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**Phytoplankton Community Structure
in Northeastern Coastal Waters
of the United States.**

II. November 1978

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Center
Woods Hole, Massachusetts

August 1981

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**Phytoplankton Community Structure
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of the United States.
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U.S. DEPARTMENT OF COMMERCE

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ABSTRACT

The phytoplankton populations observed in coastal waters between Narragansett Bay and the Gulf of Maine during a November 1978 cruise are described and discussed. Diatoms (43%) and dinophyceans (40%) composed the majority of the total species. Diatoms and nannoplankton were more dominant at near-shore stations; Leptocylindrus danicus and Nitzschia pungens were found in high concentrations over Georges Bank. A total of 248 phytoplankton species was observed.



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INTRODUCTION

This is the second in a series of reports on phytoplankton community structure for northeastern United States coastal and continental shelf waters. A total of 33 surface samples for phytoplankton analysis was collected during the cooperative MARMAP research program aboard the Soviet research vessel Belogorsk (cruise 78-04) between 15-30 November 1978. The vessel occupied standard stations located over Georges Bank, in the Gulf of Maine, and Nantucket Shoals-southern New England waters (Fig. 1). The first report in the series discussed the phytoplankton populations for October 1978, from Delaware Bay to the Gulf of Maine. Following papers will discuss data obtained from six subsequent cruises of National Oceanic and Atmospheric Administration (NOAA) vessels made in March, May, June, August and December 1979 and February 1980. This intensive, long-term, cooperative study is designed to investigate phytoplankton dynamics in the area during a 17 month period, assessing the standing stock, identifying seasonal norms of distribution and noting dominant species of particular regions. The series of reports will delineate seasonal and geographic changes in the phytoplankton and will lead to the establishment of a phytoplankton composition base for these waters.

METHODS

Coordinates for all stations, with observations on cloud cover, wind direction and speed, wave height and sea surface temperatures are listed in Table 1. The near-shore stations are defined as those within 35 km of the shore, and those beyond this distance as the far-shore stations.

Phytoplankton collection and analysis procedures used in this study were those previously reported by Marshall and Cohn (1981). The study was made in association with other investigators from the National Marine Fisheries Service concerned with chlorophyll concentrations³, primary production⁴ and nutrient analysis⁵ to provide a synoptic overview.

RESULTS AND DISCUSSION

A total of 248 phytoplankters was identified on this cruise, with representation from the Bacillariophyceae (109), Pyrrhophyceae (100), Haptophyceae (12), Cyanophyceae (4), Chrysophyceae (6), Cryptophyceae (6), Chlorophyceae (2), Euglenophyceae (4), Xanthophyceae (1) and Prasinophyceae (4). A species list is given in Table 2 with average concentrations for species given at near- and far-shore stations. The composition and concentration for the phytoplankters at each station are given in Appendix I.

The Bacillariophyceans and the Pyrrhophyceans (dinophyceans) composed the majority of the total species (43 and 40 percent respectively) noted in the samples, with the diatoms having the highest concentrations of cells. In contrast to the areal dominance exhibited by Skeletonema costatum at stations in the previous month during the Belogorsk 78-03 cruise (Marshall and Cohn, 1981), other diatoms and Nannochloris atomus were the more dominant species at near-shore stations, with Leptocylindrus danicus and Nitzschia pungens found in high concentrations over Georges Bank. Since this cruise did not occupy the stations off New Jersey and New York shores, month-to-month population comparisons for this region is not possible. The most noticeable change in the dominant species from October to November

was the general absence of a Skeletonema costatum pulse in the waters sampled and its replacement as a dominant species by several other phytoplankters. Increased significantly from the October cruise were the concentrations of the chlorophycean nanoplankter, Nannochloris atomus. This species was the most abundant phytoplankter found during the cruise, with near- and far-shore station averages being 11,673 and 1,776 cells per liter respectively. Its presence was more characteristic at stations closest to shore; numbers diminished rapidly seaward. The high counts of N. atomus for the far-shore stations given in Table 2 are more characteristic of the far-shore stations closest to the 35 km cut-off line than at stations farther out over the shelf.

Several diatoms were also co-dominants at the near-shore stations. These included Coscinodiscus lineatus (111 cells/l), Guinarida flaccida (106 cells/l), Rhizosolenia imbricata (130 cells/l), Rhizosolenia stolterfothii (106 cells/l), Thalassionema notzschoides (434 cells/l), Thalassiosira nordenskioldii (442 cells/l), Thalassiosira rotula (109 cells/l), and Thalassiothrix frauenfeldii (533 cells/l). A general pattern of decreased concentrations seaward occurred for diatoms abundant at near-shore stations. Total cell numbers were also considerably higher at station #146 (79,500 cells/l) over Georges Bank in comparison to surrounding stations. Here the diatom Leptocylindrus danicus was dominant among 32 species found at the station. This station and the adjacent station #147 (36 species) were represented by numerous diatom species, with a general representation of neritic and oceanic forms. Several of the diatoms that had distinct higher average concentrations over the shelf than at the near-shore stations were

Chaetoceros decipiens, Corethron criophilum, Coscinodiscus radiatus, Guinardia flaccida, Leptocylindrus danicus, Nitzschia pungens, Rhizosolenia alata, and Rhizosolenia styliformis.

Pyrrophyceans common to both near- and far-shore stations included Ceratium fusus, Ceratium lineatum, Ceratium tripos, Ceratium tripos var. atlanticum, Gymnodinium dissimile, Prorocentrum micans, and Protoperidinium cerasus. Prorocentrum micans was the dominant dinophycean at both near- and far-shore stations, having average counts at these stations of 187 and 459 cells/l, respectively. Sixty-two of the 100 species in this group were noted only at the near-shore stations. Although the pyrrhophyceans were generally widespread over the near-shore waters, their concentrations were basically low. The coccolithophore most typical of the samples was Emiliania huxleyi, which was found widely distributed, but in low concentrations. A greater variety of coccolithophores was noted at near-shore stations on this cruise, with Cyclococcolithus leptoporus having the highest average concentrations for the far-shore locations. The most prominent chrysophyceans were the silicoflagellates, Dictyocha fibula and Distephanus speculum, which were numerous at far-shore stations. The cyanophyceae were not abundant, being represented by four species, all noted at far-shore stations. Most numerous was Anacystis marina. The euglenophyceans and cryptophyceans were found predominantly in the near-shore stations, with the only xanthophycean, Monodus guttula, reported at far-shore stations. The prasinophyceans were generally noted in low concentrations near-shore, with higher concentrations reported for Pyramimonas grossi at several far-shore stations.

In general, the species diversity at near-shore stations (where the phytoplankton was dominated by one species, Nannochloris atomus) was lower than

at far-shore stations. Near-shore, the values for species diversity ranged from 0.170 to 3.074, at station nos. 99 and 138. Each of these stations had 36 species, and were both within the Gulf of Maine. At station no. 99, however, Nannochloris atomus composed 97.8% of the phytoplankton composition with no other species having a count greater than 184 cells/l. In contrast, all the phytoplankton at station no. 138 had low concentrations, with the majority having 16 or less cells/l and the most abundant species having 208 cells/l. This latter type of distribution, numerous species present but in low concentrations, was more characteristic away from shore and over the far shelf. Exceptions to this pattern at far-shore stations occurred when single species reached high cell concentrations (e.g., station nos. 82, 88, 114, 146). The species diversity range for far-shore stations was 0.138 to 2.882, occurring at station nos. 88 and 116, respectively. Station no. 88 is one of the inner shelf stations south of Martha's Vineyard whereas station 116 is located beyond the shelf break, southwest of Georges Bank. Low species diversity often accompanies high concentrations of cells, usually during a pulse period for a single species, and indicates a high productivity potential for that station. However, high concentrations of cells will not always be accompanied by low diversity values, especially when multiple dominants are present. The highest cell concentrations during this cruise were found at stations directly beyond Narragansett Bay (station nos. 77 and 78), where cell counts were 73,000 and 145,492 cells/l, respectively. The only other station where cell counts were comparable to these was over Georges Bank (station no. 146) where there were 79,500 cells/l.

During October, high concentrations of Skeletonema costatum were found at near-shore stations between Cape Henlopen, Delaware and the coastal

waters of Maine. Other small sized diatoms were codominant in these near-shore waters. They included Leptocylinthus danicans, Asterionella glacialis, Chaetoceros simplex, and Rhizosolenia delicatula. Cell concentrations exceeded several million cells/l at some of the near-shore stations. Nannochloris atomus was a common nanoplankter, showing large concentrations along the New York-New Jersey coastline.

Since the October 1978 cruise, there has been a marked change in the dominant species off southern New England to the Gulf of Maine and over Georges Bank. The November 1978 cruise indicates large concentrations of Nannochloris atomus at several of the near-shore stations with the general loss of Skeletonema costatum as a major constituent of the phytoplankton populations. The largest development of Nannochloris atomus was off the Narragansett Bay area, with its presence noted along the coastal areas into the Gulf of Maine. Other common phytoplankters for this month include Coscinodiscus lineatus, Guinardia flaccida, Rhizosolenia imbricata, Rhizosolenia stolterfothii, Thalassionema nitzschioides, Thalassiosira nordenskioldii, Thalassiosira rotula, and Thalassiothrix frauenfeldii. In general, the overall cell concentrations were lower than in the previous month. The two areas with greatest cell concentrations were found off Narragansett Bay and at a station over Georges Bank. In both of these areas small sized cells (nanoplankters) were most abundant. Concentrations of cells were generally higher near-shore, with lower counts over the shelf. However, patchy areas of low cell concentrations were found at both near- and far-shore locations.

The phytoplankton for this period is characterized as predominantly diatoms and pyrrhophyceans with the chlorophycean Nannochloris atomus

prominent at specific near-shore stations. Codominants were common, with the majority of samples having low concentrations of cells, moderate to high levels of species diversity, and with scattered stations where one or several species had high cell concentrations. Patchiness also occurred at several of the near-shore stations (e.g., station nos. 98 and 99) and over Georges Bank, with the potential for significant shifts in species development evident in comparison to October dominants. The use of average counts for the numerous stations over the near- and far-shore area (as presented in Table 2) is intended to reduce some of the problems associated with evaluating the various concentration levels in these waters. These values should be considered in relation to the actual locations of higher and lower regions of productivity that are being identified over the completed study period.

Due to their high concentrations and wide distribution in the samples, more comment is necessary regarding the significance of the ultraplankton components, such as Nannochloris atomus. In recent years, the ultraplankton constituents in both estuarine and marine waters have received increased attention (McCarthy et al., 1974; Waterbury et al., 1979; Johnson and Sieburth, 1979; Marshall, 1981a). In most cases these cells have been identified as either chlorophycean, haptophycean, or cyanophycean (Cyanobacterium) species. Their small size (<10 microns) and lack of distinct morphological characteristics often have led to misidentification or simply their placement in an unidentified category. However, the importance of this group in estuaries has been emphasized by McCarthy et al. (1974). In a two year study they found the ultraplankters "responsible for a substantial fraction of both the phytoplankton biomass and phytoplankton productivity in the Chesapeake Bay."

For this period they attributed 89.6% of phytoplankton productivity to the size fraction that passes through a 35 um mesh net. The ultraplankton constituents within Chesapeake Bay and coastal marine waters include representation by a wide variety of taxonomic groups. These include the bacillariophyceae, pyrrhophyceae, cyanophyceae, chlorophyceae, haptophyceae, chrysophyceae, xanthophyceae, and prasinophyceae (Marshall, 1980). In waters of the northeastern continental shelf the most commonly mentioned ultraplankton component has been the coccolithophores (haptophyceae) and specific diatoms (Hulburt, 1963, 1970). Hulburt (1970) further mentions the importance of several chlorophyceans (Chlorella, Selenastrum, Nannochloris) in estuaries. He generalizes ocean and estuary species as characteristically solitary and globular species, smaller in diameter than coastal species, sinking more slowly than species found along the coast and in the ocean. Large concentrations of these ultraplankton have been reported along the northeast coast. O'Reilly et al. (1976) noted that Nannochloris atomus was responsible for most of the nanoplankton reduction in the lower New York Bay estuary, with the nanoplankton (<20) outproducing the netplankton by a factor of 3.7:1. This study, as others in the New York Bay and near-shore areas (Patten, 1961; Hulburt, 1963; Malone, 1977), indicates distinct seasonal variations in the dominance of the ultraplankton component, with it being more prominent during summer months. However, this pattern does not exclude major population fluctuations of this group throughout the year over areas of the shelf or at specific stations (Marshall, 1981b).

During the October and November cruises discussed, as well as those reported by Marshall and Cohn (1981), high concentrations of ultraplankton species have been reported at many of the stations closest to the shore, with numbers decreasing

seaward. A patchiness in ultraplankton coastal distribution has also been evident, both along the coast and over transects directed seaward. It is speculated that this pattern is characteristic of the area, which is itself subject to fluctuating environmental conditions of both short and long duration. The background flora, larger in size, remains stable, being composed of forms less responsive or slower in growth response time to environmental changes, and is generally classified as more characteristic of the seasonal and regional assemblages for this area. The ultraplankton component responds rapidly to fluctuations of the milieu, often reaching very high concentrations. O'Reilly et al. (1976) discuss the rapid response and high growth potential for Nannochloris atomus in nutrient rich areas of the Raritan-Lower Hudson estuary. Such reactions occur in relation to fluctuating nutrient levels and separate specific environmental requirements and growth regulatory conditions. They are further augmented by the nature of the regional shelf area where there is a dynamic water system, influenced by various currents, wind action, upwelling, and changing seasonal conditions. The distribution and growth of phytoplankton is influenced by these factors differently throughout the year. The result of the changing milieu includes the high concentrations of the ultraplankton component and its sporadic appearance throughout the shelf area, with greatest development at near-shore stations, i.e., stations receiving the nutrient rich effluents of the estuaries. An unknown factor is the influence of grazers on this system and a full understanding of the seasonal periodicity of numbers.

Future reports in this series will present a more seasonal evaluation of the phytoplankton observed in the northeastern coastal waters. The

importance of the ultraplankton component will be further addressed in relation to the total phytoplankton flora for this region.

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FOOTNOTES

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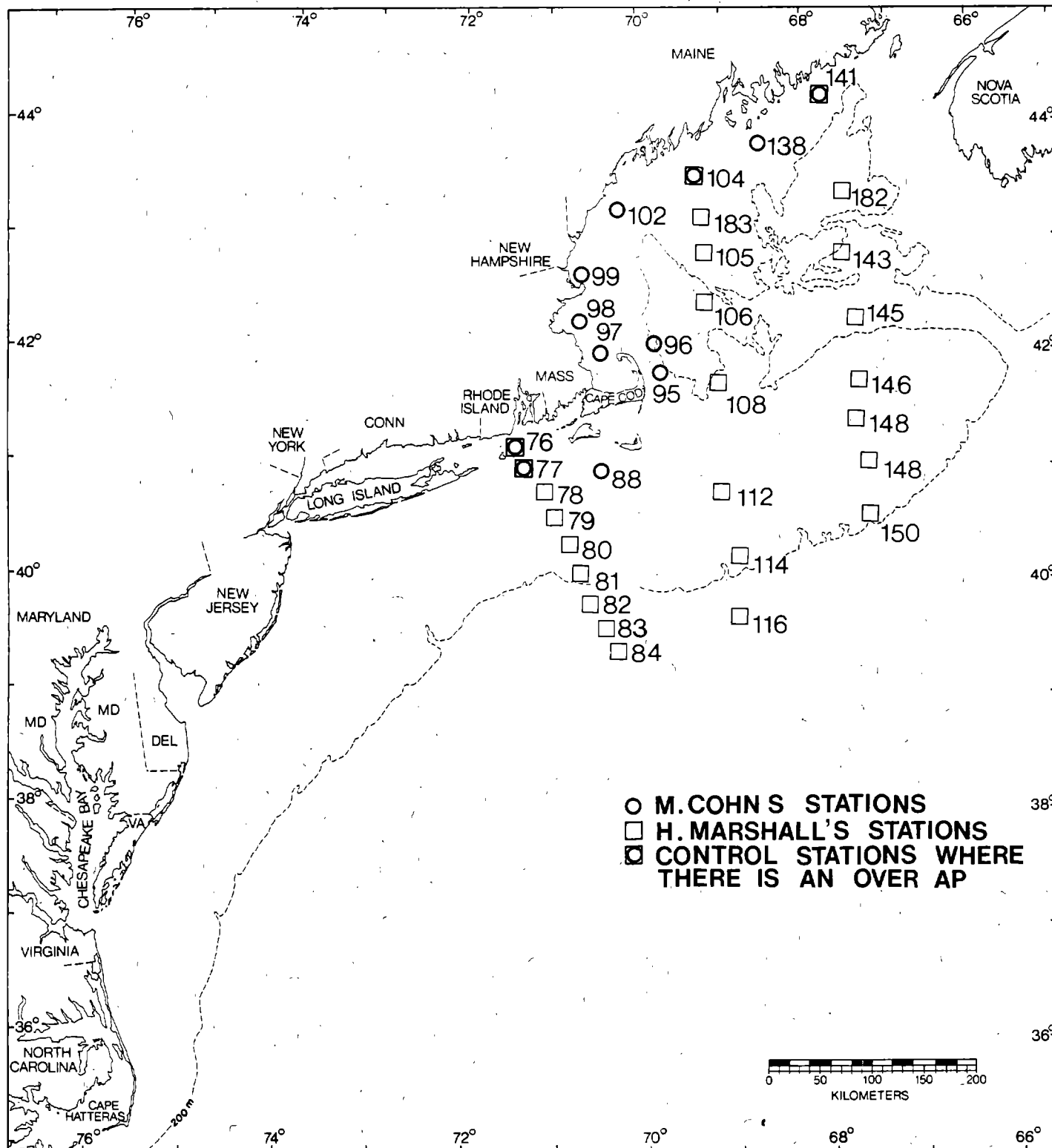


Figure 1. Phytoplankton community structure station locations for cruise BEL-78-04.

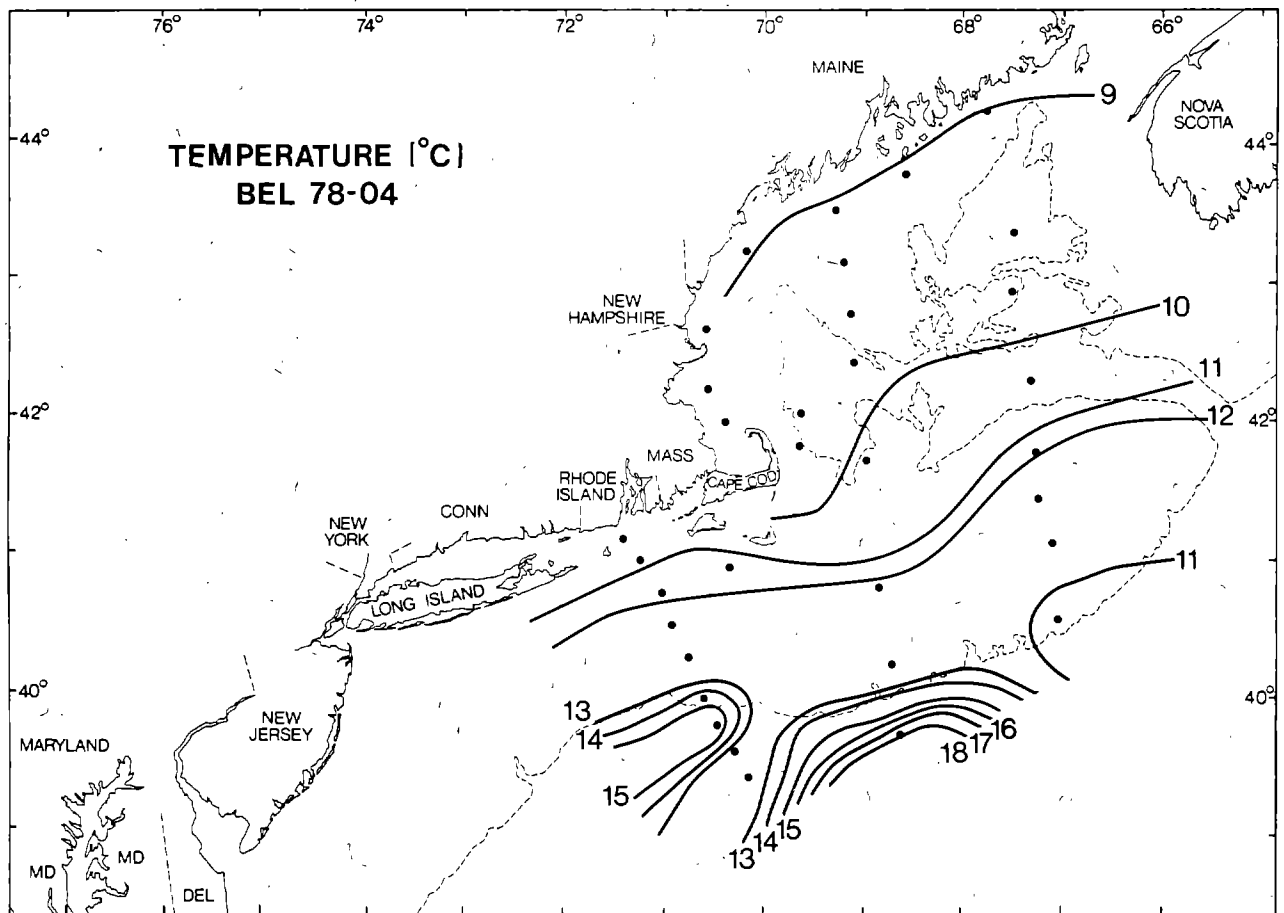
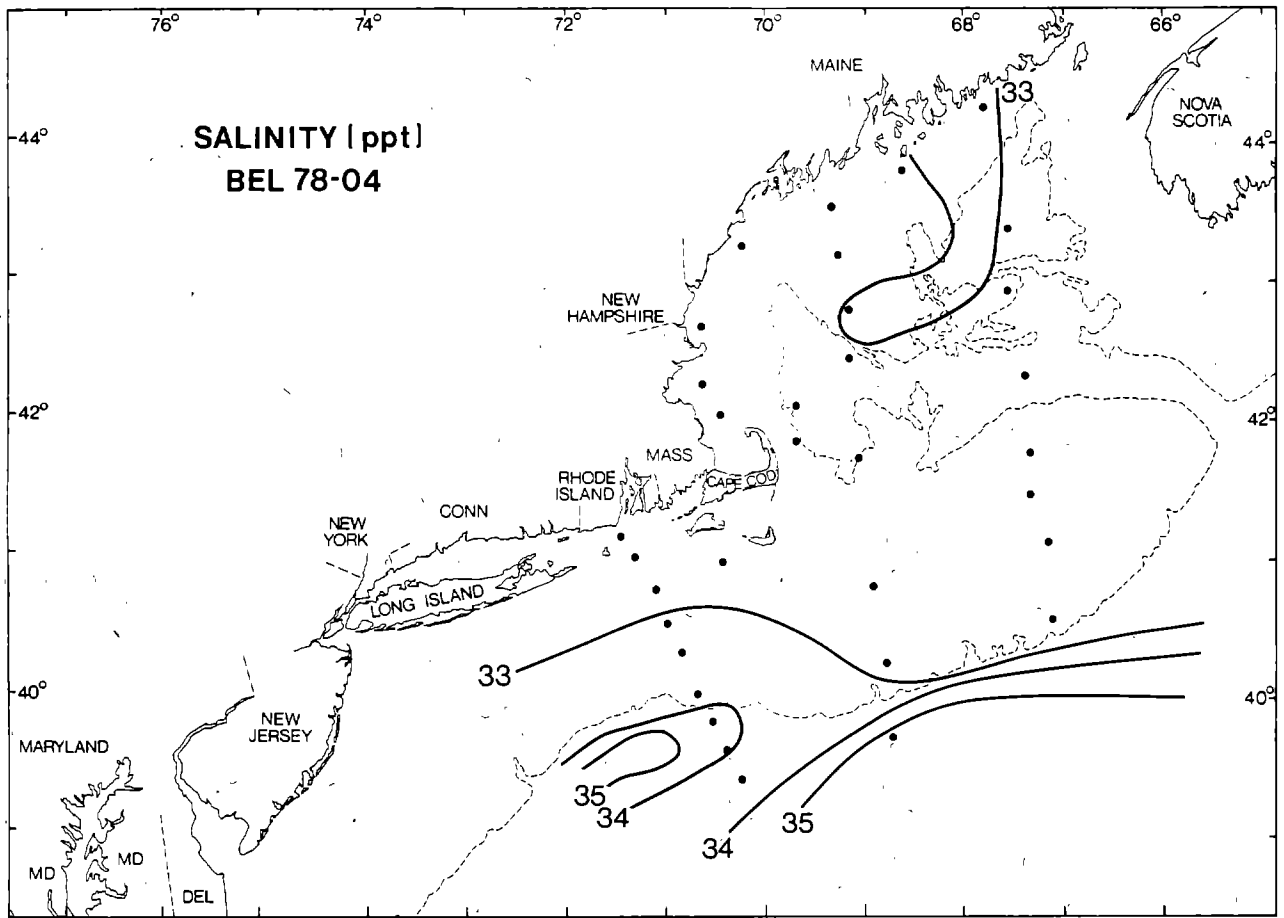


Figure 2. Salinity (ppt) and temperature (°C) determinations for cruise BEL-78-04.

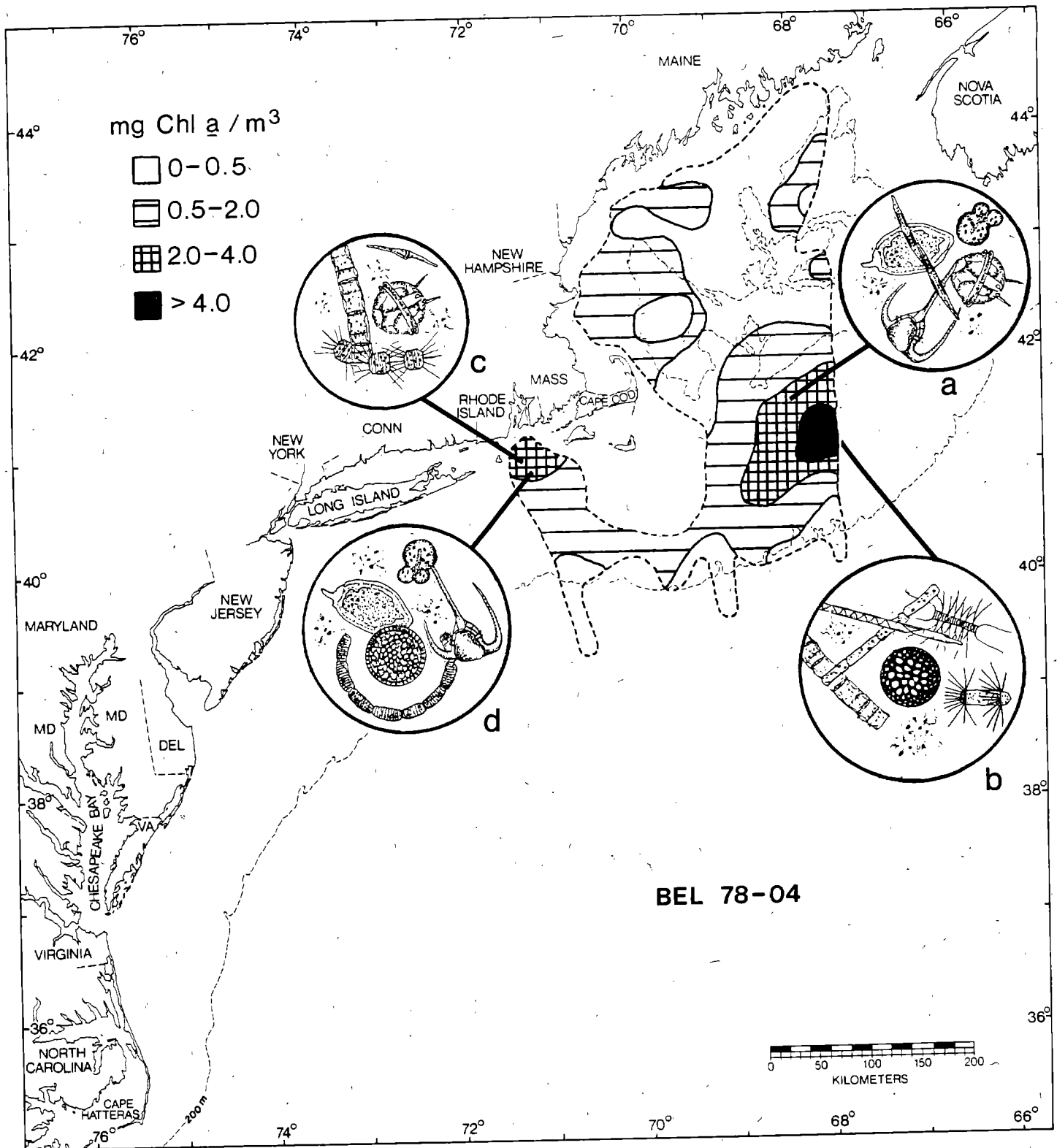


Figure 3. Some phytoplankters identified in areas of high chlorophyll *a* (determined by Christine Evans, NMFS): (a) *Nitzschia pungens*, *Gymnodinium dissimile*, *Prorocentrum micans*, *Protoperidinium* sp., *Ceratium tripos*, *Rhizosolenia alata*, *R. delicatula*, *R. stolterfothi*, *Corethron criophilum*, *Chaetoceros decipiens*, *Guinardia flaccida*, *Coscinodiscus radiatus*, nanoplankton; (b) *Nitzschia pungens*, *Protoperidinium* sp., *Thalassiosira* sp., nanoplankton; (c) *Nitzschia pungens*, *Protoperidinium* sp., *Thalassiosira* sp., nanoplankton; (d) *Gymnodinium dissimile*, *Ceratium tripos*, *Rhizosolenia stolterfothi*, *Coscinodiscus lineatus*, *Prorocentrum micans*, nanoplankton.

Table 1. Various data, species diversity and coordinates for stations in the Belogorsk 78-04 cruise.

S T A T I O N S

	<u>76</u>	<u>77</u>	<u>78</u>	<u>79</u>	<u>80</u>	<u>81</u>	<u>82</u>	<u>83</u>	<u>84</u>	<u>88</u>	<u>95</u>
Depth (m)	26	36	52	60	86	132	320	1600	2300	43	80
Wind speed (k)	23	24	15	15	20	27	13	7	4	13	27
Wind direction	90	15	30	245	270	280	320	46	40	110	320
Surf. temp. °C	10.68	10.78	11.30	12.8	12.4	12.6	15.5	12.1	12.5	11.08	8.85
Cloud cover	8	8	8	8	8	8	4	8	8	7	8
Wave ht. (m)	2.5	2.8	3.0	3.0	4.0	3.8	1.8	2.0	1.6	0.9	2.5
Salinity	32.36	32.51	32.70	33.6	33.5	33.5	35.0	34.0	33.6	32.44	32.51
Sp. diversity	1.485	1.449	1.993	2.478	2.291	2.757	0.427	1.133	2.337	0.138	0.322
Latitude (N)	41.19.0	41.08.8	40.57	40.40	40.21	40.10	39.59	39.46	39.37	41.02.5	41.57.4
Longitude (W)	71.19.9	71.14.9	71.11	71.02	70.51	70.46	70.40	70.36	70.30	70.31.9	69.49.8

	<u>96</u>	<u>97</u>	<u>98</u>	<u>99</u>	<u>102</u>	<u>104</u>	<u>105</u>	<u>106</u>	<u>108</u>	<u>112</u>	<u>114</u>
Depth (m)	216	60	70	126	95	90	152	208	210	74	78
Wind speed (k)	33	21	18	12	10	11	5	16	16	17	18
Wind direction	340	330	345	60	130	100	60	30	115	50	50
Surf. temp. °C	9.10	8.97	9.02	8.54	8.80	8.86	9.14	9.02	10.15	12.10	12.13
Cloud cover	8	6	8	8	9	8	-	4	8	7	8
Wave ht. (m)	2.5	2.0	2.7	3.0	1.0	0.5	1.0	1.5	1.8	1.8	2.0
Salinity	32.73	32.33	32.21	32.24	32.68	32.90	32.05	33.01	32.42	32.56	32.75
Sp. diversity	2.420	1.722	2.615	0.170	0.394	0.579	1.509	2.610	1.951	2.172	0.773
Latitude (N)	42.15.5	42.07.0	42.26.3	42.47.6	43.24.0	43.39.4	42.58.1	42.34.8	41.54.3	40.55.7	40.24.6
Longitude (W)	69.43.3	70.21.2	70.38.0	70.32.2	70.13.3	69.22.2	69.17.4	69.13.4	69.10.2	69.05.7	69.03.4

	<u>116</u>	<u>138</u>	<u>141</u>	<u>143</u>	<u>145</u>	<u>146</u>	<u>147</u>	<u>148</u>	<u>150</u>	<u>182</u>	<u>183</u>
Depth (m)	1900	80	70	210	228	28	29	29	75	240	158
Wind speed (k)	17	8	10	19	13	18	16	12	12	14	6
Wind direction	30	20	360	360	340	300	290	290	300	340	100
Surf. temp. °C	18.60	8.92	8.86	9.74	10.31	12.04	12.10	12.66	11.20	9.70	9.06
Cloud cover	9	4	5	8	0	0	0	1	3	4	6
Wave ht. (m)	1.5	.4	.8	1.8	2.1	1.5	1.4	1.5	1.2	1.5	0.5
Salinity	35.47	33.03	33.09	32.84	35.52	32.48	32.46	32.36	32.60	32.84	32.98
Sp. diversity	2.883	3.074	0.186	2.372	1.768	0.970	1.753	1.279	1.626	1.517	2.417
Latitude (N)	39.51.8	43.56.3	44.20.0	42.46.5	42.18.3	41.48.3	41.28.1	41.15.9	40.37.0	42.23.0	43.17.9
Longitude (W)	68.59.8	68.31.2	67.41.5	67.42.2	67.42.1	67.43.7	67.42.5	67.41.4	67.40.5	67.51.4	69.20.0

Table 2. Phytoplankton composition observed at near and far shore stations off New England coastal waters between Rhode Island and Maine in November 1978. Numbers refer to average station concentrations in numbers of cells per liter.

<u>Bacillariophyceae</u>	Near Shore	Far Shore
<i>Achnanthes</i> sp.	.4	---
<i>Actinopterychus senarius</i> Ehrenberg	61.6	43.8
<i>Actinopterychus splendens</i> Ralfs	2.4	---
<i>Amphora arenaria</i> Donkin	---	.4
<i>Amphora crassa</i> Gregory	13.2	---
<i>Asterionella glacialis</i> Castracane	38.4	---
<i>Asterolampra marylandica</i> Ehrenberg	.8	.1
<i>Asteromphalus flabellatus</i> (Brebisson) Greville	2.4	---
<i>Biddulphia alternans</i> (Bailey) Van Heurck	---	3.6
<i>Biddulphia aurita</i> (Lyngbye) Brebisson	---	.2
<i>Biddulphia regia</i> (Schultze) Ostenfeld	1.6	---
<i>Campylodiscus limbatus</i> Brebisson	1.2	---
<i>Cerataulina pelagica</i> (Cleve) Hendey	5.2	12.2
<i>Chaetoceros</i> sp.	4.0	3.3
<i>Chaetoceros atlanticum</i> Cleve	1.2	8.2
<i>Chaetoceros coarctatum</i> Lauder	24.4	15.6
<i>Chaetoceros concavicornis</i> Mangin	---	3.3
<i>Chaetoceros costatum</i> Pavillard	---	.8
<i>Chaetoceros danicum</i> Cleve	2.0	2.6
<i>Chaetoceros decipiens</i> Cleve	7.5	62.8
<i>Chaetoceros pendulum</i> Karsten	---	2.2
<i>Chaetoceros peruvianum</i> Brightwell	---	.8
<i>Chaetoceros sociale</i> Lauder	---	16.4
<i>Climacodium frauenfeldianum</i> Grunow	1.2	1.6
<i>Cocconeis scutellum</i> Ehrenberg	.4	---
<i>Corethron criophilum</i> Castracane	12.6	47.0
<i>Coscinodiscus</i> sp.	24.4	34.7
<i>Coscinodiscus asteromphalus</i> Ehrenberg	---	2.0
<i>Coscinodiscus centralis</i> Ehrenberg	3.6	---
<i>Coscinodiscus grani</i> Gough	13.2	---
<i>Coscinodiscus granulatus</i> Grunow	1.2	1.6
<i>Coscinodiscus lineatus</i> Ehrenberg	111.6	18.6
<i>Coscinodiscus marginatus</i> Ehrenberg	50.4	4.2
<i>Coscinodiscus nitidus</i> Gregory	12.4	7.3
<i>Coscinodiscus nobilis</i> Grunow	1.6	---
<i>Coscinodiscus oculus iridis</i> Ehrenberg	---	5.6
<i>Coscinodiscus radiatus</i> Ehrenberg	6.0	25.6
<i>Coscinodiscus stellaris</i> var. <i>symbolophora</i> (Grunow) Jorgensen	---	18.0
<i>Coscinodiscus sub-bulliens</i> Jorgensen	3.2	---
<i>Coscinodiscus wailesii</i> Gran and Angst	20.0	25.8
<i>Cyclotella caspia</i> Grunow	13.6	---
<i>Cylindrotheca closterium</i> (Ehrenberg) Reimann and Lew	18.0	14.7
<i>Dimerogramma</i> sp.	---	1.0
<i>Diploneis crabro</i> Ehrenberg	---	1.2
<i>Ditylum brightwellii</i> (West) Grunow	3.6	14.2

Table 2. (continued)

	Near Shore	Far Shore
<i>Eucampia zoodiacus</i> Ehrenberg	1.2	---
<i>Guinardia flaccida</i> (Castracane) Peragallo	130.0	236.2
<i>Gyrosigma balticum</i> (Ehrenberg) Cleve	---	20.0
<i>Gyrosigma hippocampus</i> (Ehrenberg) Hassall	---	.4
<i>Hemiaulus hauckii</i> Grunow	1.2	---
<i>Hemiaulus sinensis</i> Greville	.8	---
<i>Hemidiscus cuneiformis</i> Wallich	.4	---
<i>Lauderia borealis</i> Gran	.8	13.6
<i>Leptocylindrus danicus</i> Cleve	33.6	3161.1
<i>Leptocylindrus minimus</i> Gran	13.6	43.2
<i>Licmophora flabellata</i> (Carmichael) Agardh	.4	---
<i>Licmophora paradoxa</i> var. <i>tineya</i> (Agardh) Hustedt	.4	---
<i>Melosira moniliformis</i> (Muller) Agardh	---	1.6
<i>Navicula</i> sp.	6.8	.4
<i>Navicula directa</i> (Smith) Cleve	.4	---
<i>Navicula hennedyi</i> W. Smith	2.0	---
<i>Navicula palpebralis</i> (Brebisson) Smith	2.4	---
<i>Nitzschia</i> sp.	6.4	---
<i>Nitzschia lorenziana</i> Grunow	11.6	---
<i>Nitzschia pungens</i> Grunow	4.2	569.6
<i>Nitzschia recta</i> Grunow	.8	---
<i>Nitzschia seriata</i> Cleve	29.8	---
<i>Nitzschia spathulata</i> Brebisson	.4	---
<i>Paralia sulcata</i> (Ehrenberg) Cleve	91.2	77.5
<i>Plagiogramma vanheurckii</i> Grunow	0.4	---
<i>Plagiogramma staurophorum</i> (Gregory) Heilberg	15.6	10.8
<i>Pleurosigma</i> sp.	9.2	---
<i>Pleurosigma angulatum</i> (Quekett) W. Smith	.8	16.9
<i>Pleurosigma elongatum</i> W. Smith	6.4	3.2
<i>Pleurosigma hamuliferum</i> Brun	12.8	.8
<i>Pleurosigma normani</i> Ralfs	50.4	1.2
<i>Rhaphoneis amphiceros</i> Ehrenberg	---	5.4
<i>Rhaphoneis surirella</i> (Ehrenberg) Grunow	---	.8
<i>Rhizosolenia alata</i> Brightwell	81.8	147.1
<i>Rhizosolenia alata</i> f. <i>gracillima</i> (Cleve) Grunow	---	3.8
<i>Rhizosolenia alata</i> f. <i>indica</i> (Peragallo) Gran	.4	1.8
<i>Rhizosolenia bergonii</i> Peragallo	---	.4
<i>Rhizosolenia calcar-avis</i> Schultze	.4	.4
<i>Rhizosolenia delicatula</i> Cleve	21.6	39.2
<i>Rhizosolenia fragilissima</i> Bergon	1.6	.6
<i>Rhizosolenia hebetata</i> f. <i>hiemalis</i> Gran	65.6	---
<i>Rhizosolenia hebetata</i> f. <i>semispina</i> (Hensen) Gran	---	12.3
<i>Rhizosolenia imbricata</i> Brightwell	130.0	32.6
<i>Rhizosolenia imbricata</i> var. <i>shrubsolei</i> (Cleve) Van Heurck	3.6	---
<i>Rhizosolenia setigera</i> Brightwell	20.4	1.8
<i>Rhizosolenia stolterfothii</i> Peragallo.	106.4	181.1
<i>Rhizosolenia styliiformis</i> Brightwell	1.2	20.1

Table 2. (continued)

	Near Shore	Far Shore
<i>Schroederella delicatula</i> (Peragallo) Pavillard	10.4	2.0
<i>Stauroneis amphioxys</i> Gregory	.4	.8
<i>Stephanopyxis palmeriana</i> (Greville) Grunow	16.4	---
<i>Striatella unipunctata</i> (Lyngbye) Agardh	3.6	---
<i>Synedra</i> sp.	---	1.0
<i>Synedra tabulata</i> var. <i>fasciculata</i> (Lyngbye) Hustedt	---	.6
<i>Tabellaria fenestrata</i> var. <i>asterionelloides</i> Grunow	---	3.2
<i>Thalassionema nitzschioides</i> Hustedt	434.8	103.3
<i>Thalassiosira aestivalis</i> Gran and Angst	3.6	---
<i>Thalassiosira decipiens</i> (Grunow) Jorgensen	7.6	30.0
<i>Thalassiosira delicatula</i> Ostenfeld	---	.2
<i>Thalassiosira gravida</i> Cleve	45.0	84.0
<i>Thalassiosira nordenskioldii</i> Cleve	442.0	9.0
<i>Thalassiosira rotula</i> Meunier	109.2	3.3
<i>Thalassiothrix frauenfeldii</i> Grunow	533.8	115.1
<i>Triceratium favus</i> Ehrenberg	1.2	---
Unidentified pennate diatoms >20 microns	---	5.5

Dinophyceae

<i>Amphidinium</i> sp.	.4	.2
<i>Amphidinium acutissimum</i> Schiller	---	13.0
<i>Amphidinium acutum</i> Lahmann	---	.6
<i>Amphidinium carterae</i> Hulburt	.4	---
<i>Amphidinium crassum</i> Lohmann	3.6	---
<i>Amphidinium sphenoides</i> Wulff	1.6	.8
<i>Amphidinium wislouchi</i> Hulburt	.4	---
<i>Amphidoma</i> sp.	1.6	---
<i>Amphisolenia globifera</i> Stein	.4	---
<i>Ceratium bucephalum</i> Cleve	.8	---
<i>Ceratium contrarium</i> (Gourret) Pavillard	---	.4
<i>Ceratium extensum</i> (Gourret) Cleve	---	1.4
<i>Ceratium furca</i> (Ehrenberg) Claparede and Lachmann	---	2.8
<i>Ceratium fusus</i> (Ehrenberg) DuJardin	3.6	3.7
<i>Ceratium horridum</i> (Cleve) Gran	.4	---
<i>Ceratium lineatum</i> (Ehrenberg) Cleve	12.8	14.8
<i>Ceratium macroceros</i> (Ehrenberg) VanHoffen	1.2	.4
<i>Ceratium massiliense</i> (Gourret) Jorgensen	.8	---
<i>Ceratium minutum</i> Jorgensen	.8	4.8
<i>Ceratium pentagonum</i> Gourret	.4	.4
<i>Ceratium teres</i> Kofoid	.4	---
<i>Ceratium trichoceros</i> (Ehrenberg) Kofoid	---	.8
<i>Ceratium tripos</i> (Muller) Nitzsch	4.8	20.0
<i>Ceratium tripos</i> var. <i>atlanticum</i> (Ostenfeld) Paulsen	8.0	22.0
<i>Cochlodinium constrictum</i> (Schutt) Lemmerman	1.2	---
<i>Dinophysis</i> sp.	.4	---
<i>Dinophysis acuminata</i> Claparede and Lachmann	2.4	---
<i>Dinophysis acuta</i> Ehrenberg	.8	---
<i>Dinophysis fortii</i> Pavillard	---	2.8
<i>Dinophysis lachmannii</i> Paulsen	.4	---

Table 2. (continued)

	Near Shore	Far Shore
<i>Dinophysis microterygia</i> Dang	---	1.6
<i>Dinophysis norvegica</i> Claparede and Lachmann	.4	---
<i>Dinophysis ovum</i> Schutt	---	.7
<i>Dinophysis sphaerica</i> Stein	---	.5
<i>Diplopsalis lenticula</i> Bergh	.8	---
<i>Glenodinium</i> sp.	---	.1
<i>Glenodinium lenticula</i> (Bergh) Schiller	.8	---
<i>Goniaulax</i> sp.	1.2	---
<i>Goniaulax birostris</i> Stein	.4	---
<i>Goniaulax diacantha</i> (Meunier) Schiller	4.0	---
<i>Goniaulax diegensis</i> Kofoid	---	5.2
<i>Goniaulax excavata</i> (Braarud) Balech	1.6	6.4
<i>Goniaulax polyedra</i> Stein	1.2	---
<i>Goniaulax polygramma</i> Stein	.8	---
<i>Goniaulax spinifera</i> (Claparede and Lachmann) Diesing	.4	---
<i>Goniaulax unicornis</i> Lebour	.4	---
<i>Gymnodinium</i> sp.	.4	10.5
<i>Gymnodinium arcticum</i> Wulff	---	1.4
<i>Gymnodinium danicans</i> Campbell	.4	---
<i>Gymnodinium dissimile</i> Kofoid and Swezy	4.8	2.7
<i>Gymnodinium minutum</i> Hulburt	.4	---
<i>Gymnodinium nelsoni</i> Martin	7.2	---
<i>Gymnodinium simplex</i> (Lohmann) Kofoid and Swezy	1.2	---
<i>Gymnodinium splendens</i> Lebour	2.4	---
<i>Gymnodinium stellatum</i> Hulburt	4.0	---
<i>Gyrodinium</i> sp.	7.6	1.4
<i>Gyrodinium dominans</i> Hulburt	.8	---
<i>Gyrodinium estuariale</i> Hulburt	.4	---
<i>Gyrodinium fusiforme</i> Kofoid and Swezy	17.6	---
<i>Gyrodinium gloeculum</i> Hulburt	1.2	---
<i>Gyrodinium metum</i> Hulburt	4.0	---
<i>Gyrodinium pellucidum</i> Wulff	4.0	---
<i>Gyrodinium spirale</i> (Bergh) Kofoid and Swezy	.8	---
<i>Gyrodinium undulans</i> Hulburt	.8	---
<i>Gyrodinium uncatenum</i> Hulburt	8.0	---
<i>Hemidinium</i> sp.	.4	---
<i>Heterocapsa triquetra</i> (Ehrenberg) Stein	17.6	.4
<i>Katodinium rotundatum</i> (Lohmann) Loeblich	21.2	---
<i>Noctiluca miliaris</i> Suriray	1.2	---
<i>Orithocercus thurni</i> (Schmidt) Kofoid and Skogsberg	---	.2
<i>Oxytoxum</i> sp.	.4	---
<i>Oxytoxum sceptrum</i> (Stein) Schroder	---	.2
<i>Oxytoxum scolopax</i> Stein	.4	1.2
<i>Oxytoxum sphaeroides</i> Stein	1.2	---
<i>Podolampas elegans</i> Schutt	---	.1
<i>Prorocentrum</i> sp.	.8	1.3
<i>Prorocentrum aponum</i> (Schiller) Dodge	9.2	---
<i>Prorocentrum dentatum</i> Stein	---	3.8
<i>Prorocentrum maximum</i> (Gourret) Schiller	.8	---

Table 2. (continued)

	<u>Near Shore</u>	<u>Far Shore</u>
<i>Prorocentrum micans</i> Ehrenberg	187.4	459.9
<i>Prorocentrum minimum</i> (Pavillard) Schiller	8.0	---
<i>Prorocentrum rostratum</i> Stein	2.8	---
<i>Proto-peridinium</i> sp.	6.4	---
<i>Proto-peridinium abei</i> (Paulsen) Balech	.4	---
<i>Proto-peridinium brevipes</i> (Paulsen) Balech	3.2	---
<i>Proto-peridinium cerasus</i> (Paulsen) Balech	6.4	6.4
<i>Proto-peridinium conicum</i> (Gran) Balech	3.2	---
<i>Proto-peridinium depressum</i> (Bailey) Balech	---	.4
<i>Proto-peridinium leonis</i> (Pavillard) Balech	1.6	---
<i>Proto-peridinium nipponicum</i> (Abe) Ballech	---	.4
<i>Proto-peridinium oblongum</i> (Aurivallis) Parke and Dodge	.8	---
<i>Proto-peridinium oceanicum</i> (VanHoffen) Balech	1.2	---
<i>Proto-peridinium ovatum</i> Pouchet	.8	---
<i>Proto-peridinium pallidum</i> (Ostenfeld) Balech	1.6	---
<i>Proto-peridinium pellucidum</i> Bergh	.8	---
<i>Proto-peridinium pentagonum</i> (Gran) Balech	4.8	---
<i>Proto-peridinium steinii</i> (Jorgensen) Balech	---	.2
<i>Proto-peridinium subinermis</i> (Paulsen) Balech	.4	---
<i>Scrippsiella trochoidea</i> (Stein) Loeblich	11.6	---
Unidentified dinoflagellate cysts	11.2	---
Unidentified dinoflagellates	---	7.8
<u>Haptophyceae</u>		
<i>Acanthecca aculeata</i> Kamptner	.4	---
<i>Coccolithus pelagicus</i> (Wallich) Schiller	3.6	---
<i>Cyclococcolithus leptoporus</i> (Murray and Blackman) Kamptner	.4	426.5
<i>Discosphaera tubifer</i> (Murray and Blackman) Ostenfeld	.4	.4
<i>Emiliana huxleyi</i> (Lohmann) Hay and Mohler	22.8	21.2
<i>Helicosphaera carteri</i> (Wallich) Kamptner	1.6	1.6
<i>Hymenomonas carterae</i> (Braarud and Fagerland) Braarud	4.8	---
<i>Hymenomonas roseola</i> Stein	3.2	12.0
<i>Pontosphaera syracusana</i> Lohmann	.4	---
<i>Rhabdosphaera claviger</i> Murray and Blackman	.4	---
<i>Scyphosphaera apsteini</i> Lohmann	.8	---
<i>Syracosphaera pulchra</i> Lohmann	3.2	---
Unidentified coccolithophores	16.4	3.2

Table 2. (continued)

	<u>Near Shore</u>	<u>Far Shore</u>
<u>Chrysophyceae</u>		
<i>Calycomonas ovalis</i> Wulff	2.0	---
<i>Dictyocha fibula</i> Ehrenberg	19.8	91.0
<i>Distephanus speculum</i> (Ehrenberg) Haekel	29.2	93.9
<i>Ebria tripartita</i> (Schumann) Lemmermann	2.4	---
<i>Mallomonas</i> sp.	2.4	---
<i>Olisthodiscus luteus</i> Carter	5.2	1.6
<u>Cyanophyceae</u>		
<i>Anacystis marina</i> (Hansg) Drouet and Daily	---	180.3
<i>Nostoc commune</i> Vaucher	---	.2
<i>Oscillatoria erythraea</i> (Ehrenberg) Kutzing	---	.8
<i>Oscillatoria submembranacea</i> Ardissonne and Strafforel	---	2.3
<u>Euglenophyceae</u>		
<i>Euglena</i> sp.	4.8	.8
<i>Euglena acus</i> Ehrenberg	.4	---
<i>Eutreptia marina</i> Cunha	.4	---
<i>Eutreptia viridis</i> Perty	7.6	---
<u>Chlorophyceae</u>		
<i>Nannochloris atomus</i> Butcher	11673.2	1776.0
<i>Staurastrum leptocladum</i> var. <i>insidne</i> West and West	---	.6
<u>Cryptophyceae</u>		
<i>Chilomonas marina</i> Ehrenberg	8.4	1.6
<i>Chroomonas amphioxeia</i> (Conrad) Butcher	.8	---
<i>Chroomonas salina</i> (Wislouch) Butcher	.8	---
<i>Chroomonas vectensis</i> Carter	9.2	.4
<i>Cryptomonas stigmatica</i> Wislouch	8.4	---
<i>Rhodomonas amphioxeia</i>	2.0	---
<u>Xanthophyceae</u>		
<i>Monodus guttula</i> Pascher	---	426.4
<u>Prasinophyceae</u>		
<i>Bipeadinomonis pyriformis</i> Carter	.4	---
<i>Pyramimonas grossii</i> Parke	---	1047.4
<i>Pyramimonas micron</i> Conrad and Kufferath	.8	2.0
<i>Pyramimonas obovata</i> Carter	.4	---

Appendix I. Concentrations of phytoplankton observed at stations from the Belogorsk 78-04 cruise.

<u>Station 76</u>	<u>Cells/ Liter</u>		<u>Cells/ Liter</u>
Nannochloris atomus	54000	Ditylum brightwellii	40
Dictyocha fibula	144	Asterionella glacialis	768
Distephanus speculum	172	Thalassiothrix frauenfeldii	152
Ebria tripartita	24	Thalassionema nitzschioides	3048
Olisthodiscus luteus	24	Licmophora flabellata	8
Acanthoica aculeata	8	Licmophora paradoxa v. tinctoria	8
Syracosphaera pulchra	64	Striatella unipunctata	40
Unidentified coccolithophorids	128	Plagiogramma staurorophorum	88
Emiliana huxleyii	80	Cocconeis scutellum	8
Discosphaera tubifera	8	Navicula sp.	56
Helicosphaera carteri	16	Navicula palpebralis	40
Paralia sulcata	964	Stauroneis amphyoxis	8
Stephanopyxis palmeriana	328	Pleurosigma sp.	184
Corethron criophilum	72	Pleurosigma angulatum	16
Leptocylindrus danicus	672	Pleurosigma normani	600
Leptocylindrus minimus	272	Amphora crassa	192
Cyclotella caspia	152	Nitzschia sp.	80
Thalassiosira decipiens	56	Nitzschia pungens	84
Thalassiosira gravida	636	Nitzschia seriata	400
Thalassiosira nordenskioldii	1760	Nitzschia spathulata	8
Coscinodiscus sp.	104	Cylindrotheca closterium	304
Coscinodiscus centralis	48	Campylodiscus sp.	24
Coscinodiscus grani	240	Prorocentrum micans	136
Coscinodiscus marginatus	800	Prorocentrum apora	64
Coscinodiscus nitidus	40	Dinophysis acuminata	16
Coscinodiscus radiatus	20	Unidentified dinoflagellates	8
Coscinodiscus wailesii	32	Amphidinium crassum	56
Coscinodiscus granulatus	24	Gymnodinium splendens	48
Coscinodiscus sub-bulliens	40	Gyrodinium uncatenum	24
Actinopterychus senarius	464	Katodinium rotundatum	24
Asteromphalus flabellatus	32	Noctiluca miniaris	8
Hemidiscus cuneiformis	8	Diplopsalis lenticula	16
Triceratium favus	24	Glenodinium lenticula	8
Eucampia zodiacus	24	Heterocapsa triquetra	56
Hemiaulus sinensis	16	Protooperidinium sp.	80
Chaetoceros sp.	8	Protooperidinium pellucidum	16
Chaetoceros atlanticum	24	Scripsiella trochoidea	16
Chaetoceros coarctatum	200	Protooperidinium oceanicum	24
Rhizosolenia alata	1344	Protooperidinium oblongum	16
Rhizosolenia alata f. indica	8	Gonyaulax sp.	24
Rhizosolenia calcar-avis	8	Gonyaulax diacantha	8
Rhizosolenia delicatula	248	Gonyaulax polygramma	16
Rhizosolenia fragilissima	24	Gonyaulax birostris	8
Rhizosolenia hebetata f. hemiaulus	120	Ceratium fusus	8
Rhizosolenia imbricata	360	Ceratium lineatum	28
Rhizosolenia imbricata v. shruvsolei	72	Ceratium macroceros v. gallium	24
Rhizosolenia setigera	184	Ceratium pentagonum	8
Rhizosolenia stolyfothii	1152	Ceratium tripos	8
Rhizosolenia styliformis	24	Ceratium massiliense	8
Guinardia flaccida	700	Ceratium minutum	16

	<u>Cells/ Liter</u>		<u>Cells/ Liter</u>
Chilomonas mariana	40	Pleurosigma elongatum	128
Chroomonas vectensis	128	Pleurosigma hamuliferum	256
Cryptomonas stigmatica	56	Pleurosigma normani	392
Rhodomonas amphioxeia	40	Amphora crassa	72
		Nitzschia sp.	40
		Nitzschia seriata	140
		Euglenophyceae euglenales Euglena sp.	96
		Unidentified dinoflagellate cysts	224
<u>Station 77</u>		Prorocentrum micans	3580
Nannochloris atomus	101024	Prorocentrum maximum	16
Mallomonas sp.	48	Dinophysis norvegica	8
Dictyocha fibula	252	Dinophysis lachmanii	8
Distephanus speculum	388	Amphidinium crassum	16
Ebria tripartita	16	Cochlodinium constrictum	16
Pontosphaera huxleyi	8	Gymnodinium dissimile	96
Unidentified coccolithophorids	112	Gyrodinium sp.	16
Coccolithus pelagicus	8	Gyrodinium fusiforme	352
Emiliana huxleyii	40	Heterocapsa triquetra	16
Cyclococcolithus leptoporus	8	Protoperidinium sp.	24
Rhabdosphaera claviger	8	Scripsiella trochoidea	16
Paralia sulcata	860	Gonyaulax diacantha	8
Corethron criophilum	132	Ceratium fusus	24
Cyclotella caspia	104	Ceratium lineatum	212
Thalassiosira aestivalis	72	Ceratium tripos var. atlanticum	160
Thalassiosira decipiens	96	Ceratium teres	8
Thalassiosira gravis	264	Chilomonas marina	64
Thalassiosira nordenskioldii	7048	Chroomonas vectensis	8
Thalassiosira rotula	2184	Cryptomonas stigmatica	32
Lauderia annulata	16		
Coscinodiscus sp.	384		
Coscinodiscus grani	24		
Coscinodiscus lineatus	2208	<u>Station 78</u>	
Coscinodiscus marginatus	112	Dictyocha fibula	232
Coscinodiscus nitidus	160	Distephanus speculum	392
Coscinodiscus radiatus	100	Corethron criophilum	32
Coscinodiscus wailesii	152	Thalassiosira gravis	1400
Coscinodiscus sub-bulliens	8	Coscinodiscus sp.	64
Actinoptychus splendens	48	Coscinodiscus nitidus	16
Actinoptychus senarius	768	Coscinodiscus radiatus	176
Asteromphalus flabellatus	16	Coscinodiscus granulatus	32
Asterolampra marylandica	16	Actinoptychus senarius	160
Hemiaulus hauckii	16	Rhizosolenia alata	8
Chaetoceros coarctatum	288	Rhizosolenia alata f. gracillima	32
Chaetoceros danicum	40	Rhizosolenia delicatula	8
Rhizosolenia alata	260	Rhizosolenia setigera	24
Rhizosolenia hebetata f. hemiaulus	1192	Rhizosolenia stolterfothii	1288
Rhizosolenia imbricata	2240	Guinardia flaccida	56
Rhizosolenia setigera	176	Synedra sp.	8
Rhizosolenia stolterfothii	352	Thalassiothrix frauenfeldii	1456
Guinardia flaccida	1892	Plagiogramma staurophorum	112
Thalassiothrix frauenfeldii	10496	Gyrosigma balticum	400
Thalassionema nitzschioides	5624	Nitzschia pungens	24
Plagiogramma staurophorum	224	Nitzschia lorenziana	232
Navicula sp.	72		

	<u>Cells/ Liter</u>
Prorocentrum micans	4760
Dinophysis fortii	16
Ceratium lineatum	24
Ceratium tripos var. atlanticum	344
Ceratium trichoceros	8
Ceratium contortum	8

Station 79

Oscillatoria submembranacea	4
Dictyocha fibula	68
Distephanus speculum	34
Cyclococcolithus leptoporus	389
Paralia sulcata	10
Corethron criophilum	53
Leptocylindrus danicus	66
Leptocylindrus minimus	78
Coscinodiscus sp.	22
Coscinodiscus lineatus	42
Coscinodiscus radiatus	2
Chaetoceros sp.	4
Chaetoceros decipiens	42
Rhizosolenia alata	110
Rhizosolenia stolterfothii	56
Rhizosolenia styliformis	14
Guinardia flaccida	426
Ditylum brightwellii	2
Unidentified pennate diatom >20 microns	2
Thalassiothrix frauenfeldii	11
Thalassionema nitzschioides	188
Pleurosigma angulatum	38
Cylindrotheca closterium	2
Pyramimonas grossi	59
Prorocentrum micans	73
Ceratium fusus	2
Ceratium tripos	4
Podolampas elegans	1

Station 80

Hymenomonas roseola	240
Emiliana huxleyii	400
Paralia sulcata	5
Corethron criophilum	6
Leptocylindrus danicus	11
Thalassiosira delicatula	4
Coscinodiscus lineatus	41
Coscinodiscus wailesii	4
Chaetoceros concavicornis	3
Chaetoceros decipiens	6
Rhizosolenia alata	115
Rhizosolenia stolterfothii	40

	<u>Cells/ Liter</u>
Guinardia flaccida	121
Thalassiothrix frauenfeldii	5
Thalassionema nitzschioides	36
Pleurosigma angulatum	23
Pyramimonas grossi	98
Prorocentrum micans	26
Amphidinium sphenoides	16
Protoperidinium cerasus	32
Protoperidinium depressum	1
Gonyaulax excavata	128
Ceratium lineatum	2
Ceratium tripos	3

Station 81

Dictyocha fibula	256
Distephanus speculum	376
Paralia sulcata	96
Corethron criophilum	84
Leptocylindrus danicus	20
Thalassiosira gravida	164
Coscinodiscus lineatus	160
Coscinodiscus nitidus	4
Actinoptychus senarius	156
Chaetoceros atlanticum	72
Chaetoceros coarctatum	240
Rhizosolenia alata	136
Rhizosolenia delicatula	44
Rhizosolenia fragilissima	8
Rhizosolenia stolterfothii	100
Guinardia flaccida	916
Synedra sp.	8
Thalassiothrix frauenfeldii	84
Thalassionema nitzschioides	340
Rhaphoneis amphiceros	12
Pleurosigma elongatum	60
Nitzschia pungens	636
Cylindrotheca closterium	44
Prorocentrum micans	524
Dinophysis fortii	16
Amphidinium sp.	4
Amphidinium actutum	8
Amphidinium acutissimum	32
Gymnodinium dissimile	4
Protoperidinium nipponicum	8
Gonyaulax diegensis	8
Ceratium fusus	8
Ceratium lineatum	20
Ceratium pentagonum	8
Ceratium tripos var. atlanticum	23
Ceratium extensum	8
Oxytoxum sculpax	8

	<u>Cells/ Liter</u>		<u>Cells/ Liter</u>
<u>Station 82</u>		<u>Station 84</u>	
Dictyocha fibula	212	Dictyocha fibula	292
Distephanus speculum	4	Paralia sulcata	8
Monodus sp.	8528	Corethron criophilum	8
Corethron criophilum	8	Coscinodiscus lineatus	28
Leptocylindrus danicus	4	Actinoptychus senarius	316
Coscinodiscus nitidus	16	Rhizosolenia alata	8
Coscinodiscus radiatus	4	Rhizosolenia delicatula	164
Actinoptychus senarius	40	Guinardia flaccida	16
Chaetoceros peruvianum	8	Ditylum brightwellii	44
Rhizosolenia fragilissima	4	Thalassiothrix frauenfeldii	132
Guinardia flaccida	4	Pleurosigma angulatum	12
Ditylum brightwellii	8	Pleurosigma elongatum	4
Unidentified pennate diatom		Nitzschia pungens	688
>20 microns	8	Cylindrotheca closterium	36
Synedra sp.	4	Euglenophyceae euglenales Euglena sp.	8
Synedra tabulata v. fasciculata	8	Unidentified dinoflagellates	68
Thalassionema nitzschioides	8	Prorocentrum micans	32
Nitzschia pungens	336	Prorocentrum dentatum	60
Cylindrotheca closterium	16	Amphidinium acutissimum	44
Euglenophyceae euglenales Euglena sp.	4	Gymnodinium dissimile	8
Prorocentrum micans	20	Protopteridinium cerasus	32
Gyrodinium sp.	4	Gonyaulax diegensis	4
Ceratium fusus	12	Ceratium fusus	36
Ceratium minutum	8	Ceratium lineatum	60
Ceratium extensum	4	Ceratium tripos var. atlanticum	8
Oxytoxum scolpax	4	Ceratium minutum	12
		Oxytoxum scolpax	4
<u>Station 83</u>		<u>Station 88</u>	
Dictyocha fibula	3	Nannochloris atomus	35520
Corethron criophilum	4	Olisthodiscus luteus	32
Leptocylindrus danicus	390	Hymenomonas carteri	32
Leptocylindrus minimus	780	Unidentified coccolithophorids	64
Coscinodiscus lineatus	4	Emiliana huxleyii	24
Coscinodiscus radiatus	1	Discosphaera tubifera	8
Chaetoceros concavicornis	3	Thalassiosira rotula	24
Chaetoceros decipiens	4	Coscinodiscus marginatus	32
Ditylum brightwellii	2	Coscinodiscus nitidus	32
Unidentified pennate diatom		Climacodium frauenfeldianum	32
>20 microns	1	Guinardia flaccida	16
Thalassiothrix frauenfeldii	2	Thalassionema nitzschioides	128
Thalassionema nitzschioides	8	Navicula sp.	8
Pleurosigma angulatum	4	Stauroneis amphyoxis	16
Pyramimonas grossi	140	Pleurosigma normani	24
Prorocentrum micans	6	Amphora arenaria	8
Ceratium fusus	4	Pyramimonas micron	40
Ceratium tripos	5	Prorocentrum micans	40
Podolampas elegans	1	Gyrodinium sp.	8
		Heterocapsa triquetra	8
		Protopteridinium cerasus	24
		Chilomonas marina	32
		Chroomonas vectensis	8

	<u>Cells/ Liter</u>		<u>Cells/ Liter</u>
<u>Station 95</u>		Bipedinomonis pyriformis	8
Nannochloris atomus	10464	Eutreptia viridis	104
Olisthodiscus luteus	40	Prorocentrum micans	8
Hymenomonas carteri	40	Prorocentrum apora	32
Unidentified coccolithophorids	8	Dinophysis acuminata	8
Emiliana huxleyii	80	Amphidinium carterae	8
Helicosphaera carteri	8	Amphidinium sphenoides	24
Corethron criophilum	16	Amphidinium wislouchi	8
Coscinodiscus marginatus	8	Cochlodinium constrictum	8
Rhizosolenia stolterfothii	8	Gymnodinium nelsoni	16
Thalassiothrix frauenfeldii	8	Gyrodinium uncatenum	32
Thalassionema nitzschioides	16	Gyrodinium estauriale	8
Striatella unipunctata	16	Katodinium rotundatum	16
Achnanthes sp.	8	Noctiluca miliaris	16
Pyramimonas obovata	16	Heterocapsa triquetra	32
Eutreptia viridis	40	Protooperidinium sp.	24
Prorocentrum rostratum	24	Protooperidinium cerasus	40
Gymnodinium nelsoni	40	Protooperidinium ovatum	16
Gymnodinium danicans	8	Scropsiella trochoidea	40
Gyrodinium dominans	16	Protooperidinium pentagonum	16
Gyrodinium gloquema	24	Gonyaulax diacantha	24
Heterocapsa triquetra	8	Ceratium horridum	8
Scropsiella trochoidea	8	Chilomonas marina	16
Gonyaulax diacantha	16	Cryptomonas salina	8
Oxytoxum sphaeroideum	24		
Chilomonas marina	8	<u>Station 97</u>	
Chroomonas vectensis	16	Nannochloris atomus	3704
		Emiliana huxleyii	72
<u>Station 96</u>		Cyclotella caspia	16
Nannochloris atomus	1080	Coscinodiscus centralis	24
Distephanus speculum	8	Coscinodiscus lineatus	24
Ebria tripartita	8	Coscinodiscus marginatus	64
Syracosphaera sp.	8	Coscinodiscus nitidus	8
Hymenomonas carteri	16	Coscinodiscus wailesii	104
Pontosphaera syracusana	8	Coscinodiscus sub-bulliens	16
Unidentified coccolithophorids	24	Rhizosolenia stolterfothii	456
Coccolithus pelagicus	8	Nitzschia recta	8
Emiliana huxleyii	80	Prorocentrum micans	8
Corethron criophilum	32	Prorocentrum minimum	160
Thalassiosira nordenskioldii	32	Prorocentrum apora	80
Coscinodiscus marginatus	8	Unidentified dinoflagellates	8
Coscinodiscus nitidus	24	Gymnodinium nelsoni	88
Coscinodiscus wailesii	16	Gymnodinium stellatum	80
Climacodium frauenfeldianum	24	Gyrodinium pellucidum	80
Chaetoceros decipiens	56	Gyrodinium uncatenum	104
Rhizosolenia alata	32	Gyrodinium metum	80
Navicula directa	8	Katodinium rotundatum	360
Navicula hennedyii	24	Glenodinium lenticula	8
Pleurosigma normani	8	Heterocapsa triquetra	88
Phaeodactylum tricornutum	16	Scropsiella trochoidea	88
Nitzschia sp.	8	Ceratium fusus	24
Nitzschia seriata	56	Ceratium tripos	72
		Ceratium massiliense	8

	<u>Cells/ Liter</u>		<u>Cells/ Liter</u>
Ceratium bucephalum	16	Katodinium rotundatum	16
Chilomonas marina	24	Heterocapsa triquetra	24
Cryptomonas stigmatica	80	Protooperidinium brevipes	64
		Protooperidinium pallidum	32
		Scripsiella trochoidea	16
<u>Station 98</u>		Gonyaulax diacantha	16
Nannochloris atomus	56	Gonyaulax unicornis	8
Hymenomonas carteri	24	Ceratium tripos	16
Unidentified coccolithophorids	8	Oxytoxum sp.	8
Coccolithus pelagicus	8		
Emiliana huxleyii	48	<u>Station 102</u>	
Coscinodiscus wailesii	8	Nannochloris atomus	1160
Coscinodiscus nobilis	16	Hymenomonas carteri	8
Biddulphia regia	24	Coscinodiscus wailesii	16
Hemiaulus hauckii	8	Guinardia flaccida	8
Rhizosolenia setigera	8	Thalassionema nitzschioides	8
Dinophysis acuminata	8	Pyramimonas micron	8
Protooperidinium cerasus	48	Heterocapsa triquetra	24
Amphidoma sp.	32	Protooperidinium cerasus	8
Gonyaulax excavata	16	Protooperidinium subinermis	8
Chilomonas marina	16		
Chroomonas amphioxea	8	<u>Station 104</u>	
Cryptomonas salina	8	Nannochloris atomus	984
		Dictyocha fibula	1
<u>Station 99</u>		Coscinodiscus radiatus	1
Nannochloris atomus	54912	Coscinodiscus wailesii	24
Calycomonas ovalis	32	Chaetoceros decipiens	6
Olisthodiscus luteus	40	Thalassiothrix frauenfeldii	5
Hymenomonas roseola	40	Pleurosigma angulatum	1
Hymenomonas carteri	8	Amphidinium sphenoides	8
Syracosphaera apsteini	16	Heterocapsa triquetra	56
Unidentified coccolithophorids	32	Protooperidinium cerasus	16
Coccolithus pelagicus	48	Gonyaulax excavata	16
Emiliana huxleyii	48	Ceratium tripos	1
Halopappus sp.	8		
Helicosphaera carteri	8	<u>Station 105</u>	
Coscinodiscus wailesii	24	Cyclococcolithus leptoporus	1072
Coscinodiscus nobilis	16	Corethron criophilum	8
Biddulphia regia	8	Coscinodiscus stellaris	192
Chaetoceros sp.	72	Coscinodiscus wailesii	264
Rhizosolenia delicatula	184	Coscinodiscus oculus iridis	8
Rhizosolenia stolterfothii	160	Rhizosolenia alata	728
Thalassiothrix frauenfeldii	16	Rhizosolenia alata f. indica	32
Navicula sp.	8	Rhizosolenia hebetata f. semispina	24
Pyramimonas micron	8	Guinardia flaccida	32
Eutreptia marina	8	Prorocentrum micans	8
Euglena acus	8	Dinophysis sphaerica	8
Prorocentrum sp.	16	Ceratium tripos	64
Prorocentrum rostratum	32	Ceratium minutum	8
Gymnodinium simplex	24		
Gyrodinium sp.	136		

	<u>Cells/ Liter</u>		<u>Cells/ Liter</u>
<u>Station 106</u>		<u>Station 112</u>	
Distephanus speculum	8	Dictyocha fibula	632
Corethron criophilum	16	Distephanus speculum	912
Leptocylindrus danicus	12	Paralia sulcata	160
Coscinodiscus marginatus	12	Corethron criophilum	8
Coscinodiscus nitidus	4	Thalassiosira decipiens	600
Coscinodiscus radiatus	4	Coscinodiscus sp.	40
Coscinodiscus wailesii	36	Coscinodiscus wailesii	48
Actinoptychus senarius	48	Chaetoceros decipiens	512
Chaetoceros coarctatum	8	Rhizosolenia alata	800
Rhizosolenia alata	4	Rhizosolenia stolterfothii	72
Rhizosolenia alata f. gracillima	4	Rhizosolenia styliformis	48
Rhizosolenia styliformis	16	Guinardia flaccida	1440
Ditylum brightwellii	4	Thalassionema nitzschioides	176
Unidentified pennate diatom		Pleurosigma angulatum	120
>20 microns	72	Pyramimonas grossi	136
Plagiogramma staurophorum	4	Prorocentrum micans	2664
Tabellaria fenestriata v.		Ceratium furca	16
asterionelloides	44	Ceratium lineatum	16
Pleurosigma angulatum	12	Ceratium tripos	136
Nitzschia pungens	168		
Cylindrotheca closterium	12	<u>Station 114</u>	
Prorocentrum sp.	20	Dictyocha fibula	36
Amphidinium acutissimum	20	Distephanus speculum	24
Gymnodinium dissimile	20	Cyclcoccolithus leptoporus	72
Gymnodinium articum	4	Melosira moniliformis	32
Gonyaulax diegensis	4	Corethron criophilum	6
Ceratium lineatum	16	Lauderia borealis	216
Ceratium tripos var. atlanticum	8	Coscinodiscus lineatus	16
		Coscinodiscus radiatus	4
<u>Station 108</u>		Asterolampra marylandica	2
Oscillatoria submembranacea	2	Chaetoceros sp.	62
Dictyocha fibula	4	Chaetoceros pendulum	44
Distephanus speculum	1	Rhizosolenia alata	48
Corethron criophilum	2	Rhizosolenia alata f. gracillima	24
Coscinodiscus radiatus	42	Rhizosolenia hebetata f. semispina	24
Coscinodiscus wailesii	28	Rhizosolenia stolterfothii	44
Chaetoceros concavicornis	7	Guinardia flaccida	440
Rhizosolenia alata	7	Thalassiothrix frauenfeldii	112
Guinardia flaccida	1	Pleurosigma angulatum	40
Thalassionema nitzschioides	8	Pyramimonas grossi	8688
Pleurosigma angulatum	4	Prorocentrum sp.	4
Pyramimonas grossi	18	Prorocentrum micans	204
Prorocentrum micans	72	Ornithocercus thurni	4
Dinophysis sphaerica	1	Ceratium furca	16
Gymnodinium sp.	2	Ceratium tripos	28
Ceratium tripos	1		

	<u>Cells/ Liter</u>		<u>Cells/ Liter</u>
<u>Station 116</u>		Plagiogramma vanheurckii	8
Oscillatoria erythroa	16	Navicula hennedyii	16
Nostoc commune	4	Pleurosigma normani	8
Leptocylindrus danicus	48	Phaeodactylum tricornerutum	40
Lauderia borealis	20	Nitzschia recta	8
Coscinodiscus wailesii	8	Eutreptia viridis	8
Actinoptychus senarius	28	Prorocentrum micans	16
Biddulphia aurita	4	Prorocentrum apora	8
Chaetoceros atlanticum	8	Amphisolenia globifera	8
Chaetoceros costatum	16	Dinophysis acuminata	16
Rhizosolenia alata	84	Gyrodinium spirale	8
Rhizosolenia alata f. gracillima	16	Gyrodinium undulans	16
Rhizosolenia alata f. indica	4	Katodinium rotundatum	8
Rhizosolenia bergonii	8	Heterocapsa triquetra	40
Rhizosolenia calcar-avis	8	Protopteridinium cerasus	16
Rhizosolenia delicatula	8	Protopteridinium conicum	64
Rhizosolenia imbricata	20	Scripsiella trochoidea	48
Ditylum brightwellii	104	Protopteridinium pentagonum	80
Unidentified pennate diatom >20 microns	12	Protopteridinium abei	8
Dimerogramma sp.	20	Gonyaulax spinifera	8
Plagiogramma staurophorum	4	Gonyaulax diacantha	8
Tabellaria fenestriata v. asterionelloides	20	Gonyaulax polyedra	24
Nitzschia pungens	148	Ceratium fusus	16
Cylindrotheca closterium	160	Ceratium lineatum	16
Staurastrum leptocladum	12	Oxytoxum scolpax	8
Euglenophyceae euglenales Euglena sp.	4		
Prorocentrum micans	20	<u>Station 141</u>	
Prorocentrum dentatum	16	Nannochloris atomus	6032
Amphidinium actutum	4	Calycomonas gracilis	8
Amphidinium acutissimum	60	Hymenomonas roseola	24
Protopteridinium steinii	4	Striatella unipunctata	16
Ceratium fusus	4	Amphidinium sp.	8
Ceratium tripos var. atlanticum	4	Gymnodinium minutum	8
Ceratium trichoceros	8	Gyrodinium spirale	8
Ceratium extensum	16	Hemidinium sp.	8
Oxytoxum sceptrum	4	Heterocapsa triquetra	8
Oxytoxum scolpax	8	Protopteridinium excentricum	8
		Protopteridinium leonis	32
		Chroomonas vectensis	32
		Chroomonas amphioxea	8
<u>Station 138</u>			
Nannochloris atomus	48	<u>Station 143</u>	
Distephanus speculum	16	Dictyocha fibula	21
Schroederella delicatula	208	Distephanus speculum	45
Coscinodiscus marginatus	16	Corethron criophilum	8
Coscinodiscus nitidus	16	Leptocylindrus danicus	18
Coscinodiscus wailesii	24	Leptocylindrus minimus	6
Cerataulina pelagica	104	Coscinodiscus lineatus	6
Chaetoceros decipiens	88	Coscinodiscus radiatus	6
Rhizosolenia fragilissima	8	Coscinodiscus wailesii	1
Rhizosolenia setigera	40	Chaetoceros decipiens	24
Ditylum brightwellii	32		

	<u>Cells/ Liter</u>		<u>Cells/ Liter</u>
Rhizosolenia alata	4	Rhizosolenia alata	40
Rhizosolenia hebetata f. semispina	3	Rhizosolenia delicatula	560
Thalassionema nitzschioides	22	Rhizosolenia hebetata f. semispina	40
Pleurosigma angulatum	42	Rhizosolenia stolterfothii	1240
Gyrosigma hippocampus	1	Rhizosolenia styliformis	320
Pyramimonas grossi	86	Guinardia flaccida	600
Prorocentrum micans	5	Ditylum brightwellii	80
Dinophysis sphaerica	1	Thalassiothrix frauenfeldii	320
Gymnodinium sp.	1	Thalassionema nitzschioides	960
Ceratium lineatum	5	Rhaphoneis amphiceros	40
Ceratium tripos	14	Pleurosigma angulatum	40
		Anacystis marina	3600
		Pyramimonas grossi	7000
		Prorocentrum micans	240
		Ceratium lineatum	40
		Ceratium tripos	40
<u>Station 145</u>		<u>Station 147</u>	
Cyclococcolithus leptoporus	189	Dictyocha fibula	24
Corethron criophilum	3	Distephanus speculum	16
Leptocylindrus danicus	182	Paralia sulcata	632
Thalassiosira rotula	1	Corethron criophilum	48
Lauderia borealis	5	Thalassiosira gravida	112
Coscinodiscus lineatus	4	Lauderia borealis	32
Coscinodiscus radiatus	4	Coscinodiscus sp.	400
Chaetoceros concavicornis	54	Coscinodiscus lineatus	48
Rhizosolenia alata	2	Coscinodiscus nitidus	24
Rhizosolenia hebetata f. semispina	3	Biddulphia alternans	32
Rhizosolenia stolterfothii	14	Cerataulina pelagica	48
Synedra sp.	1	Chaetoceros atlanticus	80
Pleurosigma angulatum	4	Chaetoceros coarctatum	40
Anacystis marina	6	Chaetoceros danicum	48
Pyramimonas grossi	131	Chaetoceros sociale	328
Prorocentrum sp.	1	Rhizosolenia alata	64
Prorocentrum micans	8	Rhizosolenia imbricata	632
Gymnodinium sp.	8	Rhizosolenia stolterfothii	768
Glenodinium sp.	2	Guinardia flaccida	656
Ceratium tripos	1	Ditylum brightwellii	32
		Thalassiothrix frauenfeldii	152
		Rhaphoneis surirella	16
		Rhaphoneis amphiceros	56
		Plagiogramma staurophorum	96
		Diploneis crabro	24
		Pleurosigma hamuliferum	16
		Nitzschia pungens	7752
		Cylindrotheca closterium	24
		Prorocentrum micans	360
		Dinophysis micropterygia	32
		Dinophysis fortii	24
		Gymnodinium arcticum	24
		Gyrodinium sp.	16
		Protoperidinium cerasus	40
		Ceratium tripos var. atlanticum	32
		Ceratium minutum	32
<u>Station 146</u>			
Oscillatoria submembranacea	40		
Dictyocha fibula	400		
Cyclococcolithus leptoporus	200		
Paralia sulcata	640		
Corethron criophilum	240		
Schroederella delicatula	40		
Leptocylindrus danicus	62400		
Thalassiosira nordenskioldii	180		
Thalassiosira rotula	40		
Coscinodiscus sp.	160		
Coscinodiscus asteromphalus	40		
Coscinodiscus marginatus	40		
Coscinodiscus nitidus	40		
Coscinodiscus radiatus	160		
Coscinodiscus wailesii	40		
Biddulphia alternans	40		

	<u>Cells/ Liter</u>
<u>Station 148</u>	
Distephanus speculum	24
Cyclococcolithus leptoporus	2696
Coscinodiscus lineatus	24
Coscinodiscus wailesii	40
Chaetoceros decipiens	588
Chaetoceros peruvianum	8
Rhizosolenia alata	56
Rhizosolenia hebetata f. semispina	48
Thalassionema nitzschioides	160
Pyramimonas grossi	2976
Prorocentrum micans	16
Ceratium furca	16
Ceratium fusus	8
Ceratium macroceros	8
Ceratium tripos	80

Station 150

Leptocylindrus danicus	16
Thalassiosira gravida	4
Coscinodiscus nitidus	8
Actinopterychus senarius	124
Cerataulina pelagica	196
Ditylum brightwellii	8
Synedra tabulata v. fasciculata	4
Thalassiothrix frauenfeldii	28
Nitzschia pungens	1628
Unidentified dinoflagellates	88
Prorocentrum micans	120
Dinophysis ovum	12
Amphidinium acutissimum	100
Gymnodinium sp.	80
Gonyaulax diegensis	88
Ceratium lineatum	108
Ceratium tripos	16
Ceratium tripos var. atlanticum	12
Ceratium minutum	36

Station 182

Distephanus speculum	8
Cyclococcolithus leptoporus	3912
Corethron criophilum	376
Leptocylindrus danicus	56
Coscinodiscus radiatus	48
Coscinodiscus stellaris	168
Coscinodiscus wailesii	48
Coscinodiscus oculus	104
Chaetoceros decipiens	80
Rhizosolenia alata	728
Rhizosolenia hebetata f. semispina	104

Thalassionema nitzschioides	32
Pyramimonas grossi	1616
Gymnodinium sp.	120
Ceratium furca	8
Ceratium tripos	8

Station 183

Distephanus speculum	34
Corethron criophilum	30
Coscinodiscus sp.	8
Coscinodiscus nitidus	2
Coscinodiscus radiatus	62
Actinopterychus senarius	4
Chaetoceros atlanticum	4
Chaetoceros coarctatum	24
Chaetoceros danicum	4
Rhizosolenia setigera	12
Rhizosolenia styliformis	4
Unidentified pennate diatoms	
>20 microns	16
Nitzschia pungens	12
Dinophysis ovum	2
Amphidinium acutissimum	4
Gymnodinium dissimile	22
Ceratium lineatum	4
Ceratium tripos var. atlanticum	4

(continued from inside front cover)

5. *The Status of the Marine Fishery Resources of the Northeastern United States.* By Margaret M. McBride and Bradford E. Brown. December 1980. viii + 13 p., 4 figs., 3 tables.
6. *Economic and Biological Data Needs for Fisheries Management, With Particular Reference to the New England and Mid-Atlantic Areas.* By Guy D. Marchesseault, Joseph J. Mueller, and Ivar E. Strand, Jr. December 1980. vi + 10 p., 1 fig., 3 tables.
7. *Methodology for Identification and Analysis of Fishery Management Options.* By Brian J. Rothschild, Richard C. Hennemuth, Jacob J. Dykstra, Leo C. Murphy, Jr., John C. Bryson, and James D. Ackert. December 1980. vi + 10 p., 5 figs., 1 app.
8. *Phytoplankton Community Structure in Northeastern Coastal Waters of the United States. I. October 1978.* By Harold G. Marshall and Myra S. Cohn. August 1981. v + 14 p., 4 figs., 1 app.

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