in the 1950’s (Kramer 1952). The area has also been heavily logged, and the riparian zone highly degraded (Shaffer et al 2005).

Habitat function of the Twins shoreline is complex, and intriguing. The shoreline of the Twin Rivers is documented to support a diverse fish and invertebrate community (Miller et al 1980). It is an important surf smelt spawning area (Shaffer et al. 2005; WDFW Salmonscape 2008) and is heavily used for recreational smelting and crabbing. Collectively the Twin Rivers are important for a number of salmon stocks including coho, cutthroat, and steelhead (Roni et al 2008;

Haggerty in prep). Chinook use is cited for the Twins (Kramer 1952) and juvenile Chinook are theorized to use the nearshore. Little other information is available about fish use of the Twins nearshore. The purpose of this study is therefore to define Twins nearhore habitat function for juvenile fish, with an emphasis on salmonids, and the role restoration actions within the Twins nearshore may play in the larger Strait of Juan de Fuca ecosystem.

Methods and Materials

The east shoreline of the main channel of the west Twin River and marine shoreline between the mouths of the east and west Twin rivers were seined weekly from April-December 2007 and then monthly from December 2007 -March 2008. The main channel was sampled using a 24.4 meter PSAT design seine and protocol. The shoreline was sampled using the standard 37 meter PSAT design seine and protocol. One to two seines were conducted per nearshore habitat type per sampling date (Figure 1).

Basic water quality of the lower river and shoreline was recorded for each sampling date. In addition the Twins main channel was sampled once a month during daylight hours on a falling neap tide between +6 and +3 MLLW. Point data on turbidity, dissolved oxygen (DO), temperature, salinity, and conductivity were sampled using a YSI meter. The monthly water quality results are summarized in the companion report entitled ‘Nearshore water quality of WRIA 19’ see chapter 9.

Master files with weekly/monthly fish densities and lengths and water quality data will be provided in appendix in final report.

Results

The Twins nearshore comprised approximately 1-10% of all fish collected in this study (Table 1). As observed in other geographic areas of this study, the Twins nearshore showed very high seasonal abundance, diversity, and richness in fish use. Twins shoreline had some of the highest species richness and diversity of any of the sites sampled. The lower river in contrast, had some of the lowest (Figure 2-4). Fish use of the Twin's nearshore varied between the lower river and shoreline, and was also different than other sites in this study. In particular the lower river use was dominated by trout and salmon: steelhead, cutthroat, unidentified trout, and chum were dominant. Surprisingly, Chinook and coho were not observed in the Twins lower river, and only a very few coho were collected from the nearshore throughout the duration of the study (Figure 5-6; Appendix A-H).

Size of trout and salmon collected in the Twins nearshore are provided in Figure 7-8.

Another important observation of the Twins nearshore is the seasonal accumulation of drift algae in the main channel of the river, which began at the end of July and persisted through November 2007. The mat was recorded to be at a minimum 0.33 meter thick, and made up of brown and red macro algae (primarily Laminarians and fleshy reds). The mat was observed as anoxic beginning the month of August, and fish stress observed on one sampling day in August when the matt was entrained in the sampling. This stress revealed that care had to be taken not to stir up the mat during August-October sampling. The mat persisted until the middle of November when rain events flushed it out. Species composition of the mat indicated that the mat was shoreline algae pushed into the lower river by tidal energy during periods of low flow and high tides (not a macro algae bloom associated with nutrient loading)..

Smelt were the dominant fish in for the Twins shoreline (Table 1).

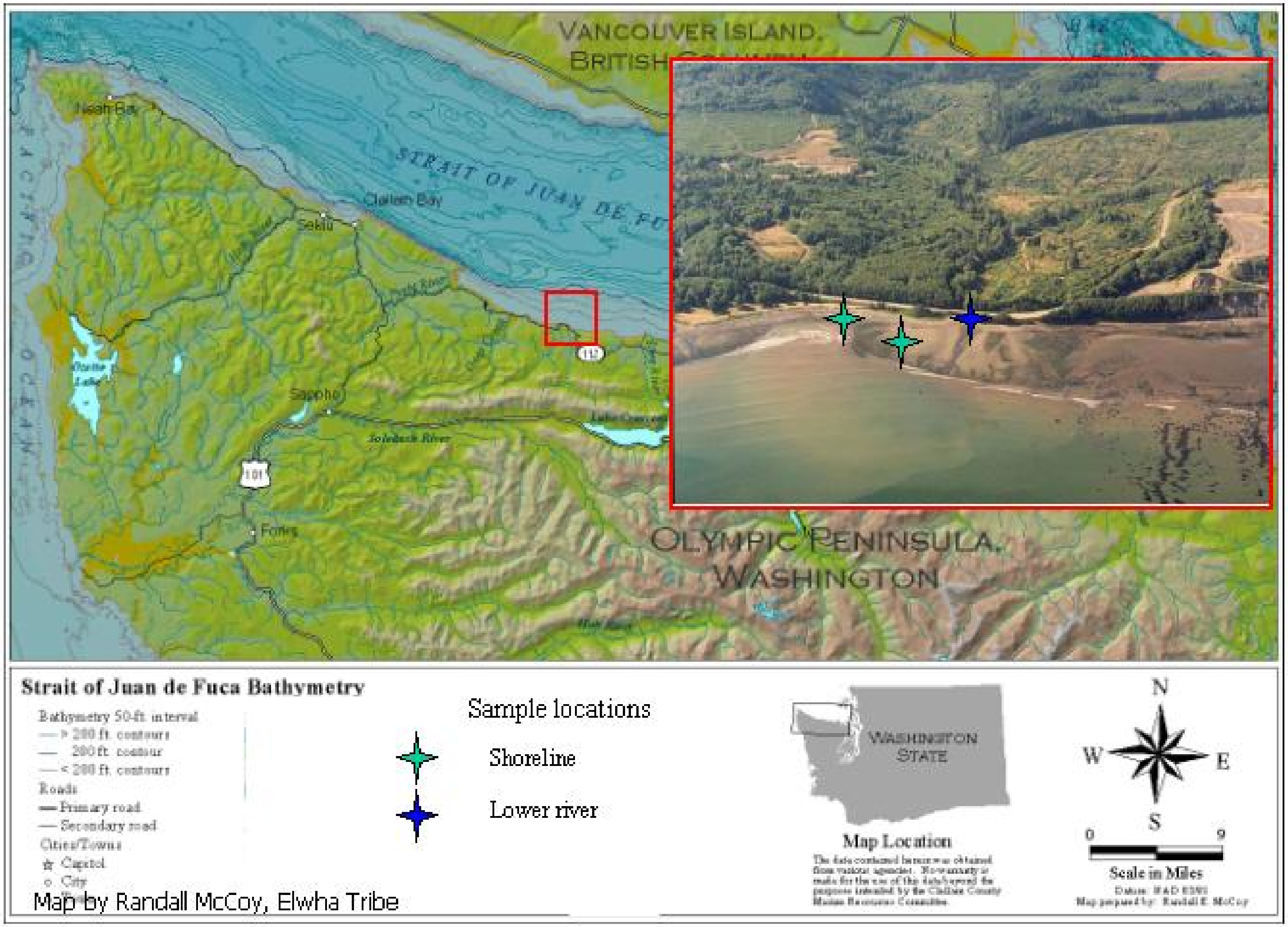


Figure 1. Sampling sites, Twins Nearshore

Table 1. Dominant species (percent) by sample site nearshore central Strait of Juan de Fuca, March 07- April 08

Site	Total # seines	Total Fish	Total fish /net	% of all fish	Chinook	Coho	Chum	Smelt (adult)	Smelt (juv)	Smelt (pl)	Herring (juv)	Sand lance (juv)	3-Spine stickle back	Shiner perch	Staghorn sculpin	Cottids <30mm	Cut throat	Prickly Sculpin	Northern Anchovy (Adult)	Cumulative %
Crescent Bay	41	11563	282	6	2	2	2	**42**	**14**	0	4	**21**	1	1	3	0	0	0	0	92
Freshwater Bay	28	12259	437.8	6	4	0	1	**14**	6	9	**56**	7	0	1	0	0	0	0	1	98
Pysht Shoreline	30	31720	1057	17	0	0	0	**11**	**79**	0	2	0	0	0	3	0	0	0	0	95
W. Twins Shoreline	32	19810	619.1	10	0	0	0	**10**	**17**	4	**19**	0	0	0	0	0	0	0	**39**	89
Elwha Bluffs	13	5518	424.5	3	10	1	9	1	**43**	**15**	**20**	1	0	0	0	0	0	0	0	99
Dungeness Bluffs	16	24960	1560	13	0	0	0	1	6	**90**	2	0	0	0	0	0	0	0	0	98
Dungeness Spit	12	5049	420.8	3	0	0	6	4	**54**	**14**	**11**	8	0	0	0	0	0	0	0	98
Ediz Hook	9	3101	344.6	2	6	0	3	5	**20**	1	**51**	**12**	0	0	0	0	0	0	0	99
Salt Creek Side Channel	52	13947	268.2	7	0	1	2	0	0	0	0	0	**12**	**54**	**22**	7	0	0	0	99
Elwha Side Channel	52	16258	312.7	9	**12**	2	1	0	0	0	0	0	**70**	0	4	5	0	1	0	96
Pysht Side Channels	36	15586	432.9	8	0	0	0	0	0	0	0	0	**49**	**26**	**19**	3	0	0	0	99
Pysht Main Channel	44	9553	217.1	5	0	1	1	0	7	0	0	0	1	0	7	79	0	0	0	96
Salt Creek Main Channel	66	18731	283.8	10	0	2	3	0	0	0	0	0	5	**68**	**14**	6	0	0	0	99
W.Twins Main channel	28	1477	52.75	1	0	0	1	0	0	0	0	0	0	0	5	**48**	6	**33**	0	93
Total	459	189532																		

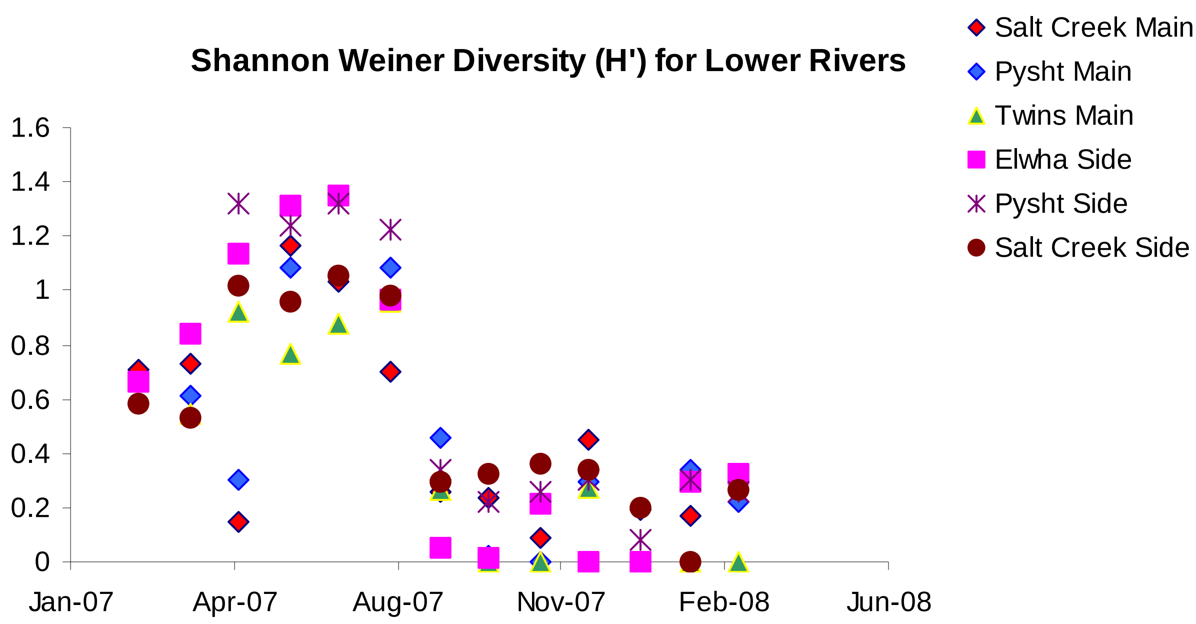


Figure 2. Diversity, central and western Strait of Juan de Fuca nearshore.

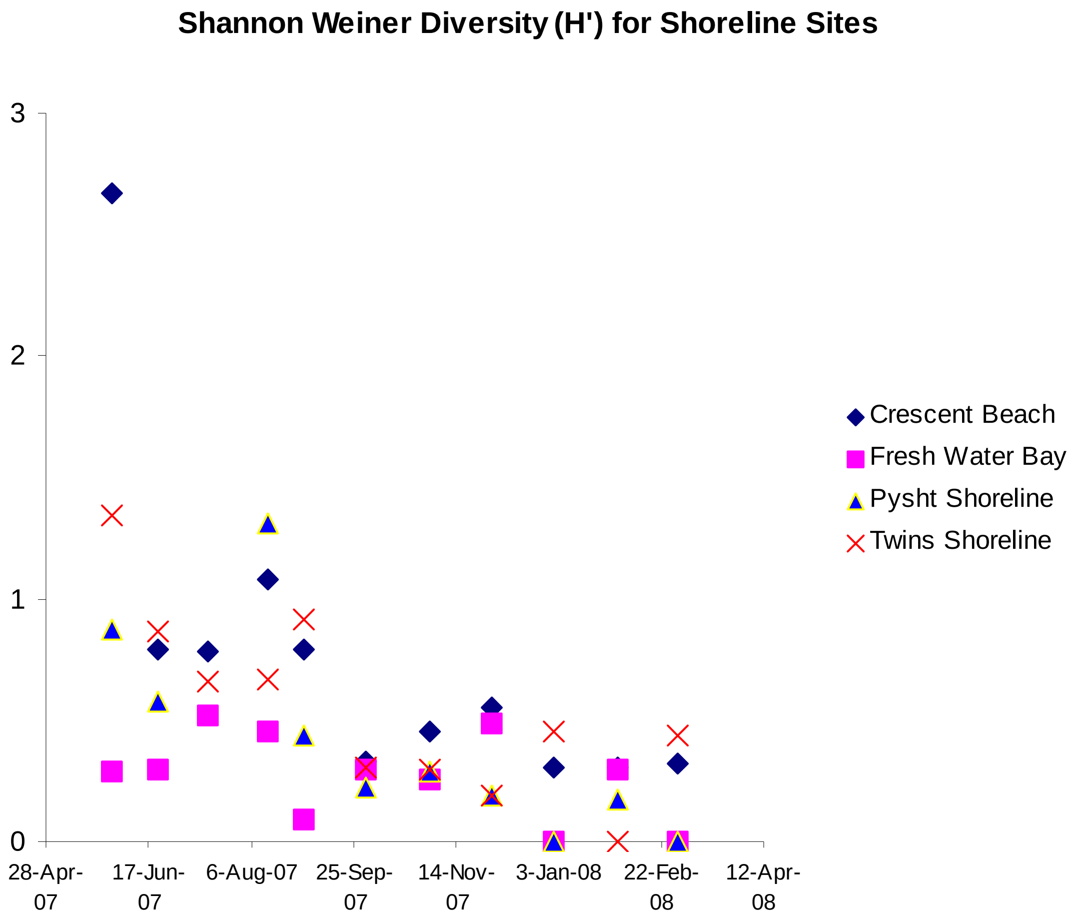


Figure 3. Diversity, central and western Strait of Juan de Fuca shoreline sites

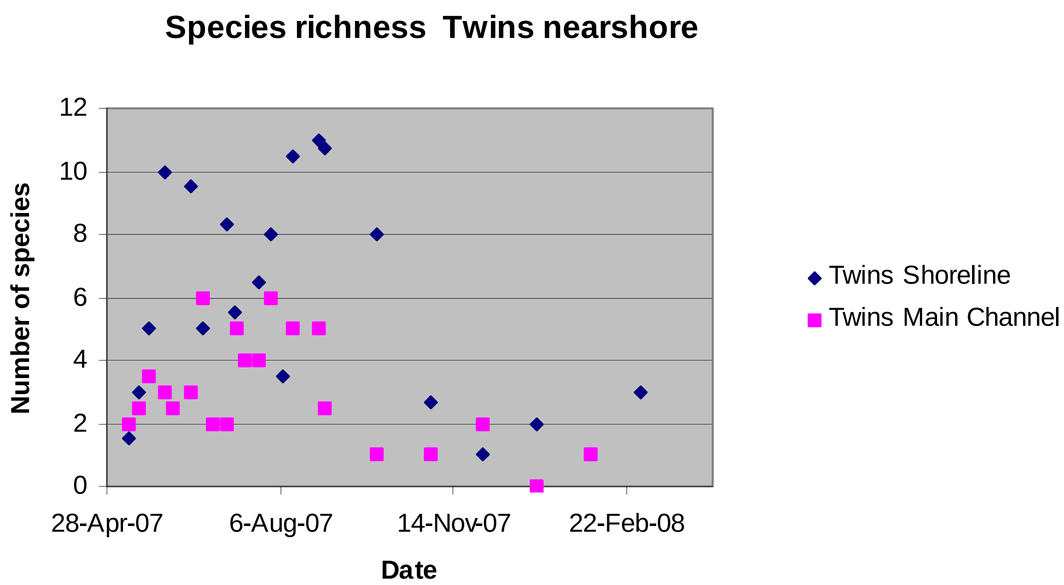


Figure 4. Species richness, Twins nearshore

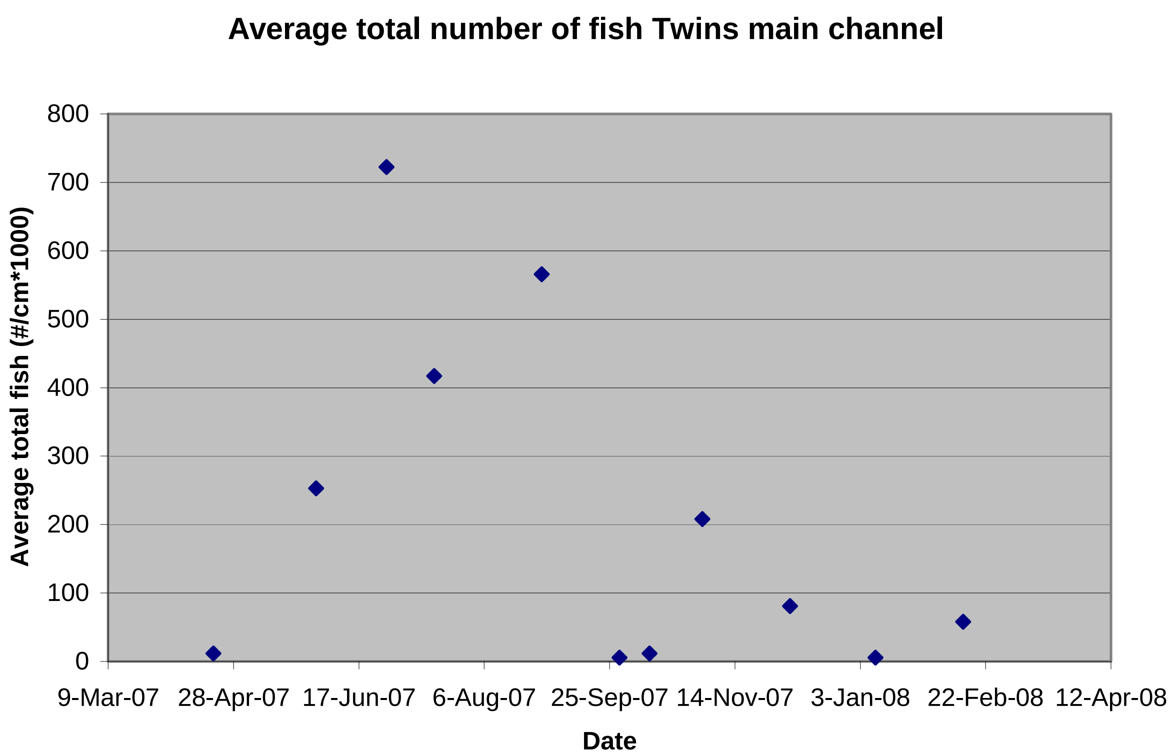


Figure 5. Average total fish, Twins nearshore main channel.

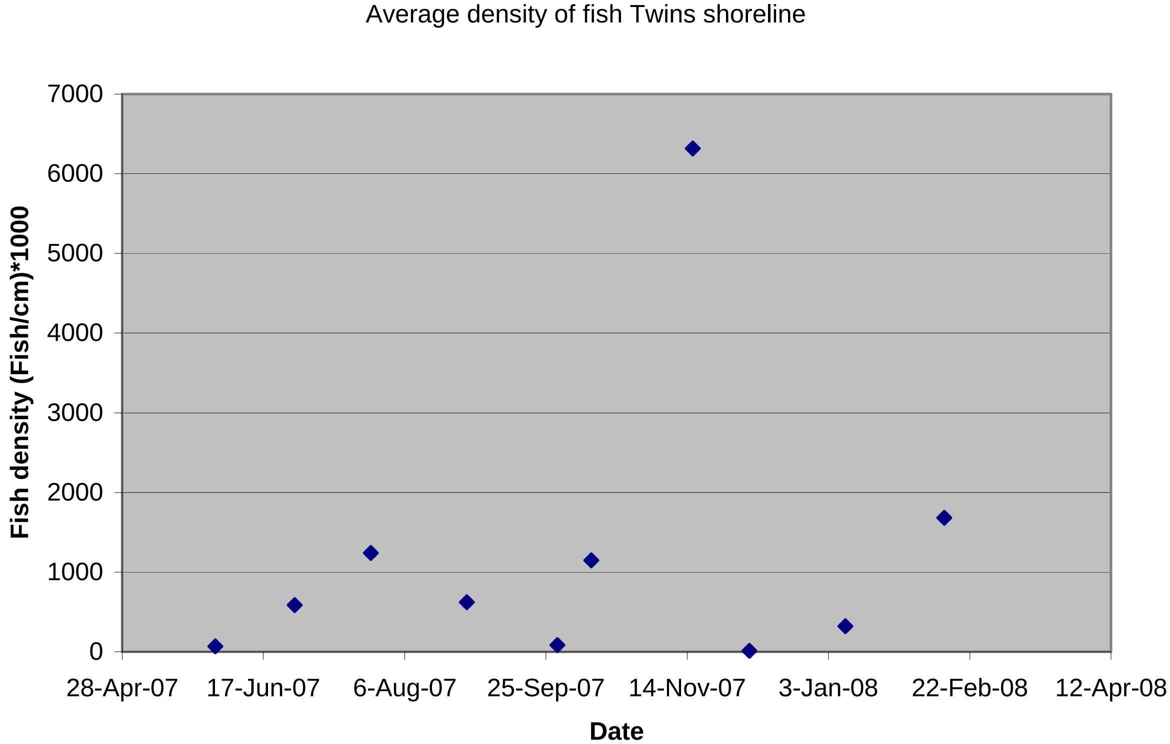


Figure 6. Average total fish, Twins nearshore shoreline.

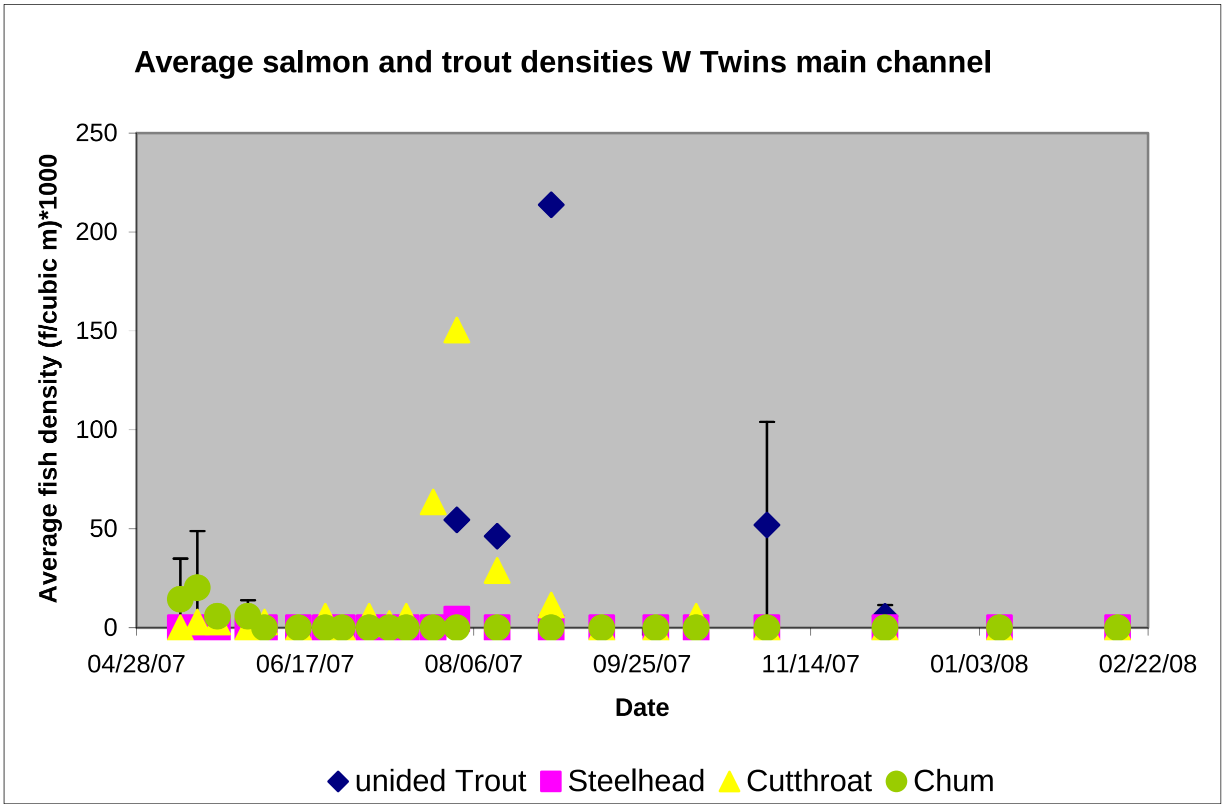


Figure 7. Salmon and trout densities, West Twins nearshore main channel

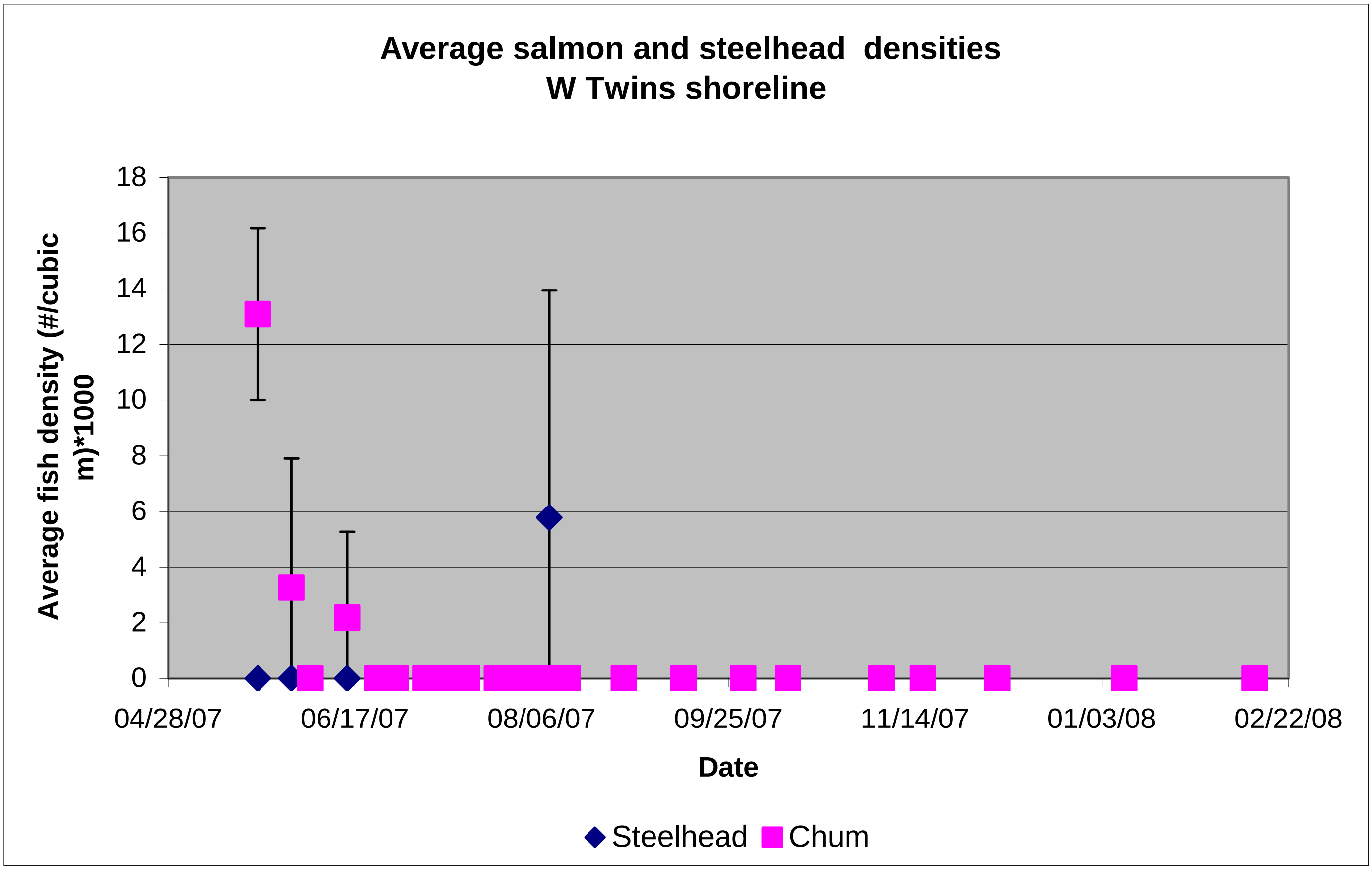


Figure 8. Salmon and trout densities, Twins nearshore shoreline site.

Table 2. Average fork length, mm, of dominant salmon and trout, Twins nearshore,2007-2008, by site.

Site	Date	Steelhead	sd	Cutthroat	sd	Unided Trout	sd	Chum	sd
Twins Shoreline	20-Apr-07	0	0	0	0	0	0	43.5	6.363961
	31-May-07	0	0	0	0	0	0	46.57143	7.039683
	28-Jun-07	0	0	0	0		0	74	8.485281
	25-Jul-07	0	0	0	0	0	0	0	0
	28-Aug-07	241.5	10.6066	0	0	0	0	0	0
	29-Sep-07	10.6066	0	0	0	0	0	0	0
	11-Oct-07	0	0	0	0	0	0	0	0
	16-Nov-07	0	0	0	0		0	0	0
	6-Dec-07	0	0	0	0	0	0	0	0
	9-Jan-08	0	0	0	0	0	0	0	0
	13-Feb-08	0	0	0	0	0	0	0	0
W Twins Main Channel									
	20-Apr-07	0	0	0	0	0	0	42	0
	31-May-07	0	0	40	0		0	38.82353	1.78419
	28-Jun-07	0	0	52.5	3.535534	0	0	0	0
	25-Jul-07	0	0	60.76923	31.81497	0	0	0	0
	29-Aug-07	152	14.14214	113.8462	54.50262	81.41667	21.77431	0	0
	29-Sep-07	0	0	0	0	57	0	0	0
	11-Oct-07	0	0	0	0	0	0	0	0
	1-Nov-07	0	0	0	0	0	0	0	0
	6-Dec-07	0	0	0	0	0	0	0	0
	9-Jan-08	0	0	0	0	0	0	0	0
	13-Feb-08	0	0	0	0	0	0	0	0

Left blank

Discussion and Recommendations

The Twins nearshore is a unique feature of the central and western Strait and provides important habitat to a complex mix of freshwater, anadromous, and marine type fishes. The high diversity of fish use observed along the west Twins shoreline in this study is consistent with previous work (Miller et al 1980) and is further validation that the Twins shoreline is extremely diverse and should be managed to preserve, and where appropriate, restore ecosystem function.

The high density of smelt observed along the Twins nearshore is consistent with the documented surf smelt spawning for this area (WDFW Salmonscape 2008). The area is very popular for launching of boats for crabbing and smelting, and is adjacent to private recreational property. Management care should be taken to preserve this high quality and function beach. Vehicle driving on the beach should be prohibited and shoreline alterations along the Twins should be avoided. The Twins nearshore should be a priority for acquisition, and restoration.

Results of this study indicate that salmon and trout use of the Twins nearshore is complex. While we know they use the Twins, coho were in very low numbers in Twins nearshore samplings and Chinook smolts were not collected at all. Both results are perplexing. Chinook were collected in the Pysht and Salt Creek nearshore (Shaffer et al in prep; see chapters x and xx), which are respectively west and east of the Twins nearshore, indicating the Chinook are migrating through the Twins nearshore. It is possible that fish are migrating along the shoreline, but offshore of our sampling area. The large pier and fill structure and associated dredging of adjacent eelgrass beds to the west of the west Twins may be related to this offshore migration if it is in fact occurring, and may possibly be disrupting salmonid migration along the Twins shoreline.

Disruption of shoreline migration however would not be expected to directly impact river outmigration by juvenile coho, or explain the lack of coho observed in the lower river of the west Twins. Roni et al 2008 documented significant numbers of coho emigrating from both the east and west Twins from 2004-2008. Outmigrating numbers for juvenile coho were approximately 33% lower in 2007/8 than previous years while outmigrating trout were at peak levels. The high numbers of trout we observed in the lower river nearshore of the west Twins are therefore consistent with Roni's observations, but the lack of coho in our lower river samples is perplexing. Possibly the lack of coho observed in the lower river and shoreline of this study could be due to fish avoidance of our sampling gear. The main channel of the Twins is a bit more constrained than other lower river nearshore areas we sampled. Fish may have been able to see the net when sampling, and avoid it. While we did not see evidence of avoidance in other similar size areas, possibly there may be specific unique elements to the Twins that allow higher avoidance. Gear avoidance, however, does not explain why only a very few coho, and no Chinook, were observed in our shoreline seining at Twins relative to all other study sites of the study.

Albeit both studies observed salmon in low numbers, our observation of coho in the shoreline areas of the Twins nearshore in December is consistent with PIT results by Roni et al (2008), who observed that, in low numbers, coho are migrating between the two Twin rivers during winter months. Coho movement is primarily from east to west Twins (Roni et al 2008). This repeated observation of juvenile coho in the nearshore during winter months is an important consideration for habitat management.

The recent listing of steelhead makes the high numbers of unidentified trout observed in August and September very important. We are currently having genetic testing done to identify these fish. Regardless of identity, the high numbers of trout and cutthroat during late summer and fall suggest that extra consideration is warranted when making habitat management decisions, including project timing for the Twins nearshore and lower river, to accommodate these later coho and high numbers of trout.

From a broader perspective, the Twins nearshore appears unique from nearshore areas of the central Strait and may in fact be representative of nearshore western Strait of Juan de Fuca, just as the Twins watershed is in many respects characteristic of other smaller order western Strait streams. It is therefore important to understand how this western nearshore system functions if we are to manage these western Strait systems wisely.

Our work leads to a number of restoration recommendations. Todd et al. 2006 describes the Twins shoreline as moderately impaired, and notes shoreline alterations and the Highway 112 as possible impactors, and states: “While not necessarily blocking fish passage, Highway 112, and associated fill prism, is built within the Twins nearshore and may have a significant effect on the Twins nearshore by disrupting the lateral channel connectivity, as well as the integrity and function of the delta south of the road prism and between the two rivers, and the connectivity between the stream delta south of the highway and the current shoreline”. Field observations indicate that sediment at the toe of the current road prism is comprised of silt, indicating the presence of wetlands prior to fill (Parks, pers obs.) A detailed analysis of the Twins nearshore, including estuarine changes, hydrologic relationship between the Twins mole and estuarine alterations, and detailed assessment of fish use, is therefore warranted, and recommended.

The observation of natural macroalgae mats in the lower river is also important. The fish stress observed when the seaweed mat was entrained in the seine during one of our August samplings may have been due to fish exposure to decreased water quality associated with the sea weed mat. Decreased water quality may include increased temperature, decreased oxygen, and high floculant/turbidity. While we were unable to detect any pre- and post change in water quality, the fish response is strong evidence that more detailed information is needed on the relationship between seaweed mats and fish use in the nearshore, and that extreme care is critical when working with macroalgae in the nearshore.

It's important to note that the observation of large accumulation of macroalgae in the lower river of the Twins was also unique in this study, and may play a role in fish use of the lower river Twins nearshore. Shan et al. 2008 documented significant diurnal changes in nearshore DO levels of a small creek. DO levels ranged from supersaturated to hypoxic and were specifically associated with macroalgae blooms. Our observations of fish stress during lower river sampling indicates that macro algae are an important feature to the Twins nearshore, and may play a role in fish use of the nearshore by limiting migration times due to low DO levels. Macroalgae mats have been documented to occur in areas of shoreline alteration as well as to result in forcing ecosystem shifts (Shaffer 2002). The macroalgae mats observed in the lower Twins may therefore be further indication of alteration of a historic estuary along the Twins lower rivers.

The absence of both coho and Chinook in the Twins nearshore relative to all other sites in this study and the high accumulation of macroalgae observed only in the Twins lower river, lead us to conclude that the Twins nearshore is in fact functioning differently than other nearshore areas in this study. One hypothesis is that coho and Chinook outmigrating to the nearshore Twins do so at night. Night migration at the Twins may be selected for due to predator avoidance, and may be a response to the very limited estuary of the lower Twins. DO levels may also play a role in outmigration timing. Historic alterations of what was once Twins estuary and shoreline may also play a role in nearshore function. Additional assessment work is recommended to further clarify juvenile salmonid use, in particular juvenile Chinook and coho use of the Twins nearshore. A detailed analysis of historic alteration of the lower rivers, and the impact alterations of the lower river including the highway road prism, historic fill and alteration of the road prism area, and Twins shoreline should be a focal point of this work.

The Twins shoreline is clearly significantly altered due to the 2.5 acre pier structure and associated dredging, which has displaced eelgrass and surf smelt spawning, disrupted longshore transport, and may be disrupting fish migration as evidenced by the lack of

Chinook along the Twins shoreline. Given the high species diversity and richness of the Twins shoreline, well documented smelt spawning in the area, and high numbers of trout and salmon documented in the Twins system by this study and other authors, we recommend the Twins pier be a priority for restoration for the western Strait nearshore.

Finally, it should be noted that Clallam County will soon embark on its update of the Shoreline Master Program. These recommendations should be included in the revised SMP if not already there.

References

Bennet, Todd. http://www.nwfsc.noaa.gov/research/staff/display_staffprofile.cfm

Haggerty, M. in prep. Water Resource Inventory Area 19 (Lyre-Hoko) Salmonid Restoration Plan. http://mhaggertyconsulting.com/uploads/ WRIA19RPDraft5_2 .pdf

Kramer, R. 1952. Completion report by stream clearance unit on the Clallam river and East Twin River. Washington Department of Fisheries, Olympia, Washington.

Lee, Sinang, Washington Department of Ecology, Olympia, Washington. sile461@ecy.wa.gov

Miller, B. C.A. Simenstad, J.Cross, K.L.Fresh, S.N. Steinfort 1980. Nearshore fish and macroinvertebrate assemblages along the Strait of Juan de Fuca including food habits of common nearshroe fish. EPA-600/7-80-027.

Parks, D. 2005. Preliminary assessment of sediment transport processes resulting from decommissioning of the Twin river clay quarry loading facility, Clallam County, Washington. Washington Department of Natural Resources, Port Angeles, Washington.

Roni, P. R. Holland, T. Bennett, G. Pess and R. Moses. 2008. Straits intensively monitored watershed contract report: results of FY07 PIT tagging on east and west Twin rivers. Northwest Fisheries Science Center, NMFS, Seattle, Washington 98112.

Shen J. Wang, T. Herman, J. , Mason P.and Arnold G.L.2008. Hypoxia in a Coastal Embayment of the Chesapeake Bay: A Model Diagnostic Study of Oxygen Dynamics. Estuaries and Coasts 31(4).

Shaffer J.A., J. Paul, P. Crain, M. McHenry, P Jensen, R. Simonson, M.Hurd, and D. Parks, 2005. Nearshore restoration strategy for Twin Rivers: a proposal by the Twins nearshore restoration workgroup Washington Department of Fish and Wildlife, Port Angeles, Washington.

Shaffer,J.A. 2002. Macroalgae blooms and nearshore habitat and resources of the Strait of Juan de Fuca. In: Proceeding, Puget Sound Research 2001. Puget Sound Water Quality Action Team, Olympia, Washington. http://www.psat.wa.gov/01_proceedings/start.htm

Todd, S., Fiztpatrick, N., Carter-Mortimer, A., and Weller, C. 2006. Historical changes to estuaries, spits, and associated tidal wetland habitats in the Hood Canal and Strait of Juan de Fuca regions of Washington State. Unpublished technical report, PNPTC TR 06-01, Kingston, Washington. 101 p. plus appendices..

Washington Department of Ecology 2008. http://www.ecy.wa.gov/services/contract/2008/ rfp0829swfap.pdf

Acknowledgements

This work was funded by the SRFB with in kind support by WDFW and the Lower Elwha Klallam Tribe. Tara Galuska, project manager RCO. The Clallam Marine Resources Committee provided funding for a number of college interns with Peninsula College Fisheries Program and Center of Excellence, Western Washington University REU program, and Seattle University. Mr. Jack Ganzhorn and Dr. Dwight Barry provided student supervision. Nancy Bleustein Johnson provided student guidance. Interns that assisted in the project include Jesse Charles, Chris DeSisto, Bryan Hara, Erica Hirsh, Keelan Hooper, Mario Laungayan, Romy Laungayan, Ross McDorman, Sean Oden, Tiffany Nabors, Rebecca Paradis, Jacob Ray, Tyler Ritchie, Melanie Roed, Justin Rondeau, Trista Simmons, Ben Warren, Karen Wilkie, Eric Wood, and Steve Wyall. Project in kind partners in order of contribution included Cathy Lear (Clallam County), Pat Crain (ONP), Ross Fuller, Chris Byrnes, Roger Mosley, Dan Penttila, Dan Doty, and Tim Quinn (WDFW), and Dave Parks (DNR). Sue Nattinger, Streamkeepers, provided water quality sampling equipment and expertise. Jenna Schilke was in charge of much of the field work and data collection. Jose Paul (WRIA 19 citizen) and Mike McHenry (LEKT) provided technical expertise and local advice. Dr. Phil Roni, NMFS, and Cathy Lear, Clallam County, provided valuable report review and technical expertise. Charlie Parks, and Kendra Parks provided good will and field help. Thank you to all.

Chapter 5. Nearshore Assessment: Fish use and water quality of the Pysht nearshore

J. Anne Shaffer[1], J. Schilke[1], M. McHenry[2], and J. Murray[3]

[1] Washington Department of Fish and Wildlife 332 E. 5th Street Port Angeles Washington 98362

[2] Lower Elwha Klallam Tribe 51 Hatchery Road Port Angeles, Washington 98362

[3] Merrill and Ring Inc. 813 E. 8th Street Port Angeles Washington 98362.

Introduction

Located along the western shore of the north Olympic Peninsula, the Pysht nearshore extends from Pillar Point Rocks east to Butler Creek, and includes the area of tidal influence approximately RM 3 to minus 30 m MLLW. It includes the tidally influenced main channel and estuary of the Pysht river, as well as the large sand spit feature that separates the river from the Strait of Juan de Fuca. Nearshore area on northern side of the spit consists of a sandy shoreline and tideflats, and eelgrass and kelp beds (Figure 1).

The Pysht estuary is the largest estuary on the western Strait of Juan de Fuca, and one of the largest estuarine complexes on the Olympic Peninsula (Todd et al 2006). Historically the Pysht estuary supported fall Chinook, coho, and chum runs, as well as winter steelhead (McHenry et al. 1996).

The Pysht nearshore has a diverse history and is highly valued culturally (Charles et al 2004). The spit and lower river was a settlement site for the Elwha Klallam Tribe. Following European settlement the lower river area was used extensively for commercial logging operations and associated log decking, rafting, and barging operations that resulted in significant diking, channelizing, and filling of the Pysht estuary and lower river (Todd et al 2006). Logging operations in the estuary ended in 1974. Many of the remnant structures remain, and are theorized to have contributed to the significant degradation of estuary function. The Pysht estuary is classified as severely impaired

(Todd et al 2006) and is owned by Merrill and Ring, a private commercial timber company.

The Pysht estuary, classified as a large stream delta system, is characterized by the low gradient Pysht River (Todd et al 2006; McHenry et al 1996). It includes approximately 100 acres of estuarine and lower river habitat. Vegetation along the spit includes both exotic and native species. Eelgrass (*Zostera marina*) is found in the main east and west side channels of the Pysht estuary (Shaffer pers obs.).

The Pysht foreshore is an exposed sandy shoreline characterized by wind driven waves from the Strait of Juan de Fuca. Dominant wind direction is westerly, with less prevailing northwest winds in fall, and northeasterly winds in winter. This zone of the Pysht nearshore includes two drift cells. The first extends from Pillar Point east to the mouth of the Pysht river and includes a large sand spit. Net transport is from west to east. The second extends from the river mouth east to Jim Creek, and is listed as having no appreciable net shore drift (WDoE 1991).

The Pysht shoreline is characterized by intertidal and shallow subtidal sand flats fringed with sparse eelgrass beds and offshore kelp beds. The intertidal beach west of the Pysht river mouth supports sand lance spawning (Shaffer et al 2004). The western Pysht shoreline is privately held. The shoreline east of the river mouth is a mix of public and private ownership.

Given the historic high cultural and biological importance of the Pysht and its large and degraded state, the landowners and co-managers of the Pysht have identified the Pysht nearshore as an area of high priority for restoration (North Olympic Lead Entity (NOPLE) strategy 2008).

The Pysht nearshore was one of fourteen sites included in the 2007 WDFW lead and Salmon Recovery Funding Board (SRFB) funded Central Strait of Juan de Fuca nearshore assessment for fish use. The Pysht was also one of a number of lower river mouth nearshore areas of WRIA 19 that was sampled for water quality for one year. Results of these two Pysht studies follow.

Methods and Materials

The shoreline, east, and west side channels and main channel of the Pysht estuary were seined bi-weekly from April-December 2007 and then monthly from December 2007 - March 2008. The east and west side channels were sampled as tide provided, using a 24.4 meter Puget Sound Ambient Monitoring Protocol (PSAMP) design seine and protocol. The Pysht lower river main channel and shoreline were sampled using the standard 37 meter PSAMP design seine and protocol. A minimum of two seines were sampled each from east and west side channels, the mainstem lower river of the estuary and shoreline. Side channel sampling was infrequently precluded by too low of a tide. Over the duration of the study juvenile Chinook salmon were sampled opportunistically for genetic tissue analysis.

Basic water quality of the west side channel, at the mouth of Reed creek, and mainstem of the Pysht river at mile post 3.28 (adjacent to highway 112), was sampled once a month during daylight hours on a falling neap tide between +6 and +3 MLLW. Point data on turbidity, DO, temperature, salinity, and conductivitiy were sampled using a YSI meter.

Results

Fish use.

Over sixty seines were sampled along the Pysht nearshore from April to September 2007. An additional 20 seines were sampled from September 2007 to February 2008. Surf smelt, shiner perch, cottids, and three spine stickleback were the dominant species collected along the Pysht shoreline and side channels (Table 1). The Pysht nearshore had the higher smelt and stickleback densities than all other sites sampled in the study. Salmonid abundance, in contrast, was among the lowest of all areas in the study (Figure 2). Ecologically the Pysht varied from other sites as well. For example, the Pysht shoreline had the highest species richness of all sites sampled, but lower diversity. Within the estuary, the Pysht side channel had consistently higher diversity than other side channel sites across the western Strait. (Figure 2 and 3). Chapter 2 of this report provides a more detailed comparison of Pysht to other central Strait nearshore sites.

Seining of the Pysht nearshore over the last ten months revealed a seasonal trend in basic ecological parameters of species richess and diversity for all sites, with highest richness and abundance during summer months. The Pysht shoreline and main channel had consistently highest richess and diversity.

Among salmon, coho and chum were the most abundant salmon collected. Coho were consistently collected from the main and side channels of the estuary, Chum from the main channel and shoreline (Figure 4-6).. Chinook were collected at the shoreline and main channel only, infrequently, and in much lower numbers than the other two species. With the exception of chum, no trends in fish size were observed, likely due to low numbers. (Figure 9-11). Chum size increased steadily over the sampling period. Genetic analysis of five juvenile Chinook collected from the Pysht shoreline revealed that over 50% of those from the Pysht shoreline originated from Columbia River stocks (Figure 4, Shaffer et al in prep, chapter 6 this report).

Forage fish were dominant along the shoreline followed by the main channel of the lower river during spring and summer months. Juvenile smelt were the most abundant, followed by adult smelt and juvenile and adult herring. Sand lance were found in fewer numbers than other forage fish species, and infrequently during spring, summer and fall (Figure 7-8).

Water quality

Water quality parameters of temperature, turbidity, and dissolved oxygen in the Pysht estuary appears very similar to other WRIA 19 nearshore areas (Figure 15-17). A strong seasonal trend was seen in all parameters, with highest turbidity and DO in winter months, and lowest DO during summer. Water quality parameters at the three sites within the Pysht also followed similar trends overall.

Discussion

From a water quality perspective the Pysht appears to be similar to other nearshore areas of the western Strait. Overall, water quality was good by state standards (DoE 2006). That said, the Pysht estuary consistently had the highest temperatures of all the nearshore sites sampled. While the monthly point temperatures for the Pysht estuary met state standards for excellent water quality, these data were quite limited and taken during high tide and early morning hours. Summer temperatures during low tides and later in the day likely are higher. These point data should therefore be interpreted to confirm that the Pysht estuary does experience high temperatures during spring and summer months. Temperature is also a concern in the watershed (MchHenry, pers comm.). A more intensive estuarine water quality monitoring effort is warranted, and recommended.

Ecologically the Pysht appears to be functioning a bit differently than other areas sampled for fish use. While seasonally very species rich, diversity of fish in the Pysht nearshore appears to be middle of the road, or lower, relative to other areas of the central Strait nearshore. On a more species specific level, juvenile salmon, which depend on estuarine areas for migration and refuge, were consistently lower in abundance than other estuarine areas of the western Strait nearshore, including areas that we might intuitively expect to have similar fish use, such as the Elwha and Salt Creek. Salmon that were collected at the Pysht were more consistently observed later in the season and for the most part along the shoreline.

Little information exists on historic salmon use of the Pysht estuary. Miller et al 1980 sampled the Pillar Point area as one of the MESA study sites, but only sampled well offshore by tow netting. In this three year effort they similarly observed that Pillar Point had some of the highest total species numbers along the Strait, and only found juvenile Chinook in any numbers in 1977. In their study of fish use of kelp beds Shaffer 2002 seined the Pysht shoreline area monthly from June-August 2001, but observed no salmon in seining, and very few salmonids in kelp beds at Pillar Point. These few comparisons compared with the results of this study indicate that juvenile salmon along the Pysht nearshore may be depressed relative to other nearshore areas of the Strait.

The documentation, and dominance, of Columbia river stocks in the composition of juvenile Chinook salmon collected from the Pysht shoreline lends another element of complexity to salmon use of the Pysht nearshore. Even if used at lower numbers than other areas of the central Strait, the Pysht nearshore is clearly highly important for juvenile salmon.

In contrast, forage fish, which seasonally use the nearshore shoreline for migration and spawning, had extremely high densities along the Pysht shoreline. This is consistent with Miller et al's 1980 tow netting observations and Shaffer 2001 kelp bed snorkeling results, although both sand lance and surf smelt, had the highest abundance in Shaffer's kelp snorkeling surveys. Combined these ecological indices and forage fish observations may indicate that the shoreline of the Pysht nearshore appears to be more functionally intact (for semi-pelagic schooling forage fish at least) than its estuarine counterparts.

Given the history of alteration in the Pysht estuary it is reasonable to interpret lower ecological indices and abundance information for key species observed in the Pysht nearshore as a result of decreased estuary habitat function. Additional, more intensive sampling of the estuary is recommended to verify these observations. These should include sampling throughout the salmon outmigration (which typically begins in March) and more intensive sampling methods, such as fyke netting. An intensive pilot fyke netting study of the east and west side channels of the Pysht estuary begin in March 2008.

It will be important to monitor fish use and water quality of the Pysht estuary over the course of the restoration as well as how the Pysht is functioning relative to the rest of the Pysht watershed and other nearshore areas. A more focused and detailed study on genetic composition of salmon using the Pysht nearshore is also warranted. Restoration planning should include all of these elements.

Acknowledgments

This work was funded by the SRFB with in kind support by WDFW and the Lower Elwha Klallam Tribe. Tara Galuska, project manager RCO. The Clallam Marine Resources Committee provided funding for a number of college interns with Peninsula College Fisheries Program and Center of Excellence, and the Western Washington University REU program. Mr. Jack Ganzhorn and Dr. Dwight Barry provided student supervision. Nancy Bleustein Johnson provided student guidance. Interns that assisted in the project include Jesse Charles, Chris DeSisto, Bryan Hara, Erica Hirsh, Mario Laungayan, Romy Laungayan, Ross McDorman, Sean Oden, Tiffany Nabors, Rebecca Paradis, Jacob Ray, Tyler Ritchie, Melanie Roed, Justin Rondeau, Trista Simmons, Ben Warren, Karen Wilkie, Eric Wood, and Steve Wyall. Project in kind partners in order of contribution included Cathy Lear (Clallam County), Pat Crain (ONP), Ross Fuller, Chris Byrnes, Roger Mosley, Dan Penttila, Dan Doty, and Tim Quinn (WDFW). Sue Nattinger, Streamkeepers, provided water quality sampling equipment and expertise.

Literature cited

Charles, B., V. Cooke, E. Grinnell, C. Morgonroth, L.M. Morganroth, M. Peterson, V. Riebe, A. Smith, and J. Wray 2004. When the tide is out: an ethnographic study of nearshore use on the Northern Olympic Peninsula. *In* Native American Traditional and Contemporary Knowledge of the Northern Olympic Peninsula. Coastal Watershed Institute and Olympic National Park. Port Angeles, Washington.

McHenry, M, J. Lichatowich, and R. Kowalski-Hagaman. 1996. Status of pacific salmon and their habitats on the Olympic Peninsula Washington. Report to the Department of Fisheries, Lower Elwha Klallam Tribe, Port Angeles, Washington.

Miller, B. C.A. Simenstad, J.Cross, K.L.Fresh, S.N. Steinfort 1980. Nearshore fish and macroinvertebrate assemblages along the Strait of Juan de Fuca including food habits of common nearshroe fish. EPA-600/7-80-027.

Shaffer, J. A. 2002. Preferential use of nearhsore kelp habitats by juvenile salmon and forage fish. Puget Sound Research Proceedings, PSAT, Olympia, Washington.

Todd, S., Fiztpatrick, N., Carter-Mortimer, A., and Weller, C. 2006. Historical changes to estuaries, spits, and associated tidal wetland habitats in the Hood Canal and Strait of Juan de Fuca regions of Washington State. Unpublished technical report, PNPTC TR 06-01, Kingston, Washington. 101 p. plus appendices.

Washington Department of Ecology 1991. Net shore drift in Washington state volume 1. Pacific Ocean and the Strait of Juan de Fuca. Shorelands and Coastal Zone Management Program, Washington Department of Ecology. Olympia, Washington. 98504.8711.

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

Figure 1. The Pysht Estuary. Red box includes Indian Creek (east side channel) and lower river; Blue box includes west side chnnel, lower river, decking area of spit, and shoreline.

Table 4. Percent of dominant species by site from beach seines March-September 2007 by geomorphic habitat type.

Site	Cumulative percent	Chinook	Coho	Chum	Cut throat	Unid'ed Trout	Surf Smelt (adult = >120)	Surf Smelt (juv = 50-120)	Smelt (pl = <50)	Sand lance (juv = 50-120)	Herring (juv = 50-120)	3-Spine stickle back	Shiner perch	Staghorn sculpin	Prickley Sculpin	Cottids <30m
Embayed shoreline																
Crescent Beach	97.95	2.00	0.92	1.41	0.00	0.00	46.33	9.00	0.25	25.76	2.99	0.02	0.97	1.95	0.00	0.00
Fresh Water Bay	96.50	13.23	0.00	0.09	0.00	0.00	50.97	2.10	0.00	24.78	2.10	0.03	2.21	0.24	0.00	0.00
Pysht Shoreline	98.92	0.02	0.01	0.26	0.00	0.00	10.86	79.57	0.00	0.05	2.18	0.00	0.00	2.38	0.00	0.07
Twins Shoreline	65.72	0.00	0.00	0.39	0.00	0.00	10.77	47.79	0.02	0.00	0.44	0.00	0.16	0.25	0.00	0.00
Bluffs																
Elwha Bluffs	98.80	12.35	1.66	10.92	0.00	0.00	0.92	53.70	18.06	0.92	0.21	0.00	0.00	0.00	0.00	0.00
Dungeness Bluffs	95.31	0.29	0.22	1.70	0.00	0.00	2.64	22.51	58.74	0.88	5.76	0.18	0.18	0.18	0.00	0.00
Spits																
Dungeness Spit	97.93	0.19	0.00	7.34	0.00	0.00	4.26	61.62	4.70	6.28	12.56	0.09	0.02	0.07	0.00	0.00
Ediz Hook	99.01	11.41	0.80	6.17	0.00	0.00	10.30	1.60	1.05	23.67	43.53	0.31	0.00	0.00	0.00	0.00
Lower river/estuary																
Elwha Side Channel	98.89	24.82	4.28	2.30	0.83	0.00	0.01	0.01	0.49	0.00	0.00	40.23	0.00	7.73	1.44	10.58
Salt Creek Side Channel	99.03	0.42	0.71	1.60	0.04	0.00	0.01	0.01	0.00	0.00	0.00	12.20	54.54	21.66	0.42	7.40
Pysht Side Channels	99.66	0.00	0.15	0.02	0.05	0.00	0.00	0.01	0.00	0.00	0.00	50.02	27.90	18.82	0.10	1.60
Lower river/estuary																
Pysht Main Channel	98.01	0.07	1.25	1.52	0.09	0.00	0.03	0.15	0.00	0.00	0.00	0.66	0.38	7.18	0.01	84.54
Salt Creek Main Channel	99.24	0.12	1.83	2.67	0.45	0.00	0.02	0.00	0.01	0.00	0.01	5.41	67.92	13.95	0.03	6.79
Twins Main Channel	98.60	0.00	0.00	1.14	6.28	4.68	0.00	0.00	0.00	0.00	0.00	0.07	0.00	4.81	28.41	53.21

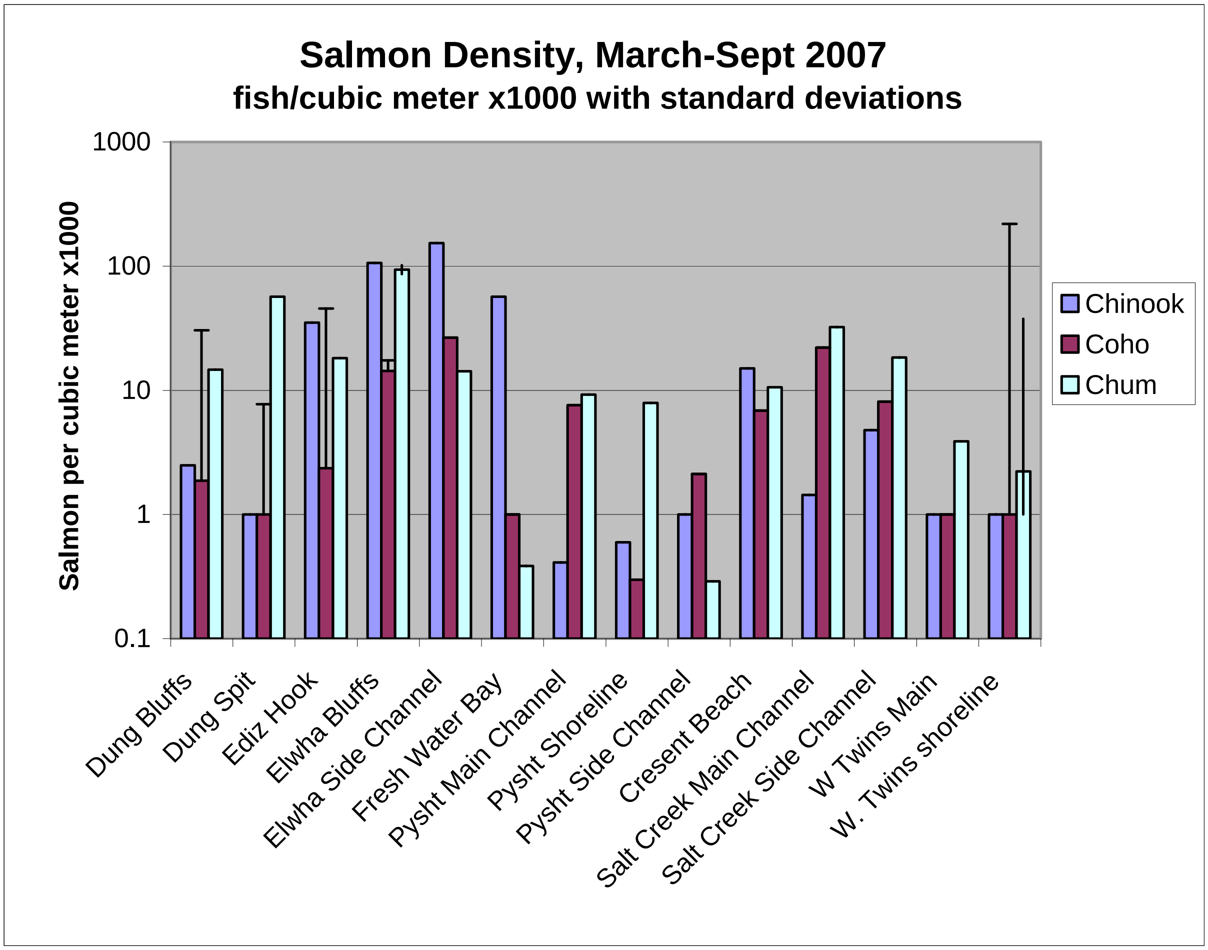
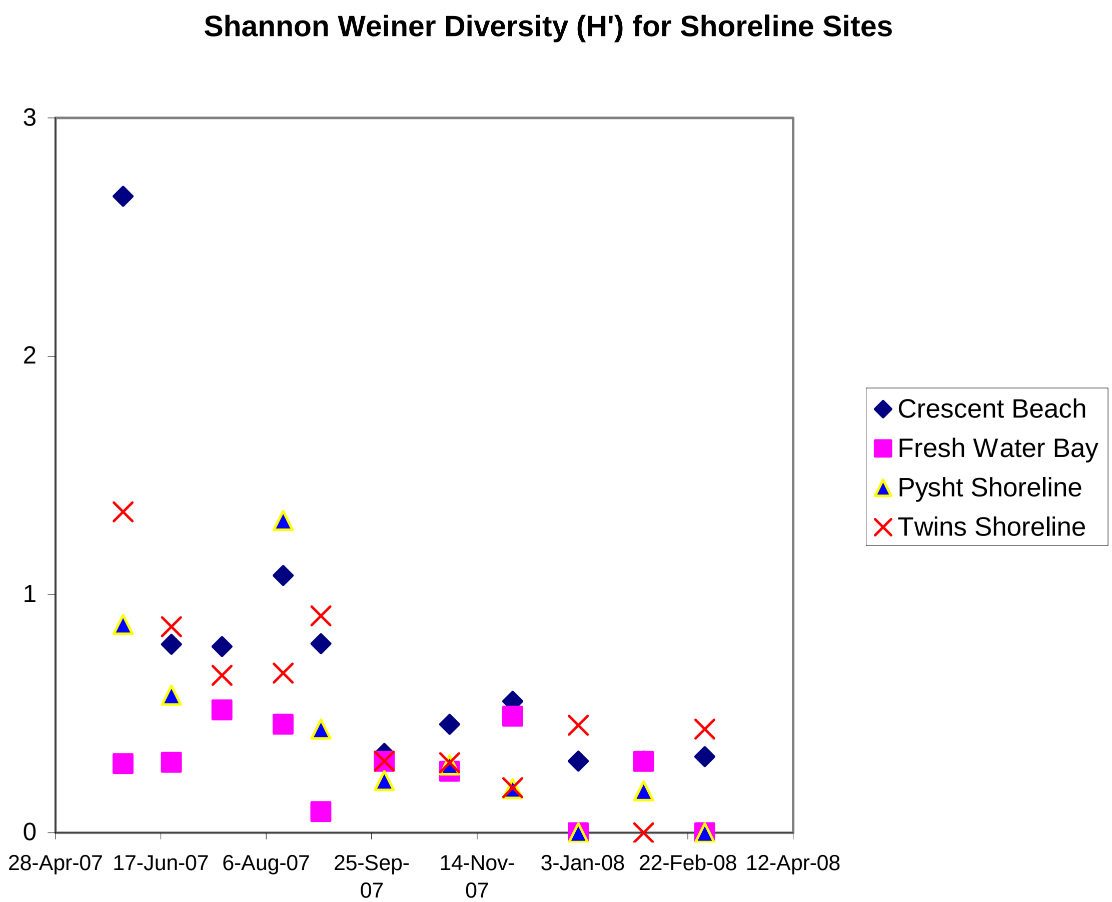

Salmon Density, March-Sept 2007
fish/cubic meter x1000 with standard deviations
Salmon per cubic meter x1000
1000
100
10
1
0.1
Chinook
Coho
Chum
Dung Bluffs
Dung Spit
Ediz Hook
Elwha Bluffs
Elwha Side Channel
Fresh Water Bay
Pysht Main Channel
Pysht Shoreline
Pysht Side Channel
Cresent Beach
Salt Creek Main Channel
Salt Creek Side Channel
W Twins Main
W. Twins shoreline

Figure 2


Shannon Weiner Diversity (H') for Shoreline Sites
3
2
1
0
28-Apr-07
17-Jun-07
6-Aug-07
25-Sep-07
14-Nov-07
3-Jan-08
22-Feb-08
12-Apr-08
Crescent Beach
Fresh Water Bay
Pysht Shoreline
Twins Shoreline

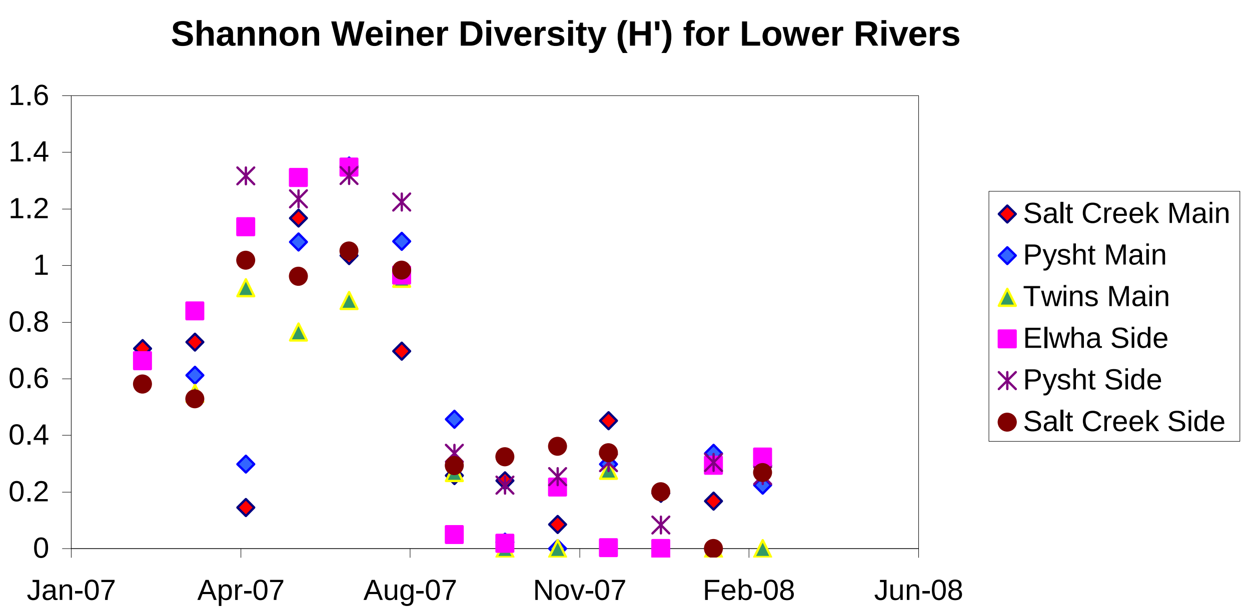

Shannon Weiner Diversity (H') for Lower Rivers
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan-07
Apr-07
Aug-07
Nov-07
Feb-08
Jun-08
Salt Creek Main
Pysht Main
Twins Main
Elwha Side
Pysht Side
Salt Creek Side

Figure 3 a and b. Shannon weiner diverisity for central Strait nearshore.

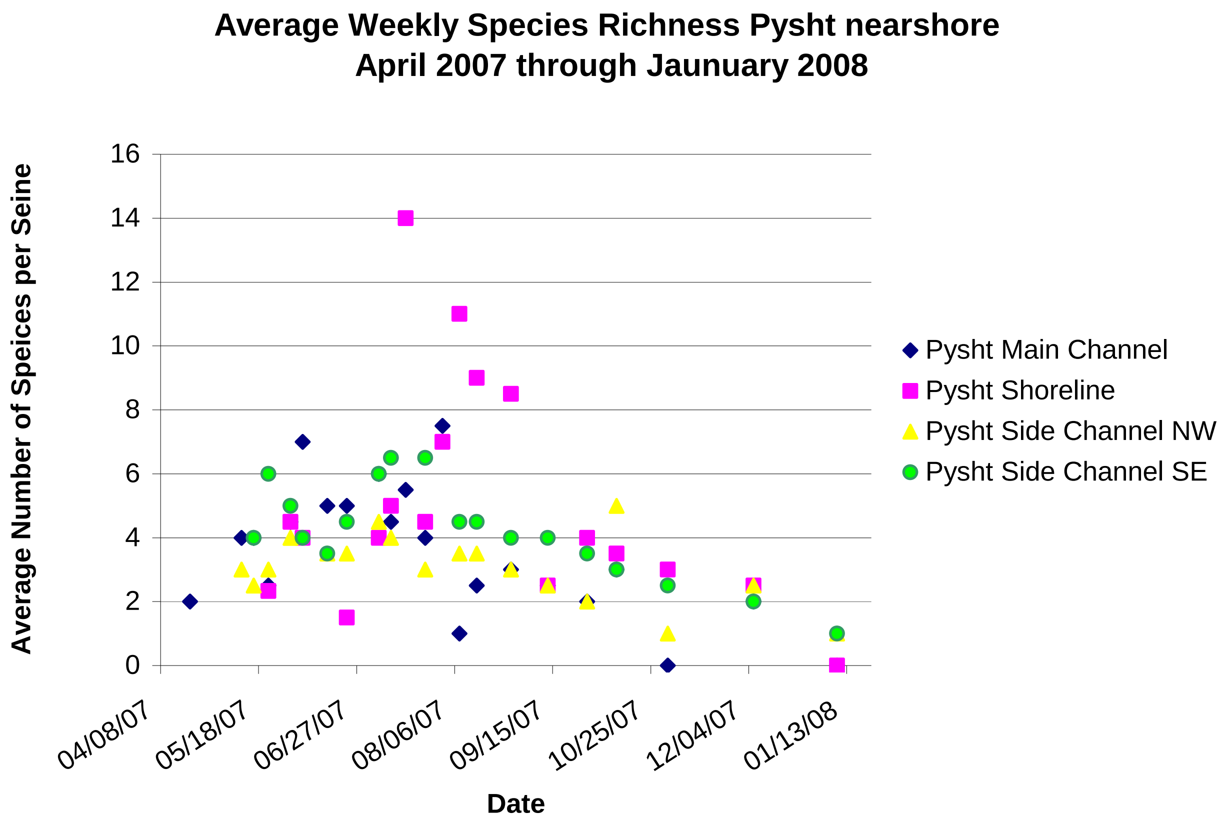

Average Weekly Species Richness Pysht nearshore
April 2007 through Jaunuary 2008
Average Number of Speices per Seine
16
14
12
10
8
6
4
2
0
04/08/07
05/18/07
06/27/07
08/06/07
09/15/07
10/25/07
12/04/07
01/13/08
Date
Pysht Main Channel
Pysht Shoreline
Pysht Side Channel NW
Pysht Side Channel SE

Figure 4.

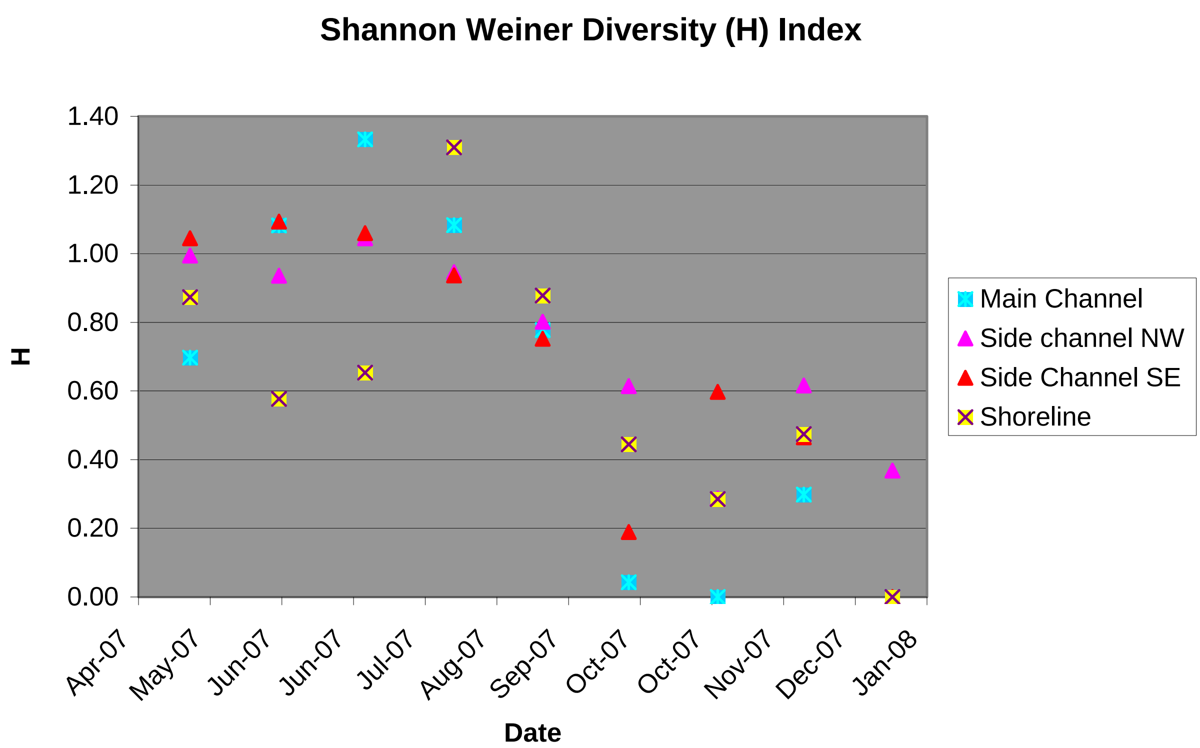

Shannon Weiner Diversity (H) Index
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
H
Apr-07
May-07
Jun-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Oct-07
Nov-07
Dec-07
Jan-08
Date
Main Channel
Side channel NW
Side Channel SE
Shoreline

Figure 5.

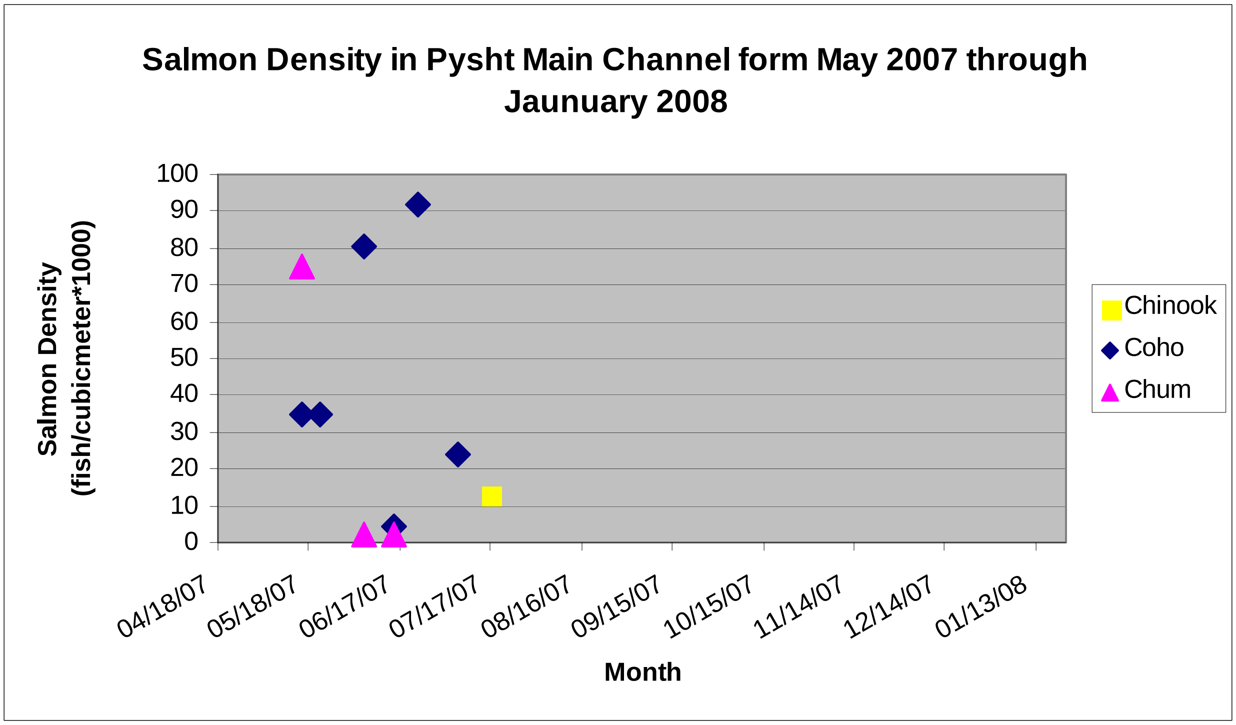


Figure 6.

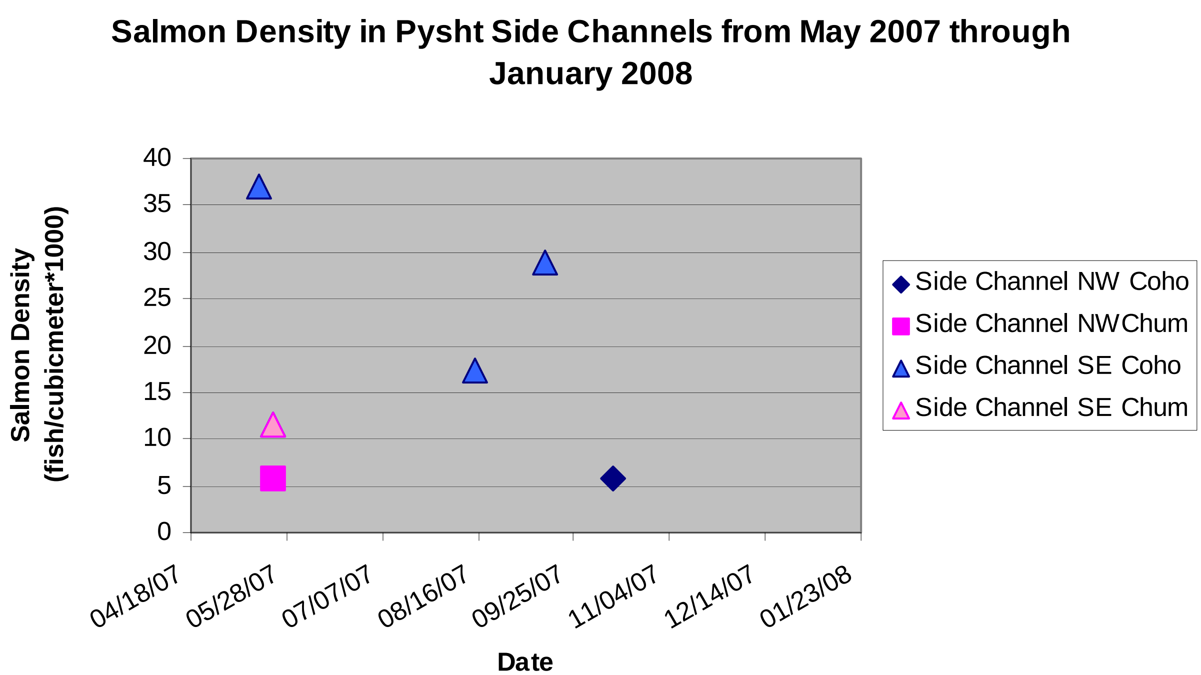


Figure 7

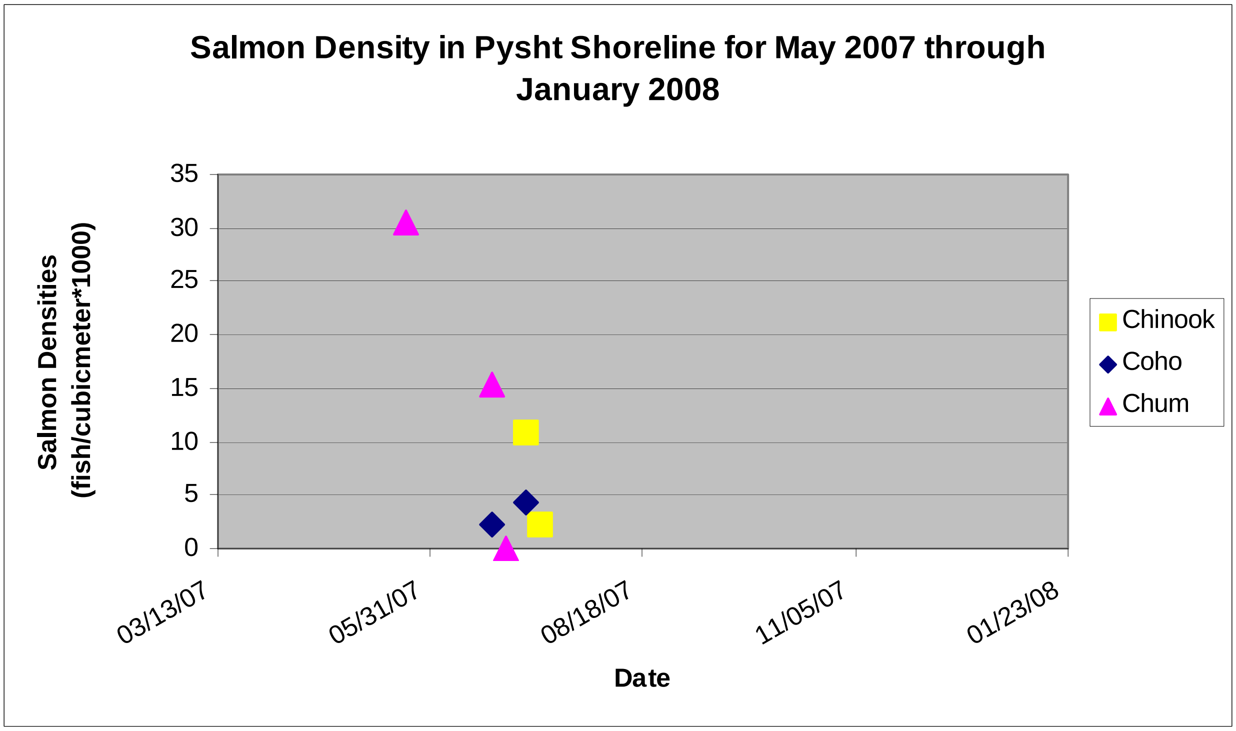


Figure 8.

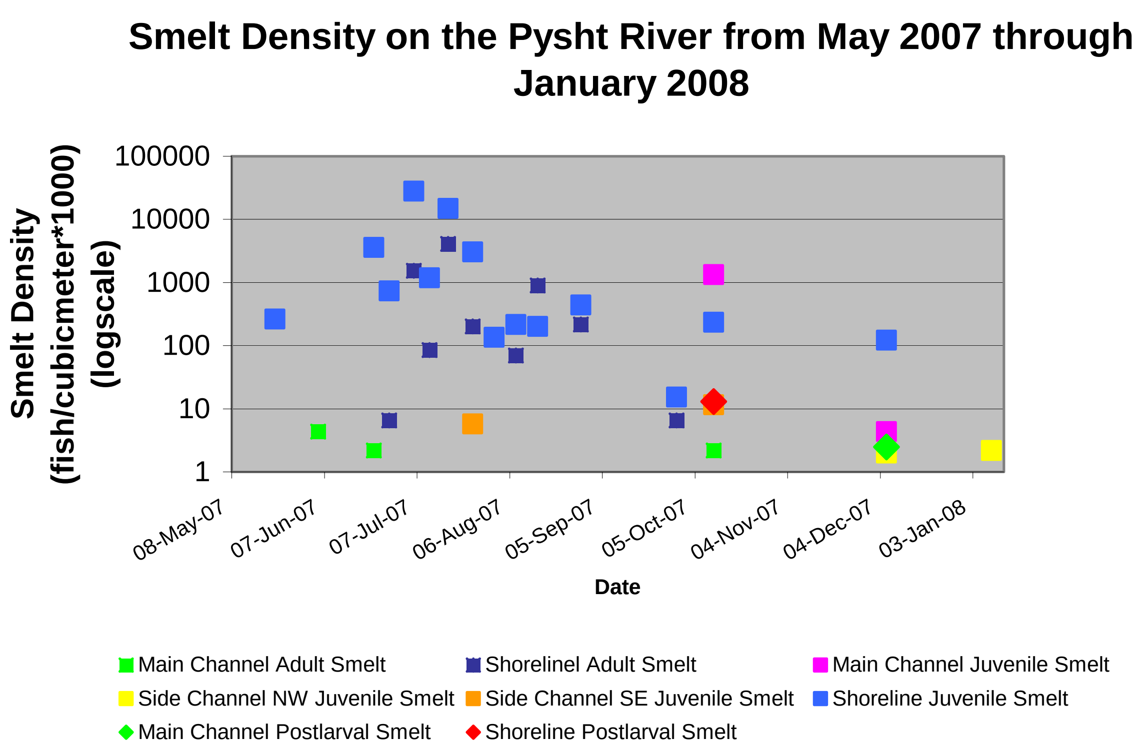


Figure 10.

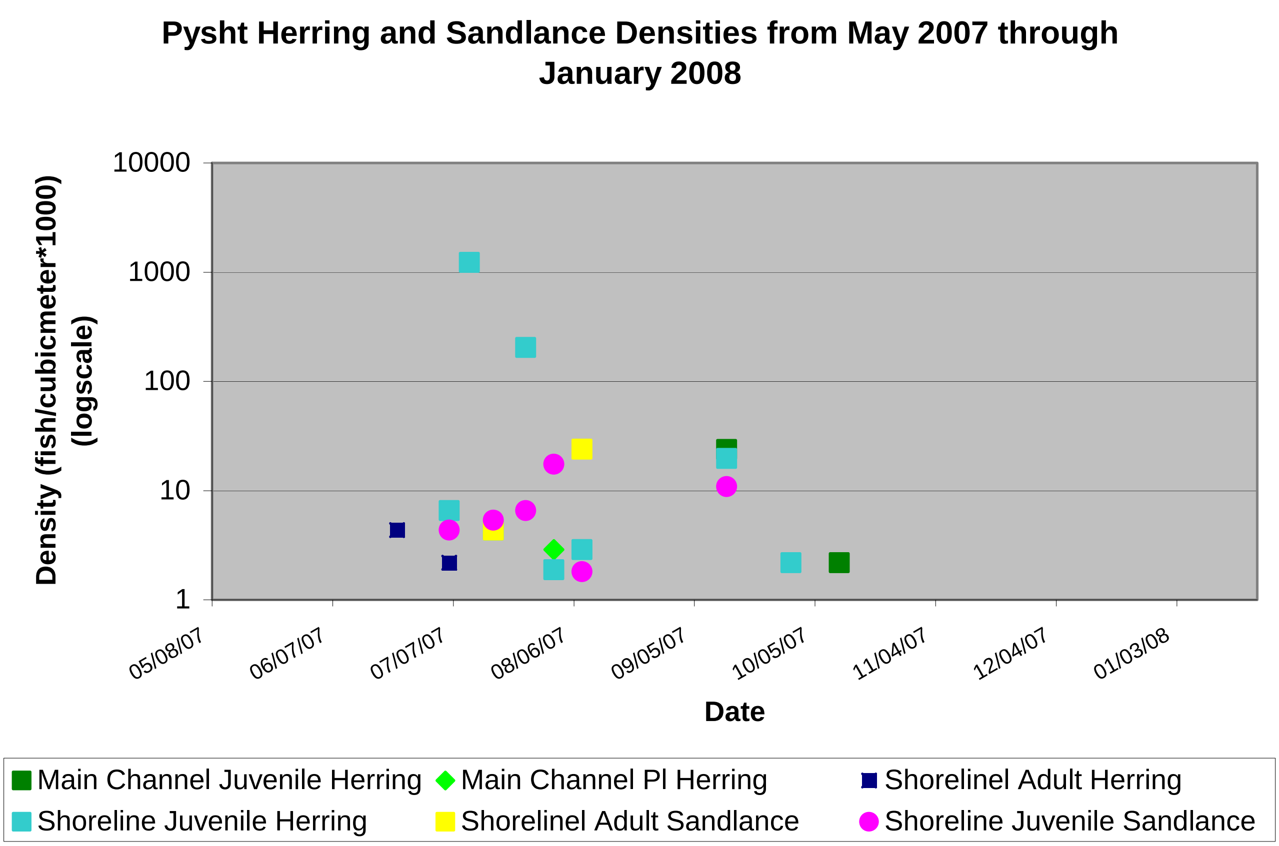

Pysht Herring and Sandlance Densities from May 2007 through January 2008
Density (fish/cubicmeter*1000) (logscale)
10000
1000
100
10
1
05/08/07
06/07/07
07/07/07
08/06/07
09/05/07
10/05/07
11/04/07
12/04/07
01/03/08
Date
Main Channel Juvenile Herring
Main Channel Pl Herring
Shorelinel Adult Herring
Shoreline Juvenile Herring
Shorelinel Adult Sandlance
Shoreline Juvenile Sandlance

Figure 11.

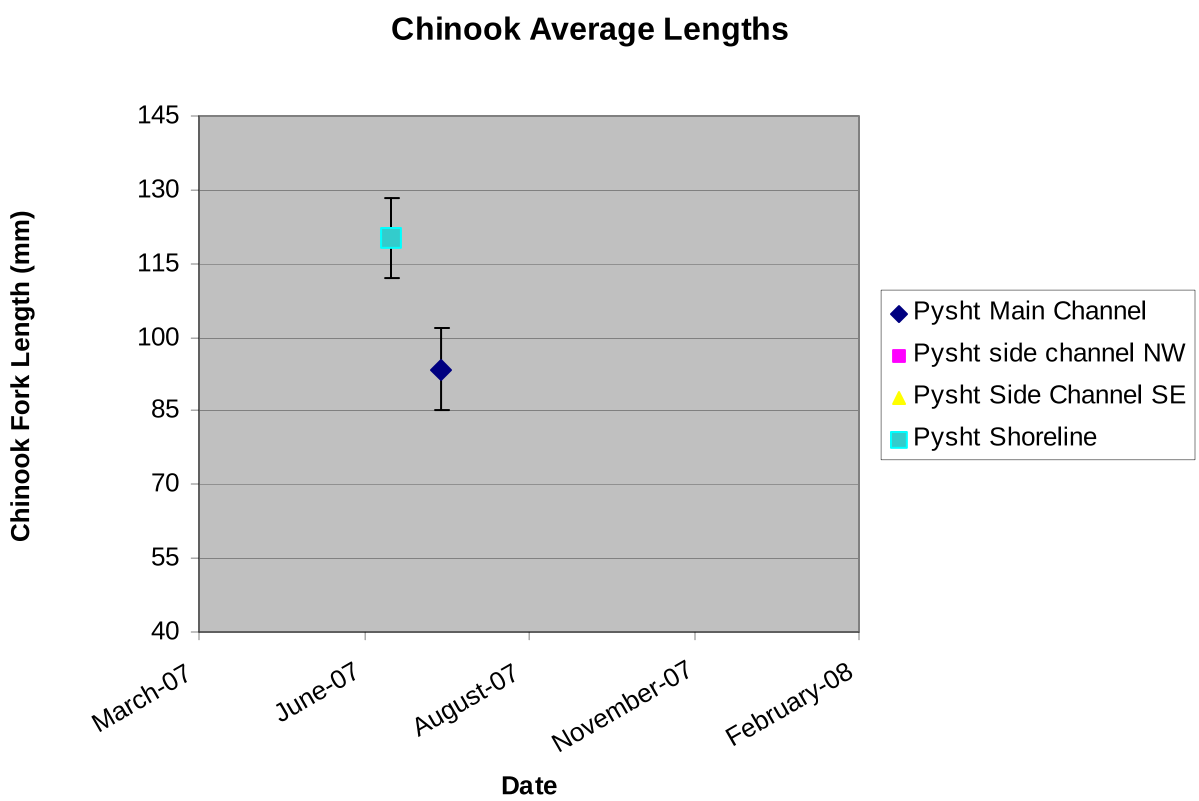

Chinook Average Lengths
Chinook Fork Length (mm)
145
130
115
100
85
70
55
40
March-07
June-07
August-07
November-07
February-08
Date
Pysht Main Channel
Pysht side channel NW
Pysht Side Channel SE
Pysht Shoreline

Figure 12.

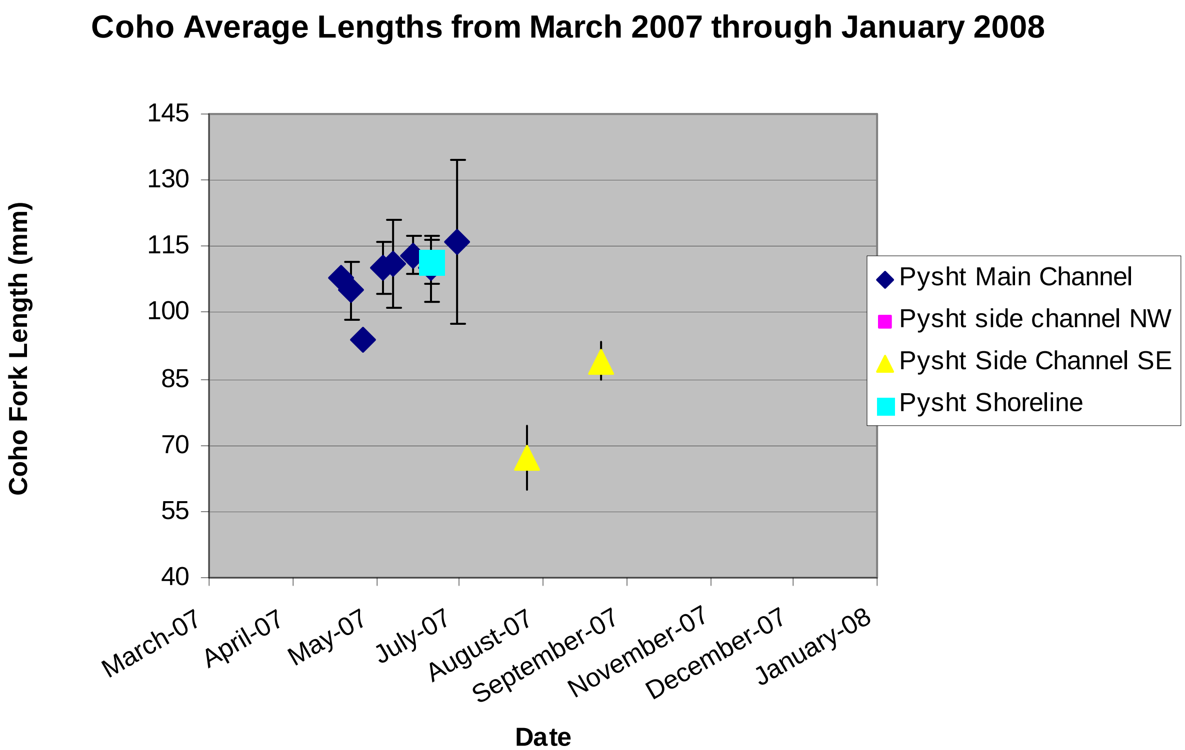

Coho Average Lengths from March 2007 through January 2008
Coho Fork Length (mm)
145
130
115
100
85
70
55
40
March-07
April-07
May-07
July-07
August-07
September-07
November-07
December-07
January-08
Date
Pysht Main Channel
Pysht side channel NW
Pysht Side Channel SE
Pysht Shoreline

Figure 13

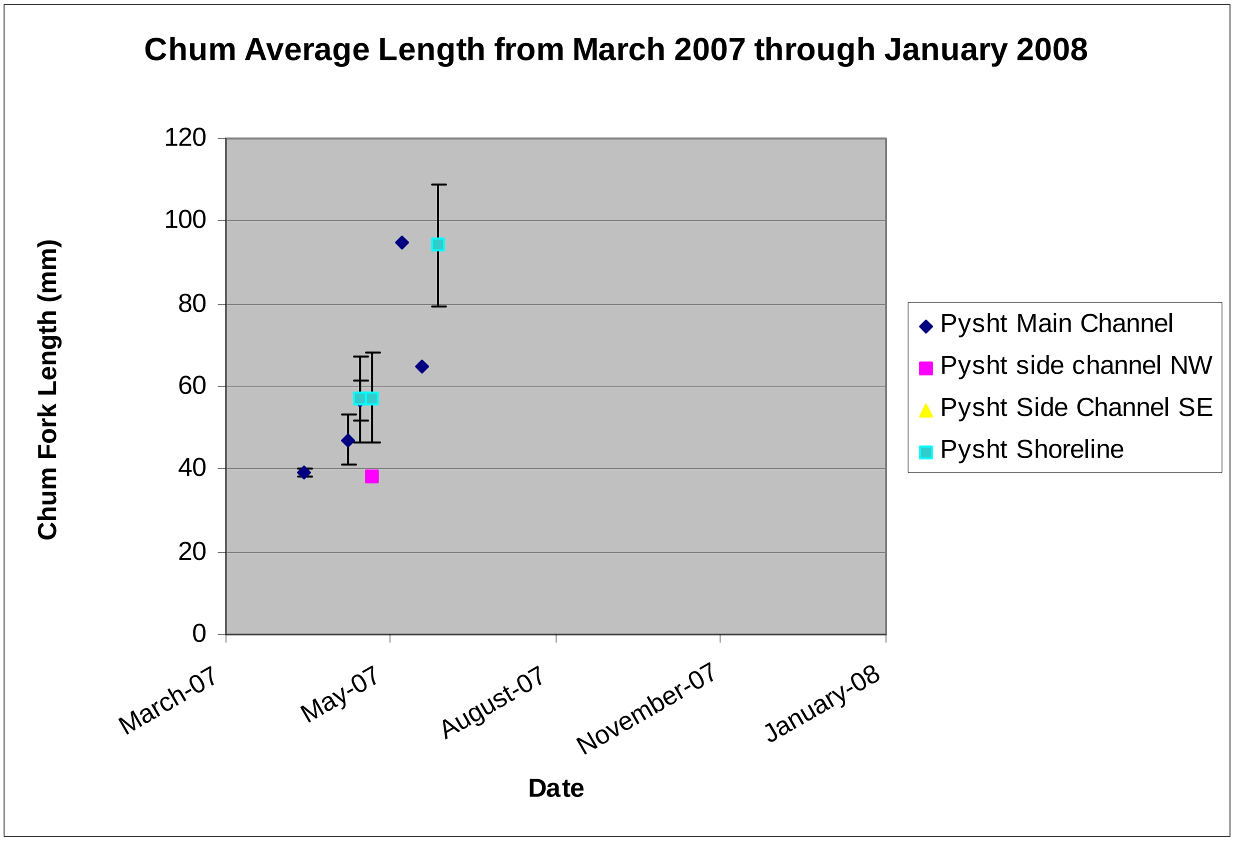


Figure 14.

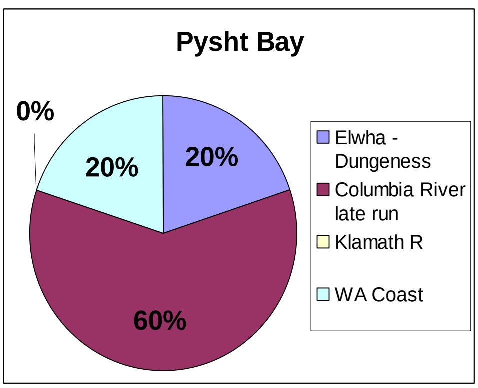


Figure 15.

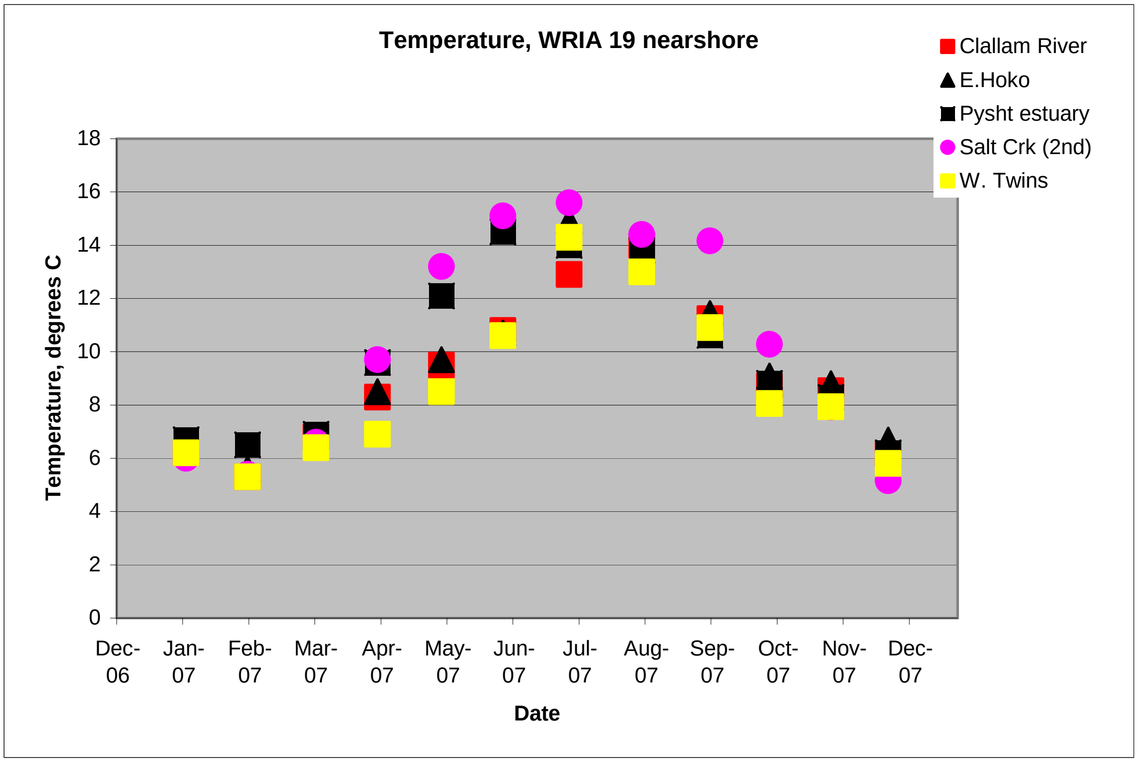


Figure 16

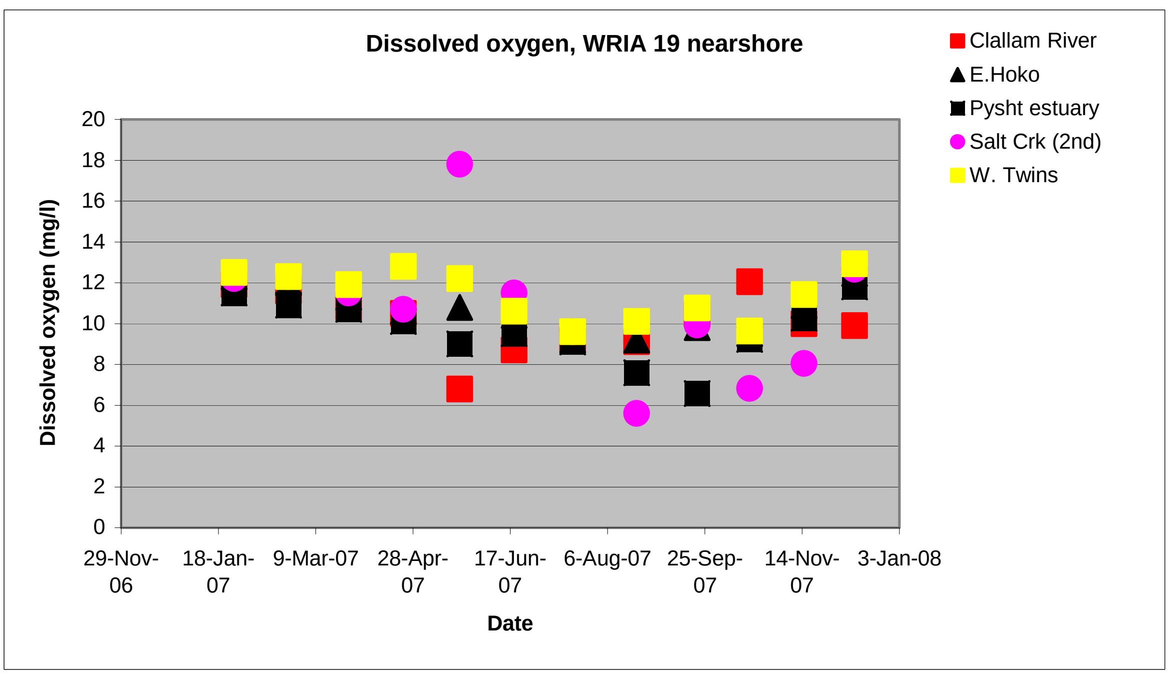


Figure 17.

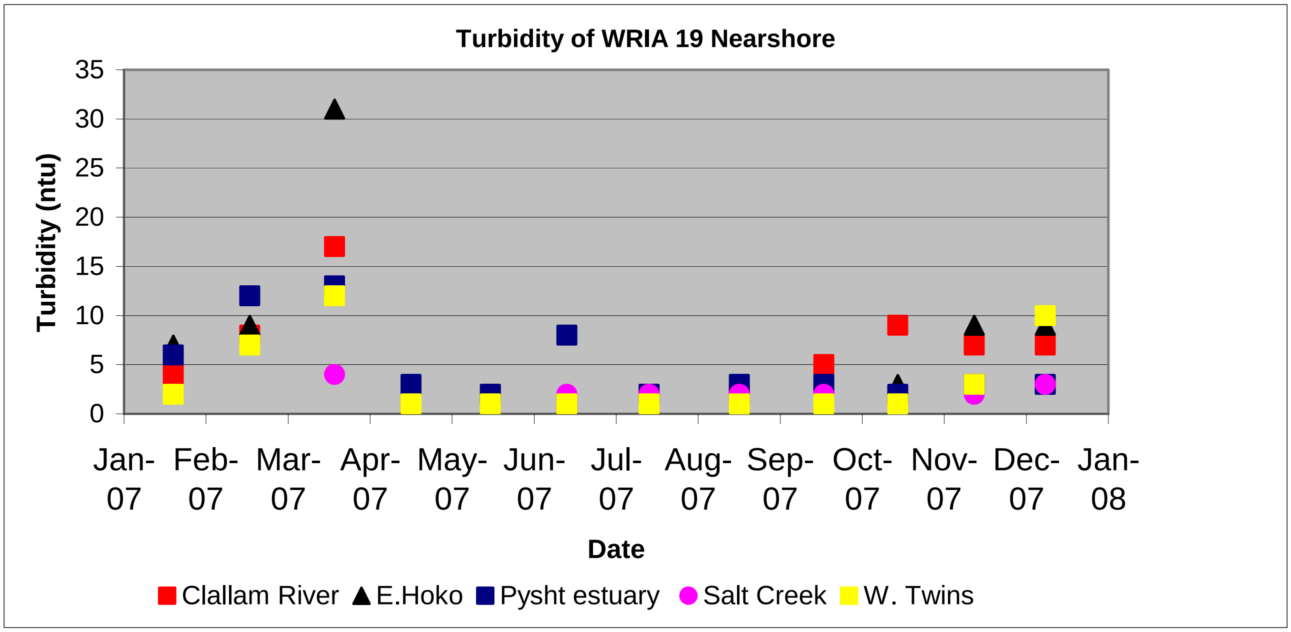


Figure 18

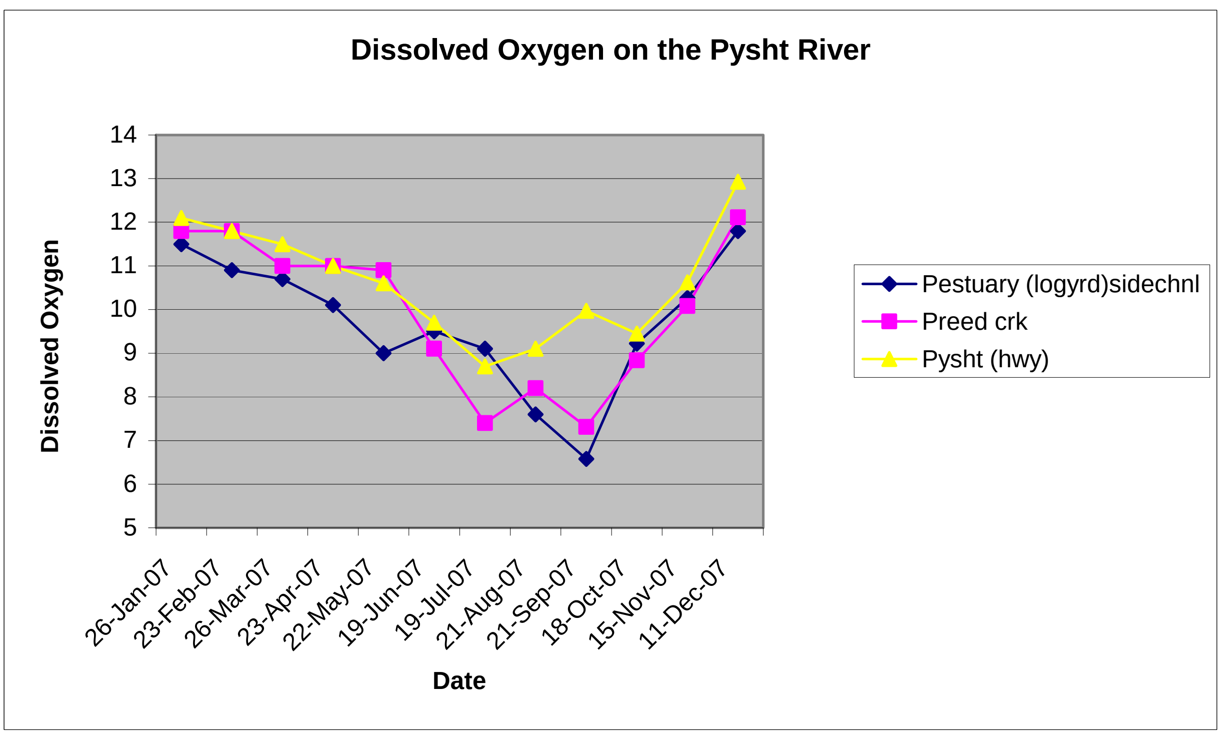


Figure 19.

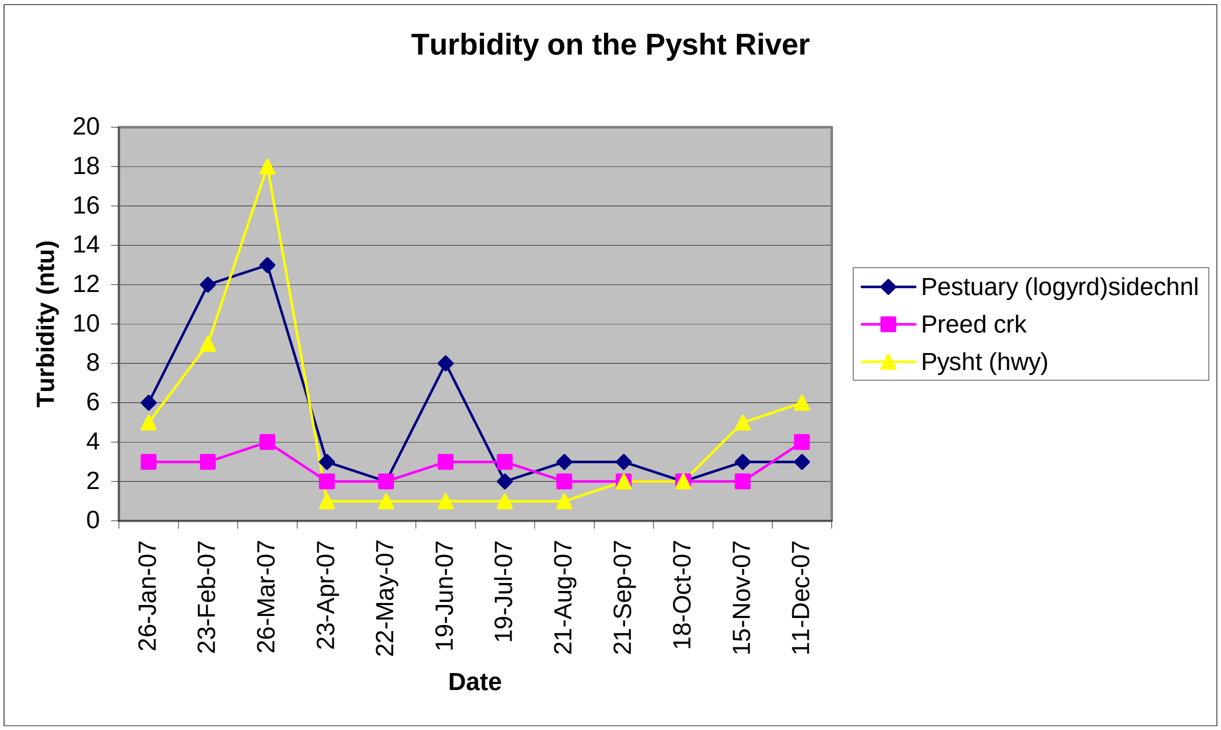


Figure 20

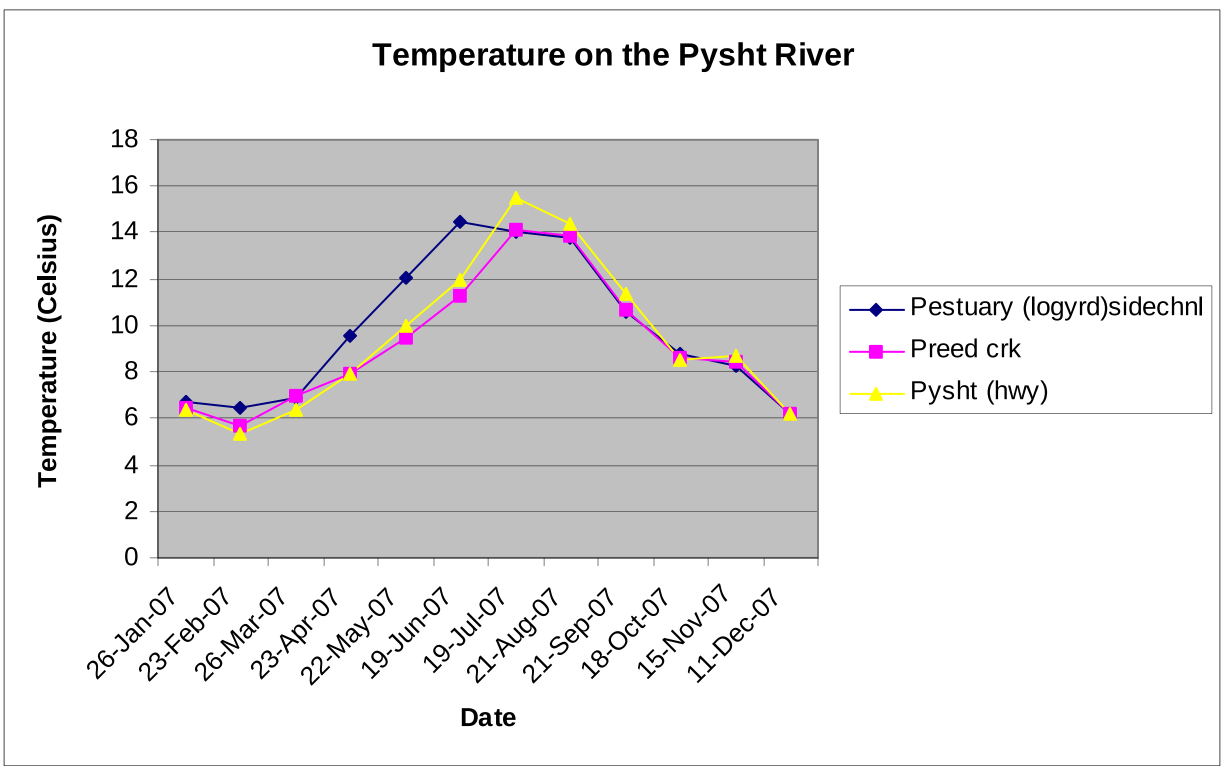


Figure 21

Appendix 1. Raw data for seining Pysht nearshore 2007-08.

Chapter 6. Nearshore Assessment: Genetic assessment of juvenile Chinook use of the nearshore central and western Strait of Juan de Fuca

Anne Shaffer[1*], Pat Crain[2], and Todd Kassler[3]

[!] Washington Department of Fish and Wildlife Habitat Program Science Division 332 E. 5th Street Port Angeles, Washington 98362 shaffjas@dfw.wa.gov

[2,] Olympic National Park 600 E. Park Avenue Port Angeles, WA 98362 patrick_crain@nps.gov

[3] Washington Department of Fish and Wildlife Molecular Genetics Lab 600 Capitol Way North Olympia, Washington 98501 kassltwk@dfw.wa.gov

Abstract

Fifty-eight juvenile Chinook salmon were collected from nearshore areas of the central and western Strait of Juan de Fuca, west of the Elwha River, between June and September 2007. Genetic analysis documented that 43% of these fish were Puget Sound Chinook salmon (Elwha/Dungeness reporting group), with 48% representing various Columbia River populations. The remaining 9% of the Chinook salmon observed were contributed by Washington Coastal and the Klamath Falls systems. These observations have important management implications as the National Marine Fisheries Service currently ends the Critical Habitat designation of nearshore habitat for the Puget Sound Chinook salmon population at the mouth of the Elwha River. It also supports long held belief that nearshore of the open coast of Washington is critical for salmon migration. Information supporting significant use of nearshore areas west of the Elwha River by listed Chinook salmon should result in revision of the Critical Habitat designation and boundary to accurately reflect the geographic area and nearshore habitats used by federally listed species.

Introduction

Juvenile Chinook salmon rely heavily on estuarine and nearshore habitats in Puget Sound during their early saltwater rearing (Beamer et al 2003; Brennan et al 2004; Fresh 2006;Simenstad et al 1982). As a result, the National Marine Fisheries Service (NMFS) declared the Puget Sound nearshore environment as “Critical Habitat” for the Puget Sound Chinook Evolutionary Significant Unit (ESU) (Shared Strategy 2007), which is listed as “threatened” under the Endangered Species Act (ESA). The Puget Sound Chinook ESU includes all populations in Puget Sound, and extends into the Strait of Juan de Fuca to include the Elwha and Dungeness River populations of Chinook. NMFS chose to end the critical habitat designation of nearshore habitat at the mouth of the Elwha River.

To date there are few data to confirm that juvenile Puget Sound Chinook utilize nearshore use in the central and western Strait of Juan de Fuca, which is defined for this paper as the area from Ediz Hook to Cape Flattery (Figure 1). Additionally, the removal of two dams on the Elwha River as early as 2012 is an unprecedented effort to restore fish populations on a watershed scale. In order to fully succeed, the nearshore ecosystem upon which Elwha fish populations rely must be understood, protected, and restored where appropriate.

In 2007 a study was intitiated to define fish use in the central and western Strait of Juan de Fuca. The study, currently underway, utilizes beach seining, forage fish spawning surveys, and snorkel surveys, to document juvenile fish use by geomorphic habitat type in selected locations across the central Strait of Juan de Fuca. Sample locations were identified from Dungeness Bay, west to the mouth of the Pysht River (Figure 1). The study implements one step of a multidisciplinary strategy developed to be used to define nearshore restoration priorities associated with the upcoming Elwha and Glines Canyon dam removals (Shaffer et al 2005). The project began in March 2007 and continues thru 2008.

This fish use assessment study provides an important opportunity to better understand juvenile Chinook salmon distribution along the central and western SJF. Genetic analysis allows detailed and accurate definition of fish stock origin. We therefore used genetic methods to estimate the population-of-origin for individual smolts from a mixture collected from nearshore localities. These methods are based on a procedure described by Rannala and Mountain (1997), which computes the probability that the source of a multilocus genotype (i.e., a genetic fingerprint from an individual fish) is an individual stock in the genetic baseline (one probability for each stock in the baseline). Others have used the basic methods developed by Rannala and Mountain (1997) to provide population-of-origin assignments of unknown individuals (Hauser et al. 2006, Taylor and Costello 2006, and Waples and Gaggiotti 2006). We used the Chinook coastwide microsatellite DNA baseline developed by the Genetic Analysis of Pacific Salmonids (GAPS) consortium (including nine laboratories from the Western United States). This consortium was established to standardize protocols for the collection and reporting of microsatellite data. The current GAPS baseline dataset for Chinook salmon (GAPS v2.1, release date August 25, 2006) consists of 13 microsatellite loci for 165 Chinook stocks, categorized into 44 regional reporting units by the Pacific Salmon Commission (PSC) (Seeb et al. 2007). An additional 36 stocks from WA State have been analyzed by the WDFW Molecular Genetics Laboratory and added to the GAPS v2.1 dataset (identified as v.2.1+). Evaluation of the smolts with this baseline allowed us to determine the population-of-origin for each smolt that was captured nearshore in the Strait of Juan de Fuca.

Methods and Materials

Survey Sample Design

Beach seining was utilized to examine fish species composition in selected locations from the Dungeness Bay west to the Pysht River (Figure 1). Seining locations were selected based upon geomorphic habitat types typical of the Strait of Juan de Fuca. Habitat types represented can be broadly described as sandy shorelines, spits, rocky shorelines, estuarine areas, stable bluffs, and eroding bluffs. A total of 15 locations were sampled (Table 1), eight of which were located west of the Elwha River. Sample sites were non-randomly selected, based upon accessibility and a qualitative assessment of the representative nature of the site. The number of sample locations was scaled to be achievable by a four person crew visiting the sites on a weekly basis. Weekly sampling began in March 2007 and continued through September 2007 after which time monthly sampling was conducted thru March 2008. Weather conditions prevented some weekly sampling at some sites. However, a minimum of 16 seine hauls were made at every location west of the Elwha River equaling approximately one sample every two weeks.

Table 1. Nearshore central Strait of Juan de Fuca sampling sites by geomorphic habitat type (blue font indicates Elwha nearshore)

Site	Embayed shoreline	Spits	Lower River/Estuarine Areas	Bluffs
Dungeness Spit		X		
Dungeness Bluffs				X
Ediz Hook		X		
Elwha Bluffs				X
Elwha River			X	
Freshwater Bay	X			
Salt Creek			X	
Crescent Bay	X			
Twin River Lower river			X	
Twin River Shoreline	X			
Pysht River Lower River			X	
Pysht Shoreline	X			

Beach seining was conducted utilizing standard protocols developed by the Puget Sound Action Team (Puget Sound Protocol 2005). Seines were deployed by a small row boat, with one end of the seine anchored to the shoreline. Two separate beach seines were utilized. The first seine was larger, and more suited to open water and sandy bottom areas. This net was 38 m in length, and was divided into two wings connected by a collection bag. Each wing consisted of two panels that were 9 m each. The outer panel was 1.0 m high at the edge and tapered to 1.4 m. The second panel was 1.4 m at the edge and tapered to 2.0 m at the bag. The collection bag was 2.0 m x 2.0 m x 2.0 m. Wing mesh is approximately 0.6 cm. Bag mesh is approximately 0.3 cm.

The smaller beach seine was approximately 24 m in length and was divided into two wings connected by a collection bag. Each wing consisted of a single panel which was approximately 11 meters in length and 1.8 m in depth. The mesh size for each panel was 0.3 cm. The collection bag was 1.8 m x 1.8 m x 1.8 m, with a bag mesh of approximately 0.3 cm.

Genetic Tissue Sampling

Genetic tissue samples of juvenile Chinook were collected from nearshore sampling seining stations from the Elwha River estuary west to the Pysht River (Figure 1). Tissue was collected using methodology provided by Kurt Fresh and Anna Kagley (NOAA) (pers. com) Tissue samples were collected from up to ten fish per day from each sample location west of the Elwha River mouth. Fish were measured (fork and total length), checked for adipose fin clips and scanned for coded wire tags utilizing an electronic wand (description needed). Genetic samples were taken by clipping a small quantity of tissue from either the dorsal fin or one lobe of the caudal fin. No more than 30 percent of the fin was clipped. Each clipping was placed in individual vials with lab grade ethyl alcohol, and the vial labeled with unique identification number. The identification label and sample vial were placed in individual plastic bags. Record of fish size, sample number, date, and location were made.

Genomic DNA was extracted for all samples by digesting a small piece of fin tissue using silica membrane based kits obtained from Macherey-Nagel (Bethlehem, PA, USA) following the manufacturers recommendations. Thirteen microsatellite loci combined into five multiplexes were screened for this study. Descriptions of the loci and PCR conditions are given in Table 2. PCR reactions were conducted with a thermal profile as follows: an initial denaturation step of 2 min at 94 C^{o}, 40 cycles of denaturation at 94 C^{o} for 15 s, 30 s at the appropriate temperature for each multiplex, and 1 min at 72^{o}C, plus a final extension at 72 C^{o} for 10 min and final holding step at 10 C^{o}. Genotypes were visualized using an ABI-3730 DNA Analyzer (Applied Biosystems, Foster City, CA, USA) with internal size standards (GS500LIZ 3730) and GENEMAPPER 3.7 software. Standardization of genetic data to GAPS allele standards was conducted following Seeb et al. (2007).

Table 2. Microsatellite DNA locus information (annealing temperature, the number of cycles used for the PCR reaction, number alleles/locus, and allele size range) for multiplexed loci used in the analysis of Chinook smolts collected in the Strait of Juan de Fuca. Number of alleles per locus and allele size range per locus is shown for the 63 Chinook samples analyzed from the Strait of Juan de Fuca.

Multiplex	Locus	Annealing temp C^{o}	# Cycles	# Alleles/ Locus	Allele Size	Citation

					Range (bp)	
Ots-M	*Oki-100*	50	40	31	208 – 325	Unpublished
	Ots-201b	50	40	31	153 – 306	Unpublished
	Ots-208b	50	40	22	158 – 266	Greig et al. 2003
	Ssa-408	50	40	17	184 – 272	Cairney et al. 2000
Ots-N	*Ogo-2*	50	40	11	214 – 236	Olsen et al. 1998
Ots-O	*Ogo-4*	56	40	13	132 – 170	Olsen et al. 1998
	Ots-213	56	40	33	206 – 358	Greig et al. 2003
	Ots-G474	56	40	10	152 – 192	Williamson et al. 2002
Ots-R	*Omm-1080*	53	40	36	162 – 342	Rexroad et al. 2001
	Ots-3M	53	40	11	130 – 160	Banks et al. 1999
Ots-S	*Ots-211*	60	40	23	204 – 296	Greig et al. 2003
	0ts-212	60	40	23	131 – 227	Greig et al. 2003
	Ots-9	60	40	6	99 – 109	Banks et al. 1999

The origin of the Chinook salmon smolts collected in the Strait of Juan de Fuca was explored by assigning them with a program written by K. Warheit (WDFW Molecular Genetics Laboratory, unpublished) in MATLAB R2007a (The Mathworks 2006). This program uses a partial Bayesian procedure based on Rannala and Mountain (1997) probabilities (see above) and the expectation-maximization (EM) algorithm to calculate the stock-source probabilities (posterior probabilities) for each smolt. We used the GAPS v2.1+ baseline to define the allele frequencies for baseline stocks. A more detailed description of the methods used by this program is in Blankenship et al. (2007).

Results

A total of 58 juvenile Chinook were collected from nearshore areas west of the Elwha River, with an additional five Chinook also sampled from a side-channel in the Elwha River. For the purposes of this paper, the Elwha River samples were not included in the analysis, as that area was already designated as Critical Habitat. Chinook were observed in seine catches as early as

May 8th, but tissue collection did not begin until June 22. Chinook continued to be observed in the catches through September, with the last samples being collected on September 12.

Genetic analysis revealed that, of the fish analyzed, 43% of the juvenile Chinook collected from these sites were from Elwha Dungeness reporting group, 48% were from the Columbia River reporting group (including the L_Columbia_R._fall, U_Columbia_R._summer/fall, and Mid_Columbia_R._tule_fall reporting groups),, and 9% were from the Washington Coastal and Klamath reporting groups (Figure 2). Distribution analysis of the 53 fish of this study revealed that Chinook salmon distribution in the Strait of Juan de Fuca west of the Elwha River appears to be strongly associated with specific habitat types, as the majority of Chinook were found at Pysht , Crescent Bay, and Freshwater Bay. Chinook were also collected from the Salt Creek main and side channels prior to the initiation of this study, an area also worthy of further sampling.

Table 3. Total number of seine hauls, by site, from March to September, 2007.

Location	# of Seine Hauls	# of Chinook Captured
Freshwater Bay	16	442
Salt Creek Side and Main Channels	72	99
Crescent Bay	26	207
Twin River	21	0
Twin River Nearshore	23	0
Pysht River Side and Main Channels	44	0
Pysht Bay	20	6
Total	222	754

Size of collected Chinook ranged from 72-146 mm fork length (Figure 4). Surprisingly, size distribution appeared to be bimodal, with larger fish being encountered both early in the year (July) and later in the year (September). This observation may be partially explained by changes in stock composition over the course of the summer (Figure 5). Fourteen discrete populations of Chinook salmon were identified during this study – three from Puget Sound, one from the

Washington Coast, one from the Klamath River, and the remainder from the Columbia River system.

Discussion

The documentation of Puget Sound Chinook stocks using the central and western Strait, while not surprising, is important for habitat and stock management and restoration. Shorelines of the central and western Strait are remote, and suffer from a variety of anthropogenic stressors (NOPLE strategy 2005). Prior to this study these areas were deemed outside the Puget Sound Chinook recovery area and so given a lower priority for restoration funding. These results clearly provide the need to include these nearshore areas as priority for ESA listed recovery. These results also clearly provide the first justification for more detailed assessment of western Strait watershed linkages and the role these watersheds play in both ESA recovery and ecosystem health.

The documentation of Columbia River and Klamath stocks in the Elwha nearshore are equally important. Adult Columbia River fish are intercepted regularly in Alaska waters. The importance of Washington coastal nearshore is clearly important for vulnerable juvenile Chinook life history stages. More detailed assessment of this use is clearly warranted.

Conclusion

This is the first genetic documentation of Puget Sound and Columbia River Chinook salmon smolts using nearshore areas of the central and western Strait of Juan de Fuca. This documentation is an important piece of information for future habitat management of Puget Sound Chinook, and should provide the basis for redefinition of the current federal critical habitat boundary designated by the TRT in 2005 (cite here).

Unfortunately we were not able to document fish that were resident to the Pysht or Salt Creek systems. This may be due to low sample size, and theorized extremely low numbers of resident fish in these systems (McHenry, 1996; McHenry 2004). Further sampling should be conducted in future years to provide more detail on the role nearshore of the central and western Strait for salmon, including federally listed stocks of Puget Sound Chinook, steelhead, and bull trout

Acknowledgements

Funding for this work was provided by the Recreation and Conservation Office/Salmon Recovery Funding Board and Clallam Marine Resources Committee, with in kind support from the Washington Department of Fish and Wildlife Habitat Science Program and Lower Elwha Klallam Tribe. Tara Galuska is the project manager from the RCO. Kurt Fresh and Anna Kagley, (NOAA) provided genetic tissue sampling methodology and vials. Joe Murray (Merrill-Ring), Pam Lowry, Ben and Irene Palzer, and Chuck and Neva Novak provided private property access. Jack Ganzhorn, Peninsula College Fisheries program, Dr. Dwight Barry, Director Peninsula College Center of Excellence and Elwha REU Programs, and Nancy Bluestein Johnson, Western Washington University (WWU) provided student support. Students Trista Simmons (Peninsula College) and Rebecca Paradis and Tyler Ritchie (WWU) provided field support. Dr's. Laurie Weitcamp, and Tim Tynan, (NOAA), and Bill Graeber, TRT, provided technical advice. Ken Warheit (WDFW) assisted in statistical analysis. Kurt Fresh (NOAA) provided critical manuscript review.

References

Banks, M.A., M.S. Blouin, B.A. Baldwin, V.K. Rashbrook, H.A. Fitzgerald, S.M. Blankenship, and D. Hedgecock. 1999. Isolation and inheritance of novel microsatellites in chinook salmon. Journal of Heredity 90: 281-288.

Beamer, E., R. Henderson, A. McBride and K.W. Wolf. 2003. The importance of non-natal pocket estuaries in Skagit Bay to wild Chinook salmon: an emerging priority for restoration. Skagit River System Cooperative, Research Department,
La Connor. Washington. 10 p

Blankenship, S., K.I. Warheit, J. Von Bargen, and D.A. Milward. 2007. Genetic stock identification determines inter-annual variation in stock composition for legal and sub-legal Chinook captured in the Washington Area-2 non-treaty troll fishery. Unpublished WDFW Molecular Genetics Laboratory Report submitted to the Pacific Salmon Commission – Chinook Technical Committee.

Brennan, J.S., K.F. Higgins, J.R. Cordell and L.A. Stamatiou. 2004. Juvenile salmon composition, timing, distribution, and diet in marine nearshore waters of central Puget Sound in 2001-2002. King County, Department of Natural Resources and Parks, Seattle Washington. 164 p.

Cairney, M., J.B. Taggart, and B. Hoyheim. 2000. Atlantic salmon (*Salmo salar* L.) and cross-species amplification in other salmonids. Molecular Ecology 9: 2175-2178.

Fresh, K.L. 2006. Juvenile Pacific Salmon in Puget Sound. Puget Sound Nearshore Partnership Report No. 2006-06. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Greig, C., J.P. Jacobson, and M.A. Banks. 2003. New tetranucleotide microsatellites for fine-scale discrimination among endangered Chinook salmon (*Oncorhynchus tshawytscha*). Molecular Ecology Notes 3:376-379.

McHenry, M., J. Lichatowich, and R.K. Hagaman. 1994. Status of pacific salmon and their habitats on the Olympic Peninsula. Report to the Lower Elwha Klallam Tribe, Port Angeles, Washington.

McHenry, M., R. McCoy and M. Haggarty. 2004. Salt Creek Watershed: An Assessment of Habitat Conditions, Fish Populations and Opportunities for Restoration. A final report to the North Olympic Salmon Coalition Pt. Townsend, WA 98368

Olsen, J.B., P.B. Bentzen, and J.E. Seeb. 1998. Characterization of seven microsatellite loci derived from pink salmon. Molecular Ecology 7:1083-1090.

PSAT (Puget Sound Action Team). 2005. Regional nearshore and marine aspects of salmon recovery planning. Puget Sound Action Team, Olympia. Available online: *www. psat.wa.gov/Programs/salmon_recovery*.

Rannala, B. and J.L. Mountain. 1997. Detecting immigration by using multilocus genotypes. Proceedings of the National Academy of Sciences USA 94, 9197-9201.

Shaffer, J.A., L. Ward, P. Crain, B. Winter, K. Fresh, and C. Lear. 2005. Elwha and Glines Canyon dam removals: nearshore restoration and salmon recovery of the central Strait of Juan de Fuca, in Proceedings, Puget Sound Research Conference 2005, Puget Sound Water Quality Action Team, Olympia Washington.

Shared Salmon Strategy. 2007. Puget Sound salmon recovery plan and National Marine Fisheries Service's (NMFS) final supplement to the Shared Strategy plan. Seattle. Available online: *www.sharedsalmonstrategy.org/plan/index.html*.

Simenstad, C.A., K.L. Fresh and E.O. Salo. 1982. The role of Puget Sound and Washington coastal estuaries in the life history of Pacific salmon: an unappreciated function. Pages 343-364 *in* V.S. Kennedy (ed.). Estuarine Comparisons. Academic Press, New York.

Rannala, B. and J.L. Mountain. 1997. Detecting immigration by using multilocus genotypes. Proceedings of the National Academy of Sciences USA 94, 9197-9201.

Rexroad, C.E., III, R.L. Coleman, A.M. Martin, W.K. Hershberger, and J. Killefer. 2001.

Thirty-five polymorphic microsatellite markers for rainbow trout (*Oncorhynchus mykiss*). Animal Genetics 32:317-319.

Shaffer, J.A., L. Ward, P. Crain, B. Winter, K. Fresh, and C. Lear. 2005. Elwha and Glines Canyon dam removals: nearshore restoration and salmon recovery of the central Strait of Juan de Fuca, in Proceedings, Puget Sound Research Conference 2005, Puget Sound Water Quality Action Team, Olympia Washington.

Shared Salmon Strategy. 2007. Puget Sound salmon recovery plan and National Marine Fisheries Service's (NMFS) final supplement to the Shared Strategy plan. Seattle. Available online: *www.sharedsalmonstrategy.org/plan/index.html*.

Simenstad, C.A., K.L. Fresh and E.O. Salo. 1982. The role of Puget Sound and Washington coastal estuaries in the life history of Pacific salmon: an unappreciated function. Pages 343-364 *in* V.S. Kennedy (ed.). Estuarine Comparisons.
Academic Press, New York.

Williamson, K.S., J.F. Cordes, and B.P. May. 2002. Characterization of microsatellite loci in chinook salmon (*Oncorhynchus tshawytscha*) and cross-species amplification in other salmonids. Molecular Ecology Notes 2:17-19.

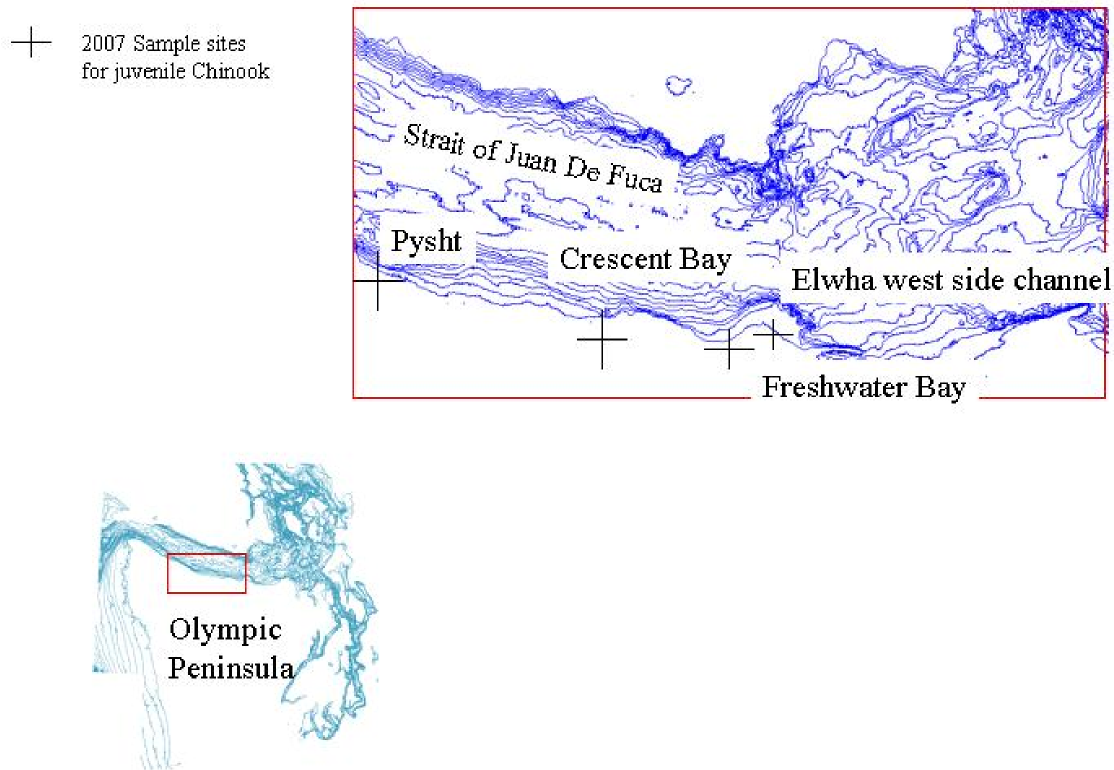


Figure 1. Sampling sites for 2007 Nearshore assessment of the central Strait of Juan de Fuca WDFW. [Note: Need to provide a different location map to match text]

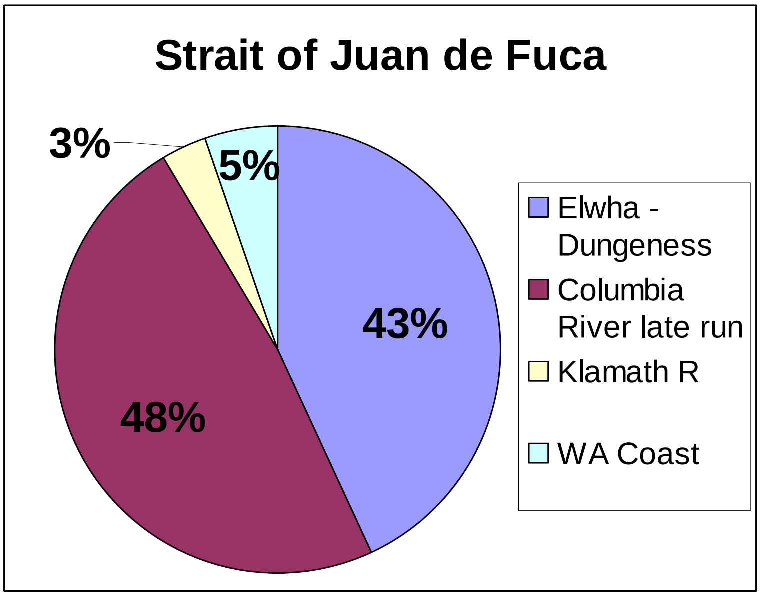


Figure 2. Chinook stock composition from the Central and Western Strait of Juan de Fuca.

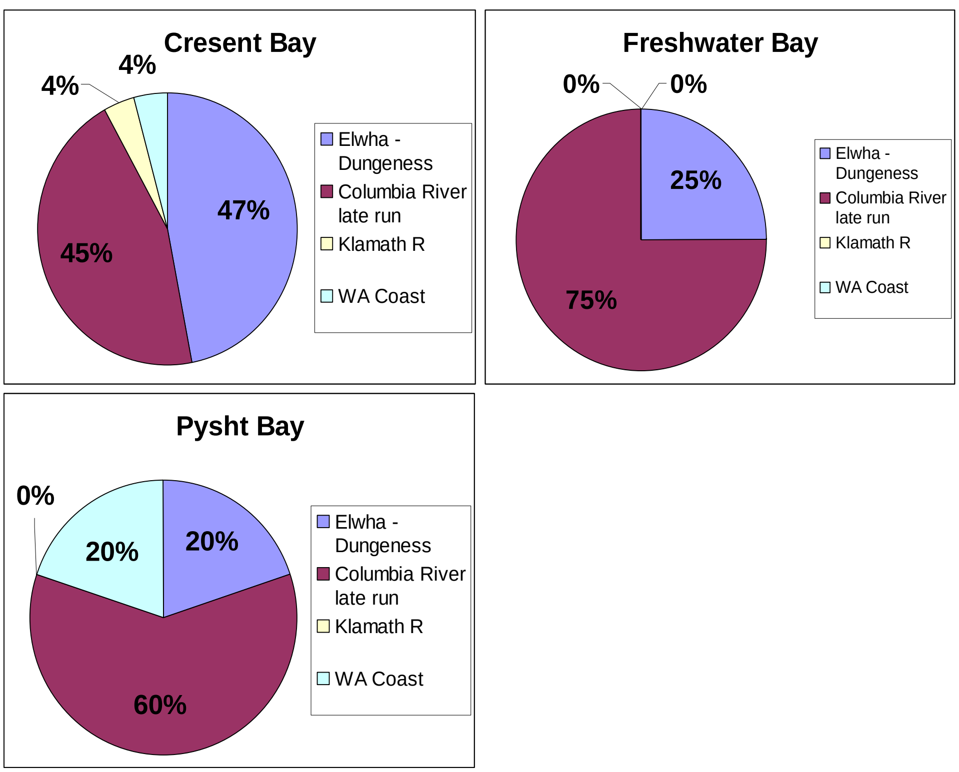


Figure3. Site specific stock composition.

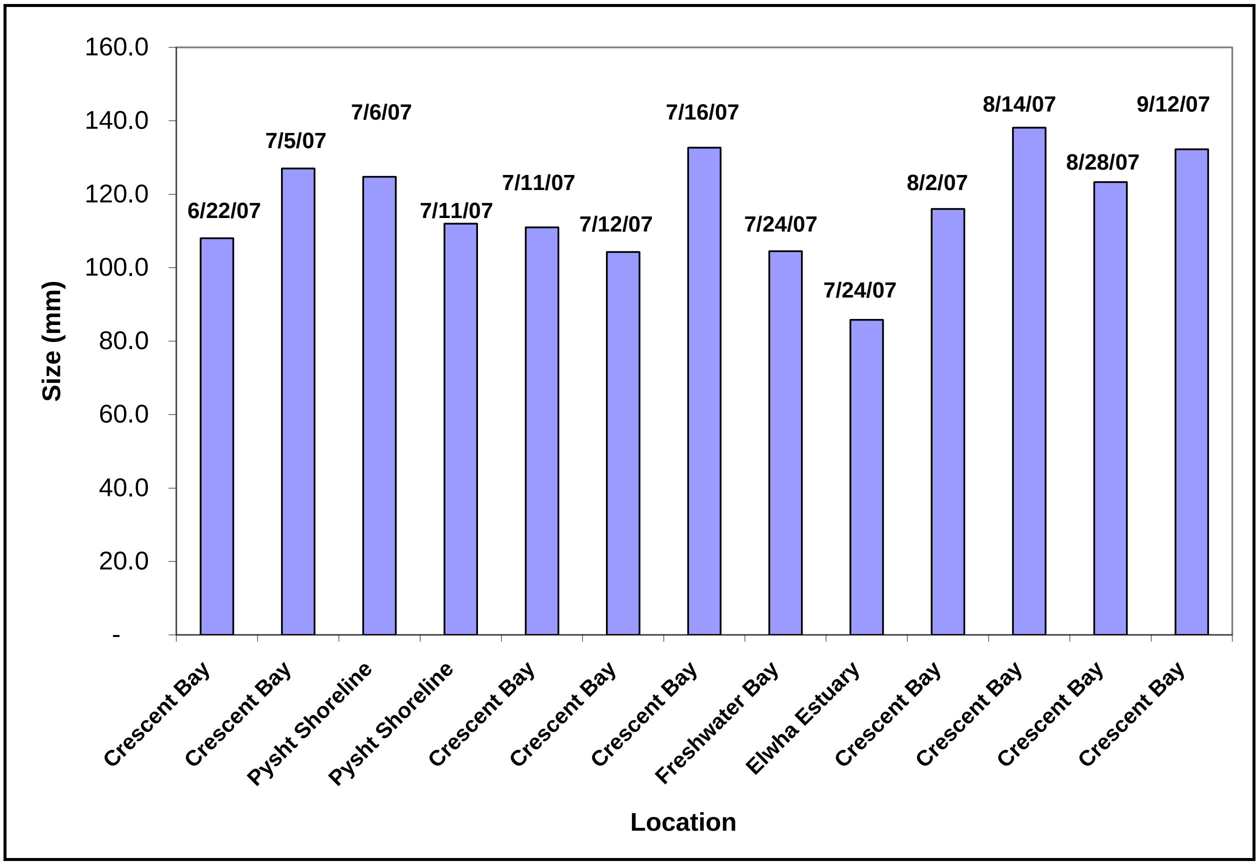


Figure 4. Chinook salmon size composition over time, by sample location.

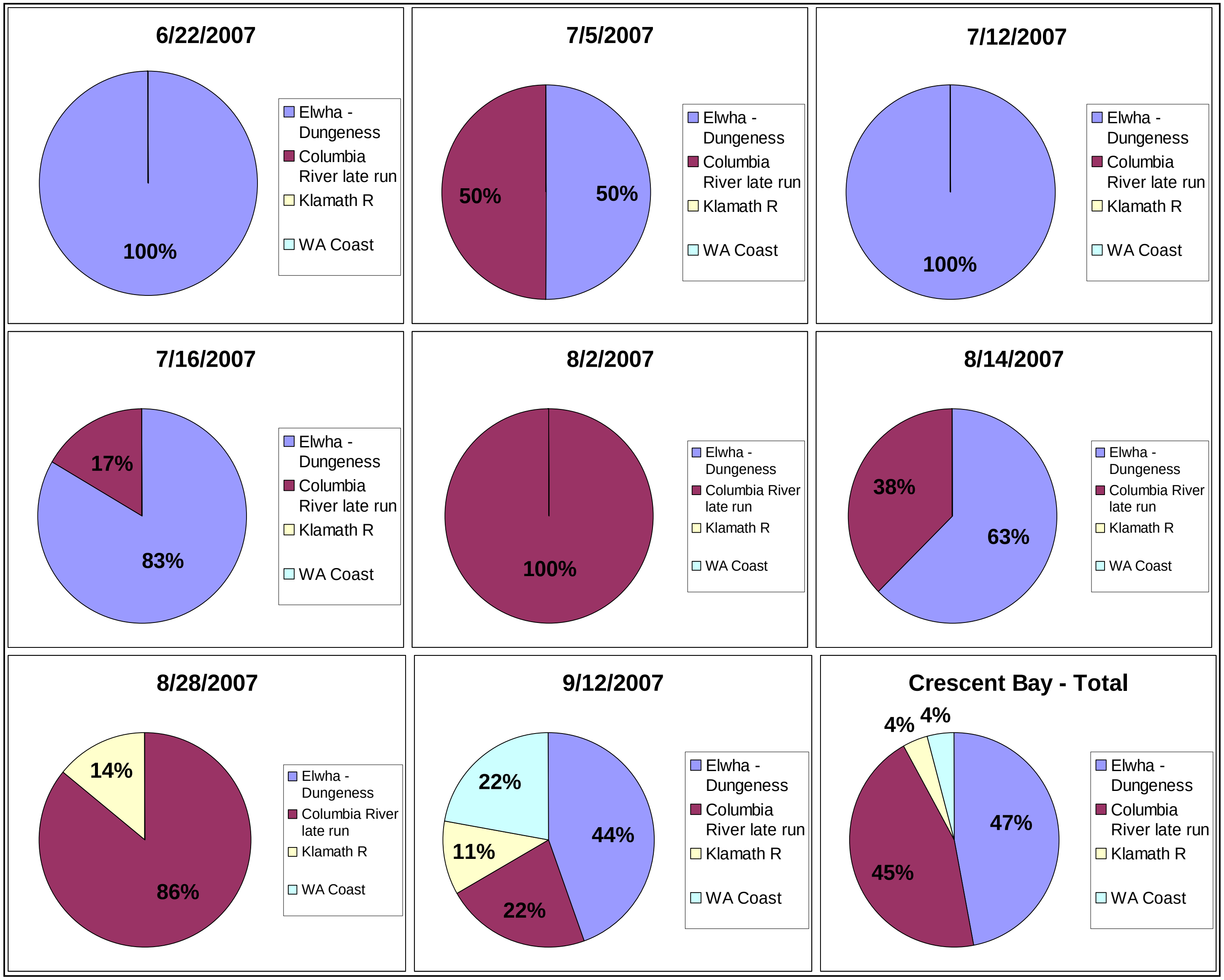


Figure 5. Crescent Bay Chinook stock composition.

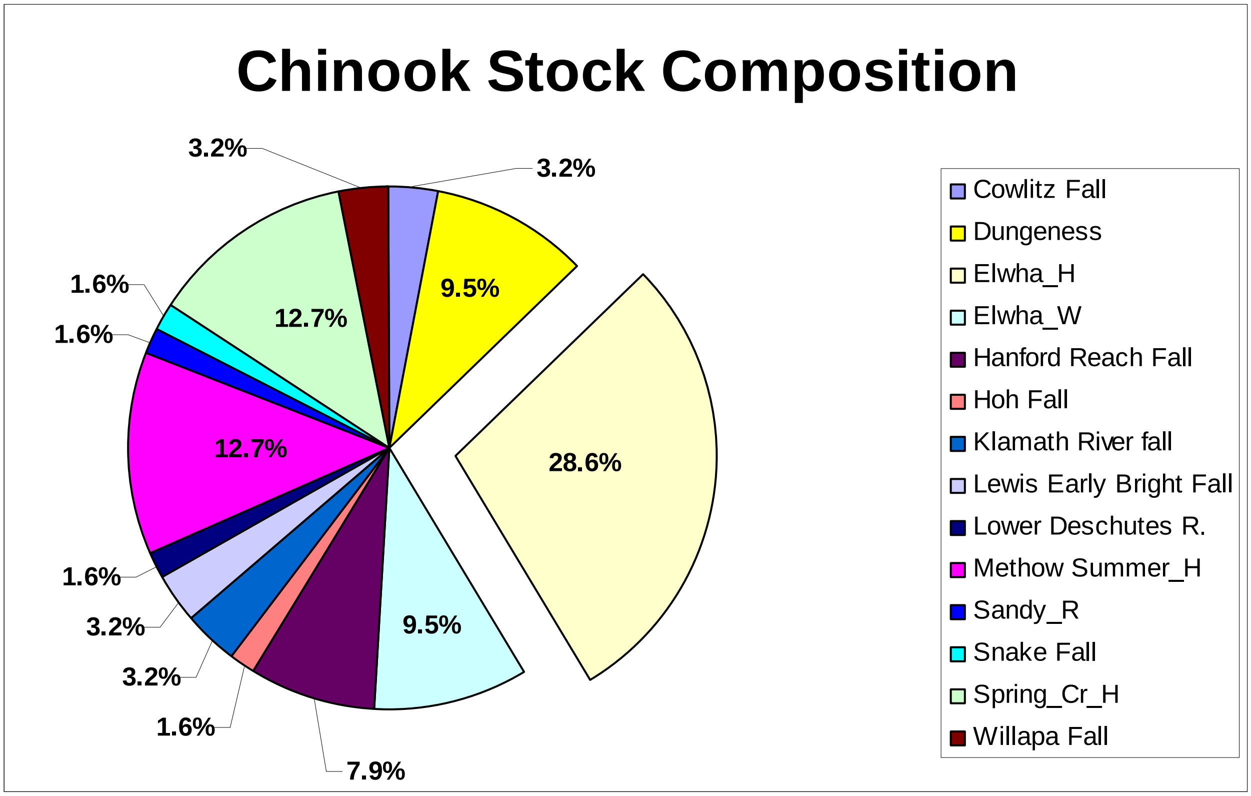


Figure 6. Federally listed populations represented

Table x. Summary of genetic analysis of juvenile Chinook samples collected from the central and western Strait of Juan de Fuca March-September 2007.

Individual	Collection Location	Collection Date	Size (mm)	Reporting Group	#1 Assignment	#1 PostProb	#2 Assignment	#2 PostProb	#3 Assignment	#3 PostProb
07IX0011	Cresecnt Bay	07/16/07	128	Elwha - Dungeness	Dungeness	0.779	Elwha_H	0.1335	Elwha_W	0.0874
07IX0012	Cresecnt Bay	07/16/07	131	Elwha - Dungeness	Elwha_H	0.954	Elwha_W	0.0456	Dungeness	0.0002
07IX0013	Cresecnt Bay	07/16/07	134	Elwha - Dungeness	Dungeness	0.431	Elwha_W	0.4275	Elwha_H	0.1418
07IX0014	Cresecnt Bay	07/16/07	146	Columbia River late run	Spring_Cr_H	0.738	Cowlitz Fall	0.0858	Hanford Reach Fall	0.0585
07IX0015	Cresecnt Bay	07/16/07	127	Elwha - Dungeness	Elwha_H	0.571	Elwha_W	0.3347	Dungeness	0.0945
07IX0016	Cresecnt Bay	07/16/07	130	Elwha - Dungeness	Elwha_H	0.639	Elwha_W	0.3601	Dungeness	0.0006
07IX0018	Freshwater Bay	07/24/07	112	Elwha - Dungeness	Dungeness	0.998	Elwha_H	0.0022	Elwha_W	1E-04
07IX0019	Freshwater Bay	07/24/07	116	Columbia River late run	Hanford Reach Fall	0.544	Methow Summer_H	0.4515	Snake Fall	0.0042
07IX0020	Freshwater Bay	07/24/07	94	Columbia River late run	Methow Summer_H	0.586	Hanford Reach Fall	0.4089	Lower Deschutes R.	0.0028
07IX0021	Freshwater Bay	07/24/07	96	Columbia River late run	Lewis Early Bright Fall	0.92	Sandy_R	0.0488	Hanford Reach Fall	0.0297
07IX0023	Elwha West Side Channel	07/24/07	101	Elwha - Dungeness	Elwha_W	0.657	Elwha_H	0.2039	Dungeness	0.1391
07IX0024	Elwha West Side Channel	07/24/07	85	Elwha - Dungeness	Elwha_H	0.969	Elwha_W	0.031	Dungeness	0.0001
07IX0025	Elwha West Side Channel	07/24/07	81	Elwha - Dungeness	Elwha_H	0.532	Elwha_W	0.3852	Dungeness	0.0829
07IX0026	Elwha West Side Channel	07/24/07	90	Elwha - Dungeness	Dungeness	0.446	Elwha_H	0.3907	Elwha_W	0.1631
07IX0027	Elwha West Side Channel	07/24/07	72	Elwha - Dungeness	Elwha_H	0.8	Elwha_W	0.2002	Dungeness	4E-05
07IX0028	Crescent Bay	08/02/07	110	Columbia River late run	Methow Summer_H	0.947	Hanford Reach Fall	0.052	Snake Fall	0.0008
07IX0029	Crescent Bay	08/02/07	112	Columbia River late run	Cowlitz Fall	0.998	Spring_Cr_H	0.0018	Lewis Early Bright Fall	0.0005
07IX0030	Crescent Bay	08/02/07	122	Columbia River late run	Sandy_R	0.597	Cowlitz Fall	0.2387	Hanford Reach Fall	0.1411
07IX0031	Crescent Bay	08/02/07	131	Columbia River late run	Spring_Cr_H	1	Cowlitz Fall	8E-05	Sandy_R	3E-06
07IX0032	Crescent Bay	08/02/07	117	Columbia River late run	Methow Summer_H	0.497	Lewis Early Bright Fall	0.4771	Cowlitz Fall	0.0192
07IX0033	Crescent Bay	08/02/07	110	Columbia River late run	Methow Summer_H	0.451	Hanford Reach Fall	0.3482	Snake Fall	0.1288
07IX0034	Crescent Bay	08/02/07	110	Columbia River late run	Lewis Early Bright Fall	0.672	Cowlitz Fall	0.1714	Spring_Cr_H	0.1168
07IX0035	Crescent Bay	08/02/07	116	Columbia River late run	Spring_Cr_H	0.991	Cowlitz Fall	0.0086	Lewis Early Bright Fall	3E-07
07IX0036	Crescent Bay	06/22/07	109	Elwha - Dungeness	Elwha_W	0.839	Elwha_H	0.1425	Dungeness	0.0179
07IX0037	Crescent Bay	06/22/07	107	Elwha - Dungeness	Elwha_H	0.513	Elwha_W	0.4871	Methow Summer_H	2E-06
07IX0071	Crescent Bay	07/05/07	121	Elwha - Dungeness	Elwha_W	0.856	Elwha_H	0.1414	Dungeness	0.0027
07IX0072	Crescent Bay	07/05/07	116	Elwha - Dungeness	Elwha_H	0.609	Elwha_W	0.3911	Dungeness	0.0001
07IX0074	Crescent Bay	07/05/07	127	Columbia River late run	Spring_Cr_H	0.999	Cowlitz Fall	0.0011	Sandy_R	3E-07
07IX0075	Crescent Bay	07/05/07	144	Columbia River late run	Spring_Cr_H	0.999	Elwha_W	0.0012	Elwha_H	0.0001
07IX0077	Pysht Shoreline	07/06/07	125	Elwha - Dungeness	Elwha_H	0.638	Elwha_W	0.362	Dungeness	3E-05
07IX0078	Pysht Shoreline	07/06/07	135	Columbia River late run	Cowlitz Fall	0.93	Sandy_R	0.0581	Spring_Cr_H	0.012

07IX0079	Pysht Shoreline	07/06/07	109	Columbia River late run	Methow Summer_H	0.981	Lower Deschutes R.	0.0109	Hanford Reach Fall	0.006
07IX0081	Pysht Shoreline	07/06/07	130	Columbia River late run	Spring_Cr_H	1	Hanford Reach Fall	0.0002	Lewis Early Bright Fall	9E-05
07IX0082	Pysht Shoreline	07/11/07	112	WA Coast	Hoh Fall	1	Hanford Reach Fall	3E-05	Willapa Fall	2E-05
07IX0083	Crescent Bay	07/11/07	111	Elwha - Dungeness	Elwha_H	0.824	Elwha_W	0.1754	Dungeness	0.0001
07IX0084	Crescent Bay	07/12/07	100	Elwha - Dungeness	Elwha_H	0.466	Elwha_W	0.2677	Puyallup	0.2314
07IX0085	Crescent Bay	07/12/07	116	Elwha - Dungeness	Elwha_H	0.997	Elwha_W	0.0028	Dungeness	2E-06
07IX0086	Crescent Bay	07/12/07	113	Elwha - Dungeness	Dungeness	0.952	Elwha_H	0.034	Elwha_W	0.0142
07IX0087	Crescent Bay	07/12/07	88	Elwha - Dungeness	Elwha_W	0.88	Elwha_H	0.1071	Dungeness	0.0131
07IX0106	Crescent Bay	08/14/07	113	Columbia River late run	Lower Deschutes R.	0.837	Hanford Reach Fall	0.1476	Methow Summer_H	0.0149
07IX0107	Crescent Bay	08/14/07	147	Elwha - Dungeness	Dungeness	0.56	Elwha_H	0.3691	Elwha_W	0.0707
07IX0108	Crescent Bay	08/14/07	111	Columbia River late run	Hanford Reach Fall	0.534	Methow Summer_H	0.4568	Snake Fall	0.0053
07IX0109	Crescent Bay	08/14/07	147	Elwha - Dungeness	Elwha_H	0.487	Dungeness	0.3431	Elwha_W	0.1702
07IX0110	Crescent Bay	08/14/07	128	Columbia River late run	Hanford Reach Fall	0.948	Lower Deschutes R.	0.0338	Methow Summer_H	0.0183
07IX0111	Crescent Bay	08/14/07	156	Elwha - Dungeness	Elwha_W	0.811	Elwha_H	0.1395	Dungeness	0.0498
07IX0112	Crescent Bay	08/14/07	157	Elwha - Dungeness	Elwha_H	0.56	Elwha_W	0.4317	Dungeness	0.0084
07IX0115	Crescent Bay	08/14/07	146	Elwha - Dungeness	Elwha_H	0.918	Elwha_W	0.082	Dungeness	4E-06
07IX0116	Crescent Bay	08/28/07	130	Columbia River late run	Spring_Cr_H	0.989	Cowlitz Fall	0.0098	Sandy_R	0.0004
07IX0117	Crescent Bay	08/28/07	119	Columbia River late run	Hanford Reach Fall	0.973	Snake Fall	0.0232	Lower Deschutes R.	0.0028
07IX0118	Crescent Bay	08/28/07	113	Klamath R	Klamath River fall	0.997	Hanford Reach Fall	0.0017	Snake Fall	0.0013
07IX0119	Crescent Bay	08/28/07	108	Columbia River late run	Snake Fall	0.885	Hanford Reach Fall	0.0949	Lower Deschutes R.	0.0194
07IX0121	Crescent Bay	08/28/07	89	Columbia River late run	Methow Summer_H	0.931	Hanford Reach Fall	0.0431	Snake Fall	0.017
07IX0122	Crescent Bay	08/28/07	122	Columbia River late run	Methow Summer_H	0.66	Hanford Reach Fall	0.3289	Lower Deschutes R.	0.0107
07IX0123	Crescent Bay	08/28/07	182	Columbia River late run	Spring_Cr_H	1	Cowlitz Fall	6E-05	Sandy_R	1E-05
07IX0124	Crescent Bay	09/12/07	123	Elwha - Dungeness	Elwha_W	0.404	Elwha_H	0.3485	Dungeness	0.2473
07IX0125	Crescent Bay	09/12/07	142	Elwha - Dungeness	Elwha_H	0.997	Dungeness	0.002	Elwha_W	0.0007
07IX0126	Crescent Bay	09/12/07	110	Elwha - Dungeness	Elwha_H	0.886	Elwha_W	0.1119	Dungeness	0.0024
07IX0127	Crescent Bay	09/12/07	122	Elwha - Dungeness	Elwha_H	0.985	Elwha_W	0.0149	Dungeness	5E-05
07IX0129	Crescent Bay	09/12/07	125	Klamath R	Klamath River fall	1	Willapa Fall	3E-07	Lewis Early Bright Fall	2E-07
07IX0130	Crescent Bay	09/12/07	139	Columbia River late run	Hanford Reach Fall	0.579	Snake Fall	0.3585	Methow Summer_H	0.0628
07IX0131	Crescent Bay	09/12/07	144	Columbia River late run	Methow Summer_H	0.761	Hanford Reach Fall	0.1831	Lower Deschutes R.	0.0332
07IX0132	Crescent Bay	09/12/07	140	WA Coast	Willapa Fall	0.977	Hoh Fall	0.0211	Hanford Reach Fall	0.0024
07IX0133	Crescent Bay	09/12/07	145	WA Coast	Willapa Fall	1	Spring_Cr_H	0.0001	Lewis Early Bright Fall	5E-05

Chapter 7. Nearshore central Strait of Juan de Fuca, including the Elwha and Dungeness drift cells, habitat form and function for forage fish spawning.

Nabors [1] Tiffany, A. Shaffer [2*], T. Ritchie [2], D. Penttila [2], and Dave Parks [3]. [1]Western Washington University; [2]Washington Department of Fish and Wildlife; [3]Washington Department of Natural Resources

*Correspondance to: WDFW Habitat Program, Science Division; 332 E. 5th Street Port Angeles, Washington 98362;360.457.2634; shaffjas@dfw.wa.gov

Introduction

Surf smelt (*Hypomesus pretiosus*) and sand lance (*Ammodytes hexapterus*) are common forage fish of the nearshore waters of Puget Sound and the Strait of Juan de Fuca. Collectively they are small, schooling fish that provide food for numerous species of marine birds, mammals, and predatory fish. One of the most notable predators of surf smelt and sand lance is the Pacific salmon, indicating the importance of this fish's role in regards to the conservation and economic concerns of the Pacific Northwest.

Surf smelt and sand lance use the nearshore, defined here the area that extends from the area of tidal influence offshore to 30m MLLW (Shaffer et al 2008), as a migration corridor, as well as nursery, feeding, and spawning grounds. Surf smelt spawning within the Strait occurs during the summer months and a bit later than Puget Sound summer surf smelt spawning; sand lance spawning, occurs primarily during winter months (Moriarty et al 2002; Penttila, 2007). Eggs are deposited during high tide in 2-3 inches of water (Moulton and Penttila, 2000; Moriarity et al., 2002); spawning takes place within the upper third of the tidal range, from approximately +3 feet to the extreme high water mark, and the eggs are then dispersed across the beach by tidal and wave activity

(Penttila, 2007; Moulton and Penttila, 2000). Egg mortality for central Strait spawning has been documented to be approximately 30%, which is consistent with egg mortalities in Puget Sound (Moriarty et al 2002; Penttila 2000)

Surf smelt and sand lance requirements for spawning closely link it with the sediment processes taking place within the habitat. One of the most critical factors involved with spawning habitat is the suitability of the substrate. The appropriate substrate for surf smelt is a sand-gravel mix ranging from 1-7mm in size, and a layer thickness from 1-10 cm (Penttila, 2007). The grain-size spectrum of typical sand lance spawning substrate can be characterized as sand, finer- grained than that of surf smelt, with the bulk of the material in the range of .2-.4 mm in diameter (Penttila 2007). Beaches at the distal ends of drift-cells, where sandy spits, cuspate forelands and other accretionary shoreforms tend to occur, commonly support sand lance spawning. Beach morphology and composition is a product of complex processes involving wave energy, windstorms, and the geologic composition of its sediment sources (Johannessen and MacLennan, 2007).

In Puget Sound, as well as in the Strait, feeder bluffs act as sediment sources for beaches. The process of bluff erosion varies both temporally and spatially, with the main contributing factors being marine, wind, and human induced (Johannessen and MacLennan, 2007). Sediment from the eroding bluffs is transported alongshore and deposited on beaches, replacing substrate there that is also washed away through wave action (Penttila, 2007; Johannessen and MacLennan, 2007).

The complexity and variability of sediment processes combined with the specific habitat requirements of surf smelt and sand lance show that a complete system is critical for forage fish spawning. Shoreline modifications that disrupt sediment transport, such as armoring, can have a negative impact on forage fish spawning habitat, stock abundance, and food availability for salmon (Penttila, 2007). Shoreline armoring can decrease the amount of sediment available for the maintenance of beaches, leading to sediment starvation, as well as cover spawning habitat, cause an increase in sediment grain size, reduce beach width, and lead to beach scouring (Johannessen and MacLennan, 2007).

The loss of vegetation and large woody debris involved with armoring can also alter the microhabitat need for egg survival (Penttila, 2007).

The nearshore environment of the central Strait of Juan de Fuca is an area documented to be utilized by surf smelt and sand lance (Morairty et al. 2002; Penttila, 2007). It is also an area that has significant alteration of sediment processes due to significant and increasing shoreline armoring (Shaffer et al 2008). Upcoming removal of the Elwha and Glines Canyon dams is anticipated to provide partial restoration of sediment processes (Warrick et al 2008; Shaffer et al 2008). Determining forage fish use, including the mapping of spawning grounds, of the Elwha nearshore and comparative sites is an important component to evaluating the response of the system to the dam removals, as well as identifying further restoration needs of the nearshore (Shaffer et al., 2005, 2008).

The goal of this study then is to define nearshore habitat function for forage fish, as well as the role upcoming restoration responses associated with dam removals may have on future spawning. Specifically we are interested in: 1. Documenting forage fish spawning occurring in Elwha and comparative drift cells; 2. Defining variation in forage fish use of the nearshore for spawning; 3. Defining correlations between available beach sediment grain size and forage fish spawning within Elwha and comparative cell sites, and; 34. Using these results as a predictive element for defining future habitat form and function response to dam removals.

Materials and Methods

Surf smelt and sand lance spawn sampling methods followed the protocols published by Moulton and Penttila (2000). Sites were selected by geomorphic habitat type (GMHT) as detailed in Shaffer et al 2008; (see Table 1). Spawn surveys were conducted in summers 2007 and 2008 to document surf smelt spawning, winter and early spring 2007-2008 to document sand lance spawning. Standard beach seining was conducted on a subsample of beaches throughout the spawn surveys. Results of seine surveys are provided in Chapter 1 of this report.

Monthly sampling for surf smelt spawn occurred in July through September 2007 and 2008. Sand lance spawn sampling was conducted monthly from November 2007 thru January 2008. Sample locations within Elwha and comparative drift cells respectively were, by geomorphic habitat type of embayed shorelines (Freshwater Bay, Crescent Beach); bluffs (Elwha Bluffs, Dungeness Bluffs) and spits (Ediz Hook and Dungeness Spit ; see Figure 1). After the sediment samples were collected and condensed, further separation, laboratory examination, and determination of egg presence was conducted by Dan Penttila, following the published procedures. Data were then summarized in a table providing the date each sample was taken, site name, sample number, time of sample collection, GPS coordinates, beach width, and the number of eggs identified (Appendix B).

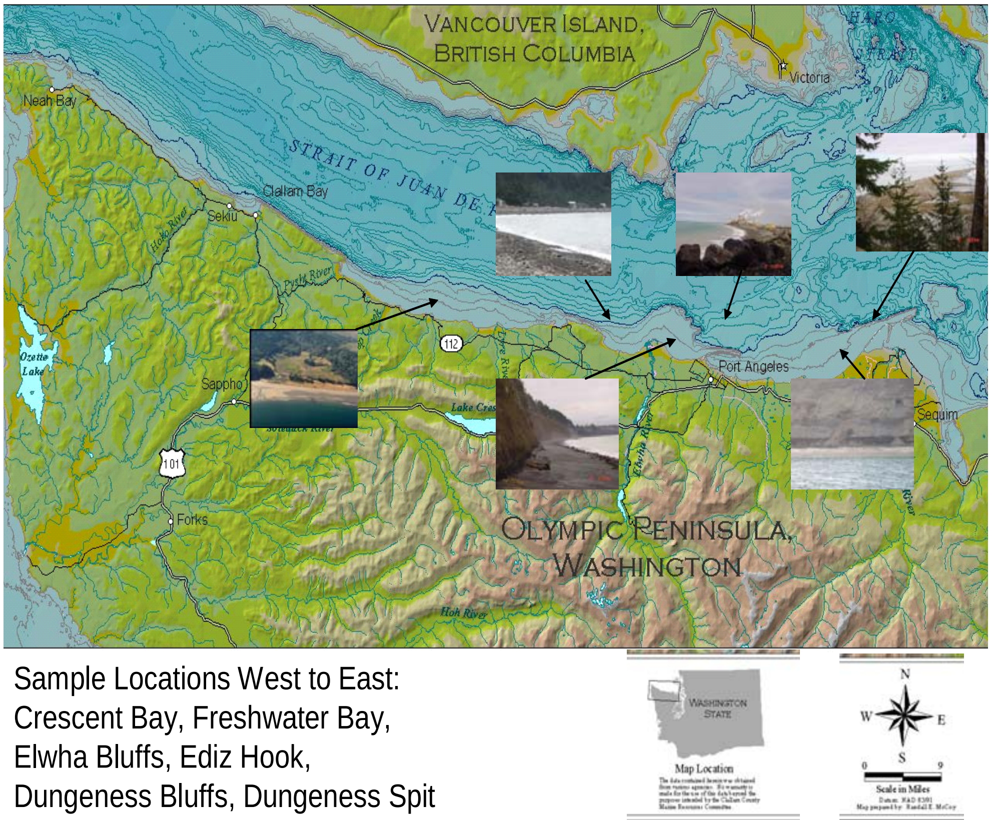
The sediment assessment portion of the study began during the November 2007- January 2008 sand lance spawn season. This work incorporates sediment assessment via photo analysis to determine sediment grain size for Elwha and comparative sites by GMHT. Surface photos of the sediment are taken at each sample site, and depth photos are taken after spawn samples have been collected using protocols detailed in xxxx. Grain size within the sample site is measured using Adobe Photoshop 7.0.1 . The mean and median sediment grain sizes for the locations can then be calculated using a correction factor determined through comparison with previously collected data (Adams, 1979).

Table 1: Sample Sites by Geomorphic Habitat Type (GMHT)*

Site	GMHT		
	Bluff	Spit	Embayment
Dungeness Bluffs	X		
Elwha Bluffs	X		
Dungeness Spit		X	
Ediz Hook		X	
Crescent Bay			X
Freshwater Bay			X

*Elwha drift cell sites shown in red, comparative sites in blue

Figure 1: Sample locations for 2007 and 2008 surf smelt surveys



Results

All surf smelt and sand lance spawn samples have been analyzed. Appendix A provides the GPS coordinates for each 2007 surf smelt and 2007-2008 sand lance spawn sample taken. 2008 grain size distribution samples are still being analyzed.

I. Surf smelt spawn

In 2007 surf smelt eggs were found in nineteen of the forty-six samples collected, and the locations were defined as surf smelt spawning beaches. These locations were at Dungeness Bluffs (357 eggs), and Freshwater Bay (62 eggs) (Table 2; Figures 2 and 3;.

In 2008, out of a total of 91 samples only a total of only nine eggs were found in a total five samples: eight eggs were found along Dungeness Bluffs and one egg was detected at

Freshwater Bay. Due to a lack of a boat for access the western portion of the Dungeness Bluff survey (from just west of Siebert Creek to approximately ½ mile west of McDonald Creek was not sampled in 2008. In 2008 approximately 1.5 mile of beach along Siebert nearshore wasn't sampled. (Table 2;see Appendix H for individual sample locations, egg count and developmental stage).

Table 2.2007 2008 July-September Surf Smelt Spawn Sample Results (see Appendix H for sample location, egg count and development stage).

Site	**Approximate Linear ft sampled**	**Approximate Linear ft sampled**	**Total eggs found**	**Total eggs found**
	2007	**2008**	**2007**	**2008**
Dungeness Spit	13,000	13,000	None	None
Ediz Hook	6,500	6,500	None	None
Dungeness Bluffs	24,000	15,840	357	8
Elwha Bluffs	13,000	13,000	None	None
Crescent Bay	9,000	9,000	None	None
Freshwater Bay	3,000	3,000	62	1

Figure 2a: General extent of surf smelt spawning beach documented in 2007 along Freshwater Bay.

Figure 2 b General extent of surf smelt spawn found along Dungeness bluffs 2007. Circle denotes one egg.

II. Sand lance spawn

Sample locations for sand lance spawn and concomitant beach grain size sampling are provided in Appendix K. A total of 86 samples were collected between November 2007 and January 2008. No sand lance eggs were found in any of the samples. Sediment grain size samples are still being analyzed.

Figure 3: Sampling Area at Freshwater Bay

The beach at Freshwater Bay was determined to be surf smelt spawning habitat in the 2007 survey.

Figure 4: Sampling Area at Dungeness Bluffs

The 2007 survey results show that the beach below Dungeness Bluffs is surf smelt spawning habitat.

III. Beach grain size study

Photos and beach samples for QA/QC of photo sediment grain size analysis and photo analysis were collected during the winter 2007-2008 sand lance surveys, and are currently being collected from the 2008 surf smelt spawn surveys. Sample workup is underway. Subsequent data analysis to define seasonal variation in beach morphology and correlation between GMHT, sediment size, and spawn presence, will occur winter 2008-2009. Results will provide habitat functional data to model future beach sediment morphology and function post dam removal, and prioritize additional restoration actions, if any accomplish prior to dam removal.

Figures 5 and 6: Surf smelt spawn survey July 2008

Figure 6: Data collection during the 2008 surf smelt survey. Figure 7: Photos of the sediment will be analyzed to determine sediment grain size at the sample locations.

IV Seining

While a detailed analysis of seining results are provided in the companion report (see Chapter 6) we felt it important to provide a snapshot of some of our more intriguing seining results. Figure 7 and Tables 3 provides a summary of long term monitoring observations for smelt densities along Freshwater and Crescent Bays, two of our forage fish spawning beach sampling sites.

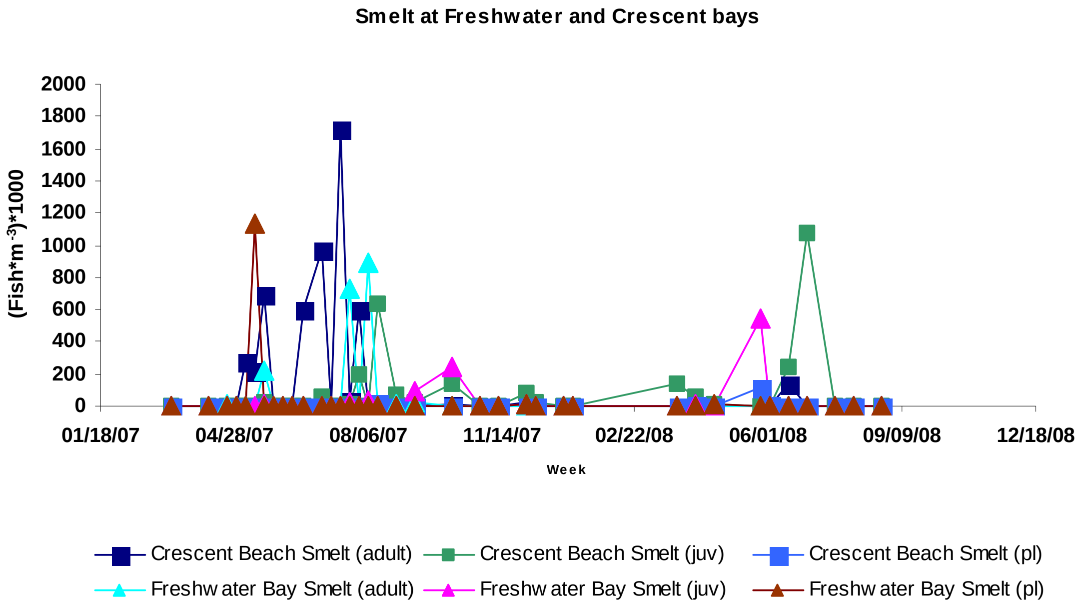


Figure 7. Smelt densities at long term sampling sites Crescent and Freshwater Bays 2007-2008.

Table 3. Percent of total smelt for each year by life history. Total smelt % change based on CPUE.

Site	20007			2008			
	Adult	Juvenile	Post larval	Adult	Juvenile	Post larval	Percent Change in total smelt
Crescent	80	19	0	8	85	7	-32
Freshwater Bay	54	12	33	0	98	2	-60

Discussion

Results of our 2007 work indicate that surf smelt spawning is related to sediment processes, but the relationship appears complex, and to have a threshold. The presence of surf smelt spawn within Freshwater Bay, an embayed shoreline within the Elwha drift cell immediately adjacent to the Elwha river mouth indicates that this area is the only site in the Elwha drift cell with sediment processes sufficient to support spawning. Elwha bluffs and spit do not. Outside the Elwha drift cell we observed spawning at Dungeness bluffs indicating that when left intact, feeder bluffs can provide important spawning habitat. The repeated finding of eggs along embayed shorelines and feeder bluffs, but not spits, is unique to this region and suggests that, along the high energy Strait of Juan de Fuca, geomorphic habitat type may also be a predictive element in forage fish spawn presence. Finally, it's important to note that surf smelt were not found to spawn at Crescent Beach, an embayed shoreline with completely intact sediment processes. Substrate at Crescent Beach is likely too small to be utilized by surf smelt, but may be important for sand lance (Shaffer and Penttila pers obs). That we found no sand lance eggs along Crescent Bay is not surprising given the high interannual variability in forage fish spawning that is a defining element of both sand lance and surf smelt spawning along the Strait of Juan de Fuca as documented by Moriarty et al. 2002 and supported by the surf smelt results of this study in which we collected a high number of eggs from a number of sites along the central Strait in 2007 but observed far lower numbers of smelt along these same beaches in 2008. The 2008 survey did not include approximately 1.5 miles of beach along the Siebert Creek area (we had no boat for access), which may explain some of the decrease in eggs, it does not sufficiently account for the sharp difference in number of eggs in the sites we did sample both years.

Our long term monitoring of smelt by seining indicates that smelt density play a role in this interannual variability. Comparing smelt densities at our two long term monitoring sites we observed up between 30-60% decrease in the smelt per cpue in 2008 compared to 2007. We also observed a large difference in the life history composition in the smelt we collected in 2007 and 2008, with a much larger proportion of adults being collected in 2007. This decrease in total number of fish and percentage of adults may be a driving factor in the decreased smelt spawn we observed in 2008 compared to 2007. Additional years of both seining and forage fish spawn sampling should be conducted to confirm: 1. If in fact an interannual cycle for Strait surf smelt spawning along the Strait of Juan de Fuca does occur, and if so, to what degree the variation is based on life history; 2. The true extent of sand lance spawning along the central Strait.

The presence of surf smelt eggs at Dungeness Bluffs, Figure 5, was an unexpected finding of the study. While feeder bluffs play a crucial role as a source of sediment within the drift cell, these areas below the bluffs had not been previously documented as spawning habitat (Shaffer et al., 2008).

Although Dungeness Bluffs is a high energy area, this study revealed that the beach associated with the bluffs is surf smelt spawning habitat. This leads us to the important conclusion that the rate at which the Dungeness bluffs are delivering appropriate size sediment to the beach is rapid enough to compensate for the high energy of the area and maintain the necessary grain size for spawning. Expanding these two finding to a management context leads to two important hypotheses/recommendations:

1. Feeder bluffs may themselves be important spawning beaches (not just a sediment source for distant spawning beaches within a drift cell), and;
2. In addition to the volume of material provided by feeder bluffs, the seasonal rate of feeder bluff sediment delivery to the nearshore is an equally important element to drift cell management.

Restoration recommendations

This study has resulted in a number of key management and restoration recommendations.

1. Feeder bluff management for the Salish sea needs to be further refined to address their potential role as active spawning beaches (not just a sediment source). The rate at which feeder bluffs feed also needs to be comprehensively addressed in feeder bluff management.
2. At a more local scale, we also provide documentation of the important function of the fragile Dungeness Feeder bluffs. These feeder bluffs are not within the Dungeness National Wildlife refuge, but are the source of sediment for the Dungeness Spit. This feature forms and protects Dungeness Bay and is a nationally recognized habitat feature. Thus this, combined with the documentation of surf smelt spawning along the feeder bluffs, makes land acquisition of the Dungeness Bluffs for preservation and/or conservation easement a top regional priority;

3. The finding of forage fish spawn at Freshwater Bay is important. While the results show the beach is functioning habitat for the fish, this shoreline is almost entirely privately owned property, putting it at much higher risk for shoreline damaging development. Preservation by acquisition, or conservation easement, would help to ensure that functionality of this area was maintained, and is recommended.;
4. The Elwha Bluffs / Ediz hook area, historically, was very similar to the Dungeness drift cell (Shaffer et al 2008). However, the sediment processes within the Elwha areas are currently impacted by approximately 9000ft of shoreline armoring, as well as by the Elwha River dams. No evidence of surf smelt spawning was found at either Elwha Bluffs or Ediz Hook. Results of the sediment grain size analysis will give insight into the sediment grain sizes and suitability of the habitat, as well as provide information to predict changes in fish habitat associated with the upcoming nearshore restoration associated with approaching dam removals. Modeling these results to predicted future sediment process conditions should be conducted to determine if additional pre-dam shoreline augmentation would be advised to promote further sediment delivery to the Elwha bluffs and spit;
5. Additional long term sampling should be conducted to determine if the interannual variability of surf smelt spawning is related to, and can be predicted by, cyclic variation in adult smelt along the Strait shoreline; as well as the extent of sand lance spawning in the Elwha and comparative drift cells.

Table 3: Restoration recommendations by Geomorphic Habitat Type (GMHT). Red indicates Elwha drift cell; blue, comparative drift cell.

Geomorphic Habitat Type	Restoration Recommendation	Priority
Spits/ Bluffs	Modeling to Define Additional Soft Shore Armoring Restoration Optimization Preservation/ Conservation Easement	High High High
Embayed Shoreline	Preservation/ Conservation Easement	High High

Conclusion

Nearshore processes are complex, and a variety of factors influence the suitability of the habitat for forage fish use for spawning, including sediment delivery and rate. Geomorphic habitat type, while important, appears to be less predictive variable than sediment size and seasonal rate of delivery for defining forage fish spawning habitat.

With the upcoming dam removals in the Elwha River, and partial restoration of nearshore sediment processes, there is a high potential for the full restoration of the Elwha River system, including the nearshore. While the removal of the dams is a central component of these efforts, the results of this, and other studies in the nearshore, show that further restoration recommendations of acquisition, restoration, and further study are warranted for complete functionality of the nearshore. The creation of preservation areas and/or conservation easements to protect functioning areas both within and outside the Elwha drift cell, as well as augmentation and or restoration of armored areas are suggested to meet full ecosystem restoration of the Elwha watershed.

Acknowledgments

The nearshore assessment project is sponsored by the North Olympic Peninsula Lead Entity and funded by the Salmon Recovery Funding Board (SRFB/RCO). Cheryl Baumann is the NOPLE coordinator, Tara Galuska is the RCO project manager. The Clallam Marine Resources Committee (MRC) provided important funding for college interns including Jesse Charles, Chris DeSisto, Bryan Hara, Erica Hirsh, Keelan Hooper, Mario Laungayan, Romy Laungayan, Ross McDorman, Sean Oden, Rebecca Paradis, Jacob Ray, Melanie Roed, Justin Rondeau, Trista Simmons, Ben Warren, Karen Wilkie, Eric Wood, and Steve Wyall from WWU, REU, and Peninsula College supervisors were Mr. Jack Ganzhorn and Dr. Dwight Barry of Peninsula College.Jenna Schilke, formerly with WDFW, supervised much of the field work. Dr. Jon Warrick, USGS, provided methods and the camera for photo analysis. The Clallam MRC continues to support student internships financially. Cathy Lear is senior staff to the MRC.

REU is supported by the National Science Foundation's Research Experience for Undergraduates program under Grant DBI-0452328.

Chuck and Neva Novak and Ben and Irene Palzer continue to provide landowner access to the private beach at Crescent Bay. Malcolm Dudley has provided invaluable private land owner support and access. Pam Lowry has provided access to forage fish spawn sampling locations in Freshwater Bay. Pam Sangunetti and Kevin Ryan (USFWS) provided invaluable partnership and field support. Charlie and Kendra Parks, Port Angeles High School, and Andy Stevenson, provided field support and good will.

References

Adams, J. 1979. Gravel Size Analysis from Photographs. Journal of the Hydraulics Division. 105(HY10):1247-1255.

Johannessen, J. and A. MacLennan. 2007. Beaches and Bluffs of Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-04. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Moriarity, R. M., J. A. Shaffer, and D. Penttila. 2002. Nearshore Mapping of the Strait of Juan de Fuca: I. Surf Smelt Spawning Habitat. A final report to the Clallam County Marine Resources Committee, Northwest Straits Commission, and Washington Department of Fish and Wildlife. WDFW, Port Angeles, Washington.

Moulton, L.L., and D.E. Penttila. 2000. Forage Fish Spawning Distribution in San Juan County and Protocols for Sampling Intertidal and Nearshore Regions. Northwest Straits Commission. Mount Vernon, WA.

Penttila, D. 2007. Marine Forage Fishes in Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-03. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Shaffer, J.A., L. Ward, P. Crain, B. Winter, K. Fresh, and C. Lear, 2005. Elwha and Glines Canyon dam removals: nearshore restoration and salmon recovery of the central Strait of Juan de Fuca *In* Proceedings Puget Sound Research 2005. Puget Sound Action Team, Olympia, Washington.

Shaffer, J.A., and J. Schilke, D. Penttila, P. Crain, and L. Ward. 2008. 1st Progress Report, Nearshore Assessment of the Central Strait of Juan de Fuca. Washington Department of Fish and Wildlife. Port Angeles, Washington.

Shaffer, J. A., P. Crain, B. Winter, M. L. McHenry, C. Lear and T. J. Randle. 2008. Nearshore restoration of the Elwha River through removal of the Elwha and Glines Canyon dams: an overview. Northwest Science 82 (Special Issue):48-58.

Warrick, J. A., G. R. Cochrane, Y. Sagy, and G. Gelfenbaum. 2008. Nearshore substrate and morphology offshore of the Elwha River. Northwest Science 82 (Special Issue):153-163.

Chapter 8. Nearshore Assessment: Overstory kelp bed snorkeling survey of the central Strait of Juan de Fuca, including the Elwha nearshore, 2007

Anne Shaffer and Tyler Ritchie
Washington Department of Fish and Wildlife, 332 E. 5th Street Port Angeles, Washington 98362
360.457.2634/shaffjas@dfw.wa.gov

Abstract

Kelp bed function in the Elwha drift cell is little understood but an important component to the upcoming nearshore restoration associated with the Elwha dam removals. This study provides information on fish use of overstory kelp beds in Elwha and comparative drift cells. A total of 14 snorkeling surveys were conducted in the kelp beds within Elwha and comparative drift cells during the summer of 2007. Surf smelt, herring, and sand lance were the dominant species. Very few salmon were observed relative to snorkeling surveys conducted during June-August 2001. Fish density was significantly higher in kelp beds than in non-kelp habitat and significantly higher in kelp beds within the comparative drift cells than in the Elwha drift cell. Geomorphic habitat type was also a significant variable in fish use of overstory kelp beds: kelp beds at embayed sites had higher fish density than spits and bluff sites. Kelp density and water depth are theorized to contribute to the observed difference in function. The drop in densities of some species from 2001 sampling may be due to stock declines, or interannual variation. Additional work defining the structure and functional processes of kelp beds, as well as long term variability in fish use, is recommended.

Introduction

Kelp beds are a dominant nearshore habitat of the Strait of Juan de Fuca (Shaffer et al 2008). In general, kelp habitats composition and form here are highly temporally and geographically variable (Thom and Hallum, 1990; Shaffer 2000). Previous study assessing of fish use of overstory kelp beds indicates that overstory kelp bed function in the central Strait is complex and species dependant (Shaffer 2004). Understory kelp beds have also been documented to be heavily used by forage fish (Norris et al 2007)

Substrate type is a determining factor for kelp distribution within the nearshore Strait of Juan de Fuca, including the Elwha nearshore (Warrick et al 2008). Sediment processes in the central Strait, including the Elwha nearshore, have been severely disrupted by extensive shoreline armoring and in river dams. The resulting sediment starvation has resulted in expanded kelp bed distribution.

The restoration response associated with upcoming dam removals on the Elwha River has not been defined for kelp beds in the Elwha drift cell (Warrick et al 2008). In particular, little is known about the current and predicted fish use of the Elwha nearshore, including overstory kelp beds (Shaffer et al 2008). Surveys of understory kelp beds in the Elwha nearshore indicate that fish use of kelp habitats is high (Norris et al 2007). Understanding overstory kelp bed function for fish use is therefore a key component to defining the role and priority of kelp beds for future restoration action. The purpose of this study then is to define salmon and forage fish use of overstory kelp beds along key areas of the central Strait, and provide at least an initial assessment of fish use of overstory kelp beds of the Elwha nearshore. This information will provide managers and researchers a baseline for developing additional restoration priorities to optimized the upcoming nearshore restoration event associated with the dam removals and additional assessment needs.

Methods and Materials

Six sites located along geomporphic habitat types of embayed shorelines, feeder bluffs, and spits within Elwha and comparative drift cells along the Strait of Juan de Fuca were selected for monthly sampling from June through August 2007 (Figure 1; Table 1; Shaffer et al 2008). Each site consisted of a paired kelp and no-kelp area. Methods were the same as those used in Shaffer 2004. Specifically, three permanent snorkeling transects were established in each kelp bed to assess inner, middle, and outer areas of each kelp bed. One permanent no-kelp transect was also established at each site. No-kelp transects were in immediate proximity to kelp beds, and shared the same orientation, depth, and distance from shore. Transect locations were defined by selecting prominent features along the shoreline that were visible from each of the transects and also distinguishable on aerial photos and USGS 7.5 minute quadrangle maps. GPS coordinates were noted for the beginning and end of transects. Lengths of each transect were calculated from coordinates. Water depth along each kelp and no kelp area was determined using boat based SONAR and converted to MLLW.

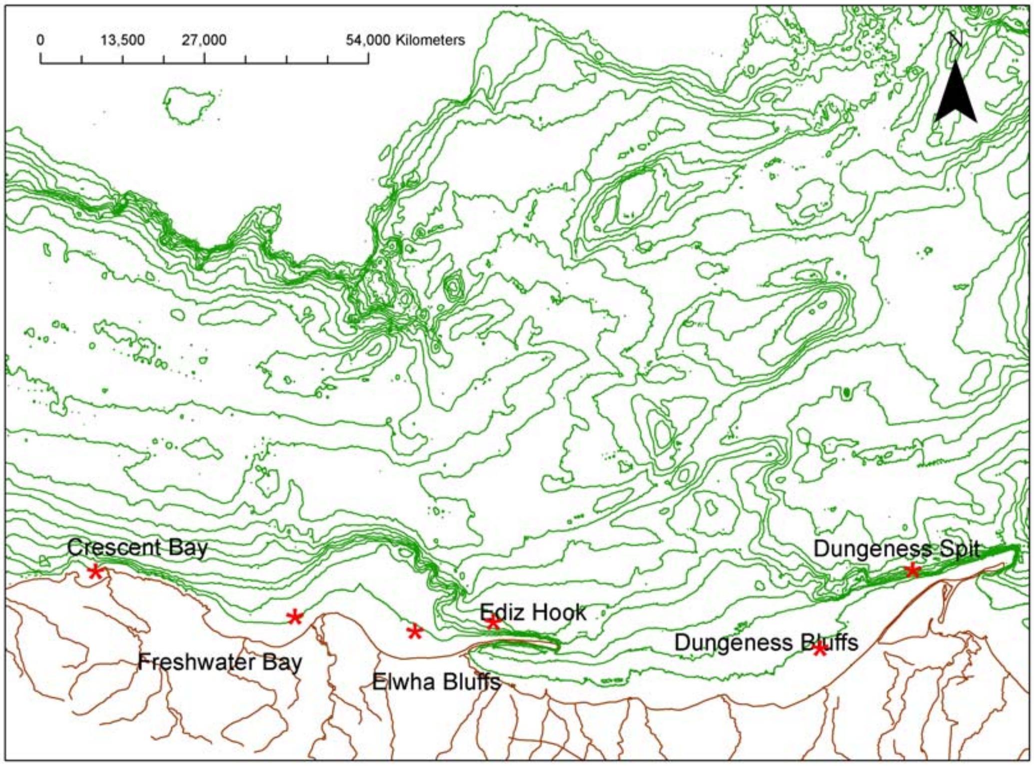


Figure 1. Kelp bed snorkeling sample sites.

Table 1. Snorkeling survey sample sites by geomorphic habitat site, 2007. Red font indicates Elwha nearshore, blue font indicates comparative habitats.

Site	Embayment	Spit	Bluff
Crescent Bay	X		
Freshwater Bay	X		
Elwha Bluffs			X
Dungeness Bluffs			X
Ediz Hook		X	
Dungeness Spit		X	

For each site, the inner kelp transect was located on the shallow edge, and parallel to, the shoreward edge of the kelp bed. The middle kelp bed transect extended in a straight line across the kelp bed from its inner to outer edge. The outer kelp bed transect covered the outer, deeper, edge of the kelp bed that bordered the main basin of the Strait. No-kelp transects were established along the same depth contour and immediately adjacent to the paired kelp bed, and parallel to the shoreline.

Kelp beds and no-kelp areas were sampled by snorkeling permanent transects. Visibility was a minimum of 15 feet (4.6 m) for sampling. Swimmers snorkeled each established transect and noted all juvenile and adult salmon and forage fish observed within three meters of the transect. Fish were identified to major grouping (salmon/ sand lance/ smelt/herring), and estimated fish depth, and water depth were recorded for each fish observation. At least two observations on kelp type and water depth were recorded for each transect, regardless of fish presence. All four transects within a site were sampled within two hours. Kelp and no-kelp beds were attempted to be sampled at least twice a month from June thru August 2007. Elwha and respective comparative sites were sampled within a two-day time period. Data were log transformed and subjected to a Kruskal-Wallis test to define significant differences in fish density between kelp and no kelp habitats, geomorphic habitat type (GMHT) and the Elwha and comparative drift cells.

Results

Sampling conditions. (in particular high turbidity) limited surveys to July and August. Areas successfully sampled for each site are provided in Table 2. A total of 14 surveys were conducted from July to September. All overstory kelp beds were comprised of bull kelp, *Nereocystis luetkeana*. Kelp depths ranged from approximately 1 meter on the inner kelp bed transect to 10 meters along the outer kelp transect. The no-kelp transects were in average of 5-9 meters of water (Table 2).

Surf smelt and herring had the highest observations. Sand lance and salmon were observed in far lower numbers (Figure 4). Kelp, geomorphic habitat type, and drift cell all played a significant role in fish density. The kelp habitats, and embayed sites outside the Elwha drift cell, were observed to have higher total fish numbers than non-kelp habitats. By species, only surf smelt had significantly higher densities in kelp than non-kelp habitats. All other species densities were non-significant (Table 3). Combined fish density, and surf smelt density was significantly different between geomorphic habitat type.

Overall the majority of fish were observed in the kelp beds within embayments. Fewer fish were observed at the spit and bluff sites. Within the embayed sites, the comparative site (Crescent Bay) had consistently higher number of fish than the site within the Elwha drift cell (Freshwater Bay) site. For the spits and bluff kelp beds, there did not appear to be a strong difference in fish numbers between the kelp and non-kelp habitat types. Location however was important: Dungeness Spit and Bluffs (comparative sites) had consistently higher numbers of fish than Elwha Bluffs and Ediz Hook located within the Elwha drift cell.

Table 2. Average kelp snorkeling survey areas (square meters), and depths (meters)

Site	Lat/Long	Area, square meters Kelp	No Kelp	Combined	Depth, meters Kelp	No-Kelp	Combined
Crescent Bay	48.16533/ 123.70624	5,418	1,806	7,224	3.6	4.8	4
Freshwater Bay	48.14293/ 123.57124	3,587	1,196	4,782	4	6.9	5
Ediz Hook	48.14013/ 123.46133	2,960	987	3,946	8.1	8.5	8.2
Dungeness Spit	48.15039/ 123.17545	4264	1421	5685	4.4	7.6	5.5
Elwha Bluffs	48.13606/ .50366	3986	1329	5314	8	9	8.3
Dungeness Bluffs	48.13932/ 123.23183	3752	1251	5003	4. 7	7.3	5.5

Figure 3. Total fish observed in 2007 kelp snorkeling surveys central Strait of Juan de Fuca.

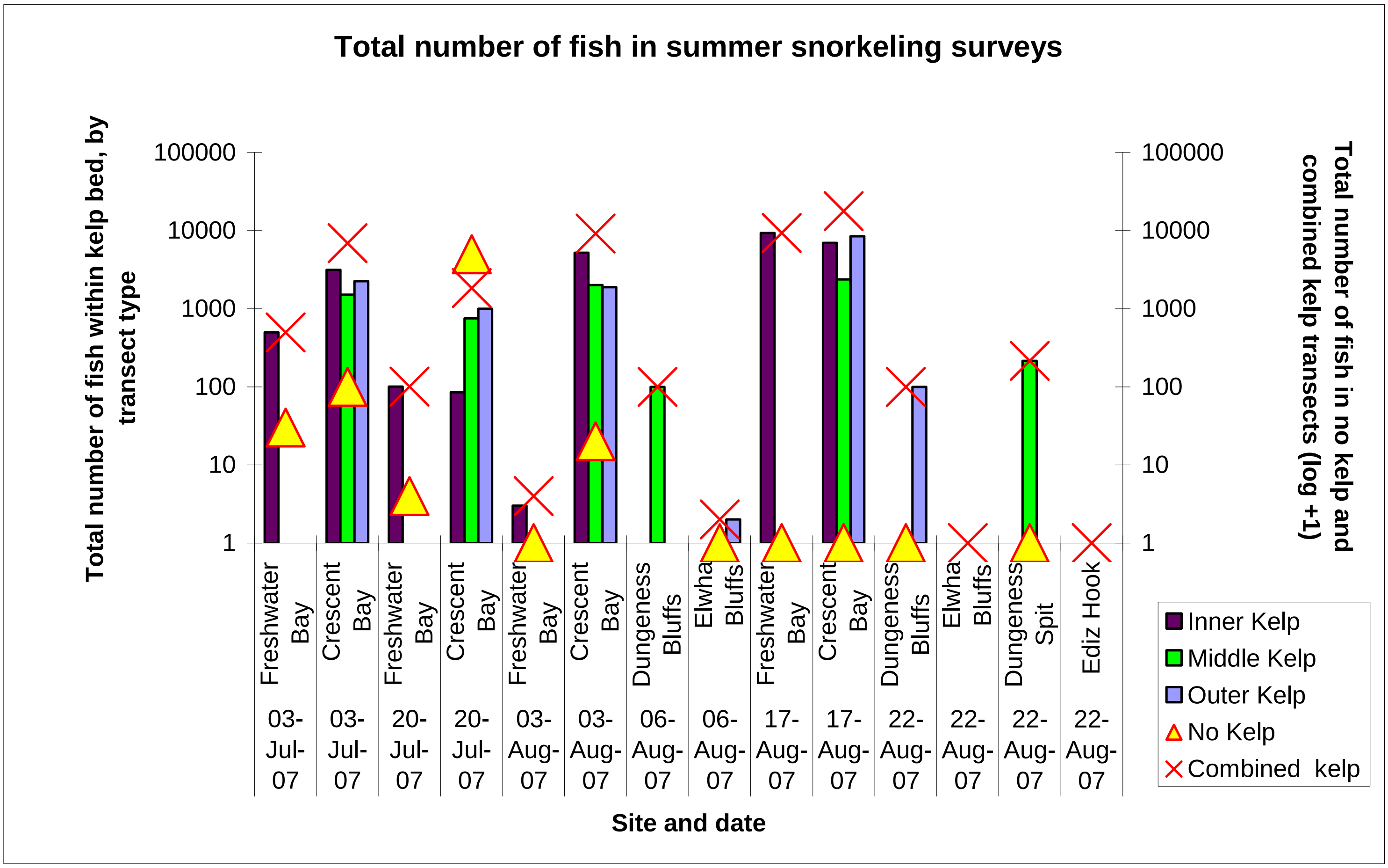


Table 3. Kruskal Wallis results of fish density, fish/sqm.

Row Labels	Chi-squared	df	p-value
Drift cell			
herring	1.3018	1	0.2539
salmon	1.6925	1	0.1933
sand lance	0.0814	1	0.7755
smelt	12.345	1	0.0004422
total fish	5.5531	1	0.01845
GMHT			
herring	4.626	2	0.09896
salmon	1.2608	2	0.5324
sand lance	9.7244	2	0.007733
smelt	0.6347	2	0.7281
total fish	8.7421	2	0.01264
Kelp presence			
herring	7.0939	2	0.02881
salmon	0.9188	2	0.6317
sand lance	1.4241	2	0.4906
smelt	7.0462	2	0.02951
total fish	12.7996	2	0.001662

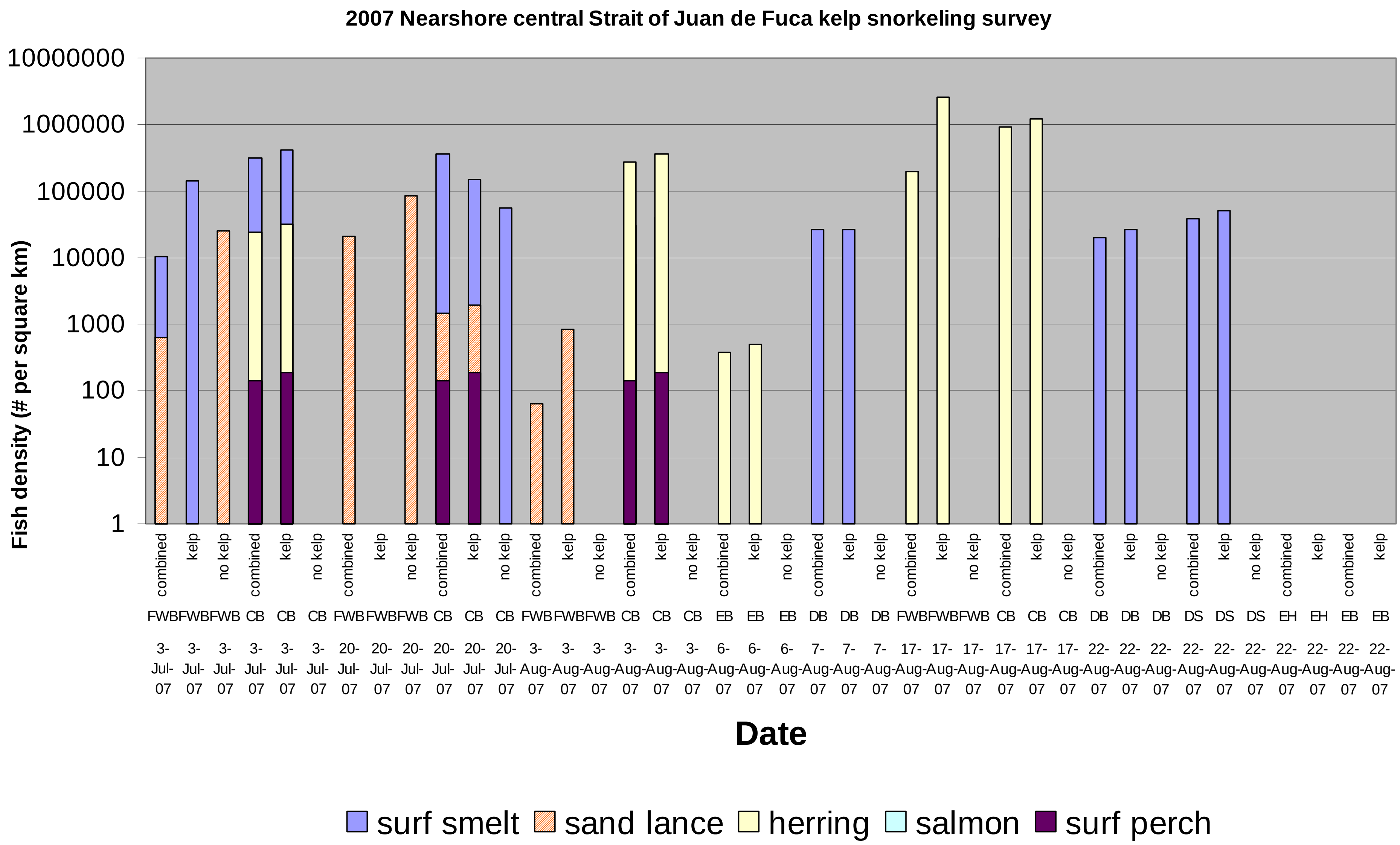


Figure 4. Fish density, number per square kilometer, by group. Central Strait of Juan de Fuca kelp beds, July and August 2007. CB=Crescent Bay, FWB=Freshwater Bay; DB=Dungeness Bluffs; EB=Elwha Bluffs; DS=Dungeness Spit; EH=Ediz Hook

Discussion

Kelp bed habitats of the central Strait of Juan de Fuca proved difficult to study this field season. Remote sites and unfavorable sea conditions combined with chronic low visibility at the spit and bluff sites often made snorkeling surveys impossible. None the less the surveys we were able to achieve provide intriguing insight into how kelp bed habitats of the central Strait function for fish, as well as how the Elwha nearshore may be functioning relative to comparative, intact kelp beds. On a broad scale, trends in observed fish use indicate that geomorphic habitat type and kelp beds both play a role in nearshore fish use, both for total fish, and by certain fish species. Embayed kelp beds are used differently than kelp beds along spits and bluffs. Also, kelp beds tend to have more fish than adjacent non-kelp areas, both in total number of fish, and fish density. Higher fish density in kelp beds relative to non-kelp beds is consistent with previous work assessing fish use of kelp beds (Shaffer 2004).

Trends in fish numbers indicate that the Elwha drift cell may be functioning differently, and in particular providing habitat for fewer fish, than comparative habitats outside of the Elwha drift cell. In all but one sample date at all habitat types the Elwha drift cell kelp habitat were observed to have fewer fish than the kelp habitat in comparative areas. Reasons for this observed trend may include different habitat composition between the kelp beds. Visually, kelp beds in the Elwha drift cell appeared less dense than kelp beds in the comparative areas. Also, average depth of the kelp beds in the Elwha drift cell was deeper than other sites (Table 2). Physical elements such as depth, sediment substrate size, and relative turbidity levels, may also be playing a role in kelp bed structure and subsequently, function. Additional scrutiny of the kelp habitat structure within the Elwha systems and comparative areas would help tease this out, and is recommended.

Another interesting trend is the change in species composition from that observed in surveys conducted seven years ago. While overall fish numbers reached about the same density, sand lance were observed in log scale fewer numbers in this study compared to kelp beds surveyed five years ago (Table 2). Similarly, salmon were observed in only one kelp bed survey of this study. The decrease in observations of these two fish groups may be due to the difference in location of kelp beds of this study: only two of the six sites sampled in this study were adjacent to river/stream mouths, while all of the study sites in 2004 were in proximity to a stream/river mouth. While not a driving factor, proximity to creek mouth may play a role in this years observation. It may also indicate temporal variation in fish species abundance. Sand lance have not been studied in detail, but observations of sand lance have been on the decline in recent years (Wildermuth, pers comm.). Salmon species are also on the decline, and the focus of extensive restoration efforts in the central Olympic Peninsula (see Ward et al 2008 for a discussion). Further surveys should be conducted in successive years to define if trends are real, or simply due to interannual variation.

Table 4 . Fish densities (f/skm) and ln density observed in 2001 and 2007 kelp bed surveys. *(2001 data are reprinted from Shaffer, 2004).

Date	Site		Salmon Lnden Average	Salmon density (f/skm) Average	Surf smelt Lnden Average	Surf smelt density (f/skm) Average	Sand lance Lnden Average	Sand lance density (f/skm) Average
2001*	Central and western Strait	Average	6.0	678.5	7.3	44,605.4	7.5	36,794.1
		sd	1.2	3374.8	2.5	194165.8	2.6	86557.5
2007	Central Strait	Average	0.3	7.7	4.4	41,558.4	2.4	4,870.2
		sd	1.1	35.2	5.5	96400.8	4.0	14485.1

In summary, this work supports existing literature documenting higher fish densities in overstory kelp habitats relative to unvegetated areas, and also suggests that kelp beds along the Strait appear to function differently, and in particular that Elwha nearshore kelp beds appear to be functioning at a lower level for fish use than kelp beds in comparative habitats outside the Elwha drift cell. Sediment starvation, a dominant limiting factor in the Elwha nearshore that is due to extensive shoreline armoring and in river dams, has resulted in an increase in overstory kelp coverage in the last 100 years (Barry 2005; Norris et al 2007; Shaffer et al 2008). Dam removals will partially restore nearshore sediment processes, and may well affect the kelp habitat associated with the Elwha nearshore (Warrick et al 2008). Our observations indicate that this change may not be a significant change for fish use of overstory kelp beds. Norris et al 2007 documented large schools of juvenile and adult forage fish utilizing understory kelp beds within the Elwha nearshore. Further detailed assessment is therefore recommended to quantify fish use of understory kelp beds and the restoration opportunies associated with shallow subtidal vegetetated habitats.

Acknowledgements

This work was sponsored by the North Olympic Peninsula Lead Entity and funded by the Salmon Recovery Funding Board with in kind support by WDFW and the Lower Elwha Klallam Tribe. Tara Galuska is the project manager RCO. The Clallam Marine Resources Committee provided funding for a number of college interns with Peninsula College Fisheries Program and Center of Excellence, and the Western Washington University REU program. Mr. Jack Ganzhorn and Dr. Dwight Barry, Peninsula College, provided student supervision. Nancy Bleustein Johnson, Western Washington University, provided student guidance. Jenna Schilke led portions of the field work. Western Washington University and Peninsula College students that assisted in this project include Tiffany Nabors, Sean Oden, Rebecca Paradis, Jacob Ray, Melanie Roed, Justin Rondeau, Trista Simmons, and Ben Warren. Larry Ward, LEKT also assisted with surveys. Private property owners and citizens Ben and Irene Palzer, Chuck and Niva Novak, Steve Wirth and Mariann Wahlen, and Bud Taggert provided much appreciated access and local knowledge. Project in kind partners in order of contribution included Cathy Lear (Clallam County), Pat Crain (ONP), Ross Fuller, Chris Byrnes, Roger Mosley, Dan Penttila, Dan Doty, and Tim Quinn (WDFW).

Literature cited

Norris, J, I. Ward**,** A**.** Shaffer and C. Lear 2007. Eelgrass mapping of the Elwha Nearshore. in Proceedings, Puget Sound Georgia Basin Conference , Puget Sound Water Quality Authority, Olympia Washington.

Shaffer, J.A. 2000. Seasonal variation in understory kelp bed habitats of the Strait of Juan de Fuca. Journal of Coastal Research. 16 (3) 768-775.

Shaffer J.A .2004. Preferential use of nearshore kelp habitats by juvenile salmon and forage fish. In T.W. Droscher and D.A. Fraser (eds). Proceedings of the 2003 Georgia Basin/Puget Sound Research Conference. http://www.psat.wa.gov/03_proceedings/start .html

Shaffer, J.A, P. Crain, B. Winter, M. McHenry, C. Lear and T. Randle. 2008. Nearshore Restoration of the Elwha River Through Removal of the Elwha and Glines Canyon Dams: An Overview. Northwest Science. 82 (Special Issue)

Ward, L., P. Crain, B. Freymond, M. McHenry, D. Morrill, G. R. Pess, R. Peters, J. A. Shaffer, B. Winter, B. Wunderlich. 2008. Elwha River Fish Restoration Plan, developed pursuant to the Elwha River Ecosystem and Fisheries Restoration Act, Public Law 102-495. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-90, 168 p

Warrick, J. A., G. R. Cochrane, Y. Sagy, and G. Gelfenbaum. 2008. Nearshore substrate and morphology offshore of the Elwha River. Northwest Science 82 (Special Issue):153-163.

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

Anne Shaffer[1] , Sue Nattinger [2], and Jenna. Schilke [1]

[1]Washington 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 comparision 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 mode (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.

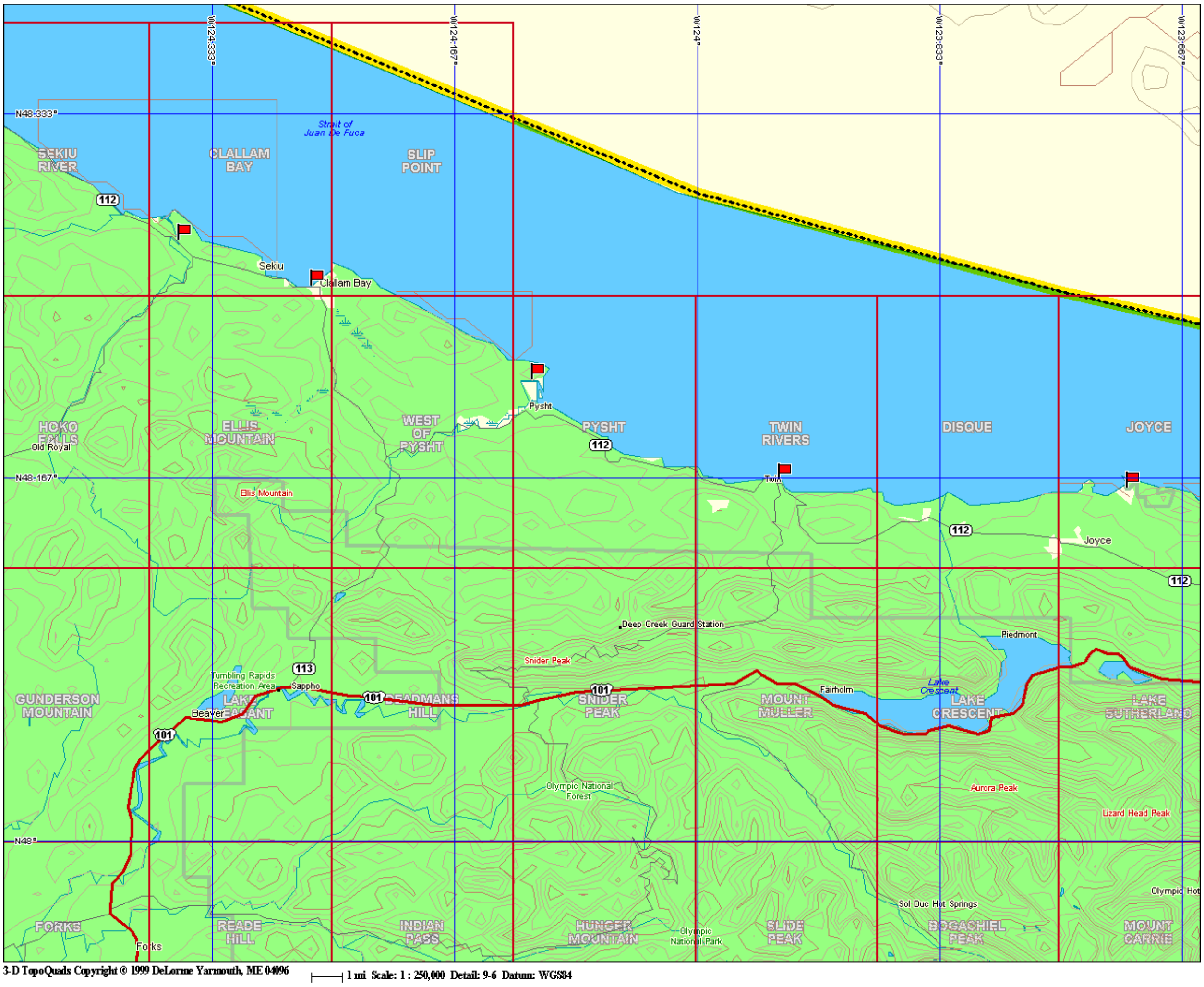


Figure 1. Sample sites, 2007 nearshore water quality study.

LEFT BLANK

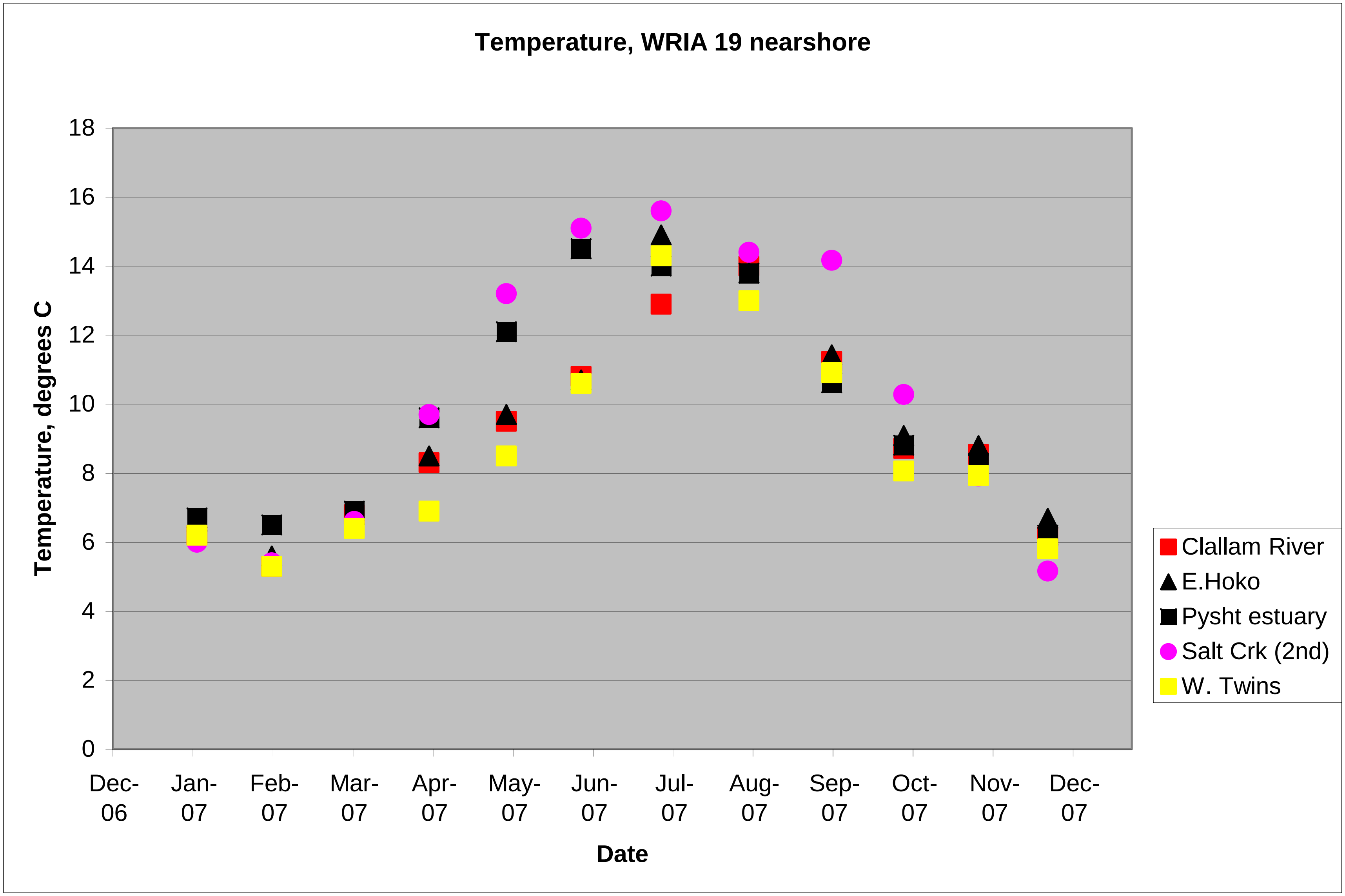


Figure 2. Temperature, select nearshore sites central and western Strait of Juan de Fuca, 2007

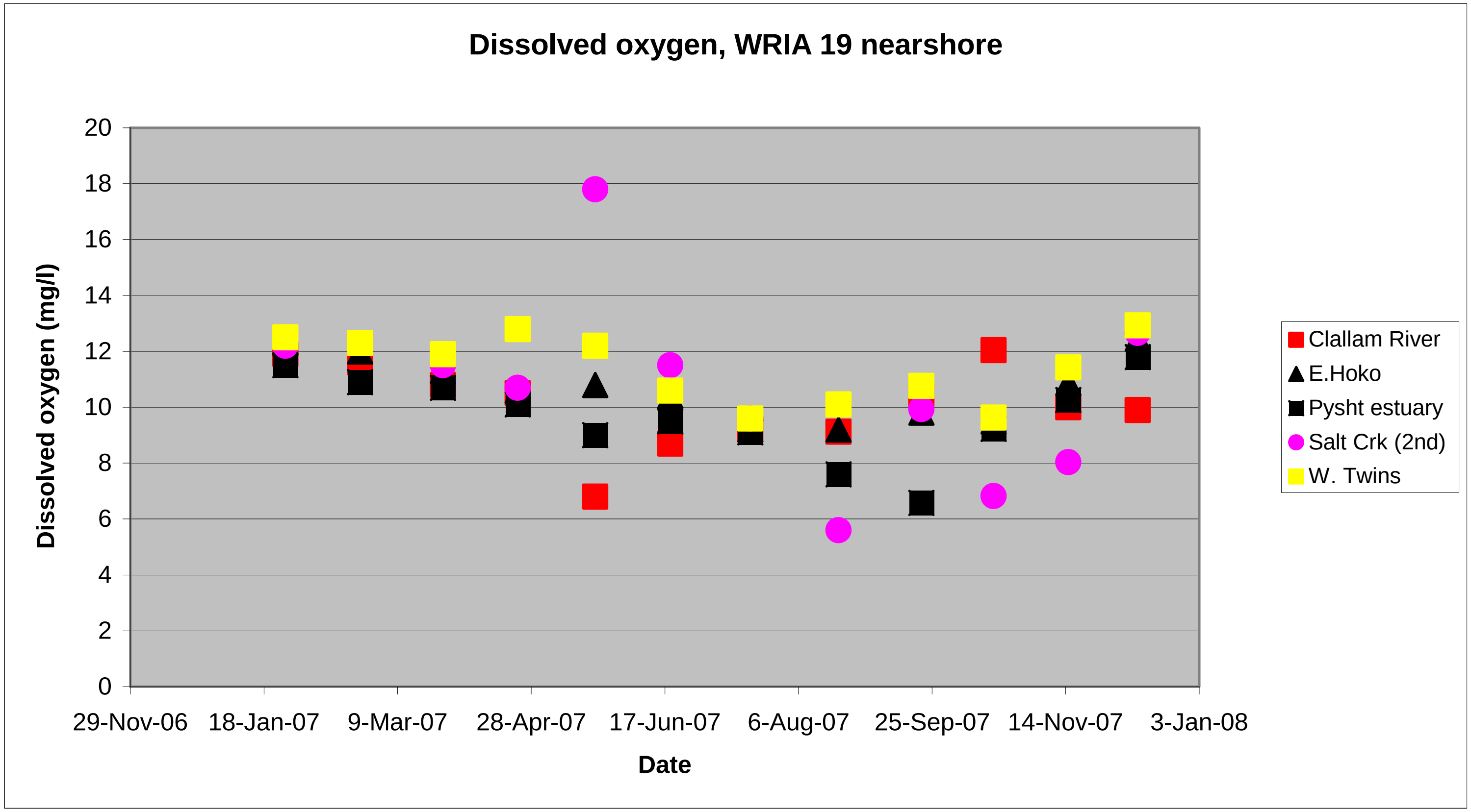


Figure 3 Dissolved oxygen select nearshore sites central and western Strait of Juan de Fuca, 2007

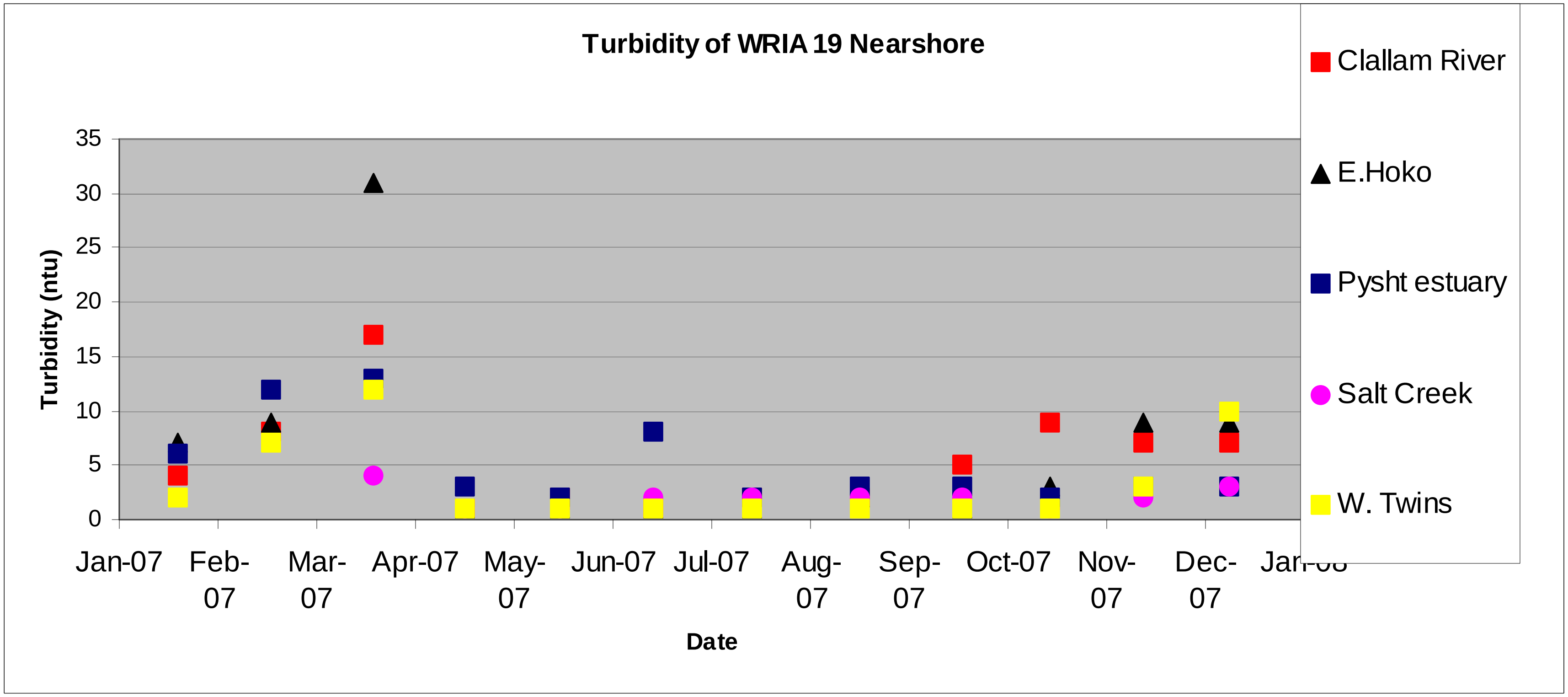


Figure 4. Turbidity, select nearshore sites central and western Strait of Juan de Fuca, 2007

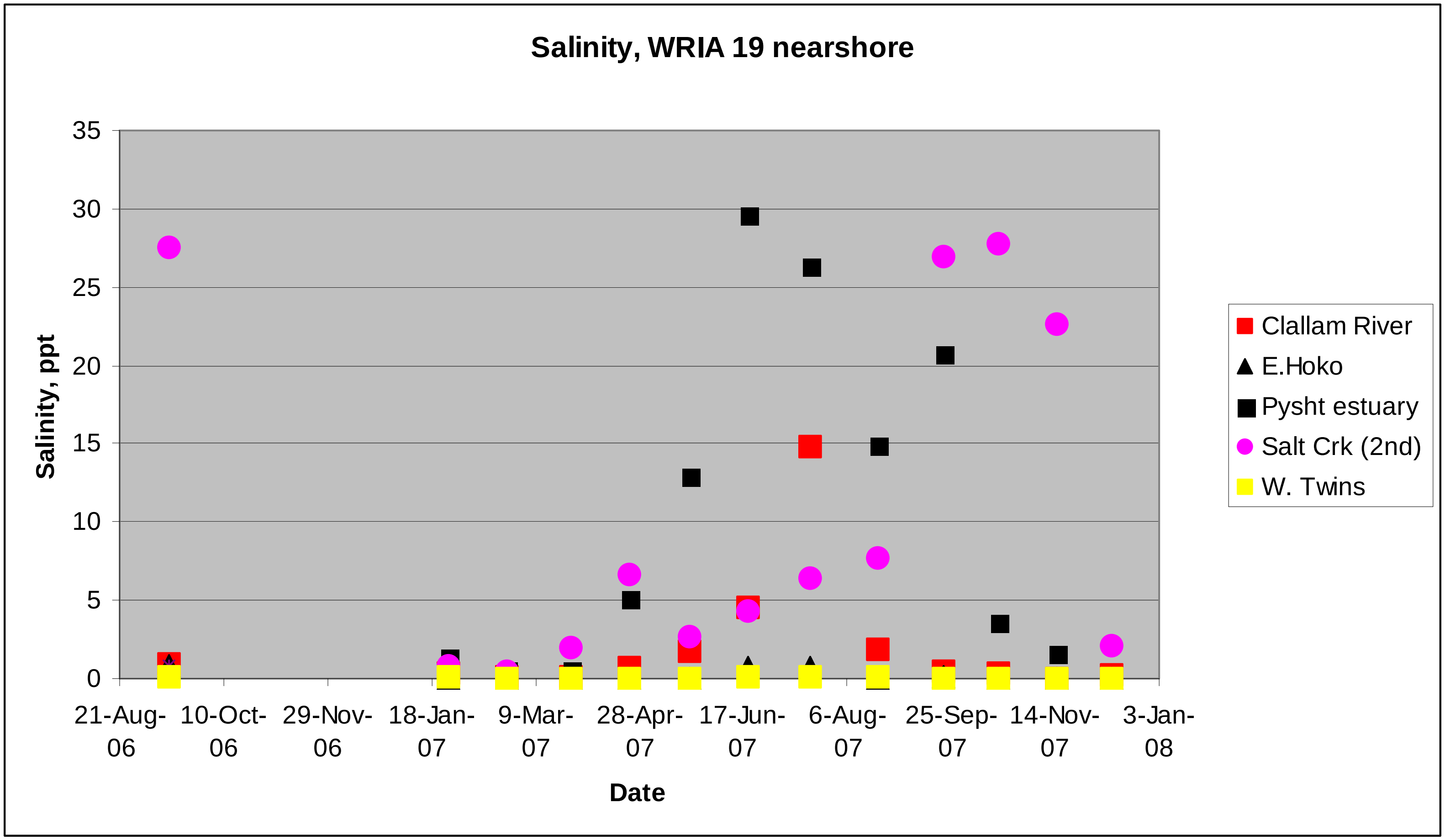


Figure 5. Salinity select nearshore sites central and western Strait of Juan de Fuca, 2007

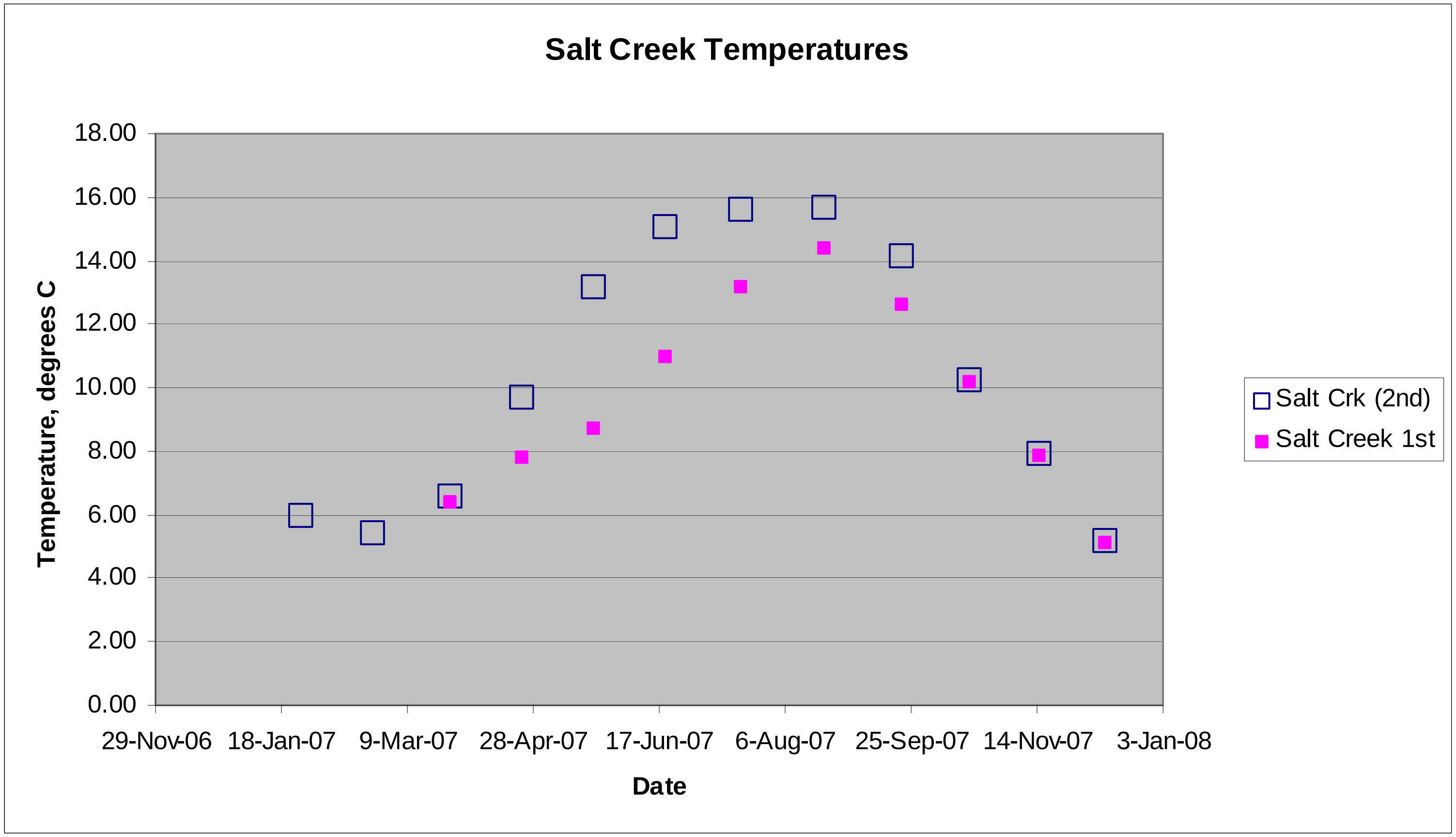


Figure 6 Temperature difference at first sampling (high tide) and second sampling (five hours after first sampling).

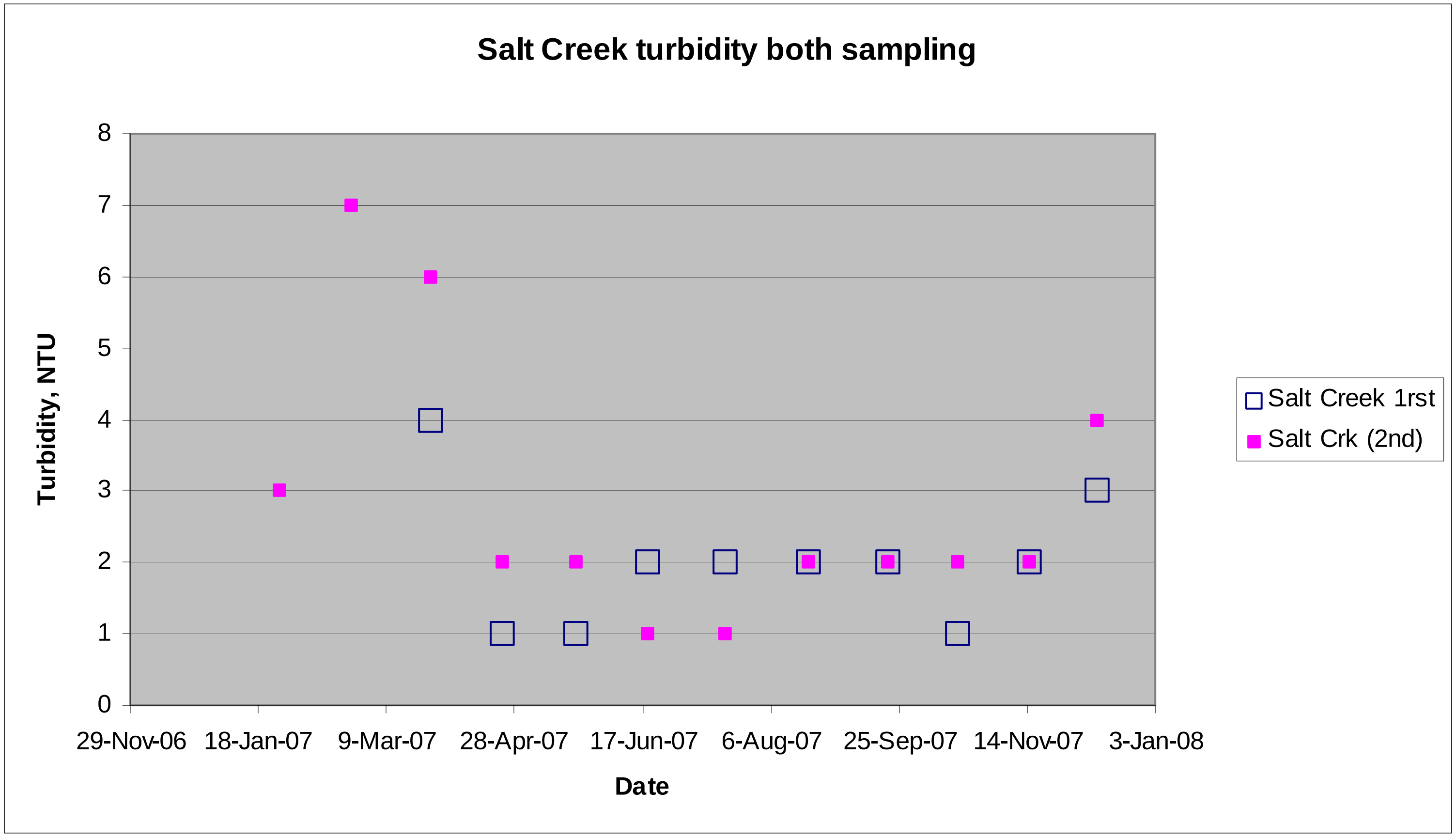


Figure 7. Turbidity at Salt Creek nearshore at first sampling (high tide) and second sampling (five hours after first sampling)

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 maximium 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 prevelant 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 theCalifornia 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 Merril 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.

					mg/l	c	ppt	ntu			microsiemans
Date	**Location**	**Lat**	**Long**	**Time**	**DO**	**Temp**	**Salinity**	**Turbidity**	**pH**	**% sat**	**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

26-Mar-07	E.Hoko	48.27312..	124.35647	8:30	11.3	6.8	0	31	7.9	93	37
Date	**Location**	**Lat**	**Long**	**Time**	**DO**	**Temp**	**Salinity**	**Turbidity**	**pH**	**% sat**	**conductivity**
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

07/19/07	Preed crk	48.21004	124.12141	9:00	7.4	14.1	14.9	3	7.1	79	19
Date	**Location**	**Lat**	**Long**	**Time**	**DO**	**Temp**	**Salinity**	**Turbidity**	**pH**	**% sat**	**conductivity**
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	712	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

12/11/07	Salt Crk	48.16106	123.70573	7:40	12.01	5.13	3.47	3	7.52	97.6	4080
Date	**Location**	**Lat**	**Long**	**Time**	**DO**	**Temp**	**Salinity**	**Turbidity**	**pH**	**% sat**	**conductivity**
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

	Crescent Beach							Dungeness Bluffs			Dungeness Spit			Ediz Hook			Elwha Bluffs			Elwha W Side Channel						
	2007				2008			2007			2007			2007			2007			2007				2008		
Species	S	Su	F	W	S	Su	F	S	Su	F	S	Su	F	S	Su	F	S	Su	F	S	Su	F	W	S	Su	F
American Shad *Alosa sapidissima*	O	O	R	-	R	-	-	R	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-
Pacific Herring (pl) *Clupea harengus pallasi*	-	-	-	-	-	-	-	O	O	A	O	R	-	-	-	-	-	R	-	-	-	-	-	-	-	-
Pacific Herring (juv) *Clupea harengus pallasi*	R	A	-	R	-	-	R	O	C	-	O	A	C	-	O	R	-	A	R	-	-	-	-	-	-	-
Pacific Herring (adult) *Clupea harengus pallasi*	R	O	-	-	-	-	-	O	O	-	-	O	-	-	-	-	-	R	-	-	-	-	-	-	-	-
Northern Anchovie (pl) *Engraulis mordax mordax*	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-
Northern Anchovie (juv) *Engraulis mordax mordax*	-	O	-	-	-	-	-	-	-	R	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Northern Anchovie (Adult) *Engraulis mordax mordax*	-	O	-	-	-	-	-	O	O	-	-	O	-	-	-	-	-	O	-	-	-	-	-	-	-	-
Cutthroat trout *Oncorhynchus clarki clarki*	R	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	C	R	-	-	O	R
Pink salmon *Oncorhynchus gorbuscha*	-	-	-	-	C	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chum salmon *Oncorhynchus keta*	O	O	-	-	C	R	-	A	-	-	-	R	-	O	R	-	A	O	-	A	-	-	-	O	-	-
Coho salmon *Oncorhynchus kitsutch*	O	O	-	-	O	O	-	R	R	-	C	-	-	-	R	-	O	R	-	O	O	O	-	O	O	R
Chinook salmon *Oncorhynchus mykiss*	O	C	-	-	R	C	-	-	O	-	-	O	-	O	R	-	R	O	-	C	C	O	R	C	C	R
Steelhead trout *Oncorhynchus tshawytsha*	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	R	R	O	-	-	-	R
Bull Trout *Salvelinus confluentus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	R	-
Unknown Juvenile Trout *Oncorhynchus* spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	R	R	-	O	R
Whitebait Smelt *Allosmerus elongatus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-
Surf Smelt (pl) *Hypomesus pretiosus*	R	O	-	-	O	-	-	O	A	A	C	O	A	R	R	A	O	O	R	R	-	-	R	-	-	-
Surf Smelt (juv) *Hypomesus pretiosus*	O	C	C	-	C	R	-	O	A	A	O	A	C	R	O	-	-	A	A	R	R	R	O	R	-	-
Surf Smelt (adult) *Hypomesus pretiosus*	O	C	R	R	R	R	-	O	O	R	-	C	-	R	R	-	R	O	-	-	R	-	-	R	-	-
Longfin Smelt *Spirinchus thaleichthys*	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Smooth Tongue *Leuroglossus schmidti*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
postlarval un-Ided	-	-	-	-	-	-	-	-	O	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific Sand Lance (pl) *Ammodytes hexapterus*	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific Sand lance (juv) *Ammodytes hexapterus*	-	O	O	-	O	O	R	O	R	-	O	O	R	R	O	-	-	C	-	-	-	-	-	-	-	-
Pacific Sand lance (adult) *Ammodytes hexapterus*	-	O	-	-	R	-	-	R	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-
Sandfish *Trichodon trichodon*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Threespine stickleback *Gasterosteus aculeatus*	O	R	O	-	R	-	-	R	R	-	R	-	-	-	O	R	-	-	-	C	C	C	R	O	O	A
Arrow Goby *Clevelandia ios*	-	-	-	-	-	-	-	R	-	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bay Pipefish *Syngnathus griseolineatus*	O	R	-	-	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tubesnout *Aulorhnchus flavidus*	O	O	-	-	-	O	A	R	C	R	-	O	-	-	R	-	R	R	R	-	-	-	-	-	-	-
Speckled Sanddab *Citharichthys stigmaeus*	-	R	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
English sole *Parophrys vetulus*	O	C	R	-	O	A	A	-	-	-	R	-	-	-	-	-	-	R	-	R	-	-	-	R	-	-
Starry Flounder *Platichthys stellatus*	C	O	C	R	O	O	-	-	R	R	-	-	-	-	-	-	-	-	-	A	C	O	-	O	C	A
Sand sole *Psettishthys melanostictus*	O	O	O	-	O	O	R	O	R	-	O	R	-	R	-	-	-	R	-	-	-	-	-	-	-	-
Juv. Flat fish	O	-	-	-	R	-	-	R	-	-	O	-	-	-	-	-	R	-	-	O	R	-	-	R	-	-
Padded Sculpin *Artedius fenestralis*	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-
Scaly head sculpin *Artedius harringtoni*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rosylip Sculpin *Ascelichthys rhodorus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silverspotted Sculpin *Blepsias cirrhosus*	R	-	-	-	O	-	R	-	O	-	-	-	-	O	-	-	-	-	-	-	-	-	-	-	-	-
Sharpnose Sculpin *Clinocottus acuticeps*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-	-	-	-
Calico Sculpin *Clinocottus embryum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manacled Sculpin *Cynchirus gilli*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-
Buffalo Sculpin *Enophrys bison*	R	-	-	-	-	O	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White spotted Greenling *Hexagrammos stelleri*	-	-	-	-	-	R	-	-	R	-	O	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-
Pacific Staghorn sculpin *Leptocottus armatus*	O	A	C	R	O	C	A	O	O	R	O	-	-	R	-	-	-	-	-	A	A	O	-	A	A	A
Sail-Fin Sculpin *Nautichthys oculofasciatus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tidepool Sculpin *Oligocottus maculosis*	-	-	-	-	-	O	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-
Prickley Sculpin *Oligocottus rimensis*	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	C	O	-	O	O	R
Fluffy Sculpin *Oligocottus snyderi*	-	-	-	-	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cottids Unknown	-	R	-	-	-	-	-	-	-	-	R	-	-	R	-	-	-	-	-	O	R	-	-	-	-	-
Cottids <30mm	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	O	R	-	-	-	-
Black Rockfish *Sebastes melanops*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-
Kelp Greenling *Hexagrammos decagrammus*	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rock Greenling *Hexagrammos lagocephalus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lingcod *Ophiodon elongatus*	-	-	-	-	O	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Big Skate *Raja binoculata*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific Cod *Gadus macrocephalus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific Tomcod *Microgadus proximus*	-	R	-	-	R	R	-	-	O	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Walleye Pollock *Theragra chalcogramma*	R	R	-	-	-	-	-	O	-	-	R	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-
poacher unknown	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redtail surf perch *Amphistichus rhodoterus*	-	R	-	-	-	-	-	O	O	R	R	-	R	-	-	-	-	R	-	-	-	-	-	-	-	-
Shiner perch *Cymatogaster aggregata*	R	O	R	-	-	R	-	R	R	R	R	-	R	-	-	-	-	-	-	-	R	O	-	-	-	-
Striped Perch *Embiotoca lateralis*	-	R	-	-	-	-	-	O	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-
Penpoint Gunnel *Apodichthys flavidus*	O	O	-	-	-	O	-	O	-	-	-	-	R	O	-	-	R	-	-	-	-	-	-	-	-	-
Crescent Gunnel *Pholis laeta*	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	R	-	-	-	-	-
Saddleback Gunnel *Pholis ornata*	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	O	R	-	R	-	-
Rockweed Gunnel *Xererpes fucorum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
unknown Gunnel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Clingfish *Gobiesox maeandricus*	-	-	-	-	-	-	-	R	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spotted Snailfish *Liparis callyodon*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marbled Snailfish *Liparis dennyi*	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tidepool Snailfish *Liparis florae*	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Slipskin Snailfish *Liparis fucensis*	-	R	-	-	-	-	-	R	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Showy Snailfish *Liparis pulchellus*	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Snake prickleback *Lumpenus sagitta*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-
Lobefin Snailfish *Polypera greeni*	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unknown Snailfish	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	Freshwater Bay							Pysht Indian Creek				Pysht Main Channel					
	2007				2008			2007				2007				2008	
Species	S	Su	F	W	S	Su	F	S	Su	F	W	S	Su	F	W	S	Su
American Shad *Alosa sapidissima*	-	O	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-
Pacific Herring (pl) *Clupea harengus pallasi*	-	R	O	-	-	-	-	-	-	-	-	-	R	-	-	-	-
Pacific Herring (juv) *Clupea harengus pallasi*	-	C	-	-	-	-	-	-	-	-	-	-	R	R	R	-	-
Pacific Herring (adult) *Clupea harengus pallasi*	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A
Northern Anchovie (pl) *Engraulis mordax mordax*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Anchovie (juv) *Engraulis mordax mordax*	-	O	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Anchovie (Adult) *Engraulis mordax mordax*	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cutthroat trout *Oncorhynchus clarki clarki*	R	O	-	-	-	-	-	-	-	-	-	O	O	R	R	-	-
Pink salmon *Oncorhynchus gorbuscha*	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	R	-
Chum salmon *Oncorhynchus keta*	O	R	-	-	-	-	-	O	-	-	-	O	-	-	-	C	R
Coho salmon *Oncorhynchus kitsutch*	R	-	-	-	O	R	-	O	O	-	-	O	O	-	-	-	A
Chinook salmon *Oncorhynchus mykiss*	O	O	-	-	R	-	-	-	-	-	-	-	R	-	-	R	R
Steelhead trout *Oncorhynchus tshawytsha*	R	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-
Bull Trout *Salvelinus confluentus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unknown Juvenile Trout *Oncorhynchus* spp.	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-
Whitebait Smelt *Allosmerus elongatus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surf Smelt (pl) *Hypomesus pretiosus*	O	-	O	-	O	-	-	-	-	-	-	-	-	R	R	R	-
Surf Smelt (juv) *Hypomesus pretiosus*	R	O	O	R	O	-	-	-	R	R	-	R	-	O	O	O	-
Surf Smelt (adult) *Hypomesus pretiosus*	O	C	O	-	-	R	-	-	-	-	-	O	R	R	R	O	A
Longfin Smelt *Spirinchus thaleichthys*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Smooth Tongue *Leuroglossus schmidti*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
postlarval un-Ided	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific Sand Lance (pl) *Ammodytes hexapterus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific Sand lance (juv) *Ammodytes hexapterus*	O	-	-	-	R	R	-	-	-	-	-	-	-	-	-	-	-
Pacific Sand lance (adult) *Ammodytes hexapterus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sandfish *Trichodon trichodon*	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-
Threespine stickleback *Gasterosteus aculeatus*	-	R	O	-	R	-	-	A	A	A	C	O	O	O	O	R	-
Arrow Goby *Clevelandia ios*	-	-	-	-	-	-	-	-	-	-	-	O	-	-	-	-	-
Bay Pipefish *Syngnathus griseolineatus*	-	R	-	-	-	-	-	-	O	-	-	R	O	-	-	-	-
Tubesnout *Aulorhnchus flavidus*	R	O	O	-	-	-	-	-	-	-	-	R	O	-	-	-	-
Speckled Sanddab *Citharichthys stigmaeus*	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
English sole *Parophrys vetulus*	-	R	-	-	-	-	-	-	-	-	-	R	O	-	-	R	-
Starry Flounder *Platichthys stellatus*	O	-	-	-	-	-	-	R	O	-	-	O	C	-	-	R	A
Sand sole *Psettishthys melanostictus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Juv. Flat fish	R	-	-	-	-	-	-	O	-	-	-	O	-	-	-	-	-
Padded Sculpin *Artedius fenestralis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scaly head sculpin *Artedius harringtoni*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rosylip Sculpin *Ascelichthys rhodorus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silverspotted Sculpin *Blepsias cirrhosus*	-	O	-	-	-	R	-	-	-	-	-	-	-	-	-	R	-
Sharpnose Sculpin *Clinocottus acuticeps*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calico Sculpin *Clinocottus embryum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manacled Sculpin *Cynchirus gilli*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buffalo Sculpin *Enophrys bison*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White spotted Greenling *Hexagrammos stelleri*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific Staghorn sculpin *Leptocottus armatus*	O	O	-	-	R	-	-	A	A	C	O	A	A	O	C	C	A
Sail-Fin Sculpin *Nautichthys oculofasciatus*	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-
Tidepool Sculpin *Oligocottus maculosis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prickley Sculpin *Oligocottus rimensis*	-	-	-	-	-	-	-	-	O	R	-	R	-	-	-	-	-
Fluffy Sculpin *Oligocottus snyderi*	-	-	-	-	-	-	-	-	-	R	-	-	R	-	-	-	-
Cottids Unknown	-	-	-	-	-	-	-	-	-	O	-	O	-	-	-	-	-
Cottids <30mm	O	-	-	-	-	-	-	-	R	-	O	O	R	-	-	O	-
Black Rockfish *Sebastes melanops*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kelp Greenling *Hexagrammos decagrammus*	-	-	-	-	O	-	-	-	-	-	-	-	-	-	-	-	-
Rock Greenling *Hexagrammos lagocephalus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lingcod *Ophiodon elongatus*	-	-	-	-	O	-	-	-	-	-	-	-	-	-	-	-	-
Big Skate *Raja binoculata*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific Cod *Gadus macrocephalus*	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific Tomcod *Microgadus proximus*	-	R	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-
Walleye Pollock *Theragra chalcogramma*	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
poacher unknown	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redtail surf perch *Amphistichus rhodoterus*	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shiner perch *Cymatogaster aggregata*	-	R	R	-	-	-	-	C	A	R	-	-	O	-	-	-	-
Striped Perch *Embiotoca lateralis*	R	R	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Penpoint Gunnel *Apodichthys flavidus*	O	O	-	-	R	O	-	-	-	-	-	-	-	R	R	-	-
Crescent Gunnel *Pholis laeta*	-	-	-	-	-	-	-	-	O	-	-	-	O	R	R	-	-
Saddleback Gunnel *Pholis ornata*	R	-	-	-	-	-	-	O	C	O	-	-	O	-	-	-	A
Rockweed Gunnel *Xererpes fucorum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
unknown Gunnel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Clingfish *Gobiesox maeandricus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spotted Snailfish *Liparis callyodon*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marbled Snailfish *Liparis dennyi*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tidepool Snailfish *Liparis florae*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Slipskin Snailfish *Liparis fucensis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Showy Snailfish *Liparis pulchellus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Snake prickleback *Lumpenus sagitta*	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lobefin Snailfish *Polypera greeni*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unknown Snailfish	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	Pysht Shoreline				Pysht Side Channel NW				Salt Creek Main Channel					Salt Creek Side Channel				W Twins Main				W Twins Shoreline			
	2007				2007				2007				2008	2007				2007				2007			
Species	S	Su	F	W	S	Su	F	W	S	Su	F	W	S	S	Su	F	W	S	Su	F	W	S	Su	F	W
American Shad *Alosa sapidissima*	-	R	-	-	-	-	-	-	R	O	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-
Pacific Herring (pl) *Clupea harengus pallasi*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	R	-
Pacific Herring (juv) *Clupea harengus pallasi*	-	O	O	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	R	O	O	-
Pacific Herring (adult) *Clupea harengus pallasi*	-	O	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-
Northern Anchovie (pl) *Engraulis mordax mordax*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Anchovie (juv) *Engraulis mordax mordax*	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Anchovie (Adult) *Engraulis mordax mordax*	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
Cutthroat trout *Oncorhynchus clarki clarki*	-	-	-	-	R	-	O	-	-	O	O	-	-	O	R	O	R	O	A	-	-	-	-	-	-
Pink salmon *Oncorhynchus gorbuscha*	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chum salmon *Oncorhynchus keta*	O	O	-	-	R	-	-	-	A	-	-	-	A	C	-	-	-	O	-	-	-	O	-	-	-
Coho salmon *Oncorhynchus kitsutch*	-	O	-	-	-	-	O	-	O	O	R	-	R	O	-	-	-	-	-	-	-	-	-	R	-
Chinook salmon *Oncorhynchus mykiss*	-	O	-	-	-	-	-	-	O	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-
Steelhead trout *Oncorhynchus tshawytsha*	-	O	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	R	-	-	-	R	-	-
Bull Trout *Salvelinus confluentus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unknown Juvenile Trout *Oncorhynchus* spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A	C	-	-	-	-	-
Whitebait Smelt *Allosmerus elongatus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surf Smelt (pl) *Hypomesus pretiosus*	R	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	O	C	R
Surf Smelt (juv) *Hypomesus pretiosus*	R	A	C	R	-	-	R	R	R	-	R	R	-	R	-	-	-	-	-	-	-	O	O	C	A
Surf Smelt (adult) *Hypomesus pretiosus*	-	A	R	R	-	-	-	-	-	R	-	-	-	R	-	-	-	-	-	-	-	O	O	O	-
Longfin Smelt *Spirinchus thaleichthys*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Smooth Tongue *Leuroglossus schmidti*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
postlarval un-Ided	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific Sand Lance (pl) *Ammodytes hexapterus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific Sand lance (juv) *Ammodytes hexapterus*	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific Sand lance (adult) *Ammodytes hexapterus*	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sandfish *Trichodon trichodon*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Threespine stickleback *Gasterosteus aculeatus*	-	R	-	-	C	A	O	R	O	C	O	-	R	C	A	O	R	-	R	-	-	-	-	-	-
Arrow Goby *Clevelandia ios*	-	-	-	-	R	R	-	-	O	-	-	-	-	O	O	O	-	-	-	-	-	-	-	-	-
Bay Pipefish *Syngnathus griseolineatus*	-	-	-	-	-	-	-	-	-	O	-	-	-	O	R	-	-	-	-	-	-	-	-	-	-
Tubesnout *Aulorhnchus flavidus*	R	O	R	R	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	O	O	O	-
Speckled Sanddab *Citharichthys stigmaeus*	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
English sole *Parophrys vetulus*	O	A	R	R	-	-	-	-	-	R	-	-	-	-	O	-	-	-	-	-	-	R	O	-	-
Starry Flounder *Platichthys stellatus*	O	A	C	R	O	O	-	-	C	O	O	R	R	O	C	O	R	O	O	-	-	O	O	-	-
Sand sole *Psettishthys melanostictus*	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	O	-	-
Juv. Flat fish	C	R	-	-	C	-	-	-	O	-	-	-	-	O	-	-	-	R	-	-	-	O	-	-	-
Padded Sculpin *Artedius fenestralis*	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	O	O	O	-
Scaly head sculpin *Artedius harringtoni*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-
Rosylip Sculpin *Ascelichthys rhodorus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C	C	R	-
Silverspotted Sculpin *Blepsias cirrhosus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	O	R	-
Sharpnose Sculpin *Clinocottus acuticeps*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	O	-
Calico Sculpin *Clinocottus embryum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	R	-
Manacled Sculpin *Cynchirus gilli*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buffalo Sculpin *Enophrys bison*	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	O	O	O	-
White spotted Greenling *Hexagrammos stelleri*	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-	-	-	-	-	-	-	-	-	-	-
Pacific Staghorn sculpin *Leptocottus armatus*	A	A	A	-	A	A	A	A	C	A	C	O	A	A	A	O	-	O	A	R	-	O	O	-	-
Sail-Fin Sculpin *Nautichthys oculofasciatus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tidepool Sculpin *Oligocottus maculosis*	O	-	-	-	-	-	-	-	-	R	-	-	-	-	R	-	-	R	R	-	-	O	C	O	-
Prickley Sculpin *Oligocottus rimensis*	-	-	-	-	-	R	R	-	-	O	R	-	R	-	O	-	-	O	A	C	R	-	-	-	-
Fluffy Sculpin *Oligocottus snyderi*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	O	R	-
Cottids Unknown	-	-	-	-	-	-	-	-	O	R	-	O	-	O	O	-	R	O	R	-	-	-	O	-	-
Cottids <30mm	R	R	-	-	O	-	-	R	O	-	R	-	R	O	R	R	-	O	C	-	-	-	-	R	-
Black Rockfish *Sebastes melanops*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kelp Greenling *Hexagrammos decagrammus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-
Rock Greenling *Hexagrammos lagocephalus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-	-	-
Lingcod *Ophiodon elongatus*	-	-	-	-	-	-	-	-	O	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-
Big Skate *Raja binoculata*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-
Pacific Cod *Gadus macrocephalus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific Tomcod *Microgadus proximus*	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Walleye Pollock *Theragra chalcogramma*	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
poacher unknown	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redtail surf perch *Amphistichus rhodoterus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	O	O	-
Shiner perch *Cymatogaster aggregata*	-	-	-	-	R	A	R	-	O	A	-	-	-	-	A	R	-	-	-	-	-	-	O	R	-
Striped Perch *Embiotoca lateralis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	C	-	R
Penpoint Gunnel *Apodichthys flavidus*	-	R	-	-	-	-	-	-	-	O	-	-	-	-	-	-	-	-	-	-	-	O	C	R	-
Crescent Gunnel *Pholis laeta*	O	O	-	-	-	R	-	-	O	O	-	-	-	-	R	-	-	-	-	-	-	O	O	-	-
Saddleback Gunnel *Pholis ornata*	O	O	-	-	-	O	-	-	O	C	-	-	-	-	O	-	-	-	-	-	-	O	O	-	-
Rockweed Gunnel *Xererpes fucorum*	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-
unknown Gunnel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-
Northern Clingfish *Gobiesox maeandricus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spotted Snailfish *Liparis callyodon*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-
Marbled Snailfish *Liparis dennyi*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tidepool Snailfish *Liparis florae*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	R	-	-	R	-
Slipskin Snailfish *Liparis fucensis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	O	-	-
Showy Snailfish *Liparis pulchellus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Snake prickleback *Lumpenus sagitta*	-	-	-	-	-	-	-	-	R	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lobefin Snailfish *Polypera greeni*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-
Unknown Snailfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Conventions

S=Spring (March-May), Su=Summer (June-Aug), F=Fall (Sept-Nov), W= Winter (Dec-Feb)

A= Abundant: present in greater than 80% of seines

C= Common: present between 60-80% of seines

O= Occasional: seen more than once

R=Rare: seen once

Appendix B. WRIA 19 Nearshore Water Quality Data

Date	Location	Lat	Long	Time	DO (mg/l)	Temp (℃)	Salinity (ppt)	Turbidity (NTU)	pH	% O_2 sat	Conductivity (µS/cm)
14-Sep-06	E.Hoko	48.27343	124.356	11:30	8.5	13.4	0.8	1	8.1	82	1161
14-Sep-06	Clallam R	48.25494	124.2621	12:00	9	12.3	0.9	1	7.9	85	1161
14-Sep-06	Pysht (hwy)	48.19561	124.1233	12:45	6.8	13.2	0.8	4	7.2	66	1253
14-Sep-06	W.Twin	48.16523	123.9527	13:15	10.4	11.7	0.1	1	7.6	95	225
14-Sep-06	Salt Crk	48.16161	123.7055	14:00	12.2	17	27.5	2	8.5	149	36000
15-Sep	Salt Crk	48.16161	123.7055	7:00	8.2	13	24.4	3	7.8	91	300000
26-Jan-07	E.Hoko	48.27342	124.356	9:10	12.3	6.6	0	7	7.3	101	42
26-Jan-07	Clallam R	48.25477	124.2622	8:40	11.9	6.2	0.4	4	7.5	96	567
26-Jan-07	Pysht (hwy)	48.19033	124.1425	9:12	12.1	6.4	0	5	7.1	98	42
26-Jan-07	Pestuary (logyrd)sidechnl	48.21177	124.1105	9:40	11.5	6.7	1.4	6	7.3	95	1731
26-Jan-07	Preed crk	48.21009	124.1216	10:00	11.8	6.5	0	3	7	96	42
26-Jan-07	W.Twin	48.16535	123.9526	10:45	12.5	6.2	0.1	2	7.5	101	78
26-Jan-07	Salt Crk	48.16109	123.7058	11:22	12.2	6	0.8	3	7.3	99	965
23-Feb-07	E.Hoko	48.27335	123.3561	8:45	12	5.6	0	9	7.8	95	39
23-Feb-07	Clallam R	48.25477	124.2623	3:36	11.6	5.3	0.1	8	7.7	91	69
23-Feb-07	Pysht (hwy)	48.19032	124.1425	12:00	11.8	5.3	0	9	7.6	93	37
23-Feb-07	Pestuary (logyrd)sidechnl	48.21181	124.1104	3:36	10.9	6.5	0.6	12	7.2	89	822
23-Feb-07	Preed crk	48.21011	124.1216	8:24	11.8	5.7	0	3	7.7	94	38
23-Feb-07	W.Twin	48.16518	123.9527	3:36	12.3	5.3	0	7	7.7	97	49
23-Feb-07	Salt Crk	48.16107	123.7058	10:48	12.3	5.4	0.5	7	7.3	97	694
26-Mar-07	Salt Crk	48.16114	123.7057	7:15	11.5	6.4	1	4	8.2	94	1303
26-Mar-07	E.Hoko	48.27312	124.3565	8:30	11.3	6.8	0	31	7.9	93	37
26-Mar-07	Clallam R	48.25472	124.2623	8:51	10.8	6.8	0.1	17	7.8	89	95
26-Mar-07	Pysht (hwy)	48.1908	124.1426	9:30	11.5	6.4	0	18	7.6	93	36
26-Mar-07	Pestuary (logyrd)sidechnl	48.2174	124.1104	10:00	10.7	6.9	0.6	13	7	88	841
26-Mar-07	Preed crk	48.21021	124.1217	10:15	11	7	0	4	7.4	90	35
26-Mar-07	W.Twin	48.1654	123.9526	10:55	11.9	6.4	0	12	7.6	97	42
26-Mar-07	Salt Crk	48.16105	123.7056	11:30	11.5	6.6	0.2	6	7.4	94	253
23-Apr-07	Salt Crk	48.16112	123.7058	6:20	10	7.8	0.9	1	7.9	86	1155
23-Apr-07	E.Hoko	48.27338	124.3561	7:30	10.6	8.5	0	1	8.1	91	44
23-Apr-07	Clallam R	48.25461	124.262	8:00	10.5	8.3	0.7	1	7.4	90	1011
23-Apr-07	Pysht (hwy)	48.19015	124.1425	8:30	11	7.9	0	1	7.7	93	46
23-Apr-07	Pestuary (logyrd)sidechnl	48.21178	124.1104	9:05	10.1	9.6	5.1	3	6.9	92	6380
23-Apr-07	Preed crk	48.21006	124.1217	9:20	11	7.9	3.3	2	7.3	95	4122
23-Apr-07	W.Twin	48.16536	123.9557	10:00	12.8	6.9	0	1	8.1	105	58
23-Apr-07	Salt Crk	48.16112	123.7058	10:30	10.7	9.7	6.8	2	7.2	98	8430
05/22/2007*	Salt Crk	48.10071	123.426	6:20	9.8	8.7	1.7	1	7.4	85	2256
05/22/2007*	E.Hoko	48.16484	124.2137	7:55	10.8	9.7	0	1	7.2	96	48
05/22/2007*	Clallam R	48.15285	124.1574	8:20	10	9.5	1.7	2	7	89	2299
05/22/2007*	Pysht (hwy)	48.11413	124.0853	8:55	10.6	10	0	1	7	94	53
05/22/2007*	Pestuary (logyrd)sidechnl	48.12707	124.0664	9:19	9	12.1	13	2	7.2	91	16340
05/22/2007*	Preed crk	48.12609	124.073	9:40	10.9	9.5	1.5	2	7.4	96	2032
05/22/2007*	W.Twin	48.09915	123.5715	10:14	12.2	8.5	0	1	7.4	105	67

Appendix B. WRIA 19 Nearshore Water Quality Data

Date	Location	Lat	Long	Time	DO (mg/l)	Temp (℃)	Salinity (ppt)	Turbidity (NTU)	pH	% O_2 sat	Conductivity (µS/cm)
05/22/2007*	Salt Crk	48.09664	123.4234	10:50	17.8	13.2	2.7	2	8.9	172	3901
06/19/2007*	Salt Crk	48.16112	123.7058	6:25	9.8	10.7	6.5	2	7.8	83	8300
06/19/2007*	E.Hoko	48.27338	124.3561	7:45	10.4	10.7	0.7	1	7.5	94	980000
06/19/2007*	Clallam R	48.25461	124.262	8:09	9.9	10.8	4.6	1	7.4	92	606000
06/19/2007*	Pysht (hwy)	48.19015	124.1425	8:52	9.7	12	0	1	7.3	90	70
06/19/2007*	Pestuary (logyrd)sidechnl	48.21178	124.1104	9:18	9.5	14.5	29.6	8	7.8	112	36510
06/19/2007*	Preed crk	48.21006	124.1217	9:38	9.1	11.3	7.8	3	7.2	88	9960
06/19/2007*	W.Twin	48.16536	123.9557	10:19	10.6	10.6	0.1	1	7.5	96	126
06/19/2007*	Salt Crk	48.16112	123.7058	11:02	11.5	15.1	4.3	1	8.2	118	6300
07/19/2007	Salt Crk	48.16108	123.7058	5:45	5.7	13.2	19.5	2	7.5	61	24250
07/19/2007	E.Hoko	48.27334	124.3563	7:03	9.2	14.9	0.7	1	6.8	92	1073
07/19/2007	Clallam R	48.25487	124.2624	7:30	6.8	12.9	14.8	2	6.8	71	18640
07/19/2007	Pysht (hwy)	48.19031	124.1424	8:11	8.7	15.5	0.1	1	7.2	87	82
07/19/2007	Pestuary (logyrd)sidechnl	48.21175	124.1107	8:38	9.1	14	26.4	2	7.7	103	35
07/19/2007	Preed crk	48.21004	124.1214	9:00	7.4	14.1	14.9	3	7.1	79	19
07/19/2007	W.Twin	48.16539	123.9526	9:39	9.6	14.3	0.1	1	7.4	94	114
07/19/2007	Salt Crk	48.16115	123.7059	10:14	9.6	15.6	6.4	1	7.7	100	9150
08/21/2007	Salt Crk	48.16107	123.7057	717	5.6	14.4	7.7	2	7.5	58	10660
08/21/2007	E.Hoko	48.27329	124.3561	838	9.2	13.8	0	2	7.6	89	75
08/21/2007	Clallam R	48.25465	124.2622	906	8.7	14	1.9	2	7.4	85	2781
08/21/2007	Pysht (hwy)	48.19024	124.1425	937	9.1	14.4	0	1	7.3	89	72
08/21/2007	Pestuary (logyrd)sidechnl	48.2483	124.1107	1001	7.6	13.8	14.9	3	7.3	81	19220
08/21/2007	Preed crk	48.21001	124.1216	10:19	8.2	13.9	6.7	2	7.4	83	9260
08/21/2007	W.Twin	48.16549	123.9526	10:58	10.1	13	0.1	1	7.3	96	80
08/21/2007	Salt Crk	48.16107	123.7057	11:33	11.2	15.7	7.6	2	7.9	118	10770
09/21/2007	Salt Crk	48.16106	123.7058	6:45	7.73	12.64	23.61	2	7.41	83.1	29948
09/21/2007	E.Hoko	48.27338	124.356	7:59	9.81	11.43	0.17	1	7.89	89.9	269
09/21/2007	Clallam R	48.25474	124.2622	8:21	9.24	11.24	0.44	5	7.33	84.8	305
09/21/2007	Pysht (hwy)	48.1903	124.1425	8:52	9.97	11.38	0.05	2	7.45	91.5	76
09/21/2007	Pestuary (logyrd)sidechnl	48.2118	124.1104	9:05	6.58	10.62	20.82	3	7.16	67.3	24411
09/21/2007	Preed crk	48.21009	124.1217	9:24	7.31	10.67	16.67	2	7.31	73.2	20015
09/21/2007	W.Twin	48.16148	123.9526	10:00	10.76	10.91	0.05	1	7.39	96.8	73
09/21/2007	Salt Crk	48.16109	123.7058	10:30	9.93	14.17	26.9	2	7.62	111.9	33590
10/18/2007	Salt Crk	48.16108	123.7058	8:10	4.33	10.22	26.05	1	712	85.5	20335
10/18/2007	E.Hoko	48.16102	124.7057	9:19	9.5	9.09	0.03	3	7.71	82.4	45
10/18/2007	Clallam R	48.25477	124.2622	9:37	9.12	8.72	0.36	9	7.27	78.5	501
10/18/2007	Pysht (hwy)	48.1902	124.1424	10:12	9.45	8.5	0.03	2	7.3	80.9	50
10/18/2007	Pestuary (logyrd)sidechnl	48.212	124.1106	10:28	9.22	8.81	3.63	2	7.21	81.2	4578
10/18/2007	Preed crk	48.21002	124.1218	10:42	8.84	8.58	0.13	2	7.03	75.8	175
10/18/2007	W.Twin	48.16535	124.9526	11:09	9.63	8.06	0.04	1	7.04	81.5	56
10/18/2007	Salt Crk	18.16108	124.7057	11:36	6.82	10.28	27.79	2	7.51	72.7	31142
11/15/2007	Salt Crk	48.1611	123.7058	7:40	7.99	7.89	16.43	2	7.63	73.4	15070
11/15/2007	E.Hoko	48.27321	124.3561	8:50	10.88	8.8	0.03	9	8.15	93.7	42
11/15/2007	Clallam R	48.25465	123.2622	9:10	10.45	8.54	0.04	7	7.49	89.5	65

Appendix B. WRIA 19 Nearshore Water Quality Data

Date	Location	Lat	Long	Time	DO (mg/l)	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	pH	% O_2 sat	Conductivity (µS/cm)
11/15/2007	Pysht (hwy)			9:32	10.62	8.71	0.03	5	7.48	91	43
11/15/2007	Pestuary (logyrd)sidechnl	48.21179	124.1107	9:52	10.26	8.28	1.66	3	7.15	88.5	2147
11/15/2007	Preed crk	48.21022	124.1218	10:06	10.08	8.43	0.03	2	6.98	86	44
11/15/2007	W.Twin	48.16533	123.9528	10:34	11.42	7.93	0.03	3	7.22	97	49
11/15/2007	Salt Crk	48.16101	123.7058	11:05	8.04	7.92	22.58	2	7.15	77.5	23950
12/11/2007	Salt Crk	48.16106	123.7057	7:40	12.01	5.13	3.47	3	7.52	97.6	4080
12/11/2007	E.Hoko	48.27342	124.3552	8:54	12.46	6.69	0.03	9	7.68	101.7	38
12/11/2007	Clallam R	48.25469	124.2621	9:12	12.04	6.16	0.2	7	7.44	96.9	271
12/11/2007	Pysht (hwy)	48.19013	124.1425	9:38	12.93	6.2	0.03	6	7.67	103.8	42
12/11/2007	Pestuary (logyrd)sidechnl	48.21206	124.1107	10:09	11.8	6.2	0.04	3	7.37	94.8	50
12/11/2007	Preed crk	48.21178	124.1107	9:56	12.11	6.22	1.58	4	7.17	98.5	1948
12/11/2007	W.Twin	48.16544	123.9527	10:37	12.93	5.81	0.04	10	7.32	102.7	56
12/11/2007	Salt Crk	48.16105	123.7057	11:07	12.66	5.16	2.13	4	7.19	100.8	2490

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Chinook		Coho		Pink		Chum		Cutthroat		Steelhead		Unknown Juvenile Trout		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (Adult)	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Crescent Beach E																																			
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	10.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	106.9	-	-	-	-	-	-	-	-	-	74.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	10.9	-	-	-	10.9	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	120.0	-	-	-	13.1	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	32.7	-	-	-	-	-	-	-	1,947.7	-	115.6	-	-	-	8.7	-	37.1	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	8.7	-	-	-	-	-	15.3	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	2.2	-	-	-	26.2	-	4,955.3	-	-	-	-	-
	07/30/07	229.0	-	2.2	-	-	-	43.6	-	-	-	-	-	-	-	604.1	-	194.1	-	-	-	4.4	-	128.7	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	67.6	-	-	-	-	-	2.2	-	-	-	-	-	-	-	26.2	-	1,273.7	-	48.0	-	8.7	-	178.8	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	10.9	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	133.0	-	2.2	-	2.2	-	2.2	-	-	-	2.2	-	209.4	-	-	-	-	-
	09/10/07	45.8	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	41.4	-	-	-	2.2	-	30.5	-	-	-	-	-	-	-	-	-	4.4	-
	03/24/08	-	-	-	-	-	-	45.8	-	-	-	-	-	-	-	-	-	218.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	444.9	-	-	-	-	-	-	-	-	-	122.1	-	21.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	525.6	-	554.0	-	-	-	-	-	-	-	-	-	30.5	-	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	6.5	-	181.0	-	1,003.3	-	1,249.7	-	2.2	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	06/30/08	165.8	-	39.3	-	667.4	-	13.1	-	-	-	-	-	-	-	-	-	1,075.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	322.8	-	-	-	-	-
	08/25/08	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.9	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	3,709.9	-	-	-	-	-
Crescent Beach W																																			
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	9.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	2.2	-	-	-	15.3	9.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	6.5	9.3	27.3	38.6	-	-	26.2	12.3	2.2	3.1	-	-	-	-	280.3	393.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	50.2	86.9	-	-	-	-	-	-	-	-	-	-	220.3	381.5	-	-	-	-	2.9	5.0	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	1.1	1.5	-	-	1.1	1.5	-	-	-	-	-	-	1,036.0	1,440.4	1.1	1.5	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	1.1	1.5	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	3.3	4.6	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	4.4	-	2.2	-	-	-	-	-	-	-	-	-	-	-	1,201.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	30.5	-	32.7	-	-	-	30.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	239.9	-	-	-	2.2	-	13.1	-	-	-	-	-
	07/09/07	10.9	-	2.2	-	-	-	2.2	-	-	-	-	-	-	-	2.2	-	4.4	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-
	07/16/07	28.4	-	-	-	-	-	6.5	-	-	-	-	-	-	-	3,446.0	-	-	-	-	-	37.1	-	2.2	-	-	-	2.2	-	34.9	-	-	-	-	-
	07/23/07	3.3	4.6	1.1	1.5	-	-	5.5	1.5	-	-	-	-	-	-	31.6	44.7	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	2.2	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	2.2	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.6	10.8	139.6	197.4	2.2	-	-	-	97.1	97.2	-	-	-	-	16.4	23.1	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28.4	-	80.7	-	-	-	-	-	-	-	-	-	-	-	19.6	-	-	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.0	-	-	-	-	-	-	-	-	-	-	-	10.9	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48.0	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	2.2	-	6.5	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	10.9	-	17.4	-	15.3	-	-	-	-	-	-	-	-	-	-	-	113.4	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Northern Anchovie (juv)		Northern Anchovie (pl)		Sand sole		English sole		Starry Flounder		Speckled Sanddab		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		Snake prickleback		3-Spine stickleback		Shiner perch		Striped Perch		Red tail surf perch		Staghorn sculpin		Cottids Unknown		Juvenile Flat Fish	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Crescent Beach E																																					
	03/12/07	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	4.4	-	-	-	2.2	-	-	-	-	-	-	-	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	19.6	-	-	-	4.4	-	-	-	-	-	-	-	21.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17.4	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	167.9	-	-	-	-	-	4.4	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.1	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	07/02/07	28.4	-	-	-	-	-	13.1	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	8.7	-	-	-	19.6	-	43.6	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	6.5	-	-	-	-	-	2.2	-	-	-	-	-
	07/16/07	6.5	-	-	-	-	-	263.9	-	10.9	-	2.2	-	-	-	-	-	2.2	-	10.9	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	07/30/07	15.3	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	2.2	-	-	-	2.2	-	2.2	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39.3	-	17.4	-	-	-	-	-	15.3	-	10.9	-	-	-	-	-	-	-	-	-
	09/10/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.7	-	13.1	-	-	-	56.7	-	2.2	-	-	-	-	-	13.1	-	2.2	-	-	-
	03/24/08	-	-	-	-	2.2	-	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	2.2	-	-	-	2.2	-
	04/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	-	-	-	-	2.2	-	10.9	-	17.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/30/08	-	-	-	-	2.2	-	91.6	-	-	-	-	-	-	-	-	-	4.4	-	34.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/04/08	-	-	-	-	-	-	19.6	-	-	-	-	-	-	-	-	-	-	-	15.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	17.4	-	30.5	-	-	-	-	-	2.2	-	-	-	-	-	45.8	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	10.9	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-	-	-	15.3	-	-	-	-	-
Crescent Beach W																																					
	03/12/07	-	-	-	-	-	-	-	-	4.4	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	3.1	-	-	-	-
	04/30/07	-	-	-	-	1.1	1.5	-	-	9.8	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	6.2	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	1.5	1.3	-	-	2.9	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	2.5
	05/21/07	-	-	-	-	-	-	1.1	1.5	3.3	1.5	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	3.3	1.5	3.3	4.6	6.5	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.8	13.9	-	-	-	-
	06/04/07	-	-	-	-	27.3	13.9	49.1	69.4	16.4	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.9	3.1	-	-	36.0	50.9
	06/11/07	-	-	-	-	-	-	7.6	7.7	10.9	6.2	-	-	-	-	-	-	1.1	1.5	1.1	1.5	-	-	-	-	-	-	-	-	-	-	14.2	1.5	-	-	-	-
	06/18/07	-	-	-	-	2.2	-	-	-	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.9	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	87.2	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.5	-	-	-	-	-
	07/09/07	-	-	-	-	6.5	-	6.5	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39.3	-	-	-	-	-
	07/16/07	21.8	-	-	-	-	-	85.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	10.9	-	-	-	-	-
	07/23/07	-	-	-	-	5.5	7.7	65.4	21.6	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18.5	4.6	-	-	-	-
	08/13/07	-	-	-	-	-	-	78.5	-	4.4	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	74.2	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	21.8	-	6.5	-	-	-	-	-	-	-	2.2	-	2.2	-	-	-	-	-	-	-	-	-	-	-	106.9	-	-	-	-	-
	09/10/07	-	-	-	-	6.5	-	6.5	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	6.5	-	85.1	-	-	-	-	-
	10/08/07	1.1	1.5	1.1	1.5	-	-	7.6	10.8	-	-	-	-	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-
	10/29/07	-	-	-	-	-	-	1.1	1.5	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	3.1	-	-	-	-
	11/12/07	-	-	-	-	1.1	1.5	-	-	3.3	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	3.3	1.5	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	4.4	-	-	-	-	-
	12/10/07	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	4.4	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Bay Pipefish		Rosylip Sculpin		Buffalo Sculpin		Lingcod		Tidepool Sculpin		Silver Spot Sculpin		Prickley Sculpin		Arrow Goby		Padded Sculpin		Fluffy Sculpin		Kelp greenling		White spotted greenling		Northern Shad		Slipskin snailfish		Tidepool Snailfish		Walleye Pollock		Tom Cod		Pacific Cod	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Crescent Beach E																																					
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	2.2	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15.3	-	-	-	-	-	2.2	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	76.3	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	15.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-
	09/10/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.6	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/30/08	4.4	-	-	-	4.4	-	1,118.9	-	-	-	28.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-
	08/04/08	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	4.4	-	52.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crescent Beach W																																					
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	6.2	-	-	-	-	1.1	1.5	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	1.3	-	-	-	-	-	-	-	-	-	-
	05/21/07	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Plun-Ided		Sharpnose Sculpin	
		avg	stddev	avg	stddev
Crescent Beach E					
	03/12/07	-	-	-	-
	04/09/07	-	-	-	-
	04/30/07	-	-	-	-
	05/21/07	-	-	-	-
	05/28/07	-	-	-	-
	06/04/07	-	-	-	-
	06/11/07	-	-	-	-
	06/18/07	-	-	-	-
	07/02/07	-	-	-	-
	07/09/07	-	-	-	-
	07/16/07	-	-	-	-
	07/30/07	-	-	-	-
	08/13/07	-	-	-	-
	08/27/07	-	-	-	-
	09/10/07	-	-	-	-
	03/24/08	-	-	-	-
	04/07/08	-	-	-	-
	04/21/08	-	-	-	-
	06/02/08	-	-	-	-
	06/30/08	-	-	-	-
	08/04/08	-	-	-	-
	08/25/08	-	-	-	-
	09/22/08	-	-	-	-
Crescent Beach W					
	03/12/07	-	-	-	-
	04/30/07	-	-	-	-
	05/07/07	-	-	-	-
	05/14/07	-	-	-	-
	05/21/07	-	-	-	-
	05/28/07	-	-	-	-
	06/04/07	-	-	-	-
	06/11/07	-	-	-	-
	06/18/07	-	-	-	-
	07/02/07	-	-	-	-
	07/09/07	-	-	-	-
	07/16/07	-	-	-	-
	07/23/07	-	-	-	-
	08/13/07	-	-	-	-
	08/27/07	-	-	-	-
	09/10/07	-	-	-	-
	10/08/07	-	-	-	-
	10/29/07	-	-	-	-
	11/12/07	-	-	-	-
	12/03/07	-	-	-	-
	12/10/07	-	-	-	-
	01/07/08	-	-	-	-
	03/24/08	-	-	-	-
	04/07/08	-	-	-	-
	04/21/08	-	-	-	-
	05/26/08	-	-	-	-

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Chinook		Coho		Pink		Chum		Cutthroat		Steelhead		Unknown Juvenile Trout		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (Adult)	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Crescent Beach W																																			
	06/02/08	-	-	4.4	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	13.1	-	-	-	-	-	-	-	-	-	2.2	-	8.7	-	-	-
	06/16/08	-	-	50.2	-	74.2	-	-	-	-	-	-	-	-	-	137.4	-	244.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/21/08	4.4	3.1	3.3	1.5	3.3	4.6	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/04/08	17.4	21.6	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dungeness Bluffs																																			
	04/30/07	-	-	-	-	-	-	21.8	28.5	-	-	-	-	-	-	14.5	25.2	402.8	697.6	18.9	32.7	-	-	0.7	1.3	-	-	5.8	10.1	-	-	-	-	1.5	2.5
	05/14/07	-	-	-	-	-	-	7.6	7.7	-	-	-	-	-	-	12.0	17.0	-	-	150.5	209.7	-	-	-	-	1.1	1.5	-	-	1.1	1.5	-	-	-	-
	05/21/07	-	-	-	-	-	-	56.7	43.2	-	-	-	-	-	-	3.3	4.6	69.8	18.5	98.1	12.3	1.1	1.5	-	-	1.1	1.5	-	-	4.4	6.2	-	-	-	-
	06/11/07	-	-	5.5	7.7	-	-	2.2	3.1	-	-	-	-	-	-	116.7	103.3	103.6	140.3	-	-	1.1	1.5	4.4	6.2	-	-	-	-	-	-	-	-	1.1	1.5
	06/18/07	26.2	-	15.3	-	-	-	6.5	-	-	-	-	-	-	-	6.5	-	152.7	-	19.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	290.1	-	76.3	-	-	-	157.0	-	111.2	-	-	-	-	-	-	-	2.2	-
	08/06/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	482.0	-	-	-	2.2	-	490.7	-	-	-	-	-	96.0	-	-	-	-	-
	08/20/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	69.8	-	30.5	-	-	-	37.1	-	30.5	-	-	-	-	-	-	-	2.2	-
	09/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	170.1	-	6,416.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/17/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	309.7	-	11,007.6	-	6.5	-	281.4	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	2.2	-	1,145.0	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.9	-	29,487.5	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
Dungeness Spit																																			
	04/30/07	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	116.7	128.0	-	-	-	-	-	-	-	-	-	-	22.9	29.3	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	209.4	296.1	-	-	-	-	-	-	-	-	27.3	38.6	179.9	211.3	-	-	-	-	2.2	3.1	-	-	6.5	9.3	-	-	-	-
	06/11/07	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	38.2	54.0	4.4	6.2	-	-	418.8	465.8	2.2	3.1	-	-	2.2	3.1	-	-	-	-
	06/18/07	-	-	-	-	-	-	19.6	-	-	-	-	-	-	-	-	-	447.1	-	15.3	-	-	-	117.8	-	-	-	-	-	85.1	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	137.4	-	141.8	-	-	-	-	-	111.2	-	21.8	-	-	-	-	-	-	-	-	-
	08/06/07	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	152.7	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/20/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	24.0	-	1,251.9	-	-	-	2.2	-	61.1	-	-	-	-	-	479.8	-	-	-	2.2	-
	09/03/07	10.9	-	-	-	-	-	-	-	-	-	-	-	-	-	80.7	-	3,786.3	-	2.2	-	2.2	-	34.9	-	-	-	-	-	-	-	-	-	285.7	-
	09/17/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	10.9	-	-	-	39.3	-	-	-	-	-	17.4	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-
	10/22/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	231.2	-	787.4	-	-	-	13.1	-	-	-	-	-	259.5	-	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.1	-	353.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ediz Hook																																			
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	9.8	1.5	-	-	-	-	-	-	-	-	9.8	13.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	14.2	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	182.1	155.8	-	-	-	-	84.0	118.8	-	-	1.1	1.5	-	-	78.5	111.0	-	-	14.2	20.0	-	-	-	-	-	-	2.2	3.1	191.9	271.4	-	-	-	-
	06/18/07	39.3	-	28.4	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,317.3	-	-	-	-	-	316.2	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	207.2	-	34.9	-	-	-	-	-	222.5	-	-	-	-	-	137.4	-	-	-	-	-
	08/20/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/17/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,306.4	-	-	-	-	-	1,788.4	-	-	-	-	-	4.4	-	-	-	-	-
	10/22/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.9	-	-	-	111.2	-	-	-	-	-	-	-	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elwha Bluffs																																			
	04/23/07	-	-	-	-	-	-	152.7	-	-	-	-	-	-	-	-	-	126.5	-	1,703.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	38.2	50.9	-	-	-	-	-	-	-	-	28.4	40.1	-	-	-	-	-	-	-	-	-	-	31.6	44.7	-	-	-	-
	05/21/07	-	-	27.3	35.5	-	-	359.9	219.0	-	-	-	-	-	-	39.3	55.5	525.6	391.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	872.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	187.6	-	102.5	-	-	-	69.8	-	-	-	-	-	-	-	-	-	1,112.3	-	2.2	-	-	-	2.2	-	-	-	-	-	4.4	-	-	-	-	-
	07/23/07	100.3	-	-	-	-	-	15.3	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	6.5	-	4.4	-	-	-	13.1	-	-	-	-	-
	08/06/07	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	183.2	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	2.2	-

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Northern Anchovie (juv)		Northern Anchovie (pl)		Sand sole		English sole		Starry Flounder		Speckled Sanddab		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		Snake prickleback		3-Spine stickleback		Shiner perch		Striped Perch		Red tail surf perch		Staghorn sculpin		Cottids Unknown		Juvenile Flat Fish	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Crescent Beach W																																					
	06/02/08	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	06/16/08	-	-	-	-	178.8	-	-	-	19.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.1	-	-	-	-	-
	07/21/08	-	-	-	-	5.5	1.5	26.2	33.9	13.1	12.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38.2	4.6	-	-	-	-
	08/04/08	-	-	-	-	-	-	110.1	41.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.6	9.3	-	-	-	-
	08/25/08	-	-	-	-	-	-	6.5	-	4.4	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.0	-	-	-	-	-
	09/22/08	-	-	-	-	4.4	-	2.2	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	8.7	-	-	-	-	-
Dungeness Bluffs																																					
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	1.3
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	9.8	13.9	-	-	-	-	2.2	3.1	1.1	1.5	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.6	10.8	1.1	1.5	-	-	-	-
	06/11/07	-	-	-	-	36.0	47.8	-	-	-	-	-	-	-	-	-	-	2.2	3.1	1.1	1.5	-	-	-	-	1.1	1.5	-	-	1.1	1.5	1.1	1.5	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	15.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	4.4	-	2.2	-	-	-	-	-
	08/06/07	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/20/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	377.3	-	-	-	-	-	19.6	-	13.1	-	2.2	-	8.7	-	-	-	-	-
	09/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/17/07	-	-	10.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	2.2	-	-	-	2.2	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	10.9	-	-	-	2.2	-	2.2	-	-	-	-	-
	11/05/07	13.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dungeness Spit																																					
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	4.4	6.2	3.3	1.5	-	-	2.2	3.1
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	6.2	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	16.4	17.0	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51.3	72.5	9.8	7.7
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/20/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/17/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	10/22/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ediz Hook																																					
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	1.1	1.5	-	-	-	-	-	-	1.1	1.5	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/20/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/17/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/22/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
Elwha Bluffs																																					
	04/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	1.1	1.5	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	1.1	1.5
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Bay Pipefish		Rosylip Sculpin		Buffalo Sculpin		Lingcod		Tidepool Sculpin		Silver Spot Sculpin		Prickley Sculpin		Arrow Goby		Padded Sculpin		Fluffy Sculpin		Kelp greenling		White spotted greenling		Northern Shad		Slipskin snailfish		Tidepool Snailfish		Walleye Pollock		Tom Cod		Pacific Cod	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Crescent Beach W																																					
	06/02/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-
	06/16/08	-	-	-	-	-	-	2,270.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/21/08	1.1	1.5	-	-	-	-	2.2	3.1	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/04/08	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dungeness Bluffs																																					
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	2.2	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-
	06/11/07	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	1.1	1.5	1.1	1.5	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	08/20/07	-	-	-	-	-	-	-	-	-	-	15.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.5	-	-	-
	09/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/17/07	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	8.7	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dungeness Spit																																					
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	9.3	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/20/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-
	09/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/17/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/22/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ediz Hook																																					
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	6.5	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/20/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/17/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/22/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elwha Bluffs																																					
	04/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	65.4	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Plun-Ided avg	Plun-Ided stddev	Sharpnose Sculpin avg	Sharpnose Sculpin stddev
Crescent Beach W					
	06/02/08	-	-	-	-
	06/16/08	-	-	-	-
	07/21/08	-	-	-	-
	08/04/08	-	-	-	-
	08/25/08	-	-	-	-
	09/22/08	-	-	-	-
Dungeness Bluffs					
	04/30/07	-	-	-	-
	05/14/07	-	-	-	-
	05/21/07	-	-	-	-
	06/11/07	-	-	-	-
	06/18/07	-	-	-	-
	07/23/07	-	-	-	-
	08/06/07	2.2	-	-	-
	08/20/07	10.9	-	-	-
	09/03/07	-	-	-	-
	09/17/07	-	-	-	-
	10/01/07	-	-	-	-
	11/05/07	-	-	-	-
Dungeness Spit					
	04/30/07	-	-	-	-
	05/14/07	-	-	-	-
	05/21/07	-	-	-	-
	06/11/07	-	-	-	-
	06/18/07	-	-	-	-
	07/23/07	-	-	-	-
	08/06/07	-	-	-	-
	08/20/07	2.2	-	-	-
	09/03/07	-	-	-	-
	09/17/07	-	-	-	-
	10/01/07	-	-	-	-
	10/22/07	-	-	-	-
	11/05/07	-	-	-	-
Ediz Hook					
	04/30/07	-	-	-	-
	05/14/07	-	-	-	-
	05/21/07	-	-	-	-
	06/11/07	-	-	-	-
	06/18/07	-	-	-	-
	07/23/07	-	-	-	-
	08/06/07	-	-	-	-
	08/20/07	-	-	-	-
	09/03/07	-	-	-	-
	09/17/07	-	-	-	-
	10/22/07	-	-	-	-
	11/05/07	-	-	-	-
Elwha Bluffs					
	04/23/07	-	-	-	-
	05/14/07	-	-	-	-
	05/21/07	-	-	-	-
	06/11/07	-	-	-	-
	06/18/07	-	-	-	-
	07/23/07	-	-	-	-
	08/06/07	-	-	-	-

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Chinook		Coho		Pink		Chum		Cutthroat		Steelhead		Unknown Juvenile Trout		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (Adult)	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
	08/20/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	2,543.1	-	2.2	-	-	-	6.5	-	-	-	-	-	6.5	-	-	-	2.2	-
	09/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.9	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	09/17/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	8.7	-	43.6	-	-	-	6.5	-	28.4	-	-	-	-	-	2.2	-	-	-	-	-
	10/22/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.9	-	98.1	-	-	-	2,338.1	-	-	-	-	-	-	-	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater Bay																																			
	04/23/07	-	-	13.1	-	-	-	10.9	-	-	-	-	-	-	-	13.1	-	-	-	4.4	-	-	-	-	-	-	-	-	-	85.1	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	100.3	132.6	-	-	-	-	-	-	-	-	-	-	1,134.1	######	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	219.2	220.5	16.4	23.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	410.0	542.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.6	1.5	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	2.2	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	5.5	7.7	-	-	-	-	-	-	-	-	-	-
	07/23/07	66.5	94.1	-	-	-	-	2.2	3.1	-	-	-	-	-	-	728.5	1,027.1	21.8	6.2	-	-	16.4	17.0	32.7	6.2	1.1	1.5	1.1	1.5	895.3	1,266.2	-	-	-	-
	08/06/07	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	887.7	1,255.4	34.9	49.4	-	-	6.5	9.3	25.1	13.9	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	08/27/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	15.3	9.3	1.1	1.5	-	-	-	-	10.9	15.4	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.7	29.3	98.1	135.7	-	-	12.0	17.0	3,381.7	4,400.0	-	-	-	-	1.1	1.5	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	1.5	243.2	325.4	-	-	-	-	315.2	4.6	-	-	-	-	-	-	-	-	29.4	41.6
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	13.1	-	15.3	18.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.6	1.5	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-
	05/26/08	2.2	3.1	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	546.3	772.7	1.1	1.5	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-
	06/02/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/16/08	-	-	13.1	12.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/30/08	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	08/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pysht Shoreline																																			
	05/14/07	-	-	-	-	-	-	72.0	55.5	-	-	-	-	-	-	-	-	-	-	128.7	182.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	10.2	12.0	-	-	-	-	-	-	-	-	88.0	152.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	1.1	1.5	-	-	7.6	10.8	-	-	-	-	-	-	-	-	1,802.6	2,123.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	732.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	10.9	-	4.4	-	-	-	128.7	-	-	-	-	-	-	-	1,542.0	-	28,187.6	-	-	-	4.4	-	-	-	-	-	-	-	4.4	-	-	-	-	-
	07/09/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	85.1	-	1,193.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,076.3	-	14,896.4	-	-	-	2.2	-	6.5	-	-	-	4.4	-	4.4	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	100.3	101.8	1,528.9	166.6	-	-	-	-	614.0	868.3	-	-	-	-	3.3	4.6	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	67.6	74.0	67.6	18.5	-	-	-	-	2.2	3.1	-	-	-	-	8.7	12.3	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.9	27.8	108.0	1.5	-	-	-	-	102.5	145.0	-	-	12.0	17.0	1.1	1.5	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	896.4	-	202.8	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	108.0	124.9	221.4	266.8	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5	7.7	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	15.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	117.8	166.6	6.5	6.2	-	-	9.8	13.9	-	-	-	-	-	-	-	-	1.1	1.5
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	61.1	24.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Northern Anchovie (juv)		Northern Anchovie (pl)		Sand sole		English sole		Starry Flounder		Speckled Sanddab		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		Snake prickleback		3-Spine stickleback		Shiner perch		Striped Perch		Red tail surf perch		Staghorn sculpin		Cottids Unknown		Juvenile Flat Fish	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
	08/20/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/03/07	-	-	-	-	2.2	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/17/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-
	10/22/07	10.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater Bay																																					
	04/23/07	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	21.8	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	1.1	1.5	8.7	12.3	-	-	1.1	1.5	-	-	-	-	8.7	9.3	-	-	-	-	-	-	-	-	2.2	3.1	-	-	17.4	24.7
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	1.1	1.5	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41.4	49.4	1.1	1.5	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	17.4	15.4	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-
	08/06/07	7.6	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-
	08/13/07	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	13.1	15.4	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	3.3	1.5	-	-	-	-	80.7	114.1	-	-	-	-	6.5	9.3	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	5.5	4.6	-	-	-	-
	10/08/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5	1.5	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	1.5	-	-	4.4	3.1	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	1.1	1.5	-	-	-	-	-	-	2.2	3.1	-	-	-	-
	06/02/08	-	-	-	-	-	-	2.2	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/16/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/30/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-
Pysht Shoreline																																					
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52.3	37.0	-	-	1.1	1.5
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.2	7.0	-	-	82.2	70.9
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.6	15.4	-	-	3.3	4.6
	06/04/07	-	-	-	-	-	-	22.9	20.0	2.2	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	116.7	7.7	-	-	5.5	4.6
	06/18/07	-	-	-	-	-	-	20.7	23.1	9.8	10.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39.3	18.5	32.7	46.3	-	-
	06/25/07	-	-	-	-	8.7	-	78.5	-	13.1	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-	-	-	24.0	-	-	-	2.2	-
	07/02/07	4.4	-	-	-	-	-	34.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.9	-	-	-	-	-
	07/09/07	-	-	-	-	8.7	-	176.7	-	30.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37.1	-	-	-	-	-
	07/16/07	13.1	-	-	-	-	-	52.3	-	8.7	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	202.8	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	29.4	17.0	3.3	1.5	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	55.6	20.0	-	-	-	-
	07/30/07	1.1	1.5	-	-	2.2	-	91.6	52.4	3.3	1.5	3.3	4.6	3.3	1.5	7.6	10.8	-	-	3.3	1.5	-	-	-	-	-	-	-	-	-	-	135.2	138.8	-	-	-	-
	08/06/07	-	-	-	-	-	-	656.5	132.6	8.7	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.9	18.5	-	-	-	-
	08/13/07	4.4	-	-	-	-	-	61.1	-	15.3	-	-	-	-	-	6.5	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	41.4	-	-	-	-	-
	08/27/07	-	-	-	-	1.1	1.5	117.8	18.5	36.0	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	206.1	50.9	-	-	-	-
	09/10/07	-	-	-	-	-	-	10.9	15.4	5.5	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25.1	4.6	-	-	-	-
	09/24/07	-	-	-	-	-	-	10.9	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	63.2	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	9.8	10.8	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	24.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	6.2	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Bay Pipefish avg	Bay Pipefish stddev	Rosylip Sculpin avg	Rosylip Sculpin stddev	Buffalo Sculpin avg	Buffalo Sculpin stddev	Lingcod avg	Lingcod stddev	Tidepool Sculpin avg	Tidepool Sculpin stddev	Silver Spot Sculpin avg	Silver Spot Sculpin stddev	Prickley Sculpin avg	Prickley Sculpin stddev	Arrow Goby avg	Arrow Goby stddev	Padded Sculpin avg	Padded Sculpin stddev	Fluffy Sculpin avg	Fluffy Sculpin stddev	Kelp greenling avg	Kelp greenling stddev	White spotted greenling avg	White spotted greenling stddev	Northern Shad avg	Northern Shad stddev	Slipskin snailfish avg	Slipskin snailfish stddev	Tidepool Snailfish avg	Tidepool Snailfish stddev	Walleye Pollock avg	Walleye Pollock stddev	Tom Cod avg	Tom Cod stddev	Pacific Cod avg	Pacific Cod stddev
	08/20/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/03/07	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/17/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/22/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater Bay																																					
	04/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5	7.7	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	5.5	7.7	-	-	-	-	-	-	-	-	1.1	1.5
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	6.2
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/16/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/30/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	4.6	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pysht Shoreline																																					
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	14.2	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.5	-	-	-	-	-	4.4	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Plun-Ided		Sharpnose Sculpin	
		avg	stddev	avg	stddev
	08/20/07	-	-	-	-
	09/03/07	-	-	-	-
	09/17/07	-	-	-	-
	10/22/07	-	-	-	-
	11/05/07	-	-	-	-
Freshwater Bay					
	04/23/07	-	-	-	-
	05/14/07	-	-	-	-
	05/21/07	-	-	-	-
	06/11/07	-	-	-	-
	06/18/07	-	-	-	-
	07/09/07	-	-	-	-
	07/16/07	-	-	-	-
	07/23/07	-	-	-	-
	08/06/07	-	-	-	-
	08/13/07	-	-	-	-
	08/27/07	-	-	-	-
	09/10/07	-	-	-	-
	10/08/07	-	-	-	-
	10/29/07	-	-	-	-
	11/12/07	-	-	-	-
	12/03/07	-	-	-	-
	12/31/07	-	-	-	-
	03/24/08	-	-	-	-
	04/07/08	-	-	-	-
	04/21/08	-	-	-	-
	05/26/08	-	-	-	-
	06/02/08	-	-	-	-
	06/16/08	-	-	-	-
	06/30/08	-	-	-	-
	08/04/08	-	-	-	-
	08/25/08	-	-	-	-
	09/22/08	-	-	-	-
Pysht Shoreline					
	05/14/07	-	-	-	-
	05/21/07	-	-	-	-
	05/28/07	-	-	-	-
	06/04/07	-	-	-	-
	06/18/07	-	-	-	-
	06/25/07	-	-	-	-
	07/02/07	-	-	-	-
	07/09/07	-	-	-	-
	07/16/07	-	-	-	-
	07/23/07	-	-	-	-
	07/30/07	-	-	-	-
	08/06/07	-	-	-	-
	08/13/07	-	-	-	-
	08/27/07	-	-	-	-
	09/10/07	-	-	-	-
	09/24/07	-	-	-	-
	10/08/07	-	-	-	-
	10/29/07	-	-	-	-
	12/10/07	-	-	-	-
	01/07/08	-	-	-	-

Appendix C: Average Density of Fish Species at Shoreline Sites ($fish \times m^{-3} \times 1000$)

Site	Week	Chinook		Coho		Pink		Chum		Cutthroat		Steelhead		Unknown Juvenile Trout		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (Adult)	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.1	-	381.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W Twins Shoreline																																			
	04/16/07	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	5.5	7.7	-	-	-	-	-	-	1,594.3	2,254.7	-	-	3.3	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	13.1	3.1	-	-	-	-	-	-	-	-	8.7	12.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	16.4	23.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	4.4	6.2	-	-	-	-	2.2	3.1	1.1	1.5	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	941.1	1,330.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	615.0	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W Twins Shoreline																																			
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40.4	57.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	317.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,279.9	1,810.1	2,328.7	3,293.2	-	-	-	-	43.3	61.3	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.6	16.7	57.8	100.1	-	-	-	-	1.9	3.3	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	5.8	8.2	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52.0	73.5	161.8	188.0	-	-	14.4	20.4	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28.9	40.9	-	-	20.2	28.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	15.3	-	-	-	4.4	-	4,000.0	-	-	-	-	-	-	-	-	-	8,375.1	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.5	33.9	134.1	186.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41.4	-	1,234.5	-	388.2	-	-	-	8.7	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	34.9	-	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Northern Anchovie (juv)		Northern Anchovie (pl)		Sand sole		English sole		Starry Flounder		Speckled Sanddab		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		Snake prickleback		3-Spine stickleback		Shiner perch		Striped Perch		Red tail surf perch		Staghorn sculpin		Cottids Unknown		Juvenile Flat Fish	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
	02/11/08	-	-	-	-	-	-	6.5	-	8.7	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W Twins Shoreline																																					
	04/16/07	-	-	-	-	-	-	-	-	-	-	-	-	3.3	1.5	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	5.5	7.7	-	-	-	-	1.1	1.5
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	4.4	6.2	3.3	4.6	5.5	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1
	05/28/07	-	-	-	-	-	-	-	-	2.2	3.1	-	-	2.2	3.1	1.1	1.5	7.6	1.5	1.1	1.5	-	-	-	-	-	-	-	-	14.2	20.0	-	-	-	-	2.2	3.1
	06/04/07	-	-	-	-	1.1	1.5	8.7	12.3	3.3	4.6	-	-	2.2	3.1	5.5	1.5	43.6	58.6	1.1	1.5	-	-	-	-	-	-	2.2	3.1	3.3	4.6	2.2	3.1	-	-	-	-
	06/11/07	-	-	-	-	117.8	166.6	-	-	16.4	23.1	-	-	5.5	7.7	15.3	21.6	18.5	13.9	16.4	17.0	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	1.1	1.5
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	10.9	-	-	-	8.7	-	6.5	-	58.9	-	48.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	5.8	-	-	-	5.8	-	-	-	34.7	-	-	-	202.2	-	5.8	-	-	-	-	-	-	-	17.3	-	5.8	-	-	-	5.8	-	-	-
W Twins Shoreline																																					
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	5.8	8.2	-	-	26.0	36.8	-	-	-	-	-	-	-	-	92.5	24.5	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.8	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	5.8	8.2	2.9	4.1	-	-	-	-	2.9	4.1	2.9	4.1	2.9	4.1	-	-	-	-	14.4	12.3	8.7	12.3	-	-	2.9	4.1	-	-	-	-
	07/30/07	-	-	-	-	3.9	6.7	5.8	10.0	3.9	6.7	-	-	9.6	12.0	19.3	33.4	11.6	15.3	7.7	13.3	-	-	-	-	3.9	6.7	27.0	41.8	11.6	15.3	5.8	10.0	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	418.9	592.5	-	-	-	-	5.8	8.2	-	-
	08/13/07	-	-	-	-	-	-	54.9	77.6	-	-	-	-	23.1	32.7	89.6	118.5	66.5	28.6	54.9	69.5	-	-	-	-	-	-	57.8	65.4	2.9	4.1	-	-	5.8	8.2	-	-
	08/27/07	-	-	-	-	28.9	40.9	161.8	228.8	-	-	-	-	118.5	167.5	208.0	294.2	89.6	77.6	202.2	269.7	-	-	-	-	-	-	37.6	12.3	-	-	5.8	8.2	-	-	-	-
	09/10/07	-	-	-	-	-	-	8.7	12.3	-	-	-	-	20.2	28.6	20.2	28.6	57.8	49.0	37.6	44.9	-	-	-	-	5.8	8.2	23.1	-	23.1	32.7	-	-	2.9	4.1	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.7	12.3	2.9	4.1	-	-	-	-	2.9	4.1	23.1	24.5	-	-	-	-	-	-	-	-
	10/08/07	15.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.7	-	67.6	-	-	-	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Bay Pipefish		Rosylip Sculpin		Buffalo Sculpin		Lingcod		Tidepool Sculpin		Silver Spot Sculpin		Prickley Sculpin		Arrow Goby		Padded Sculpin		Fluffy Sculpin		Kelp greenling		White spotted greenling		Northern Shad		Slipskin snailfish		Tidepool Snailfish		Walleye Pollock		Tom Cod		Pacific Cod	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W Twins Shoreline																																					
	04/16/07	-	-	2.2	3.1	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	16.4	13.9	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	14.2	7.7	3.3	4.6	1.1	1.5	1.1	1.5	1.1	1.5	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	54.5	55.5	7.6	7.7	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	200.7	280.7	13.1	18.5	-	-	1.1	1.5	3.3	1.5	-	-	-	-	7.6	10.8	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	17.4	-	24.0	-	-	-	-	-	15.3	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	86.7	-	306.3	-	-	-	5.8	-	5.8	-	-	-	-	-	-	-	5.8	-	-	-	-	-	-	-	28.9	-	-	-	-	-	-	-	-	-
W Twins Shoreline																																					
	07/09/07	-	-	11.6	8.2	14.4	20.4	-	-	-	-	2.9	4.1	-	-	-	-	5.8	8.2	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.8	-	-	-	-	-	-	-	5.8	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	11.6	15.3	32.7	56.7	-	-	15.4	14.5	-	-	-	-	-	-	-	-	1.9	3.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	5.8	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	193.6	273.8	8.7	12.3	-	-	8.7	4.1	5.8	8.2	-	-	-	-	8.7	4.1	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	121.3	163.4	101.1	134.8	-	-	11.6	16.3	-	-	-	-	-	-	98.2	138.9	20.2	20.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	193.6	151.2	26.0	36.8	-	-	8.7	4.1	-	-	-	-	-	-	11.6	8.2	28.9	32.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	11.6	16.3	-	-	-	-	-	-	2.9	4.1	-	-	-	-	5.8	-	2.9	4.1	-	-	-	-	-	-	2.9	4.1	8.7	12.3	-	-	-	-	-	-
	10/08/07	-	-	-	-	2.2	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/05/07	-	-	-	-	1.1	1.5	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix C: Average Density of Fish Species at Shoreline Sites (fish×m^{-3}×1000)

Site	Week	Plun-Ided		Sharpnose Sculpin	
		avg	stddev	avg	stddev
	02/11/08	-	-	-	-
W Twins Shoreline					
	04/16/07	-	-	-	-
	05/07/07	-	-	-	-
	05/14/07	-	-	-	-
	05/21/07	-	-	-	-
	05/28/07	-	-	-	-
	06/04/07	-	-	-	-
	06/11/07	-	-	-	-
	06/18/07	-	-	-	-
	06/25/07	-	-	-	-
	07/02/07	-	-	-	-
W Twins Shoreline					
	07/09/07	-	-	-	-
	07/16/07	-	-	-	-
	07/23/07	-	-	-	-
	07/30/07	-	-	-	-
	08/06/07	-	-	-	-
	08/13/07	-	-	-	-
	08/27/07	-	-	-	-
	09/10/07	-	-	11.6	8.2
	09/24/07	-	-	8.7	12.3
	10/08/07	-	-	4.4	-
	11/05/07	-	-	-	-
	11/12/07	-	-	-	-
	12/03/07	-	-	-	-
	01/07/08	-	-	-	-
	02/11/08	-	-	-	-

Appendix D: Average Density of Fish Species at Elwha Sites (fish×m^{-3}×1000)

Site	Week	Chinook		Coho		Pink		Chum		Cutthroat		Steelhead		juvenile trout		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (Adult)	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Dudley's Pond																																			
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elwha W Side Channel																																			
	03/12/07	-	-	-	-	-	-	91.6	120.3	-	-	-	-	-	-	-	-	-	-	41.4	58.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	78.5	111.0	-	-	-	-	25.1	13.9	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	137.4	194.3	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	285.7	401.0	46.9	66.3	-	-	7.6	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	134.1	189.7	7.6	10.8	-	-	9.8	13.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	85.1	114.1	129.8	183.5	-	-	2.2	-	2.2	3.1	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	315.2	445.7	100.3	141.9	-	-	15.3	9.3	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	924.5	-	242.7	-	-	-	75.1	-	17.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	168.2	129.9	28.6	25.0	-	-	29.8	25.8	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	346.7	-	11.6	-	-	-	11.6	-	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	474.7	440.0	2.9	4.1	-	-	-	-	11.6	16.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	606.7	-	75.1	-	-	-	-	-	23.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	301.2	268.6	-	-	-	-	-	-	21.3	27.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	208.9	227.6	3.3	4.6	-	-	-	-	34.7	49.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	161.3	147.9	-	-	-	-	-	-	24.2	31.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	93.1	23.7	-	-	-	-	-	-	54.9	77.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	54.9	53.1	-	-	-	-	-	-	2.9	4.1	5.8	8.2	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	86.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	8.7	12.3	-	-	-	-	-	-	-	-	-	-	15.3	21.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	2.2	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	1.1	1.5	-	-	-	-	-	-	-	-	1.1	1.5	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	1.1	1.5	-	-	-	-	-	-	2.2	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.9	15.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	31.6	44.7	4.4	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	14.2	20.0	-	-	-	-	41.4	58.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	210.5	294.6	10.9	15.4	-	-	7.6	7.7	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	199.6	282.2	274.8	388.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/05/08	90.5	128.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	352.5	-	23.1	-	-	-	156.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	124.7	142.4	1.1	1.5	-	-	75.2	81.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/23/08	2,005.1	2,835.6	2.9	4.1	-	-	-	-	8.7	12.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/30/08	395.5	543.9	-	-	-	-	-	-	5.8	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/21/08	837.9	1,184.9	2.9	4.1	-	-	-	-	20.2	28.6	-	-	52.0	73.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/04/08	260.0	367.7	-	-	-	-	-	-	2.9	4.1	-	-	66.5	94.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	2.9	4.1	-	-	-	-	-	-	2.9	4.1	-	-	20.2	28.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	205.1	290.1	2.9	4.1	-	-	-	-	14.4	20.4	2.9	4.1	26.0	36.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix D: Average Density of Fish Species at Elwha Sites (fish×m^{-3}×1000)

Site	Week	Northern Anchovie (ju		Northern Anchovie (pl		English sole		Starry Flounder		Speckled Sanddab		Crescent gunnel		Saddleback gunne		Penpoint gunnel		Tubesnout		Snake pricklebac		3-Spine stickleback		Shiner perch		Striped Perch		Red tail surf perch		Staghorn sculpin		Cottids Unknown		Juvenile Flat Fish		Lingcod		Silver Spot Sculpin		Prickley Sculpin		Kelp greenling	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Dudley's Pond																																											
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.6	9.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	92.7	75.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	124.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75.2	54.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44.7	29.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,452.6	1,878.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	725.2	970.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29.4	17.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elwha W Side Channel																																											
	03/12/07	-	-	-	-	-	-	8.7	3.1	-	-	-	-	-	-	-	-	-	-	-	-	3.3	1.5	-	-	-	-	-	-	1.1	1.5	45.8	40.1	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	15.3	12.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5	1.5	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	-	-	13.1	15.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	5.5	7.7	-	-	-	-	-	-	-	-	-	-	-	-	6.5	9.3	-	-	-	-	-	-	4.4	-	6.5	9.3	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	8.7	12.3	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	77.4	####	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	10.9	15.4	-	-	-	-	-	-	-	-	-	-	-	-	4.4	6.2	-	-	-	-	-	-	57.8	72.5	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	5.5	7.7	-	-	-	-	-	-	-	-	-	-	-	-	22.9	32.4	-	-	-	-	-	-	37.1	33.9	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	34.7	-	-	-	-	-	-	-	-	-	-	-	-	-	231.1	-	-	-	-	-	-	-	23.1	-	-	-	###	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	34.7	49.0	25.7	20.9	-	-	-	-	-	-	-	-	-	-	-	-	67.3	27.4	-	-	-	-	-	-	38.1	4.8	-	-	1.1	1.5	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	28.9	-	-	-	-	-	-	-	-	-	-	-	-	-	329.4	-	-	-	-	-	-	-	40.4	-	-	-	###	-	-	-	-	-	40.4	-	-	-
	06/18/07	-	-	-	-	-	-	104.0	147.1	-	-	-	-	-	-	-	-	-	-	-	-	511.4	723.2	-	-	-	-	-	-	69.9	15.6	-	-	-	-	-	-	-	-	17.3	24.5	-	-
	06/25/07	-	-	-	-	-	-	184.9	-	-	-	-	-	-	-	-	-	-	-	-	-	554.7	-	-	-	-	-	-	-	####	-	-	-	-	-	-	-	-	-	23.1	-	-	-
	07/02/07	-	-	-	-	-	-	121.3	171.6	-	-	-	-	-	-	-	-	-	-	-	-	592.3	837.6	-	-	-	-	-	-	####	47.5	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	132.9	188.0	-	-	-	-	1.1	1.5	-	-	-	-	-	-	352.5	498.5	-	-	-	-	-	-	####	####	-	-	-	-	-	-	-	-	23.1	32.7	-	-
	07/16/07	-	-	-	-	-	-	86.7	122.6	-	-	-	-	1.1	1.5	-	-	-	-	-	-	205.1	290.1	-	-	-	-	-	-	14.1	4.5	-	-	2.9	4.1	-	-	-	-	2.9	4.1	-	-
	07/23/07	-	-	-	-	-	-	106.9	151.2	-	-	1.1	1.5	-	-	-	-	-	-	-	-	801.4	1,130.3	-	-	-	-	-	-	74.8	73.1	-	-	-	-	-	-	-	-	46.2	65.4	-	-
	07/30/07	-	-	-	-	-	-	164.7	232.9	-	-	-	-	2.9	4.1	-	-	-	-	-	-	1,756.6	2,484.2	-	-	-	-	-	-	34.7	24.5	-	-	-	-	-	-	-	-	121.3	171.6	-	-
	08/06/07	-	-	-	-	-	-	254.2	-	-	-	-	-	-	-	-	-	-	-	-	-	3,865.7	-	-	-	-	-	-	-	28.9	-	-	-	-	-	-	-	-	-	57.8	-	-	-
	08/13/07	-	-	-	-	-	-	27.3	38.6	-	-	-	-	-	-	-	-	-	-	-	-	534.4	755.7	-	-	-	-	-	-	10.9	-	-	-	-	-	-	-	-	-	13.1	18.5	-	-
	08/27/07	-	-	-	-	-	-	28.4	-	-	-	-	-	-	-	-	-	-	-	-	-	569.2	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	15.3	-	-	-
	09/10/07	-	-	-	-	-	-	21.8	30.8	-	-	-	-	2.2	3.1	-	-	-	-	-	-	605.2	855.9	2.2	3.1	-	-	-	-	6.5	3.1	27.3	38.6	-	-	-	-	-	-	18.5	26.2	-	-
	09/24/07	-	-	-	-	-	-	8.7	12.3	-	-	-	-	-	-	-	-	-	-	-	-	1,801.5	2,547.7	1.1	1.5	-	-	-	-	22.9	32.4	-	-	-	-	-	-	-	-	8.7	12.3	-	-
	10/01/07	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	8.7	12.3	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	19.6	27.8	-	-	-	-	-	-	-	-	-	-	-	-	6,492.9	9,182.4	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16.4	23.1	-	-
	11/12/07	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	1.1	1.5	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	4.4	6.2	-	-
	12/03/07	-	-	-	-	-	-	1.1	1.5	-	-	-	-	5.5	7.7	-	-	-	-	-	-	17.4	21.6	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	9.8	10.8	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5	1.5	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25.1	4.6	-	-	-	-	-	-	-	-	2.2	3.1	-	-
	04/21/08	-	-	-	-	-	-	8.7	12.3	-	-	-	-	-	-	-	-	-	-	-	-	89.4	126.5	-	-	-	-	-	-	80.7	70.9	21.8	30.8	-	-	-	-	-	-	-	-	-	-
	05/05/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29.4	41.6	-	-	-	-	-	-	####	17.0	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	-	-	-	-	46.2	-	-	-	-	-	-	-	-	-	-	-	-	-	75.1	-	-	-	-	-	-	-	####	-	-	-	###	-	-	-	-	-	-	-	-	-
	06/02/08	-	-	-	-	78.0	####	26.0	36.8	-	-	-	-	-	-	-	-	-	-	-	-	20.2	28.6	-	-	-	-	-	-	####	####	-	-	8.7	###	-	-	-	-	14.4	20.4	-	-
	06/23/08	-	-	-	-	-	-	72.2	94.0	-	-	-	-	-	-	-	-	-	-	-	-	707.8	1,001.0	-	-	-	-	-	-	78.0	69.5	-	-	-	-	-	-	-	-	8.7	12.3	-	-
	06/30/08	-	-	-	-	-	-	69.3	98.1	-	-	-	-	-	-	-	-	-	-	-	-	375.6	531.2	-	-	-	-	-	-	30.0	14.7	-	-	-	-	-	-	-	-	2.9	4.1	-	-
	07/21/08	-	-	-	-	-	-	57.8	81.7	-	-	-	-	-	-	-	-	-	-	-	-	453.6	641.5	-	-	-	-	-	-	11.6	16.3	-	-	-	-	-	-	-	-	2.9	4.1	-	-
	08/04/08	-	-	-	-	-	-	84.9	116.9	-	-	-	-	-	-	-	-	-	-	-	-	1,164.3	1,646.6	-	-	-	-	-	-	6.5	9.3	-	-	-	-	-	-	-	-	5.8	8.2	-	-
	08/25/08	-	-	-	-	-	-	69.3	98.1	-	-	-	-	-	-	-	-	-	-	-	-	829.2	1,172.7	-	-	-	-	-	-	36.5	30.1	-	-	-	-	-	-	-	-	2.9	4.1	-	-
	09/22/08	-	-	-	-	-	-	18.4	23.0	-	-	-	-	-	-	-	-	-	-	-	-	1,353.2	1,910.7	-	-	-	-	-	-	48.9	4.4	-	-	-	-	-	-	-	-	28.9	40.9	-	-

Appendix D: Average Density of Fish Species at Elwha Sites (fish$\times$m^{-3}$\times$1000)

Site	Week	Northern Shad avg	Northern Shad stddev	Walleye Pollock avg	Walleye Pollock stddev	Tom Cod avg	Tom Cod stddev	Pacific Cod avg	Pacific Cod stddev	Sharpnose Sculpin avg	Sharpnose Sculpin stddev
Dudley's Pond											
	04/09/07	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-
Elwha W Side Channel											
	03/12/07	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	4.4	3.1
	12/31/07	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-
	05/05/08	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	-	-	-	-	-	-	-	-
	06/02/08	-	-	-	-	-	-	-	-	-	-
	06/23/08	-	-	-	-	-	-	-	-	-	-
	06/30/08	-	-	-	-	-	-	-	-	-	-
	07/21/08	-	-	-	-	-	-	-	-	-	-
	08/04/08	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-

Appendix D: Average Density of Fish Species at Elwha Sites ($fish \times m^{-3} \times 1000$)

Site	Week	Chinook		Coho		Pink		Chum		Cutthroat		Steelhead		juvenile trout		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (Adult)	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Freshwater Bay																																					
	04/23/07	-	-	13.1	-	-	-	10.9	-	-	-	-	-	-	-	13.1	-	-	-	4.4	-	-	-	-	-	-	-	-	-	85.1	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	100.3	132.6	-	-	-	-	-	-	-	-	-	-	1,134.1	1,542.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	219.2	220.5	16.4	23.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	410.0	542.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.6	1.5	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	2.2	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	5.5	7.7	-	-	-	-	-	-	-	-	-	-
	07/23/07	66.5	94.1	-	-	-	-	2.2	3.1	-	-	-	-	-	-	728.5	1,027.1	21.8	6.2	-	-	16.4	17.0	32.7	6.2	1.1	1.5	1.1	1.5	895.3	1,266.2	-	-	-	-
	08/06/07	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	887.7	1,255.4	34.9	49.4	-	-	6.5	9.3	25.1	13.9	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	08/27/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	15.3	9.3	1.1	1.5	-	-	-	-	10.9	15.4	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.7	29.3	98.1	135.7	-	-	12.0	17.0	3,381.7	4,400.0	-	-	-	-	1.1	1.5	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	1.5	243.2	325.4	-	-	-	-	315.2	4.6	-	-	-	-	-	-	-	-	29.4	41.6
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.1	-	15.3	18.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.6	1.5	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-
	05/26/08	2.2	3.1	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	546.3	772.7	1.1	1.5	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-
	06/02/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/16/08	-	-	13.1	12.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/30/08	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	08/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix D: Average Density of Fish Species at Elwha Sites (fish×m^{-3}×1000)

Site	Week	Northern Anchovie (ju		Northern Anchovie (p		English sole		Starry Flounder		Speckled Sanddab		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		Snake pricklebac		3-Spine stickleback		Shiner perch		Striped Perch		Red tail surf perch		Staghorn sculpin		Cottids Unknown		Juvenile Flat Fish		Lingcod		Silver Spot Sculpin		Prickley Sculpin		Kelp greenling	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Freshwater Bay																																											
	04/23/07	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	21.8	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	1.1	1.5	8.7	###	-	-	1.1	1.5	-	-	-	-	8.7	9.3	-	-	-	-	-	-	-	-	2.2	3.1	-	-	###	###	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	1.1	1.5	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41.4	49.4	1.1	1.5	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	17.4	15.4	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	7.6	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	1.1	1.5	-	-	-	-
	08/13/07	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	13.1	15.4	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	3.3	1.5	-	-	-	-	80.7	####	-	-	-	-	6.5	9.3	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	5.5	4.6	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5	1.5	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	1.5	-	-	4.4	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-
	04/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	1.1	1.5
	05/26/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	1.1	1.5	-	-	-	-	-	-	2.2	3.1	-	-	-	-	1.1	1.5	-	-	-	-	-	-
	06/02/08	-	-	-	-	2.2	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/16/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/30/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix D: Average Density of Fish Species at Elwha Sites (fish×m^{-3}×1000)

Site	Week	Northern Shad avg	Northern Shad stddev	Walleye Pollock avg	Walleye Pollock stddev	Tom Cod avg	Tom Cod stddev	Pacific Cod avg	Pacific Cod stddev	Sharpnose Sculpin avg	Sharpnose Sculpin stddev
Freshwater Bay											
	04/23/07	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	5.5	7.7	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-
	08/06/07	5.5	7.7	-	-	-	-	1.1	1.5	-	-
	08/13/07	-	-	-	-	-	-	4.4	6.2	-	-
	08/27/07	-	-	-	-	2.2	3.1	-	-	-	-
	09/10/07	1.1	1.5	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	-	-	-	-	-	-	-	-
	06/02/08	-	-	-	-	-	-	-	-	-	-
	06/16/08	-	-	-	-	-	-	-	-	-	-
	06/30/08	-	-	-	-	-	-	-	-	-	-
	08/04/08	-	-	-	-	3.3	4.6	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-

Appendix E: Average Length of Fish Species at Elwha Sites (mm)

Site	Week	Chinook (fork) avg	Chinook (fork) stddev	Coho (fork) avg	Coho (fork) stddev	Pink (fork) avg	Pink (fork) stddev	Chum (fork) avg	Chum (fork) stddev	Cutthroat (fork) avg	Cutthroat (fork) stddev	Steelhead (fork) avg	Steelhead (fork) stddev	Bull Trout (fork) avg	Bull Trout (fork) stddev	Unknown Juvenile Trout (fork) avg	Unknown Juvenile Trout (fork) stddev
Dudley's Pond																	
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	385	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	76	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elwha W Side Channel																	
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	55	9	-	-	-	-	44	5	-	-	-	-	-	-	-	-
	04/16/07	57	8	-	-	-	-	40	1	-	-	-	-	-	-	-	-
	04/23/07	59	4	130	11	-	-	45	8	-	-	-	-	-	-	-	-
	04/30/07	65	11	111	20	-	-	48	3	-	-	-	-	-	-	-	-
	05/07/07	66	14	134	9	-	-	55	21	-	-	247	72	-	-	-	-
	05/21/07	78	25	122	14	-	-	48	8	173	-	-	-	-	-	-	-
	05/28/07	76	6	113	17	-	-	56	5	196	43	-	-	-	-	-	-
	06/04/07	79	7	108	19	-	-	56	5	150	-	-	-	-	-	-	-
	06/11/07	84	7	91	11	-	-	55	4	43	-	-	-	-	-	-	-
	06/18/07	76	7	59	-	-	-	-	-	33	1	-	-	-	-	-	-
	06/25/07	78	5	75	8	-	-	-	-	34	2	-	-	-	-	-	-
	07/02/07	78	8	-	-	-	-	-	-	34	3	-	-	-	-	-	-
	07/09/07	79	6	89	5	-	-	-	-	36	4	-	-	-	-	-	-
	07/16/07	83	10	-	-	-	-	-	-	29	4	-	-	-	-	-	-
	07/23/07	86	10	-	-	-	-	-	-	33	3	-	-	-	-	-	-
	07/30/07	80	8	-	-	-	-	-	-	32	-	36	2	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	6
	08/13/07	86	4	-	-	-	-	-	-	-	-	-	-	-	-	40	4
	08/27/07	65	-	-	-	-	-	-	-	-	-	-	-	-	-	51	2
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	60	-	-	-	-	-	-	-
	11/12/07	740	-	-	-	-	-	-	-	-	-	-	-	-	-	88	-
	12/03/07	-	-	78	-	-	-	-	-	-	-	413	491	315	-	-	-
	12/31/07	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38	-
	03/24/08	45	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	159	34	109	28	-	-	40	2	-	-	-	-	-	-	-	-
	04/21/08	97	46	139	14	-	-	-	-	-	-	-	-	-	-	-	-
	05/05/08	53	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	69	12	77	40	-	-	63	9	-	-	-	-	-	-	-	-
	06/02/08	72	16	-	-	-	-	61	9	-	-	-	-	-	-	-	-
	06/23/08	83	6	135	-	-	-	57	-	138	84	-	-	-	-	-	-
	06/30/08	87	6	-	-	-	-	-	-	148	2	-	-	-	-	-	-
	07/21/08	101	6	107	-	-	-	-	-	170	45	-	-	147	-	34	4
	08/04/08	91	10	-	-	-	-	-	-	124	-	-	-	-	-	36	6
	08/25/08	79	-	-	-	-	-	-	-	190	-	-	-	-	-	48	11
	09/22/08	103	11	105	-	-	-	-	-	170	29	83	-	-	-	62	8

Site	Week	Smelt (adult) avg	Smelt (adult) stddev	Smelt (juv) avg	Smelt (juv) stddev	Smelt (pl) avg	Smelt (pl) stddev	Herring (adult) avg	Herring (adult) stddev	Herring (juv) avg	Herring (juv) stddev	Herring (pl) avg	Herring (pl) stddev	Sand lance (adult) avg	Sand lance (adult) stddev	Sand lance (juv) avg	Sand lance (juv) stddev	Sand Lance (pl) avg	Sand Lance (pl) stddev	Northern Anchovie (adult) avg	Northern Anchovie (adult) stddev	Northern Anchovie (juv) avg	Northern Anchovie (juv) stddev	Northern Anchovie (pl) avg	Northern Anchovie (pl) stddev	English sole avg	English sole stddev
Dudley's Pond																											
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elwha W Side Channel																											
	03/12/07	-	-	-	-	43	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	113	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	5
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	162	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	102	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	78	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	71	14	47	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	74	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/05/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27	-
	06/23/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/30/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix E: Average Length of Fish Species at Elwha Sites (mm)

Site	Week	Starry Flounder		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		Snake prickleback		3-Spine stickleback		Shiner perch		Staghorn sculpin		cottids unknown		Juv Flat Fish		Lingcod		Red tail surf perch		Striped perch		Kelp greenling		Silver spot sculpin		Prickley Sculpin		Northern Shad		Walleye Pollock		Tom Cod		Pacific Cod	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Dudley's Pond																																											
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	36	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	36	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	-	-	-	-	-	-	-	-	41	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	-	-	-	-	-	-	44	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	40	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	41	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	42	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	57	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	46	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	43	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elwha W Side Channel																																											
	03/12/07	116	35	-	-	-	-	-	-	-	-	-	-	37	18	-	-	78	-	28	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	112	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	117	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	88	9	-	-	-	-	-	-	-	-	-	-	49	6	-	-	58	11	34	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	105	29	-	-	-	-	-	-	-	-	-	-	43	4	-	-	40	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	111	27	-	-	-	-	-	-	-	-	-	-	48	12	-	-	59	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	85	32	-	-	-	-	-	-	-	-	-	-	54	4	-	-	55	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	103	13	-	-	-	-	-	-	-	-	-	-	54	4	-	-	74	11	-	-	27	6	-	-	-	-	-	-	-	-	-	-	51	2	-	-	-	-	-	-	-	-
	06/04/07	53	37	-	-	-	-	-	-	-	-	-	-	52	6	-	-	60	15	-	-	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	88	33	-	-	-	-	-	-	-	-	-	-	52	7	-	-	107	25	-	-	30	4	-	-	-	-	-	-	-	-	-	-	60	10	-	-	-	-	-	-	-	-
	06/18/07	41	23	-	-	-	-	-	-	-	-	-	-	56	8	-	-	73	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	64	8	-	-	-	-	-	-	-	-
	06/25/07	34	8	-	-	-	-	-	-	-	-	-	-	55	6	-	-	97	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	54	28	-	-	-	-	-	-	-	-
	07/02/07	38	5	-	-	-	-	-	-	-	-	-	-	54	5	-	-	93	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	43	17	-	-	104	-	-	-	-	-	-	-	53	8	-	-	90	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	69	14	-	-	-	-	-	-	-	-
	07/16/07	43	4	-	-	129	-	-	-	-	-	-	-	55	4	-	-	86	13	-	-	17	-	-	-	-	-	-	-	-	-	-	-	33	-	-	-	-	-	-	-	-	-
	07/23/07	48	8	106	-	-	-	-	-	-	-	-	-	46	15	-	-	98	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67	24	-	-	-	-	-	-	-	-
	07/30/07	56	11	-	-	80	-	-	-	-	-	-	-	36	15	-	-	99	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	106	23	-	-	-	-	-	-	-	-
	08/06/07	49	12	-	-	-	-	-	-	-	-	-	-	41	12	-	-	126	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	105	26	-	-	-	-	-	-	-	-
	08/13/07	47	11	-	-	-	-	-	-	-	-	-	-	40	9	-	-	112	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	37	-	-	-	-	-	-	-	-
	08/27/07	54	9	-	-	-	-	-	-	-	-	-	-	35	10	-	-	118	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	20	-	-	-	-	-	-	-	-
	09/10/07	57	6	-	-	132	15	-	-	-	-	-	-	30	10	61	2	125	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	30	-	-	-	-	-	-	-	-
	09/24/07	52	11	-	-	-	-	-	-	-	-	-	-	34	9	92	-	133	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52	25	-	-	-	-	-	-	-	-
	10/01/07	39	-	-	-	-	-	-	-	-	-	-	-	40	10	-	-	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	53	10	-	-	-	-	-	-	-	-	-	-	37	8	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	7	-	-	-	-	-	-	-	-
	11/12/07	51	10	-	-	-	-	-	-	-	-	-	-	36	4	85	-	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46	13	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	120	22	-	-	-	-	-	-	37	4	-	-	51	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	108	57	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	83	14	-	-	-	-	-	-	-	-	-	-	38	6	-	-	37	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42	16	-	-	-	-	-	-	-	-
	04/21/08	94	18	-	-	-	-	-	-	-	-	-	-	44	6	-	-	42	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/05/08	85	37	-	-	-	-	-	-	-	-	-	-	44	7	-	-	45	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	138	130	-	-	-	-	-	-	-	-	-	-	43	6	-	-	48	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	65	45	-	-	-	-	-	-	-	-	-	-	50	6	-	-	73	111	-	-	40	-	-	-	-	-	-	-	-	-	-	-	44	5	-	-	-	-	-	-	-	-
	06/23/08	66	37	-	-	-	-	-	-	-	-	-	-	55	5	-	-	52	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75	25	-	-	-	-	-	-	-	-
	06/30/08	59	34	-	-	-	-	-	-	-	-	-	-	52	5	-	-	74	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/21/08	57	15	-	-	-	-	-	-	-	-	-	-	55	5	-	-	86	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/04/08	73	29	-	-	-	-	-	-	-	-	-	-	53	6	-	-	90	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	72	-	-	-	-	-	-	-	-	-
	08/25/08	71	17	-	-	-	-	-	-	-	-	-	-	51	11	-	-	90	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86	-	-	-	-	-	-	-	-	-
	09/22/08	89	23	-	-	-	-	-	-	-	-	-	-	55	10	-	-	120	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	92	11	-	-	-	-	-	-	-	-

Appendix E: Average Length of Fish Species at Elwha Sites (mm)

Site	Week	Chinook (fork)		Coho (fork)		Pink (fork)		Chum (fork)		Cutthroat (fork)		Steelhead (fork)		Bull Trout (fork)		Unknown Juvenile Trout (fork)		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (adult)		Northern Anchovie (juv)		Northern Anchovie (pl)		English sole	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Freshwater Bay																																											
	04/23/07	-	-	149	18	-	-	38	3	-	-	-	-	-	-	-	-	118	18	-	-	50	3	-	-	-	-	-	-	-	-	95	4	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	53	11	-	-	-	-	-	-	-	-	-	-	-	-	55	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	37	-	-	-	-	-	-	-	-	-	160	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	85	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62	4	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	148	22	54	-	-	-	-	-	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	152	7	-	-	-	-	-	-	54	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	107	21	-	-	-	-	94	-	-	-	-	-	-	-	-	-	161	5	98	14	-	-	149	23	67	12	46	-	118	-	87	9	-	-	-	-	123	6	-	-	49	-
	08/06/07	108	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	162	8	90	10	-	-	136	9	73	20	-	-	-	-	-	-	-	-	-	-	118	5	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	156	1	-	-	-	-	-	-	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	71	-
	08/27/07	100	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	161	6	87	-	-	-	-	-	69	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	165	12	110	8	-	-	144	12	76	9	-	-	-	-	85	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	162	10	103	9	-	-	-	-	67	7	-	-	-	-	-	-	-	-	129	8	90	34	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	15	47	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	98	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	41	4	-	-	-	-	-	-	-	-	-	-	56	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44	2	-	-	-	-	-	-	-	-	-	-	26	-	-	-	-	-	-	-	-	-
	05/26/08	101	52	-	-	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73	8	77	49	-	-	-	-	-	-	-	-
	06/02/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	92	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42	-
	06/16/08	-	-	87	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/30/08	-	-	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	83	-	-	-	-	-	-	-	-	-	-	-
	08/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	169	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix E: Average Length of Fish Species at Elwha Sites (mm)

Site	Week	Starry Flounder		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		Snake prickleback		3-Spine stickleback		Shiner perch		Staghorn sculpin		cottids unknown		Juv Flat Fish		Lingcod		Red tail surf perch		Striped perch		Kelp greenling		Silver spot sculpin		Prickley Sculpin		Northern Shad		Walleye Pollock		Tom Cod		Pacific Cod	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Freshwater Bay																																											
	04/23/07	141	-	-	-	-	-	136	50	-	-	-	-	-	-	-	-	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	130	-	-	-	100	-	-	-	-	-	100	27	-	-	-	-	95	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	156	23	156	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	134	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	142	26	152	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	370	-	-	-	47	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59	4	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	210	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	76	5	-	-	-	-	-	-	143	-	-	-	-	-	-	-	-	-	-	-	-	-	65	-	-	-	169	4	-	-	-	-	96	-
	08/13/07	-	-	-	-	-	-	-	-	82	4	-	-	-	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	58	11
	08/27/07	-	-	-	-	-	-	-	-	82	5	-	-	-	-	122	9	151	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	1	-	-
	09/10/07	-	-	-	-	-	-	-	-	92	-	-	-	-	-	-	-	165	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	177	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	70	27	-	-	-	-	86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	88	32	-	-	41	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38	-	-	-	-	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	-	-	-	-	112	-	-	-	-	-	40	-	-	-	71	10	-	-	-	-	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	285	-	120	12	110	-	105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53	-	-	-	-	-	43	7	-	-	-	-
	06/16/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/30/08	-	-	-	-	-	-	176	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/04/08	-	-	-	-	-	-	-	-	76	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75	11	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	111	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	374	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix F: Average Density of Fish Species at Salt Creek Sites (fish×m^{-3}×1000)

Site	Week	Chinook		Coho		Pink		Chum		Cutthroat		Steelhead		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Crescent Beach E																					
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	8.7	-	-	-
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	10.9	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	106.9	-	-	-	-	-	-	-	74.2	-	-	-	-	-
	05/28/07	-	-	10.9	-	-	-	10.9	-	-	-	-	-	2.2	-	-	-	-	-	-	-
	06/04/07	-	-	120.0	-	-	-	13.1	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	06/11/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	32.7	-	-	-	-	-	######	-	115.6	-	-	-	8.7	-
	07/09/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	8.7	-	-	-	-	-	15.3	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	07/30/07	229.0	-	2.2	-	-	-	43.6	-	-	-	-	-	604.1	-	194.1	-	-	-	4.4	-
	08/13/07	67.6	-	-	-	-	-	2.2	-	-	-	-	-	26.2	-	######	-	48.0	-	8.7	-
	08/27/07	10.9	-	-	-	-	-	-	-	-	-	-	-	2.2	-	133.0	-	2.2	-	2.2	-
	09/10/07	45.8	-	-	-	-	-	-	-	-	-	-	-	6.5	-	41.4	-	-	-	2.2	-
	03/24/08	-	-	-	-	-	-	45.8	-	-	-	-	-	-	-	218.1	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	444.9	-	-	-	-	-	-	-	122.1	-	21.8	-	-	-
	04/21/08	-	-	-	-	525.6	-	554.0	-	-	-	-	-	-	-	30.5	-	6.5	-	-	-
	06/02/08	6.5	-	181.0	-	######	-	######	-	2.2	-	-	-	-	-	-	-	2.2	-	-	-
	06/30/08	165.8	-	39.3	-	667.4	-	13.1	-	-	-	-	-	-	-	######	-	-	-	-	-
	08/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crescent Beach W																					
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	6.5	9.3	-	-	-	-	-	-
	04/30/07	-	-	2.2	-	-	-	15.3	9.3	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	6.5	9.3	27.3	38.6	-	-	26.2	12.3	2.2	3.1	-	-	280.3	393.3	-	-	-	-	-	-
	05/14/07	-	-	50.2	86.9	-	-	-	-	-	-	-	-	220.3	381.5	-	-	-	-	2.9	5.0
	05/21/07	-	-	1.1	1.5	-	-	1.1	1.5	-	-	-	-	######	######	1.1	1.5	-	-	-	-
	05/28/07	-	-	1.1	1.5	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	3.3	4.6	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	1.1	1.5	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-
	06/18/07	4.4	-	2.2	-	-	-	-	-	-	-	-	-	######	-	-	-	-	-	-	-
	07/02/07	30.5	-	32.7	-	-	-	30.5	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	10.9	-	2.2	-	-	-	2.2	-	-	-	-	-	2.2	-	4.4	-	-	-	-	-
	07/16/07	28.4	-	-	-	-	-	6.5	-	-	-	-	-	######	-	-	-	-	-	37.1	-
	07/23/07	3.3	4.6	1.1	1.5	-	-	5.5	1.5	-	-	-	-	31.6	44.7	6.5	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	2.2	-	-	-	-	-
	08/27/07	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	7.6	10.8	139.6	197.4	2.2	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	28.4	-	80.7	-	-	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.0	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48.0	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	2.2	-	6.5	-	-	-	-	-	-	-	2.2	-	-	-	-	-
	05/26/08	-	-	10.9	-	17.4	-	15.3	-	-	-	-	-	-	-	-	-	####	-	-	-
	06/02/08	-	-	4.4	-	4.4	-	-	-	-	-	-	-	-	-	-	-	13.1	-	-	-
	06/16/08	-	-	50.2	-	74.2	-	-	-	-	-	-	-	137.4	-	244.3	-	-	-	-	-
	07/21/08	4.4	3.1	3.3	1.5	3.3	4.6	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-
	08/04/08	17.4	21.6	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Site	Week	Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (Adult)		Northern Anchovie (juv)		Northern Anchovie (pl)		Sand sole		English sole	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Crescent Beach E																					
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.6	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	37.1	-	-	-	-	-	-	-	-	-	-	-	28.4	-	-	-	-	-	13.1	-
	07/09/07	6.5	-	-	-	-	-	-	-	-	-	-	-	8.7	-	-	-	19.6	-	43.6	-
	07/16/07	2.2	-	-	-	26.2	-	4,955.3	-	-	-	-	-	6.5	-	-	-	-	-	####	-
	07/30/07	####	-	-	-	-	-	-	-	-	-	-	-	15.3	-	-	-	2.2	-	-	-
	08/13/07	####	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	2.2	-	2.2	-
	08/27/07	2.2	-	-	-	2.2	-	209.4	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	30.5	-	-	-	-	-	-	-	-	-	4.4	-	2.2	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	8.7	-
	04/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	2.2	-	10.9	-
	06/30/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	91.6	-
	08/04/08	-	-	-	-	-	-	322.8	-	-	-	-	-	-	-	-	-	-	-	19.6	-
	08/25/08	-	-	-	-	-	-	10.9	-	-	-	-	-	-	-	-	-	4.4	-	-	-
	09/22/08	2.2	-	-	-	-	-	3,709.9	-	-	-	-	-	-	-	-	-	-	-	10.9	-
Crescent Beach W																					
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	1.3	-	-
	05/21/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	1.5	3.3	4.6
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27.3	13.9	49.1	69.4
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.6	7.7
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-
	07/02/07	####	-	-	-	2.2	-	13.1	-	-	-	-	-	-	-	-	-	-	-	87.2	-
	07/09/07	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	6.5	-	6.5	-
	07/16/07	2.2	-	-	-	2.2	-	34.9	-	-	-	-	-	21.8	-	-	-	-	-	85.1	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5	7.7	65.4	21.6
	08/13/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	78.5	-
	08/27/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21.8	-
	09/10/07	6.5	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	6.5	-	6.5	-
	10/08/07	97.1	97.2	-	-	-	-	16.4	23.1	-	-	-	-	1.1	1.5	1.1	1.5	-	-	7.6	10.8
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-
	12/03/07	-	-	-	-	-	-	19.6	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/10/07	-	-	-	-	-	-	10.9	-	-	-	-	-	-	-	-	-	2.2	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	-	-	-	-	-	-	2.2	-	8.7	-	-	-	-	-	-	-	-	-	-	-
	06/16/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	178.8	-	-	-
	07/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5	1.5	26.2	33.9
	08/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	####	41.6
	08/25/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	2.2	-

Appendix F: Average Density of Fish Species at Salt Creek Sites (fish×m^{-3}×1000)

Site	Week	Starry Flounder		Speckled Sanddab		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		Snake prickleback		3-Spine stickleback		Shiner perch		Striped Perch		Red tail surf perch		Staghorn sculpin		Cottids Unknown		Juvenile Flat Fish		Bay Pipefish		Buffalo Sculpin		Lingcod		Tidepool Sculpin		Silver Spot Sculpin		Prickley Sculpin	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Crescent Beach E																																									
	03/12/07	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	2.2	-	-	-	-	-	-	-	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	4.4	-	-	-	-	-	-	-	21.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17.4	-	-	-	2.2	-	-	-	-	-	2.2	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	167.9	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	13.1	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	6.5	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	10.9	-	2.2	-	-	-	-	-	2.2	-	10.9	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	39.3	-	17.4	-	-	-	-	-	15.3	-	10.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15.3	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	8.7	-	13.1	-	-	-	56.7	-	2.2	-	-	-	-	-	13.1	-	2.2	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	2.2	-	-	-	2.2	-	-	-	-	-	2.2	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	17.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-
	06/30/08	-	-	-	-	-	-	-	-	4.4	-	34.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	4.4	-	######	-	-	-	28.4	-	-	-
	08/04/08	-	-	-	-	-	-	-	-	-	-	15.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	17.4	-	30.5	-	-	-	-	-	2.2	-	-	-	-	-	45.8	-	-	-	-	-	-	-	-	-	-	-	4.4	-	52.3	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-	-	-	15.3	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-
Crescent Beach W																																									
	03/12/07	4.4	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	9.8	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	2.9	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	2.5	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	3.3	1.5	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-
	05/28/07	6.5	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.8	13.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	16.4	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.9	3.1	-	-	36.0	50.9	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	10.9	6.2	-	-	-	-	-	-	1.1	1.5	1.1	1.5	-	-	-	-	-	-	-	-	-	-	14.2	1.5	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	06/18/07	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	10.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18.5	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	4.4	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	74.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	6.5	-	-	-	-	-	-	-	2.2	-	2.2	-	-	-	-	-	-	-	-	-	-	-	106.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	6.5	-	85.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	3.3	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	3.3	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-
	04/21/08	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-
	06/02/08	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/16/08	19.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.1	-	-	-	-	-	-	-	-	-	######	-	-	-	-	-	-	-
	07/21/08	13.1	12.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38.2	4.6	-	-	-	-	1.1	1.5	-	-	2.2	3.1	-	-	2.2	3.1	-	-
	08/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.6	9.3	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	08/25/08	4.4	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix F: Average Density of Fish Species at Salt Creek Sites (fish$\times$m$^{-3}\times$1000)

Site	Week	Arrow Goby		Padded Sculpin		Fluffy Sculpin		Northern Shad		Tidepool Snailfish		Walleye Pollock		Tom Cod	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Crescent Beach E															
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	15.3	-	-	-	2.2	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	76.3	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	19.6	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/30/08	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-
	08/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crescent Beach W															
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	4.4	6.2	-	-	1.1	1.5	-	-
	05/14/07	-	-	-	-	-	-	0.7	1.3	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-
	06/18/07	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-
	06/16/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/22/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix F: Average Density of Fish Species at Salt Creek Sites (fish×m^{-3}×1000)

Site	Week	Chinook avg	Chinook stddev	Coho avg	Coho stddev	Pink avg	Pink stddev	Chum avg	Chum stddev	Cutthroat avg	Cutthroat stddev	Steelhead avg	Steelhead stddev	Smelt (adult) avg	Smelt (adult) stddev	Smelt (juv) avg	Smelt (juv) stddev	Smelt (pl) avg	Smelt (pl) stddev	Herring (adult) avg	Herring (adult) stddev
Salt Creek Main Channel																					
	03/12/07	-	-	1.1	1.5	-	-	18.5	17.0	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	58.9	74.0	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	1.1	1.5	-	-	39.3	55.5	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	1.1	1.5	-	-	134.1	####	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	178.8	####	-	-	-	-	-	-	-	-	1.1	1.5	-	-
	05/07/07	4.4	6.2	3.3	4.6	-	-	44.7	4.6	20.7	20.0	2.2	3.1	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	30.5	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	98.2	-	1,756.6	-	-	-	69.3	-	46.2	-	-	-	11.6	-	-	-	-	-	-	-
	05/28/07	-	-	2.9	4.1	-	-	28.9	40.9	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	28.9	-	-	-	5.8	-	8.7	4.1	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	5.8	8.2	-	-	-	-	60.7	85.8	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	1.1	1.5	-	-	-	-	7.6	10.8	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	10.9	15.4	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	7.6	10.8	-	-	2.2	3.1	-	-	-	-	1.1	1.5
	08/06/07	-	-	-	-	-	-	-	-	3.3	1.5	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	7.6	10.8	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	4.4	6.2	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-
	12/03/07	-	-	1.1	1.5	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/05/08	-	-	2.2	3.1	-	-	92.7	97.2	-	-	-	-	-	-	-	-	-	-	-	-

Site	Week	Herring (juv) avg	Herring (juv) stddev	Herring (pl) avg	Herring (pl) stddev	Sand lance (adult) avg	Sand lance (adult) stddev	Sand lance (juv) avg	Sand lance (juv) stddev	Sand Lance (pl) avg	Sand Lance (pl) stddev	Northern Anchovie (Adu avg	Northern Anchovie (Adu stddev	Northern Anchovie (ju avg	Northern Anchovie (ju stddev	Northern Anchovie (pl) avg	Northern Anchovie (pl) stddev	Sand sole avg	Sand sole stddev	English sole avg	English sole stddev
Salt Creek Main Channel																					
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5	7.7
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/05/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix F: Average Density of Fish Species at Salt Creek Sites (fish$\times$m$^{-3}\times$1000)

Site	Week	Starry Flounder		Speckled Sanddab		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		Snake prickleback		3-Spine stickleback		Shiner perch	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Salt Creek Main Channel																			
	03/12/07	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-
	04/09/07	4.4	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	4.4	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	3.3	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-
	05/14/07	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.7	-	277.4	-
	05/28/07	14.4	4.1	-	-	2.9	4.1	5.8	8.2	-	-	-	-	5.8	8.2	121.3	171.6	92.5	130.7
	06/04/07	2.9	4.1	-	-	-	-	5.8	8.2	-	-	-	-	-	-	57.8	65.4	-	-
	06/11/07	-	-	-	-	2.9	4.1	2.9	4.1	-	-	-	-	-	-	176.2	224.7	681.8	188.0
	06/18/07	5.8	8.2	-	-	5.8	8.2	2.9	4.1	2.9	4.1	-	-	-	-	664.5	923.4	-	-
	07/02/07	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	93.8	132.6	######	2,213.1
	07/09/07	2.2	-	-	-	-	-	1.1	1.5	-	-	-	-	1.1	1.5	176.7	249.8	887.7	629.2
	07/16/07	2.2	3.1	-	-	3.3	1.5	1.1	1.5	-	-	-	-	-	-	90.5	124.9	258.5	137.3
	07/23/07	2.2	3.1	-	-	3.3	1.5	2.2	3.1	1.1	1.5	-	-	-	-	54.5	70.9	520.2	455.0
	07/30/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	110.1	155.8	######	1,571.5
	08/06/07	2.2	3.1	-	-	1.1	1.5	3.3	1.5	-	-	-	-	-	-	63.2	89.4	######	277.6
	08/13/07	1.1	1.5	-	-	-	-	4.4	3.1	1.1	1.5	-	-	-	-	45.8	61.7	######	1,375.7
	08/27/07	-	-	-	-	-	-	2.2	-	2.2	3.1	-	-	-	-	17.4	24.7	######	262.2
	09/10/07	2.2	3.1	-	-	-	-	3.3	1.5	-	-	-	-	-	-	4.4	3.1	763.4	413.3
	09/24/07	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	5.5	4.6
	10/01/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	6.5	9.3	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31.6	44.7
	12/03/07	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-
	12/31/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/05/08	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-

Site	Week	Striped Perch		Red tail surf perch		Staghorn sculpin		Cottids Unknown		Juvenile Flat Fish		Bay Pipefish		Buffalo Sculpin		Lingcod		Tidepool Sculpin		Silver Spot Sculpin		Prickley Sculpin	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Salt Creek Main Channel																							
	03/12/07	-	-	-	-	8.7	12.3	12.0	17.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	4.4	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	6.5	6.2	-	-	-	-	-	-
	05/07/07	-	-	-	-	22.9	20.0	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	353.3	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	98.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	251.4	36.8	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	494.0	143.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	95.3	20.4	2.9	4.1	5.8	8.2	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	369.8	179.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	100.3	108.0	-	-	-	-	3.3	1.5	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	196.3	74.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	307.5	262.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	245.4	232.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-
	07/30/07	-	-	-	-	470.0	189.7	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	1.1	1.5
	08/06/07	-	-	-	-	292.3	268.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-
	08/13/07	-	-	-	-	193.0	155.8	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	199.6	226.7	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	1.1	1.5
	09/10/07	-	-	-	-	199.6	91.0	1.1	1.5	-	-	2.2	-	-	-	-	-	-	-	-	-	1.1	1.5
	09/24/07	-	-	-	-	6.5	9.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5
	10/01/07	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	4.4	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	3.3	4.6	17.4	21.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/05/08	-	-	-	-	25.1	10.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	6.2

Appendix F: Average Density of Fish Species at Salt Creek Sites ($fish \times m^{-3} \times 1000$)

Site	Week	Arrow Goby		Padded Sculpin		Fluffy Sculpin		Northern Shad		Tidepool Snailfish		Walleye Pollock		Tom Cod	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Salt Creek Main Channel															
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	6.5	9.3	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-
	05/14/07	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	5.5	7.7	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	5.5	7.7	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	5.5	7.7	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/05/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix F: Average Density of Fish Species at Salt Creek Sites (fish×m^{-3}×1000)

Site	Week	Chinook		Coho		Pink		Chum		Cutthroat		Steelhead		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (Adu		Northern Anchovie (ju		Northern Anchovie (pl)		Sand sole		English sole	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Salt Creek Side Channel																																									
	03/12/07	-	-	1.1	1.5	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	10.1	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	8.7	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	46.5	57.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	118.1	####	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	109.8	190.2	124.0	129.0	-	-	27.3	29.7	1.9	3.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	18.5	4.6	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	8.7	12.3	-	-	17.3	24.5	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1
	08/06/07	-	-	-	-	-	-	-	-	5.8	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	3.3	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix F: Average Density of Fish Species at Salt Creek Sites (fish×m^{-3}×1000)

Site	Week	Starry Flounder avg	Starry Flounder stddev	Speckled Sanddab avg	Speckled Sanddab stddev	Crescent gunnel avg	Crescent gunnel stddev	Saddleback gunnel avg	Saddleback gunnel stddev	Penpoint gunnel avg	Penpoint gunnel stddev	Tubesnout avg	Tubesnout stddev	Snake prickleback avg	Snake prickleback stddev	3-Spine stickleback avg	3-Spine stickleback stddev	Shiner perch avg	Shiner perch stddev	Striped Perch avg	Striped Perch stddev	Red tail surf perch avg	Red tail surf perch stddev	Staghorn sculpin avg	Staghorn sculpin stddev	Cottids Unknown avg	Cottids Unknown stddev	Juvenile Flat Fish avg	Juvenile Flat Fish stddev	Bay Pipefish avg	Bay Pipefish stddev	Buffalo Sculpin avg	Buffalo Sculpin stddev	Lingcod avg	Lingcod stddev	Tidepool Sculpin avg	Tidepool Sculpin stddev	Silver Spot Sculpin avg	Silver Spot Sculpin stddev	Prickley Sculpin avg	Prickley Sculpin stddev
Salt Creek Side Channel																																									
	03/12/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23.5	24.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	4.4	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	92.5	130.7	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-
	04/16/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.0	6.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.8	-	-	-	-	-	-	-	43.3	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	8.7	12.3	-	-	-	-	-	-	140.2	161.3	-	-	25.3	29.6	-	-	-	-	8.7	12.3	-	-	-	-	-	-
	05/07/07	0.7	1.3	-	-	-	-	-	-	-	-	-	-	-	-	44.3	53.7	-	-	-	-	-	-	301.0	265.2	-	-	1.5	2.5	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	3.9	6.7	-	-	-	-	-	-	-	-	-	-	-	-	3.4	3.0	1.5	2.5	-	-	-	-	70.5	84.5	-	-	0.7	1.3	-	-	-	-	6.5	11.3	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	154.9	215.9	-	-	-	-	-	-	117.8	30.8	-	-	4.4	6.2	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86.2	84.8	-	-	-	-	-	-	274.8	157.3	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	141.6	200.2	-	-	-	-	-	-	511.4	69.5	-	-	-	-	8.7	4.1	-	-	-	-	-	-	-	-	-	-
	06/11/07	5.8	8.2	-	-	-	-	-	-	-	-	-	-	-	-	710.7	915.2	-	-	-	-	-	-	600.9	449.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	346.7	384.1	2.9	4.1	-	-	-	-	1,204.8	314.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	352.5	277.8	23.1	8.2	-	-	-	-	476.7	44.9	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	14.4	20.4
	07/09/07	5.1	1.0	-	-	-	-	-	-	-	-	-	-	-	-	152.9	151.5	236.1	252.2	-	-	-	-	257.7	281.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49.1	69.5
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	515.5	186.2	######	1,092.5	-	-	-	-	311.7	98.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49.9	52.0
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	98.2	-	-	-	-	-	-	-	57.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	275.9	282.2	996.7	1,400.3	-	-	-	-	428.6	525.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	9.3
	08/06/07	14.4	4.1	-	-	-	-	8.7	12.3	-	-	-	-	-	-	317.8	302.4	######	4,690.6	-	-	-	-	1,037.2	796.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17.3	24.5
	08/13/07	2.9	4.1	-	-	-	-	2.9	4.1	-	-	-	-	-	-	229.2	231.6	######	2,232.8	-	-	-	-	143.7	105.2	6.9	6.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	112.0	127.6	######	1,796.2	-	-	-	-	218.1	157.3	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	5.8	8.2
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23.5	24.0	76.0	99.2	-	-	-	-	193.7	241.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.7	12.3
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17.3	24.5	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	7.6	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.6	6.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix F: Average Density of Fish Species at Salt Creek Sites (fish$\times m^{-3}\times$1000)

Site	Week	Arrow Goby		Padded Sculpin		Fluffy Sculpin		Northern Shad		Tidepool Snailfish		Walleye Pollock		Tom Cod	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Salt Creek Side Channel															
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	2.9	5.0	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	2.9	5.0	0.7	1.3	-	-	-	-	-	-	-	-	-	-
	05/21/07	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	7.6	10.8	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-
	08/13/07	13.1	18.5	-	-	-	-	-	-	3.3	4.6	-	-	-	-
	08/27/07	4.4	6.2	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix G: Average Length of Fish Species at Salt Creek Sites (mm)

Site	Week	Chinook (fork) avg	Chinook (fork) stddev	Coho (fork) avg	Coho (fork) stddev	Pink (fork) avg	Pink (fork) stddev	Chum (fork) avg	Chum (fork) stddev	Cutthroat (fork) avg	Cutthroat (fork) stddev	Steelhead (fork) avg	Steelhead (fork) stddev	Bull Trout (fork) avg	Bull Trout (fork) stddev	Unknown Juvenile Trout (fork) avg	Unknown Juvenile Trout (fork) stddev	Smelt (adult) avg	Smelt (adult) stddev	Smelt (juv) avg	Smelt (juv) stddev	Smelt (pl) avg	Smelt (pl) stddev	Herring (adult) avg	Herring (adult) stddev	Herring (juv) avg	Herring (juv) stddev	Herring (pl) avg	Herring (pl) stddev	Sand lance (adult) avg	Sand lance (adult) stddev	Sand lance (juv) avg	Sand lance (juv) stddev	Sand Lance (pl) avg	Sand Lance (pl) stddev	Northern Anchovie (adult) avg	Northern Anchovie (adult) stddev	Northern Anchovie (juv) avg	Northern Anchovie (juv) stddev	Northern Anchovie (pl) avg	Northern Anchovie (pl) stddev	Sand sole avg	Sand sole stddev
Crescent Beach E																																											
	04/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	42	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	138	25
	05/21/07	-	-	-	-	-	-	43	6	-	-	-	-	-	-	-	-	-	-	58	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	102	6	-	-	54	11	-	-	-	-	-	-	-	-	-	-	68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	114	52
	06/11/07	88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	156	18	83	8	-	-	151	43	68	5	-	-	-	-	-	-	-	-	-	-	113	5	-	-	-	-
	07/09/07	111	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	76	7	-	-	-	-	-	-	-	-	-	-	116	11	-	-	89	38
	07/16/07	125	8	-	-	-	-	67	8	-	-	-	-	-	-	-	-	-	-	82	-	-	-	-	-	70	-	-	-	131	11	90	11	-	-	-	-	118	3	-	-	-	-
	07/30/07	118	15	123	-	-	-	101	13	-	-	-	-	-	-	-	-	160	12	87	6	-	-	135	-	93	18	-	-	-	-	-	-	-	-	-	-	119	26	-	-	79	-
	08/13/07	121	18	-	-	-	-	108	-	-	-	-	-	-	-	-	-	163	9	95	-	52	5	126	5	93	11	-	-	-	-	-	-	-	-	-	-	116	-	-	-	57	-
	08/27/07	112	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	153	-	78	17	35	-	122	-	75	-	-	-	121	-	89	5	-	-	-	-	-	-	-	-	-	-
	09/10/07	132	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	143	18	101	15	-	-	127	-	96	8	-	-	-	-	-	-	-	-	124	-	94	4	-	-	-	-
	03/24/08	-	-	-	-	-	-	40	3	-	-	-	-	-	-	-	-	-	-	145	113	48	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	156	-
	04/07/08	-	-	-	-	-	-	41	4	-	-	-	-	-	-	-	-	-	-	62	6	46	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	42	4	41	3	-	-	-	-	-	-	-	-	-	-	50	5	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	74	27	105	8	60	9	59	7	168	-	-	-	-	-	-	-	-	-	-	-	32	-	-	-	-	-	-	-	-	-	112	-	-	-	-	-	-	-	-	-	143	-
	06/30/08	109	10	113	9	77	10	80	24	-	-	-	-	-	-	-	-	-	-	66	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	233	-
	08/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	94	10	-	-	-	-	-	-	-	-	-	-
	08/25/08	94	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	97	4	-	-	-	-	-	-	-	-	222	17
Crescent Beach W																																											
	03/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	251	-	-	-	44	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	134	12	-	-	47	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	95	-
	05/07/07	129	15	129	13	-	-	53	25	170	22	-	-	-	-	-	-	152	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	117	13	-	-	-	-	-	-	-	-	-	-	-	-	158	5	-	-	-	-	134	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	95	66
	05/21/07	-	-	125	-	-	-	52	-	-	-	-	-	-	-	-	-	159	8	60	-	-	-	-	-	130	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	106	50
	05/28/07	-	-	101	9	-	-	44	7	-	-	-	-	-	-	-	-	185	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	97	31
	06/04/07	-	-	107	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	96	34
	06/11/07	-	-	100	-	-	-	-	-	-	-	-	-	-	-	-	-	139	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	98	4	114	-	-	-	-	-	-	-	-	-	-	-	-	-	150	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	162	-
	07/02/07	122	11	125	11	-	-	96	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110	-	-	-	132	-	103	16	-	-	-	-	-	-	-	-	-	-
	07/09/07	107	12	72	-	-	-	89	-	-	-	-	-	-	-	-	-	168	-	90	1	-	-	-	-	-	-	-	-	-	-	81	6	-	-	-	-	-	-	-	-	71	6
	07/16/07	129	20	-	-	-	-	88	8	-	-	-	-	-	-	-	-	159	6	-	-	-	-	152	18	81	-	-	-	137	-	93	10	-	-	-	-	115	22	-	-	-	-
	07/23/07	117	9	95	-	-	-	84	3	-	-	-	-	-	-	-	-	156	8	97	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62	11
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	157	8	65	-	-	-	-	-	83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	143	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	101	16	-	-	-	-	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	58	5	-	-	-	-	90	-	-	-	-	-	-	-	-	-	74	15
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	127	4	103	10	53	2	-	-	76	12	-	-	-	-	86	7	-	-	-	-	70	-	51	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	63	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	130	6	110	39	-	-	-	-	-	-	-	-	-	-	93	8	-	-	-	-	-	-	-	-	210	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	6	-	-	-	-	-	-	-	-	-	-	115	11	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	146	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	147	200	-	-	-	-	-	-	-	-	-	-	103	4	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	39	-	42	2	-	-	-	-	-	-	-	-	-	-	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	111	11	77	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42	4	-	-	106	-	-	-	-	-	69	10	-	-	-	-	-	-	-	-	-	-
	06/16/08	-	-	113	10	80	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	131	7	98	11	-	-	-	-	-	-	-	-	66	40
	07/21/08	130	5	138	23	93	30	-	-	-	-	-	-	-	-	-	-	168	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	101	21
	08/04/08	138	12	146	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix G: Average Length of Fish Species at Salt Creek Sites (mm)

Site	Week	English sole		Starry Flounder		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		3-Spine stickleback		Shiner perch		Staghorn sculpin		cottids unknown		Juv Flat Fish		Bay Pipefish		Buffalo Sculpin		Lingcod		Striped perch		Slipskin snailfish		Silver spot sculpin		Prickley Sculpin		Arrow Goby		Speckled Sanddab		Northern Shad		Tidepool Snailfish		Tom
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg
Crescent Beach E																																														
	04/09/07	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	-	-	-	-	-	-	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	40	-	40	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	167	16	-	-	-	-	118	5	-	-	-	-	-	-	-	-	-	-	56	7	-	-	80	-	-	-	-	-	-	-	54	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	101	7	104	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	136	10	-	-	-	-	-	-	73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	81	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	66	10	-	-	-	-	-	-	-	-	75	-	-	-	109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86	41	-	-	-
	07/09/07	78	11	-	-	-	-	-	-	195	-	-	-	-	-	76	55	87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	74	11	71	8	-	-	-	-	92	-	66	11	-	-	-	-	92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	92	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	-	-	92	-	-	-	109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	109	-	-	-	-	-	-	-	157	15	-	-	-
	08/13/07	75	-	-	-	-	-	-	-	-	-	80	-	-	-	-	-	116	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	158	10	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	79	10	86	9	-	-	67	9	-	-	-	-	-	-	-	-	-	-	-	-	118	43	58	9	73	8	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	93	19	88	3	34	10	162	-	151	14	33	-	-	-	340	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	169	41	-	-	-
	03/24/08	41	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	46	2	53	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	1	-	-	-	-	-	-	-	-	-	-	-
	06/30/08	67	14	-	-	-	-	-	-	138	11	58	10	-	-	-	-	-	-	-	-	-	-	147	-	96	1	94	6	-	-	-	-	61	10	-	-	-	-	-	-	-	-	-	-	59
	08/04/08	90	8	-	-	-	-	-	-	-	-	78	11	-	-	-	-	-	-	-	-	-	-	-	-	93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	-	-	-	-	-	-	-	-	88	19	84	9	-	-	75	-	159	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	77	13	-	-	-	-	-	-	-	-	91	5	-
Crescent Beach W																																														
	03/12/07	-	-	155	12	-	-	-	-	-	-	-	-	-	-	-	-	130	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	101	13	-	-	66	7	-	-	-	-	-
	04/30/07	-	-	161	28	-	-	-	-	-	-	-	-	-	-	-	-	108	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	145	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	138	19	-	-	-
	05/14/07	-	-	154	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	133	-	-	-	-
	05/21/07	-	-	160	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49	-	140	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	84	50	110	-	-	-	-
	05/28/07	59	2	155	27	-	-	-	-	128	35	-	-	-	-	-	-	47	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	61	10	154	23	-	-	-	-	-	-	-	-	-	-	-	-	93	59	-	-	62	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	69	8	157	16	-	-	-	-	99	-	-	-	-	-	-	-	100	34	-	-	-	-	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67	1	-
	06/18/07	-	-	131	51	-	-	-	-	-	-	-	-	-	-	-	-	100	51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	136	-	-	-	-
	07/02/07	77	11	293	95	-	-	-	-	-	-	-	-	-	-	-	-	115	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	154	-	-	-	-
	07/09/07	65	3	162	19	-	-	-	-	-	-	-	-	-	-	-	-	121	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	76	8	-	-	-	-	-	-	-	-	-	-	-	-	40	-	119	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	167	16	-	-	-
	07/23/07	81	9	191	23	-	-	-	-	-	-	-	-	-	-	-	-	110	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	95	28	177	12	-	-	-	-	-	-	70	-	-	-	-	-	120	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	90	21	135	45	-	-	-	-	81	-	92	-	-	-	-	-	134	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	97
	09/10/07	101	19	-	-	-	-	-	-	99	-	-	-	-	-	-	-	131	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	86	14	-	-	-	-	-	-	-	-	95	2	-	-	-	-	124	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	125	-	205	-	-	-	-	-	-	-	-	-	-	-	-	-	135	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	191	54	-	-	-	-	-	-	-	-	-	-	93	2	125	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	222	-	-	-	-	-	-	-	-	-	29	4	-	-	112	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	114	6	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	231	-	-	-	-	-	-	-	-	-	-	-	-	-	123	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	03/24/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/07/08	53	4	270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/21/08	-	-	148	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	312	110	-	-	-	-	-	-	-	-	-	-	-	-	151	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	-	-	-	-	-	-	-	-	-	-	-	64
	06/16/08	-	-	65	22	-	-	-	-	-	-	-	-	-	-	-	-	102	7	-	-	-	-	-	-	-	-	92	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/21/08	93	12	166	54	-	-	-	-	-	-	-	-	-	-	-	-	128	17	-	-	-	-	151	-	-	-	111	11	-	-	-	-	77	-	-	-	-	-	-	-	-	-	-	-	-
	08/04/08	83	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	134	14	-	-	-	-	226	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/25/08	100	16	149	50	-	-	-	-	-	-	-	-	-	-	-	-	139	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	105	-	-	-	-	-	-

Appendix G: Average Length of Fish Species at Salt Creek Sites (mm)

Site	Week	, Cod
		stddev
Crescent Beach E		
	04/09/07	-
	04/30/07	-
	05/21/07	-
	06/04/07	-
	06/11/07	-
	06/18/07	-
	07/02/07	-
	07/09/07	-
	07/16/07	-
	07/30/07	-
	08/13/07	-
	08/27/07	-
	09/10/07	-
	03/24/08	-
	04/07/08	-
	04/21/08	-
	06/02/08	-
	06/30/08	6
	08/04/08	-
	08/25/08	-
Crescent Beach W		
	03/12/07	-
	04/30/07	-
	05/07/07	-
	05/14/07	-
	05/21/07	-
	05/28/07	-
	06/04/07	-
	06/11/07	-
	06/18/07	-
	07/02/07	-
	07/09/07	-
	07/16/07	-
	07/23/07	-
	08/13/07	-
	08/27/07	-
	09/10/07	-
	10/08/07	-
	10/29/07	-
	11/12/07	-
	12/03/07	-
	12/10/07	-
	01/07/08	-
	03/24/08	-
	04/07/08	-
	04/21/08	-
	05/26/08	-
	06/16/08	-
	07/21/08	-
	08/04/08	-
	08/25/08	-

Appendix G: Average Length of Fish Species at Salt Creek Sites (mm)

Site	Week	Chinook (fork)		Coho (fork)		Pink (fork)		Chum (fork)		Cutthroat (fork)		Steelhead (fork)		Bull Trout (fork)		Unknown Juvenile Trout (fork)		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (adult)		Northern Anchovie (juv)		Northern Anchovie (pl)		Sand sole	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Salt Creek Main Channel																																											
	03/12/07	-	-	71	-	-	-	38	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	40	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	138	-	-	-	40	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	88	-	-	-	45	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	41	4	-	-	-	-	-	-	-	-	-	-	-	-	51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	158	37	149	19	-	-	42	4	190	42	120	92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	40	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	133	14	111	14	-	-	48	6	135	52	-	-	-	-	-	-	146	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	109	-	-	-	44	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	100	10	-	-	57	-	149	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	102	4	-	-	-	-	175	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	107	-	-	-	-	-	297	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	191	62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	212	47	-	-	-	-	-	-	160	1	-	-	-	-	154	-	120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	243	138	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	168	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	225	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	205	130	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	102	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/05/08	-	-	72	52	-	-	47	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Salt Creek Side Channel																																											
	03/12/07	-	-	75	-	-	-	-	-	-	-	-	-	-	-	-	-	109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	-	-	-	-	39	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	-	-	-	-	39	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	42	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	-	-	-	-	43	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	43	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	70	6	122	18	-	-	43	5	165	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	42	5	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	64	6	-	-	43	4	148	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	173	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	215	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix G: Average Length of Fish Species at Salt Creek Sites (mm)

Site	Week	English sole		Starry Flounder		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		3-Spine stickleback		Shiner perch		Staghorn sculpin		cottids unknown		Juv Flat Fish		Bay Pipefish		Buffalo Sculpin		Lingcod		Striped perch		Slipskin snailfish		Silver spot sculpin		Prickley Sculpin		Arrow Goby		Speckled Sanddab		Northern Shad		Tidepool Snailfish		Tom
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg
Salt Creek Main Channel																																														
	03/12/07	-	-	148	5	-	-	-	-	-	-	-	-	31	-	-	-	50	7	17	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	157	17	-	-	-	-	-	-	-	-	-	-	-	-	31	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	132	-	-	-	-	-	-	-	-	-	-	-	-	-	69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	167	16	-	-	-	-	-	-	-	-	-	-	-	-	60	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	132	77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	3	22	-	-	-	-	-	43	4	-	-	-	-	-	-	-	-	48	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	55	-	-	-	40	12	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	140	-	-	-	-
	05/14/07	-	-	155	-	-	-	-	-	-	-	-	-	-	-	-	-	38	4	-	-	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	13	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	46	5	124	11	65	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	81	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	156	16	58	-	116	6	-	-	-	-	46	5	113	14	58	18	-	-	28	-	-	-	-	-	-	-	-	-	-	-	-	-	71	6	41	-	-	-	-	-	-	-	-
	06/04/07	-	-	140	-	-	-	62	3	-	-	-	-	47	7	-	-	62	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	50	-	67	-	-	-	-	-	46	5	110	17	58	20	132	-	29	2	-	-	-	-	-	-	-	-	-	-	-	-	31	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	98	67	56	8	63	-	62	-	-	-	48	6	-	-	65	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	52	7	122	25	78	18	-	-	-	-	163	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	162	8	-	-	-
	07/09/07	-	-	46	30	-	-	65	-	-	-	-	-	48	5	95	39	91	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	115	57	77	3	74	-	-	-	-	-	52	5	94	29	91	17	-	-	-	-	149	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	154	-	-	-	-
	07/23/07	-	-	64	21	82	23	88	8	61	-	-	-	58	17	78	33	100	28	-	-	-	-	173	45	-	-	-	-	-	-	-	-	-	-	103	10	-	-	-	-	150	3	-	-	-
	07/30/07	94	10	70	-	-	-	-	-	-	-	-	-	57	6	69	31	90	18	-	-	-	-	115	-	-	-	-	-	-	-	-	-	-	-	110	-	-	-	-	-	163	8	-	-	-
	08/06/07	-	-	67	3	120	-	114	29	-	-	-	-	58	6	55	4	97	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	97	3	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	70	-	-	-	96	12	144	-	-	-	53	13	61	16	98	17	-	-	-	-	196	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	77	11	88	6	-	-	62	8	84	21	94	14	-	-	-	-	196	13	89	-	-	-	-	-	-	-	-	-	30	-	-	-	-	-	207	-	-	-	-
	09/10/07	-	-	77	1	-	-	120	32	-	-	-	-	62	5	75	21	105	15	-	-	-	-	199	62	-	-	-	-	-	-	-	-	-	-	108	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	100	-	-	-	76	8	113	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	103	15	-	-	-	-	-	-	-	-	53	11	-	-	79	62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	117	19	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	108	25	-	-	-	-	-	-	-	-	42	1	-	-	46	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	218	-	-	-	-	-	-	-	-	-	-	-	-	-	56	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	17	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/05/08	-	-	111	-	-	-	-	-	-	-	-	-	48	-	-	-	44	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49	11	-	-	-	-	-	-	-	-	-
Salt Creek Side Channel																																														
	03/12/07	-	-	143	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/09/07	-	-	133	17	-	-	-	-	-	-	-	-	-	-	-	-	25	11	-	-	-	-	-	-	-	-	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/16/07	-	-	139	-	-	-	-	-	-	-	-	-	-	-	-	-	29	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/23/07	-	-	-	-	-	-	-	-	-	-	-	-	29	1	-	-	43	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/30/07	-	-	147	40	-	-	-	-	-	-	-	-	35	6	-	-	42	9	-	-	16	11	-	-	-	-	-	-	-	-	-	-	-	-	44	3	42	4	-	-	-	-	-	-	-
	05/07/07	-	-	150	-	-	-	-	-	-	-	-	-	40	7	-	-	46	12	-	-	23	4	-	-	-	-	-	-	-	-	-	-	-	-	53	-	48	2	-	-	-	-	-	-	-
	05/14/07	-	-	109	33	-	-	-	-	-	-	-	-	45	11	129	15	43	14	-	-	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44	4	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	41	6	-	-	47	10	-	-	28	7	-	-	-	-	-	-	-	-	-	-	-	-	64	7	46	3	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	43	8	-	-	48	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	82	24	44	6	-	-	-	-	-	-	-
	06/04/07	-	-	133	-	-	-	-	-	-	-	-	-	46	7	-	-	64	25	-	-	-	-	135	14	-	-	-	-	-	-	-	-	-	-	69	11	50	-	-	-	-	-	-	-	-
	06/11/07	-	-	44	11	-	-	-	-	-	-	-	-	44	6	-	-	65	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59	22	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	55	-	-	-	-	-	-	-	-	-	50	7	95	-	68	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	47	10	-	-	-	-	-	-	-	-	52	6	54	25	68	13	-	-	-	-	232	-	-	-	-	-	-	-	-	-	-	-	93	19	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	37	12	-	-	-	-	-	-	-	-	51	9	47	19	66	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	85	22	60	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	53	7	48	14	90	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	79	12	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	45	14	-	-	66	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	84	1	93	-	-	-	-	-	-	-	-	-	43	13	50	4	76	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56	26	45	1	-	-	-	-	-	-	-
	08/06/07	91	-	66	16	96	-	75	-	-	-	-	-	45	14	55	5	84	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	74	19	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	73	-	-	-	86	-	-	-	-	-	41	12	59	4	85	26	41	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	54	11	-	-	-	-	-	-	-
	08/27/07	110	-	89	-	-	-	-	-	-	-	-	-	45	15	67	7	84	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	2	51	5	-	-	-	-	44	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	50	7	70	8	91	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	7	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	82	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/01/07	-	-	117	-	-	-	-	-	-	-	-	-	42	-	-	-	91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	3	-	-	-	-	-	-	-
	10/29/07	-	-	119	14	-	-	-	-	-	-	-	-	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	-	-	-	-	-	-	-	-

Appendix G: Average Length of Fish Species at Salt Creek Sites (mm)

Site	Week	,, Cod
		stddev
Salt Creek Main Channel		
	03/12/07	-
	04/09/07	-
	04/16/07	-
	04/23/07	-
	04/30/07	-
	05/07/07	-
	05/14/07	-
	05/21/07	-
	05/28/07	-
	06/04/07	-
	06/11/07	-
	06/18/07	-
	07/02/07	-
	07/09/07	-
	07/16/07	-
	07/23/07	-
	07/30/07	-
	08/06/07	-
	08/13/07	-
	08/27/07	-
	09/10/07	-
	09/24/07	-
	10/01/07	-
	10/29/07	-
	11/12/07	-
	12/03/07	-
	12/31/07	-
	02/04/08	-
	05/05/08	-
Salt Creek Side Channel		
	03/12/07	-
	04/09/07	-
	04/16/07	-
	04/23/07	-
	04/30/07	-
	05/07/07	-
	05/14/07	-
	05/21/07	-
	05/28/07	-
	06/04/07	-
	06/11/07	-
	06/18/07	-
	07/02/07	-
	07/09/07	-
	07/16/07	-
	07/23/07	-
	07/30/07	-
	08/06/07	-
	08/13/07	-
	08/27/07	-
	09/10/07	-
	09/24/07	-
	10/01/07	-
	10/29/07	-

Appendix G: Average Length of Fish Species at Salt Creek Sites (mm)

Site	Week	Chinook (fork)		Coho (fork)		Pink (fork)		Chum (fork)		Cutthroat (fork)		Steelhead (fork)		Bull Trout (fork)		Unknown Juvenile Trout (fork)		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (adult)		Northern Anchovie (juv)		Northern Anchovie (pl)		Sand sole	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Salt Creek Side Channel																																											
	11/12/07	-	-	-	-	-	-	-	-	279	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	288	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	102	-	-	-	-	-	-	-	310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix G: Average Length of Fish Species at Salt Creek Sites (mm)

Site	Week	English sole		Starry Flounder		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		3-Spine stickleback		Shiner perch		Staghorn sculpin		cottids unknown		Juv Flat Fish		Bay Piperfish		Buffalo Sculpin		Lingcod		Striped perch		Slipskin snailfish		Silver spot sculpin		Prickley Sculpin		Arrow Goby		Speckled Sanddab		Northern Shad		Tidepool Snailfish		Tom
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg
Salt Creek Side Channel																																														
	11/12/07	-	-	127	6	-	-	-	-	-	-	-	-	-	-	-	-	102	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	60	-	-	-	87	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/31/07	-	-	240	-	-	-	-	-	-	-	-	-	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/04/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix G: Average Length of Fish Species at Salt Creek Sites (mm)

Site	Week	..Cod
		stddev
Salt Creek Side Channel		
	11/12/07	-
	12/03/07	-
	12/31/07	-
	02/04/08	-

Appendix H: Average Density of Fish Species at Twins Sites (fish×m^{-3}×1000)

Site	Week	Chinook		Coho		Pink		Chum		Cutthroat		Steelhead		Unknown Juvenile Trout		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (Adult)		Northern Anchovie (juv)		Northern Anchovie (pl)		Sand sole	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
W Twins Main																																									
	04/16/07	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	14.4	20.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	20.2	28.6	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	5.8	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	5.8	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	63.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	150.5	-	4.4	-	54.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	28.9	-	-	-	46.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	11.6	-	-	-	213.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	52.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W Twins Shoreline																																									
	04/16/07	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	5.5	7.7	-	-	-	-	-	-	1,594.3	2,254.7	-	-	3.3	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	13.1	3.1	-	-	-	-	-	-	-	-	8.7	12.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	16.4	23.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	4.4	6.2	-	-	-	-	2.2	3.1	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5
	06/11/07	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	117.8	166.6
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	941.1	1,330.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	615.0	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.8	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40.4	57.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	317.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,279.9	1,810.1	2,328.7	3,293.2	-	-	-	-	43.3	61.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.6	16.7	57.8	100.1	-	-	-	-	1.9	3.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.9	6.7
	08/06/07	-	-	-	-	-	-	-	-	-	-	5.8	8.2	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28.9	40.9
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52.0	73.5	161.8	188.0	-	-	14.4	20.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28.9	40.9	-	-	20.2	28.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	15.3	-	-	-	4.4	-	4,000.0	-	-	-	-	-	-	-	-	-	######	-	15.3	-	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.5	33.9	134.1	186.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41.4	-	1,234.5	-	388.2	-	-	-	8.7	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-
	12/03/07	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	34.9	-	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix H: Average Density of Fish Species at Twins Sites (fish×m^{-3}×1000)

Site	Week	English sole avg	English sole stddev	Starry Flounder avg	Starry Flounder stddev	Crescent gunnel avg	Crescent gunnel stddev	Saddleback gunnel avg	Saddleback gunnel stddev	Penpoint gunnel avg	Penpoint gunnel stddev	Tubesnout avg	Tubesnout stddev	Shiner perch avg	Shiner perch stddev	Striped Perch avg	Striped Perch stddev	Red tail surf perch avg	Red tail surf perch stddev	Staghorn sculpin avg	Staghorn sculpin stddev	Cottids Unknown avg	Cottids Unknown stddev	Juvenile Flat Fish avg	Juvenile Flat Fish stddev	Rosylip Sculpin avg	Rosylip Sculpin stddev	Buffalo Sculpin avg	Buffalo Sculpin stddev	Lingcod avg	Lingcod stddev	Tidepool Sculpin avg	Tidepool Sculpin stddev	Silver Spot Sculpin avg	Silver Spot Sculpin stddev	Prickley Sculpin avg	Prickley Sculpin stddev	Padded Sculpin avg	Padded Sculpin stddev	Fluffy Sculpin avg	Fluffy Sculpin stddev	Kelp greenling avg	Kelp greenling stddev
W Twins Main																																											
	04/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.7	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.8	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.6	16.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26.0	36.8	20.2	###	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	2.9	4.1	-	-	28.9	40.9	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.6	16.3	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	34.7	24.5	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	98.2	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28.9	-	5.8	-	-	-	-	-	-	-	-	-	5.8	-	-	-	473.8	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	323.6	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	248.5	-	-	-	-	-	-	-
	07/09/07	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21.8	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	115.6	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	161.8	-	-	-	-	-	-	-
	07/30/07	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45.8	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	491.2	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	236.9	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	144.5	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75.1	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	57.8	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.6	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40.4	-	-	-	-	-	-	-
W Twins Shoreline																																											
	04/16/07	-	-	-	-	3.3	1.5	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	5.5	7.7	-	-	-	-	1.1	1.5	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	4.4	6.2	3.3	4.6	5.5	7.7	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	16.4	13.9	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	2.2	3.1	2.2	3.1	1.1	1.5	7.6	1.5	1.1	1.5	-	-	-	-	14.2	20.0	-	-	-	-	2.2	3.1	14.2	7.7	3.3	4.6	1.1	1.5	1.1	1.5	1.1	1.5	-	-	-	-	-	-	2.2	3.1
	06/04/07	8.7	12.3	3.3	4.6	2.2	3.1	5.5	1.5	43.6	58.6	1.1	1.5	-	-	2.2	3.1	3.3	4.6	2.2	3.1	-	-	-	-	54.5	55.5	7.6	7.7	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-
	06/11/07	-	-	16.4	23.1	5.5	7.7	15.3	21.6	18.5	13.9	16.4	17.0	-	-	-	-	-	-	2.2	3.1	-	-	1.1	1.5	200.7	280.7	13.1	18.5	-	-	1.1	1.5	3.3	1.5	-	-	7.6	10.8	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	1.1	1.5	-	-
	06/25/07	-	-	10.9	-	8.7	-	6.5	-	58.9	-	48.0	-	-	-	-	-	-	-	-	-	-	-	-	-	17.4	-	24.0	-	-	-	-	-	15.3	-	-	-	2.2	-	-	-	-	-
	07/02/07	-	-	5.8	-	34.7	-	-	-	202.2	-	5.8	-	-	-	17.3	-	5.8	-	-	-	5.8	-	-	-	86.7	-	306.3	-	-	-	5.8	-	5.8	-	-	-	-	-	5.8	-	-	-
	07/09/07	-	-	-	-	5.8	8.2	-	-	26.0	36.8	-	-	-	-	92.5	24.5	-	-	-	-	-	-	-	-	11.6	8.2	14.4	20.4	-	-	-	-	2.9	4.1	-	-	5.8	8.2	2.9	4.1	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.8	-	-	-
	07/23/07	5.8	8.2	2.9	4.1	-	-	2.9	4.1	2.9	4.1	2.9	4.1	14.4	12.3	8.7	12.3	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-
	07/30/07	5.8	10.0	3.9	6.7	9.6	12.0	19.3	33.4	11.6	15.3	7.7	13.3	3.9	6.7	27.0	41.8	11.6	15.3	5.8	10.0	-	-	-	-	11.6	15.3	32.7	56.7	-	-	15.4	14.5	-	-	-	-	-	-	1.9	3.3	-	-
	08/06/07	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	418.9	592.5	-	-	-	-	5.8	8.2	-	-	-	-	-	-	-	-	5.8	8.2	-	-	-	-	-	-	-	-	-	-
	08/13/07	54.9	77.6	-	-	23.1	32.7	89.6	118.5	66.5	28.6	54.9	69.5	-	-	57.8	65.4	2.9	4.1	-	-	5.8	8.2	-	-	193.6	273.8	8.7	12.3	-	-	8.7	4.1	5.8	8.2	-	-	8.7	4.1	2.9	4.1	-	-
	08/27/07	161.8	228.8	-	-	118.5	####	208.0	294.2	89.6	77.6	202.2	####	-	-	37.6	12.3	-	-	5.8	8.2	-	-	-	-	121.3	163.4	101.1	134.8	-	-	11.6	16.3	-	-	-	-	98.2	138.9	20.2	20.4	-	-
	09/10/07	8.7	12.3	-	-	20.2	28.6	20.2	28.6	57.8	49.0	37.6	44.9	5.8	8.2	23.1	-	23.1	32.7	-	-	2.9	4.1	-	-	193.6	151.2	26.0	36.8	-	-	8.7	4.1	-	-	-	-	11.6	8.2	28.9	32.7	-	-
	09/24/07	-	-	-	-	-	-	-	-	8.7	12.3	2.9	4.1	2.9	4.1	23.1	24.5	-	-	-	-	-	-	-	-	11.6	16.3	-	-	-	-	-	-	2.9	4.1	-	-	5.8	-	2.9	4.1	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.7	-	67.6	-	-	-	-	-	-	-	-	-	2.2	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix H: Average Density of Fish Species at Twins Sites (fish×m^{-3}×1000)

Site	Week	Northern Shad		Slipskin snailfish		Tidepool Snailfish		Sharpnose Sculpin	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev
W Twins Main									
	04/16/07	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	5.8	-	-	-
	01/07/08	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-
W Twins Shoreline									
	04/16/07	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-
	05/28/07	-	-	2.2	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-
	06/11/07	-	-	1.1	1.5	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-
	06/25/07	-	-	2.2	-	-	-	-	-
	07/02/07	-	-	28.9	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-
	07/16/07	-	-	5.8	-	-	-	-	-
	07/23/07	2.9	4.1	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	11.6	8.2
	09/24/07	-	-	2.9	4.1	8.7	12.3	8.7	12.3
	10/08/07	-	-	-	-	-	-	4.4	-
	11/05/07	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-

Appendix I: Average Length of Fish Species at G Sites (mm)

Site	Week	Chinook (fork) avg	Chinook (fork) stddev	Coho (fork) avg	Coho (fork) stddev	Pink (fork) avg	Pink (fork) stddev	Chum (fork) avg	Chum (fork) stddev	Cutthroat (fork) avg	Cutthroat (fork) stddev	Steelhead (fork) avg	Steelhead (fork) stddev	Bull Trout (fork) avg	Bull Trout (fork) stddev	Unknown Juvenile Trout (fork) avg	Unknown Juvenile Trout (fork) stddev	Smelt (adult) avg	Smelt (adult) stddev	Smelt (juv) avg	Smelt (juv) stddev	Smelt (pl) avg	Smelt (pl) stddev	Herring (adult) avg	Herring (adult) stddev	Herring (juv) avg	Herring (juv) stddev	Herring (pl) avg	Herring (pl) stddev	Sand lance (adult) avg	Sand lance (adult) stddev	Sand lance (juv) avg	Sand lance (juv) stddev	Sand Lance (pl) avg	Sand Lance (pl) stddev	Northern Anchovie (adult) avg	Northern Anchovie (adult) stddev	Northern Anchovie (juv) avg	Northern Anchovie (juv) stddev	Northern Anchovie (pl) avg	Northern Anchovie (pl) stddev	Sand sole avg	Sand sole stddev
W Twins Main																																											
	04/16/07	-	-	-	-	-	-	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	38	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	39	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	37	1	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	40	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	154	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	55	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	117	50	152	14	-	-	83	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	66	12	-	-	-	-	65	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	205	14	-	-	-	-	86	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W Twins Shoreline																																											
	04/16/07	-	-	-	-	-	-	44	6	-	-	-	-	-	-	-	-	-	-	62	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	43	6	-	-	-	-	-	-	-	-	156	5	-	-	52	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	64	-	-	-	-	-	-	-	-	-	162	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	48	6	-	-	-	-	-	-	-	-	-	-	53	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	42	3	-	-	-	-	-	-	-	-	154	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	139	-	59	5	-	-	-	-	50	10	45	-	-	-	-	-	-	-	-	-	-	-	-	-	232	-
	06/11/07	-	-	-	-	-	-	74	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	97	73
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	143	-	69	5	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	159	7	80	4	-	-	-	-	75	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	154	3	79	14	-	-	-	-	76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	188	136
	08/06/07	-	-	-	-	-	-	-	-	-	-	242	11	-	-	-	-	-	-	86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67	12
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	77	15	45	3	-	-	65	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	162	5	-	-	50	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	116	-	104	11	-	-	158	3	72	5	-	-	-	-	-	-	-	-	128	5	71	8	-	-	-	-
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55	3	49	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	89	16	60	10	48	2	-	-	75	14	-	-	-	-	-	-	-	-	-	-	60	4	-	-	-	-
	12/03/07	-	-	69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	58	5	47	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52	-	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix I: Average Length of Fish Species at G Sites (mm)

Site	Week	English sole		Starry Flounder		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		Shiner perch		Staghorn sculpin		cottids unknown		Juv Flat Fish		Surf perch		Rosylip Sculpin		Buffalo Sculpin		Lingcod		Red tail surf perch		Striped perch		Tidepool Sculpin		Slipskin snailfish		Silver spot sculpin		Prickley Sculpin		Padded sculpin		Fluffy Sculpin		Sharp nose Sculpin	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
W Twins Main																																															
	04/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	110	-	-	-	-	-	-	-	-	-	-	-	41	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	84	-	-	-	-	-	-	-	-	-	-	-	57	13	52	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53	-	-	-	-	-	60	9	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	5	-	-	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	64	18	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	64	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62	20	-	-	-	-	-	-
	06/18/07	-	-	51	-	-	-	-	-	-	-	-	-	-	-	74	25	128	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52	-	-	-	-	-	85	15	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	79	11	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	64	12	-	-	-	-	-	-
	07/09/07	-	-	45	-	-	-	-	-	-	-	-	-	-	-	52	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	16	-	-	-	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55	16	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	72	14	-	-	-	-	-	-
	07/30/07	-	-	48	-	-	-	-	-	-	-	-	-	-	-	56	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70	20	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	71	22	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	65	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	54	26	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	96	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46	9	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	9	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	7	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38	-	-	-	-	-	33	4	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	3	-	-	-	-	-	-
W Twins Shoreline																																															
	04/16/07	-	-	-	-	100	35	-	-	102	4	-	-	-	-	-	-	-	-	-	-	305	7	50	1	145	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44	-	-	-	-	-	61	-	-	-	242	27	290	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	111	10	109	17	115	13	-	-	-	-	-	-	-	-	45	5	-	-	59	9	79	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	248	25	120	21	110	-	128	34	59	-	-	-	-	-	-	-	41	13	-	-	66	12	133	64	450	-	155	28	-	-	56	-	75	28	34	-	-	-	-	-	-	-	-	-
	06/04/07	48	11	95	76	114	26	123	15	125	29	57	-	-	-	165	120	-	-	-	-	-	-	67	7	87	43	-	-	234	36	286	42	-	-	56	-	-	-	-	-	61	-	-	-	-	-
	06/11/07	-	-	56	9	105	22	122	10	130	38	57	6	-	-	-	-	83	-	55	-	-	-	69	7	74	22	-	-	-	-	-	-	60	-	60	-	49	8	-	-	93	35	-	-	-	-
	06/18/07	54	-	-	-	-	-	-	-	-	-	67	7	-	-	-	-	-	-	-	-	-	-	60	-	124	-	-	-	-	-	-	-	57	6	-	-	-	-	-	-	-	-	32	-	-	-
	06/25/07	-	-	194	107	103	36	111	18	139	19	68	8	-	-	-	-	-	-	-	-	156	129	65	8	87	41	-	-	-	-	-	-	-	-	111	-	65	8	-	-	###	-	-	-	-	-
	07/02/07	-	-	180	-	129	7	-	-	125	20	64	-	-	-	-	-	86	-	-	-	-	-	68	9	89	19	-	-	220	-	225	132	46	-	83	8	76	-	-	-	-	-	35	-	-	-
	07/09/07	-	-	-	-	134	32	-	-	130	8	-	-	-	-	-	-	-	-	-	-	-	-	62	6	80	17	-	-	-	-	93	61	-	-	-	-	43	-	-	-	62	6	36	-	-	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	101	-	-	-	-	-	-	-	26	-	-	-
	07/23/07	85	10	204	-	-	-	92	-	147	-	101	-	121	32	132	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	84	2	60	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	69	13	315	7	100	9	105	23	109	42	85	8	125	16	250	52	-	-	-	-	-	-	70	10	56	25	-	-	72	2	83	5	41	13	-	-	-	-	-	-	-	-	28	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	140	-	-	-	114	-	-	-	35	5	-	-	-	-	-	-	-	-	-	-	-	-	89	4	28	6	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	81	15	-	-	98	33	76	25	94	42	89	11	-	-	-	-	33	4	-	-	-	-	55	18	104	18	-	-	79	-	90	5	44	19	-	-	60	36	-	-	68	18	43	-	-	-
	08/27/07	82	24	-	-	106	21	101	24	117	45	94	9	-	-	181	140	-	-	-	-	-	-	61	20	59	33	-	-	-	-	94	5	43	8	-	-	77	9	-	-	77	23	35	6	-	-
	09/10/07	97	18	-	-	114	28	110	19	112	26	98	7	79	16	-	-	64	-	-	-	-	-	56	17	80	37	-	-	90	6	96	8	47	12	-	-	-	-	-	-	76	11	44	4	42	4
	09/24/07	-	-	-	-	-	-	-	-	86	6	105	-	74	-	-	-	-	-	-	-	-	-	44	2	-	-	-	-	-	-	304	18	-	-	42	-	75	-	-	-	96	28	45	-	46	3
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	-	-	-	214	40	313	19	39	4	-	-	-	-	-	-	-	-	-	-	44	3
	11/05/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	179	-	-	-	-	-	-	-	31	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/12/07	-	-	-	-	-	-	-	-	-	-	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	325	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix I: Average Length of Fish Species at G Sites (mm)

Site	Week
	v
W Twins Main	
	04/16/07
	05/07/07
	05/14/07
	05/21/07
	05/28/07
	06/04/07
	06/11/07
	06/18/07
	06/25/07
	07/02/07
	07/09/07
	07/16/07
	07/23/07
	07/30/07
	08/13/07
	08/27/07
	09/10/07
	09/24/07
	10/08/07
	10/29/07
	12/03/07
	01/07/08
	02/11/08
W Twins Shoreline	
	04/16/07
	05/07/07
	05/14/07
	05/21/07
	05/28/07
	06/04/07
	06/11/07
	06/18/07
	06/25/07
	07/02/07
	07/09/07
	07/16/07
	07/23/07
	07/30/07
	08/06/07
	08/13/07
	08/27/07
	09/10/07
	09/24/07
	10/08/07
	11/05/07
	11/12/07
	12/03/07
	01/07/08
	02/11/08

Appendix J: Average Density of Fish Species at Pysht Sites ($fish \times m^{-3} \times 1000$)

Site	Week	Chinook		Coho		Pink		Chum		Cutthroat		Steelhead		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (Adult)		Northern Anchovie (juv)		Northern Anchovie (pl)		Sand sole		English sole	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Pysht Main Channel																																									
	04/16/07	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	0.5	1.1	-	-	63.8	79.9	1.1	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	17.3	17.3	-	-	25.0	43.4	-	-	-	-	-	-	25.0	43.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	20.2	20.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	40.3	47.8	-	-	1.1	1.5	3.3	1.5	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5
	06/11/07	-	-	2.2	3.1	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	45.8	3.1	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5
	07/02/07	-	-	12.0	17.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5	1.5
	07/09/07	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	6.5	9.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	3.1
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5
	08/06/07	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	10.9	15.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	1.1	1.5	-	-	1.1	1.5	665.2	928.4	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/14/08	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/28/08	43.6	61.7	-	-	-	-	####	####	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/12/08	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5	7.7
	05/26/08	-	-	-	-	-	-	12.0	7.7	-	-	-	-	2.2	-	5.5	7.7	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	-	-	-	-	5.5	7.7	38.2	35.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/23/08	-	-	887.7	-	-	-	4.4	-	-	-	-	-	19.6	-	65.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/07/08	13.1	-	13.1	-	-	-	-	-	-	-	-	-	100.3	-	80.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pysht Shoreline																																									
	05/14/07	-	-	-	-	-	-	72.0	55.5	-	-	-	-	-	-	-	-	128.7	182.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	10.2	12.0	-	-	-	-	-	-	88.0	152.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.9	20.0
	06/18/07	-	-	1.1	1.5	-	-	7.6	10.8	-	-	-	-	-	-	1,802.6	2,123.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.7	23.1
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	732.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.7	-	78.5	-
	07/02/07	10.9	-	4.4	-	-	-	####	-	-	-	-	-	1,542.0	-	28,187.6	-	-	-	4.4	-	-	-	-	-	-	-	4.4	-	-	-	-	-	4.4	-	-	-	-	-	34.9	-
	07/09/07	2.2	-	-	-	-	-	-	-	-	-	-	-	85.1	-	1,193.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.7	-	176.7	-
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	4,076.3	-	14,896.4	-	-	-	2.2	-	6.5	-	-	-	4.4	-	4.4	-	-	-	-	-	13.1	-	-	-	-	-	52.3	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	1.1	1.5	100.3	####	1,528.9	166.6	-	-	-	-	614.0	868.3	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	29.4	17.0
	07/30/07	-	-	-	-	-	-	-	-	-	-	4.4	-	67.6	74.0	67.6	18.5	-	-	-	-	2.2	3.1	-	-	-	-	8.7	12.3	-	-	-	-	1.1	1.5	-	-	2.2	-	91.6	52.4
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	34.9	27.8	108.0	1.5	-	-	-	-	102.5	145.0	-	-	12.0	17.0	1.1	1.5	-	-	-	-	-	-	-	-	-	-	656.5	132.6
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	896.4	-	202.8	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	61.1	-
	08/27/07	-	-	-	-	3.3	4.6	-	-	-	-	-	-	108.0	####	221.4	266.8	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	117.8	18.5
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5	7.7	-	-	-	-	-	-	-	-	-	-	10.9	15.4
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	15.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.9	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	117.8	166.6	6.5	6.2	-	-	9.8	13.9	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	61.1	24.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	13.1	-	381.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-

Appendix J: Average Density of Fish Species at Pysht Sites (fish×m^{-3}×1000)

Site	Week	Starry Flounder avg	Starry Flounder stddev	Speckled Sanddab avg	Speckled Sanddab stddev	Crescent gunnel avg	Crescent gunnel stddev	Saddleback gunnel avg	Saddleback gunnel stddev	Penpoint gunnel avg	Penpoint gunnel stddev	Tubesnout avg	Tubesnout stddev	3-Spine stickleback avg	3-Spine stickleback stddev	Shiner perch avg	Shiner perch stddev	Staghorn sculpin avg	Staghorn sculpin stddev	Cottids Unknown avg	Cottids Unknown stddev	Juvenile Flat Fish avg	Juvenile Flat Fish stddev	Bay Pipefish avg	Bay Pipefish stddev	Tidepool Sculpin avg	Tidepool Sculpin stddev	Silver Spot Sculpin avg	Silver Spot Sculpin stddev	Prickley Sculpin avg	Prickley Sculpin stddev	Arrow Goby avg	Arrow Goby stddev	Fluffy Sculpin avg	Fluffy Sculpin stddev	Northern Shad avg	Northern Shad stddev	Walleye Pollock avg	Walleye Pollock stddev
Pysht Main Channel																																							
	04/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	4.4	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	95.4	120.2	-	-	1.6	2.1	-	-	-	-	-	-	-	-	1.6	3.3	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	94.4	114.7	-	-	86.7	110.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.9	9.3	-	-	2.2	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	231.1	220.6	-	-	-	-	-	-	-	-	-	-	5.8	8.2	-	-	413.2	273.8	-	-	2.9	4.1	-	-	-	-	-	-	-	-	66.5	94.0	-	-	-	-	-	-
	06/04/07	4.4	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.6	6.2	-	-	5.5	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	19.6	15.4	-	-	-	-	-	-	-	-	1.1	1.5	4.4	3.1	-	-	12.0	13.9	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-
	06/18/07	29.4	35.5	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	94.9	128.0	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	37.1	9.3	-	-	2.2	3.1	2.2	3.1	-	-	-	-	2.2	3.1	1.1	1.5	60.0	35.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-
	07/09/07	15.3	18.5	-	-	3.3	4.6	3.3	4.6	-	-	-	-	1.1	1.5	2.2	3.1	7.6	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	21.8	18.5	-	-	-	-	15.3	6.2	-	-	-	-	1.1	1.5	9.8	13.9	25.1	17.0	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	2.2	-	-	-	-	-	2.2	3.1	-	-	-	-	4.4	-	1.1	1.5	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	6.5	6.2	-	-	4.4	-	12.0	17.0	-	-	-	-	48.0	67.9	4.4	3.1	42.5	4.6	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-	18.5	23.1	10.9	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	2.2	3.1	1.1	1.5	-	-	-	-	1.1	1.5	-	-	5.5	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	1.1	1.5	-	-	-	-	6.5	9.3	-	-	-	-	-	-	-	-	5.5	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	2.2	3.1	-	-	1.1	1.5	-	-	1.1	1.5	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	21.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/14/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/28/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/12/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	57.8	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	2.2	3.1	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	16.4	17.0	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-
	06/23/08	2.2	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	10.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/07/08	4.4	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pysht Shoreline																																							
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52.3	37.0	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	0.7	1.3	-	-	-	-	-	-	-	-	10.2	7.0	-	-	82.2	70.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	2.2	-	1.1	1.5	-	-	-	-	-	-	-	-	19.6	15.4	-	-	3.3	4.6	-	-	14.2	7.7	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	2.2	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	116.7	7.7	-	-	5.5	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	9.8	10.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39.3	18.5	32.7	46.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	13.1	-	-	-	-	-	-	-	-	-	6.5	-	-	-	-	-	24.0	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.5	-	4.4	-
	07/09/07	30.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	8.7	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	202.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-
	07/23/07	3.3	1.5	-	-	-	-	-	-	-	-	-	-	1.1	1.5	-	-	55.6	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5
	07/30/07	3.3	1.5	3.3	4.6	3.3	1.5	7.6	10.8	-	-	3.3	1.5	-	-	-	-	135.2	138.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	8.7	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34.9	18.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	15.3	-	-	-	-	-	6.5	-	4.4	-	-	-	-	-	-	-	41.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	36.0	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	206.1	50.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	5.5	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25.1	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	63.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	3.3	4.6	-	-	-	-	-	-	-	-	1.1	1.5	-	-	-	-	9.8	10.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	24.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/10/07	3.3	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.5	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	8.7	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix J: Average Density of Fish Species at Pysht Sites (fish×m^{-3}×1000)

Site	Week	Chinook		Coho		Pink		Chum		Cutthroat		Steelhead		Smelt (adult)		Smelt (juv)	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Pysht Side Channel NW																	
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	2.2	3.1	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	5.8	-	-	-	-	-	5.8	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	1.1	1.5	-	-	-	-	1.1	1.5	-	-	-	-	1.1	1.5
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.5
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pysht Side Channel SE																	
	05/14/07	-	-	18.5	17.0	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	5.8	8.2	-	-	5.8	-	2.9	4.1	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	11.6	8.2	-	-	-	-	2.9	4.1
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	8.7	12.3	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	14.4	20.4	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/15/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.8	8.2
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Site	Week	Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (Adult)		Northern Anchovie (juv)		Northern Anchovie (pl)		Sand sole		English sole	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Pysht Side Channel NW																									
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pysht Side Channel SE																									
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/15/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix J: Average Density of Fish Species at Pysht Sites (fish×m^{-3}×1000)

Site	Week	Starry Flounder		Speckled Sanddab		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		3-Spine stickleback		Shiner perch		Staghorn sculpin		Cottids Unknown		Juvenile Flat Fish		Bay Pipefish		Tidepool Sculpin		Silver Spot Sculpin		Prickley Sculpin		Arrow Goby		Fluffy Sculpin		Northern Shad		Walleye Pollock	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Pysht Side Channel NW																																							
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	11.6	8.2	-	-	456.5	433.1	-	-	26.0	36.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	551.8	461.7	-	-	20.2	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,066.1	976.5	-	-	37.6	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	4.4	6.2	-	-	-	-	-	-	-	-	-	-	9.8	4.6	5.5	7.7	36.0	4.6	-	-	4.4	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	17.3	8.2	-	-	-	-	-	-	-	-	-	-	135.8	110.3	-	-	66.5	69.5	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-
	06/18/07	63.6	89.9	-	-	2.9	4.1	-	-	-	-	-	-	150.2	147.1	75.1	106.2	424.7	600.6	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-
	06/25/07	109.8	-	-	-	-	-	-	-	-	-	-	-	144.5	-	-	-	127.1	-	-	-	-	-	-	-	-	-	-	-	5.8	-	-	-	-	-	-	-	-	-
	07/02/07	78.0	53.1	-	-	-	-	2.9	4.1	-	-	-	-	1,750.8	245.2	274.5	298.3	505.6	151.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	43.3	20.4	-	-	-	-	-	-	-	-	-	-	1,357.9	155.3	1,271.2	1,675.2	69.3	65.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	479.6	310.5	75.1	65.4	156.0	81.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	2.9	4.1	-	-	-	-	-	-	-	-	-	-	872.5	1,119.5	121.3	114.4	216.7	77.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	2.9	4.1	-	-	-	-	277.4	228.8	690.5	77.6	254.2	245.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	63.6	16.3	8.7	4.1	26.0	20.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	40.4	8.2	2.9	4.1	34.7	24.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	8.7	4.1	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	11.6	-	28.9	-	11.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23.1	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	4.4	6.2	-	-	4.4	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.7	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	15.3	-	-	-	261.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pysht Side Channel SE																																							
	05/14/07	1.1	1.5	-	-	-	-	-	-	-	-	-	-	28.4	6.2	-	-	74.2	12.3	-	-	1.1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	161.8	32.7	5.8	-	684.7	461.7	-	-	11.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	2.2	3.1	-	-	-	-	1.1	1.5	-	-	-	-	278.1	177.4	12.0	7.7	184.3	57.1	-	-	1.1	1.5	-	-	-	-	-	-	4.4	6.2	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	20.2	28.6	-	-	-	-	1,938.6	2,161.4	202.2	269.7	788.7	608.8	-	-	5.8	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	2.9	4.1	-	-	-	-	762.7	841.7	132.9	171.6	430.5	208.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	11.6	-	-	-	-	-	5.8	-	-	-	-	-	2,161.1	1,675.2	673.2	126.7	554.7	130.7	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	5.8	-	-	-	-	-	-	-	-	-	-	-	710.7	-	5.8	-	109.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	11.6	8.2	-	-	11.6	-	28.9	16.3	-	-	-	-	1,577.5	882.6	3,501.7	3,301.4	153.1	20.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	14.4	12.3	-	-	2.9	4.1	8.7	4.1	-	-	-	-	1,181.7	36.8	1,080.5	310.5	144.5	171.6	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	2.9	4.1	-	-	-	-	5.8	8.2	-	-	-	-	3,438.1	1,332.0	3,221.4	1,793.7	150.2	163.4	-	-	-	-	-	-	-	-	-	-	5.8	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	2.9	4.1	-	-	-	-	2,132.2	1,707.9	31.8	4.1	234.0	69.5	-	-	-	-	2.9	4.1	-	-	-	-	20.2	28.6	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	2.9	4.1	-	-	-	-	800.3	314.6	369.8	237.0	101.1	61.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	2.9	4.1	2.9	4.1	-	-	-	-	673.2	494.4	34.7	16.3	40.4	40.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	14.4	20.4	-	-	-	-	11.6	16.3	-	-	-	-	456.5	506.7	-	-	78.0	20.4	-	-	-	-	-	-	-	-	-	-	8.7	12.3	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	5.8	8.2	-	-	-	-	147.3	61.3	8.7	12.3	8.7	12.3	-	-	-	-	5.8	8.2	-	-	-	-	5.8	8.2	-	-	-	-	-	-	-	-
	10/15/07	-	-	-	-	-	-	2.9	4.1	-	-	-	-	210.9	290.1	-	-	8.7	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	52.0	40.9	-	-	37.6	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	40.4	24.5	-	-	-	-	8.7	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	2.9	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	17.3	8.2	-	-	40.4	49.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix K: Average Length of Fish Species at Pysht Sites (mm)

Site	Week	Chinook (fork)		Coho (fork)		Pink (fork)		Chum (fork)		Cutthroat (fork)		Steelhead (fork)		Bull Trout (fork)		Unknown Juvenile Trout (fork)		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (adult)		Northern Anchovie (juv)		Northern Anchovie (pl)		Sand sole	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Pysht Main Channel																																											
	04/16/07	-	-	-	-	-	-	39	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	108	-	-	-	47	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	105	7	-	-	57	5	-	-	-	-	-	-	-	-	53	5	57	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	110	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	111	10	-	-	95	-	-	-	-	-	-	-	-	-	117	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	113	4	-	-	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	110	8	-	-	-	-	-	-	-	-	-	-	-	-	152	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	116	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	167	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	94	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	179	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	176	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	206	-	-	-	-	-	-	-	-	-	-	-	-	-	105	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	192	-	-	-	-	-	-	-	121	-	108	8	-	-	-	-	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	69	25	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/14/08	-	-	-	-	-	-	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/28/08	44	5	-	-	-	-	42	4	-	-	-	-	-	-	-	-	-	-	64	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/12/08	-	-	-	-	-	-	42	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	-	-	-	-	50	3	-	-	-	-	-	-	-	-	124	1	94	10	46	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	-	-	-	-	61	7	58	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/23/08	-	-	121	8	-	-	42	6	-	-	-	-	-	-	-	-	125	2	109	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/07/08	107	14	130	8	-	-	-	-	-	-	-	-	-	-	-	-	130	8	111	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pysht Shoreline																																											
	05/14/07	-	-	-	-	-	-	57	10	-	-	-	-	-	-	-	-	54	10	-	-	56	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	57	11	-	-	-	-	-	-	-	-	-	-	57	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	118	-	-	-	80	10	-	-	-	-	-	-	-	-	-	-	83	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	118	14	84	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67	21
	07/02/07	120	8	112	5	-	-	94	15	-	-	-	-	-	-	-	-	153	18	81	4	-	-	144	8	-	-	-	-	-	-	-	-	103	23	-	-	120	3	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	157	5	85	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	78	14
	07/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	154	8	87	9	-	-	163	-	66	4	-	-	124	5	96	20	-	-	-	-	108	27	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	225	-	-	-	-	-	158	11	88	8	-	-	-	-	60	4	-	-	-	-	98	7	-	-	-	-	-	-	-	-	-	-
	07/30/07	-	-	-	-	-	-	-	-	-	-	267	66	-	-	-	-	149	18	100	12	-	-	-	-	58	1	-	-	-	-	93	7	-	-	-	-	110	-	-	-	55	18
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	144	15	93	10	-	-	-	-	94	-	-	-	129	7	115	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	149	11	104	9	-	-	-	-	117	-	-	-	-	-	-	-	-	-	-	-	125	11	-	-	-	-
	08/27/07	-	-	-	-	220	8	-	-	-	-	-	-	-	-	-	-	139	19	101	12	-	-	-	-	112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	105	8	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	148	10	107	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	104	4	47	4	-	-	87	8	-	-	-	-	-	-	-	-	155	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	142	18	103	19	44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix K: Average Length of Fish Species at Pysht Sites (mm)

Site	Week	English sole avg	English sole stddev	Starry Flounder avg	Starry Flounder stddev	Crescent gunnel avg	Crescent gunnel stddev	Saddleback gunnel avg	Saddleback gunnel stddev	Penpoint gunnel avg	Penpoint gunnel stddev	Tubesnout avg	Tubesnout stddev	3-Spine stickleback avg	3-Spine stickleback stddev	Shiner perch avg	Shiner perch stddev	Staghorn sculpin avg	Staghorn sculpin stddev	cottids unknown avg	cottids unknown stddev	Juv Flat Fish avg	Juv Flat Fish stddev	Bay Pipefish avg	Bay Pipefish stddev	Lingcod avg	Lingcod stddev	Tidepool Sculpin avg	Tidepool Sculpin stddev	Silver spot sculpin avg	Silver spot sculpin stddev	Prickley Sculpin avg	Prickley Sculpin stddev	Arrow Goby avg	Arrow Goby stddev	Speckled Sanddab avg	Speckled Sanddab stddev	Northern Shad avg	Northern Shad stddev	Walleye Pollock avg	Walleye Pollock stddev	Fluffy Sculpin avg	Fluffy Sculpin stddev
Pysht Main Channel																																											
	04/16/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	144	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/07/07	-	-	179	60	-	-	-	-	-	-	-	-	-	-	-	-	40	17	-	-	-	-	-	-	47	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45	13	23	-	25	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	11	-	-	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	39	25	-	-	-	-	-	-	-	-	36	6	-	-	48	17	-	-	45	-	-	-	-	-	-	-	-	-	-	-	48	6	-	-	-	-	-	-	-	-
	06/04/07	70	-	55	47	-	-	-	-	-	-	-	-	-	-	-	-	46	10	-	-	33	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	33	5	-	-	-	-	-	-	54	-	27	4	-	-	46	11	-	-	-	-	-	-	-	-	-	-	-	-	55	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	73	-	44	7	-	-	-	-	-	-	-	-	-	-	-	-	57	6	-	-	-	-	172	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	83	13	51	8	62	1	55	4	-	-	-	-	27	1	42	-	71	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	138	-	-	-	-	-
	07/09/07	-	-	51	7	64	4	66	2	-	-	-	-	24	-	45	-	68	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	89	4	59	7	-	-	67	17	-	-	-	-	28	-	50	4	78	13	-	-	-	-	167	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	56	18	-	-	71	4	-	-	-	-	27	5	41	-	79	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/30/07	101	-	71	7	74	5	75	16	-	-	-	-	44	-	48	3	102	27	91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	92	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	93	9	-	-	-	-	-	-	59	5	103	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	65	7	74	-	-	-	-	-	43	-	-	-	101	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	82	-	-	-	88	11	-	-	-	-	-	-	-	-	101	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	79	-	-	-	-	-	-	-	50	-	-	-	107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	106	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	39	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/14/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	04/28/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/12/08	26	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/26/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/02/08	-	-	41	5	-	-	-	-	-	-	-	-	42	-	-	-	51	13	-	-	-	-	-	-	-	-	-	-	45	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/23/08	-	-	43	-	-	-	117	-	-	-	-	-	-	-	-	-	84	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/07/08	-	-	55	6	-	-	61	-	-	-	-	-	-	-	-	-	54	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pysht Shoreline																																											
	05/14/07	-	-	122	30	-	-	-	-	-	-	-	-	-	-	-	-	44	14	-	-	51	9	-	-	-	-	-	-	-	-	-	-	42	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	127	-	-	-	-	-	-	-	-	-	58	26	-	-	39	11	-	-	-	-	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	99	4	82	-	-	-	-	-	-	-	-	-	76	26	-	-	59	17	-	-	-	-	53	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	50	9	112	73	127	-	42	-	-	-	45	-	-	-	-	-	75	14	-	-	34	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	73	13	154	31	-	-	-	-	-	-	-	-	-	-	-	-	107	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	74	8	136	57	-	-	-	-	-	-	80	8	-	-	-	-	105	23	-	-	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	92	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	117	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	166	29	90	7	-	-
	07/09/07	84	25	126	89	-	-	-	-	-	-	-	-	-	-	-	-	113	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/16/07	94	12	76	6	123	-	-	-	-	-	-	-	-	-	-	-	112	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	-	-	-
	07/23/07	75	21	112	45	-	-	-	-	-	-	-	-	46	-	-	-	111	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	93	-	-	-
	07/30/07	70	16	124	42	80	38	90	33	-	-	72	6	-	-	-	-	108	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	106	2	-	-	-	-	-	-
	08/06/07	80	14	98	34	-	-	-	-	-	-	-	-	-	-	-	-	122	18	-	-	-	-	-	-	-	-	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	88	13	108	38	-	-	72	20	86	19	-	-	-	-	-	-	132	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	86	15	110	33	-	-	-	-	-	-	-	-	-	-	-	-	162	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	79	13	155	64	-	-	-	-	-	-	-	-	-	-	-	-	151	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	89	7	243	166	-	-	-	-	-	-	-	-	-	-	-	-	156	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	126	9	-	-	-	-	-	-	101	-	-	-	-	-	124	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	156	83	-	-	-	-	-	-	-	-	-	-	-	-	107	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/10/07	-	-	243	18	-	-	-	-	-	-	-	-	-	-	-	-	44	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	73	22	137	93	-	-	-	-	-	-	106	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix K: Average Length of Fish Species at Pysht Sites (mm)

Site	Week	Chinook (fork)		Coho (fork)		Pink (fork)		Chum (fork)		Cutthroat (fork)		Steelhead (fork)		Bull Trout (fork)		Unknown Juvenile Trout (fork)		Smelt (adult)		Smelt (juv)		Smelt (pl)		Herring (adult)		Herring (juv)		Herring (pl)		Sand lance (adult)		Sand lance (juv)		Sand Lance (pl)		Northern Anchovie (adult)		Northern Anchovie (juv)		Northern Anchovie (pl)		Sand sole	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Pysht Side Channel NW																																													
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	99	66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	106	-	-	-	-	-	220	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	245	-	-	-	-	-	-	-	-	-	94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pysht Side Channel SE																																													
	05/14/07	-	-	97	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	104	8	-	-	46	7	152	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	-	-	194	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	-	-	-	-	-	-	76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	66	12	-	-	-	-	-	-	-	-	83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	67	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	89	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/15/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	106	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix K: Average Length of Fish Species at Pysht Sites (mm)

Site	Week	English sole		Starry Flounder		Crescent gunnel		Saddleback gunnel		Penpoint gunnel		Tubesnout		3-Spine stickleback		Shiner perch		Staghorn sculpin		cottids unknown		Juv Flat Fish		Bay Piperfish		Lingcod		Tidepool Sculpin		Silver spot sculpin		Prickley Sculpin		Arrow Goby		Speckled Sanddab		Northern Shad		Walleye Pollock		Fluffy Sculpin	
		avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev	avg	stddev
Pysht Side Channel NW																																											
	05/07/07	-	-	-	-	-	-	-	-	-	-	-	-	32	2	-	-	38	7	-	-	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/14/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	7	-	-	24	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43	5	-	-	25	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	34	4	-	-	-	-	-	-	-	-	32	6	98	3	46	10	-	-	46	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	47	13	-	-	-	-	-	-	-	-	32	6	-	-	56	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	65	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	56	3	68	-	-	-	-	-	-	-	35	12	-	-	63	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	61	12	-	-	-	-	-	-	-	-	33	6	-	-	73	18	-	-	-	-	-	-	-	-	-	-	-	-	62	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	55	14	-	-	67	-	-	-	-	-	38	10	47	3	95	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	66	7	-	-	-	-	-	-	-	-	33	5	49	4	83	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	-	-	-	-	-	-	-	-	-	-	32	5	49	7	79	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	78	-	-	-	-	-	-	-	-	-	39	7	58	9	98	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	89	-	-	-	-	-	36	5	62	10	86	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	-	-	-	-	-	-	-	-	39	10	67	4	105	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	-	-	-	-	-	-	-	-	-	-	43	11	72	-	95	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	-	-	-	-	-	-	37	-	-	-	129	8	-	-	-	-	-	-	-	-	-	-	-	-	40	-	-	-	-	-	-	-	-	-	-	-
	10/08/07	-	-	-	-	-	-	-	-	-	-	-	-	44	10	82	5	160	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	83	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/03/07	-	-	-	-	-	-	-	-	-	-	-	-	44	10	-	-	72	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	49	12	-	-	37	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pysht Side Channel SE																																											
	05/14/07	-	-	114	-	-	-	-	-	-	-	-	-	39	9	-	-	52	14	-	-	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/21/07	-	-	-	-	-	-	-	-	-	-	-	-	39	8	95	38	59	11	-	-	18	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	05/28/07	-	-	28	5	-	-	105	-	-	-	-	-	44	7	114	21	71	17	-	-	-	-	-	-	-	-	-	-	-	-	101	5	-	-	-	-	-	-	-	-	-	-
	06/04/07	-	-	-	-	-	-	93	26	-	-	-	-	44	7	118	16	72	18	-	-	39	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/11/07	-	-	-	-	-	-	108	-	-	-	-	-	47	10	113	28	75	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/18/07	-	-	54	11	-	-	68	1	-	-	-	-	39	13	94	49	78	17	-	-	-	-	163	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	06/25/07	-	-	60	-	-	-	-	-	-	-	-	-	42	12	42	-	76	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/02/07	-	-	53	6	73	8	83	18	-	-	-	-	39	16	68	38	82	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/09/07	-	-	57	2	80	-	60	7	-	-	-	-	47	12	65	34	81	17	-	-	-	-	201	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	07/23/07	-	-	52	-	-	-	101	51	-	-	-	-	42	14	50	5	81	12	-	-	-	-	-	-	-	-	-	-	-	-	79	57	-	-	-	-	-	-	-	-	-	-
	08/06/07	-	-	-	-	-	-	73	-	-	-	-	-	44	13	68	29	96	19	-	-	-	-	188	-	-	-	-	-	-	-	49	4	-	-	-	-	-	-	-	-	-	-
	08/13/07	-	-	-	-	-	-	78	-	-	-	-	-	46	12	60	5	99	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	08/27/07	-	-	-	-	73	-	87	-	-	-	-	-	46	12	73	4	102	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09/10/07	-	-	86	10	-	-	73	10	-	-	-	-	42	11	-	-	106	24	-	-	-	-	-	-	-	-	-	-	-	-	53	14	-	-	-	-	-	-	-	-	-	-
	09/24/07	-	-	-	-	-	-	92	6	-	-	-	-	44	11	80	5	99	5	-	-	-	-	133	29	-	-	-	-	-	-	60	1	-	-	-	-	-	-	-	-	-	-
	10/15/07	-	-	-	-	-	-	87	-	-	-	-	-	30	12	-	-	49	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10/29/07	-	-	-	-	-	-	-	-	-	-	-	-	33	7	-	-	39	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47	-
	12/10/07	-	-	-	-	-	-	-	-	-	-	-	-	35	9	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01/07/08	-	-	-	-	-	-	-	-	-	-	-	-	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	02/11/08	-	-	-	-	-	-	-	-	-	-	-	-	39	13	-	-	33	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix H. Forage fish sample location and egg count for 2007-2008 Nearshore Strait of Juan de Fuca assessment

Date	Site	Time	Sample number	Latitude	Longitude	Species	1 cell to morula	blastula	gastrula	1/2-1 coil	1 coil	11/2 coil	>11/2 coil	late eyed	dead	# eggs	% dead	# broods
7/27/07	east of morse creek		5	48.13700	123.20030	smelt									3	3	100%	
7/27/07	east of morse creek		6	48.13389	123.20599	smelt									6	6	100%	
7/27/07	east of morse creek		7	48.12999	123.21208	smelt									1	1	100%	
7/27/07	east of morse creek		8	48.12650	123.21785											0		
7/27/07	west of McDonald Creek		1	48.07033	123.14591	smelt					2	9	6		21	38	55%	3
7/27/07	west of McDonald Creek		2	48.07119	123.14194	smelt			1	4	6	2			8	21	38%	4
7/27/07	west of McDonald Creek		3	48.07293	123.13745	smelt					4	6			17	27	63%	2
7/27/07	west of McDonald Creek		4	48.07480	123.13338	smelt					1				23	24	96%	1
8/2/07	Freshwater Bay		1	48.13662	123.58345											0		
8/2/07	Freshwater Bay		2	48.13837	123.57930	smelt			1	1	2				2	6		3
8/2/07	Freshwater Bay		3	48.13963	123.57085	smelt			4	1		1			7	13		3
8/2/07	Freshwater Bay		4	48.14132	123.59372	smelt									5	5	100%	
8/2/07	Freshwater Bay		5	48.13763	123.58910	smelt			7		1				8	16	50%	2
8/2/07	Freshwater Bay		6	48.13895	123.57825	smelt									4	4	100%	1
8/2/07	Freshwater Bay		7	48.14021	123.57578											0		
8/7/07	Dungeness Bluffs		1	48.12048	123.28492	smelt			4	14	11	21	8		48	106	45%	5
8/7/07	Dungeness Bluffs		2	48.11896	123.28432											0		
8/7/07	Dungeness Bluffs		3	48.11892	123.29663	smelt			3	9		5	8	1	35	61	57%	5
8/7/07	Dungeness Bluffs		4	48.11763	123.30074	smelt				3		2		1	9	15	60%	3
8/7/07	Dungeness Bluffs		5	48.11600	123.30537											0		
8/7/07	Dungeness Bluffs		6	48.11475	123.31222											0		
8/7/07	Dungeness Bluffs		7	48.11719	123.27420	smelt		3			2				4	9	44%	2
8/7/07	Dungeness Bluffs		8	48.11806	123.28246	smelt				6		1	1		18	26	69%	3
8/7/07	Dungeness Bluffs		9	48.11338	123.32187											0		
8/7/07	Dungeness Bluffs		10	48.11325	123.31897	smelt				5	4	11	4		23	47	49%	4
8/7/07	Dungeness Bluffs		11	48.11340	123.31585											0		
8/7/07	Dungeness Bluffs		12	48.11407	123.31241											0		
11/5/07	Cresent Beach	16:00	1	48.10635	123.71197											0		
11/5/07	Cresent Beach	16:10	2	48.16143	123.70967											0		
11/5/07	Cresent Beach	16:30	3	48.16293	123.70643											0		
11/5/07	Cresent Beach	16:45	4	48.16433	123.70474											0		
11/20/07	Ediz Hook	15:49	1	48.13804	123.46049											0		
11/20/07	Ediz Hook	16:04	2	48.13801	123.45678											0		
11/20/07	Ediz Hook	16:14	3	48.14005	123.45185											0		
11/20/07	Ediz Hook	16:30	4	48.14207	123.42791											0		
11/20/07	Elwha Bluffs	13:30	1	48.16219	123.70705											0		
11/20/07	Elwha Bluffs	14:00	2	48.13198	123.50306											0		
11/20/07	Elwha Bluffs	14:20	3	48.13200	123.49923											0		
11/20/07	Elwha Bluffs	15:00	4	48.13244	123.48788											0		
11/21/07	Dungeness Bluffs/ McDo	14:13	1	48.12580	123.21981											0		
11/21/07	Dungeness Bluffs/ McDo	14:29	2	48.12776	123.21529											0		
11/21/07	Dungeness Bluffs/ McDo	14:45	3	48.13162	123.20977											0		
11/21/07	Dungeness Bluffs/ McDo	14:56	4	48.13371	123.20610											0		
11/21/07	Dungeness Bluffs/ McDo	15:13	5	48.13933	123.19733											0		
11/21/07	Dungeness Spit	15:36	1	48.16748	123.16101											0		
11/21/07	Dungeness Spit	15:45	2	48.16159	123.10549											0		

Appendix H. Forage fish sample location and egg count for 2007-2008 Nearshore Strait of Juan de Fuca assessment

Date	Site	Time	Sample number	Latitude	Longitude	Species	1 cell to morula	blastula	gastrula	1/2-1 coil	1 coil	11/2 coil	>11/2 coil	late eyed	dead	# eggs	% dead	# broods
11/21/07	Dungeness Spit	16:00	3	48.15695	123.17509											0		
11/21/07	Dungeness Spit	16:21	4	48.15136	123.18211											0		
11/22/07	Fresh Water Bay	14:10	1	48.13671	123.58242											0		
11/22/07	Fresh Water Bay	14:30	2	48.13759	123.59049											0		
11/22/07	Fresh Water Bay	14:40	3	48.13838	123.57890											0		
11/22/07	Fresh Water Bay	15:00	4	48.14245	123.57179											0		
11/22/07	Fresh Water Bay	15:10	5	48.14143	123.57337											0		
11/24/07	DB- Siebert Ck/ McDona	15:00	1	48.12505	123.22120											0		
11/24/07	DB- Siebert Ck/ McDona	15:23	2	48.12262	123.22651											0		
11/24/07	DB- Siebert Ck/ McDona	15:43	3	48.11972	123.23336											0		
11/24/07	DB- Siebert Ck/ McDona	16:02	4	48.11756	123.23959											0		
12/17/07	Cresent Beach	13:40	1	48.16504	123.70442											0		
12/17/07	Cresent Beach	14:20	2	48.15884	123.71478											0		
12/17/07	Cresent Beach	14:40	3	48.15996	123.71253											0		
12/17/07	Cresent Beach	14:55	4	48.16090	123.71015											0		
12/17/07	Cresent Beach	15:00	5	48.16175	123.70841											0		
12/18/07	Ediz Hook	15:35	1	48.14197	123.43775											0		
12/18/07	Ediz Hook	15:40	2	48.14207	123.43461											0		
12/18/07	Ediz Hook	15:55	3	48.14209	123.42795											0		
12/18/07	Ediz Hook	16:14	4	48.13786	123.46100											0		
12/18/07	Elwha Bluffs	13:10	1	48.13178	123.50685											0		
12/18/07	Elwha Bluffs	13:40	2	48.13193	123.50041											0		
12/18/07	Elwha Bluffs	13:55	3	48.13228	123.49432											0		
12/18/07	Elwha Bluffs	14:10	4	48.13240	123.48819											0		
12/18/07	Elwha Bluffs	14:30	5	48.13269	123.48242											0		
12/19/07	Dung Bluffs	12:50	1	48.12605	123.21867											0		
12/19/07	Dung Bluffs	13:03	2	48.12998	123.21149											0		
12/19/07	Dung Bluffs	13:15	3	48.13370	123.20596											0		
12/19/07	Dung Bluffs	13:26	4	48.13765	123.19982											0		
12/19/07	Dung Bluffs	13:35	5	48.14154	123.19376											0		
12/19/07	Dung Spit	13:51	1	48.16275	123.16748											0		
12/19/07	Dung Spit	14:02	2	48.15932	123.17187											0		
12/19/07	Dung Spit	14:09	3	48.15683	123.17524											0		
12/19/07	Dung Spit	14:19	4	48.18259	123.18066											0		
12/20/07	Fresh Water Bay	13:15	1	48.13645	123.58326											0		
12/20/07	Fresh Water Bay	13:30	2	48.13716	123.58154											0		
12/20/07	Fresh Water Bay	13:39	3	48.13800	123.57962											0		
12/20/07	Fresh Water Bay	13:47	4	48.13877	123.57806											0		
1/15/08	Cresent Bay	11:01	1	48.16224	123.70638											0		
1/15/08	Cresent Bay	11:15	2	48.15970	123.71315											0		
1/15/08	Cresent Bay	11:28	3	48.16042	123.71129											0		
1/15/08	Cresent Bay	11:40	4	48.16217	123.70769											0		
1/15/08	Cresent Bay	11:56	5	48.16461	123.70476											0		
1/16/08	Fresh Water Bay	11:01	1	48.13699	123.58194											0		
1/16/08	Fresh Water Bay	11:11	2	48.13824	123.57909											0		
1/16/08	Fresh Water Bay	11:21	3	48.13949	123.57679											0		

Appendix H. Forage fish sample location and egg count for 2007-2008 Nearshore Strait of Juan de Fuca assessment

Date	Site	Time	Sample number	Latitude	Longitude	Species	1 cell to morula	blastula	gastrula	1/2-1 coil	1 coil	11/2 coil	>11/2 coil	late eyed	dead	# eggs	% dead	# broods
1/16/08	Fresh Water Bay	11:31	4	48.14090	123.57416											0		
1/16/08	Fresh Water Bay	11:42	5	48.14172	123.57280											0		
1/17/08	Ediz Hook	14:54	1	48.13960	123.45467											0		
1/17/08	Ediz Hook	15:15	2	48.14068	123.44827											0		
1/17/08	Ediz Hook	15:30	3	48.14152	123.44215											0		
1/17/08	Ediz Hook	15:48	4	48.14200	123.43589											0		
1/17/08	Ediz Hook	16:02	5	48.14223	123.43628											0		
1/17/08	Elwha Bluffs	12:53	1	48.13140	123.50555											0		
1/17/08	Elwha Bluffs	13:07	2	48.13189	123.50159											0		
1/17/08	Elwha Bluffs	13:26	3	48.13218	123.49651											0		
1/17/08	Elwha Bluffs	13:44	4	48.13240	123.49070											0		
1/17/08	Elwha Bluffs	14:04	5	48.13243	123.48594											0		
1/18/08	Dungeness Bluffs	13:43	1	48.12565	123.22010											0		
1/18/08	Dungeness Bluffs	13:59	2	48.12777	123.21529											0		
1/18/08	Dungeness Bluffs	14:11	3	48.13095	123.21032											0		
1/18/08	Dungeness Bluffs	14:23	4	48.13444	123.20493											0		
1/18/08	Dungeness Bluffs	14:33	5	48.13818	123.19908											0		
1/18/08	Dungeness Spit	14:56	1	48.16255	123.16792											0		
1/18/08	Dungeness Spit	15:06	2	48.16000	123.17119											0		
1/18/08	Dungeness Spit	15:17	3	48.15448	123.17848											0		
1/18/08	Dungeness Spit	15:28	4	48.15248	123.18091											0		
7/15/08	Crescent Beach	7:15	1	48.15897	123.71400											0		
7/15/08	Crescent Beach	7:40	2	48.15988	123.71270											0		
7/15/08	Crescent Beach	7:55	3	48.16050	123.71107											0		
7/15/08	Crescent Beach	8:05	4	48.16119	123.70959											0		
7/15/08	Crescent Beach	8:25	5	48.16485	123.70457											0		
7/15/08	Freshwater Bay	9:30	1	48.13663	123.58346											0		
7/15/08	Freshwater Bay	9:44	2	48.13721	123.58179											0		
7/15/08	Freshwater Bay	9:55	3	48.13784	123.58025											0		
7/15/08	Freshwater Bay	10:06	4	48.13868	123.57867											0		
7/15/08	Freshwater Bay	10:20	5	48.14014	123.57565											0		
7/16/08	Ediz Hook	9:15	1	48.13969	123.45418											0		
7/16/08	Ediz Hook	9:31	2	48.14030	123.45016											0		
7/16/08	Ediz Hook	9:52	3	48.14096	123.44600											0		
7/16/08	Ediz Hook	9:15	10	48.14219	123.43294											0		
7/16/08	Ediz Hook	9:30	11	48.14218	123.43069											0		
7/16/08	Ediz Hook	9:45	12	48.14229	123.42846											0		
7/16/08	Elwha Bluffs	7:15	1	48.13193	123.50731											0		
7/16/08	Elwha Bluffs	7:27	2	48.13192	123.50497											0		
7/16/08	Elwha Bluffs	7:35	3	48.13196	123.50294											0		
7/16/08	Elwha Bluffs	7:50	4	48.13251	123.49675											0		
7/16/08	Elwha Bluffs	8:00	5	48.13233	123.19260											0		
7/16/08	Elwha Bluffs	8:10	6	48.13248	123.49034											0		
7/16/08	Elwha Bluffs	8:30	7	48.13318	123.47980											0		
7/17/08	Dungeness Bluffs	8:40	1	48.12173	123.22842											0		
7/17/08	Dungeness Bluffs	8:50	2	48.12277	123.22652											0		

Appendix H. Forage fish sample location and egg count for 2007-2008 Nearshore Strait of Juan de Fuca assessment

Date	Site	Time	Sample number	Latitude	Longitude	Species	1 cell to morula	blastula	gastrula	1/2-1 coil	1 coil	11/2 coil	>11/2 coil	late eyed	dead	# eggs	% dead	# broods
7/17/08	Dungeness Bluffs	9:16	3	48.12499	123.22152											0		
7/17/08	Dungeness Bluffs	9:38	4	48.12666	123.21754											0		
7/17/08	Dungeness Bluffs	9:55	5	48.12890	123.21363	smelt									1	1	100%	1
7/17/08	Dungeness Bluffs	10:09	6	48.13138	123.20991											0		
7/17/08	Dungeness Bluffs	10:25	7	48.13365	123.20644											0		
7/17/08	Dungeness Bluffs	10:40	8	48.13570	123.20331											0		
7/17/08	Dungeness Bluffs	10:57	9	48.13769	123.20019											0		
7/17/08	Dungeness Spit	9:20	1	48.16182	123.16870											0		
7/17/08	Dungeness Spit	9:40	2	48.15976	123.17165											0		
7/17/08	Dungeness Spit	9:55	3	48.15761	123.17449											0		
7/17/08	Dungeness Spit	10:10	4	48.15549	123.17736											0		
7/17/08	Dungeness Spit	10:22	5	48.15340	123.18003											0		
7/17/08	Dungeness Spit	10:38	6	48.15111	123.18245											0		
8/14/08	Dungeness Bluffs	7:57	1	48.11880	123.23634	smelt			1		1					2	0%	2
8/14/08	Dungeness Bluffs	8:17	2	48.12016	123.23253											0		
8/14/08	Dungeness Bluffs	8:31	3	48.12182	123.22862	smelt		3								3	0%	1
8/14/08	Dungeness Bluffs	8:47	4	48.12339	123.22522	smelt		1							1	2	50%	1
8/14/08	Dungeness Bluffs	9:01	5	48.12482	123.22204											0		
8/14/08	Dungeness Bluffs	9:18	6	48.12624	123.21859	smelt									1	1	100%	1
8/14/08	Dungeness Bluffs	9:36	7	48.12871	123.21402											0		
8/14/08	Dungeness Bluffs	9:50	8	48.13123	123.21004											0		
8/14/08	Dungeness Bluffs	10:05	9	48.13350	123.20660											0		
8/14/08	Dungeness Bluffs	10:19	10	48.13514	123.20401											0		
8/14/08	Dungeness Spit	8:10	50	48.13317	123.43194											0		
8/14/08	Dungeness Spit	8:25	51	48.16873	123.15936											0		
8/14/08	Dungeness Spit	8:40	52	48.16645	123.16288											0		
8/14/08	Dungeness Spit	8:50	53	48.16405	123.16616											0		
8/14/08	Dungeness Spit	9:05	54	48.16147	123.16936											0		
8/14/08	Dungeness Spit	9:20	55	48.15962	123.17186											0		
8/14/08	Dungeness Spit	9:35	56	48.15725	123.17500											0		
8/14/08	Dungeness Spit	9:45	57	48.15480	123.17828											0		
8/14/08	Dungeness Spit	9:58	58	48.15222	123.18132											0		
8/15/08	Ediz Hook	9:55	1	48.13957	123.45463											0		
8/15/08	Ediz Hook	10:13	2	48.14051	123.44919											0		
8/15/08	Ediz Hook	10:21	3	48.14118	123.44418											0		
8/15/08	Ediz Hook	10:48	4	48.14185	123.43905											0		
8/15/08	Ediz Hook	9:50	6	48.14205	123.43729											0		
8/15/08	Ediz Hook	10:01	7	48.14216	123.43478											0		
8/15/08	Ediz Hook	10:20	8	48.14226	123.43017											0		
8/15/08	Ediz Hook	10:30	9	48.14215	123.42682											0		
8/15/08	Elwha Bluffs	7:15	1	48.13197	123.50705											0		
8/15/08	Elwha Bluffs	7:35	2	48.13180	123.50254											0		
8/15/08	Elwha Bluffs	7:45	3	48.13213	123.49791											0		
8/15/08	Elwha Bluffs	8:05	4	48.13242	123.49424											0		
8/15/08	Elwha Bluffs	8:20	5	48.13249	123.49095											0		
8/15/08	Elwha Bluffs	8:40	6	48.13255	123.48682											0		

Appendix H. Forage fish sample location and egg count for 2007-2008 Nearshore Strait of Juan de Fuca assessment

Date	Site	Time	Sample number	Latitude	Longitude	Species	1 cell to morula	blastula	gastrula	1/2-1 coil	1 coil	11/2 coil	>11/2 coil	late eyed	dead	# eggs	% dead	# broods
8/15/08	Elwha Bluffs	8:55	7	48.13268	123.48320											0		
8/16/08	Crescent Beach	9:00	1	48.15932	123.71422											0		
8/16/08	Crescent Beach	9:15	2	48.16045	123.71270											0		
8/16/08	Crescent Beach	9:25	3	48.16155	123.70881											0		
8/16/08	Crescent Beach	9:40	4	48.16301	123.70551											0		
8/16/08	Crescent Beach	9:55	5	48.16470	123.70475											0		
8/16/08	Crescent Beach	10:07	6	48.16395	123.70471											0		
8/16/08	Freshwater Bay	6:49	1	48.14216	123.42675											0		
8/16/08	Freshwater Bay	7:00	2	48.13810	123.57978											0		
8/16/08	Freshwater Bay	7:12	3	48.13999	123.57591											0		
8/16/08	Freshwater Bay	7:30	4	48.14514	123.56942											0		
8/16/08	Freshwater Bay	7:44	5	48.14328	123.57083											0		
8/16/08	Freshwater Bay	7:55	6	48.14213	123.57239											0		
9/11/08	Crescent Beach	9:50	1	48.15972	123.71329											0		
9/11/08	Crescent Beach	10:05	2	48.16098	123.71019											0		
9/11/08	Crescent Beach	10:18	3	48.16225	123.70742											0		
9/11/08	Crescent Beach	10:32	4	48.16490	123.70477											0		
9/11/08	Crescent Beach	10:46	5	48.70479	123.70481											0		
9/11/08	Freshwater Bay	7:26	1	48.13659	123.58335											0		
9/11/08	Freshwater Bay	7:42	2	48.13812	123.57966											0		
9/11/08	Freshwater Bay	7:56	3	48.14008	123.57595											0		
9/11/08	Freshwater Bay	8:11	4	48.14168	123.57317	smelt									1	1	100%	1
9/11/08	Freshwater Bay	8:23	5	48.14307	123.57107											0		
9/11/08	Freshwater Bay	8:33	6	48.14436	123.56980											0		
9/12/08	Elwha Bluffs	7:10	1	48.13182	123.50722											0		
9/12/08	Elwha Bluffs	7:25	2	48.13198	123.50256											0		
9/12/08	Elwha Bluffs	7:40	3	48.13220	123.49836											0		
9/12/08	Elwha Bluffs	7:55	4	48.13236	123.49434											0		
9/12/08	Elwha Bluffs	8:10	5	48.13254	123.48941											0		
9/12/08	Elwha Bluffs	8:25	6	48.13308	123.48502											0		
9/13/08	Dungeness Bluffs	7:40	1	48.11972	123.23344											0		
9/13/08	Dungeness Bluffs	7:57	2	48.12151	123.22906											0		
9/13/08	Dungeness Bluffs	8:07	3	48.12344	123.22492											0		
9/13/08	Dungeness Bluffs	8:19	4	48.12530	123.22095											0		
9/13/08	Dungeness Bluffs	8:34	5	48.12685	123.21711											0		
9/13/08	Dungeness Bluffs	8:48	6	48.12917	123.21304											0		
9/13/08	Dungeness Bluffs	9:04	7	48.13187	123.20894											0		
9/13/08	Dungeness Bluffs	9:18	8	48.13497	123.20422											0		
9/13/08	Dungeness Bluffs	9:31	9	48.13937	123.19730											0		
9/13/08	Dungeness Spit	7:40	1	48.16782	123.16046											0		
9/13/08	Dungeness Spit	7:55	2	48.16539	123.16432											0		
9/13/08	Dungeness Spit	8:10	3	48.16267	123.16787											0		
9/13/08	Dungeness Spit	8:30	4	48.16024	123.17096											0		
9/13/08	Dungeness Spit	8:43	5	48.15776	123.17427											0		
9/13/08	Dungeness Spit	9:00	6	48.15519	123.17769											0		
9/13/08	Dungeness Spit	9:11	7	48.15263	123.18072											0		

Appendix H. Forage fish sample location and egg count for 2007-2008 Nearshore Strait of Juan de Fuca assessment

Date	Site	Time	Sample number	Latitude	Longitude	Species	1 cell to morula	blastula	gastrula	1/2-1 coil	1 coil	11/2 coil	>11/2 coil	late eyed	dead	# eggs	% dead	# broods
9/15/08	Ediz Hook	9:00	1	48.13955	123.45477											0		
9/15/08	Ediz Hook	9:17	2	48.14009	123.45182											0		
9/15/08	Ediz Hook	9:27	3	48.14058	123.44867											0		
9/15/08	Ediz Hook	9:38	4	48.14100	123.44561											0		
9/15/08	Ediz Hook	9:05	75	48.14217	123.43443											0		
9/15/08	Ediz Hook	9:10	76	48.14233	123.43288											0		
9/15/08	Ediz Hook	9:34	77	48.14227	123.42881											0		
11/5/07	Cresent Beach	16:00	1	48.10635	123.71197	sand lance										0		
11/5/07	Cresent Beach	16:10	2	48.16143	123.70967											0		
11/5/07	Cresent Beach	16:30	3	48.16293	123.70643											0		
11/5/07	Cresent Beach	16:45	4	48.16433	123.70474											0		
11/20/07	Ediz Hook	15:49	1	48.13804	123.46049											0		
11/20/07	Ediz Hook	16:04	2	48.13801	123.45678											0		
11/20/07	Ediz Hook	16:14	3	48.14005	123.45185											0		
11/20/07	Ediz Hook	16:30	4	48.14207	123.42791											0		
11/20/07	Elwha Bluffs	13:30	1	48.16219	123.70705											0		
11/20/07	Elwha Bluffs	14:00	2	48.13198	123.50306											0		
11/20/07	Elwha Bluffs	14:20	3	48.132	123.49923											0		
11/20/07	Elwha Bluffs	15:00	4	48.13244	123.48788											0		
11/21/07	Dungeness Spit	15:36	1	48.16748	123.16101											0		
11/21/07	Dungeness Spit	15:45	2	48.16159	123.10549											0		
11/21/07	Dungeness Spit	16:00	3	48.15695	123.17509											0		
11/21/07	Dungeness Spit	16:21	4	48.15136	123.18211											0		
11/21/07	Dungeness Bluffs/ McDo	14:13	1	48.1258	123.21981											0		
11/21/07	Dungeness Bluffs/ McDo	14:29	2	48.12776	123.21529											0		
11/21/07	Dungeness Bluffs/ McDo	14:45	3	48.13162	123.20977											0		
11/21/07	Dungeness Bluffs/ McDo	14:56	4	48.13371	123.20610											0		
11/21/07	Dungeness Bluffs/ McDo	15:13	5	48.13933	123.19733											0		
11/22/07	Fresh Water Bay	14:10	1	48.13671	123.58242											0		
11/22/07	Fresh Water Bay	14:30	2	48.13759	123.59049											0		
11/22/07	Fresh Water Bay	14:40	3	48.13838	123.57890											0		
11/22/07	Fresh Water Bay	15:00	4	48.14245	123.57179											0		
11/22/07	Fresh Water Bay	15:10	5	48.14143	123.57337											0		
11/24/07	DB- Siebert Ck/ McDona	15:00	1	48.12505	123.22120											0		
11/24/07	DB- Siebert Ck/ McDona	15:23	2	48.12262	123.22651											0		
11/24/07	DB- Siebert Ck/ McDona	15:43	3	48.11972	123.23336											0		
11/24/07	DB- Siebert Ck/ McDona	16:02	4	48.11756	123.23959											0		
12/17/07	Cresent Beach	13:40	1	48.16504	123.70442											0		
12/17/07	Cresent Beach	14:20	2	48.15884	123.71478											0		
12/17/07	Cresent Beach	14:40	3	48.15996	123.71253											0		
12/17/07	Cresent Beach	14:55	4	48.1609	123.71015											0		
12/17/07	Cresent Beach	15:00	5	48.16175	123.70841											0		
12/18/07	Elwha Bluffs	13:10	1	48.13178	123.50685											0		
12/18/07	Elwha Bluffs	13:40	2	48.13193	123.50041											0		
12/18/07	Elwha Bluffs	13:55	3	48.13228	123.49432											0		
12/18/07	Elwha Bluffs	14:10	4	48.1324	123.48819											0		

Appendix H. Forage fish sample location and egg count for 2007-2008 Nearshore Strait of Juan de Fuca assessment

Date	Site	Time	Sample number	Latitude	Longitude	Species	1 cell to morula	blastula	gastrula	1/2-1 coil	1 coil	11/2 coil	>11/2 coil	late eyed	dead	# eggs	% dead	# broods
12/18/07	Elwha Bluffs	14:30	5	48.13269	123.48242											0		
12/18/07	Ediz Hook	15:35	1	48.14197	123.43775											0		
12/18/07	Ediz Hook	15:40	2	48.14207	123.43461											0		
12/18/07	Ediz Hook	15:55	3	48.14209	123.42795											0		
12/18/07	Ediz Hook	16:14	4	48.13786	123.46100											0		
12/19/07	Dung Spit	13:51	1	48.16275	123.16748											0		
12/19/07	Dung Spit	14:02	2	48.15932	123.17187											0		
12/19/07	Dung Spit	14:09	3	48.15683	123.17524											0		
12/19/07	Dung Spit	14:19	4	48.18259	123.18066											0		
12/19/07	Dung Bluffs	12:50	1	48.12605	123.21867											0		
12/19/07	Dung Bluffs	13:03	2	48.12998	123.21149											0		
12/19/07	Dung Bluffs	13:15	3	48.1337	123.20596											0		
12/19/07	Dung Bluffs	13:26	4	48.13765	123.19982											0		
12/19/07	Dung Bluffs	13:35	5	48.14154	123.19376											0		
12/20/07	Fresh Water Bay	13:15	1	48.13645	123.58326											0		
12/20/07	Fresh Water Bay	13:30	2	48.13716	123.58154											0		
12/20/07	Fresh Water Bay	13:39	3	48.138	123.57962											0		
12/20/07	Fresh Water Bay	13:47	4	48.13877	123.57806											0		
1/15/08	Cresent Bay	11:01	1	48.16224	123.70638											0		
1/15/08	Cresent Bay	11:15	2	48.1597	123.71315											0		
1/15/08	Cresent Bay	11:28	3	48.16042	123.71129											0		
1/15/08	Cresent Bay	11:40	4	48.16217	123.70769											0		
1/15/08	Cresent Bay	11:56	5	48.16461	123.70476											0		
1/16/08	Fresh Water Bay	11:01	1	48.13699	123.58194											0		
1/16/08	Fresh Water Bay	11:11	2	48.13824	123.57909											0		
1/16/08	Fresh Water Bay	11:21	3	48.13949	123.57679											0		
1/16/08	Fresh Water Bay	11:31	4	48.1409	123.57416											0		
1/16/08	Fresh Water Bay	11:42	5	48.14172	123.57280											0		
1/17/08	Ediz Hook	14:54	1	48.1396	123.45467											0		
1/17/08	Ediz Hook	15:15	2	48.14068	123.44827											0		
1/17/08	Ediz Hook	15:30	3	48.14152	123.44215											0		
1/17/08	Ediz Hook	15:48	4	48.142	123.43589											0		
1/17/08	Ediz Hook	16:02	5	48.14223	123.43628											0		
1/17/08	Elwha Bluffs	12:53	1	48.1314	123.50555											0		
1/17/08	Elwha Bluffs	13:07	2	48.13189	123.50159											0		
1/17/08	Elwha Bluffs	13:26	3	48.13218	123.49651											0		
1/17/08	Elwha Bluffs	13:44	4	48.1324	123.49070											0		
1/17/08	Elwha Bluffs	14:04	5	48.13243	123.48594											0		
1/18/08	Dungeness Bluffs	13:43	1	48.12565	123.22010											0		
1/18/08	Dungeness Bluffs	13:59	2	48.12777	123.21529											0		
1/18/08	Dungeness Bluffs	14:11	3	48.13095	123.21032											0		
1/18/08	Dungeness Bluffs	14:23	4	48.13444	123.20493											0		
1/18/08	Dungeness Bluffs	14:33	5	48.13818	123.19908											0		
1/18/08	Dungeness Spit	14:56	1	48.16255	123.16792											0		
1/18/08	Dungeness Spit	15:06	2	48.16	123.17119											0		
1/18/08	Dungeness Spit	15:17	3	48.15448	123.17848											0		

Appendix H. Forage fish sample location and egg count for 2007-2008 Nearshore Strait of Juan de Fuca assessment

Date	Site	Time	Sample number	Latitude	Longitude	Species	1 cell to morula	blastula	gastrula	1/2-1 coil	1 coil	11/2 coil	>11/2 coil	late eyed	dead	# eggs	% dead	# broods
1/18/08	Dungeness Spit	15:28	4	48.15248	123.18091											0		

comments

sample lost

comments

comments

comments

comments

comments

comments

comments