Particle Grain Size Analysis of Surface Sediments in Sequim Bay

Tasha Williams-Davis, Julie Masura, and Cheryl Greengrove
University of Washington Tacoma

Introduction

Sequim Bay, Washington is located along the Strait of Juan de Fuca at the entrance to Puget Sound (Fig. 1). In September 2009 surface sediments were collected because of the discovery of the bay's high concentration of *Alexandrium catenella* during a survey in 2005. The particle grains size analysis was done in conjunction with additional studies which were conducted to measure which environmental factors could be attributed to the high levels of *A. catenella*. The purpose of this study was to measure the grain size of sediments found in the bay, and to later indicate whether or not a relationship can be linked between grain size and the abundance of cyst discovered in the 2005 survey.

Field Methods

Surface sediments were collected from Sequim Bay with a van Veen sediment grabber by removing the top 2.5cm of mud from a selected location (Fig. 2). Sediments were collected in Ziploc bags and placed in a cooler with ice. Sediments were then stored in a refrigerator in the dark at 4°C until inventoried, processed and re-inventoried. 3m of core sediments was collected with Kasten Core and sampled on the deck of the vessel. Sediments were collected in Ziploc bags and placed in a cooler with ice. Sediments were then stored in a refrigerator in the dark at 4°C until inventoried, processed and re-inventoried.

Methods for PSA

Beckman Coulter LS Particle Size Analyzer

1. Samples were prepared by filling a beaker with about 80mL of tap water
2. Sediments were massaged in the sampling bag
3. approximately ¼ teaspoon of the sediment was added to the beaker
4. sediment was then stirred until the water was no longer transparent
5. the beaker was placed on a stir motor plate at a setting best to agitate the sediment to form a steady motion of sediments swirling from top to bottom
6. using an open squeeze bulb, the tip was placed at the bottom of the mixing sediment and water solution, careful to drag the tip through the solution to gather samples from bottom to top
7. the solution in the squeeze bulb was added to the PSA, being careful to add slowly due to the delay in time between adding the sample and obscuration level change
8. repeated adding the sample until obstruction levels were between 8-12%,
9. When the appropriate obscuration level was reached, a lid was placed over vessel while the sample was analyzed
10. the sample was analyzed for 60 seconds and when finished a histogram of grain size distribution was created
11. the histogram which was generated was saved to a folder and a hard copy was printed for records
12. the PSA was then prepared for a new sample by selecting the cycle icon; after the cycle was complete the sample was repeated to compare the second set of data with that of the first histogram.
13. information gathered was keyed to generate a histogram on an Excel spreadsheet with averages of the two samples taken

Map of Sequim Bay

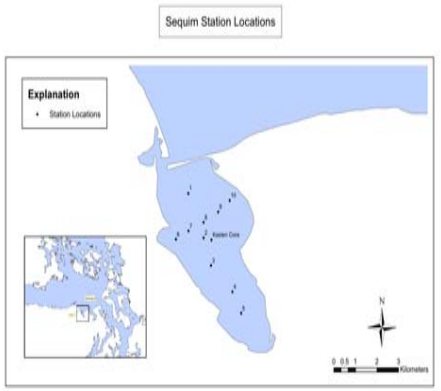

Fig.1. Map of Sequim Bay- 10 sites were surface samples were collected.

Fig.2. van Veen Sediment Grab

Wentworth Scale

Millimeters	µm	Phi (ϕ)	Wentworth size class	
		-20		
4096		-12	Boulder (-8 to -12ϕ)	
1024		-10		
256		-8	Pebble (-6 to -8ϕ)	
64		-6		
16		-4	Pebble (-2 to -6ϕ)	Gravel
4		-2		
3.36		-1.75		
2.83		-1.50	Gravel	
2.38		-1.25		
2.00		-1.00		
1.68		-0.75		
1.41		-0.50	Very coarse sand	
1.19		-0.25		
1.00		-0.00		
0.84		0.25		
0.71		0.50	Coarse sand	
0.59		0.75		
1/2	0.50	500	1.00	
0.42		420	1.25	
0.35		350	1.50	Medium sand
0.30		300	1.75	
1/4	0.25	250	2.00	Sand
0.210		210	2.25	
0.177		177	2.50	Fine sand
0.149		149	2.75	
1/8	0.125	125	3.00	
0.105		105	3.25	
0.088		88	3.50	Very fine sand
0.074		74	3.75	
1/16	0.0625	63	4.00	
0.0530		53	4.25	
0.0440		44	4.50	Coarse silt
0.0370		37	4.75	
1/32	0.0310	31	5	Medium silt
1/64	0.0156	15.6	6	Fine silt
1/128	0.0078	7.8	7	Very fine silt
1/256	0.0039	3.9	8	Mud
	0.0020	2.0	9	
	0.00098	0.98	10	
	0.00049	0.49	11	Clay
	0.00024	0.24	12	
	0.00012	0.12	13	
	0.00006	0.06	14	

Fig. 3. Wentworth Scale - Grade scale which classifies the diameter of sediments. Ranges from clay (smallest) to boulder (largest).

Histogram of Surface Sediments

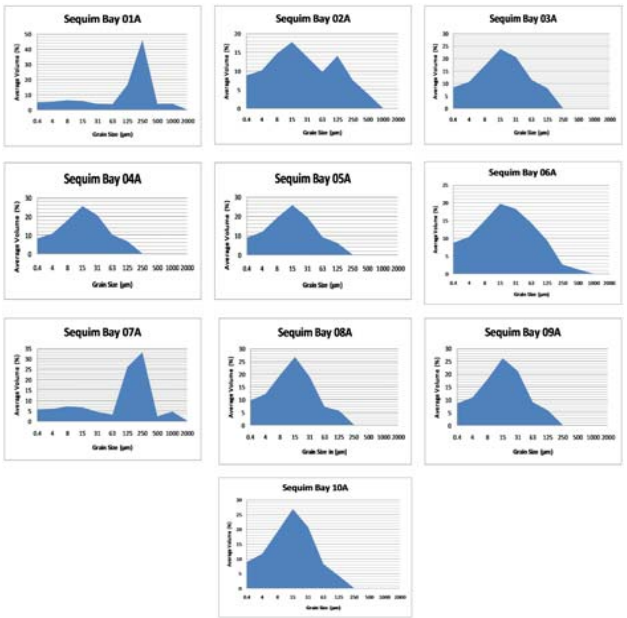

Fig.4. Histogram of surface sediments in Sequim Bay

Results

Stations 2-6, & 8-10 (Fig. 4) was found to have a majority of the grain size to measure 15µm, which is classified as medium silt according to the Wentworth scale (Fig.3). Stations 1&7 both had a majority of the grain size measuring 250 µm, which is consistent with medium sand (Fig.3). An average of 97.84% of surface sediments at sites 1, 2, 6 & 7 had a grain size distribution of 0.4 -1000µm with a Wentworth size class of very fine silt to very coarse sand. Of sites 3, 4, 5 & 9, 99.99% is of this section had a grain size distribution of 0.4 -250µm, with a Wentworth size class of very fine silt to fine sand. An average of 95.3% of surface sediments at stations 8 & 10 had a grain size distribution of 0.4 -125µm classifying these sites with sediments which range from of very fine silt to fine sand.

Discussion

The ten stations had a broad distribution of grain size in the surface sediment ranging between 0.4µm -1000µm, with a majority of the grain size in the range of medium silt (15µm). The even distribution of silt indicates low energy flow for Sequim bay. Water with high energy is able to move many particles as bed load (sand and gravel) or in suspension (silt and clay). As the amount of energy decreases, the size of particles the water can hold in suspension also decreases Fig. 5. (GVSU). Low energy is typical of small inlets like Sequim bay, because they generally slow the flow of the tide limiting the movement of particles.

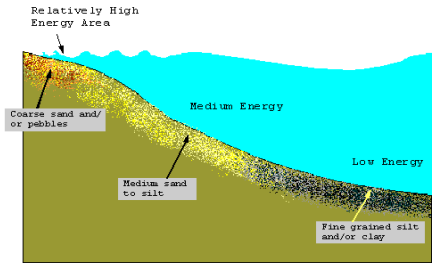

Fig.5. Relationship between energy and grain size.

Acknowledgements

Special thanks to:

•Anna Wallace of the University of Washington Tacoma for providing the map of Sequim Bay.

• Julie Masura for all your instruction, patience and guidance.