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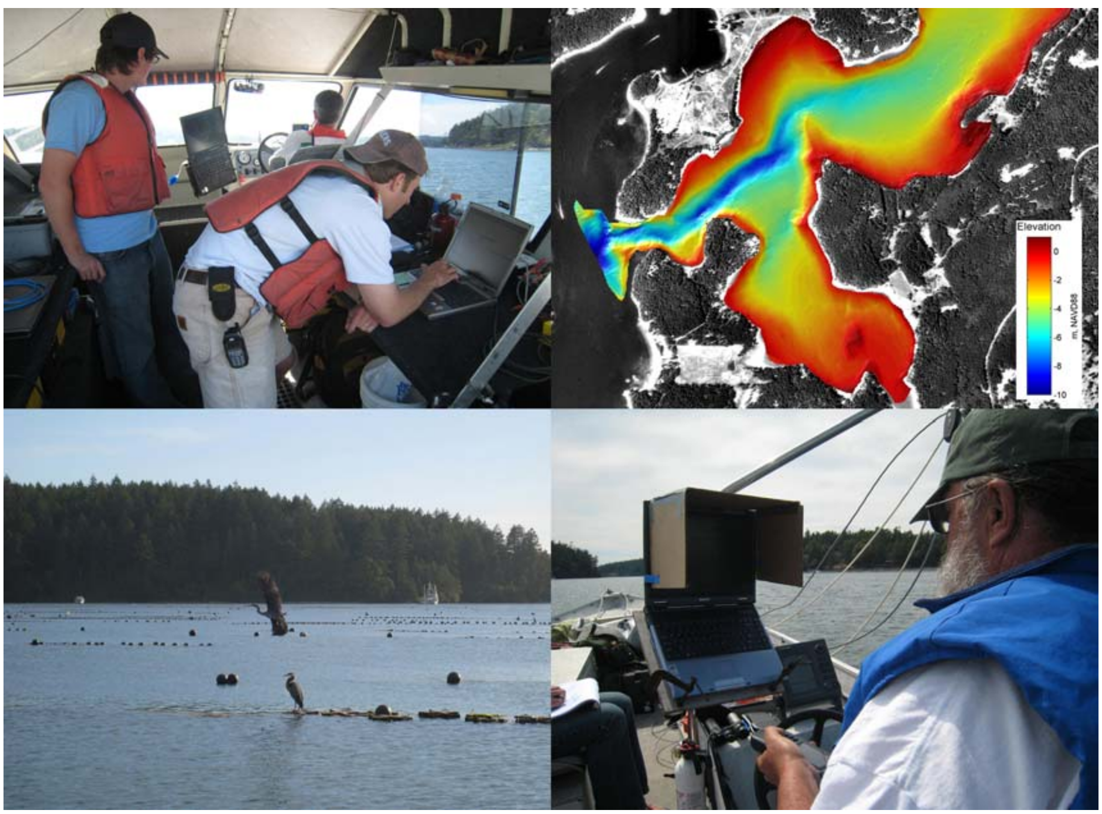
Bathymetry, Substrate and Circulation in Westcott Bay, San Juan Islands, Washington



By Eric Grossman, Andrew Stevens, Chris Curran, Collin Smith, and Andrew Schwartz

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Bathymetry, Substrate, and Circulation in Westcott Bay, San Juan Islands, Washington

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Abstract

Nearshore bathymetry, substrate type, and circulation patterns in Westcott Bay, San Juan Islands, Washington, were mapped using two acoustic sonar systems, video and direct sampling of seafloor sediments. The goal of the project was to characterize nearshore habitat and conditions influencing eelgrass (*Z. marina)* where extensive loss has occurred since 1995. A principal hypothesis for the loss of eelgrass is a recent decrease in light availability for eelgrass growth due to increase in turbidity associated with either an increase in fine sedimentation or biological productivity within the bay. To explore sources for this fine sediment and turbidity, a dual-frequency Biosonics sonar operating at 200 and 430 kHz was used to map seafloor depth, morphology and vegetation along 69 linear kilometers of the bay. The higher frequency 430 kHz system also provided information on particulate concentrations in the water column. A boat-mounted 600 kHz RDI Acoustic Doppler Current Profiler (ADCP) was used to map current velocity and direction and water column backscatter intensity along another 29 km, with select measurements made to characterize variations in circulation with tides. An underwater video camera was deployed to ground-truth acoustic data. Seventy one sediment samples were collected to quantify sediment grain size distributions across Westcott Bay. Sediment samples were analyzed for grain size at the Western Coastal and Marine Geology Team sediment laboratory in Menlo Park, CA. These data reveal that the seafloor near the entrance to Westcott Bay is rocky with a complex morphology and covered with dense and diverse benthic vegetation. Current velocities were also measured to be highest at the entrance and along a deep channel extending 1 km into the bay. The substrate is increasingly comprised of finer sediments with distance into Westcott Bay where current velocities are lower. This report describes the data collected and preliminary findings of USGS Cruise B-6-07-PS conducted between May 31, 2007 and June 5, 2007.

Introduction

In response to recent, extensive loss of the eelgrass *Z. marina* throughout the San Juan Islands (Berry et al. 2003; Wyllie-Echeverria et al. 2003), scientists from Washington State Department of Natural Resources (WADNR) Aquatic Resources Division, University of Washington (UW), and the U.S. Geological Survey (USGS) have initiated studies of nearshore habitat structure and hydrodynamic processes to examine possible stressors. A principal hypothesis for the loss of *Z. marina* in Westcott Bay, San Juan Island, is a recent decrease in light availability for eelgrass growth due to increase in turbidity associated with either an increase in fine sedimentation or biological productivity within the bay. To examine conditions influencing possible *Z. marina* recovery in Westcott Bay *Z. marina* transplant studies were paired with time-series water column property measurements during the summer of 2007 as part of the WA DNR "Eelgrass Stressor-Response Project". To characterize sources and processes influencing sediment transport and turbidity that affect light conditions for *Z. marina*, bathymetric, substrate, and circulation mapping were conducted. This report describes the bathymetry, substrate, and circulation data collected and preliminary findings that relate to the nearshore and *Z. marina* habitat in Westcott Bay.

Study Area

Westcott Bay is located along the northwest coast of San Juan Island (Figure 1).

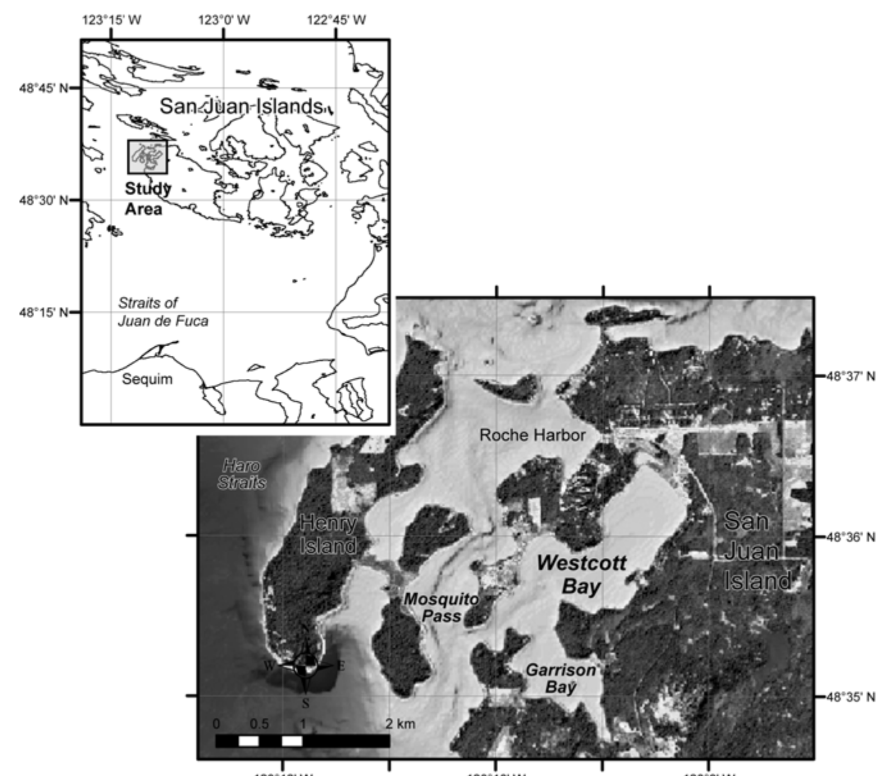

Figure 1. Location map showing Westcott Bay study area.

Westcott Bay is 3 km in length and averages 800 m in width and is connected to Garrison Bay inside of a narrow (150 m) mouth opening into Mosquito Pass. Westcott Bay is relatively shallow reaching a maximum depth of approximately -8.5 m, although 35% of the bay is less than -2 m and 48% is less than -3 m. It is bounded by a relatively low relief watershed composed of Paleozoic and Mesozoic sedimentary rocks that have been folded into a broad syncline, some of which have been metamorphosed by igneous rocks of Mesozoic age. Two small intermittent streams discharge into the head of the bay. Westcott Bay is oriented WSW-ENE and because of its narrow mouth, receives little swell in the form of wind waves originating from summertime northwest and periodic wintertime southwest fetch. This region of the San Juan Islands is characterized by a 3.5-4.0 m tide regime which generates strong observable tidal currents in Mosquito Pass. Sediment sources for Westcott Bay are likely to include fluvial-derived sediment input from the two small streams, erosion of bedrock outcrops near headlands and along the seafloor, autochthonous organic matter and calcareous shell production, and possibly import of fine materials from outside the bay through advection.

Data Acquisition

Bathymetric mapping

Sixty-nine (69) kilometers of acoustic bathymetry/substrate data were collected with a dual-frequency (200 and 430 kHz) Biosonics DT-X sonar system along 142 transects in Westcott and Garrison Bays between 5/31/07 and 6/2/07 (Fig. 2, Appendix 1).

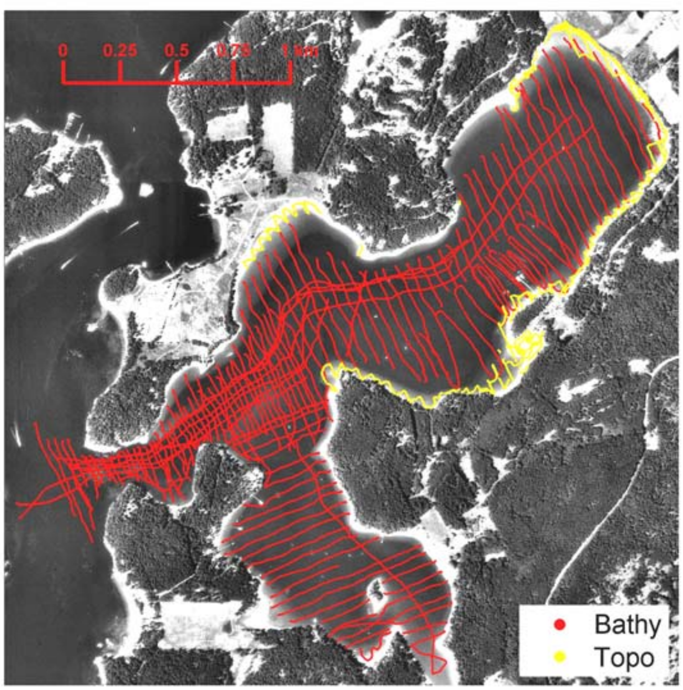

Fig. 2. Map of survey track lines where bathymetry and acoustic substrate data (red) and topographic RTK-DGPS data (yellow) were collected

The Biosonics sonar generates a 6-degree cone of sound, which translates into a footprint on the seafloor ranging 0.2 to 0.8 m for the water depths surveyed (2 - 8 m). Ship speed generally ranged 4.0-4.5 kts and data were merged with GPS positions at 1 Hz. Resulting data therefore represent 0.2-0.8 m pixels on the seafloor spaced approximately 1-2 m apart along track lines. Track lines were spaced 25 m apart. Twenty (20) km of topographic elevation data were also collected across the upper intertidal region by walking the shoreface with a portable Trimble 4700 RTK-DGPS receiver. This receiver utilized a Trimble Zepher Antenna and Pacific Crest radio receiver to obtain real time position corrections from a base station operating a Trimble 4400 receiver and L1/L2 antenna with a Pacific Crest 35 Watt radio transmitter. Elevation data over emergent beaches and tide flats collected by walking are 2-3 times denser as a result of survey speeds ranging 0.5-1.0 kts. The combined bathymetric and topographic data were merged to create a digital elevation model representing the surface topography of Westcott Bay. This surface is referenced to the WGS 84 datum in the UTM Zone 10 North projection with a horizontal accuracy of 2.3 cm. Elevations are referenced to NAVD88 with an estimated vertical accuracy ranging 2.6-9.8 cm. This includes error from the RTK-DGPS and Biosonics sonar, and errors introduced in data processing. The root mean square (RMS) error of the processed surface elevation values were derived from survey line crossings. Line crossings did not always capture the same point on the seafloor (because of GPS accuracy, navigation, currents, and timing of data recording). Therefore, variability in elevation values at crossings is likely in part derived from variability in the bathymetry of the seafloor where line crossings spanned 0.5 to 2 m apart in the horizontal.

Because there can be significant natural variability in depth/elevation across 0.5 to 2.0 m of the seafloor, the vertical error of the survey was determined from analysis of three classes of elevation values at line crossings:

1) values within 2 m of each other from all areas of Westcott Bay including vegetated, rocky and smooth areas (RMS=9.8 cm, n=66)
2) values within 2 m of each other from the smooth area between Bell Point and the head of Westcott Bay (RMS=3.6 cm, n=22)
3) values within 0.5 m of each other within the smooth area between Bell Point and the head of Westcott Bay (RMS=2.6 cm, n=6)

The overall error for the entire survey is therefore 9.8 cm, although particular areas, especially characterized by low relief likely have much smaller errors.

Sediment Samples for Grain Size Analyses

Sediment samples were collected using a van veen grab sampler at 71 stations on a 200-250 m grid (Fig. 3) to characterize grain size distribution throughout Westcott Bay and sources of fine material for suspension and transport.

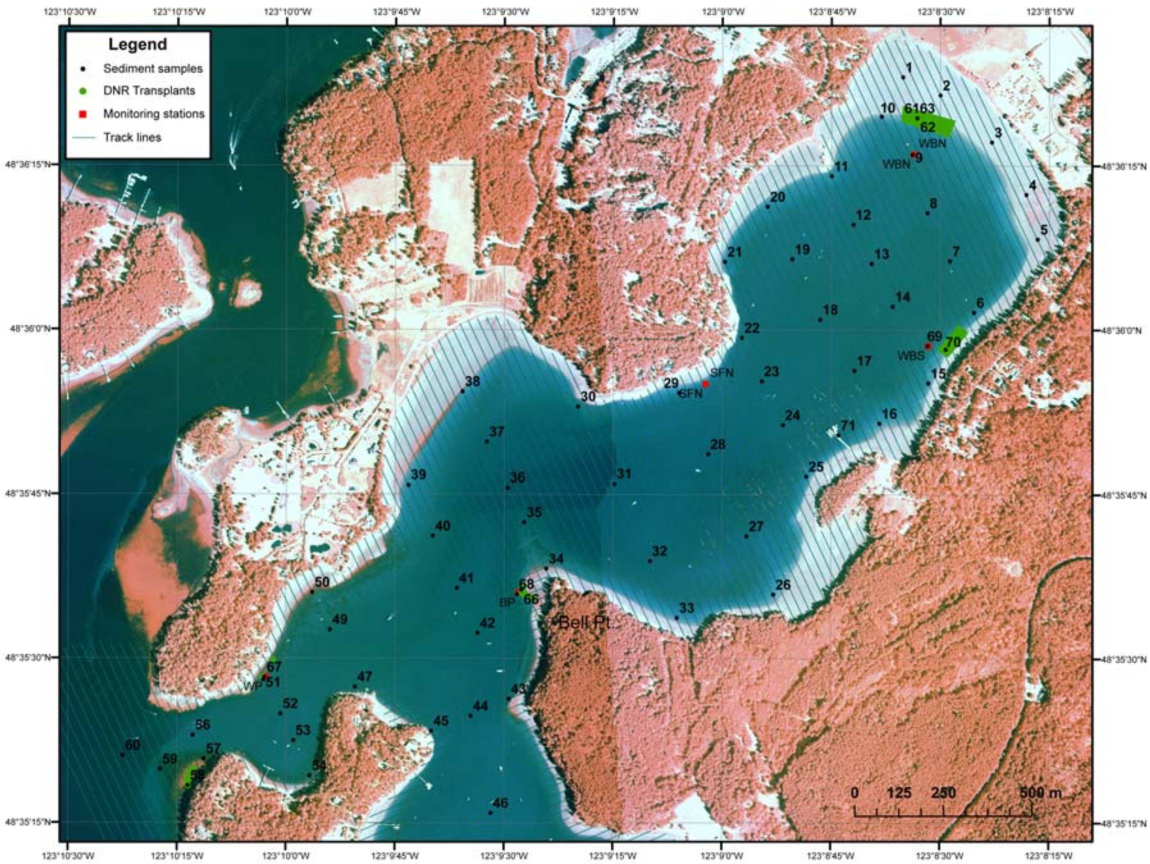

Fig. 3. Map showing sediment grab sample locations.

The shallow stratigraphy was well-preserved in the sediment grabs so that a 1-3 cm thick aerated surface layer could be observed at most stations dominated by fines (Figure 4).

Fig. 4. Photo of sediment grab sample WB9 showing fluffy, light colored, aerated top layer overlying a sharp contact (arrow) with a denser, cohesive mud/clay below.

In the field, a sub-sample of the uppermost 1-3 cm of each grab was collected and placed into storage bags, labeled, logged, and frozen. Several 10-cm push cores were also collected. Triplicate samples were collected at sites WBN and BP for error analyses. Appendix 2 summarizes sample times and environmental conditions at collection sites.

In the laboratory, sediment samples were split for grain size and carbon analyses and later archived at the Western Coastal and Marine Geology Team sediment laboratory in Menlo Park, CA. Samples were disaggregated and sieved through 2000 and 62 micron screens to separate gravel, sands and mud after the organic component was removed by treatment with hydrogen peroxide. Sediment grain size of sands was determined using the settling methods and principles of Stokes Law (Guy 1969) on the USGS 3-m long settling tubes. The fine fraction (silts and clays) were analyzed on a Coulter 230 Laser Particle Analyzer. Three samples had less than 3% intermediate fraction and were analyzed on the Coulter. Single sample runs were made on the tubes, while results from the laser particle analyzer are averages of triplicates with standard deviations around the mean ranging 18 to 24 microns due to instrument errors. Results from the tubes and laser particle analyzer were merged using standard USGS methods found in the USGS particle analysis program pcSedSize http://water.usgs.gov/software/sedsize.html). Analyses of triplicate samples collected at stations WBN and BP show that inter-station variability around the mean grain size ranged ±0.054 mm. The complete grain size results are provided in Appendix 3. These results were then gridded across the bathymetric surface with a nearneighbor gridding algorithm averaging between the three nearest points.

Video of the seafloor was collected along several principal transects in the western and central portions of Westcott Bay to ground-truth the sonar data and provide direct observations of the complex substrate, substrate transitions, and benthic vegetation. These results will be furnished in subsequent revisions to this report.

Nearshore Currents

Current velocity, direction and backscatter amplitude were collected along 65 transects in Westcott Bay (Fig. 5) with a 600 kHz RDI ADCP (Acoustic Doppler Current Profiler) and recorded with WinRiver software following Oberg and others, (2005). Select transects at the mouth of Westcott Bay, Bell Point and immediately east of the Westcott Sea Farm were repeated ~2-3 times under flooding and ebbing tides. ADCP were recorded with GPS position at 1 hz with a ship speed of 2.0-2.5 kts, so raw ADCP data cover a lateral distance of 1.00 to 1.25 m. The raw ADCP data were vertically binned at 0.25 m and include a blanking distance of 0.25 m (no data in uppermost 0.25 m below the transducer). The RDI ADCP is accurate to within 0.25% of boat + water velocity, resulting in an error for our velocity data of 0.25 to 0.45 cm/s based on our survey speed of 2 kts and measured velocities ranging 0 to 1.5 m/s.

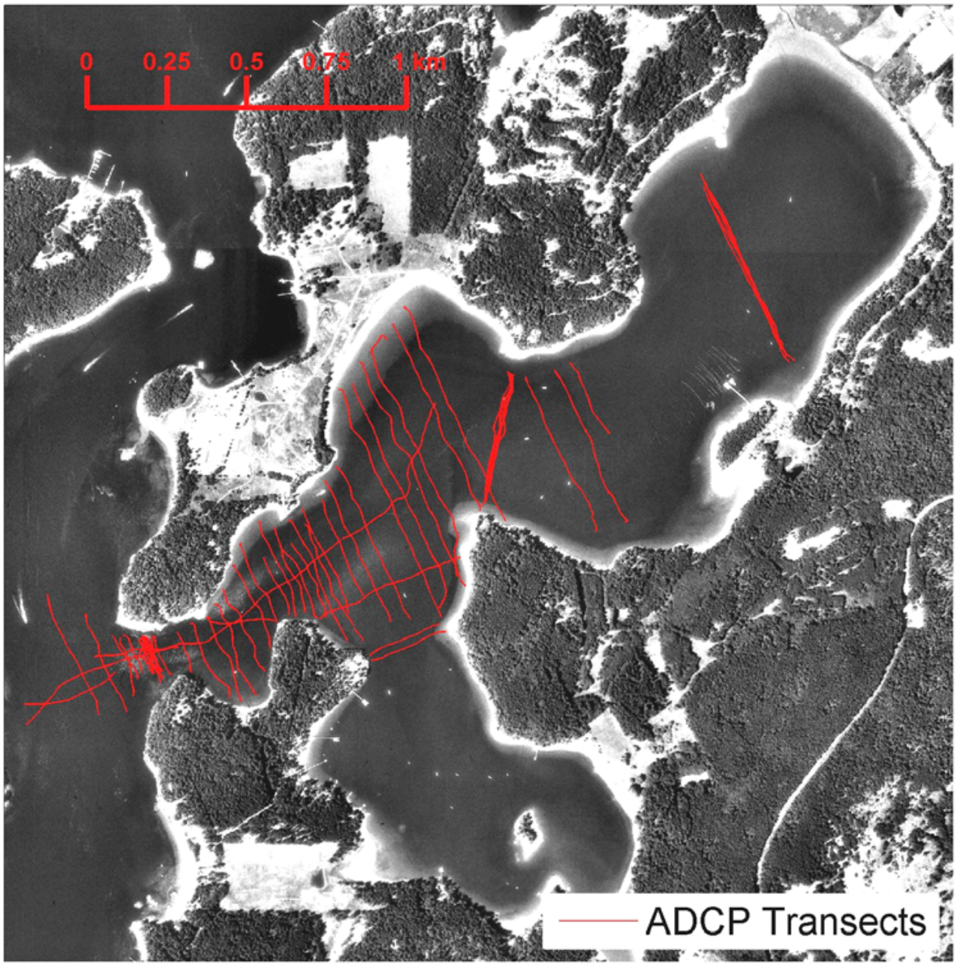

Fig. 5. Map of ADCP survey lines. Three principal lines (bold lines) at the mouth of Westcott Bay, Bell Point and just east of the sea farm were repeated multiple times to examine variability under ebb and flood tides.

Results

Bathymetry and geomorphology

The resulting bathymetric surface map derived from the combined DGPS and biosonics sonar data shows that the seafloor of Westcott Bay is complex with high relief between the entrance at Mosquito Pass and Bell Point, while the head of the bay is shallow, smooth and lacking relief (Fig. 6). A distinct narrow channel incises to -8.5 m along the central axis of the outer bay and is deeper along the north edge of the entrance to the bay. A sill 7-8 m deep separates Mosquito Pass from Westcott Bay. The channel/trough extends east to the area north of Bell Point, where it gradually shallows toward the head of the bay. The margins of the trough are relatively steep, exceeding 35-40% slope immediately southeast of White Point (Fig. 7). These complex sill and trough features are likely a result of complex and strong currents, the presence of rocky substrate at the seafloor, and the regional glacial history. The bathymetry between Bell Point and the head of the bay is relatively smooth and featureless likely reflecting extensive sedimentation of fine material.

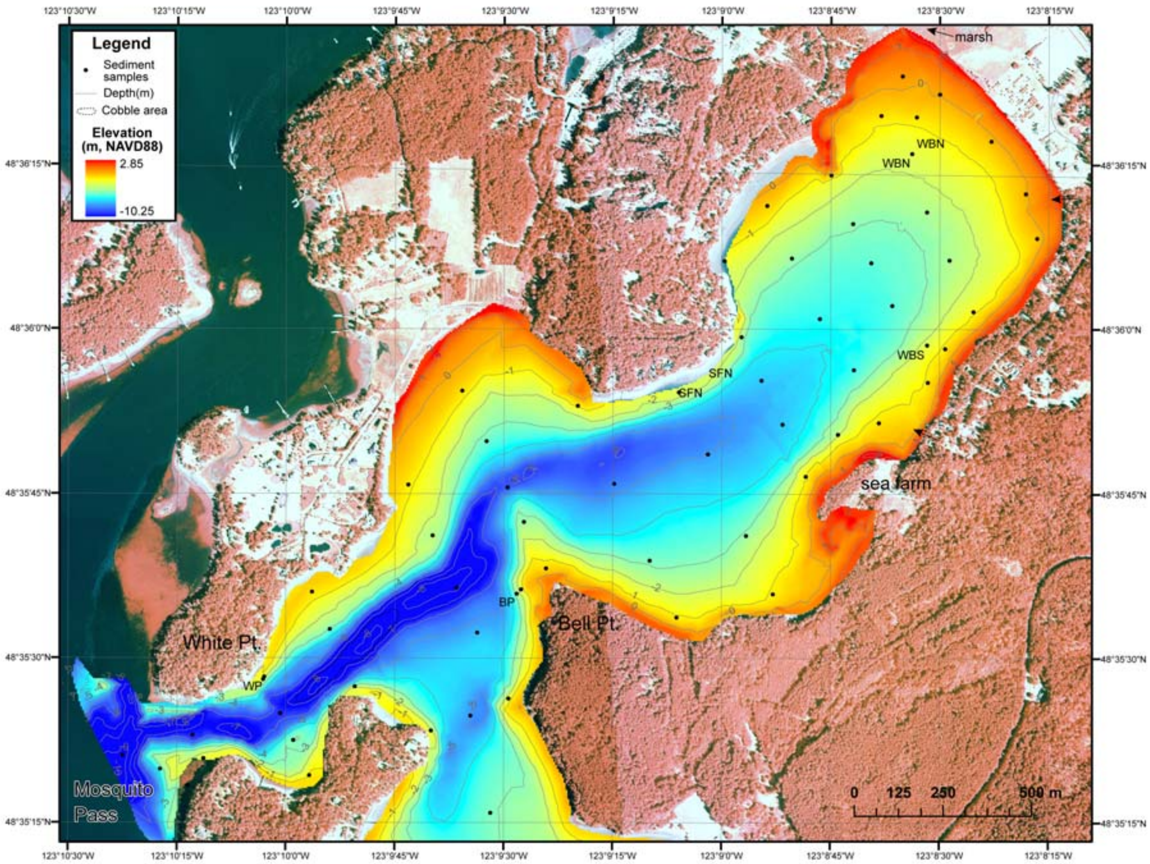

Fig. 6. Surface map of Westcott Bay based on bathymetry and topographic data collected showing narrow linear deep trough along center axis of outer Westcott Bay and shallow smooth surface of the head of the bay.

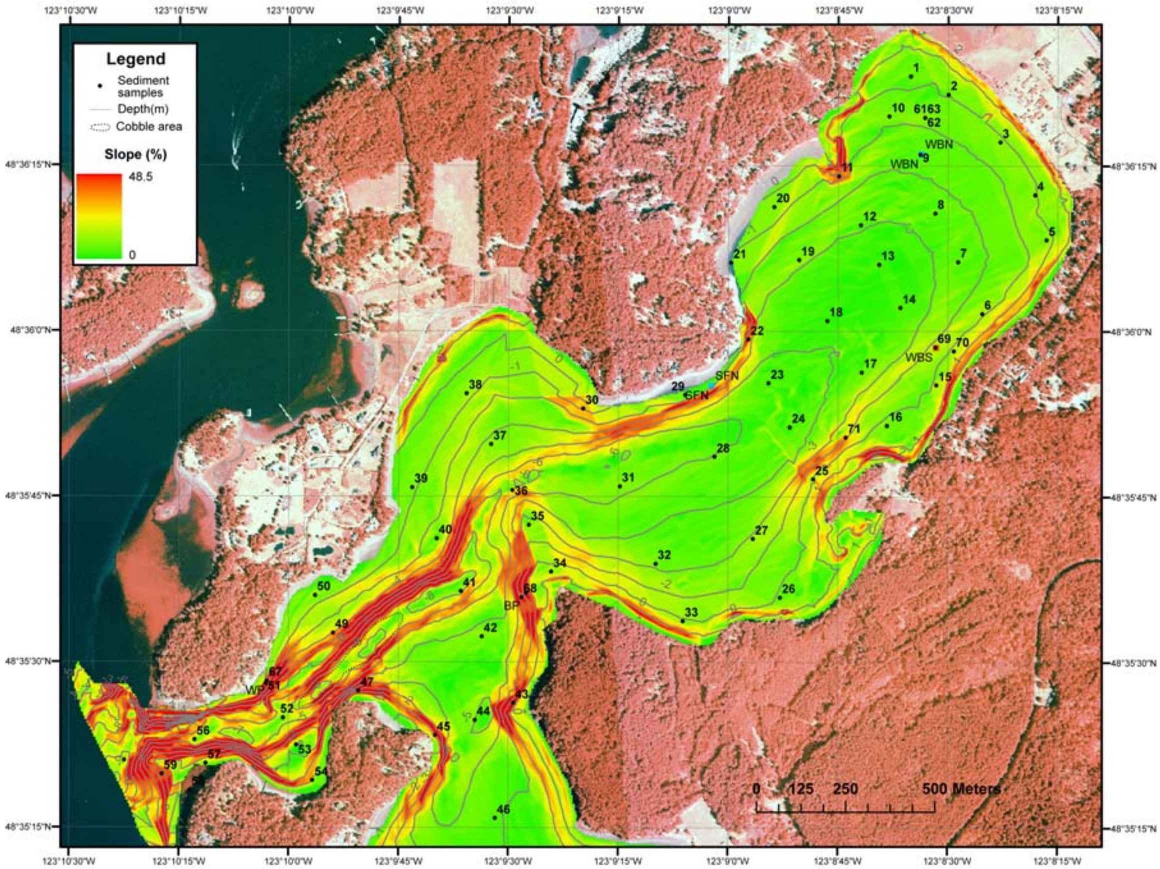

Fig. 7. Map showing seafloor slope of Westcott Bay with steep slopes characterizing the complex sill and trough region of the western half of the bay and relatively low slopes common of the broad gentle seafloor at the head of the bay.

Sediment grain size distribution

Figure 8 shows the mean grain size distribution in mm of unconsolidated sediments across Westcott Bay. Although the substrate was generally rocky in Mosquito pass and at the mouth of Westcott Bay, sand occurred within what appeared to be thin veneers of surface sediments. This region supported diverse communities of large kelp, seaweeds and algae. Along the central channel extending from Mosquito Pass to Bell Point, video observations along with grain size analyses indicated that the bottom was characterized by coarse sediments including gravel and cobbles. This region is delineated on all subsequent grain size distribution maps with a dotted polygon. Sand also dominates unconsolidated materials on the seafloor at the entrance to Garrison Bay, and near the intermittent stream mouths at the head of the bay and at the inlet to the marsh at the northeast corner of the bay. Otherwise silt predominates as the mean grain size throughout the central region and head of the bay.

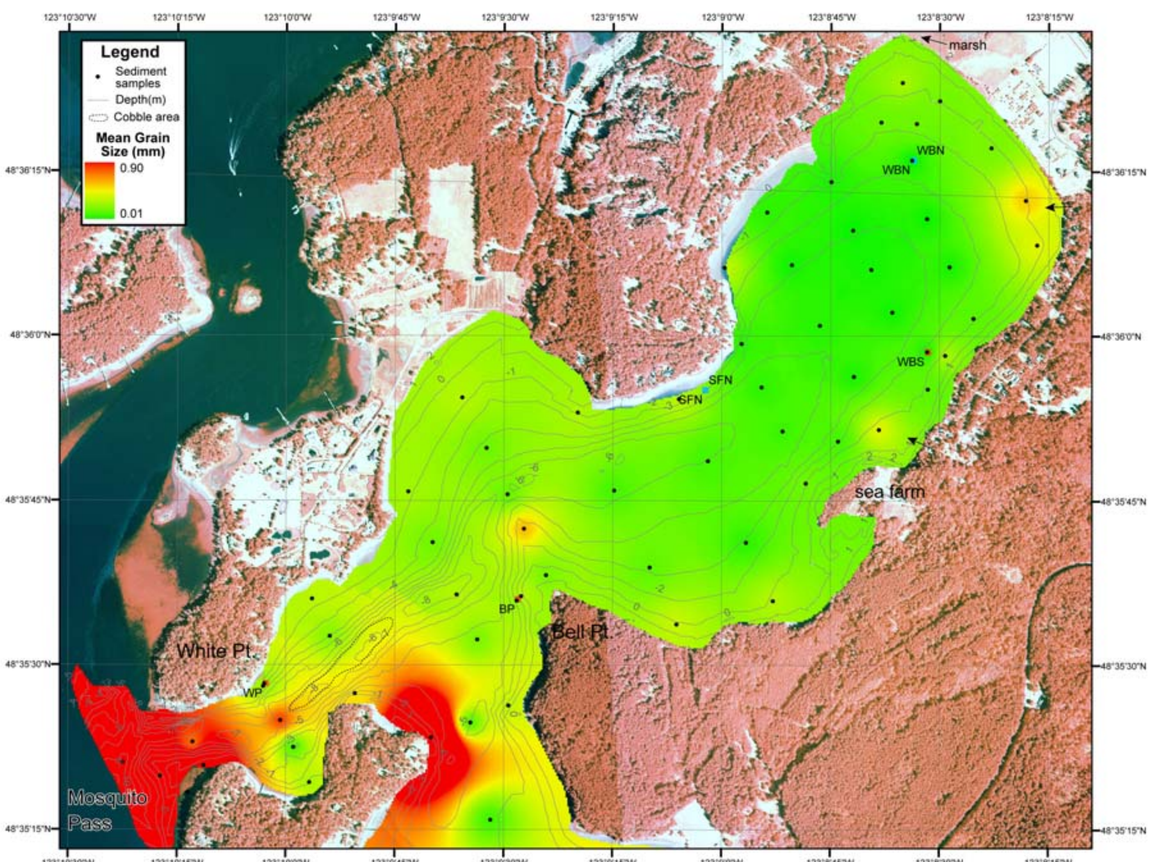

Fig. 8. Map of mean grain size in mm across the study area. Cobble- and pebble-rich channel outlined in black dotted polygon; streams shown with black arrows.

Figure 9 shows the mean grain size in mm classified by predominant grain size classes. This better shows the isolation of medium sands and coarser material near the entrance to Westcott and Garrison Bays, and fine silts in the central head of the bay. Exceptions to this include very fine to fine sand along the shoreline at the head of the bay likely associated with the two creeks and lagoon that meet the shore there.

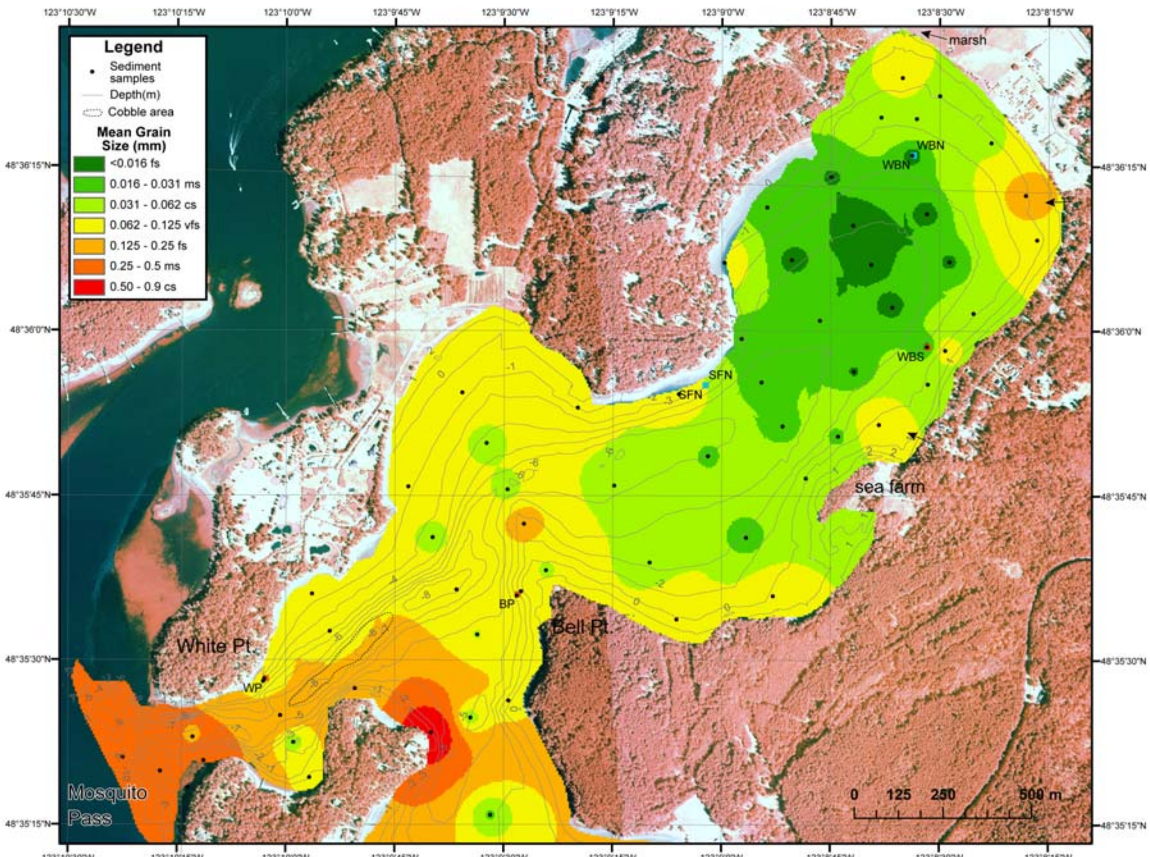

Fig. 9. Map of mean grain size classified by classes (in mm) across the study area. In order of increasing size (top to bottom) beginning with <0.016 mm, fs=fine silt, ms-medium silt, cs=coarse silt, vfs=very fine sand, fs=fine sand, ms=medium sand, 0.5-0.9 cs=coarse sand. Cobble- and pebble-rich channel outlined in black dotted polygon; streams shown with black arrows.

Figure 10 shows the mean grain size distribution in phi units, which allows for slightly greater dynamic range in display of the size gradients. Similar to figure 8, sands are restricted to the mouth and entrance to Garrison Bay, as well as, the small intermittent stream mouths at the head of the bay. Silt dominates the center and head of the bay.

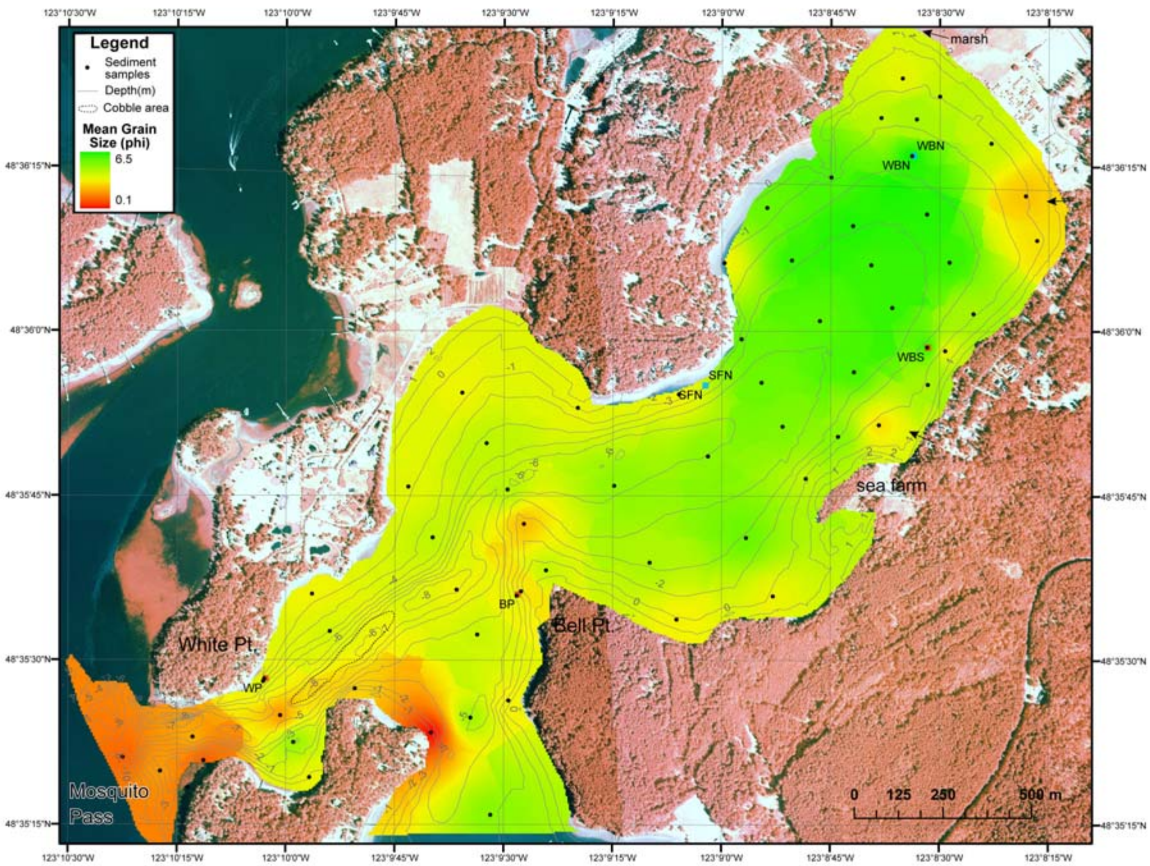

Fig. 10. Map of mean grain size in phi units across the study area. Cobble- and pebble-rich channel outlined in black dotted polygon; streams shown with black arrows.

Figure 11 displays the mean grain size in phi units classified by dominant grain size classes. This also shows that medium and coarse sands occur near the mouth and entrance to Garrison Bay, and fine silts dominate in the central head of the bay, except along the shore at the head of the bay where fine sand is associated with the mouth of the intermittent streams.

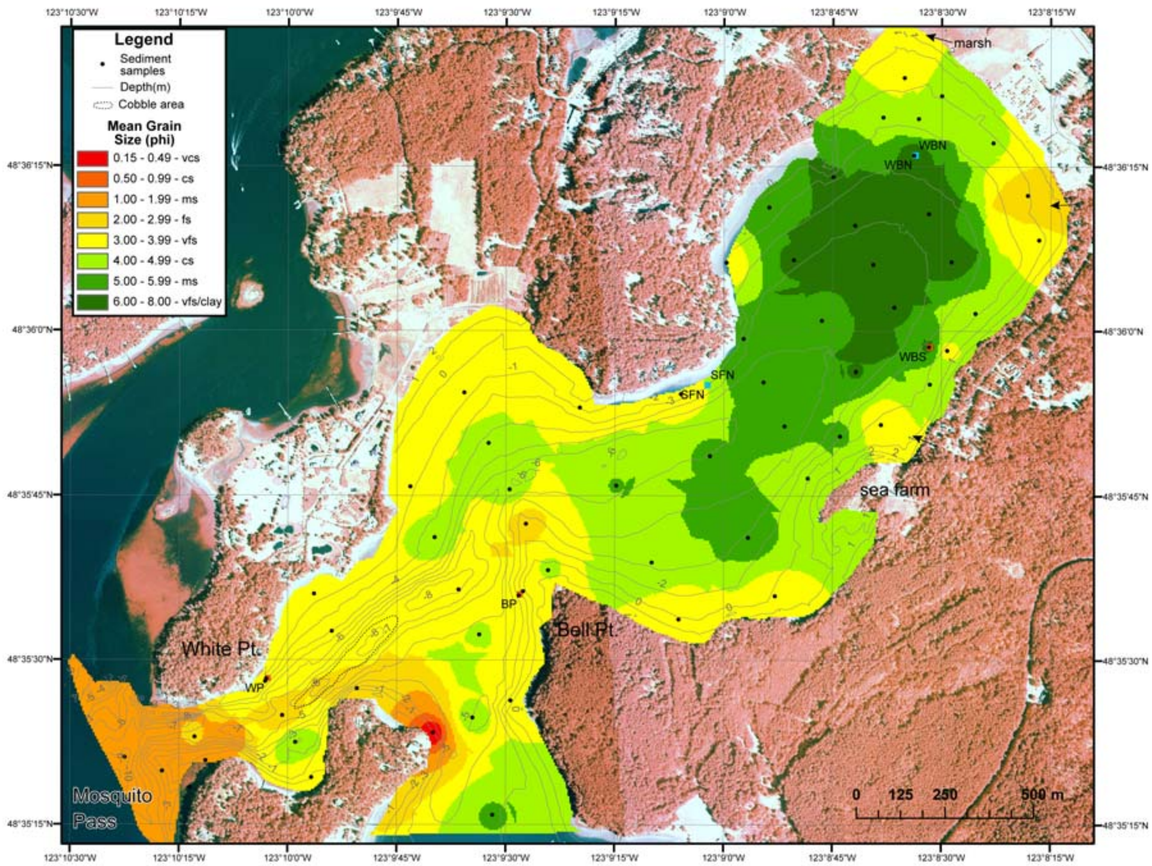

Fig. 11. Map of mean grain size classified by classes (in phi) across the study area. In order of decreasing size (top to bottom) beginning with 0.15-0.49 vcs=very coarse sand, cs=coarse sand, ms=medium sand, fs=fine sand, vfs=very fine sand, cs=coarse silt, ms=medium silt, vfs/clay=very fine silt/clay. Cobble- and pebble-rich channel outlined in black dotted polygon; streams shown with black arrows.

Figure 12 shows the degree of sorting of surface sediments across Westcott Bay. This is the calculated standard deviation around the mean grain size. Poorly sorted areas are reflected in the warm (red) colors, while well sorted areas are depicted in cool (blue) colors. Poorly sorted sediments were common immediately inside Westcott Bay across an inverted, u-shape area around the entrance to Garrison Bay. Sediments were generally poorly sorted along the eastern central bay and at the far head of the bay. Sediments were well-sorted along the central axis in the head of the bay and at the easternmost stream mouth and lagoon inlet. Sediments were generally well sorted inside the entrance to Garrison Bay. These variations in sorting are likely associated with strong circulation processes that oscillate in and out of the bay daily and sediment sources (e.g. the intermittent streams). Sediments were generally poorly sorted near the sea farm.

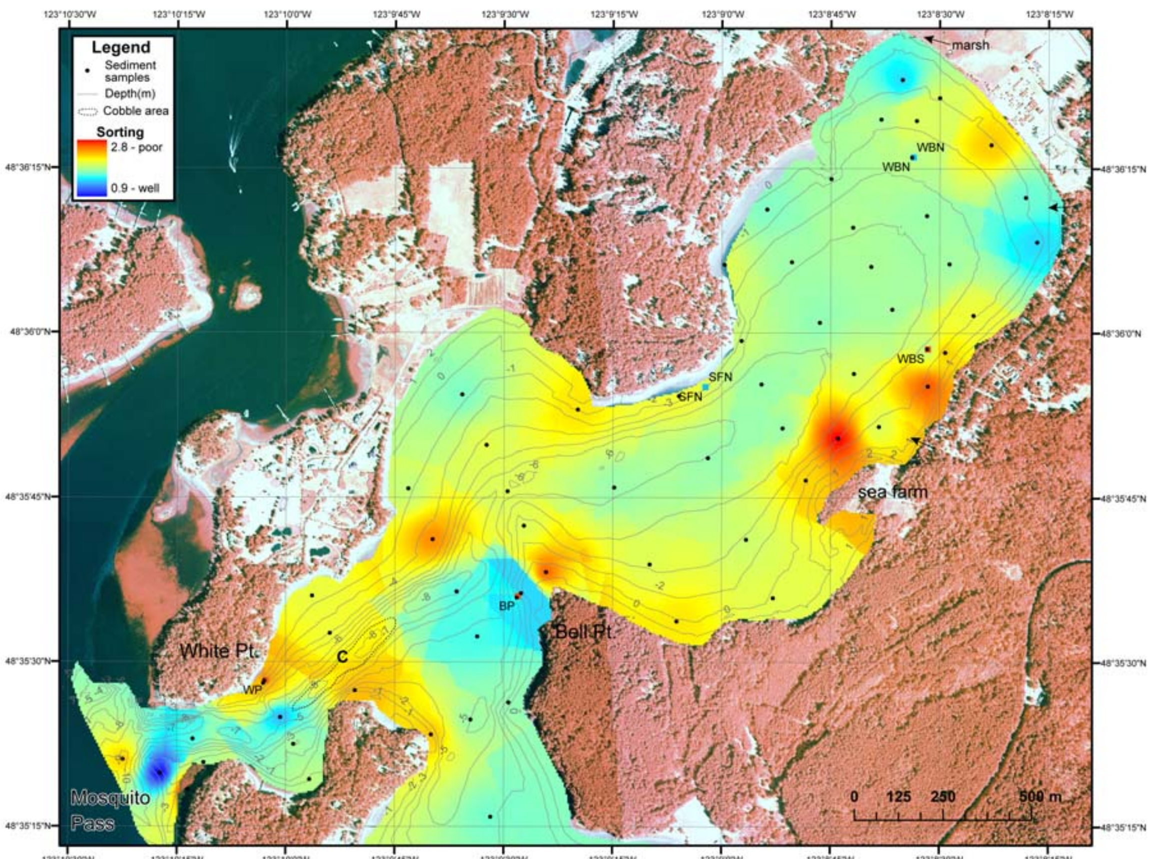

Fig. 12. Map of sediment sorting across the study area. Poorly sorted sediment are represented with warm (red) colors; well-sorted sediments with cool (blue) colors. Cobble- and pebble-rich channel outlined in black dotted polygon; streams shown with black arrows.

Figure 13 shows the fraction of sand in surface sediments across Westcott Bay in percent of total size classes. At the mouth of the bay and small intermittent stream, sand makes up >80% of seafloor sediment. In the central bay west of Bell Point, sand comprises generally >50% of all material, while to the east toward the head of the bay sand reaches a low of 5%.

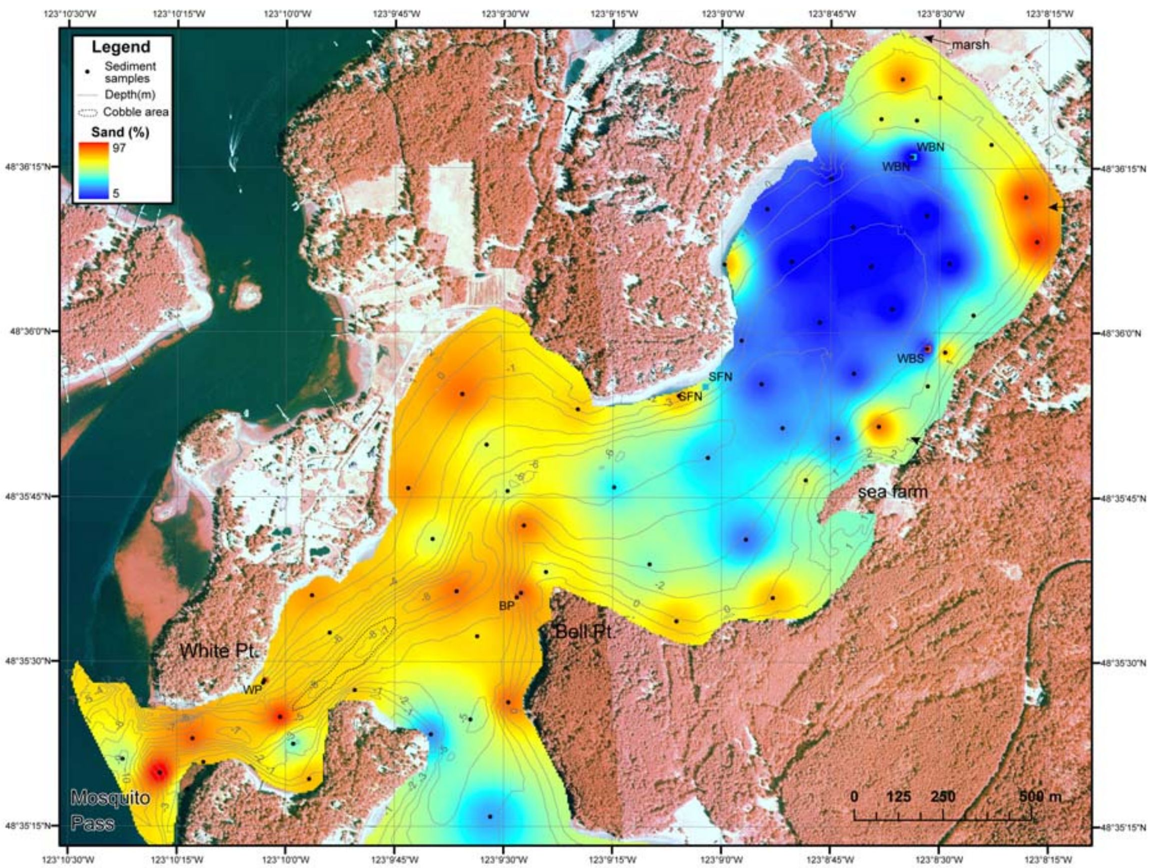

Fig. 13. Map of percent sand occurrence across the study area. Cobble- and pebble-rich channel outlined in black dotted polygon; streams shown with black arrows.

Figure 14 shows the fraction of silt in surface sediments across Westcott Bay in percent of total size classes. Silt is clearly restricted to the areas within Garrison Bay and within the head of Westcott Bay where it reaches a maximum of 76%. East of Bell Point, silt generally comprises at least 50% of the sediment.

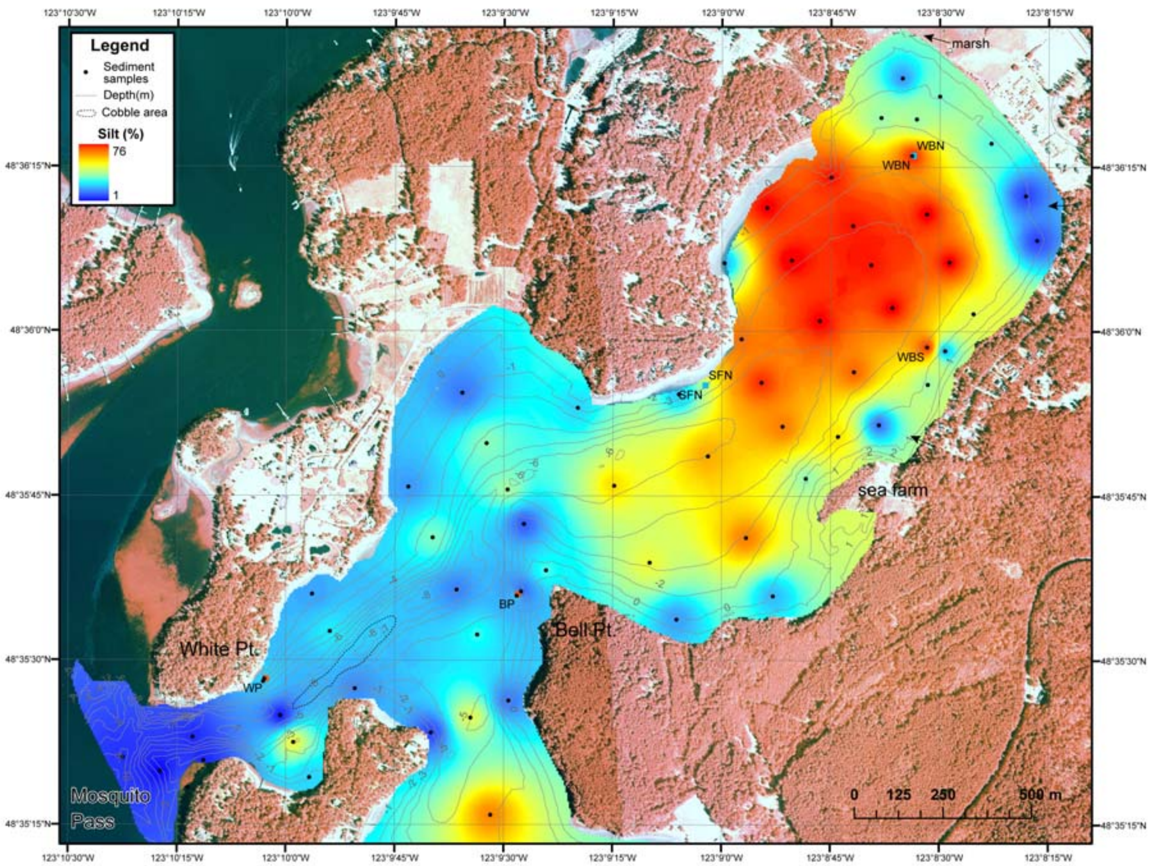

Fig. 14. Map of percent silt occurrence across the study area. Cobble- and pebble-rich channel outlined in black dotted polygon; streams shown with black arrows.

Figure 15 shows the fraction of clay in surface sediments across Westcott Bay in percent of total size classes. Clay is largely absent west of Bell Point, except for two isolated stations just northwest of Bell Point where it reaches ~10%. Within the head of the bay, clay comprises up to 21% of the sediment.

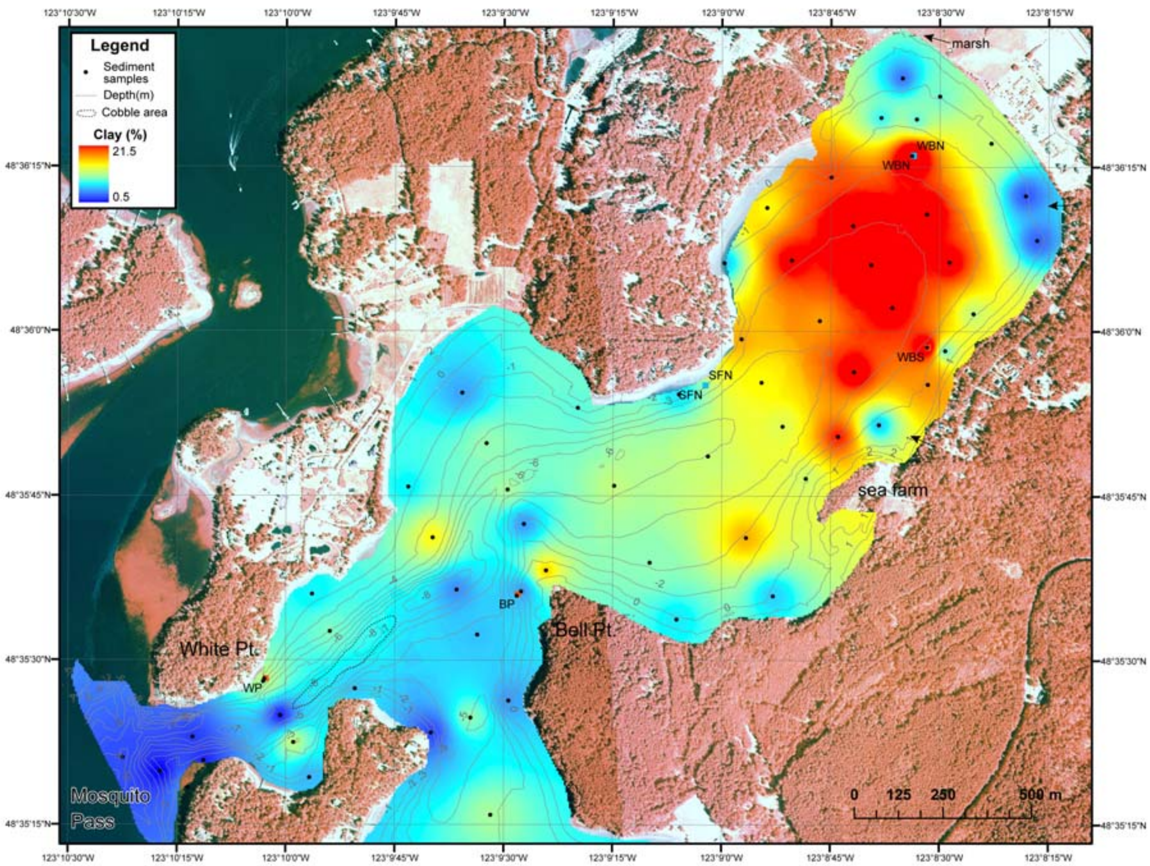

Fig. 15. Map of percent clay occurrence across the study area. Cobble- and pebble-rich channel outlined in black dotted polygon; streams shown with black arrows.

In summary, sand size sediment dominates at the mouth of Westcott and Garrison Bays and along the shoreline at the head of the bay near the small intermittent stream and lagoon inlet. Along the deep trough in the center of the bay, surficial sediments are also characterized by sand and coarse silt with outcrops of rock and cobbles. Inside Garrison Bay and the head of Westcott Bay and especially east of Bell Point, sediments are dominated by silt with a significant (15-20%) proportion of clay.

Nearshore currents and circulation

Figures 16 and 17 illustrate the boat-mounted ADCP-derived currents at the entrance to Westcott Bay under a flooding tide of May 31, 2007. The highest current velocities occur along the north edge of the entrance along the deep trough found there. Current velocities at the surface reached 0.75 to 1.00 m/s.

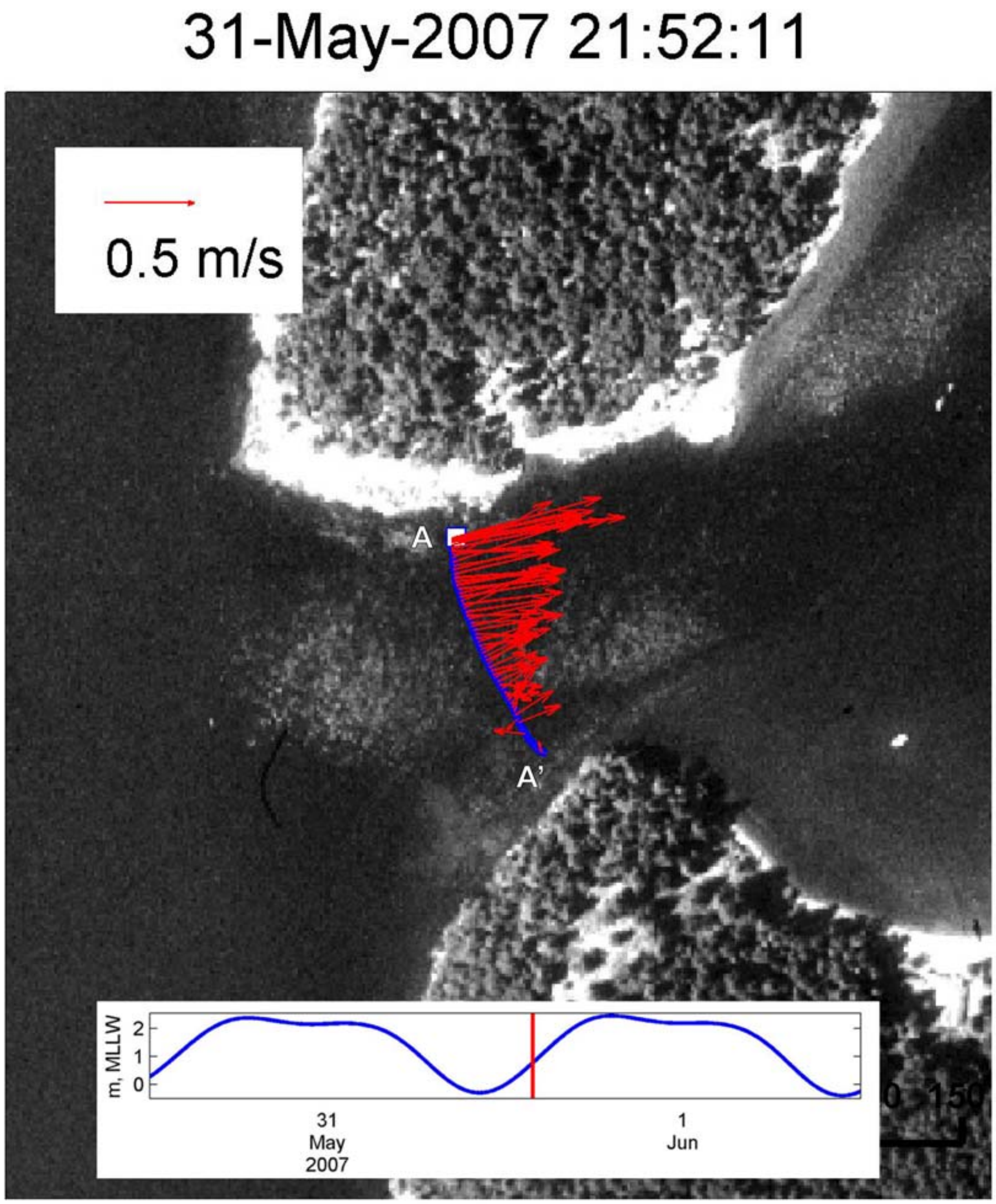

Fig. 16. Map of depth-averaged current velocity averaged across 5 ensembles (lateral distance) during flooding tide of May 31, 2007 (inset; water level from Friday Harbor tide predictions, http://tidesandcurrents.noaa.gov/data_menu.shtml?stn=9449880%20Friday%20Harbor,%20WA&type=Tide+Predictions). Current velocities were stronger along northwest edge of the entrance to Westcott Bay, likely associated with deeper trough there.

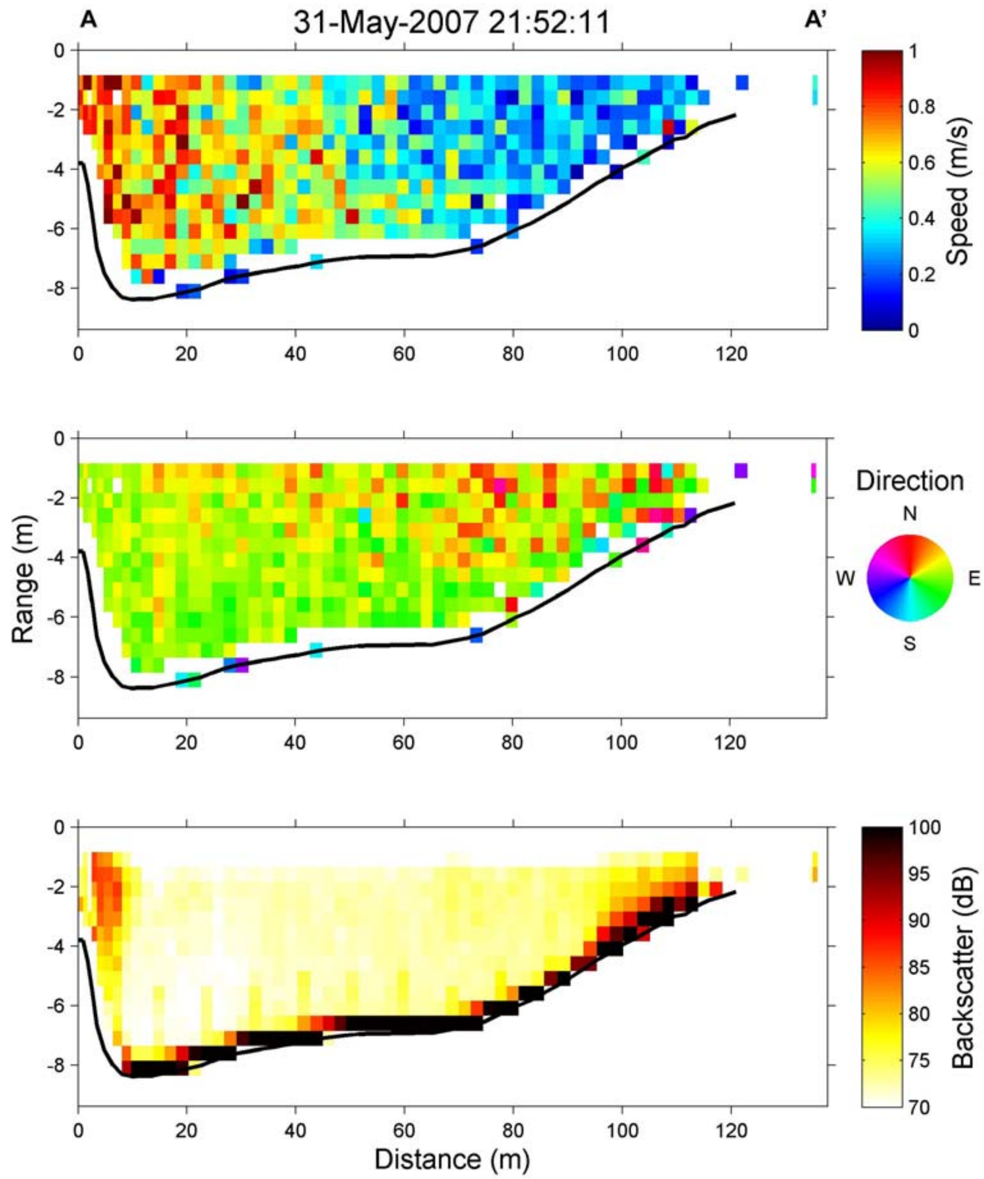

Fig. 17. Cross-sectional diagram of ADCP derived current velocity (top), current direction (middle) and measured backscatter (bottom) showing stronger current velocities along northwest edge of the entrance to Westcott Bay (left edge of top plot) Data averaged across 5 ensembles (across distance).

Figures 18 and 19 illustrate the strong currents flowing out of the entrance of Westcott Bay under an ebbing tide of June 2, 2007. Current velocities were strongest (0.5-0.6 m/s) in the middle of the Westcott Bay entrance and lacked the lateral asymmetry observed during flood tide (Fig. 16).

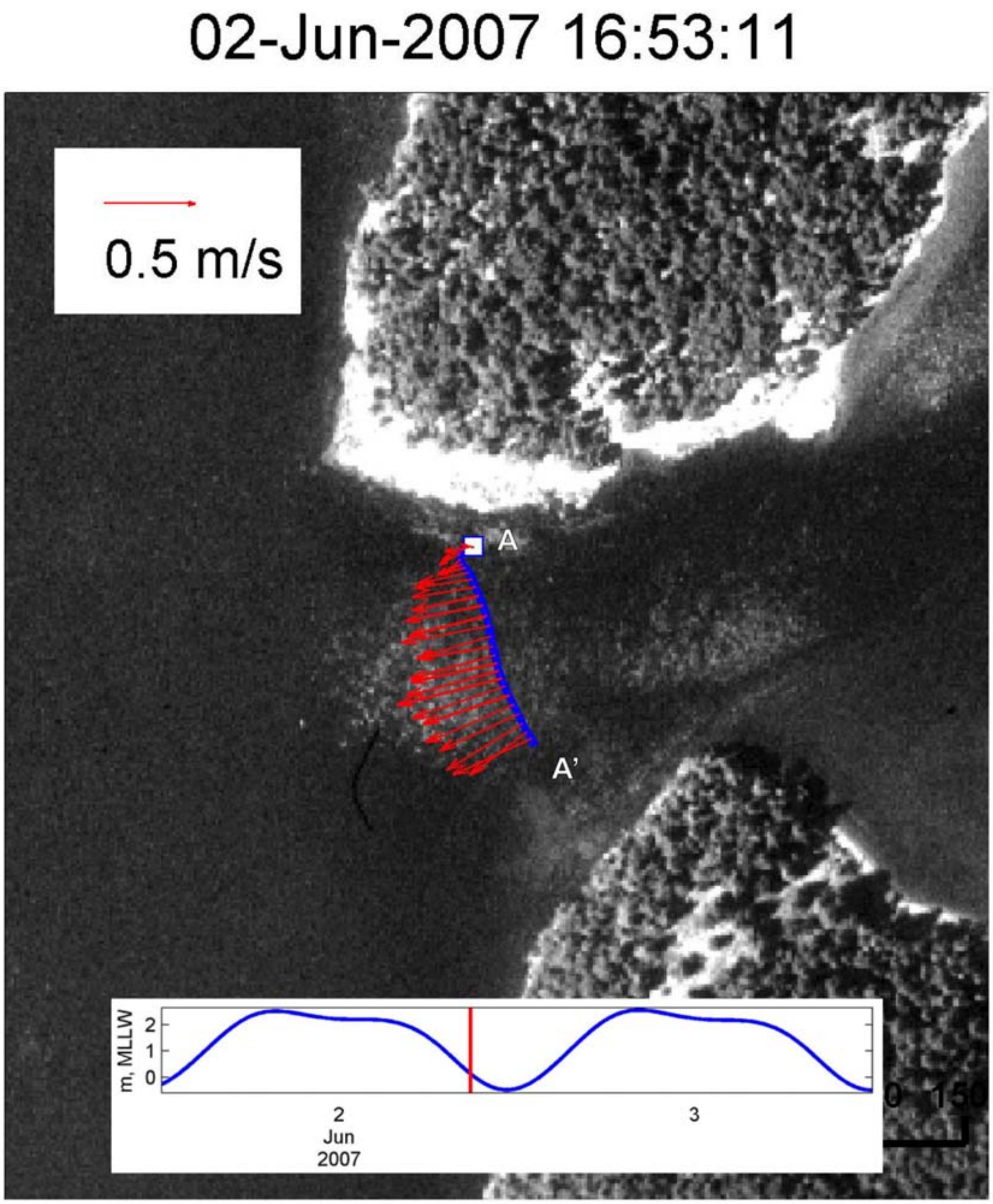

Fig. 18. Map of depth-averaged current velocity averaged across 5 ensembles (lateral distance) during ebbing tide of June 2, 2007 (inset). Current velocities were strongest in the middle of the Westcott Bay entrance and lacked the lateral asymmetry observed during flood tide.

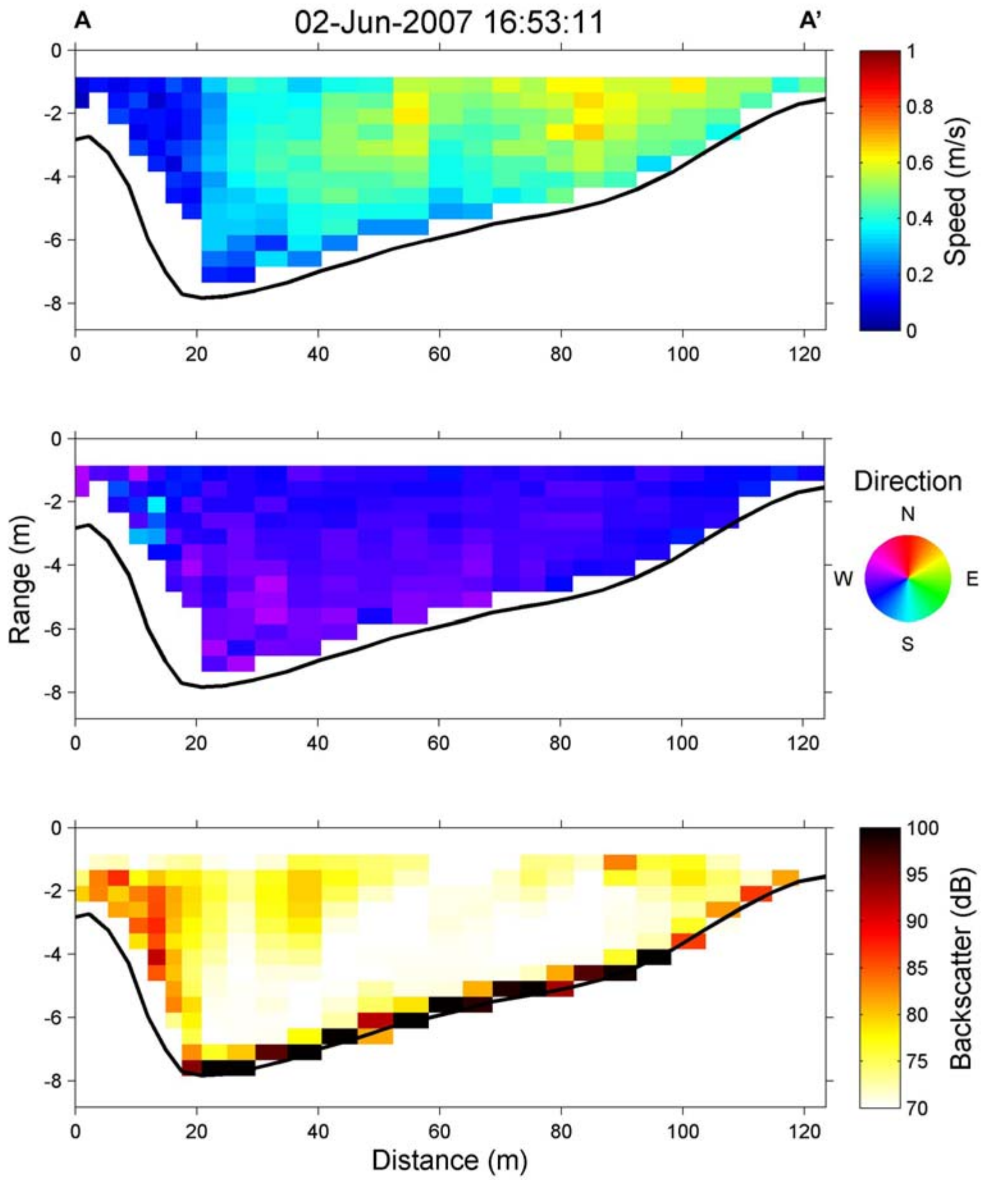

Fig. 19. Cross-sectional diagram of ADCP derived current velocity (top), current direction (middle) and measured backscatter (bottom) during an ebbing tide. Currents were stronger in the middle of the entrance to Westcott Bay and more symmetric than during flood tide. Data averaged across 5 ensembles (across distance) and are coarser than data in Figure 17 because of higher boat speed during data collection.

Figure 20 shows the ADCP data collected on all transects of May 31, 2007 (from west to east) over the period of 2 hours as the tide flooded into Westcott Bay. Generally, higher currents were found along the central axis of Westcott Bay, and especially along the northwest edge of the entrance to Westcott Bay. A slight eddy was apparent west of Bell Point in the entrance to Garrison Bay with flow directed in a clockwise gyre. The northern portion of this eddy (black arrows) correlates with a region of poor sediment sorting (Fig. 12).

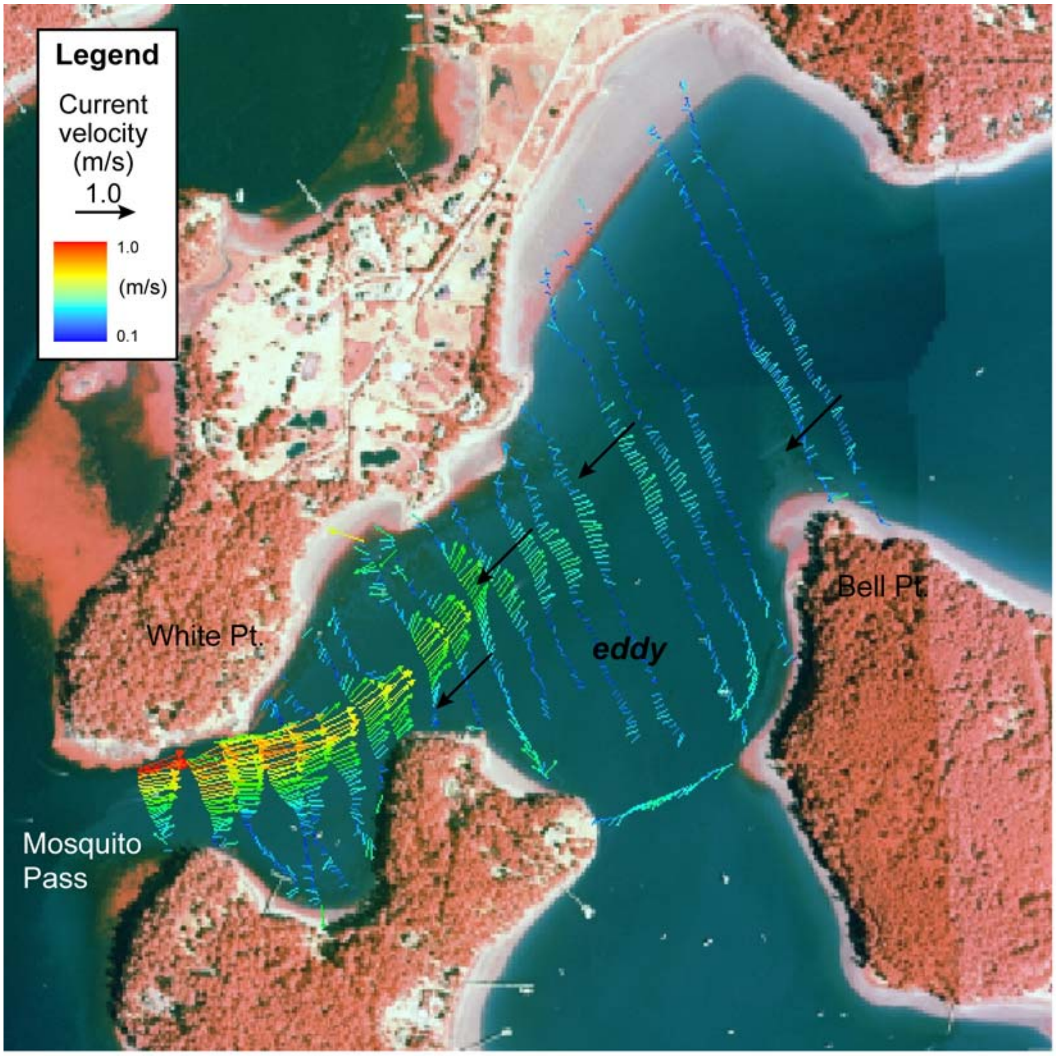

Fig. 20. Map of depth-averaged current velocities and directions over a 2- hour flood tide period on May 31, 2007 (velocities scaled to arrow in legend and color coded: red=high, blue=low). Highest velocities were observed along the northern portion of the main channel into Westcott Bay, while lower velocities occured along the edges inside the entrance and generally within the central bay. A clockwise eddy was apparent west of Bell Point within the entrance to Garrison Bay. The northern margin of the eddy (black arrows) correlates with the area of poor sorting in Figure 12.

Conclusion

Seafloor mapping using a dual-frequency Biosonics acoustic sonar along with a boat-mounted ADCP and RTK-DGPS enabled characterization of seafloor depth, morphology and nearshore circulation patterns during a range of tide regimes. Contemporaneous sampling and subsequent analysis of surface sediment grain size distributions provide quantitative data for classifying the seafloor by principal morphology and substrate types. Westcott Bay seafloor composition and morphology is complex in its western half where high-relief bedrock and extensive reaches of sand, gravel and cobble are exposed along a linear channel northeast from the entrance of Westcott Bay toward Bell Point. This complex topography and substrate is associated with strong currents that reach 1.0 m/s and scour the bottom. Stronger currents along this deep channel indicate that the circulation is also partly controlled by the geomorphology. A sill 0.5-1.0 m shallower than the channel separates Westcott Bay from Mosquito Pass. The eastern half of Westcott Bay (east of Bell Point) in contrast, is broad, gently sloping and the surface sediments are dominated by high silt and clay fractions. Current velocities decreased steadily with distance into the head of the bay. In the central portion of Westcott Bay an eddy circulating in a clockwise rotation was observed during a flood tide. A portion of this eddy coincided with a region of poor sediment sorting and complex seafloor morphology. It remains uncertain if the flux, transport, and accumulation of sediment in Westcott Bay are adversely impacting *Z. marina*. Ongoing and future efforts will synthesize the data reported here with time series measurements of water quality to develop models of sediment transport and habitat conditions to explore environmental variability and possible thresholds of stress to eelgrass growth and recovery.

Acknowledgements

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Revision Information

Please refer to http://pubs.usgs.gov/of/2007/1305/ for additions and revisions to this report.

Data Catalogue

All data generated from this mapping of bathymetry, substrate type and nearshore currents are referenced to USGS Cruise ID B-6-07-PS.

Metadata

Metadata are available at URL:
http://walrus.wr.usgs.gov/infobank/b/b607ps/html/b-6-07-ps.meta.html

Digital surface elevation data

A survey log summarizing line numbers, file names, survey information and environmental conditions are provided in Appendix 1.

Digital x,y,z (depth) data for individual survey lines are provided as text files on the data CD under B-6-07-PS/bathymetry/line#.xyz and for the entire survey under B-6-07-PS/bathymetry/westcott0507.xyz.

Digital sediment grain size data

Station information for the sediment grain size samples is provided in Appendix 2 and the summary grain size results are listed in Appendix 3.

Digital ADCP data

The ADCP data with current velocity, direction and backscatter amplitude are transferred to DNR on the attached data CD in three formats:

1) original WinRiver filename_T.OOO format, which can be opened with any text editor software
   (see B-6-07-PS/ADCP/WESTCOTT_DAY#/filename)
   - (3 folders, one for each day)
2) graphic JPG cross-sections of the RAW ADCP bottom tracked data by line
   (see B-6-07-PS/ADCP/WESTCOTT/ADCP_jpegs/)
3) graphic JPG cross-sections and depth averaged maps of currents averaged across 5 ensembles (horizontal averaging) by line
   (see B-6-07-PS/ADCP/WESTCOTT/ADCP/processedData/)

Please refer to Appendix 1 to cross reference filename with line number.

APPENDIX I. Bathymetry/ADCP Survey Log for USGS Cruise ID (B-6-07-PS)

Line	Biosonics_Filename	Date Collected	Elapsed Time (min)	Total Length (m)	ADCP_Filename	Comments
line56_1	20070531_192732.dt4	39233.47745	10.13	1385.45	-	4-m contour alongshore 215 to mouth
line56_1a	20070531_193744.dt4	39233.48455	6.76	877.4	-	Part 2 of line
line126	20070531_194740.dt4	39233.49144	3.93	499.19	-	shallow reef at start; algae
line124	20070531_195257.dt4	39233.49512	2.93	447.99	-	veg at start; kelp mid
line122	20070531_195741.dt4	39233.49839	2.09	233.43	-	reef at start
line115	20070531_200441.dt4	39233.50326	1.46	123.97	-	-
line114	20070531_200633.dt4	39233.50456	1.29	132.1	-	-
line112	20070531_200912.dt4	39233.50639	1.53	155.95	-	eelgrass at start; strong current into bay
line110	20070531_201133.dt4	39233.50802	1.87	197.82	-	end at dock
line108	20070531_201509.dt4	39233.51056	2.5	264.65	-	-
line106	20070531_201843.dt4	39233.513	2.5	316.36	-	-
line104	20070531_202313.dt4	39233.51613	1.73	230.74	-	end in eelgrass
line102	20070531_202613.dt4	39233.51821	2.32	184.11	-	steep rock at end with algae
line100	20070531_202924.dt4	39233.52042	1.56	186.36	-	-
line116	20070531_215040.dt4	39233.9102	2.29	137.74	WESC053107_000	eelgrass at end; strong current into bay
line113	20070531_215450.dt4	39233.91308	2.39	150.83	WESC053107_001	eelgrass at start
line111	20070531_215830.dt4	39233.91564	4.62	278.88	WESC053107_002	circumvent dock near end
line109	20070531_220607.dt4	39233.92093	4.7	285.15	WESC053107_003	-
line107	20070531_221224.dt4	39233.92528	3.86	335.26	WESC053107_004	DNR Sonde at start; high backscatter near mid channel
line105	20070531_221812.dt4	39233.92931	3.19	303.98	WESC053107_005	eelgrass at start/end; platform at 6m
line103	20070531_222309.dt4	39233.93274	3.22	291.39	WESC053107_006	strong currents/backscatter mid channel
line101	20070531_222923.dt4	39233.93709	2.66	275.26	WESC053107_007	-
line98	20070531_223323.dt4	39233.93985	3.43	322.16	WESC053107_008	veg/resuspension? mid channel
line96	20070531_223837.dt4	39233.94348	3	320.43	WESC053107_009	rock at start; high backscatter mid; sand/rock at end
line94	20070531_224300.dt4	39233.94652	4.06	427.19	WESC053107_010	rock at start; high backscatter mid
line145	20070531_224950.dt4	39233.95126	3.09	255.9	WESC053107_011	across Garrison Bay mouth
line92	20070531_225616.dt4	39233.95573	3.22	361.47	WESC053107_012	rock at end
line90	20070531_230027.dt4	39233.95865	3.59	364.13	WESC053107_013	start just offshore of rock shoal

line88	20070531_230525.dt4	39233.96209	5.13	506.17	WESC053107_014	start mid Garrison Bay; rock at end
line86	20070531_231154.dt4	39233.96659	4.45	550.35	WESC053107_015	End mid Garrison Bay
line84	20070531_232300.dt4	39233.97431	6.73	689.43	-	start mid Garrison Bay; turbid water visible
line82	20070531_233149.dt4	39233.98042	7.33	802.11	WESC053107_016	turbid at start
line80	20070531_234002.dt4	39233.98613	6.42	773.01	WESC053107_017	eelgrass at start; strong current
line78	20070531_234719.dt4	39233.99119	6.69	790.38	WESC053107_018	-
line76	20070531_235515.dt4	39233.99669	6.79	764.38	WESC053107_019	-
line74	20070601_000446.dt4	39234.00331	4.79	609.06	-	-
line72	20070601_001128.dt4	39234.00796	10.09	663.51	WESC053107_020	Bell Pt.; ADCP at 2kts
line70	20070601_002231.dt4	39234.01563	6.92	748.56	WESC053107_021	-
line35	20070601_011712.dt4	39234.05362	9.76	1102.25	-	start E side of dock; through oyster beds
line30	20070601_012702.dt4	39234.06047	9.83	1095.63	-	2nd half of oysters E side
line38	20070601_013911.dt4	39234.06889	8.23	783.01	-	Oyster beds W side of dock
line42	20070601_014748.dt4	39234.07487	8.85	1053.39	-	2nd section of oysters W side
line4	20070601_030128.dt4	39234.12602	2.97	184.64	-	-
line6	20070601_030543.dt4	39234.12898	3.79	420.21	-	-
line8	20070601_031111.dt4	39234.13278	4.56	591.91	-	-
line10	20070601_031654.dt4	39234.13675	6.16	713.08	-	poor water quality NW head of bay
line12	20070601_032411.dt4	39234.14179	0.77	54.84	-	-
line14	20070601_033317.dt4	39234.14811	5.73	775.76	-	-
line16	20070601_033954.dt4	39234.15271	5.99	787.77	-	rough microtopography? mid; whispy blades near end
line18	20070601_034644.dt4	39234.15747	5.69	751.72	-	poor WQ; floating debris/solids
line20	20070601_035342.dt4	39234.1623	5.8	750.28	-	-
line22	20070601_040033.dt4	39234.16706	5.89	747.84	-	start near DNR station; poor WQ
line24	20070601_040724.dt4	39234.17181	7.5	805.2	-	avoid rock at start; revetment at end
line26_1	20070601_041630.dt4	39234.17814	6.76	780.2	-	revetment
line28b	20070601_042418.dt4	39234.18354	6.3	819.6	-	microtopography? 100-200 m into line?
line1	20070601_175546.dt4	39234.74706	5.62	386.02	WESC060107_000	-
line117_1	20070601_181300.dt4	39234.75921	2.23	121.99	WESC060107_001	-
line68	20070601_181628.dt4	39234.76144	4.09	428.22	-	Alongshore ~2m depth
line28	20070601_182129.dt4	39234.76491	0.49	43.85	-	alongshore
line28a	20070601_182843.dt4	39234.76993	3.23	456.97	-	alongshore
line68a	20070601_183840.dt4	39234.77684	4.86	517.76	-	-

line66	20070601_184430.dt4	39234.7809	4.53	545.71	-	-
line64	20070601_185020.dt4	39234.78495	4.52	526.99	-	-
line62	20070601_185645.dt4	39234.78941	5.36	558.28	-	-
line60	20070601_190253.dt4	39234.79367	5.59	546.01	WESC060107_002	-
line58	20070601_190926.dt4	39234.79821	5.16	538.53	WESC060107_003	-
line56	20070601_191526.dt4	39234.80238	5.03	548.42	WESC060107_004	-
line54	20070601_192149.dt4	39234.80681	2.36	264.09	WESC060107_005	-
line52	20070601_194548.dt4	39234.82347	2.19	239.94	-	-
line50	20070601_194845.dt4	39234.82553	1.69	182.88	-	-
line48	20070601_195107.dt4	39234.82716	1.53	177.97	-	-
line46	20070601_195319.dt4	39234.8287	1.55	184.74	-	-
line44	20070601_195531.dt4	39234.83022	1.92	216.15	-	-
line42_1	20070601_195835.dt4	39234.83235	1.93	214.84	-	-
line40	20070601_200135.dt4	39234.83443	2.8	292.29	-	-
line38a	20070601_200607.dt4	39234.83759	2.79	333.72	-	-
line36	20070601_200924.dt4	39234.83986	2.55	327.44	-	-
line34	20070601_201255.dt4	39234.84231	2.77	362.52	-	-
line32	20070601_201618.dt4	39234.84465	2.79	329.52	-	-
line30a	20070601_202008.dt4	39234.84733	3.16	405.49	-	-
line29	-	39234.87569	-	-	WESC060107_006	-
line7	-	39234.84306	-	-	WESC060107_007	-
line117_1	-	39234.85427	-	-	WESC060107_008	-
line109a	20070601_213757.dt4	39234.90135	3.62	266.08	WESC060107_009	-
line120	20070601_214756.dt4	39234.90831	3.77	144.07	WESC060107_010	-
line129	20070601_215431.dt4	39234.91285	8.27	1047.41	-	alongshore deep section of channel
line129a	20070601_220256.dt4	39234.9187	8.77	1101.94	-	alongshore
line129b	20070601_221150.dt4	39234.92488	6.65	814.84	-	alongshore
line127	20070601_222008.dt4	39234.93065	10.3	1111.56	-	alongshore
line127b	20070601_223034.dt4	39234.93789	8.93	938.82	-	alongshore
line117_1	-	39234.51984	-	-	WESC060107_011	-
line1	-	39234.98581	-	-	WESC060107_012	-
line137	20070601_235118.dt4	39234.99399	8.96	487.5	WESC060107_013	Garrison Bay
line1a	20070602_000201.dt4	39235.00154	4.93	314.37	-	sandlance/smelt? Eelgrass

line147	20070602_000709.dt4	39235.00497	2.93	297.05	-	-
line149	20070602_001132.dt4	39235.00802	4.13	430.32	-	-
line151	20070602_001733.dt4	39235.01219	4.03	491.6	-	-
line153	20070602_002252.dt4	39235.01588	5.33	580.7	-	-
line155	20070602_003013.dt4	39235.02098	4.56	589.98	-	-
line157	20070602_003610.dt4	39235.02513	4.8	520.42	-	-
line159	20070602_004309.dt4	39235.02997	4.07	480.18	-	-
line161	20070602_004811.dt4	39235.03346	3.89	466.29	-	-
line163	20070602_005332.dt4	39235.03718	4.25	539.41	-	-
line165	20070602_010202.dt4	39235.04309	2.52	331.02	-	-
line167	20070602_010524.dt4	39235.04542	4.99	715.89	-	-
line169	20070602_011120.dt4	39235.04955	6.13	713.93	-	-
line171	20070602_011826.dt4	39235.05447	3.06	359.12	-	-
line173	20070602_012254.dt4	39235.05757	2	236.97	-	-
line175	20070602_012602.dt4	39235.05975	2.27	237.31	-	-
line177	20070602_012857.dt4	39235.06178	1.86	216.17	-	-
line179	20070602_013136.dt4	39235.06362	1.79	212.06	-	-
line181	20070602_013347.dt4	39235.06513	3.8	264.35	-	-
line171a	20070602_024828.dt4	39235.11699	2.26	258.12	-	-
line173a	20070602_025142.dt4	39235.11922	2.26	276.34	-	-
line175a	20070602_025445.dt4	39235.12135	3.33	348.32	-	-
line177a	20070602_025834.dt4	39235.124	2.69	330.08	-	-
line179a	20070602_030156.dt4	39235.12634	2.56	304.66	-	-
line1b	20070602_030433.dt4	39235.12816	1.97	235.78	-	-
line181a	20070602_030944.dt4	39235.13176	1.73	201.16	-	-
line183	20070602_031224.dt4	39235.1336	1.4	164.83	-	-
line184	20070602_031414.dt4	39235.13487	10.66	1491.02	-	alongshore
line57	20070602_032915.dt4	39235.1453	10.06	1417.65	-	oyster farm
line57a	20070602_033921.dt4	39235.15233	5.06	722.42	-	oyster farm surface map
line117_1	-	39235.59931	-	-	WESC060207_000	-
line144	-	39235.60972	-	-	WESC060207_001	Garrison Bay at mouth
line1	-	39235.61389	-	-	WESC060207_002	-
line29	-	39235.62222	-	-	WESC060207_003	-

line117_1	-	39235.63194	-	-	WESC060207_004	-
line1	-	39235.6375	-	-	WESC060207_005	-
line29	-	39235.64444	-	-	WESC060207_006	-
line117_1	-	39235.65347	-	-	WESC060207_007	-
line1	-	-	-	-	WESC060207_008	time in file
line29	-	39235.66944	-	-	WESC060207_009	-
line117_1	-	39235.67847	-	-	WESC060207_010	-
line1	-	-	-	-	WESC060207_011	time in file
line29	-	39235.69375	-	-	WESC060207_012	-
line117_1	-	39235.70347	-	-	WESC060207_013	-
line68_3	20070602_175434.dt4	39235.74623	13.69	2045.87	-	alongshore
line73	20070602_181503.dt4	39235.76045	7.16	554.73	WESC060207_014	across Mosquito Pass; boat wake; eelgrass
line73_2	20070602_193824.dt4	39235.81833	4.62	333.02	WESC060207_015	across Mosquito Pass (replicate)
line193	20070602_194305.dt4	39235.82159	10.37	1435.99	-	along main axis of Westcott Bay channel
line2	20070602_201318.dt4	39235.84257	13.86	1430.5	WESC060207_016	alongshore
line117_1	-	39235.85417	-	-	WESC060207_017	-
line126a	20070602_203845.dt4	39235.86024	4.22	455.88	WESC060207_020	-
line123	20070602_204727.dt4	39235.86628	5.27	341.79	WESC060207_021	-
line121	20070602_205353.dt4	39235.87074	2.53	207.56	WESC060207_022	boat wake
line119_1	20070602_205741.dt4	39235.87338	2.02	139.15	WESC060207_023	-
line118	20070602_210119.dt4	39235.87591	1.85	109.13	WESC060207_024	-
line117_1	-	-	-	-	WESC060207_025	-
line99	20070602_211052.dt4	39235.88257	3.49	209.19	WESC060207_026	eelgrass
line97	20070602_211614.dt4	39235.88632	4.67	247.86	WESC060207_027	eelgrass
line95	20070602_212315.dt4	39235.89116	4.65	262.69	WESC060207_028	eelgrass
line93	20070602_212925.dt4	39235.89544	8	450.8	WESC060207_029	-
line117_1	-	-	-	-	WESC060207_031	-
line138	20070602_222112.dt4	39235.9314	3.49	457.26	-	-
line140	20070602_222543.dt4	39235.93454	2.99	408.46	-	-
line142	20070602_222930.dt4	39235.93716	2.5	335.21	-	-
line91	20070602_230431.dt4	39235.96148	2.46	325.6	-	-
line89	20070602_230728.dt4	39235.96353	2.66	359.33	-	-
line87	20070602_231106.dt4	39235.96605	2.59	348.12	-	-

line85	20070602_231421.dt4	39235.9683	3.75	418.67	-	-
line83	20070602_231849.dt4	39235.97141	3.43	432.02	-	-
line81	20070602_232255.dt4	39235.97425	3.79	471.36	-	-
line79	20070602_232712.dt4	39235.97723	3.46	480.54	-	-

APPENDIX II. Sediment Sampling Log (B-6-07-PS)

Station	Local_Time	UTC	Lon	Lat	Depth_m	Comment
1	6/1/07 20:44	6/2/07 3:44	-123.1430877	48.60642247	2.286	-
2	6/1/07 20:35	6/2/07 3:35	-123.1416559	48.60596625	2.1336	18.6 C
3	6/1/07 20:28	6/2/07 3:28	-123.1396819	48.60476647	2.4384	22.4 C
4	6/1/07 20:21	6/2/07 3:21	-123.1383557	48.6034425	2.4384	21 C
5	6/1/07 20:10	6/2/07 3:10	-123.1379259	48.60230609	2.1336	-
6	6/1/07 20:05	6/2/07 3:05	-123.1403608	48.60044935	3.3528	-
7	6/2/07 16:50	6/2/07 23:50	-123.1412818	48.60175168	3.6576	-
8	6/2/07 17:00	6/3/07 0:00	-123.1421506	48.60297386	3.6576	19 C
9	6/2/07 17:05	6/3/07 0:05	-123.1427175	48.6044497	3.048	WBN-SONDE
10	6/1/07 20:48	6/2/07 3:48	-123.1438967	48.60541356	3.048	-
11	6/1/07 20:54	6/2/07 3:54	-123.1458085	48.60390776	3.3528	-
12	6/2/07 16:27	6/2/07 23:27	-123.1449813	48.60267691	3.9624	-
13	6/2/07 16:35	6/2/07 23:35	-123.1442752	48.60168593	3.9624	-
14	6/2/07 16:45	6/2/07 23:45	-123.1434713	48.60059519	4.572	-
15	6/1/07 19:24	6/2/07 2:24	-123.1421019	48.59864869	2.4384	-
16	6/1/07 17:10	6/2/07 0:10	-123.1439795	48.5976315	2.1336	floc?
17	6/2/07 15:40	6/2/07 22:40	-123.1449351	48.59896955	4.2672	-
18	6/2/07 16:05	6/2/07 23:05	-123.1462388	48.60026471	4.572	-
19	6/2/07 16:09	6/2/07 23:09	-123.1473201	48.60179786	3.6576	-
20	6/2/07 16:20	6/2/07 23:20	-123.148262	48.60313373	2.1336	-
21	6/2/07 16:15	6/2/07 23:15	-123.1498974	48.60172972	1.9812	-
22	6/2/07 15:20	6/2/07 22:20	-123.1492409	48.59979738	2.4384	-
23	6/2/07 15:30	6/2/07 22:30	-123.1484785	48.59869397	5.0292	-
24	6/2/07 15:35	6/2/07 22:35	-123.1476722	48.59758652	5.1816	-
25	6/1/07 17:00	6/2/07 0:00	-123.1467698	48.59627812	2.286	-
26	6/1/07 16:45	6/1/07 23:45	-123.1480227	48.59330183	2.1336	-
27	6/1/07 16:55	6/1/07 23:55	-123.1490594	48.59477483	4.4196	-
28	6/2/07 15:05	6/2/07 22:05	-123.1505265	48.59684596	5.1816	mud
29	6/2/07 15:15	6/2/07 22:15	-123.1516348	48.59839777	1.6764	-
30	6/2/07 14:28	6/2/07 21:28	-123.1554968	48.59805066	1.0668	-
31	6/2/07 14:35	6/2/07 21:35	-123.1541046	48.59609766	5.1816	-

32	6/1/07 16:40	6/1/07 23:40	-123.1527509	48.59414851	3.9624	-
33	6/1/07 16:35	6/1/07 23:35	-123.1517106	48.59270764	1.2192	-
34	6/1/07 16:27	6/1/07 23:27	-123.1567103	48.5939465	1.8288	-
35	6/1/07 16:20	6/1/07 23:20	-123.1575561	48.59512673	3.5052	-
36	6/1/07 16:14	6/1/07 23:14	-123.1581907	48.59599792	7.0104	-
37	6/1/07 15:30	6/1/07 22:30	-123.1589914	48.59715466	3.9624	-
38	6/1/07 15:18	6/1/07 22:18	-123.1599242	48.59843233	1.524	-
39	6/1/07 15:10	6/1/07 22:10	-123.1619828	48.59606753	1.2192	-
40	6/1/07 15:00	6/1/07 22:00	-123.1610457	48.59478295	5.7912	-
41	6/1/07 14:55	6/1/07 21:55	-123.1601357	48.5934547	8.5344	-
42	6/1/07 14:40	6/1/07 21:40	-123.1593413	48.59231698	5.7912	-
43	6/1/07 14:34	6/1/07 21:34	-123.1581413	48.59064567	1.8288	water temp 65 F
44	6/1/07 14:28	6/1/07 21:28	-123.1595903	48.5902156	5.1816	-
45	6/1/07 14:15	6/1/07 21:15	-123.1611018	48.5898281	2.1336	-
46	6/1/07 14:05	6/1/07 21:05	-123.1588285	48.58774659	3.048	-
47	6/1/07 13:50	6/1/07 20:50	-123.1640143	48.59094643	1.524	eelgrass dense
48	6/1/07 13:40	6/1/07 20:40	-123.1645209	48.59171271	7.62	cobble
49	6/1/07 13:35	6/1/07 20:35	-123.1649866	48.59240379	1.8288	fish
50	6/1/07 13:32	6/1/07 20:32	-123.1656586	48.59335283	0.762	patchy eelgrass
51	6/1/07 13:08	6/1/07 20:08	-123.1675292	48.591132	1.0668	eelgrass near DNR site
52	6/1/07 13:00	6/1/07 20:00	-123.1668798	48.59026557	6.096	sandy
53	6/1/07 12:57	6/1/07 19:57	-123.1663797	48.58958473	1.8288	-
54	6/1/07 12:50	6/1/07 19:50	-123.1657538	48.58869312	0.9144	-
55	6/1/07 12:40	6/1/07 19:40	-123.170589	48.59020657	5.7912	rock, no sample
56	6/1/07 12:25	6/1/07 19:25	-123.1702311	48.58971595	6.096	sand cobble
57	6/1/07 12:15	6/1/07 19:15	-123.1698061	48.58911829	0.9144	eelgrass
58	6/1/07 12:05	6/1/07 19:05	-123.1704144	48.5884425	0.4572	sand, cobble, eelgrass
59	6/1/07 23:55	6/2/07 6:55	-123.171477	48.5888478	1.9812	Rocky, eelgrass (drops=3)
60	6/1/07 11:35	6/1/07 21:35	-123.1729	48.58919782	8.5344	Mosquito Pass
61	6/2/07 13:28	6/2/07 20:28	-123.1425453	48.6053862	0.3048	WBN-1
62	6/2/07 13:28	6/2/07 20:28	-123.1425453	48.6053862	0.3048	WBN-2
63	6/2/07 13:28	6/2/07 20:28	-123.1425453	48.6053862	0.3048	WBN-3
64	6/2/07 13:59	6/2/07 20:59	-123.1576585	48.5934125	0.4572	BP-1

65	6/2/07 13:59	6/2/07 20:59	-123.1576585	48.5934125	0.4572	BP-2
66	6/2/07 13:59	6/2/07 20:59	-123.1576585	48.5934125	0.4572	BP-3
67	6/2/07 14:12	6/2/07 21:12	-123.1674891	48.5911956	1.524	WP-SONDE
68	6/2/07 14:19	6/2/07 21:19	-123.1578369	48.5933055	2.5908	BP-SONDE
69	6/2/07 14:47	6/2/07 21:47	-123.1421332	48.5996015	1.3716	WBS-SONDE
70	6/2/07 14:52	6/2/07 21:52	-123.141445	48.5995073	0.9144	WBS
71	6/1/07 10:00	6/1/07 17:00	-123.145544	48.597332	2.4384	SF_Dock
72	6/2/07 13:28	6/2/07 20:28	-123.1425453	48.6053862	0.3048	WBN-PUSH
73	6/2/07 13:59	6/2/07 20:59	-123.1576585	48.5934125	0.4572	BP-PUSH

NOTES: Depth=depth in meters at time of sampling (not corrected to a datum).
Triplicates taken at WBN and BP.
PUSH=Pushcore 6 inch.

APPENDIX III. Grain size results. Size classes in percent.

Station	Boulder	Cobble	Gravel	Sand	Silt	Clay	Mud	Mean Phi	Mean mm	Std_Dev	Skewness	Kurtosis
1	0	0	0.46	80.41	15.96	3.17	19.13	3.552	0.085	1.482	2.246	10.021
2	0	0	0	61.11	31.68	7.21	38.89	4.174	0.055	2.011	1.306	4.317
3	0	0	0.6	61.16	28.84	9.4	38.25	4.102	0.058	2.354	0.975	3.356
4	0	0	3.11	87.59	6.85	2.44	9.29	2.588	0.166	1.673	1.847	9.374
5	0	0	0	90.17	7.16	2.67	9.83	3.015	0.124	1.473	2.733	11.841
6	0	0	0	45.37	45.31	9.32	54.63	4.731	0.038	2.112	0.866	3.148
7	0	0	0	7.02	75.28	17.7	92.98	6.207	0.014	1.816	0.651	2.778
8	0	0	0	5.82	75.34	18.84	94.18	6.34	0.012	1.799	0.607	2.689
9	0	0	0	6.08	72.56	21.37	93.92	6.486	0.011	1.888	0.264	2.915
10	0	0	0	59.01	34.67	6.32	40.99	4.292	0.051	1.86	1.414	4.69
11	0	0	0	10.14	74.02	15.84	89.86	6.019	0.015	1.826	0.75	2.937
12	0	0	0	5.85	73.9	20.25	94.15	6.391	0.012	1.856	0.443	2.767
13	0	0	0	8.19	73.86	17.94	91.81	6.185	0.014	1.839	0.675	2.708
14	0	0	0	6.78	75.13	18.09	93.22	6.216	0.013	1.831	0.671	2.73
15	0	0	0.94	49.29	35.59	14.18	49.77	4.644	0.04	2.672	0.487	2.26
16	0	0	0.49	81.68	12.86	4.98	17.84	3.024	0.123	2.047	1.84	6.068
17	0	0	0.39	14.25	66.93	18.42	85.36	6.053	0.015	2.025	0.328	2.946
18	0	0	0	11.37	74.86	13.77	88.63	5.832	0.018	1.774	0.953	3.269
19	0	0	0	6.29	76.13	17.59	93.71	6.226	0.013	1.807	0.596	2.945
20	0	0	0	13.6	75.04	11.37	86.4	5.637	0.02	1.728	1.048	3.733
21	0	0	0	75.91	19.13	4.96	24.09	3.307	0.101	2.043	1.624	5.127
22	0	0	0	20.47	66.11	13.42	79.53	5.627	0.02	1.965	0.632	2.963
23	0	0	0.23	16.12	72.3	11.35	83.65	5.546	0.021	1.789	0.902	3.954
24	0	0	0	25.32	64.51	10.16	74.68	5.288	0.026	1.797	1.162	3.891
25	0	0	0	56.15	34.26	9.59	43.85	4.311	0.05	2.319	0.961	2.98
26	0	0	1.86	73.81	19.21	5.12	24.33	3.44	0.092	2.065	1.343	5.08
27	0	0	0	22.68	64.09	13.23	77.32	5.556	0.021	1.977	0.7	3.052
28	0	0	0	31.3	59.35	9.35	68.7	5.129	0.029	1.788	1.258	4.16
29	0	0	0.07	73.92	20.54	5.48	26.02	3.383	0.096	2.145	1.393	4.508

30	0	0	0.07	70.95	22.17	6.81	28.99	3.504	0.088	2.273	1.3	4.014
31	0	0	0	37.33	53.64	9.03	62.67	5.005	0.031	1.798	1.355	4.274
32	0	0	0	45.66	46.63	7.71	54.34	4.548	0.043	2.054	0.861	3.5
33	0	0	5.83	71.86	16.62	5.69	22.31	3.235	0.106	2.264	1.069	4.732
34	0	0	0	60.23	27.5	12.27	39.77	4.142	0.057	2.65	0.856	2.554
35	0	0	4.83	81.73	9.44	3.99	13.43	2.516	0.175	2.04	1.734	6.928
36	0	0	0	56.26	35.43	8.31	43.74	4.426	0.047	2.037	1.214	3.83
37	0	0	0.09	59.17	32.8	7.93	40.73	4.27	0.052	2.069	1.241	3.997
38	0	0	0	83.21	12.6	4.19	16.79	3.415	0.094	1.724	2.154	7.729
39	0	0	0	78.16	15.93	5.91	21.84	3.599	0.083	1.937	1.866	6.029
40	0	0	0	57.11	31.54	11.35	42.89	4.23	0.053	2.532	0.85	2.695
41	0	0	0	82.7	13.58	3.72	17.3	3.393	0.095	1.63	2.318	8.568
42	0	0	0	68.39	26.83	4.78	31.61	4.047	0.06	1.615	1.989	7.181
43	0	0	0.05	83.08	12.88	3.99	16.87	3.237	0.106	1.776	1.989	7.358
44	0	0	0	48.26	44.07	7.67	51.74	4.676	0.039	1.798	1.477	4.769
45	0	0	64.34	26.01	7.59	2.07	9.66	0.153	0.9	2.357	2.247	7.7
46	0	0	0	28.4	63.26	8.34	71.6	5.085	0.029	1.701	1.405	4.733
47	0	0	10	70.51	14.45	5.04	19.49	2.732	0.151	2.404	0.978	4.434
49	0	0	0	68.63	24	7.37	31.37	3.873	0.068	2.133	1.409	4.218
50	0	0	0	77.45	16.7	5.84	22.55	3.345	0.098	2.102	1.581	5.143
51	0	0	0.51	71.69	19.64	8.17	27.8	3.601	0.082	2.334	1.315	3.996
52	0	0	5.57	90.39	2.82	1.22	4.04	2.001	0.25	1.401	1.837	13.66
53	0	0	0	43.83	47.12	9.05	56.17	4.852	0.035	1.841	1.363	4.26
54	0	0	0	73.72	21.7	4.58	26.28	3.479	0.09	1.903	1.515	5.539
56	0	0	9.46	84.86	3.95	1.73	5.67	2.129	0.229	1.619	1.382	10.384
57	0	0	21.69	73.62	3.47	1.22	4.69	1.067	0.477	1.84	1.529	7.735
58	0	0	43.39	42.38	10.05	4.17	14.23	1.407	0.377	2.846	1.113	3.762
59	0	0	0.6	97.52	1.31	0.57	1.88	1.912	0.266	0.909	4.175	35.176
60	0	0	41.8	51.4	4.69	2.11	6.8	1.104	0.465	2.329	1.164	5.014
61	0	0	0.95	56.72	35.26	7.06	42.32	4.282	0.051	2.03	1.031	4.249
62	0	0	0	40.16	48.98	10.86	59.84	5.019	0.031	2.06	0.924	3.142
63	0	0	0	52.8	39.54	7.66	47.2	4.489	0.045	1.977	1.167	3.915

64	0	0	0.12	86.21	9.86	3.81	13.67	3.262	0.104	1.623	2.553	9.711
65	0	0	0	90.18	7.22	2.6	9.82	3.043	0.121	1.392	3.172	13.942
66	0	0	0.88	90.82	6.06	2.24	8.3	2.984	0.126	1.356	2.796	14.549
67	0	0	1.33	66.3	22.94	9.43	32.37	3.684	0.078	2.551	1.019	3.223
68	0	0	0	75.03	20.02	4.94	24.97	3.886	0.068	1.654	2.142	7.432
69	0	0	0	9.18	71.74	19.08	90.82	6.268	0.013	1.907	0.412	2.689
70	0	0	1.07	72.42	19.21	7.3	26.51	3.523	0.087	2.339	1.203	3.975
71	0	0	7.42	23.29	52.75	16.54	69.29	5.161	0.028	2.851	-0.363	2.892