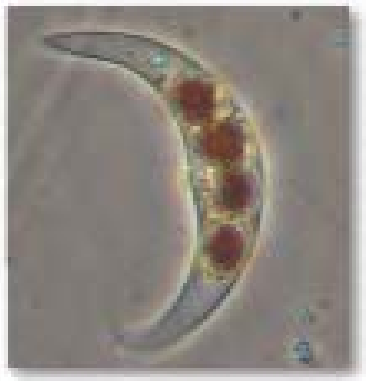
Hood Canal
Dissolved Oxygen Monitoring Program
Phytoplankton Analyses
2009 Progress Report







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Pacific Shellfish Institute Phytoplankton Analyses July 2009 Progress Report

The Pacific Shellfish Institute (PSI) was subcontracted by the Hood Canal Salmon Enhancement Group (HCSEG) from 2005-2009 to analyze phytoplankton samples collected as part of the Hood Canal Dissolved Oxygen Monitoring Program (HCDOP). PSI staff Mary Middleton analyzed the samples as they were received.

Task 1 involved routine marine water phytoplankton analysis. For this task phytoplankton samples from the HCDOP weekly monitoring program were analyzed by PSI staff. Sample sites were Potlatch, Sister's Point, Bamban Cove, and Sund Rock. One net tow sample and one whole water or discrete sample was collected at each monitoring site. Samples are taken at the depth of the chlorophyll maximum. Whole water and net tow samples were preserved in 1% Lugol's iodine solution and transported to PSI. Whole water phytoplankton samples were allowed to settle overnight prior to being concentrated 10-fold and viewed under an Olympus® inverted microscope using a 0.1 ml Palmer-Maloney counting chamber. Net tow samples were not used for quantification, but rather screened for species presence. A complete species list was generated and each species was classified as dominant (1-2 species that comprise approximately 40-50% of species composition), prominent (2-3 species that comprise of sub blooms) or present (majority of species that are found in smaller quantities) for each sample.

Task 2 involved emergency response marine water phytoplankton analysis. For this task PSI was part of the HCDOP-IAM emergency response (ER) phone tree. The HCDOP developed an emergency response team that responds to reports of algal blooms and fish kills. The ER mechanism is set in motion by a call to the Washington Department of Ecology (WADOE). The WADOE then contacts representatives from HCDOP-IAM to develop an appropriate response for the situation. For these situations, PSI processed water samples quickly, within 1-2 days, in order to provide immediate information feedback on the status of the water conditions. PSI was called on to respond to 2 phytoplankton blooms in the spring of 2009. Both of these blooms were dominated by the dinoflagellates *Noctiluca scintillans,* over 3 million cells/L in May and over 500,000cells/L in June.

Results

2009

Figures 1 and 2 show the results for the 2009 samples that have been analyzed through early June. Figure 1 shows the total plankton counts for each site. Counts remain low through early April when we see a bloom of *Odontella species*, 1,366,000 cells/L. After this first spring bloom counts drop again until late May when we see another bloom of *Rhizosolenia species,* 1,434,000 cells/L. Figure 2 shows the species composition of the 2009 samples with diatoms clearly dominating all samples. 2009 Cell counts are relatively low compared to past years. Even the bloom were not over 2 million cells per liter, and in 2008 spring blooms were over 6 million cells per liter. This may have been caused by a problem with the Lugol's preservative used during the first part of this year. It was very dilute and did not appear to preserve as well as

usual. In early June a new batch of stronger Lugol's was given to the Hood Canal Salmon Enhancement group. The samples for the rest of the year should be adequately preserved.

Figure 1

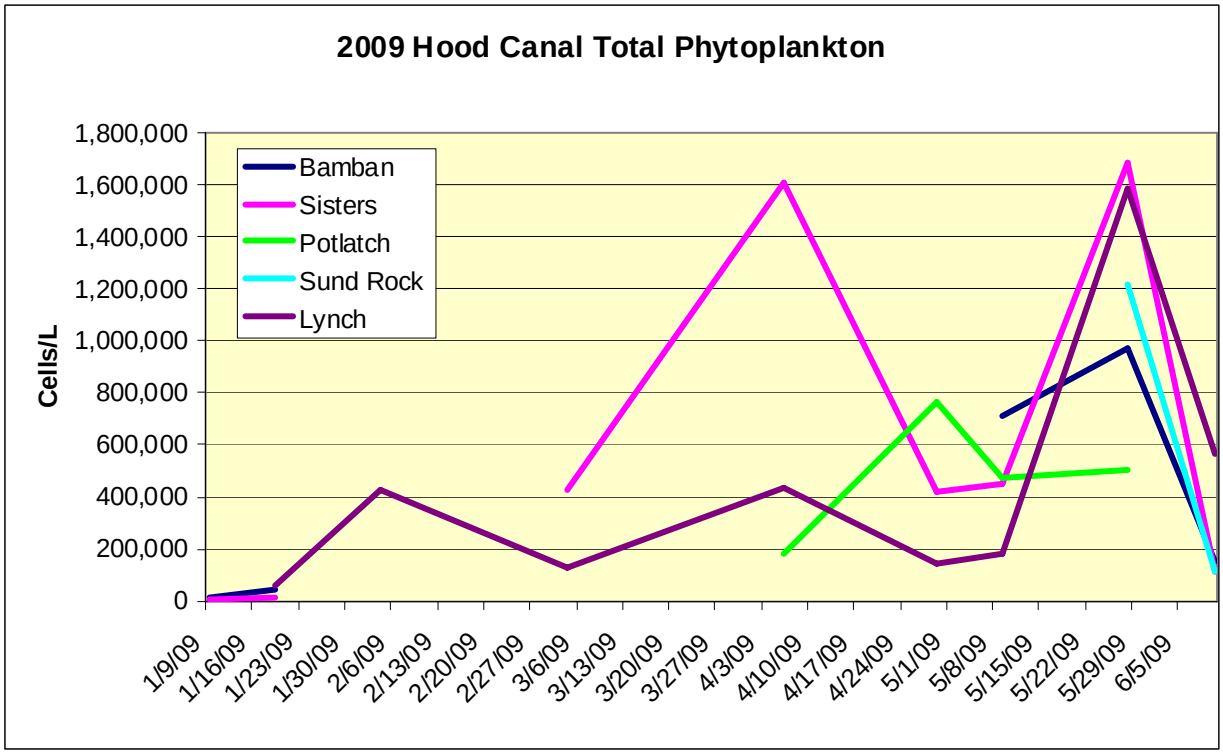
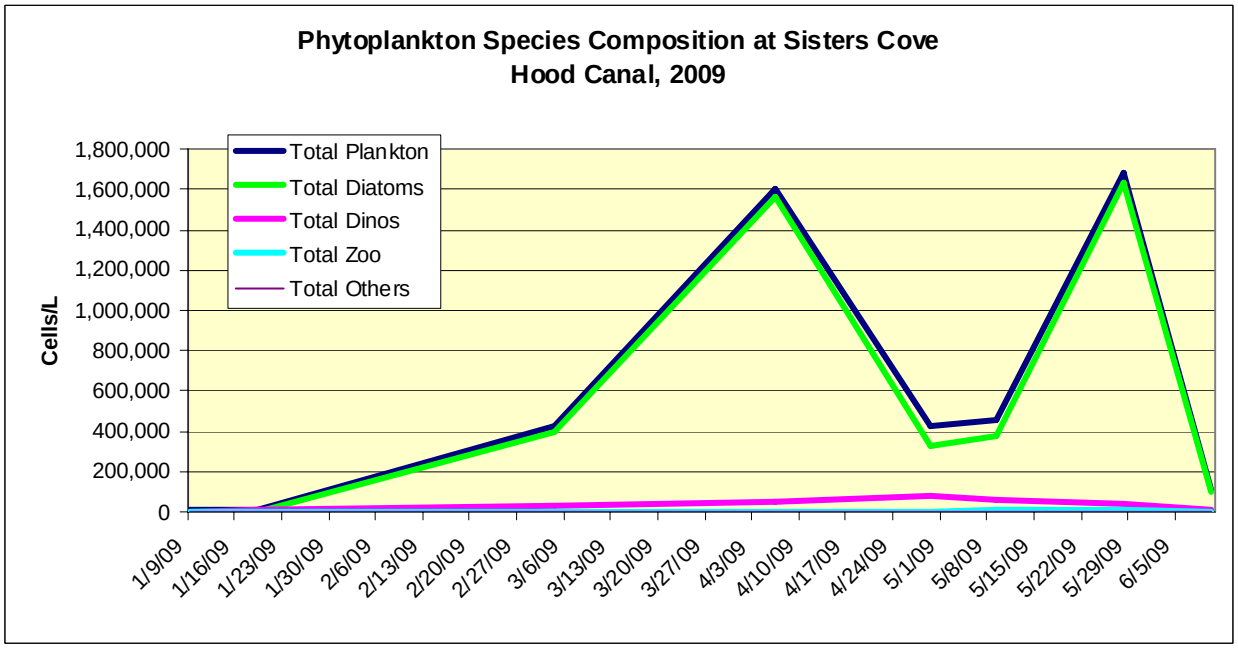


Figure 2



2008

Figure 3 shows the total plankton counts for all sites sampled in 2008. The largest spring bloom was seen at Bamban Cove on April 3rd with over 17 million cells per liter. This bloom was dominated by *Skeletonema costatum*, 11,294,000 cells/liter, and *Chaetoceros spp.*, 4,548,000 cells/liter. The composition of plankton in samples from Bamban Cove is shown in Figure 4. Diatoms dominated the spring blooms and continued to dominate the samples through most of the year with the exception of a fall bloom of an unknown species similar to Heterosigma akashiwo, 6,020,000 cells/liter. This bloom also consisted of *Cerataulina pelagica* with 1,538,000 cells/liter.

Figure 3

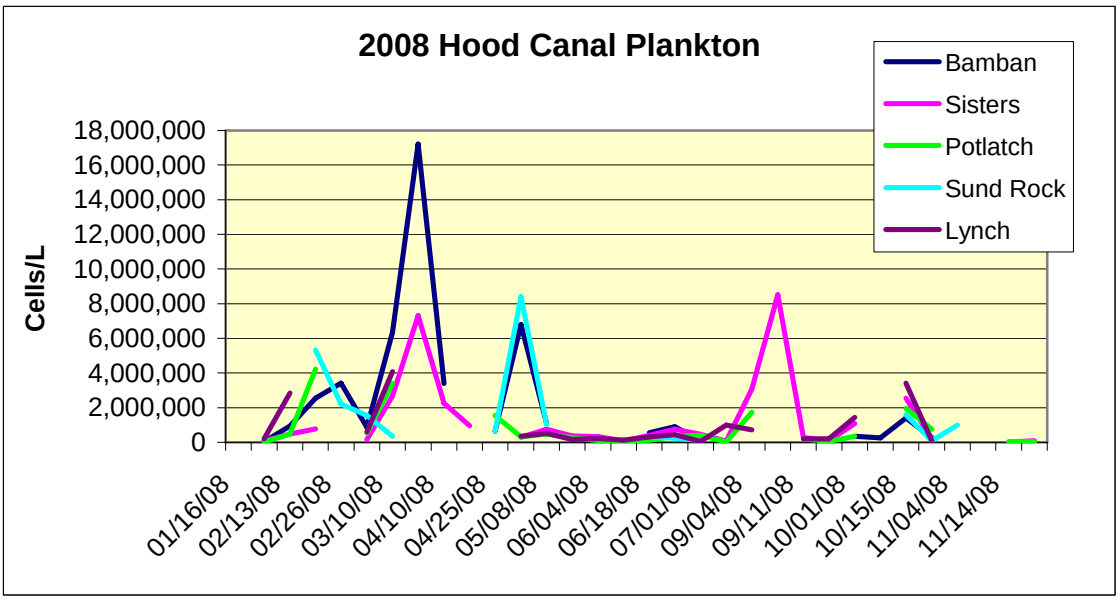
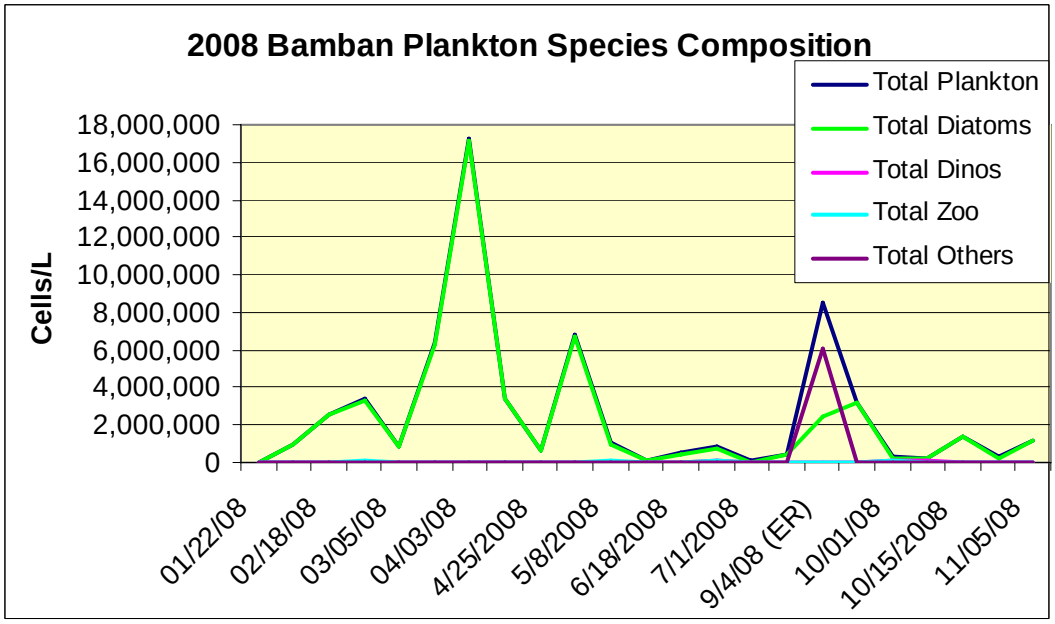


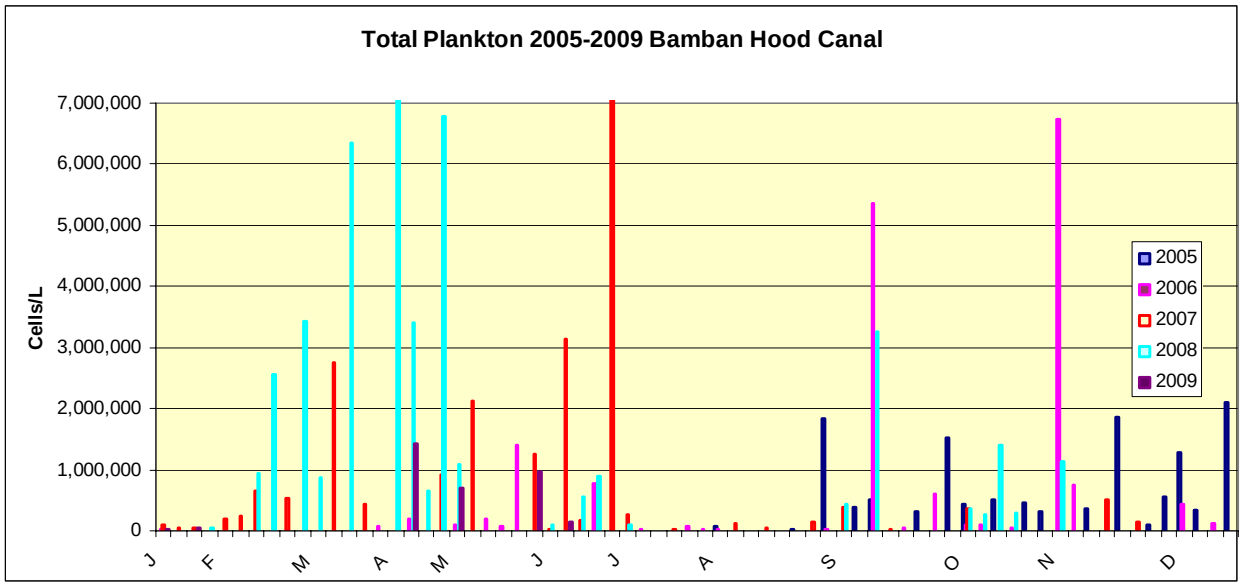
Figure 4



2005-2009 Results

The following chart, figure 5, displays total plankton counts for Bamban beginning in August of 2005 and continuing through June 2009. The Bamban data were selected because this site has been consistently sampled over past years, although in 2009 it was not sampled as frequently as Sister or Lynch. Although, there is a great deal of variation in cell counts from year to year each year showed higher cell counts in the spring and fall, with a significant drop off from late July through August. This is most likely due to highly stratified waters during these months of typically hot weather which would make nutrients less available to the phytoplankton. In 2005 cell counts remained high throughout the fall and into December. The 2006 spring bloom was small in comparison the fall blooms in September and November, which had cell counts over 5 million cells/L and more that 6 million cells/L respectively. 2006 cell counts do not remain high into December as they did in 2005. In 2007 there were large spring blooms beginning in March and continuing into July then dropping off and remaining low for the remainder of the year. 2008 began with some large spring blooms starting in February cell counts remain high through late May and then decrease until early September, when we saw the unidentified "Others" bloom. Cell counts decrease for the remainder of the year after September, and diatoms continue to dominate these cell counts.

Figure 5



Conclusion

Over the past four years PSI has analyzed over 480 phytoplankton samples from Hood Canal. Few areas in Puget Sound have such a detailed account of phytoplankton blooms and species composition. This sampling program has allowed us to begin to see patterns in the cycle of phytoplankton in Hood Canal. Comparing data from all three years we do see the typical cold water trend of large spring blooms, with a decrease in the number of cells during mid summer, and then smaller fall blooms followed by decreasing numbers in late fall and early winter. When looking at individual years we see variations from this trend. The beginning two years of this project showed phytoplankton counts remaining high into early winter, but this was not seen last

year. Typically we would expect to see the spring blooms composed mostly of diatoms and the fall blooms dominated by dinoflagellates. This pattern was observed in Hood Canal during 2005 and 2006, but in 2007 the entire year was dominated by diatoms. Most of 2008 was also dominated by diatom species with the exception of a fall bloom consisting of an unidentified Heterosigma-like species.

Since not all dinoflagellates produce Chlorophyll sampling at the depth of maximum Chlorophyll could bias the sample toward diatom species, but the data from the net tow samples also show a year round dominance of diatom species. The 2008 and 2007 net tow samples from Bamban Cove were dominated year round by diatoms. Several research projects analyzing levels of Nitrogen and Silica in marine waters have shown that these factors can have significant affects on phytoplankton species composition. Diatoms require Silica as well as Phosphorus and Nitrogen for photosynthesis. In temperate regions dissolved Silicate is usually supplied through land weathering to estuaries and coastal zones (Officer, 1980). A review of historic data from the Mississippi delta found a shift in dominant diatoms toward species which were more lightly silicified between 1955-1957 and 1972-1973. These species included many common species seen in Hood Canal, such as *Rhizosolenia spp*. and *Cerataulina pelagica*. In the Mississippi delta study, this change in species composition coincides with increased nutrient concentrations and loadings of Nitrogen and Phosphorus and a decrease in Silica since 1950 (Rabalais, 1996). This research suggests that an increase in Nitrogen could lead to an increase in the dominance of lightly-silicified diatoms and non-diatoms, such as dinoflagellate species. In order to look more closely at the impacts water quality conditions may have on species composition of phytoplankton in Hood Canal, further analysis of the water quality data collected at the time of plankton sampling is needed. This factor will be explored more in the next year as part of the continued phytoplankton monitoring of Hood Canal.

References

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Rabalais, Nancy N.; Wiseman, William J. Jr.; Turner, R. Eugene; Sen Gupta, Barun K.; Dortch, Quay. 1996. Nutrient Changes in the Mississippi River and System Responses on the Adjacent Continental Shelf. Estuaries. Vol. 19. No. 2B. 386-407.