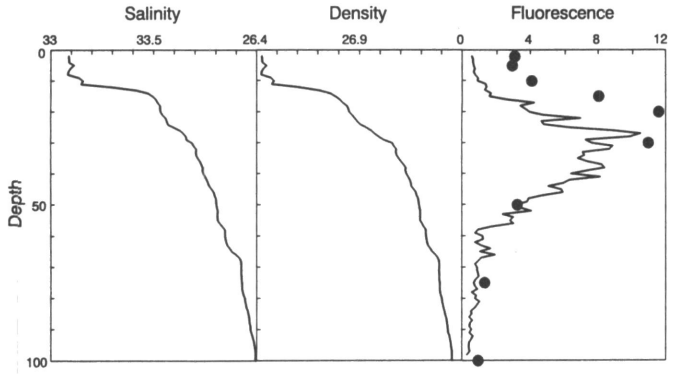

Figure 3. Continuous-depth profiles (0-100 meters) of salinity (in parts per thousand), density (expressed as sigma-T) and *in situ* fluorescence (arbitrary units) for Marguerite Bay station #115 (see table for coordinates). The solid circles in the right-hand panel are the values of chlorophyll *a* (units of micrograms per liter) measured for the discrete water samples.

Marguerite Bay station locations and maximum upper-water-column chlorophyll and particulate adenosine triphosphate concentrations (units of micrograms per liter)

Station#	Latitude (South)	Longitude (West)	Maximum chl-*a*	Biomass ATP
110	68° 6.3'	68° 2.0'	21.8	3.11
111	68° 4.7'	68° 1.8'	17.9	2.26
112	68° 3.2'	68° 2.8'	15.0	1.66
113	68° 2.0'	68° 3.9'	16.3	1.97
114	67° 59.0'	68° 5.0'	14.2	ND[1]
115	67° 56.2'	68° 7.1'	11.6	1.75
116	67° 54.8'	68° 8.0'	13.4	ND
117	67° 53.5'	68° 9.0'	14.1	ND
118	67° 52.3'	68° 10.0'	14.5	1.99
119	67° 50.9'	68° 11.0'	12.8	ND
120	67° 48.2'	68° 12.8'	11.9	1.96
121	67° 45.4'	68° 14.8'	17.7	ND

[1]ND = not determined

early November, we estimate that the initial phase of the spring bloom could have contributed up to 1 mole nitrogen per square meter in the form of new phytoplankton production (equivalent to 6 to 7 moles carbon per square meter) to the local ecosystem. Furthermore, our data on dissolved oxygen and on the derived ratio of silicon uptake-to-[nitrate+nitrite]-uptake suggest that only a negligible portion of the total primary production was supported by regenerated nutrients. Consequently, unless ice-edge upwelling processes can supply allochthonous nutrients at a rate required to sustain this apparent demand for new nitrogen, the Marguerite Bay phytoplankton bloom appears to be on the verge of collapse, or at least ripe for macrozooplankton grazing.

We would like to express our appreciation to the members of the RACER3 scientific party for their numerous contributions to the success of our 1991 field program and to the crew members of the R/V *Polar Duke* and ASA personnel for their help in sample collection. This research was supported by National Science Foundation grants DPP 88-18899, DPP 88-17635, DPP 89-07287, and DPP 89-17778. SOEST contribution #3129.

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RACER: Distributions of nitrogenous nutrients near receding pack ice in Marguerite Bay

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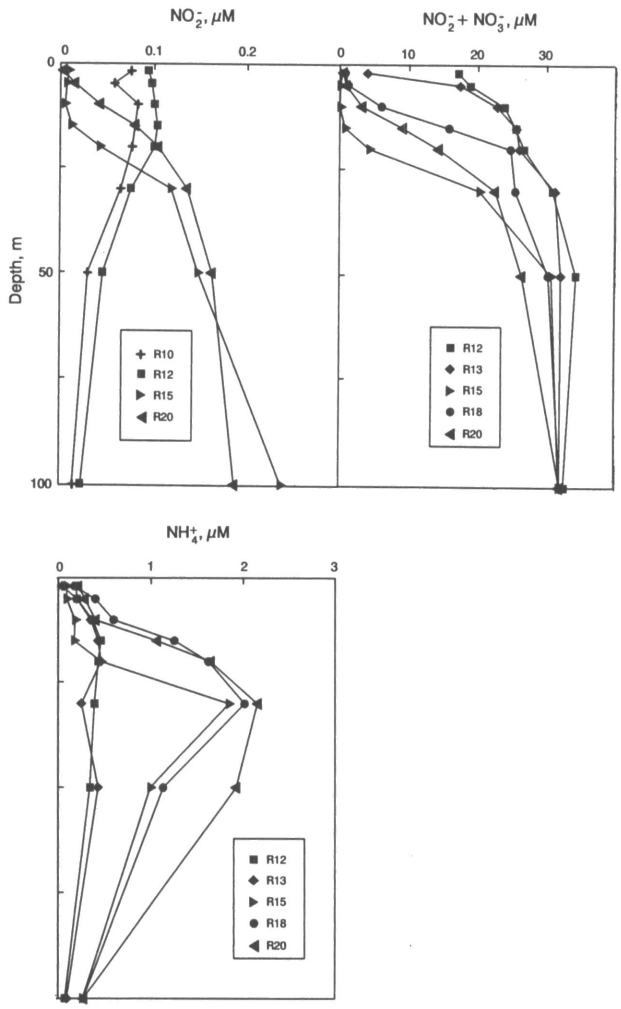
During the RACER3 cruise to the Antarctic Peninsula region, a series of hydrocasts were made along a transect in Marguerite Bay, south of Adelaide Island. Twelve stations were occupied, beginning at the edge of a large formation of pack ice and extending into the open waters of the bay (see Karl et al. this issue, for cruise dates and station locations). We report here preliminary results on distributions of dissolved nitrate (NO_3), nitrite (NO_2-) and ammonium (NH_4+) along this transect. Analysis of these results provides an initial evaluation of the nutritional status of the microbial communities near and away from the receding ice edge. The primary new nitrogen source for the spring phytoplankton bloom in the coastal areas of the peninsula is nitrate (Holm-Hansen and Mitchell 1991), while ammo-



Concentration vs. depth profiles of nitrogenous nutrients. Top panel, nitrite; center panel, [nitrate+nitrite]; bottom panel, ammonium. Depths in meters, concentrations in micromoles per liter. Estimated precisions of analyses are: 0.005 micromolar for nitrite, 0.020 micromolar for [nitrate+nitrite] and ammonium. Stations indicated in legend.

nium is usually an indicator of organic matter that has remineralized and is the main nitrogen source for recycled production. Nitrite is a redox intermediate between ammonium and nitrate; its accumulation in the water column is an indication of biologically mediated nitrogen-cycle activity (Rakestraw 1936).

A conductivity-temperature-depth/rosette system with eleven 12-liter Niskin bottles was used to collect water column samples; eight depths between the surface and 100 meters were sampled for nutrients. Acid-washed polyethylene bottles were rinsed three times with sample and then filled. These were immediately filtered (Whatman GF/F) and the contents transferred to three other sets of acid-washed polyethylene bottles. From each depth, one sample set was frozen for later analysis of a suite of nutrients, including ammonium and [nitrate+nitrite], by autoanalyzer. A second set was frozen for later analysis of nitrite alone, by chemiluminescence (Garside 1982); nitrate may be calculated by difference. The third set was analyzed for ammonium at sea, using a standard colorimetric technique (Strickland and Parsons 1972). A linear regression of 40 analyses of ammonium by both autoanalyzer (after frozen storage) and by colorimetry (fresh)

Depth-integrated (0 to 100 meters) values of nitrite, [nitrate+nitrite], and ammonium. All in units of millimoles per square meter.

Station	Nitrite	Nitrate + Nitrite	Ammonium
Type MB			
R10	4.3	ND	ND
R12	5.8	3051.9	28.3
R13	ND	2905.9	29.3
Mean	5.1	2978.9	28.8
S.D.	1.1	103.2	0.7
No.	2	2	2
Type LB			
R15	13.4	2193.1	75.1
R18	ND	2537.4	100.7
R20	13.9	2214.6	128.3
Mean	13.7	2315.0	101.4
S.D.	0.4	192.9	26.6
No.	2	3	3.0

Note: Mean, standard deviation, and number of stations sampled of each type (MB vs. LB) given for comparison. ND indicates no data available at this time.

yielded a slope not significantly different from 1 (at alpha = 0.05); but the regression did produce a significant intercept of 0.085 micromolar. Inspection of these data shows higher values in the fresh analyses, pronounced at the low end, pointing to a general contamination problem in the shipboard laboratory. We therefore report here the autoanalyzer ammonium data.

Four nitrite depth profiles and five profiles each of [nitrate+nitrite] and ammonium are presented in the figure. (Some samples have not been analyzed yet. Hence, all three nutrients from each station are not always shown, and calculation of nitrate is not always possible. The use of [nitrate+nitrite], rather than nitrate alone, results in only a slight overestimate.) The stations appear to fall into two distinct groups: the first group, exemplified by stations R10, R12, and R13, is characterized by moderate levels of nitrite and ammonium near the surface, decreasing gradually to low levels at depth, and greater than 4 micromolar nitrate near the surface. The second group, represented here by stations R15, R18, and R20, shows lower near-surface nitrite and ammonium, a pronounced subsurface ammonium maximum at 30 meters, increasing levels of nitrite with depth, and less than 1 micromolar nitrate near the surface. We believe that the first group, closer to the ice edge, represents stations in early to middle stages of an algal bloom; the second group is in a later stage of the bloom, where regenerative processes have become significant (Karl et al. this issue). Henceforth, we will refer to these groups as type MB (mid-bloom) and type LB (late-bloom).

The type MB stations have higher nitrite at the surface, probably because the primary source of nitrite is from the incomplete reduction of nitrate by phytoplankton (Kiefer et al. 1976); nitrite production by means of this mechanism is expected to be highest when the rate of nitrate reduction is maximal, as in the early to middle stages of a bloom.

Another possible source of nitrite is bacterial nitrification; however, this process is unlikely to be important at the type MB stations for two reasons. First, nitrifying bacteria are light-inhibited, and thus, their activity is expected to be negligible at the surface. Second, the source of nitrite in nitrification is ammonium, which shows low levels at these stations. The type LB stations exhibit much more regenerative activity, as evidenced by

the large ammonium maximum. The direct relationship of nitrite with depth at type LB stations suggests a source not associated with phytoplankton; in this case, nitrite is probably produced through oxidation of ammonium by nitrifiers. The accumulation of nitrite at these depths, however, indicates low activity of nitrite-oxidizing bacteria. Given the low light intensities at the deeper depths sampled, this is probably not associated with differential light inhibition (Olson 1981), but may be a successional phenomenon (Dore and Karl this issue).

The distinction between the MB and LB stations is supported by associated data on chlorophyll *a* and bacterial exoenzyme activity. Depth-integrated values of the nitrogenous nutrients show large positive shifts for nitrite and ammonium and a negative shift for nitrate between the MB and LB stations (table). These are paralleled by an upward shift in integrated chlorophyll *a* (Karl et al. this issue) and in integrated beta-glucosidase activity (Christian and Karl personal communication). These data indicate that both autotrophic biomass and heterotrophic activity are substantially higher at LB stations than at MB stations. Further study of the transect data set should focus on the physical phenomena responsible for the transition, particularly the role of the melting ice pack.

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RACER: Small-scale distribution of *Euphausia superba* in winter measured by acoustic Doppler current profiler

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In spring and summer the antarctic krill, *Euphausia superba* Dana, is distributed throughout the upper 200 meters (Bargmann 1937; Marr 1962). The species does not appear to exhibit diel vertical migration, but diel changes in aggregation behavior are observable. Dense concentrations, ranging from hundreds of meters to several kilometers in horizongal extent, have been reported to be dispersed at night and concentrated during daylight (Macaulay et al. 1984). In the Gerlache Strait, juveniles and small adults (25 to 33 millimeters), however, have been consistently found concentrated in the upper 50 meters during spring, with no apparent differences between day and night distributions (Huntley et al. 1990).

We observed the same types of distributions during investigations in the Gerlache Strait in spring 1991-1992. A major question remains regarding the distribution of antarctic krill during winter. Whether they aggregate near the extensive surface sea ice (Marschall 1988), perform a bathypelagic winter ontogenetic migration, reside in the coastal shelf benthos (Kawaguchi et al. 1986), or remain distributed, as they are in summer, is simply not known.

One of the principal goals of the 1992 winter Research on Antarctic Coastal Ecosystem Rates (RACER) expedition was to investigate the distribution of *E.superba* in ice-covered seas in waters west of the Antarctic Peninsula. The two instruments we used to make such observations were a Multiple Opening Closing Net and Environmental Sampling System (MOCNESS) and a 150 kilohertz acoustic Doppler current profiler. The MOCNESS

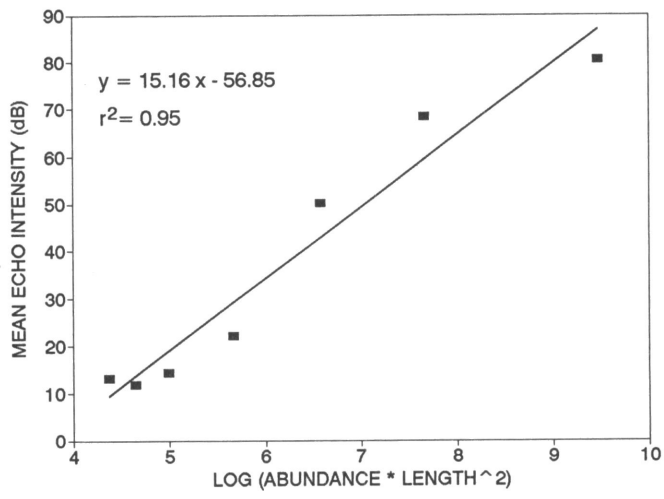

Figure 1. Mean backscatter intensity (db) recorded by the 150-kilohertz acoustic Doppler current profiler during a MOCNESS tow at station 26 in the northern Gerlache Strait and plotted as a function of biomass of euphausiids caught in each of the eight nets of the discrete-depth sampling MOCNESS. The euphausiids were primarily *Euphausia superba* and some *Thysanoessa macrura*.