Palmer LTER: Temporal variability in primary production in Arthur Harbor during the 1994–1995 growth season

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An understanding of spatial and temporal variability in primary production and its relationship to physical and biological factors is necessary to model carbon cycling in the antarctic ecosystem. The Palmer Long-Term Ecological Research (LTER) program is testing the hypothesis that the magnitude and distribution in carbon uptake by phytoplankton is linked to the extent of ice cover during the preceding winter months. Two main sampling modes are used in this investigation: the study of temporal variability at a coastal station near Arthur Harbor on Anvers Island and spatial distribution on the continental shelf during the month of January. The results from a 4-month study at a station in Arthur Harbor show the extent and timing of productivity in the area. These 4 months represent the growth season in coastal waters of the Antarctic Peninsula, which on the average extends from November to March (Tokarczyk 1986; Smith, Dierssen, and Vernet in press).

Water samples were obtained biweekly from a transect covering four stations (stations B, C, D, and E within Palmer LTER inshore grid), starting off Bonaparte Point, Anvers Island, toward offshore (64°48.9'S 64°02.4'W). Samples were taken with a Go-flo bottle at depths corresponding to surface (100 percent of incident radiation) and 55, 27, 11, 5, and 2 percent of incident radiation. Depths were established by measuring photosynthetic available radiation with a LICOR 193-SA Quantum Sensor. Water was stored in a cooler and transported back to station. Duplicate samples were inoculated with 5 microCuries of carbon-14-bicarbonate and incubated outside the station. Neutral nickel screens were used to simulate the corresponding light levels. Running sea water through the incubator kept the samples at *in situ* temperature. After 24 hours, samples were filtered onto a Whatman GF/F filter, acidified with 0.4 milliliters of 15 percent Glacial Acetic Acid, and counted after addition of Universol ES. Production rates are expressed as milligrams carbon per cubic meter per day.

The major pulses in primary production in this area occurred in late spring (December) and summer (January) as well as later in the summer (February and March) (Prézelin et al. 1992). The first event is generally larger and can last for a few weeks whereas the second pulse is of secondary magnitude. In the 1994–1995 season, we observed three pulses in productivity, occurring in mid-December, mid-January, and late February (figure). Maximum rates were observed at the surface or subsurface (50 percent of the incident radiation corresponding to depths from 2 to 5 meters). Integrated primary production levels during these events were high: 1.68, 2.74, and 1.55 grams carbon per square meter per day for 15 December, 19 January, and 23 February, respectively. Yearly production at this station, based on the 14 sampling dates and extending the growth season from 15 November to 15 March, was estimated at 117.6 grams carbon per square meter per year. These pulses of productivity lasted approximately 1 to 2 weeks and were associated with different types of phytoplankton, mainly diatoms and cryptomonads (Kozlowski, Lamerdin, and Vernet, *Antarctic Journal*, in this issue).

The winter of 1994 was characterized by heavy ice in the region of the western coast of the Antarctic Peninsula. This heavy ice occurs in the area every 5 to 6 years (Smith and Stammerjohn in press). The results presented here support the hypothesis that high primary production is associated with the

ice extent. Further analysis of the data will concentrate on the physical and biological factors associated with this enhanced productivity.

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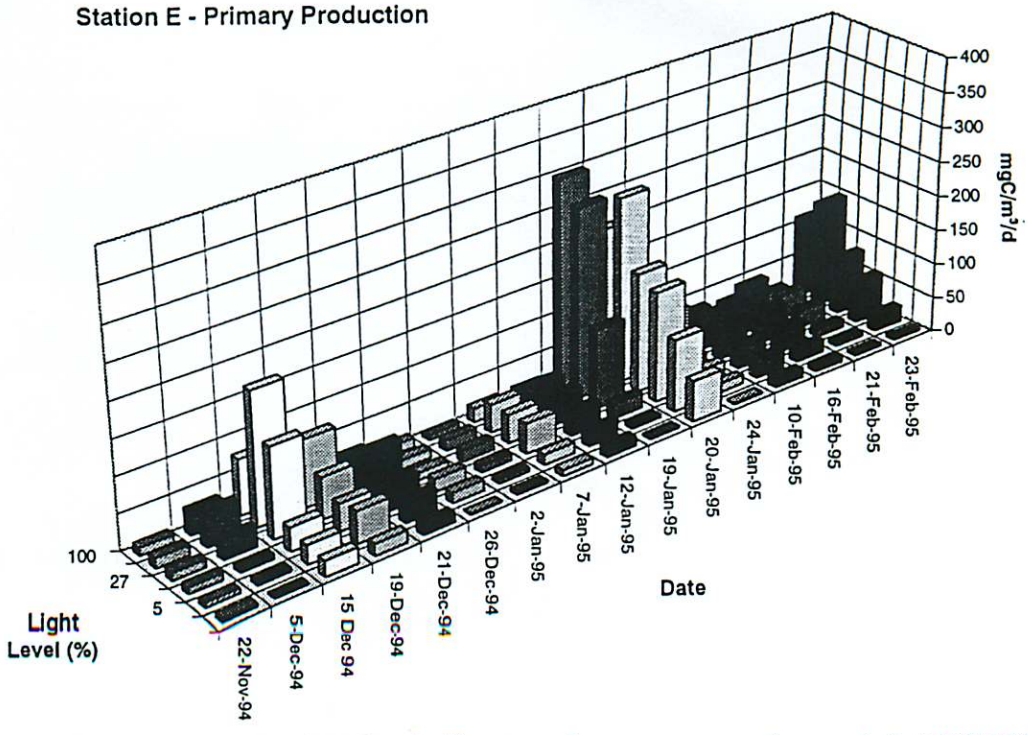

Primary production estimates (in units of milligrams carbon per square meter per day) at 64°48.9'S 64°02.4'W, based on simulated *in situ* incubations done during the 1994–1995 growth season. Samples were taken at six depths corresponding to 100, 55, 27, 11, 5, and 2 percent of the incident irradiance.

References

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