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REPORT OF OCEANOGRAPHIC STUDIES CONDUCTED DURING THE 2000 EASTERN TROPICAL PACIFIC OCEAN SURVEY ON THE RESEARCH VESSELS *DAVID STARR JORDAN*, AND *McARTHUR*

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

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National Marine Fisheries Service
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INTRODUCTION

In 2000, the Southwest Fisheries Science Center (SWFSC) conducted the third year of a three-year research project designed to estimate the absolute abundance of dolphin populations in the eastern tropical Pacific Ocean (ETP). The International Dolphin Conservation Program Act (IDCPA), a 1997 amendment to the Marine Mammal Protection Act, required this research to aid in determining if the intentional chase and encirclement of dolphins in the purse-seine fishery for tuna is having a significant adverse impact on depleted dolphin stocks (primarily *Stenella* spp.).

Two research vessels were used for this survey: the NOAA ships *David Starr Jordan* (hereafter referred to as the *Jordan*) and *McArthur*. The vessels operated concurrently in the ETP for four months, from July 28 to December 9, 2000. Approximately the same area and time period were surveyed during each year of the study.

This report describes the types of oceanographic data collected and sampling techniques used, and summarizes the data collected aboard the *Jordan* and *McArthur* during the 2000 *Stenella* Abundance Research Project (STAR) survey. Oceanographic data collected during the first and second surveys, in 1998 and 1999, are reported in Philbrick *et al.* (2001a and 2001b; respectively). Separate reports summarize the marine mammal data (Kinzey *et al.* 2001) and the seabird, marine turtle and surface fauna data (Olson *et al.* 2001).

OBJECTIVES

The primary objective of this survey was to estimate absolute abundance of several dolphin stocks. The secondary objective was to collect physical and biological oceanographic data in the area inhabited by these stocks. The oceanographic data are collected and analyzed to provide information about the effects of large-scale environmental variation on changes in estimated dolphin abundance. Oceanographic and other environmental variables, including chlorophyll *a*, nutrients, temperature, salinity, zooplankton biomass and the occurrence of seabirds and other animals, are sampled concurrently with the dolphin sighting survey. These parameters fluctuate both seasonally and as a result of large-scale ocean-atmosphere interactions, notably the El Niño-Southern Oscillation (ENSO). In addition to year-to-year environmental effects on estimated abundance, studying oceanographic patterns and variability concurrently with the fauna may reveal regional or local associations related to ecosystem processes. This ecosystem approach provides information necessary for understanding the biological basis of dolphin distribution and abundance.

STUDY AREA AND ITINERARY

The ships covered the eastern tropical Pacific Ocean from 33°N to 18°S, west to 153°W and east to the coasts of North, Central and South America. These tracklines (Figure 1) were selected to encompass the known ranges of the target dolphin species (Gerrodette *et al.* 1998). The area was systematically surveyed using line-transect methods to estimate dolphin abundance.

The *Jordan* and *McArthur* departed San Diego, California on 29 July and 28 July respectively, and both returned to San Diego on 9 December. The cruise was conducted in six legs on the *Jordan* and five legs on the *McArthur* (see itinerary below).

The itinerary for each ship was as follows:

	Jordan	**McArthur**
Leg I		
Departure	San Diego, California 29 July	San Diego, California 28 July
Arrival	Manzanillo, Mexico 16 August	Honolulu, Hawaii 25 August
Leg II		
Departure	Manzanillo, Mexico 19 August	Honolulu, Hawaii 30 August
Arrival	Acapulco, Mexico 08 September	Puntarenas, Costa Rica 29 September
Leg III		
Departure	Acapulco, Mexico 12 September	Puntarenas, Costa Rica 05 October
Arrival	Puntarenas, Costa Rica 01 October	Callao, Peru 25 October
Leg IV		
Departure	Puntarenas, Costa Rica 05 October	Callao, Peru 29 October
Arrival	Puerto Quetzal, Guatemala 23 October	Panama City, Panama 14 November
Leg V		
Departure	Puerto Quetzal, Guatemala 29 October	Panama City, Panama 18 November
Arrival	Manzanillo, Mexico 16 November	San Diego, California 09 December
Leg VI		
Departure	Manzanillo, Mexico 20 November	
Arrival	San Diego, California 09 December	

MATERIALS AND METHODS

Oceanography

Temperature and salinity of surface water were measured continuously and recorded in digital form. Seawater was sampled from an intake 3 meters below the surface by a Sea-Bird Electronics (SBE) thermosalinograph (Model SBE-21). A Windows[1] data acquisition program (WinDACS; Holland 1993) recorded the data on a laptop computer with a serial connection to a Sea-Bird junction box. GPS position information was appended to the data stream through the box's NMEA 0183 input port. The ships' Scientific Computing System (SCS) also collected these data, as well as information from other navigational and weather sensors. Discrete bucket temperatures and salinity samples were collected at regular intervals to verify thermosalinograph readings.

Expendable bathythermograph (XBT) drops, to 760 meters depth, were made daily at 0900, 1200 and 1500 hours (local ship time). On the *McArthur*, the Shipboard Environmental (data) Acquisition System (SEAS), developed by NOAA, collected data from the Sippican Deep Blue probes. On the *McArthur*, low resolution, unprocessed XBT data were transmitted in real-time over the Global Telecommunications System after acquisition by the SEAS. The *Jordan* used Sippican software to acquire data, and conversion to the SEAS format was not possible at sea. The XBT data presented here (full resolution) were processed after the cruise according to guidelines presented in Bailey *et al.* (1994).

Conductivity, temperature and depth (CTD) casts were made each morning before sunrise and each evening after sunset using a Sea-Bird Electronics 911*plus* CTD and General Oceanics rosette system. The CTD was lowered to 1000 meters and sensors connected to shipboard computers measured conductivity (salinity), temperature and pressure (depth). Water samples were collected on all CTD casts for salinity calibration, nutrient and phytoplankton pigment analysis. Samples for ^{14}C-uptake incubations were taken only from morning casts.

CTD cast data were processed using Sea-Bird Electronics' software package, SEASOFT©, version 4.236. Standard processing following the manufacturers instructions were used with the pre-cruise calibration coefficients and post-cruise calibration adjustments.

Hydrochloric acid (2%) and Micro®-washed General Oceanics Niskin bottles (1.7-liter on the *Jordan* and 5-liter on the *McArthur*) were retrofitted with silicon rubber o-rings in the valves and endcaps. Silicon rubber tubing was used as the closing mechanism. On morning casts, Niskin bottles 1 (surface) to 9 were tripped at 7 variable light depths and 2 additional depths less than 200 m as determined by the "ZECALC" program (see below). Two additional bottles were tripped at 500 m and 1000 m (or bottom) for salinity calibration samples. On evening casts, bottle samples were collected from 12 standard depths (0, 20, 40, 60, 80, 100, 120, 140, 170, 200, 500, 1000 m).

Nine samples from $\leq$ 200 m were collected for chlorophyll *a* (275 ml each) and nutrient (15 ml each) analysis at each station. Chlorophyll *a* and phaeophytin were determined by the

1 Windows is a registered trademark of the Microsoft Corporation.

fluorometric technique (Holm-Hansen *et al.* 1965) using a Turner Designs Model 10-AU fluorometer calibrated with chlorophyll *a* standards (Turner Designs). These data were entered at sea and processed at the SWFSC following the cruise. Nutrient samples were collected and immediately frozen for analysis following the cruise. Two 150 ml salinity samples per CTD cast (or 6 on every fourth cast) were also collected and analyzed on a Guildline Instruments AutoSal® salinometer (Model 8400) calibrated during each run with IAPSO[2] standard seawater. These data were used at sea to monitor the accuracy of CTD and thermosalinograph conductivity cells.

Water samples for determination of dissolved inorganic carbon uptake were collected from depths at which irradiance of PAR (photosynthetically active radiation) is a standard fraction (100, 50, 30, 15, 5, 1 and 0.1%) of irradiance just below the sea surface. A program, ZECALC, calculated an initial estimate of euphotic zone depth (1% light level) from pigment profiles observed on previous ETP cruises (1986-1990, 1992, 1993, 1998, 1999) according to the spectral model of attenuation by Morel (1988). This estimate was adjusted by a few meters when euphotic zone depths estimated from observed pigment concentrations at preceding stations were much deeper or shallower than predicted.

Samples were drawn into conditioned screw cap "Vitro" glass 150 ml bottles (Wheaton Corporation) rinsed twice with sample water. Radioactively labeled sodium carbonate ($NaH^{14}CO_3$) was added to each sample bottle (10 μCi). The bottles were then incubated in nickel screens (Perforated Products) in an on-deck seawater-cooled Plexiglas® incubator for 24 hours with natural sunlight as the light source. The screens act as neutral density filters, reducing the light intensity to the same level as that occurring at the depth from which the sample was collected. Two extra samples at the 100% and 0.1% light levels were inoculated with radioactive tracer and filtered immediately without incubation to determine abiotic particulate ^{14}C incorporation (Chavez and Barber 1987). For determination of particulate carbon fixation, the water was filtered onto Whatman GF/F filters at <10 psi of vacuum. The filter was acidified with 0.5 N HCl for 12 hours then immersed in 10 mls of scintillation cocktail (CytoScint ES). These vials were counted on a liquid scintillation counter (Beckman LS6000) following the end of the cruise. The total inorganic carbon activity was determined by adding 1.0 ml of incubated sample water (from the 100% and 30% light levels) to a scintillation vial containing 1 ml of β-phenyl-ethylamine in 20 mls of scintillation cocktail. An average of these two values was used as the total amount of added activity for each station in the calculation of carbon uptake for each sample. Primary productivity data were processed after the cruise at the SWFSC.

Net Tows

On each ship, in complete darkness after the evening CTD cast, a Manta net was towed at the surface for 15 minutes. A Bongo net was then towed obliquely from 200 meters depth for 15 minutes. This is a paired zooplankton net frame with two 333-micrometer (μm) mesh nets, fitted with a flowmeter in the outboard side. A sample was collected only from the outboard net, preserved in 5% buffered formalin, then labeled and stored for post-cruise analysis.

When time allowed, both ships also used a ½ meter ring net, with 333-μm mesh, towed

2 The International Association for Physical Science of the Ocean (IAPSO) Standard Seawater is manufactured by Ocean Scientific International.

obliquely from 200 meters depth for 15 minutes. Samples were preserved in buffered formalin, then labeled and stored for later analysis.

Acoustic Backscatter

An acoustic data acquisition system (ADA) collected 38 kHz and 200 kHz acoustic backscatter data from the ship's Simrad EQ-50 echosounder. Backscatter was digitized and integrated in 5-meter intervals between the surface and a depth of 500 meters (actually 5 m below the transducer, or about 9 m, and 504 m). Nominal ping interval was 5 seconds; thirty pings were averaged every three to seven minutes to reduce data volume, depending on the central processing unit (CPU) speed of the ADA PC. Data collection and processing were similar to the methods described in Fiedler, *et al.* (1998). Acoustic backscatter profiles were corrected for variation in time-varied gain and sound absorption using observed sound speed profiles derived from CTD data.

RESULTS

Oceanography

Figure 1 illustrates cruise tracks for the *Jordan* and *McArthur*. The total number of oceanographic casts, net tows, and samples collected on the *Jordan* and *McArthur* are presented in Tables 1 and 2, respectively.

Figure 2 shows the locations of the 208 *Jordan* and 204 *McArthur* CTD casts. Tables 3 and 4 are CTD cast summaries for each ship, including the number of samples taken per station (chlorophyll, productivity, nutrient, and salinity) for which data exist. Stations where samples were not collected due to equipment malfunction or lack of processing time are blank. In general, the CTD water sample salinities on both ships agreed with the CTD sensor values to within ±0.006 PSU (practical salinity units).

Figure 3 shows XBT deployment locations (659 total drops) for both ships.

Sea surface temperature (Figure 4) and thermocline depth (Figure 5) are plotted from both CTD and XBT data. Surface temperature and salinity data from the thermosalinograph are presented in Figure 6.

Surface chlorophyll concentrations from the *Jordan* and *McArthur* are shown in Figure 7.

Nutrient samples (4438 total) are in frozen storage, to be analyzed for nitrate, nitrite, silicate and phosphate at a later time.

Primary productivity data integrated within the euphotic zone are shown in Figure 8.

All CTD, XBT and sample data will be submitted to NOAA/National Oceanographic Data Center following this publication.

Net Tows

A total of 192 Manta tows was completed: 90 on the *Jordan* and 102 on the *McArthur*. A total of 169 Bongo tows was completed: 67 on the *Jordan* and 102 on the *McArthur*. Manta samples have been sorted and identified. Bongo samples have been volumed, but not sorted or identified. Results will be presented in a separate technical memorandum (SWFSC Tech. Memo. in prep). Ring net samples are archived at the SWFSC.

Acoustic Backscatter

In general, attenuation of the 200 kHz pulse was too high for the backscatter data to be useful at depths below about 50 m. Echograms (time-depth plots) derived from the archived 38 kHz backscatter data show detailed and informative views of the distribution of scatterers in the water column, but are too extensive to include in this report. Results are summarized by contour plots of daily mean backscatter in the surface layer (5-100 m) during the day (0800-1600 L) and night (2000-0400 L) in Figure 9. The day-night difference reflects the importance of a deep scattering layer that moved up into and down out of the surface layer during hours of the day near sunset and sunrise, respectively.

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Table 1. Summary of data collected aboard the *Jordan*, 29 July – 9 December 2000.

	LEG 1	LEG 2	LEG 3	LEG 4	LEG 5	LEG 6	TOTALS
CTD casts	30	39	37	35	34	33	208
CTD chlorophyll samples	300	380	350	328	326	330	2014
Surface chlorophyll samples	73	74	70	66	61	64	408
Primary productivity samples	105	133	119	126	116	112	711
Nutrient samples	331	429	383	358	359	363	2223
Salinity samples	96	118	90	91	98	108	601
XBT drops	52	61	55	55	51	55	329
Manta tows	15	20	14	16	18	7	90
Bongo tows	4	13	8	16	18	8	67
Ring net tows	0	11	8	7	3	0	29

Table 2. Summary of data collected aboard the *McArthur*, 28 July – 9 December 2000.

	LEG 1	LEG 2	LEG 3	LEG 4	LEG 5	TOTALS
CTD casts	48	49	39	29	39	204
CTD chlorophyll samples	475	490	379	281	392	2017
Surface chlorophyll samples	98	117	71	52	60	398
Primary productivity samples	160	161	126	91	133	671
Nutrient samples	524	539	417	305	430	2215
Salinity samples	134	142	115	82	127	600
XBT drops	81	91	57	41	60	330
Manta tows	24	24	20	15	19	102
Bongo tows	24	26	20	15	17	102
Ring net tows	9	14	8	9	19	59

Table 3. *Jordan* 2000 CTD cast summary: station number, date, time, location, depth of cast (m), and numbers of samples for phytoplankton pigments (chl), primary production (prod), nutrients and salinity. Station dates and times are in Greenwich Mean Time. Negative longitude values indicate western (W) positions.

Station number	Date	Time	Latitude	Longitude	Depth	Chl.	Prod.	Nutrients	Salinity
1	7/31	0419	28.85	-115.85	1010	10		11	6
2	7/31	1159	28.65	-115.77	1010	10	7	11	2
3	8/1	0353	27.17	-114.77	1012	10		11	2
4	8/1	1155	26.58	-115.55	1004	10	7	11	2
5	8/2	0349	26.70	-114.11	808	10		11	6
6	8/2	1204	25.85	-113.40	316	11	7	12	2
7	8/3	0345	24.62	-112.53	342	10		11	2
8	8/3	1155	24.45	-113.55	1010	10	7	11	2
9	8/4	0355	24.00	-115.75	1002	10		11	6
10	8/4	1208	23.81	-116.76	1008	10	7	11	2
11	8/5	0353	22.41	-116.96	1008	10		11	2
12	8/5	1209	22.37	-116.14	1008	10	7	11	2
13	8/6	0352	23.03	-114.22	1010	10		11	6
14	8/6	1157	23.49	-113.29	1010	9	7	10	2
15	8/7	0328	23.99	-111.57	300	10		11	2
16	8/7	1202	23.36	-110.85	350	11	7	12	2
17	8/8	0324	21.83	-110.14	1006	10		11	6
18	8/8	1153	21.39	-109.61	1006	10	7	11	2
19	8/9	0325	22.55	-108.85	1010	10		11	2
20	8/9	1138	23.51	-109.20	1012	10	7	11	2
21	8/10	0323	25.11	-109.74	1008	10		11	2
22	8/10	1137	24.74	-108.71	600	10	7	11	2
23	8/11	0306	23.42	-107.19	598	10		11	6
24	8/12	0313	22.31	-107.46	1008	10		11	2
25	8/12	1140	21.78	-107.01	1012	10	7	11	2
26	8/13	0253	20.73	-105.98	322	10		11	6
27	8/13	1140	20.83	-107.10	1006	10	7	11	2
28	8/14	1138	20.74	-107.37	1008	10	7	11	2
29	8/15	1141	20.45	-105.79	1012	10	7	11	2
30	8/16	0249	19.14	-104.95	647	10		11	10
31	8/20	0255	18.25	-105.25	1010	10		11	6
32	8/20	1134	17.57	-105.96	1006	10	7	11	2
33	8/21	0250	16.95	-107.85	1010	10		11	2
34	8/21	1151	16.70	-108.80	1008	10	7	11	2
35	8/22	0246	16.20	-110.45	1010	10		11	6
36	8/22	1207	15.96	-111.31	1010	10	7	11	2
37	8/23	0311	15.61	-112.87	1012	10		11	2
38	8/23	1223	15.23	-113.88	1010	10	7	11	2
39	8/24	0320	14.63	-115.92	1010	10		11	6
40	8/24	1222	14.35	-117.00	1008	10	7	11	2
41	8/25	0335	13.65	-119.30	1010	10		11	2

Table 3. (*Jordan* 2000 CTD cast summary) continued.

Station number	Date	Time	Latitude	Longitude	Depth	Chl.	Prod.	Nutrients	Salinity
42	8/25	1238	13.33	-119.23	1010	10	7	11	2
43	8/26	0321	12.90	-117.65	1008	10		11	6
44	8/26	1222	12.74	-116.72	1008	10	7	11	2
45	8/27	0321	12.25	-114.91	1010	10		11	2
46	8/27	1223	11.76	-115.07	1006	10	7	11	2
47	8/28	0319	10.67	-116.69	1006	10		11	6
48	8/28	1238	10.10	-117.53	1012	10	7	11	2
49	8/29	0320	9.08	-119.02	1004	10		11	2
50	8/29	1239	8.58	-119.80	1006	10	7	11	2
51	8/30	0322	6.88	-118.82	1010	10		11	6
52	8/30	1238	7.20	-117.75	1006	10	7	11	2
53	8/31	0334	8.23	-115.80	1010	10		11	2
54	8/31	1224	8.61	-114.78	1006	10	7	11	2
55	9/1	0307	9.23	-112.76	1010	10		11	6
56	9/1	1208	8.42	-112.19	1006	10	7	11	2
57	9/2	0249	6.66	-111.01	1012	10		11	2
58	9/2	1208	7.34	-110.11	1006	10	7	11	2
59	9/3	0251	8.75	-108.36	1012	10		11	6
60	9/3	1151	9.41	-107.45	1004	10	7	11	2
61	9/4	0234	10.76	-105.72	1010	10		11	2
62	9/4	1138	11.36	-104.91	1010	9	6	11	2
63	9/5	0222	12.61	-103.26	1010	10		11	6
64	9/5	1142	12.98	-102.40	1008	10	7	11	2
65	9/6	0208	13.12	-100.58	1004	10		11	2
66	9/6	1124	13.14	-99.66	1012	10	7	11	2
67	9/7	0208	14.75	-98.64	1010	10		11	6
68	9/7	1124	15.83	-98.22	1010	10	7	11	2
69	9/8	0209	16.29	-99.42	1010			11	2
70	9/13	0227	17.09	-101.18	1013	10		11	6
71	9/13	1135	16.87	-102.07	1010	10	7	11	2
72	9/14	0220	15.99	-103.63	1010	10		11	2
73	9/14	1138	15.47	-104.19	1010	10	7	11	2
74	9/14	0244	14.47	-105.60	1008	10		11	12
75	9/15	1151	13.85	-106.50	1006	10	7	11	2
76	9/16	0237	12.68	-108.15	1008	10		11	2
77	9/16	1153	12.08	-109.04	1010	10	7	11	2
78	9/17	0257	10.86	-110.18	1021	10		11	6
79	9/17	1216	10.30	-110.62	1012	10	7	11	2
80	9/18	0251	8.97	-111.61	1008	10		11	2
81	9/18	1206	8.24	-112.19	1006	10	7	11	2
82	9/19	0252	6.53	-113.53	1008	10		11	5
83	9/19	1211	5.95	-112.74	1008	10	7	11	2
84	9/20	0238	5.28	-110.91	1010	10		11	2
85	9/20	1146	4.98	-110.01	1010	10	7	11	2
86	9/21	0236	5.53	-108.49	1004	10		11	6
87	9/21	1156	5.94	-107.43	1008	10	7	11	2

Table 3. (*Jordan* 2000 CTD cast summary) continued.

Station number	Date	Time	Latitude	Longitude	Depth	Chl.	Prod.	Nutrients	Salinity
88	9/22	0230	6.82	-106.13	1010	10		11	2
89	9/22	1134	7.47	-105.37	1010	10	7	11	2
90	9/23	0223	8.57	-104.16	1006	10		11	6
91	9/23	1135	9.23	-103.30	1010	10	7	11	2
92	9/24	0223	10.28	-102.04	1008	10		11	2
93	9/24	1117	11.05	-101.16	1006	10	7	11	2
94	9/25	0200	11.96	-99.34	1031	10		11	6
95	9/25	1203	12.24	-98.14	1012	10	7	11	2
96	9/26	0136	12.56	-96.56	1008	10		11	2
97	9/26	1105	12.85	-95.37	1006	10	7	11	2
98	9/27	0122	13.28	-93.67	1010	10		11	6
99	9/27	1050	13.48	-92.63	1008	10	7	11	2
100	9/28	0110	13.40	-90.82	262	10		11	2
101	9/28	1021	13.13	-89.65	97	9	7	9	2
102	9/29	0107	12.66	-87.86	52	4		4	
103	9/29	1021	12.28	-87.42	78	7	7	7	1
104	9/30	0106	10.79	-87.30	1010	10		11	6
105	9/30	1010	10.52	-86.26	441	10		11	2
106	10/1	0110	9.24	-84.55	1010				
107	10/6	0058	9.20	-84.40	596	10		11	6
108	10/6	1010	8.35	-83.71	1010	10	7	11	2
109	10/7	0024	7.75	-82.06	103	6		6	
110	10/7	0952	7.50	-81.38	58	7	7	7	
111	10/8	0038	6.14	-82.11	1010	10		11	2
112	10/8	1009	6.18	-83.14	1010	10	7	11	2
113	10/9	0056	6.62	-84.81	1010	10		11	3
114	10/9	1023	7.53	-85.53	1010	10	7	11	2
115	10/10	0111	9.10	-86.72	1010	10		11	2
116	10/10	1026	9.97	-87.38	1010	10	7	11	2
117	10/11	0202	11.61	-88.83	1010	10		11	6
118	10/11	1037	10.86	-89.37	1010	10	7	11	2
119	10/12	0123	9.49	-90.37	1012	10		11	2
120	10/12	1051	8.97	-90.73	1010	10	7	11	2
121	10/13	0124	10.18	-91.22	1010	10		11	6
122	10/13	1050	11.16	-91.52	1010	10	7	11	2
123	10/14	0125	10.48	-92.46	1010	10		11	2
124	10/14	1051	9.71	-93.25	1010	10	7	11	2
125	10/15	0126	8.74	-94.38	1010	10		11	6
126	10/15	1051	8.76	-95.44	1010	10	7	11	2
127	10/16	0138	8.65	-97.23	1010	10		11	2
128	10/16	1105	8.72	-98.54	1010	10	7	11	2
129	10/17	0154	8.80	-100.45	1010	10		11	6
130	10/17	1122	9.84	-100.37	1008	10	6	11	2
131	10/18	0151	10.73	-98.93	1008	10		11	2
132	10/18	1107	11.20	-98.01	1010	10	7	11	2
133	10/19	0144	11.82	-96.65	1012	10		11	6

Table 3. (*Jordan* 2000 CTD cast summary) continued.

Station number	Date	Time	Latitude	Longitude	Depth	Chl.	Prod.	Nutrients	Salinity
134	10/19	1111	12.86	-96.99	1008	10	7	11	2
135	10/20	0140	14.74	-97.60	1008	10		11	2
136	10/20	1122	15.81	-97.88	1010	10	7	11	2
137	10/21	0125	15.52	-96.54	1012	10		11	6
138	10/21	1109	15.71	-95.32	590	10	7	11	2
139	10/22	0111	15.06	-93.67	177	10		10	2
140	10/22	1033	14.59	-92.71	34	5		5	
141	10/23	0100	13.37	-91.46	506				
142	10/30	1059	12.79	-92.20	1008	10	7	11	2
143	10/31	0123	11.49	-93.55	1008	10		11	6
144	10/31	1051	10.68	-94.41	1010	10	7	11	2
145	11/1	0129	9.78	-95.71	1010	10		11	2
146	11/1	1109	8.99	-96.50	1006	10	7	11	2
147	11/2	0140	7.95	-97.57	1004	10		11	6
148	11/2	1106	7.26	-98.34	1010	10	7	11	2
149	11/3	0153	6.49	-99.71	1010	9		10	2
150	11/3	1122	6.40	-100.76	1010	10	7	11	2
151	11/4	0152	6.35	-102.42	1006	10		11	6
152	11/4	1123	6.35	-103.51	1010	10	7	11	2
153	11/5	0211	6.40	-105.34	1012	10		11	2
154	11/5	1139	6.30	-106.37	1008	10	7	11	2
155	11/6	0222	6.27	-108.38	1012	10		11	6
156	11/6	1153	6.25	-109.47	1010	9	6	10	2
157	11/7	0241	6.24	-111.36	1008	10		11	2
158	11/7	1212	6.24	-112.54	1008	9	6	10	2
159	11/8	0239	6.22	-114.51	1010	10		11	6
160	11/8	1223	7.10	-114.44	1010	10	7	11	2
161	11/9	0240	8.26	-112.71	1010	10		11	2
162	11/9	1211	8.54	-112.08	1006	10	7	11	2
163	11/10	0225	9.52	-110.46	1008	10		11	6
164	11/10	1210	10.00	-109.66	1004	10	7	11	2
165	11/11	0214	10.32	-109.21	260	10		11	2
166	11/11	1154	11.05	-108.24	1008	9	6	10	2
167	11/12	0208	12.37	-106.51	1006	10		11	6
168	11/12	1153	13.12	-105.53	1004	10	7	11	2
169	11/13	0155	14.15	-104.20	1010	10		11	2
170	11/13	1140	14.74	-103.41	1006	10		11	2
171	11/14	0137	15.81	-101.92	1010	10		11	6
172	11/14	1139	16.37	-100.61	1010	10	7	11	2
173	11/15	0140	17.37	-101.73	1008	10		11	2
174	11/15	1155	17.66	-102.18	911	10	7	11	2
175	11/16	0155	18.10	-103.48	1006				
176	11/21	0155	18.08	-104.59	1010	10		11	6
177	11/21	1155	16.82	-104.82	1012	10	7	11	2
178	11/22	0154	16.05	-106.61	1008	10		11	2
179	11/22	1212	15.50	-107.85	1010	10	7	11	2

Table 3. (*Jordan* 2000 CTD cast summary) continued.

Station number	Date	Time	Latitude	Longitude	Depth	Chl.	Prod.	Nutrients	Salinity
180	11/23	0216	14.77	-104.57	1012	10		11	6
181	11/23	1227	14.52	-110.09	1012	10	7	11	2
182	11/24	0226	13.68	-111.49	1010	10		11	2
183	11/24	1229	12.76	-110.83	1014	10	6	11	2
184	11/25	0228	13.43	-112.66	1012	10		11	6
185	11/25	1241	13.43	-113.67	1012	10	7	11	2
186	11/26	0241	14.23	-115.29	1006	10		11	2
187	11/26	1259	14.77	-116.41	1010	10	7	11	2
188	11/27	0256	15.65	-118.34	1010	10		11	6
189	11/27	1259	16.26	-119.41	1012	10	7	11	2
190	11/28	0258	16.71	-118.68	1010	10		11	2
191	11/28	1328	16.84	-117.52	1010	10	7	11	2
192	11/29	0242	17.32	-116.06	1012	10		11	6
193	11/29	1240	17.60	-114.69	1010	10	7	11	2
194	11/30	0229	18.01	-112.82	1010	10		11	2
195	11/30	1242	18.30	-111.33	1012	10	7	11	2
196	12/1	0214	18.94	-109.88	1012	10		11	6
197	12/1	1257	19.31	-110.76	994	10	7	11	2
198	12/2	0213	19.81	-110.97	1014	10		11	2
199	12/2	1243	20.67	-112.12	1014	10	7	11	2
200	12/3	0225	20.01	-114.03	1012	10		11	6
201	12/3	1257	19.40	-115.44	1012	10	7	11	2
202	12/4	0244	18.77	-117.05	1014	10		11	2
203	12/4	1307	20.23	-117.37	1010	10	7	11	2
204	12/5	0236	21.69	-117.64	1012	10		11	6
205	12/5	1309	20.13	-118.23	1004	10	7	11	2
206	12/6	0239	24.62	-119.44	1012	10		11	2
207	12/6	1324	26.14	-119.10	1010	10	7	11	2
208	12/7	0225	27.75	-118.53	1012	10		11	12

Table 4. *McArthur* 2000 CTD cast summary: station number, date, time, location, depth of cast (m), and number of samples for phytoplankton pigments (chl), primary production (prod), nutrients and salinity. Station dates and times are in Greenwich Mean Time. Negative latitude values indicate southern (S) positions and negative longitude values indicate western (W) positions.

Station number	Date	Time	Latitude	Longitude	Depth	Chl.	Prod.	Nutrients	Salinity
1	7/29	1221	31.32	-118.15	901			10	10
2	7/30	0434	29.15	-119.71	1004	9		10	2
3	7/30	1207	28.45	-120.20	1002	10	7	11	2
4	7/31	0410	26.18	-120.55	1002	10		11	2
5	7/31	1222	25.57	-121.26	1002	10	7	11	2
6	8/1	0419	23.98	-123.11	1002	10		11	6
7	8/1	1238	23.32	-123.91	1008	10	7	11	2
8	8/2	0420	21.77	-125.72	1002	10		11	2
9	8/2	1253	21.14	-125.75	1004	10	7	11	2
10	8/3	0409	20.01	-123.65	1002	10		11	2
11	8/3	1237	19.80	-123.26	1000	10	7	11	2
12	8/4	0408	19.49	-121.50	1004	10		11	6
13	8/4	1237	19.97	-120.76	1000	10	7	11	2
14	8/5	0352	21.77	-119.24	1000	10		11	2
15	8/5	1223	22.33	-118.36	1002	10	7	11	2
16	8/6	0352	19.85	-119.16	1004	10		11	2
17	8/6	1225	18.81	-119.48	1000	9	6	10	
18	8/7	0349	16.93	-120.25	1002	10		11	2
19	8/7	1237	16.13	-120.76	1004	10	7	11	2
20	8/8	0358	14.45	-121.78	1002	10		11	2
21	8/8	1237	13.59	-122.23	1002	10	7	11	2
22	8/9	0353	11.44	-123.42	1002	10		11	2
23	8/9	1250	10.66	-123.90	1002	10	7	11	2
24	8/10	0407	9.14	-125.13	1002	10		11	6
25	8/10	1308	9.59	-125.85	1002	10	7	11	2
26	8/11	0418	10.71	-127.59	1002	10		11	2
27	8/11	1304	11.11	-128.30	1000	10	7	11	2
28	8/12	0420	12.06	-129.89	1000	10		11	6
29	8/12	1321	12.53	-130.61	1002	10	7	11	2
30	8/13	0437	13.42	-132.16	1004	10		11	2
31	8/13	1324	12.73	-132.44	1004	10	7	11	2
32	8/14	0438	10.75	-132.72	1002	10		11	6
33	8/14	1321	9.79	-132.96	1002	10	7	11	2
34	8/15	0435	7.85	-133.85	1004	10		11	2
35	8/15	1340	7.36	-134.66	1017	10	7	11	2
36	8/16	0442	6.66	-135.80	1000	9		10	2
37	8/16	1350	6.10	-136.76	1002	10	7	11	2
38	8/17	0451	5.08	-138.26	1008	10		11	6
39	8/17	1353	4.58	-139.28	1002	10	7	11	2

Table 4. (*McArthur* 2000 CTD cast summary) continued.

Station number	Date	Time	Latitude	Longitude	Depth	Chl.	Prod.	Nutrients	Salinity
40	8/18	0453	5.08	-140.70	1002	10		11	2
41	8/18	1408	6.20	-141.00	1002	10	7	11	2
42	8/19	0506	8.24	-141.75	1002	10		11	2
43	8/19	1407	8.39	-142.85	1004	10	7	11	2
44	8/20	0522	8.71	-145.06	1002	10		11	6
45	8/20	1423	8.55	-146.13	1002	10	7	11	2
46	8/21	0522	8.84	-148.14	1004	10		11	2
47	8/21	1439	9.54	-148.97	1002	10	7	11	2
48	8/22	0548	11.21	-148.99	1002	10		11	6
49	9/4	0511	12.82	-142.00	1012	10		11	2
50	9/4	1411	12.03	-141.05	1014	10	7	11	2
51	9/5	0453	10.50	-139.18	1010	10		11	6
52	9/5	1355	9.70	-138.21	1017	10	7	11	2
53	9/6	0437	8.02	-136.35	1081	10		11	2
54	9/6	1355	7.41	-135.44	1012	9	6	11	2
55	9/7	0420	5.90	-133.63	1014	10		11	6
56	9/7	1341	5.16	-132.73	1010	10	7	11	2
57	9/8	0406	3.75	-131.05	1012	10		11	2
58	9/8	1321	3.00	-130.17	1023	10	7	11	2
59	9/9	0409	2.03	-128.97	1012	10		11	6
60	9/9	1325	1.27	-128.07	1017	10	7	11	2
61	9/10	0411	-0.00	-126.54	1014	10		11	2
62	9/10	1304	-1.05	-126.29	1014	10	7	11	2
63	9/11	0350	-3.21	-126.22	1012	10		11	6
64	9/11	1308	-4.50	-126.18	1014	10	7	11	2
65	9/12	0421	-4.74	-124.56	1016	10		11	2
66	9/12	1252	-4.65	-123.42	1014	10	7	11	2
67	9/13	0353	-4.53	-121.24	1055	10		11	6
68	9/13	1251	-4.47	-120.28	1017	10	7	11	2
69	9/14	0429	-4.36	-118.44	1010	10		11	2
70	9/14	1236	-4.33	-117.65	1023	10	7	11	2
71	9/15	0309	-4.25	-115.87	1012	10		11	6
72	9/15	1220	-4.16	-114.77	1014	10	7	11	2
73	9/16	0331	-4.05	-112.63	1014	10		11	2
74	9/16	1207	-3.56	-111.97	1041	10	7	11	2
75	9/17	0250	-1.64	-111.50	1016	10		11	2
76	9/17	1207	-0.88	-111.31	1021	10	7	11	2
77	9/18	0249	1.21	-110.82	1012	10		11	6
78	9/18	1205	2.08	-110.59	1017	10	7	11	2
79	9/19	0237	4.11	-110.05	1025	10		11	2
80	9/19	1207	3.97	-109.34	1014	10	6	11	2
81	9/20	0237	3.20	-107.26	1012	10		11	6
82	9/20	1157	2.92	-106.50	1035	10	7	11	2
83	9/21	0220	3.85	-104.80	1016	10		11	2
84	9/21	1140	3.45	-103.78	1014	10	7	11	2

Table 4. (*McArthur* 2000 CTD cast summary) continued.

Station number	Date	Time	Latitude	Longitude	Depth	Chl.	Prod.	Nutrients	Salinity
85	9/22	0206	3.75	-101.51	1012	10		11	6
86	9/22	1119	4.16	-100.30	1012	10	7	11	2
87	9/23	0150	4.73	-98.07	1012	10		11	2
88	9/23	1106	5.04	-96.96	1012	10	7	11	2
89	9/24	0135	5.68	-95.15	1012	10		11	6
90	9/24	1055	6.00	-94.36	1012	10	7	11	2
91	9/25	0125	7.09	-92.49	1012	10		11	2
92	9/26	0127	6.96	-91.32	1016	10		11	2
93	9/26	1056	7.34	-90.77	1027	10	7	11	2
94	9/27	0122	8.04	-88.78	1014	10		11	6
95	9/27	1037	7.29	-88.68	1014	10	7	11	2
96	9/28	0105	8.74	-87.63	1014	10		11	2
97	9/28	1022	8.37	-87.09	1012	10		11	2
98	10/5	0113	8.54	-84.43	1011	10		11	6
99	10/6	1037	7.70	-84.54	1010	10	6	11	2
100	10/7	0107	6.94	-86.42	1004	10		11	2
101	10/7	1027	6.53	-87.44	831	10	7	11	2
102	10/8	0139	5.69	-89.36	1035	10		11	6
103	10/8	1043	4.99	-90.03	1017	10	7	11	2
104	10/9	0127	4.04	-92.12	1021	10		11	2
105	10/9	1037	3.25	-92.83	1023	10	7	11	2
106	10/10	0139	1.40	-94.48	1010	9		10	5
107	10/10	1052	1.03	-94.81	1019	10	7	11	2
108	10/11	0136	-0.18	-95.84	1012	10		11	2
109	10/11	1052	-0.95	-96.57	1039	10	7	11	2
110	10/12	0153	-2.31	-97.79	1010	10		11	6
111	10/12	1105	-3.10	-98.49	1016	10	7	11	2
112	10/13	0149	-4.89	-100.09	1019	10		11	2
113	10/13	1121	-5.66	-100.78	1012	10	7	11	2
114	10/14	0213	-7.36	-102.31	1010	10		11	6
115	10/14	1119	-8.12	-102.99	1014	10	7	11	2
116	10/15	0222	-9.80	-104.51	1010	10		11	2
117	10/15	1123	-10.07	-104.87	1012	10	7	11	2
118	10/16	0226	-10.02	-102.68	1014	10		11	6
119	10/16	1125	-9.91	-101.80	1027	10	7	11	2
120	10/17	0214	-9.77	-99.63	1014	10		11	2
121	10/17	1109	-9.70	-98.49	1014	10	7	11	2
122	10/18	0417	-9.59	-96.30	1014	10		11	6
123	10/18	1050	-9.53	-95.78	1012	10	7	11	2
124	10/19	0137	-9.38	-93.60	1012	10		11	2
125	10/19	1033	-9.34	-92.93	1012	10	7	11	2
126	10/20	0128	-9.30	-90.97	1012	10		11	6
127	10/20	1018	-9.39	-90.35	1012	10	7	11	2
128	10/21	0128	-10.52	-88.80	1014	10		11	2
129	10/21	1004	-10.89	-88.12	1014	10	7	11	2

Table 4. (*McArthur* 2000 CTD cast summary) continued.

Station number	Date	Time	Latitude	Longitude	Depth	Chl.	Prod.	Nutrients	Salinity
130	10/22	0107	-12.07	-86.31	1014	10		11	6
131	10/22	1002	-12.33	-85.92	1014	10	7	11	2
132	10/23	0050	-12.40	-83.67	1012	10		11	2
133	10/23	0952	-12.42	-83.10	1012	10	7	11	2
134	10/24	0050	-12.49	-81.06	1016	10		11	6
135	10/24	0934	-12.53	-79.96	1016	10		11	2
136	10/25	0033	-12.69	-78.34	1004				
137	10/30	0009	-11.17	-78.01	207	10		10	4
138	10/30	0941	-10.26	-78.89	133	10	7	10	2
139	10/31	0024	-8.73	-79.03	60	7		7	1
140	10/31	0949	-8.63	-79.09	58	7	7	7	1
141	11/1	0027	-8.46	-80.24	487	10		11	5
142	11/1	0954	-8.79	-81.39	1012	10	7	11	2
143	11/2	0051	-8.14	-82.89	1010	10		11	2
144	11/2	0952	-7.19	-83.00	1012	10	7	11	2
145	11/3	0053	-7.00	-81.09	990	10		11	6
146	11/4	0039	-6.36	-81.38	1010	10		11	2
147	11/4	0937	-5.23	-81.37	161	10	7	11	2
148	11/5	0022	-3.64	-80.92	101	10		11	5
149	11/5	1019	-2.59	-81.06	387	10	7	11	2
150	11/6	0040	-1.97	-82.87	1014	10		11	2
151	11/6	1006	-1.49	-83.70	1027	10	7	11	2
152	11/7	0035	-0.41	-82.87	1012	10		11	6
153	11/7	0950	-0.86	-81.86	1017	10	7	11	2
154	11/8	0028	-0.01	-80.64	310	10		11	2
155	11/8	0950	0.67	-81.44	1014	10	7	11	2
156	11/9	0037	2.42	-81.49	1012	10		11	6
157	11/9	0952	2.01	-80.63	1012	10	7	11	2
158	11/10	0024	2.00	-79.12	467	10		11	2
159	11/10	1010	2.81	-78.42	346	10	7	11	2
160	11/11	0009	3.21	-77.94	314	10		11	5
161	11/11	1006	3.51	-77.58	54	7	7	7	1
162	11/12	0000	4.84	-77.69	471	10		11	2
163	11/12	1009	4.95	-77.55	274	10	7	11	2
164	11/13	0048	6.56	-77.92	1502	10		11	6
165	11/13	1024	7.06	-78.18	1012	10		11	2
166	11/19	0007	7.77	-79.62	121	12		12	6
167	11/19	0953	6.80	-79.47	1010	10	7	11	2
168	11/20	0019	5.07	-79.16	1014	10		11	2
169	11/20	1005	5.14	-80.06	1014	10	7	11	2
170	11/21	0044	5.23	-82.02	1012	10		11	6
171	11/21	1006	5.29	-83.22	1012	10	7	11	2
172	11/22	0050	5.40	-85.45	1014	10		11	2
173	11/22	1017	5.47	-86.50	1012	10	7	11	2
174	11/23	0042	5.54	-87.35	461	10		11	5

Table 4. (*McArthur* 2000 CTD cast summary) continued.

Station number	Date	Time	Latitude	Longitude	Depth	Chl.	Prod.	Nutrients	Salinity
175	11/23	1034	5.58	-88.53	1012	10	7	11	2
176	11/24	0110	5.70	-90.65	1014	10		11	2
177	11/24	1049	5.74	-91.68	1012	10	7	11	2
178	11/25	0120	5.85	-93.66	1012	10		11	6
179	11/25	1049	5.92	-94.67	1012	10	7	11	2
180	11/26	0136	6.81	-96.45	1010	10		11	2
181	11/26	1122	7.32	-97.41	1010	10	7	11	2
182	11/27	0135	7.49	-99.30	1012	10		11	6
183	11/27	1123	7.58	-100.45	1012	10	7	11	2
184	11/28	0154	8.29	-102.11	1012	10		11	2
185	11/28	1137	8.59	-103.19	1014	10	7	11	2
186	11/29	0152	8.94	-105.17	1010	10		11	6
187	11/29	1151	9.10	-106.39	1012	10	7	11	2
188	11/30	0222	9.41	-108.34	1012	10		11	2
189	11/30	1221	10.28	-109.16	1010	10	7	11	2
190	12/1	0222	10.48	-110.88	1016	10		11	6
191	12/1	1222	10.58	-112.07	1012	10	7	11	2
192	12/2	0220	12.38	-112.73	1014	10		11	2
193	12/2	1219	13.57	-113.03	1012	10	7	11	2
194	12/3	0220	15.09	-113.48	1012	10		11	6
195	12/3	1236	15.86	-114.52	1014	10	7	11	2
196	12/4	0220	17.71	-115.14	1012	10		11	2
197	12/4	1234	19.16	-114.76	1012	10	7	11	2
198	12/5	0219	21.02	-114.19	1012	10		11	6
199	12/5	1236	21.94	-113.24	1010	10	7	11	2
200	12/6	0219	23.58	-113.49	1012	10		11	2
201	12/6	1251	24.89	-113.72	1014	10	7	11	2
202	12/7	0221	26.13	-115.38	1014	10		11	6
203	12/7	1334	27.22	-116.26	1012	10	7	11	2
204	12/8	0237	28.90	-116.54	1016	10		11	12

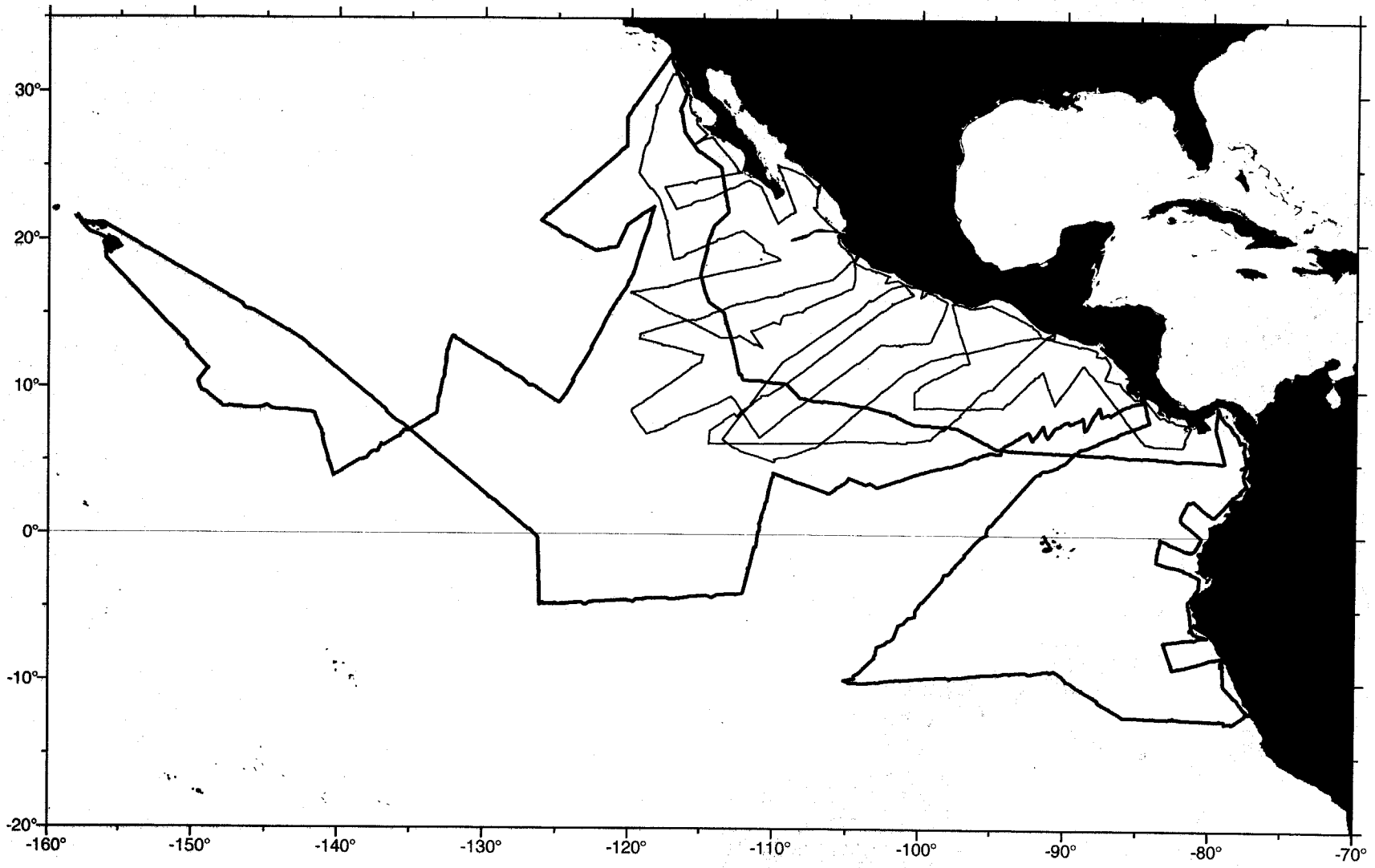


Figure 1. Cruise tracks, *Jordan* (—) and *McArthur* (—), 28 July - 9 December 2000.

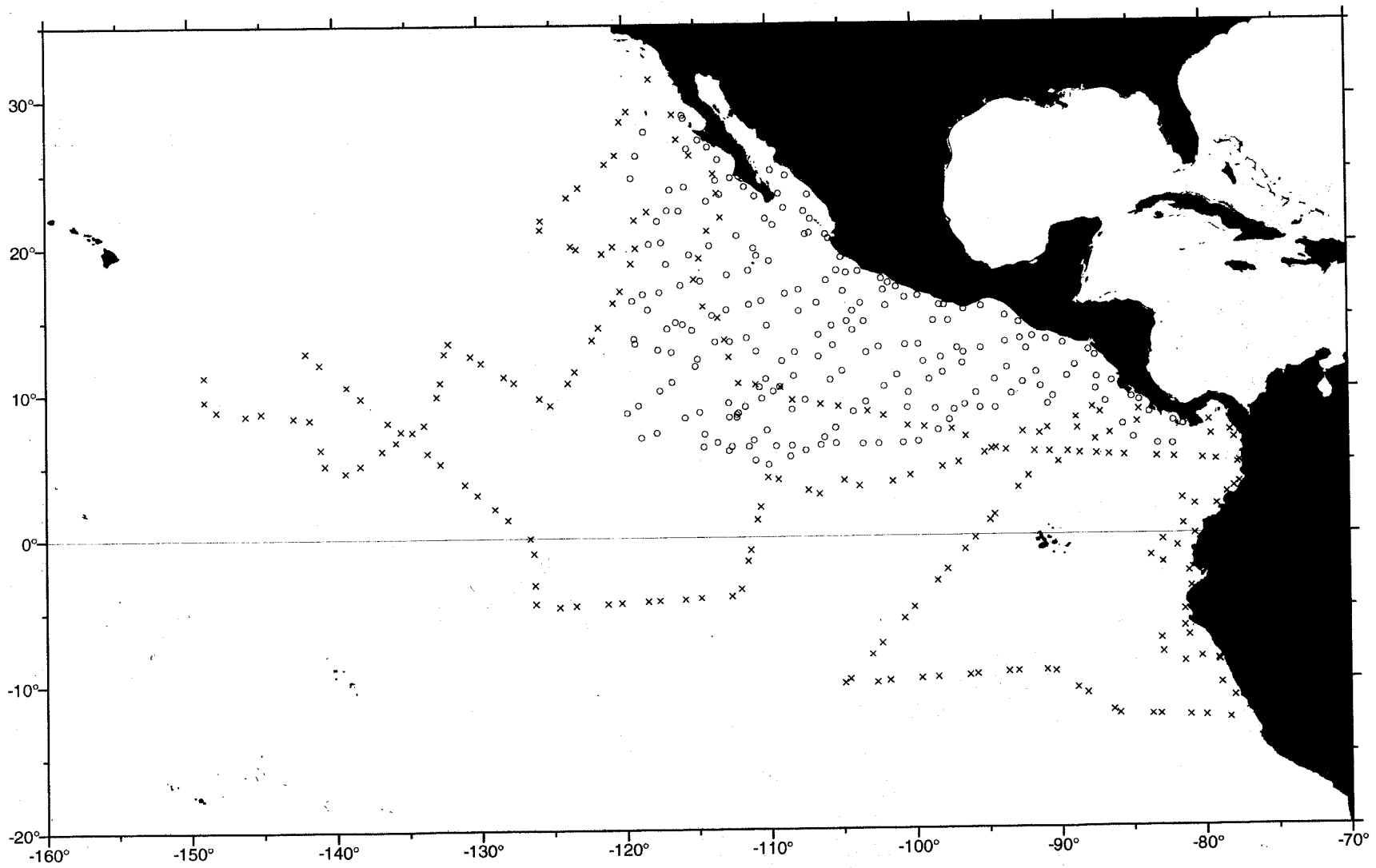


Figure 2. CTD stations, *Jordan* (○) and *McArthur* (x), 28 July - 9 December 2000.

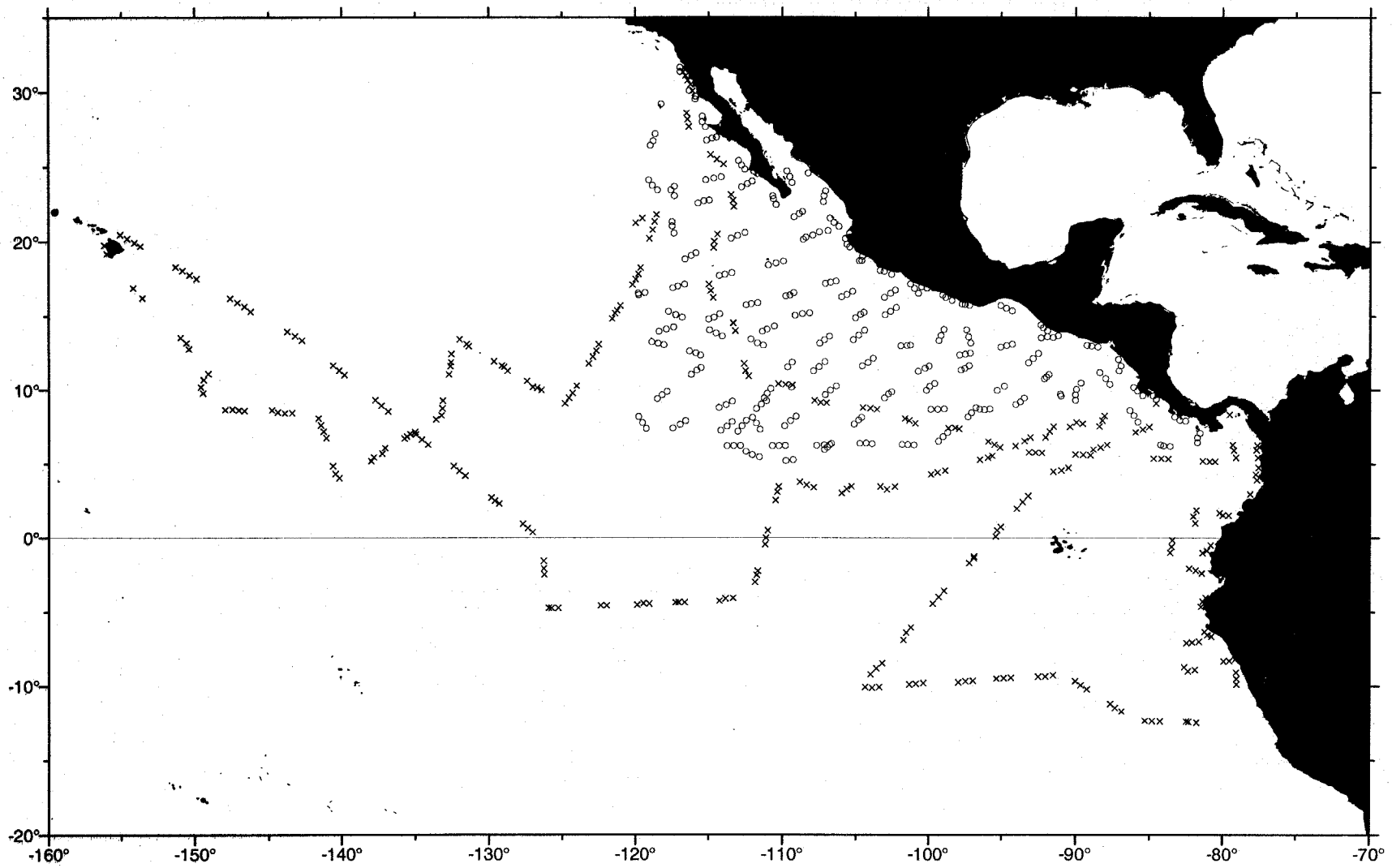


Figure 3. XBT deployments, *Jordan* (○) and *McArthur* (x), 28 July - 9 December 2000.

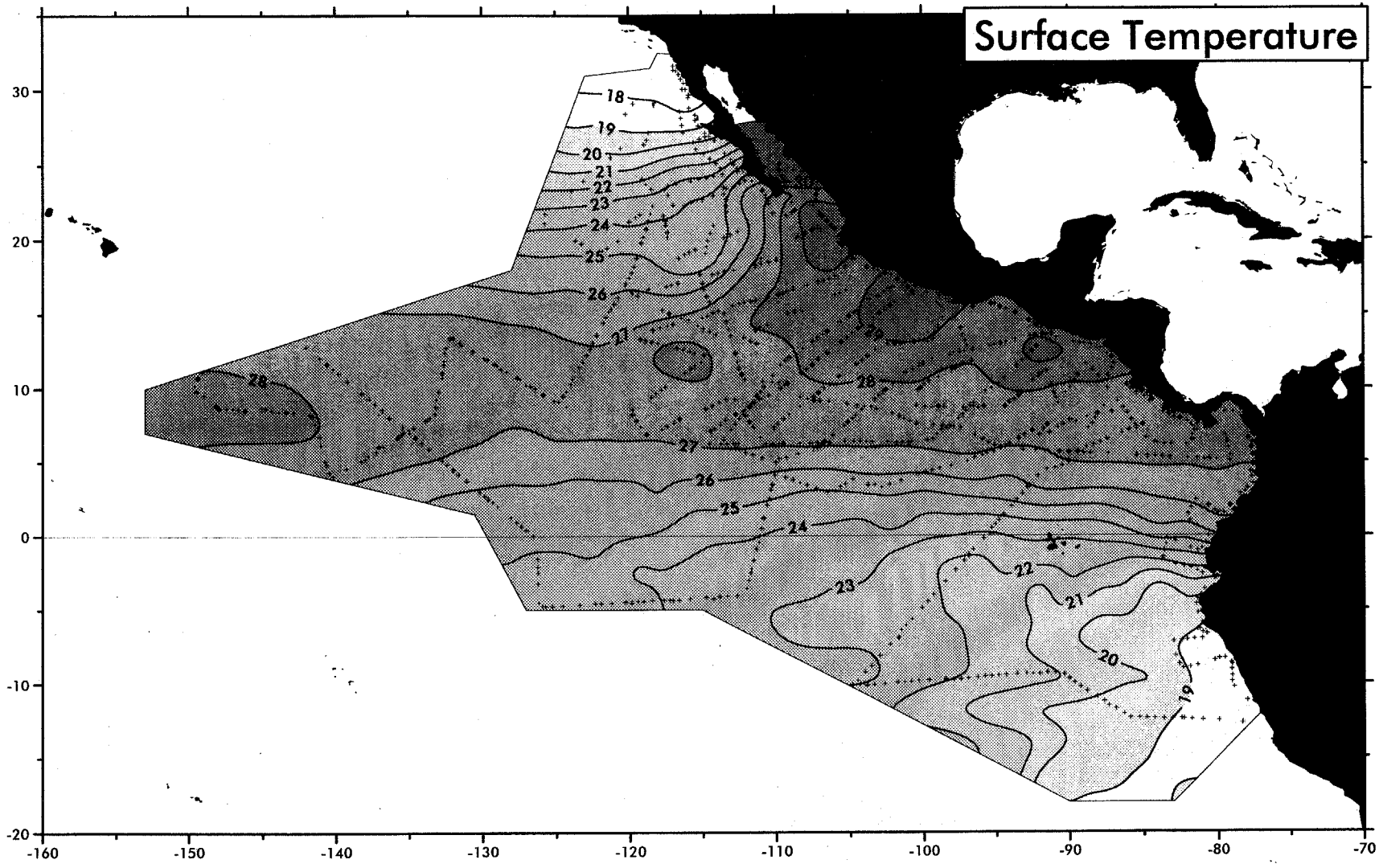


Figure 4. Sea surface temperature (°C) from CTD and XBT profiles (+), 28 July - 9 December 2000.

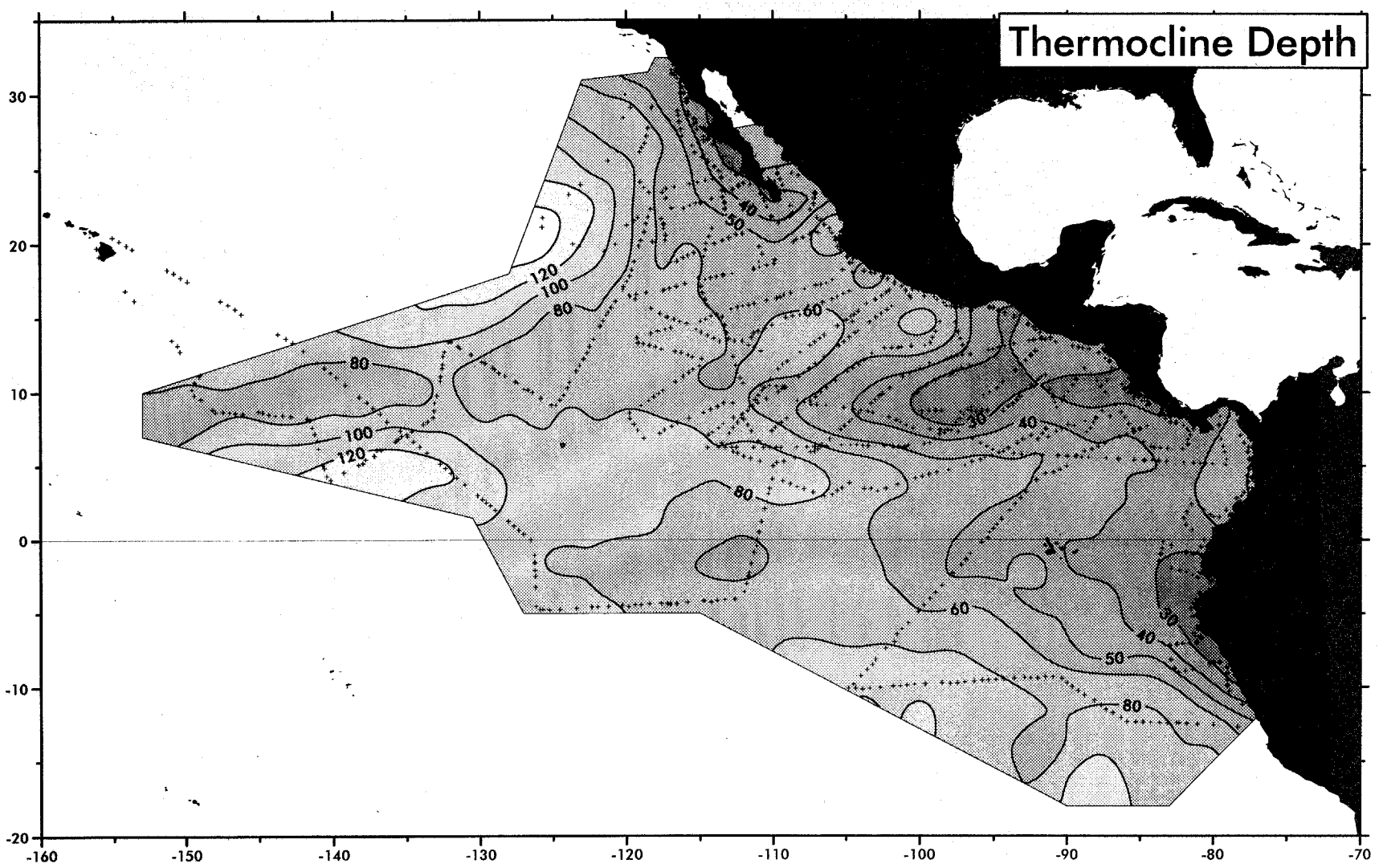
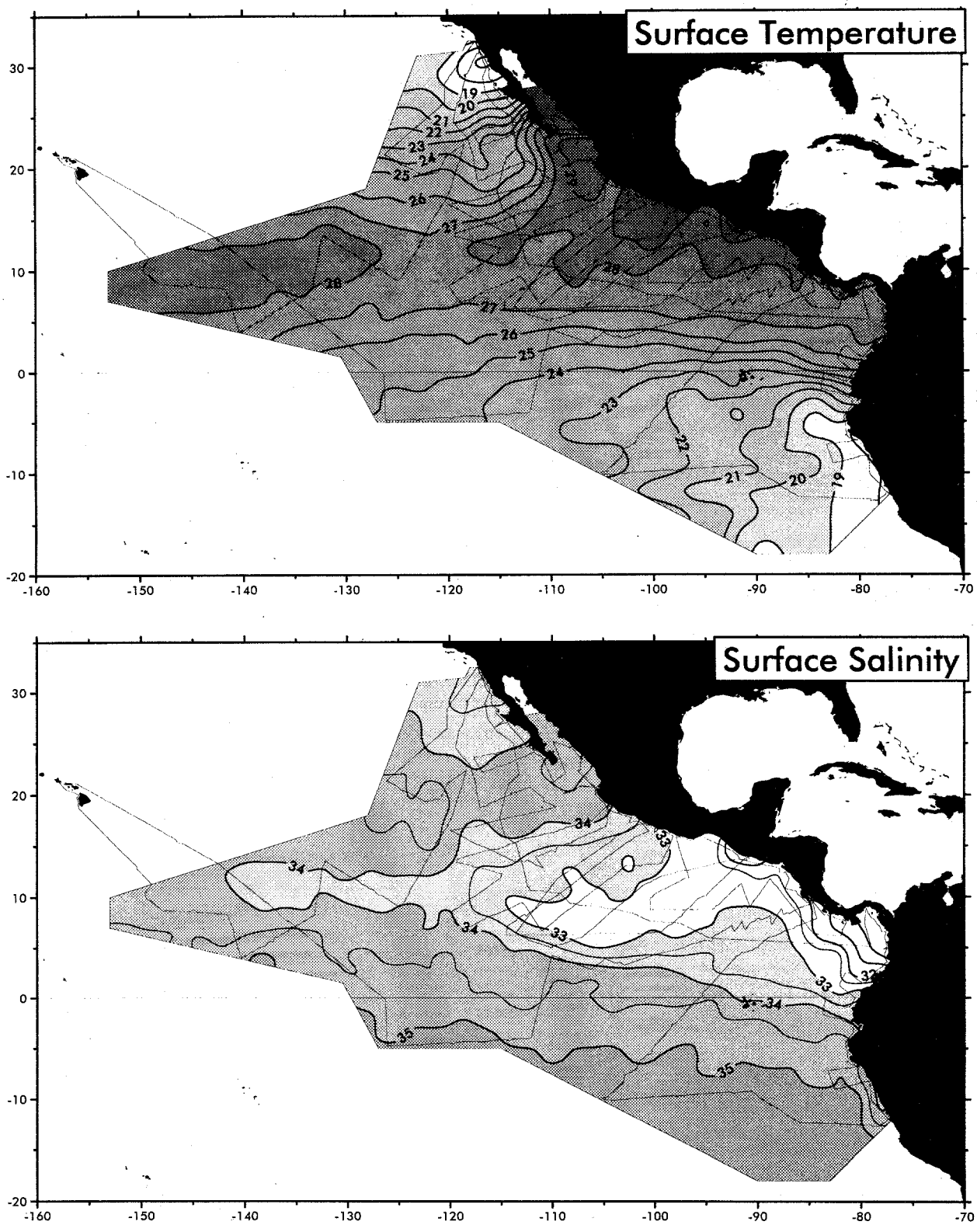


Figure 5. Thermocline depth (m, depth of maximum temperature gradient over an interval of 30 m) from CTD and XBT profiles (+), 28 July - 9 December 2000.

Figure 6. Sea surface temperature (°C) and salinity (PSU) from thermosalinograph data, 28 July - 9 December 2000. Thin lines indicate cruise tracks for both ships.



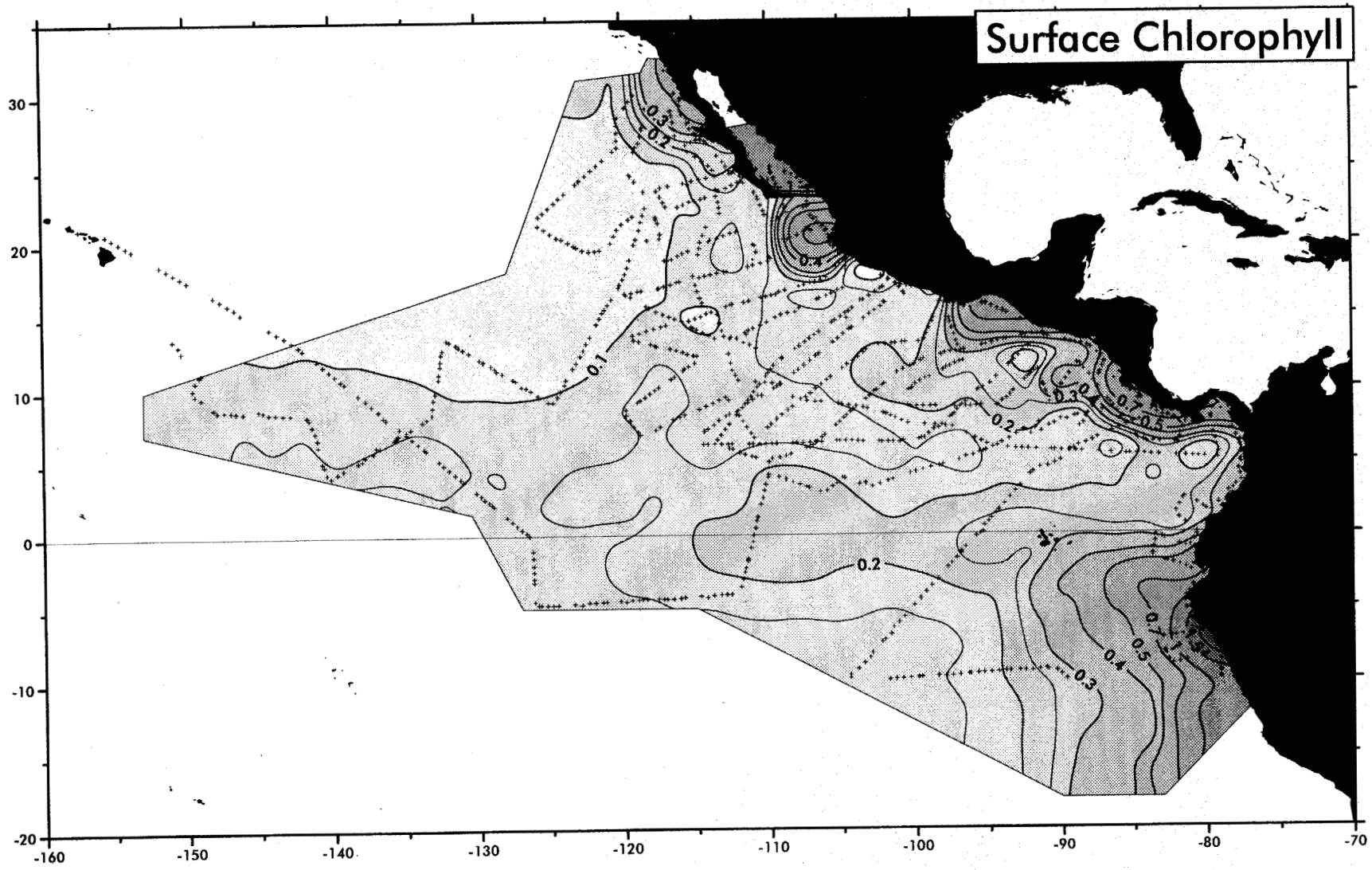


Figure 7. Surface chlorophyll concentration (mg m^{-3}), from CTD casts and underway samples (+), 28 July - 9 December 2000.

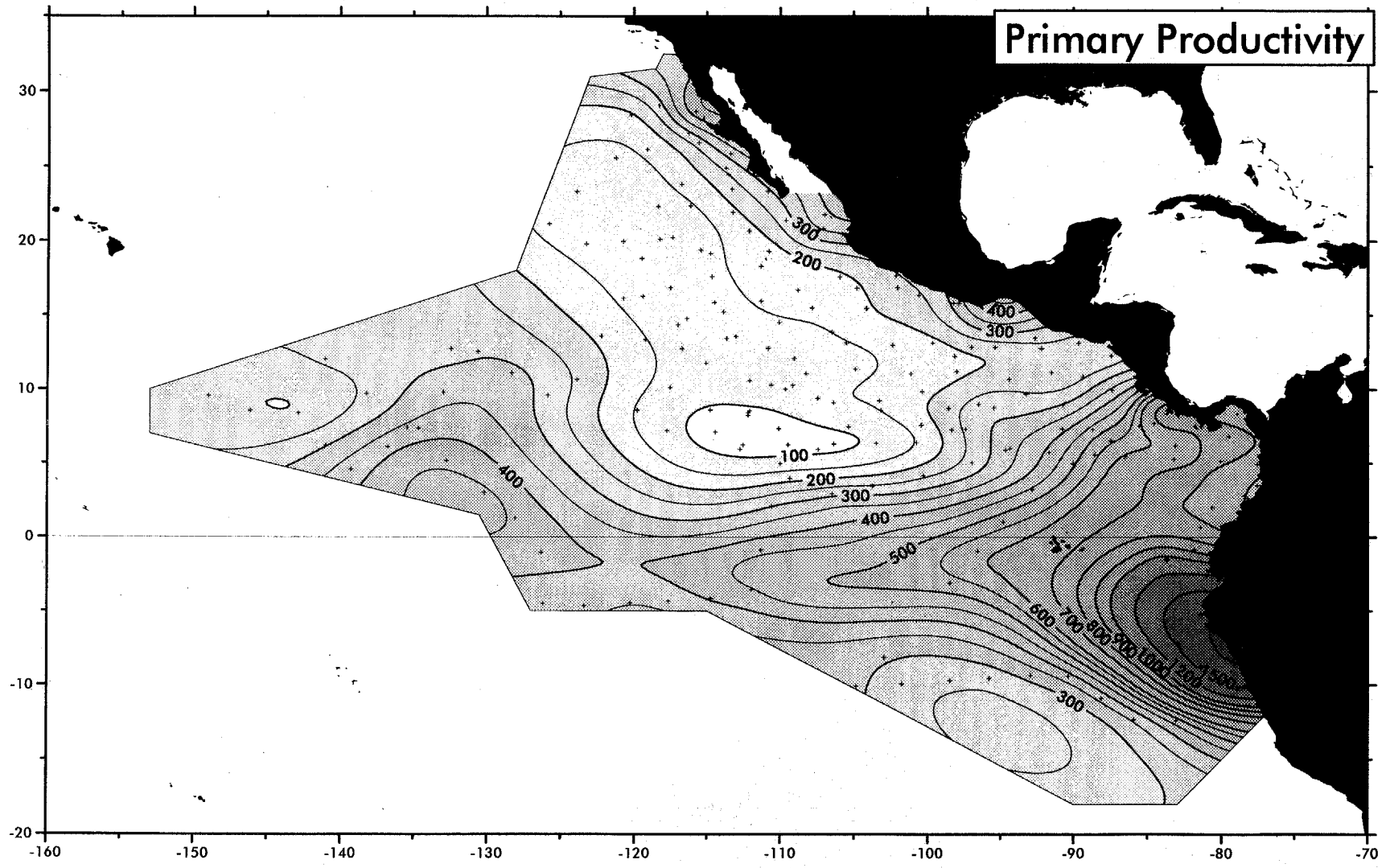
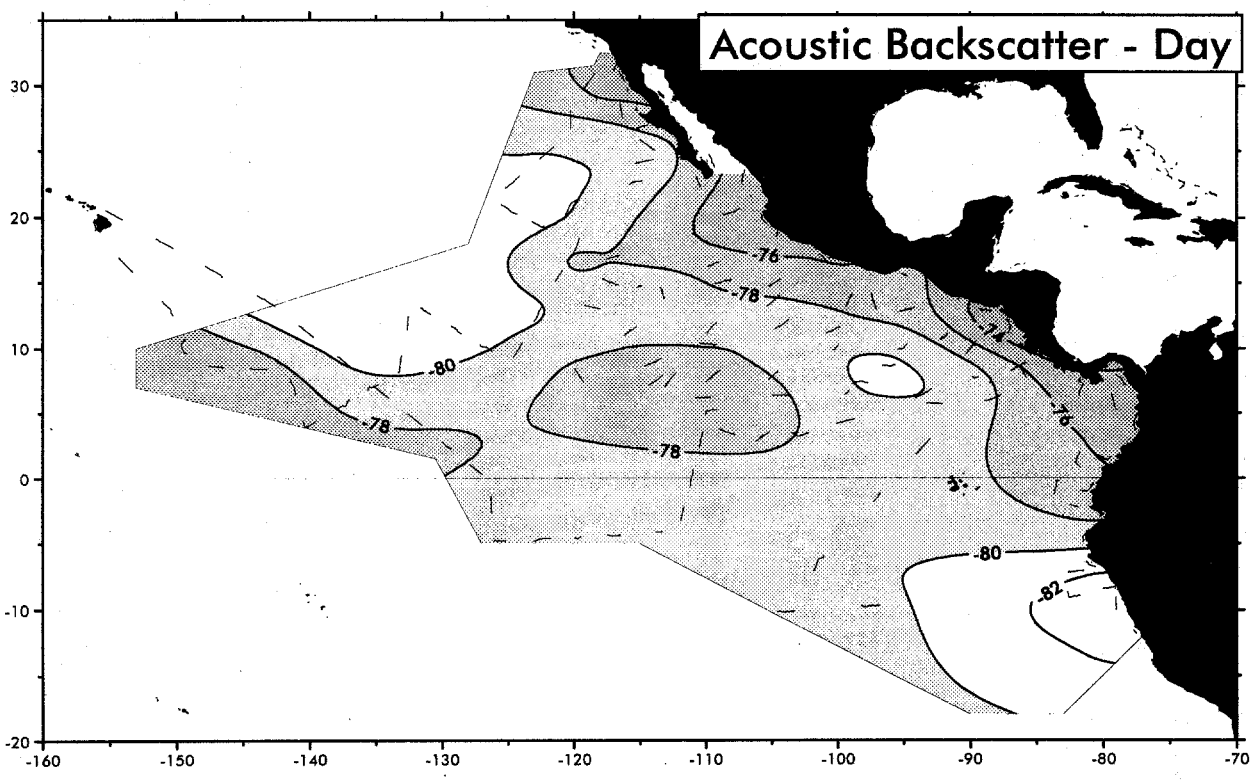
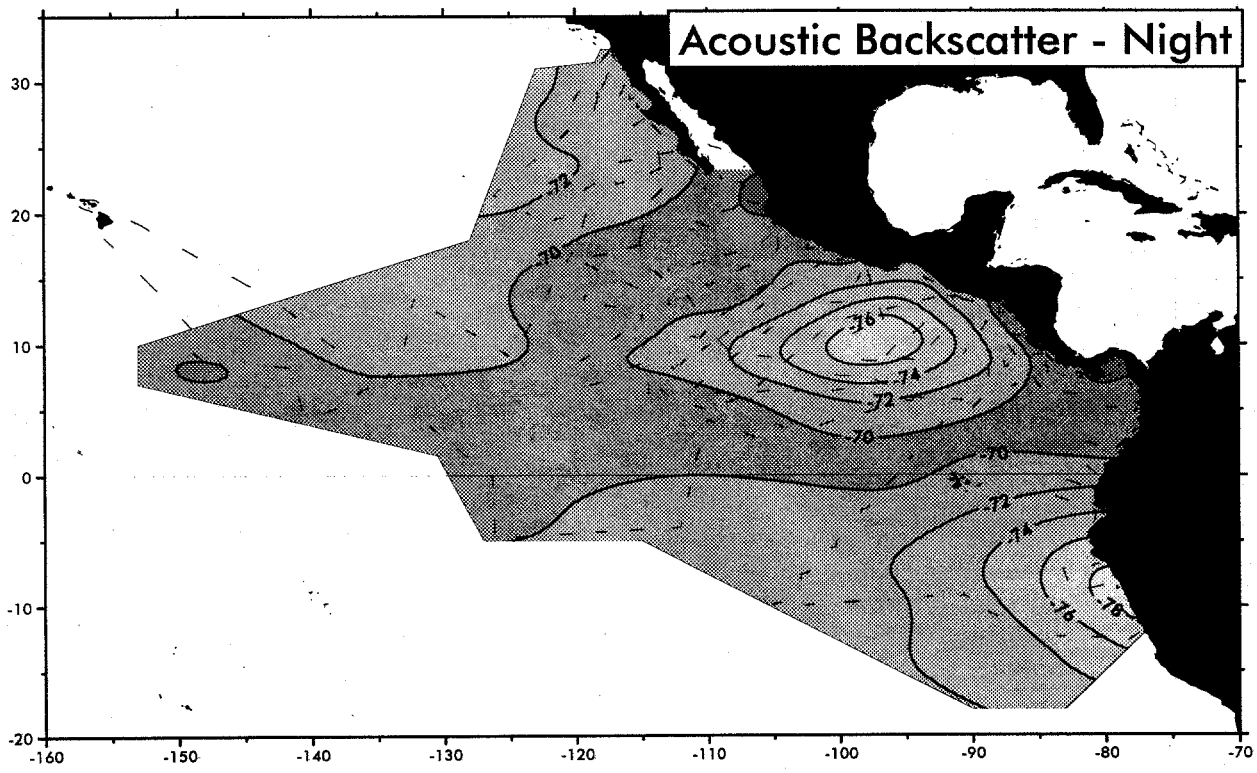


Figure 8. Primary productivity (mg C m^{-2} d^{-1}) in the euphotic zone, from morning CTD casts (+), 28 July - 9 December 2000.

Figure 9. Acoustic backscatter (dB, 38 kHz), daily 0-100m means from 0800-1600 hours local ship time (top) and 2000-0400 h (bottom), 28 July - 9 December 2000. Thin lines indicate transect intervals during which displayed data were collected.





APPENDIX A

SCIENTIFIC PERSONNEL

Cruise Leaders	**Ship (Leg #s)**
Lisa Ballance, SWFSC (Chief scientist)	D.S. Jordan (3-5) McArthur (1)
Robert Pitman, SWFSC	D.S. Jordan (1,2,6)
Sarah Mesnick, SWFSC	McArthur (2)
Eric Archer, SWFSC	McArthur (3)
James Carretta, SWFSC	McArthur (4)
Tim Gerrodette, SWFSC	McArthur (5)
Marine Mammal Identification Specialists	
Doug Kinzey, SWFSC	D.S. Jordan (1-3) McArthur (3-5)
Paula Olson, SWFSC	D.S. Jordan (1-3) McArthur (3-5)
James Cotton, SWFSC	D.S. Jordan (4-6) McArthur (1-2)
Richard Rowlett, SWFSC	D.S. Jordan (4-6) McArthur (1-2)
Marine Mammal Observers	
Erin LaBrecque, SWFSC	D.S. Jordan (1-3) McArthur (3-5)
Juan Carlos Salinas, SWFSC	D.S. Jordan (1-3) McArthur (3-5)
Suzanne Yin, SWFSC	D.S. Jordan (1-3) McArthur (3-5)
Laura Morse, SWFSC	D.S. Jordan (1-3) McArthur (3-5)
Isabel Beasley, SWFSC	D.S. Jordan (4-6) McArthur (1,2)
Anne Douglas, SWFSC	D.S. Jordan (4-6) McArthur (1,2)
Kathy Hough, SWFSC	D.S. Jordan (4-6) McArthur (1,2)
Ernesto Vázquez, SWFSC	D.S. Jordan (4-6) McArthur (1,2)
Bird Observers	
Michael Force, SWFSC	D.S. Jordan (1-4) McArthur (4,5)
Sophie Webb, SWFSC	D.S. Jordan (1,2)
Robert Pitman, SWFSC	D.S. Jordan (3-5)
Brett Jarrett, SWFSC	D.S. Jordan (4-6) McArthur (1-3)
Chris Hoefer, SWFSC	McArthur (1-5)
Oceanographers	
Kerry Kopitsky, SWFSC	D.S. Jordan (1-6)
Valerie Philbrick, SWFSC	D.S. Jordan (1)
Amy Hays, SWFSC	D.S. Jordan (2)
Ron Dotson, SWFSC	D.S. Jordan (3,4)
Dave Griffith, SWFSC	D.S. Jordan (5,6)
Pierre Malan, SWFSC	McArthur (1,2)
Dagmar Merkle, SWFSC	McArthur (3-5)
Acoustic Technicians	
Jay Barlow, SWFSC	McArthur (1)
Shannon Rankin, SWFSC	McArthur (1-5)
Megan Ferguson, Scripps Institute of Oceanography	McArthur (2)
Ann Chen, SWFSC	McArthur (3)
Tom Norris, SWFSC	McArthur (4)
Xenia Brobeil, SWFSC	McArthur (5)

Foreign Observers/Guest Scientists

Rueben Valenzuela, Instituto National de la Pesca, Mexico (INP)	D.S. Jordan (1)
Nathan Lovejoy, University of California, Berkeley	D.S. Jordan (4)
Guillermo Jiménez-Bastida, INP	D.S. Jordan (6) McArthur (2)
Julie Oswald, SIO	McArthur (1)
Nelson Fabian-Caro, Armada Nacional - Dirección General Marítima, Colombia	McArthur (3)
Gladys Torres, Instituto Oceanográfico de la Armada de Ecuador	McArthur (4)
Ruth Bello, Instituto del Mar del Perú	McArthur (5)

Photogrammetrists

John Brandon, SWFSC	D.S. Jordan (1,2)
Morgan Lynn, SWFSC	D.S. Jordan (1,2,4)
Jim Gilpatrick, SWFSC	D.S. Jordan (3,5)
Charlie Stinchcomb, SWFSC	D.S. Jordan (3,4)
Katie Cramer, SWFSC	D.S. Jordan (5,6)
Wayne Perryman, SWFSC	D.S. Jordan (6)

Helicopter Support

Roy Dehart, Aircraft Operations Center (AOC)	D.S. Jordan (1,2,6)
Julie Helmers, AOC	D.S. Jordan (1,2,6)
Ron Helgeson, AOC	D.S. Jordan (3-5)
Dave Gardner, AOC	D.S. Jordan (3,4)
Debora Barr, AOC	D.S. Jordan (5)

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K.A. FORNEY, J. BARLOW, M.M. MUTO, M. LOWRY, J. BAKER, G. CAMERON, J. MOBLEY, C. STINCHCOMB, and J.V. CARRETTA
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P.A. OLSON, R.L. PITMAN, L.T. BALLANCE, K.R. HOUGH, P. DUTTON, and S.B. REILLY
(March 2001)

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J.D. LIPSKY (editor)
(March 2001)

303 Marine mammal data collected during a survey in the eastern tropical Pacific Ocean aboard the NOAA ships *McArthur* and *David Starr Jordan*, July 28 - December 9, 2000.
D. KINZEY, T. GERRODETTE, A. DIZON, W. PERRYMAN, P. OLSON, and S. RANKIN
(May 2001)

304 Summary of seabird, marine turtle, and surface fauna data collected during a survey in the eastern tropical Pacific Ocean, July 28 - December 9, 2000.
P.A. OLSON, R.L. PITMAN, L.T. BALLANCE, K.R. HOUGH, P.H. DUTTON, and S.B. REILLY
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(July 2001)

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