Palmer Long-Term Ecological Research

Palmer Long-Term Ecological Research (LTER): Annual January cruise for 1996 (*PD*96-1)

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The Palmer Long-Term Ecological Research (LTER) annual cruises make physical and biological measurements west of the Antarctic Peninsula (Ross, Hofmann, and Quetin in press). Sampling on *PD*96-1 from 8 January to 10 February 1996 aboard the R/V *Polar Duke* included cardinal transect lines, inshore stations, and periodic visits to the nearshore Palmer grid to provide temporal continuity to the Palmer Station season sampling effort (figure 1). Standard measurements included optics; hydrography; microbial parameters; plant pigments; primary production; plant physiology; acoustic surveys; net tows for zooplankton, krill, and fish; and krill physiological condition (figure 2).

In addition, higher density observations within the foraging area of Palmer Adélie penguins link this apex predator to the environment during critical periods of its life history. Surveys of seabird abundances (figure 3) were continued using picket line (PL) transects, high-density grids (HD), and observations from zodiacs. Also, a day was spent recording Adélie penguins arriving and departing from Torgersen Island. A continuous underway carbon dioxide equilibrator system mapped variations in the air-to-sea gradients in carbon dioxide partial pressure. Two 1-day experiments were

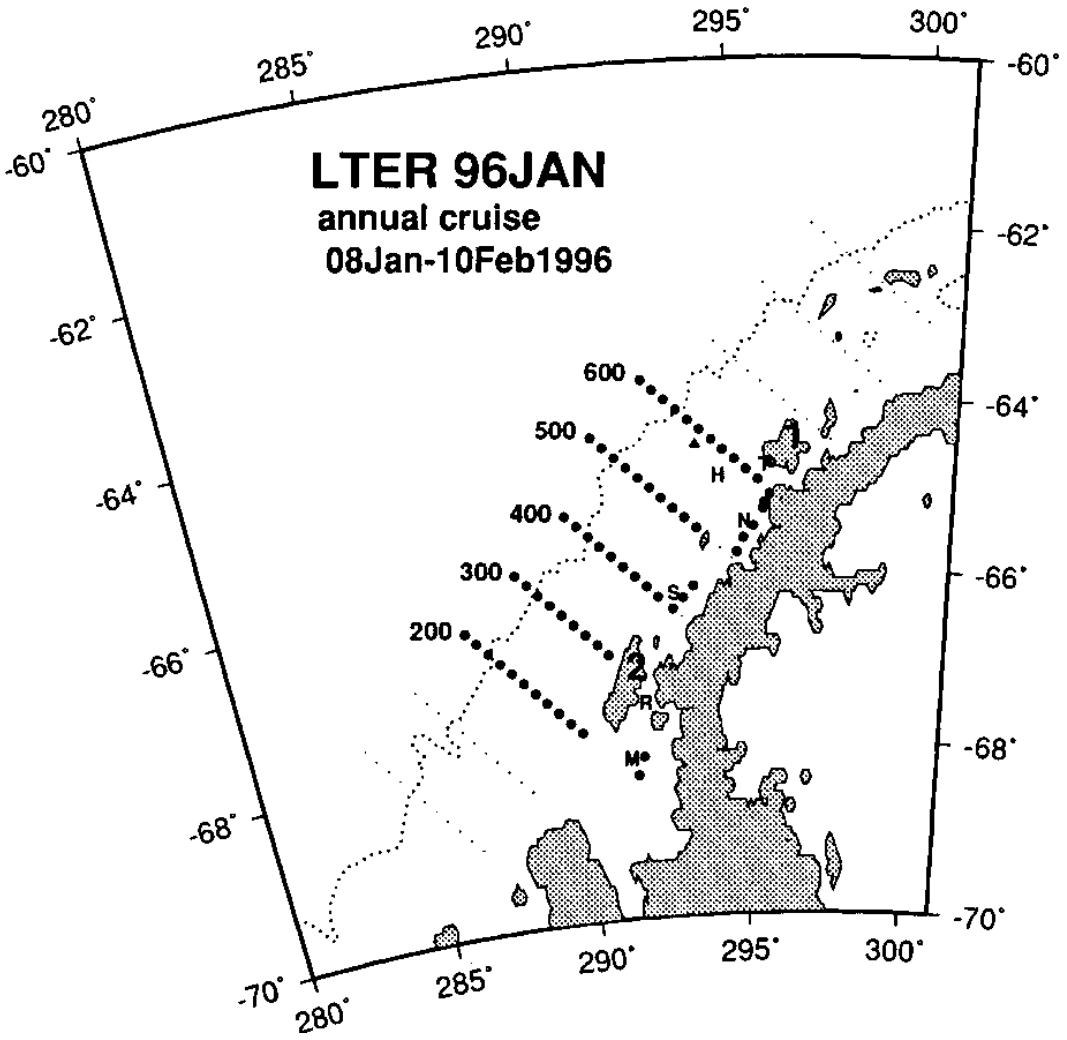

Figure 1. The cardinal stations of the Palmer LTER regional grid (dots) off the Antarctic Peninsula are overlaid with large dots to indicate stations occupied during *PD*96-1. Labeled are Anvers Island (1), Adelaide Island (2), Torgersen Island (T), Palmer Station (o), Rothera Station (R), Hugo automatic weather station (H; 64°57'S 65°41'W), northern stations (N), southern stations (S), and Marguerite Bay (M). The Hugo area sediment-trap site is marked with a filled triangle. The 1,000-meter bathymetry line (dotted) is shown.

conducted to investigate particle flux in ice-covered regions in Marguerite Bay. Stations north (N, figure 1) (Biscoe-Renaud/Lemaire/Grandidier) and south (S, figure 1) (Biscoe-Levoisier/Crystal Sound) inshore of the coastal islands are ice covered in some years, are often highly productive, and are considered nursery grounds for larval fish and antarctic krill.

High-density sampling (Quetin et al. 1995) along with coincidental measurements of terrestrial sampling on Adélie penguin foraging durations were collected. Over time, this sampling has been modified based on results from previous cruises. Originally a 70-kilometer (km) × 70-km grid near Palmer was sampled twice in January 1993. A smaller 50-km × 50-km grid

LTERJAN96 (PD96-1) Cruise Overview

		cruise	grid	station	grid	grid	picket lines(km)				bird	hugo	Other
month	day	day	line	600.040	inshore	HD	3.7	10	30	multi	zodiac		Info
Jan	8	1			B;E		1	1					B;E;500.060;PL3.7;PL10
Jan	9	2	500										500.060;080
Jan	10	3	500									canceled	500.100;120;140;160;Hugo
Jan	11	4	500										500.180;200;220;240
Jan	12	5	600										600.240;220;200;180;160;140
Jan	13	6	600										600.120;100;080
Jan	14	7	600									batts;probe	600.060;Hugo
Jan	15	8					2	2					PL3.7*2;PL10*2
Jan	16	9	600	1	B-J								600.040;B-J
Jan	17	10	600	1		HD1			1				PL30;HD1(600.060,040)
Jan	18	11		1		HD1							HD1(600.040.060)
Jan	19	12								PLR			E;PLRadial;PL10;PL20;Accoustics200m
Jan	20	13			B-E		1				6		B-E;PL3.7;zodiacs
Jan	21	14	N										N(595.014,585.010)Lamaire
Jan	22	15	N										N(575.010;560.005;530.005)Grandidier;ice
Jan	23	16				HDBis							HDBis
Jan	24	17			B-J			1			2		B-J;PL10;zodiacs
Jan	25	18								1			PLMulti(20-60)
Jan	26	19	400									canceled	400.200;180;160;140;Hugo
Jan	27	20	400										400.120;100;080;060;040
Jan	28	21	300										300.040;060;080;100
Jan	29	22	300										300.120;140;160;180;200
Jan	30	23	200										200.200;180;160;140
Jan	31	24	200										200.120;100;080;060;040;020
Feb	1	25	200										200.000;Rothera
Feb	2	26											MB1.1-1.3;sedtrap(1.1deploy);ice
Feb	3	27											MB1.4-1.7;2.1-2.2;sedtrap(1.7retrieve;2.1deploy)
Feb	4	28											MB2.3-2.6;sedtrap(2.6retrieve)
Feb	5	29											storm
Feb	6	30	S										S(440.015);crossing
Feb	7	31	S										S(400.015;420.015)CrystalSound;ice
Feb	8	32			B-J		2						B-J;PL3.7*2
Feb	9	33		1								panels	600.040;TorgBirdExp;AWSHugo;AWSBona_repair
Feb	10	34					2						PL3.7*2;arrivePalmer
Feb	11												
Feb	12												
Feb	13											wind,probe	depart Palmer,Hugo
Feb	14												
Feb	15												
Feb	16												
Feb	17												arrive PA

	#events	%time/ day	#days	%time
grid lines			11	32%
grid(N/S)			4	12%
grid nearshore(B-J)	4	0.6	2.4	7%
grid nearshore(B&E)	1	0.33	0.33	1%
high density grid(HD)	4	1	4	12%
picket line(PL3.7;10;30)	9	0.3	2.7	8%
picket line(PLMulti;Radial)	2	1	2	6%
bird observations(zodiacs)	3	0.6	1.8	5%
weather days			1	3%
AWSHugo(H)			1.5	4%
Marguerite Bay Exp(MB)			3	9%
Torg Bird Count Exp(T)			1	3%
total			34.73	100%

Figure 2. LTER January 1996 (*PD*96-1) cruise overview. Daily events summarized including LTER gridlines, LTER nearshore stations, high-density grid (HD), picket lines (PL), zodiac operations, and automatic weather station. Event time use during cruise is summarized at the bottom of the table.

within the previous 70-km grid was sampled once in January 1994. Based on these results, a 10-km × 20-km grid (HD1) within the 50-km × 50-km area was sampled three times in January 1995 and twice in January 1996. During January 1996, the Bismarck Strait was sampled (HDB; figure 3) in addition to acoustic transects on the south side of the Bismarck Strait and along the 200-km contour to the east of the Palmer Basin.

Picket line seabird censuses, adopted during *PD*95-1 (Smith et al. 1995), indicated again foraging range of Adélie penguins to be within 50 km of Palmer Station. Acoustic biomass measurements were added to the last four 3.7-km picket line surveys to quantify the temporal link between the location of penguins and acoustic (primarily krill) biomass. A new radial picket line (PLR; figure 3) was initiated to determine whether counting penguins in the direction of travel affected a survey. The direction of travel from island breeding sites was determined using penguin tracking from zodiacs.

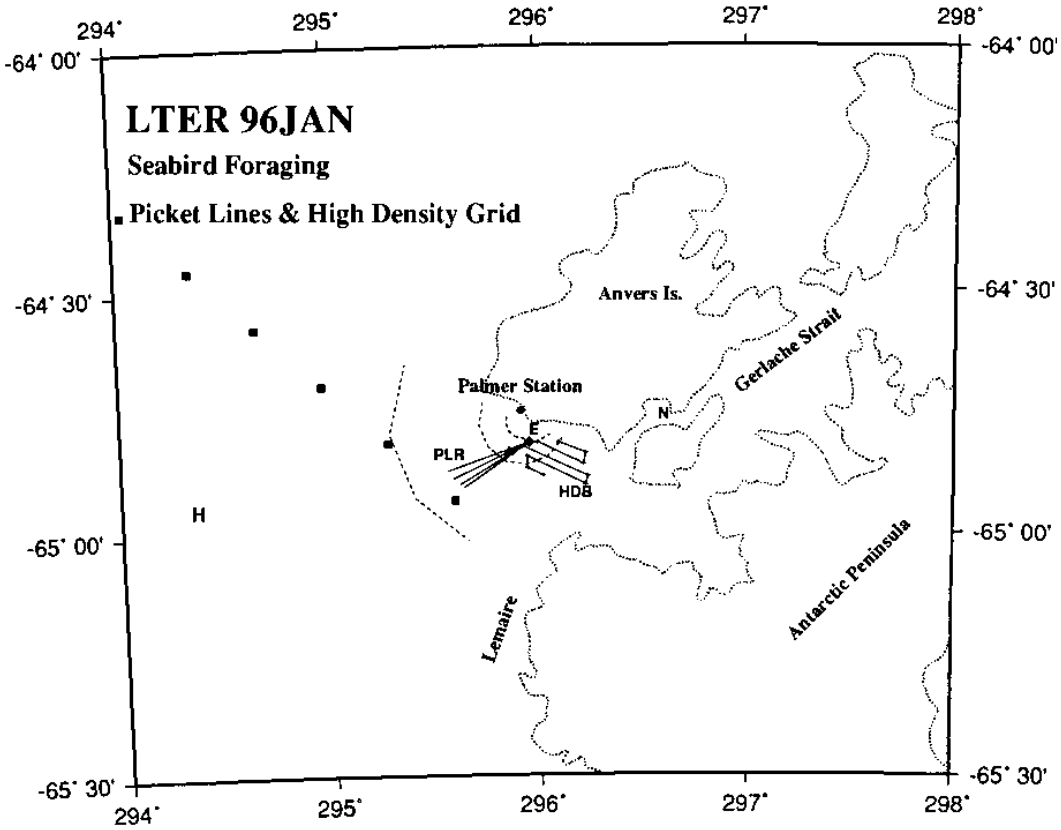

Figure 3. Sampling area near Palmer Station on Anvers Island with the Neumeyer (N) and Gerlache Strait to the east. The Hugo automatic weather station (H) location is given. The Palmer basin sediment-trap site is marked with a filled triangle. Shown are the 3.7-km, 10-km, and 30-km picket lines (dashed lines), the radial picket line sampling (PLR) grid originating at station E (triangle), and the Bismark high-density grid (HDB). The LTER regional grid 600 line stations 040, 060, 080, 100, and 120 are marked (filled squares).

In addition, the Hugo automatic weather station was serviced. High seas prevented small boat landings on later visits to repair the water-temperature probe. A visit to the British Antarctic Survey Station at Rothera permitted discussion of a British nearshore sampling program scheduled to begin in 1996–1997. Annual servicing of the two LTER program sediment-trap moorings (Hugo Island and Palmer Basin) was conducted on *PD*95-10 the preceeding December.

Ice-free open water was observed during most of the cruise. Ice was encountered in the southern part of Grandidier Strait (inshore North), in the southern part of Crystal Sound (inshore South), and in the southern part of Marguerite Bay. Bad weather days were used to sample nearshore, so only 1 day (5 February) was lost because of stormy weather.

The highest concentration of feeding penguins was found farther from Torgersen Island as January progressed, varying from within 3.7 km on 9 January, to within 10 km on 16 January, and to within 30 km on 25 January. Acoustic biomass was observed with higher concentrations nearshore, along the 200-meter contour line, and in Palmer Basin. During January, the pattern of krill aggregations changed from layers to more defined swarms. Phytoplankton biomass was higher than in the three previous January cruises with a strong north-south component and large biomass accumulation in Palmer Basin and Marguerite Bay. A large diatom bloom near Palmer Station extended to 600.080 and the Lemaire Channel.

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