Palmer LTER: Temporal variability in HPLC pigmentation and inorganic nutrient distribution in surface waters adjacent to Palmer Station, December 1991-February 1992

BARBARA B. PREZELIN, MARK MOLINE,
KEITH SEYDEL, AND KAI SCHEPPE

Department of Biological Sciences

and

Marine Science Institute
University of California at Santa Barbara
Santa Barbara, California 93106

A set of nearfield stations were established in waters adjacent to Palmer Station in the austral spring of 1991 (Kirk and Smith 1993). A range of hydrographic, optical, chemical, and biological properties of the water columns at these sites were repeatedly characterized during late austral spring and summer (December 1991-March 1992). The data will be used to define patterns and scales of variability for food-chain parameters in the area surrounding important nesting and fledgling sites for large populations of antarctic seabirds. Here, we present our preliminary data on the temporal variability and possible succession of phytoplankton communities within surface waters of the Palmer grid and their correspondance with changes in the availability of major plant nutrients.

A zodiac-based sampling strategy was used to collect water samples at five stations (stations A-E) along a transect line from Arthur Harbor out to the 100-Fathom Line (figure 1). At each station, surface samples were collected with a 5-liter GoFlo bottle, transferred to a black bottle, and returned to the laboratory where samples were filtered to determine pigmentation by high-performance liquid chromatography (HPLC). The filtrates of replicate

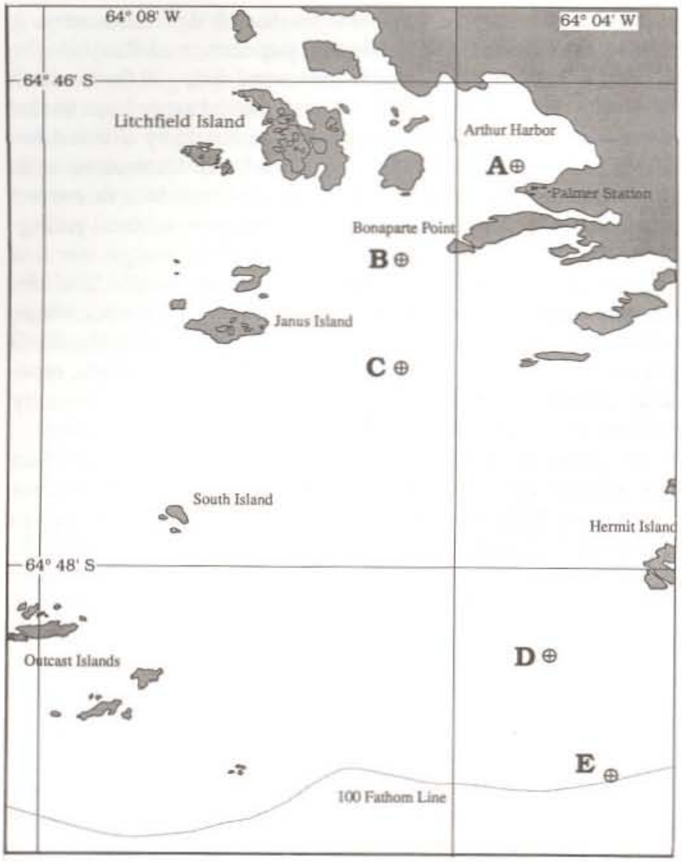

Figure 1. Location of transect stations (after Defense Mapping Agency Map "Vicinity of Arthur Harbor").

CHN samples were deep frozen, transported to the University of California at Santa Barbara, and analyzed at the Marine Science Analytical Laboratories for inorganic nutrient content (Johnson et al. 1985). All HPLC analyses were completed in the field, following procedures outlined in Prezelin et al. (1993a). Some plant pigments are found only in select groups of phytoplankton and can be used as chemotaxonomic markers. Changes in their abundance may indicate a change in the abundance of phytoplankton group (e.g., Smith et al. 1987, 1992). The significance, range of abundance, and mean concentration (± standard deviation) of pigment markers evident in the present field study are summarized in the table.

The frequency of sampling is shown in figure 2a as an overlay on a contour plot of temporal/spatial variability in surface chlorophyll *a* distribution. It is evident that a series of blooms (with chlorophyll *a* values greater than 15,000 nanograms per liter) occurred between mid-December and mid-January, with earlier blooms being lower in intensity and spread along a greater distance of the transect line than the last, very intense bloom that occurred off Bonaparte Point. Prior to the blooms, inorganic nutrients were abundant (figures 2j-l), and phytoplankton communities appeared dominated by prymnesiophytes and dinoflagellates (figures 2e and 2j).

The initiation of the bloom series was coincident with melting of the pack ice, decreasing ice coverage, and a differential rate of decline in surface-water nutrient concentrations (figures 2j-21). Large changes in the ratio of available nitrate:$Si(OH)_4$:PO_4 were observed during the period of bloom events and, as has been reported for other antarctic regions (cf. Sommer 1986, 1988; Smith et al. 1992), appeared to be an important determinant of short-term variability in phytoplankton distribution and community composition observed at the long-term ecological research program (LTER) nearfield stations. Diatoms (figure 2d) dominated the first observed bloom, at a time when silicate (figure 2k) and phosphate (figure 21) levels fell sharply, while prymnesiophytes

Comparision of the range and mean concentrations of chemotaxonomic pigment markers present in the surface waters off Palmer Station between December 1991 and mid-February 1992

Pigment	Chemotaxonomic marker for	Range (ng/L) Min. Max.	*Mean ± SD (ng/L)
Chlorophyll *a*	plant biomass	488 to 29,214	4,339 ± 3,068
Chlorophyll *b*	chlorophytes and/or prasinophytes	nd to 1,731	217 ± 94
Chlorophyll *c*	chromophytes	nd to 811	58 ± 105
Fucoxanthin	diatoms	nd to 28,672	3,332 ± 1,212
19' Hexanoyl-fucoxanthin	prymnesiophytes	nd to 374	60 87
Peridinin	dinoflagellates	nd to 160	36 ± 43
Butanoyl-fucoxanthin	chrysophytes	nd to 72	20 ± 14
Alloxanthin	cryptophytes	nd to 7,117	859 ± 316
Zeaxanthin	cyanobacteria	nd to 460	53 ± 16
Prasinoxanthin	prasinophytes	nd to 7,117	172 ± 97

nd = not detectable
* mean of all samples in which pigments were detectable

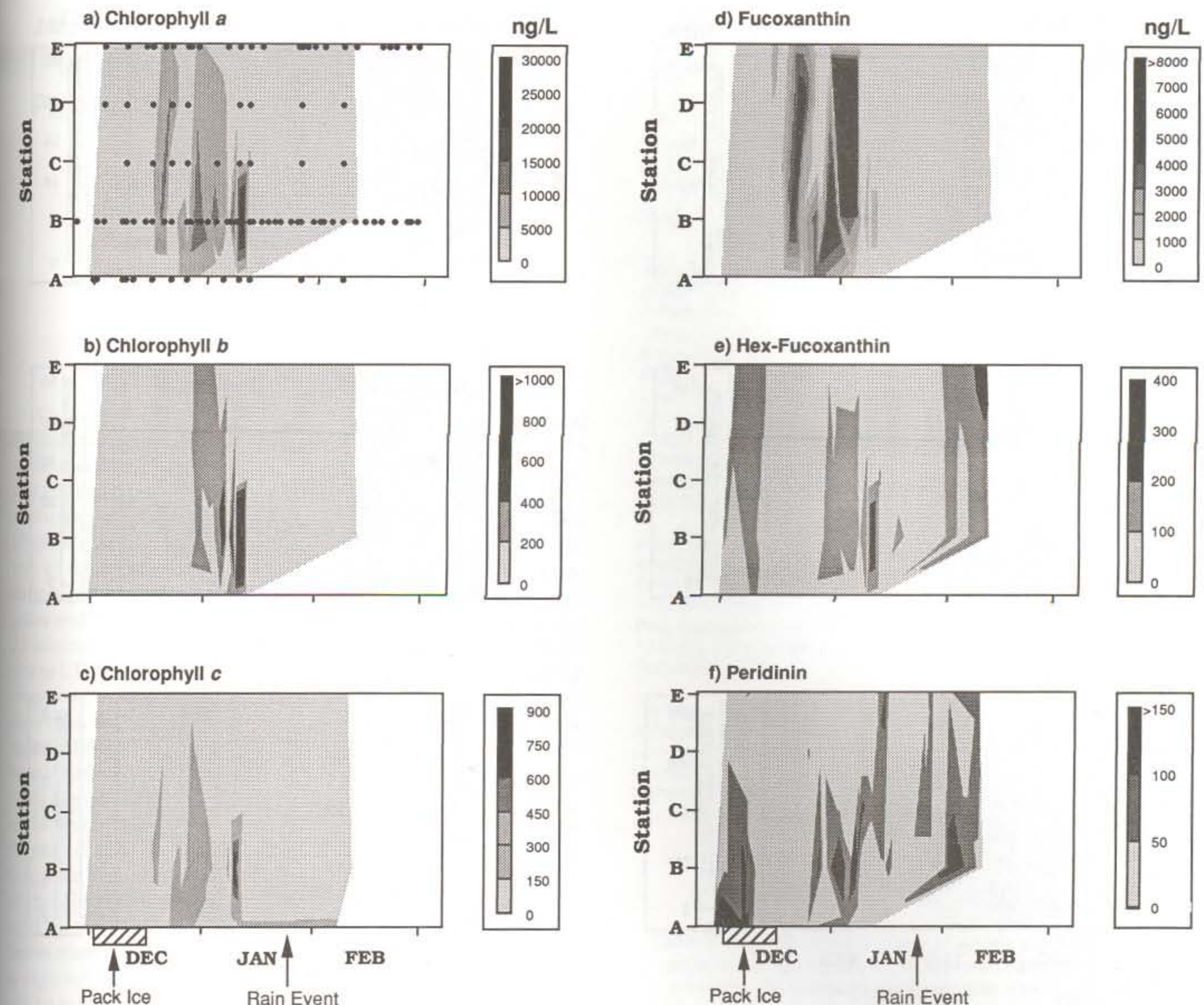

Figure 2a-f. Contour plots of the spatial and temporal variability in pigment and inorganic nutrient distribution along the transect line between December 1991 and March 1992. Only surface data is reported.

(figure 2e) and dinoflagellates (figure 2f) became less abundant. The only other significant phytoplankton group to increase appears to be prasinophytes (figure 2i). In subsequent blooms, we observed major increases in prymnesiophytes, dinoflagellates, cryptophytes (figure 2g), and cyanobacteria (figure 2h).

An intense but localized bloom near Palmer in mid-January was not dominated by diatoms, but rather by prymnesiophytes, cyanobacteria, and cryptophytes. The demise of the bloom series was sudden, coincident with a period of heavy rain and with the presence of a larger area of glacial flowering in the waters between station A-C. We observed an associated increase in nitrate and phosphate levels, with silicate abundance relatively unchanged (figures 2j-l). Depth profiles (not shown) also revealed evidence that diatom populations sank out of surface waters. It appears that within a few weeks of the demise of the first series of blooms, the abundance of prymnesiophytes and dinoflagellates was increasing again (figures 2a-f), and perhaps advecting in from offshore waters in late February/early March (data not shown).

The results indicate that significant changes in phytoplankton abundances and community composition can and do occur on time scales less than a week. Analyses of pigmentation data, in combination with nutrient, optical, and physical data, as well as photophysiological data on phytoplankton photosynthetic properties, should provide significant insight into the mechanisms of food-web dynamics and some aspects of biogeochemical cycling in the LTER nearfield sampling grid.

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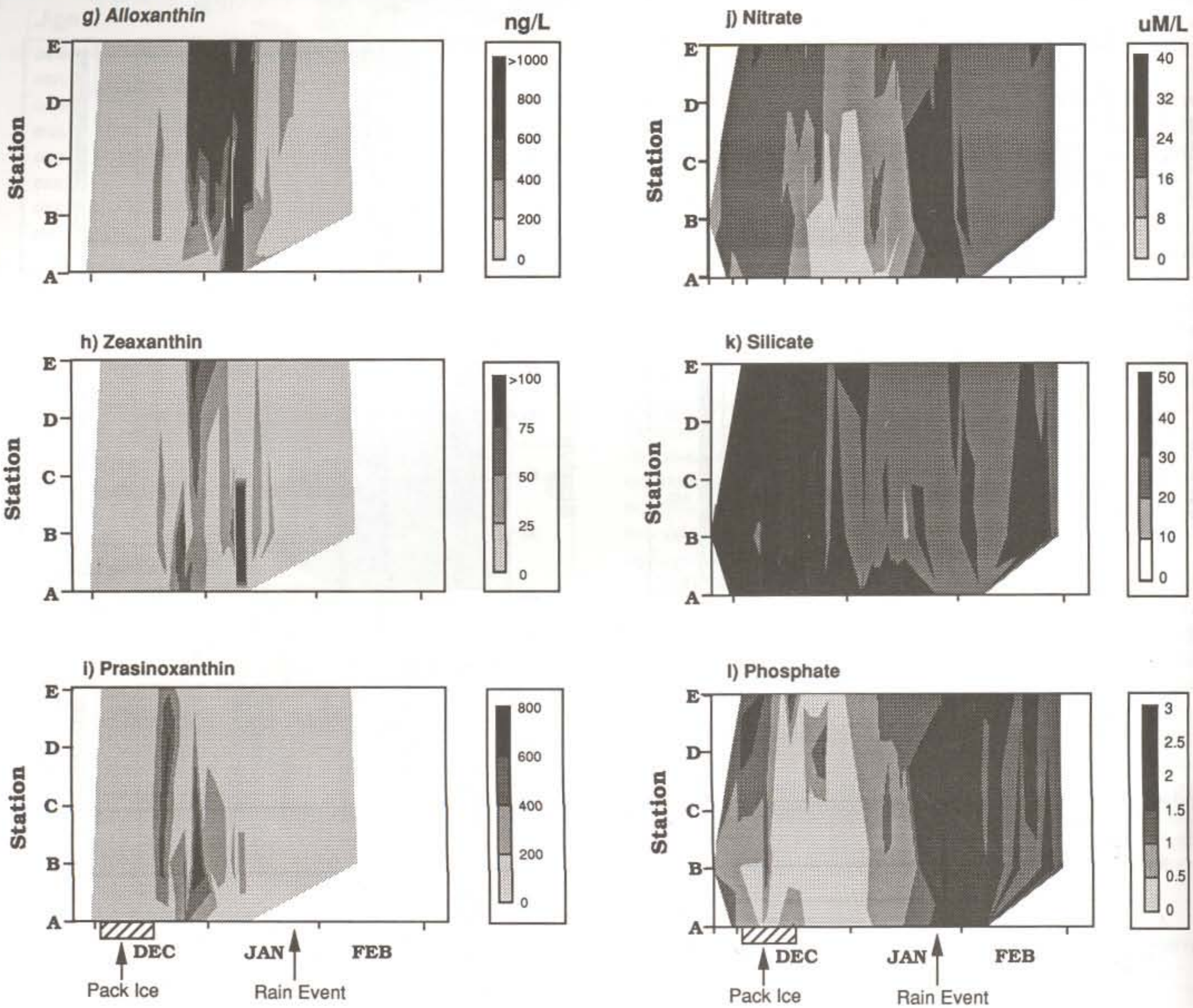

Figure 2g-l. Contour plots of the spatial and temporal variability in pigment and inorganic nutrient distribution along the transect line between December 1991 and March 1992. Only surface data is reported.

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