


2010 Quartermaster Harbor Water Properties in Relation to Favorable Growth Conditions for *Alexandrium catenella*

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Introduction

Puget Sound usually experiences phytoplankton blooms in the spring and fall during favorable water conditions (Horner *et al*. 1997). Decreasing salinity, due to freshwater input, along with warmer temperatures create stratified water columns that support plankton growth. Some phytoplankton produce toxins which can bio-accumulate in filter-feeding shellfish and cause paralytic shellfish poisoning (PSP) when humans consume shellfish with concentrated amounts of toxins (DOH 2011). The causative agent of PSP in Puget Sound is *Alexandrium catenella* which can cause a range of symptoms from tingling sensations in extremities to difficulty breathing and, in extreme cases, death when muscles become paralyzed and suffocation results (Horner *et al.* 1997). Outbreaks of *A. catenella* close beaches for shellfish harvesting creating costly impacts to shoreline communities with commercial and residential shellfish industry.

Alexandrium catenella

- *A. catenella* is a dinoflagellate with two flagella that enables it to migrate from the surface of the water column to the bottom increasing their access to nutrients. (Fig. 1)

- Conducive growth conditions include a stable (stratified) water column, adequate light for photosynthesis, nutrients for growth, and surface temperatures between 9°-14° C (Nishitani and Chew 1984)

- *Alexandrium* cysts lay dormant in sediment until conditions are favorable then the cysts opens and a cell emerges. Cells reproduce by asexual fission and sexual reproduction. When nutrients are depleted and conditions become adverse, they return to cyst form and fall to seafloor. (Fig. 2)

- A 2005 sediment survey found that 20 of 32 stations sampled in Puget Sound contained *A. catenella* cysts (Greengrove *et al*. 2005). Those stations are indicated on the map by red circles (Fig. 3) with the highest cysts concentration in Quartermaster harbor.

- Cysts are resistant to extreme environmental conditions and provide seed populations for future blooms of *A. catenella* (Horner *et al.* 1997).

Fig. 1. Microscopic view of *A. catenella*

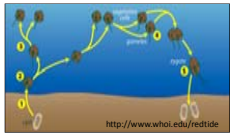

Fig. 2. Life cycle of *Alexandrium*.

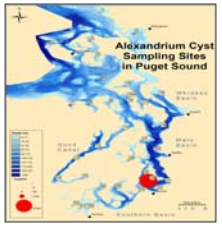

Fig. 3. *Alexandrium* cyst sampling sites and concentration amounts.

Quartermaster Harbor

- Quartermaster Harbor is a shallow harbor located between Vashon and Maury Islands (Fig. 4).

- The inner harbor is about 5m-7m deep and experiences little tidal flushing (King County 2009).

- The outer harbor varies between 11m-46m deep and has rapid tidal flushing at the mouth of the outer harbor that decreases as it moves towards the inner harbor (King County 2009).

- A better understanding of the circulation patterns in Quartermaster Harbor could help predict *A. catenella* blooms and give shellfish harvesters advance warning.

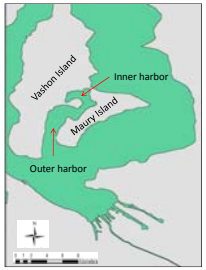

Fig. 4. Map of Quartermaster Harbor

Methods

- Beginning with Station 50 (Commencement Bay), stations were then sampled from the outer harbor to the inner harbor ending with Station 56 (Fig. 5).

- A CTD profile was taken at 1m intervals for temperature, salinity, conductivity, dissolved oxygen, fluorescence, and pressure.

- Discrete water samples were taken with a Nisken bottle for dissolved oxygen, chlorophyll, and plankton.

- Net tows to collect plankton were conducted and secchi readings were taken to determine water turbidity.

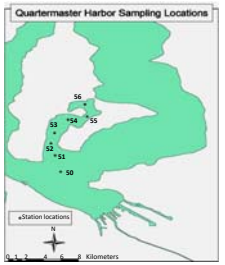

Fig. 5. Map of sampling locations.

Results

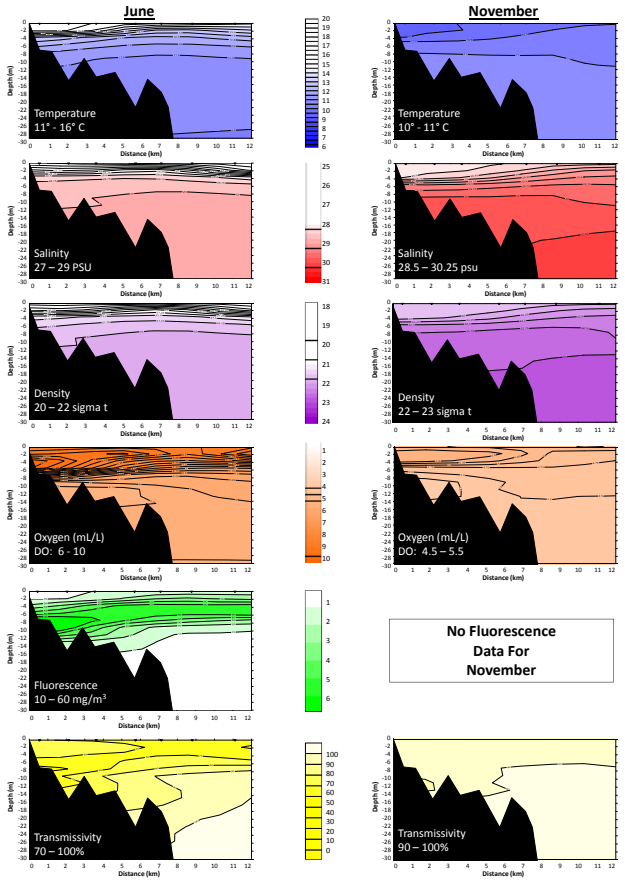

Fig. 6. From the data collected thus far, June and November are two months conclusive for the presence of *A. catenella*. CTD profiles are labeled accordingly and the range of measurements for each parameter are indicated.

Discussion

- June: Water column temperatures between 11° - 16° C, low levels of salinity and density at the surface created a stratified water column. High levels of dissolved oxygen and fluorescence along with low transmissivity indicate the presence of phytoplankton (Fig. 6). *A. catenella* was found at the surface at Station 54 and the thermocline (4m) at Station 50. Surface temperature for June was 16° C which is two degrees higher than indicated optimal conditions, so the bloom may have been dying off at the time of sampling. This may explain why *A. catenella* was found at only two stations.

- November: Water column temperatures between 10° - 11° C, lower levels of salinity and density at the surface created a stratified water column. Slightly higher levels of dissolved oxygen and low transmissivity indicate the presence of phytoplankton (Fig. 6). *A. catenella* was found at the surface at Stations 52, 54, 55, and 56. In the late fall there is usually an excess of nutrients in the water and these months usually experience some slight atmospheric mixing. In addition to these environmental factors, November of 2010 experienced some days that had temperatures that reached into the low 70° F. There may have been enough interaction between atmospheric temperatures and sea surface temperatures during these days to initiate the bloom in November.

Conclusion

Although cross-sections for each month are slightly different, both June and November fit the parameters for conducive conditions that support the growth of *A. catenella*. These results support previous studies that indicate *A. catenella* emerges in the spring and fall during months with conducive conditions.

Future Work

The 2010 water property results will be used in an ongoing investigation of Quartermaster Harbor that is being conducted in order to create a circulation model of the Harbor. The circulation model will be used to assist in predicting future outbreaks of *A. catenella.*

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Acknowledgements

This study is funded by a West Coast Estuaries Initiative (WEI) grant by Region 10 of the U.S. Environmental Protection Agency (EPA).

Special thanks to Julie Masura, Cheryl Greengrove, Dave Thoreson, Nannette Huber, John Pelerine, Jerry Desmul, and to all UWT students who helped with fieldwork.

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