Spatial and Temporal Trends in Quartermaster Harbor Phytoplankton

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Introduction

In 2005, an NOAA/ECOHAB survey found high abundances of *Alexandrium catenella* cysts in the surface sediments of Quartermaster Harbor (QMH). When conditions are right, these cysts germinate to become the phytoplankton *A. catenella, a* dinoflagellate which is known to produce a powerful neurotoxin. This neurotoxin can accumulate in filter-feeding shellfish and, if ingested by humans, can cause paralytic shellfish poisoning. In 2007, a study of the phytoplankton community in QMH was started. This study is helping to broaden the understanding of the relationship between environmental conditions, the cysts present in the sediment, and the abundance of the *A. catenella.*

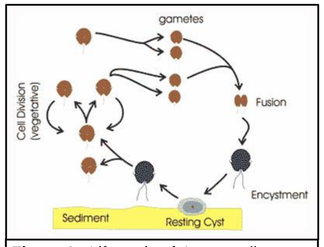

Figure 1: Life cycle of *A. catenella.*
Image credit: http://www.marine-genomics-europe.org

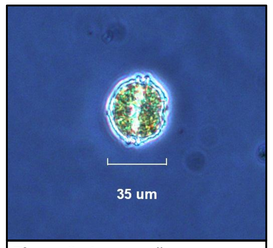

Figure 2: *A. catenella.*
Image credit: Nannette Huber

Methods

- Surveys of seven stations in QMH have been taken approximately monthly since October 2006.
- These surveys include CTD profiles of temperature, salinity, density, dissolved oxygen, fluorescence and transmissivity.
- Discrete water samples are also taken, returned to the lab, and analyzed for dissolved oxygen, chlorophyll, nutrients and phytoplankton.
- In the lab, phytoplankton are fixed with formaldehyde, allowed to settle, and counted with a phase-contrast microscope and a Palmer-Maloney slide.

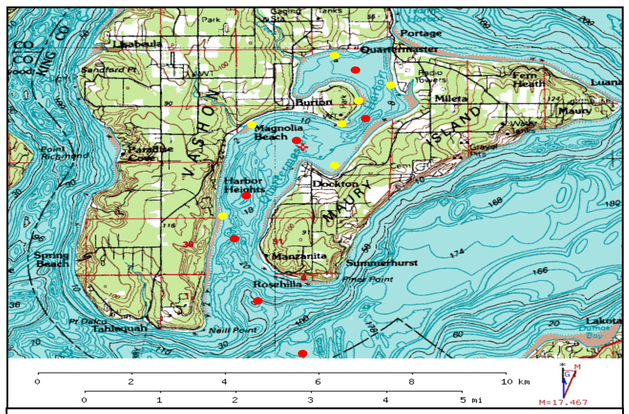

Figure 3: Map of Quartermaster Harbor between Vashon and Maury Islands (USGS 2007).
● -UWT sample stations ● - WDOH sample sites

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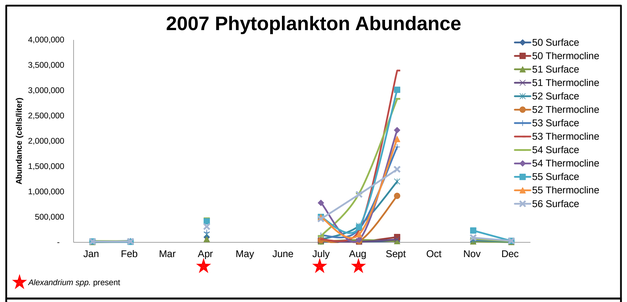

Figure 4: Monthly phytoplankton abundance (cells/liter) in Quartermaster Harbor during calendar year 2007. *Alexandrium spp.* was found to be present in April, July, and August. One bloom was documented in September. Data are unavailable for the months of March, May, June, and October.

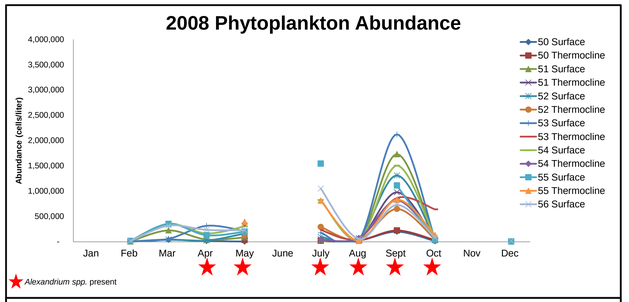

Figure 5: Monthly phytoplankton abundance (cells/liter) in Quartermaster Harbor during calendar year 2008. *Alexandrium spp.* was found to be present in April, May, July, August, September, and October. One peak in abundance was documented in September. Data are unavailable for the months of January, June, November, and December.

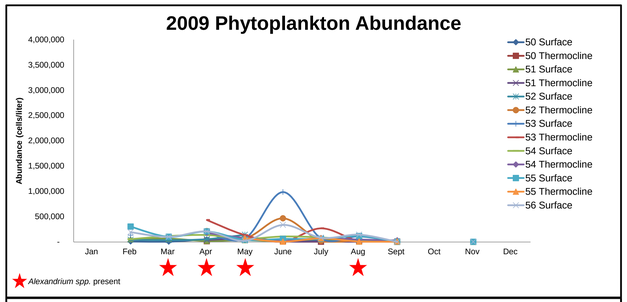

Figure 6: Monthly phytoplankton abundance (cells/liter) in Quartermaster Harbor during calendar year 2009. *Alexandrium spp.* was found to be present in March, April, May, and August. One bloom was documented in June. Data are unavailable for the months of January, October and December.

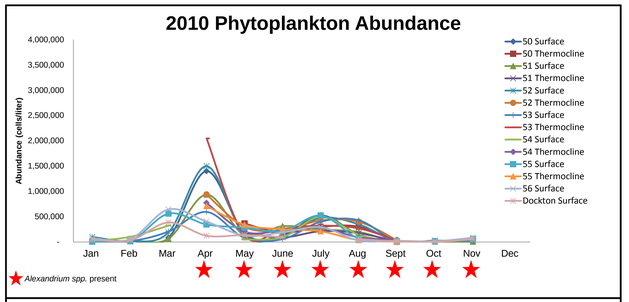

Figure 7: Monthly phytoplankton abundance (cells/liter) in Quartermaster Harbor during calendar year 2010. *Alexandrium spp.* was found to be present in April through November. One bloom was documented in April. Data are unavailable for the month December.

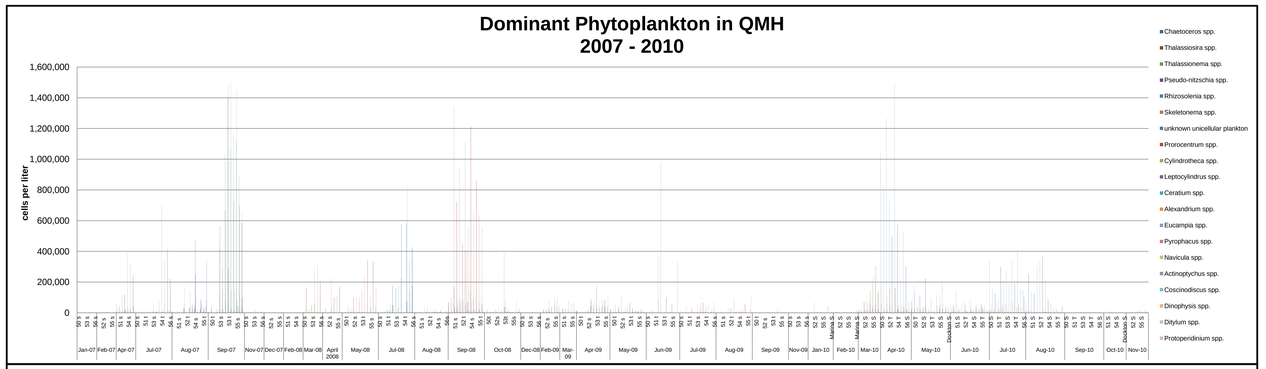

Figure 8: Dominant phytoplankton in Quartermaster Harbor (2007-2010). Bloom trends show that blooms begin in the inner harbor and progress to the outer harbor.

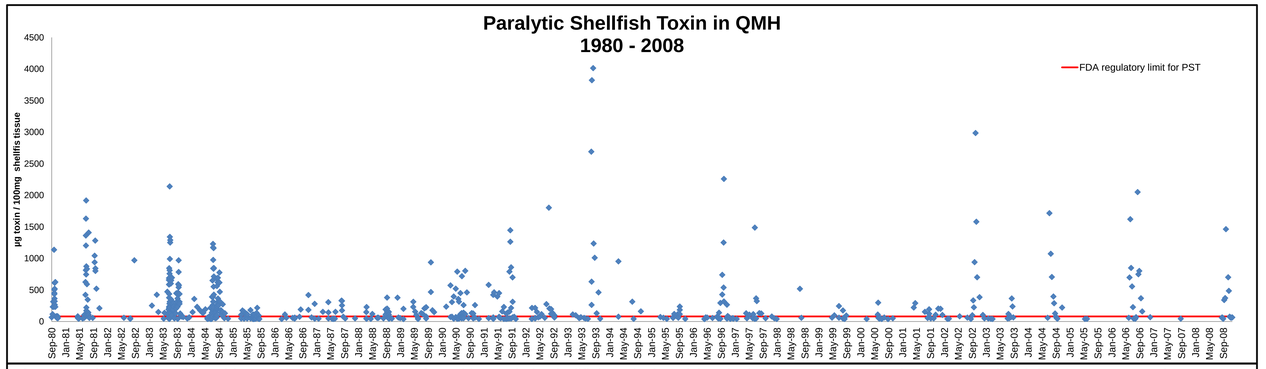

Figure 9: Time series of Washington State Department of Health paralytic shellfish toxin (PST) levels in Quartermaster Harbor. Seasonally high PST concentrations occur in the fall, the same time A. catenella blooms are likely to occur.

Table 1: Ranking of dominant genus present in Quartermaster Harbor (2007-2010). *Alexandrium spp.* is ranked 12th in both the total number of cells present and in average cells per liter.

Genus Present	Total cells 2007-2010	Average cells/liter
Chaetoceros spp.	30,690,919	79,924
Thalassiosira spp.	13,514,012	35,193
Thalassionema spp.	9,591,330	24,977
Pseudo-nitzschia spp.	6,150,633	16,017
Rhizosolenia spp.	3,920,479	10,210
Skeletonema spp.	3,285,015	8,555
Unknown unicellular	2,411,178	6,279
Prorocentrum spp.	2,279,073	5,935
Cylindrotheca spp.	1,996,868	5,200
Leptocylindrus spp.	1,617,297	4,212
Ceratium spp.	1,543,110	4,019
Alexandrium spp.	1,405,929	3,661
Eucampia spp.	774,637	2,017
Pyrophacus spp.	599,841	1,562
Navicula spp.	597,285	1,555
Actinoptychus spp.	557,658	1,452
Coscinodiscus spp.	457,683	1,192
Dinophysis spp.	455,633	1,187
Ditylum spp.	404,155	1,052
Protoperidinium spp.	376,855	981

Table 2: Frequency ranking of genus present in Quartermaster Harbor (2007-2010). *Alexandrium spp.* is ranked 13th in frequency found.

Genus Present	Frequency
Chaetoceros spp.	0.77
Thalassiosira spp.	0.67
Cylindrotheca spp.	0.54
Pseudo-nitzschia spp.	0.54
Navicula spp.	0.45
Skeletonema spp.	0.45
Pyrophacus spp.	0.41
Thalassionema spp.	0.41
Coscinodiscus spp.	0.35
Prorocentrum spp.	0.33
Actinoptychus spp.	0.33
Protoperidinium spp.	0.32
Alexandrium spp.	0.30
Scrippsiella spp.	0.29
Rhizosolenia spp.	0.29
Ceratium spp.	0.28
Leptocylindrus spp.	0.24
Dinophysis spp.	0.23
Eucampia spp.	0.19
Hemiaulus spp.	0.18

Results and Future Work

- A partial summary of the QMH phytoplankton community is outlined here. Occurrences of *A. catenella* are highlighted.
- In QMH, blooms occur in April and/or September.
  - In 2007 & 2008 the largest bloom occurred in the fall (Figures 4 & 5)
  - In 2009 & 2010 the largest bloom occurred in the spring (Figures 6 & 7)
- Blooms in QMH typically start in the inner harbor, followed by blooms in the outer harbor (Figure 8).
- Blooms of *A. catenella* coincide with increased concentrations of PST (Figure 9).
- Statistical analysis of these data are being done to develop a more efficient sampling plan.
- Data are also being used in a hydrodynamic/water quality model currently being developed by Washington State Department of Ecology and King County as part of the QMH Nitrogen Management Study.

References

Horner RA. 2002. *A Taxonomic Guide to Some Common Marine Phytoplankton*. Biopress Ltd., Bristol.

Horner RA, Greengrove CL, Postel JR, Gawel JE, Davies-Vollum KS, Cox A, Hoffer S, Sorensen K, Hubert J, Neville J, and Frost BW. 2008. *Alexandrium* cysts in Puget Sound, Washington, USA. In: Ø. Moestrup et al. (Eds.) Proceedings of the XII International Conference on Harmful Algae.

Acknowledgments

THE RUSSELL FAMILY FOUNDATION

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