

1980

Annual Operating Report
SAN ONOFRE NUCLEAR GENERATING STATION

Oceanographic and Biological
Summary Data Report

Volume I

ENVIRONMENTAL TECHNICAL SPECIFICATIONS
Unit 1

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
Units 1, 2, and 3

CONSTRUCTION MONITORING PROGRAM
Units 2 and 3

PREOPERATIONAL MONITORING PROGRAM
Units 2 and 3

SOUTHERN CALIFORNIA EDISON COMPANY
P.O. Box 800
Rosemead, CA 91770

BROWN and CALDWELL
Marine Sciences Division
965 West 18th Street
Costa Mesa, CA 92627

LOCKHEED ENVIRONMENTAL SCIENCES
6350 Yarrow Drive
Carlsbad, CA 92008

MARINE BIOLOGICAL CONSULTANTS, INC.
947 Newhall Street
Costa Mesa, CA 92627

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CONTENTS

	Page
1. INTRODUCTION.....	1 - 1
Figure 1-1. Study area location.....	1 - 3
Figure 1-2. Major San Onofre regulatory programs.....	1 - 4
Figure 1-3. San Onofre Nuclear Generating Station Unit 1 operating characteristics during 1979.....	1 - 2
Table 1-1. 1980 data collection record for regulatory requirements....	1 - 2
2. OCEANOGRAPHY.....	2A- 1
A. TEMPERATURE.....	2A- 1
Figure 2A-1. Environmental surveillance zones and physical and chemical station locations.....	2A- 4
Figure 2A-2. Location and identification of oceanographic sampling stations.....	2A- 5
Figure 2A-3. Temperature profiles for January 8, 1980.....	2A- 6
Figure 2A-4. Temperature profiles for March 13, 1980.....	2A-10
Figure 2A-5. Surface temperature and time at each station from profile measurements, January 8, 1980.....	2A-14
Figure 2A-6. Surface temperature and time at each station from profile measurements, March 13, 1980.....	2A-15
Figure 2A-7. Surface isotherms from temperature profiles, January 8, 1980.....	2A-16
Figure 2A-8. Surface isotherms from temperature profiles, March 13, 1980.....	2A-17
Figure 2A-9. Surface isotherms from infrared radiometer measurements, 1420-1451 PST, January 8, 1980.....	2A-18
Figure 2A-10. Surface isotherms from infrared radiometer measurements, 1:56-1342 PST, March 13, 1980.....	2A-19
Figure 2A-11. Continuous temperature graphs for the surface, mid-depth and bottom of Stations C2S and C22S, January, 1980.....	2A-20
Figure 2A-12. Continuous temperature graphs for the surface, 15 and 30 feet depths, and bottom of Station F2S, January 1980..	2A-21
Figure 2A-13. Continuous temperature graphs for the surface, mid-depth and bottom of Stations C2S and C22S, February 1980.....	2A-22
Figure 2A-14. Continuous temperature graphs for the surface, 15 and 30 feet depths, and bottom of Station F2S, February 1980....	2A-23
Figure 2A-15. Continuous temperature graphs for the surface, mid-depth and bottom of Stations C2S and C22S, March 1980.....	2A-24
Figure 2A-16. Continuous temperature graphs for the surface, 15 and 30 feet depths, and bottom of Station F2S, March 1980.....	2A-25
Figure 2A-17. Continuous temperature graphs for the surface, mid-depth and bottom of Stations C2S and C22S, April 1980.....	2A-26
Figure 2A-18. Continuous temperature graphs for the surface, 15 and 30 feet depths, and bottom of Station F2S, April 1980.....	2A-27
Figure 2A-19. Comparison of intake, discharge, and ocean ambient temperatures, January and February 1980.....	2A-28
Figure 2A-20. Comparison of intake, discharge, and ocean ambient temperatures, March and April 1980.....	2A-29
Table 2A-1. Shoreline temperatures (°C) during 1980 surveys.....	2A- 3

	Page
B. TURBIDITY.....	2B- 1
Table 2B-1. Percent light transmittance at the surface, mid-depth (4m), and near bottom, and Secchi disc reading for January 8, 1980.....	2B- 3
Table 2B-2. Percent light transmittance at the surface, mid-depth (4m), and near bottom, and Secchi disc reading for March 13, 1980.....	2B- 4
C. WATER QUALITY.....	2C- 1
Table 2C-1. Surface dissolved oxygen concentration (mg/liter) from required SONGS Unit 1 operation and Units 2 and 3 preoperational monitoring stations during 1980.....	2C- 3
Table 2C-2. Surface hydrogen ion concentration (pH) from required SONGS Unit 1 operation and Units 2 and 3 preoperational monitoring stations during 1980.....	2C- 3
Table 2C-3. Receiving water and ocean bottom sediment heavy metal concentrations during 1980.....	2C- 4
3. INTERTIDAL.....	3 - 1
Figure 3-1. Intertidal station locations.....	3 - 2
Table 3-1. Mean density of intertidal organisms (number/5 liter core) by transect, February 1980.....	3 - 3
Table 3-2. Mean grain size analysis by station and tidal elevation, February 1980.....	3 - 4
4. BENTHOS.....	4A- 1
A. ROCK/COBBLE SUBSTRATE, KELP BEDS.....	4A- 1
Figure 4A-1. ETS, CMP, and PMP benthic station locations at San Onofre Nuclear Generating Station.....	4A- 2
Table 4A-1. Rank, mean abundance (percent or number/m ²), and frequency of occurrence of benthic organisms sampled at ETS benthic stations during the January 1980 survey period.....	4A- 5
Table 4A-2. Rank, mean abundance (percent or number/m ²), and frequency of occurrence of benthic organisms sampled at ETS benthic stations during the April 1980 survey period.....	4A- 6
Table 4A-3. Rank, mean abundance (percent or number/m ²), and frequency of occurrence of benthic organisms sampled at ETS benthic stations during the July 1980 survey period..	4A- 7
Table 4A-4. Rank, mean abundance (percent or number/m ²), and frequency of occurrence of benthic organisms sampled at ETS benthic stations during the October 1980 survey period.....	4A- 8
Table 4A-5. Rank, mean abundance (percent or number/m ²), and frequency of occurrence of benthic organisms sampled at CMP benthic stations during the April 1980 survey period.	4A- 9
Table 4A-6. Rank, mean abundance (number of contacts/6.0 or 0.125 m ²) frequency of occurrence of benthic organisms sampled at PMP benthic stations during the January 1980 survey period.....	4A-10
Table 4A-7. Rank, mean abundance (number of contacts/6.0 or 0.125 m ²) frequency of occurrence of benthic organisms sampled at PMP benthic stations during the April 1980 survey period.	4A-11

	Page
B. BENTHIC INFAUNAL STUDY.....	4B- 1
Figure 4B-1. Benthic infaunal station locations.....	4B- 2
Table 4B-1. San Onofre infaunal survey mean number of individuals/liter March 1980.....	4B- 4
Table 4B-2. Mean infaunal grain size analysis, organic carbon content, and Secchi disc by station, March 1980.....	4B- 6
Table 4B-3. San Onofre monthly sediment heights, 1980.....	4B- 7
5. PLANKTON - RECEIVING WATERS.....	5 - 1
Figure 5-1. ETS and PMP plankton receiving water station locations at San Onofre Nuclear Generating Station.....	5 - 2
Table 5-1. Rank, mean abundance (number/m ³), and frequency of occurrence of select zooplankton sampled at all ETS plankton stations during the 1980 survey period.....	5 - 5
Table 5-2. Rank, mean abundance (number/m ³), and frequency of occurrence of select zooplankton sampled at all PMP plankton stations during the 1980 survey period.....	5 - 5
Table 5-3. Mean chlorophyll (C) and phaeopigment (P) concentrations (mg/m ³) sampled in upper and lower strata during the 1980 study period.....	5 - 7
Table 5-4. Mean zooplankton dry weight biomass (mg/m ³) values in upper and lower strata in PMP stations during the 1980 study period.....	5 - 8
6. FISH.....	6A- 1
A. FISH IN THE RECEIVING WATERS - GILL NETS.....	6A- 1
Figure 6A-1. ETS and PMP fish receiving water station locations at San Onofre Nuclear Generating Station.....	6A- 2
Figure 6A-2. Length-frequency histograms of <i>Seriphus politus</i> derived from gill net samples from the 9.1- and 13.7-m isobaths during 1980.....	6A- 8
Figure 6A-3. Length-frequency histograms of <i>Genyonemus lineatus</i> derived from gill net samples from the 9.1- and 13.7-m isobaths during 1980.....	6A- 8
Table 6A-1. Total number of individuals and species captured by gill nets set on the 9.1- and 13.76-m isobaths during the ETS and PMP surveys of 1980.....	6A- 5
Table 6A-2. The rank order of abundance of fish species collected by gill nets set on the 9.1- and 13.7-m isobaths during 1980.....	6A 6
B. FISH IMPINGEMENT.....	6B- 1
Table 6B-1. Total number and weight of fish appearing in 32 normal operation samples taken at San Onofre Unit 1 in 1980.....	6B- 2

Chapter 1

INTRODUCTION

This report volume presents a summary of regulatory required physical-chemical oceanographic and biological data collected during investigations of the marine environment in the vicinity of the San Onofre Nuclear Generating Station conducted for Southern California Edison Company (SCE). Included is a summary of pertinent data collected in compliance with Environmental Technical Specifications (ETS) for San Onofre Unit 1, The National Pollutant Discharge Elimination System (NPDES) requirements for San Onofre Units 1, 2, and 3, the Preoperational Monitoring Program (PMP) and the Construction Monitoring Program (CMP) for San Onofre Units 2 and 3.

STUDY REQUIREMENTS

The ETS is an appendix to the San Onofre Unit 1 Provisional Operating License and hence a Nuclear Regulatory Commission (NRC) requirement. Contained within the ETS requirements are both oceanographic and biological study elements oriented to the investigation of San Onofre Unit 1 operational effects upon the local environment. The oceanographic elements consist of temperature, turbidity, heavy metals, dissolved oxygen, and pH, while the biological elements include plankton, fish, intertidal, kelp, and hard benthic communities together with investigations of station impingement and entrainment. Radiological monitoring elements, included with the ETS requirements, are reported to the NRC under a separate cover.

The PMP, also a NRC environmental requirement, is designed to establish a two-year preoperational data base for San Onofre Units 2 and 3. The data base will be used to measure the operational effects of San Onofre Units 2 and 3 on the local marine environment. The PMP study design contains elements similar to the ETS investigation except generating station entrainment is not addressed.

The CMP requirements are included in the California Regional Water Quality Control Board-San Diego Region (CRWQCB-SDR) Order 71-6, change T-3. The order requires that a monitoring program be established to determine the effects, on the marine environment, associated with the construction of San Onofre Units 2 and 3. Study elements include sedimentation analysis, intertidal and subtidal infaunal studies, and a kelp investigation.

The NPDES permits for San Onofre Units 1, 2, and 3 contain essentially the identical operational study elements set forth in the ETS requirements.

Related or complimentary study elements of the programs outlined above were conducted in concert, where possible, in order to optimize data collection while meeting the individual program objectives. A schedule of field efforts conducted to meet the requirements outlined above is presented in Table 1-1.

SITE LOCATION

The site for the San Onofre Nuclear Generating Station is located on the coast of southern California at approximately 30° 22.5' North latitude and 117° 32.5' West longitude. San Clemente, the closest city to SONGS, is on the coast approximately 4 km to the northwest, while the nearest municipality to the

Table 1-1. 1980 data collection record for regulatory requirements.

	ETS	NPDES	CMP	PMP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<u>Oceanographic Surveys</u>																
Temperature Vertical Profiles	X	X		X	8		13		14		9		10		5	
Aerial Infrared Radiometry	X	X			8		13		14		9		10		5	
Shoreline Temperature	X	X			8		13		14		9		10		5	
Continuous Temperature Maintenance	X			X	3	4	4,26	4,25	1	4	3	1	4	1	3	9
Turbidity Vertical Profiles	X	X		X	8		13		14		9		10		5	
Secchi Disc Visibility	X	X		X	8		13		14		9		10		5	
Aerial Photographs of Turbidity	X				8		13		14		9		10		5	
Heavy Metals	X	X		X	10		10		13		8		10		5	
Dissolved Oxygen	X	X		X	8		13		14		9		10		5	
Hydrogen Ion Concentration	X	X		X	8		13		14		9		10		5	
<u>Biological Surveys</u>																
Plankton	X	X		X	8,10,13		10-12		15-18*		19		16		5	
Intertidal Sand			X			13-15										
Subtidal Sand			X				5-7									
Cobble	X	X	X	X	24-----10 ^a		28-----6		24-----18		23-----3					
Fish																
Gill Nets	X	X		X	26-27		23-24		25-26*		21-22		20-23		10-11	
Impingement**					b	b	b		b	b						
Normal Operation	X	X			13		23									
Heat Treatments	X	X														
Kelp Bed Mapping			X				10-15									
Photography	X				9		13						18			8

^a Survey required several days to complete.

^b Frequency greater than once/week.

*Preoperational Monitoring Program terminated.

**SONGS offline for refueling and repairs from 10 April through end of 1980. Circulators were on briefly from 12 June to 18 July. Sampling continued during this period.

southeast is Oceanside some 19 km downcoast from the station. The study area extends approximately 6.4 km (4 miles) upcoast, 11.5 km (7 miles) downcoast, and 4 km (2 miles) offshore of the generating station site (Figure 1-1).

HISTORICAL BACKGROUND

Oceanographic and marine biological studies, referred to as the Marine Environmental Monitoring Program (MEM), began in 1963 in the San Onofre area and were reported on a semiannual basis to CRWQCB-SDR until 1975 (Figure 1-2). In 1975 the Unit 1 ETS program was implemented in compliance with NRC requirements. The ETS program has continued to the present. In 1976, the CRWQCB issued permits for SONGS Units 1, 2, and 3 under the NPDES which included marine monitoring programs to replace previous MEM requirements. The NPDES marine monitoring requirements (Figure 1-2) have continued to the present.

Studies of the effects of SONGS Units 2 and 3 construction were initiated in 1974 as required by the CRWQCB (Figure 1-2). These studies focused on the impacts of sand disposal onto the beach from onshore construction site excavations. The studies, called the Sand Disposal Monitoring Program, continued through 1976. The emphasis shifted in 1977 when dredging for the emplacement of the offshore portions of Units 2 and 3 cooling systems began. Studies focused on the offshore construction activities started in December 1976, as set forth in the CRWQCB order No. 71-6. These studies are referred to as the Construction Monitoring Program (CMP).

In 1978, a Preoperational Monitoring Program was initiated in compliance with requirements of the NRC (Figure 1-2). This Program along with the others mentioned above, will provide a baseline of oceanographic and marine biological

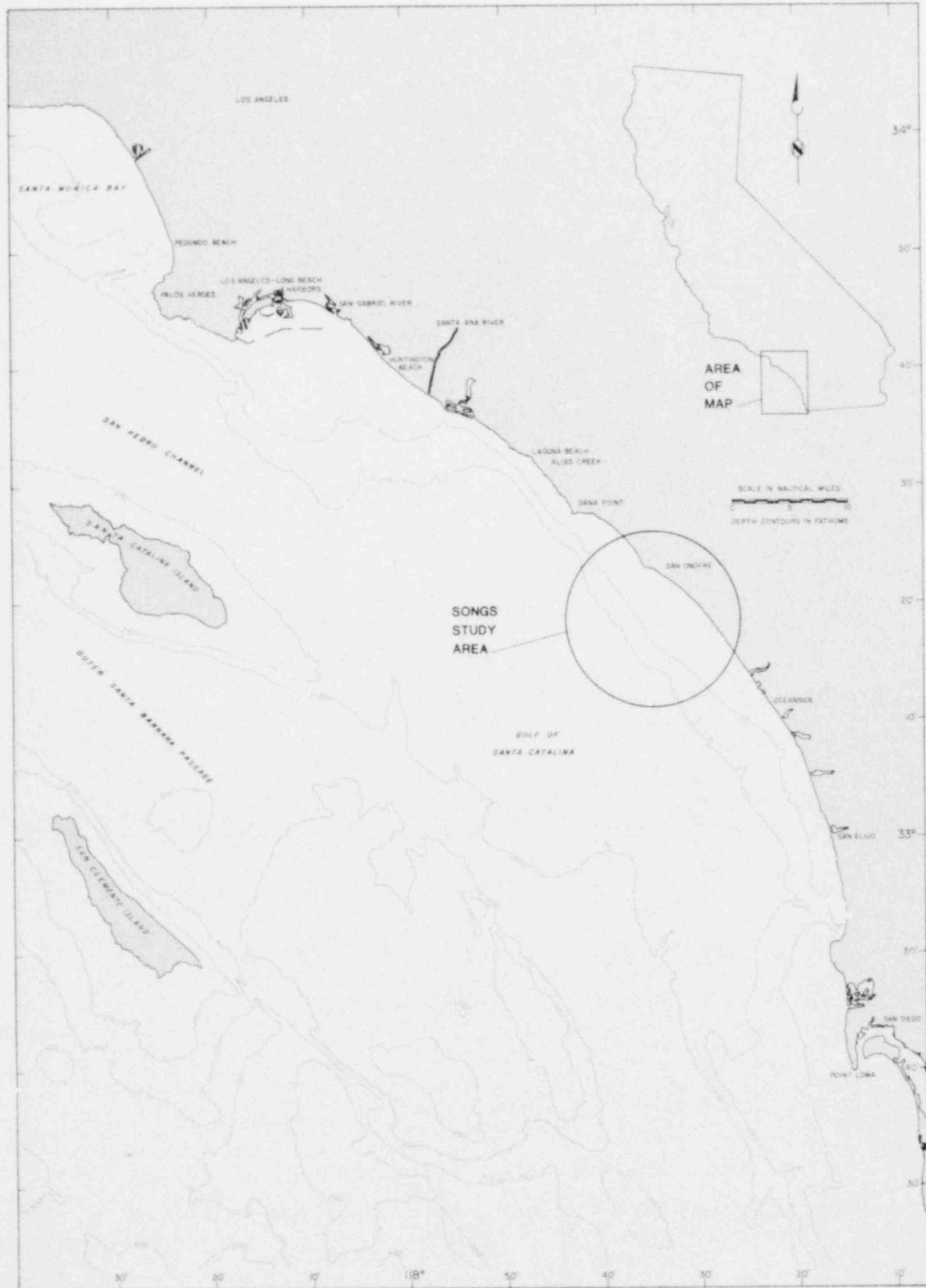


Figure 1-1. Study area location.

Figure 1-2. Major San Onofre regulatory programs.

Program and Study Elements	M J S D 1974	M J S D 1975	M J S D 1976	M J S D 1977	M J S D 1978	M J S D 1979	M J S D 1980
Marine Environmental Monitoring (MEM) Oceanography - bimonthly temperature, currents, turbidity, water quality Biological - plankton, benthos, intertidal			1964-XXXXXXXXXXXXXX				
Environmental Technical Specifications (ETS)/NPDES Oceanography - bimonthly temperature, turbidity, water quality, continuous temperature Biological - plankton, hard benthos, kelp, gill netting, impingement				XX			
Sand Disposal Study (SDS) Kelp, intertidal and subtidal infaunal and benthos			XXXXXXXXXXXXXXXXXXXX				
Construction Monitoring Program (CMP) Sedimentology, kelp, infaunal (intertidal and subtidal), intertidal special study				XX			
Preoperational Monitoring Program (PMP) Oceanography - bimonthly temperature, turbidity, water quality, continuous temperature Biological - plankton, hard benthos, gill netting, trawling, kelp, special study - ichthyoplankton (78-mid 79)					XXXXXXXXXXXXXXXXXXXX		
Interim Studies/NPDES Oceanography - continuous temperature, aerial turbidity photographs Biological - trawling, kelp							XXXXX
316(b) Program Biological - monthly larval entrainment, transit loss determination							XXXXXXXXXX

M = March J = June S = September D = December

data prior to the operation of Units 2 and 3. The PMP is complimentary to the Unit 1 ETS Program and essentially expands the study area further offshore into the area of Units 2 and 3 diffusers.

1980 REGULATORY DEVELOPMENTS

Preoperational Monitoring Program

The PMP investigation which began in mid 1978 terminated in mid 1980 in accordance with NRC authorization following two complete years of baseline data collection.

Environmental Technical Specifications

Section 4.3 of the Unit 1 ETS requires that a study plan to categorize and determine effects of plankton entrained within the circulatory water system be submitted for NRC approval. San Onofre Unit 1 is also subject to a Federal Water Pollution Control Act (FWPCA Section 316(b) demonstration which is administered by the CRWQDB for the EPA. In order to reduce redundant efforts and regulate duplication between the NRC and EPA, a formal request to delete the NRC requirement was forwarded to the Commission on 15 November 1979.

A FWPCA 316(b) ichthyoplankton entrainment inventory and loss study was completed in 1980 which will meet the objective of the ETS plankton entrainment study requirement. The ichthyoplankton inventory study report will be finalized in 1981 and submitted to the CRWQCB-SDR.

On 6 February 1980 a formal Change Request (No. 86) was sent to the NRC to delete the receiving water plankton study from the ETS. On 15 October 1980 another Change Request (No. 94) to delete environmental monitoring from the ETS requirements and add a reference to the NPDES permit was sent. Further, a request was prepared for transmittal to the NRC to suspend the ETS program while San Onofre Unit 1 is inoperable.

No response has been received to date on any of these requests.

NPDES/Interim Program

In order to maintain continuity with pertinent preoperational study elements (i.e. continuous temperature monitoring, turbidity studies, trawling, and kelp programs), an interim monitoring program was initiated by SCE in mid 1980. The interim program is anticipated to continue until the combined commercial operation of San Onofre Units 2 and 3 is initiated. The CRWQCB-SDR was advised of this action and it is anticipated that a form of the interim program will be included in the 1981 NPDES permits.

Construction Monitoring Program

The CMP investigation was suspended in March 1980 in accordance with the CRWQCB-SDR authorization as construction activity was completed. A study to assess the effects of the temporary seawall removal will be initiated upon its removal.

SCOPE AND ORGANIZATION

This report volume complies with the April 1 deadline for the presentation of a summary of results from the previous year's activities required by the various regulatory agencies. The regulations allow for the detailed analysis and interpretation of the data collected, to be submitted by July 1 of the reporting year.

The chapters in this report are organized by general study elements (i.e. Oceanography, Fish, etc.). All regulatory requirements associated with a particular element (i.e. ETS/NPDES, PMP, and CMP programs) are addressed in the chapter.

San Onofre Unit 1 was offline for a substantial portion of the year; thus, study elements designed to monitor immediate operating effects of the station, such as changes in temperature and turbidity, were not affected during the offline period. For the purpose of this summary, only data from the operational period are included for these elements.

Due to their voluminous nature, all raw data collected in 1980 are presented in a separate Comprehensive Data Supplement, Volume II, which is available from SCE upon request. The Comprehensive Data Supplement contains all regulatory required data as well as data gathered from investigations not contained within the regulatory requirements for the station operation, i.e. Interim Program, and other ancillary data collected to meet program objectives.

A detailed analysis and interpretation of all ecological data collected for SCE at San Onofre, and information from other appropriate sources relating to the program objectives, will be submitted to the regulatory agencies and available for distribution by 1 July 1981 in Volume III of the Annual Operating Report.

DESCRIPTION OF THE GENERATING STATION

San Onofre Unit 1 is an electrical generating facility utilizing a pressurized water nuclear reactor which began commercial operation in 1968. San Onofre Unit 1 is a base-load plant and is normally operated at full capacity. Electrical output of Unit 1 is 456 MW.

A once-through cooling system is used to cool the steam condensers. Seawater is drawn from a point 907.4 m (2977 ft) offshore, located in approximately 8.2 m (27 ft) of water. The offshore intake structure is fitted with a velocity cap which is designed to reduce the entrapment of marine organisms and draws water horizontally from a depth of 4 to 5 m. After passage through the intake conduit and the condensers, the cooling water travels through a discharge conduit which terminates in a vertical discharge structure located 750.4 m (2,462 ft) offshore in approximately 7.6 m (25 ft) of water. The discharge results in a surface-oriented thermal plume. Under normal operating conditions, the temperature of the cooling water is raised approximately 19°F across the condensers at a flow rate of 1,325 m³/min (350,620 gpm).

The Unit 1 screenwell contains traveling screens and bar racks to remove debris and entrapped marine organisms from the cooling water before it reaches the pumps and steam condensers. Marine fouling growth in the cooling water system is controlled through periodic heat treatments which are typically conducted at intervals of from six to ten weeks. During heat treatments, the temperature of the cooling water in the screenwell is raised to approximately 100°F for 1.75 hr. At this time, all of the fish within the screenwell which have avoided impingement on the traveling screens during normal operation are succumb to the higher temperature and are removed from the system.

San Onofre Units 2 and 3 are under construction and are scheduled to begin operation in 1981 and 1983, respectively. Each of the new units will have an electrical output of 1110 MW. The once-through cooling system for each unit will have a flow rate of 3,137 m³/min (830,000 gpm) and a normal operational temperature increase across the condensers of 19.2°F. The intakes will be located 970.2 m (3,183 ft) offshore in 9.8 m (32 ft) of water. Both units will have diffuser type discharges consisting of 63 ports spread over a distance of 762 m (2,500 ft). The Unit 2 discharge diffuser will extend from 1,786.1 m (5,860 ft) to 2,510.9 m (8,238 ft) offshore and range in depth from 11.9 m (39 ft) to 14.9 m (49 ft). The Unit 3 discharge diffuser will extend from 1,024.4 m (3,361 ft) to 1,889.8 m (6,200 ft) offshore and range in depth from 9.8 m (32 ft) to 11.6 m (38 ft).

GENERATING STATION OPERATION

Unit 1

The station was offline from 10 April through the end of 1980 due to problems associated with the steam generator which required extensive system repair. The circulating pumps reoperation briefly in June and July, and fish impingement studies resumed during this period.

An illustration depicting plant operation including mean daily megawatt output (station load), inplant ΔT [(°C) discharge temperature minus intake temperature], and circulating water flow at SONGS Unit 1 during 1980 are presented in Figure 1-3.

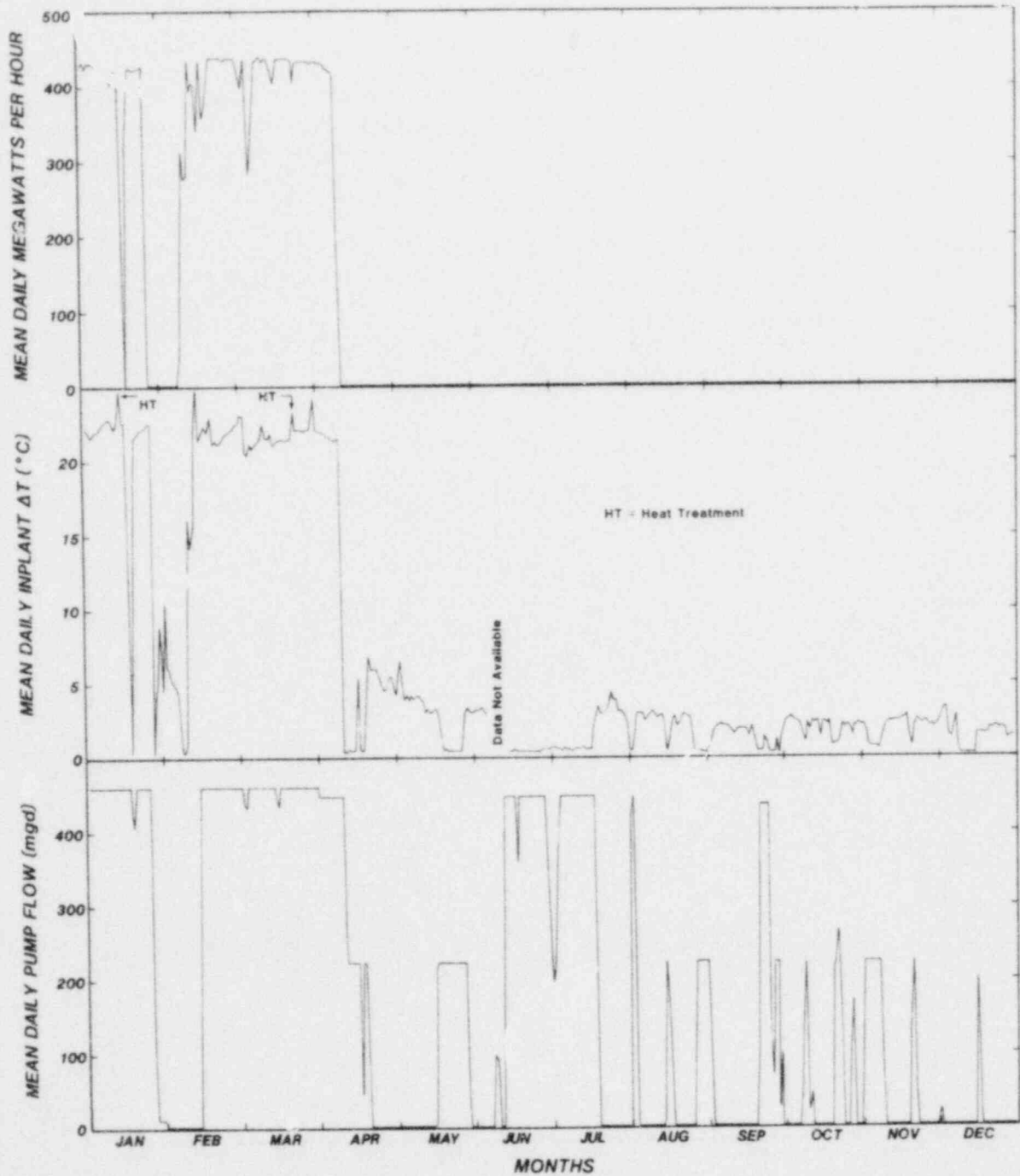


Figure 1-3. San Onofre Nuclear Generating Station Unit 1 operating characteristics during 1979.

Units 2 and 3

Intermediate testing of Units 2 and 3 circulation water pumps occurred in September and December 1981. This testing procedure was associated with startup activities.

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- Southern California Edison Company. 1981b. Annual operating report, San Onofre Nuclear Generating Station. Volume III: Environmental technical specifications Unit 1; national pollutant discharge elimination system, Units 1, 2, and 3; construction monitoring program Units 2 and 3; preoperational monitoring program. Prepared by Brown and Caldwell, Lockheed Environmental Sciences, and Marine Biological Consultants, Inc. (in preparation).

Chapter 2

OCEANOGRAPHY

A. TEMPERATURE

Monitoring of temperature in the San Onofre receiving waters was conducted bimonthly during 1980 at 46 Unit 1 operational sampling stations in compliance with Environmental Technical Specifications (ETS) Section 3.1.1.a.(5) and NPDES permits and at 28 additional sampling stations as part of the San Onofre Units 2 and 3 Preoperational Monitoring Program (PMP) (Figures 2A-1 and 2A-2). A data collection record for 1980 is presented in Table 1-1. The objectives of the temperature studies were to: 1) document large spatial and temporal changes in temperature throughout the study area, 2) establish preoperational baseline conditions before operation of San Onofre Units 2 and 3, 3) determine the horizontal and vertical extent of the thermal plume from Unit 1, 4) determine the area of influence of Unit 1, 5) estimate the extent to which heated water from Unit 1 is recirculated back into the intake of the circulating water system, and 6) provide temperature data for the analysis and interpretation of biological findings. Temperature monitoring for the Units 2 and 3 PMP, except for continuous temperature monitoring, was discontinued on 5 September 1980. Continuous temperature monitoring was conducted throughout 1980.

SAMPLING METHODS

A detailed description of instrumentation and methods used for temperature measurements are presented in Brown and Caldwell's procedures manual for ETS and PMP (BC 1979). Detailed methods were also reported in Volume I, Oceanographic Data Report (SCE 1980).

The following presents a synopsis of methods. Vertical profiles of temperature were measured with a Martek transistor probe and recorded digitally. Infrared radiometer measurements were taken from an aircraft along predetermined flight paths with a Barnes PRT-5 precision radiometer. Shoreline temperature measurements were taken at 11 shoreline stations in conjunction with aerial infrared measurements using a calibrated bucket thermometer. Continuous temperature data was recorded hourly at the surface, mid-depth, and near-bottom of Stations C2S and C22S, and at the surface, 15 and 30 ft depths, and near-bottom of Station F2S (Figures 2A-1 and 2A-2). In-plant intake and discharge temperature data were continuously recorded by SCE in-plant personnel at the tsunami wall within the upper 3 ft of the intake and discharge conduits.

RESULTS

Results of temperature data collected from January through April 1980 while Unit 1 was in operation for the San Onofre environmental monitoring programs are presented in tabular and graphic form by survey in chronological order. Unit 1 went offline on 9 April 1980. Results of temperature data collected from May through December 1980 are presented in the Comprehensive Data Supplement (SCE 1981a). Temperature data presented in this report for periods when Unit 1 was in operation include: vertical temperature profiles required by ETS during bimonthly surveys (Figures 2A-3 and 2A-4); surface temperatures and times from profile measurements (Figures 2A-5 and 2A-6); surface temperature isotherms from profile measurements (Figures 2A-7 and 2A-8); surface temperature isotherms from infrared

radiometer measurements (Figures 2A-9 and 2A-10); results of shoreline temperature measurements (Table 2A-1); graphs of continuous temperature measurements (Figures 2A-11 through 2A-18); and graphs comparing intake, discharge, and ambient temperatures (Figures 2A-19 through 2A-22).

An analysis of all temperature data collected during 1980 will be presented in the Volume III, Annual Operating Report (SCE 1981b).

Section 5.6.3b(3)(a) of Appendix B of the ETS for Unit 1 requires that data losses from continuous monitoring systems (including the continuous temperature recording system) shall not exceed one week continuous or a total in excess of three weeks per year. If data losses exceed these limits, a non-routine report of the occurrence to the Nuclear Regulatory Commission (NRC) is required. Data losses of greater than one week duration occurred at Station C22S mid-depth from 23 January through 4 March 1980, and at Station C22S near-bottom from 4 March through 4 April 1980. These losses were reported to the NRC on 23 July 1980 (NRC Docket No. 50-206).

On 16 May 1980, the NRC formally exempted continuous temperature recording systems from non-routine reporting and required an annual offshore continuous temperature retrieval rate of at least 80%. ETS now requires losses resulting in less than 80% return to be described and discussed in the Annual Operating Report. Temperature data retrieval was more than 80% during 1980.

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Table 2A-1. Shoreline temperatures (°C) during 1980 surveys.

Date	Run	Time (PST)	Station											Max		
			1	4000'S	2	3	1000'S	Pier	1000'S	2000'S	4000'S	4	5		10000'S	
Jan. 8	1	0800-0912	15.2	15.9	15.7	16.1	16.2	16.0	15.3	15.1	15.1	15.1	15.1	15.1	-	15.5
	2	1100-1219	16.1	16.3	16.2	16.6	16.5	16.7	17.5	15.6	15.8	15.6	15.6	15.7	-	16.2
	3	1400-1524	16.2	16.3	16.3	16.9	1 9	17.0	15.7	15.6	15.5	16.1	16.3	16.3	-	16.3
Mar. 11	1	0806-0914	-	16.3	16.3	16.2	16.2	16.7	16.9	16.9	16.9	17.2	17.2	-	16.7	
	2	1005-1113	-	17.4	17.7	18.1	18.3	17.7	17.5	17.7	17.7	17.7	17.6	-	17.7	
	3	1300-1451	-	18.6	18.8	19.5	19.6	19.5	19.1	19.6	18.9	19.3	19.1	-	19.2	
May 14	1	1006-1141	-	15.7	15.7	16.0	16.0	16.0	16.3	16.3	16.4	16.6	16.7	-	16.2	
	2	1308-1450	-	17.9	18.1	16.9	17.4	17.0	16.7	16.9	17.1	17.8	17.7	-	17.3	
Jul. 9	1	0905-1039	-	17.6	18.0	18.2	18.4	18.3	17.6	17.6	18.2	18.4	18.5	18.6	18.1	
	2	1235-1437	-	19.6	20.0	19.8	19.6	19.8	18.8	19.2	19.9	20.0	20.1	20.0	19.7	
Sep. 10	1	0739-1028	19.2	19.8	19.8	19.8	19.9	19.6	19.5	19.5	19.5	19.4	19.4	19.3	19.6	
Nov. 5	1	1319-1500	17.4	17.6	17.8	18.1	18.3	17.8	17.5	17.5	17.5	17.7	17.7	17.4	17.7	

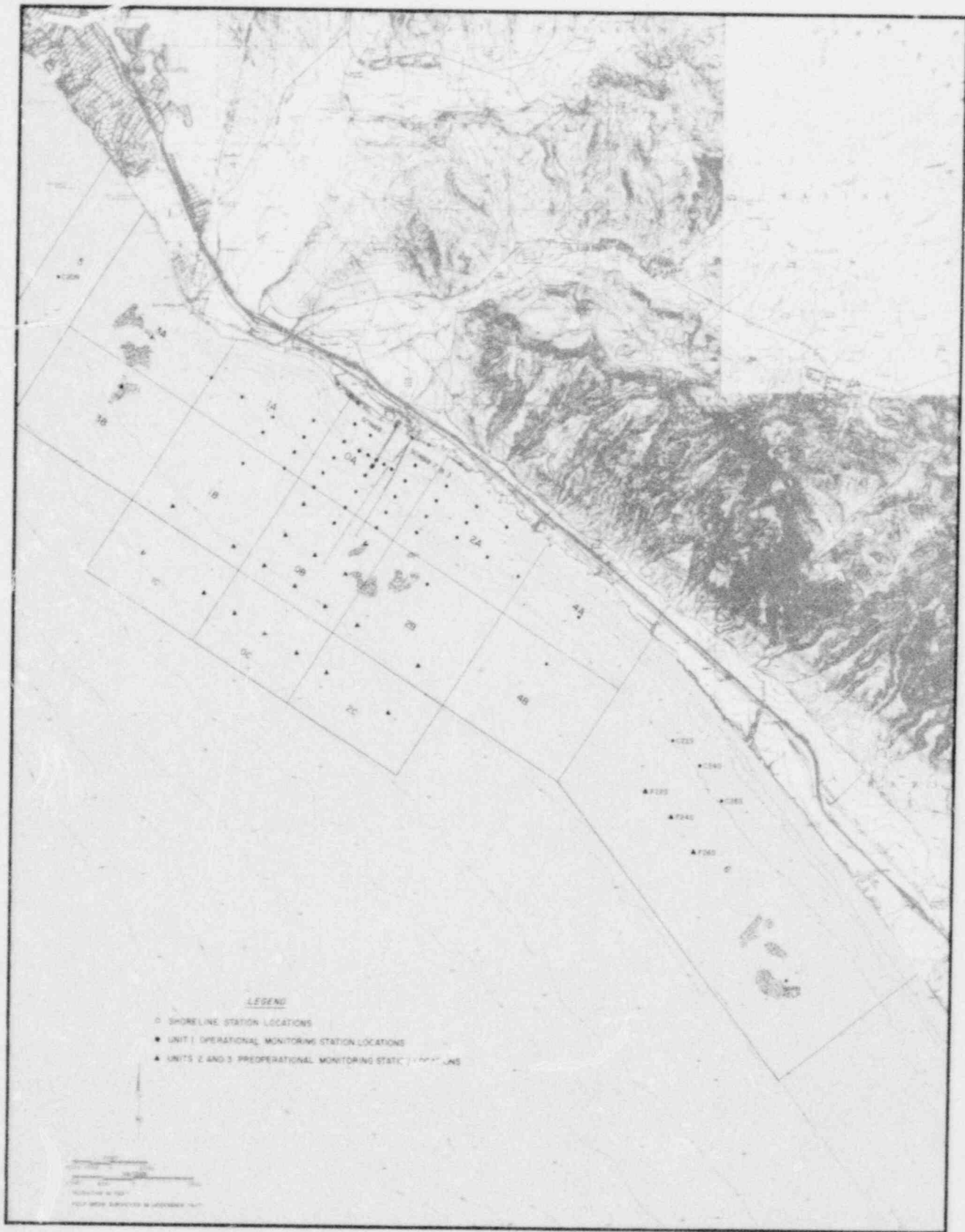


Figure 2A-1. Environmental surveillance zones and physical and chemical station locations.

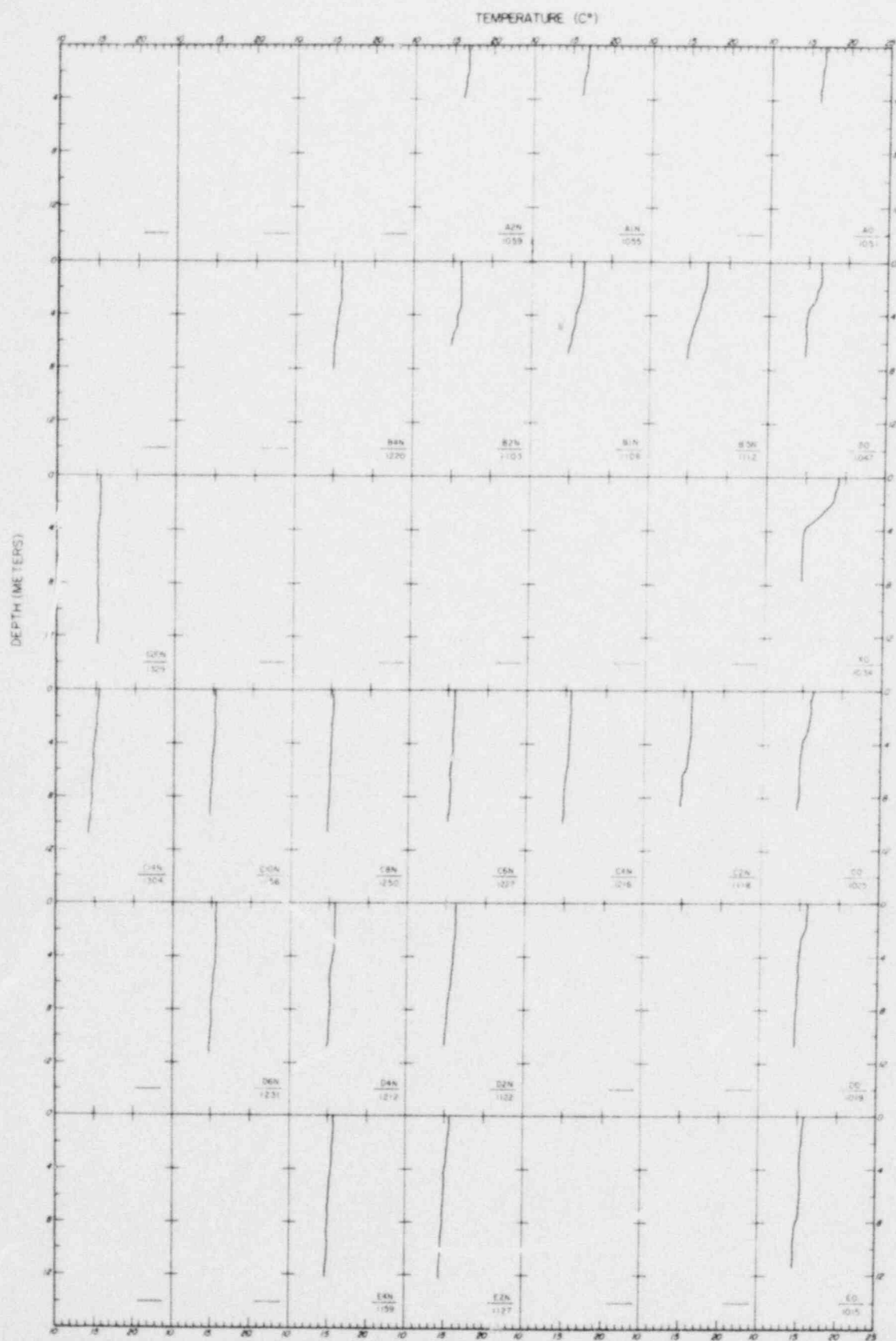


Figure 2A-3. Temperature profiles for January 8, 1980.

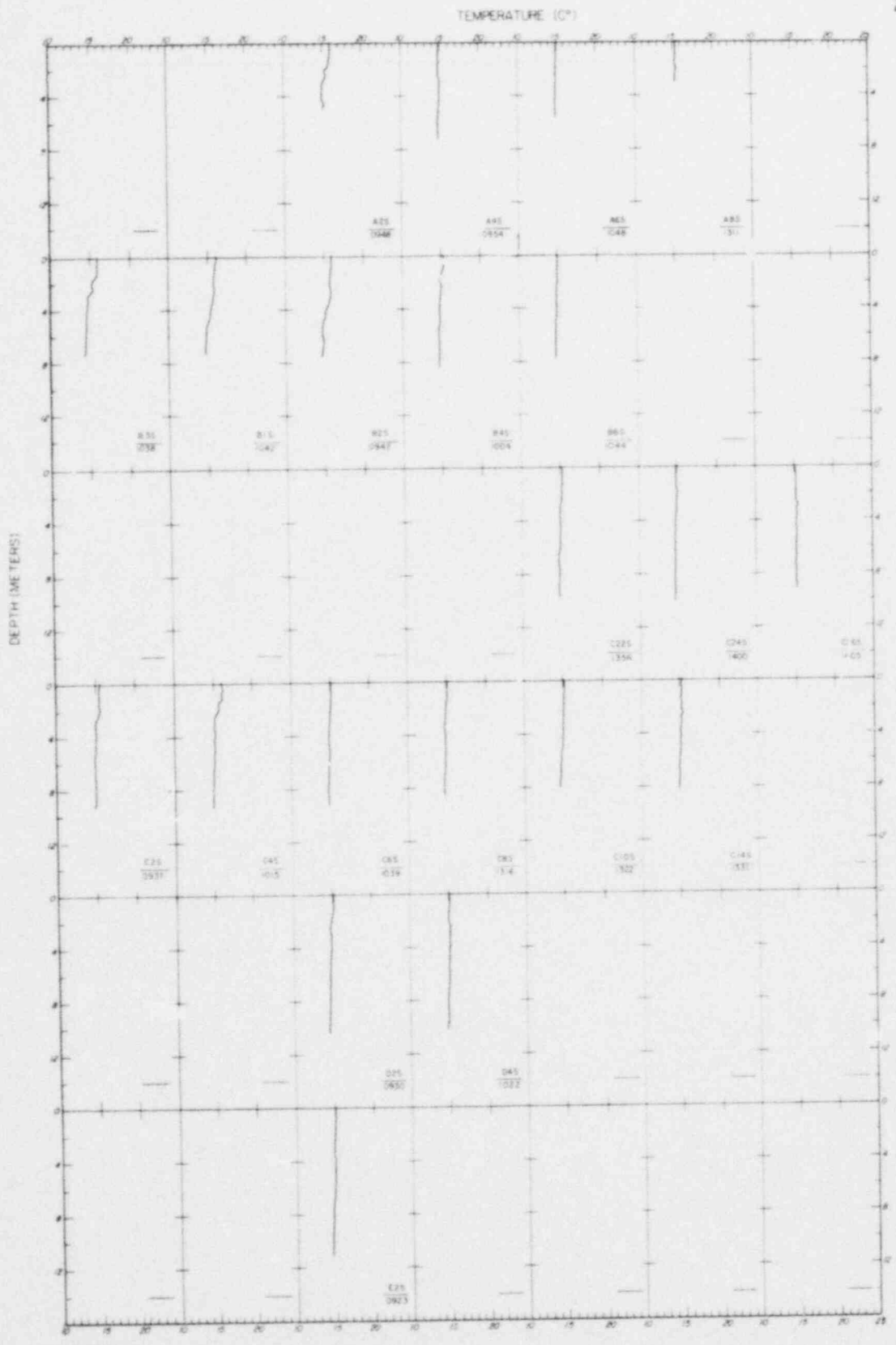


Figure 2A-3. Temperature profiles for January 8, 1980 (Cont).

2A-8



Figure 2A-3. Temperature profiles for January 8, 1980 (Cont).

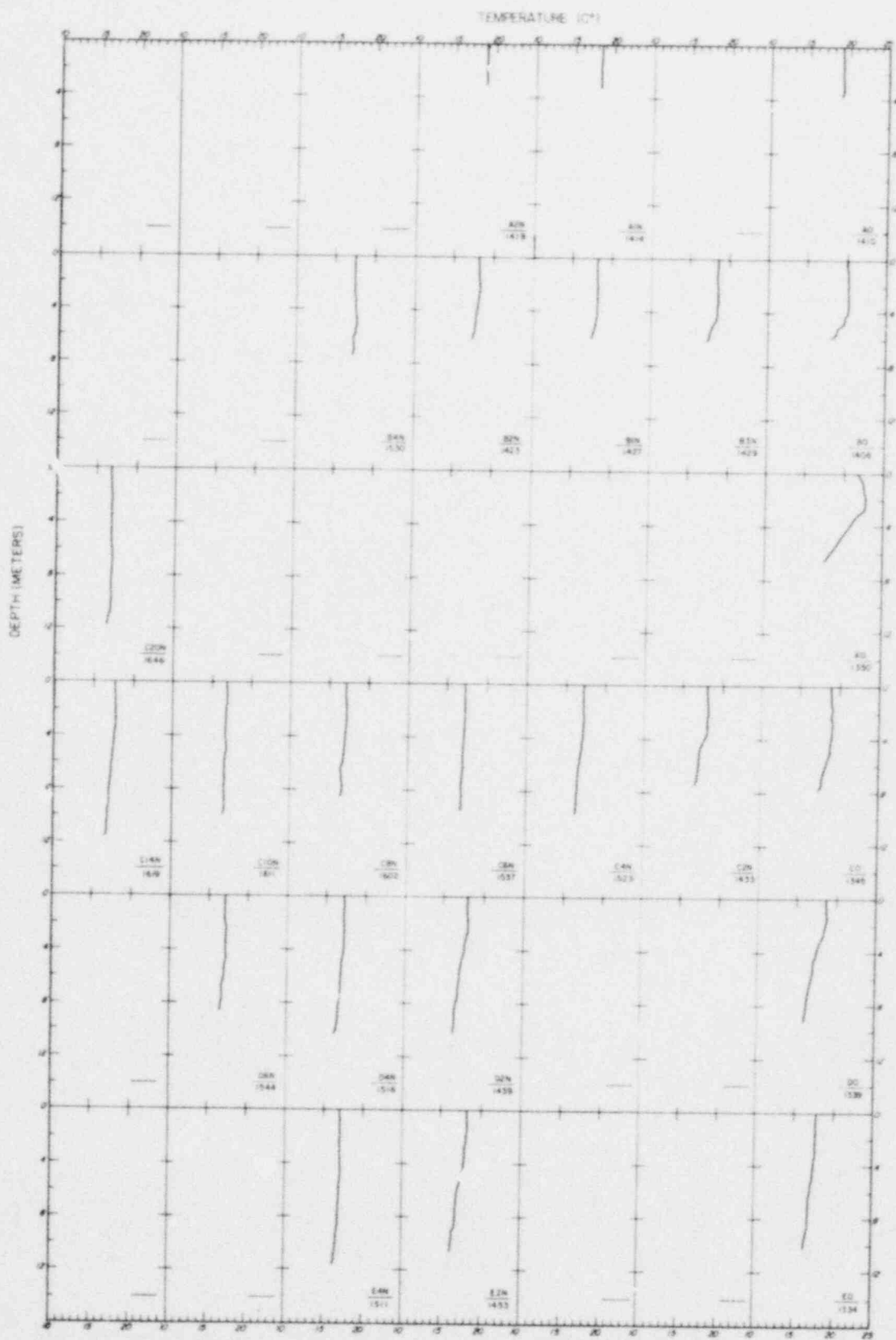


Figure 2A-4. Temperature profiles for March 13, 1980.

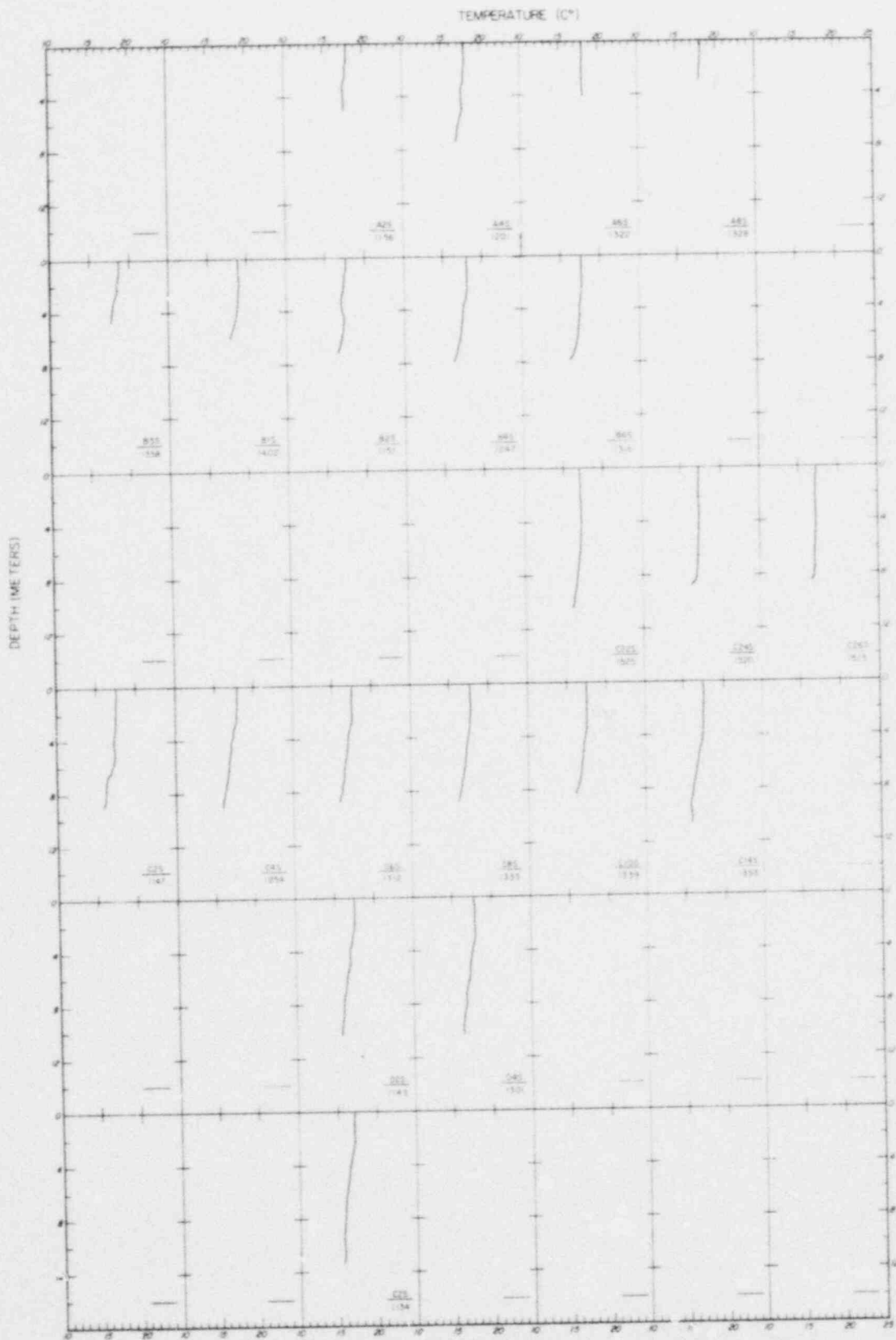


Figure 2A-4. Temperature profiles for March 13, 1980 (Cont).

2A-12



Figure 2A-4. Temperature profiles for March 13, 1980 (Cont).

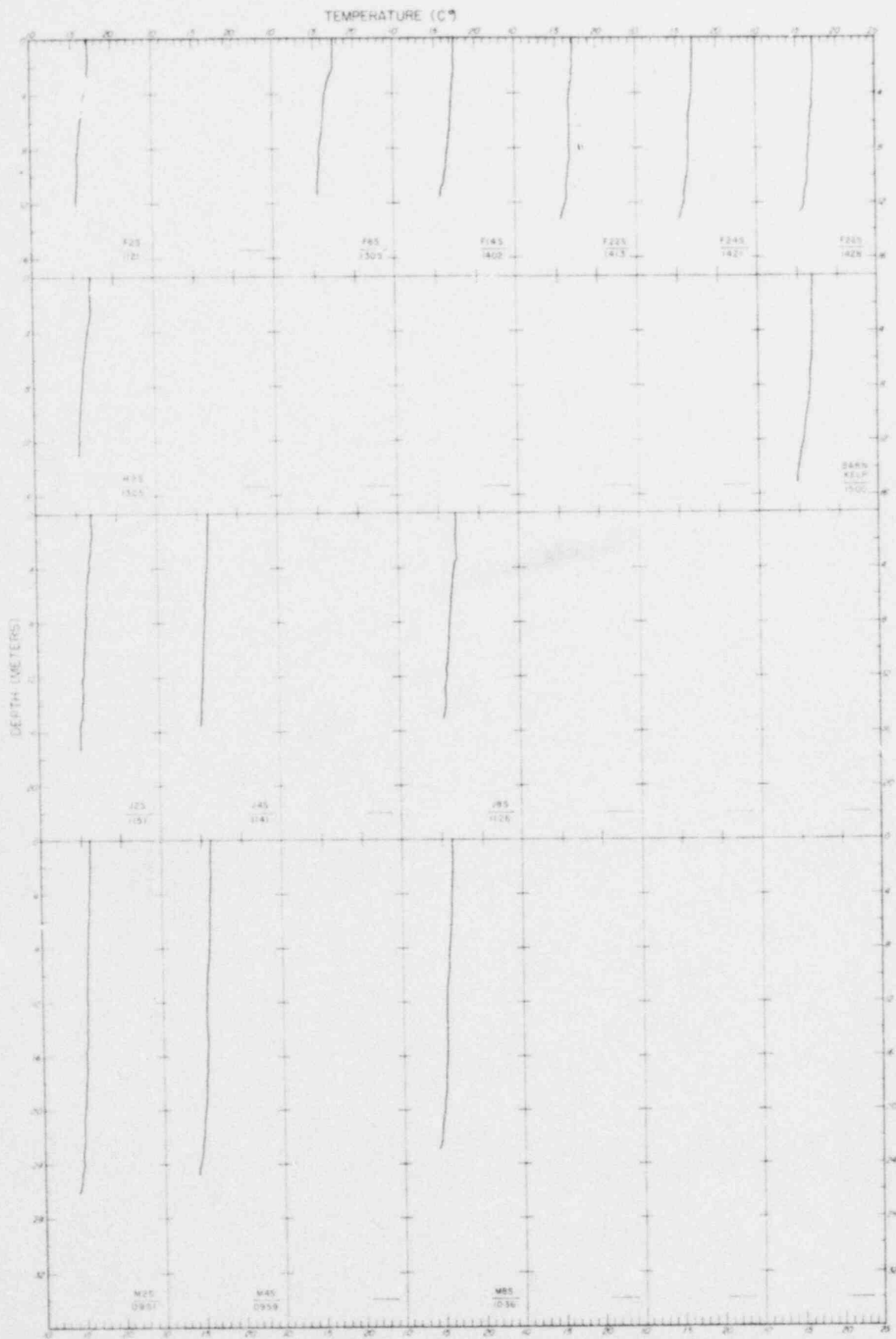


Figure 2A-4. Temperature profiles for March 13, 1980 (Cont).

Figure 2A-5
not
available

time of
publication

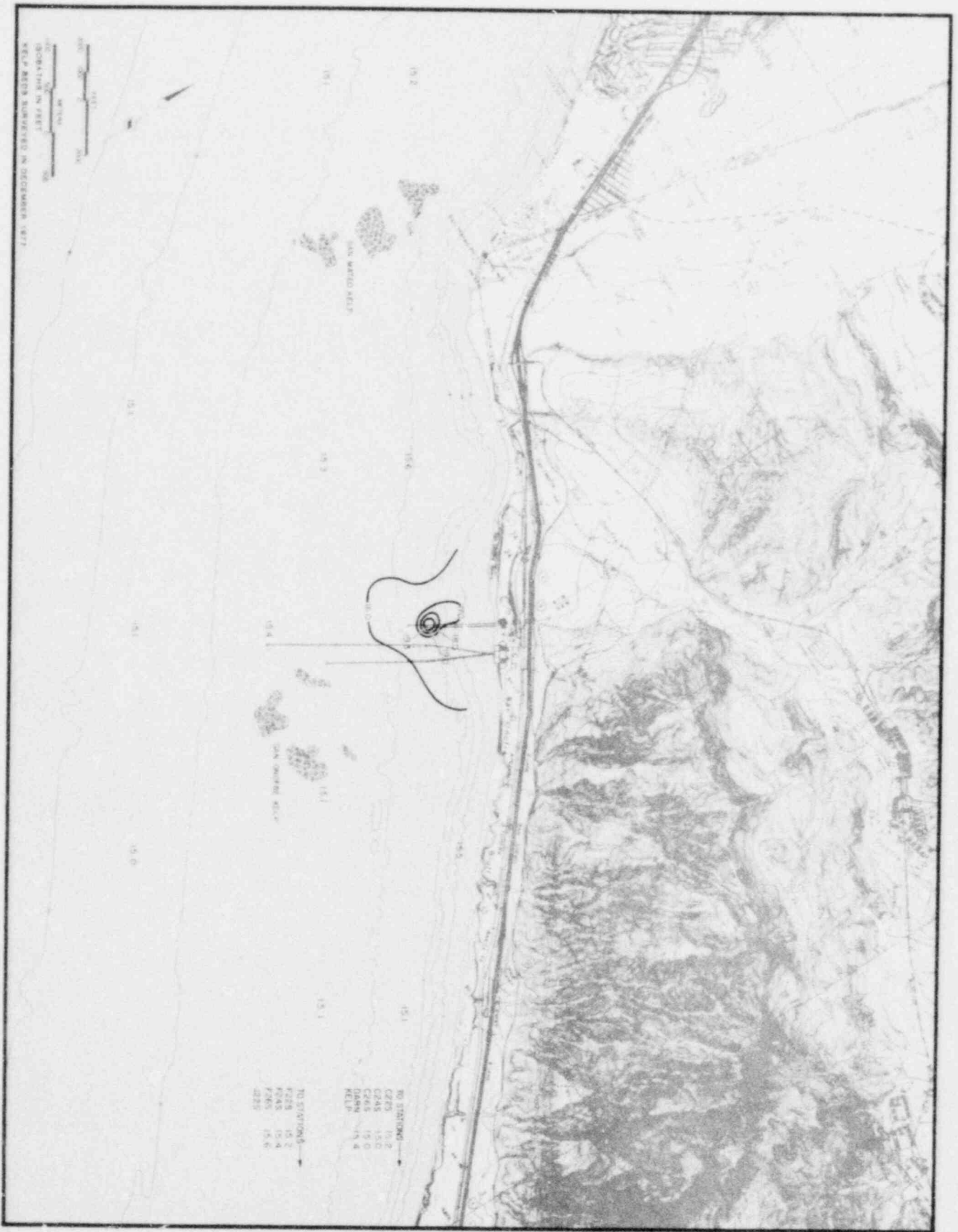


Figure 2A-7. Surface isotherms from temperature profiles, January 8, 1980.

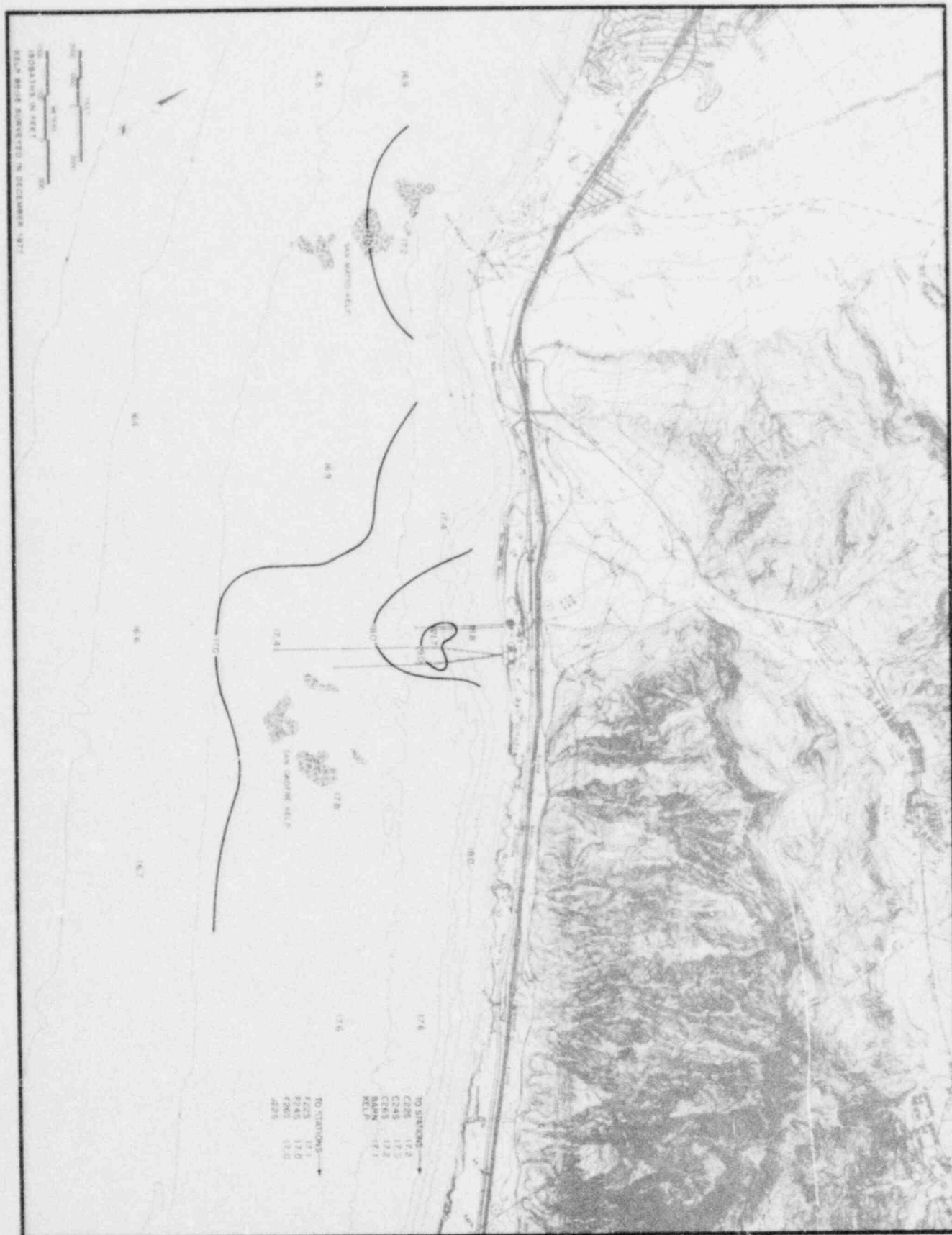


Figure 2A-8. Surface isotherms from temperature profiles, March 13, 1980.



Figure 2A-9. Surface isotherms from infrared radiometer measurements, 1420-1451 PST, January 8, 1980.

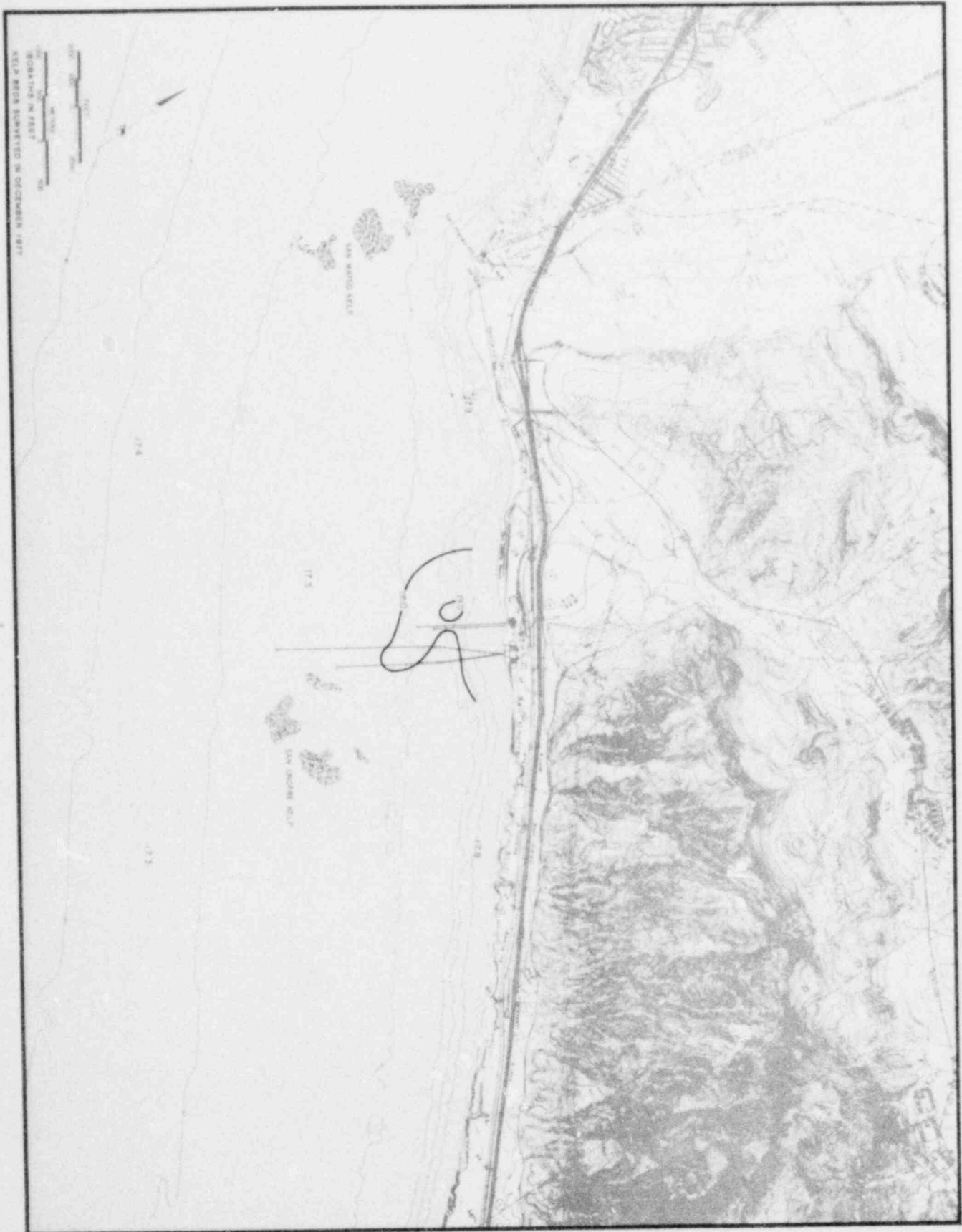


Figure 2A-10. Surface isotherms from infrared radiometer measurements, 1256-1342 PST, March 13, 1980.

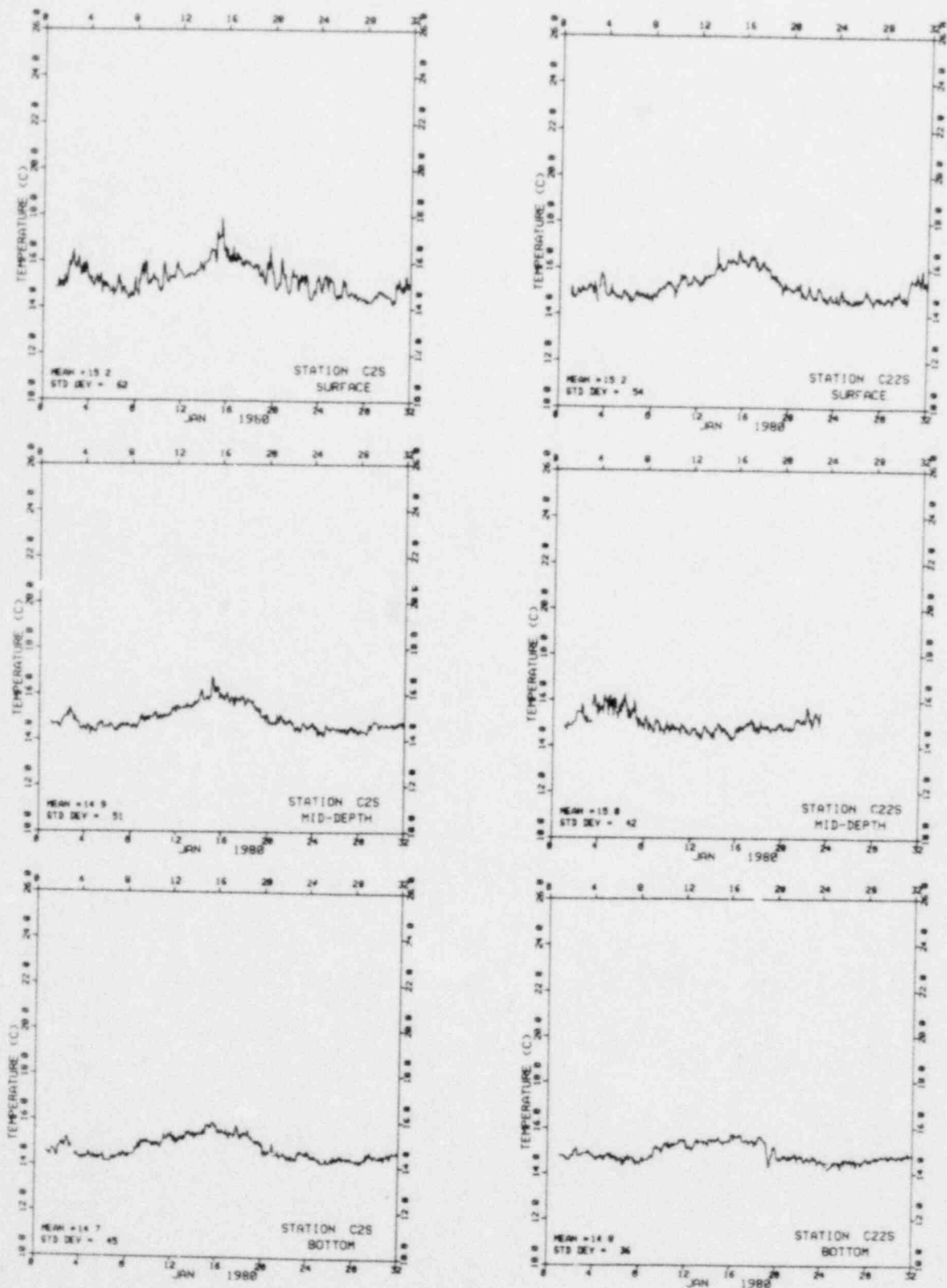


Figure 2A-11. Continuous temperature graphs for the surface, mid-depth and bottom of Stations C2S and C22S, January, 1980.

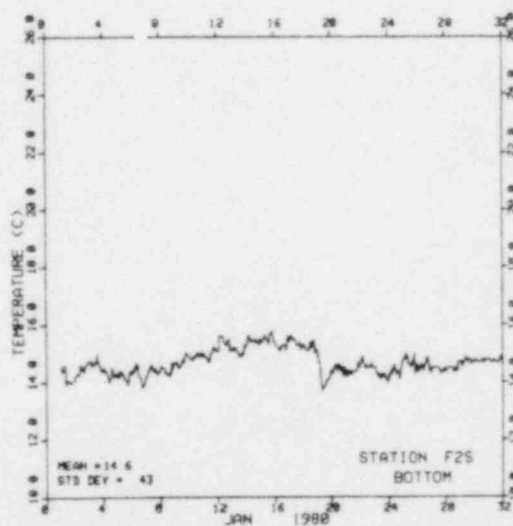
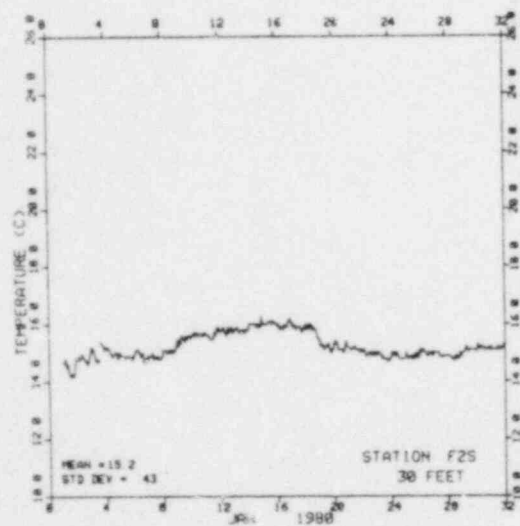
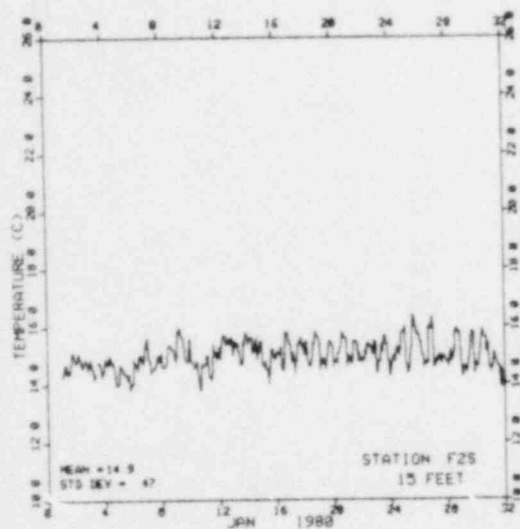
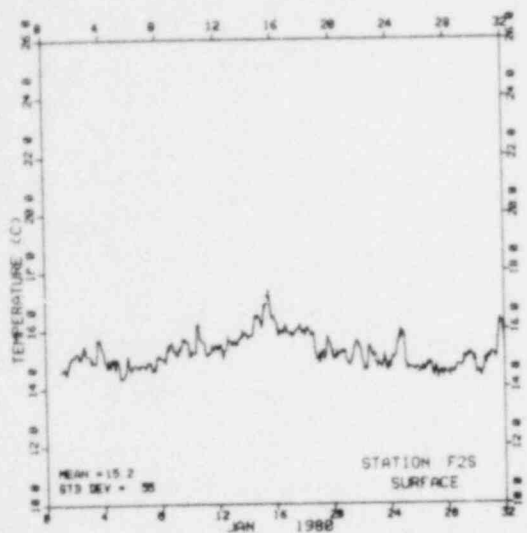


Figure 2A-12. Continuous temperature graphs for the surface, 15 and 30 feet depths, and bottom of Station F2S, January, 1980.

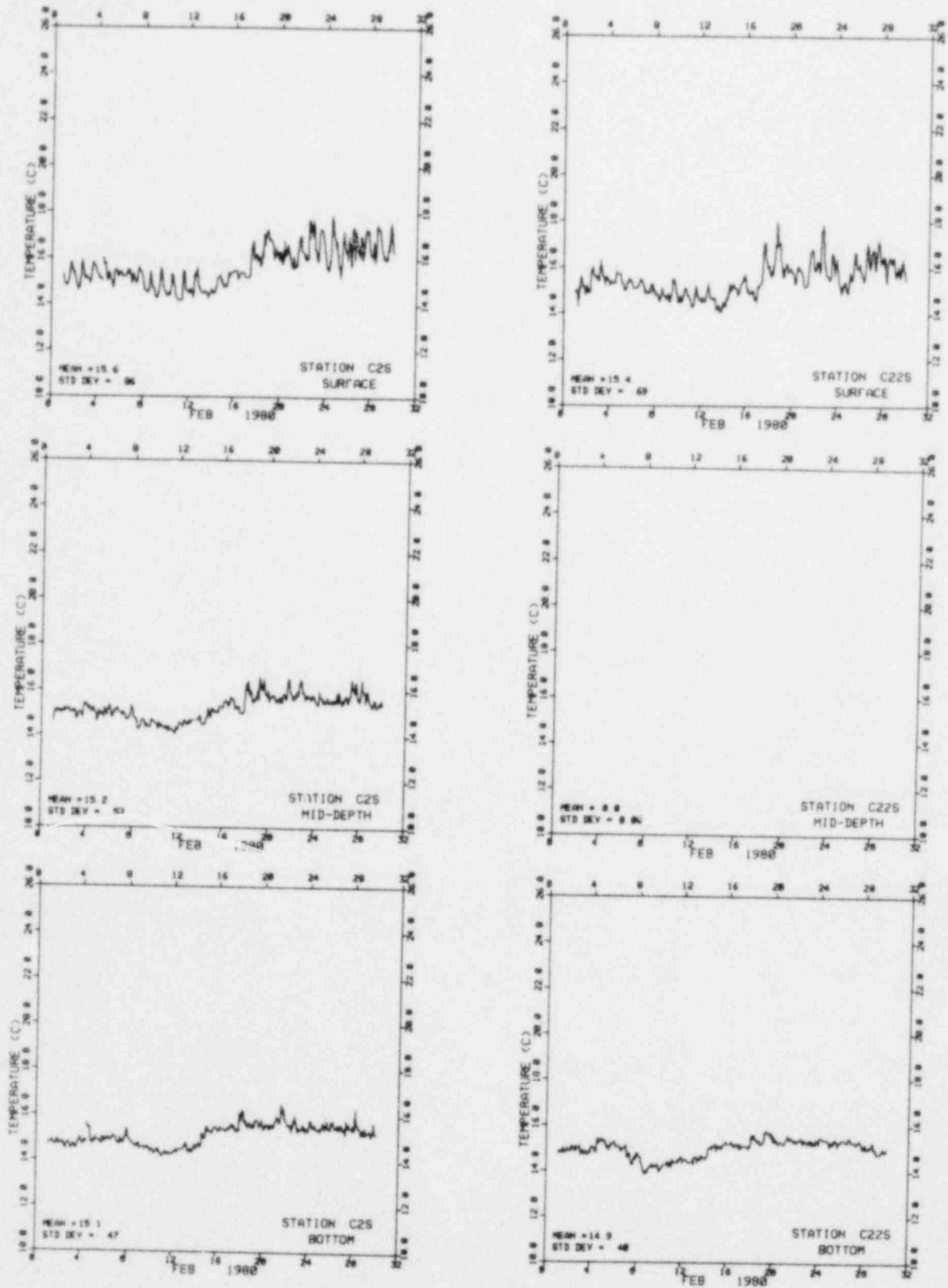


Figure 2A-13. Continuous temperature graphs for the surface, mid-depth and bottom of Stations C2S and C22S, February, 1980.

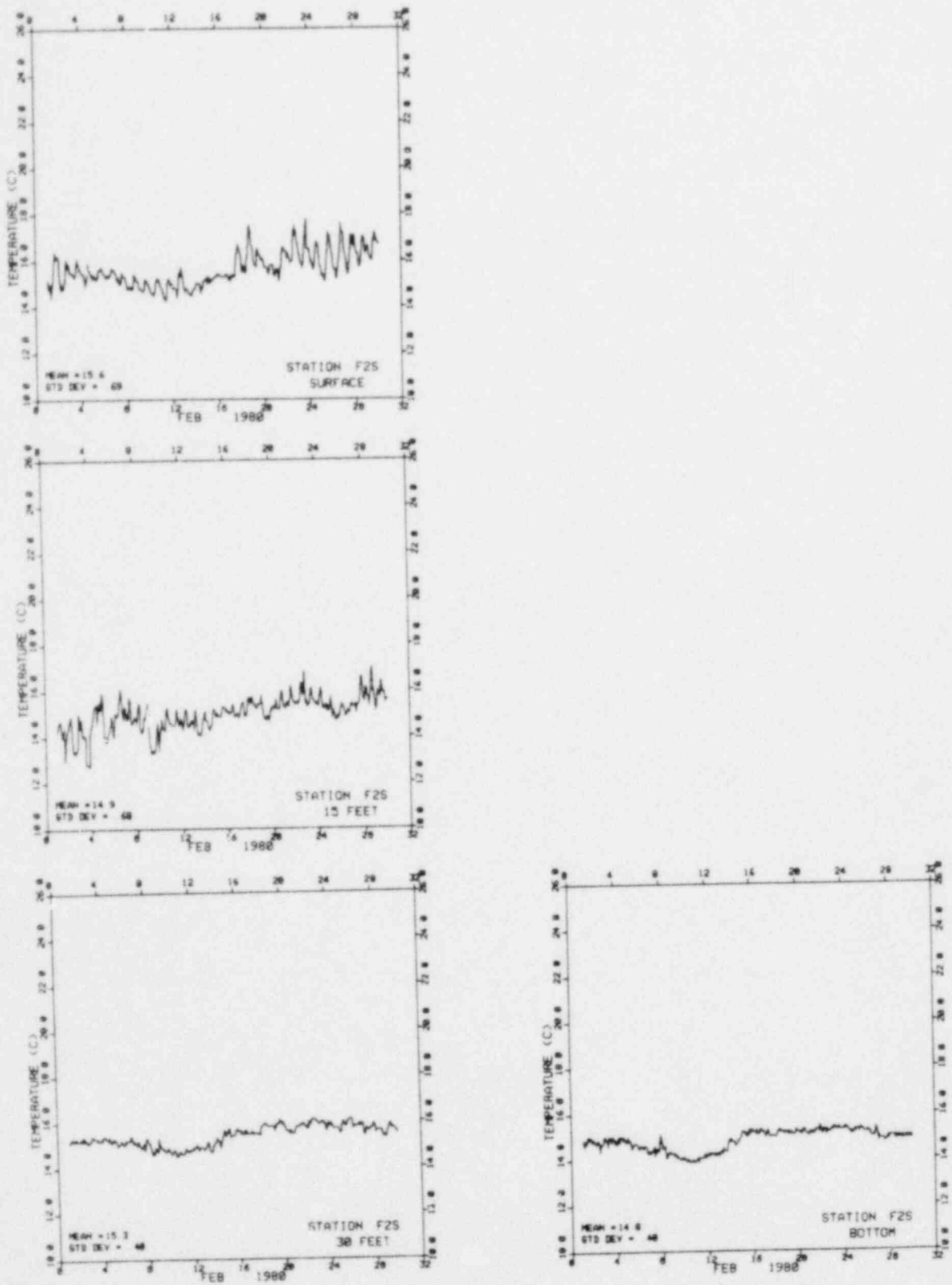


Figure 2A-14. Continuous temperature graphs for the surface, 15 and 30 feet depths, and bottom of Station F2S, February, 1980.

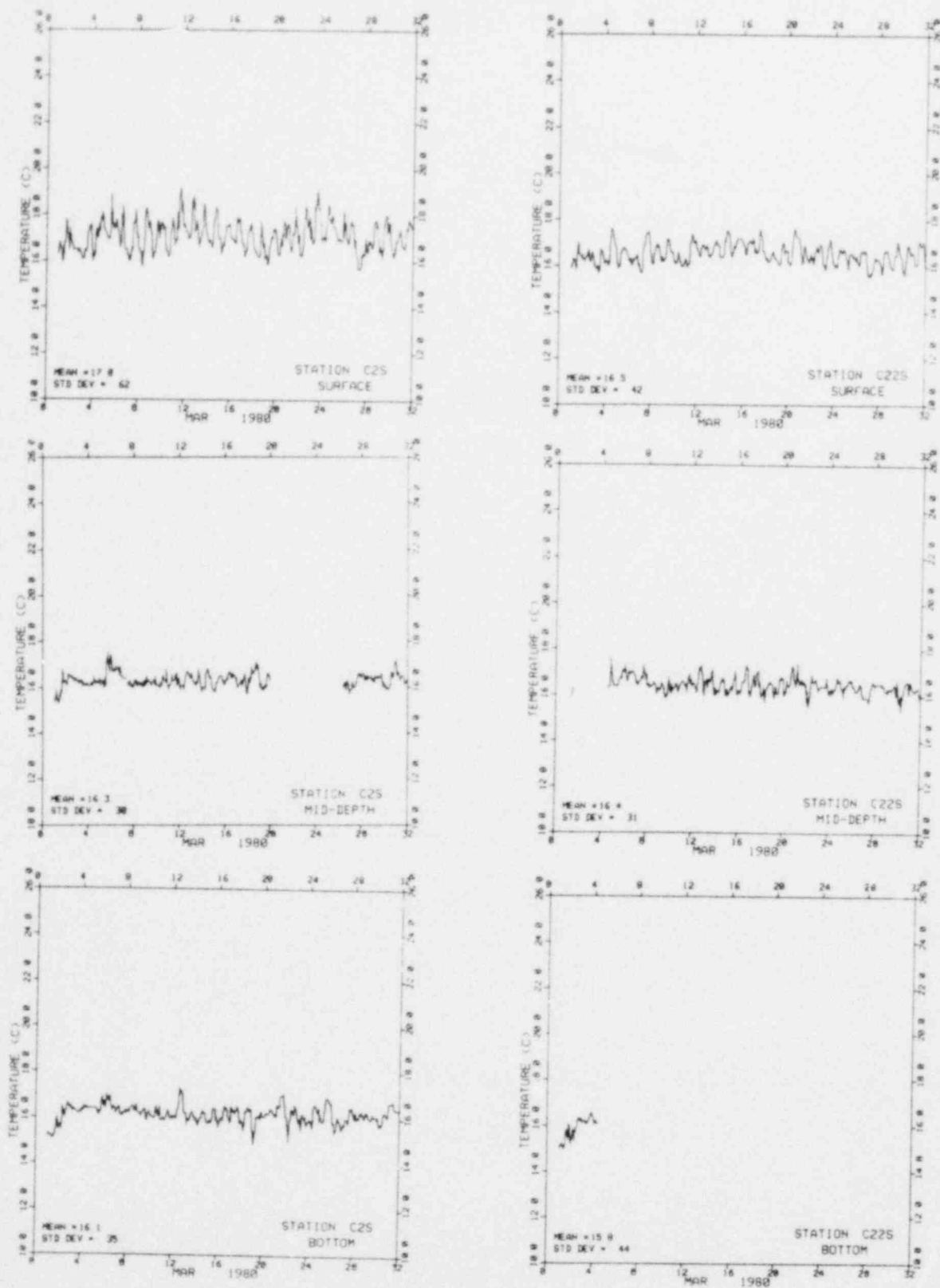


Figure 2A-15. Continuous temperature graphs for the surface, mid-depth and bottom of Stations C2S and C22S, March, 1980.

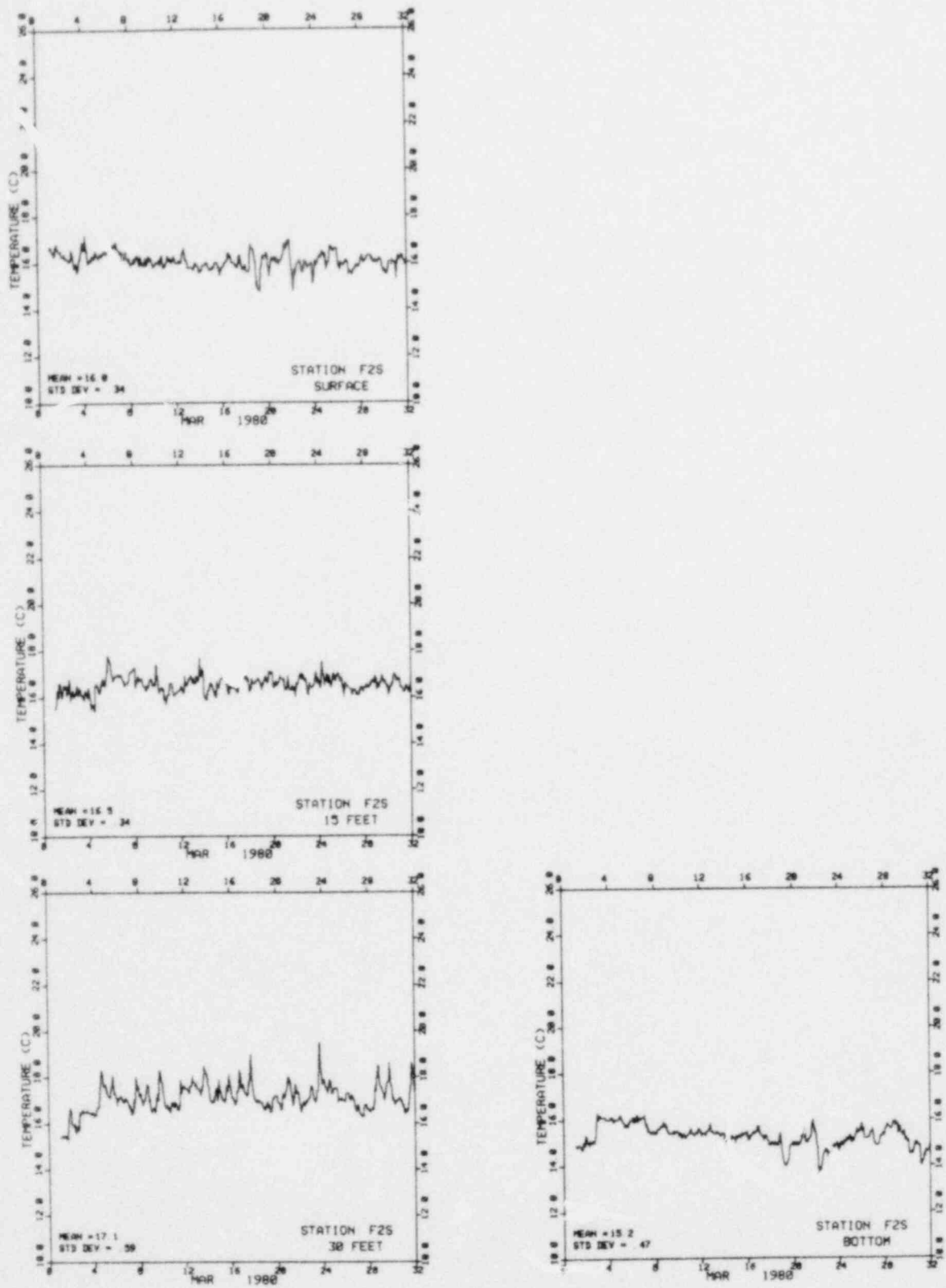


Figure 2A-16. Continuous temperature graphs for the surface, 15 and 30 feet depths, and bottom of Station F2S, March, 1980.

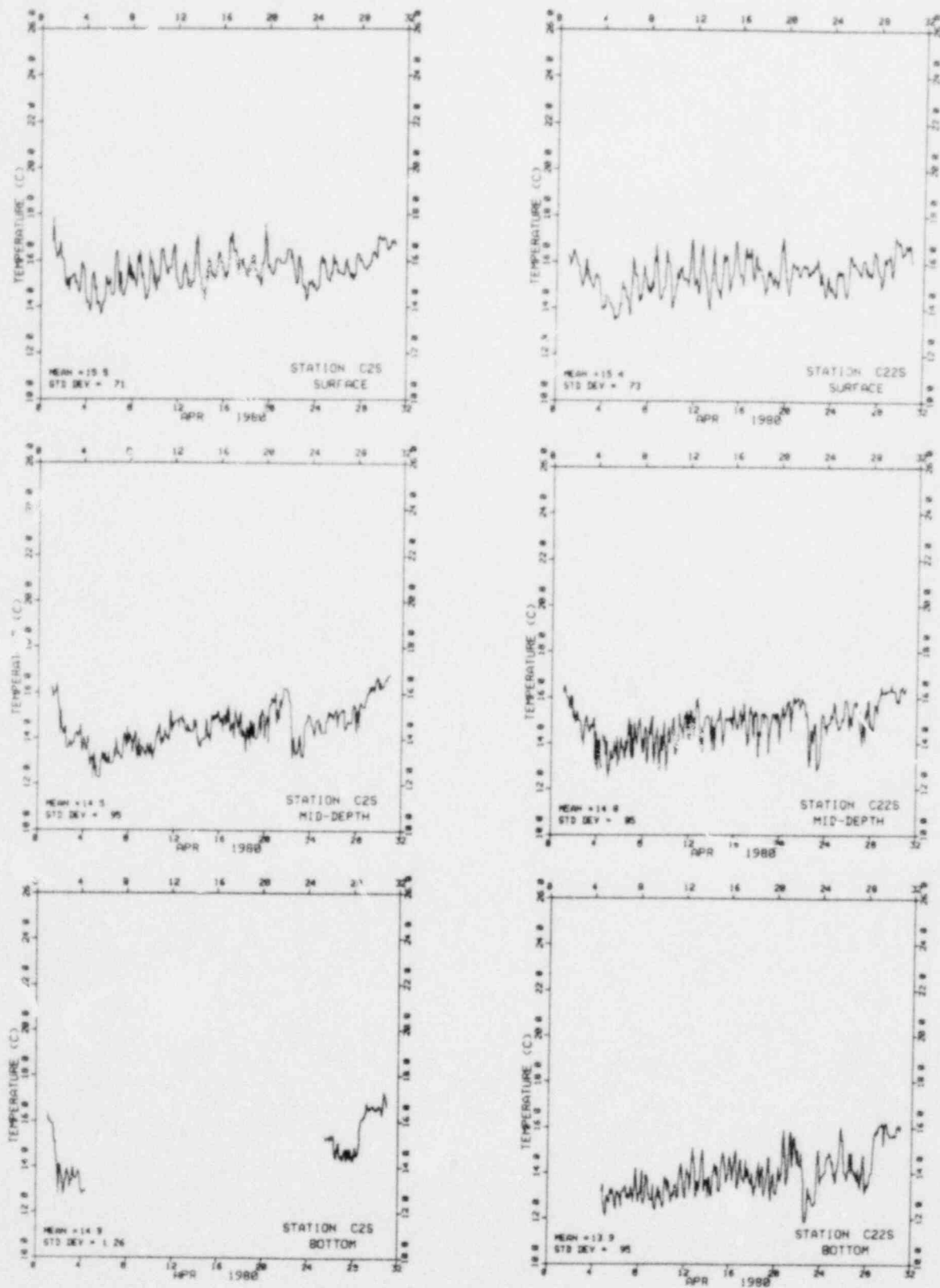


Figure 2A-17. Continuous temperature graphs for the surface, mid-depth and bottom of Stations C2S and C22S, April, 1980.

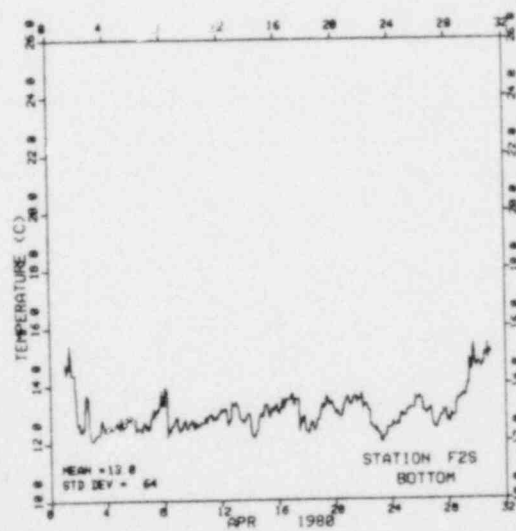
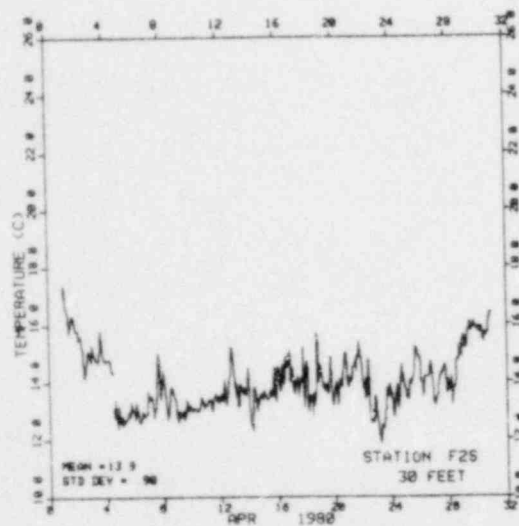
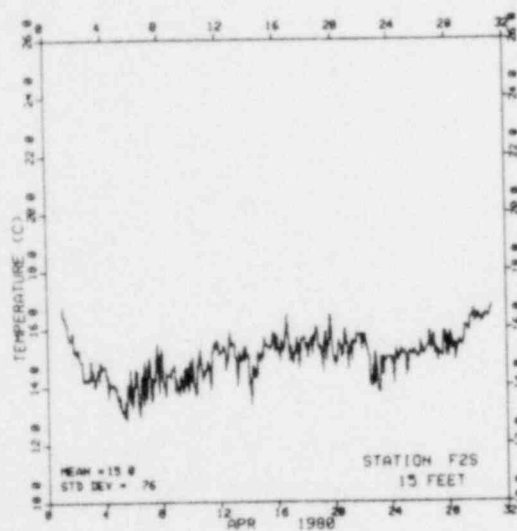
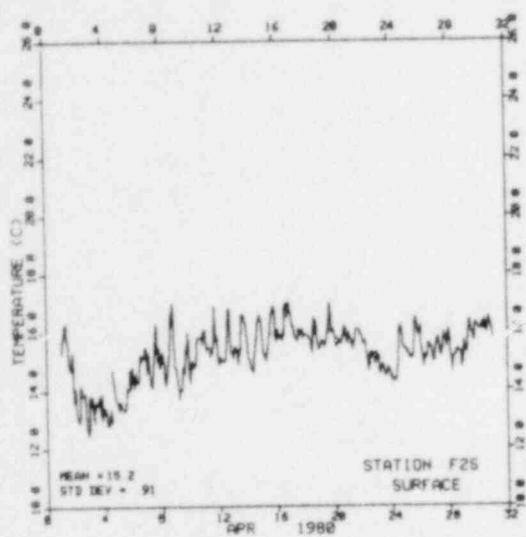


Figure 2A-18. Continuous temperature graphs for the surface, 15 and 30 feet depths, and bottom of Station F2S, April, 1980.

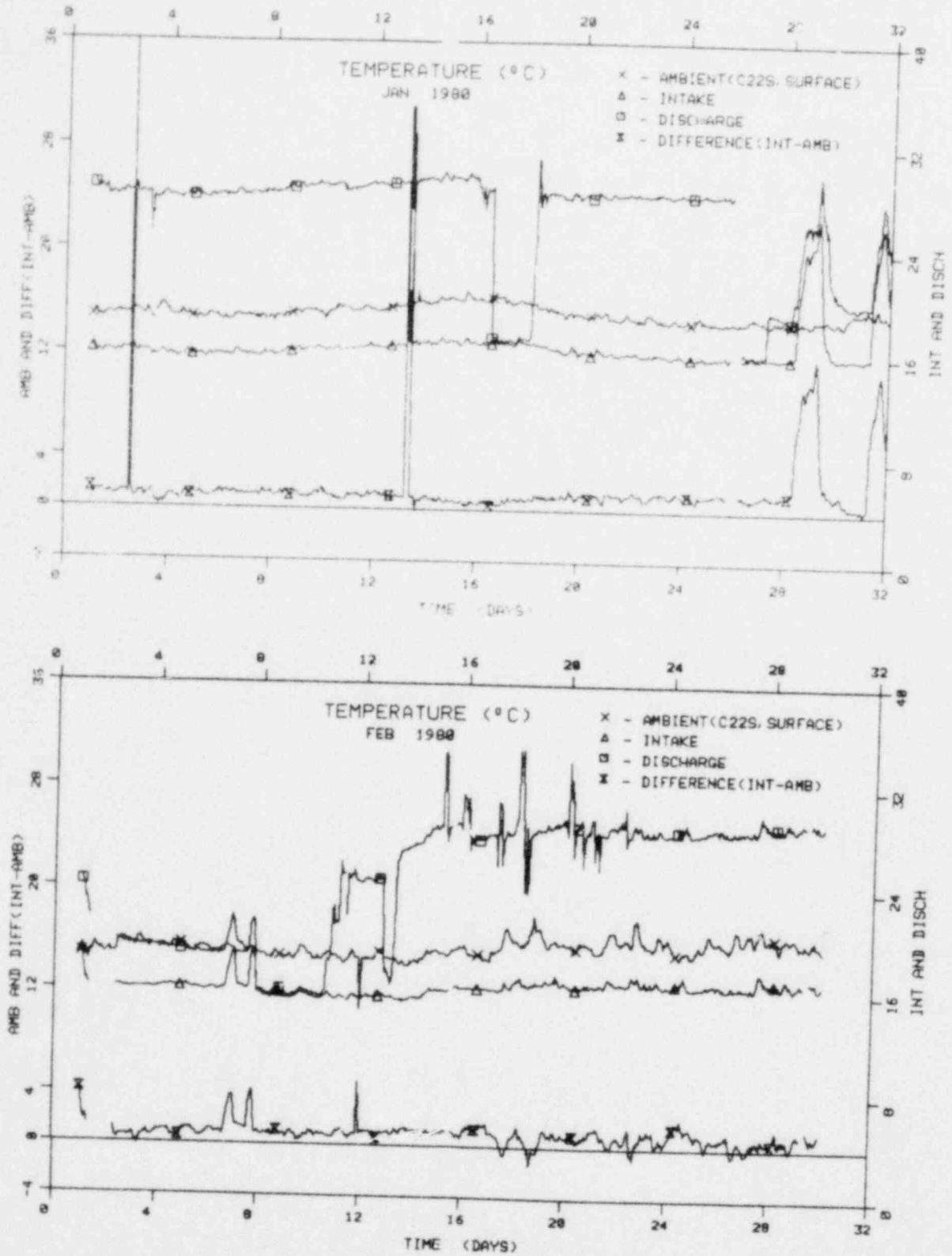


Figure 2A-19. Comparison of intake, discharge, and ocean ambient temperatures, January and February, 1980.

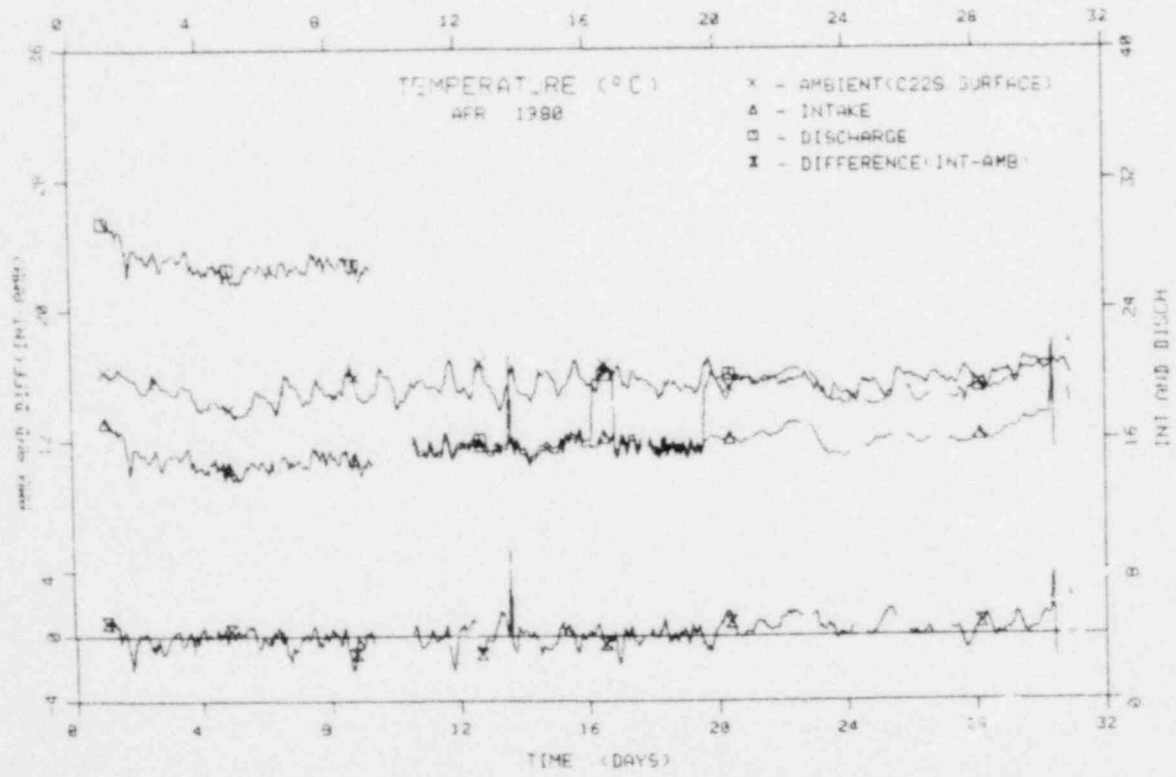
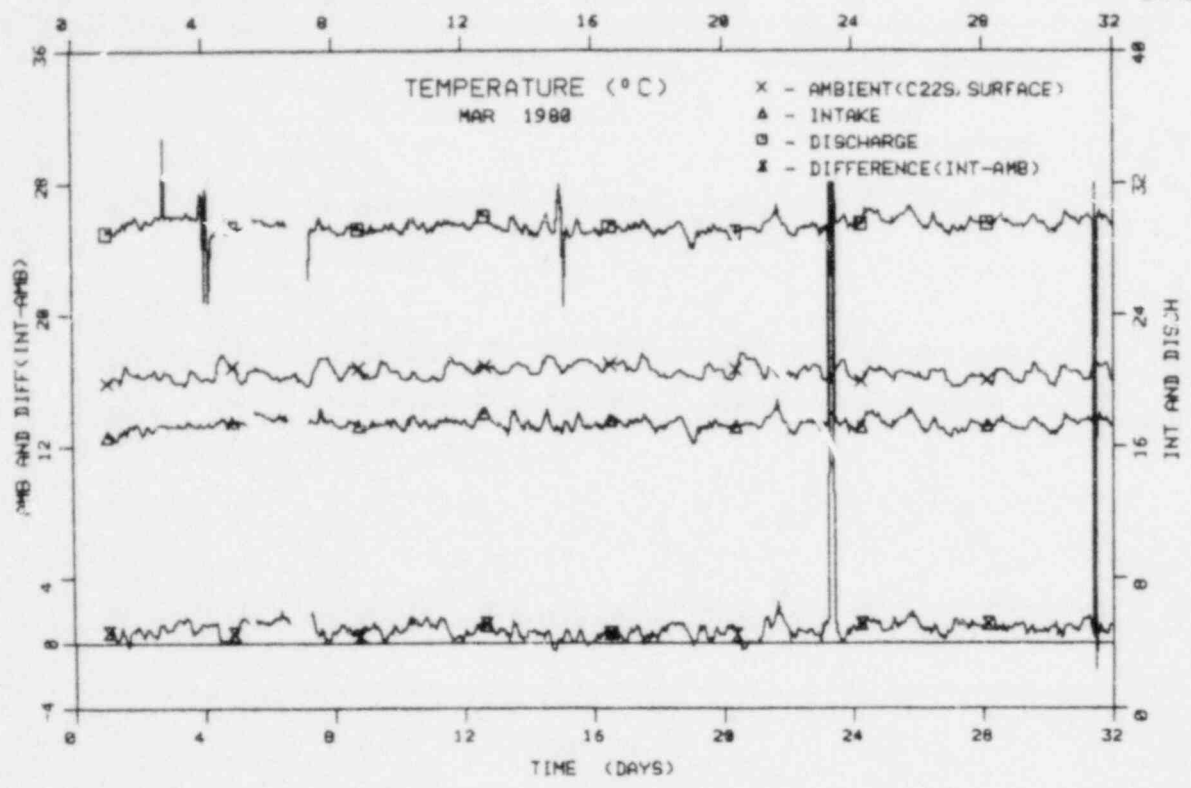


Figure 2A-20. Comparison of intake, discharge, and ocean ambient temperatures, March and April, 1980.

B. TURBIDITY

Turbidity was measured in the San Onofre receiving waters bimonthly during 1980 at 46 Unit 1 operational sampling stations in compliance with Environmental Technical Specification (ETS) Section 3.1.1.a.(4) and NPDES permits and at 28 additional sampling stations in the Units 2 and 3 receiving waters in compliance with Preoperational Monitoring Program (PMP) requirements (Figures 2A-1 and 2A-2). A data collection record for 1980 is presented in Table 1-1. Turbidity study objectives are to monitor suspended solids in terms of turbidity in the receiving waters near Unit 1 in order to determine any effect of the discharge upon water clarity. The objective of preoperational turbidity monitoring is to provide a receiving water baseline for water clarity and turbidity in the vicinity of Units 2 and 3 diffusers. The PMP for oceanographic characteristics was terminated on 5 September 1980.

SAMPLING METHODS

A detailed description of instrumentation and methods used for turbidity measurements are presented in Brown and Caldwell's procedures manual for ETS and PMP (BC 1979). Detailed methods were also reported in Volume I, Oceanographic Data Report (SCE 1980).

The following presents a synopsis of methods. Vertical profiles of percent light transmittance along a 1 m path were measured with a Martek transmissometer and recorded digitally. Observations of the depth of visibility of a 30 cm white Secchi disc were also obtained at each station to document surface water clarity. Aerial photographs of turbidity were taken from an airplane with a 35 mm SLR camera.

RESULTS

Results of turbidity data collected for the San Onofre environmental monitoring program from January through April 1980 when Unit 1 was operational are presented. Unit 1 was non-operational from 9 April 1980 through the end of the year. Data collected from May through December 1980 are presented in the Comprehensive Data Supplement (SCE 1981a).

Results of light transmittance profiles and Secchi disc measurements are presented in Tables 2B-1 and 2B-2. Results of turbidity photographs are on file and are available on request.

An analysis of all turbidity data collected during 1980 will be presented in the Volume III, Annual Operating Report (SCE 1981b).

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- Southern California Edison Company. 1981a. Oceanographic and biological comprehensive data supplement, San Onofre Nuclear Generating Station. Volume II: Environmental technical specifications Unit 1; national pollutant discharge elimination system Units 1, 2, and 3; construction monitoring program Units 2 and 3; preoperational monitoring program Units 2 and 3; interim studies and accessory data. Prepared by Brown and Caldwell Marine Sciences Division; Lockheed Environmental Sciences; and Marine Biological Consultants, Inc.
- Southern California Edison Company. 1981b. Annual operating report, San Onofre Nuclear Generating Station. Volume III: Environmental technical specifications Unit 1; national pollutant discharge elimination system Units 1, 2, and 3; construction monitoring program Units 2 and 3; preoperational monitoring program. Prepared by Brown and Caldwell Marine Sciences Division; Lockheed Environmental Sciences; and Marine Biological Consultants, Inc. (in preparation).

Table 2B-1. Percent light transmittance at the surface, mid-depth (4m), and near bottom, and Secchi disc reading for January 8, 1980.

Station	Time (PST)	Light Transmittance (%)				Secchi depth (m)	Station	Time (PST)	Light Transmittance (%)				Secchi depth (m)
		Surface	Mid-depth	Near bottom	Secchi depth (m)				Surface	Mid-depth	Near bottom	Secchi depth (m)	
A2N	1059	18	0	- ^A	3.5	D8N	1212	24	35	3	5.0		
A1N	1055	14	-	- ^B	3.0	D2N	1122	26	24	3	5.0		
A0	1051	10	0	- ^A	3.0	D0	1019	23	33	11	5.0		
A2S	0948	15	14	3	1.7	D2S	0930	25	33	12	6.0		
A4S	0954	0	1	0	2.5	D4S	1022	29	61	15	7.5		
M6S	1049	15	17	0	2.8	E4S	1159	35	41	4	7.3		
M8S	1311	6	-	- ^B	1.7	E2N	1127	32	27	1	5.0		
14N	1229	8	4	1	3.0	H0	1015	23	23	6	5.5		
32N	1103	19	0	0	4.0	E2S	0933	40	32	9	7.5		
W1N	1108	19	10	0	3.5	F08N	1320	46	53	47	6.0		
B. 5N	1122	15	12	0	3.0	F14N	1430	73	72	24	11.0		
H0	1047	13	2	0	3.0	Y6N	1216	61	69	5	12.0		
B. 5S	1038	10	17	5	3.0	K2N	1133	31	69	17	12.0		
M1S	1042	13	14	12	3.0	FC	1009	27	27	10	5.0		
M2S	0942	22	17	5	3.5	F2S	0918	47	60	6	9.0		
M4S	1034	13	27	6	4.0	M6S	1031	53	59	16	11.0		
M6S	1044	35	22	7	4.5	F14S	1342	65	64	15	11.0		
C0N	1129	39	24	6	6.5	F22S	1438	73	72	25	12.0		
C14N	1304	39	51	32	6.5	F24S	1429	73	71	47	14.0		
C10N	1256	42	25	2	5.0	F26S	1424	72	70	48	12.0		
C8N	1250	71	55	14	13.0	H2N	0949	61	75	11	11.5		
C6N	1227	17	49	7	3.5	H0	0955	45	75	11	11.0		
C4N	1216	15	14	0	3.5	H2S	1001	57	66	20	11.5		
C2N	1118	19	16	1	4.5	J8N	0938	73	58	45	9.5		
40	1034	4	23	4	2.5	J4N	0931	73	53	0	10.0		
42	1025	17	7	0	3.5	J2N	0926	75	58	37	9.5		
C2S	0937	29	24	3	4.0	J0	0920	76	63	25	11.0		
C4S	1015	22	54	17	5.5	J2S	0913	75	63	38	9.4		
C6S	1019	44	27	3	6.0	J4S	0903	73	64	37	9.3		
C8S	1316	22	27	4	4.5	J6S	0853	71	71	21	11.0		
C10S	1322	22	22	5	3.7	M8N	0732	71	70	0	14.0		
C14S	1331	38	23	5	4.3	M6N	0751	72	72	12	10.0		
C22S	1356	71	68	8	10.0	K6N	0803	74	72	0	9.0		
C24S	1400	69	44	12	9.0	M0	0812	27	54	0	9.0		
C26S	1405	70	56	18	10.0	M2S	0828	38	65	0	9.5		
M0.P	1414	19	71	17	13.5	M4S	0835	75	70	27	12.0		
M6N	1231	36	41	2	9.0	M6S	0845	73	73	51	11.0		

^ABottom depth equals 4 meters.

^BBottom depth less than 4 meters.

Table 2B-2. Percent light transmittance at the surface, mid-depth (4m), and near bottom, and Secchi disc reading for March 13, 1980.

Station	Time (PST)	Light Transmittance (%)				Secchi Depth (m)	Station	Time (PST)	Light Transmittance (%)				Secchi Depth (m)
		Surface	Mid-depth	Near Bottom	Secchi Depth (m)				Surface	Mid-depth	Near Bottom	Secchi Depth (m)	
A2N	1418	0	-	- ^b	1.2	D4N	1516	11	13	0	3.5		
A1N	1414	2	-	- ^b	1.6	D2N	1439	1	39	0	2.3		
A0	1410	3	-	- ^b	2.0	D0	1339	4	27	0	4.5		
A2S	1156	19	12	6	2.5	D2S	1143	19	23	0	4.5		
A40	1201	16	5	0	3.0	D40	1301	20	17	0	4.5		
A60	1322	15	1	- ^b	2.6	E4N	1511	12	9	0	3.0		
A80	1328	1	-	- ^a	1.4	E2N	1451	4	23	0	3.0		
D4N	1530	3	6	4	2.6	CD	1334	29	12	0	5.8		
B2N	1423	3	3	0	1.6	S2S	1134	21	32	1	5.3		
B1N	1427	1	2	0	2.0	F20N	1637	42	49	9	8.7		
R. 5N	1429	2	0	0	1.7	F72N	1626	46	44	19	7.2		
B0	1404	0	0	0	1.7	F6N	1553	27	18	0	5.0		
R. 5S	1358	3	1	- ^a	2.2	F2N	1503	19	21	0	3.5		
B1S	1402	4	0	0	2.3	F0	1329	17	38	0	5.5		
B2S	1151	19	6	0	3.1	F2S	1121	23	26	0	5.0		
B40	1247	18	6	0	4.0	F60	1305	20	7	0	4.0		
B60	1316	16	19	0	3.9	F140	1402	21	18	0	4.5		
C20N	1646	27	27	1	5.0	F220	1413	12	27	0	6.0		
C14N	1619	35	46	25	6.5	F240	1421	29	29	0	6.0		
C10N	1611	42	31	1	6.8	F260	1428	32	25	0	5.5		
C8N	1602	37	15	0	5.8	I2N	1249	17	23	0	4.7		
C5N	1537	18	12	1	3.8	H0	1257	28	33	0	5.3		
C4N	1523	9	16	0	2.4	I2S	1305	30	36	1	5.7		
C2N	1433	5	11	1	1.9	J6N	1237	15	15	7	4.0		
X0	1350	1	0	0	1.9	J4N	1225	15	38	2	5.0		
C0	1345	1	5	6	2.2	J2N	1212	27	36	1	6.0		
C2S	1147	11	13	0	3.7	J0	1201	32	55	0	7.1		
C4S	1254	20	3	0	3.3	J2S	1151	29	59	5	6.5		
C6S	1312	19	2	0	3.3	J4S	1141	33	48	2	8.0		
C8S	1313	18	4	0	3.1	J6S	1126	26	41	0	5.2		
C10S	1339	18	10	0	3.6	M6N	0917	20	35	0	4.5		
C14S	1353	16	10	0	4.0	M4N	0927	30	40	1	10.8		
C220	1525	22	23	0	4.8	M2N	0935	32	60	0	10.8		
C240	1520	23	20	1	4.2	M0	0942	14	57	0	10.0		
C260	1515	20	21	0	4.2	M2S	0951	33	67	0	10.9		
WLP	1500	31	29	1	6.0	M4S	0959	32	51	0	9.8		
D0N	1544	26	17	2	5.8	M6S	1036	27	54	0	5.7		

^aBottom depth equals 4 meters.

^bBottom depth less than 4 meters.

C. WATER QUALITY

Measurements of surface DO and pH at San Onofre Unit 1 monitoring Stations CO, XO, and C22S (Figure 2A-2) were required bimonthly during 1980 by Environmental Technical Specifications (ETS) Sections 3.1.1.a.(3) and 3.1.1.a.(7), respectively, and NPDES permits. Surface water samples for DO and pH taken bimonthly during 1980 at Units 2 and 3 monitoring Stations J2S, J2N, J4S, and F22S (Figure 2A-2) fulfilled Preoperational Monitoring Program (PMP) requirements. A data collection record for 1980 is presented in Table 1-1. PMP monitoring for Units 2 and 3 was terminated on 5 September 1980.

The objectives of the dissolved oxygen and pH studies were to: 1) assure that natural dissolved oxygen and pH levels are maintained, 2) continue to increase the data base that has been established, 3) indicate the extent to which the operation of Unit 1 affects dissolved oxygen and pH concentrations in the receiving waters, and 4) provide a preoperational receiving water data base prior to operation of Units 2 and 3, which will subsequently be compared to operational conditions to determine the effects of Units 2 and 3 on the receiving waters. The reporting level for dissolved oxygen is a depression of dissolved oxygen concentration of more than 10% from that which occurs naturally, as measured at the control station. The reporting level for pH is values measured outside the range of 7.1 to 8.7.

Monitoring of heavy metal concentrations in the Unit 1 receiving waters and ocean bottom sediments was conducted quarterly during 1980 in compliance with ETS Section 3.1.1.a.(2) and NPDES permits. Unit 1 operational monitoring stations included Station XO, C22S, D4N, and D4S (Figure 2A-2). Units 2 and 3 quarterly heavy metals monitoring was conducted at Stations J0, J2S, J4S, J4N, and J22S (Figure 2A-2) in compliance with the PMP until September 1980 when the program was terminated.

The objectives of heavy metals studies were to: 1) detect any measureable increase in heavy metals concentrations in receiving waters or ocean bottom sediments in the vicinity of the Unit 1 discharge, and 2) provide a receiving water and ocean bottom sediment predischarge data base for Units 2 and 3 to be used as a reference to aid in subsequent determination of operational effects of Units 2 and 3 on the concentration of heavy metals in the environment.

SAMPLING METHODS

Methods for measurement of dissolved oxygen, pH, and heavy metals are presented in detail in Brown and Caldwell's procedures manual for ETS and PMP (BC 1979). Detailed methods were also reported in Volume I, Oceanographic Data Report (SCE 1980).

Surface concentrations of dissolved oxygen were measured electronically at Stations CO, XO, and C22S using a Martek dissolved oxygen probe. A modified Winkler titration method was used to calibrate the electronic sensors. Surface hydrogen ion concentrations were measured at Stations CO, XO, and C22S using a Martek pH probe. Mid-depth water and ocean bottom sediment samples for determination of heavy metals were collected by divers and analyzed by atomic absorption to determine the concentrations of chromium, copper, nickel, iron, and titanium. Sample analyses were conducted in compliance with guidelines established by the U.S. Environmental Protection Agency (USEPA 1969).

RESULTS

Results of surface dissolved oxygen, pH, and heavy metals measurements from bimonthly surveys during 1980 required by ETS and PMP are presented. Additional measurements including dissolved oxygen, pH, salinity, and density profile data, currents, and ocean bottom sediment grain size distributions, from bimonthly surveys are presented in the Comprehensive Data Supplement (SCE 1981a).

Results of surface dissolved oxygen measurements are presented in Table 2C-1. Results of surface hydrogen ion concentration (pH) measurements are presented in Table 2C-2. Results of receiving waters and ocean bottom sediments heavy metals concentration determinations are presented in Table 2C-3.

An analysis of all dissolved oxygen, hydrogen ion concentration, and heavy metals data will be included in the Volume III, Annual Operating Report (SCE 1981b).

Dissolved oxygen concentrations and hydrogen ion concentrations did not exceed specified limits during 1980.

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Table 2C-1 Surface dissolved oxygen concentrations (mg/liter) from required SONGS Unit 1 operation and Units 2 and 3 preoperational monitoring stations during 1980.

Survey Date	Unit 1 - Operational			Units 2 and 3 - Preoperational					
	CO (Intake)	XO (Discharge)	C228 (Control)	Unit 1 Mean	J2N	J2S	J4S	F22S	Units 2 & 3 Mean
Jan 8	7.9	7.8	9.3	8.3	8.0	7.9	8.0	9.4	8.3
Mar 13	8.9	9.1	1.7	8.9	9.5	9.0	9.2	8.4	9.0
May 14	8.8	8.0	8.0	8.3	9.1	8.8	8.8	9.0	9.0
Jul 9	8.4	8.3	8.1	8.5	8.7	8.8	8.8	9.1	8.8
Sep 10	7.4	7.1	7.6	7.4	-	-	-	-	-
Nov 5	8.5	8.4	8.4	8.4	-	-	-	-	-

Table 2C-2. Surface hydrogen ion concentrations (pH) from required SONGS Unit 1 operational and Units 2 and 3 preoperational monitoring stations during 1980.

Survey Date	Unit 1 - Operational				Units 2 and 3 - Preoperational				
	CO (Intake)	XO (Discharge)	C228 (Control)	Unit 1 Mean	Low	J2S	J4S	F22S	Units 2 & 3 Mean
Jan 8	8.26	8.25	8.21	8.24	8.24	8.22	8.22	8.22	8.23
Mar 13	8.25	8.24	8.12	8.27	8.32	8.33	8.31	7.33	8.32
May 14	8.30	8.24	8.31	8.28	8.31	8.29	8.30	8.31	8.30
Jul 9	8.06	8.07	8.16	8.10	8.15	8.16	8.16	8.21	8.17
Sep 10	8.20	8.16	8.23	8.20	-	-	-	-	-
Nov 5	8.24	8.22	8.26	8.24	-	-	-	-	-

Table 2C-3 Receiving water and ocean bottom sediment heavy metal concentrations during 1980.

Station	Receiving Water						Ocean Bottom Sediment					
	Survey Date						Survey Date					
	Jan 10	Mar 10	May 13	Jul 8	Nov 1	Mean	Jan 10	Mar 10	May 13	Jul 8	Nov 3	Mean
	Copper, mg/l						Copper, mg/kg					
X0	0.006	0.005	0.004	0.003	0.021	.008	4.2	4.4	5.7	7.3	5.0	4.5
C22S	0.004	0.004	0.002	0.005	0.002	.003	4.2	3.7	3.0	4.4	4.0	4.1
D4N	0.003	0.018	0.004	0.004	0.003	.006	3.2	8.9	8.0	7.1	8.5	7.2
D4S	0.003	0.006	0.003	0.004	0.001	.003	4.2	24	4.6	3.2	1.2	7.4
J0	0.004	0.005	0.002	0.004	-	.004	6.0	3.6	4.0	5.4	-	4.8
J2S	0.004	0.004	0.005	0.004	-	.005	4.6	1.2	2.3	6.1	-	3.5
J4N	0.002	0.003	0.002	0.003	-	.002	5.9	2.9	3.0	4.0	-	4.0
J4S	0.003	0.002	0.002	0.003	-	.002	4.3	2.6	0.7	4.2	-	3.0
J22S	0.004	0.002	0.004	0.001	-	.003	3.9	4.2	1.7	3.2	-	3.2
	Chromium, mg/l						Chromium, mg/kg					
X0	<0.001	<0.001	<0.001	<0.001	0.002	.001	12	14	17	15	-	14
C22S	<0.001	<0.001	<0.001	<0.001	0.002	.001	15	15	23	19	13	17
D4N	<0.001	<0.001	<0.001	<0.001	0.002	.001	12	20	25	18	21	19
D4S	<0.001	<0.001	<0.001	<0.001	0.002	.002	19	44	26	18	6.0	23
J0	0.005	0.001	0.001	0.001	-	.002	19	15	20	20	-	18
J2S	<0.001	<0.001	<0.001	<0.001	-	.001	19	17	18	19	-	18
J4N	<0.001	0.003	<0.001	<0.001	-	.002	18	13	20	15	-	16
J4S	<0.001	<0.001	<0.001	<0.001	-	.001	21	7.9	13	19	-	15
J22S	<0.001	<0.001	<0.001	<0.001	-	.001	16	15	24	17	-	18
	Iron, mg/l						Iron, mg/kg					
X0	0.43	0.71	0.41	0.25	0.24	0.43	7550	9850	9190	7220	8300	84.0
C22S	0.23	0.09	0.30	0.27	0.14	0.21	7360	7290	8890	8310	6100	75.0
D4N	0.18	0.12	0.36	0.20	0.28	0.23	5190	14400	17000	11900	13600	1241.0
D4S	0.23	0.09	0.34	0.27	0.15	0.22	8400	28800	10300	6070	2000	1111.0
J0	0.20	0.09	0.16	0.22	-	0.17	9770	7350	9650	8830	-	8900
J2S	0.18	0.09	0.18	0.16	-	0.15	8240	1240	7690	9490	-	6660
J4N	0.23	0.06	0.18	0.18	-	0.16	9430	6770	10000	6820	-	8260
J4S	0.20	0.09	0.20	0.14	-	0.16	8180	2270	5860	7170	-	5870
J22S	0.20	0.09	0.16	0.14	-	0.15	6540	7430	7260	6070	-	6820
	Nickel, mg/l						Nickel, mg/kg					
X0	0.010	0.001	0.001	0.006	0.007	.005	7.2	5.7	7.0	4.0	9.3	6.6
C22S	0.006	0.003	0.001	0.012	0.006	.006	7.4	5.7	9.0	6.8	7.7	7.3
D4N	0.002	0.005	0.001	0.007	0.009	.005	5.8	12	13	7.8	13	10
D4S	0.008	0.007	0.001	0.015	0.009	.008	10	28	11	6.5	4.5	12
J0	0.006	0.001	0.001	0.006	-	.004	9.6	5.6	8.0	7.8	-	7.8
J2S	0.003	0.001	0.001	0.006	-	.003	8.8	1.3	6.5	8.8	-	6.4
J4N	0.002	0.001	0.004	0.004	-	.020	9.9	3.2	7.0	5.6	-	6.4
J4S	0.001	0.001	0.001	0.006	-	.003	8.6	4.8	4.4	6.5	-	6.1
J22S	0.005	0.001	0.001	0.006	-	.003	7.2	5.5	7.0	5.5	-	6.3
	Titanium, mg/l						Titanium, mg/kg					
X0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	458	570	699	795	529	610
C22S	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	514	535	969	912	526	691
D4N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	352	770	1240	1010	850	844
D4S	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	581	990	1190	1160	389	862
J0	<0.1	<0.1	<0.1	<0.1	-	<0.1	828	459	1130	1040	-	864
J2S	<0.1	<0.1	<0.1	<0.1	-	<0.1	948	124	850	845	-	692
J4N	<0.1	<0.1	<0.1	<0.1	-	<0.1	528	351	1130	728	-	684
J4S	<0.1	<0.1	<0.1	<0.1	-	<0.1	989	201	503	1060	-	688
J22S	<0.1	<0.1	<0.1	<0.1	-	<0.1	686	456	1140	1015	-	824
	Total Solids, percent						Total Solids, percent					
X0							76.5	70.8	75.1	75.5	75.4	74.7
C22S							77.8	74.8	74.8	74.0	80.8	76.4
D4N							78.1	72.7	71.1	73.9	73.5	73.9
D4S							77.4	60.6	75.6	77.4	83.8	75.0
J0							75.5	76.2	75.1	74.2	-	75.2
J2S							76.5	80.6	73.5	74.0	-	76.7
J4N							75.8	78.3	75.4	75.5	-	76.2
J4S							75.8	88.2	74.6	77.5	-	79.0
J22S							76.5	76.7	74.7	77.6	-	76.4

Chapter 3

INTERTIDAL

The infaunal intertidal investigation was conducted in compliance with the California Regional Water Quality Control Board - San Diego Region (CRWQCB-SDR) Monitoring and Reporting Program No. 71-6 for construction of the San Onofre Nuclear Generating Station Units 2 and 3, including Technical Change Orders 1, 2, and 3. The purpose of the investigation was to determine if construction related changes in the sandy intertidal habitat would have a detrimental effect on the sandy intertidal community. In 1980, the program was conducted in February only, as construction activities terminated 6 February 1980. Five permanent intertidal transects, used since December 1976 (MBC 1978) were reoccupied during February 1980 (Figure 3-1). Sampling was conducted on three consecutive days during the lower tidal series of the month. Beach profiling was conducted on the first day. Biological and sedimentological core sampling was performed on the two days following the surveying.

SAMPLING METHODS

Biological Sampling

Along each transect, seven biological sampling stations were established at one foot vertical increments between mean lower low water (0 ft) and the +6 ft elevation using a modified surveyor's transect. Five replicate 5 liter cores (15.24 cm in diameter and 30 cm long) were collected at each station as it was exposed on a receding tide; one core from the transect centerline, and one at 3 and 6 m to either side. Cores were field screened through a 1.0 mm mesh. Retained organisms were preserved in 10% buffered Formalin-seawater. All specimens were returned to the laboratory, identified to the lowest possible taxon, and enumerated.

Physical Measurements and Grain Size Determination

At each transect a beach profile was constructed from the 0 ft tidal elevation to the maximum tidal excursion of the survey day, using a self-leveling surveyor's transit. Surf temperatures were recorded at each transect.

A core sample for grain size analysis was collected adjacent to each biological sample. Grain size distribution of the sediment was determined by standard automatic settling tube analyses (combined with sieving for gravel when necessary).

RESULTS

Tables 3-1 and 3-2 present a summary of the pertinent biological and physical data collected. For a complete presentation of the biological and physical data collected (SCE 1981a). Analysis of these data will be presented in the Volume III, Annual Operating Report (SCE 1981b).

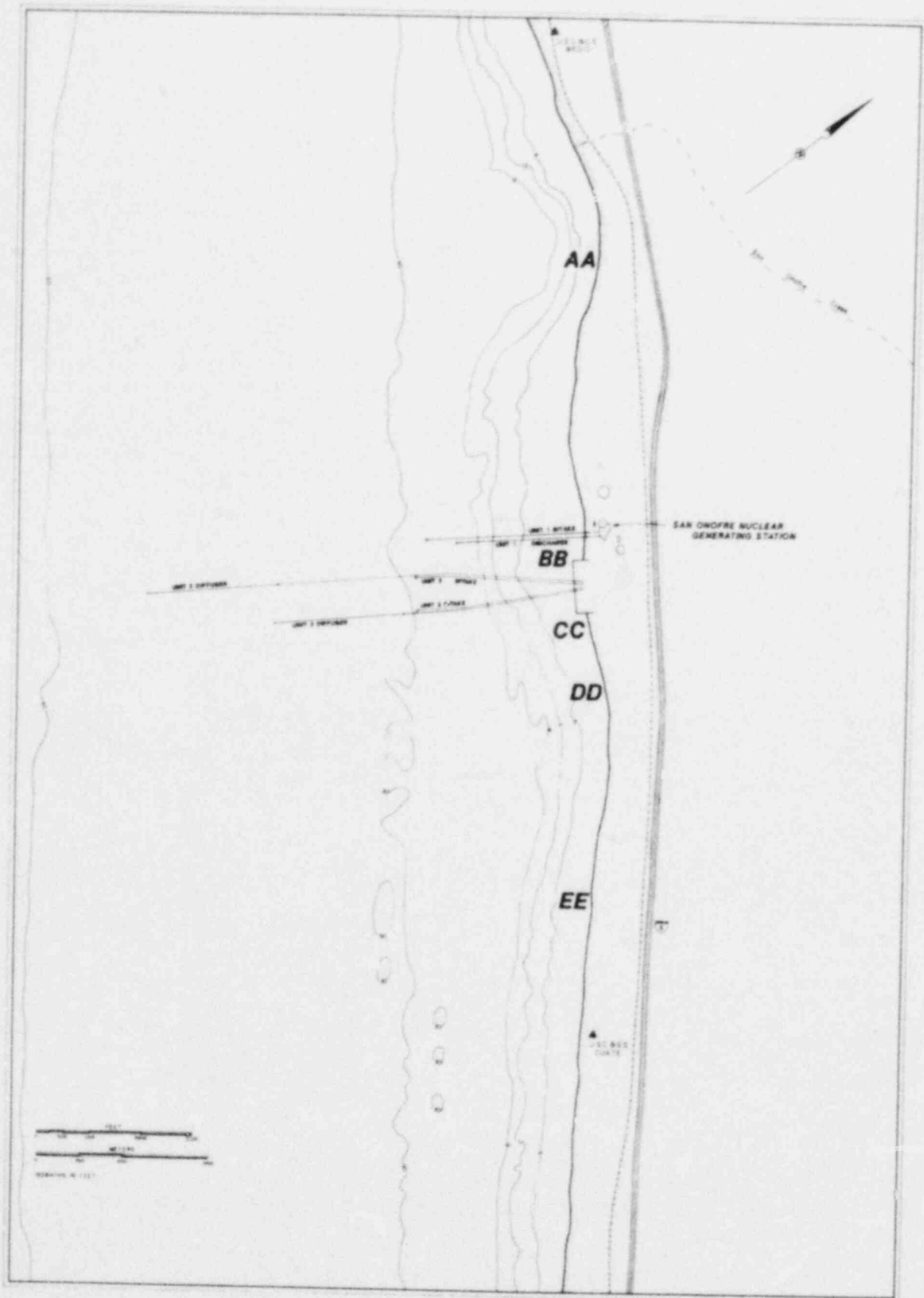


Figure 3-1. Intertidal infaunal transect locations.

Table 3-1. Mean density of intertidal organisms (number/5 liter core) by transect, February 1980.

SPECIES	MEAN	SPECIES	MEAN
	TRANSECT AA		TRANSECT DD
HEMIPODUS BOREALIS	0.03	HEMIPODUS BOREALIS	0.06
EMERITA ANALOGA	0.17	EXCIROLANA KINCAIDI	0.03
		EMERITA ANALOGA	0.54
	TRANSECT BB		TRANSECT EE
HEMIPODUS BOREALIS	0.06	HEMIPODUS BOREALIS	0.14
EXCIROLANA LINGUIFRON	0.03	LUMBRINERIS ZONATA	0.03
EMERITA ANALOGA	0.06	EMERITA ANALOGA	0.57
	TRANSECT CC		
HEMIPODUS BOREALIS	0.03		
MICROSPIO ACUTA	0.03		
EXCIROLANA LINGUIFRON	0.03		
EMERITA ANALOGA	0.31		

Table 3-2. Mean grain size analysis by station and tidal elevation, February 1980.

PARAMETER	TIDAL ELEVATION (MLLW)						
	0	1	2	3	4	5	6
<u>TRANSECT AA</u>							
% GRAVEL	27.60	15.60	16.16	15.46	10.18	5.44	4.58
% SAND	72.40	84.40	83.78	84.54	89.82	94.56	95.42
% SILT/CLAY	0.00	0.00	0.06	0.00	0.00	0.00	0.00
MEAN PHI	-0.25	0.33	0.57	0.32	0.52	0.75	0.85
SKEWNESS	-0.46	-0.66	-0.59	-0.58	-0.57	-0.43	-0.78
KURTOSIS	-0.06	1.62	0.85	1.43	2.27	1.71	4.41
SORTING	45.93	53.33	51.59	53.81	56.68	61.05	64.01
<u>TRANSECT BB</u>							
% GRAVEL	3.36	1.00	0.14	0.00	1.08	0.54	0.16
% SAND	96.64	99.00	99.86	100.00	98.92	99.46	99.84
% SILT/CLAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEAN PHI	1.20	1.18	1.16	1.07	0.89	0.99	1.05
SKEWNESS	-0.48	-0.29	-0.09	0.14	-0.02	-0.00	0.06
KURTOSIS	1.07	0.43	0.11	0.11	0.71	2.05	1.01
SORTING	58.60	63.18	66.55	68.15	65.06	70.30	70.68
<u>TRANSECT CC</u>							
% GRAVEL	1.16	2.16	0.24	0.44	0.60	0.24	0.04
% SAND	98.84	97.86	99.76	99.56	99.40	99.76	99.96
% SILT/CLAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEAN PHI	1.18	0.51	0.98	0.79	0.73	0.77	0.88
SKEWNESS	-0.32	-0.00	-0.00	0.9	0.07	0.12	0.25
KURTOSIS	1.43	0.98	0.80	0.67	2.25	1.54	1.22
SORTING	63.87	65.22	69.18	68.30	70.92	74.16	74.91
<u>TRANSECT DD</u>							
% GRAVEL	6.72	1.52	1.94	2.12	1.52	1.18	0.82
% SAND	93.28	98.48	98.06	97.88	98.48	93.82	99.18
% SILT/CLAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEAN PHI	0.52	0.85	0.63	0.65	0.69	0.69	0.75
SKEWNESS	-0.59	-0.34	-0.37	-0.33	-0.48	-0.49	-0.44
KURTOSIS	2.04	1.93	3.32	3.52	2.94	2.97	2.17
SORTING	61.14	67.34	66.92	67.34	72.07	72.55	72.46
<u>TRANSECT EE</u>							
% GRAVEL	4.08	2.72	6.32	4.44	2.00	0.90	0.70
% SAND	95.92	97.28	93.68	95.56	98.00	99.10	99.30
% SILT/CLAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MEAN PHI	0.88	0.98	0.59	0.63	0.76	0.83	0.85
SKEWNESS	-0.36	-0.49	-0.19	-0.31	-0.40	-0.28	-0.46
KURTOSIS	2.26	3.26	0.71	1.17	2.45	1.34	3.66
SORTING	63.30	65.96	59.69	63.20	66.07	69.87	71.35

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CHAPTER 4

BENTHOS

A. ROCK/COBBLE SUBSTRATA, KELP BEDS

ENVIRONMENTAL TECHNICAL SPECIFICATIONS (ETS) - UNIT 1

This program was established to assess whether the operation of San Onofre Nuclear Generating Station Unit 1 has any significant environmental effect on the dominant, field identifiable members of the epibenthic communities of subtidal cobble habitats and the kelp beds in the vicinity of San Onofre Unit 1. Benthic diving and infrared kelp surveys are conducted in compliance with ETS Section 3.1.2.a(1)C.1, the Construction Monitoring Program (CMP) requirements, and the National Pollutant Discharge Elimination System (NPDES) Permit requirements.

Methods

A detailed description of station locations and field methodology is given in ETS Benthic Survey Procedures (LES Procedures EMP 25-5-35). A general review is presented below.

Eleven permanent benthic stations were established in areas of comparable substrata in February 1975, eight (Stations 1-8) along the 10-m depth contour and three (Stations 9-11) in kelp beds (Figure 4A-1). Stations were marked with permanent surface buoys. Four stations (Stations 1-4) were established near the discharge; five stations (Stations 5, 6, 7, 8, 11) were established downcoast, including one in Barn Kelp; one station in San Onofre Kelp (Station 10); and one station in San Mateo Kelp (Station 9). Two additional stations (Stations 22 and 23) were located in San Onofre Kelp as part of the Construction Monitoring Program (CMP). A permanent band transect 10 m in length and 1 m wide was established at each benthic station.

Field identifiable epibenthic macrobiota were surveyed quarterly at each of the permanently marked benthic stations using nondestructive sampling techniques. Conditions permitting, marine biologists identified and enumerated epibenthic macrobiota, made estimates of percent areal coverage of colonial and encrusting taxa in each of 10 1-m² quadrats at each station, and recorded data on preprinted data sheets. In order to maintain consistency in data recording among biologists, the type of data to be reported for each organism was standardized and indicated on the data sheets.

Additionally, the following information was collected within the band transects at Barn Kelp, San Onofre Kelp, and San Mateo Kelp stations: (1) number of stipes on each individual kelp plant counted 2-m above the bottom, (2) general conditions of the kelp plants (e.g., frayed fronds), and (3) kelp growth (e.g., new fronds). Ancillary data on the configuration and areal extents of the kelp canopies were determined by aerial infrared and electronic procedures, respectively.

Epibenthic macrobiota were surveyed quarterly from 24 January - 10 February, 28 April - 2 June, 24 July - 17 August, and 23 October - 3 November. Nearshore winter storms during January, February, and March resulted in unacceptable diving

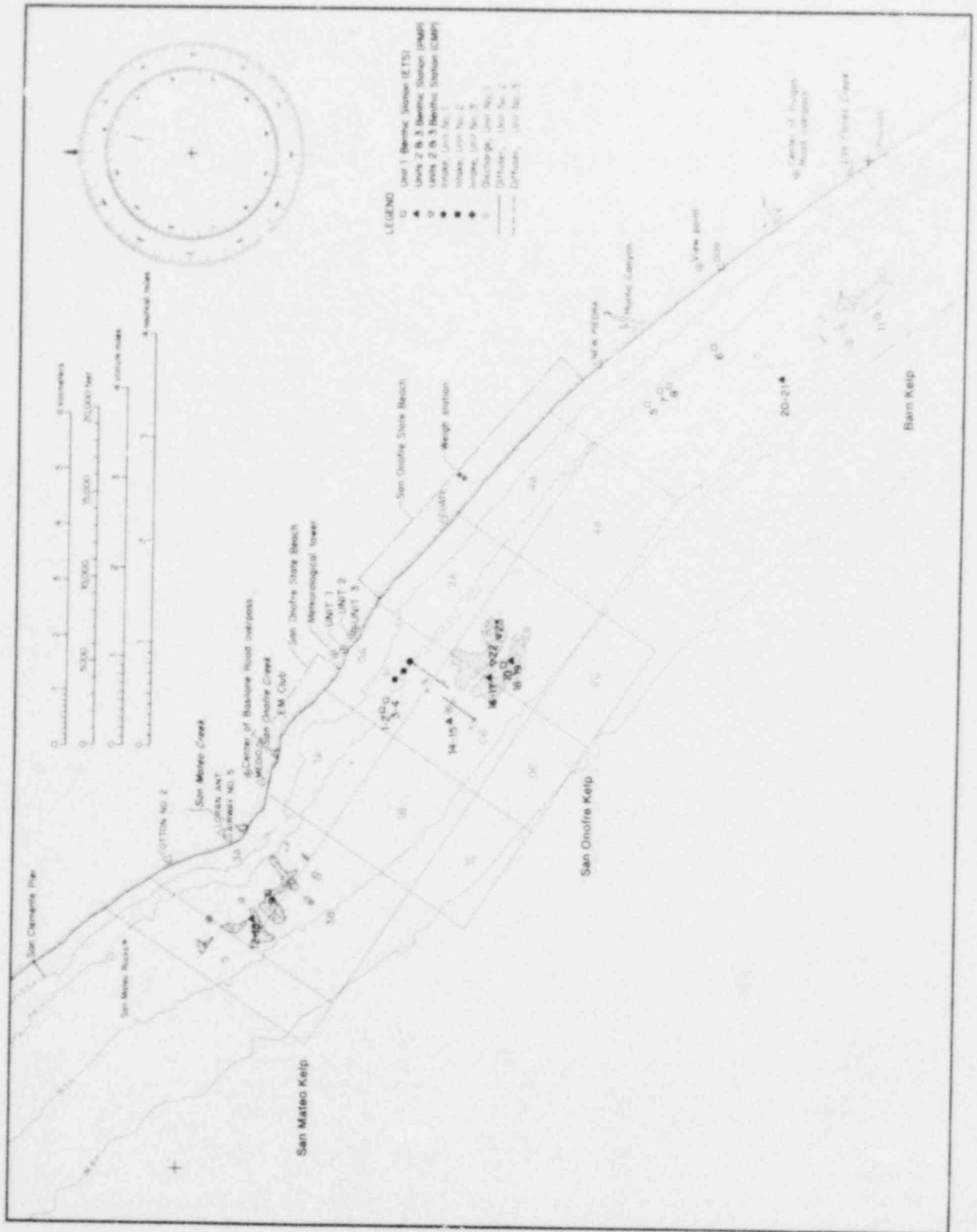


Figure 4A-1. ETS, CMP, and PMP benthic station locations at San Onofre Nuclear Generating Station. Shaded areas represent the areal extent of the kelp canopies sampled in December 1978.

conditions; consequently only six ETS benthic stations were sampled during the first quarterly sampling period of 1980. This data loss was reported to the Nuclear Regulatory Commission (NRC) by means of a 30-day non-routine report submitted in March 1980 in accordance with Administrative Control Section 5 of the ETS. Adverse weather conditions prevented Construction Monitoring Stations 22 and 23 from being effectively sampled during the first quarterly survey period. Sampling at these stations was conducted during the April-June survey.

The configurations of the kelp canopies of the San Mateo, San Onofre, and Barn Kelp Beds were monitored quarterly by aerial infrared photography. The areal extents of the kelp canopies were mapped twice a year by electronic procedures (SCE 1980e).

Results

A summary of data collected during 1980 ETS and CMP benthic surveys is presented in the following tables. Rank, mean abundance, and frequency of occurrence of percent cover and enumerated taxa sampled at all stations during each survey are presented in tabular form. The detailed distribution and abundance of organisms sampled at each station are contained in Volume II: Comprehensive Annual Data Report (SCE 1981a) and will be analyzed in Volume III: Data Analysis for the 1980 Annual Operating Report (SCE 1981b).

Results of the quarterly monitoring of the San Mateo, San Onofre, and Barn Kelp canopies by aerial infrared photography, and the semiannual kelp mapping surveys are on file.

PREOPERATIONAL MONITORING PROGRAM (PMP) - UNITS 2 AND 3

Preoperational benthic surveys were conducted quarterly in compliance with specifications set forth by the Nuclear Regulatory Commission on 6 July 1978, for San Onofre Units 2 and 3.

The objective of this study was to provide baseline data for use in determining the nature, extent, and significance of the effects of Units 2 and 3 on the species composition, distribution, and abundance of the epibenthic biota associated with the cobble/sand habitat.

Methods

A detailed description of station locations and field methodology is given in PMP Benthic Survey Procedures (LES Procedures B-1-1/79). A general review is presented below.

Ten permanent benthic stations were established along the 15-m isobath in areas of comparable substrata in June and July of 1978 (Figure 4A-1). Stations were established in pairs and marked with permanent surface buoys. Two stations are located in Zone 3A (Stations 12, 13), OB (Stations 14, 15), and 6 (Stations 20, 21), and four stations (Stations 16-19) are located in Zone 2B. Each permanent benthic station consists of a rectangular 6.0-m² area (2 m x 3 m).

Diving marine biologists utilized two reference (stationary) lines and one movable sampling line to sample each 6.0-m² station area with 300 evenly distributed points. Data collected at each point included the identification of substratum and biological taxa. Up to three taxa levels, indicating layering in the community, were recorded. Additionally, four 0.125-m² square quadrats were randomly located within the 6.0-m² station area and were sampled with 60 evenly distributed points to identify small cryptic, clumped, or patchily distributed

taxa. Data for both sampling elements (6.0-m² and 0.125-m² quadrats) were recorded by individual biologists on task-specific, waterproof data sheets.

The PMP benthic study was completed in June 1980, in compliance with the objectives of the PMP as approved by the NRC. Although the PMP benthic sampling periods were scheduled quarterly, only the second quarterly survey was completed during 1980. Only two PMP benthic stations were sampled during the first 1980 sampling effort before it was terminated due to unacceptable diving conditions resulting from nearshore storms. This data loss was reported to the Nuclear Regulatory Commission (NRC) by means of a 30-day non-routine report submitted in March 1980 in accordance with Administrative Control Section 5 of the ETS. The second quarterly sampling was completed during the period from 7 May - 2 June 1980.

Results

A summary of data collected during the 1980 PMP benthic surveys is presented in the following tables. Rank, mean abundance, and frequency of occurrence of taxa sampled by the 6.0-m² and 0.125-m² techniques at all stations during each survey are presented in tabular form. The detailed distribution and abundance of organisms sampled at each station are contained in Volume II: Comprehensive Annual Data Report (SCE 1981a) and will be analyzed in Volume III: Data Analysis for the Annual Operating Report (SCE 1981b).

LITERATURE CITED

- Southern California Edison Company (SCE). 1981a. Oceanographic and Biological Comprehensive Data Supplement, San Onofre Nuclear Generating Station. Volume II: Environmental Technical Specifications Unit 1, National Pollutant Discharge Elimination System Units 1, 2, and 3, Construction Monitoring Program Units 2 and 3, Preoperational Monitoring Program Units 2 and 3, Interim Studies, and Ancillary Data. Prepared by Brown and Caldwell, Lockheed Environmental Sciences, and Marine Biological Consultants, Inc.
- Southern California Edison Company (SCE). 1981b. Oceanographic and Biological Annual Operating Report, San Onofre Nuclear Generating Station. Volume III: Environmental Technical Specifications Unit 1, National Pollutant Discharge Elimination System Units 1, 2, and 3, Construction Monitoring Program Units 2 and 3, and Preoperational Monitoring Program Units 2 and 3. Prepared by Brown and Caldwell, Lockheed Environmental Sciences, and Marine Biological Consultants, Inc., (in press).

Table 4A-1. Rank, mean abundance (percent or number/m²), and frequency of occurrence of benthic organisms sampled at ETS benthic stations during the January 1980 survey period.

PERCENT COVER DATA				ENUMERATION DATA			
RANK	ABUNDANCE	FREQUENCY	NAME	RANK	ABUNDANCE	FREQUENCY	NAME
1.0	4.299998	4	ECTOPROCTS, UNIDENT. (ERECT)	1.0	2.866669	3	CHELOSOMA PRODUCTUM
2.0	4.183334	5	HYDROIDS, UNIDENT.	2.0	2.483334	1	MITRELLA CARINATA
3.0	3.183334	4	RHODYMENIA SPP.	3.0	1.980000	5	MURICIA CALIFORNICA
4.0	2.900002	4	CRUSTOSE CORALS, UNIDENT.	4.0	1.816667	4	DIOPATRA ORNATA
5.0	2.516666	3	CORALLINA / HALIMEDA	5.0	1.550000	2	MOLGULA SPP.
6.0	2.266666	4	PARVOSILVOSA	6.0	1.150001	4	STYELA MONTEREYENSIS
7.0	2.000000	4	PTEROCALDIA / GELIDIUM	7.0	0.950000	1	CYSTOSEIRA / HALIDRYIS
8.0	1.716667	2	ERYOPSIS HYPOIDES	8.0	0.900000	3	DIOPATRA SPLENDIDISSIMA
9.0	1.120000	3	PORIFERANS, UNIDENT.	9.0	0.700000	3	ANEMONE, UNIDENT.
10.0	0.966667	4	LEUCILLA NUTTINGI	10.0	0.666667	1	ONUPHIS, UNIDENT.
11.0	0.933333	3	ECTOPROCTS, UNIDENT. (ENCRUSTING)	11.0	0.466667	2	STRONGYLOCENTROTUS FRANCISCANUS
12.0	0.583333	3	ASTRANGIA SPP.	12.0	0.433333	1	LYTECHINUS SPP.
12.5	0.583333	3	BOSSIELLA SPP.	13.0	0.333333	3	MURICIA FRUTICOSA
14.0	0.583333	3	EUHERDMANIA CLAVIFORMIS	14.0	0.316667	2	CLAVELINA HUNTSMANI
15.0	0.500000	2	PHAEOPHYTE, UNIDENT.	15.0	0.250000	1	PHRAGMATOPOMA CALIFORNICA
16.0	0.483333	2	RHODOPHYTES, UNIDENT.	16.0	0.200000	2	PTEROPUFURA FESTIVA
17.0	0.466667	2	PRIONITIS SPP.	17.0	0.193333	2	KELLETIA KELLETII
18.0	0.433333	3	PYCNOCLAVELLA STANLEYI	19.0	0.166667	2	PHYLLOCHAETOPTERUS PROLIFICA
19.0	0.416667	4	HILDENBRANDIA PROTOTYPUS	19.5	0.166667	2	MACROCYSTIS SPP.
20.0	0.350000	3	ASCIDIAN SPP.	19.5	0.166667	2	SPIROCHAETOPTERUS COSTARUM
21.0	0.333333	2	COLONIAL ASCIDIAN, UNIDENT.	20.0	0.166667	1	LAMINARIA SPP.
22.0	0.300000	4	LEUCAMERA HEATHI	22.0	0.133333	2	SABELLARIID, UNIDENT.
22.5	0.300000	1	BALANUS TINTINABULUM	23.0	0.116667	2	CONUS CALIFORNICUS
24.0	0.233333	1	ASCIDIAN G	25.0	0.100000	1	MAXWELLIA GEMMA
25.0	0.200000	1	SPIROBIDS, UNIDENT.	25.0	0.100000	1	STRONGYLOCENTROTUS PURPURATUS
26.0	0.183333	2	PLOCAMUM SPP.	25.0	0.100000	1	MOLGULA SPP.
27.0	0.166667	1	COELOSEIRA / CHAMPIA	28.0	0.083333	2	PYURA HAUSTOR
28.0	0.150000	3	AMISOCLADELLA PACIFICA	28.0	0.083333	1	PTERYGOPHORA CALIFORNICA
29.0	0.133333	2	CORYNACTIS CALIFORNICA	28.0	0.083333	2	PISTA SPP.
29.5	0.133333	2	TRIDIDEMNUM / DIDEMNUM	31.0	0.066666	1	SOLITARY ASCIDIAN, UNIDENT.
32.0	0.116667	2	CALLOPHYLLIS SPP.	31.0	0.066666	1	TEGULA SPP.
32.0	0.116667	1	DICTYOTA / PACHYDICTYON	31.0	0.066666	1	TEALIA SPP.
32.0	0.116667	1	BALANUS SPP.	31.0	0.066666	1	CHAMA SPP.
34.0	0.083333	2	WHITE CORALLINE CRUST	34.0	0.050000	1	PARASTICHOPUS PARVIMENSIS
34.5	0.083333	1	SALMAGINA TRIBRANCHIATA	35.0	0.033333	2	PHOLAD, UNIDENT.
7.5	0.066666	2	CLADOPHORA SPP.	37.0	0.033333	1	ASTRAEA UNDOSA
1.5	0.066666	1	BOTRYOCLADIA PSEUDODICHOTOMA	37.0	0.033333	1	DODECACERIA FEWKESII
1.5	0.066666	2	CRYPTONEMIA / HALYMENIA / SCHIZYMENIA	37.0	0.033333	1	NASSARIUS PERPINGUIS
1.5	0.066666	1	MURICIA MORIBUND HOLDFASTI	44.0	0.016667	1	SABELLARIA CEMENTARIUM
1.5	0.050000	1	JANIA SPP.	44.0	0.016667	1	PISASTER GIGANTEUS
1.5	0.050000	2	GIGARTINA SPP.	44.0	0.016667	1	CRASSISPIRA SEMIINFATA
42.0	0.050000	1	MACROCYSTIS SPP. (HOLDFAST)	44.0	0.016667	1	NASSARIUS MENDICUS
4.0	0.050000	1	ACROSORIUM UNCINATUM	44.0	0.016667	1	ANTHOPLEURA KANTHOGRAMMICA
50.0	0.050000	2	SERPULIDS, UNIDENT.	44.0	0.016667	1	ROPERIA FOULSONI
45.5	0.016667	1	BALANUS SPP. (DEAD)	44.0	0.016667	1	PAGURIDS, UNIDENT.
45.5	0.016667	1	HALCAMPA DECEMENTACULATA	44.0	0.016667	1	PAGURISTES SPP.
	33.666668	6†	TOTAL AND MAXIMUM FREQUENCY	44.0	0.016667	1	LOXORHYNCHUS SPP.
				44.0	0.016667	1	RUDIBRANCH EGGS
				44.0	0.016667	1	DERMATERIAS IMBRICATA
				44.0	0.016667	1	PATIRIA MINIATA
				19.283340		6	TOTAL AND MAXIMUM FREQUENCY

† A total of six ETS stations were surveyed due to adverse weather conditions which precluded sampling the remaining ETS stations.

Table 4A-2. Rank, mean abundance (percent or number/m²), and frequency of occurrence of benthic organisms sampled at all ETS benthic stations during the April 1980 survey period.

PERCENT COVER DATA				ENUMERATION DATA			
RANK	ABUNDANCE	FREQUENCY	NAME	RANK	ABUNDANCE	FREQUENCY	NAME
1.0	7.000000	7	CRUSTOSE CORALLINES, UNIDENT.	1.0	24.000000	7	CHELYOSOMA PRODUCTUM
2.0	3.450001	8	ECTOPROCTS, UNIDENT. (ENCrustING)	2.0	2.100000	8	MURICEA CALIFORNICA
3.0	3.300000	6	ECTOPROCTS, UNIDENT. (ERECT)	3.0	2.100000	7	DIOPATRA ORNATA
4.0	3.240001	6	PARVOSILVOSA	4.0	1.400000	5	STYELA MONTEREYENSIS
5.0	3.190001	7	RHODYMENIA SPP.	5.0	0.570000	7	SPICHRASTOPTERUS COSTARICENSIS
6.0	2.500000	7	HYDROIDS, UNIDENT.	6.0	0.560000	4	CYSTOSEIRA / HALIDRYS
7.0	1.430000	7	CORALLINA / HALIPTYLON	7.0	0.500000	6	DIOPATRA SLEBODINI
8.0	1.200000	6	NILDEBRANDIA PROTOTYPUS	8.0	0.500000	6	STYRA HAUSTOR
9.0	1.260000	6	PTEROCLADIA / GELIDIUM	9.0	0.400000	7	KELLETIA KELLETII
10.0	1.010000	7	HALAMUS SPP.	10.0	0.400000	4	SAOLUTUS ACTIVUS
11.0	0.750000	4	WHITE CORALLINE CRUST	11.0	0.400000	3	LYTECHINUS SPP.
12.0	0.680000	1	BRYOPSIS CORTICULANS	12.0	0.340000	4	NITRELLA CARINATA
13.0	0.590000	7	ASTRANGIA SPP.	13.0	0.270000	3	ANTHOPLERA ANTEMISIA
14.0	0.560000	5	BOSSIELLA SPP.	14.0	0.260000	4	MURICEA FRUTICOSA
15.0	0.530000	7	RHODOPHYTES, UNIDENT.	15.0	0.230000	1	STRONGYLOCENTROTUS FRANCISCANUS
16.0	0.510000	7	LEUCILLA NUTTLERI	16.0	0.180000	4	PAGURIDS, UNIDENT.
17.0	0.480000	1	BRYOPSIS HYPNOIDES	17.0	0.170000	3	FATIRIA MINIATA
18.0	0.420000	5	PORIFERANS, UNIDENT.	18.0	0.130000	2	ONUPHID, UNIDENT.
19.0	0.360000	4	FRIGONITIS SPP.	19.0	0.110000	1	LAMINARIA SPP.
20.0	0.300000	6	EUREKMANIA CLAVIFORMIS	20.0	0.070000	2	STRONGYLOCENTROTUS PURPURATUS
21.0	0.270000	4	TRIDIDEMNUM / DIDEMNUM	21.0	0.060000	2	PTERYGOPHORA CALIFORNICA
22.0	0.220000	3	ASCIDIAN F	22.0	0.050000	3	SABELLARIID, UNIDENT.
23.0	0.200000	1	ACROSORIUM UNICINATUM	23.0	0.050000	2	PAGURISTES SPP.
24.0	0.160000	6	COLONIAL ASCIDIAN, UNIDENT.	24.0	0.050000	2	ASTRAEA UNDOSA
25.0	0.130000	2	MACROCYSTIS SPP. (HOLDFAST)	25.0	0.050000	4	POLYCHAETES, UNIDENT.
26.0	0.120000	3	GIGARTINA SPP.	26.0	0.050000	1	MAXWELLIA GEMMA
27.0	0.110000	3	KELLETIA EGGS	27.0	0.040000	2	PHOLAD, UNIDENT.
28.0	0.090000	2	CORYNACTIS CALIFORNICA	28.0	0.040000	3	PTEROPURPURA FESTIVA
29.0	0.070000	1	PLOCAMUM SPP.	29.0	0.040000	3	ANEMONE, UNIDENT.
30.0	0.060000	4	BOTRYOCLADIA PSEUDODICHTOMA	30.0	0.040000	3	FISASTER GIGANTEUS
31.0	0.060000	3	SERPULIDS, UNIDENT.	31.0	0.040000	2	CLAVELINA HUNTSMANI
32.0	0.060000	3	APLIDIUM SPP.	32.0	0.030000	3	CONUS CALIFORNICUS
33.0	0.060000	1	ANISOCLADELLA PACIFICA	33.0	0.030000	3	FISASTER BREVISPINUS
34.0	0.060000	2	SALMACINA TRIBRANCHIATA	34.0	0.030000	3	FISTA SPP.
35.0	0.040000	1	CALLOPHYLLIS SPP.	35.0	0.030000	1	SABELLARIA CEMENTARIUM
36.0	0.040000	1	HYMENAMPHIASIRA CYANOCRYPTA	36.0	0.020000	2	TEALIA SPP.
37.0	0.040000	1	CRYPTONEMIA / HALYMENIA / SCHIEYMENIA	37.0	0.020000	2	HOLOTHURCID, UNIDENT.
38.0	0.040000	1	PHAEOPHYTE, UNIDENT.	38.0	0.020000	2	LOXORHYNCHUS SPP.
39.0	0.030000	3	LEUCOSOLENIA SPP.	39.0	0.020000	2	SOLITARY ASCIDIAN, UNIDENT.
40.0	0.030000	1	COELOSEIRA / CHAMPIA	40.0	0.020000	1	NUDIBRANCH EGGS
41.0	0.020000	1	LEUCANDRA HEATHI	41.0	0.020000	1	BALANOPHYLLIA ELEGANS
42.0	0.010000	1	PHYCODYRS SPP.	42.0	0.020000	1	CHELIDONURA INERMIS
43.0	0.010000	1	JANIA SPP.	43.0	0.020000	1	SABELLID, UNIDENT.
43.0	0.010000	1	DICTYOTA / PACHYDICTYON	43.0	0.020000	1	ANTHOPLERA SPP.
	35.769970	10	TOTAL AND MAXIMUM FREQUENCY	43.0	0.020000	1	LAMINOID, UNIDENT.
				44.0	0.020000	1	PHRAGMATOPOMA CALIFORNICA
				45.0	0.010000	1	CREPIDULA SPP.
				46.0	0.010000	1	PHYLLOCHASTOPTERUS PROLIFICA
				47.0	0.010000	1	TENEHELLID, UNIDENT.
				48.0	0.010000	1	ASTEROIDS, UNIDENT. (JUV.)
				49.0	0.010000	1	HERMISSENDA CRASSICORNIS
				50.0	0.010000	1	DERMASTERIAS IMERICATA
				50.0	0.010000	1	STYELA SPP. (JUV.)
				50.0	0.010000	1	ANTHOPLERA XANTHOGAMMICA
				50.0	36.949970	10	TOTAL AND MAXIMUM FREQUENCY

Table 4A-3. Rank, mean abundance (percent or number/m²), and frequency of occurrence of benthic organisms sampled at all ETS benthic stations during the July 1980 survey period.

PERCENT COVER DATA				ENUMERATION DATA			
RANK	ABUNDANCE	FREQUENCY	NAME	RANK	ABUNDANCE	FREQUENCY	NAME
1.0	9.311111	6	PARVOSILVOSA	1.0	71.833360	7	CHELYSOMA PRODUCTUM
2.0	8.866669	7	CRUSTOSE CORALLINES, UNIDENT.	2.0	3.344443	7	MURICEA CALIFORNICA
3.0	6.711112	8	ECTOPROCTS, UNIDENT. (ERECT)	3.0	2.766666	8	DIOPATRA ORNATA
4.0	4.144444	8	ECTOPROCTS, UNIDENT. (ENCrustING)	4.0	2.622221	7	STYLLA MONTEVERDISIS
5.0	3.055555	7	RHOZYMNIA SPP.	5.0	0.588889	3	ANEMONE UNIDENT.
6.0	1.795559	1	CORALLINA / HALIPTYLON	6.0	0.577778	6	SPIROCHAETOPTERUS COSTARUM
7.0	1.233334	8	BALANUS SPP.	7.0	0.488889	3	CYTOSEIRA / HALIDRYX
8.0	1.155556	7	HYDROIDS, UNIDENT.	8.0	0.455556	4	PYURA HAUSTOR
9.0	1.066667	5	PTEROCLADIA / GELIDIUM	9.0	0.355556	5	ZAOLUTUS ACTIUS
10.0	1.044444	2	BRYOPSIS HYPNOIDES	10.0	0.344445	6	KELLETTIA KELLETTII
11.0	0.888889	2	ACROSORIUM UMCINATUM	11.0	0.322222	4	MURICEA FRUTYCOSA
12.0	0.766667	5	ASTRANGIA SPP.	12.0	0.300000	6	ONUPHID, UNIDENT.
13.0	0.566667	5	RHOZOPHYTES, UNIDENT.	13.0	0.300000	5	CONUS CALIFORNICUS
14.0	0.544445	6	LEUCILLA MUTTINII	14.0	0.277778	3	STRONGYLOCENTROTUS FRANCISCANUS
15.0	0.466667	4	FORYERANS UNIDENT.	15.0	0.244444	4	PATIRIA MINIATA
16.0	0.433333	7	BALANUS SPP. (DEAD)	16.0	0.200000	2	PAGURISTES SPP.
17.0	0.411111	2	MACROCYSTIS SPP. (HOLDFAST)	17.0	0.200000	1	MITRELLA CARINATA
17.5	0.411111	3	BOSSIELLA SPP.	18.0	0.144444	2	DIOPATRA SPLENDIDISSIMA
19.0	0.400000	5	HILDENERANDIA PROTOTYPUS	18.5	0.144444	3	PAGURIDS, UNIDENT.
20.0	0.322222	5	TRIDIDEMNUM / DIDEMNUM	18.5	0.144444	3	HOLOTHUROID, UNIDENT.
21.0	0.266667	2	PRIONITIS SPP.	21.0	0.122222	1	CYTOSEIRA SPP.
21.5	0.244444	4	CRYPTONEMIA / HALYMENIA / SCHIZYMENIA	21.5	0.122222	2	STRONGYLOCENTROTUS PURPURATUS
22.0	0.233333	5	COLONIAL ASCIDIAN, UNIDENT.	21.5	0.122222	1	PAGURUS SPP.
23.0	0.233333	3	PLATYTHAMNION SPP.	24.0	0.111111	1	SABELLID, UNIDENT.
24.0	0.200000	4	LEUCOSOLENIA SPP.	24.0	0.100000	1	LAMINARIA SPP.
25.0	0.188889	4	CORYNACTIS CALIFORNICA	25.0	0.100000	3	ANTHOPELEURA ARTEMISIA
25.5	0.188889	2	GIGARTINA SPP.	26.0	0.100000	4	PTEROPURPURA FESTIVA
27.0	0.177778	4	EUPHEROMANIA CLAVIFORMIS	28.0	0.077777	3	PHRAGMATOPOMA CALIFORNICA
28.0	0.155556	4	SALMACINA TRIBRANCHIATA	29.0	0.066666	2	LYTECHINUS SPP.
29.0	0.122222	2	CALLOPHYLLIS SPP.	30.0	0.055556	1	PTERYGOPHORA CALIFORNICA
30.5	0.111111	4	BOTRYOCLADIA PSEUDODICHOTOMA	30.5	0.055556	1	HENRICIA SPP.
30.5	0.111111	3	PHAEOPHYTE, UNIDENT.	31.0	0.044444	2	SABELLARIID, UNIDENT.
32.0	0.100000	3	ANISOCLEDELLA PACIFICA	31.0	0.044444	1	PISASTER GIGANTEUS
33.0	0.077777	4	PLOCAMTUM SPP.	31.0	0.044444	1	DODECACERIA / EWKESII
33.5	0.077777	1	APLIDIUM SPP.	32.0	0.033333	2	ANTHOPELEURA XANTHOGRAMMICA
36.0	0.066666	2	LEUCANDRA HEATHI	33.0	0.033333	2	HERMISSENDA CRASSICORNIS
36.0	0.066666	1	ASCIDIAN F	36.0	0.033333	1	POLYCERA TRICOLOR
36.0	0.066666	3	DESMARESTIA SPP.	36.0	0.033333	2	CLAVELINA HUNTSMANI
38.0	0.044444	1	MURICEA MORIBUND HOLDFAST	40.0	0.022222	1	NUDIBRANCH EGGS
38.5	0.044444	1	PYCNOCLEAVELLA STANLEYI	40.0	0.022222	1	MACROCYSTIS SPP.
42.0	0.033333	2	CLADOPHORA SPP.	40.0	0.022222	1	LORORHYNCHUS SPP.
42.0	0.033333	2	KELLETTIA EGGS	49.5	0.011111	1	OCTOPUS SPP.
42.0	0.033333	1	JANIA SPP.	49.5	0.011111	1	DERMASTERIA IMBRICATA
42.0	0.033333	2	SERPULIDS, UNIDENT.	49.5	0.011111	1	FLABELLINOPIA IODINEA
42.0	0.033333	1	WHITE ERECT CORALLINE	49.5	0.011111	1	ASTRASA UNDOSA
48.0	0.011111	1	DICTYOTA / PACHYDICTYON	49.5	0.011111	1	POLYCHAETES, UNIDENT.
48.0	0.011111	1	HYMENAMPHIASTRA CYANOCRYPTA	49.5	0.011111	1	PHOLAD, UNIDENT.
48.5	0.011111	1	LAURENCIA SPP.	49.5	0.011111	1	PISASTER BREVISPINUS
48.5	0.011111	1	BRYOPSIS CORTICULANS	49.5	0.011111	1	OLIVELLA BIPICATA
48.5	0.011111	1	ASCIDIAN G	49.5	0.011111	1	PISTA SPP.
48.5	0.011111	1	COELOSEIRA / CHAMPIA	49.5	0.011111	1	TETHYA AURANTIA
48.5	0.011111	1	RHODOPTILUM PLUMOSUM	49.5	0.011111	1	CANCER ANTENNARIUS
48.5	0.011111	1	TOTAL AND MAXIMUM FREQUENCY	49.5	0.011111	1	POLYCERA ATRA
	48.311148	9		49.5	0.011111	1	PARASTICHOPUS PARVIMENSIS
				49.5	0.011111	1	PUGETTIA SPP.
				49.5	0.011111	1	DORID, UNIDENT.
				49.5	0.011111	1	SOLITARY ASCIDIAN, UNIDENT.
				49.5	0.011111	1	TOTAL AND MAXIMUM FREQUENCY
				87.17 / 80		9	

Table 4A-4. Rank, mean abundance (percent or number/m²), and frequency of occurrence of benthic organisms sampled at all ETS benthic stations during the October 1980 survey period.

PERCENT COVER DATA				ENUMERATION DATA			
RANK	ABUNDANCE	FREQUENCY	NAME	RANK	ABUNDANCE	FREQUENCY	NAME
1.0	10.990000	7	ECTOPROCTS. UNIDENT. (ENCRUSTING)	1.0	32.500000	6	CHELYSOMA PRODUCTUM
2.0	10.170000	7	ECTOPROCTS. UNIDENT. (ERECT)	2.0	3.400000	8	DIOPATRA ORNATA
3.0	8.100000	7	CRUSTOSE CORALLINES, UNIDENT.	3.0	3.375555	7	MURICEA CALIFORNICA
4.0	5.905555	7	PARVOSILVOSA	4.0	1.930000	7	STYELA MONTEREYENSIS
5.0	2.950000	7	HYDROIDS, UNIDENT.	5.0	1.420000	7	STYELLA CARINATA
6.0	2.790001	7	RHODYMENIA SPP.	6.0	0.900000	7	PHIDICRAEPTERUS CORTARUM
7.0	1.473000	7	CORALLINA / HALIPTYLON	7.0	0.800000	5	SABELLARIID, UNIDENT.
8.0	1.400000	5	BRYOPSIS HYPNOIDES	8.0	0.710000	5	DIOPATRA SPLENDIDISSIMA
9.0	1.170000	7	HALAMUS SPP.	9.0	0.580000	3	RAOLTIUS ACTIUS
10.0	1.010000	5	PTEROCLEADIA / GELIDIUM	10.0	0.550000	4	CYSTOSEIRA / HALIDRYX
11.0	0.570000	6	MILDENBRANDIA PROTOTYPUS	11.0	0.480000	6	PYURA NAUSTOR
12.0	0.920000	7	ASTRANGIA SPP.	12.0	0.450000	3	PAGURIDS, UNIDENT.
13.0	0.500000	7	EUREDMANIA CLAVIFORMIS	13.0	0.440000	5	ONUPNID, UNIDENT.
14.0	0.570000	7	LEUCILLA NUTTINGI	14.0	0.420000	2	PHRAGMATOPOMA CALIFORNICA
15.0	0.540000	6	COLONIAL ASCIDIAN, UNIDENT.	15.0	0.410000	5	PAGURISTES SPP.
16.0	0.500000	7	PORIFERANS, UNIDENT.	16.0	0.390000	5	PISTA SPP.
17.0	0.390000	3	PRIONITIS SPP.	17.0	0.370000	5	MURICEA FRUTICOSA
18.0	0.370000	5	RHODOPHYTES, UNIDENT.	18.0	0.360000	3	STRONGYLOCENTROTUS FRANCISCAEUS
19.0	0.290000	2	SALMACINA TRIERRANCHIATA	19.0	0.270000	6	KELLETIA KELLETII
20.0	0.250000	3	TRIDIDEMNUM / DIDEMNUM	20.0	0.260000	1	SABELLARIA CEMENTARIUM
21.0	0.240000	1	COELGSEIRA / CHAMPIA	21.0	0.250000	1	LAMNOLID, UNIDENT.
22.0	0.240000	4	SERPULIDS, UNIDENT.	22.0	0.180000	3	OMENIA COLLARIS
23.0	0.220000	1	ACROSORIUM UNCINATUM	23.0	0.150000	1	PATIR: NIATA
24.0	0.210000	4	ASCIDIAN F	23.5	0.150000	4	CHEPIDULA F
25.0	0.160000	3	BOSSIELLA SPP.	25.0	0.140000	1	HELOTHUROI, UNIDENT.
26.0	0.150000	1	MACROCYSTIS SPP. (HOLDFAST)	26.0	0.130000	4	CONUS CALIF. sp.
27.0	0.130000	2	CORYNACTIS CALIFORNICA	27.0	0.120000	4	ANTHOPLEURA ARTEMISIA
27.5	0.130000	2	WHITE CORALLINE CRUST	28.0	0.110000	3	PAGURUS SPP.
29.0	0.120000	2	MURICEA MORIBUND HOLDFAST:	28.5	0.110000	1	LAMINARIA SPP.
30.0	0.100000	3	ASCIDIAN G	29.0	0.090000	4	CLAVELINA HUNTSMANI
31.0	0.090000	2	BCTRYOCLEADIA PSEUDODICHOTOMA	30.0	0.090000	3	LYTECHINUS SPP.
32.0	0.090000	3	DICTYOTA / PACHYDICTYON	31.0	0.080000	2	STRONGYLOCENTROTUS PURPURATUS
32.0	0.090000	3	CRYPTONEMIA / HALYMENIA / SCHIZYMENIA	32.0	0.080000	3	PISASTER GIGANTEUS
34.0	0.090000	4	BRYOPSIS CORTICULANS	33.0	0.060000	1	SOLITARY ASCIDIAN, UNIDENT.
35.0	0.080000	2	LEUCANDRA HEATHI	34.0	0.050000	3	PTERYGOPHORA CALIFORNICA
37.0	0.070000	1	GELIDIUM SPP.	35.0	0.040000	1	FLABELLIMOPSIS IODINEA
37.5	0.070000	3	CALLOPHYLII S SPP.	36.5	0.030000	3	POLYCERA TRICOLOR
37.5	0.070000	2	PYCNOCLEAVELLA STANLEYI	36.5	0.030000	3	NASSARIUS HENDICUS
37.5	0.070000	1	PLOCAMION SPP.	38.0	0.020000	1	HIPPOLYTIID, UNIDENT.
40.0	0.040000	2	LEUCOSOLENIA SPP.	38.5	0.020000	2	TEGULA AUREO INCTA
41.0	0.020000	2	SPIRORRIDS, UNIDENT.	41.5	0.020000	2	LAILA COCKERELLI
42.0	0.020000	1	ECTOCARPUS SPP.	41.5	0.020000	2	ANTHOPLEURA XANTHOGRAMMICA
42.5	0.020000	1	MACROCYSTIS MORIBUND HOLDFAST:	41.5	0.020000	1	CRASSISPINA SEMIINFATA
46.0	0.010000	1	ANISOCLADELLA PACIFICA	47.5	0.020000	2	POLYCHAETES, UNIDENT.
46.0	0.010000	1	KELLETIA EGGS	47.5	0.020000	1	PTEROPURPURA FESTIVA
46.0	0.010000	1	JAWIA SPP.	47.5	0.020000	1	MAXWELLIA GEMMA
46.0	0.010000	1	RHYMENAMPHIASTRA CYANOCRYPTA	47.5	0.020000	1	MAXWELLIA SANTAROSANA
48.0	0.010000	1	PHAEOPHYTE, UNIDENT.	47.5	0.020000	1	HEMIMISSIDA CRASSICORNIS
54.000000	10	10	TOTAL AND MAXIMUM FREQUENCY	47.5	0.020000	1	PTYLOCHAETOPTERUS PROLIFICA
				47.5	0.020000	1	CACTOSOMA ARENARIA?
				47.5	0.020000	1	TETHYA AURANTIA
				59.0	0.010000	1	LOXORHYNCHUS SPP.
				59.0	0.010000	1	POLYCERA ATRA
				59.0	0.010000	1	ASTRAEA UNDOSA
				59.0	0.010000	1	CORYPHELLA SPP.
				59.0	0.010000	1	PARACYPHUS SPP.
				59.0	0.010000	1	PISASTER SPP. (JOV.)
				59.0	0.010000	1	CYPRAEA SPADICEA
				59.0	0.010000	1	TRIVIA SPP.
				59.0	0.010000	1	PARASTICHOPIUS PARVIMENSIS
				59.0	0.010000	1	PISASTER BREVISPINUS
				59.0	0.010000	1	POLYPLACOPHORAN, UNIDENT.
				59.0	0.010000	1	CHAUA SPP.
				59.0	0.010000	1	PHILOMID, UNIDENT.
				59.0	0.010000	1	SERPULIDIS SCUMIGERUS
				59.0	0.010000	1	DORID, UNIDENT.
				52.419940	10	TOTAL AND MAXIMUM FREQUENCY	

Table 4A-5. Rank, mean abundance (percent or number/m²), and frequency of occurrence of benthic organisms sampled at all CMP benthic stations during the April 1980 survey period.

PERCENT COVER DATA				ENUMERATION DATA			
RANK	ABUNDANCE	FREQUENCY	NAME	RANK	ABUNDANCE	FREQUENCY	NAME
1.0	11.350000	2	RHOZYMNIA SPP.	1.0	159.050000	2	CHELYSOMA PRODUCTUM
2.0	8.949997	2	CRUSTOSE CORALLINES, UNIDENT.	2.0	9.899998	2	STYELA MONTESEYENSIS
3.0	7.700000	2	PARVOSILVOSA	3.0	7.500000	2	PTERYGOPHORA CALIFORNICA
4.0	5.250000	2	PTEROCLODIA / GELIDIUM	4.0	1.650000	2	SIDOPHORA OPHITA
5.0	3.800000	2	ECTOPROCTS, UNIDENT. (ENCRUSTING)	5.0	2.200000	2	HITRELLA CANNINATA
6.0	1.550000	2	HYDROIDS, UNIDENT.	6.0	1.400000	2	KELLETTIA KELLETTII
7.0	1.200001	2	ECTOPROCTS, UNIDENT. (ERECT)	7.0	1.250002	2	ANEMONE, UNIDENT.
8.0	0.350000	2	CORALLINA / HALIPTYLON	8.0	1.100000	2	GNUPHID, UNIDENT.
9.0	1.650001	1	BOSSIELLA SPP.	9.0	1.000000	2	SPIROCHAETOPTERUS COSTARUM
10.0	1.600000	2	ASTRANGIA SPP.	10.5	0.850000	2	PYURA HAUSTON
11.0	1.100000	2	HILDENBRANDIA PROTOTYPUS	10.5	0.850000	2	PATRIA MINIATA
12.0	0.750000	2	LEUCILLA NUTTINCI	12.0	0.650000	2	STRONGYLOCENTROTUS FRANCISCANUS
13.0	0.700000	2	PORIFERANS, UNIDENT.	13.5	0.600000	1	STYELA SPP. (JUV.)
14.0	0.600000	2	COLONIAL ASCIDIUM, UNIDENT.	13.5	0.600000	1	PAGURIDS, UNIDENT.
15.0	0.550000	2	RHODOPHYTES, UNIDENT.	15.0	0.550000	2	ANTHOPLEURA KANTHOGRAMMICA
16.5	0.500000	2	EUREDMANIA CLAVIFORMIS	16.5	0.450000	2	CYSTOSEIRA / HALIDRYS
16.5	0.500000	2	BALANUS SPP.	16.5	0.450000	2	MURICEA CALIFORNICA
18.0	0.350000	2	PYCNOCLAVELLA STANLEYI	18.0	0.400000	2	CONUS CALIFORNICUS
19.5	0.300000	1	CALLOPHYLLIS SPP.	19.0	0.300000	2	POLYCHAETES, UNIDENT.
19.5	0.300000	1	CRYPTONEMIA / HALYMENIA / SCHIZYMENIA	20.0	0.250000	1	CYPRAEA SPADICEA
21.0	0.200000	1	PRIONITIS SPP.	20.5	0.150000	2	MITRA IDAE
22.0	0.150000	2	ASCIDIAN C	22.5	0.150000	1	PAGURISTES SPP.
23.5	0.100000	1	WHITE CORALLINE CRUST	22.5	0.150000	1	ANTHOPLEURA ARTEMISIA
23.5	0.100000	1	LEUCOSOLENIA SPP.	22.5	0.150000	1	STRONGYLOCENTROTUS PURPURATUS
26.5	0.050000	1	NIENBURGIA ANDERSONIANA	20.5	0.050000	1	MURICEA FRUITICOSA
26.5	0.050000	1	CORYNACTIS CALIFORNICA	20.5	0.050000	1	PHOLAD, UNIDENT.
26.5	0.050000	1	ANISOCLELLA PACIFICA	20.5	0.050000	1	LAMINARIA SPP.
26.5	0.050000	1	SERPULIDS, UNIDENT.	20.5	0.050000	1	OLIVELLA BIFLICATA
26.5	0.050000	1	TOTAL AND MAXIMUM FREQUENCY	20.5	0.050000	1	PISTA SPP.
	55.600050	2		20.5	0.050000	1	NASSARIUS MENDICUS
				20.5	0.050000	1	ROPERIA POULSONI
				20.5	0.050000	1	MAJID, UNIDENT.
				20.5	0.050000	2	TOTAL AND MAXIMUM FREQUENCY
					100.000100		

Table 4A-6. Rank, mean abundance (number of contacts/6.0 or 0.125 m²), and frequency of occurrence of benthic organisms sampled at all PMP benthic stations during the January 1980 survey period.

6.0 m ² DATA				0.125 m ² DATA			
RANK	ABUNDANCE	FREQUENCY	NAME	RANK	ABUNDANCE	FREQUENCY	NAME
1.0	80.00000	2	HYDROIDS, UNIDENT.	1.0	79.50000	2	ECTOPROCTS, UNIDENT. (ERECT)
2.5	77.00000	2	ECTOPROCTS, UNIDENT. (ERECT)	2.0	57.00000	2	PARVOSILVOSA
2.5	77.00000	2	MURICEA CALIFORNICA	3.0	42.00000	2	ECTOPROCTS, UNIDENT. (ENCRUSTING)
4.0	63.50000	2	ECTOPROCTS, UNIDENT. (ENCRUSTING)	4.0	40.00000	2	CRUSTOSE CORALLINES, UNIDENT.
5.0	42.50000	2	RHODYMENIA SPP.	5.0	36.00000	2	MURICEA CALIFORNICA
6.5	26.00000	2	CRUSTOSE CORALLINES, UNIDENT.	6.0	31.00000	2	RHODYMENIA SPP.
6.5	26.00000	2	DRIFT ALGAE	7.0	10.00000	2	HYDROIDS, UNIDENT.
8.0	12.00000	2	PRIONITIS SPP.	8.0	9.00000	2	DRIFT ALGAE
9.0	6.00000	2	ASTRANGIA SPP.	9.0	7.50000	1	PRIONITIS SPP.
10.5	5.00000	2	PARVOSILVOSA	10.0	6.50000	2	ASTRANGIA SPP.
12.0	3.00000	2	PORIFERANS, UNIDENT.	11.0	3.00000	2	PORIFERANS, UNIDENT.
14.0	2.50000	1	HILDENBRANDIA PROTOTYPUS	12.0	2.50000	1	WHITE CORALLINE CRUST
14.0	2.50000	1	MURICEA FRUTICOSA	13.5	2.00000	1	CORALLINA / HALIPTYLON
14.0	2.50000	1	CORYNACTIS CALIFORNICA	13.5	2.00000	1	PISASTER GIGANTEUS
16.5	2.00000	2	SALACINA TRIDBRANCHIATA	15.5	1.50000	2	ANISOCLADELLA PACIFICA
16.5	2.00000	2	TRIDIDEMNUM / DIDEMNUM	15.5	1.50000	1	PISTA SPP.
18.0	1.50000	2	EUHERDMANIA CLAVIFORMIS	19.5	1.00000	1	EUHERDMANIA CLAVIFORMIS
20.0	1.00000	2	CORALLINA / HALIPTYLON	19.5	1.00000	1	HILDBRANDIA PROTOTYPUS
20.0	1.00000	2	RHODOPHYTES, UNIDENT.	19.5	1.00000	1	ANEMONE, UNIDENT.
20.0	1.00000	1	STRONGYLOCENTROTUS FRANCISCANUS	19.5	1.00000	2	CLADOPHORA SPP.
20.0	1.00000	1	PATIRIA MINIATA	19.5	1.00000	1	COLONIAL ASCIDIAN UNIDENT.
26.0	0.50000	1	ANISOCLADELLA PACIFICA	19.5	1.00000	1	TRIDIDEMNUM / DIDEMNUM
26.0	0.50000	1	SERPULIDS, UNIDENT.	25.0	0.50000	1	MURICEA FRUTICOSA
26.0	0.50000	1	TETHYA AURANTIA	25.0	0.50000	1	TETHYA AURANTIA
26.0	0.50000	1	PISTA SPP.	25.0	0.50000	1	PAGURISTES SPP.
26.0	0.50000	1	PARASTICHOPUS PARVIMENSIS	25.0	0.50000	1	CHELYSOMA PRODUCTUM
26.0	0.50000	1	PHYCORYS SPP.	25.0	0.50000	1	ASTRANGIA (MORBUND)
26.0	0.50000	1	PAGURISTES SPP.	350.50000		2 †	TOTAL AND MAXIMUM FREQUENCY
26.0	0.50000	1	STYELA MONTEREYENSIS				
26.0	0.50000	1	CLAVELINA HUNTSMANI				
441.50000		2 †	TOTAL AND MAXIMUM FREQUENCY				

† A total of two PMP stations were surveyed due to adverse weather conditions which precluded sampling the remaining PMP stations.

Table 4A-7. Rank, mean abundance (number of contacts/6.0 or 0.125 m²), and frequency of occurrence of benthic organisms sampled at all PMP benthic stations during the April 1980 survey period.

6.0 m ² DATA				0.125 m ² DATA			
RANK	ABUNDANCE	FREQUENCY	NAME	RANK	ABUNDANCE	FREQUENCY	NAME
1.0	54.00000	10	PARVOSILVOSA	1.0	75.00000	9	CRUSTOSE CORALLINES, UNIDENT.
2.0	51.70000	9	CRUSTOSE CORALLINES, UNIDENT.	2.0	63.30000	9	PARVOSILVOSA
3.0	49.60000	6	PTERYGOPHORA CALIFORNICA	3.0	52.35000	9	ECTOPROCTS, UNIDENT. (ENCRUSTING)
4.0	29.70000	10	HYDROIDS, UNIDENT.	4.0	25.32000	9	PTERYGOPHORA CALIFORNICA
5.0	26.00000	10	ECTOPROCTS, UNIDENT. (ENCRUSTING)	5.0	16.82000	6	RHOODYMENIA SPP.
6.0	23.50000	9	MURICEA CALIFORNICA	6.0	16.30000	7	ECTOPROCTS, UNIDENT. (ERECT)
7.0	22.05000	9	RHOODYMENIA SPP.	7.0	14.60000	5	MURICEA CALIFORNICA
8.0	18.00000	9	ECTOPROCTS, UNIDENT. (ERECT)	8.0	10.40000	6	DRIFT ALGAE
9.0	5.90000	4	CHELYSOMA PRODUCTUM	9.0	9.20000	8	WHITE CORALLINE CRUST
10.0	5.20000	7	DRIFT ALGAE	10.0	6.40000	7	CHELYSOMA PRODUCTUM
11.0	4.80000	7	ASTRANGIA SPP.	11.0	6.00000	7	HYDROIDS, UNIDENT.
12.0	3.90000	7	DIOPATRA ORNATA	12.0	4.30000	6	ASTRANGIA SPP.
13.0	3.10000	7	HILDENERANDIA PROTOTYPUS	13.0	3.60000	7	RHOODOPHYTES, UNIDENT.
14.0	3.00000	7	WHITE CORALLINE CRUST	14.0	3.30000	7	HILDENERANDIA PROTOTYPUS
15.0	2.90000	7	RHOODOPHYTES, UNIDENT.	15.0	3.00000	3	FORIFERANS, UNIDENT.
16.0	2.80000	8	PATIRIA MINIATA	16.0	1.90000	5	PTEROCLADIA / GELIDIUM
16.5	2.80000	6	PTEROCLADIA / GELIDIUM	17.0	1.70000	5	DIOPATRA ORNATA
18.0	1.90000	6	FORIFERANS, UNIDENT.	18.0	1.50000	4	PATIRIA MINIATA
19.0	1.50000	4	STYELA MONTEREYENSIS	19.0	1.40000	5	CORALLINA / HALIPTYLON
19.5	1.50000	3	PRIONITIS SPP.	20.0	1.30000	2	PRIONITIS SPP.
21.0	1.20000	4	CORALLINA / HALIPTYLON	21.0	1.20000	3	ANISOCLADELLA PACIFICA
22.0	1.10000	3	CORYNACTIS CALIFORNICA	22.0	0.70000	3	COELOSEIRA / CHAMPIA
23.0	1.00000	4	COELOSEIRA / CHAMPIA	24.0	0.60000	3	BALANUS SPP.
24.0	0.70000	2	MURICEA FRUTICOSA	24.5	0.60000	1	PARASTICHOPUS PARVIMENSIS
26.0	0.60000	2	BOSSIELLA SPP.	24.5	0.60000	4	ASCIDIAN G
26.5	0.60000	1	CYSTOSEIRA / HALIDRYS	24.5	0.60000	4	SABELLARIID UNIDENT.
26.5	0.60000	5	KELLETIA KELLETII	27.0	0.50000	1	EUBERDMANIA CLAVIFORMIS
26.5	0.60000	2	STRONGYLOCENTROTUS FRANCISCANUS	29.0	0.40000	2	CORYNACTIS CALIFORNICA
29.0	0.50000	3	BALANUS SPP.	29.0	0.40000	2	PAGURISTES SPP.
29.5	0.50000	3	ANISOCLADELLA PACIFICA	29.0	0.40000	2	BOSSIELLA SPP.
31.0	0.40000	4	TRIDIDEMNUM / DIDEMNUM	31.0	0.30000	2	LEUCILLA NUTTINGI
31.5	0.40000	1	SALMACINA TRIBRANCHIATA	31.0	0.30000	2	SPIROCHAETOPTERUS COSTARUM
35.0	0.30000	2	PARASTICHOPUS PARVIMENSIS	32.0	0.30000	2	STYELA MONTEREYENSIS
35.0	0.30000	3	PAGURISTES SPP.	36.0	0.20000	1	KELLETIA KELLETII
35.0	0.30000	3	SPIROCHAETOPTERUS COSTARUM	36.0	0.20000	1	TETHYA AURANTIA
35.0	0.30000	3	LEUCILLA NUTTINGI	36.0	0.20000	1	LYTECHINUS SPP.
35.0	0.30000	1	GIGARTINA SPP.	36.0	0.20000	2	HYMENAMPHIASIRA CYANOCRYPTA
39.0	0.20000	2	CRYPTONEMIA / HALYENIA / SCHIZYMENIA	36.0	0.20000	1	DIOPATRA SPLENDIDISSIMA
39.5	0.20000	2	MACROCYSTIS SPP.	40.5	0.10000	1	ANTHOZOA UNIDENT.
39.5	0.20000	1	EUBERDMANIA CLAVIFORMIS	40.5	0.10000	1	ZOOLUTUS ACTIUS
39.5	0.20000	2	LYTECHINUS SPP.	40.5	0.10000	1	COLONIAL ASCIDIAN, UNIDENT.
46.0	0.10000	1	ASTRAEA UNDOSA	40.5	0.10000	1	ERYOPSIS CORTICULANS
46.5	0.10000	1	NOTRYOCLADIA PSEUDODICHOTOMA	40.5	0.10000	10	TOTAL AND MAXIMUM FREQUENCY
46.5	0.10000	1	DIOPATRA SPLENDIDISSIMA				
46.5	0.10000	1	PISTA SPP.				
46.5	0.10000	1	CALLOPHYLLIS SPP.				
46.5	0.10000	1	ZOOLUTUS ACTIUS				
46.5	0.10000	1	PYURA HAUSTOR				
46.5	0.10000	1	CYPRAEA SPADICEA				
46.5	0.10000	1	ERYOPSIS CORTICULANS				
46.5	0.10000	1	BALANUS SPP. (DEAD)				
46.5	0.10000	10	TOTAL AND MAXIMUM FREQUENCY				
	329.801000						

4B. BENTHIC INFAUNAL STUDY

The benthic infaunal investigation was conducted in compliance with the California Regional Water Quality Control Board - San Diego Region (CRWQCB-SDR) Monitoring and Reporting Program No. 71-6 for construction of the San Onofre Nuclear Generating Station Units 2 and 3, including Technical Change Orders 1, 2, and 3. The purpose of the investigation was to investigate effects of dredge induced sedimentation on the infaunal invertebrate community adjacent to San Onofre. In 1980 the program was conducted in March only (Table 1-1) as construction activities terminated 6 February 1980. Biological collections were made along six permanent transects used since December 1976 (MBC 1978). Biological collections were made at stations located on the 6, 9, and 15 m isobaths of six offshore transects. Two of the six transects were established as reference areas, one upcoast and one downcoast of the construction area. The remaining four treatment transects flank the axis along which dredging and conduit emplacement proceeded (Fig. 4B-1).

SAMPLING METHODS

Biological Sampling

At each station, biological samples were collected for the identification and enumeration of taxa present. At stations located along the 6 m isobath (A1, B1, C1, D1, E1, and F1) five one liter (10 cm x 10 cm x 10 cm) replicate box core samples were collected by divers. Collections from the 9 and 15 m isobath stations (A2, B2, C2, D2, E2, F2, A3, B3, C3, D3, E3, and F3) consisted of 12 replicate one liter samples. Each sample was screened through a 0.5 mm screen in the field and the retained fraction preserved in 10% Formalin-seawater.

Physical Measurement and Sediment Characteristic Determination

At each station, sediment stake heights (vertical distance from substrate to top of a permanent monument), which are used to detect changes in bottom height between surveys, were determined with a tape measure. Sediment deposition rates were calculated from sediment trap collections. At each station, sediment traps were positioned on top of the permanent monuments. The traps were replaced monthly. The contents were returned to the laboratory, oven dried at 100°C for 24 hrs, and their dry weight recorded.

Sediment samples for total organic carbon determinations and grain size analysis were collected at each station adjacent to the biological samples. At stations located along the 6 m isobath, three core samples each were collected for both sediment size and organic carbon analyses. At stations located along the 9 and 15 m isobaths, four core samples were collected for sediment size analysis and eight samples collected for organic carbon analyses. Total organic carbon content was determined for each sample using a LECO gasometric carbon analyzer. Grain size was determined by automatic settling tube analyses of sand sized fractions (combined with sieving for gravel when necessary). Silt-clay fractions were analyzed using standard hydrometric techniques. Calculations for mean phi, skewness, kurtosis, and other sediment descriptive characteristics followed the formula of Inman (1952).

Bottom water and Secchi disc readings (measuring water clarity) were collected at all stations during the survey.

RESULTS

Dates of subtidal infaunal field surveys and sediment trap retrieval are indicated in Table 1-1. Tables 4B-1, 4B-2, and 4B-3 present a summary of the pertinent data collected during the March survey of 1980. For a complete presentation of the biological and physical data collected (SCE 1981a). Analysis of these data will be presented in the Volume III, Annual Operating Report (SCE 1981b).

Literature Cited

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- Southern California Edison Company. 1981b. Annual operating report, San Onofre Nuclear Generating Station. Volume III: Environmental technical specifications Unit 1; national pollutant discharge elimination system, Units 1, 2, and 3; construction monitoring program Units 2 and 3; preoperational monitoring program. Prepared by Brown and Caldwell, Lockheed Environmental Sciences, and Marine Biological Consultants, Inc. (in preparation).

Table 4B-1. San Onofre infaunal survey mean number of individuals/liter, March 1980.

SPECIES	MAR	SPECIES	MAR
HYDROZOA, UNID.	0.02	AEDICIRA PACIFICA	0.01
PLATYHELMINTHES, UNID.	0.02	ACESTA CATHERINAE	0.32
NEMERTEA, UNID.	0.17	ACESTA HORIKOSHII	0.01
CARINOMA MUTABILIS	0.26	ACESTA SP.	0.01
PARANEMERTES SP. A	0.03	PARAONIDAE, GENUS A	0.01
MICRURA ALASKENSIS	0.02	SPIONIDAE, UNID.	0.01
NEMATODA, UNID.	0.04	DISPIO UNCINATA	0.02
STHENOLEPIS FIMBRIARUM	0.01	PRIONOSPIONIDAE, UNID.	0.05
EUSIGALION SPINOSUM	0.14	PRIONOSPIONIDAE MALMGRENI	0.01
EUPHROSINE PAUCIBRANCHIATA	0.01	PARAPRIONOSPIONIDAE PINNATA	0.02
ANAITIDES SP.	0.01	APOPRIONOSPIONIDAE PYGMAEUS	2.29
ETEONE DILATAE	0.01	SPIOPHANES BOMBYX	0.09
EULALIA BILINEATA	0.01	SPIOPHANES SP.	0.02
EUMIDA BIFOLIATA	0.01	MAGELONA SACCULATA	0.06
HESIONURA COINEAUI DIFFICILIS	0.07	POECILOCHAETUS JOHNSONI	0.01
ETEONE LIGHTI	0.01	SPIOCHAETOPTERUS COSTARUM	0.02
HESIONIDAE, UNID.	0.01	CHAETOZONE SETOSA	0.24
GYPTIS BREVI PALPA	0.02	CHAETOZONE SP.	0.01
ANCISTROSYLLIS HAMATA	0.01	CIRRIFORMIA SPIRABRANCHIA	0.01
SYLLIDAE, UNID.	0.01	THARYX SP.	0.06
ODONTOSYLLIS PHOSPHOREA	0.01	ARMANDIA BIOCULATA	0.01
TYPOSYLLIS ACICULATA	0.07	TRAVISIA GIGAS	0.01
TYPOSYLLIS FASCIATA	0.00	CAPITELLIDAE, UNID.	0.02
NEREIS PROCERA	0.02	MEDIOMASTUS AMBISETA	0.16
NEREIS SP.	0.02	MEDIOMASTUS ACUTUS	0.24
NEPHTYS CAECOIDES	0.21	MEDIOMASTUS CALIFORNIENSIS	0.24
NEPHTYS CORNUTA FRANCISCANA	0.13	MEDIOMASTUS SP.	0.03
NEPHTYS SP.	0.02	HETEROMASTUS FILIFORMIS	0.01
SPHAERODOROPSIS SP.	0.01	ANOTOMASTUS GORDIODES	0.04
GLYCERA CONVOLUTA	0.05	AMASTIGOS ACUTUS	1.70
GLYCERA SP.	0.01	ASYCHIS DISPARIDENTATA	0.05
GLYCIDAE ARMIGERA	0.01	OWENIA COLLARIS	0.02
GONIADA BRUNNEA	0.02	PECTINARIA CALIFORNIENSIS	0.01
GONIADA LITTOREA	0.70	AMAEANA OCCIDENTALIS	0.02
GONIADA SP.	0.02	PISTA FASCIATA	0.01
ONUPHIS EREMITA	0.01	SABELLINAE, UNID.	0.01
NOTHRIA IRIDESCENS	0.05	TUBIFICIDAE, UNID.	0.01
LUMBRINERIS LATREILLI	0.03	ENCHYTRAIDAE, UNID.	0.01
LUMBRINERIS TETRAURA	0.43	GOLFINGIA MISAKIANA	0.21
LUMBRINERIS ZONATA	0.03	PYCNOGONIDA, UNID.	0.01
LUMBRINERIS SP.	0.20	CALLIPALLENE PALPIDA	0.02
LUMBRINERIS PALLIDA	0.01	CYLINDROLEBERIDIDAE, UNID.	0.04
LUMBRINERIS PLATYPYGOS	0.01	EUPHILOMEDES LONGISETA	0.18
ARABELLA IRICOLOR	0.02	EUPHILOMEDES CARCHARODONTA	0.04
NOTOCIRRUS CALIFORNIENSIS	0.01	RUTIDERMA ROSTRATA	0.02
DRILONEREIS SP.	0.01	CYCLOLEBERIS AMERICANA	0.01
PROTODORVILLEA GRACILIS	0.03	CYCLOPOIDA, UNID.	0.01
SCALEWORM, UNID.	0.01	HARPACTICOIDA, UNID.	0.01
HAPLOSCOLOPLOS ELONGATUS	0.17	CALANOIDA, UNID.	0.25
SCOLOPLOS ARMIGER	0.43	NEBALIA SP.	0.01
PARAONELLA PLATYBRANCHIA	0.01	ACANTHOMYSIS DAVISI	0.03
TAUBERIA OCVLATA	0.01	ACANTHOMYSIS SCULPTA	0.01
PARAONIDAE, UNID.	0.01	MYSIDOPSIS CALIFORNICA	0.01
ARICIDEA WASSI	0.01	MYSIDACEA, UNID.	0.01

Table 4B-1. San Onofre infaunal survey mean number of individuals/liter, March 1980 (Cont).

SPECIES	MAR	SPECIES	MAR
ANCHICOLURUS OCCIDENTALIS	0.01	KURTZIELLA PLUMBEA	0.01
DIASTYLOPSIS TENUIS	0.17	OPHIODERMELLA CANCELLATA	0.01
CAMPYLASPIS SP. C	0.02	ACTEOCINA CULCITELLA	0.01
LEPTOCHELIA DUBIA	0.01	ACTEOCINA HARPA	0.01
BATHYCOPEA GRANULATUS	0.03	CYLICHA DIEGENSIS	0.01
EDOTEA SUBLITTORALIS	0.02	VOLVULELLA CYLINDRICA	0.01
JAEROPSIS DUBIA	0.01	AGLAJA DICMEDEA	0.01
AMPELISCA CRISTATA	0.02	HERMISSENDA CRASSICORNIS	0.01
AMPELISCA COMPRESSA	0.01	CYCLOSTREMELLA DALLI	0.01
AROIDES COLUMBIAE	0.01	YOLDIA SCISSURATA	0.03
MEGALUROPOUS LONGIMERUS	0.01	MYTILUS EDULIS	0.01
EOHAUSTORIUS WASHINGTONIANUS	0.03	MODIOLUS NEGLECTUS	0.01
PLATYISCHNOMUS VISCANA	0.02	MYTILIDAE, UNID.	0.02
PHOTIS MACROTHICA	0.01	PARVILUCINA TENUISCUPTA	0.01
JASSA FALCATA	0.26	MYSELLA PEDROANA	0.01
MICROJASSA LITOTES	0.01	MYSELLA GRIPPI	0.02
LEPIDEPECREUM GURJANOVAE	0.01	NEAEROMYA COMPRESSA	0.01
WESTWOODILLA CAECULA	0.01	TELLINA MODESTA	0.18
SYNHELIDIUM SP.	0.06	TELLINA SP.	0.09
PHOXOCEPHALIDAE, UNID.	0.03	MACOMA SP.	0.04
MANDIBULOPHOXUS GILESI	0.01	SOLENI SICARIUS	0.01
PARAPHOXUS SP.	0.01	SOLENI SP.	0.01
RHEPOXYNIUS ABRONIUS	0.10	PERIPLOMA DISCUS	0.09
RHEPOXYNIUS BICUSPIDATUS	0.07	PELECYPODA, UNID.	0.01
RHEPOXYNIUS EPISTOMUS	1.01	PHORONIDA, UNID.	0.03
RHEPOXYNIUS HETEROCUSPIDATUS	0.01	PHORONIS SP.	0.01
FOXIPHALUS OBTUSIDENS	0.01	OPHIUROIDEA, UNID.	0.01
RHEPOXYNIUS STENODES	0.07	OPHIOPHRAGMUS DIGITATA	0.01
RHEPOXYNIUS VARIATUS	0.07	DENDRASTER EXCENTRICUS	0.03
METHARPINIA JONESI	0.05	LEPTOSYNAPTA SP.	0.02
PARAPLEUSTES PUGETTENSIS	0.01	HEMICHORDATA, UNID.	0.14
STENOTHOE ESTACOLA	0.01	BRANCHIOSTOMA CALIFORNIENSE	0.03
STENOTHOE VALIDA	0.01		
GAMMARIDEA, UNID.	0.02		
CAPRELLIDAE, UNID.	0.04		
DEUTELLA CALIFORNICA	0.02		
CAPRELLA EQUILIBRA	0.01		
OGYRIDES SP.A	0.01		
HIPPOLYTIDAE, ZOEAE, UNID.	0.01		
CALLIANASSA SP.	0.03		
CALLIANASSA, ZOEAE, UNID.	0.01		
PUGETTIA DALLI	0.01		
PINNIXA SP.	0.02		
PINNIXA, ZOEAE, UNID.	0.10		
LEPIDOPA CALIFORNICA	0.01		
TRICOLIA SUBSTRIATA	0.01		
CAECUM CREBRICINCTUM	0.03		
CREPIDULA SP.	0.01		
NEVERITA RECLUZIANA	0.01		
ALIA CARINATA	0.01		
NASSARIUS PERPINGUIS	0.01		
OLIVELLA BAETICA	0.14		
OLIVELLA BIPLICATA	0.02		
OLIVELLA SP.	0.01		

Table 4B-2. Mean infaunal grain size analysis, organic carbon content, and Secchi disc by station, March 1980.

PARAMETER	STATION								
	A1	A2	A3	B1	B2	B3	C1	C2	C3
	MARCH 1980								
% GRAVEL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% SAND	42.43	41.67	52.30	92.07	44.90	36.10	92.17	100.00	51.60
% SILT	52.57	51.20	46.42	7.30	48.22	57.87	7.57	0.00	47.72
% CLAY	4.93	6.90	1.08	0.37	6.50	5.90	0.00	0.00	0.00
MEAN PHI	4.40	4.73	4.12	3.18	4.76	4.81	3.24	1.37	3.88
SKEWNESS	1.50	1.29	1.12	1.35	1.25	1.26	0.41	0.44	0.19
KURTOSIS	11.09	7.58	7.80	12.07	7.36	7.88	4.67	2.32	1.03
SORTING	57.61	51.45	65.54	69.50	49.06	51.33	72.58	70.94	57.23
% CARBONATE CARBON	0.08	0.08	0.05	0.10	0.19	0.08	0.02	0.18	-1.03
% ORGANIC CARBON	0.23	0.38	0.23	1.09	1.12	0.28	0.13	0.16	-1.08
SECCHI DISC (M)	0.80	0.80	0.80	0.50	0.50	1.00	0.50	0.50	0.80
	D1	D2	D3	E1	E2	E3	F1	F2	F3
% GRAVEL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% SAND	96.50	86.15	66.15	87.67	78.50	95.27	92.07	73.07	53.30
% SILT	3.23	13.20	29.30	11.50	21.32	4.22	7.40	26.40	45.87
% CLAY	0.23	0.45	4.50	0.77	0.13	0.00	0.00	0.47	0.80
MEAN PHI	2.93	3.09	3.51	3.48	3.61	1.82	3.26	3.76	4.07
SKEWNESS	0.10	0.47	0.84	1.75	0.60	0.86	1.10	0.95	0.86
KURTOSIS	8.23	3.10	4.13	16.20	5.11	4.51	6.69	8.78	5.77
SORTING	65.31	58.88	45.31	75.47	71.94	64.49	73.2	71.87	66.23
% CARBONATE CARBON	0.00	0.08	2.04	0.00	0.07	0.73	0.05	0.06	0.05
% ORGANIC CARBON	0.11	0.11	0.13	0.12	0.14	0.14	0.28	0.70	0.61
SECCHI DISC (M)	0.80	1.30	2.30	1.30	1.00	2.00	2.50	2.30	2.00

Table 4B-3. San Onofre monthly sediment heights, 1980.

STATION	MONTHS		
	JAN	FEB	MAR
A1	122.0	95.0	98.0
A2	97.0	95.0	95.0
A3	90.0	69.0	60.0
B1	97.0	70.0	102.0
B2	79.0	73.0	80.0
B3	90.0	61.0	69.0
C1	100.0	80.0	59.0
C2	108.0	62.0	72.0
C3	117.0	109.0	109.0
D1	80.0	52.0	55.0
D2	86.0	107.0	95.0
D3	105.0	**	96.0
E1	97.0	140.0	44.0
E2	105.0	95.0	98.0
E3	110.0	105.0	120.0
F1	102.0	50.0	32.0
F2	88.0	100.0	89.0
F3	90.0	92.5	90.0

** MISSING DATA

CHAPTER 5

PLANKTON - RECEIVING WATERS

This single program meets the requirements of the Environmental Technical Specifications (ETS), the Preoperational Monitoring Program (PMP), and the National Pollutant Discharge Elimination System (NPDES). This program was designed to determine the nature, extent, and significance of the effects of San Onofre Units 1, 2, and 3 operations on the species composition, distribution, and abundance of plankton offshore San Onofre.

METHODS

A detailed description of station locations and field and laboratory methodology is given in combined ETS and PMP procedures (LES Procedures P-0-8/78). A general review is presented below.

Field

Eleven stations comprise the required plankton sampling station array for the combined Unit 1 ETS and Units 2 and 3 PMP programs (Figure 5-1). The ETS stations (Stations 1-7) are located upcoast, downcoast, and directly offshore of SONGS along the 10-m isobath. The required PMP stations (Stations 10-13) are similarly located on the 15-m isobath (Figure 5-1).

Biological sampling included collection of zooplankton samples and whole-water samples for analysis of chlorophyll *a* and phaeopigment concentration. These samples were collected concurrently from two strata within the water column at each station by use of a plankton pump system. The upper stratum extends from the surface to 5-m depth at the ETS stations and from the surface to 8-m depth at the PMP stations. The lower stratum encompasses the depth interval from 5 to 10 m at the ETS stations and from 8 m to the bottom for the PMP stations. Within each of these strata, samples were integrated by obtaining 0.33 m³ of water at each 1-m depth interval within a stratum. Zooplankton were obtained by filtering water through a 202- μ m mesh plankton net. A 450-ml whole-water sample was obtained for chlorophyll *a* and phaeopigment concentration analysis by collecting a small fraction of the water pumped through the plankton net. Two replicate water samples and two replicate zooplankton samples were collected from each stratum at each station. The first replicate was taken as the pump intake was lowered and the second as it was raised. This procedure was repeated on three days within a seven-day period for each survey during January, March, and May except that inshore Stations 2, 3, and 5 were not sampled on the second and third days. All samples were collected during daylight hours.

Physical data were collected concurrently with biological sampling. Temperature and transmissivity measurements were taken at 1-m intervals using a Martek XMS temperature-transmissivity unit. During 1980, transmissivity-depth profiles were obtained at selected stations during the January, March, and May surveys only. Temperature-depth profiles were obtained each time a station was sampled. Gross current speed and direction of flow was estimated by deployment of a subsurface drogue for a measured length of time (15 min to 1 h) while each station was occupied. Meteorological information, including cloud cover, wind, and sea conditions were obtained each time a station was occupied. These data are presented in Volume II: Comprehensive Annual Data Report (SCE 1981a) and will, where

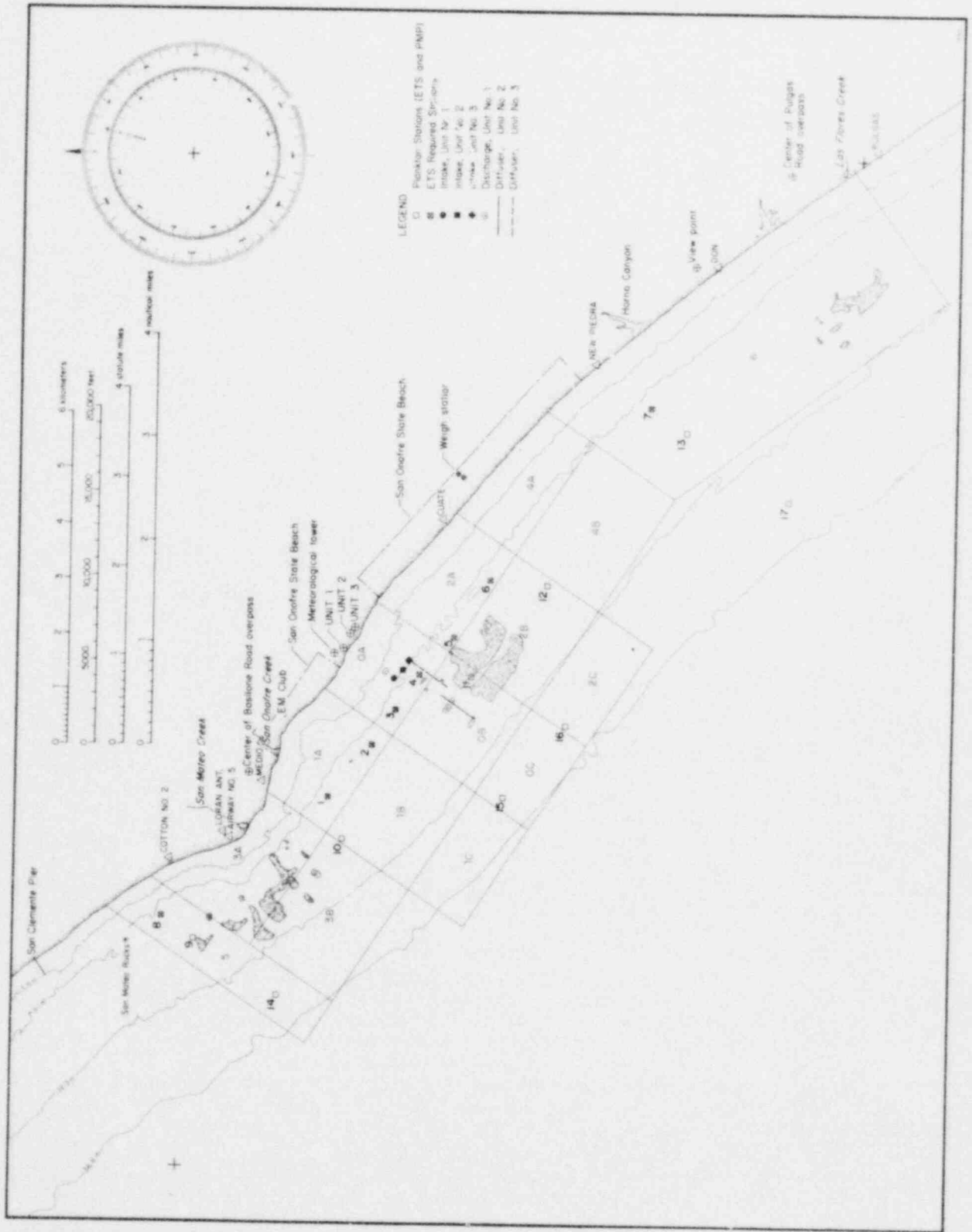


Figure 5-1. ETS and PMP plankton receiving water station locations at San Onofre Nuclear Generating Station. Shaded areas represent the areal extent of the kelp canopies sampled in December 1978.

appropriate, be analyzed with the biological data in Volume III: Data Analysis for the 1980 Annual Operating Report (SCE 1981b).

Plankton surveys were conducted on 8, 10, and 13 January; 10-12 March, 15, 17, and 18 May; 19 July; 16 September; and 5 November 1980. During the January, March, and May surveys all 11 required stations were sampled in accordance with combined ETS, NPDES, and PMP requirements. The two-year PMP was completed in May 1980, therefore, surveys during July, September, and November were conducted only at Stations 1-7 in accordance with the ETS.

Laboratory

Phytoplankton populations were assessed by determining phytopigment concentrations from whole-water samples. These samples were glass-fiber filtered, ground in acetone, and examined with a Turner fluorometer for the determination of chlorophyll a and phaeopigment concentrations.

Assessment of zooplankton populations was conducted on the basis of identification and enumeration of select zooplankton taxa and determination of total dry weight biomass. Using properly selected zooplankton species, the time and expense of sample processing can be reduced without an accompanying loss of information. Each of the select taxa examined was numerically abundant based on three years of ETS data and is considered a major component of the taxonomic and trophic structure of the zooplankton community offshore of San Onofre. These select taxa consist of Penilia avirostris, Acartia tonsa, Acartia spp. copepodites, Corycaeus anglicus, Euterpina acutifrons, Labidocera trispinosa copepodites, Oithona oculata, Paracalanus parvus, Paracalanus parvus copepodites, Clausocalanus spp., all other copepods as an aggregate, cypris larvae, cyphonautes larvae, Sagitta spp., and all other plankton taxa as an aggregate. If an additional taxon was found to comprise more than 30% of the samples during a survey, it was also enumerated. Generally, zooplankton samples were sufficiently dense that sample abundances were estimated from subsamples. Stempel pipettes were used to obtain measured subsamples, or, if abundances were very low, a Folsom plankton splitter was used, or an entire sample was enumerated.

Zooplankton biomass was measured for each zooplankton sample collected during the January, March, and May surveys. Biomass samples were filtered and dried at 60°C for 24 h prior to weighing.

RESULTS

Data collected during the 1980 plankton surveys are presented in the following data tables. Mean zooplankton abundance data sampled at the ETS and PMP stations are presented for each survey. Ancillary data collected but not required are presented in Volume II: Comprehensive Annual Data Report (SCE 19 1a). These data, where appropriate, will be analyzed in detail in Volume III: Data Analysis for the 1980 Annual Operating Report (SCE 1981b). Mean chlorophyll a, phaeopigment data, and zooplankton biomass are presented by survey, station, and strata.

LITERATURE CITED

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Interim Studies, and Ancillary Data. Prepared by Brown and Caldwell, Lockheed Environmental Sciences, and Marine Biological Consultants, Inc.

Southern California Edison Company (SCE). 1981b. Oceanographic and Biological Annual Operating Report, San Onofre Nuclear Generating Station. Volume III: Environmental Technical Specifications Unit 1, National Pollutant Discharge Elimination System Units 1, 2, and 3, Construction Monitoring Program Units 2 and 3, and Preoperational Monitoring Program Units 2 and 3. Prepared by Brown and Caldwell, Lockheed Environmental Sciences, and Marine Biological Consultants, Inc., (in press).

Table 5-1. Rank, mean abundance (number/m³), and frequency of occurrence of select zooplankton sampled at all ETS plankton stations during the 1980 survey period.

JANUARY				MARCH			
RANK	ABUNDANCE	FREQUENCY	NAME	RANK	ABUNDANCE	FREQUENCY	NAME
1.0	881.143300	7	ACARTIA SPP. (COPEPODITES)	1.0	1257.795000	7	OTHER PLANKTON TAXA COMBINED
2.0	878.495600	7	PARACALANUS PARVUS (COPEPODITES)	2.0	1156.848000	7	ACARTIA SPP. (COPEPODITES)
3.0	885.533900	7	CLAUSSOCALANUS SPP.	3.0	1101.641000	7	CORYCAEUS ANGLICUS
4.0	703.873300	7	OTHER PLANKTON TAXA COMBINED	4.0	877.481500	7	PARACALANUS PARVUS (COPEPODITES)
5.0	314.511500	7	PARACALANUS PARVUS	5.0	555.615200	7	ACARTIA TONSA
6.0	298.986000	7	OTHER COPEPODS	6.0	511.913300	7	SAGITTA SPP.
7.0	229.959700	7	CORYCAEUS ANGLICUS	7.0	449.159.00	7	PARACALANUS PARVUS
8.0	190.980300	7	ACARTIA TONSA	8.0	258.826900	7	LABIDOCERA TRISPINOSA (COPEPODITES)
9.0	188.828100	7	CYPHONAUTES LARVAE	9.0	121.453300	7	CYPHONAUTES LARVAE
10.0	139.833500	7	LABIDOCERA TRISPINOSA (COPEPODITES)	10.0	108.992800	7	EUTERPINA ACUTIFRONS
11.0	109.125700	7	OITHONA OCULATA	11.0	108.992800	7	OTHER COPEPODS
12.0	57.582300	7	EUTERPINA ACUTIFRONS	12.0	65.86.910	7	CYPRIS LARVAE
13.0	49.858350	7	SAGITTA SPP.	13.0	27.826500	7	CLAUSSOCALANUS SPP.
14.0	13.757800	6	PODON POLYPHEMOIDES	14.0	2.47.3318	5	OITHONA OCULATA
15.0	10.153750	7	CYPRIS LARVAE	15.0	0.850919	1	PODON POLYPHEMIDFS
16.0	8.183960	2	PENILIA AVIROSTRIS				TOTAL AND MAXIMUM FREQUENCY
	4838.988000	7	TOTAL AND MAXIMUM FREQUENCY		7038.381000	7	
MAY				JULY			
RANK	ABUNDANCE	FREQUENCY	NAME	RANK	ABUNDANCE	FREQUENCY	NAME
1.0	4246.438000	7	OTHER PLANKTON TAXA COMBINED	1.0	686.251200	7	OTHER PLANKTON TAXA COMBINED
2.0	3479.555000	7	PODON POLYPHEMOIDES	2.0	245.775600	7	PARACALANUS PARVUS
3.0	3283.889000	7	ACARTIA SPP. (COPEPODITES)	3.0	228.627800	7	PODON POLYPHEMOIDES
4.0	1257.482000	7	PARACALANUS PARVUS (COPEPODITES)	4.0	211.540800	7	CYPHONAUTES LARVAE
5.0	586.477100	7	SAGITTA SPP.	5.0	156.225600	7	ACARTIA SPP. (COPEPODITES)
6.0	395.256400	7	ACARTIA TONSA	6.0	138.421100	7	PARACALANUS PARVUS (COPEPODITES)
7.0	268.611800	7	LABIDOCERA TRISPINOSA (COPEPODITES)	7.0	127.962600	7	OTHER COPEPODS
8.0	254.965400	7	PARACALANUS PARVUS	8.0	83.589250	7	CYPRIS LARVAE
9.0	241.970100	7	CORYCAEUS ANGLICUS	9.0	22.941130	7	LABIDOCERA TRISPINOSA (COPEPODITES)
10.0	111.278900	7	OTHER COPEPODS	10.0	18.825070	7	CORYCAEUS ANGLICUS
11.0	72.796800	7	EUTERPINA ACUTIFRONS	11.0	12.327570	7	SAGITTA SPP.
12.0	37.455840	7	CYPHONAUTES LARVAE	12.0	11.941310	7	CLAUSSOCALANUS SPP.
13.0	13.941500	6	CLAUSSOCALANUS SPP.	13.0	7.912737	7	EUTERPINA ACUTIFRONS
14.0	8.951216	4	CYPRIS LARVAE	14.0	6.839130	7	ACARTIA TONSA
15.0	8.951160	4	OITHONA OCULATA		1958.282000	7	TOTAL AND MAXIMUM FREQUENCY
	14178.878000	7	TOTAL AND MAXIMUM FREQUENCY				
SEPTEMBER				NOVEMBER			
RANK	ABUNDANCE	FREQUENCY	NAME	RANK	ABUNDANCE	FREQUENCY	NAME
1.0	4654.633000	7	ACARTIA SPP. (COPEPODITES)	1.0	598.646700	7	ACARTIA SPP. (COPEPODITES)
2.0	1542.766000	7	OTHER PLANKTON TAXA COMBINED	2.0	298.898400	7	OTHER PLANKTON TAXA COMBINED
3.0	1086.971000	7	ACARTIA TONSA	3.0	298.371300	7	PARACALANUS PARVUS (COPEPODITES)
4.0	942.112800	7	CORYCAEUS ANGLICUS	4.0	291.429400	7	OTHER COPEPODS
5.0	623.589500	7	SAGITTA SPP.	5.0	223.833900	7	CYPHONAUTES LARVAE
6.0	394.465700	7	PARACALANUS PARVUS	6.0	162.621200	7	ACARTIA TONSA
7.0	281.818300	7	PARACALANUS PARVUS (COPEPODITES)	7.0	87.420410	7	CLAUSSOCALANUS SPP.
8.0	177.518600	7	CYPHONAUTES LARVAE	8.0	48.614150	7	PENILIA AVIROSTRIS
9.0	69.851100	6	CLAUSSOCALANUS SPP.	9.0	39.312610	6	OITHONA OCULATA
10.0	67.384840	7	LABIDOCERA TRISPINOSA (COPEPODITES)	10.0	33.724010	7	CYPRIS LARVAE
11.0	43.733370	7	OTHER COPEPODS	11.0	32.476520	7	SAGITTA SPP.
12.0	20.262420	5	OTHER COPEPODS	12.0	31.479480	7	PARACALANUS PARVUS
13.0	14.927170	4	PENILIA AVIROSTRIS	13.0	24.584590	7	EUTERPINA ACUTIFRONS
14.0	8.836716	4	EUTERPINA ACUTIFRONS	14.0	23.253200	7	CORYCAEUS ANGLICUS
15.0	8.754229	3	CYPRIS LARVAE	15.0	16.858650	7	LABIDOCERA TRISPINOSA (COPEPODITES)
	9844.266000	7	TOTAL AND MAXIMUM FREQUENCY		2202.521000	7	TOTAL AND MAXIMUM FREQUENCY

Table 5-2. Rank, mean abundance, and frequency of occurrence of select zooplankton sampled at all PMP plankton stations during the 1980 sampling period.

JANUARY			
RANK	ABUNDANCE	FREQUENCY	NAME
1.0	1082.988000	4	CLAUSOCALANUS SPP.
2.0	748.147700	4	OTHER PLANKTON TAXA COMBINED
3.0	536.426000	4	PARACALANUS PARVUS(COPEPODITES)
4.0	355.712900	4	ACARTIA SPP.(COPEPODITES)
5.0	221.780600	4	CORYCAEUS ANGLICUS
6.0	221.698200	4	PARACALANUS PARVUS
7.0	206.221200	4	CYTHONAUTES LARVAE
8.0	178.666500	4	OTHER COPEPODS
9.0	165.290600	4	ACARTIA TONSA
10.0	98.542110	4	LABIDOCERA TRISPINOSA(COPEPODITES)
11.0	89.694950	4	SAGITTA SPP.
12.0	55.671950	4	EUTERPINA ACUTIFRONS
13.0	46.318770	4	OITHONA OCULATA
14.0	4.443993	4	PODON POLYPHEMOIDES
15.0	2.439610	4	CYPRIS LARVAE
16.0	0.352898	2	PENILIA AVIROSTRIS
	4814.397000	4	TOTAL AND MAXIMUM FREQUENCY

MARCH			
RANK	ABUNDANCE	FREQUENCY	NAME
1.0	1285.919000	4	PARACALANUS PARVUS(COPEPODITES)
2.0	1261.372000	4	CORYCAEUS ANGLICUS
3.0	1259.072000	4	OTHER PLANKTON TAXA COMBINED
4.0	672.793700	4	PARACALANUS PARVUS
5.0	633.921600	4	ACARTIA SPP.(COPEPODITES)
6.0	558.076900	4	SAGITTA SPP.
7.0	280.223100	4	ACARTIA TONSA
8.0	265.888200	4	LABIDOCERA TRISPINOSA(COPEPODITES)
9.0	263.854300	4	CYTHONAUTES LARVAE
10.0	144.103300	4	EUTERPINA ACUTIFRONS
11.0	111.291700	4	OTHER COPEPODS
12.0	107.460700	4	CYPRIS LARVAE
13.0	27.950370	4	CLAUSOCALANUS SPP.
14.0	0.748981	3	OITHONA OCULATA
	6872.684000	4	TOTAL AND MAXIMUM FREQUENCY

MAY			
RANK	ABUNDANCE	FREQUENCY	NAME
1.0	4547.156000	4	OTHER PLANKTON TAXA COMBINED
2.0	2615.763000	4	ACARTIA SPP.(COPEPODITES)
3.0	1545.434000	4	PODON POLYPHEMOIDES
4.0	1103.709000	4	PARACALANUS PARVUS(COPEPODITES)
5.0	877.993400	4	SAGITTA SPP.
6.0	533.163600	4	CORYCAEUS ANGLICUS
7.0	517.913000	4	ACARTIA TONSA
8.0	372.689700	4	PARACALANUS PARVUS
9.0	231.319500	4	LABIDOCERA TRISPINOSA(COPEPODITES)
10.0	148.597300	4	OTHER COPEPODS
11.0	95.957210	4	EUTERPINA ACUTIFRONS
12.0	27.498170	4	CYTHONAUTES LARVAE
13.0	14.928300	4	CLAUSOCALANUS SPP.
14.0	12.445250	4	CYPRIS LARVAE
15.0	0.208223	1	OITHONA OCULATA
	12664.780000	4	TOTAL AND MAXIMUM FREQUENCY

Table 5-3. Mean chlorophyll (C) and phaeopigment (P) concentrations (mg/m³) samples in upper and lower strata during the 1980 study period.

Survey Strata	JANUARY		MARCH		MAY		JULY		SEPTEMBER		NOVEMBER	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
ETS Station 1												
C	0.99	0.49	4.38	2.82	4.04	7.14	1.39	2.82	2.60	2.51	0.72	2.18
P	0.12	0.16	0.54	0.62	0.71	1.26	0.50	1.45	1.90	1.28	0.60	0.72
2												
C	0.28	0.53	2.89	2.39	1.31	8.09	1.90	5.95	2.46	2.49	2.25	1.98
P	0.36	0.71	0.92	0.64	0.21	0.06	0.51	1.17	1.35	1.68	0.66	0.70
3												
C	0.46	0.50	2.76	2.58	0.98	5.38	2.15	4.42	1.98	3.10	1.84	1.96
P	0.62	0.74	0.66	0.71	0.12	1.01	0.53	0.54	1.30	1.46	0.66	0.57
4												
C	1.00	0.48	1.56	2.37	3.71	3.76	1.49	3.55	2.16	1.95	1.10	0.85
P	0.37	0.39	0.48	0.67	0.99	1.11	0.34	0.34	1.43	1.13	0.40	0.26
5												
C	0.41	0.46	2.88	3.43	6.29	4.77	1.69	3.55	0.84	0.77	1.05	0.80
P	0.35	0.37	0.47	0.54	1.17	0.96	0.19	0.27	0.54	0.38	0.59	0.27
6												
C	1.10	0.57	1.58	2.31	1.14	6.02	1.60	2.21	0.78	0.81	0.67	1.14
P	0.23	0.30	0.35	0.67	0.57	0.98	0.14	0.23	0.44	0.43	0.31	0.78
7												
C	0.82	0.67	2.10	1.93	5.71	6.86	4.64	7.25	1.25	2.30	0.48	0.81
P	0.23	0.27	0.51	0.59	0.53	0.73	0.88	1.07	0.68	1.52	0.22	0.39
PMP Station 10												
C	0.62	0.37	6.87	2.93	4.80	6.83	†	†	†	†	†	†
P	0.23	0.18	0.95	0.80	0.81	1.08	†	†	†	†	†	†
11												
C	0.58	0.57	2.15	2.51	1.49	3.76	†	†	†	†	†	†
P	0.20	0.30	0.63	0.77	0.36	0.74	†	†	†	†	†	†
12												
C	1.25	0.60	3.68	3.59	2.12	4.70	†	†	†	†	†	†
P	0.19	0.33	0.68	0.97	0.42	0.68	†	†	†	†	†	†
13												
C	0.63	0.52	2.43	2.59	2.17	6.44	†	†	†	†	†	†
P	0.18	0.28	0.43	1.35	0.32	0.81	†	†	†	†	†	†

† No PMP data required.

Table 5-4. Mean zooplankton dry weight biomass (mg/m^3) values in upper and lower strata in PMP stations during the 1980 study period.

Survey Strata	January		March		May	
	Upper	Lower	Upper	Lower	Upper	Lower
Stations						
10	18.1	12.1	24.1	19.8	37.5	102.3
11	34.7	56.0	27.0	41.0	32.3	44.1
12	26.6	20.9	36.5	46.3	36.8	42.6
13	17.5	13.6	33.0	115.7	25.5	29.2

CHAPTER 6

FISH

A. FISH IN THE RECEIVING WATERS - GILL NETS

This single program meets the requirements of both the Environmental Technical Specifications (ETS) and Preoperational Monitoring Program (PMP). This program was designed to determine the nature, extent, and significance of the effects of San Onofre Unit 1 operations and to provide baseline information for San Onofre Units 2 and 3 on the species composition, distribution, and abundance of adult fish offshore San Onofre in conjunction with an additional program based on samples collected by otter trawl.

METHODS

A detailed description of station locations and field methodology is given in ETS Fish Survey Procedures (LES Procedures EMP 25-5-35) and PMP Fish Survey Procedures (LES Procedures N-1-1/79). A general review of these procedures is given below.

Field

A total of 14 (6 ETS and 8 PMP) gill net stations were established at sites in an upcoast (San Mateo Point) reference area; an area directly offshore of San Onofre Units 1, 2, and 3; and a downcoast (Don Light) reference area (Figure 6A-1). Each gill net station consisted of a pair of identical Marinovich experimental monofilament gill nets for replicate sampling. Each net measured 45.7 m long, 1.8 m deep, and contained six 7.6-m panels of bar mesh of the following sizes: 19 mm, 25 mm, 32 mm, 38 mm, 44 mm, and 64 mm. All nets were set over mostly cobble substrata, perpendicular to the shoreline and were retrieved after 24 h. This fishing period encompassed both dusk and dawn, the periods of greatest fish activity. Eight of the 14 stations (Stations 1, 2, 3, 6, 7, 8, 11, and 12) were located on the 9.1-m (30-ft) isobath. The remaining six stations (Stations 4, 5, 9, 10, 13, and 14) were located on the 13.7-m (45-ft) isobath (Figure 6A-1). Station 3 was located within 50 m of the San Onofre Unit 1 discharge and Station 6 was located approximately 2 km downcoast of Stations 7 and 8. Stations 1 through 6 were ETS stations; the remaining stations were PMP stations.

Temperature-transmissivity profile data were collected at each cluster of 9.1-m and 13.7-m gill net stations once daily for the two days of the survey. Data were taken at 1-m depth intervals from the surface to the bottom and are presented in Volume II: Comprehensive Annual Data Report (SCE 1981a).

Both ETS and PMP gill net sampling was conducted bimonthly on 26-27 February, 23-24 April, and 25-26 June 1980. In June the two-year PMP ended and the ETS continued during the remainder of 1980. The remaining 1980 ETS sampling was conducted quarterly on 21-22 August and 10-11 December 1980.

Laboratory

All fishes collected in gill net samples were identified, counted, and visually inspected for anomalies, diseases, and parasites. A group of select fish

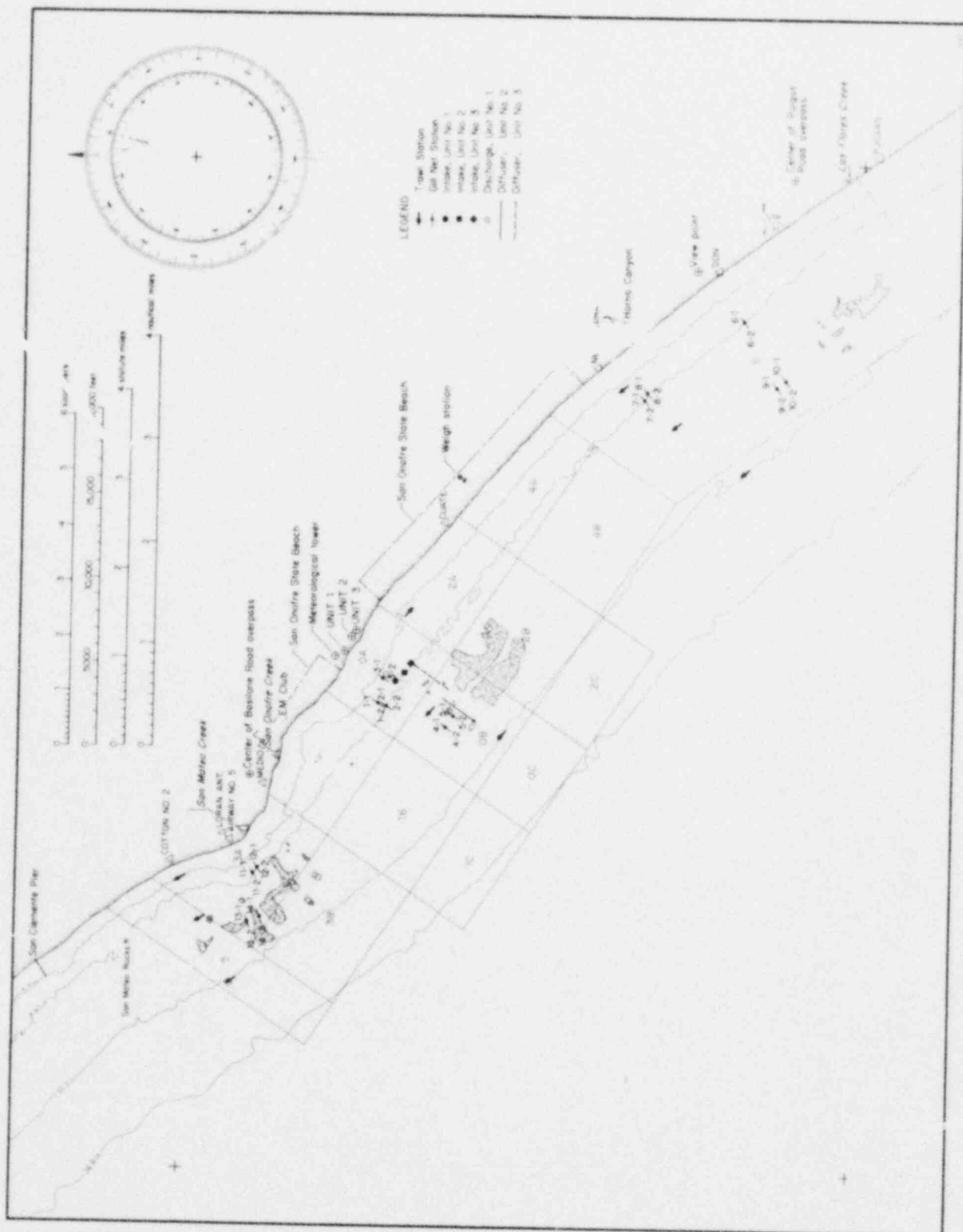


Figure 6A-1. ETS and PMP fish receiving water station locations at San Onofre Nuclear Generating Station. Shaded areas represent the areal extent of the kelp canopies sampled in December 1978.

species has been studied more intensively with the onset of the combined program. These following species were selected because of their numerical dominance in San Onofre Unit 1 impingement samples, their abundance offshore, and/or because of their value to local sport and commercial fisheries.

<u>Seriphus politus</u>	- Queenfish
<u>Genyonemus lineatus</u>	- White croaker
<u>Roncador stearnsii</u>	- Spotfin croaker
<u>Cynoscion nobilis</u>	- White seabass
<u>Hyperprosopon argenteum</u>	- Walleye surfperch
<u>Phanerodon furcatus</u>	- White surfperch
<u>Paralabrax clathratus</u>	- Kelp bass
<u>Paralabrax nebulifer</u>	- Barred sand bass
<u>Paralabrax maculatofasciatus</u>	- Spotted sand bass
<u>Paralichthys californicus</u>	- California halibut

Select species were identified, enumerated, measured, and sexed. Standard lengths (tip of the snout to the end of the vertebral column) of a maximum of 125 individuals per species from each gill net sample were measured. A subset of no more than 50 individuals per species were sexed (male, female, indeterminate) by examining their gonads or by noting secondary sexual characteristics when evident. Indeterminate fish were sexually immature, recently spawned, or damaged such that sex cannot be determined. General reproductive condition of fish was also noted.

A maximum of 10 female Seriphus politus and 10 female Genyonemus lineatus per net were subsampled for gonosomatic index analysis except during the December survey. Gonad and total body wet weights were determined for each subsampled female with gonad weight divided by total body weight to determine the index on a survey, area, and depth basis.

In addition to the preceding methods, which were utilized for the combined Units 1, 2, and 3 program, certain additional length and sex data were taken to maintain compliance with the Unit 1 ETS at some stations. The ETS required that all fish from the six nets near the Unit 1 discharge (Zone 0A) and the six nets at the downcoast inshore reference area (Zone 6) be measured and that a maximum of 10 individuals of resident species be subsampled for sex composition.

RESULTS

Summary community composition and total abundance data tables for all species combined and for four select species (Seriphus politus, Genyonemus lineatus, Hyperprosopon argenteum, and Phanerodon furcatus) collected during 1980 are presented. Length-frequency histograms including the ratio of males:females of the two most frequently collected species, S. politus and G. lineatus, are presented as annual totals based on area and depth.

A presentation of abundance, species composition, sex composition, gonosomatic indices (GSI), length-frequency, parasitized and anomalous species, and temperature-transmissivity profile data, and field notes collected for the ETS and PMP are presented in Volume II: Comprehensive Annual Data Report (SCE 1981a). Analysis of this data will be presented in Volume III: Data Analysis for the 1980 Annual Operating Report (SCE 1981b).

LITERATURE CITED

Southern California Edison Company (SCE). 1981a. Oceanographic and Biological Comprehensive Data Supplement, San Onofre Nuclear Generating Station. Volume II: Environmental Technical Specifications Unit 1, National Pollutant

Discharge Elimination System Units 1, 2, and 3, Construction Monitoring Program Units 2 and 3, Preoperational Monitoring Program Units 2 and 3, Interim Studies, and Ancillary Data. Prepared by Brown and Caldwell, Lockheed Environmental Sciences, and Marine Biological Consultants, Inc.

Southern California Edison Company (SCE). 1981b. Oceanographic and Biological Annual Operating Report, San Onofre Nuclear Generating Station. Volume III: Environmental Technical Specifications Unit 1, National Pollutant Discharge Elimination System Units 1, 2, and 3, Construction Monitoring Program Units 2 and 3, and Preoperational Monitoring Program Units 2 and 3. Prepared by Brown and Caldwell, Lockheed Environmental Sciences, and Marine Biological Consultants, Inc., (in press).

Table 6A-1. Total number of individuals and species captured by gill nets set on the 9.1- and 13.7-m isobaths during the ETS and PMP surveys of 1980. Areas surveyed for both ETS and PMP were Don Light (DL), an area 500 m up-coast of the Unit 1 Discharge (SONGS-U), and an area adjacent to the Unit 1 Discharge (SO-D). San Mateo Point (SMP) was surveyed for the PMP.

Total number of individuals (species)

Depth Station Replicates †	9.1 m					13.7 m			
	DL 30	SONGS 20	SO-D 10	SMP 12	TOTAL 72	DL 12	SONGS 12	SMP 12	TOTAL 36
Feb	141 (16)	219 (18)	99 (14)	186 (23)	645 (33)	221 (13)	101 (18)	225 (19)	547 (25)
Apr	98 (9)	54 (12)	25 (10)	203 (21)	380 (29)	75 (15)	70 (11)	65 (8)	210 (19)
Jun	372 (14)	130 (18)	54 (7)	92 (15)	648 (28)	123 (17)	97 (17)	75 (18)	295 (29)
Aug	436 (13)	367 (21)	145 (12)	††	948 (29)	††	††	††	—
Dec	145 (18)	163 (21)	119 (13)	††	427 (27)	††	††	††	—
TOTAL	1,193 (28)	933 (33)	442 (26)	475 (34)	3,043 (49)	419 (24)	268 (23)	365 (26)	1,052 (38)

† Total number of individuals of *Seriphus politus*, *Genyonemus lineatus*, *Hyperprosopon argenteum*, and *Phanerodon furcatus* collected in gill nets set on the 9.1- and 13.7-m isobaths during 1980.

Depth Station Replicates †	9.1 m					13.7 m			
	DL 30	SONGS 20	SO-D 10	SMP 12	TOTAL 72	DL 12	SONGS 12	SMP 12	TOTAL 36
<i>Seriphus politus</i>									
Feb	23	7	28	44	102	11	8	16	35
Apr	26	14	5	105	150	31	28	28	87
Jun	177	32	23	23	255	24	30	20	74
Aug	210	222	95	††	527	††	††	††	—
Dec	8	24	17	††	49	††	††	††	—
TOTAL	444	299	168	172	1,083	66	66	64	196
<i>Genyonemus lineatus</i>									
Feb	48	25	35	40	148	112	29	101	242
Apr	21	3	5	5	34	19	22	19	60
Jun	89	5	14	0	108	17	4	0	21
Aug	137	51	30	††	218	††	††	††	—
Dec	8	2	12	††	22	††	††	††	—
TOTAL	303	86	96	45	530	148	55	120	323
<i>Hyperprosopon argenteum</i>									
Feb	6	6	19	28	59	0	1	1	2
Apr	0	3	1	9	13	1	5	3	9
Jun	2	7	6	2	17	2	1	5	8
Aug	8	7	0	††	15	††	††	††	—
Dec	1	12	10	††	23	††	††	††	—
TOTAL	17	35	36	39	127	3	7	9	19
<i>Phanerodon furcatus</i>									
Feb	1	1	0	7	9	4	4	6	14
Apr	3	0	0	7	10	6	2	11	19
Jun	0	3	2	22	27	50	9	—	73
Aug	27	16	0	††	43	††	††	††	—
Dec	19	38	18	††	75	††	††	††	—
TOTAL	50	58	20	36	164	60	15	31	106

† Number of replicates per survey: 9.1 m - DL (6), SONGS (4), SO-D (2), SMP (4); 13.7 m four in each area.
 †† All PMP (9.1-m SMP; 13.7-m DL, SONGS, and SMP) stations were not sampled during the August and December 1980 surveys.

Table 6A-2. The rank order of abundance of fish species collected by gill nets set on the 9.1- and 13.7-m isobaths during 1980. The sampling locations were Don Light (DL), 500 m upcoast of and adjacent to the Unit 1 Discharge (SONGS), and San Mateo Point (SMP). (Continued)

DEPTH SURVEY ZONE	FEBRUARY			APRIL			9.1 m Isobath			AUGUST		DECEMBER		TOTAL 9.1m	13.7 m Isobath			TOTAL 13.7m	GRAND TOTAL										
	DL	SONGS	SMP	DL	SONGS	SMP	DL	SONGS	SMP	DL	SONGS	DL	SONGS		DL	SONGS	SMP			DL	SONGS	SMP							
EMBIOTRIDAE																													
<i>Amphistichus argenteus</i>		18.5	-	-	13	-	-	-	-	21	-	21.5	25	-	-	-	-	-	-	-	27	16.5							
<i>Brachyistius frenatus</i>	-	-	-	-	-	15.5	-	-	13.5	7.5	3	14	-	16	-	-	-	-	-	-	21	26							
<i>Cymatogaster aggregata</i>	-	-	-	-	-	-	8.5	-	13.5	-	-	-	-	-	-	-	11.5	6	-	9.5	-	24	23						
<i>Gnathichthys vacca</i>	-	-	-	-	13	15.5	-	16.5	-	-	-	14	14	23	-	-	-	-	-	-	2	14.5	8	10					
<i>Enhiotoca jacksoni</i>	-	18.5	9	8.5	6.5	2	-	6	-	12.5	7.5	14	5	9	8	11	17.5	11.5	-	-	-	4.5	9	7					
<i>Hyacrosopon argenteum</i>	5.5	4	3	-	8.5	4	8.5	4	10	7.5	7.5	14	4	7	-	15	17.5	11.5	3.5	4	9.5	2	4	4					
<i>Micrometrus minimus</i>	-	18.5	-	-	13	-	-	-	-	-	-	-	-	-	8	8	7	3	6	3	1	3	2	4	4				
<i>Phanerodon furcatus</i>	13.5	18.5	6	7	-	5	-	8.5	2	3	5	3	1	4	-	15	17.5	11.5	-	6.5	9.5	6	7	11.5	19				
<i>Rhacochilus toxotes</i>	-	-	20.5	-	-	19.5	-	12.5	-	-	-	11.5	-	14	21	-	-	-	-	-	-	-	-	-	34.5	53.5			
POMACENTRIDAE																													
<i>Chronis punctipinnis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	33	-	-	-	-	-	-	-	-	-	-	37				
<i>Hypsypops rubicundus</i>	9.5	-	20.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	16.5	21		
LABRIDAE																													
<i>Halichoeres semicinctus</i>	-	-	7	-	-	-	-	8.5	-	-	21	-	18	20	-	-	13	-	-	-	-	-	-	-	-	47	53.5		
<i>Oxyjulis californica</i>	-	-	20.5	-	-	-	-	-	-	-	-	-	-	17	-	15	-	11.5	-	-	-	-	6	9.5	14	18			
<i>Pseudomutinus pulchrum</i>	-	18.5	-	-	-	19.5	8.5	12.5	5.5	11	11.5	9	-	-	-	-	-	-	-	-	-	-	-	-	-	14.5	29.5	37	
SPHYRAENIDAE																													
<i>Sphyaena argentea</i>	-	-	-	-	-	-	-	-	-	-	21	-	-	47	-	-	-	-	6.5	-	-	-	-	-	-	14.5	29.5	37	
CLINIDAE																													
<i>Heterostichus rostratus</i>	-	-	20.5	-	-	-	-	-	-	-	-	-	-	47	-	15	13	-	-	-	15	18	-	21	31				
SCORPAENIDAE																													
<i>Sarda chiliensis</i>	-	9	-	8.5	-	-	4	-	-	4	21	-	12	-	-	-	-	3.5	-	-	15	-	-	-	-	34.5	42		
<i>Scorpaenopsis japonica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	47	-	-	-	-	-	-	15	-	-	-	-	34.5	53.5		
STROMATEIDAE																													
<i>Peprilus simillimus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-		
SCORPAENIDAE																													
<i>Scorpaena guttata</i>	13.5	18.5	16	-	-	10	12.5	-	7.5	-	21	14	21.5	19	-	15	-	-	-	-	9.5	8.5	-	16.5	20				
<i>Sebastes atrovirens</i>	-	-	-	-	-	-	-	-	-	-	21	-	-	37	-	-	-	-	-	-	-	-	-	-	-	-	42		
<i>Sebastes auriculatus</i>	-	-	-	-	13	-	-	-	-	-	-	-	-	47	-	-	-	-	-	-	-	-	-	-	-	-	42		
<i>Sebastes carnatus</i>	-	-	-	-	13	-	-	-	-	-	-	-	-	37	-	-	-	-	-	-	-	-	-	-	-	-	42		
<i>Sebastes rostratus</i>	-	-	16	-	-	-	-	-	-	-	-	-	-	47	-	-	-	-	-	-	-	7	24	33.5					
<i>Sebastes serranoides</i>	-	-	-	-	-	19.5	-	-	-	-	-	-	-	47	-	-	17.5	-	-	-	-	-	-	-	-	34.5	53.5		
<i>Sebastes serriceps</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53.5		
COTTIDAE																													
<i>Leptocottus armatus</i>	-	-	-	-	-	-	-	-	-	21	-	-	47	-	-	-	-	-	-	-	-	-	-	-	-	-	42		
<i>Scorpaenichthys marmoratus</i>	-	-	-	-	-	-	16.5	-	-	-	-	-	21.5	37	-	-	-	-	-	-	-	-	-	-	-	-	-	42	
BOYRIIDAE																													
<i>Citharichthys stirmaeus</i>	13.5	-	-	-	-	-	-	-	-	-	-	-	-	47	-	-	-	-	-	-	-	-	-	-	-	-	24	35	
<i>Citharichthys xanthurus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	24	35	
<i>Paralichthys californicus</i>	-	-	-	-	-	-	16.5	10	-	21	14	-	28	-	12.5	-	13	11.5	-	6.5	15	-	-	-	-	18.5	24.5		
PLEURONECTIDAE																													
<i>Pleuronichthys verticalis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.5	-	-	-	-	-	-	-	-	-	34.5	53.5	

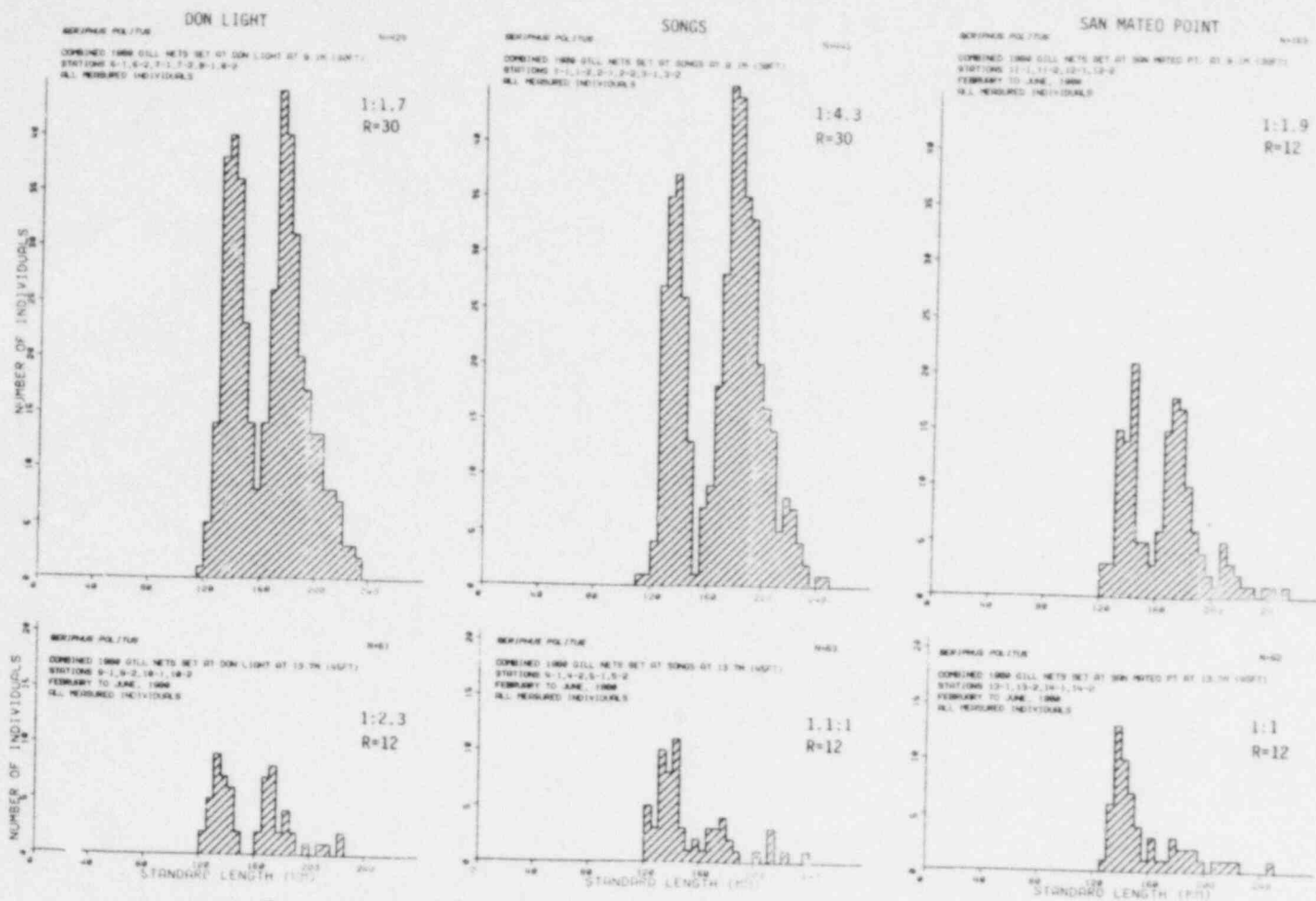


Figure 6A-2. Length-frequency histograms of *Seriphys politus* derived from gill net samples from the 9.1- and 13.7-m isobaths in the following areas during 1980: Don Light (DL), 500 m upcoast of and adjacent to the Unit 1 Discharge (SONGS), and San Mateo Point (SMP). The number of replicates collected per year is indicated by R and number of individuals by N. Sex ratios (Males: Females) are also presented.

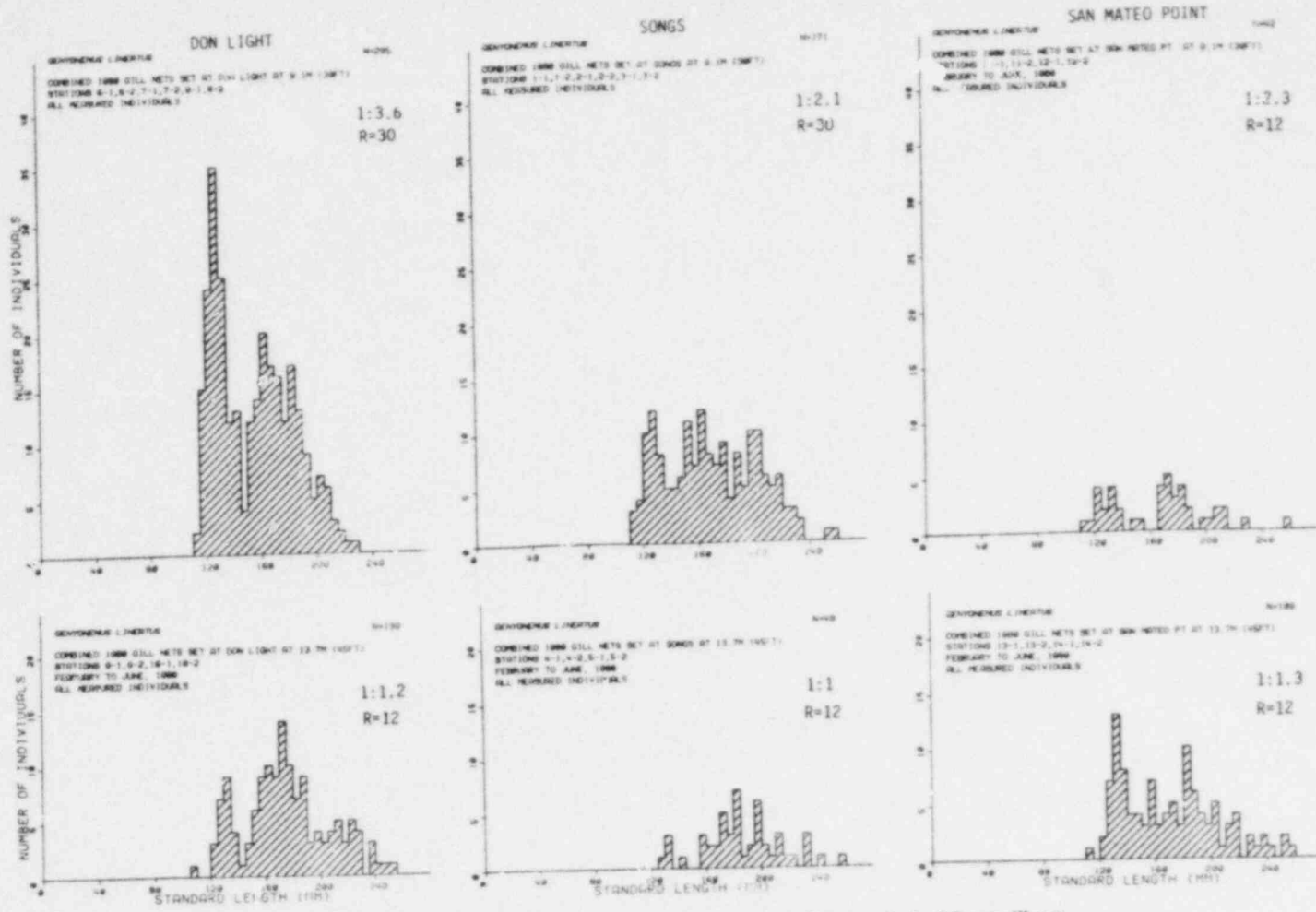


Figure 6A-3. Length-frequency histograms of *Genyonemus lineatus* derived from gill net samples from the 9.1- and 13.7-m isobaths in the following areas during 1980: Don Light (DL), 500 m upcoast of and adjacent to the Unit 1 Discharge (SONGS), and San Mateo Point (SMP). The number of replicates collected per year is indicated by R and number of individuals by N. Sex ratios (Males:Females) are also presented.

6B. FISH IMPINGEMENT

The impingement study was conducted in compliance with Environmental Technical Specification (ETS) Section 3.1.2.a(2) Heat Treatment, and ETS Section 4.2 Normal Operation, to provide data on the fish impinged by SONGS Unit 1.

METHODS

A detailed description of impingement sampling methods is given in ETS procedures for both normal operation (SCE R&D Procedures EMP 25-5-25) and heat treatments (SCE R&D Procedures EMP 25-5-58). A general review is presented below.

Normal Operation

Samples are collected at least weekly during normal flow operations. These samples are based upon a period of 24 hrs of continuous operations. Abundance data collected on an operational period of less than 24 hrs will be standardized to a 24 hr operational period. Due to irregular flow scheduling resulting from station shutdown, fish samples in 1980 could only be taken during the months of January, February, March, April, June, and July.

The data collected consists of the total number of taxa, number of individuals per taxon, and the aggregate weight per taxon of fish impinged on the traveling screens and bar rakes during the sampling period. Standard length for a maximum of 125 individuals per select species and sex for a maximum of 50 individuals per select species are also determined.

Heat Treatment

During each heat treatment, fish collected by traveling screens and bar rakes were identified, enumerated, weighed, and measured. Data collected is the same as described for normal operation sampling.

RESULTS

Fish impingement data collected during 1979 were obtained from two heat treatment, and 32 normal operation samples. A summary of the data collected are presented in the following tables. The number of individuals and aggregate weight per taxon are summarized for normal operation and heat treatment collections.

A more detailed breakdown of the data by individual sample is presented in the Comprehensive Data Supplement (SCE 1981). In addition, a detailed summary of length and sex data of impinged fish as well as abiotic parameters measured at the time of sampling are presented in the Supplement.

Table 6B-1. TOTAL NUMBER AND WEIGHT OF FISH APPEARING IN 32 NORMAL OPERATION SAMPLES TAKEN AT SAN ONOFRE UNIT 1 IN 1980.

----- PLANT=SAN ONOFRE UNIT=1 -----			
SPECIES NAME	COMMON NAME	COUNT	WT(KG)
ALOPIAS VULPINUS	PELAGIC THRESHER	1	9.98
AMPHISTICHUS ARGENTEUS	BARRED SURFPERCH	74	5.55
ANCHOA COMPRESSA	DEEP BODY ANCHOVY	482	5.75
ANISOTREMUS DAVIDSONI	SARGO	50	8.10
ATHERINOPS AFFINIS	TOPSMELT	167	5.41
ATHERINOPSIS CALIFORNIENSIS	JACKSMELT	3269	407.78
BRACHYISTIUS FRENATUS	KELP SURFPERCH	33	1.42
CHEILOSTREMA SATURNUM	BLACK CROAKER	20	3.45
CHROMIS PUNCTIPINNIS	BLACKSMITH	2	0.12
CITHARICHTHYS STIGMAEUS	SPECKLED SANDDAB	269	3.12
CYMATOGASTER AGGREGATA	SHINER SURFPERCH	148	4.08
CYNOSCION NOBILIS	WHITE SEABASS	16	4.31
DAMALICHTHYS VACCA	PILE SURFPERCH	20	4.82
EMBIOTOCA JACKSONI	BLACK SURFPERCH	91	7.01
ENGRAULIS MORDAX	NORTHERN ANCHOVY	3219	24.57
GENYONEMUS LINEATUS	WHITE CROAKER	7014	445.05
GIRELLA NIGRICANS	OPALEYE	59	42.53
GYMNOTHORAX MORDAX	CALIFORNIA MORAY	1	2.04
GYMNURA MARMORATA	CALIFORNIA BUTTERFLY RAY	11	22.45
HALICHOERES SEMICINCTUS	ROCK WRASSE	2	0.68
HERMOSILLA AZUREA	ZEBRAPERCH	1	1.13
HETERODONTUS FRANCISCI	HORN SHARK	5	3.62
HETEROSTICHUS ROSTRATUS	GIANT KELPFISH	60	4.43
HYPERPROSOPON ARGENTEUM	WALLEYE SURFPERCH	6931	229.11
HYPSSOBLENNIUS JENKINSI	MUSSEL BLENNY	11	0.46
HYPSPSETTA GUTTULATA	DIAMOND TURBOT	35	9.68
HYPSPOPS RUBICUNDA	GARIBALDI	5	2.05
LEPTOCOTTUS ARMATUS	STAGHORN SCULPIN	2	0.28
LEURESTHES TENUIS	CALIFORNIA GRUNION	1143	22.53
MENTICIRRHUS UNDULATUS	CALIFORNIA CORBINA	246	53.07
MERLUCCIIUS PRODUCTUS	PACIFIC HAKE	1	0.45
MICROMETRUS MINIMUS	DWARF SURFPERCH	42	1.23
MUSTELUS CALIFORNICUS	GRAY SMOOTHHOUND	23	14.05
MYLIOBATIS CALIFORNICA	BAT RAY	29	204.39
OTOPHIDIUM SCRIPPSAE	BASKETWEAVE CUSK-EEL	115	9.92
OTOPHIDIUM TAYLORI	SPOTTED CUSK-EEL	12	1.58
OXYJULIS CALIFORNICA	SEÑORITA	1	0.23
PARALABRAX CLATHRATUS	KELP BASS	4	0.85
PARALABRAX NEBULIFER	BARRED SAND BASS	60	10.83
PARALICHTHYS CALIFORNICUS	CALIFORNIA HALIBUT	91	16.85
PAROPHRYUS VETULUS	ENGLISH SOLE	2	0.57
PEPRILUS SIMILLIMUS	PACIFIC BUTTERFISH	751	30.11
PHANERODON FURCATUS	WHITE SURFPERCH	909	33.20
PINELOMETOPON PULCHRUM	CALIFORNIA SHEEPHEAD	1	0.23
PLATYRHINOIDIS TRISERIATA	THORNBACK	68	30.03
PLEURONICHTHYS COENOSUS	C-O TURBOT	21	5.72
PLEURONICHTHYS RITTERI	SPOTTED TURBOT	25	3.49
PLEURONICHTHYS VERTICALIS	HORNHEAD TURBOT	8	0.67
PORICHTHYS HYRIASTER	SPECKLEFIN MIDSHIPMAN	7	3.29
PORICHTHYS NOTATUS	PLAINFIN MIDSHIPMAN	169	15.78
RAJA BINOCULATA	BIG SKATE	1	1.47
RHACCOCHILUS TOXOTES	RUBBERLIP SURFPERCH	23	1.23
RHINOBATOS PRODUCTUS	SHOVELNOSE GUITARFISH	43	18.32
RONCALOR STEARNSI	SPOTFIN CROAKER	267	138.44
SCORPAENA GUTTATA	SCULPIN	137	19.10
SCORPAENICHTHYS MARMORATUS	CABEZON	3	1.02
SEBASTES AURICULATUS	BROWN ROCKFISH	5	0.85
SEBASTES PAUCISPINIS	BOCACCIO	2	0.05
SEBASTES KASTRELLIGER	GRASS ROCKFISH	13	2.83
SEBASTES SERRANOIDES	OLIVE ROCKFISH	29	18.48
SERIPHUS POLITUS	QUEENFISH	66263	1528.88
SQUALUS ACANTHIAS	SPINY DOGFISH	60	138.12
SYNGNATHUS	PIPEFISH	20	1.18
TORPEDO CALIFORNICA	CALIFORNIA ELECTRIC RAY	34	562.69
TRIAKIS SEMIFASCIATA	LEOPARD SHARK	20	7.27
UMBRINA RONCADOR	YELLOWFIN CROAKER	74	5.10
UROLOPHUS HALLERI	ROUND STRINGRAY	237	87.44
VOMER DECLIVIFRONS	PACIFIC MOONFISH	1	0.23
XENISTIUS CALIFORNIENSIS	SALEMA	77	2.66
XYSTREURYS LIOLEPIS	FANTAIL SOLE	2	0.22
TOTAL SPECIES		93117	4253.63

Table 6B-1. TOTAL NUMBER AND WEIGHT OF FISH APPEARING IN 1980 HEAT TREATMENT OPERATIONS AT SAN ONOFRE UNIT 1.

----- PLANT=SAN ONOFRE UNIT=1 -----			
SPECIES NAME	COMMON NAME	COUNT	WT(KG)
AMPHISTICHUS ARGENTEUS	BARRED SURFFERCH	1	0.11
ANCHOA COMPRESSA	DEEP BODY ANCHOVY	45	0.50
ANISOTREMUS DAVIDSONI	SARGO	33	14.18
ATHERINOPS AFFINIS	TOPSMELT	165	4.47
ATHERINOPSIS CALIFORNIENSIS	JACKSMELT	201	22.23
CHEILOSTREMA SATURNUM	BLACK CROAKER	23	2.84
CHROMIS PUNCTIPINNIS	BLACKSMITH	3	0.23
CYMATOGASTER AGGREGATA	SHINER SURFFERCH	1	0.11
CYNOSCION NOBILIS	WHITE SEABASS	3	1.59
DAMALICHTHYS VACCA	PILE SURFFERCH	8	2.27
EMDIOTOCA JACKSONI	BLACK SURFFERCH	22	3.74
ENGRAULIS MORDAX	NORTHERN ANCHOVY	11	0.16
GENYONEMUS LINEATUS	WHITE CROAKER	23	2.50
GIRELLA NIGRICANS	OPALEYE	18	13.61
HETEROSTICHUS ROSTRATUS	GIANT KELPFISH	3	0.34
HYPERPROSOPON ARGENTEUM	WALLEYE SURFFERCH	3900	170.66
HYPSSOBLENNIUS JENKINSI	MUSSEL BLENNY	3	0.05
HYPSSYPOPS RUBICUNDA	GARIBALDI	3	0.80
LEURESTHES TENUIS	CALIFORNIA GRUNION	21	0.28
MENTICIRRHUS UNDULATUS	CALIFORNIA CORBINA	4	0.45
OTOPHIDIUM SCRIPPSAE	BASKETWEAVE CUSK-EEL	1	0.11
OTOPHIDIUM TAYLORI	SPOTTED CUSK-EEL	1	0.23
PARALABRAX NEBULIFER	BARRED SAND BASS	149	19.05
PARALICHTHYS CALIFORNICUS	CALIFORNIA HALIBUT	3	0.34
PEPRILUS SIMILLIMUS	PACIFIC BUTTERFISH	2	0.05
PHANERODON FURCATUS	WHITE SURFFERCH	11	1.02
PIMELOMETOPON PULCHRUM	CALIFORNIA SHEEPHEAD	7	6.35
PLATYRHINOIDIS TRISERIATA	THORNBACK	1	0.57
RONCADOR STEARNSI	SPOTFIN CROAKER	8	3.85
SCORPAENA GUTTATA	SCULPIN	62	5.67
SCORPAENICHTHYS MARMORATUS	CABEZON	3	1.13
SEBASTES RASTRELLIGER	GRASS ROCKFISH	23	4.08
SERIPHUS POLITUS	QUEENFISH	617	34.70
SQUALUS ACANTHIAS	SPINY DOGFISH	2	3.29
TORPEDO CALIFORNICA	CALIFORNIA ELECTRIC RAY	4	74.39
UMBRINA RONCADOR	YELLOWFIN CROAKER	19	1.82
UROLOPHUS HALLERI	ROUND STINGRAY	7	3.07
XENISTIUS CALIFORNIENSIS	SALEMA	5	0.05
TOTAL SPECIES		5416	400.89