GBCW Monitoring Water Quality and Phytoplankton 7/1/03-6/30/04

A Final Report to the New Hampshire Coastal Program

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Executive Summary

The Great Bay Coast Watch (GBCW) was founded in 1990 as part of the University of New Hampshire Cooperative Extension/Sea Grant citizen outreach and education program. The GBCW mission is to protect the long-term health of New Hampshire's coastal environment through volunteer monitoring and education programs.

GBCW is New Hampshire's most wide-ranging program for direct citizen involvement in monitoring estuarine waters. The GBCW strives to involve citizens in conservation efforts aimed at the whole Great Bay Estuarine System, the Hampton/Seabrook Estuary, and the Atlantic Coast of New Hampshire. Citizens are also educated and encouraged to be conscious of how activities in their own backyards affect these ecosystems. The inspiration to change their activities is a reflection of GBCW's influence. GBCW includes adults from all occupations, as well as teachers and students from local schools.

Since 1990, GBCW has expanded water quality monitoring coverage from seven sites to twenty-one sites. Our database currently contains results from over 4,000 monitoring visits. At each visit, GBCW volunteers measure water temperature, pH, salinity, dissolved oxygen (DO), transparency, depth, and fecal coliform bacteria. Samples are taken at high tide and low tide on the same day according to the lunar calendar. All sampling activities are subject to rigorous quality control procedures.

The phytoplankton monitoring program continued at six sites, into its fifth season, under a grant from the NH Coastal Program. Work continued on assembling a library of digital photographs, resulting in a new key to assist volunteers with phytoplankton identification.

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Introduction

Working within the University of New Hampshire (UNH) Cooperative Extension / New Hampshire Sea Grant Program, the Great Bay Coast Watch (GBCW) has a fifteen year history of educating citizens about the Great Bay Estuary, Atlantic Coast, and Gulf of Maine watershed through active participation in actual monitoring and an accompanying educational program. During the period of this grant, the following project tasks and work products were accomplished.

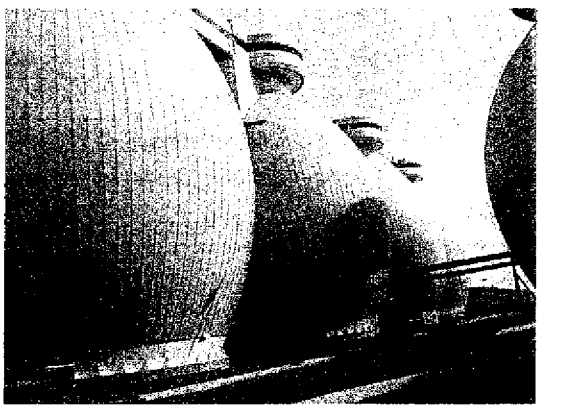
Project Goals, Objectives, Activities and Results

1. Recruit and Train new volunteers for water quality monitoring and phytoplankton sampling.

GBCW used several different methods for recruiting additional volunteers during the grant period. A listing was included on the Seacoast United Way Volunteer Action website resulting nine new volunteers. Recruiting advertisements appeared in the Foster's Daily Democrat and Portsmouth Herald newspapers. GBCW volunteers also took part in a Martin Luther King Volunteer Day display at Portsmouth Middle School. Currently, word of mouth through active volunteers continues to be one of the best ways of attaining new, interested, and capable people.

2. Develop an education program to increase overall volunteer understanding of the relationships between coastal land use issues and ocean processes in the Gulf of Maine.

Figure 1 Deer Island Waste Water Treatment Plant Tour



Issues surrounding sewage treatment and disposal were the focus of the GBCW 2003 end of the season meeting. Aware that a proposal for a feasibility study on constructing a pipe to deliver treated sewage from the towns of Rochester, Somersworth, and surrounding communities offshore for disposal has been submitted for consideration in Concord, GBCW wanted to provide a venue for citizens to learn about the implications of such a project. A panel of five individuals representing local, state, and private concerns

debated the potential outcomes of this proposal. Volunteers also had the opportunity to attend a GBCW monthly meeting with a presentation on how sewage treatment plants work and a tour of Boston's Deer Island sewage treatment plant.

3. Continue water quality monitoring at 21 sites around Great Bay and its tributaries within the towns of Exeter, Stratham, Greenland, Newmarket, Durham, Dover, Portsmouth, Newington, and New Castle. Each site shall be tested on a monthly basis at both high and low tide to measure fecal coliform, dissolved oxygen, clarity, pH, salinity and temperature

   The 2003 season was completed and the 2004 season has begun. For 2003, all of the data and Quality Assurance and Quality Control (QAQC) results are detailed in the GBCW 2003 Annual Report, which is available in hard copy upon request. Included in this report is a CD which contains the 2003 Annual Report. All of the goals for accuracy and precision were met (See table below.).

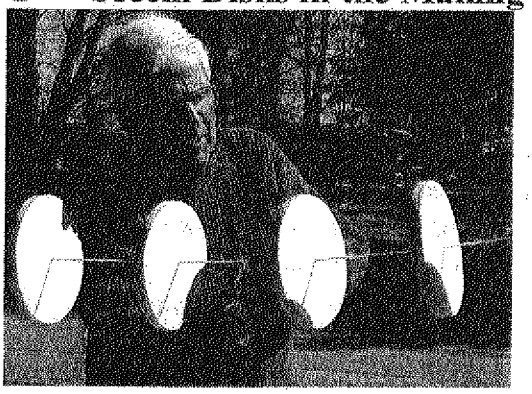
   Our data set for 2003 is 96.90% complete. The majority of missing data points were due to a safety issue that developed at Site 5 from natural erosion and damage to the dock at Site 10. GBCW continues to work with the owners of these properties in 2004 to ensure future access to these sites. While the Site 10 dock is under repair, the low tide sampling is being taken from a nearby dock that is about 100 yards upriver from the original site. There are no significant changes in the water flow between these two sites, therefore significant changes in water quality are not expected.

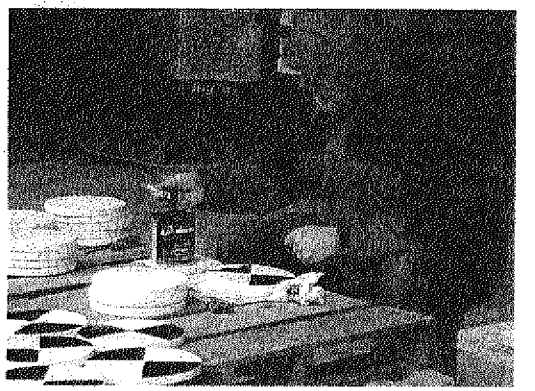
Table 1. GBCW Accuracy and Precision for QAQC Sessions 2003

	Accuracy		Precision		
	Goal	**Actual**	**Goal**	**Actual**	**RSD**
Salinity Test 1 Low	0.82 ppt	0.000	1.0 ppt	0.000	0.06
Salinity Test 2 Medium	0.82 ppt	0.000	1.0 ppt	0.000	0.05
Salinity Test 3 High	0.82 ppt	0.000	1.0 ppt	0.000	0.08
pH	0.1 units	0.074	0.1 units	0.111	3.03
Dissolved Oxygen	0.3 mg/L	0.240	0.9 mg/L	0.300	11.72
Water Temperature	0.5°C	0.113	1°C	0.253	8.89

RSD = Relative Standard Deviation, >20% is considered out of acceptable range.

Figure 2 Secchi Disks in the Making





The New Hampshire Department of Environmental Services (NHDES) has placed all of the GBCW data, including the 2003 season, on the Watershed Management Bureau Environmental Monitoring Database. Our data is now available through their website to anyone who wishes to use it. The NHDES, with GBCW and other data providers' input, is working to develop a system of reporting that will inform us of who is using our data and why.

In addition, UNH Microbiology Professor, Dr. Elise Sullivan used our data to teach her microbiology class how to analyze data. When they completed their project, they presented their findings to GBCW at a monthly meeting. Some recommendations were made for improving our fecal coliform results. The Technical Advisory Committee agreed to the changes and they were implemented. As a result, the laboratory team is spending less time and supplies, while obtaining fewer "To Numerous To Count" (TNTC) results, improving our dataset. This class is offered for one semester every other year and we hope to continue this relationship in the future when the next class is offered.

4. Continue to monitor phytoplankton populations at GBCW sites in New Castle, Rye, Dover, Hampton, Seabrook and on Star Island at the Isles of Shoals

During the grant period, GBCW phytoplankton monitoring volunteers reported over 447 hours of effort and drove 3459 miles in support of this project. Samples were collected and recorded weekly from the five coastal sites beginning in April and ending in November. Four new phytoplankton monitors were added in the spring of 2004, they were trained in monitoring methods at sessions in March and also provided with an opportunity to join volunteers that are more experienced and the Maine phytoplankton monitoring group for additional training at the Darling Marine Center in Walpole Maine March 12 &13th. As in previous years, our connection with the Maine program gave access to additional training opportunities and allowed us to share resources.

Spring of 2003 proved to be an extremely active time for the cell Alexandrium spp. one of the most toxic of our target species. The number of Alexandrium cells observed and reported by GBCW volunteers correlated with reported increased toxin levels in the shellfish that were collected from coastal sites and tested at the New Hampshire Department of Health Laboratory in Concord. For example, the state standard for PSP toxins levels is 80µg per 100g of shellfish tissue. Results of <44µg are not detectable, anything over 44µg is indicative of the presence of some type of possible toxin accumulation. On June 9, relatively large numbers of Alexandrium cells were noted at the Rye monitoring site. Mussel samples

taken from Hampton Harbor the following day showed a corresponding increase in toxin levels.

Of interest, during the spring 2003 season, was the large number of observed Dinophysis cells in our samples. Dinophysis are another of our target species which are under observation because they are believed to produce a toxin which causes diarrahetic shellfish poisoning. This large increase in cells was noted all along the coast from Delaware to Maine. GBCW observations were shared with the other programs and the United States Food and Drug Administration (USFDA) in Washington. During this time, Maine reported two illnesses of people who had consumed mussels. Though they had consumed other foods at the same time, the Dinophysis toxin was suspect. At this point, there is no direct link between Dinophysis and these illnesses; however, much is unknown about this cell. This event, under scores the importance of sharing data across political boundaries.

The phytoplankton monitoring project continues to provide a unique and powerful tool for connecting with students and the public. While traveling back and forth to the Star Island sampling site on the Isles of Shoals Steamship Company ship, the Thomas Leighton, phytoplankton monitors offer fellow travelers the opportunity to help process samples collected from Star Island and engage them in conversations about the work we do. Phytoplankton monitoring has continued to be part of the UNH Spring Floating Lab program offered to middle school students in Seabrook Harbor, the public Discovery Cruises to Appledore Island sponsored by UNH Cooperative Extension and the Great Bay Discovery Cruises sponsored by CICEET, the Cooperative Institute for Coastal Environmental and Estuarine Technology. Additionally, phytoplankton volunteers have presented programs to the students of the Portsmouth Middle School as part of their study of South Mill Pond ecosystems and to adults during the UNH Elderhostel week held in May of this year.

5. Continue to develop a digital photo library of local phytoplankton species.

Three GBCW volunteers are currently involved in assisting a UNH research project with phytoplankton identification and counts. This has provided the opportunity to access offshore samples and photograph species on a regular basis using higher quality equipment than we currently own. The involved volunteers have been able to connect with scientists at both the University of Rhode Island and St. Joseph College in Maine. These scientists have been able to assist by confirming species identifications and by providing photographs of a few species difficult to capture with the equipment available to us.

The project has been so successful we have been able to develop a photographic phytoplankton key to distribute to GBCW phytoplankton volunteers. Although at this time, the key is still in a final draft stage, there is interest among other volunteer phytoplankton monitoring groups in being able to access copies. A preliminary draft of this key is included in this report. A draft of this key has been included on the accompanying CD.

6. Update the water quality fact sheet and present to decision makers in Dover and Newmarket

Great Bay staff brought updated information to the Dover Open Lands Committee meetings and distributed copies of the 2003 Annual Report which contained updated town information. Reports were also distributed to the Newmarket Conservation Commission members and the

Newmarket Planning Board. GBCW staff also shared information at the Great Bay Resource Protection Partnership bimonthly meetings. Included in these meetings were representatives of the Seacoast Land Trust, Rockingham Land Trust, Strafford Regional Planning Commission, Lamprey River Watershed Association, The Nature Conservancy, Clean Water Action, and NH Audubon Society.

7. Create and file an addendum to the EPA approved GBCW Quality Assurance Project Plan (QAPP) reflecting recent changes in monitoring methods.

   Some changes in monitoring methods have occurred over time with resulting improvements in how procedures are conducted. GBCW continues to follow "Standard Methods for the Examination of Water and Wastewater" procedures as they have been upgraded. GBCW and the City of Dover joined together in monitoring for stormwater bacterial discharge. As a part of this project, an EPA approved QAPP was created which included an update of the GBCW SOP for processing sample water for the potential of fecal coliform bacteria. The majority of changes included QAQC additions and clarifications. Since then, the changes have been presented to the Technical Advisory Committee and been approved. Since their approval, the GBCW laboratory team has been following this method.

8. Revise and publish the 2004 GBCW Volunteer Water Quality Methods Manual to reflect approved changes in current monitoring methods

   The 2004 GBCW Volunteer Water Quality Methods Manual was upgraded to an interactive CD with videos and a printable book. Though methods were not changed, except for the laboratory work mentioned above, fine points were clarified and the manual was reorganized. Volunteers have been very pleased with the new format, and have shown a great appreciation for the videos that they can watch at leisure. Records show that of 20 hard copies of the manual, one remains in the office for reference, and all others were distributed to volunteers. Initially, 57 CD's of the manual were created, and all of them were distributed between volunteers, the Technical Advisory Committee, and interested agencies. More CD's have been produced upon request. Thanks to Joe Danahy, the Information Technologist at UNH Computing and Information services, we were able to produce the videos included on the CD. His ability to help us use modern technology has greatly reduced the cost of producing the manual and improved its accessibility for the volunteers. The accompanying CD contains the manual with the videos.

9. Write, publish and distribute a report on the data collected during the 2003 sampling season

   The GBCW 2003 Annual Report was published in the spring of 2004. Forty hard copies were printed and distributed to volunteers, towns with sampling sites, and community decision making boards. Several CD's of this document have been distributed upon request. It is included on the accompanying CD.

10. Enlist and support local schools involvement in GBCW activities to foster a continuing connection with young area residents

Over the period of the grant, GBCW staff worked to continue our involvement with area schools. Currently six schools monitor water quality at GBCW sites. Those involved over the past year included Oyster River High School in Durham, Marshwood High School in Eliot Maine, Newmarket Middle School, Portsmouth Middle School, Little Harbor Elementary School, and the New Franklin Elementary School in Portsmouth. Additionally, GBCW staff worked with the UNH Microbiology class of Dr. Elise Sullivan. Her students analyzed GBCW fecal coliform data from two sites and presented recommendations for improvements to the established method.

Every spring, school science fairs offer the opportunity for students to use their GBCW volunteer experiences as a basis for projects. The 2004 projects proved extremely successful with Josh Balance, winning first place in the eighth grade division, at the Lincoln Akerman Science Fair with his project on, "Which local body of water has the greatest buffer capacity?" and Claire Antaya, a phytoplankton monitoring volunteer and sophomore at the Seacoast School of Technology winning the biological division of the New Hampshire State Science Fair with her project, "Investigation into the Stimulatory Growth Factors of Phytoplankton". Claire's success provided her scholarship to the UNH project SMART summer school where she will be working with UNH scientists.

Figure 3 Clair Antaya and her Award Winning Science Project

Conclusions

During the grant period, GBCW continued to involve adults and students of all ages in educational activities that connected them to the New Hampshire estuarine systems. New volunteers were made welcome and more data that is reliable was collected. Our data was incorporated into the NHDES database where it will accessible to anyone who asks for it. This makes our data set more valuable to researchers everywhere. GBCW is proud to have a

quality control program the meets the high standards of the Environmental Protection Agency (EPA), such that our data is usable for government offices. Strong support from NHCP allows us to keep these high standards.

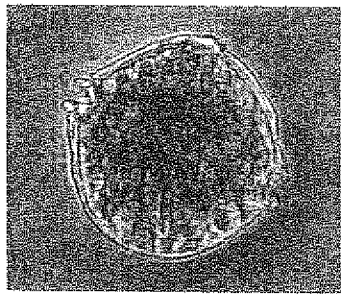
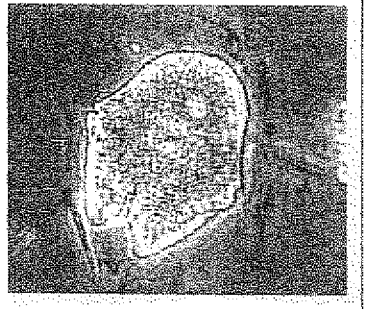
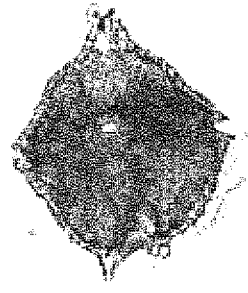
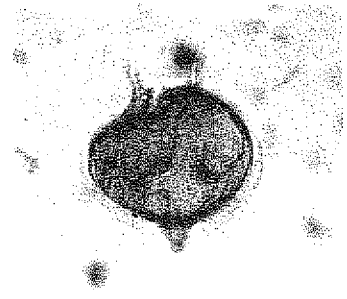
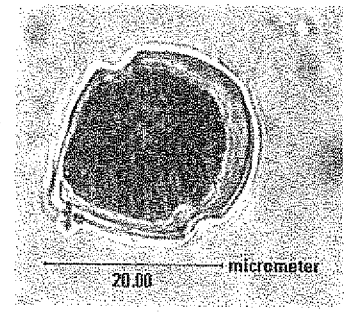
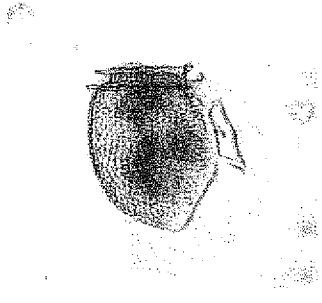
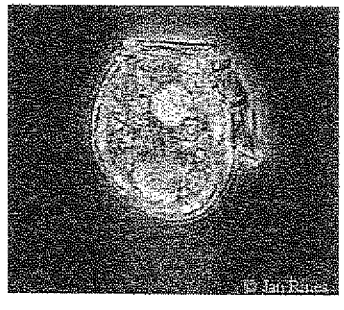
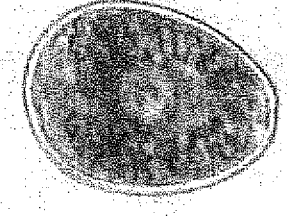
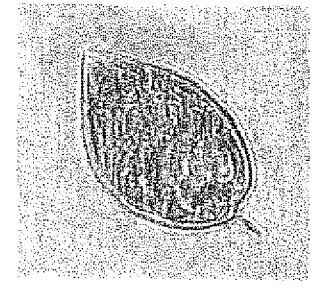
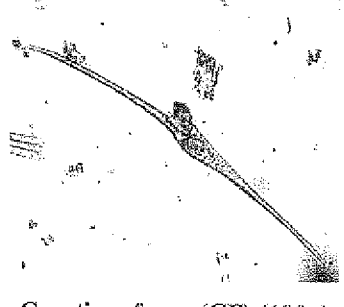
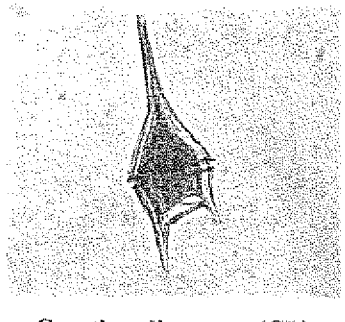
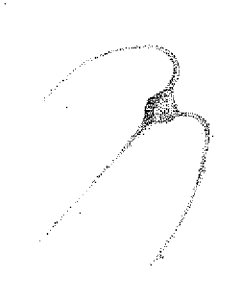
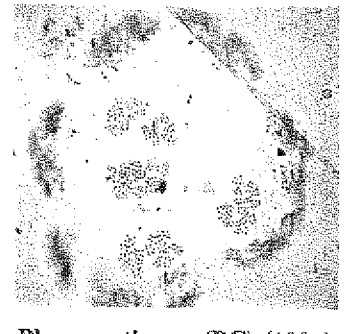
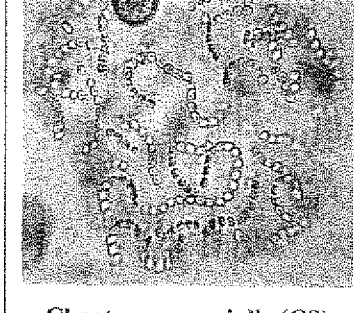
Upon the completion of the third quarter, GBCW volunteers had provided $51,294.51 in time and mileage match. Therefore, no additional time and mileage is needed to fulfill our match requirements. The GBCW volunteers continue to be a great asset to the NHCP program.

Recommendations

Continuing into its 15th sampling season GBCW will act as an agent for the New Hampshire Coastal Program initiatives. This grant in combination with other resources, has allowed GBCW to grow and expand our outreach and education programs, along with providing basic high quality long term water quality data. Continued support by NHCP will help ensure that this important water quality monitoring program can continue into the future.

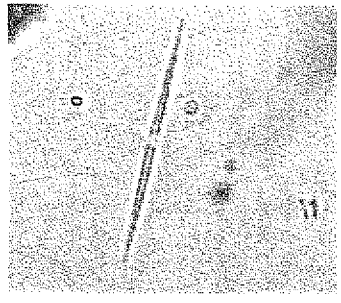
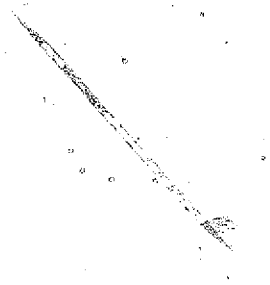
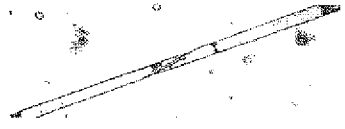
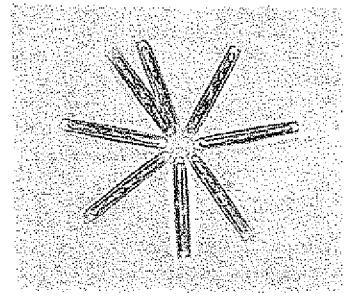
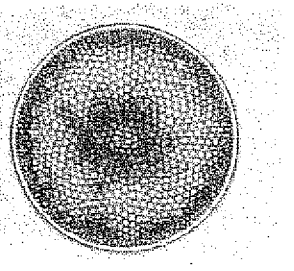
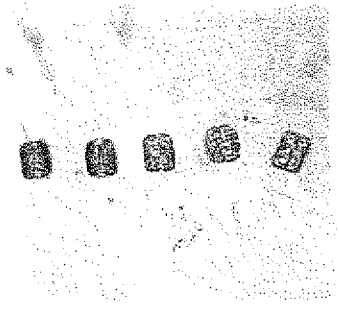
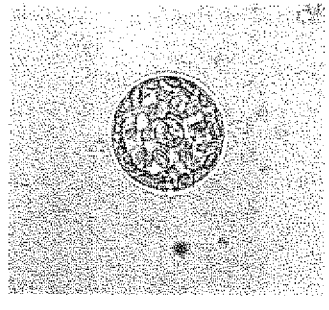
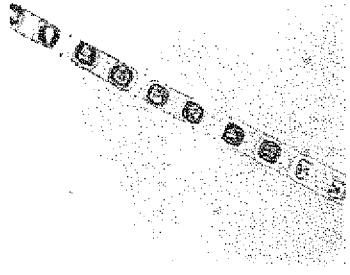
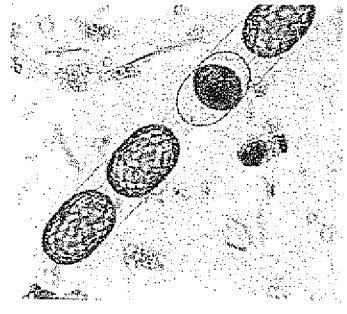
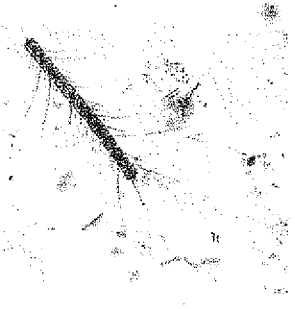
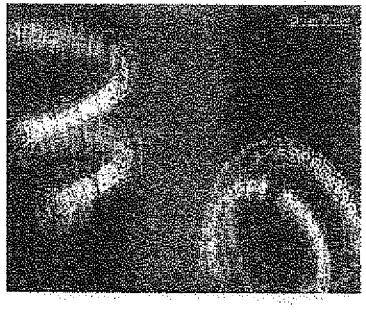
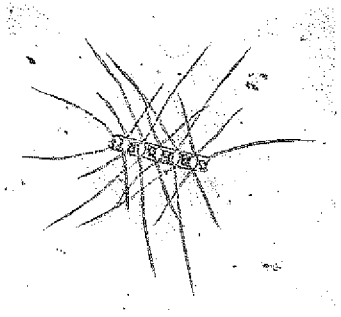
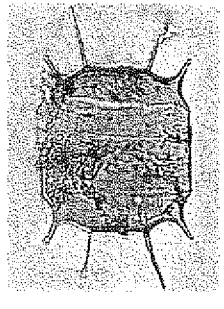
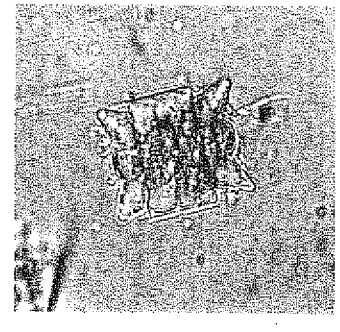
Appendices

Common Gulf of Maine Phytoplankton (page 1 of 4)

 Alexandrium tamarense (AT) (400x)	 Gymnodinium sanguineum (GS) (400x)	 Gonyaulax spinifera (GP) (400x)	 Protoperidinium spp (PP) (400x)	 Scrippsiella spp (SP) (400x)
 Dinophysis norvegica (DN) (400x)	 Dinophysis acuminata (DA) (400x)	 Dinophysis tripos (DT)(400x)	 Prorocentrum lima (PL) (400x)	 Prorocentrum micans (PM) (400x)
 Ceratium fusus (CF) (100x)	 Ceratium lineatum (CL) (100x)	 Ceratium trichoceros (CT) (100x)	 Phaeocystis spp (PC) (100x)	 Chaetoceros socialis (CS) (100x)

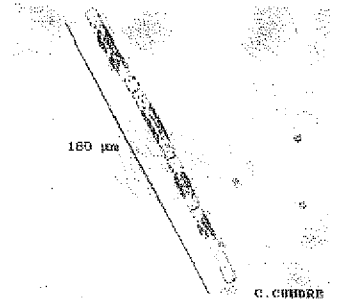
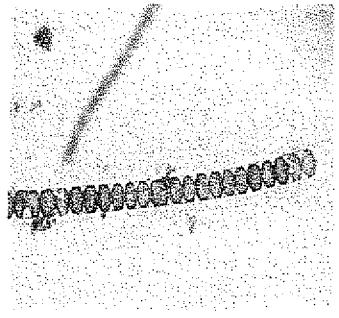
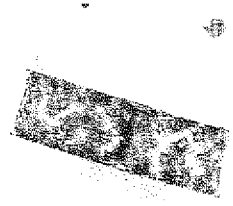
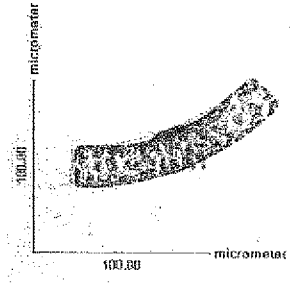
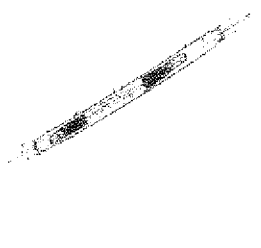
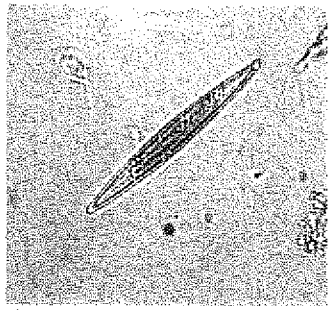
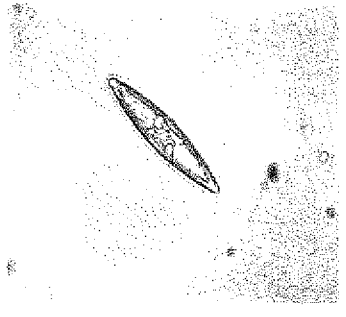
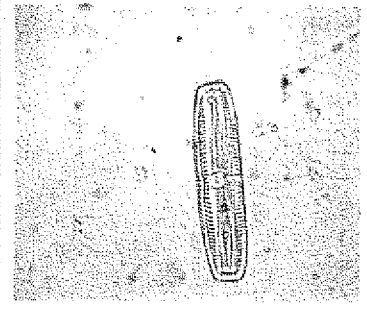
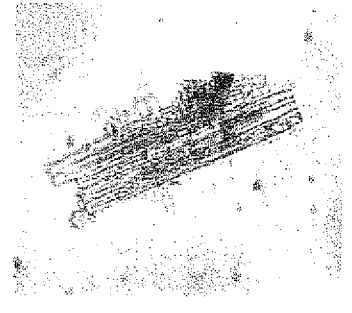
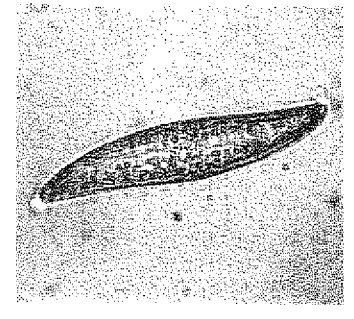
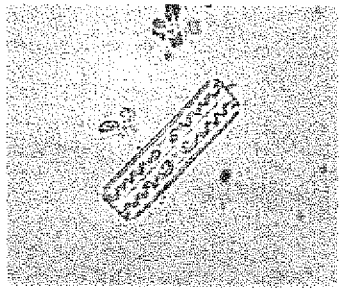
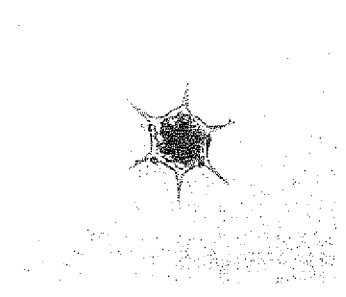
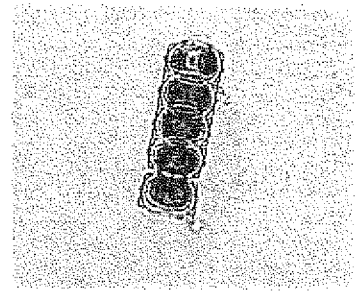
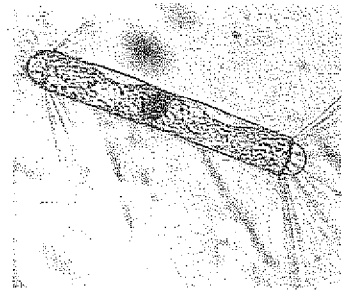
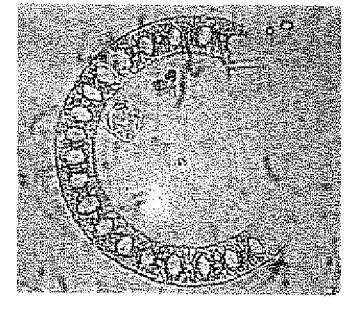
Note: Species with light yellow shading around potentially produce harmful toxins.

Common Gulf of Maine Phytoplankton (page 2 of 4)

 Pseudonitzschia spp (PP) (100x)	 Pseudonitzschia delicatissima (PD) (400x)	 Rhizosolenia spp (RH) (100x)	 Rhizosolenia end (400x)  Rhizosolenia junction (400x)	 Thalassionema nitzschiodes (TN) (400x)
 Coscinodiscus spp (CD) (400x) Valve view	 Thalassiosira spp (TS) (400x) Girdle view	 Thalassiosira spp (TS) (400x) Valve view	 Skeletonema costatum (SC) (400x)	 Stephanopyxis spp (SP) (400x)
 Chaetoceros spp (CC) (100x)	 Chaetoceros debilis (CC) (100x)	 Chaetoceros spp (CC) (100x)	 Biddulphia spp (BD) (400x)	 Odontella spp (OD) (400x)

Note: Species with light yellow shading around potentially produce harmful toxins.

Common Gulf of Maine Phytoplankton (page 3 of 4)

 Leptocylindrus danicus (LC) (400x)	 Melosira spp (MS) (400x)	 Guinardia flaccida (GF) (400x)	 Guinardia striata (GS) (400x)	 Ditylum brightwelli (DB) (100x)
 Navicula spp (NC) (400x)	 Navicula spp (NC) (400x)	 Pinnuavis spp (PA) (400x)	 Bacillaria paradoxa (BP) (400x)	 Gyrosigma spp (GS) (400x)
 Grammatophore spp (GM) (400x)	 Dictyocha spp (DY) (400x)	 Paralia sulcata (PS) (400x)	 Corethron spp (CR) (400x)	 Eucampia spp (EC) (400x)

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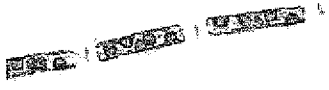
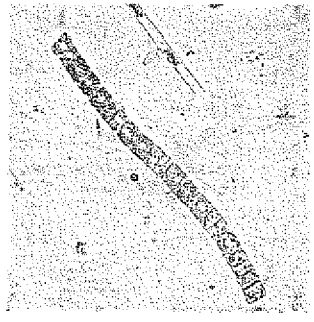
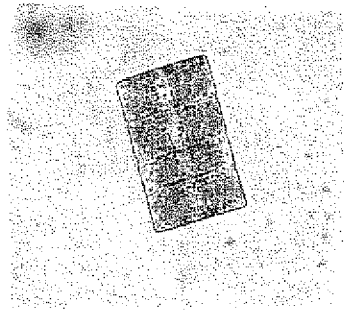
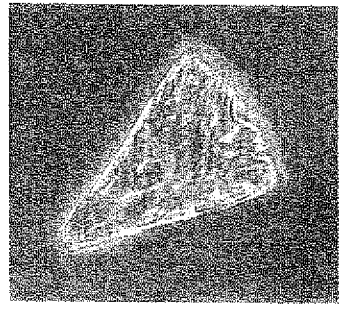
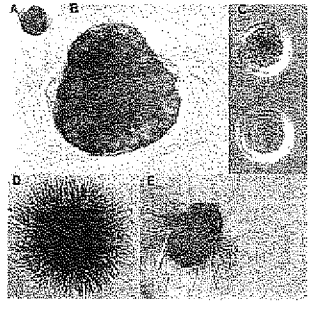
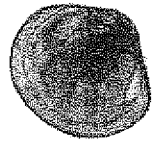
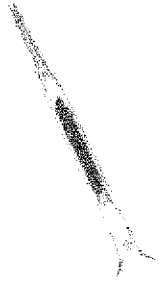
 Dactyliosolen spp (DS) (400x)	 Detonula spp (DL) (400x)	 Fragilariopsis spp (FG) (400x)	 Asterionellopsis spp (AS) (400x)	 Licmophora spp (LC) (400x)
 Fragilaria spp (FG) (400x)	 Mesodinium rubrum (MR) (400x)	For Future Use	For Future Use	For Future Use
 Pollen (not phytoplankton) (100x)	 C. nauplii (zooplankton) (100x)	 Clam larva (zooplankton) (100x)	 Tintinid (zooplankton) (100x)	For Future Use

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