

Unusual Happenings: King County Puget Sound Marine Monitoring Results for 2014-15

INTRODUCTION

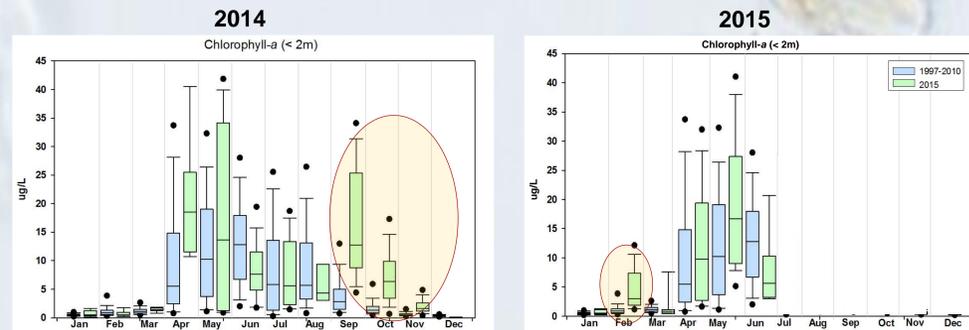
King County has a Marine Monitoring Program that measures water quality at 14 offshore locations for a variety of physical (ex., temperature & salinity), chemical (ex., nutrients), and biological (ex., bacteria & plankton) variables. Both phytoplankton and zooplankton are collected to assess abundance and distribution. Samples are collected twice monthly and moorings at three locations collect data at 15-minute intervals. The purpose of the monitoring program is to provide an understanding of water quality within King County, evaluate status and trends, and provide insight into natural variations.

HIGHLIGHTS

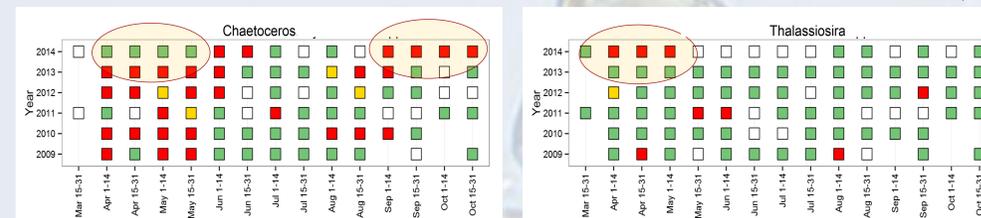
- Bottom waters started warming in September 2014 and were much warmer than normal by November 2014 (1.0-1.8°C). Bottom waters continued to be over 1°C warmer than normal through April 2015. Although surface waters are starting to approach typical summer temperatures, bottom waters are still above normal (0.71°C thru June 16).
- An unusually large and longer than normal fall phytoplankton bloom occurred from early September through October 2014, coinciding with the warmer than normal temperatures, and was dominated by the diatom *Chaetoceros*. A small, early phytoplankton bloom occurred at most locations sampled in the Central Basin in mid-February 2015. A bloom this early has rarely occurred (twice in over a 25 year monitoring record for some locations). These changes/shifts in phytoplankton dynamics can have consequences for other organisms, from zooplankton to mammals, as they form the basis of the Puget Sound food web. These blooms are often very visual if sufficiently large and can discolor the water (green, reddish/brown, and bright orange) which can be alarming to the public. While most blooms are harmless, some can affect human health (mainly from eating contaminated shellfish), fish, birds, and marine mammals.
- Shifts in the phytoplankton community were noted in 2014. The dinoflagellate population remained small throughout the year, with the exception of Quartermaster Harbor, particularly in late summer and fall when this group is usually abundant. Changes in the dominant diatoms during the spring bloom were also observed.
- Nutrient levels were affected by the unusually long and large fall 2014 phytoplankton bloom. A sharp decrease in nutrients (nitrate and silica) occurred from September through November 2014 coinciding with the large fall bloom. Surface water nutrients (nitrate and silica) were lower than normal in February 2015 due to the unusual February bloom.
- Warmer than normal bottom waters in late 2014 coincided with lower than normal dissolved oxygen (DO) concentrations. Bottom water DO levels were below normal starting in October 2014 and have remained below normal as of mid-June 2015. If anomalous phytoplankton conditions continue throughout 2015 with large blooms, DO levels will be a concern as levels typically drop following a bloom due to the decay process. Embayments with poor flushing (such as Quartermaster Harbor) will be closely watched throughout the summer and fall for low DO levels which could cause fish kills.

CHLOROPHYLL & PHYTOPLANKTON

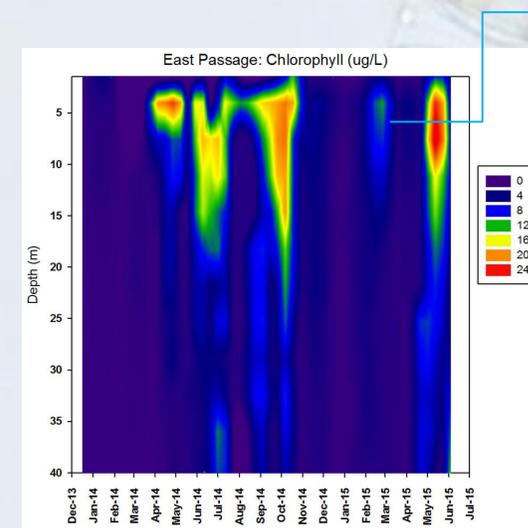
Chlorophyll is a green pigment present in all green plants and is responsible for the absorption of light to energy for photosynthesis. Phytoplankton are microscopic photosynthetic organisms that form the bottom of the aquatic food web. Two major groups are the diatoms and the dinoflagellates, which play different roles in the food web.



Box & whisker plots above show chlorophyll-a values for 12 sites combined in 2014 (green bars left graph) and 2015 (green bars right graph) compared to the long-term average (blue bars). Lines within bars indicate median values, box boundaries show 25th & 75th percentiles, whiskers (error bars) show 10th & 90th percentiles, and black dots show 5th & 95th percentiles. **Important points: the fall bloom was larger and persisted longer than normal in 2014 and the small February 2015 bloom was very unusual.**

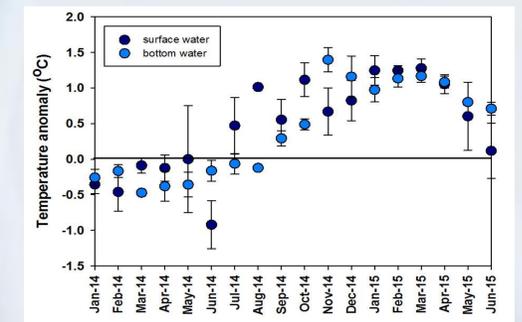


The figures above show the relative abundance between 2009 and 2014 for two phytoplankton diatom genera (*Chaetoceros* on the left and *Thalassiosira* on the right) at Pt. Jefferson. **Important points: in 2014 the spring bloom was dominated by *Thalassiosira* and *not* *Chaetoceros* and the large fall bloom was dominated by *Chaetoceros*, all very unusual occurrences. This highlights one of the several shifts in phytoplankton community structure that was noted in 2014.**

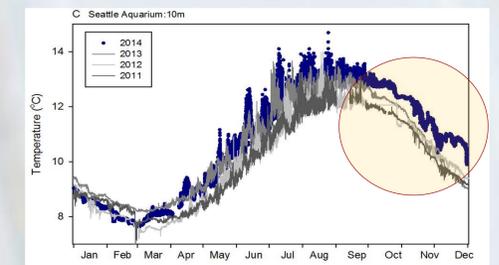


The figure to the left shows chlorophyll levels (proxy for phytoplankton) at East Passage. Yellow to red colors indicate higher chlorophyll levels and blooms. **Important points: chlorophyll was high through much of the year in 2014, the fall bloom was unusually large and long, and the small February 2015 bloom was evident at most sampling sites. This is noteworthy as blooms are rarely seen in February. The February bloom consisted primarily of the diatom *Coscinodiscus*.**

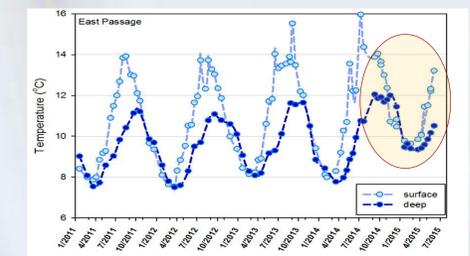
WATER TEMPERATURE



Plot above shows water temperatures from 7 sites combined in 2014/15 compared to the long-term (1999-2010) average. Positive values indicate warmer than normal & negative values indicate colder than normal. **Important points: both bottom & surface waters were warmer than normal starting in September 2014 and while surface waters are just now approaching normal summer temperatures, bottom waters are still warmer than normal.**

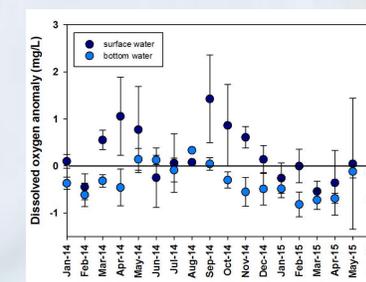


Plot above shows water temperatures at Seattle Aquarium mooring at 10m. Data were collected at 15-minute intervals. **Important point: 2014 fall and winter water temperatures were much warmer than previous years.**

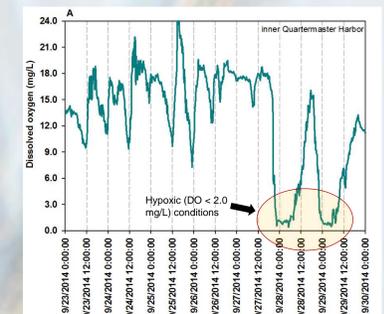


Plot above shows water temperatures at East Passage over last 5 years. **Important point: 2014 water temperatures were much warmer than previous years and bottom waters continue to be warm through June 2015.**

DISSOLVED OXYGEN (DO)



Plot above shows DO from 7 sites combined in 2014/15 compared to the long-term (1999-2010) average. Positive values indicate more DO than normal, negative values indicate less DO than normal. **Important points: bottom waters from September 2014 thru present have less DO than normal due to warm Blob water.**



Plot above shows DO in inner Quartermaster Harbor and the low seasonal DO that typically occurs in fall. **Important point: already seasonally low DO in Quartermaster Harbor could be much worse this fall and lead to fish kills if trends continue.**

