

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

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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 overall 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. Crescent 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 degradation. 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 (NOPL) 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 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 its 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 NOPL 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 Strategy. 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 twelve 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 (Figure 4 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 samplings 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, Freshwater 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

Dungeness 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.

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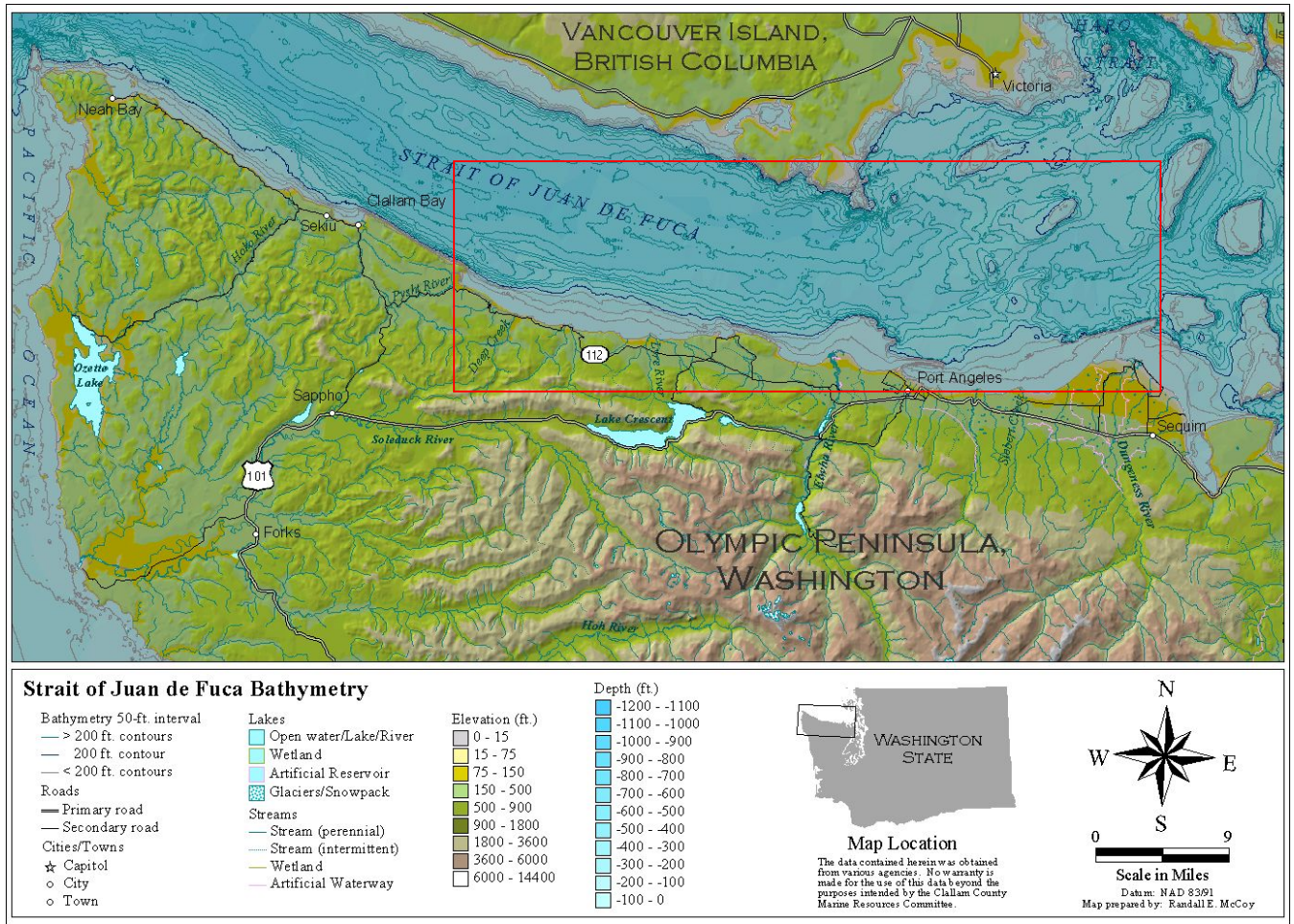
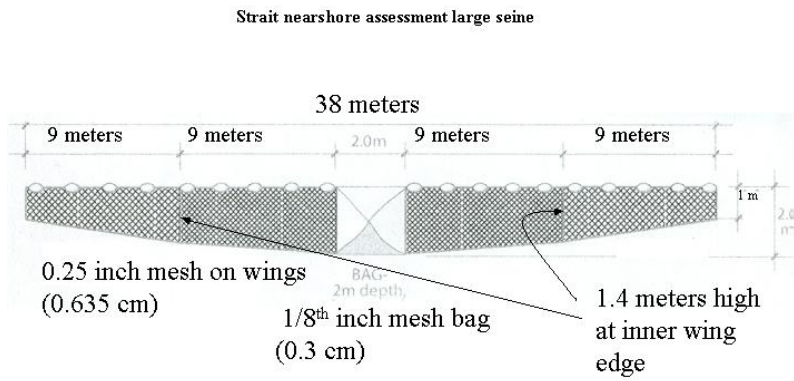
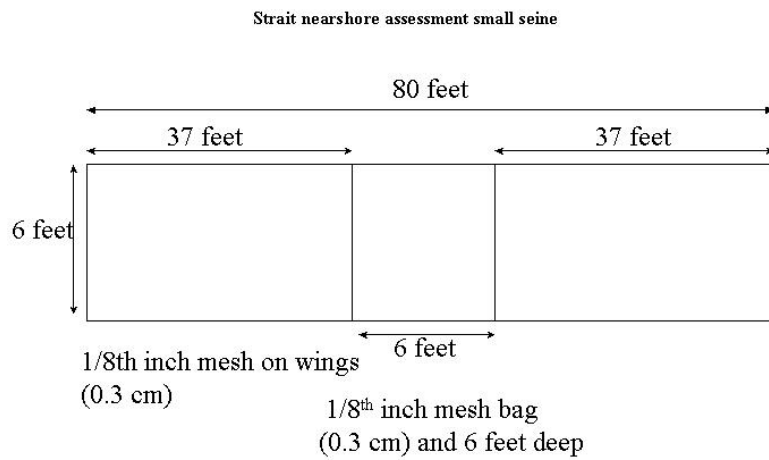


Figure 1. Strait of Juan de Fuca and central Strait of Juan de Fuca study area.



Shaffer et al., 2007
11/20/07



Shaffer et al., 2007
11/20/07

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

Executive Summary Nearshore Assessment of the Central Strait of Juan de Fuca

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.

<u>Site</u>	<u>Embayment</u> <u>s</u>	<u>Lower</u> <u>river/Pocket</u> <u>Estuary</u>	<u>Spits</u>	<u>Bluffs</u>
<u>Pysht Lower</u> <u>River/Estuary</u>		X		
<u>Twins Lower</u> <u>River/Estuary</u>		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	

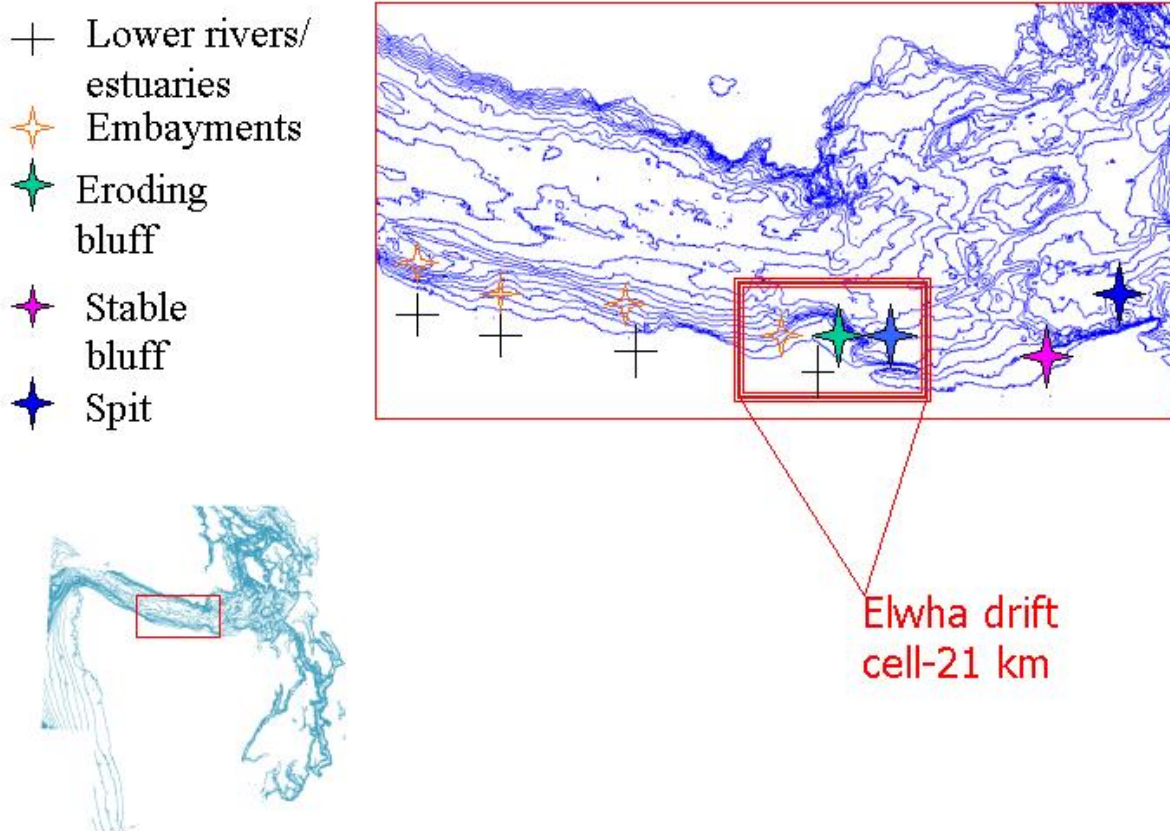


Figure 3. Sampling sites for Central Strait Nearshore Assessment

Executive Summary Nearshore Assessment of the Central Strait of Juan de Fuca

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

Habitat Type ▶	<u>Sandy shore intertidal and shallow subtidal</u>	<u>Spit (intertidal and shallow subtidal)</u>	<u>Rocky Shore (intertidal and shallow subtidal)</u>	<u>Pocket Estuary intertidal and shallow subtidal</u>	<u>Stable bluff Intertidal and shallow subtidal</u>	<u>Eroding bluff intertidal and shallow subtidal</u>
Habitat Structure ▶	<u>Unvegetated, & eelgrass bed)</u>	<u>Unvegetated & eelgrass beds</u>	<u>Kelp beds</u>	<u>Unvegetated & eelgrass beds</u>	<u>Unvegetated & eelgrass beds</u>	<u>Unvegetated & kelp beds</u>
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 sculpin	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*	189532	100															

*63% of which were March - September 07

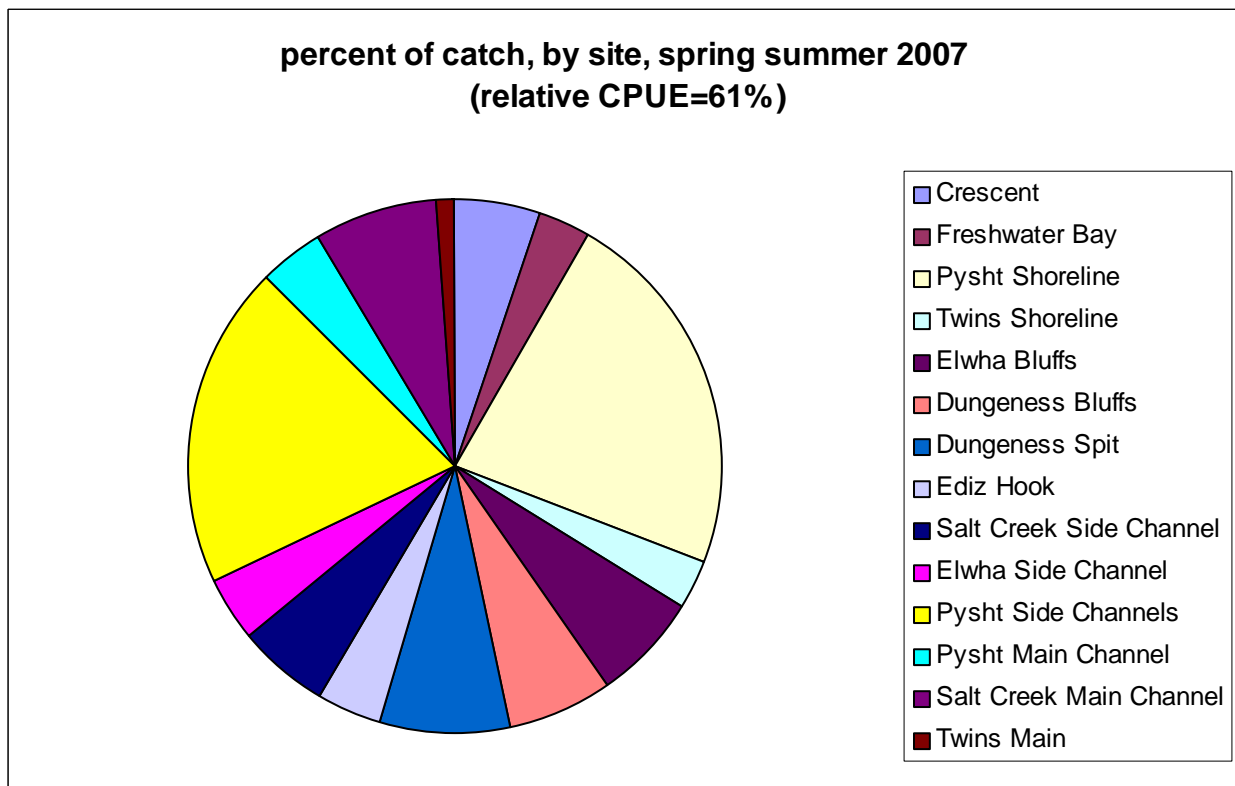
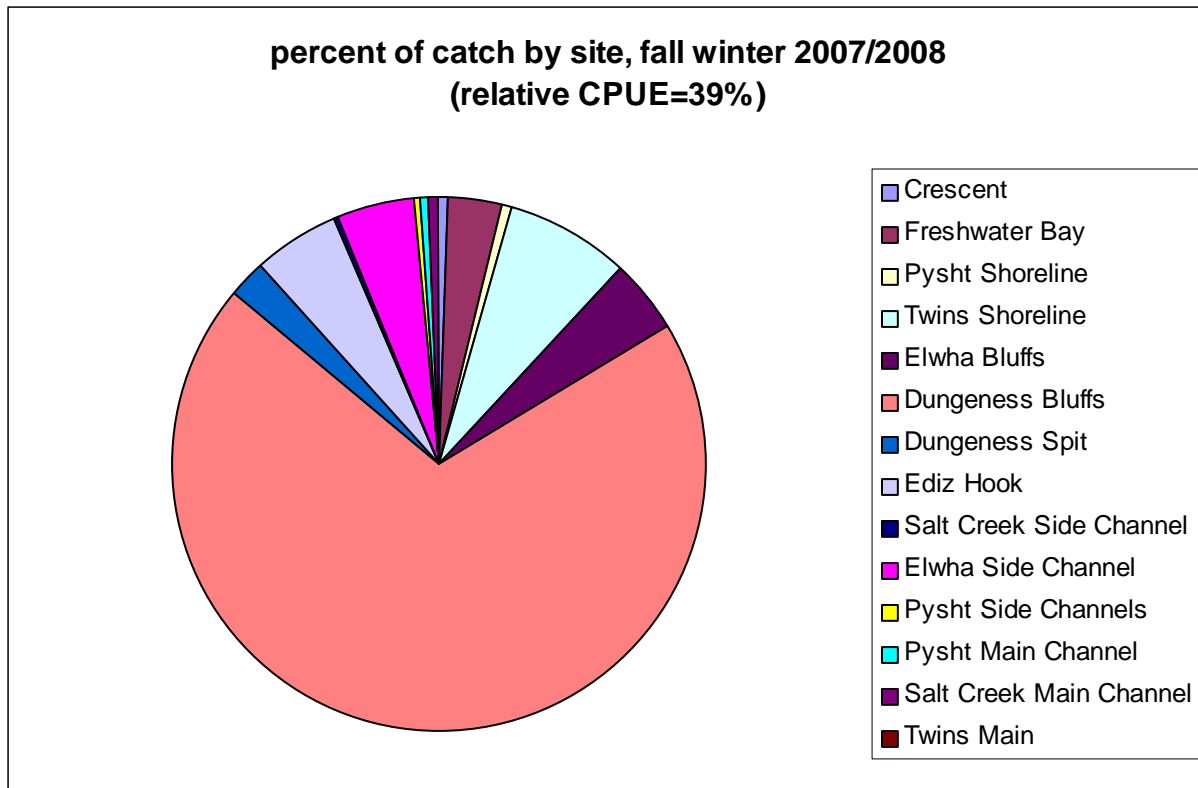


Figure 4. Composition of catch by season, Strait of Juan de Fuca.

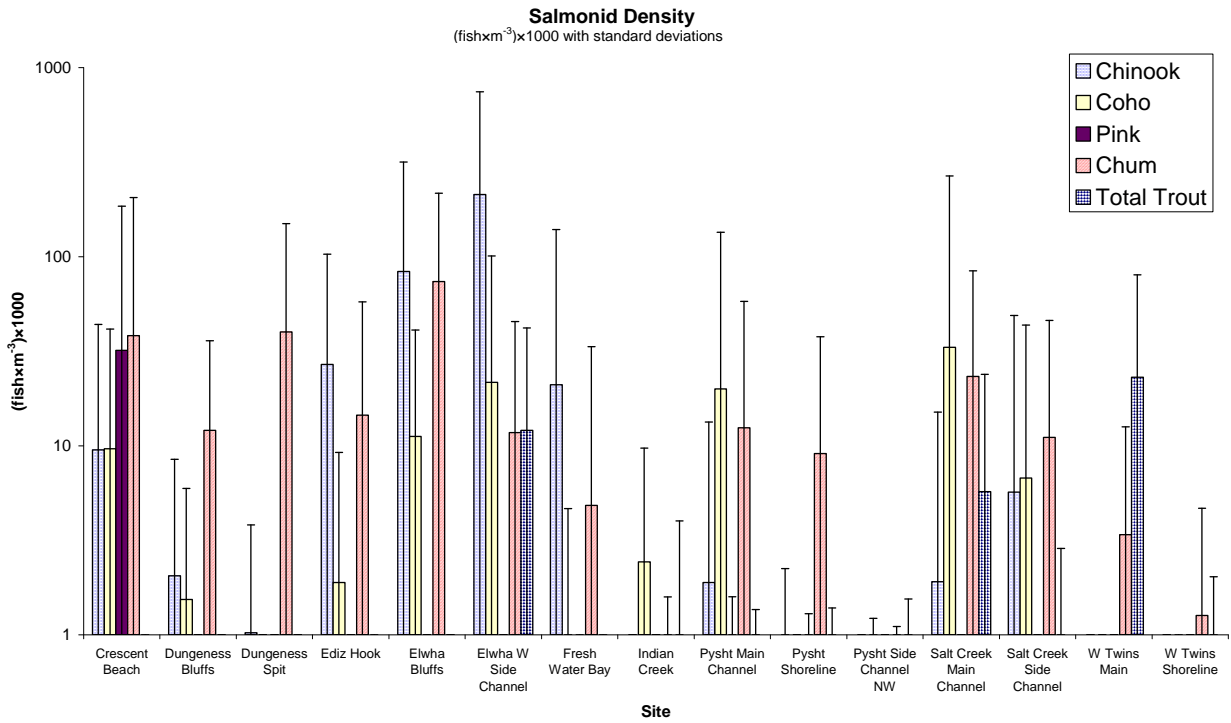


Figure 5. Salmon densities by geomorphic habitat type, central and western Strait of Juan de Fuca, March 2007-March 2008.

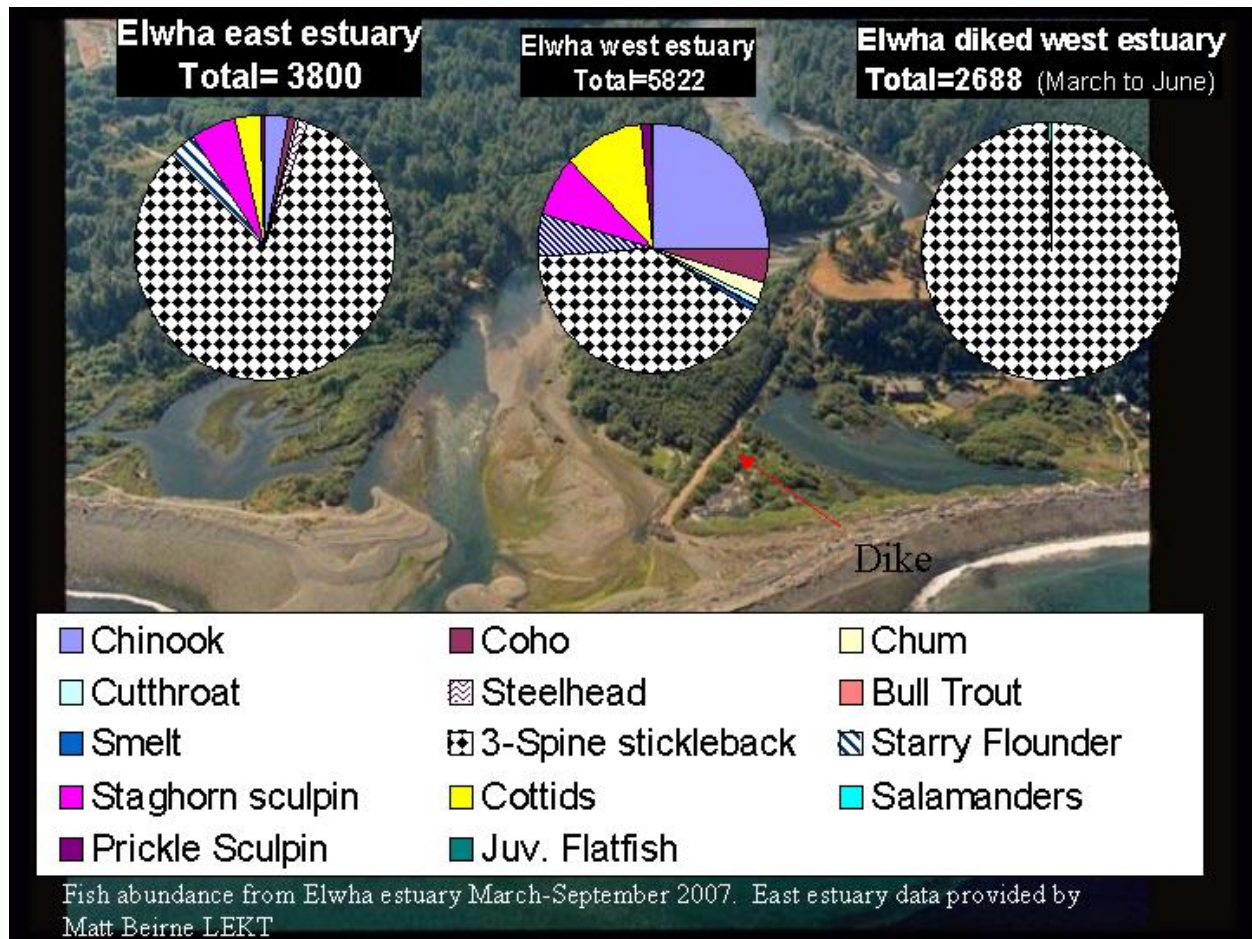
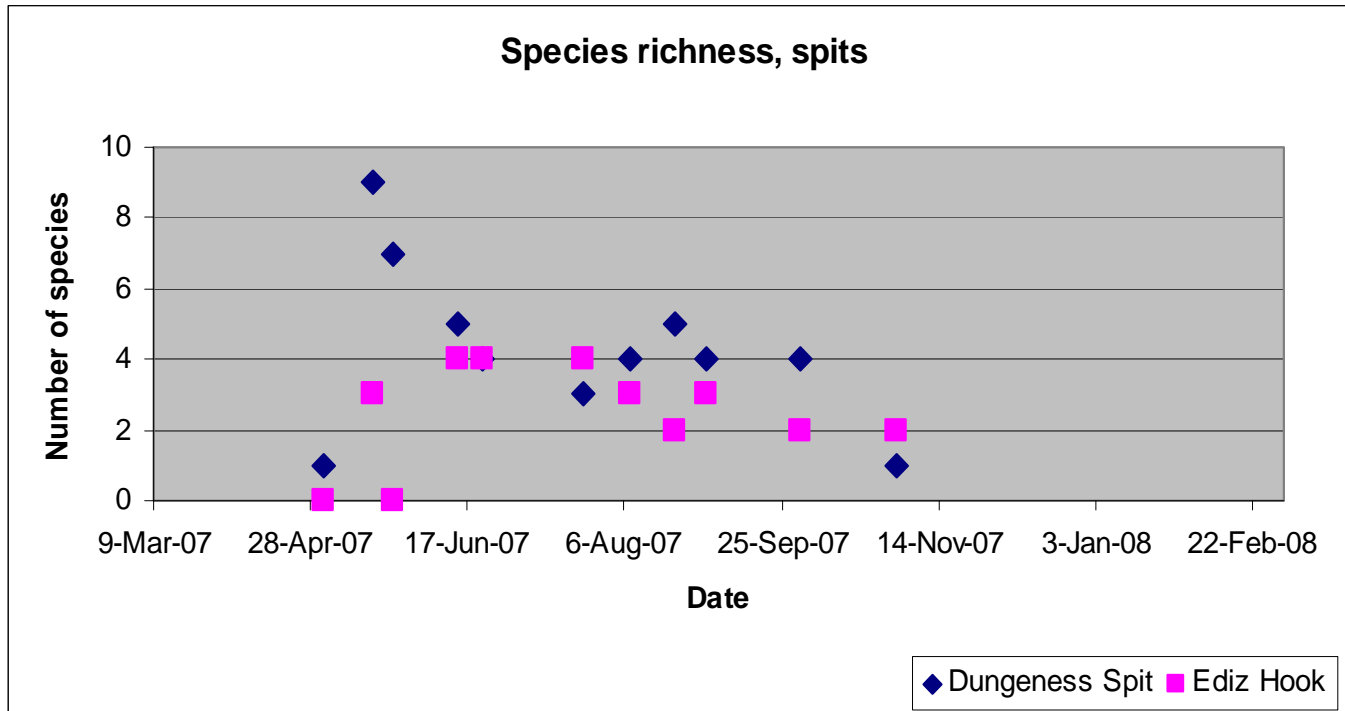


Figure 6. Fish abundance from Elwha estuary March-September 2007.



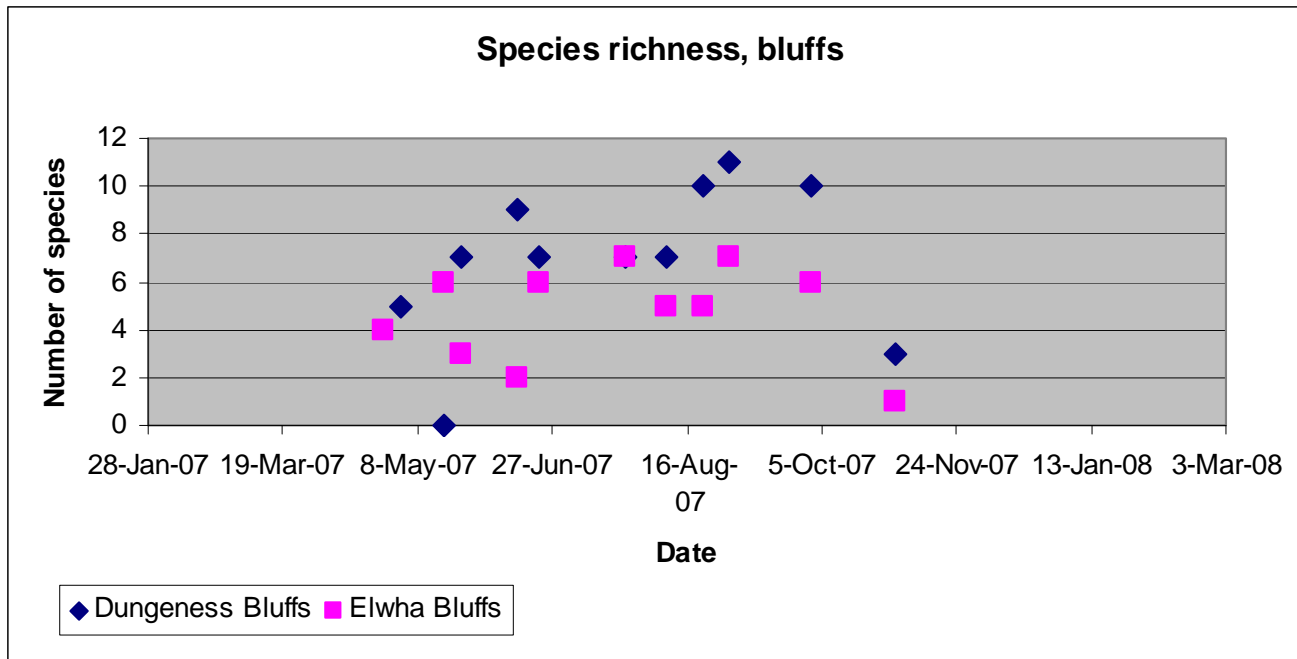


Figure 7a. Species richness spits and bluffs

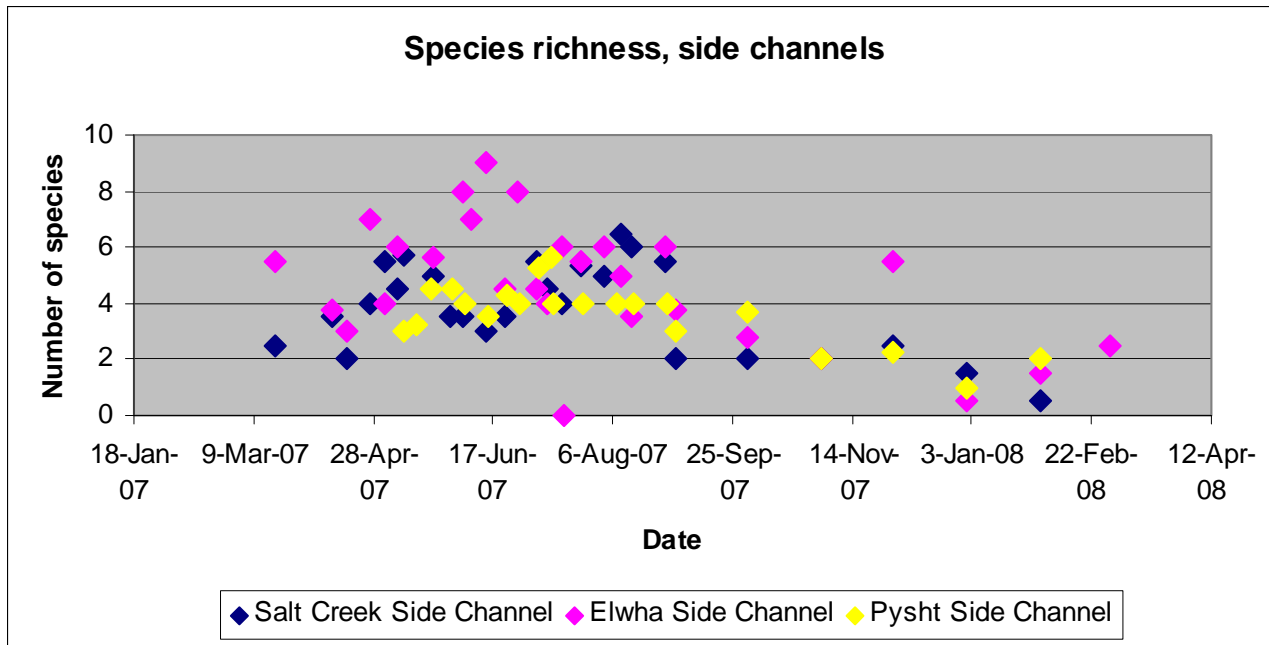


Figure 7b. Species richness side channels

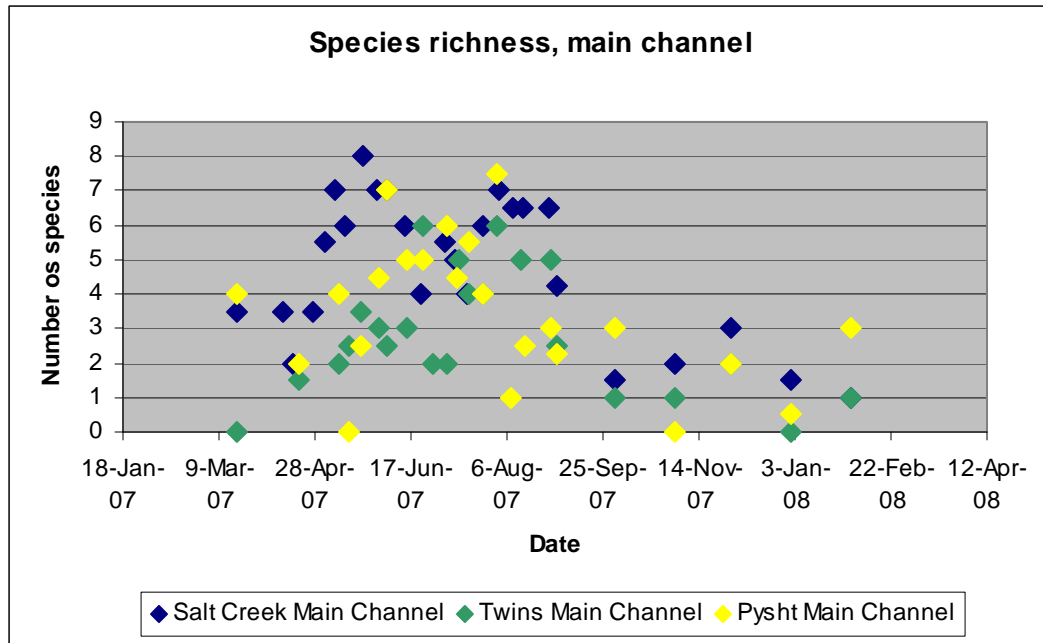


Figure 7c. Species richness for lower rivers main channel of central Strait of Juan de Fuca,

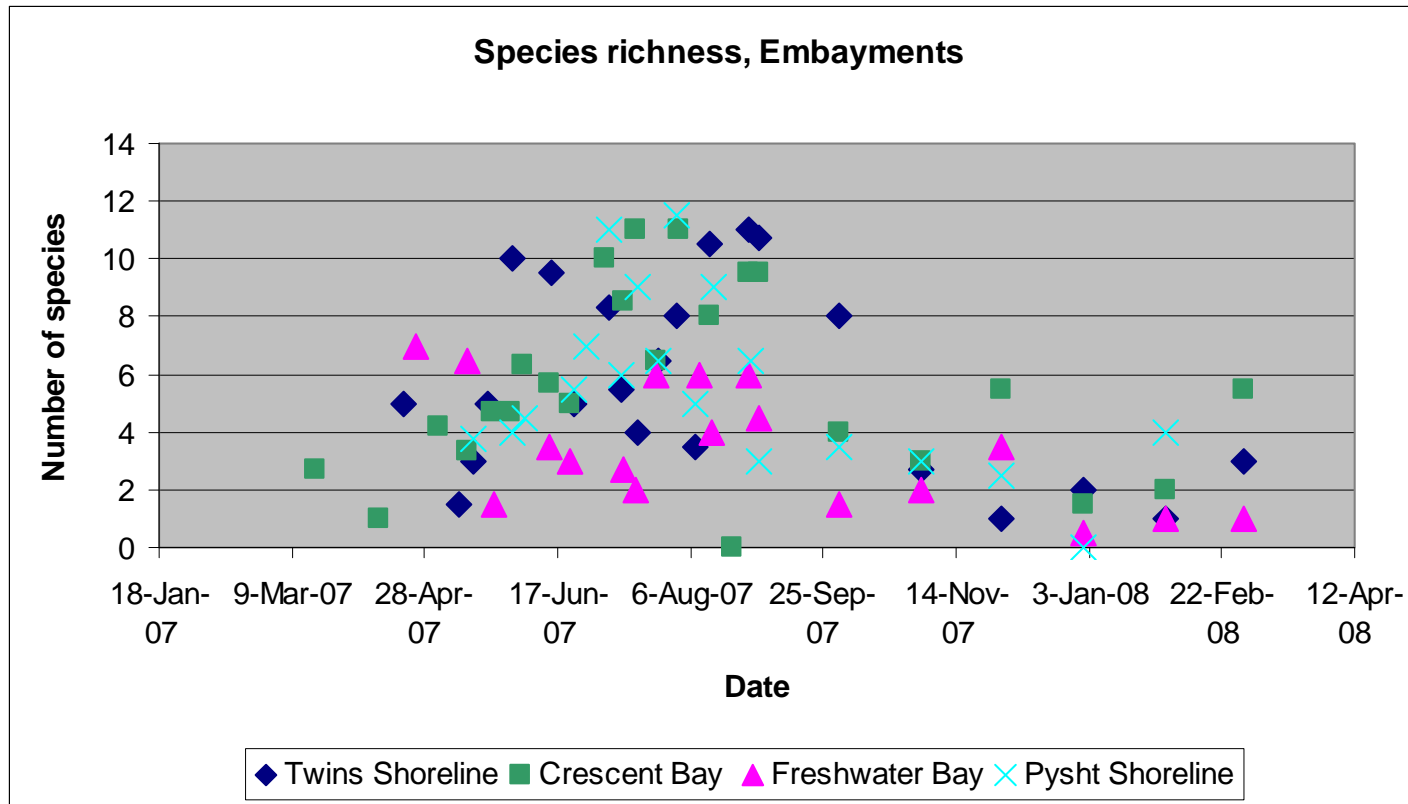


Figure 7d. Species richness for bays and shorelines of central Strait of Juan de Fuca,

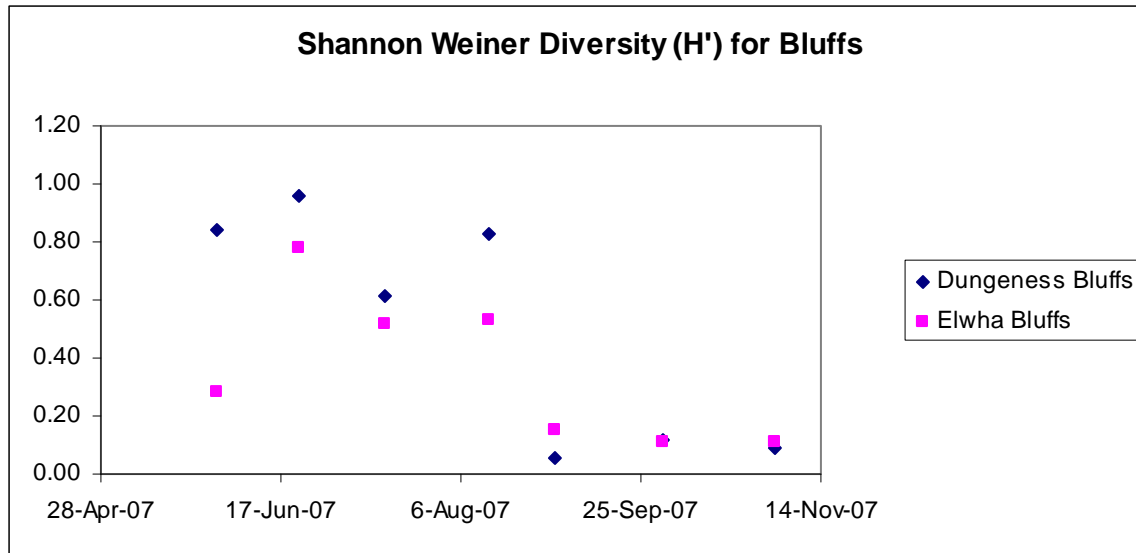


Figure 8 A. Species diversity for bluffs of central Strait of Juan de Fuca, March-October 2007.

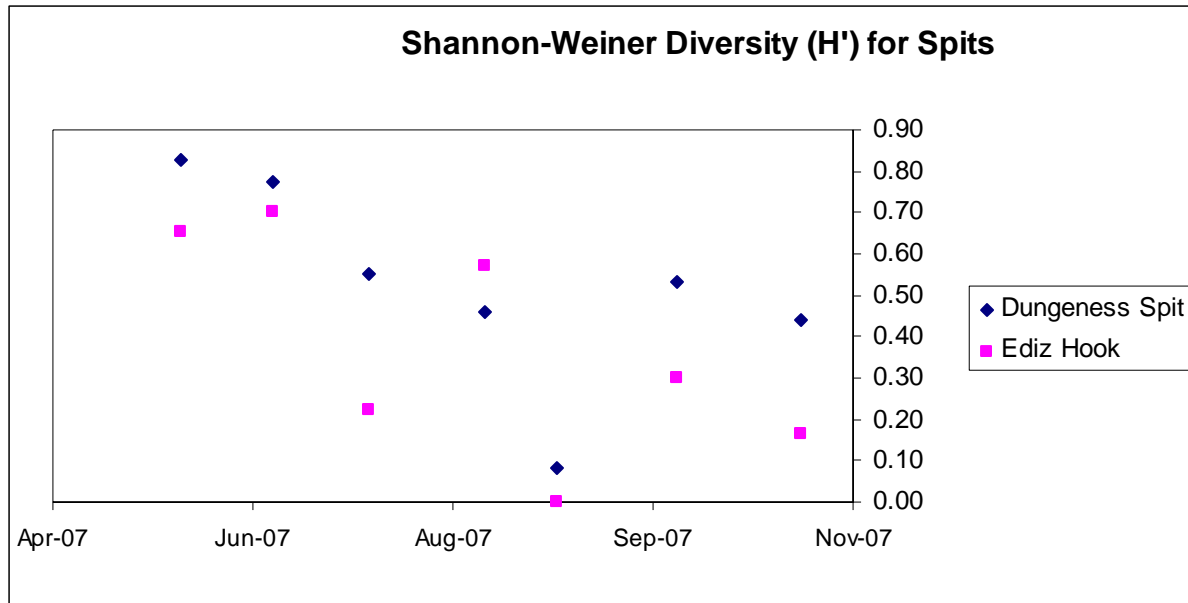


Figure 8 B. Species diversity for spits of central Strait of Juan de Fuca, March-October 2007 .

Shannon Weiner Diversity (H') for Shoreline Sites

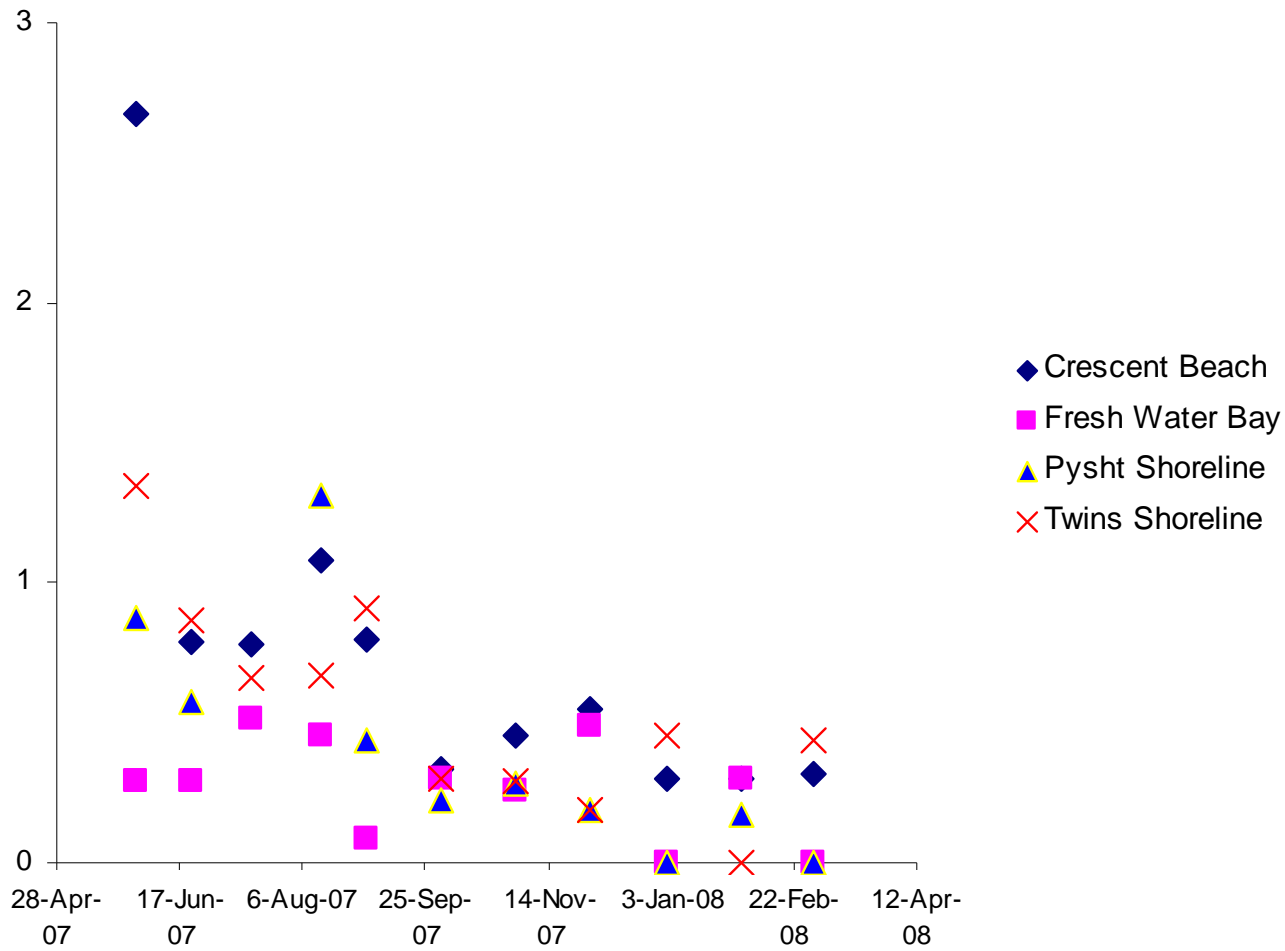
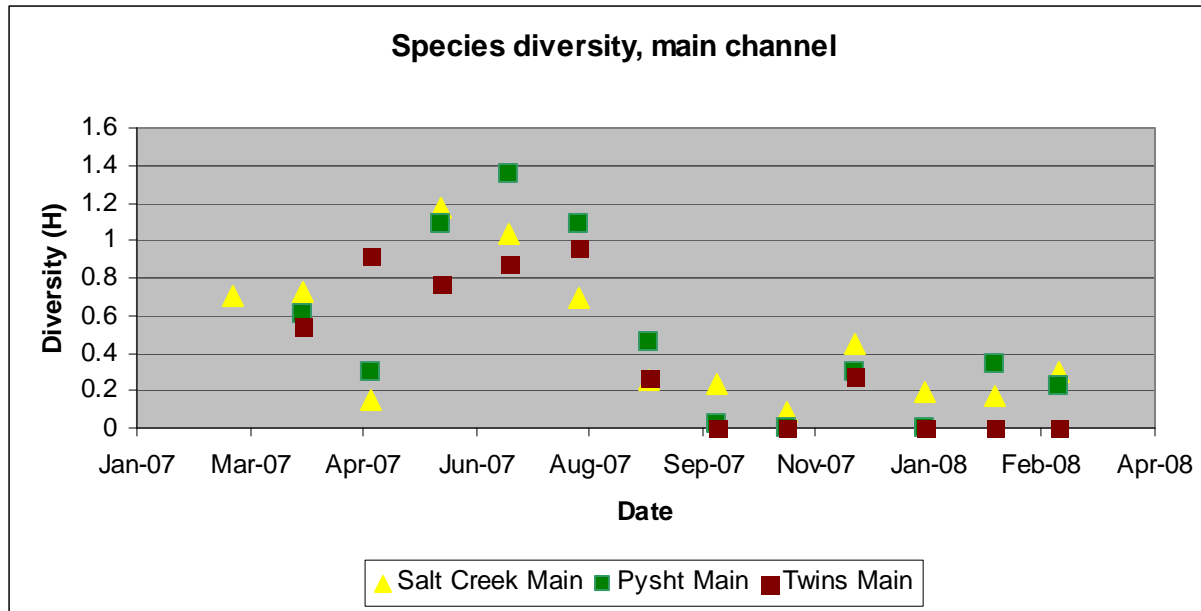


Figure 8 C. Species diversity for bay shorelines sites of central Strait of Juan de Fuca, March 2007- March 2008.



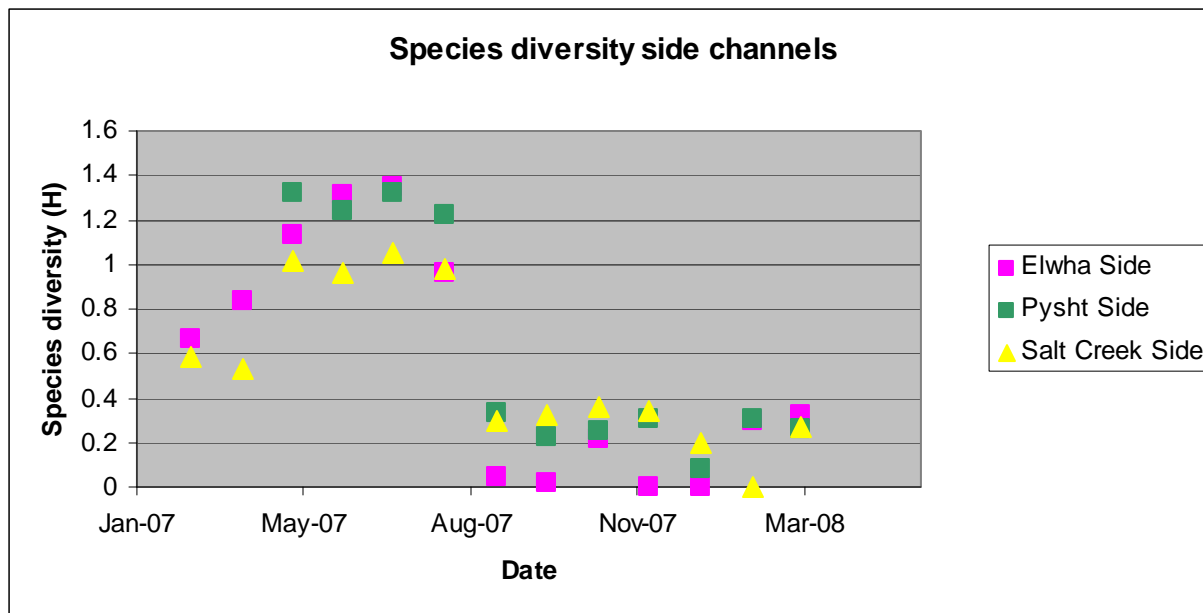


Figure 8 D. Species diversity for lower rivers and side channels of central Strait of Juan de Fuca, March 2007- March 2008.

Executive Summary Nearshore Assessment of the Central Strait of Juan de Fuca

Appendix A. Weekly densities, seining nearshore assessment

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

Executive Summary Nearshore Assessment of the Central Strait of Juan de Fuca