The calculations given above reveal that dissolved organic matter could supply a significant input to the energy needs of embryos and larvae. The data given in figure 3, block B further support this suggestion. Eggs of *Odontaster validus* were reared for 35 days in particle-free seawater. During this initial 35-day period of development, the embryos lack a digestive system and are unable to feed on particulate material. Yet, we observed a net increase in dry organic mass during early development. Biomass doubled during this period from the egg (625 ± 18 nanograms) to the gastrula stage (1,355 ± 71 nanograms). Thus, growth occurred for those stages lacking a digestive system, presumably through the use of dissolved organic matter.

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Daily variability of phytoplankton and oceanographic parameters during the fall in Arthur Harbor

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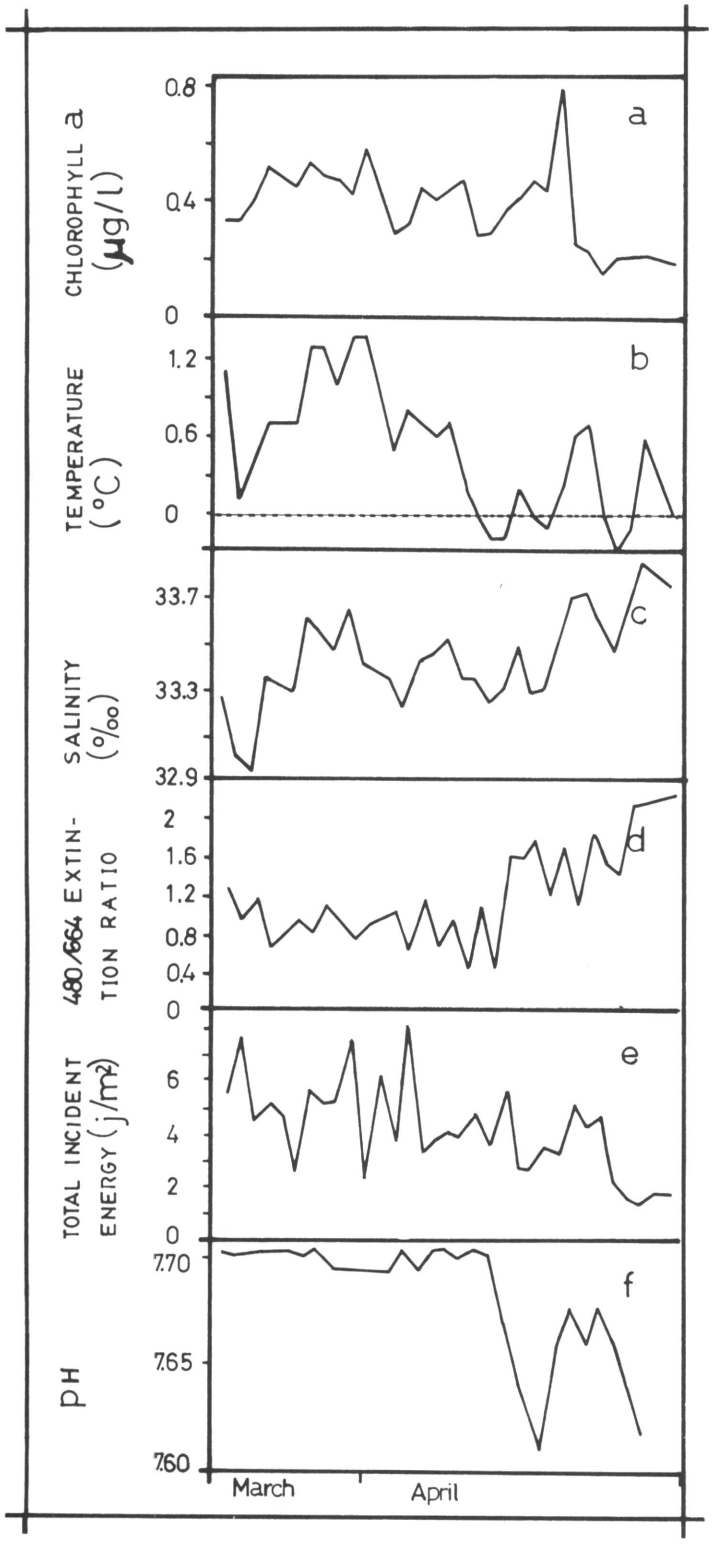
A survey of several biological and physicochemical parameters was carried out in the vicinity of Palmer Station (Arthur Harbor) (64°46'S 64°05'W) from 21 March to 22 April 1990. The goal of this research was to understand the behavior of phytoplankton during this period and to complement future investigations on microzooplankton variability and survival of diatom resting forms.

A high-resolution sampling was deployed during the investigation period. Subsurface Niskin water samples were taken daily for seawater analysis, and net plankton tows were performed with a 26-micrometer net for qualitative studies. Chlorophyll *a* measurements were done by filtering seawater through Whatman GF/F glass fiber filters; readings of extinctions of 90 percent acetone pigment extracts were carried out with a dual beam spectrophotometer; and equations of Jeffrey and Humprey (1975) were used for the calculations. Relative carotenoid concentrations were expressed as the ratio between 480- and 663-nanometer extinctions of the acetone extracts (Howard-Williams and Warwick 1989). pH was measured with a Cole-Parmer ph-meter; salinity with a Beckman induction salinometer, and temperature with an YSI model 58 oxygen-temperature probe. Wind velocity and direction were recorded by the anemometer of the station, and daily incident energy of visible sunlight was measured with an Eppley Precision Spectral Pyranometer (Biospherical Instruments Inc.). Seawater samples for nutrient studies were stored frozen at −30 °C for subsequent analysis with a Technicon II Autoanalyzer system in the laboratory of the Instituto Antartico Argentino. Three replicate samples of seawater were filtered through pre-combusted (500 °C) GF/F Whatman glass fiber filters for carbon-hydrogen-nitrogen analysis. This material was lyophilized and stored frozen at −30 °C. Determinations will be done in the laboratory of the University of Quebec at Rimouski (Department of Oceanography).

Salinity levels increased gradually during the period studied as a result of the decrease of summer freshwater runoff (Krebs 1977); while temperature showed a generally inverse pattern (figure, blocks B and C). Superimposed on this general trend, cyclic variations in both salinity and temperature were observed, with higher values following stormy days. Bienati and Comes (1970) and Krebs (1977) pointed out that the water column remained stratified until April in Paradise Bay and Arthur Harbor, with coldest temperatures and lowest salinities at the surface as a result of the input of meltwater from the surrounding glaciers. Cross-correlation analyses of the detrended data showed that these periodicities were strongly associated with wind fluctuations. During the investigation period, wind blowed 76 percent of the time from the north-northeast-northwest-east-west quadrants. This engendered local events in which surface water was pushed offshore, giving rise to subsequent upwelling processes that could explain the above-described variability.

The behavior of phytoplanktonic standing crop in the area of Arthur Harbor has been described by Krebs (1973, 1977) as presenting characteristic blooms in spring, summer, and fall. The present study focused on the high-frequency temporal variability of phytoplankton at the end of the fall growth period. Throughout the period of our observations, chlorophyll *a* values decreased consistently, in agreement with decreasing incident radiation, temperature, and pH (figure, block A). The decrease in pH values reflected a transition from a situation dominated by primary production to one where heterotrophic activity became increasingly important, which confirms the results of Krebs (1977) and Shabica, Hedgpeth, and Park (1977). A significant negative correlation was found between relative carotenoid concentrations and variations in daily incident radiation (figure, blocks D and E). Goldman, Mason, and Wood (1963) suggested that fluctuations in carotenoid/chlorophyll *a* ratios are more closely associated with chlorophyll degradation than with carotenoid buildup, and Auclair et al. (1982) showed the presence of high-frequency endogenous chlorophyll *a* synthesis and degradation, triggered in a response to changes in the stability of the water column during the semi-diurnal tidal cycle. The observed daily variability of the carotenoid ratio could be explained by similar mechanisms, suggesting a high degree of adaptability of the dominant phytoplankton assemblages to the adverse light conditions characteristic of the late



Daily variability of chlorophyll *a*, temperature, salinity, carotenoid ratio, total incident radiation, and pH in subsurface Arthur Harbor waters during March and April 1990.

fall. Phytoplankton and microzooplankton species composition, community structure, and succession studies will be undertaken to complement the information obtained during this first step of our research.

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