PHYTOPLANKTON ASSEMBLAGES WITHIN THE CHESAPEAKE BAY PLUME AND ADJACENT WATERS OF THE CONTINENTAL SHELF

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SUMMARY

The Chesapeake Bay plume was identified and plotted in relation to the presence and high concentrations of phytoplankton assemblages. Seasonal differences occurred within the plume during the collection period, with *Skeletonema costatum* and an ultraplankton component the dominant forms. Patchiness was found along the transects, with variations in composition and concentrations common on consecutive day sampling within the plume in its movement along the shelf. The presence of 236 species is noted, with their presence indicated for plume and shelf stations during the March, June, and October 1980 collections.

INTRODUCTION

The Chesapeake Bay represents the largest estuary on the United States east coast. It extends along a north-south direction from the mouth of the Susquehanna River for approximately 275 km to the Virginia Capes. Typical of other estuaries, it receives outflow and substances from tributaries and other sources along its borders. These products come from agricultural and land run-off, an assortment of industries and municipalities, and shipping and boating activities within its waters. Throughout the year, the degree that these substances are present will often vary in combination with other ecological variables, resulting in a changing milieu more favorable at times to the growth of certain species than others within the phytoplankton community. These responses to changes in water quality and environmental conditions are enhanced by the short life cycle and the potential for rapid growth present in the phytoplankton populations. These population dynamics may then result in a phytoplankton complex that would be characteristic of Chesapeake Bay waters and the effluent that passes to the continental shelf. The initial purpose of this study was to characterize the phytoplankton within the Chesapeake Bay effluent plume in relation to phytoplankton populations over the continental shelf during three seasonal collection periods in March, June, and October 1980. Another goal was to use these assemblages as index species in identifying the passage and eventual breakdown of the plume over the continental shelf. For definition, the Chesapeake Bay plume is considered as the water outflow from the lower Chesapeake Bay onto the continental shelf which is characterized by certain phytoplankton assemblages present in the lower Chesapeake Bay. In addition, it has subsequently become apparent that these data sets may have additional significance because the collection year (1980) coincided with a period of stream flow into the Chesapeake Bay that was approximately one-half of the water entry for a typical year (ref. 1). The influence of this reduced flow on the water quality and biota is unknown, but is a factor that should be further evaluated in subsequent studies.

Past phytoplankton studies in the lower Chesapeake Bay have identified the major phytoplankters as neritic north temperate species (ref. 2, 3, 4). Seasonal fluctuations in populations are common, with the flora generally dominated by diatoms through fall, winter, and spring, with a combination of diatoms, phytoflagellates, and nanoplankters common in the summer. The importance of Chesapeake Bay nanoplankton has been previously stressed in regard to high productivity values and its composition (ref. 4, 5, 6). Other forms seasonally common to the lower Bay are found over the continental shelf (ref. 4).

METHODS

Water samples were obtained from the participating vessels in the Superflux program. These included vessels from the National Marine Fisheries Service of NOAA, Old Dominion University, and the Virginia Institute of Marine Science. Additional launches were provided by the NASA Langley Research Center, the U.S. Coast Guard, and others. All collections were made during March, June and October 1980. These months were originally selected to coincide with periods of high, moderate, and low outflow from the Bay. However, as previously mentioned, this was an atypical year of very low stream inflow, so the quantity of outflow to the shelf was below seasonal averages. Samples for phytoplankton analysis were obtained at stations presented in Figures 1-4. These stations were located within the lower Bay, at the Bay entrance, and eastward to the shelf break and south to Oregon Inlet. Station coordinates, with salinity and temperature values, are also presented in Tables 1-3. In addition to the surface samples taken at each station, a series of vertical collections were also obtained at selected stations during each cruise. Several other side experiments were made, but will not be discussed at this time. Standard hydrographic water bottle casts were used to obtain the samples, of which 500 ml were placed directly in polyethylene bottles containing a buffered formalin solution. Using a settling and siphoning procedure, a 20 ml concentrate was obtained and subsequently examined with a Zeiss inverted plankton microscope. Random fields and minimal numbers were counted at 312X to provide a statistical accuracy of 85% (ref. 7). Species diversity was determined using the Shannon-Weaver diversity index. Identification was in accordance with the classification followed by Hendey (ref. 8) and Parke and Dixon (ref. 9). Salinity and temperature measurements were taken by personnel from the participating vessels. Special acknowledgement is given to Charles K. Rutledge, Stephen Cibik, and Laurie Kalenak for their assistance in this project.

RESULTS

During the three collection periods in March, June, and October 1980 a total of 223 water samples were analyzed for phytoplankton composition and concentration. A total of 236 phytoplankters were noted from these collections (Table 4). These consisted of Bacillariophyceae (126), Pyrrhophyceae (74), Haptophyceae (15), Cyanophyceae (9), Chlorophyceae (4), Cryptophyceae (3), Euglenophyceae (2), and Chrysophyceae (3). In addition, there was an unidentified ultraplankton component prominent in the plume and at the near shore stations. The ultraplankton are defined according to the classification given by Strickland (ref. 10), who placed cells within the size range of 0.5 to 10 μm as ultraplankton. These cells consisted of three size groups: less than 3 μm, 3-5 μm, and 5-10 μm. Several samples of these cells exhibited fluorescence when stained with acridine orange and examined under a fluorescent microscope, whereas other cells did not fluoresce. This ultraplankton component is considered to be composed of several species, including coccoid cyanophyceans and chlorophyceans.

Concentrations of the phytoplankton were consistently higher in samples from the lower Bay and the Bay entrance area. Progressing eastward over the shelf there was a decrease in cell numbers and a change in the phytoplankton composition. Most typical was the transition in dominance from diatoms and ultraplankton cells (described above) in the Bay entrance area, to coccolithophores, with another diatom assemblage seaward. Evidence was also found of an increase in phytoplankton concentration near the shelf break. Moving southward from the Bay entrance to Oregon Inlet, the higher phytoplankton concentrations taper off, remaining larger near shore. Evidence for the breakdown of the plume and for mixed populations of shelf and plume phytoplankton increases toward Oregon Inlet. Throughout the collection period the phytoplankton composition within the Bay entrance and the Bay plume contained assemblages that could distinguish the plume from adjacent shelf waters.

March 1980

The dominant phytoplankton found in Bay entrance waters and the Chesapeake Bay plume included the diatoms: *Asterionella glacialis*, *Cyclotella* sp., *Skeletonema costatum*, *Leptocylindrus minimus*, a pyrrhophycean *Prorocentrum minimum*, a cyanophycean *Gomphosphaeria aponina*, and the ultraplankton group of unidentified cells. In the Bay entrance, the concentration of *Prorocentrum minimum* was over 1.2 million cells per liter, with *Cyclotella* sp. at approximately 434,000 cells per liter. The different size categories of the ultraplankton group varied in their concentrations. Cells smaller than 3.0 μm averaged approximately 200,000 cells/l in the Bay entrance and 770,000 cells/l in the near shelf stations. The cells in the 3-5 μm range averaged approximately 100,000 cells/l in the Bay entrance, with numbers markedly reduced beyond the entrance. The larger sized ultraplankton (5-10 μm) did not reach the concentrations of the other size classes near shore, but had highest concentrations (29,318 cells/l) at far shelf stations.

The phytoplankton composition and concentrations changed beyond the Bay entrance. The cell concentrations dropped significantly, only to increase dramatically at Station 22 where cell counts were over 1.1 million cells per liter. Dominant species at this station, located about 33 km beyond the Bay entrance, consisted of *Prorocentrum minimum*, several small-sized diatoms, dinoflagellates, cyanophyceans, and the ultraplankton green cells 5-10 μm in size. In a clustering analysis of stations in this study, it was shown that Station 22 and Stations 7 and 8 (located in the lower Bay entrance area), which were sampled two days apart, have very close species relationships. This gives the impression that Station 22 waters may represent a pulse, or remnant, of an earlier plume outflow from the Bay. Continuing seaward the phytoplankton concentrations generally decreased. However, there was a population increase farther out over the shelf at Station 3. Here, the cell counts were over 394,000 cells per liter. At this station, small chain-forming diatoms were dominant with the most abundant forms being *Rhizosolenia delicatula* and *Thalassiosira nordenskioldii*. The diatoms *Nitzschia longissima* and *Thalassiosira rotula* and the coccolithophore *Emiliania huxleyi* were also in high concentrations. A similar composition but in lower cell concentrations was found at the two most distant stations (1 and 2) along the transect.

Vertical Distribution

Differences were noted in the vertical distribution of the phytoplankton. Similar species composition over the vertical series was found at several of the stations with other stations having a mixed assemblage (Table 5). *Leptocylindrus danicus* and *Leptocylindrus minimus* were common dominants or sub-dominants at several of these stations. At scattered surface locations there were also high cell concentrations for *Emiliania huxleyi* (Station 1), *Prorocentrum minima* (Station 5), green cells, 5-10 μm (Station 22), and *Guinardia flaccida* (Station 33). When no dominant form was present, the composition was a mixed selection of predominantly diatoms. Species diversity was characteristically lower in plume waters, or where a few species were present in high concentrations. The higher diversity readings were noted in samples where concentrations were more uniform among a greater variety of species. Differences in station counts over the vertical range were mainly attributed to a higher concentration of one or two species that were typically dominant within the vertical sampling range. The unidentified green cells and *Prorocentrum minimum* were found in highest numbers at the surface, decreasing significantly with depth. With the exception of several samples where a single species dominated the counts, there was a similarity in composition over the vertical range of sampling. This was found in the Bay entrance and at stations located over the shelf.

Plume Phytoplankton

The outflow from the Chesapeake Bay is directed southward, moving as a narrow band along the Virginia and North Carolina coast (ref. 11). This flow would be altered seasonally in its extent eastward over the shelf and southward toward Cape Hatteras. The results of the March study associated highest cell concentrations with the plume at the entrance of the Bay, directly south of the entrance (Station 12), with an apparent isolated segment of the plume east of the Bay entrance at Station 22 (Figure 5). Beyond this area eastward increased concentrations of coccolithophores and other typical shelf species occurred. The plume phytoplankton assemblage was distinct for this sampling period in contrast to phytoplankton at the far shelf stations. Various degrees of mixing and phytoplankton patchiness were also identified in the shelf areas.

To summarize the results of the March collections, the dominant constituents of the Bay plume were the unidentified green cells, found in the three ultraplankton size groups. This component was significant in regard to its high concentrations and wide distribution. These were found to be more prevalent in the surface collections, with the majority of these cells believed to be either cyanophyceans or chlorophyceans. The vertical distribution patterns and concentrations of the phytoplankton were generally homogeneous, with the exception of several stations where there occurred high concentrations of single species (and green cells) at surface collections. The plume phytoplankton included *Asterionella glacialis*, *Cyclotella* sp., *Skeletonema costatum*, *Leptocylindrus minimus*, *Prorocentrum minimum*, *Gomphosphaeria aponia*, and unidentified ultraplankton-sized green cells. This assemblage was distinguished from the shelf populations.

June 1980

Distinct differences were also apparent in the phytoplankton composition of the plume compared to other shelf stations in June 1980. The plume waters of the Chesapeake Bay were identified as extending from the Bay entrance southward and close to the Virginia coastline (Figure 6). The phytoplankton within the plume reached concentrations of over 7.9 million cells/liter. These waters were dominated by diatoms and the unidentified green cells in the 3-5 μm size range. *Skeletonema costatum* was the major constituent, with sub-dominants being *Nitzschia pungens*, *Leptocylindrus danicus*, *Rhizosolenia delicatula*, and *Chaetoceros* spp. The pyrrhophyceans, coccolithophores and other representatives were in low concentrations within the plume. The diversity index for these stations ranged from 0.8351 to 2.1241. Because the sampling protocol placed specific restrictions on each vessel, collections were made over a six-day period, preventing short term synoptic coverage of the area. This was unfortunate because the location of the plume is known to fluctuate in its passage southward (ref. 11). Thus, the data used as a basis to identify the plume in Figure 3 were obtained over a six-day period and do not represent the plume outline for a specific date. Even with these limitations, the direction of plume flow is easily identified as moving south of the Virginia Capes and along the Virginia coastline. These waters apparently favor the growth of *Skeletonema costatum* and the green cell component. These are plankters of small cell size (ultraplankton) and high reproductive potential. Larger sized diatoms and the pyrrhophyceans were rare at these stations. A more southern extension of the plume was noted off the North Carolina coast that was separated from the plume directly south of the Bay entrance by an area of lower cell count and mixed composition. The plume segment off the North Carolina coast was dominated by *Skeletonema costatum*, but contained a mixture of other forms, such as *Emiliania huxleyi* which is considered · a common shelf species. This mixed composition is accompanied by increased species diversity values. During 23-27 June 1980 another leg of the cruise series was conducted that included stations near the Bay entrance and over the shelf (Figure 3). Even in this abbreviated collection series, large phytoplankton concentrations were noted in an identifiable plume south of the Bay entrance, with these larger concentrations directed southward (Figure 7). These stations have a similar assemblage of dominant species, as was found in the 17-22 June 1980 collections.

There was an increase in the species diversity at stations bordering the plume that ranged from 1.7258 to 2.8403. These waters also differed from the plume by having an increased number of co-dominant species. These included *Emiliania huxleyi*, *Leptocylindrus danicus*, the various sized green cells, *Chaetoceros* sp., *Nitzschia pungens*, *Cryptomonas* sp., *Gymnodinium* sp., and *Rhizosolenia fragilaria*. The stations nearest the Bay entrance had greater concentrations of *Skeletonema costatum* and *Emiliania huxleyi*, in contrast to what was found along the North Carolina coastline. *Skeletonema costatum* was noted at stations off the Carolina coast nearest to the shoreline. However, green cells that were less than 3 μm and 3-5 μm in size were the most abundant form in the near shore waters. These more southern plume waters indicate a degree of mixing between shelf waters and the Bay plume by the changing concentrations of *Skeletonema costatum* and *Emiliania huxleyi*. The concentrations of *Skeletonema costatum* in the plume decrease with movement of the plume southward and eastward over the shelf. The mixing and transformation of the plume phytoplankton increase both southward and eastward, with the concentrations of *Emiliania huxleyi* and other coccolithophores increasing.

Stations located near the shelf break and far east of the Bay plume contain a phytoplankton assemblage distinct from the plume waters and the near shelf mixing zone. These stations also show a trend of a decreasing species diversity in comparison to the near shore stations (ranging from 1.4187 to 2.3112). The dominant components at these stations were the coccolithophores with several dinoflagellates and green cells (3-5 μm) the sub-dominants. The major coccolithophores were *Emiliania huxleyi*, *Syracosphaera pulchra*, *Rhabdosphaera* sp. and *Pontosphaera* sp. Prominent diatoms included *Rhizosolenia alata*, *R. styliformis*, and *R. delicatula*, with an increased variety of the pyrrhophyceans. These included *Ceratium fusus*, *C. extensum*, *C. tripos*, *C. macroceros*, *Prorocentrum micans*, and *Protoperidinium* spp. The high concentration of coccolithophores in these waters supports the use of appropriate preservatives that would not destroy these populations prior to examination.

High concentrations of cells were commonly found in the sub-surface samples within the Bay plume (Table 6). *Skeletonema costatum* was the major constituent with green cells (3-5 μm) in high concentrations throughout the water column. Species diversity remained low below the surface, having lowest concentrations in the Bay entrance area, increasing slightly below Cape Henry. In the shelf areas on either side of the plume, numerous co-dominants provided a mixture of major species at the various depths that included green cells (3-5 μm), *Leptocylindrus danicus*, *Emiliania huxleyi*, and reduced numbers of *Skeletonema costatum*. The vertical sampling was limited to the surface and 3 meters at the far shelf stations, with the major constituents being the coccolithophores at both depths. The number of different species represented at these stations was much less (56) than at the near shore stations (155).

In summary, the June phytoplankton within the plume contained high concentrations of the diatom *Skeletonema costatum*, in association with unidentified green cells. Sub-dominants included *Chaetoceros* sp., *Cylindrotheca closterium*, *Leptocylindrus danicus*, *Nitzschia pungens*, and *Rhizosolenia delicatula*. The plume extended slightly eastward beyond the Bay entrance, with its flow to the south along the Virginia and North Carolina coastline. There was basically a homogeneous vertical distribution of dominants within the plume near the Bay entrance. This condition gradually broke down with the movement of the plume southward, with increasing numbers of coccolithophores and a decrease in *Skeletonema costatum*. A similar decrease in the various "green cells" within the plume did not occur. Numbers remained high for this group over the near shelf waters between the Virginia Capes and Oregon Inlet.

October 1980

The highest phytoplankton concentrations for October were found at the Chesapeake Bay entrance (Station 801), off Cape Henry (Stations 69, 803), and to the south (Stations 808, 809, 811). Dominant phytoplankters were *Skeletonema costatum* and unidentified green cells (<3 microns in size). The concentrations at these stations were generally above a million cells per liter, with the highest counts found at Station 808 (October 15, 1980) where there were approximately 13.8 million cells/liter. South of the False Cape area to Oregon Inlet, the cell counts remained above one million cells/liter at the near shore stations, decreasing in numbers rapidly seaward. The Bay plume appears to extend over these stations, tapering from the area beyond the Bay entrance toward the North Carolina coastline (Figure 8). Beyond this plume area and extending over the shelf, the concentrations of *Skeletonema costatum* declined, but the ultraplankton component was present in reduced but significant concentrations. Diatoms also found in high concentrations at the plume stations were *Asterionella glacialis*, *Nitzschia pungens*, *Chaetoceros* sp., *Lauderia borealis*, *Leptocylindrus danicus*, *Nitzschia delicatissima*, *Rhizosolenia stolterfothii*, *R. delicatula*, *R. fragilissima*, *Thalassiothrix mediterranea*, and *Cylindrotheca closterium*. Other plume phytoplankters were *Anacystis* sp., *Cryptomonas* sp., and *Emiliania huxleyi*. The dinoflagellates were common throughout the sampling area, but were consistently found in low concentrations. An apparent patchiness in cell concentrations and composition was also noted at stations along transects, with variations in concentrations at some of the same stations on subsequent sampling days.

An example of patchiness occurred on October 15, 1981 along transect Stations 69-805. At Station 802, the total cell count was approximately 121,000 with dominant species being *Asterionella glacialis* and *Chaetoceros costatum*. *Skeletonema costatum* was not found in the sample. At adjacent stations (69 and 803) located approximately 2 km to the east and west, cell counts for both stations were over 2 million cells per liter with *Skeletonema costatum* at concentrations of 1.9 and 1.7 million cells per liter. In contrast, the pattern along the 808-811 transect on October 15, 1981 indicated a decline in cell concentrations seaward along the first four stations in this series. However, there was a significant rise in population numbers (3.2 million) at Station 811, the station most distant from shore in this transect (Table 7). The presence of *Emiliania huxleyi* throughout the plume differs from the results of the June samples. This species was more common over the shelf and outside of the plume area in June, with its degree of entry along the peripheral areas of the plume more indicative of the extent of mixing and breakdown of the plume structure.

The shelf waters beyond the area of the plume contained a variety of phytoplankters, with many dominants similar to those in the plume waters. These included *Skeletonema costatum*, *Leptocylindrus danicus*, *Nitzschia pungens*, *Anacystis* sp., *Emiliania huxleyi*, and the unidentified ultraplankton components. The composition for the major phytoplankton groups along the transects is given in Table 7. The diatoms consistently have the highest concentrations of cells in the Bay entrance and in the plume directly south of Cape Henry. The green cell component is also significant, becoming more abundant than the diatoms southward. On October 22, samples were taken from an additional 4 stations along a transect from Cape Henry 125 km eastward and beyond the continental shelf. The general pattern in this series, as in the other transects seaward, was a marked reduction in the concentration of the phytoplankton. Cell concentrations dropped from 1.4 million cells per liter at Station 15 off Cape Henry to about 24,000 cells per liter at the far shelf station.

In summary, the dominant species for October at near shore stations and within the Bay plume was *Skeletonema costatum*. Also prominent in the majority of the samples were ultraplankton sized cells which were unidentified but appeared similar to coccoid cyanophyceans and chlorophycean species previously mentioned. The pyrrhophyceans were common but not abundant in the samples. Coccolithophores were common within the plume waters and were the dominant forms in the more distant stations over the shelf. *Cryptomonas* sp. was the dominant species at several stations with several cyanophyceans also abundant in the samples. In general, species diversity reflected the degree of dominance by *Skeletonema costatum* (or the other dominants), being lower where a large population concentration was the product of one or a few species, and usually found near shore. A higher diversity index value was more typical in assemblages of lower population numbers and lacking a significantly dominant form (Station 802).

PHYTOPLANKTON ASSEMBLAGES

The Chesapeake Bay plume was characterized by its phytoplankton composition and high concentration of cells. Seasonal assemblages within the plume and in adjacent shelf waters for March, June, and October are given in Table 8. The predominant species throughout the year in the plume waters was *Skeletonema costatum*, in association with certain ultraplankton forms. These included several unidentified round, green cells of three different size groups (<3 µm, 3-5 µm, 5-10 µm) that appear to be coccoid cyanophycean and chlorophycean species. The plume species were dominated by ultraplankton and nanoplankton components, generally characteristic of enriched areas, and capable of rapid growth. Beyond the plume, the shelf waters contained a variety of diatoms, the green cell component, and phytoflagellates, but were generally dominated by coccolithophores. Transects from near shore stations seaward were characterized by decreasing phytoplankton populations, from mainly a diatom floral assemblage to a mixed group with coccolithophores most prominent. The coccolithophores were useful indicators of the degree of plume mixing with the shelf waters for March and June, but to a lesser degree in October, when they were also common in the plume. The dominant species within the plume were similar to species previously noted for waters of this region (ref. 4, 12), with the high concentrations of *Skeletonema costatum* at near shore stations not unusual (ref. 4, 13). However, a high concentration of *Skeletonema costatum* was one of the characteristics that identified the plume. The ultraplankton group is also associated with the plume and to a lesser extent the shelf waters outside of the plume. Greater recognition has been given this group in recent years as a common and often major component of estuaries and marine waters (ref. 12, 13, 14, 15). There is need for many of these ultraplankton cells to be isolated, cultured, and identified to assure uniformity in the reporting of these species by various investigators.

The extent and permanence of the plume over the shelf varied during the sampling periods. Generally, there was a bulge area of high cell concentration just beyond the Bay entrance, with the southward extension of the plume close to the Virginia shoreline, tapering off toward Oregon Inlet. Although populations decreased in numbers seaward, there was also evidence along several transects of a moderate increase in cell concentration near the shelf break. Patchiness was also common along transects, indicating areas of both high and low concentrations, or dominant species development, along a series of stations. Significant variations in the composition and concentrations of the phytoplankton were also noted during consecutive-day sampling at the same station. Such changes occurred near shore, at the Bay entrance, and within the plume in its extent south toward Oregon Inlet. This implies a dynamic state for the area, in which water movement will be influenced by local wind patterns, tidal currents, and offshore upwelling and current action. Since the degree to which these activities are present will vary, fluctuations in the concentration and composition of the phytoplankton in these waters may be expected over short time periods, and may be included in the seasonal assemblages.

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Table 1. Station coordinates with surface salinity, temperature, and date sampled, for March 1980 collections.

Station	Coordinates		Salinity ‰	Temp. °C	Date
4	36°57,6N	76°01.7W	21.5	12.5	17 March 1980
7	36°57.6	76°02.2	21.0	4.1	17 March 1980
8	36°57.6	76°02.2	20.2	4.3	17 March 1980
5	36°56.9	75°57.2	22.2	5.9	17 March 1980
15	36°56.0	75°57.1	24.0	6.0	19 March 1980
12	36°56.1	75°57.5	25.0	6.1	19 March 1980
6	36°55.9	75°51.7	22.5	--	17 March 1980
21	36°50.1	75°42.9	29.5	16.1	19 March 1980
22	36°55.1	75°34.8	24.0	6.0	19 March 1980
11	36°52.5	75°30.7	23.9	6.0	19 March 1980
16	36°52.4	75°30.6	27.8	6.0	19 March 1980
33	36°51.9	75°29.8	--	6.2	19 March 1980
34	36°52.0	75°29.8	--	6.3	19 March 1980
3	36°45.0	74°54.2	30.5	9.6	17 March 1980
2	36°43.3	74°42.3	30.5	12.4	17 March 1980
1	36°41.2	74°33.0	30.5	15.2	17 March 1980

Table 2. Station coordinates, with surface salinity, temperature, and date sampled for June 1980.

Station	Coordinates		Salinity ‰	Temp. °C	Date
800	36°57.3N	76°02.9W	21.63	22.3	17 June 1980
801	36°59.2	76°00.6	26.00	20.2	18 June 1980
69	36°55.0	75°58.0	27.48	20.5	18 June 1980
802	36°56.0	75°55.8	25.49	20.8	18 June 1980
803	36°58.0	75°51.5	29.02	20.4	18 June 1980
804	37°00.6	75°44.4	32.15	18.7	18 June 1980
805	36°52.0	75°56.0	25.97	21.0	19 June 1980
70	36°52.4	75°53.5	26.5	21.4	19 June 1980
806	36°53.2	75°48.6	29.58	20.0	19 June 1980
807	36°54.4	75°41.8	31.60	19.4	19 June 1980
808	36°45.5	75°54.7	29.44	20.0	20 June 1980
809	36°46.4	75°49.0	27.34	21.0	20 June 1980
810	36°47.6	75°41.2	30.08	20.2	20 June 1980
811	36°48.7	75°32.6	31.87	20.1	21 June 1980
813	36°35.9	75°31.2	30.42	20.2	21 June 1980
812	36°34.5	75°40.2	28.68	22.0	21 June 1980
71	36°33.7	75°48.1	29.75	21.0	21 June 1980
814	36°11.5	75°44.1	27.80	21.2	21 June 1980
815	36°13.1	75°38.7	29.36	21.2	21 June 1980
72	36°15.0	75°32.6	29.66	20.6	21 June 1980
1	36°57.6	75°59.0	28.02	20.0	19 June 1980
2	36°56.6	75°58.9	24.25	20.8	19 June 1980
3	36°56.6	75°59.0	24.37	21.5	19 June 1980
66	36°40.2	74°30.0	34.48	19.4	20 June 1980
67	36°41.6	74°36.4	34.56	19.8	20 June 1980
68	36°42.9	74°42.6	33.62	18.4	20 June 1980
81	36°43.9	74°49.2	32.67	18.6	20 June 1980
82	36°45.3	74°55.7	32.47	19.0	20 June 1980
83	36°46.5	75°02.6	32.35	19.6	20 June 1980
46	36°30.0	75°23.3	31.17	19.9	23 June 1980
47	36°30.0	75°31.9	29.77	21.1	23 June 1980
48	36°30.0	75°40.7	30.28	20.8	23 June 1980
49	36°52.0	75°31.0	30.59	21.3	27 June 1980
50	36°52.0	75°43.0	30.21	21.9	27 June 1980
51	36°52.0	75°55.6	25.65	22.1	27 June 1980
816	36°18.1	75°23.1	31.50	20.0	22 June 1980
818	35°54.3	75°17.1	29.86	20.8	22 June 1980
817	35°52.3	75°23.9	30.01	21.5	22 June 1980
73	35°50.2	75°30.2	30.73	21.7	22 June 1980
805b	36°52.0	75°56.1	25.07	21.8	25 June 1980
70	36°52.3	75°53.6	29.02	21.5	25 June 1980
819	36°40.0	75°52.8	31.45	20.5	26 June 1980
820	36°42.4	75°53.9	27.96	2.4	26 June 1980

Table 3. Station coordinates, with surface salinity, temperature and date sampled for October 1980 collections.

Station	Coordinates		Salinity $^{o}/oo$	Temp. ^{o}C	Date
800	36°57.2N	76°02.8W	27.09	18.6	14 October 1980
801	36°59.0	76°01.2	28.32	18.3	14 October 1980
69	36°54.8	75°57.0	29.60	18.1	16 October 1980
802	36°55.9	75°55.4	30.47	18.3	16 October 1980
803	36°58.2	75°51.6	31.37	19.5	16 October 1980
804	37°01.2	75°44.2	31.71	19.3	16 October 1980
805	36°52.2	75°55.8	31.98	19.5	17 October 1980
70	36°52.5	75°53.1	31.64	19.4	17 October 1980
806	36°53.4	75°48.5	32.33	20.2	17 October 1980
807	36°54.8	75°41.0	31.09	19.9	17 October 1980
808	36°45.7	75°54.6	32.60	18.4	15 October 1980
809	36°46.3	75°48.7	--	18.3	15 October 1980
821	36°47.4	75°42.6	--	19.8	15 October 1980
810	36°47.6	75°41.1	--	19.3	15 October 1980
811	36°48.7	75°32.2	--	19.6	15 October 1980
808	36°46.1	75°54.6	32.71	20.4	18 October 1980
809	36°46.5	75°48.6	32.47	20.3	18 October 1980
810	36°48.0	75°41.1	31.78	20.1	18 October 1980
811	36°48.8	75°31.9	32.61	20.2	17 October 1980
71	36°34.0	75°47.2	32.88	20.8	18 October 1980
812	36°35.0	75°39.9	32.34	20.6	18 October 1980
813	36°36.2	75°30.8	32.61	20.9	18 October 1980
814	36°11.6	75°44.0	32.81	20.4	19 October 1980
815	36°13.2	75°38.9	32.85	20.8	19 October 1980
72	36°15.2	75°33.1	32.32	20.8	19 October 1980
816	36°17.7	75°23.4	32.71	20.9	19 October 1980
73	35°50.0	75°30.4	31.48	21.4	19 October 1980
817	35°52.3	75°24.1	32.17	21.6	19 October 1980
15	36°56.11	75°50.0	--	19.3	22 October 1980
14	36°55.8	75°33.0	--	19.8	22 October 1980
13	36°56.0	75°18.0	--	19.5	22 October 1980
1	36°56.0	74°30.0	--	20.1	22 October 1980

Table 4. Phytoplankton observed during the March, June, and October 1980 Superflux cruises. The degree of numerical dominance for each period, within the plume at the Bay entrance and at shelf stations, is indicated by A, B, C (with A the most dominant) and X noting presence in the samples.

	March		June		October	
	Plume	Shelf	Plume	Shelf	Plume	Shelf
BACILLARIOPHYCEAE						
Actinoptychus sp.	–	–	–	X	–	–
Actinoptychus senarius Ehrenberg	–	–	X	X	–	–
Amphora cuneata Cleve	–	–	–	X	–	X
Amphora sp.	X	–	–	X	–	X
Asterionella glacialis Castracane	A	X	X	X	C	C
Bacillaria paxillifer (Muller) Hendey	–	–	X	–	–	–
Bacteriastrum delicatulum Cleve	–	X	–	–	–	–
Bacteriastrum hyalinum Lauder	–	X	–	–	–	X
Bacteriastrum sp.	–	X	–	–	–	–
Bellochea horologicalis Von Stosch	–	–	–	X	X	–
Biddulphia alternans (Bailey) Van Heurck	–	X	X	X	X	X
Biddulphia aurita (Lyngbye) Brebisson	–	–	X	–	–	–
Biddulphia longicruris Greville	–	–	–	–	–	–
Biddulphia mobiliensis (Bailey) Grunow	–	X	X	X	X	X
Biddulphia rhombus f. *trigona* Hustedt	–	–	–	–	–	X
Biddulphia sinensis Greville	–	–	–	X	–	X
Biddulphia sp.	–	–	–	–	–	X
Campylosira cymbelliformis (Schmidt) Grunow	–	–	–	–	–	X
Chaetoceros pelagica (Cleve) Hendey	X	X	X	X	X	C
Chaetoceros affine Lauder	–	X	–	–	X	X
Chaetoceros atlanticum Cleve	–	–	X	X	X	X
Chaetoceros coarctatum Lauder	–	–	–	–	X	X
Chaetoceros compressum Lauder	X	X	–	X	X	–
Chaetoceros costatum Pavillard	–	–	–	X	–	X
Chaetoceros curvisetum Cleve	–	X	–	X	X	X
Chaetoceros danicum Cleve	X	X	X	X	–	–
Chaetoceros decipiens Cleve	–	X	X	X	X	X
Chaetoceros gracile Schutt	–	X	X	X	X	–
Chaetoceros lorenzianum Grunow	–	–	–	–	X	–
Chaetoceros pendulum Karsten	–	–	–	X	X	–
Chaetoceros peruvianum Brightwell	–	–	X	X	–	X
Chaetoceros sociale Lauder	X	X	–	X	–	–
Chaetoceros sp.	X	C	X	X	B	–
Climacodium frauenfeldianum Gurnow	–	–	–	–	X	X

Table 4. Continued.

	March		June		October	
	Plume	Shelf	Plume	Shelf	Plume	Shelf
Cocconeis sp.	-	-	-	X	X	X
Corethron criophilum Castracane	C	X	-	-	X	-
Coscinodiscus asteromphalus Ehrenberg	-	X	-	-	-	-
Coscinodiscus centralis Ehrenberg	-	X	-	-	-	-
Coscinodiscus grani Gough	-	-	-	-	-	X
Coscinodiscus gigas Ehrenberg	-	X	X	X	-	-
Coscinodiscus granulosus Grunow	-	X	-	X	-	-
Coscinodiscus lineatus Ehrenberg	X	X	X	X	-	X
Coscinodiscus marginatus Ehrenberg	-	-	-	-	-	-
Coscinodiscus nitidus Gregory	-	X	-	X	-	-
Coscinodiscus oculus iridis Ehrenberg	-	-	-	X	-	-
Coscinodiscus radiatus Ehrenberg	-	-	-	-	-	X
Coscinodiscus sp.	-	X	-	-	X	X
Coscinodiscus wailesii Gran and Angst	X	-	-	X	X	X
Coscinosira polychorda (Gran) Gran	-	-	-	X	-	-
Cyclotella sp.	Z	X	X	X	X	-
Cylindrotheca closterium (Ehrenberg) Reimann and Lew	X	X	C	X	C	-
Cymatosira belgica Grunow	-	-	-	-	-	X
Dactyliosolen mediterraneus Peragallo	-	-	-	X	-	-
Diploneis crabro Ehrenberg	X	-	-	-	-	-
Diploneis smithii (Brebisson) Cleve	X	-	-	-	-	-
Ditylum brightwellii (West) Grunow	X	X	-	X	X	X
Eucampia zoodiacus Ehrenberg	-	-	-	X	X	X
Fragilaria pinnata Ehrenberg	-	X	-	-	-	-
Fragilaria sp.	-	X	-	-	-	-
Grammatophora sp.	-	X	X	-	-	X
Guinardia flaccida (Castracane) Pergallo	C	X	X	X	X	X
Gyrosigma balticum similis (Grunow) Cleve	X	-	-	-	-	-
Gyrosigma sp.	-	-	-	X	X	-
Hemiaulus hauckii Grunow	-	X	-	X	X	-
Hemiaulus sinensis Greville	-	X	-	X	X	X
Lauderia borealis Gran	-	-	-	-	C	X
Leptocylindrus danicus Cleve	C	B	B	A	B	B
Leptocylindrus minimus Gran	B	B	X	C	X	-
Licmophora sp.	-	X	-	-	-	X

Table 4. Continued.

	March		June		October	
	Plume	Shelf	Plume	Shelf	Plume	Shelf
Navicula cancellata Donkin	–	–	X	X	–	X
Navicula lyra Ehrenberg	–	–	–	X	X	–
Navicula sp.	–	X	–	X	X	X
Navicula transitans var. *asymmetrica* (Cleve) Cleve	–	–	–	X	–	–
Nitzschia delicatissima Cleve	–	B	–	–	C	X
Nitzschia gracillima Heiden and Kolbe	–	–	X	X	–	–
Nitzschia insignis Gregory	–	–	–	–	–	–
Nitzschia longissima (Brebisson) Ralfs	–	X	–	X	–	–
Nitzschia panduriformis Gregory	–	–	–	–	–	X
Nitzschia pungens Grunow	C	C	B	X	C	C
Nitzschia seriata Cleve	X	X	–	X	X	X
Nitzschia sp.	X	X	–	X	X	X
Nitzschia spathulata Brebisson	–	–	X	X	–	–
Paralia sulcata (Ehrenberg) Cleve	C	X	X	X	X	X
Plagiogramma sp.	–	X	–	X	–	–
Plagiogramma staurophorum (Gregory) Heilberg	–	X	X	X	–	X
Plagiogramma vanheurckii Grunow	–	–	X	X	X	X
Pleurosigma angulatum (Quekett) W. Smith	–	X	–	X	–	–
Pleurosigma naviculaceum Brebisson	X	–	–	–	–	–
Pleurosigma nicobaricum (Grunow) Grunow	–	X	–	–	–	–
Pleurosigma normanii Ralfs	–	–	–	X	–	–
Pleurosigma sp.	X	X	X	X	X	X
Rhaphoneis amphiceros Ehrenberg	X	–	X	X	X	X
Rhaphoneis sp.	–	–	X	–	–	–
Rhaphoneis surirella (Enrenberg) Grunow	–	–	–	X	–	X
Rhizosolenia alata Brightwell	X	X	–	C	X	X
Rhizosolenia alata f. *gracillima* (Cleve) Grunow	X	–	–	X	X	–
Rhizosolenia alata f. *indica* (Peragallo) Gran	–	X	–	X	X	X
Rhizosolenia bergonii Peragallo	–	–	–	X	X	X
Rhizosolenia calcar-avis Schultze	–	X	X	X	X	X
Rhizosolenia delicatula Cleve	B	A	C	X	C	C
Rhizosolenia fragilissima Gergon	B	X	X	X	B	B
Rhizosolenia hebetata f. *semispina* (Hensen) Gran	–	–	–	–	–	X
Rhizosolenia imbricata Brightwell	X	X	–	X	X	X
Rhizosolenia robusta Norman	–	–	–	X	X	–
Rhizosolenia setigera Brightwell	–	–	X	X	X	X
Rhizosolenia sp.	X	–	–	–	–	X
Rhizosolenia stolterfothii Peragallo	–	X	–	X	B	B

Table 4. Continued.

	March		June		October	
	Plume	Shelf	Plume	Shelf	Plume	Shelf
Rhizosolenia styliformis Brightwell	X	–	X	X	X	X
Schroederella delicatula (Peragallo) Pavillard	–	–	–	–	X	–
Skeletonema costatum (Greville) Cleve	A	X	A	B	A	B
Stephanopyxis palmeriana (Greville) Grunow	–	–	–	X	X	X
Stephanopyxis turris (Greville) Ralfs	–	–	–	X	X	–
Striatella unipunctata (Lyngbye) Agardh	X	–	–	–	X	X
Synedra sp.	X	X	–	–	–	X
Tabellaria fenestrata var. *asterionelloides* Grunow	X	X	X	–	–	–
Tabellaria fenestrata (Lyngbye) Kutzing	–	X	–	X	–	–
Thalassionema nitzschioides Hustedt	C	X	X	X	X	X
Thalassiosira eccentrica (Ehrenberg) Cleve	–	–	X	X	–	–
Thalassiosira gravida Cleve	C	X	X	X	–	–
Thalassiosira nordenskioldii Cleve	B	B	–	X	–	–
Thalassiosira pseudonana (Hustedt) Hasle and Heimdal	–	–	X	X	–	–
Thalassiosira rotula Meunier	–	B	X	X	X	–
Thalassiosira sp.	–	–	X	–	–	–
Thalassiothrix frauenfeldii Grunow	X	X	–	X	–	X
Thalassiothrix mediterranea Pavillard	–	–	–	–	C	X
Tricetatium acutum Ehrenberg	–	–	–	X	–	–
Unidentified centric diatoms <20 microns	–	X	–	X	X	X
Unidentified centric diatoms 20 to 100 microns	–	X	–	X	–	X
Unidentified pennate diatoms <20 microns	X	X	X	X	X	X
Unidentified pennate diatoms >20 microns	–	–	X	X	X	X
PYRRHOPHYCEAE						
Amphidinium acutum Lahmann	–	X	–	X	X	X
Amphidinium acutissimum Schiller	–	X	–	X	–	–
Amphidinium schroederi Schiller	–	–	–	X	–	–
Amphidinium sp.	X	X	–	X	–	X
Ceratium arcticum (Ehrenberg) Cleve	–	–	–	–	–	X
Ceratium buceros (Zacharias) Schiller	–	–	X	X	–	–
Ceratium contortum (Gourret) Cleve	–	–	–	–	X	–
Ceratium extensum (Gourret) Cleve	–	–	–	X	X	X

Table 4. Continued.

	March		June		October	
	Plume	Shelf	Plume	Shelf	Plume	Shelf
Ceratium furca (Ehrenberg) Claparede and Lachmann	-	-	-	X	-	-
Ceratium fusus (Ehrenberg) Dujardin	X	X	X	X	X	X
Ceratium lineatum (Ehrenberg) Cleve	X	C	X	X	X	X
Ceratium macroceros (Ehrenberg) Vanhoffen	-	X	X	X	X	X
Ceratium massiliense (Gourret) Jorgensen	-	-	X	X	-	X
Ceratium minutum Jorgensen	-	X	X	X	-	X
Ceratium pentagonum Gourret	-	-	-	X	X	X
Ceratium sp.	-	X	-	-	-	-
Ceratium trichoceros (Ehrenberg) Kofoid	X	X	-	X	-	X
Ceratium tripos (Muller) Nitzsch	-	X	X	X	X	X
Ceratium tripos var. *atlanticum* (Ostenfeld) Paulsen	X	X	X	X	X	-
Cladopyxis brachiolata Stein	-	-	-	-	X	-
Dinophysis acuminanta Claparede and Lachmann	X	-	-	X	-	-
Dinophysis acuta Ehrenberg	-	X	X	X	-	X
Dinophysis caudata Kent	-	-	-	X	X	X
Dinophysis fortii Pavillard	X	X	X	X	-	X
Dinophysis hastata Stein	-	-	-	X	-	-
Dinophysis norvegica Claparede and Lachmann	-	-	X	X	-	-
Dinophysis ovum Schutt	-	X	X	X	X	X
Dinophysis punctata Jorgensen	-	-	X	X	-	X
Dinophysis rotundata Claparede and Lachmann	-	-	X	X	-	-
Dinophysis sp.	-	-	-	X	X	-
Dinophysis tripos Gourret	-	-	-	X	-	-
Goniaulax diegensis Kofoid	-	-	-	X	-	-
Goniaulax digitalis (Pouchet) Kofoid	-	-	-	X	-	X
Goniaulax sp.	X	X	-	X	-	-
Goniaulax spinifera (Claparede and Lachmann) Diesing	-	-	-	X	-	-
Gymnodinium arcticum Wulff	-	-	X	X	-	X
Gymnodinium breve Davis	-	-	X	X	-	-
Gymnodinium sp.	X	X	X	X	X	X
Gyrodinium estuariale Hulburt	-	-	-	-	X	-
Gyrodinium sp.	-	X	X	X	X	X
Heterocapsa triquetra (Ehrenberg) Stein	X	-	-	-	-	-

Table 4. Continued.

	March		June		October	
	Plume	Shelf	Plume	Shelf	Plume	Shelf
Oxytoxum elegans Pavillard	-	-	-	X	-	-
Oxytoxum milneri Murray and Whitting	-	-	-	X	X	-
Oxytoxum parvum Schiller	-	-	-	-	X	-
Oxytoxum sceptrum (Stein) Schroder	-	-	-	X	-	-
Oxytoxum scolopax Stein	-	-	-	X	X	X
Oxytoxum sp.	-	-	-	-	X	X
Oxytoxum turbo Kofoid	-	-	-	-	X	-
Podolampas palmipes Stein	-	-	-	-	X	-
Prorocentrum aporum (Schiller) Dodge	-	-	-	-	X	-
Prorocentrum balticum (Lohmann) Loeblich III	-	X	X	X	-	X
Prorocentrum cassubicum (Woloszynska) Dodge	-	-	-	-	X	X
Prorocentrum compressum (Bailey) Abe	-	-	-	X	-	-
Prorocentrum dentatum Stein	X	X	-	-	X	-
Prorocentrum micans Ehrenberg	X	X	X	X	X	X
Prorocentrum minimum (Pavillard) Schiller	A	X	X	X	-	X
Prorocentrum nanum Schiller	-	X	-	-	-	-
Prorocentrum scutellum Schroder	-	-	X	X	-	-
Prorocentrum sp.	-	X	-	X	-	-
Prorocentrum triestinum Schiller	-	-	-	X	X	-
Protoperidinium sp.	X	X	X	X	X	X
Protoperidinium breve (Paulsen) Balech	-	X	-	-	-	-
Protoperidinium cerasus (Paulsen) Balech	-	X	-	X	-	-
Protoperidinium depressum (Bailey) Balech	X	-	X	X	X	X
Protoperidinium oceanicum (Vanhoffen) Balech	-	-	X	X	-	-
Protoperidinium punctulatum (Paulsen) Balech	-	-	-	X	-	-
Protoperidinium claudicans (Paulsen) Balech	-	-	-	X	-	-
Protoperidinium steinii (Jorgensen) Balech	-	-	-	X	X	X
Protoperidinium minutum (Kofoid) Loeblich III	-	-	-	X	-	-
Protoperidinium divergens (Ehrenberg) Balech	-	-	-	X		
Pyrocystis fusiformis (Wyville-Thomson) Murray	-	-	-	-	-	X
Pyrophacus horologium Stein	-	-	-	X	X	-
Pyrophacus sp.	-	-	-	X	-	-

Table 4. Continued.

	March		June		October	
	Plume	Shelf	Plume	Shelf	Plume	Shelf
Scrippsiella trochoidea (Stein) Loeblich III	-	-	-	-	X	-
Unidentified dinoflagellate cysts	X	X	X	X	X	X
Unidentified dinoflagellates	-	C	-	X	X	X
HAPTOPHYCEAE						
Acanthoica quattrospina Lohmann	-	-	-	X	-	-
Calciocolenia granii Schiller	-	-	-	X	X	-
Calciosolenia murrayi Gran	-	-	-	-	X	-
Discosphaera tubifer (Murray and Blackman) Ostenfeld	-	-	-	-	X	X
Emiliania huxleyi (Lohmann) Hay and Mohler	X	A	X	A	C	B
Michaelsarsia elegana Gran	-	X	-	-	-	-
Monodus sp.	X	-	-	-	-	-
Ophiaster hydroides (Lohmann) Lohmann	-	X	-	X	X	-
Pontosphaera sp.	-	-	-	X	-	-
Pontosphaera syracusana Lohmann	-	-	-	C	-	X
Rhabdosphaera claviger Murray and Blachman	-	-	-	-	X	X
Rhabdosphaera hispida Lohmann	-	X	-	-	X	-
Rhabdosphaera stylifer Lohmann	-	-	-	X	-	-
Rhabdosphaera sp.	-	X	-	C	-	X
Syracosphaera pulchra Lohmann	-	X	-	B	X	X
Unidentified coccolithophores	-	X	X	X	X	X
CHRYSOPHYCEAE						
Dictyocha fibula Ehrenberg	-	X	X	X	X	X
Distephanus speculum (Ehrenberg) Haekel	-	X	X	X	X	X
Ebria tripartita (Schumann) Lemmermann	X	-	-	X	-	-

Table 4. Concluded.

	March		June		October	
	Plume	Shelf	Plume	Shelf	Plume	Shelf
CYANOPHYCEAE						
Anacystis aeruginosa Drouet and Daily	–	X	–	–	–	–
Anacystis sp.	–	–	–	–	B	C
Gomphosphaeria aponina Kutzing	A	X	–	–	–	–
Johannesbaptistia pellucida (Dickie) Taylor and Drouet	–	X	–	X	–	–
Merismopedia sp.	–	–	–	–	–	X
Nostoc commune Vaucher	B	X	–	–	X	X
Oscillatoria erythraea (Ehrenberg) Kutzing	–	–	–	–	X	X
Oscillatoria sp.	X	X	–	–	–	–
Oscillatoria submembranacea Ardissone and strafforella	X	–	–	–	–	–
EUGLENOPHYCEAE						
Euglena sp.	X	X	–	–	X	X
Eutreptia sp.	–	–	–	X	X	X
CHLOROPHYCEAE						
Chlorella sp.	–	–	X	X	X	X
Crucigenia tetrapedia (Kirchner) West and West	–	–	–	–	X	–
Pediastrum simplex (Meyer) Lemmermann	–	–	–	X	–	–
Scenedesmus sp.	X	–	–	–	–	–
CRYPTOPHYCEAE						
Chroomonas sp.	X	X	–	X	X	X
Cryptomonas sp.	C	C	X	X	C	B
Ochromonas variabilis Meyer	–	X	–	–	–	–
OTHERS						
Green cells (<3.0 microns)	A	A	X	A	A	A
Green cells (3–5 microns)	A	C	A	B	C	B
Green cells (5–10 microns)	X	B	X	X	X	–

Table 5. Total cell concentrations for surface, 3 meter and 7 meter depths at stations with species diversity and dominant species noted for each station for March 1980. Samples lacking a universally dominant single species are indicated as mixed sample.

Station		Surface	3 meters	7 meters
Bay Entrance	5	*Prorocentrum minima* 1,046,697 cells/l 2.308	*Leptocylindrus danicus* 62,700 cells/l 1.986	Mixed 43,890 cells/l 2.983
Shelf	11	*Leptocylindrus danicus* 247,248 cells/l 0.939	*Leptocylindrus minimus* 171,296 cells/l 1.931	*Leptocylindrus minimus* 397,631 cells/l 2.690
Shelf	16	*Leptocylindrus danicus* 19,920 cells/l 2.527	*Leptocylindrus danicus* 36,022 cells/l 2.065	*Leptocylindrus danicus* 51,975 cells/l 2.543
Shelf	21	Mixed 40,283 cells/l 3.781	Mixed 31,050 cells/l 3.488	Mixed 39,105 cells/l 3.870
Shelf	22	Green cells 1,546,185 cells/l 0.647	*Leptocylindrus danicus* 36,630 cells/l 2.495	Mixed 39,765 cells/l 3.723
Shelf	33	*Guinardia flaccida* 53,130 cells/l 2.107	*Leptocylindrus danicus* 54,450 cells/l 2.289	*Leptocylindrus danicus* 43,725 cells/l 2.014
Shelf	34	*Leptocylindrus danicus* 42,735 cells/l 2.500	*Leptocylindrus danicus* 109,890 cells/l 1.946	*Leptocylindrus danicus* 34,485 cells/l 2.635
Far Shelf	1	*Emiliania huxleyi* 32,576 cells/l 3.776	Mixed 16,040 cells/l 3.878	Mixed 11,700 cells/l 3.746
Far Shelf	2	Mixed 29,100 cells/l 3.505	Mixed 34,815 cells/l 3.155	Mixed 26,712 cells/l 3.080

Table 6. The dominant species, total cell concentrations (cells/l x 10^4), and species diversity at various depths for stations within the plume, shelf and far shelf for June 1980.

	Stations	Surface	3-5 meters	7-12 meters	13-15 meters
Plume	800	*S. costatum* 363.4 1.1286	*S. costatum* 377.8 0.8449	*S. costatum* 424.3 0.5929	
	802	*S. costatum* 166.2 2.1864	*S. costatum* 87.0 1.5723	Green cells 97.0 1.6851	Green cells 28.3 1.3973
	69	*S. costatum* 687.9 1.1119	*S. costatum* 740.0 1.2272	*S. costatum* 217.6 1.2699	
	70	*S. costatum* 370.2 1.2068	*S. costatum* 367.7 1.0645	*S. costatum* 188.7 2.1251	*L. danicus* 76.1 2.1516
	809	*S. costatum* 233.4 1.3133	*S. costatum* 320.9 1.2772	*S. costatum* 240.4 1.8871	
Shelf	807	Green cells *E. huxleyi* 14.0 2.6515	Green cells 12.7 2.1013	Green cells *E. huxleyi* 155.3 2.3160	Green cells *E. huxleyi* 27.9 2.0051
	812	*L. danicus* *S. costatum* 77.1 2.8104	Mixture 153.2 2.0961	Mixture 73.4 2.7542	Mixture 121.5 2.4503
	817	Mixture 59.5 2.4880	*E. huxleyi* *L. danicus* 39.0 2.4052	*E. huxleyi* Mixture 41.0 2.2177	Mixture 43.1 2.5666
	818	Mixture 56.7 2.5176	*E. huxleyi* Mixture 26.8 2.0901	Mixture 61.6 2.4303	Mixture 39.05 3.0197
Far Shelf	66	Coccolithophores 18.9 2.3113	Coccolithophores 39.5 1.8696		
	67	Coccolithophores 23.7 1.9474	Coccolithophores 44.0 1.5609		

Table 7. Representative composition at stations during the October 1980 Superflux collections. Concentrations are in numbers per liter x 10^4.

Stations

	800	801	69	802	803	804	69	802	803	804
Diatoms	72.5	169.1	207.7	9.5	200.3	142.7	287.2	92.1	145.0	3.3
Pyrrhophyceae	.4	.1	.1	<.1	<.1	.3	.3	.2	.4	<.1
Coccolithophores	0	0	.7	0	6.5	0	0	.7	1.9	.2
Cyanophyceae	0	0	0	0	3.9	18.5	9.7	3.9	2.9	.1
Cryptophyceae	0	6.9	13.6	.8	.1	2.3	2.3	1.7	.3	<.1
Green cells	23.9	61.5	50.7	1.2	24.4	21.4	40.0	39.0	29.7	93.7
Others	.9	5.1	.9.9	.4	0	0	0	6.3	0	0
Total cells/l	97.9	242.9	274.0	12.1	235.3	185.5	339.7	144.1	180.4	97.4
Diversity Index	1.776	1.863	1.521	3.394	1.673	2.282	1.306	2.194	1.560	1.022
Date	10/14	10/14	10/15	10/15	10/15	10/15	10/16	10/16	10/16	10/16

	808	809	821	810	811	808	809	810	811
Diatoms	1169.0	170.7	20.7	18.8	294.4	91.2	148.8	5.4	1.1
Pyrrhophyceae	.5	.7	.3	<.1	0	3.6	.4	.2	.2
Coccolithophores	3.0	4.5	0	.4	1.1	.5	7.0	.3	.4
Cyanophyceae	19.5	3.9	4.8	1.4	3.9	0	13.6	.4	1.5
Cryptophyceae	2.2	15.9	.8	1.9	.1	.6	.7	.9	1.0
Green cells	191.3	66.4	32.4	3.0	28.8	59.5	167.9	5.7	18.9
Others	0	0	0	0	0	5.1	13.7	0	.2
Total cells/l	1385.4	262.3	59.1	25.7	328.4	160.6	352.2	13.0	23.6
Diversity Index	1.262	2.306	2.617	3.319	1.006	2.459	3.155	3.103	1.488
Date	10/15	10/15	10/15	10/15	10/15	10/18	10/18	10/18	10/17

Table 7. Concluded.

	Stations							
	805	70	806	807	15	14	13	1
Diatoms	41.4	72.1	21.9	81.4	75.7	2.6	.1	<.1
Pyrrhophyceae	<.1	.2	.8	1.1	.4	.5	.2	.3
Coccolithophores	0	3.2	1.1	1.1	1.7	<.1	.2	1.2
Cyanophyceae	9.7	0	.6	3.9	0	<.1	.7	<.1
Cryptophyceae	3.4	5.2	<.1	0	7.5	.1	7.7	<.1
Green cells	66.8	93.7	12.3	34.1	52.7	12.0	6.1	.5
Others	5.8	.3	2.5	34.1	1.9	.1	0	.3
Total cells/1	127.5	175.0	39.5	121.8	140.4	15.6	15.2	2.4
Diversity Index	2.976	2.777	2.909	1.728	2.918	1.448	1.892	2.985
Date	10/17	10/17	10/17	10/17	10/22	10/22	10/22	10/22

	71	812	813	814	815	72	816	73	817
Diatoms	81.7	10/9	8.9	123.7	10.5	3.2	.6	54.0	5.3
Pyrrhophyceae	.2	.1	<.1	<.1	<.1	.5	<.1	<.1	.1
Coccolithophores	5.8	1.3	3.4	.7	<.1	2.2	1.8	1.3	1.2
Cyanophyceae	1.4	3.9	4.9	0	0	4.4	<.1	14.6	.2
Cryptophyceae	2.6	.4	.9	3.3	0	.2	3.2	13.9	<.1
Green cells	83.9	10.6	23.2	22.5	15.4	29.1	13.8	46.7	8.9
Others	.9	1.7	.2	0	0	1.2	.9	.8	.7
Total cells/1	176.8	29.1	41.6	150.3	26.0	41.0	20.4	119.2	16.6
Diversity Index	2.932	3.413	2.562	2.723	2.493	2.433	1.778	2.942	3.140
Date	10/18	10/18	10/18	10/19	10/19	10/19	10/19	10/19	10/19

Table 8. Phytoplankton assemblages within the Chesapeake Bay plume and adjacent shelf waters for March, June, and October 1980. Numerical dominance is indicated for each collection period.

	Bay Entrance - Plume	Shelf
March	Asterionella glacialis	Bacteriastrum hyalinum
	Cyclotella sp.	Chaetoceros costatum
	Guinardia flaccida	Nitzschia longissima
	Leptocylindrus danicus	Rhizosolenia delicatula
	Leptocylindrus minimus	Thalassiosira nordenskioldii
	Nitzschia pungens	Thalassiosira rotula
	Paralia sulcata	*Emiliania huxleyi
	Rhizosolenia delicatula	Green cells 5-10 microns
	Rhizosolenia fragilissima	
	*Skeletonema costatum	
	Thalassiosira nordenskioldi	
	Gomphosphaeria aponina	
	Nostoc commune	
	*Prorocentrum minimum	
	*Green cells <3 microns	
	*Green cells 3-5 microns	
June	Chaetoceros spp.	Rhizosolenia alata
	Cylindrotheca closterium	*Emiliania huxleyi
	Leptocylindrus danicus	Pontosphaera sp.
	Nitzschia pungens	Rhabdosphaera sp.
	Rhizosolenia delicatula	Syracosphaera pulchra
	*Skeletonema costatum	
	*Green cells 3-5 microns	
October	*Asterionella glacialis	Nitzschia pungens
	Cerataulina pelagica	Rhizosolenia delicatula
	Cylindrotheca closterium	Rhizosolenia fragilissima
	Lauderia borealis	Skeletonema costatum
	Leptocylindrus danicus	*Emiliania huxleyi
	Nitzschia pungens	*Green cells <3 microns
	Rhizosolenia delicatula	*Green cells 3-5 microns
	*Skeletonema costatum	Mixed phytoflagellates
	*Emiliania huxleyi	
	*Green cells <3 microns	
	*Green cells 3-5 microns	
	Anacystis sp.	
	Cryptomonas sp.	

*Dominant phytoplankters

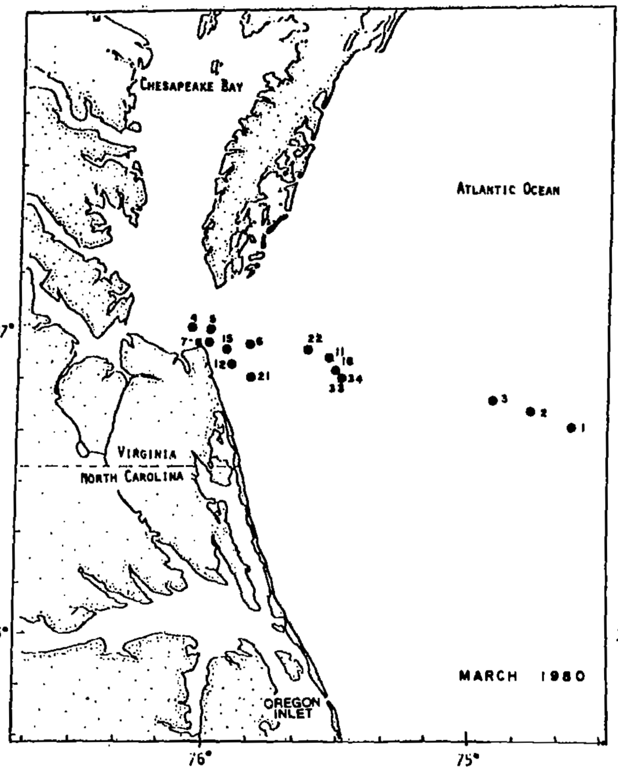

Figure 1.- Station locations.

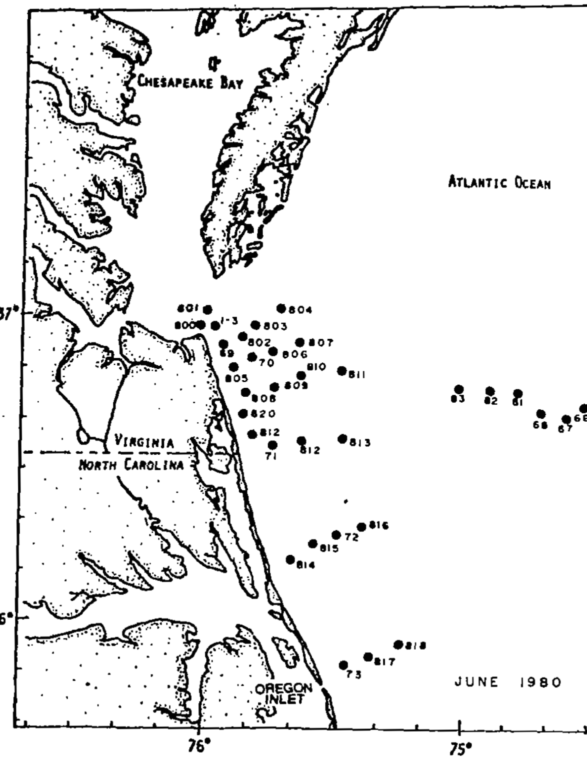

Figure 2.- Station locations.

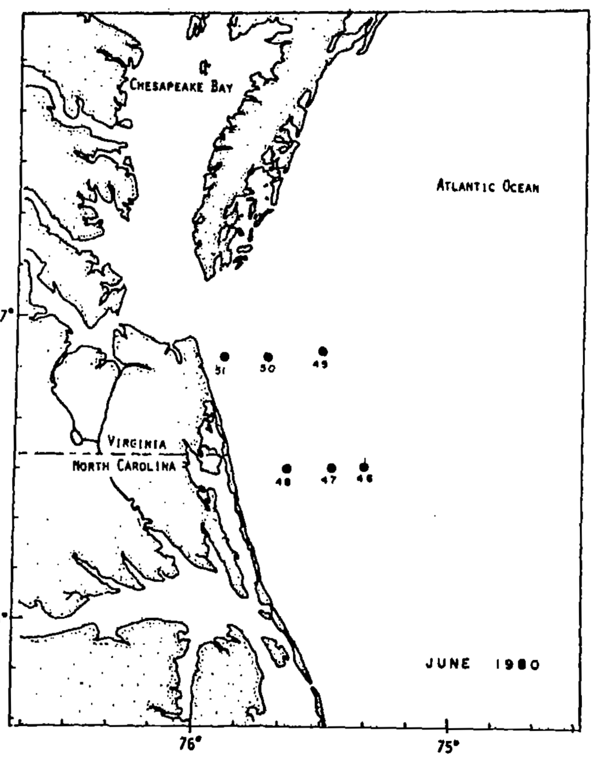

Figure 3.- Station locations.

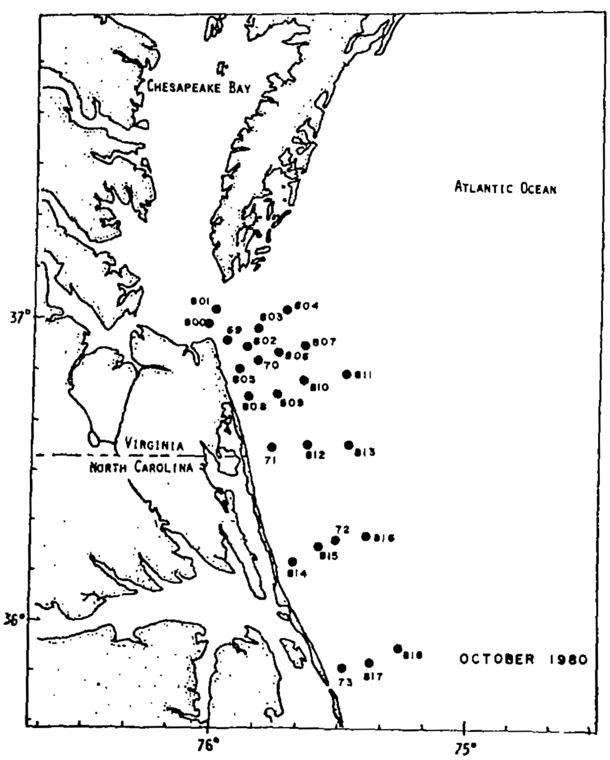

Figure 4.- Station locations.

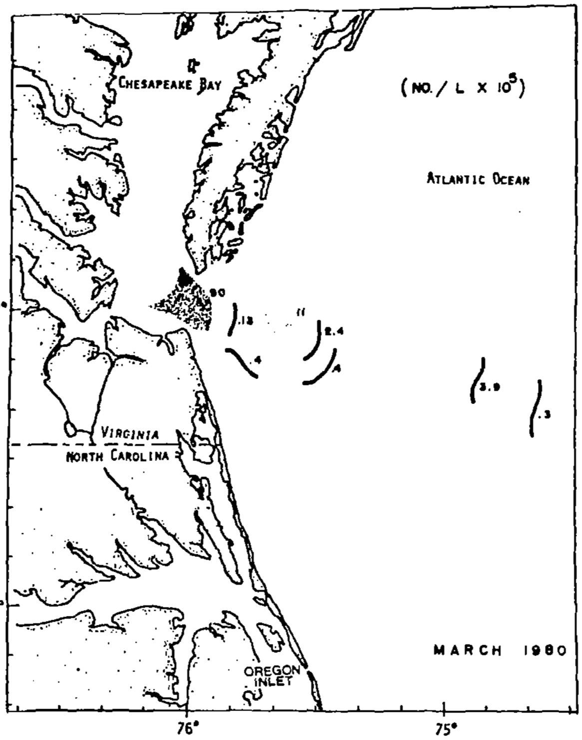

Figure 5.- Cell concentrations.

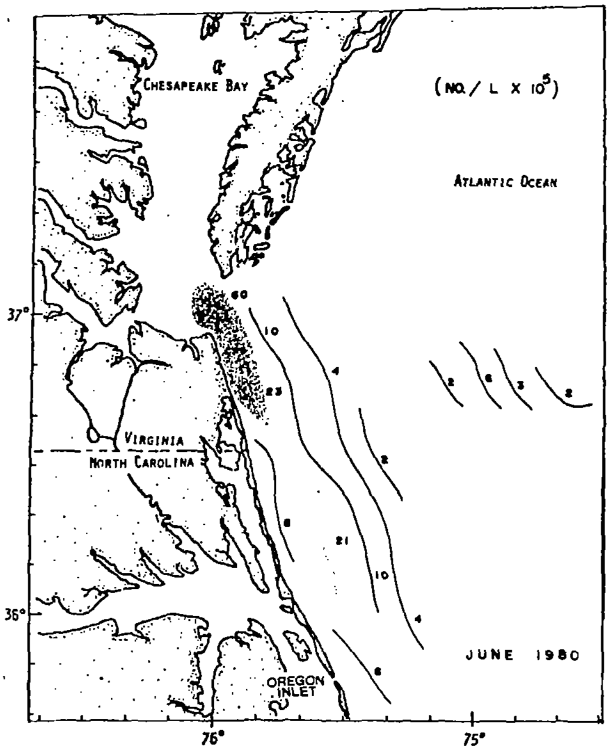

Figure 6.- Cell concentrations.

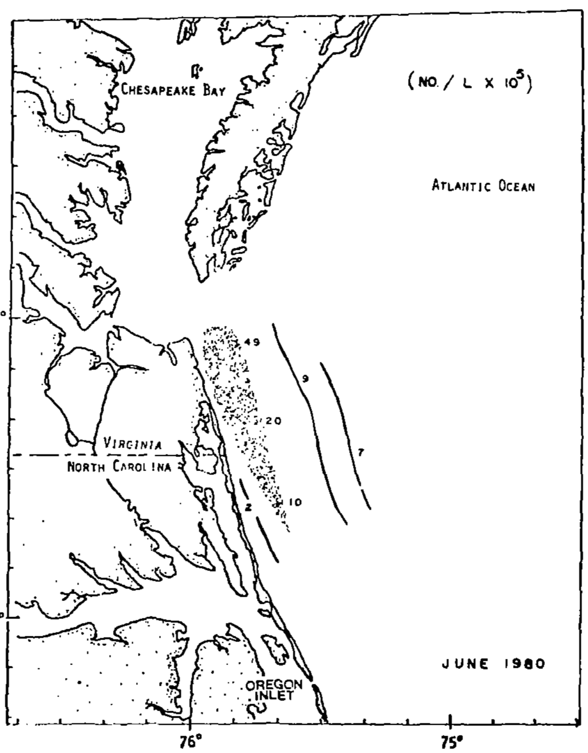

Figure 7.- Cell concentrations.

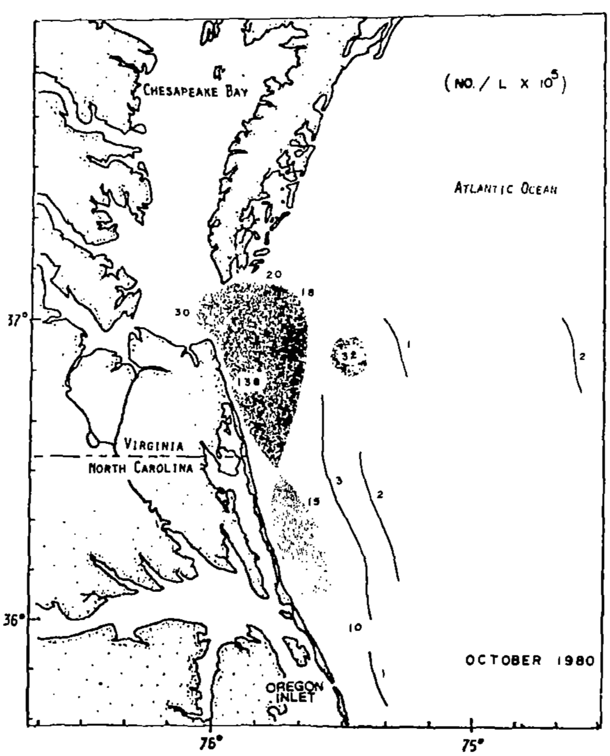

Figure 8.- Cell concentrations.