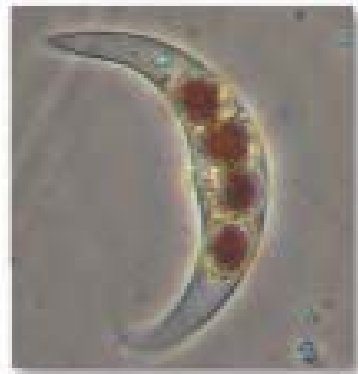
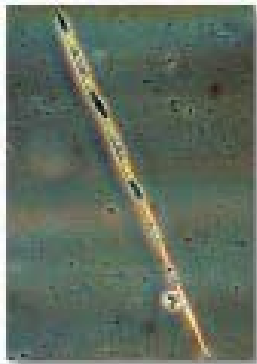


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**Hood Canal  
Dissolved Oxygen Monitoring Program  
Phytoplankton Analyses  
2008 Progress Report**



**Mary Middleton  
Pacific Shellfish Institute  
Olympia, Washington  
July 11, 2008**

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## **Hood Canal Dissolved Oxygen Monitoring Program Pacific Shellfish Institute Phytoplankton Analyses July 2008 Progress Report**

The Pacific Shellfish Institute (PSI) was subcontracted by the Hood Canal Salmon Enhancement Group (HCSEG) from 2005-2008 to analyze phytoplankton samples collected as part of the Hood Canal Dissolved Oxygen Monitoring Program (HCDOP). PSI staff Mary Middleton and Aimee Christy 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.

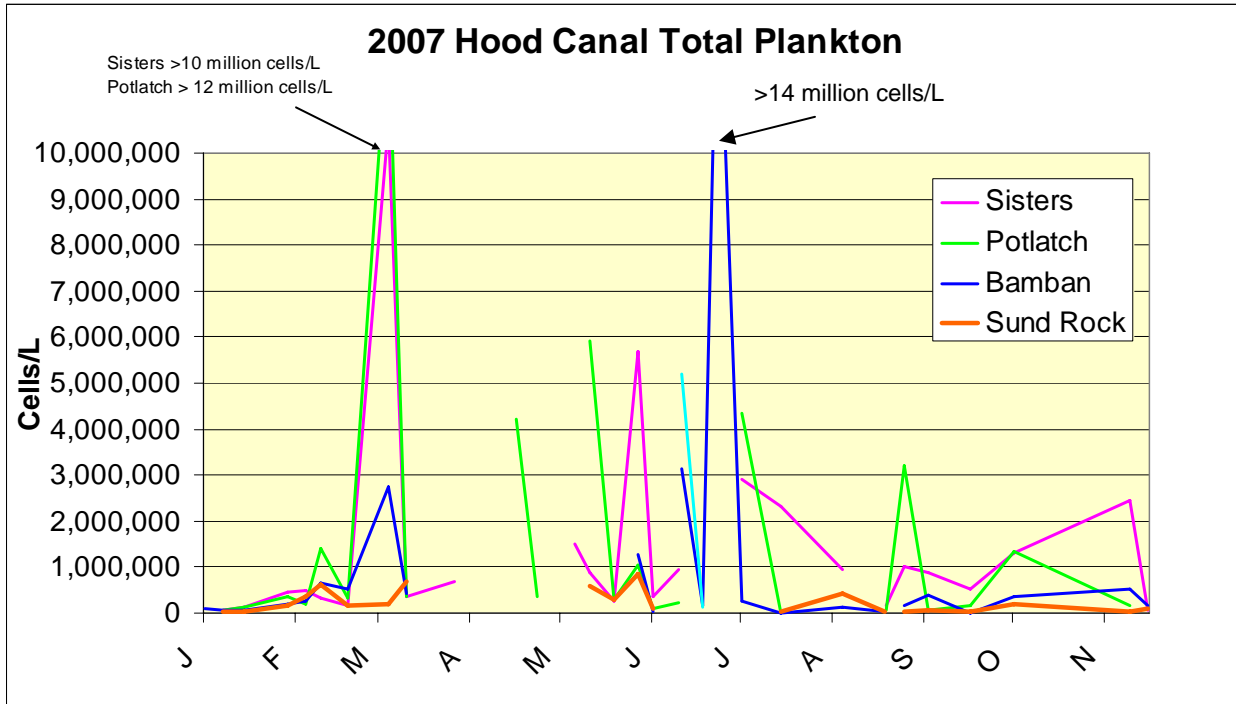
Task 2 involved emergency response marine water phytoplankton analysis. For this task PSI was part of the HCDOP-IAM emergency response (ER) phone tree. The HCDOP developed an emergency response team that responds to reports of algal blooms and fish kills. The ER mechanism is set in motion by a call to 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 not called on to respond to any bloom events in 2007-2008.

### **Results**

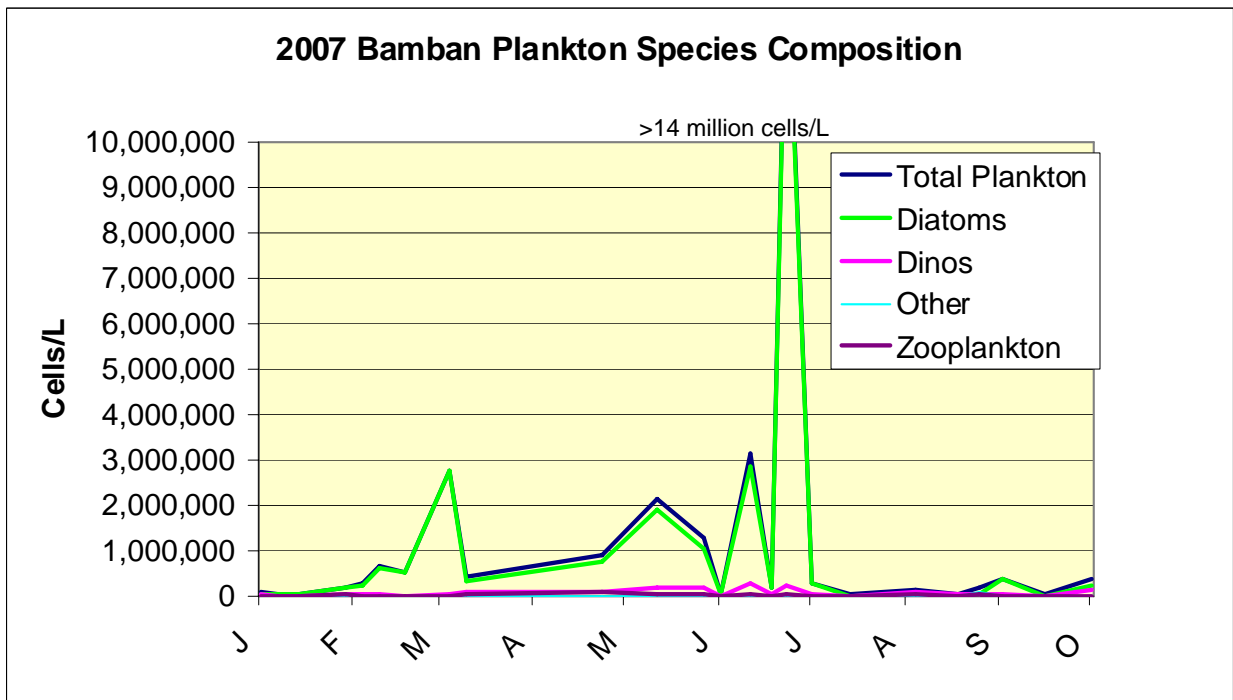
#### **2007**

Figure 1 shows the total plankton counts for all four sites sampled in 2007. Samples taken from Sisters and Potlatch showed spring blooms with cell counts over 10 million cells per liter. These samples were dominated by *Chaetoceros* spp. and *Detonula pumila*. An early summer bloom sampled at Bamban Cove on June 27<sup>th</sup> had a count of 14,733,000 cells/L. This was dominated by *Skeletonema costatum*, *Nitzschia ascicularis*, and *Psuedo-nitzschia* species. The composition of plankton in samples from Bamban Cove is shown in Figure 2. Diatoms dominated the spring blooms and continued to dominate the samples through the summer and fall. This was different than previous years when there was a small dinoflagellate bloom in the fall, September 2005 and November 2006. Dinoflagellates typically dominate when waters are more stratified and nutrients are less available.

**Figure 1**



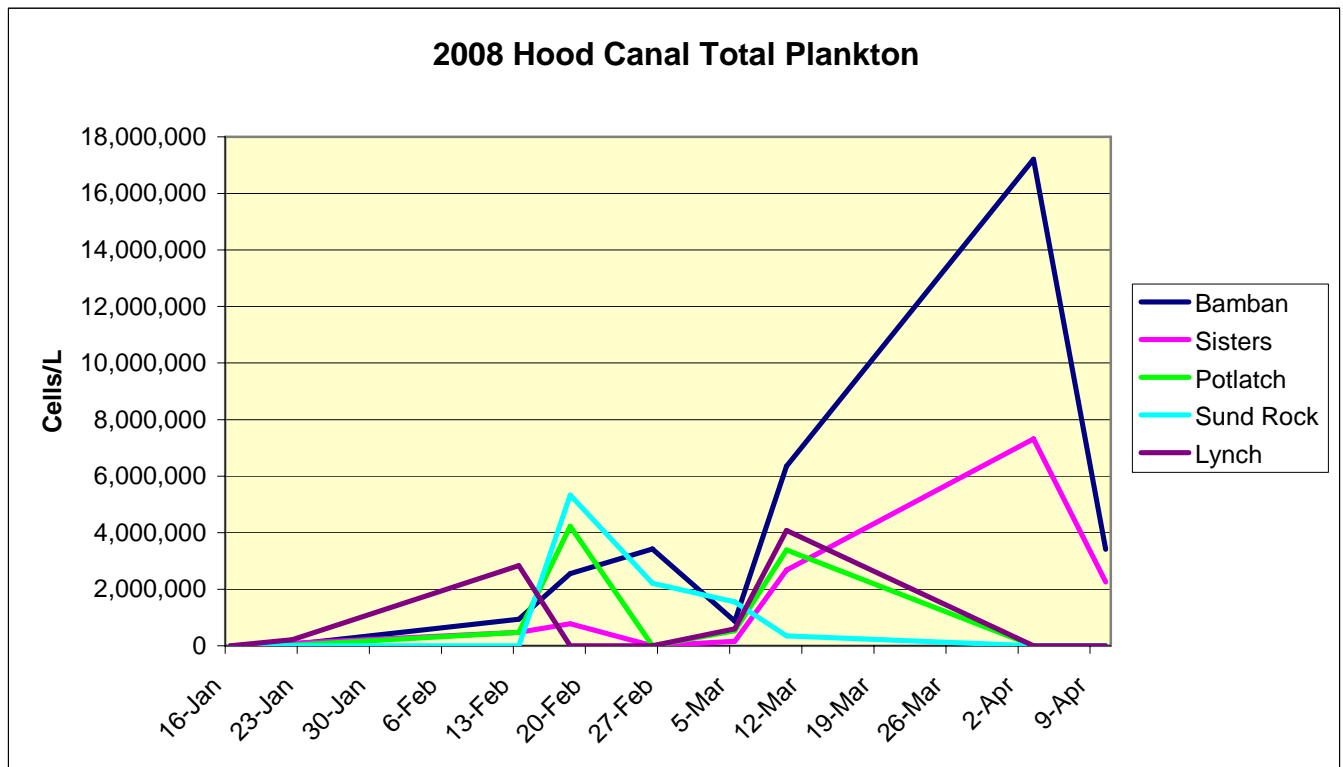
**Figure 2**



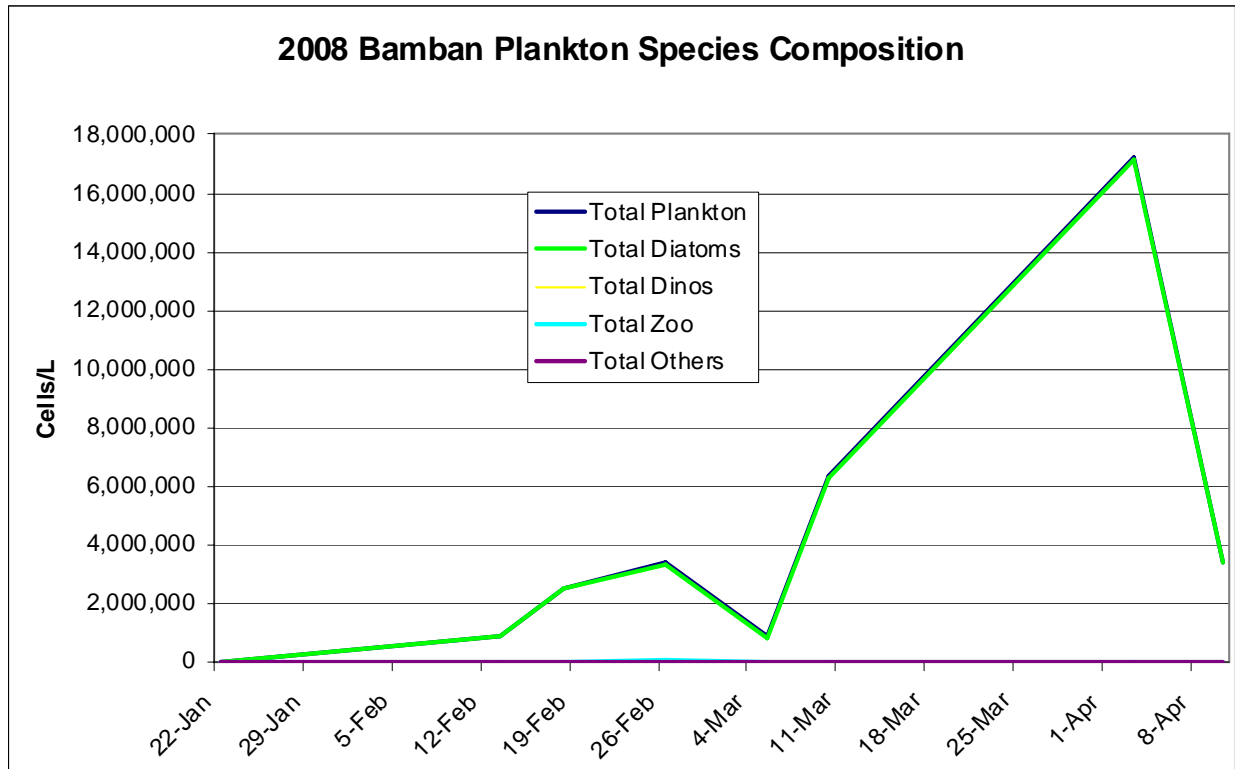
## 2008

Figures 3 and 4 show the results for the 2008 samples that have been analyzed through early April. Lynch Cove and Hama Hama were new sites sampled this year. Hama Hama has only been sampled one time this year, January 16<sup>th</sup> with a total cell count of 34,000 cells/L, because there was only one data point for this site and the cell count was relatively low it is not included in the following chart. Figure 3 shows the total plankton counts for each site. Counts remained low until mid February when there were small blooms with counts between 2,552,000 and 5,326,000 cells/L. These samples were dominated by *Chaetoceros* and *Thalassiosira* species. This small early spring bloom was likely in response to warm temperatures reaching more than 18 °C during that week. Cell counts begin to increase again in March especially at Bamban Cove where counts reached 17,212,000 cells/L on April 10<sup>th</sup>. This bloom was dominated by *Skeletonema costatum* and *Chaetoceros* species. Figure 4 shows the species composition of the samples with diatoms clearly dominating all the samples collected in 2008.

**Figure 3**



**Figure 4**



### Comparison with Puget Sound and Willapa plankton

PSI has been monitoring plankton in Puget Sound for about 8 years at sites on Eld and Totten Inlets as part of NOAA/Sea Grant Oyster Disease Program. Samples at Totten Inlet are collected beginning in early spring when temperatures start to rise and continues into fall until temperatures begin to drop and cell counts decrease. Most years south Puget Sound phytoplankton have displayed trends typical of cold temperature regions with chain-forming diatoms blooming in spring, sustained to a lesser degree throughout summer and giving rise to dinoflagellate species during periods of prolonged stratification usually in the mid to late summer. Figure 5 shows the total cell counts as well as the total diatom and dinoflagellate numbers. For 2007 Totten Inlet cell counts were highest in the spring, these counts consisting mostly of diatoms. Dinoflagellate numbers increased in late July, but mostly stayed lower than the diatoms for the remainder of the sampling period. Cell counts decreased significantly in October when sampling ended.

We have had a monitoring site in Willapa Bay since 2001, which began as a part of the Olympic Region Harmful Algal Bloom (ORHAB) program with continued funding provided by the University of Washington. In Willapa samples are collected every two days using an ISCO autosampler during the summer months from June through October. Figure 6 displays the data collected in Willapa Bay during the 2007 sampling season. Diatom blooms are seen here during July and August, and diatoms continue to dominate the samples throughout the sampling period.

Figure 5

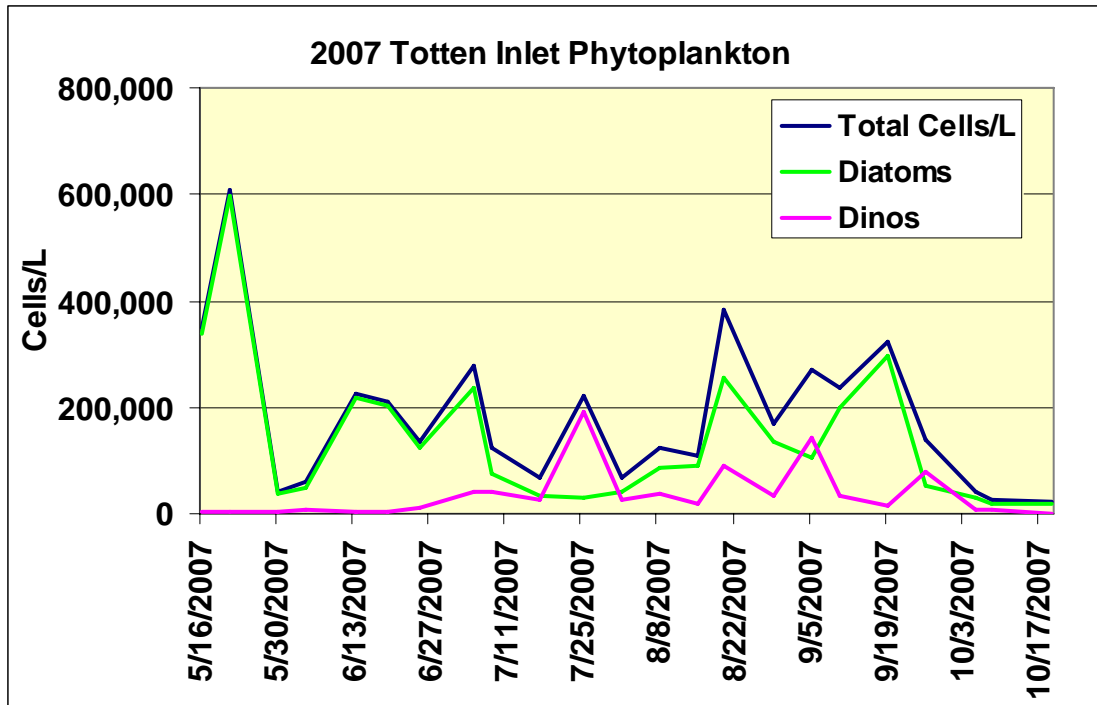
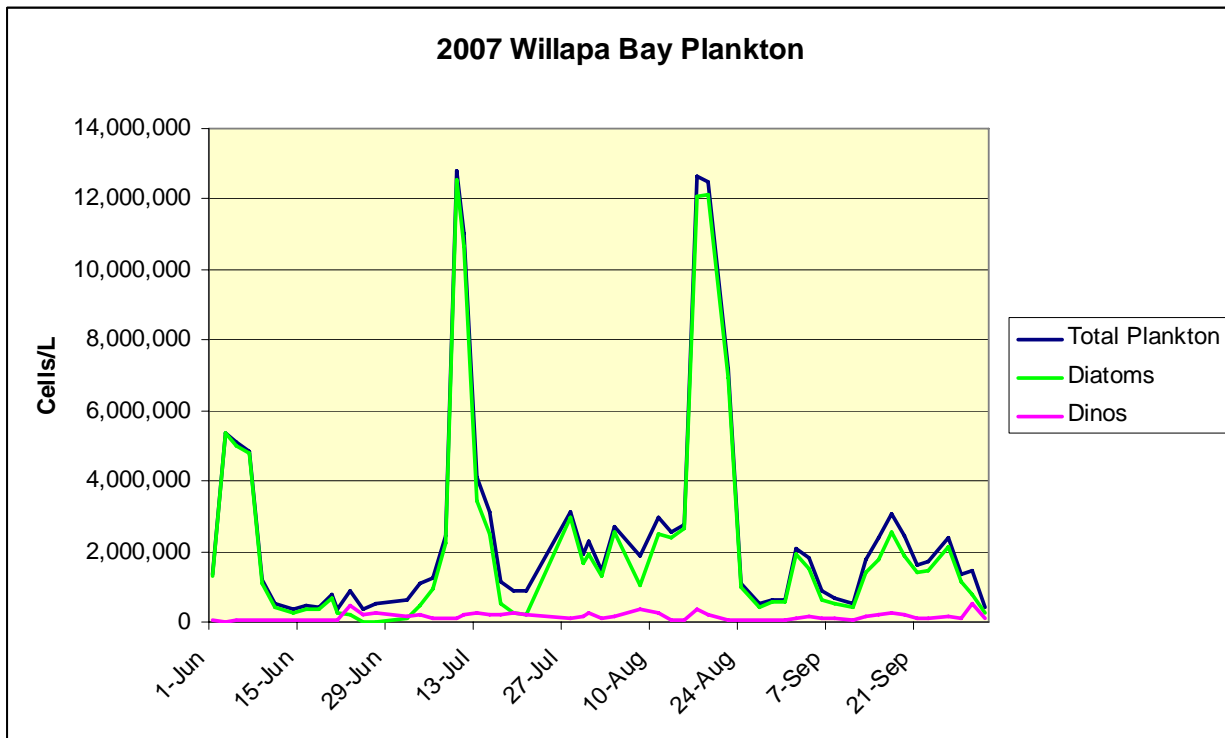


Figure 6

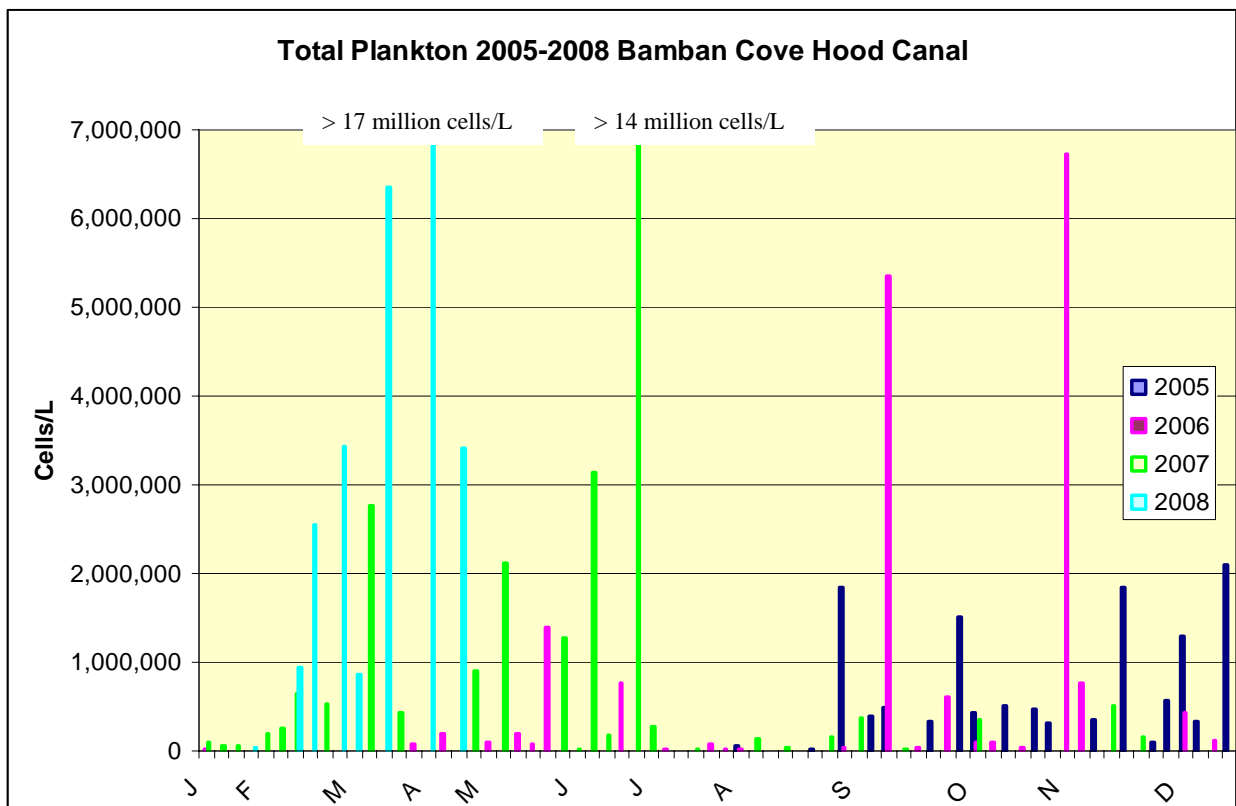


Plankton cell counts in Hood Canal appear to remain high later in the year than we have seen at our other sites. In 2005 phytoplankton cell counts in Hood Canal remained high through December, and in 2006 there was a large plankton bloom in November, over 6 million cells/L. We did not see this same pattern in 2007, during this year counts dropped off in July and remained low for the remainder of the year.

**2005-2008 Results**

The following figure displays total plankton counts for Bamaban beginning in August of 2005 and continuing through April 2008. The Bamaban data were selected because this site has been consistently sampled over the years. 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, and cell counts were still above 3 million cells/L in the last samples analyzed in April.

**Figure 7**



## **Conclusion**

Over the past three years PSI has analyzed over 300 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. With more data we may be able to determine if these differences were anomalous for these years or if there is a difference in the patterns of phytoplankton in Hood Canal than typical cold temperate regions.