

**LONG-TERM MONITORING PROGRAM:
INDIAN POINT AND SAMBRO, NOVA
SCOTIA, FOR THE PERIOD JULY 1992 TO
DECEMBER 1994**

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Canada

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by

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ABSTRACT

Keizer, P.D., G. Bugden, D.V. Subba Rao, and P. Strain. 1996. Long-term monitoring program: Indian Point and Sambro, Nova Scotia, for the period July 1992 to December 1994. Can. Data Rep. Fish. Aquat. Sci. 980: v + 20 p.

In March 1992, the Department of Fisheries and Oceans made a commitment to establish two long-term monitoring sites in Nova Scotia. Sampling at these sites, one at the mouth of Sambro Harbour and the other at Indian Point in Mahone Bay, began in July 1992. Information collected included water column depth profiles of salinity, temperature, dissolved oxygen, *in vivo* fluorescence, and photosynthetically active radiation. Discrete water samples were collected at three depths for plant nutrients, chlorophyll *a*, and identification and enumeration of phytoplankton. A vertical net tow for phytoplankton was also taken. Continuously recording thermographs were moored at two depths at the Indian Point site. This report summarizes the information collected up to the end of December 1994.

RÉSUMÉ

Keizer, P.D., G. Bugden, D.V. Subba Rao, and P. Strain. 1996. Long-term monitoring program: Indian Point and Sambro, Nova Scotia, for the period July 1992 to December 1994. Can. Data Rep. Fish. Aquat. Sci. 980: v + 20 p.

En mars 1992, le ministère des Pêches et des Océans s'est engagé à établir deux sites de surveillance à long terme en Nouvelle-Écosse. L'échantillonnage dans ces deux sites, situés l'un à l'embouchure du port de Sambro, l'autre à Indian Point, dans la baie Mahone, a commencé en juillet 1992. Les données recueillies comprennent des profils de salinité, de température, d'oxygène dissous, de fluorescence *in vivo* et de rayonnement photosynthétiquement utilisable de la colonne d'eau. Des échantillons discrets d'eau ont été recueillis à trois profondeurs en vue d'analyser les nutriments végétaux et la chlorophylle *a*, ainsi que d'identifier et de recenser le phytoplancton. On a également procédé à un trait de chalut vertical pour recueillir du phytoplancton. Des thermographes à enregistrement permanent ont été installés à deux profondeurs au site de Indian Point. Le présent rapport fournit un sommaire des données recueillies jusqu'à la fin décembre.

INTRODUCTION

In March 1992, the Department of Fisheries and Oceans made a commitment to establish two long-term monitoring sites in Nova Scotia. This commitment followed an assessment of the results of the past 5 yr of the phytoplankton monitoring program which regularly monitored five sites in the province to determine the species of phytoplankton normally present. Some basic physical and chemical oceanographic data were collected at the same time in order to provide a basis for analysing the phytoplankton data. This long-term monitoring program uses the same sampling protocols that were used during the initial phytoplankton monitoring program, i.e.:

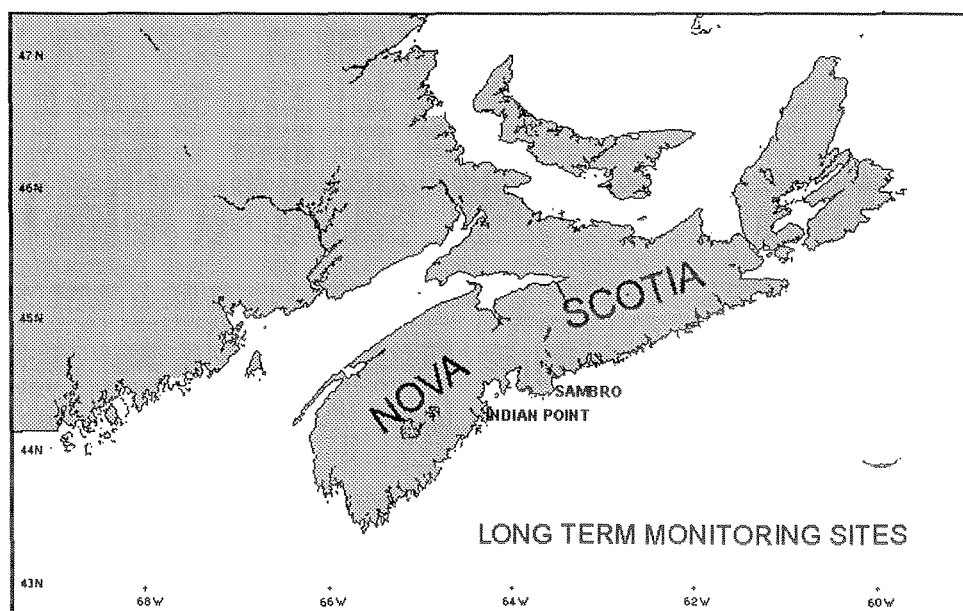
- physical properties of the water column
- plant nutrients
- phytoplankton identification and enumeration

The criteria for the selection of the two sites were:

- a nearshore area used for aquaculture
- waters minimally impacted by land based influences

To maximize the likelihood that the monitoring sites could be maintained for a long time, it was important that sampling costs be kept to a minimum. The sites chosen were (Fig. 1):

- Indian Point - intensive mussel culture area
- Sambro Harbour - off the headland at the entrance to Sambro Harbour



Both of these sites are close to Halifax, thus minimizing the cost of travel. The Indian Point site has an easily accessible boat-launching site; and a local mussel farmer, Peter Darnell, offered his assistance if needed. The search for the second site was solved when the Canadian Coast Guard staff at Sambro graciously offered to assist us and provide transportation from their station in Sambro to the sampling site.

METHODS

SAMPLE/DATA COLLECTION

Sampling began on July 16, 1992. The frequency of sampling varied throughout the year, being less frequent during the winter months and more frequent in late spring, summer, and early fall. Both sites were sampled 26 times each year. Detailed information is provided for each station as part of the site descriptions below. This report covers the period from July 16, 1992, to December 31, 1994.

Discrete Water Samples

Samples were collected with a Niskin bottle from 1 m below the surface, mid-depth, and 1 m above the bottom. The water was transferred to carboys and kept in a cooler until returned to the laboratory for processing. Subsamples were taken for salinity, plant nutrients, extracted chlorophyll, suspended particulate matter (SPM), and phytoplankton analyses. Water temperature was also recorded for the three samples, and live subsamples were also taken for culture.

Depth Profiles

A SeaBird Model 25 Profiling CTD was used to collect vertical profiles of temperature, salinity, dissolved oxygen, photosynthetically active radiation (PAR), and *in vivo* chlorophyll *a* fluorescence as a function of pressure at each site.

Thermographs

Thermographs recording the temperature each hour at two depths were moored at the Indian Point site. The Sambro site is too exposed to accomplish this inexpensively, but the same functionality was provided by thermograph sites in Halifax Harbour maintained by other programs.

Phytoplankton Net Samples

A vertical plankton net tow was collected at each site using a 20- μ m mesh, 0.5- or 0.25-diameter net. The sample was then filtered through a 200- μ m mesh seive to remove the larger organisms and measured for volume in a graduated cylinder. A live subsample was taken for culture. The sample was stored in an opaque plastic bottle and preserved in 1% para-formaldehyde/glutaraldehyde (1:1 by volume, 1 mL/100 mL sample) for later identification and counting.

ANALYSIS

Plant Nutrients

Silicate, phosphate, ammonia, and nitrate (nitrite + nitrate) were determined using the standard method for the Technicon Autoanalyzer II (ca. 1973), with modifications for phosphate.

Chlorophyll *a*

Chlorophyll *a* was determined according to the method of Strickland and Parsons (1968).

Phytoplankton Analyses

A subsample of 500 mL was taken from each of the three water samples, put in opaque bottles, and preserved with 5 mL of 1% para-formaldehyde/glutaraldehyde (1:1 by volume, 1 mL/100 mL sample), and kept for later identification and enumeration.

DATA MANAGEMENT

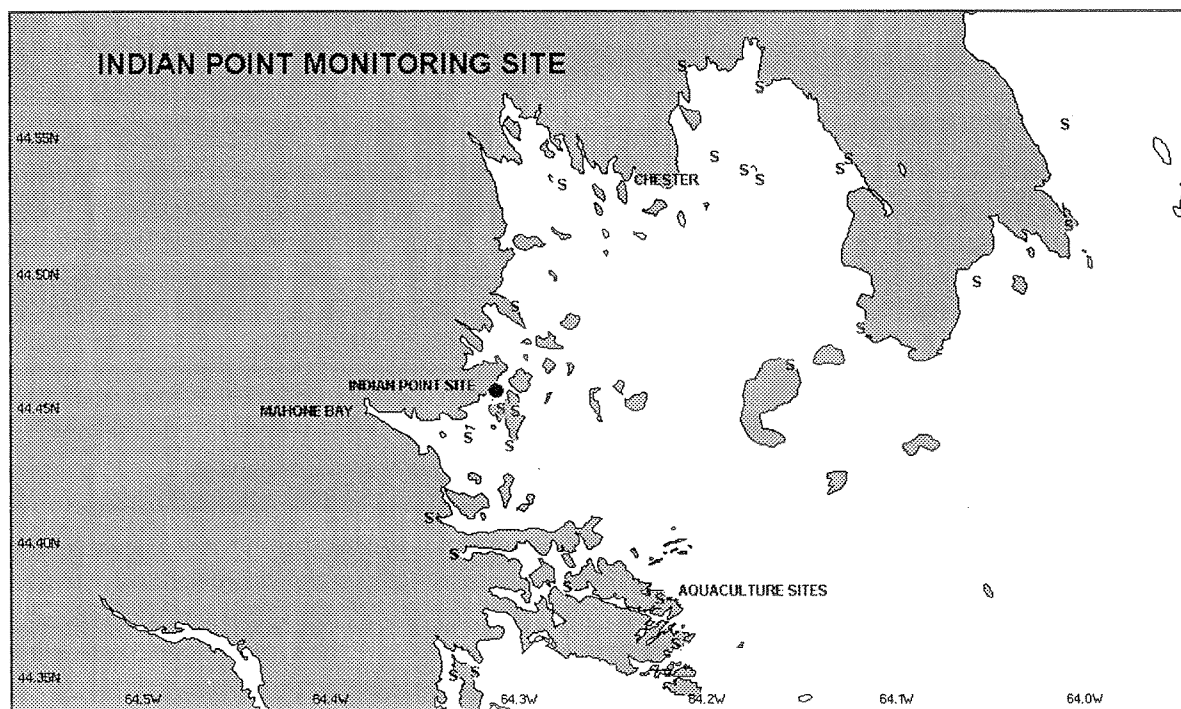
All samples and data were tracked with an identification number assigned at the time of sample collection. Information was entered, maintained, and accessed using a relational database management system.

DESCRIPTION OF THE DATABASE

Data for the three depths corresponding to the Niskin bottle samples which were collected were extracted from the SeaBird depth profile data. These data were stored with the data from the discrete samples in a relational database. The individual depth profiles from the SeaBird profiler and information from the vertical plankton net tows were stored separately. Only the data for the discrete sampling depths are presented here.

INDIAN POINT

The Indian Point station is located at $44^{\circ}27.25'N$; $64^{\circ}19.00'W$ in 10 m of water at LLW with a tidal range of approximately 2 m. The area is extensively used for shellfish culture, primarily blue mussels, with two leases in the immediate area.

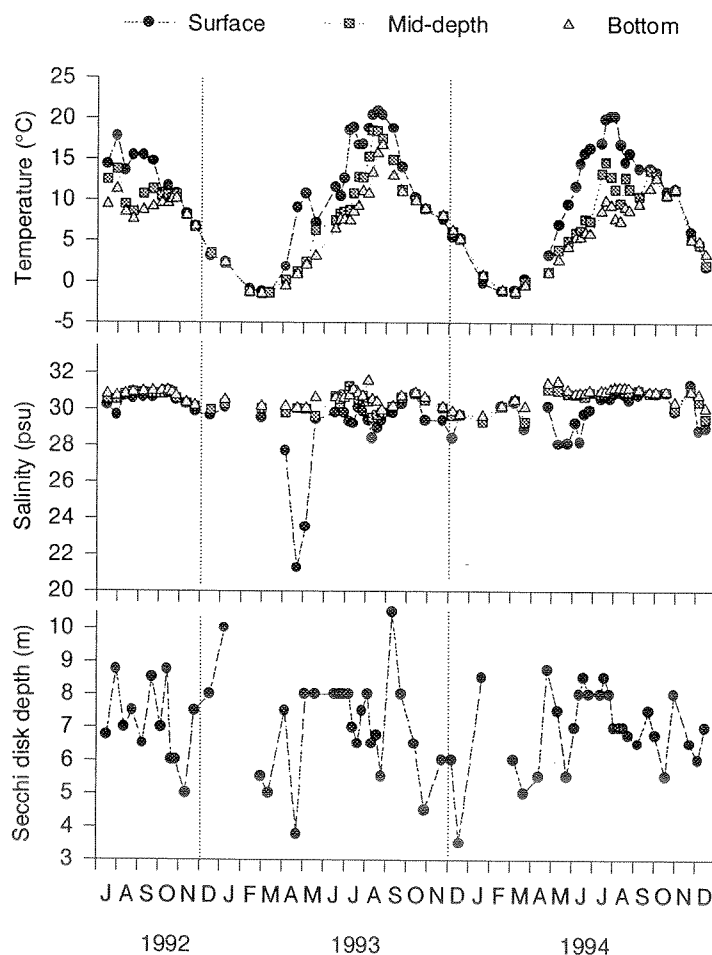


PHYSICAL PROPERTIES

Temperature ranged from -1.5 to 20.8°C with a thermal gradient developing in April and breaking down in late August or early September. Mid-water temperatures were intermediate to surface and bottom temperatures during the summer months. This site was ice covered at times during the winter months.

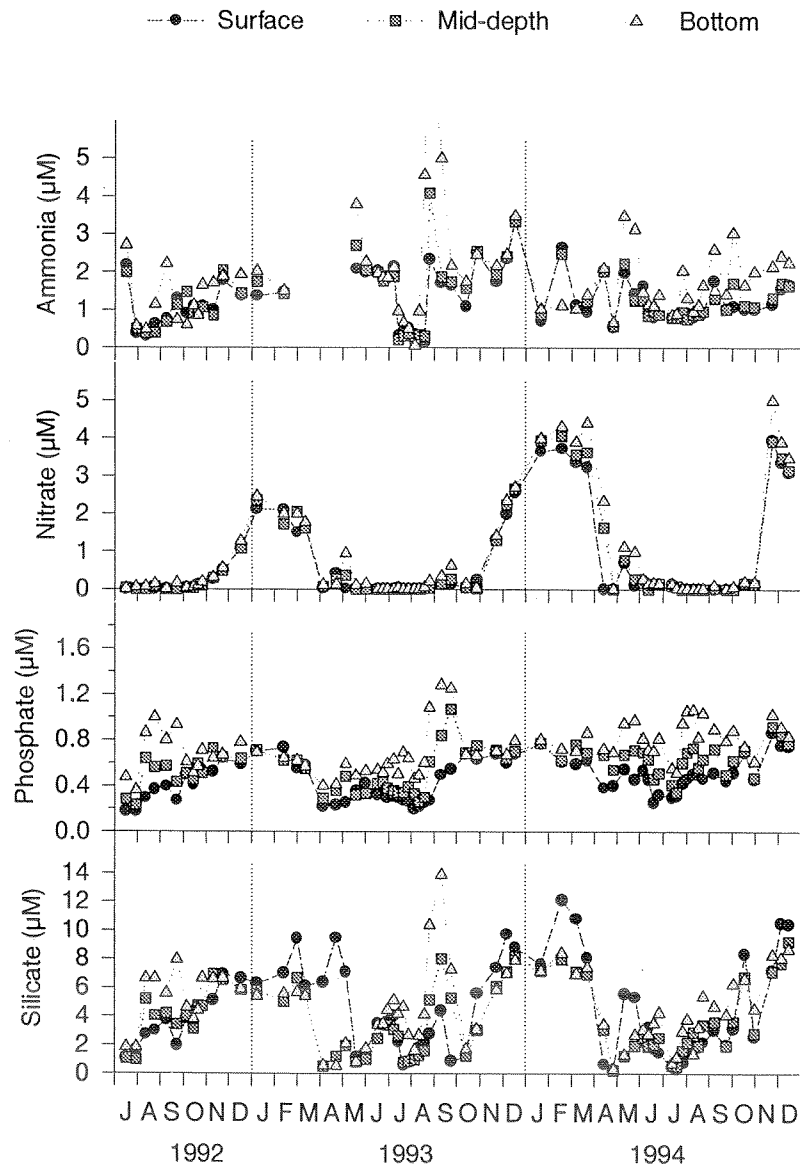
Salinity ranged from 21.3 to 31.5 psu with the lower values occurring during the spring in the surface water. Surface water was generally less saline than the mid-depth and bottom water throughout the year.

Secchi disk depth varied from 3.5 to 10.5 m with a mean of 7.0 m.



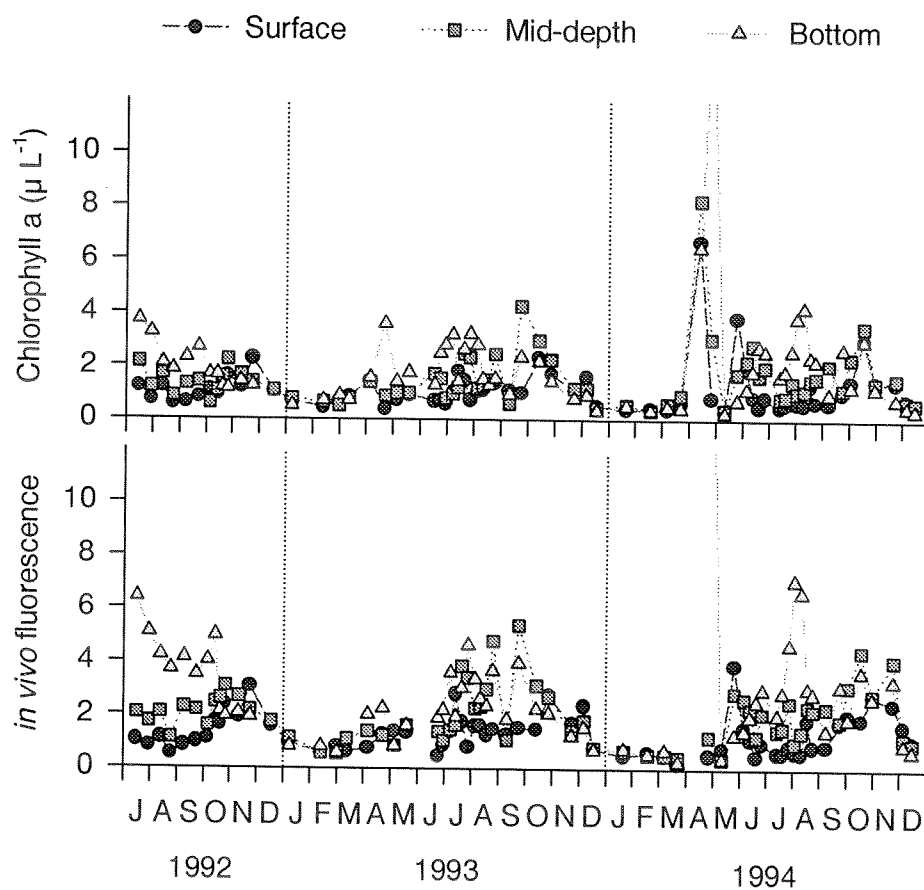
PLANT NUTRIENTS

The following plots show the seasonal variation in the concentration of ammonia, nitrate, phosphate, and silicate at the three depths at Indian Point. Ammonia concentrations ranged from 0.0 to 8.5 μM , nitrate from 0.0 to 5.0 μM , phosphate from 0.2 to 1.3 μM , and silicate from 0.2 to 13.9 μM .



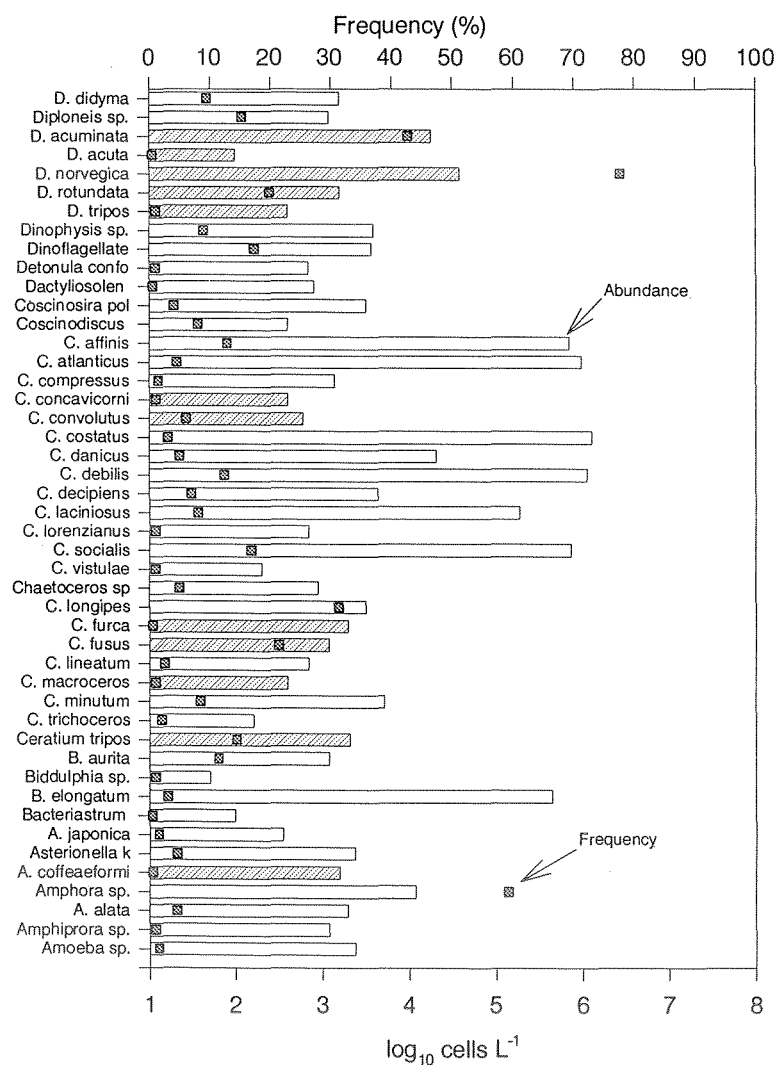
PLANT PIGMENTS

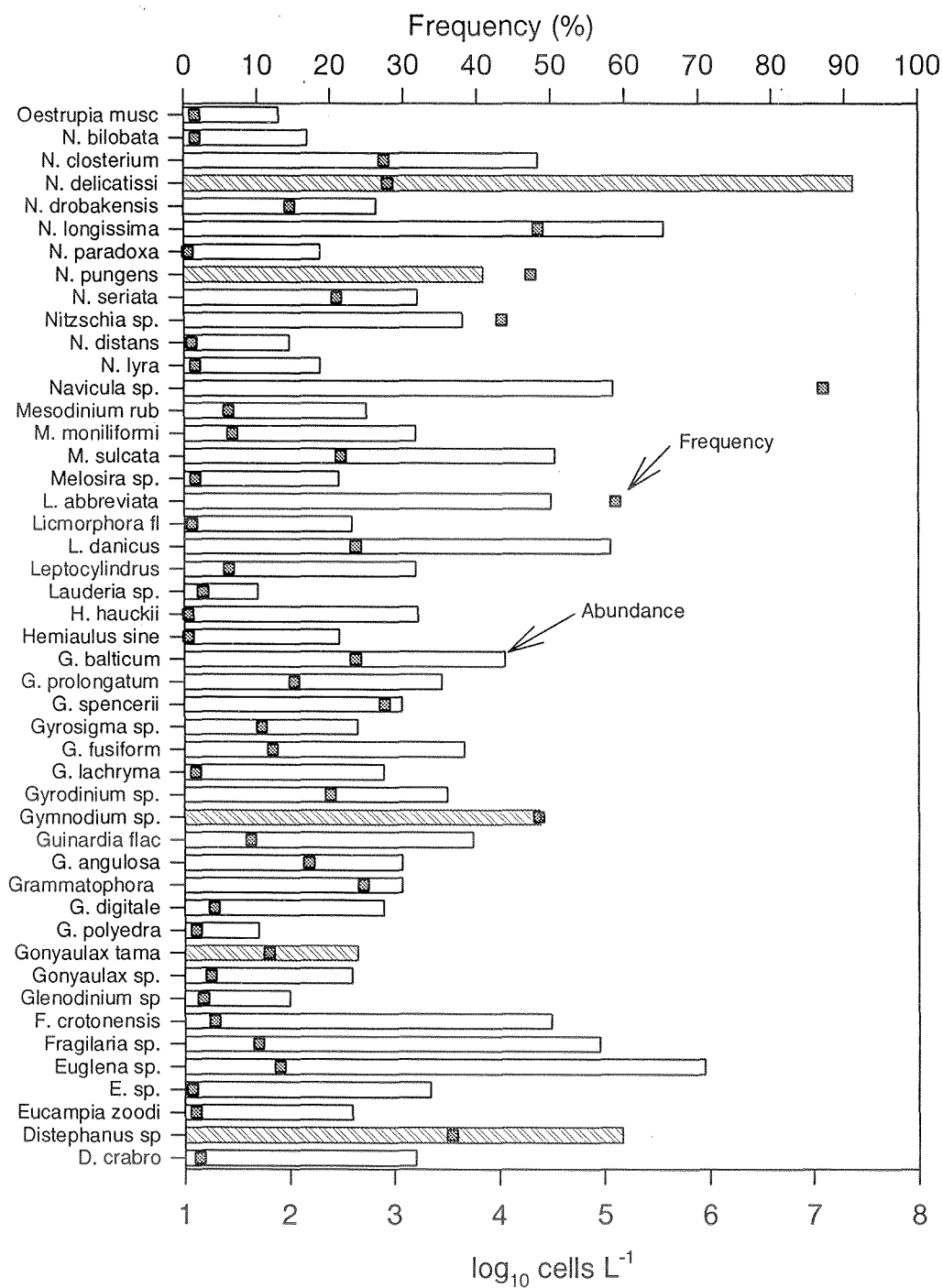
Both chlorophyll *a* and *in vivo* fluorescence showed a strong seasonal variation with lower values occurring during the winter months. Chlorophyll concentrations ranged from 0.2 to 15.2 $\mu\text{g L}^{-1}$ while *in vivo* fluorescence values ranged from 0 to 20 $\mu\text{g L}^{-1}$.

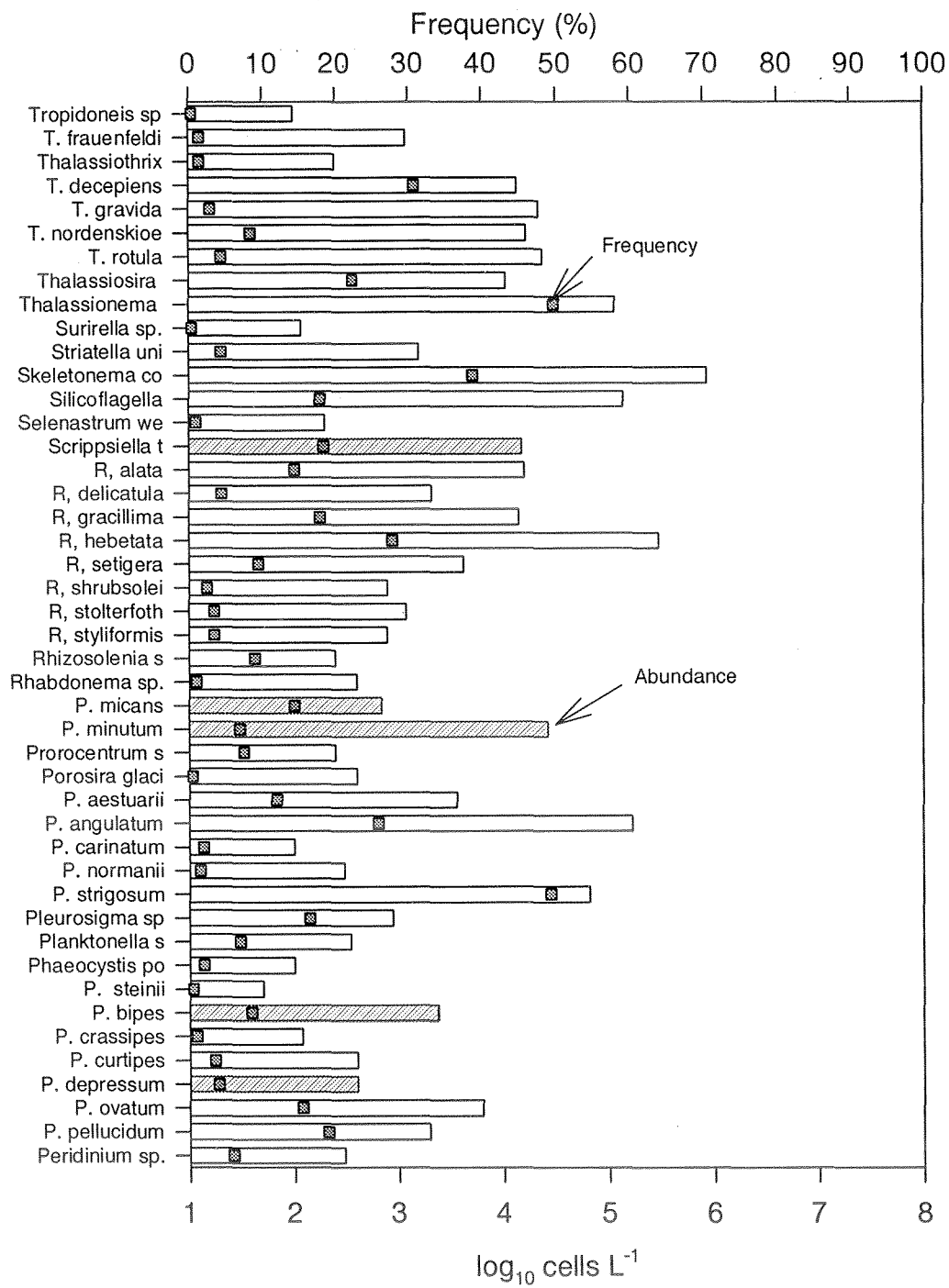


PHYTOPLANKTON - IDENTIFICATION AND ENUMERATION

A total of 138 phytoplankton species were found in samples at the Indian Point site with numbers in individual samples ranging from 3 to 108 and averaging 57. Data for all depths for all sampling dates are condensed to graphs which display for each species the fraction of samples in which it was found (% frequency) and maximum cell density. The cell density bars for potentially harmful phytoplankton are shaded. Due to software limitations, species names are truncated in these plots; the Appendix is a complete list of species observed.

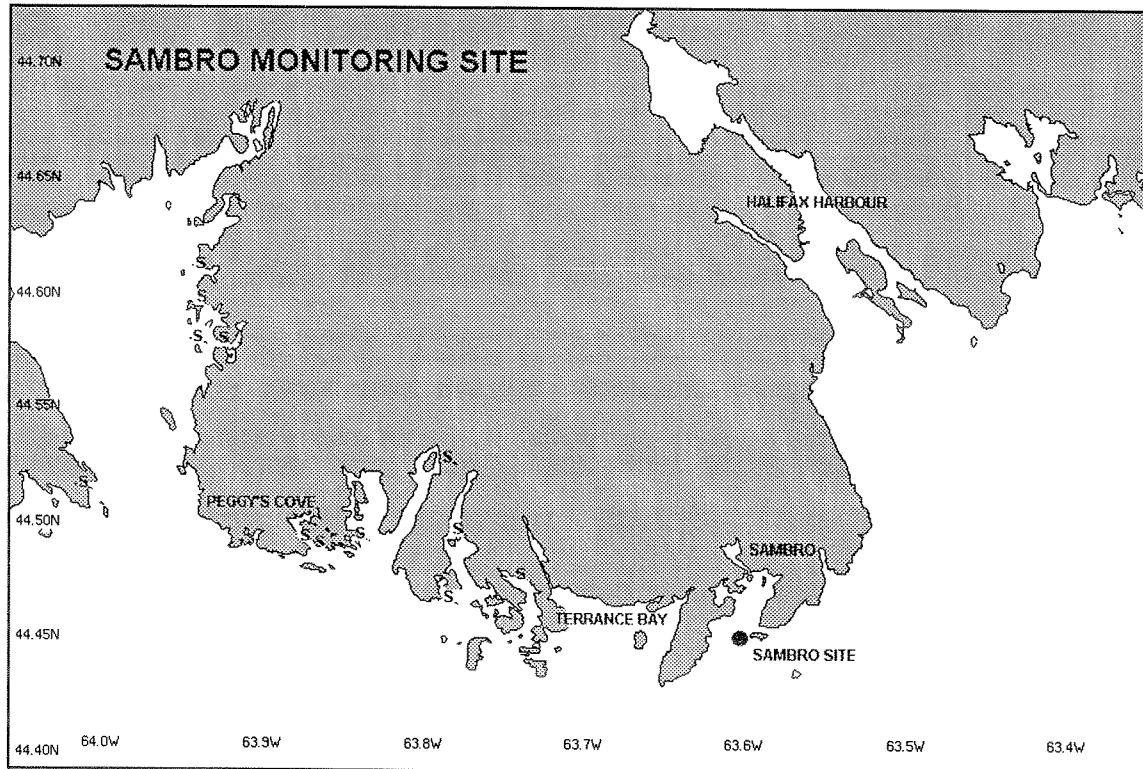






SAMBRO

The Sambro station is located at $44^{\circ}27.20'N$; $63^{\circ}35.73'W$ in 16 m of water at LLW with a tidal range of approximately 2 m. The site is at the mouth of Sambro Harbour which is a small fishing port just to the east of Halifax Harbour, a major trans-Atlantic shipping port and urban centre.

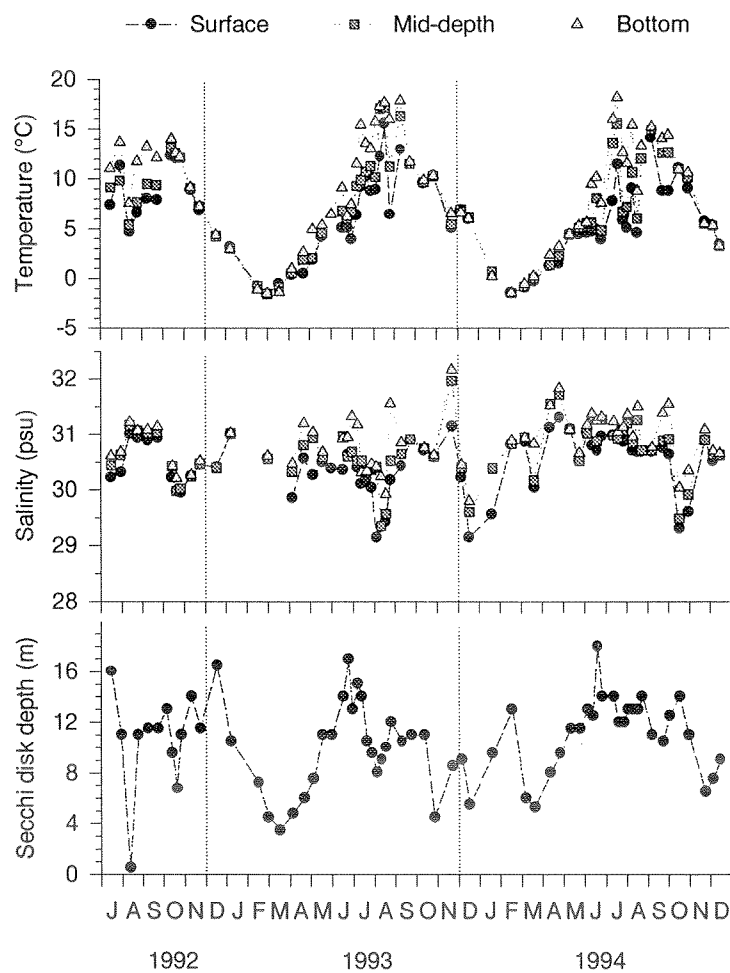


PHYSICAL PROPERTIES

Temperature ranged from -1.7 to 18.1°C with a thermal gradient developing in April and breaking down in late August or early September. Mid-water temperatures were intermediate to surface and bottom temperatures during the summer months. This site is much more exposed to wind and wave action than the Indian Point site.

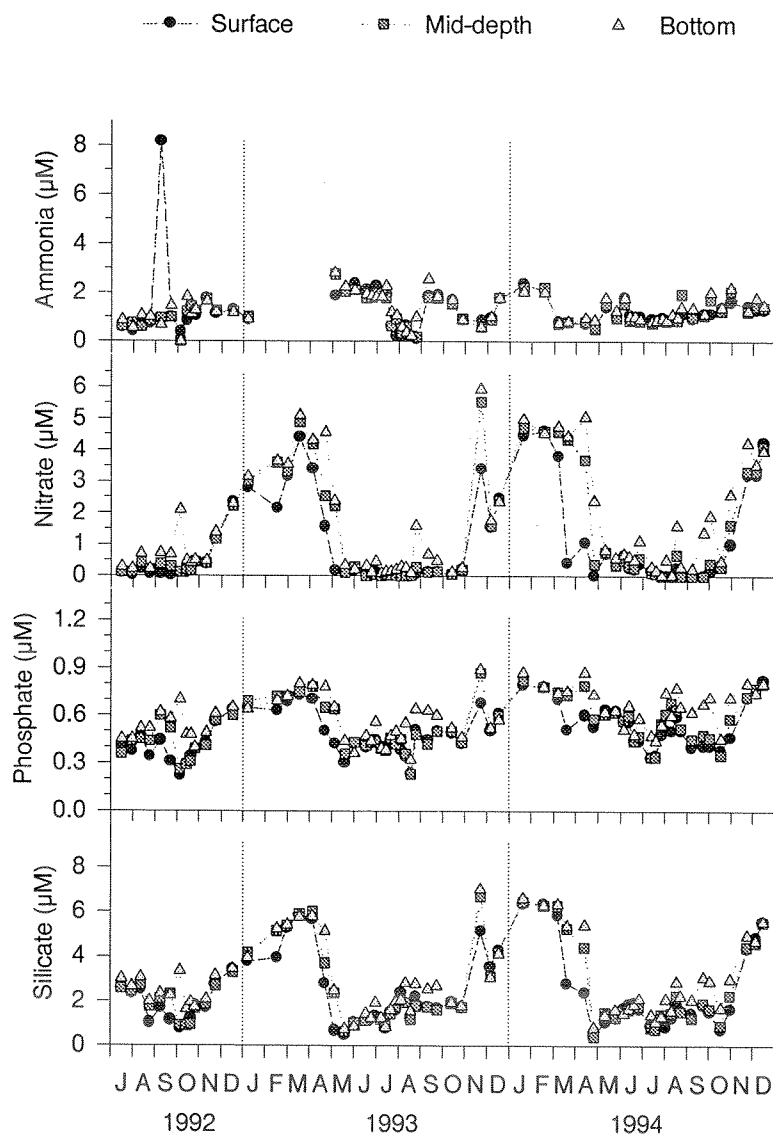
Salinity ranged from 29.2 to 32.2 psu with the lower values occurring during the spring in the surface water. Surface water was generally less saline than the mid-depth and bottom water throughout the year.

Secchi disk depth varied from 0.5 to 18 m with a mean of 10.5 m.



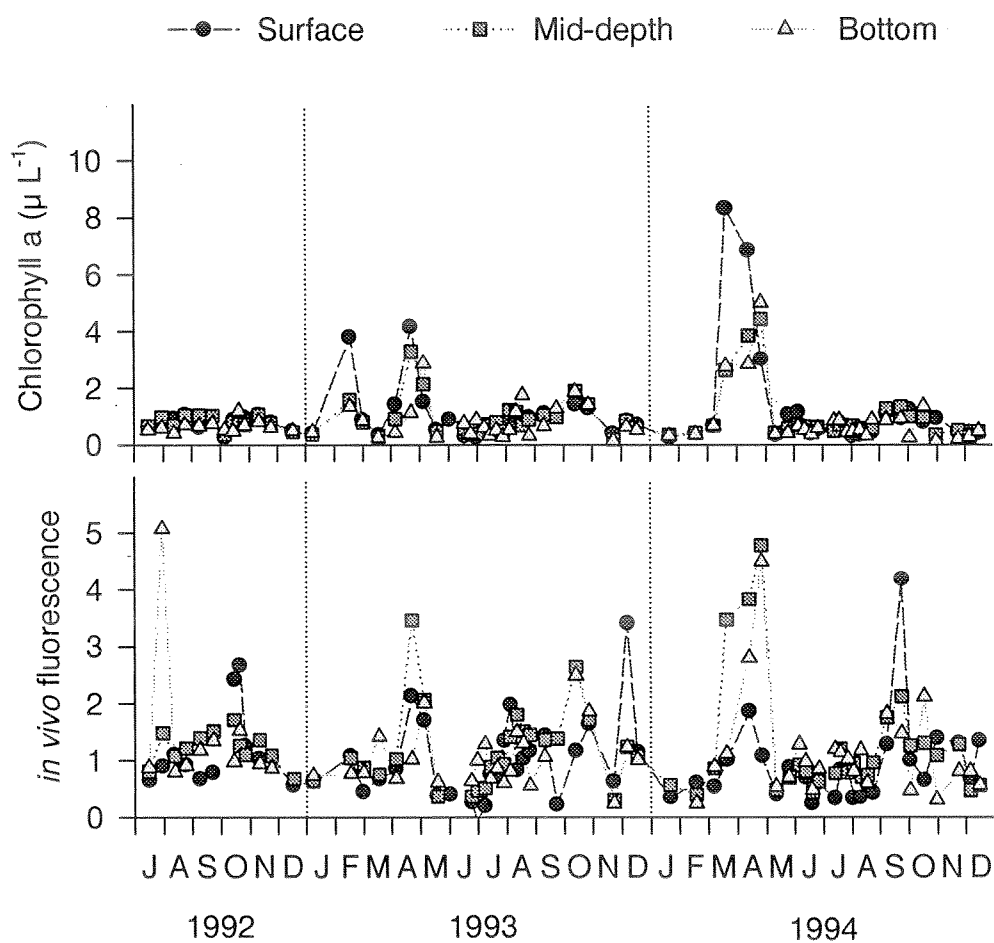
PLANT NUTRIENTS

The following plots show the seasonal variation in the concentration of ammonia, nitrate, phosphate, and silicate at the three depths at Sambro. Ammonia concentrations ranged from 0.0 to 8.2 μM , nitrate from 0.0 to 5.9 μM , phosphate from 0.2 to 0.9 μM , and silicate from 0.4 to 7.0 μM .



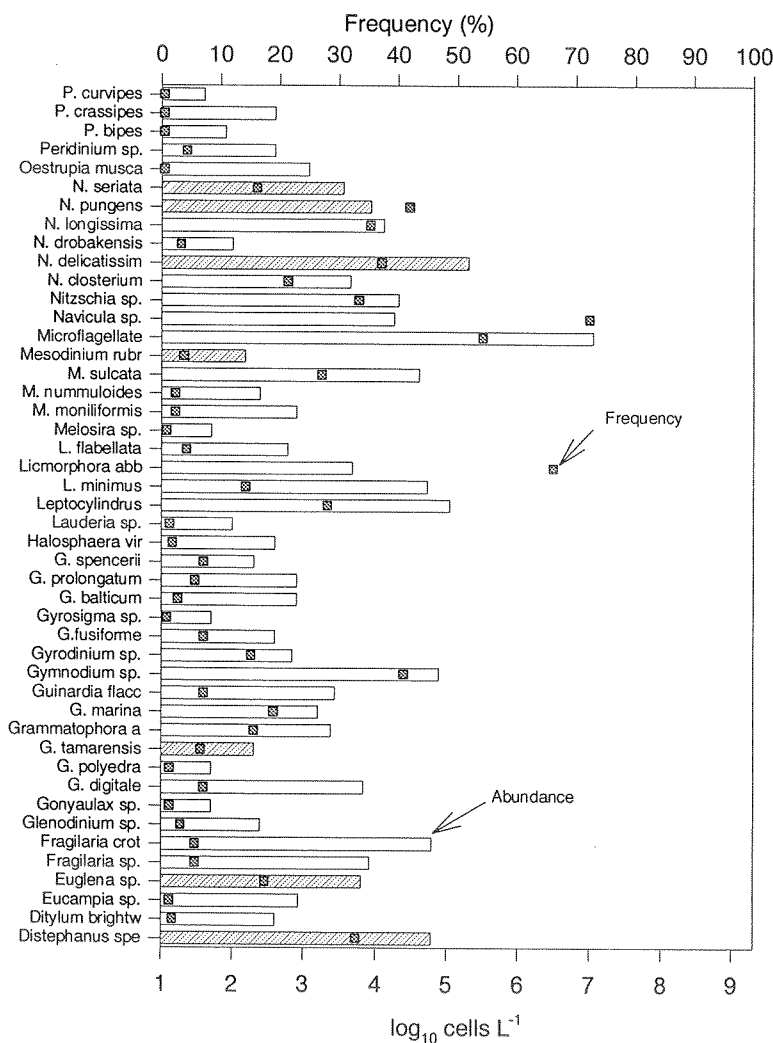
PLANT PIGMENTS

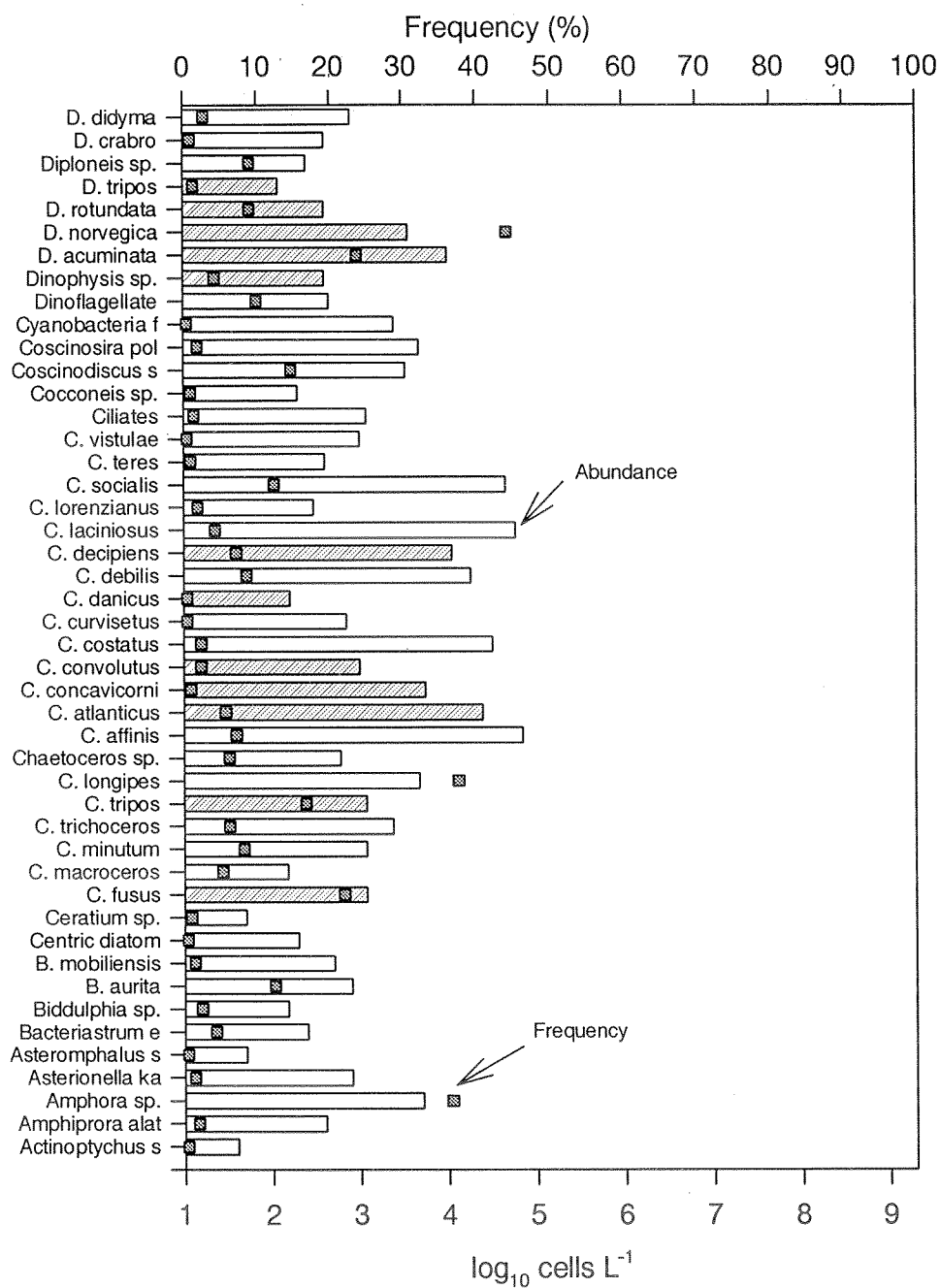
Both chlorophyll *a* and *in vivo* fluorescence showed a strong seasonal variation with lower values occurring during the winter months. Chlorophyll concentrations ranged from 0.1 to 8.3 $\mu\text{g L}^{-1}$, while *in vivo* fluorescence values ranged from 0 to 5.1.

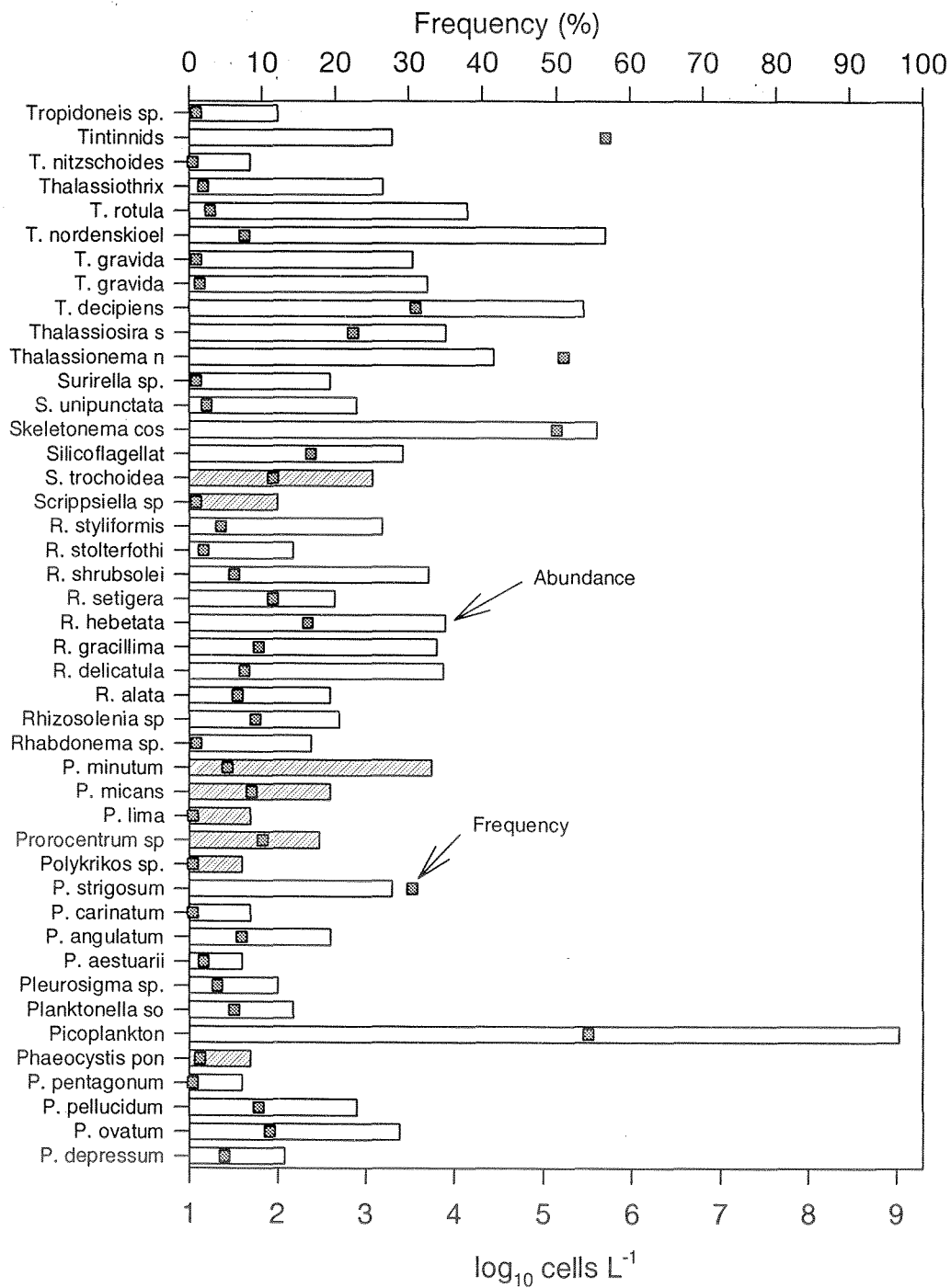


PHYTOPLANKTON - IDENTIFICATION AND ENUMERATION

A total of 136 phytoplankton species were found in samples at the Sambro site with numbers in individual samples ranging from 3 to 87 and averaging 45. Data for all depths for the entire sampling period are condensed to graphs which display for each species the fraction of samples in which it was found (% frequency) and maximum cell density observed. The cell density bars for potentially harmful phytoplankton are shaded. Due to software limitations, species names are truncated in these plots; the Appendix is a complete list of species observed.







ACKNOWLEDGEMENTS

The project manager was Paul Keizer. Ann Orr (DFO, retired) supervised the day-to-day operations of the project, conducted the chlorophyll analysis, and was responsible for the data management. Sprytech Biological Services conducted the field work, splitting of samples, and some of the laboratory work. Gary Bugden supervised the collection and processing of the SeaBird data, and Peter Strain supervised the nutrient analysis in cooperation with Phil Yeats. Pierre Clement conducted the analyses. Subba Rao Durvasula supervised the phytoplankton analyses which were conducted under contract. Contractors involved in this work to date include Maritimes Testing (1985) Limited and Pan's Algal and Shellfish.

Special thanks is extended to the staff at the Canadian Coast Guard base at Sambro. Without their assistance it would not have been possible to sample this location.

REFERENCES

- Strickland, J.D.H, and T.R. Parsons. 1968. A practical handbook of seawater analysis. Fish. Res. Board Can. Bull. 167, 311 p.

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APPENDIX 1. THE SPECIES AND GENUS NAMES OF THE PHYTOPLANKTON SPECIES FOUND IN THE SAMPLES AT BOTH SITES

These may be truncated in the figures which display the summary data. The full names are listed here.

Actinoptychus senarius
Amoeba sp.
Amphiprora alata
Amphiprora sp.
Amphora coffeaeformis
Amphora sp.
Asterionella japonica
Asterionella kariana
Asteromphalus sp.
Bacteriastrum elongatum
Bacteriastrum sp.
Biddulphia aurita
Biddulphia mobiliensis
Biddulphia sp.
 Centric diatom
Ceratium furca
Ceratium fusus
Ceratium lineatum
Ceratium longipes
Ceratium macroceros
Ceratium minutum
Ceratium sp.
Ceratium trichoceros
Ceratium tripos
Chaetoceros affinis
Chaetoceros atlanticus
Chaetoceros compressus
Chaetoceros concavicornis
Chaetoceros convolutus
Chaetoceros costatus
Chaetoceros curvisetus
Chaetoceros danicus
Chaetoceros debilis
Chaetoceros decipiens
Chaetoceros laciniosus
Chaetoceros lorenzianus

Chaetoceros socialis
Chaetoceros sp.
Chaetoceros teres
Chaetoceros vistulae
 Ciliates
Cocconeis sp.
Coscinodiscus sp.
Coscinosira polychorda
Cyanobacteria filamentous
Dactyliosolen mediterraneus
Detonula confervacea
 Dinoflagellate cysts
Dinophysis acuminata
Dinophysis acuta
Dinophysis norvegica
Dinophysis rotundata
Dinophysis sp.
Dinophysis tripos
Diploneis crabro
Diploneis didyma
Diploneis sp.
Distephanus speculum
Ditylum brightwelli
Eucampia sp.
Eucampia zoodiacus
Euglena sp.
Fragilaria crotonensis
Fragilaria sp.
Glenodinium sp.
Gonyaulax digitale
Gonyaulax polyedra
Gonyaulax sp.
Gonyaulax tamarensis
Grammatophora angulosa
Grammatophora marina
Guinardia flaccida

- Gymnodium* sp.
Gyrodinium fusiforme
Gyrodinium lachryma
Gyrodinium sp.
Gyrosigma balticum
Gyrosigma prolongatum
Gyrosigma sp.
Gyrosigma spencerii
Halosphaera viridis
Hemiaulus hauckii
Hemiaulus sinensis
Lauderia sp.
Leptocylindrus danicus
Leptocylindrus minimus
Licmophora abbreviata
Licmophora flabellata
Melosira moniliformis
Melosira nummuloides
Melosira sp.
Melosira sulcata
Mesodinium rubrum
Microflagellate
Navicula distans
Navicula lyra
Navicula sp.
Nitzschia bilobata
Nitzschia closterium
Nitzschia delicatissima
Nitzschia drobakensis
Nitzschia longissima
Nitzschia paradoxa
Nitzschia pungens
Nitzschia seriata
Nitzschia sp.
Oestrupia musca
Peridinium bipes
Peridinium crassipes
Peridinium curvipes
Peridinium depressum
Peridinium ovatum
Peridinium pellucidum
Peridinium pentagonum
Peridinium sp.
Peridinium steinii
Phaeocystis ponchetti
Picoplankton
Planktonella sol
Pleurosigma aestuarii
Pleurosigma angulatum
Pleurosigma carinatum
Pleurosigma normanii
Pleurosigma sp.
Pleurosigma strigosum
Polykrikos sp.
Porosira glacialis
Prorocentrum lima
Prorocentrum micans
Prorocentrum minutum
Prorocentrum sp.
Rhabdonema sp.
Rhizosolenia alata
Rhizosolenia delicatula
Rhizosolenia gracillima
Rhizosolenia hebetata
Rhizosolenia setigera
Rhizosolenia shrubsolei
Rhizosolenia sp.
Rhizosolenia stolterfothii
Rhizosolenia styliformis
Scrippsiella sp.
Scrippsiella trochoidea
Selenastrum westii
Silicoflagellate
Skeletonema costatum
Striatella unipunctata
Surirella sp.
Thalassionema nitzschoides
Thalassiosira decipiens
Thalassiosira gravaida
Thalassiosira gravaida
Thalassiosira nordenskiöldii
Thalassiosira rotula
Thalassiosira sp.
Thalassiothrix frauenfeldii
Thalassiothrix nitzschoides
Tintinnids
Tropidoneis sp.