

Palmer LTER: Annual January Cruise for 1999 (LMG99-1)

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Each austral summer since 1993, the Palmer Long-Term Ecological Research (LTER) program has surveyed the continental shelf and slope west of the Antarctic Peninsula and between Anvers and Adelaide islands. The mesoscale study region is covered by a standard grid set up at the initiation of the LTER program (Waters and Smith 1992).

During the 1999 cruise aboard the research ship *Laurence M. Gould* (LMG99-1) sampling occurred between 8 January and 12 February. The cruise plan (tables 1 and 2) included standard cardinal transect lines (figure 1), high density sampling within the foraging range of Adélie penguins nesting near Palmer Station (figure 2), periodic visits to the seasonal stations within 3.7 km of Palmer Station, and spatial variance transects. Three of the five major cruise objectives are common to all January cruises:

1. to document spatial and interannual variation in core physical and biological variables along and offshore;
2. to investigate the linkage between marine resources and Adélie penguins during a time of peak food requirements for the chicks; and
3. to maintain seasonal sampling on the Palmer nearshore stations.

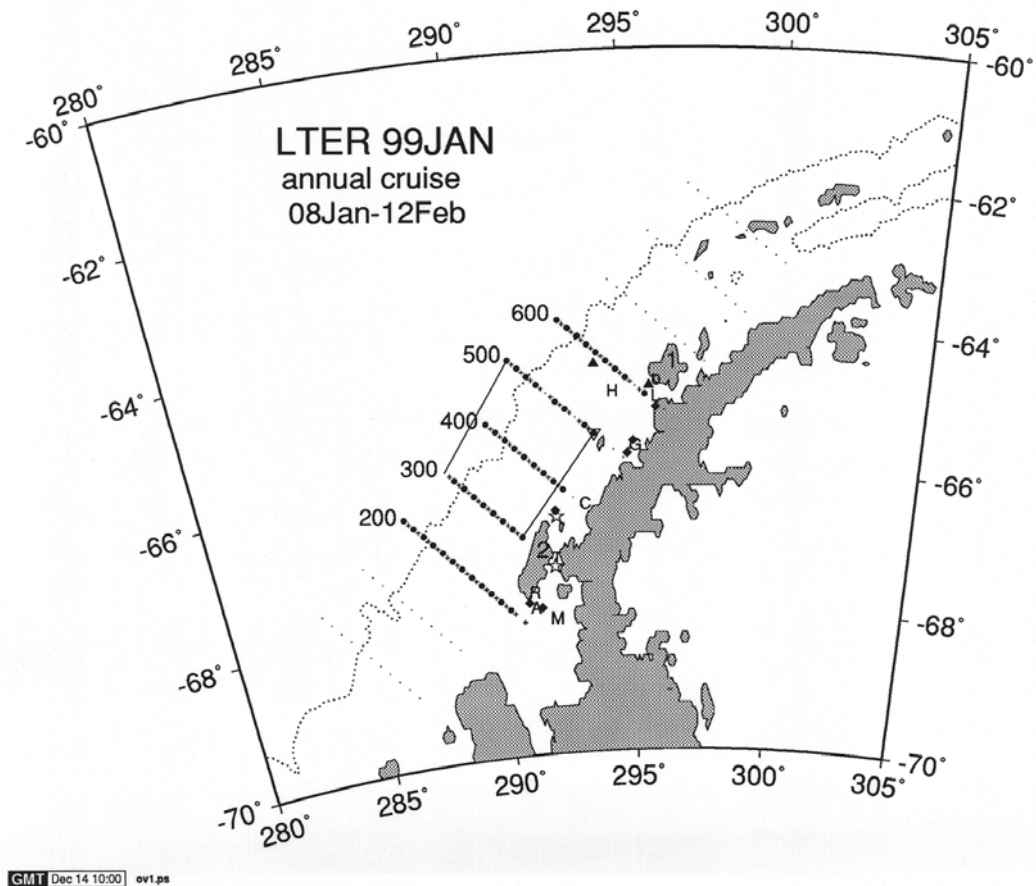


Figure 1. The cardinal stations of the Palmer LTER regional grid (dots) off the Antarctic Peninsula are overlaid to indicate standard station sampling with CTD (large dots) and with XBT (cross) during LMG99-1. Lines show spatial variance transects for inside and outside grid stations. Inside stations are labeled with filled diamonds. Labeled are Palmer Station (o), Anvers Island (1), Adelaide Island (2), Marguerite Bay (M), Avian Island (A), Rothera Station (®), Tickle Channel (T), Crystal Sound (C), Grandidier (G), Lemaire Channel (L), Hugo Automatic Weather Station (H; 64deg 57'S, 65deg 41'W), sediment traps (filled triangles), drifter deployment (unfilled triangle), and sea ice experiments (star). The 1000 m bathymetry line (dotted) is shown.

The Palmer nearshore stations are sampled from zodiacs from November through March to document interannual variability in seasonal patterns. The fourth objective for 99Jan LTER was to continue a study of spatial variance initiated in 97Jan LTER. Data on a subset of the core parameters were collected continuously both between stations on the 5 standard cardinal transect lines (~ 200 km each), and alongshore both on the outer slope and the inner shelf (~ 200 km each). The fifth objective was to repeat a subset of the initial regime on two of the cardinal transects, one at the north end of the LTER sampling region (600.*) and one at the south end (300.*) to determine if timing of the various processes is the same all over the grid or moves north to south in a temporal sequence.

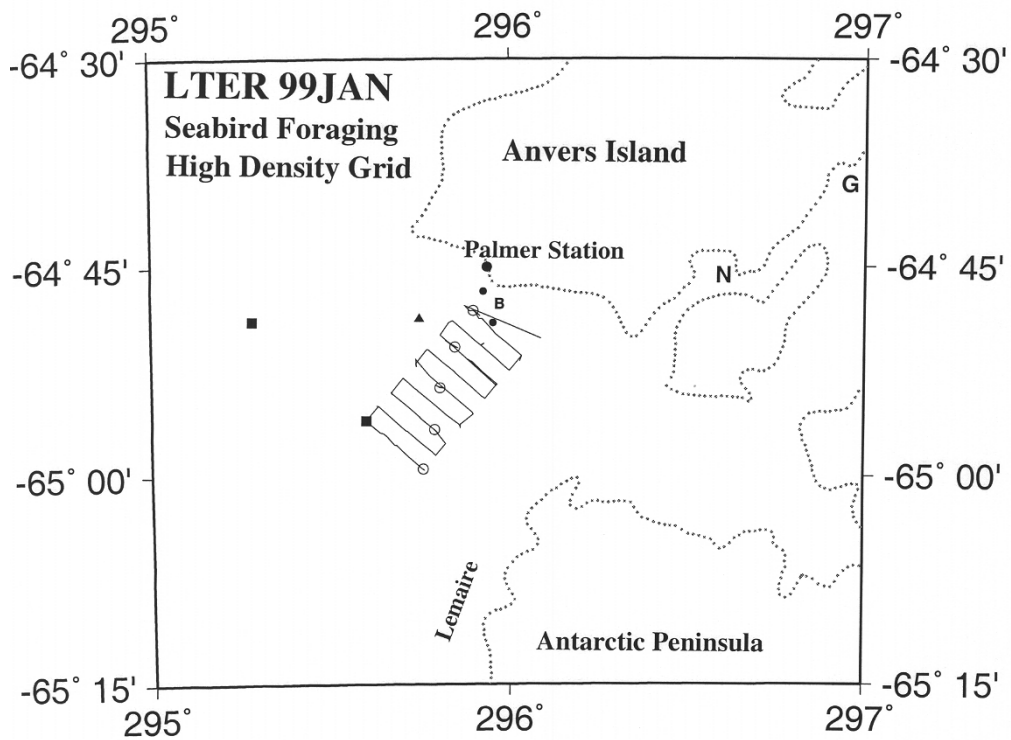


Figure 2. Sampling area near Palmer Station on Anvers Island with the Neumeyer (N) and Gerlache Strait (G) to the East and the Lemaire to the South. The LTER regional grid 600 line stations 040 and 060 (filled squares) and two sediment traps (triangle) are marked. The high-density grid (lines) with CTD stations (open circles) and the location of inshore stations (filled circles) of the Palmer grid are shown.

Table 1. Overview of the LTER cruise LMG99-01 where the day of the month and activities are listed including LTER grid locations (xxx.xxx). LTER Palmer basin stations (A, B, E, F, J), high-density grid sampling (HD1), Inside Islands North (InN) and South (InS) stations.

Date	Site
January	
02	Punta Arenas depart
03	Transect
04	Transect
05	Palmer arrive
06	Palmer dock
07	Palmer dock
08	Tests, B&E
09	InN: Grandidier (510.000,530.005)
10	500.060, Drifter deploy
11	500.120, 500.140, 500.16012
12	500.200, 500.220
13	500.240, Transect Outside 500.240 to 300.200
14	300.180
15	300.160, 300.140
16	300.140, 300.120, 300.100
17	300.080. 300.060, 300.040
18	600.040, 600.060
19	600.080, 600.100, 600.120
20	600.140, 600.160, TrapHugo retrieve, 600.180
21	600.220, 600.200, 600.180
22	HD1 (620.040), Transect 600, dock A-E, F-J
23	InN: Lemaire (595.014), B, E, TrapPalmer deploy
24	HD1 (610.040, 620.040, 615.037, 610.035, 605.032)
25	600.030, TrapHugo deploy
26	400.200, 400.180, 400.160, 400.140
27	400.160, 400.140, 400.120
28	400.080, 400.040
29	200.040, 200.020, 200.000

Date	Site
30	200.-020, Rothera dock
31	Avianls (235.-56), diet & GPS, CTD (with BAS)
February	
01	Avian Island, 200.-06, Sealce Tickle
02	200.060 200.080, 200.100
03	200.120, 200.140, 200.160
04	200.180, 200.200
05	300.200, 300.180, 300.160, 300.140, 300.120, 300.100
06	300.080, 300.060, 300.040, Sealce Crystal_Sound/Matha_Strait, 366.028
07	400.00, Crossing Ceremony, Transect Inside 300.040 to 500.060
08	Transect 500
09	600.100deep, 500.160deep, 600.200, 600.180
10	600.160, 600.140, 600.120, 600.100, 600.080
11	B, E, 600.060, 600.040
12	Palmer dock
13	Palmer dock
14	Palmer depart
15	Transect
16	Transect
17	Transect
18	Punta Arenas arrive

Table 2. Summary of LTER Cruise LMG99-1 events.

Parameter	Number of events	Number of days per event	Number of days	Percentage of cruise
Grid lines	x	x	23	66%
Grid north/south	2	1	2	6%
Grid inshore B, E	3	0.33	1	3%
High-density grid	1	2	2	6%
Picket line/3.7, 10	0	0.33	0	–
Bird zodiac	0	–	0	–
Weather/tests	2	–	1	3%
AWS Hugo	–	–	0	–
Spatial Variance Transect	2	1	2	6%
Traps	3	0.33	1.0	3%
Drifter	1	0.33	0.3	1%
Rothera/Avian Island	2.5	2.5	2.5	7%
Total			35	100%

In addition, we retrieved and re-deployed the Hugo sediment trap, and deployed a new trap outside the Outcast Islands south of Anvers Island. The moored sediment trap array near Hugo Island now includes an ice sonar that senses both the presence and thickness of sea ice. This is the eighth deployment at the Hugo site. Cooperative studies with scientists at Rothera Station continued, with 16 British Antarctic Survey scientists joining the *Laurence M. Gould* on January 31. We accomplished three major objectives that day:

- sampling the diet of Adélie penguins nesting on Avian Island (19 samples);
- landing of a BAS team on Avian Island to complete global positioning system work;
- establishing a full water-column station, during which we compared data from the LTER and BAS CTDs to 200 m and did a deep water bottle cast for biogenic N and S gases.

We anticipate that the comparison of the seasonal dynamics in the two areas separated by 400 km will be enlightening.

Standard measurements at stations 20 kilometers apart on cardinal transect lines included: a PRR/PUV cast to measure downwelling and upwelling radiation in UV and visible wavelengths; a shallow CTD cast with a HydroScat to measure backscattering in 6 visible wavelengths; a core CTD cast with full bottle sampling to characterize the gases, nutrients and living microorganisms, including primary producers, in the water column; 2

net tows with simultaneous bioacoustic transects; and seabird observations. Experiments were conducted at selected stations with the microorganisms and Antarctic krill collected. Both measurements of backscattering and of the spectral absorption by total particulate, detrital and chromophoric dissolved organic matter were parameters added by graduate student research projects. Underway measurements between stations included: seabird distributions; bioacoustics (120 kHz); continuous surface temperature, salinity, fluorescence, carbon dioxide partial pressure (as measured with a carbon dioxide equilibrator system), dissolved oxygen, pH and nitrate; and discrete samples taken at hourly intervals for nutrients and chlorophyll a.

Sea ice was only encountered in the southern part of Grandidier Channel (inside North), the inner reaches of Crystal Sound (inside South), and Tickle Channel in Marguerite Bay. The skies were consistently overcast, and light levels low even at mid-day. Chlorophyll a and primary productivity values were low, close to baseline, with the exception of the stations in the Grandidier Channel and near Avian Island at the mouth of Marguerite Bay. However, surface waters were undersaturated in CO₂. For higher trophic levels, salps and krill co-occurred at many stations, with Antarctic krill abundances at average levels.

In addition, intensive sampling was conducted within the foraging area of Adélie penguins whose reproductive success and foraging ecology was being studied simultaneously by investigators at Palmer Station. The relative distributions of the predator (Adélie penguins) and prey (Antarctic krill) were observed on a high density grid at 2.5 km spacing, as described for 95 January (Quetin et al. 1995) (figure 2). On 19 January one of four giant petrels nesting near Palmer Station and fitted with a satellite transmitter was spotted from the bridge. This sighting will provide an accurate test of the Argos positions for this project.

This research cruise was a result of a productive team composed of Palmer LTER research teams, Antarctic Support Associates personnel with MPC R. Sleister, and Captain Warren Sanamo and his crew of the RESEARCH SHIP LM Gould. Our grateful appreciation is extended to all. This research was supported by National Science Foundation grant OPP 96-9632763 with additional funding provided by the Regents at the University of California.

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