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THE NEARSHORE PHYSICAL OCEANOGRAPHY OFF THE CENTRAL CALIFORNIA COAST DURING MAY-JUNE, 1989: A SUMMARY OF CTD DATA FROM JUVENILE ROCKFISH SURVEYS

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

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ABSTRACT

Hydrographic conditions over a 30-day period in May-June 1989 from the coastal ocean bounded by Cypress Pt. (36°35'N) and Pt. Reyes, CA (38°10'N), and from the coast to about 75 km offshore, are summarized in a series of horizontal maps and vertical transects. A total of 380 CTD casts were obtained during the DAVID STARR JORDAN cruise DS8904, over the course of three consecutive sweeps of the region. Data products contained in this report include: (1) a master list of all CTD stations during the cruise; (2) surface meteorological time series from the region's four NDBC meteorological buoys and a coastal station; (3) horizontal maps of temperature, salinity, σ_t and other hydrographic products at depths of 5 m, 30 m, 50 m, 100 m and 200 m; (4) temperature, salinity and σ_t along one alongshelf and five cross-shelf vertical transects; and (5) temperature-salinity plots.

INTRODUCTION

In recent years, attempts have been made to integrate the studies of fisheries biologists investigating the recruitment problem (Sissenwine 1984; Rothschild 1986) with those of physical oceanographers studying coastal circulation patterns. This development is due to the widely held perception that spatial and temporal variations in hydrodynamics, on a wide range of scales, have a direct influence on the retention of young-of-the-year in areas favorable for their growth and survival (*e.g.*, Sinclair 1988). This realization has fostered the development of interdisciplinary studies in the area of "recruitment fisheries oceanography" (Wooster 1988; Office of Oceanic and Atmospheric Research 1989[1]).

Along the central California coast, rockfishes of the genus *Sebastes* are a major component of the west coast groundfish fishery (Gunderson and Sample 1980), with annual landings from 1981-88 averaging in excess of 45,000 MT yr^{-1} (Pacific Fishery Management Council 1989). Current management of the rockfish fishery is based largely upon analyses of catch at age data. Such models are usually poorly constrained in the absence of other information (Deriso *et al.* 1985). Auxiliary data, such as an independent recruitment index, have the potential to greatly assist in the management of this fishery.

Research conducted at the Southwest Fisheries Science Center's (SWFSC) Tiburon Laboratory since 1983 has attempted to develop a recruitment index for rockfish. Data obtained during annual midwater trawl surveys have provided information regarding distributional and abundance patterns of young-of-the-year pelagic juveniles in the area between Monterey and Bodega Bay (latitude 36°30'-38°10'N; Wyllie-Echeverria *et al.* 1990). Results of this research show a complex pattern in the spatial distribution of pre-recruits of a variety of commercially significant species (*e.g.*, widow rockfish [*S. entomelas*], chilipepper [*S. goodei*], yellowtail rockfish [*S. flavidus*],

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[1]Office of Oceanic and Atmospheric Research. 1989. Program Development Plan for the NOAA Recruitment Fisheries Oceanography Program. National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Washington, D.C. 28 p.

bocaccio [*S. paucispinis*] and shortbelly rockfish [*S. jordani*]). Moreover, extreme interannual fluctuations in abundance have occurred, with combined stratified mean catches per haul ranging from 5-1,000 juvenile rockfish/tow (Ralston 1990[2]).

Field studies have shown that the survey region is hydrodynamically complex. The California Current provides the backdrop for large scale, seasonal circulation patterns (Hickey 1979). Coastal upwelling also occurs regionally for most of the year, especially from April-September (Huyer 1983). On the mesoscale (10-100 km), irregularities in the coastline interact with the wind stress field (Kelly 1985), resulting in turbulent jets, eddies and upwelling filaments, all of which are common features along the central California coast (Mooers and Robinson 1984; Flament *et al.* 1985; Njoku *et al.* 1985). Moreover, wind-driven fluctuations in coastal flow (Chelton *et al.* 1988) and freshwater discharge from the San Francisco Bay tidal plume (Applied Environmental Science Division[3]) add further complexity to the circulation regime.

Realizing that a basic description of the physical environment is necessary to better understand the distribution and abundance of young-of-the-year rockfish, collection of CTD data was initiated in 1987 as part of the Tiburon Laboratory's annual midwater trawl surveys. In the spirit of Wooster (1988), staff of the SWFSC Pacific Fisheries Environmental Group subsequently developed an interest in analyzing the CTD data and were enlisted in this recruitment fisheries oceanography study. Ultimately, it is our goal to determine and forecast the manner in which rockfish year class strength is affected by variations in the physical environment.

This report summarizes results obtained from the CTD data collected in 1989. Due to the large quantity of data analyzed and the extensive array of results presented herein, we make no attempt to provide detailed interpretations of our findings. Also, we refer the reader to a companion volume (Schwing and Ralston 1990[4]), which contains individual traces of temperature, salinity, and density (σ_t) plotted against depth for each CTD cast conducted. Additional reports covering juvenile groundfish cruises during 1987, 1988, and 1990 are currently in preparation. Further scientific analysis of these data, and their linkages to fisheries recruitment, will be compiled in future peer-reviewed scientific publications.

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[2]Ralston, S. (editor). 1990. Progress in rockfish recruitment studies. Southwest Fish. Cent. Admin. Rep. T-90-02, 45 p.

[3]Applied Environmental Science Division. Final report California seabird ecology study. Volume II. Satellite data analysis. Science Applications International Corporation. Monterey, California.

[4]Schwing, F. B., and S. Ralston. 1990. Individual cast data for CTD stations conducted during cruise DSJ-89-04 (May 14-June 13, 1989). Southwest Fish. Sci. Cent. Admin. Rep. PFEG-91-01, 7 p. + figs.

MATERIALS AND METHODS

Juvenile Rockfish Survey Design

Annual 30-day cruises aboard the NOAA R/V DAVID STARR JORDAN began in 1983 and have been conducted during late spring (May-June), a time when most pelagic-stage juvenile rockfishes are identifiable to species, but prior to their settling to nearshore and benthic habitats. Throughout this time a standard haul consisted of a 15-minute nighttime tow of a large midwater trawl set to a depth of 30 m. Additional tows have been made at other depths (*i.e.*, 10 and 100 m) as allowed by constraints imposed by time and bottom topography.

In 1986, the sampling design was altered to permit three consecutive "sweeps" through a study area bounded by Cypress Pt. (36°35'N) and Pt. Reyes (38°10'N), and from the coast to about 75 km offshore. Trawls are now conducted at 5-6 stations along a transect each night; each sweep is composed of 7 transects. Starting in 1987, a CTD cast was conducted at each trawl station occupied. In addition, daytime activities were restructured to permit sampling of a new grid of CTD stations (Table 1; Fig. 1). As an operational goal, 112 casts are planned for each of three sweeps during a cruise (Table 1). Although each sweep typically lasts approximately 10 days (7 nights of scheduled work plus 3 nights of additional discretionary sampling), adverse weather conditions can extend the completion date of a sweep. Logistical constraints can also restrict the number of casts completed. Discretionary sampling typically was focused on specific bathymetric features, such as Cordell Bank or Pioneer Canyon, or devoted to the intense study of oceanic features or processes that may be key to successful recruitment.

Collection of CTD Data at Sea

All CTD data obtained during the 1989 juvenile rockfish surveys were collected with a Sea-Bird Electronics SEACAT-SBE-19 profiler[5]. This particular unit is rated to a depth of 200 m and contains 64K of memory. Four data channels were used to record pressure (0.05% of full scale range [50-5,000 psia]), temperature (0.01 °C from -5 to +35 °C), and conductivity (0.001 S/m from 0 to 7 S/m) at a baud rate of 9,600. The profiler has been recalibrated annually by Sea-Bird Electronics, Inc. since its purchase in 1987. The CTD unit aboard the JORDAN was also intercalibrated *a posteriori* with three other CTD units, which were used by personnel from Monterey Bay Aquarium Research Institute, Naval Postgraduate School and UC-Santa Cruz to collect data at selected mutually occupied stations during the time period of this cruise. This intercalibration revealed that the difference between these four systems at the deepest common depths, where natural variability is expected to be lowest, is less than that actually occurring at these stations, based on repeated sampling using the same unit.

During deployment, the vessel was brought to a dead stop and the profiler was attached to a hydrographic winch cable. The profiler was then switched on and suspended underwater at the surface for a period of at least one minute to allow the conductivity and temperature sensors to equilibrate.

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[5]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

The rate of descent was 60 m/min to a depth 10 m off the bottom if water depths were less than 200 m. Otherwise the profiler was lowered to its maximum rated depth (200 m). Only data collected on the downcast were ultimately preserved for analysis. During the cast, certain collection information was recorded on data sheets, including: (1) the date; (2) time; (3) geographical stratum; (4) a profiler assigned cast number; (5) a cruise consecutive index number; (6) the trawl station number (when appropriate); (7) latitude; (8) longitude; and (9) bottom depth. Position fixes were obtained from the bridge using LORAN-C.

Due to the limited storage capacity of the SEACAT-SBE-19 profiler (64K) data collected from a short series of casts (usually no more than 5-7) were periodically downloaded to a personal computer on board the vessel. During this step, each cast was stored as an individual file and named using a unique cruise consecutive index number. After downloading, the profiler was reinitialized and the files on the personal computer were backed up to diskette.

An independent source of hydrographic data was also available. The JORDAN contains a CAMAC unit that provides a continuous data stream of surface temperature and salinity. These data were stored on diskette for further processing, analysis, and comparison with and verification of CTD observations. Position fixes for CAMAC were based on the SATNAV navigation system.

Data Processing

The first step in data processing was to convert the downloaded binary data to ASCII format. This was accomplished using the SEASCII program supplied by Sea-Bird Electronics, Inc. The data were then analyzed with a FORTRAN program that performed the following functions: (1) removal of the equilibration phase from the data stream; (2) removal of the upcast or retrieval phase from the data stream; (3) removal of extreme outliers (*i.e.*, spikes); (4) correcting phase differences in sensor response by reverse-lagging temperature data

$$\text{(i.e., } T_i = T_i + 0.9[T_{i+1} - T_i]\text{);}$$

(5) smoothing conductivity and temperature values using {1,4,6,4,1} weighting; (6) computing salinity and density for each scan using algorithms adapted from programs supplied by Sea-Bird Electronics, Inc. (SEASOFT, Version 2.5); (7) averaging temperature, salinity, and density values into 1 m depth bins, and; (8) smoothing these using {1,2,3,2,1} weighting. A detailed discussion of the rationale behind these procedures may be found in the SEACAT-SBE-19 Conductivity, Temperature, Depth Recorder Operating and Repair Manual[6] [see also UNESCO (1988)].

The bin-averaged data from each cast were then merged with the correct collection information (*e.g.*, date, time, position, etc.) and archived as cast-specific dBase III files. Prior to analysis, these were subsequently converted to ASCII format using a SAS macro (SAS 1987).

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[6]SEACAT-SBE-19 Conductivity, Temperature, Depth Recorder Operating and Repair Manual, Serial Number 24, 30 March 1987, Sea-Bird Electronics, Inc., 1405 132nd Avenue NE, Suite 3, Bellevue, Washington 98005, USA.

Processed hydrographic data were summarized, by sweep, in a series of horizontal maps and vertical transects, and are presented in this report. All contouring of CTD data and products was done objectively using NCAR subroutines. The area containing data is triangulated, and a virtual grid is laid over the triangulated area. Values for the parameter being plotted are interpolated at each virtual grid point, using a smooth data interpolation scheme based on Lawson's C1 surface interpolation algorithm (Akima 1978). Computer graphic metafiles were then post-processed using the Adobe Illustrator 88 version 1.9.3 graphics software package (Adobe Systems Incorporated, Mountain View, California). Obviously bad CTD data values were excluded from the interpolation.

The CAMAC raw data stream was edited to provide a nearly continuous sampling track from south to north during each sweep. These data were contoured using the SURFER version 4.0 graphics software package (Golden Software, Inc., Golden, Colorado), which computes estimates of temperature and salinity throughout a rectangular region, based on CAMAC observations. Kriging was used as the gridding method for the algorithm.

The calculation of potential temperature and the density parameter σ_θ (based on potential temperature) was not necessary, since there is no significant difference between temperature and potential temperature at depths less than 200 m. To date, no attempt has been made to calculate geostrophic velocity because 1) the maximum cast depth of 200 m is much shallower than the reference depth of no motion (500 m) used by CalCOFI, and 2) the large number of shallow stations during the survey necessitate the extrapolation of isopycnals into the shore, a procedure that is subject to great uncertainty. In addition, recent studies (Berryman 1989; Tisch 1990) suggest that geostrophic velocities calculated for stations spaced closer than the internal Rossby radius frequently feature alternating current bands of reversed flow, which are thought to be associated with inertial currents. The Rossby radius in the survey region is generally about 10-20 km, which is similar to the typical station spacing of the NMFS surveys. We are presently investigating the method that best determines dynamic heights based on closely spaced, shallow water stations, before attempting to calculate the geostrophic velocity field during these surveys.

Meteorological data were obtained for selected sites in the survey region. These sites include the region's four National Data Buoy Center (NDBC) moored buoys; 46013 (Bodega Bay; 38.2°N, 123.3°W), 46026 (Farallones; 37.8°N, 122.7°W), 46012 (Half Moon Bay; 37.4°N, 122.7°W) and 46042 (Monterey Bay; 36.8°N, 122.4°W), and a shore station at Monterey (Monterey Bay Aquarium; 36.6°N, 121.9°W). Daily averages of several surface meteorological parameters, including air and sea temperature, east and north wind components, and barometric pressure, were calculated for the time period that includes the 1989 JORDAN rockfish survey. Plots of several of these products are provided in this report, to aid in the interpretation of the hydrographic results and suggest possible atmospheric-oceanic interactions.

RESULTS

Below are a few brief comments on each of the data products contained in this report, in the order that they appear.

1. Master list of CTD stations during JORDAN Cruise 8904

The station list includes, from left to right; CTD station number, date (month, day, year), time (Pacific Daylight Time), latitude and longitude (degrees, minutes), and total station depth (in meters). Sweep 1 (14-22 May) includes stations 0-138 (135 acceptable casts), sweep 2 (22 May-3 June) includes stations 139-299 (153 casts) and sweep 3 (4-13 June) includes stations 300-393 (92 casts).

2. Bathymetric map of survey region

The bathymetry shown on the map at the beginning of the figures was determined from CTD station depths from all sweeps. The locations of all 380 acceptable casts from the three sweeps are denoted with an "**x**". The close coincidence between many of these locations reflects the repeated occupation of CTD station positions during each sweep.

3. Atmospheric time series

Meteorological time series are presented for the four NDBC buoys and the land station at Monterey Bay Aquarium, as described above. The locations of these stations are shown on a map. The second figure in this section summarizes the daily average wind speed (m/s) and direction (relative to true north) at these stations, in stick vector form, for the period January through June, 1989. Vectors point in the direction toward which the wind was blowing; an arrow pointing toward the top of the page represents a northward-directed wind.

The following figures show scalar time series of sea surface temperature, or SST (°C); air temperature (°C); the north-south component of wind speed (m/s), a crude indicator of upwelling-favorable wind; and barometric pressure (millibars) at each meteorological station for the first 180 Julian days of 1989. Positive wind values denotes a northward-directed wind component. The survey period, divided by sweep, is shaded in all time series plots.

4. Horizontal maps of CTD station locations and hydrographic parameters, organized by sweep

a) Station location maps

Maps are presented at the beginning of each set of horizontal maps, showing the location of each CTD station by its last three digits. DS8904 in the upper right hand corner of the station and all subsequent maps refers to the JORDAN cruise number; the number to the right of the cruise number denotes the sweep number.

b) Maps of CAMAC surface temperature and salinity

Maps of surface temperature (°C) and salinity (ppt) obtained from the CAMAC continuous profiling unit aboard the JORDAN are presented for each sweep. The contour intervals are 0.2 °C for temperature and 0.05 ppt for salinity. They are included to provide some verification for the CTD observations. The gridding algorithm was set to extrapolate contours over the region set by the sampling array. The 5 m CTD and surface CAMAC maps display very good quantitative agreement, despite the fact that 1) the data used to generate each were collected by different instrument packages, and 2) each set of maps was generated independently by two separate research groups utilizing different software systems, objective interpolation schemes and computer hardware.

c) Maps of CTD temperature, salinity and σ_t, by depth

Horizontal maps of temperature (°C), salinity (ppt) and σ_t (kg/m^3) are presented at depths of 5 m, 30 m, 50 m, 100 m and 200 m. The 5 m surface was selected to represent near-surface conditions because 1) the quality of data in the first few meters below the surface was not acceptable at some stations, and 2) localized, ephemeral conditions, related to factors such as strong surface heating and low vertical mixing, that did not reflect the realistic, longer-term conditions of the region, were generally confined to the upper 5 m (refer to footnote 4). The 30 m surface was contoured to coincide with the standard midwater trawl depth during the surveys. The contour intervals are 0.2 °C, 0.1 ppt and 0.1 kg/m^3, respectively. Bold contours at 1.0 °C, 0.5 ppt and 0.5 kg/m^3 have been included for clarity.

d) Maps of other hydrographic products

i) Mixed layer depths (m) were calculated as the shallowest depth below which the density increased by more than 0.15 kg/m^3 over a 5 m interval of depth. The contour interval is 5 m; bold contours are included every 20 m.

ii) The density difference between 30 m and 0 m is generally related to the mixed layer depth. The contour interval is 0.1 kg/m^3; bold contours are included every 0.4 kg/m^3. Positive values denote an increase in density with depth. Shaded areas denote a change of $\leq$ .1 kg/m^3 (denoting an unstable or well mixed upper water column).

iii) The depths of the 10.5 °C and 8.5 °C isotherms are included. These isothermal surfaces were selected to represent conditions above and below the thermocline, respectively, and to optimize the number of CTD stations whose data could be included in each map. The contour interval is 5 m; bold contours are included every 20 m. Shaded areas denote regions where the 10.5 °C isotherm outcrops at the surface. The heavy line on the 8.5 °C map denotes the approximate position where that isotherm intersects with the bottom.

iv) The depth of, and temperature and salinity on the 26.0 σ_t surface is contoured in the final series of maps in this section. Again this surface was selected to maximize the number of CTD casts that included the same σ_t value. The contour intervals are 5 m, 0.2 °C and 0.1 ppt, respectively. Bold contours at 20 m, 1.0 °C and 0.5 ppt have been included. Shaded areas denote regions where the 26.0 σ_t surface outcrops at the surface. In the absence of geostrophic velocity calculations, these maps provide a crude estimate of the circulation (Leipper 1970; Moomy 1973). The flow is generally parallel to the topography of this surface, such that the surface shoals from right to left, looking downstream. Closer-spaced depth contours indicate areas of higher velocity.

5. Vertical transects

Vertical transects of temperature, salinity and σ_t are contoured for five cross-shelf transects; Pt. Reyes (38.2°N), Farallones (37.8°N), Pescadero (37.3°N), Davenport (37.0°N) and Monterey (36.7°N); and for stations along the 100 m isobath. Station maps denote the location of each transect and the stations used to generate the plots for each sweep. The large solid circles on the transect contour plots show the position of all CTD stations used to generate contours. The contour interval for these figures is 0.5 °C for temperature, 0.1

ppt for salinity and 0.1 kg/m^3. Bold contours at 2.0 °C, 0.5 ppt and 0.5 kg/m^3 have been included.

6. Temperature-salinity plots

Temperature-salinity pairs are plotted, by sweep, at 1 m depth intervals for all CTD casts. Bad data pairs have been edited out. Selected subsets of T-S pairs have been plotted separately. These include: T-S pairs for the five vertical transects described above, comparing sweeps 1 and 3; T-S pairs for stations along the 100 m isobath, by sweep; and T-S pairs for stations located over Cordell Bank, during sweep 2 (stations 272-299).

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LITERATURE CITED

Akima, H. 1978. A method of bivariate interpolation and smooth surface fitting for irregularly distributed data points. *ACM Trans. Math. Software. 4:* 148-159.

Berryman, P. 1989. Study of currents along the Pt. Sur transect in February 1989, M.S. Thesis, Naval Postgraduate School, Monterey, CA, 51pp.

Chelton, D.B., R.L. Bernstein, A. Bratkovich, and P.M. Kosro. 1988. Poleward flow off central California during the spring and summer of 1981 and 1984. *J. Geophys. Res. 93:* 10604-10620.

Clare, F., L. Henderson, S. Henderson, B. Horner-Miller, J. Humbrecht, and D. Kennison. 1986. The NCAR GKS-Compatible Graphics System. NCAR Technical Note NCAR/TN-267+1A, National Center for Atmospheric Research, Boulder, CO.

Deriso, R. B., T. J. Quinn II, and P. R. Neal. 1985. Catch-age analysis with auxiliary information. *Can. J. Fish. Aquat. Sci. 42:* 815-824.

Flament, P., L. Armi, and L. Washburn. 1985. The evolving structure of an upwelling filament. *J. Geophys. Res. 90:* 11765-11778.

Gunderson, D. R., and T. M. Sample. 1980. Distribution and abundance of rockfish off Washington, Oregon, and California during 1977. *Mar. Fish. Rev. 4:* 2-16.

Hickey, B. M. 1979. The California Current System -- hypotheses and facts. *Prog. Oceanog. 8:* 191-279.

Huyer, A. 1983. Coastal upwelling in the California current system. *Prog. Oceanog. 12:* 259-284.

Kelly, K. A. 1985. The influence of winds and topography on the sea surface temperature patterns over the northern California slope. *J. Geophys. Res. 90:* 11783-11798.

Leipper, D.F. 1970. A sequence of current patterns in the Gulf of Mexico. *J. Geophys. Res. 75:* 637-657.

Mooers, C. N. K., and A. R. Robinson. 1984. Turbulent jets and eddies in the California current and inferred cross-shore transports. *Science 223:* 51-53.

Moomy, D.H. 1973. Temperature variations throughout Monterey Bay September 1971-October 1972, M.S. Thesis, Naval Postgraduate School, Monterey, CA, 166pp.

Njoku, E. G., T. P. Barnett, R. M. Laurs, and A. C. Vastano. 1985. Advances in satellite sea surface temperature measurement and oceanographic applications. *J. Geophys. Res. 90:* 11573-11586.

Pacific Fishery Management Council. 1989. Status of the Pacific coast groundfish fishery through 1989 and recommended acceptable biological catches for 1990. Pacific Fishery Management Council, Portland, Oregon. 49 pp. + appendices.

Rothschild, B. J. 1986. Dynamics of Marine Fish Populations. Harvard University Press, Cambridge, Massachusetts. 277 pp.

SAS. 1987. SAS Guide to Macro Processing (Version 6 Edition). SAS Institute Inc., Cary, North Carolina. 233 pp.

Sinclair, M. 1988. Marine Populations: An Essay on Population Regulation and Speciation. Washington Sea Grant Program, Seattle. 252 pp.

Sissenwine, M. P. 1984. Why do fish populations vary? In R. M. May (ed.), Dahlem Workshop on Exploitation of Marine Communities, pp. 59-94. Springer-Verlag, Berlin.

Tisch, T.D. 1990. Seasonal variability of the geostrophic velocity and water mass structure off Point Sur, California, M.S. Thesis, Naval Postgraduate School, Monterey, CA, 163 pp.

UNESCO. 1988. The acquisition, calibration, and analysis of CTD data. A Report of SCOR Working Group 51. UNESCO Technical Papers in Marine Science 54, 92 pp.

Wooster, W. S. 1988. Immiscible investigators: oceanographers, meteorologists, and fishery scientists. *Fisheries 13:* 18-21.

Wyllie-Echeverria, T., W. H. Lenarz, and C. A. Reilly. 1990. Survey of the abundance and distribution of pelagic young-of-the-year rockfishes off central California. U. S. Depart. Commerce, NOAA Tech. Memo. NOAA-TM-NMFS-SWFC-147, 125 pp.

Table 1.--List of planned CTD stations conducted during cruises of the rockfish recruitment program at the Tiburon Laboratory.

Latitude	Longitude	Station Type
36 30.0	122 4.0	CTD Only
36 30.0	122 10.0	CTD Only
36 30.0	122 16.0	CTD Only
36 30.0	122 22.5	CTD Only
36 35.0	122 2.0	Trawl and CTD
36 35.0	122 6.0	CTD Only
36 35.0	122 10.5	Trawl and CTD
36 35.0	122 16.0	CTD Only
36 35.0	122 21.5	CTD Only
36 38.5	121 51.5	Trawl and CTD
36 38.8	122 3.0	Trawl and CTD
36 39.3	121 56.8	Trawl and CTD
36 40.0	122 10.0	CTD Only
36 40.0	122 15.0	CTD Only
36 40.0	122 21.5	CTD Only
36 42.0	122 6.5	Trawl and CTD
36 42.5	121 54.5	Trawl and CTD
36 44.4	121 58.6	Trawl and CTD
36 44.4	122 2.5	CTD Only
36 44.4	122 16.0	CTD Only
36 44.4	122 22.0	CTD Only
36 44.4	122 27.0	CTD Only
36 46.0	121 52.0	Trawl and CTD
36 46.4	122 9.0	Trawl and CTD
36 49.0	122 5.0	CTD Only
36 49.0	122 11.0	CTD Only
36 49.0	122 17.0	CTD Only
36 49.0	122 23.5	CTD Only
36 49.0	122 29.5	CTD Only
36 49.0	122 36.0	CTD Only
36 50.8	121 59.0	Trawl and CTD
36 54.0	122 4.5	CTD Only
36 54.0	122 11.0	CTD Only
36 54.0	122 17.0	CTD Only
36 54.0	122 23.0	CTD Only
36 54.0	122 30.0	CTD Only
36 54.0	122 36.0	CTD Only
36 59.0	122 12.5	Trawl and CTD
36 59.0	122 17.5	Trawl and CTD
36 59.0	122 22.5	Trawl and CTD
36 59.0	122 25.5	Trawl and CTD
36 59.0	122 35.5	Trawl and CTD
36 59.0	122 40.0	CTD Only
37 8.0	122 23.5	CTD Only
37 8.0	122 30.0	CTD Only
37 8.0	122 36.0	CTD Only
37 8.0	122 43.0	CTD Only
37 8.0	122 50.0	CTD Only
37 8.0	122 55.5	CTD Only
37 8.0	123 10.0	CTD Only
37 16.5	122 29.0	Trawl and CTD
37 16.5	122 34.0	Trawl and CTD

37 16.5	122 39.0	Trawl and CTD
37 16.5	122 49.0	Trawl and CTD
37 16.5	122 59.0	Trawl and CTD
37 16.5	123 10.0	CTD Only
37 23.5	122 30.0	CTD Only
37 23.5	122 37.5	CTD Only
37 23.5	122 43.0	CTD Only
37 23.5	122 49.0	CTD Only
37 23.5	122 55.0	CTD Only
37 23.5	123 1.5	CTD Only
37 23.5	123 10.0	CTD Only
37 35.0	122 43.0	CTD Only
37 35.0	122 55.0	CTD Only
37 35.0	123 1.5	CTD Only
37 35.0	123 7.5	CTD Only
37 38.0	122 46.0	Trawl and CTD
37 39.5	123 2.5	Trawl and CTD
37 39.5	123 12.5	Trawl and CTD
37 39.5	123 17.5	CTD Only
37 39.5	123 23.5	CTD Only
37 42.0	122 54.5	Trawl and CTD
37 42.0	122 58.0	CTD Only
37 45.0	123 8.0	Trawl and CTD
37 47.5	122 52.0	Trawl and CTD
37 47.5	123 3.5	CTD Only
37 48.0	123 12.5	CTD Only
37 48.0	123 20.0	CTD Only
37 48.0	123 26.0	CTD Only
37 51.0	122 46.0	Trawl and CTD
37 53.0	123 7.0	CTD Only
37 53.0	123 15.0	CTD Only
37 53.0	123 19.0	Trawl and CTD
37 53.0	123 25.0	CTD Only
37 53.0	123 30.0	Trawl and CTD
37 53.0	123 33.0	CTD Only
37 55.0	122 51.5	CTD Only
37 58.0	122 56.0	Trawl and CTD
38 0.0	123 8.5	CTD Only
38 0.0	123 13.5	CTD Only
38 5.0	123 2.5	CTD Only
38 5.0	123 8.5	CTD Only
38 5.0	123 13.5	CTD Only
38 5.0	123 18.5	CTD Only
38 5.0	123 23.5	CTD Only
38 5.0	123 28.5	CTD Only
38 9.5	123 5.0	Trawl and CTD
38 10.0	123 0.0	Trawl and CTD
38 10.0	123 10.0	Trawl and CTD
38 10.0	123 17.0	Trawl and CTD
38 10.0	123 22.0	Trawl and CTD
38 10.0	123 28.5	CTD Only
38 15.0	123 2.5	CTD Only
38 15.0	123 8.5	CTD Only
38 15.0	123 13.5	CTD Only
38 15.0	123 18.5	CTD Only
38 15.0	123 23.5	CTD Only
38 15.0	123 28.5	CTD Only

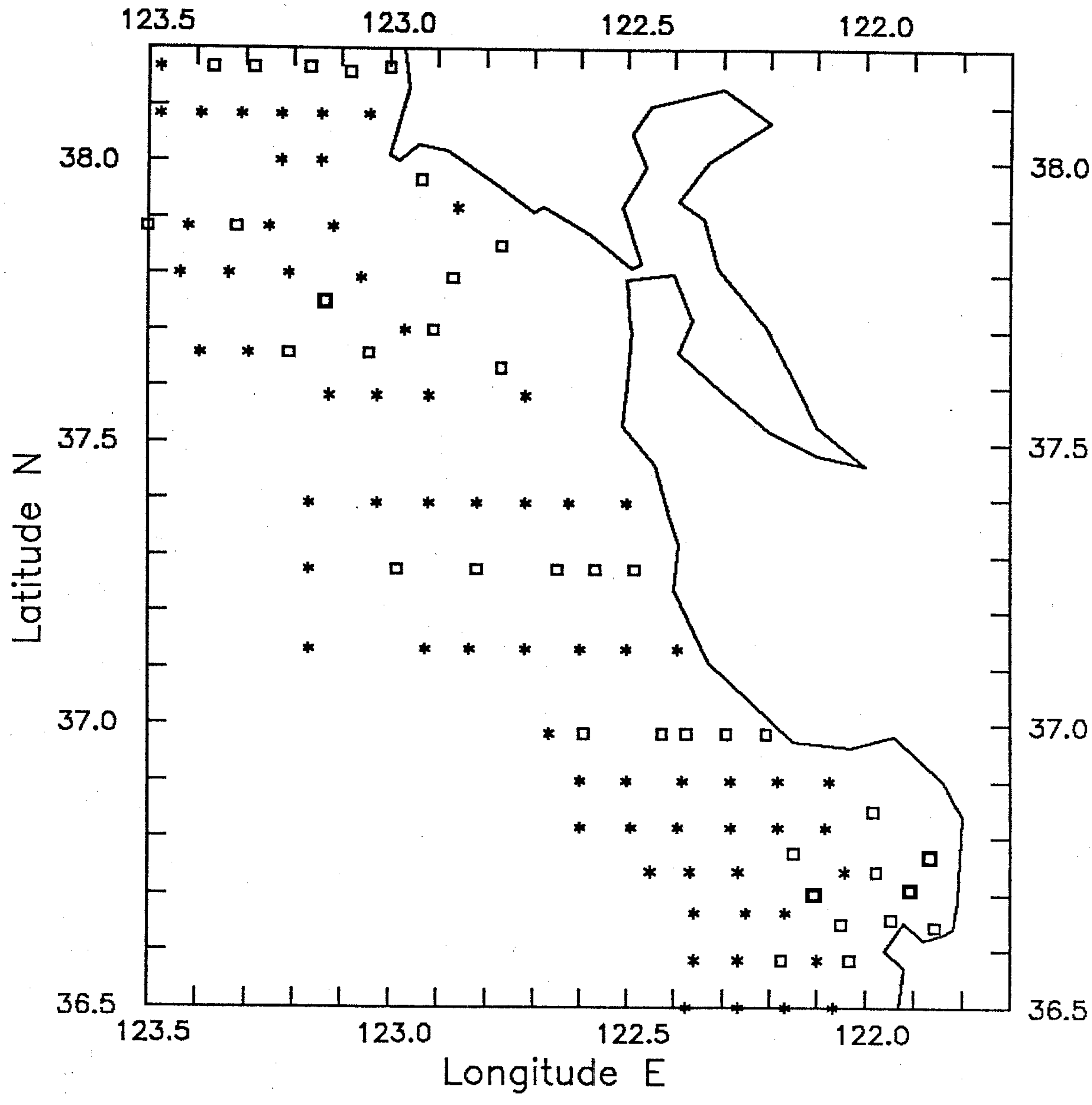


Fig. 1--Map of the juvenile rockfish recruitment study area. Trawl stations are shown as open squares and supplemental CTD stations as asterisks.

APPENDIX 1: MASTER LIST OF CTD STATIONS

SWEEP 1

STATION	DATE	TIME	LAT	LONG	DEPTH
8904001	051489	1420	36 49.0	122 5.0	106
8904002	051489	1501	36 49.0	122 11.0	494
8904003	051489	1546	36 49.0	122 17.1	1280
8904004	051489	1635	36 53.9	122 17.0	340
8904005	051489	1717	36 54.0	122 10.9	95
8904006	051489	1755	36 54.0	122 4.6	57
8904007	051489	2020	36 50.6	121 59.0	91
8904008	051489	2302	36 45.8	121 52.7	101
8904009	051489	2345	36 44.4	121 58.6	256
8904010	051589	130	36 43.1	121 55.5	97
8904011	051589	213	36 38.5	121 51.4	37
8904012	051589	500	36 40.1	121 58.2	102
8904013	051589	543	36 38.7	122 3.0	808
8904014	051589	632	36 40.0	122 9.9	1106
8904015	051589	710	36 40.0	122 14.9	1353
8904016	051589	751	36 40.0	122 21.5	1646
8904017	051589	837	36 35.0	122 21.5	2195
8904018	051589	919	36 35.0	122 16.0	2195
8904019	051589	1000	36 35.0	122 10.5	2195
8904020	051589	1034	36 35.0	122 6.0	1372
8904021	051589	1105	36 35.0	122 2.0	547
8904022	051589	1150	36 30.0	122 4.0	905
8904023	051589	1300	36 30.0	122 10.1	1280
8904024	051589	1340	36 30.0	122 16.1	1373
8904025	051589	1425	36 29.9	122 22.6	1609
8904026	051589	2030	36 34.8	122 10.5	2195
8904027	051689	30	36 36.2	122 3.1	530
8904028	051689	54	36 38.9	122 2.9	871
8904029	051689	257	36 41.4	122 8.1	1214
8904030	051689	342	36 46.4	122 9.1	1013
8904031	051689	544	36 44.4	122 16.0	958
8904032	051689	632	36 44.4	122 22.0	1591
8904033	051689	707	36 44.4	122 27.0	2012
8904034	051689	748	36 49.0	122 29.5	2103
8904035	051689	830	36 49.0	122 36.0	1829
8904036	051689	925	36 54.0	122 30.1	1070
8904037	051689	1005	36 54.0	122 36.0	1554
8904038	051689	1055	36 58.8	122 40.0	585
8904039	051689	1206	37 8.1	122 36.0	108
8904040	051689	1243	37 8.0	122 29.9	90
8904041	051689	1327	37 8.0	122 23.4	40
8904042	051689	2020	36 58.9	122 12.5	37
8904043	051689	2205	36 58.9	122 17.6	84
8904044	051689	2330	36 59.0	122 22.5	121
8904046	051789	248	36 59.3	122 27.1	139
8904047	051789	310	36 59.0	122 35.5	386
8904048	051789	520	37 0.5	122 43.5	624
8904049	051789	610	37 8.0	122 43.0	230
8904050	051789	701	37 8.0	122 49.9	457
8904051	051789	740	37 8.0	122 55.4	561
8904052	051789	905	37 8.0	123 10.0	1829
8904053	051789	1016	37 16.5	123 10.0	1044
8904054	051789	1113	37 23.5	123 10.0	978
8904055	051789	1206	37 23.5	123 1.5	838

STATION	DATE	TIME	LAT	LONG	DEPTH
8904056	051789	1251	37 23.5	122 55.0	450
8904057	051789	1335	37 23.5	122 48.9	110
8904058	051789	1415	37 23.5	122 42.9	90
8904059	051789	1535	37 23.5	122 37.4	75
8904060	051789	1616	37 23.5	122 30.1	44
8904061	051789	2010	37 16.5	122 29.0	53
8904062	051789	2044	37 16.5	122 34.0	88
8904063	051789	2240	37 16.1	122 40.6	102
8904064	051789	2335	37 16.9	122 49.0	181
8904065	051889	410	37 16.4	122 59.0	163
8904066	051889	723	37 35.0	122 55.0	99
8904067	051889	804	37 35.0	123 1.5	271
8904068	051889	847	37 35.0	123 7.5	1079
8904069	051889	1009	37 39.5	123 17.5	1737
8904070	051889	1128	37 48.0	123 12.5	0
8904071	051889	1218	37 48.0	123 20.1	625
8904072	051889	1303	37 47.9	123 25.8	1372
8904073	051889	1448	37 53.0	123 33.1	2213
8904074	051889	2025	37 58.0	122 56.0	53
8904075	051889	2320	37 50.6	122 46.6	44
8904076	051989	0	37 47.4	122 52.1	0
8904077	051989	155	37 42.2	122 56.0	57
8904078	051989	300	37 37.9	122 45.9	55
8904079	051989	545	37 35.0	122 43.0	55
8904080	051989	723	37 42.0	122 58.0	51
8904081	051989	903	37 55.0	122 51.5	49
8904082	051989	1025	37 47.5	123 3.5	75
8904083	051989	1112	37 53.0	123 7.0	93
8904084	051989	1203	37 53.0	123 15.2	101
8904086	051989	2025	37 39.3	123 1.8	102
8904087	051989	2305	37 39.8	123 13.5	1189
8904088	052089	0	37 45.0	123 8.0	66
8904089	052089	250	37 52.6	123 18.9	102
8904090	052089	550	37 52.4	123 30.6	1463
8904091	052089	742	38 5.0	123 28.6	143
8904092	052089	835	38 10.0	123 28.5	364
8904093	052089	930	38 15.0	123 28.5	322
8904094	052089	1008	38 15.0	123 23.5	174
8904095	052089	1044	38 15.0	123 18.5	123
8904096	052089	1117	38 15.0	123 13.5	102
8904097	052089	1148	38 15.0	123 8.5	88
8904098	052089	1239	38 15.0	123 2.3	51
8904099	052089	1344	38 4.9	123 2.5	60
8904100	052089	1424	38 5.0	123 8.6	86
8904101	052089	1459	38 4.9	123 13.6	113
8904102	052089	1534	38 5.0	123 18.5	137
8904103	052089	1613	38 5.0	123 23.5	159
8904104	052089	1805	38 0.0	123 13.6	110
8904105	052089	1839	38 0.0	123 8.6	88
8904106	052089	2047	38 10.0	123 0.0	53
8904107	052089	2317	38 9.6	123 5.4	79
8904108	052089	2350	38 10.0	123 10.0	93
8904109	052189	150	38 9.1	123 15.1	117
8904110	052189	500	38 9.8	123 22.0	187
8904111	052189	1220	36 59.9	123 0.0	2286
8904112	052189	1304	37 0.0	123 6.3	2515

STATION	DATE	TIME	LAT		LONG		DEPTH
8904113	052189	1347	36	59.9	123	12.4	2606
8904114	052189	1435	37	0.0	123	18.6	2505
8904115	052189	1518	37	0.0	123	24.8	2761
8904116	052189	1603	37	0.0	123	31.0	3475
8904117	052189	1647	37	0.0	123	37.2	3530
8904118	052189	2100	37	0.0	123	31.0	3475
8904119	052189	2140	37	0.5	123	32.1	3475
8904120	052189	2205	37	0.6	123	31.0	3475
8904121	052189	2256	37	0.3	123	32.1	3475
8904122	052189	2346	37	0.1	123	25.9	3292
8904123	052289	36	37	0.9	123	27.0	3292
8904124	052289	56	37	0.7	123	25.8	3292
8904125	052289	200	37	1.2	123	25.8	3292
8904126	052289	225	37	1.0	123	21.4	3383
8904127	052289	402	37	1.7	123	22.2	3383
8904128	052289	542	37	0.0	123	12.1	2652
8904129	052289	618	37	0.0	123	7.0	2524
8904131	052289	746	37	0.0	122	53.7	1445
8904132	052289	834	37	0.0	122	46.7	1042
8904133	052289	919	37	0.0	122	40.0	494
8904134	052289	1033	36	50.6	122	40.0	2195
8904135	052289	1117	36	50.0	122	46.7	2469
8904136	052289	1159	36	50.0	122	53.4	2743
8904137	052289	1259	36	50.2	123	0.1	2844
8904138	052289	1412	36	49.9	123	10.1	3054

SWEEP 2

8904139	052289	2055	36	59.8	123	11.0	3658
8904140	052289	2120	36	58.3	123	10.4	3658
8904141	052289	2210	37	0.0	123	9.0	2560
8904142	052289	2345	36	59.0	123	9.1	2560
8904143	052389	33	37	0.0	122	59.9	2195
8904144	052389	215	37	0.4	123	1.7	2195
8904145	052389	305	37	0.0	122	53.0	1372
8904146	052389	445	37	0.6	122	54.4	1631
8904147	052389	808	36	40.0	122	40.0	2560
8904148	052389	850	36	40.0	122	45.8	2743
8904149	052389	937	36	40.0	122	51.8	2743
8904150	052389	1012	36	40.0	122	57.8	2926
8904151	052389	1051	36	40.0	123	3.9	3109
8904152	052389	1132	36	40.0	123	10.0	3292
8904153	052389	1201	36	34.9	123	10.0	3292
8904154	052389	1254	36	35.1	123	3.8	3200
8904155	052389	1335	36	35.0	122	57.8	2880
8904156	052389	1415	36	35.0	122	51.8	2926
8904157	052689	1454	36	35.0	122	45.8	2893
8904158	052389	1532	36	35.0	122	39.9	2743
8904159	052389	2100	36	37.0	123	13.4	3292
8904160	052389	2226	36	37.4	123	10.4	3292
8904161	052489	4	36	35.9	123	5.9	3255
8904162	052489	222	36	36.1	123	6.3	3200
8904163	052489	315	36	34.6	122	58.4	2926
8904164	052489	513	36	35.1	122	56.3	2853
8904165	052489	2115	36	50.4	121	59.2	91
8904166	052489	2325	36	46.8	121	53.5	311

STATION	DATE	TIME	LAT		LONG		DEPTH
8904167	052589	4	36	44.4	121	58.6	305
8904168	052589	202	36	43.2	121	55.4	99
8904169	052589	255	36	38.5	121	51.5	38
8904170	052589	519	36	40.0	121	57.3	97
8904171	052589	630	36	38.8	122	3.0	914
8904172	052589	720	36	40.0	122	9.9	1134
8904173	052589	759	36	40.0	122	14.9	1353
8904174	052589	848	36	40.0	122	21.5	1646
8904175	052589	928	36	35.0	122	21.5	2195
8904176	052589	1008	36	35.0	122	16.0	2195
8904177	052589	1047	36	35.0	122	10.5	2195
8904178	052589	1121	36	35.0	122	6.0	1372
8904179	052589	1154	36	35.0	122	2.0	622
8904180	052589	1234	36	29.8	122	4.2	878
8904181	052589	1322	36	29.9	122	10.1	1280
8904182	052589	1409	36	30.0	122	16.1	1353
8904183	052589	1501	36	30.1	122	22.6	1609
8904184	052589	2130	36	44.4	122	2.5	741
8904185	052589	2220	36	49.0	122	5.0	106
8904186	052589	2304	36	54.0	122	5.0	57
8904187	052889	2052	36	46.5	122	9.1	914
8904188	052889	2310	36	42.1	122	7.1	1829
8904189	052889	2347	36	38.7	122	3.1	914
8904190	052989	140	36	33.6	122	7.1	823
8904191	052989	459	36	34.8	122	11.7	2323
8904192	052989	713	36	44.4	122	16.0	971
8904193	052989	756	36	44.4	122	16.0	1591
8904194	052989	834	36	44.4	122	26.9	2012
8904195	052989	916	36	49.0	122	29.5	2103
8904196	052989	1001	36	49.0	122	36.0	1829
8904197	052989	1052	36	54.0	122	30.0	1061
8904198	052989	1135	36	54.0	122	35.9	1006
8904199	052989	1225	36	59.0	122	40.1	578
8904200	052989	1335	37	8.0	122	36.1	108
8904201	052989	1413	37	8.0	122	29.9	90
8904202	052989	1453	37	8.0	122	23.4	42
8904203	052989	2112	36	58.6	122	12.9	46
8904204	052989	2250	36	58.9	122	18.5	88
8904205	052989	2320	36	59.0	122	22.5	119
8904206	053089	220	36	59.0	122	26.6	187
8904207	053089	352	36	59.6	122	26.6	371
8904208	053089	554	37	8.0	122	43.0	227
8904209	053089	640	37	8.0	122	50.0	457
8904210	053089	715	37	8.0	122	55.4	558
8904211	053089	842	37	8.0	123	10.0	1829
8904212	053089	950	37	16.5	123	10.0	1097
8904213	053089	1052	37	23.4	123	10.0	978
8904214	053089	1144	37	23.5	123	1.5	805
8904215	053089	1252	37	23.5	122	49.0	110
8904216	053089	1352	37	23.5	122	37.5	75
8904217	053089	1934	37	23.5	122	30.1	46
8904218	053089	2104	37	15.9	122	29.0	53
8904219	053089	2250	37	16.4	122	35.5	93
8904220	053089	2312	37	16.5	122	39.0	99
8904221	053189	229	37	16.1	122	50.1	216
8904222	053189	404	37	16.4	123	0.3	580

STATION	DATE	TIME	LAT		LONG		DEPTH
8904223	053189	719	37	35.0	122	55.0	101
8904224	053189	750	37	35.0	123	1.5	280
8904225	053189	831	37	35.0	123	7.5	1189
8904226	053189	942	37	39.5	123	17.5	1737
8904227	053189	1100	37	48.0	123	12.5	82
8904228	053189	1150	37	48.0	123	20.0	768
8904229	053189	1235	37	48.0	123	26.0	1372
8904230	053189	1342	37	53.0	123	33.0	2213
8904231	053189	1432	37	53.0	123	25.0	262
8904232	053189	1530	37	53.0	123	15.1	101
8904233	053189	1627	37	53.0	123	7.1	93
8904235	053189	2100	37	39.3	123	2.7	110
8904237	053189	2359	37	45.0	123	20.5	66
8904238	060189	227	37	53.0	123	20.5	112
8904244	060189	1001	38	15.0	123	13.5	102
8904245	060189	1037	38	15.0	123	8.5	90
8904246	060189	1110	38	15.0	123	2.5	0
8904247	060189	1220	38	5.0	123	2.5	64
8904248	060189	1333	38	5.0	123	13.6	113
8904249	060189	1455	38	5.0	123	23.6	163
8904250	060189	1533	38	5.0	123	28.5	144
8904251	060189	2056	38	9.8	123	22.1	229
8904252	060189	2308	38	9.5	123	15.6	119
8904253	060289	18	38	9.9	123	9.8	95
8904254	060289	153	38	10.7	123	5.2	80
8904255	060289	237	38	10.0	123	0.0	55
8904256	060289	556	38	0.0	123	13.5	108
8904257	060289	640	38	0.0	123	8.5	86
8904258	060289	802	37	52.9	123	15.7	106
8904259	060289	855	37	49.5	123	11.1	75
8904260	060289	940	37	52.2	123	8.2	95
8904261	060289	1135	37	58.0	123	4.8	51
8904262	060289	1320	37	47.1	123	5.5	77
8904263	060289	1356	37	43.9	123	0.5	62
8904264	060289	1538	37	56.4	122	48.6	35
8904265	060289	1613	37	52.7	122	44.3	27
8904266	060289	1857	37	37.8	122	45.1	62
8904267	060289	2104	37	37.8	122	46.0	57
8904268	060289	2312	37	42.7	122	56.0	57
8904269	060389	11	37	47.5	122	52.0	59
8904270	060389	205	37	50.6	122	44.3	37
8904271	060389	326	37	58.0	122	56.0	53
8904272	060389	606	37	58.3	123	21.4	106
8904273	060389	626	37	58.3	123	23.3	86
8904274	060389	642	37	58.3	123	25.0	73
8904275	060389	700	37	58.3	123	27.0	289
8904276	060389	715	38	0.0	123	28.0	128
8904277	060389	750	38	0.0	123	25.3	51
8904278	060389	802	38	0.0	123	24.0	66
8904279	060389	818	38	0.0	123	22.0	102
8904280	060389	840	38	1.5	123	23.0	108
8904281	060389	905	38	1.5	123	25.0	55
8904282	060389	918	38	1.5	123	26.5	49
8904283	060389	935	38	1.5	123	28.5	112
8904284	060389	1000	38	2.5	123	29.0	104
8904285	060389	1022	38	2.5	123	27.0	68

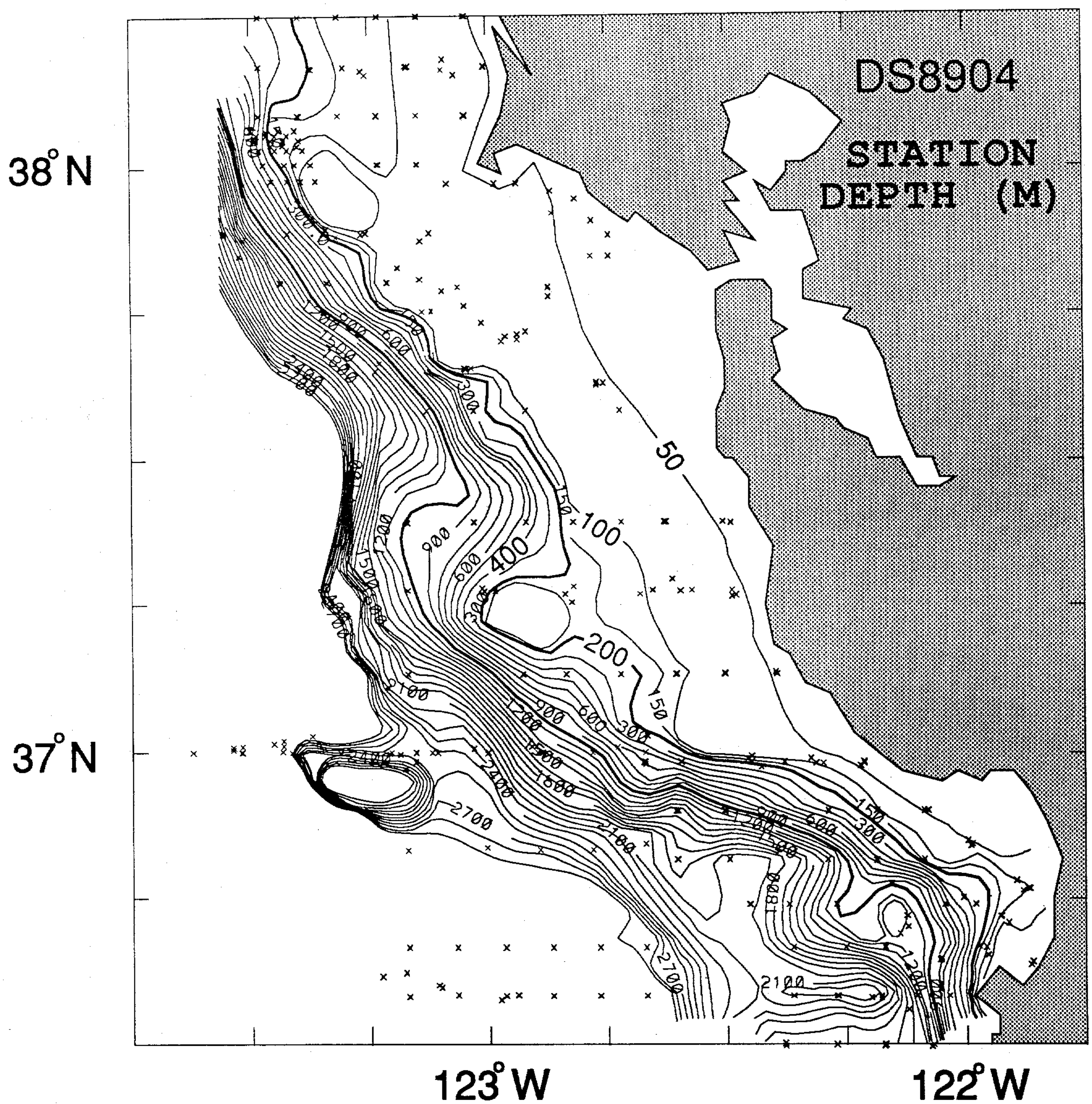
STATION	DATE	TIME	LAT		LONG		DEPTH
8904286	060389	1045	38	2.5	123	25.5	69
8904287	060389	1102	38	2.5	123	23.5	113
8904288	060389	1120	38	3.5	123	24.0	126
8904289	060389	1143	38	3.5	123	26.0	113
8904290	060389	1240	38	3.4	123	27.6	91
8904291	060389	1258	38	3.5	123	29.6	132
8904292	060389	1547	38	1.9	123	23.7	104
8904294	060389	1607	38	2.0	123	25.5	71
8904295	060389	1620	38	2.0	123	27.0	80
8904296	060389	1704	38	3.0	123	25.0	106
8904297	060389	1720	38	3.0	123	26.5	82
8904298	060389	1748	38	3.0	123	27.6	84
8904299	060389	1756	38	3.0	123	28.8	104

SWEEP 3

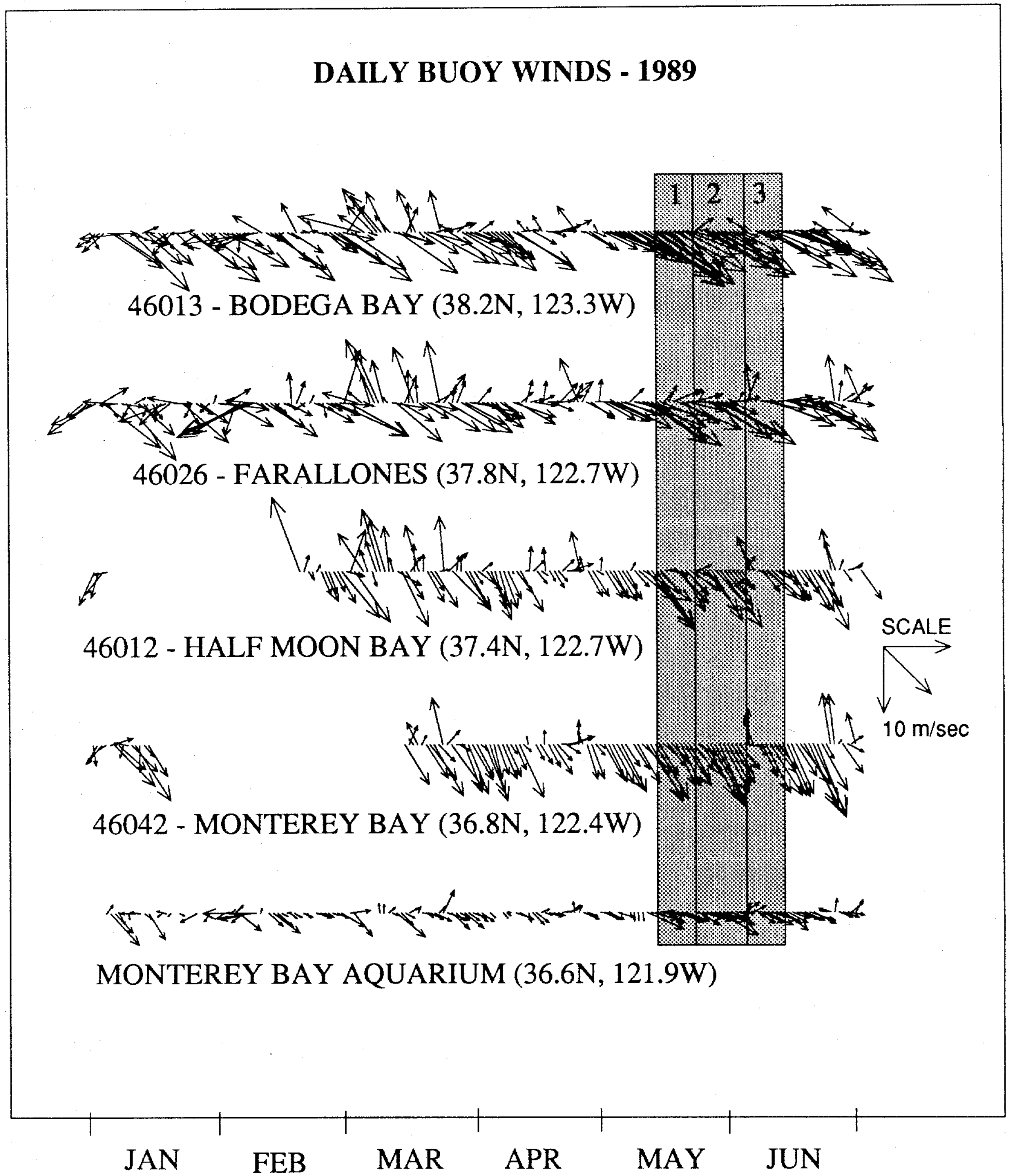
8904300	060489	603	36	44.4	122	16.0	956
8904301	060489	1651	36	40.0	122	10.0	1134
8904302	060489	1717	36	35.0	122	15.9	2286
8904303	060489	1837	36	30.0	122	10.0	1280
8904304	060489	2103	36	35.0	122	10.5	2323
8904305	060589	109	36	35.7	122	3.1	549
8904306	060589	141	36	38.8	122	2.9	914
8904307	060589	318	36	43.2	122	7.2	1920
8904308	060589	354	36	46.5	122	9.2	914
8904309	060589	540	36	44.4	122	2.5	732
8904310	060589	615	36	49.0	122	5.0	108
8904311	060589	620	36	49.0	122	5.0	108
8904312	060589	656	36	48.9	122	11.0	486
8904314	060589	740	36	49.0	122	17.1	1280
8904315	060589	830	36	54.0	122	17.0	274
8904316	060589	1012	36	54.0	122	11.0	97
8904317	060589	1052	36	54.0	122	4.5	59
8904318	060589	1218	36	46.0	121	52.0	79
8904319	060589	2101	36	38.2	121	51.7	38
8904320	060589	2306	36	39.2	121	57.1	99
8904321	060589	2338	36	42.5	121	54.5	88
8904322	060689	113	36	45.1	122	0.2	732
8904323	060689	206	36	46.0	121	51.8	86
8904324	060689	326	36	50.9	121	59.5	88
8904325	060689	646	36	49.0	122	29.5	2103
8904326	060689	750	36	49.0	122	36.0	1829
8904327	060689	827	36	53.9	122	30.0	1134
8904328	060689	913	36	54.0	122	36.2	1554
8904329	060689	1002	36	59.0	122	40.0	563
8904330	060689	1130	37	1.7	122	39.7	375
8904331	060689	1220	37	8.0	122	36.0	110
8904332	060689	1309	37	8.1	122	29.9	91
8904333	060689	1348	37	8.2	122	23.5	42
8904334	060689	2110	36	59.0	122	12.5	40
8904335	060689	2258	36	59.4	122	19.2	117
8904336	060689	2314	36	59.0	122	22.5	143
8904337	060789	214	36	58.5	122	25.4	262
8904338	060789	323	36	59.0	122	35.5	384
8904339	060789	550	37	8.0	122	43.0	223
8904340	060789	636	37	8.0	122	50.0	461

STATION	DATE	TIME	LAT		LONG		DEPTH
8904341	060789	715	37	8.0	122	55.5	560
8904342	060789	854	37	16.5	123	10.0	1116
8904343	060789	1008	37	23.5	123	1.6	655
8904344	060789	1056	37	23.5	122	55.0	201
8904345	060789	1136	37	23.5	122	49.0	104
8904346	060789	1209	37	23.5	122	49.0	90
8904347	060789	1243	37	23.5	122	37.3	71
8904348	060789	1330	37	23.5	122	30.0	42
8904349	060789	2103	37	16.0	122	28.5	53
8904350	060789	2243	37	17.6	122	36.5	93
8904351	060789	2304	37	16.5	122	39.0	101
8904352	060889	150	37	15.3	122	49.2	201
8904353	060889	346	37	16.7	123	0.6	574
8904354	060889	618	37	35.0	122	55.0	101
8904355	060889	2108	37	58.0	122	56.0	57
8904356	061089	1203	37	53.0	123	15.1	99
8904357	061089	1339	37	52.8	123	33.0	2213
8904358	061089	1437	37	48.0	123	25.9	1372
8904359	061089	1520	37	48.0	123	20.0	518
8904360	061089	1605	37	48.0	123	12.4	88
8904361	061089	1736	37	39.5	123	17.5	1737
8904362	061089	1844	37	35.0	123	7.5	1079
8904363	061089	2101	37	39.2	123	2.5	115
8904364	061089	2306	37	39.0	123	14.0	1189
8904365	061189	12	37	45.0	123	8.0	66
8904366	061189	244	37	53.4	123	20.1	110
8904367	061189	532	37	50.7	123	31.1	1463
8904368	061189	812	38	5.0	123	28.5	134
8904369	061189	854	38	10.0	123	28.5	362
8904370	061189	939	38	15.0	123	28.5	329
8904371	061189	1038	38	15.0	123	18.6	123
8904372	061189	1131	38	15.0	123	8.4	90
8904373	061189	1210	38	15.0	123	2.4	53
8904374	061189	1316	38	4.9	123	2.5	60
8904375	061189	1415	38	5.0	123	13.5	113
8904376	061189	1516	38	4.9	123	23.5	161
8904377	061189	2059	38	9.7	123	21.9	187
8904378	061289	29	38	9.9	123	17.9	110
8904379	061289	115	38	10.0	123	9.7	93
8904380	061289	257	38	9.1	123	3.8	75
8904381	061289	323	38	9.9	123	0.0	55
8904382	061289	533	38	0.0	123	13.5	110
8904383	061289	604	38	0.0	123	8.5	90
8904384	061289	702	37	58.0	122	58.8	64
8904385	061289	821	37	48.3	123	8.3	84
8904386	061289	900	37	45.6	123	2.7	71
8904387	061289	1035	37	57.2	122	51.7	44
8904388	061289	1109	37	54.2	122	46.5	29
8904389	061289	1334	37	42.5	122	57.5	55
8904391	061289	2114	37	37.6	122	46.0	55
8904392	061289	2342	37	43.0	122	54.9	57
8904393	061389	22	37	46.5	122	52.0	55

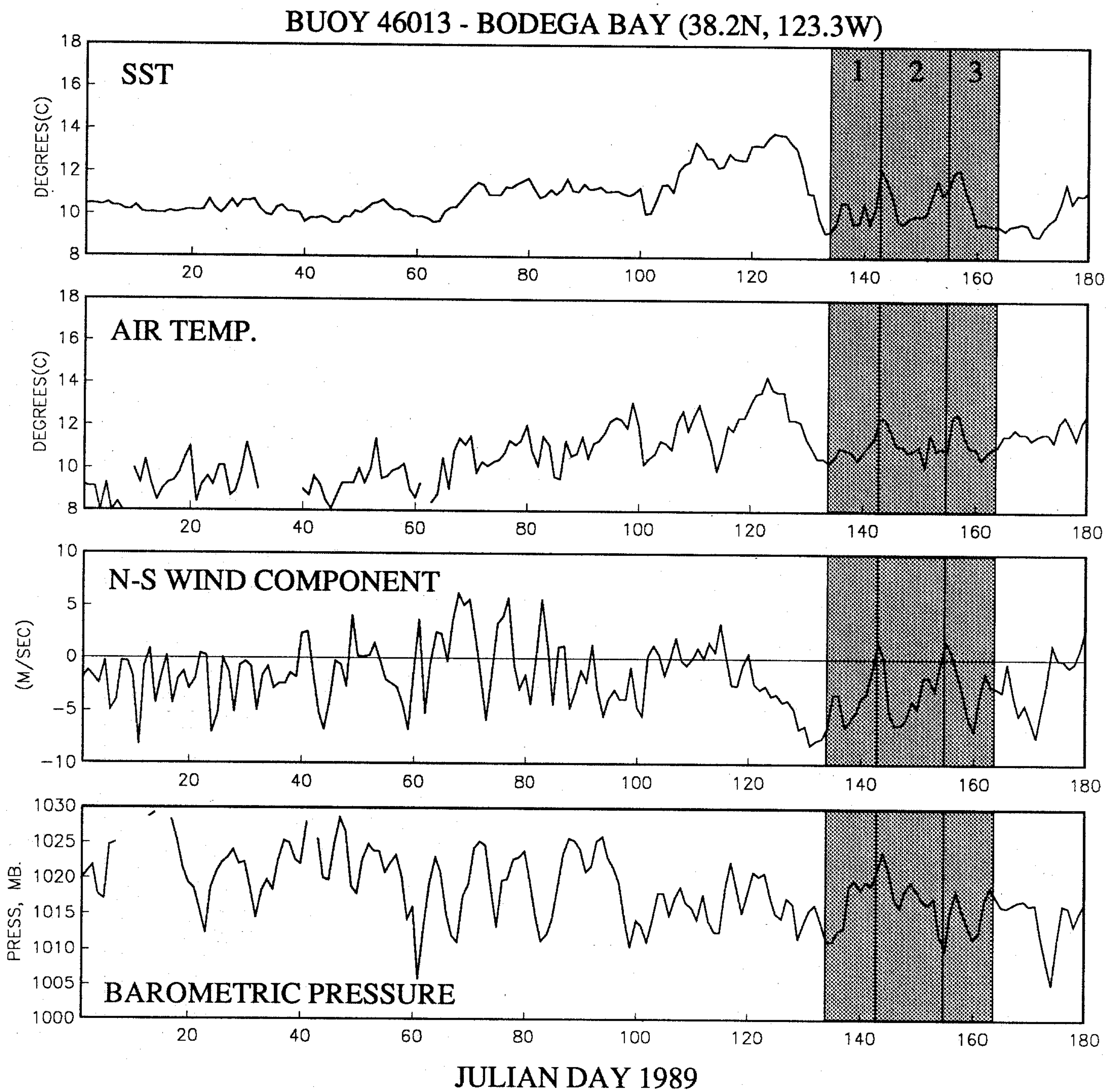
APPENDIX 2: BATHYMETRIC MAP OF SURVEY REGION

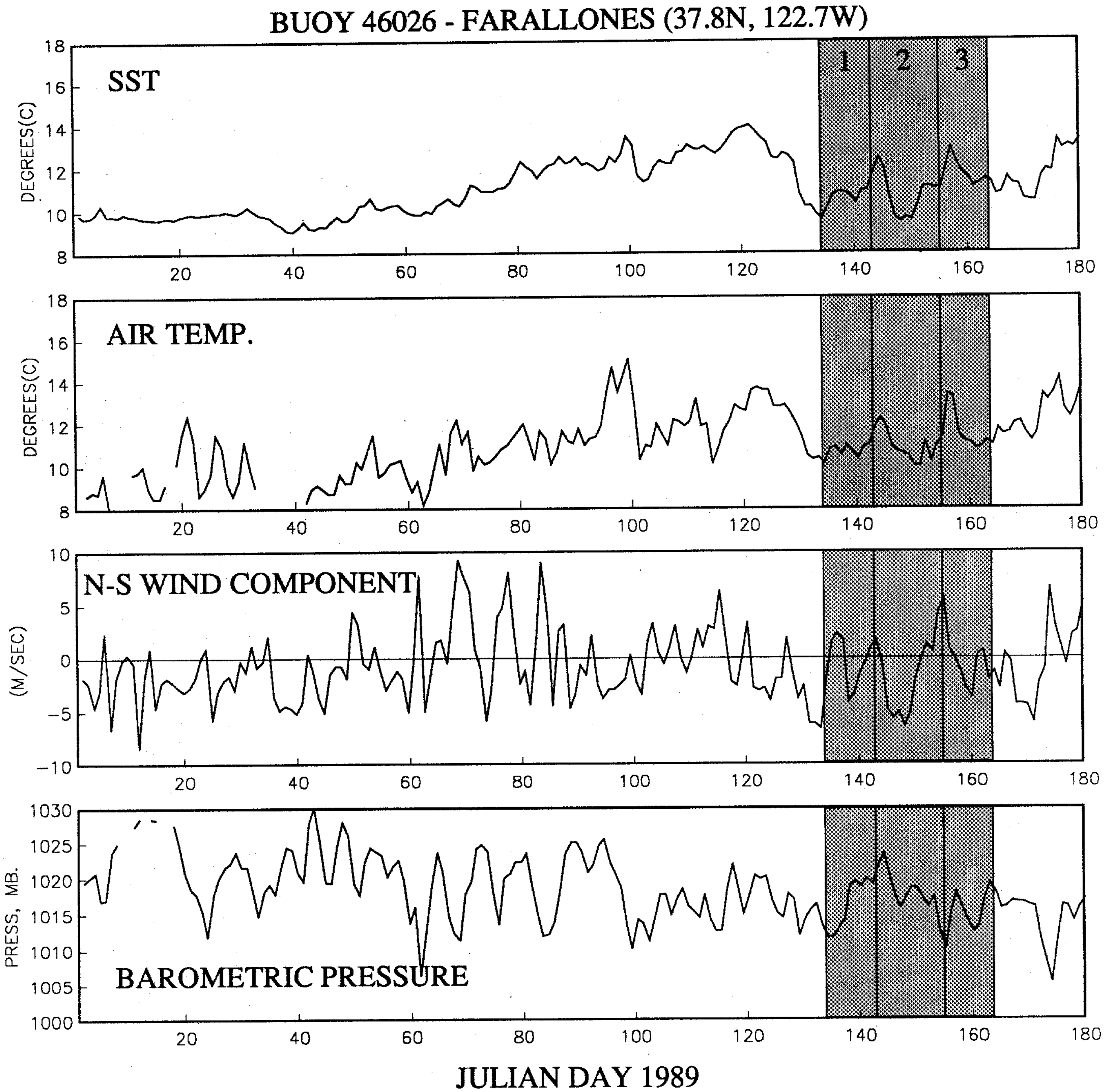

DS8904
STATION
DEPTH (M)
38°N
37°N
123°W
122°W
50
100
200
400

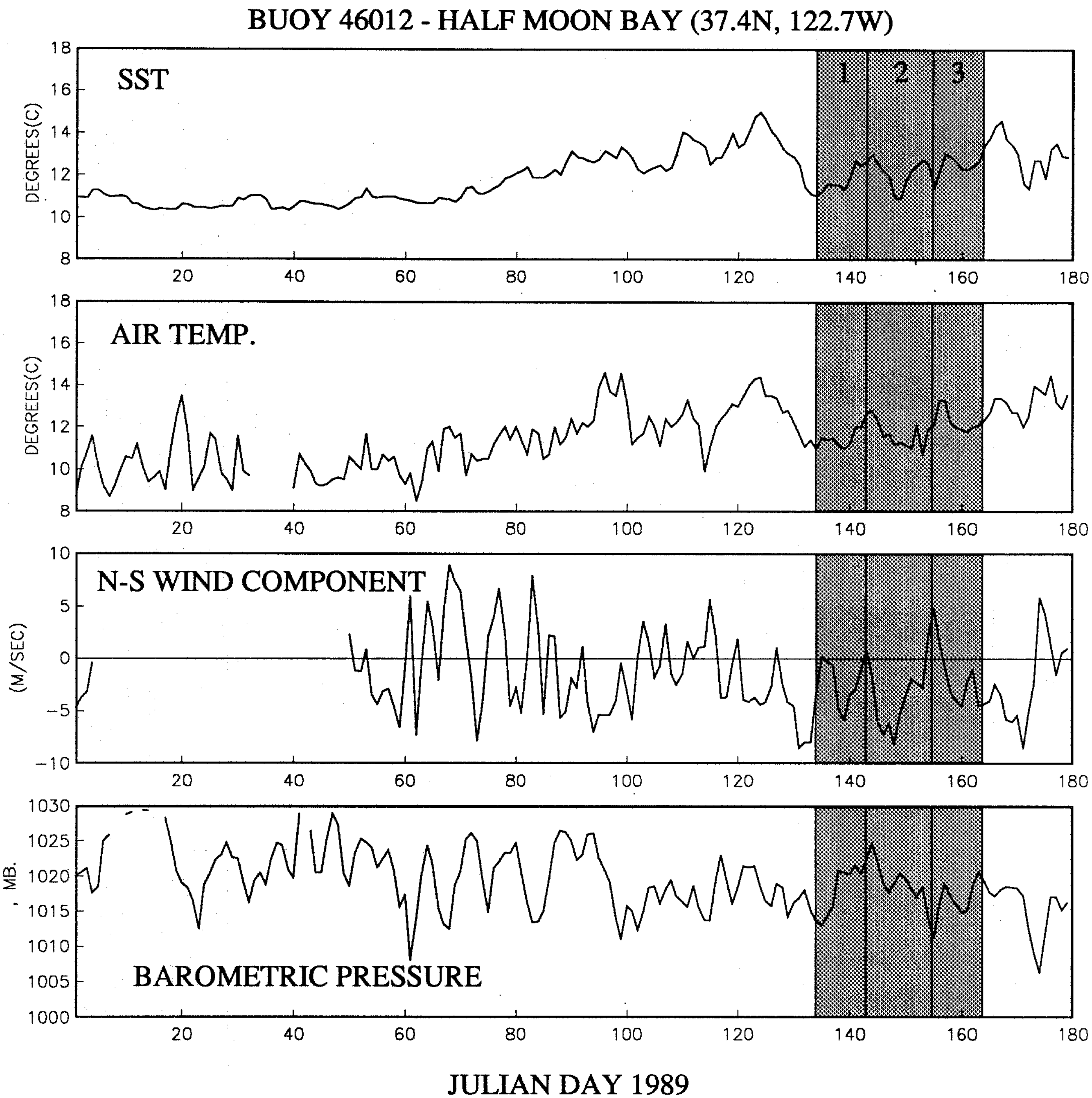
APPENDIX 3: ATMOSPHERIC TIME SERIES



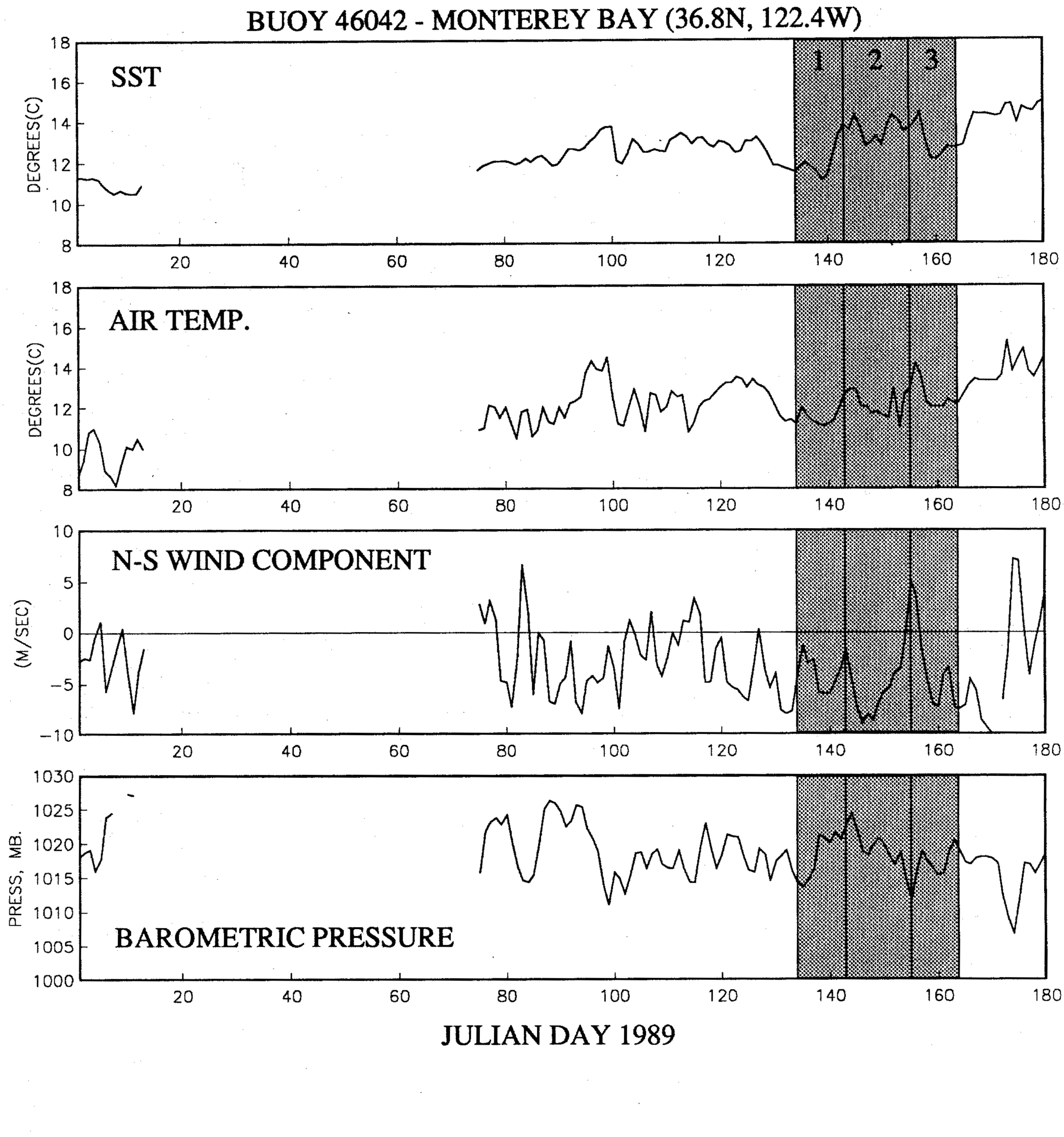
DAILY BUOY WINDS - 1989
1
2
3
46013 - BODEGA BAY (38.2N, 123.3W)
46026 - FARALLONES (37.8N, 122.7W)
46012 - HALF MOON BAY (37.4N, 122.7W)
SCALE
10 m/sec
46042 - MONTEREY BAY (36.8N, 122.4W)
MONTEREY BAY AQUARIUM (36.6N, 121.9W)
JAN
FEB
MAR
APR
MAY
JUN

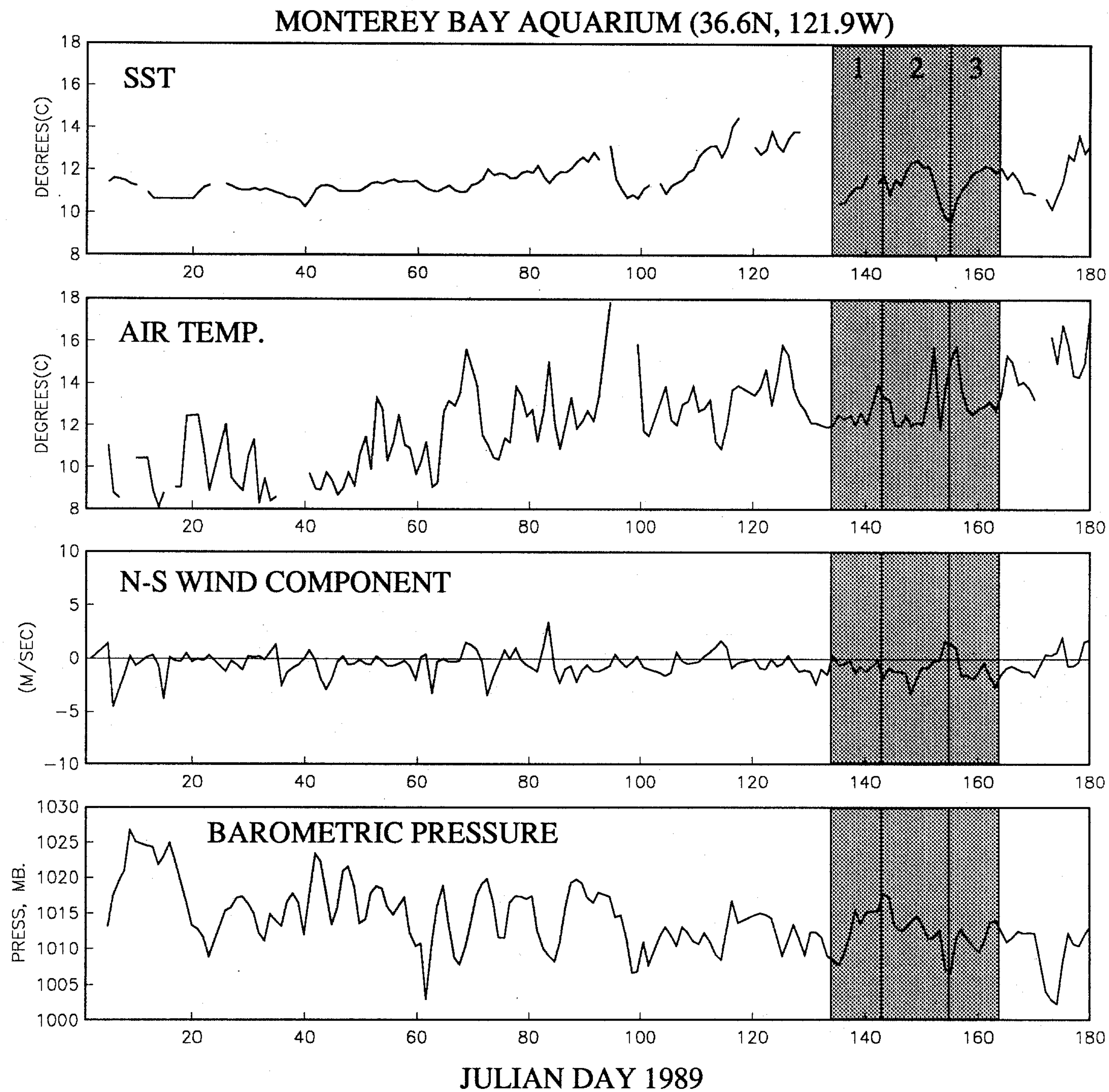

BUOY 46013 - BODEGA BAY (38.2N, 123.3W)
SST
DEGREES(C)
1
2
3
AIR TEMP.
DEGREES(C)
N-S WIND COMPONENT
(M/SEC)
BAROMETRIC PRESSURE
PRESS, MB.
JULIAN DAY 1989


BUOY 46026 - FARALLONES (37.8N, 122.7W)
SST
DEGREES(C)
1
2
3
AIR TEMP.
DEGREES(C)
N-S WIND COMPONENT
(M/SEC)
BAROMETRIC PRESSURE
PRESS, MB.
JULIAN DAY 1989

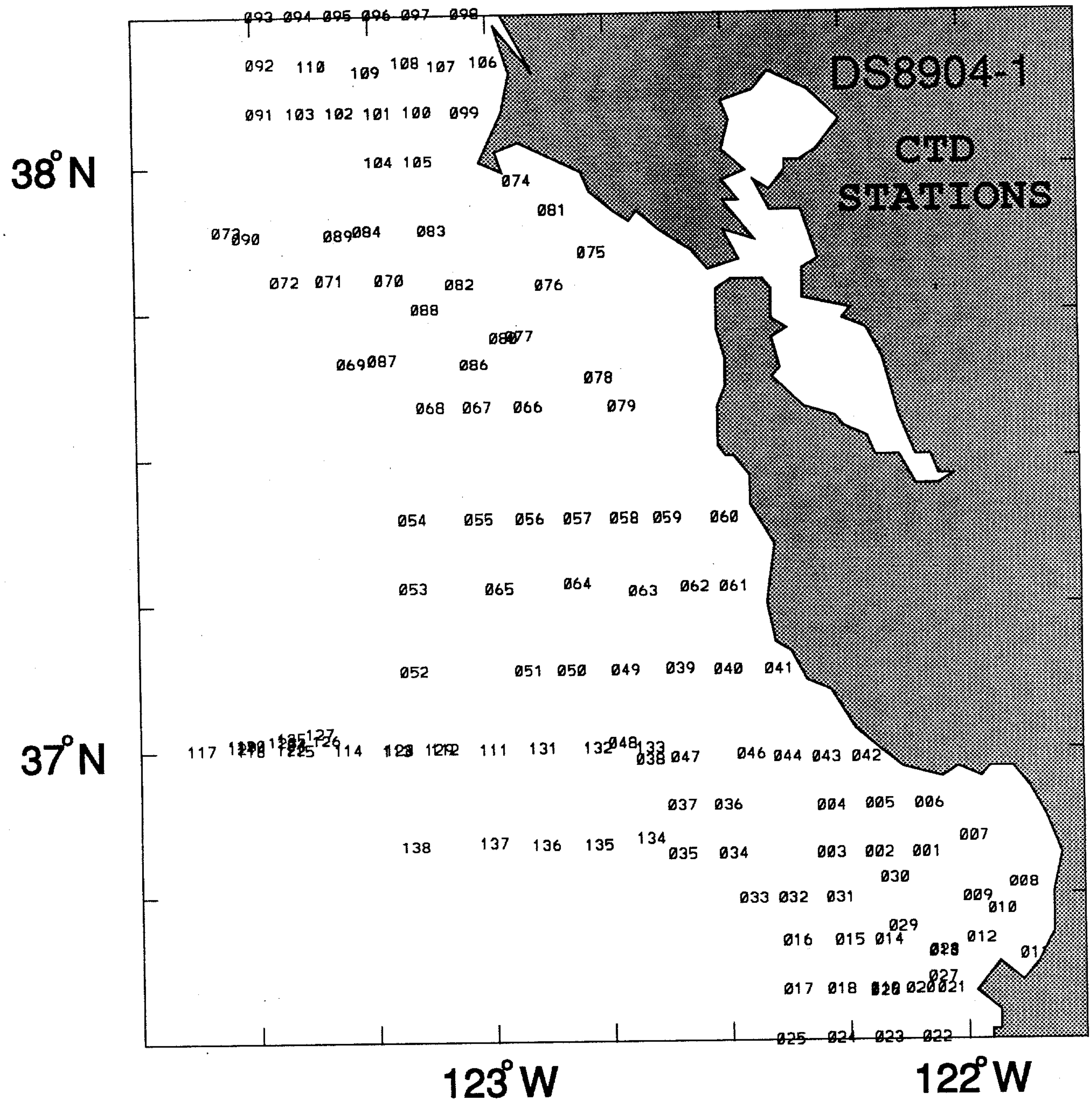


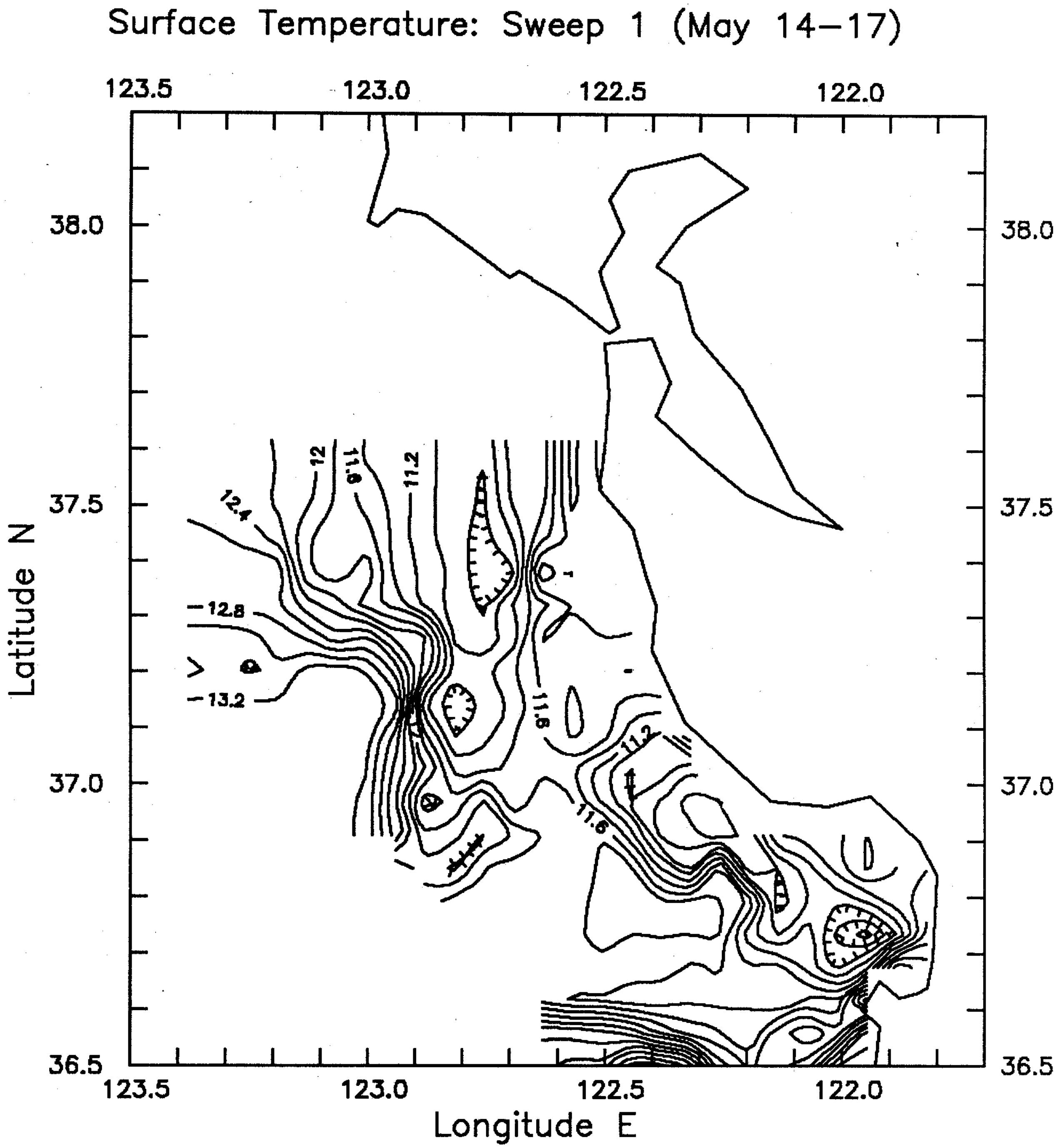
BUOY 46012 - HALF MOON BAY (37.4N, 122.7W)
SST
DEGREES(C)
1
2
3
AIR TEMP.
DEGREES(C)
N-S WIND COMPONENT
(M/SEC)
MB.
BAROMETRIC PRESSURE
JULIAN DAY 1989


BUOY 46042 - MONTEREY BAY (36.8N, 122.4W)
SST
DEGREES(C)
1
2
3
AIR TEMP.
DEGREES(C)
N-S WIND COMPONENT
(M/SEC)
BAROMETRIC PRESSURE
PRESS, MB.
JULIAN DAY 1989

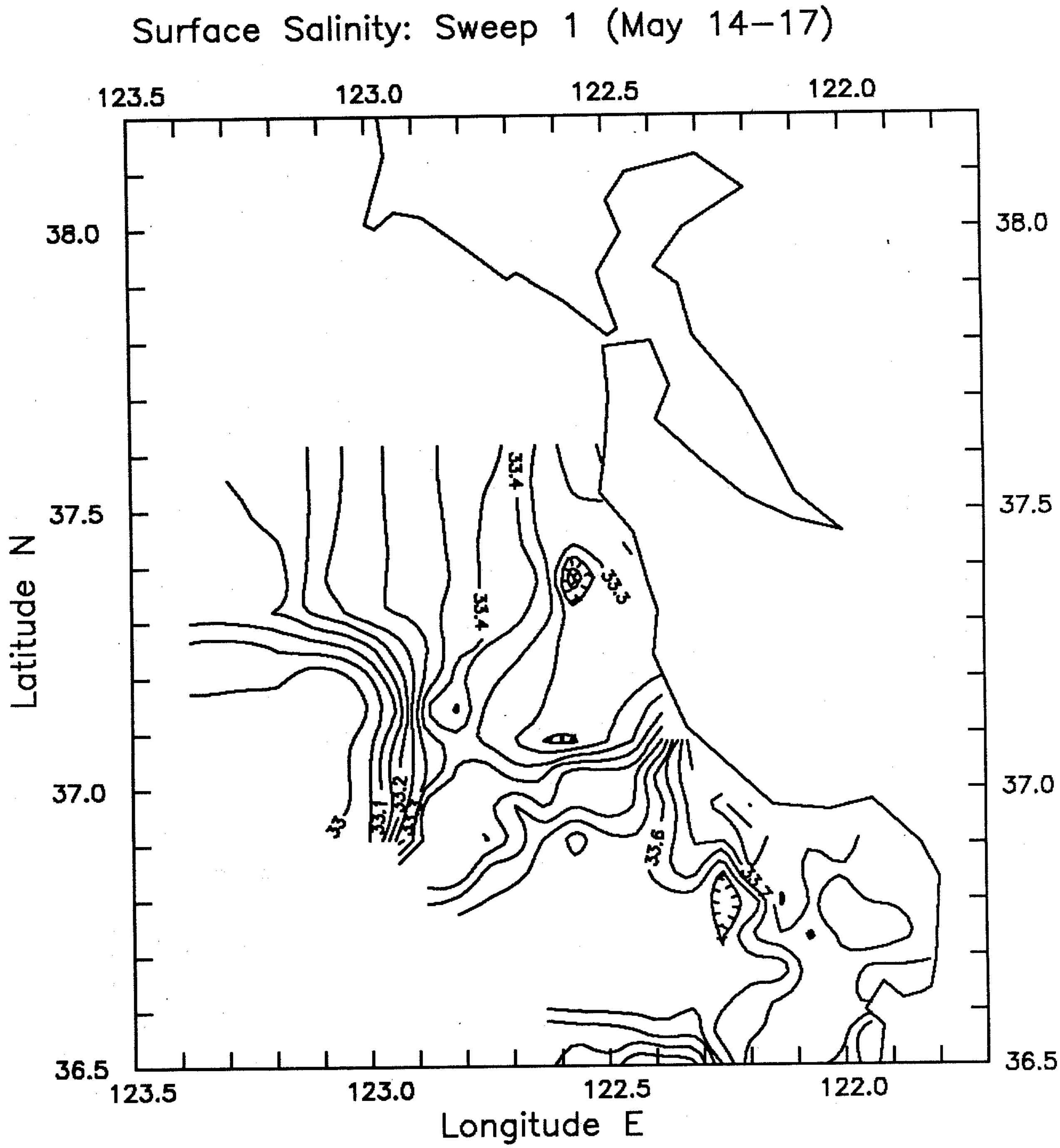

MONTEREY BAY AQUARIUM (36.6N, 121.9W)
SST
AIR TEMP.
N-S WIND COMPONENT
BAROMETRIC PRESSURE
DEGREES(C)
(M/SEC)
PRESS, MB.
1
2
3
JULIAN DAY 1989

APPENDIX 4.1: HORIZONTAL MAPS- SWEEP 1

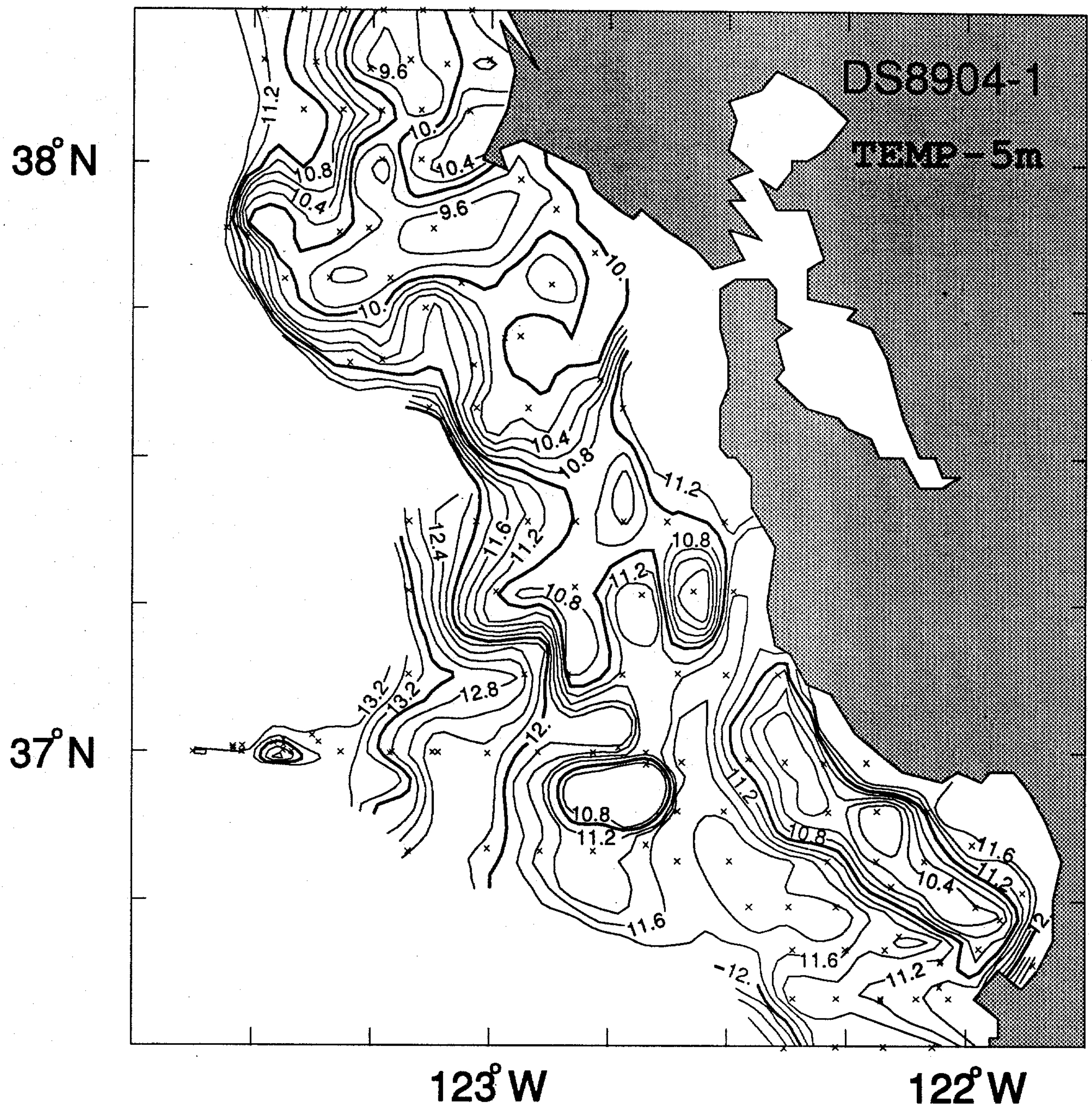

DS8904-1
CTD
STATIONS
38°N
37°N
123°W
122°W



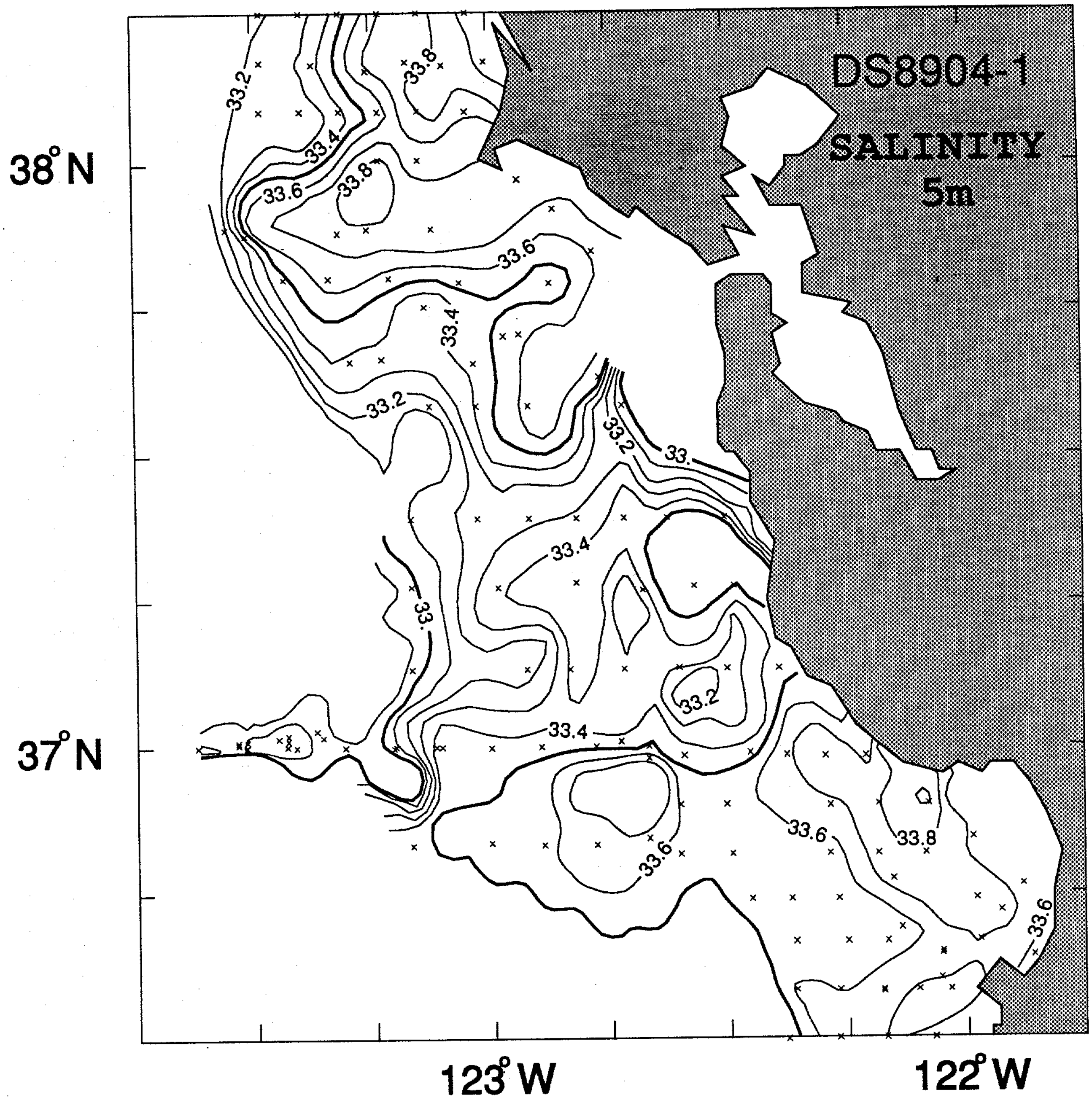
Surface Temperature: Sweep 1 (May 14–17)
123.5
123.0
122.5
122.0
38.0
37.5
37.0
36.5
Latitude N
Longitude E
12
11.6
11.2
12.4
12.8
13.2
11.6
11.2
11.6

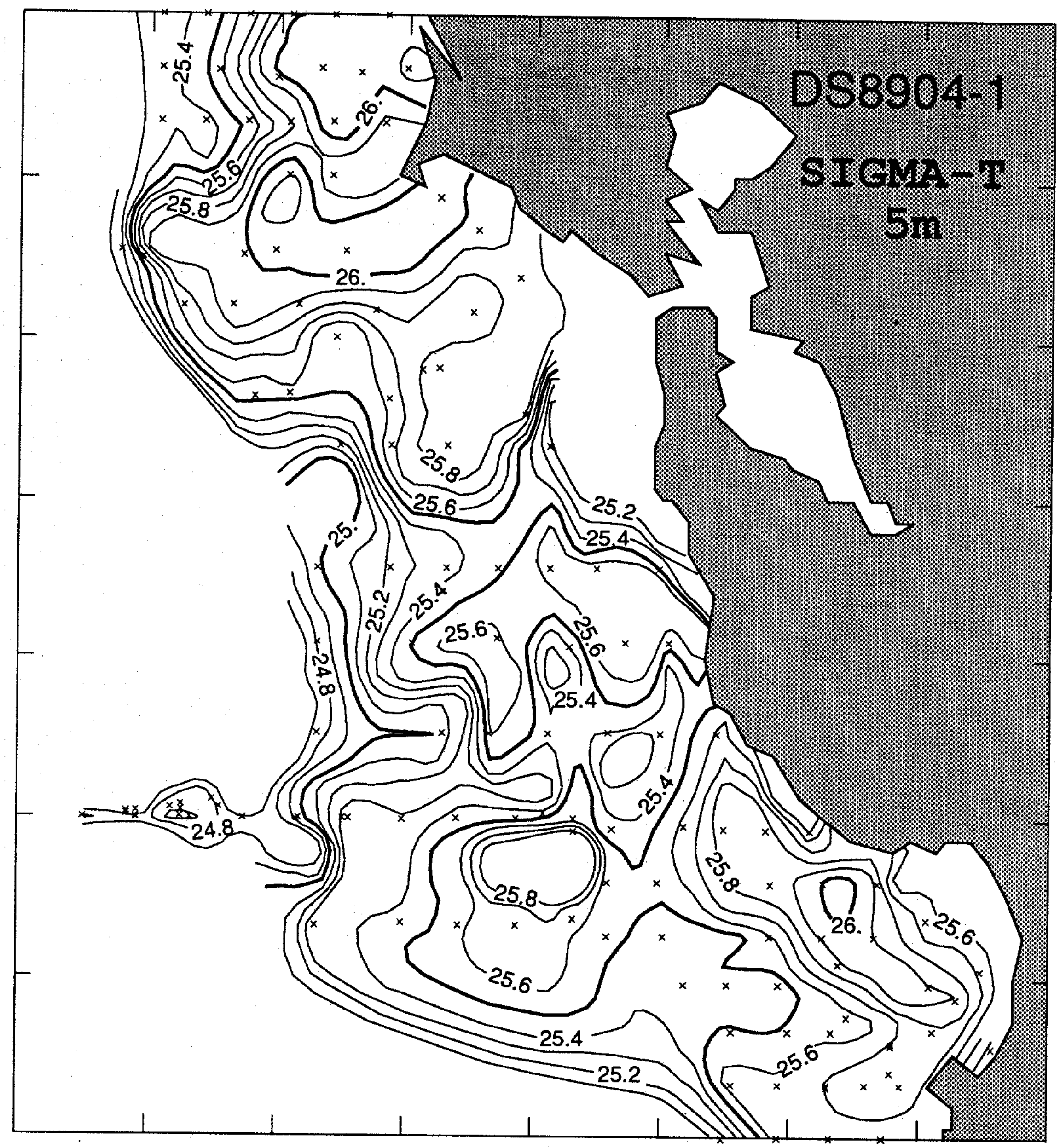


Surface Salinity: Sweep 1 (May 14-17)
123.5
123.0
122.5
122.0
38.0
37.5
37.0
36.5
Latitude N
Longitude E
33.4
33.3
33
33.1
33.2
33.6
33.7

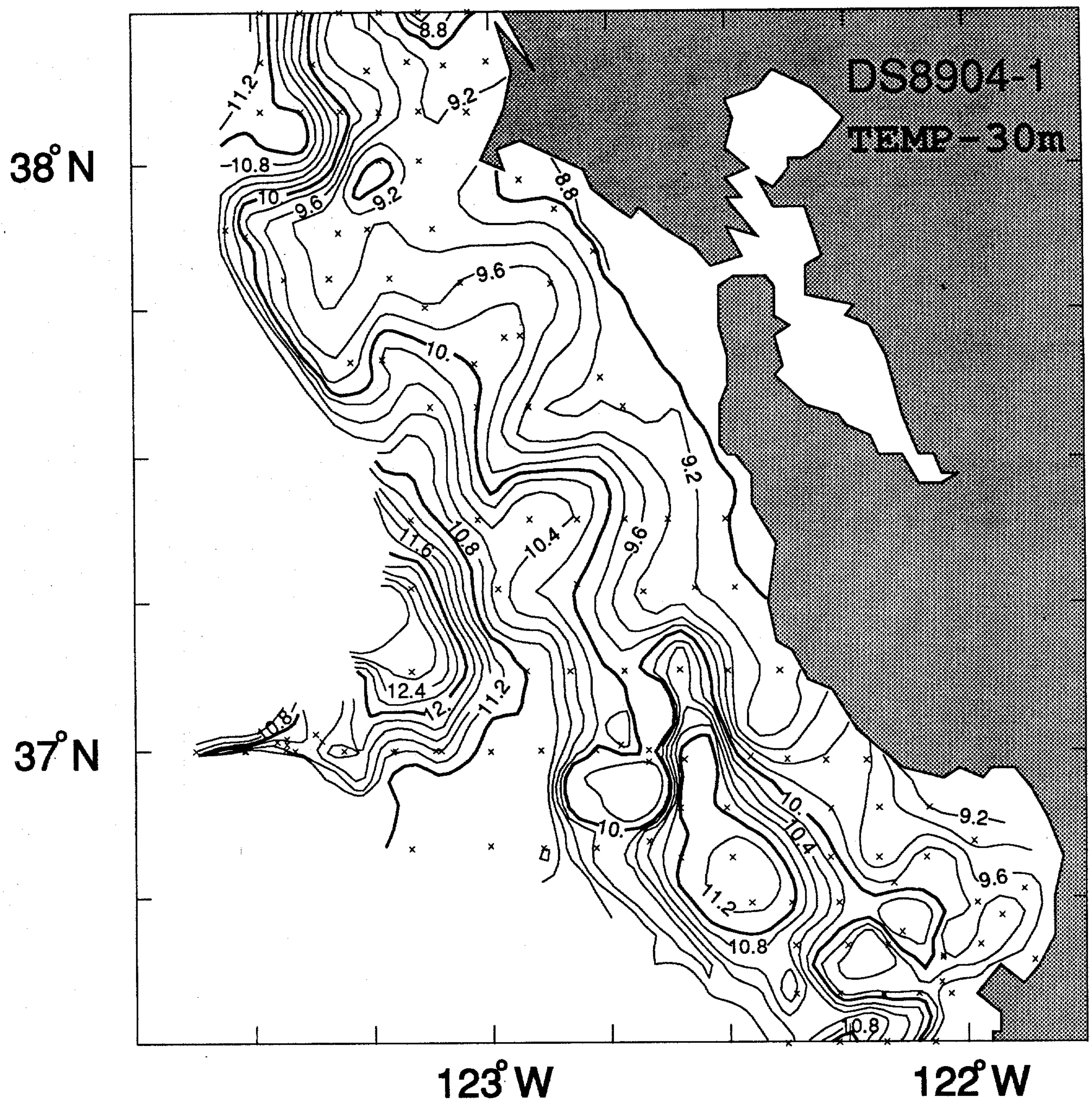


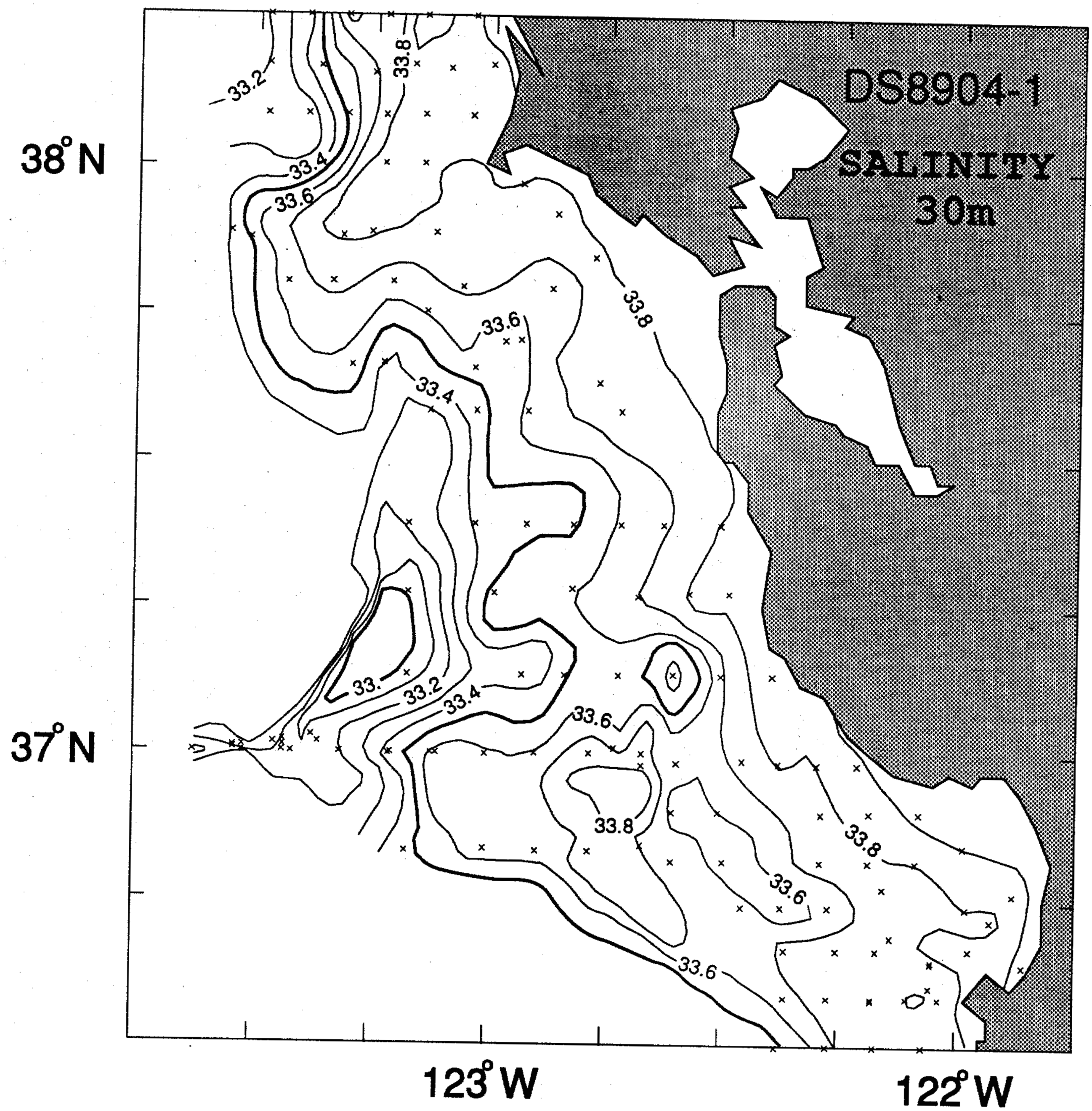
DS8904-1
TEMP - 5m
38° N
37° N
123° W
122° W

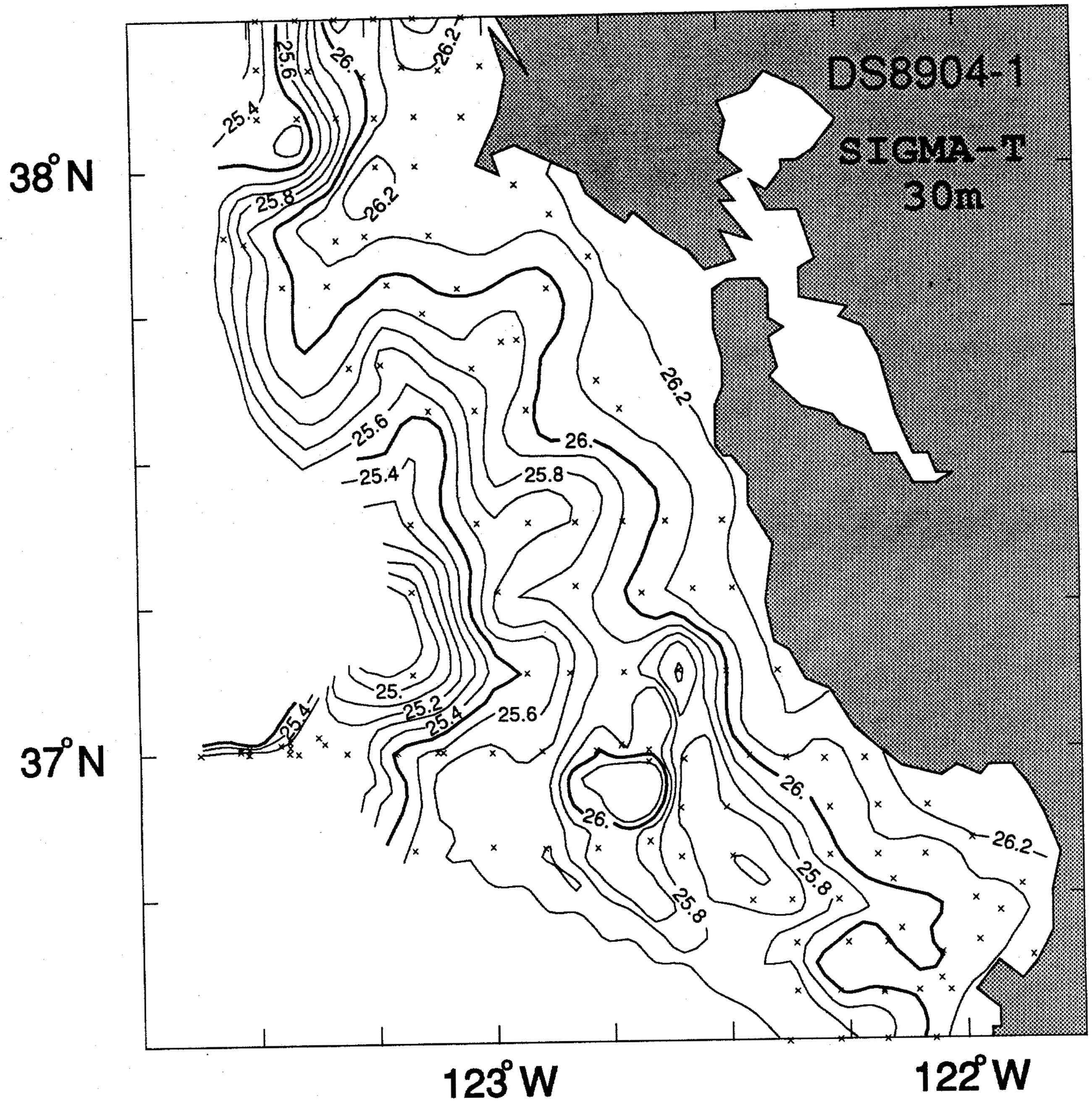

DS8904-1
SALINITY
5m
38° N
37° N
123° W
122° W
33.2
33.4
33.6
33.8
33.

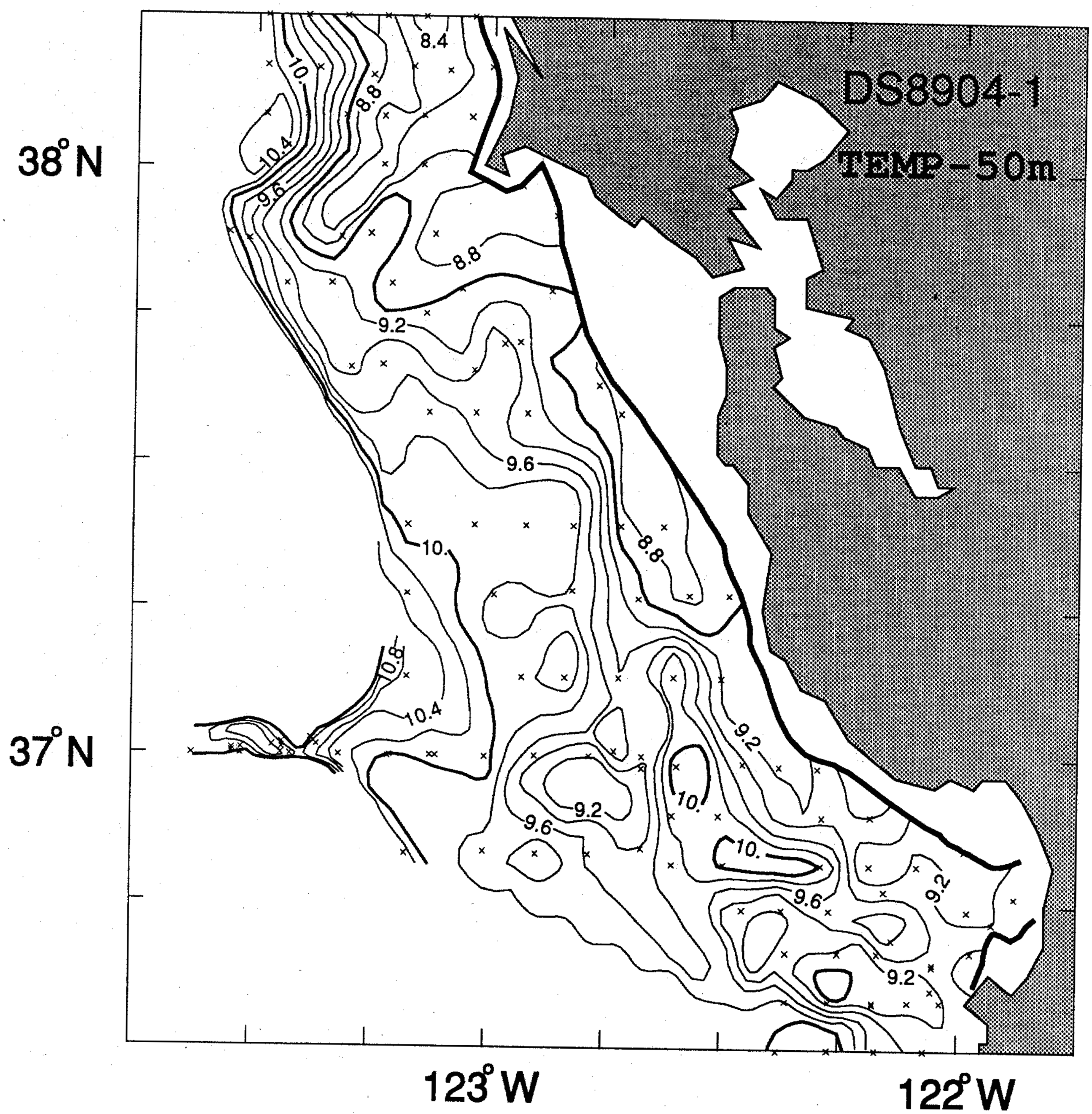


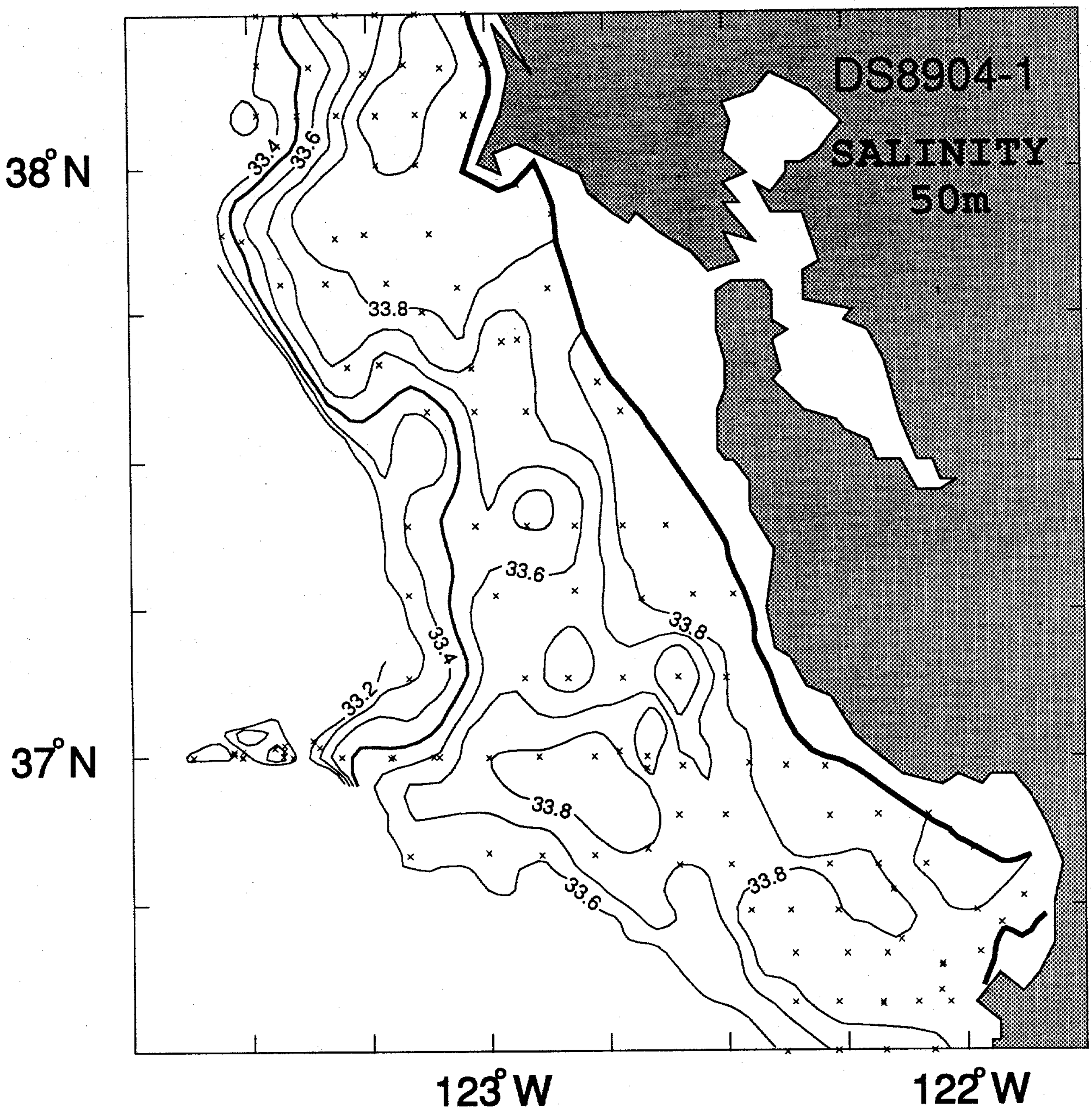
DS8904-1
SIGMA-T
5m
38° N
37° N
123° W
122° W
25.4
25.6
25.8
26.
25.2
25.
24.8

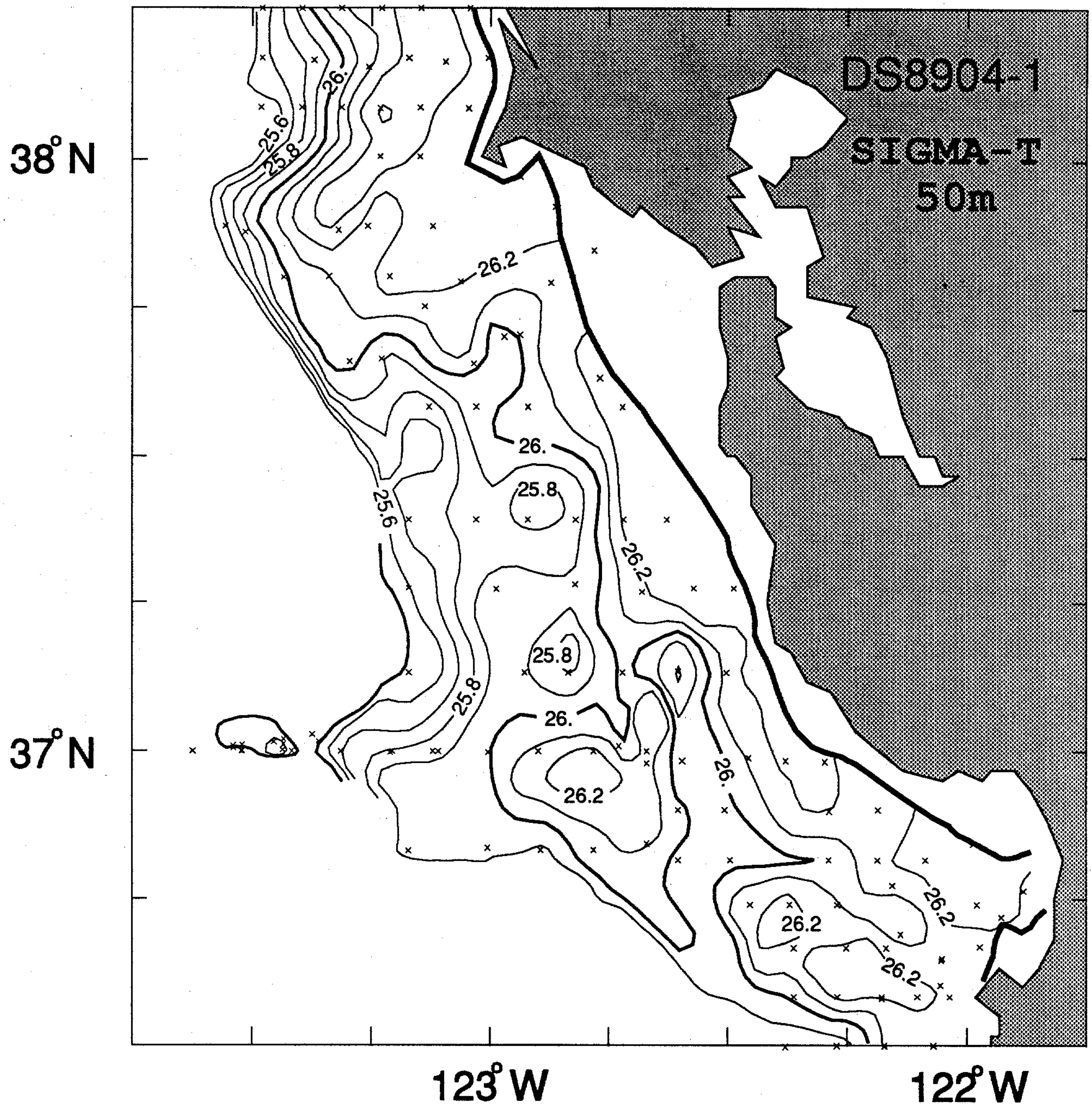

DS8904-1
TEMP - 30m
38° N
37° N
123° W
122° W
8.8
9.2
9.6
10.
10.4
10.8
11.2
11.6
12.
12.4


DS8904-1
SALINITY
30m
38° N
37° N
123° W
122° W
33.2
33.4
33.6
33.8
33.6
33.8
33.4
33.
33.2
33.4
33.6
33.8
33.8
33.6
33.6

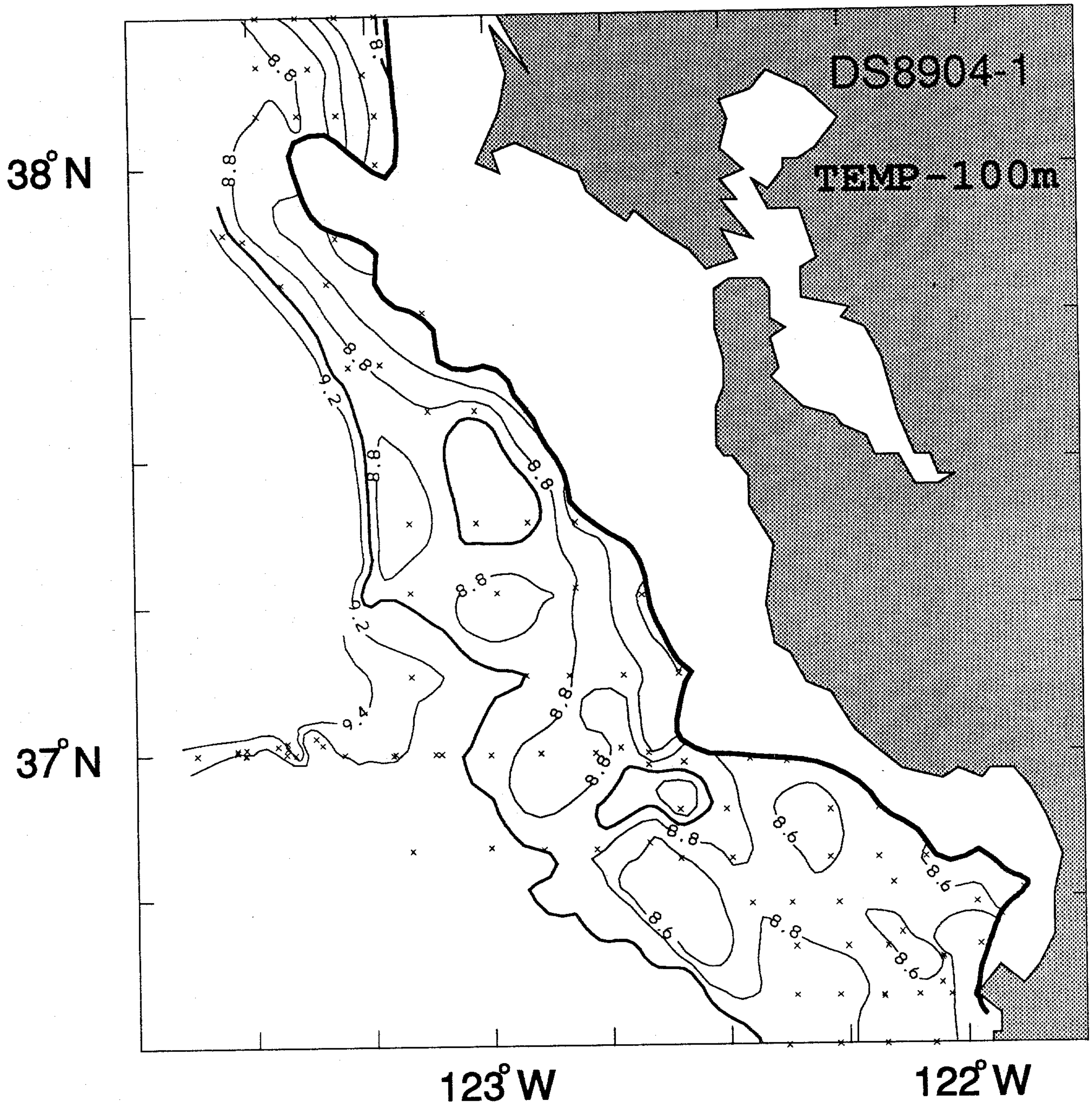

DS8904-1
SIGMA-T
30m
38° N
37° N
123° W
122° W
25.4
25.6
25.8
26.
26.2
25.
25.2


DS8904-1
TEMP - 50m
38°N
37°N
123°W
122°W
8.4
8.8
9.2
9.6
10.
10.4
10.8

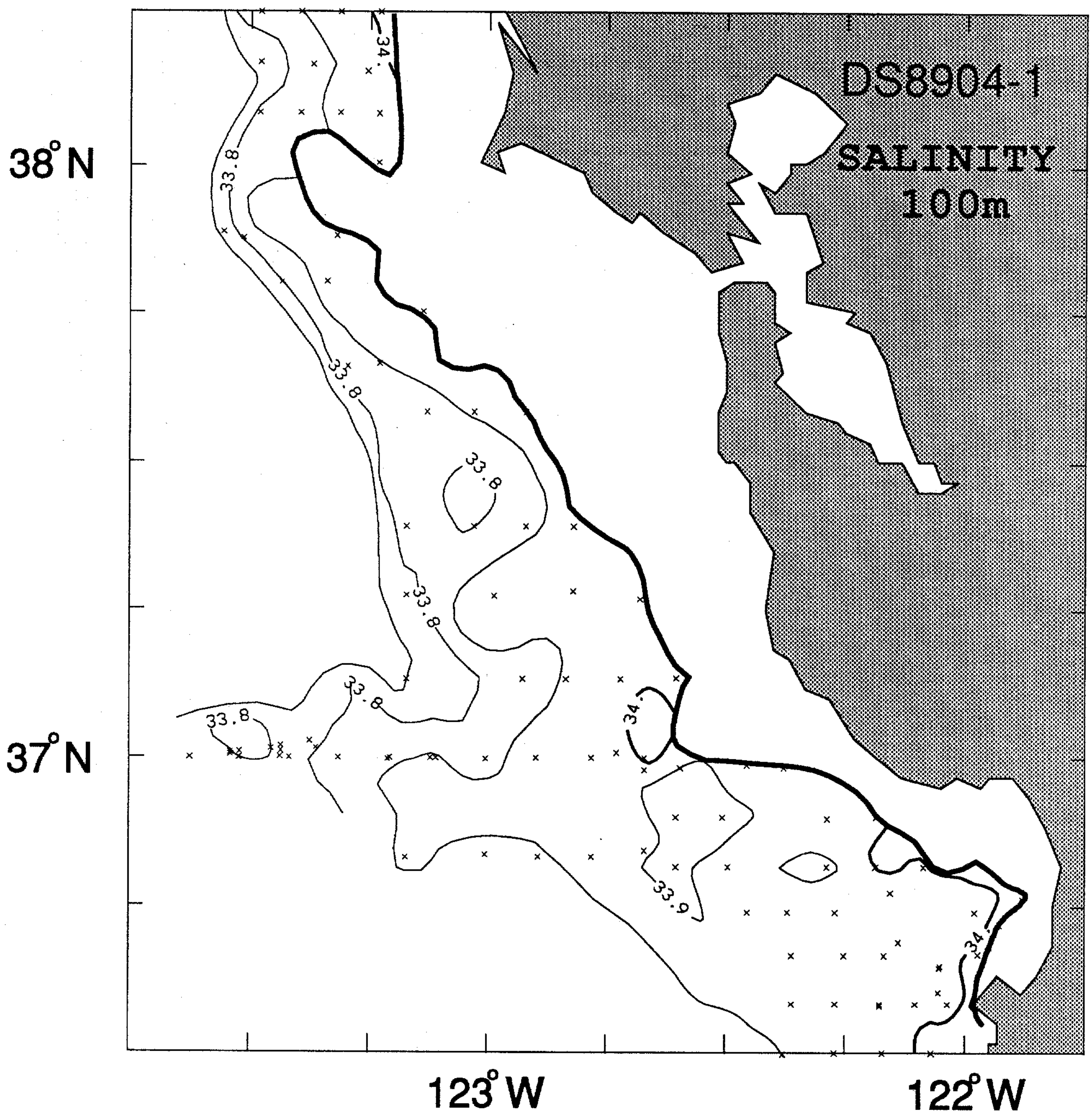

DS8904-1
SALINITY
50m
33.4
33.6
33.8
33.6
33.8
33.4
33.2
33.8
33.6
33.8
38° N
37° N
123° W
122° W

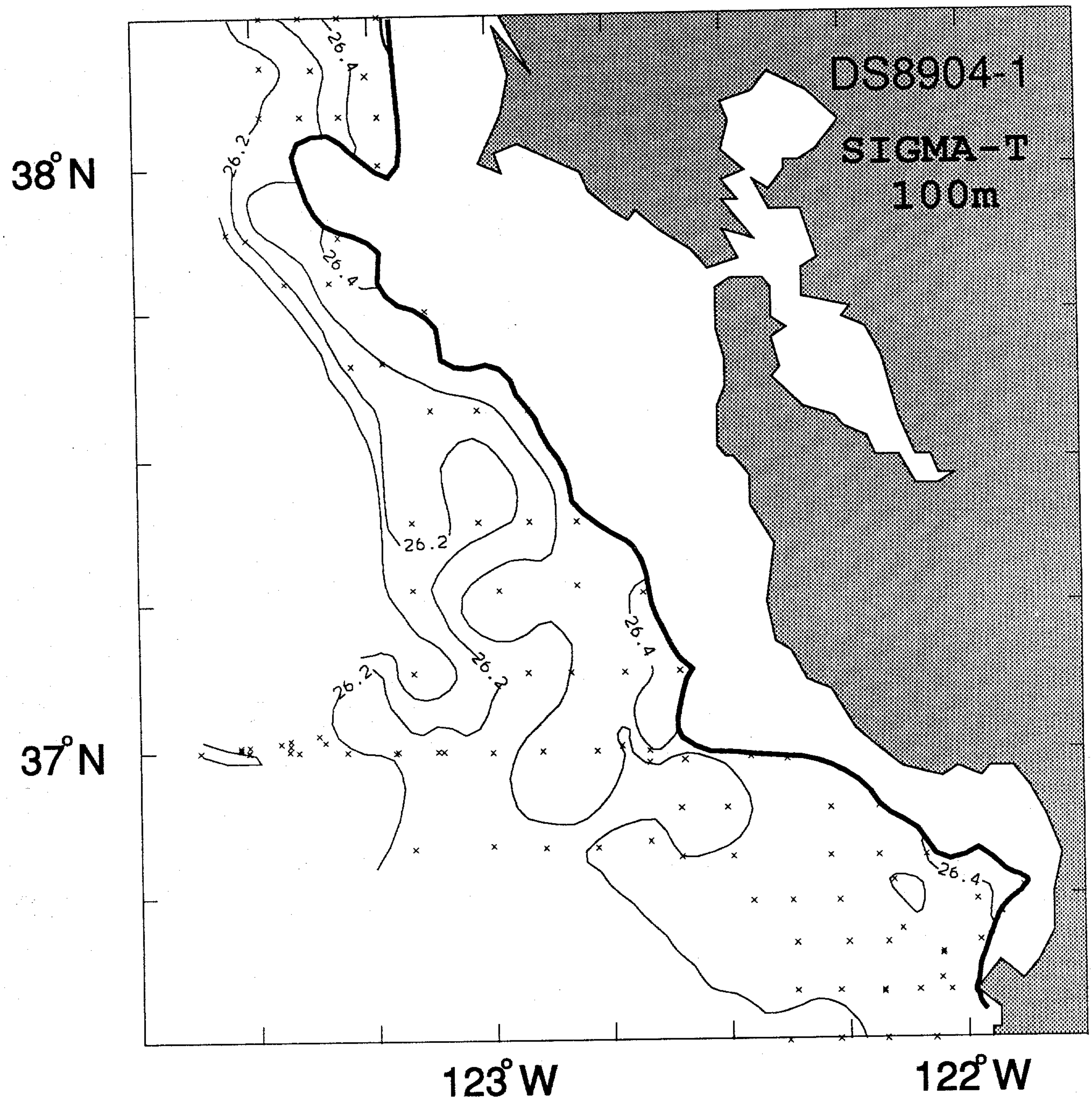


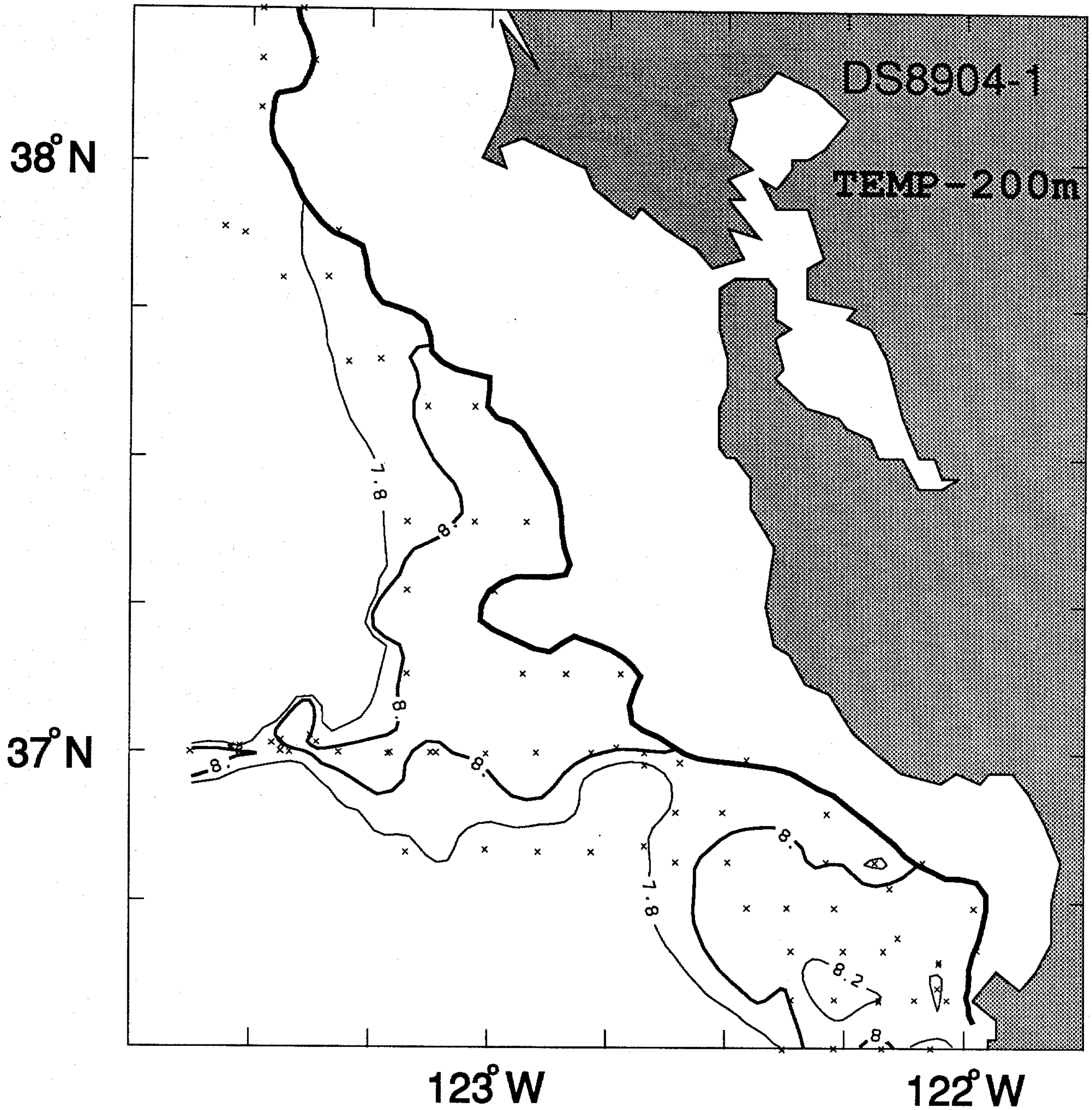
DS8904-1
SIGMA-T
50m
38° N
37° N
123° W
122° W
25.6
25.8
26.
26.2
26.
25.8
25.6
26.2
25.8
25.8
26.
26.2
26.
26.2
26.2
26.2

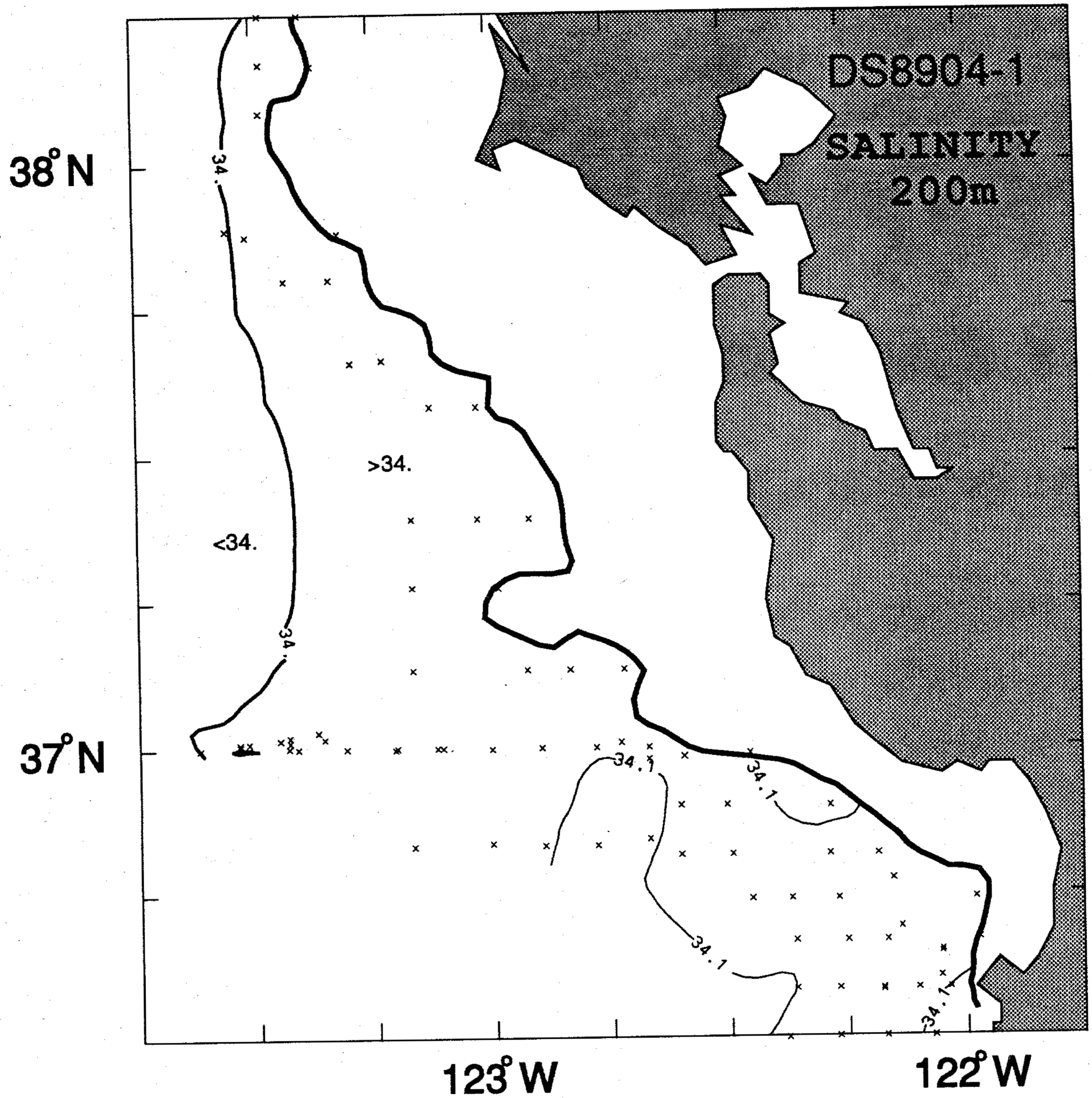


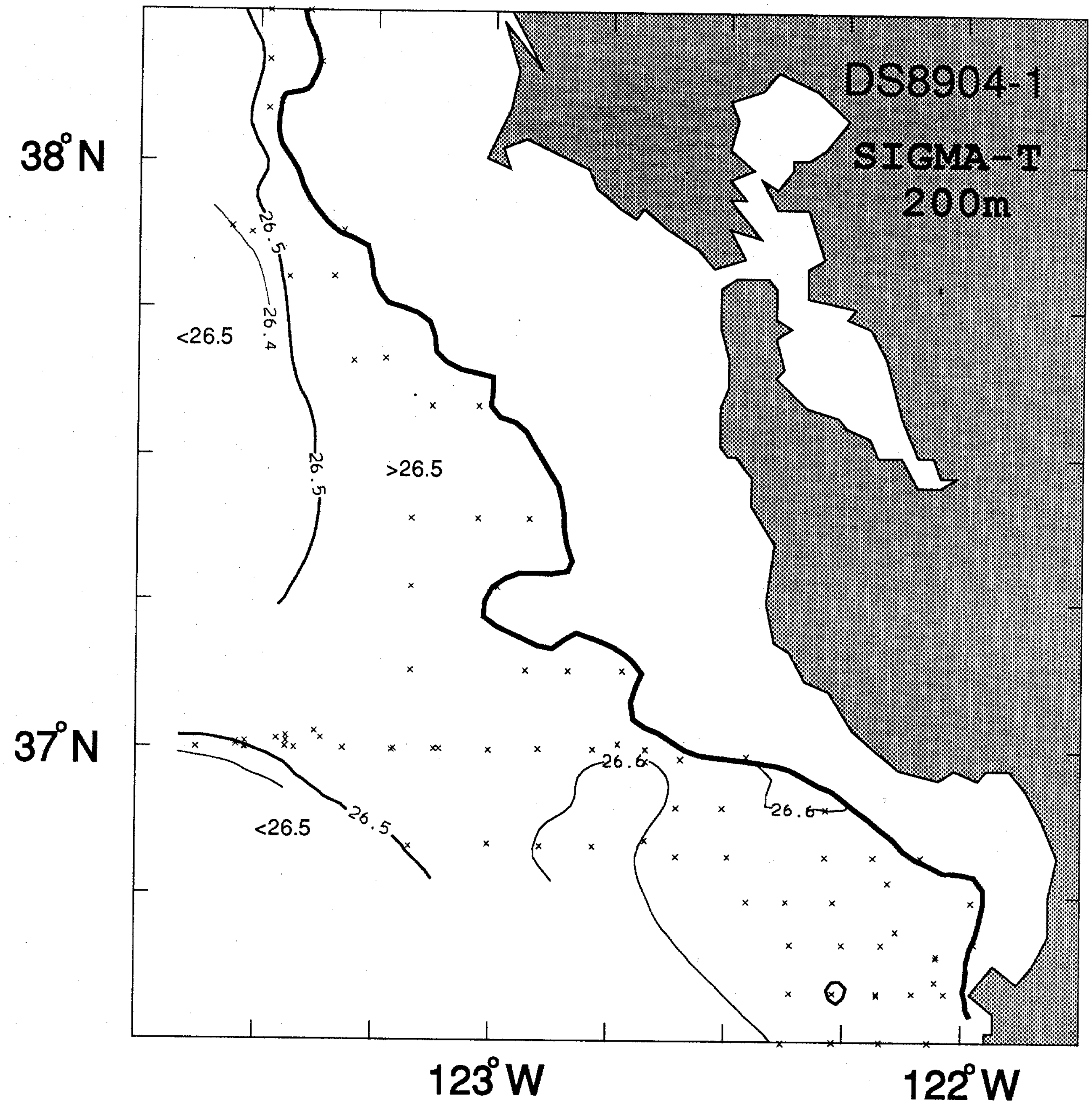
DS8904-1
TEMP - 100m
38° N
37° N
123° W
122° W
8.8
9.2
9.4
8.6

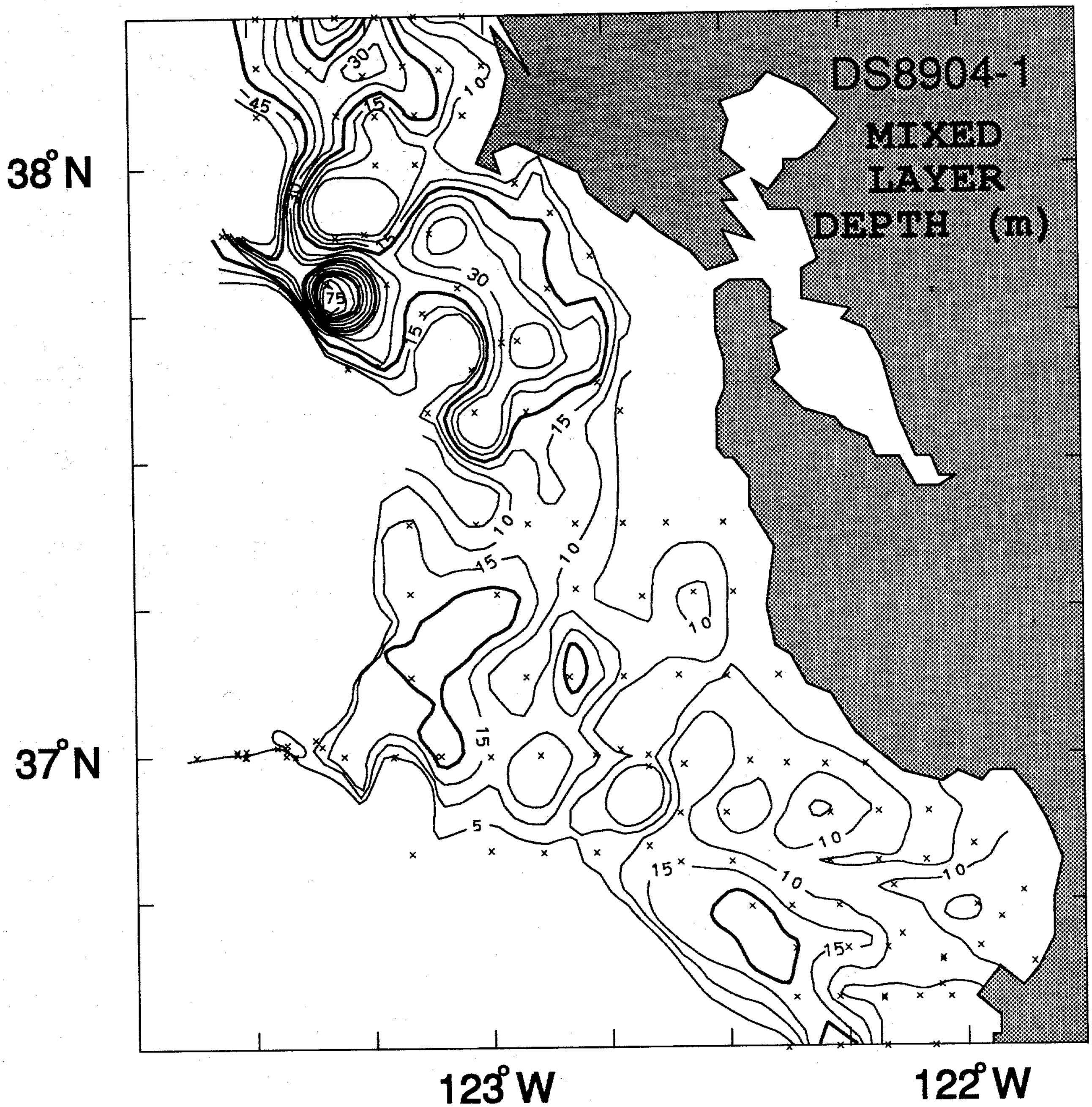

DS8904-1
SALINITY
100m
38°N
37°N
123°W
122°W
34.
33.8
33.8
33.8
33.8
33.8
33.8
34.
33.9
34.

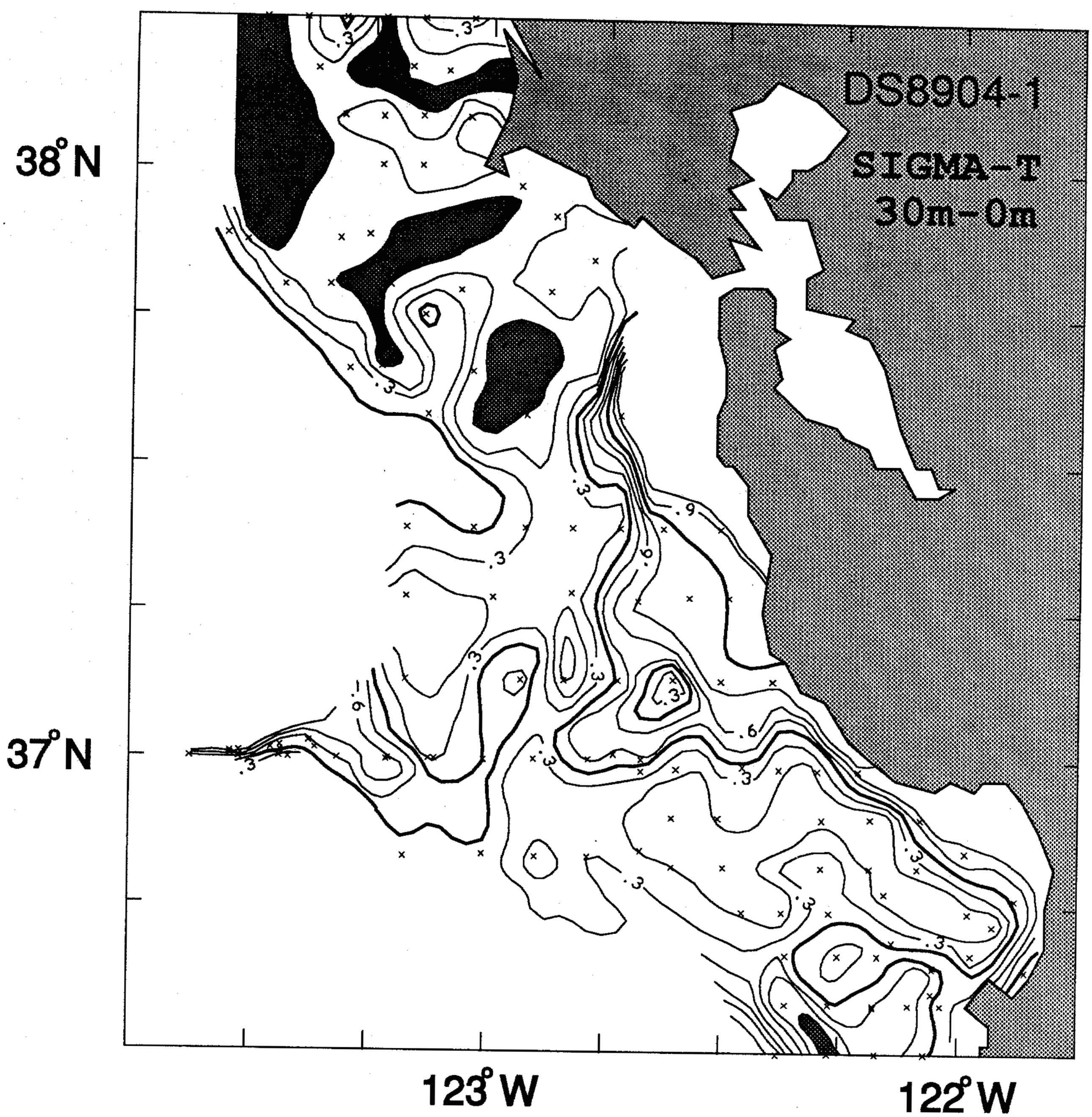

DS8904-1
SIGMA-T
100m
38° N
37° N
123° W
122° W
26.2
26.4
26.2
26.4
26.2
26.2
26.4
26.4

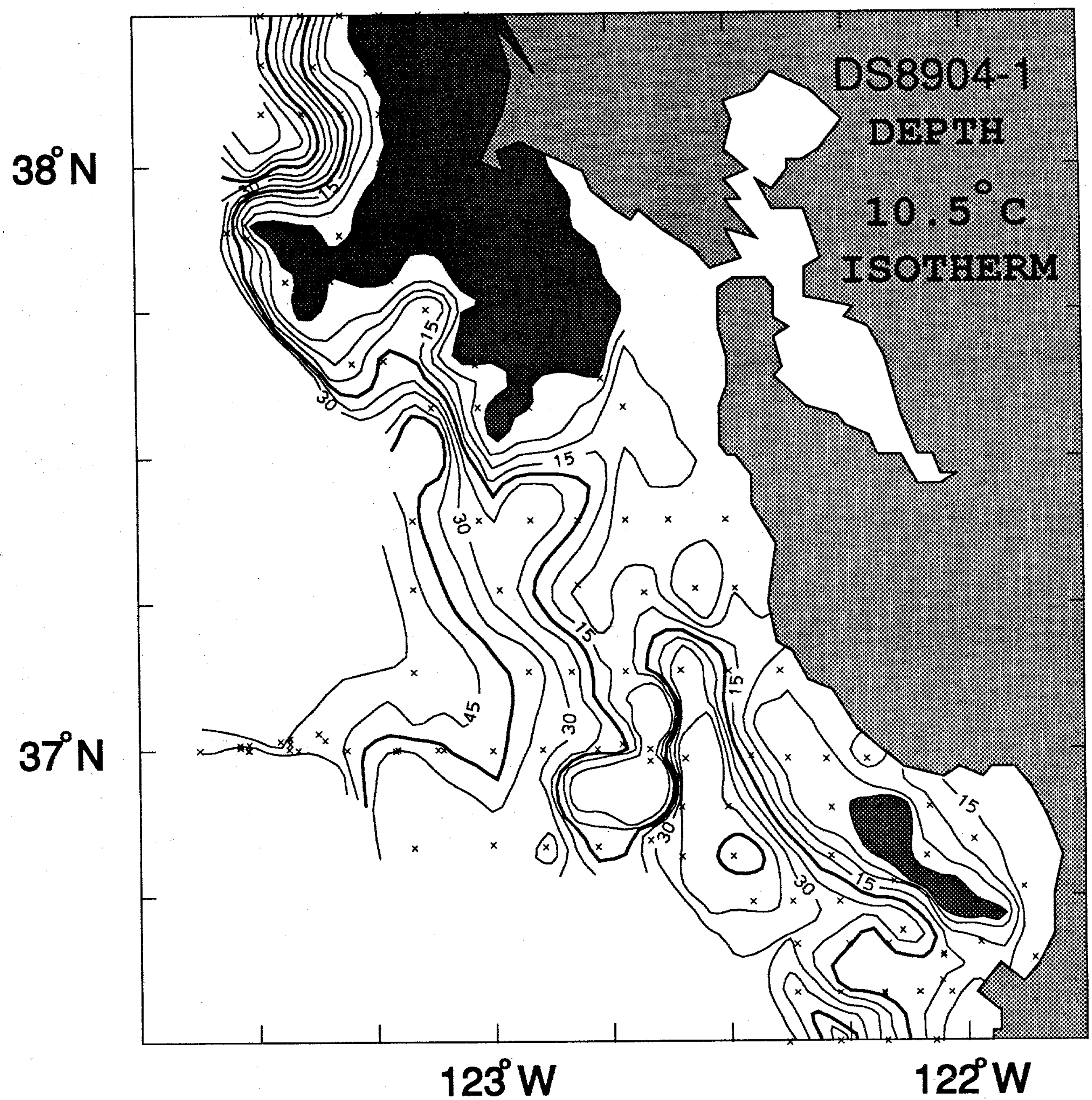

DS8904-1
TEMP-200m
38°N
37°N
123°W
122°W
7.8
8.
8.2

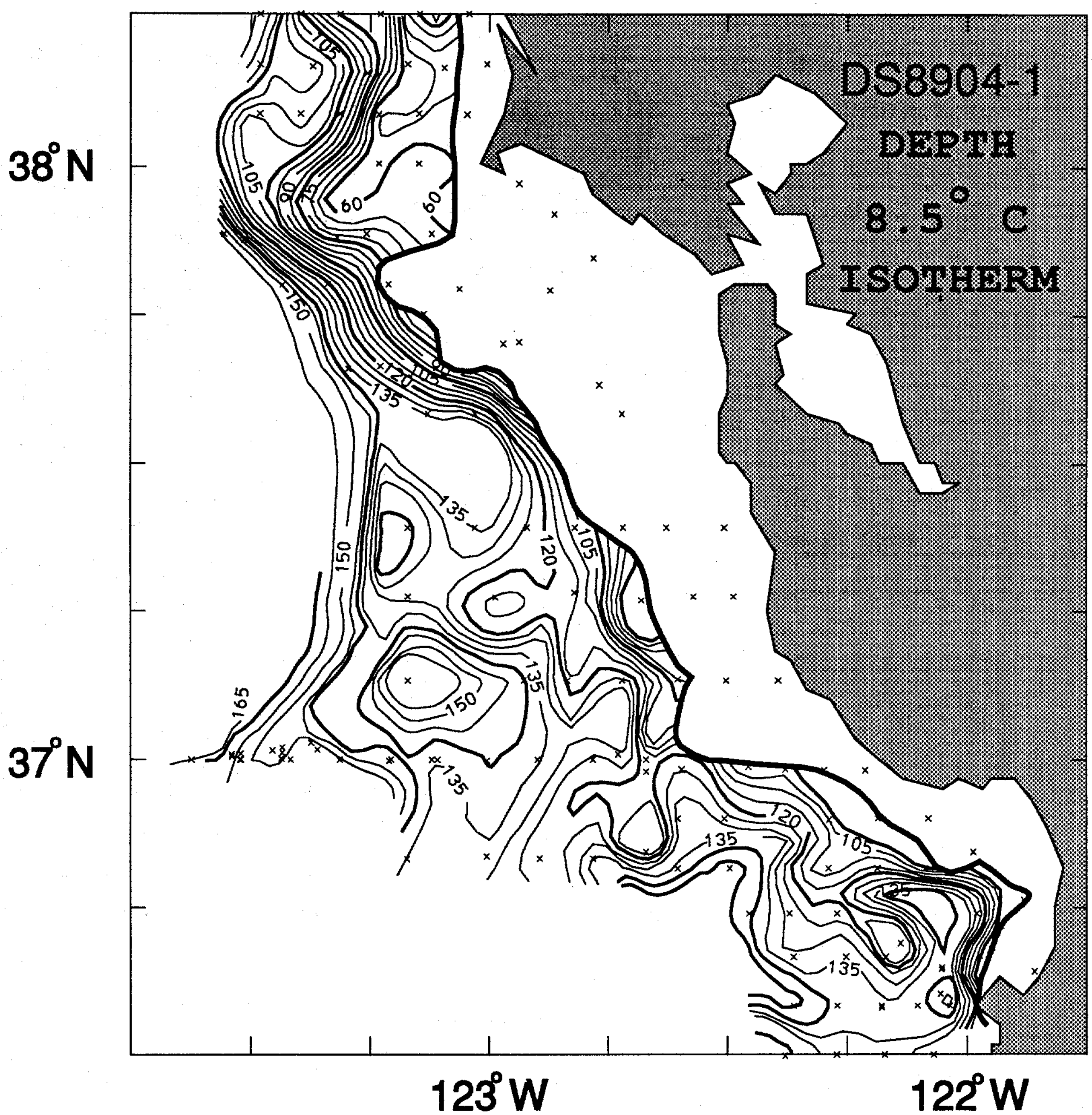

DS8904-1
SALINITY
200m
38° N
37° N
123° W
122° W
34.
34.
<34.
>34.
34.1
34.1
34.1
34.1

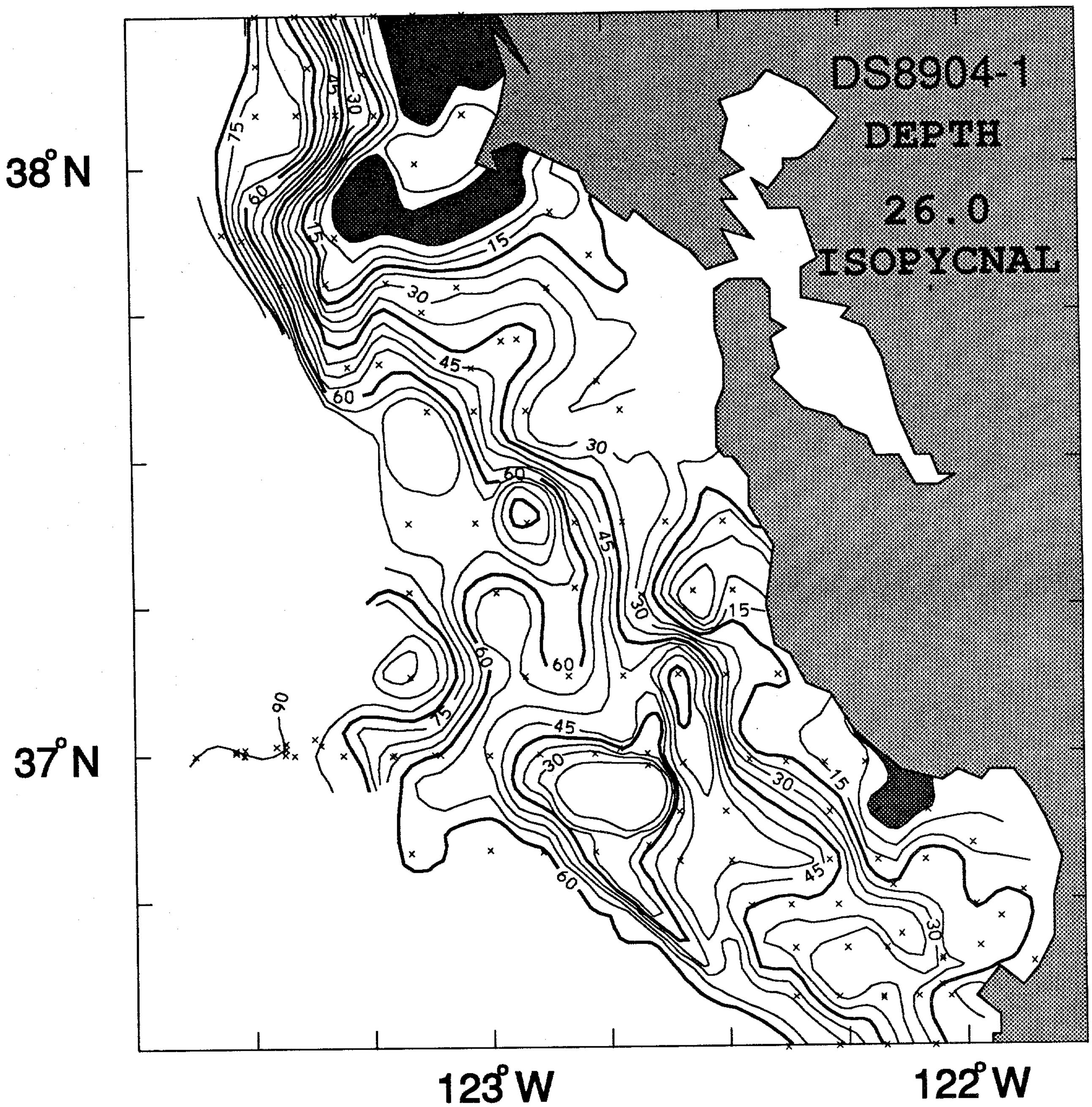

DS8904-1
SIGMA-T
200m
38°N
37°N
123°W
122°W
<26.5
>26.5
<26.5
26.5
26.4
26.5
26.6
26.6
26.5

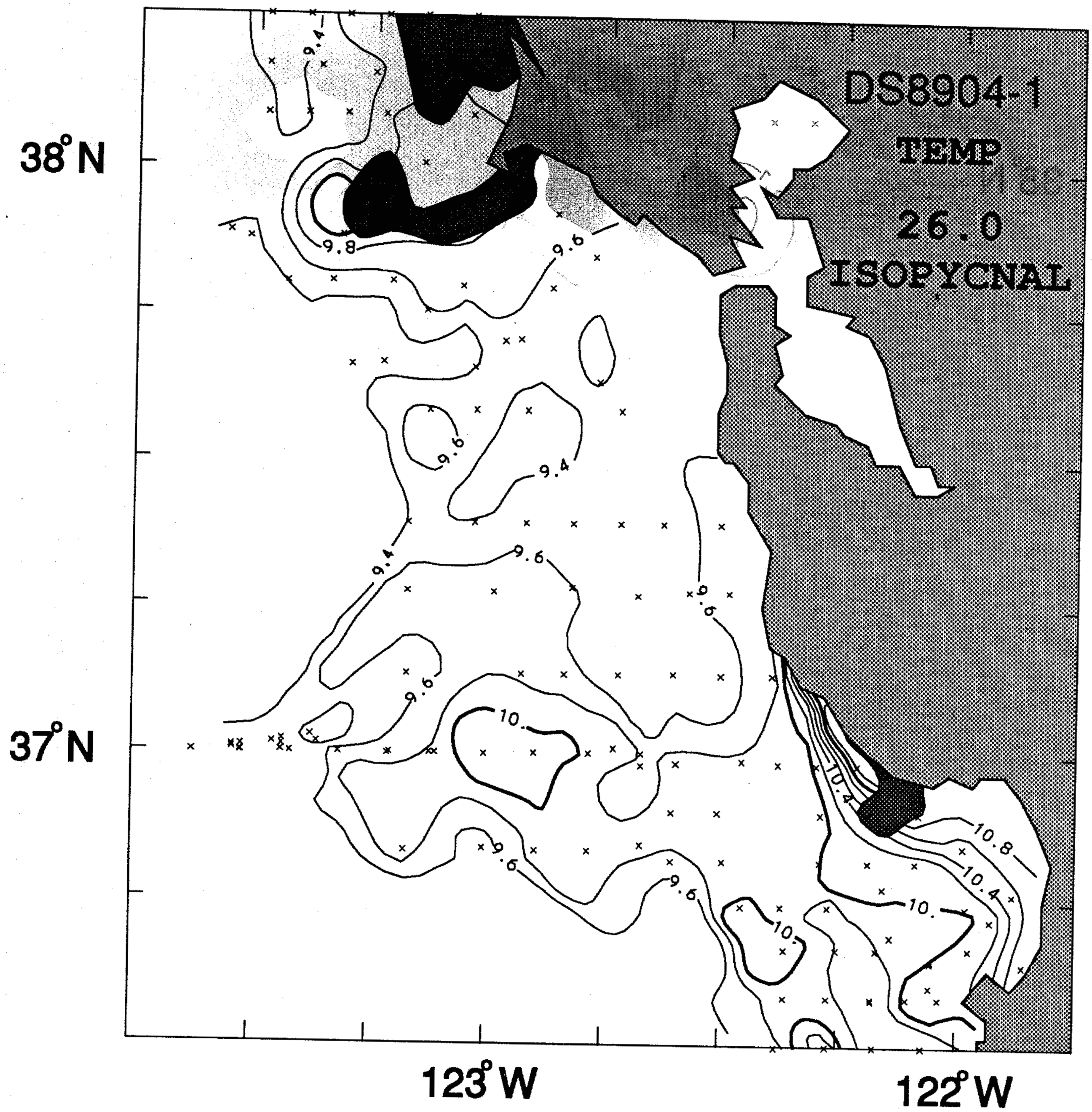

DS8904-1
MIXED
LAYER
DEPTH (m)
38° N
37° N
123° W
122° W
45
30
15
10
75
5

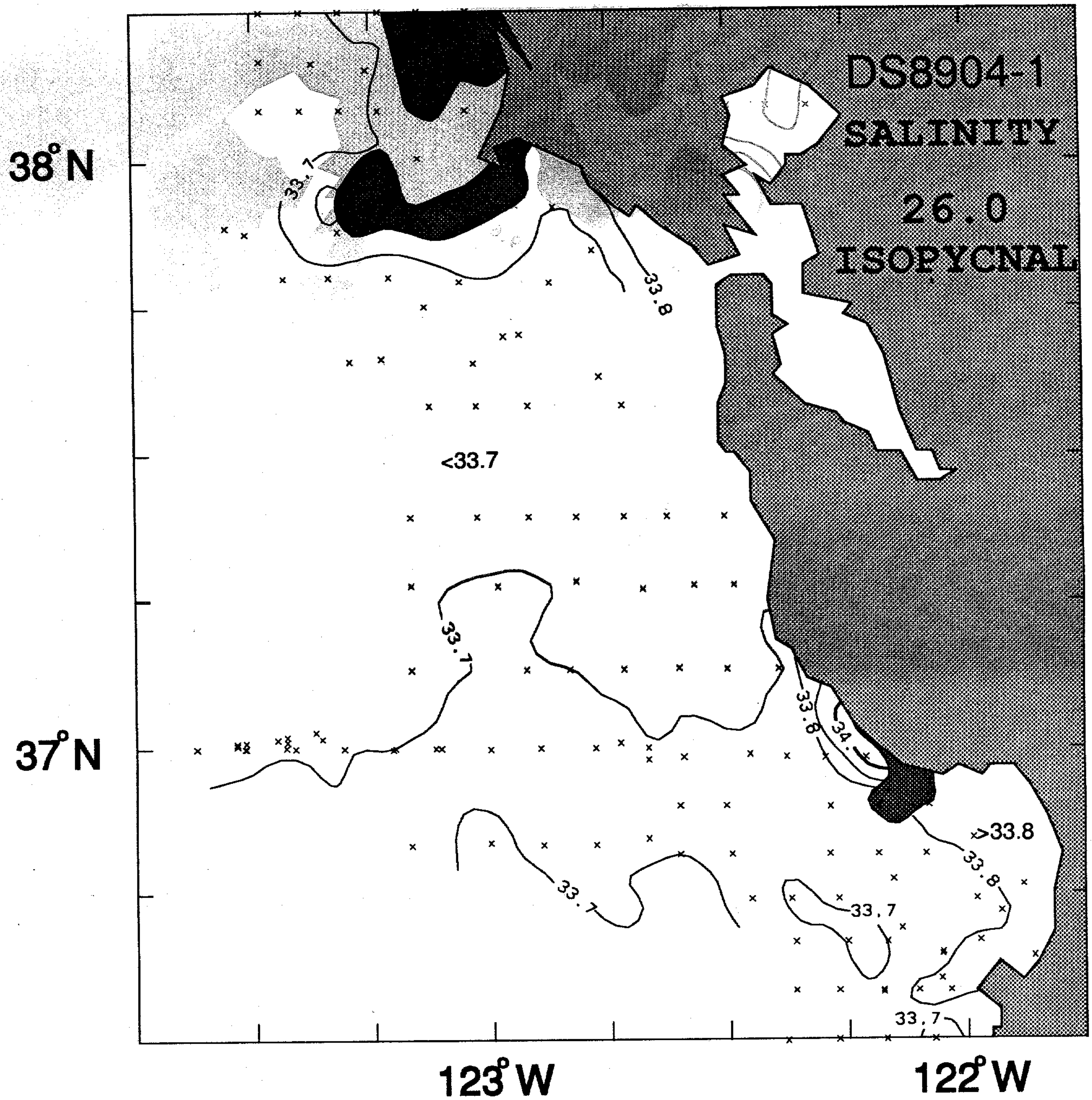

DS8904-1
SIGMA-T
30m-0m
38° N
37° N
123° W
122° W


DS8904-1
DEPTH
10.5°C
ISOTHERM
38°N
37°N
123°W
122°W
15
30
45

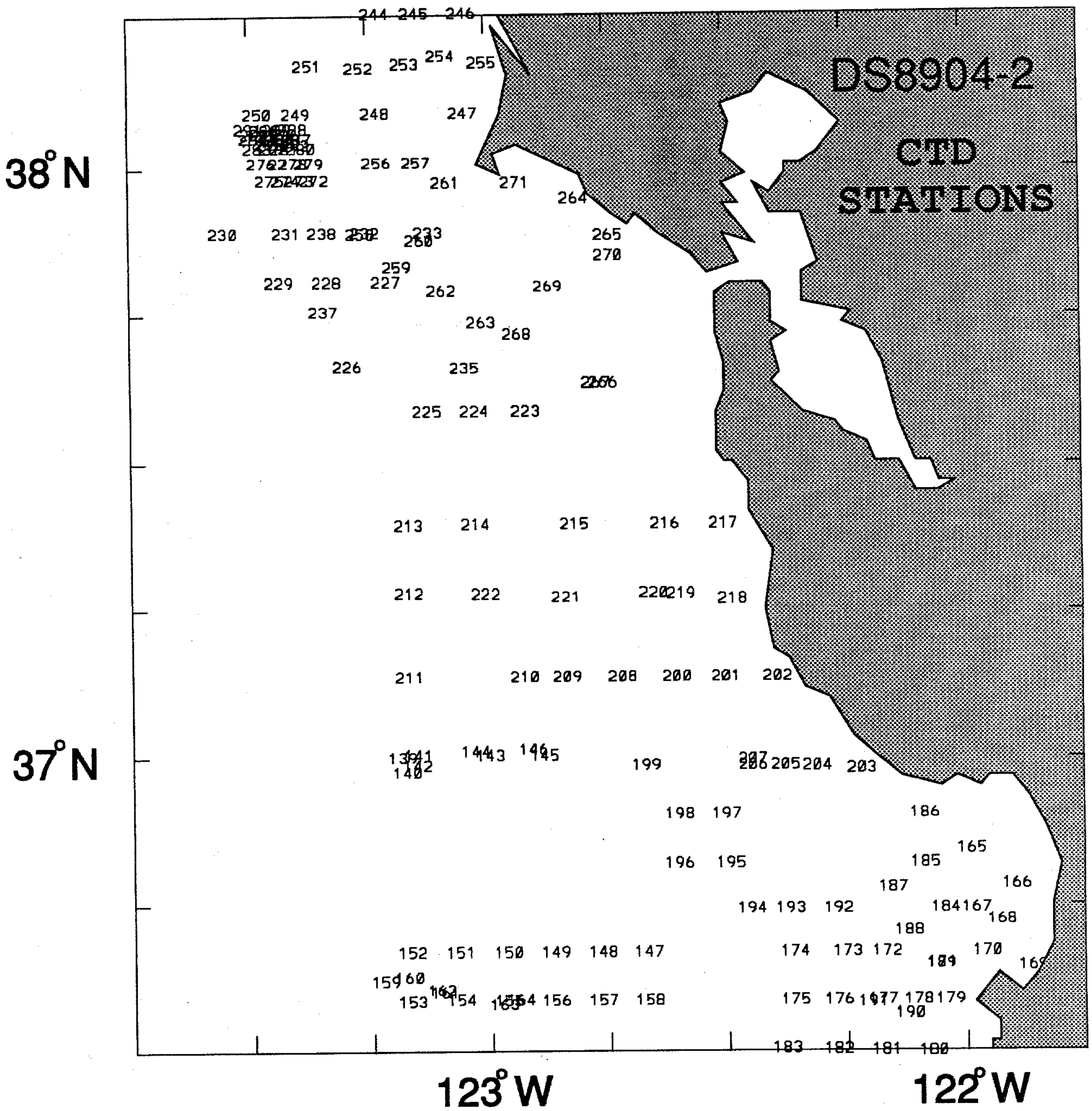

DS8904-1
DEPTH
8.5° C
ISOTHERM
38° N
37° N
123° W
122° W


DS8904-1
DEPTH
26.0
ISOPYCNAL
38°N
37°N
123°W
122°W
15
30
45
60
75
90

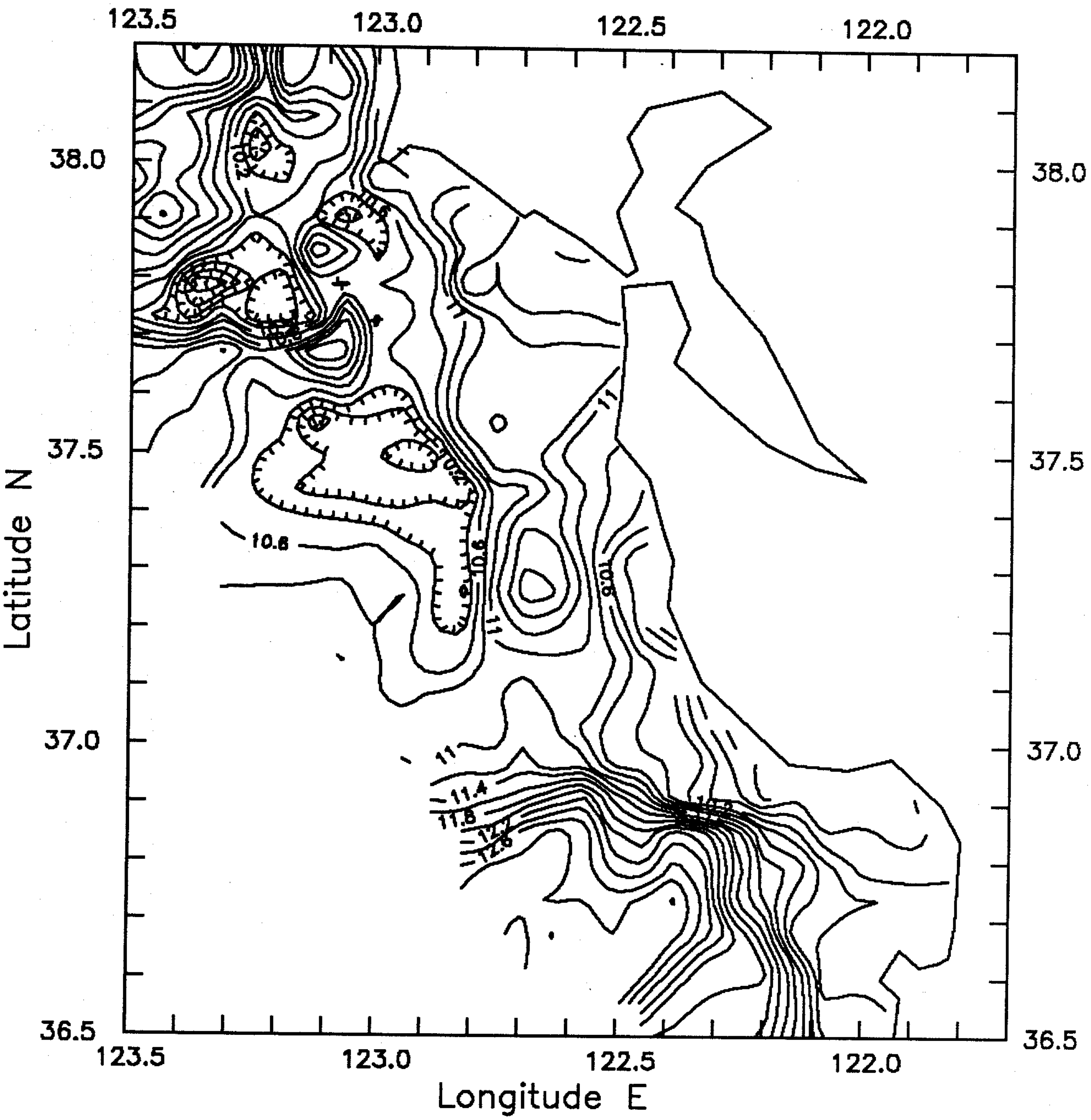

DS8904-1
TEMP
26.0
ISOPYCNAL
38°N
37°N
123°W
122°W
9.4
9.6
9.8
10.
10.4
10.8

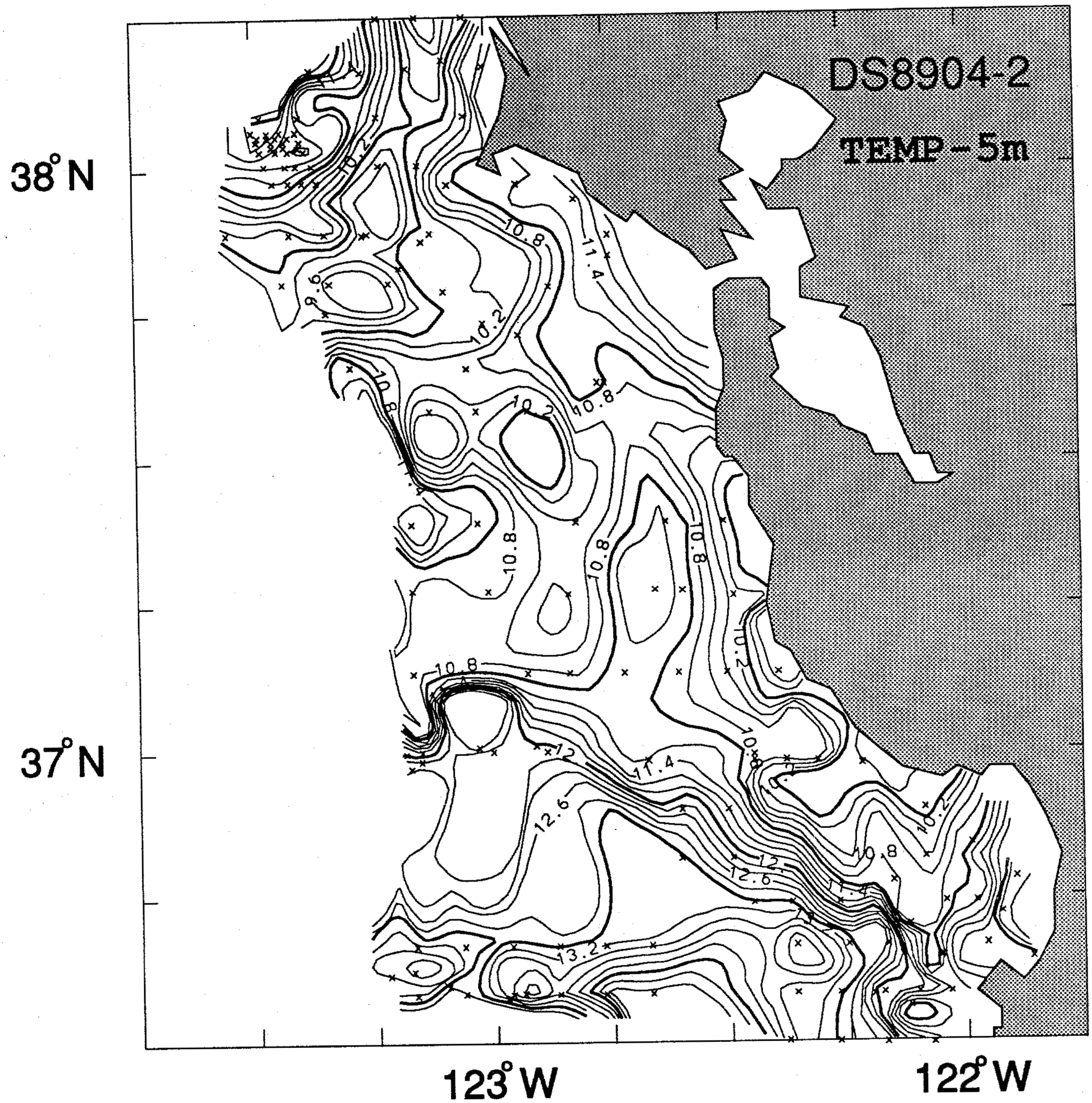

DS8904-1
SALINITY
26.0
ISOPYCNAL
38°N
37°N
123°W
122°W
<33.7
>33.8
33.7
33.8
34.

APPENDIX 4.2: HORIZONTAL MAPS- SWEEP 2

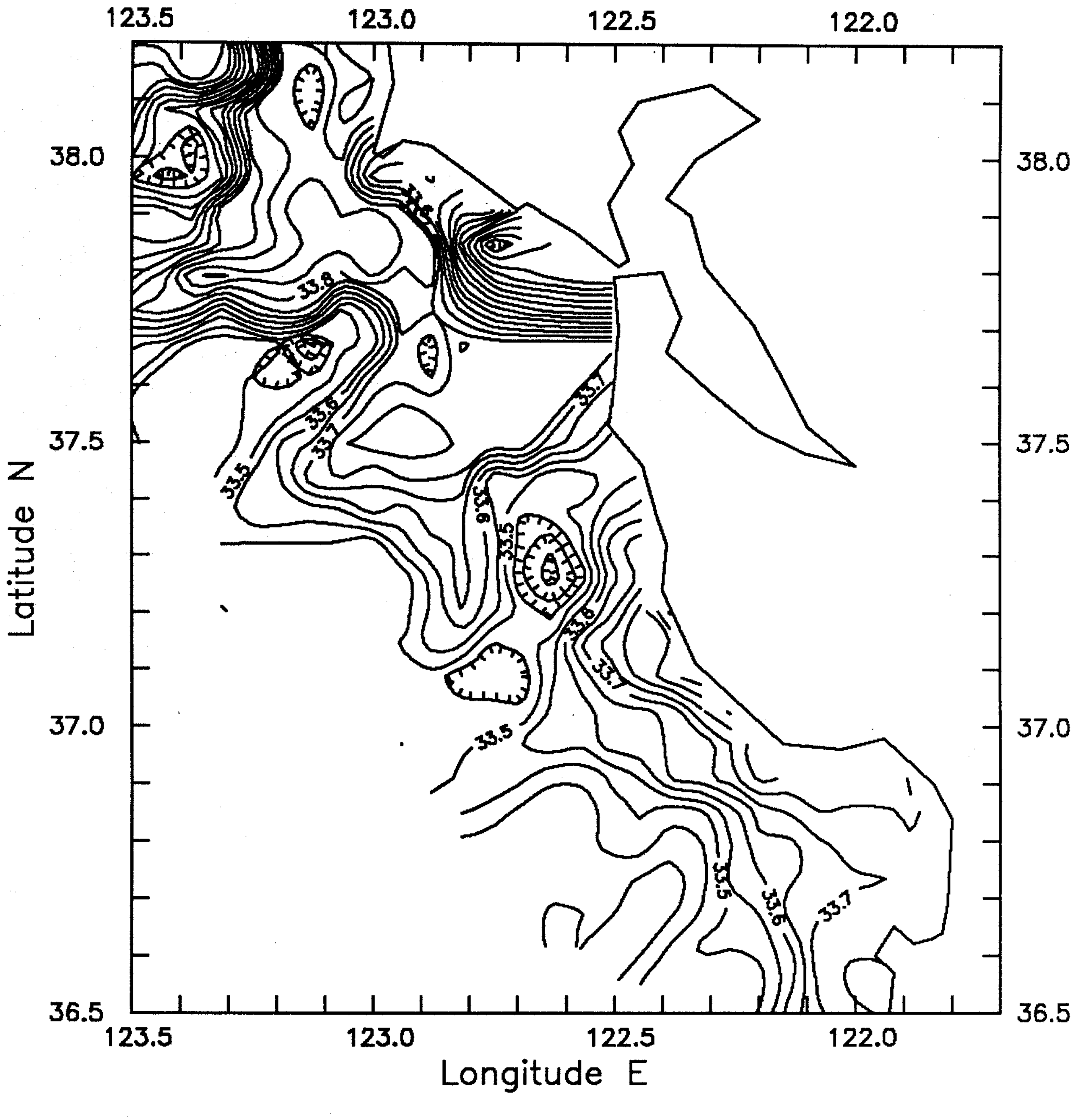

DS8904-2
CTD
STATIONS
38° N
37° N
123° W
122° W
244 245 246
251 252 253 254 255
250 249 248 247
256 257
261 271 264
230 231 238 233
265
270
259
229 228 227 262 269
237
263 268
226 235
225 224 223
213 214 215 216 217
212 222 221 219 218
211 210 209 208 200 201 202
144 143 145 199 205 204 203
198 197 186
196 195 185 165
187 166
194 193 192 168
188
152 151 150 149 148 147 174 173 172 170
153 154 156 157 158 175 176 178 179
190
183 182 181 180

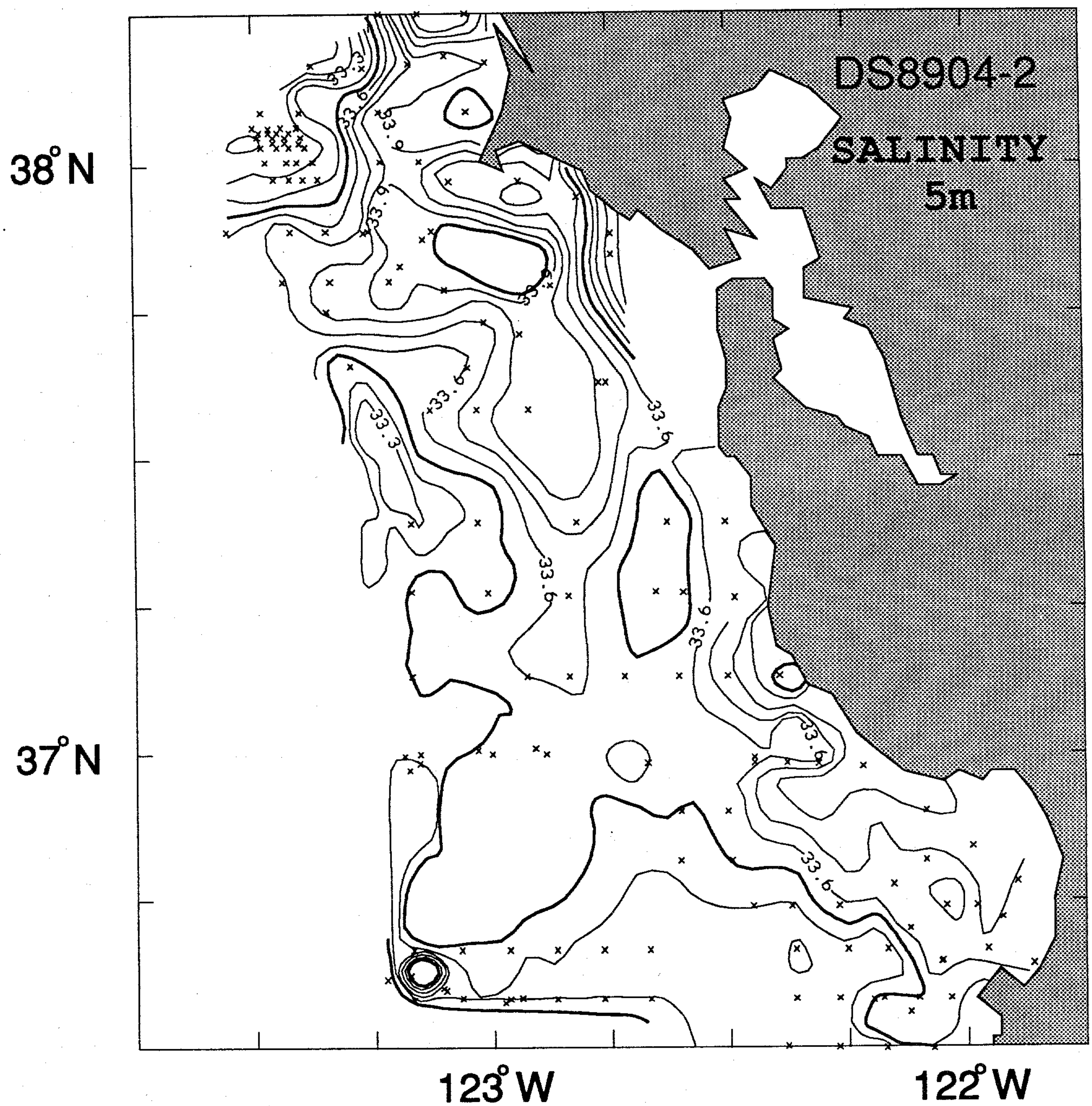
Surface Temperature: Sweep 2 (May 29–June 4)

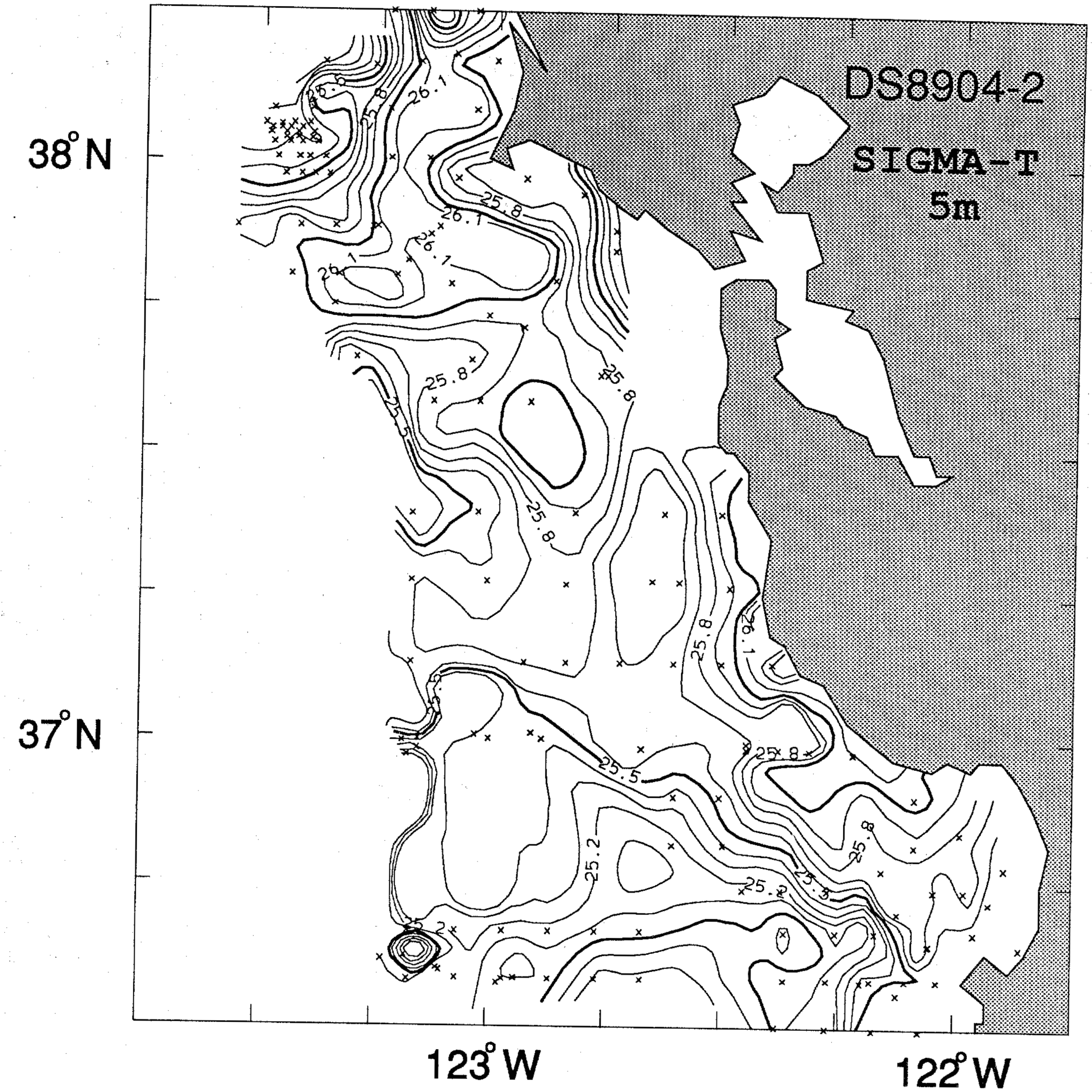


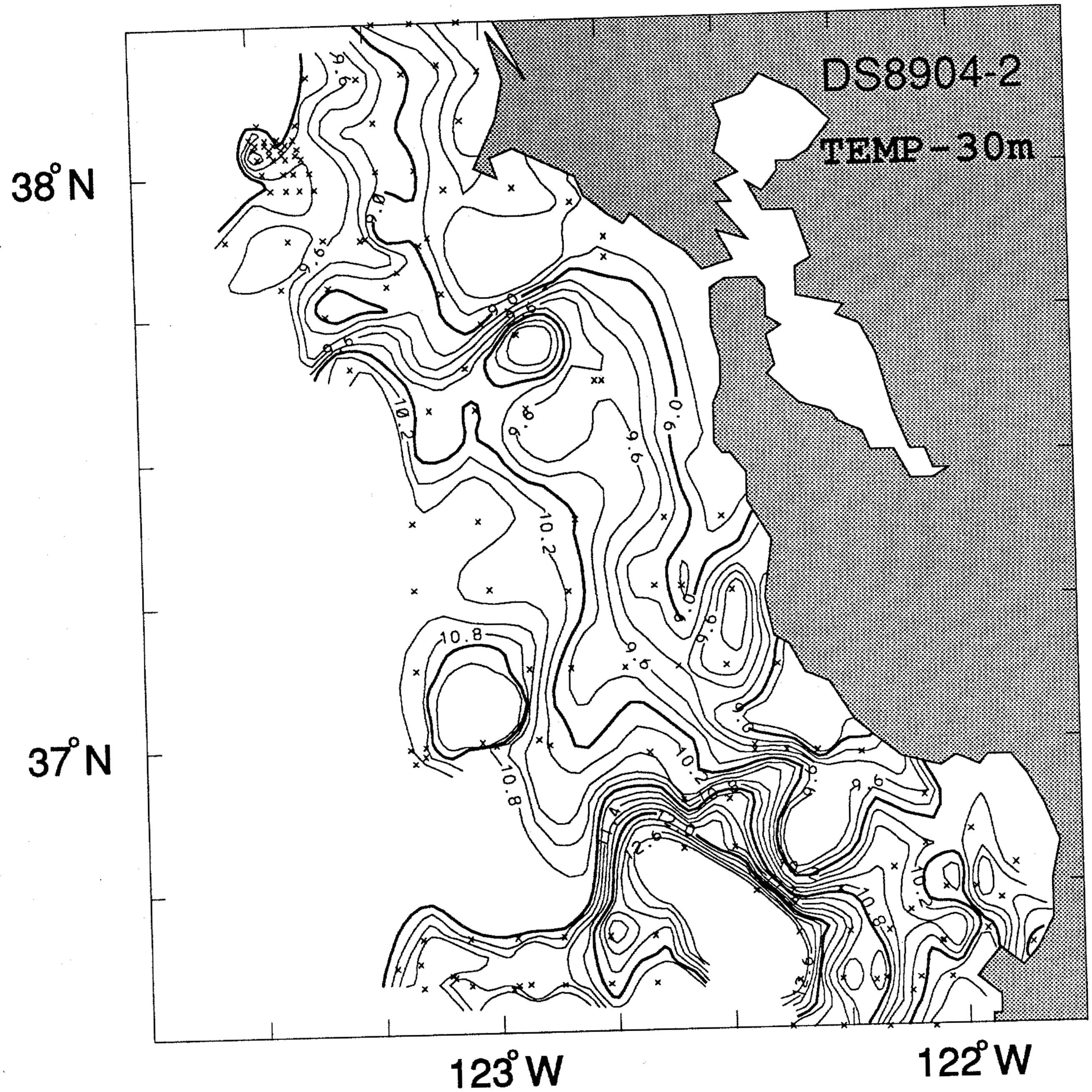

DS8904-2
TEMP - 5m
38° N
37° N
123° W
122° W
10.8
11.4
10.2
9.6
12.6
12
13.2

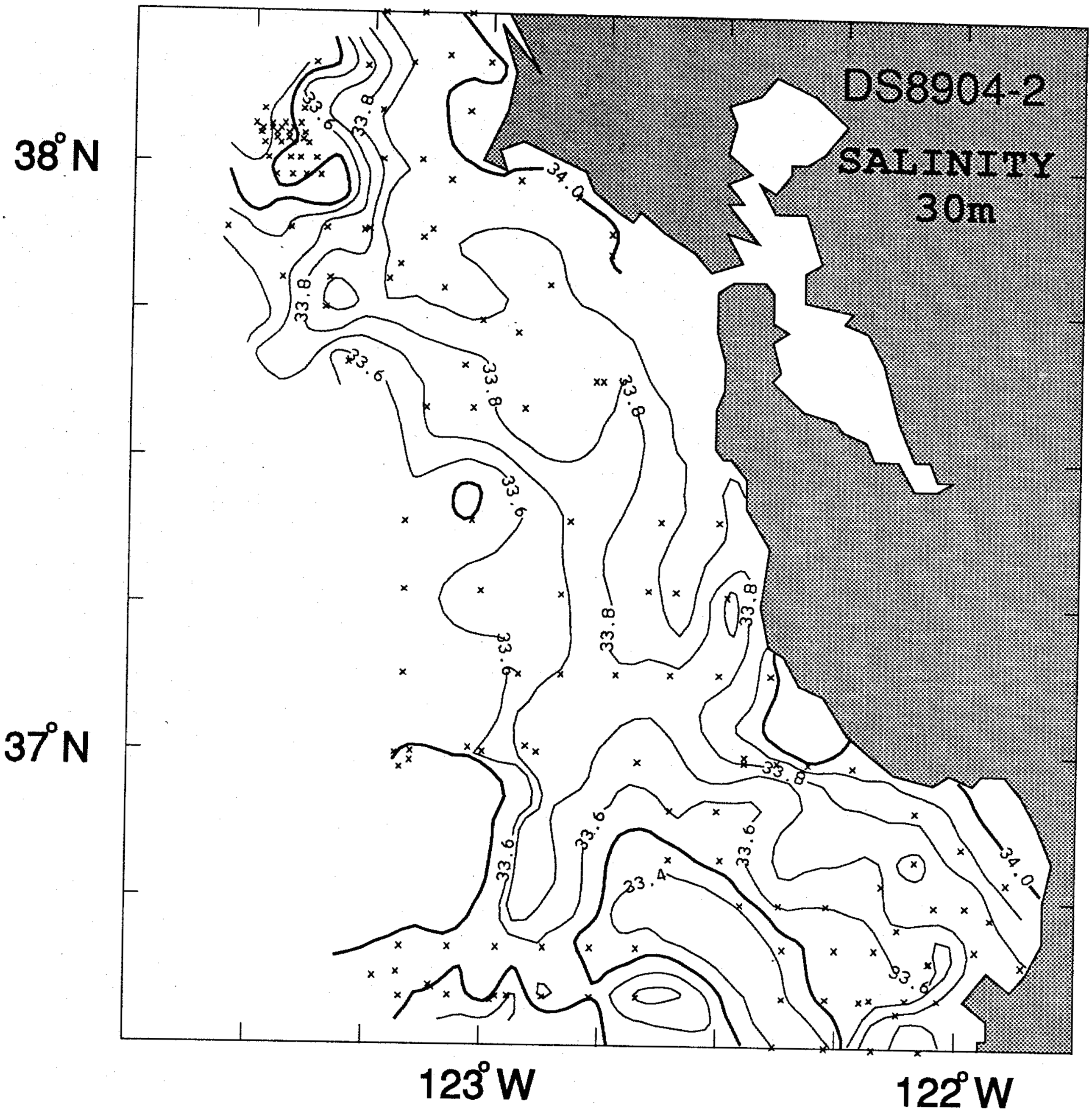
Surface Salinity: Sweep 2 (May 29—June 4)



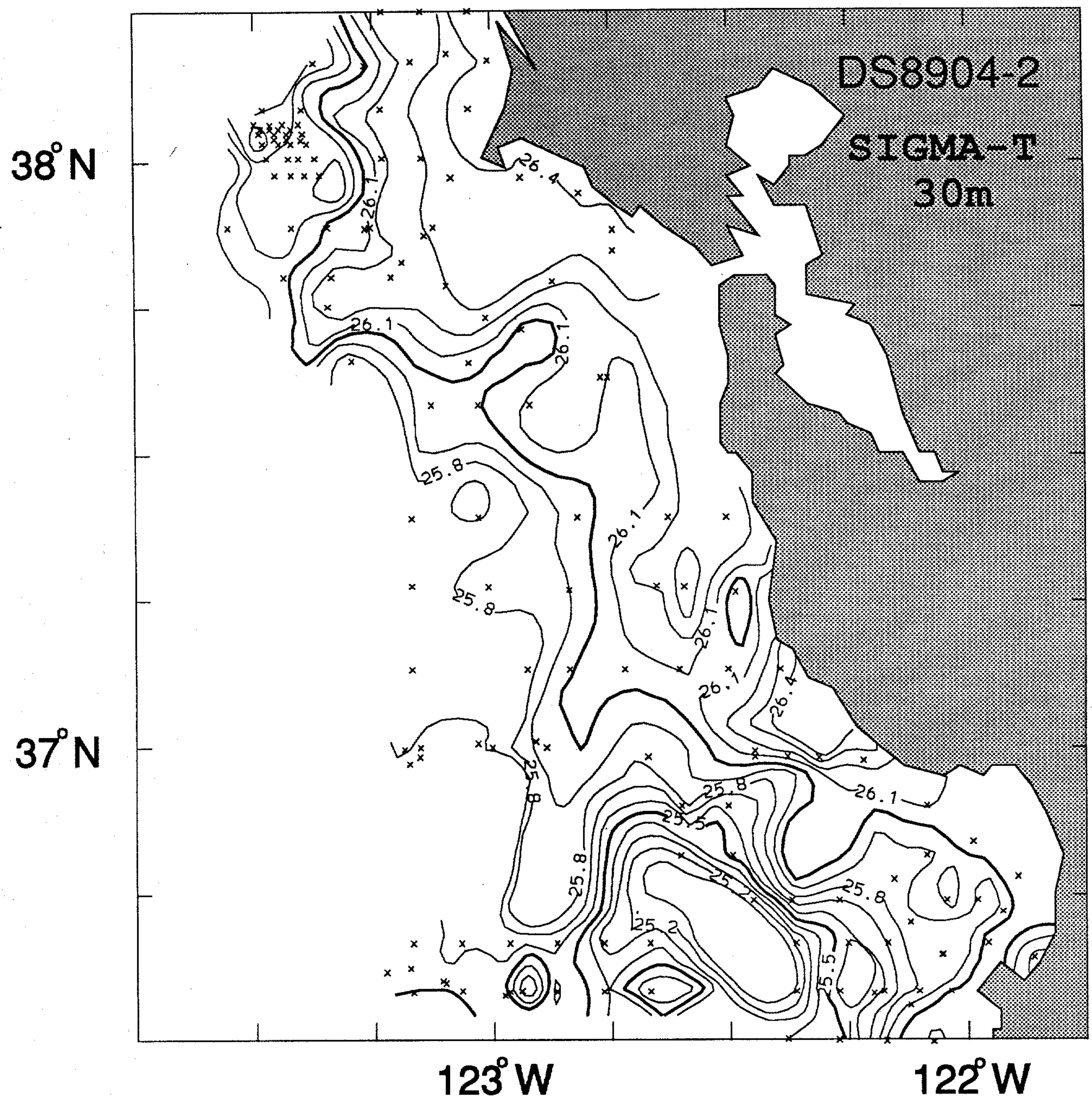

DS8904-2
SALINITY
5m
38° N
37° N
123° W
122° W
33.3
33.6
33.9
33.6
33.6
33.3
33.6
33.6
33.6
33.6
33.6

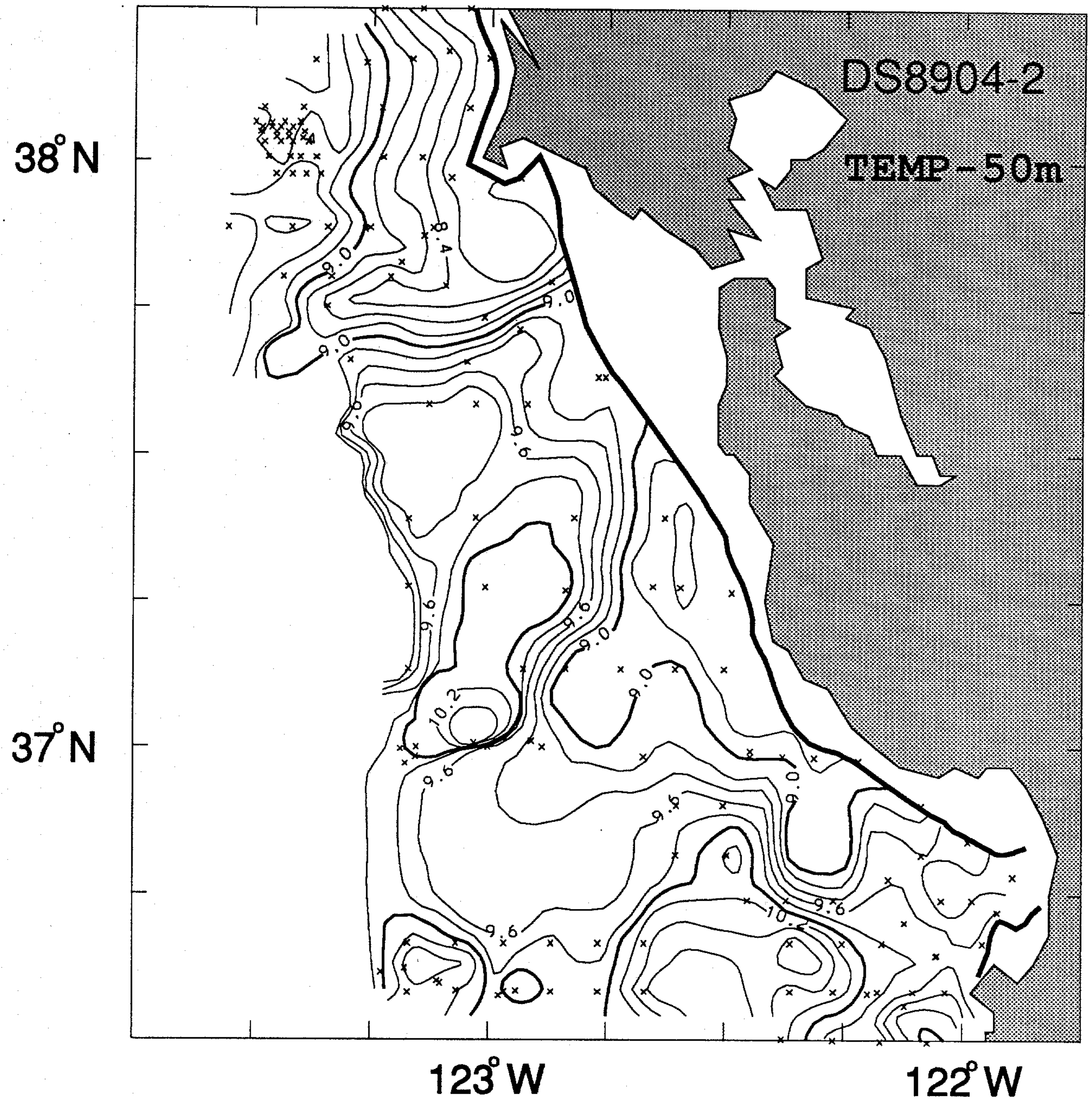

DS8904-2
SIGMA-T
5m
38° N
37° N
123° W
122° W
26.1
25.8
25.5
25.2

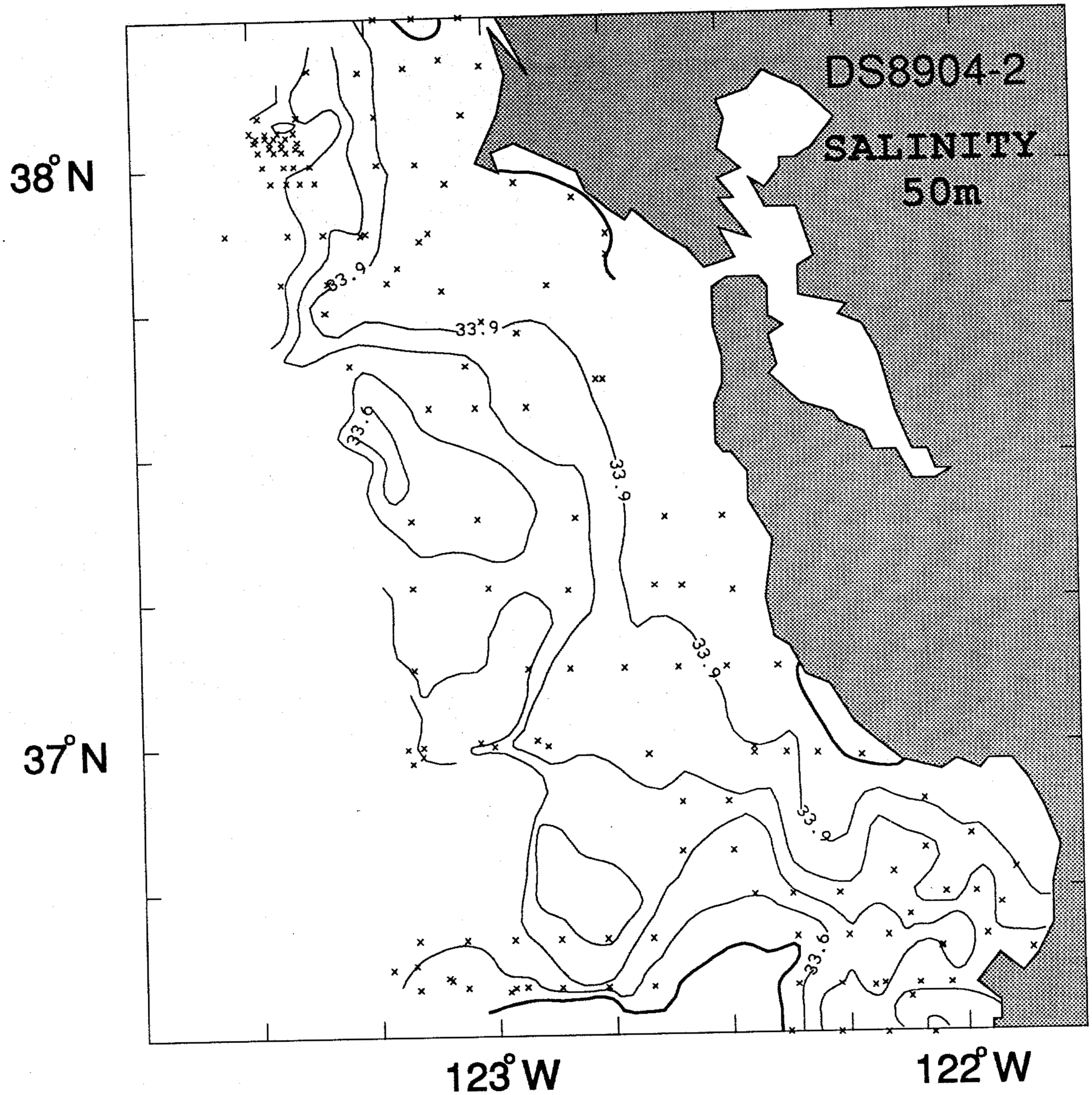

DS8904-2
TEMP - 30m
38° N
37° N
123° W
122° W
9.6
10.2
10.8
9.0

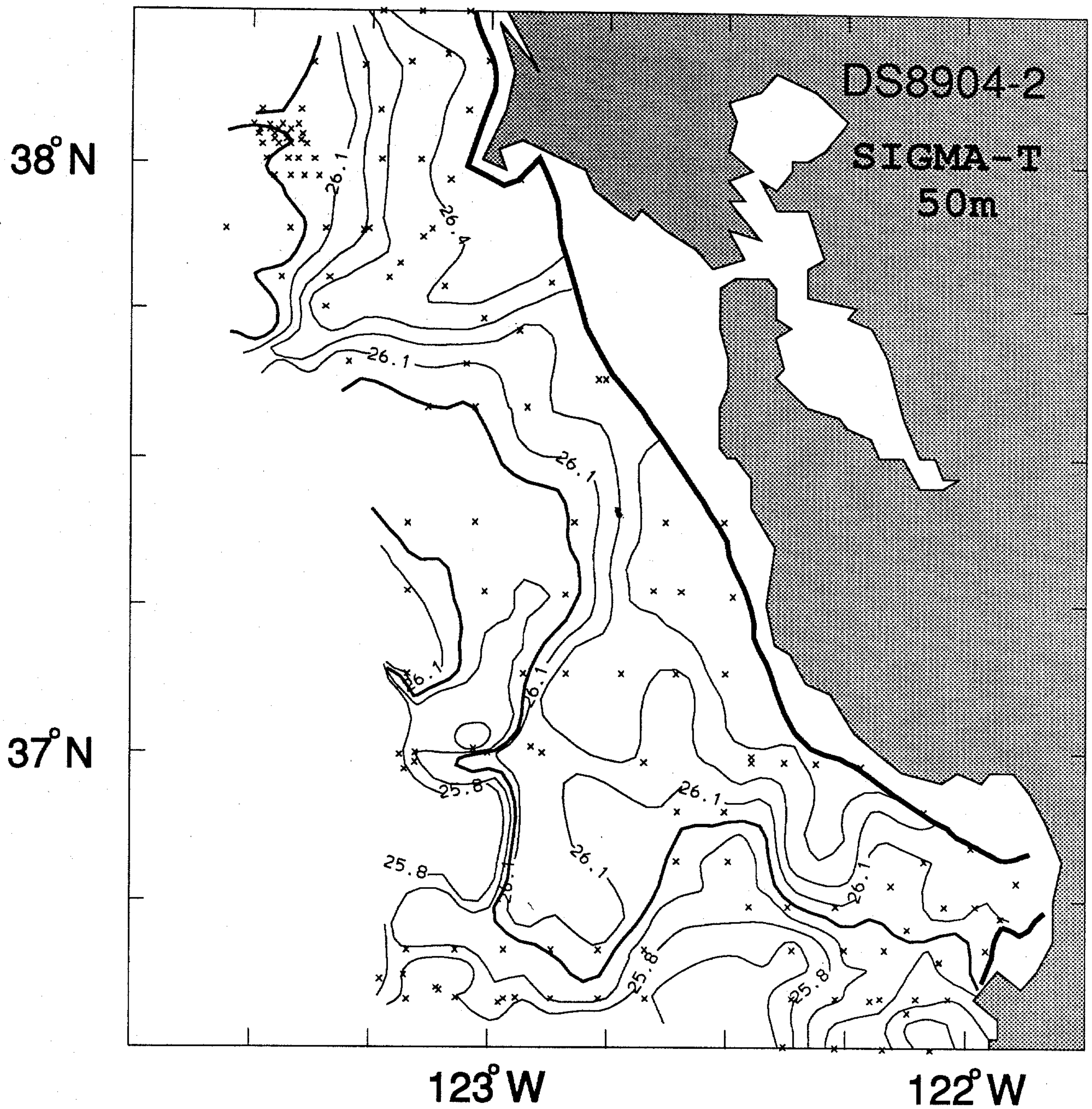


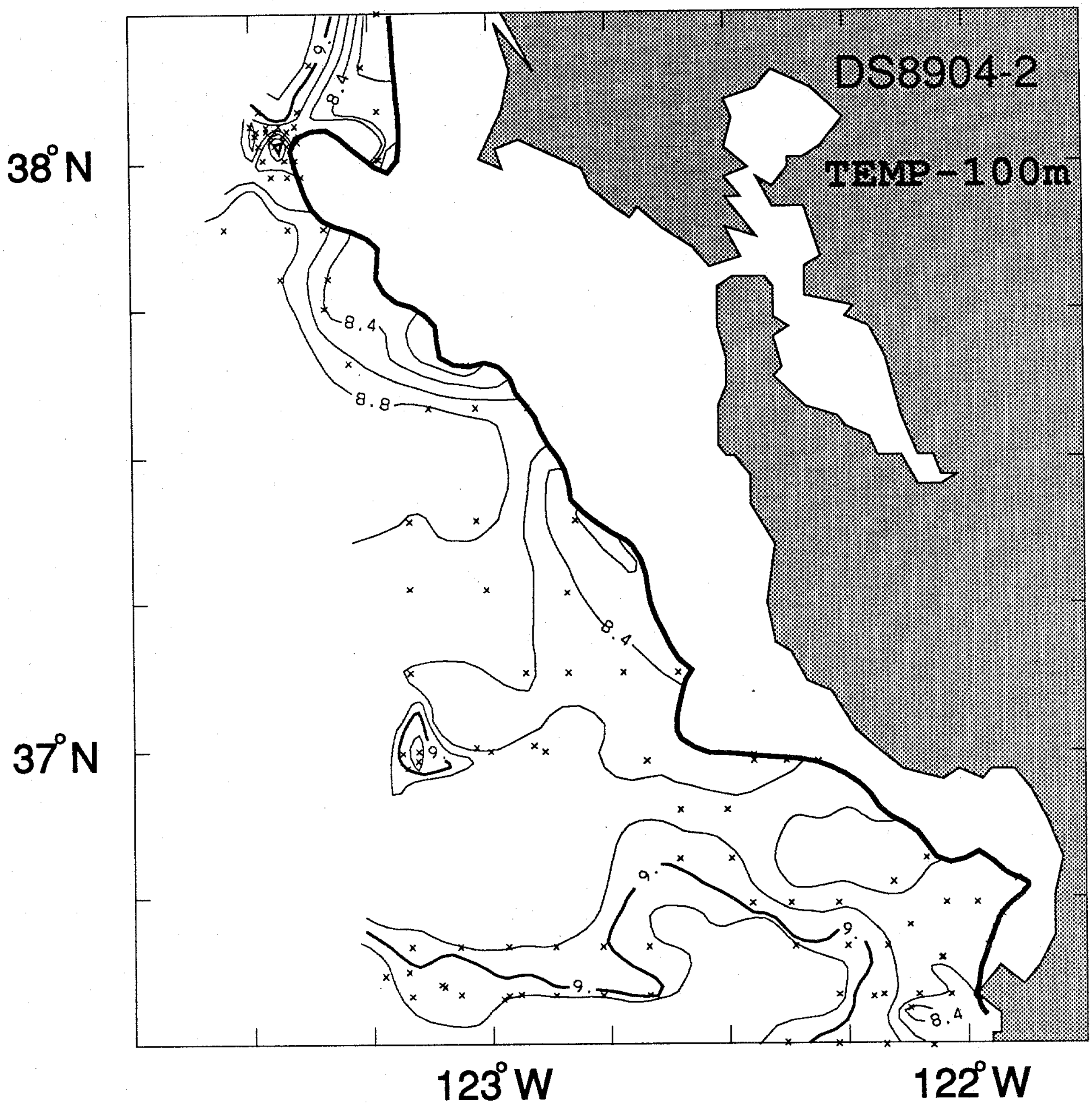
DS8904-2
SALINITY
30m
38°N
37°N
123°W
122°W
34.0
33.8
33.6
33.4

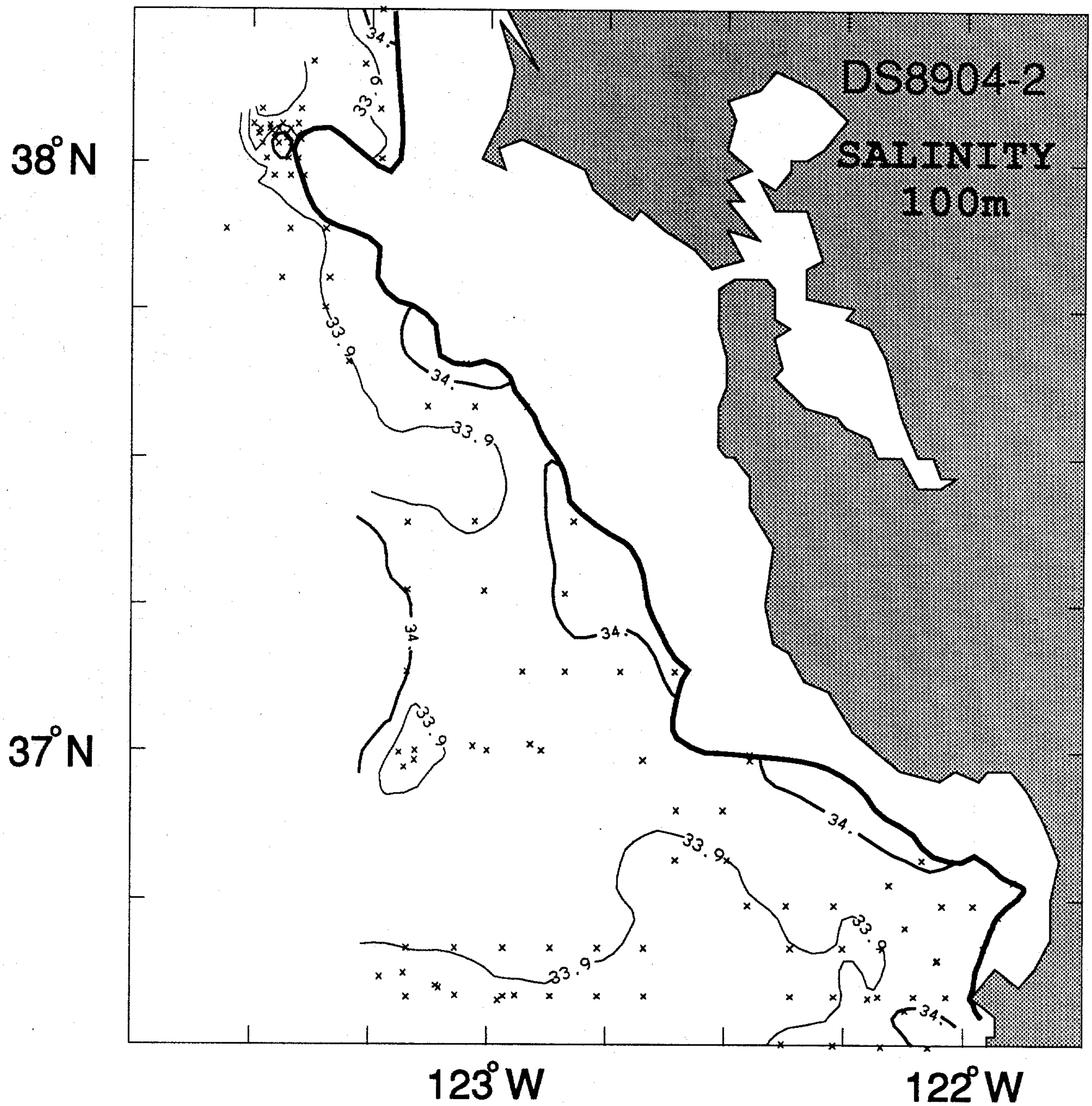

DS8904-2
SIGMA-T
30m
38°N
37°N
123°W
122°W
26.4
26.1
25.8
25.5
25.2

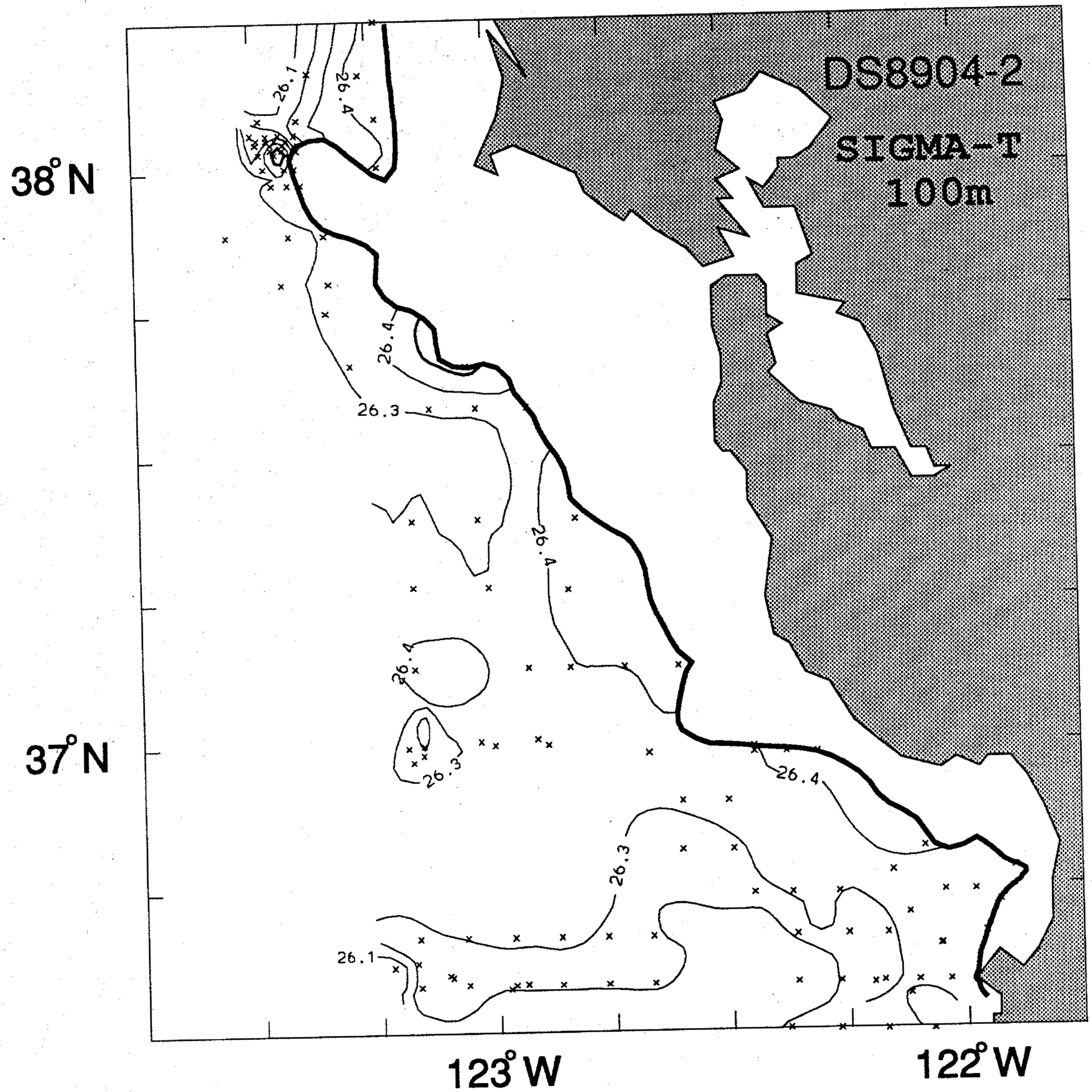

DS8904-2
TEMP - 50m
38° N
37° N
123° W
122° W

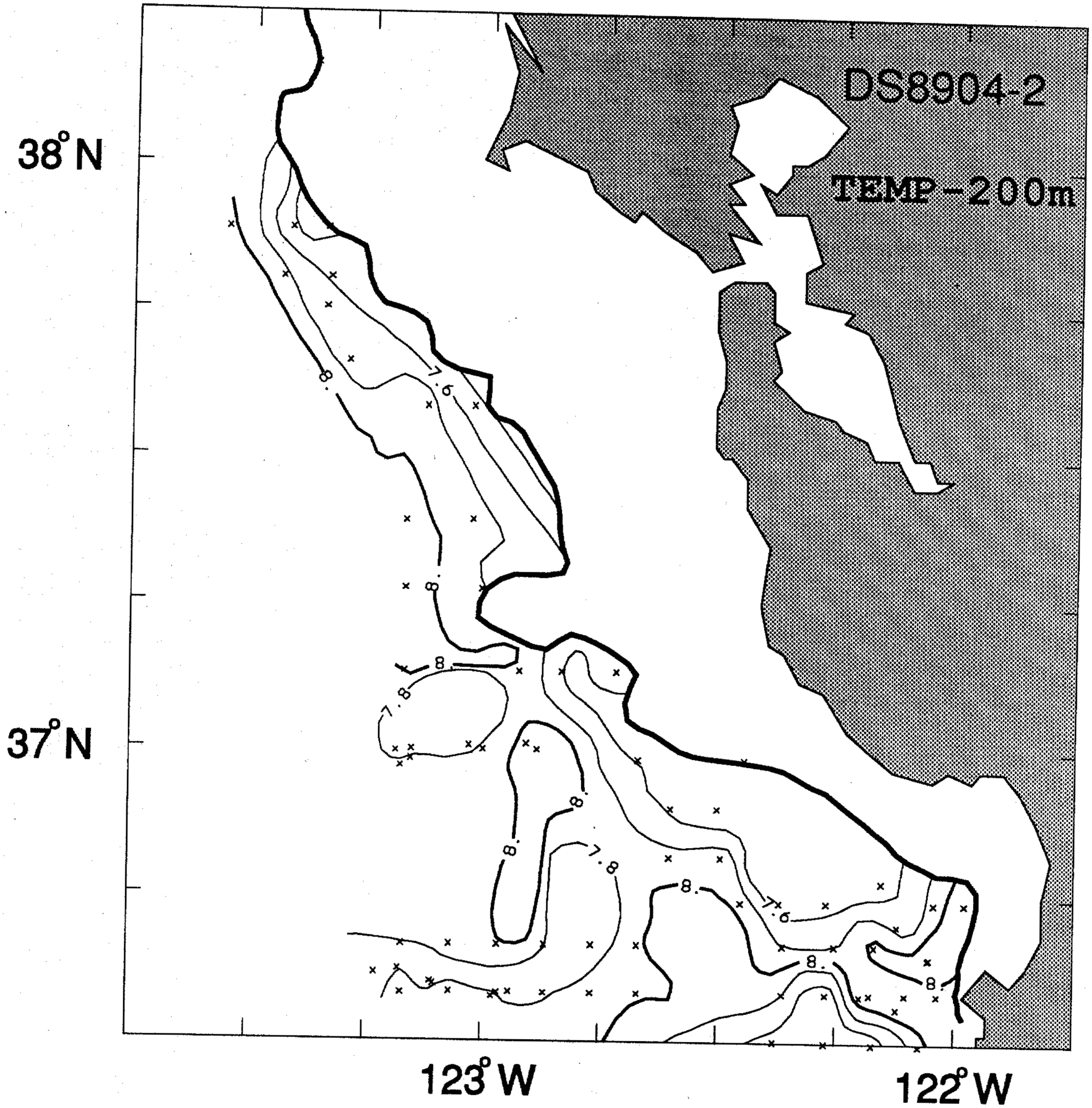

DS8904-2
SALINITY
50m
38°N
37°N
123°W
122°W
33.9
33.9
33.6
33.9
33.9
33.9
33.6

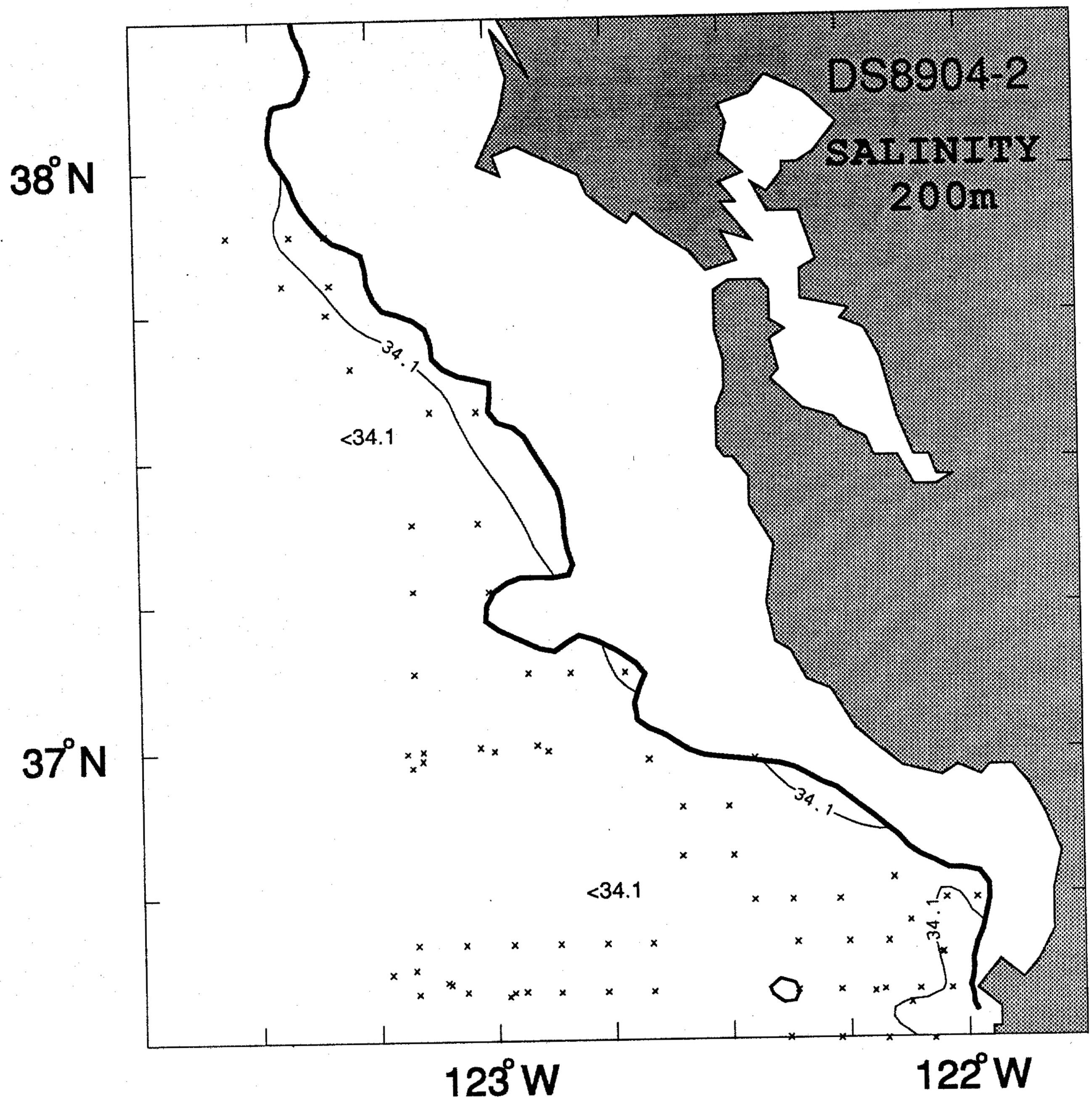

DS8904-2
SIGMA-T
50m
38°N
37°N
123°W
122°W
26.1
26.4
25.8

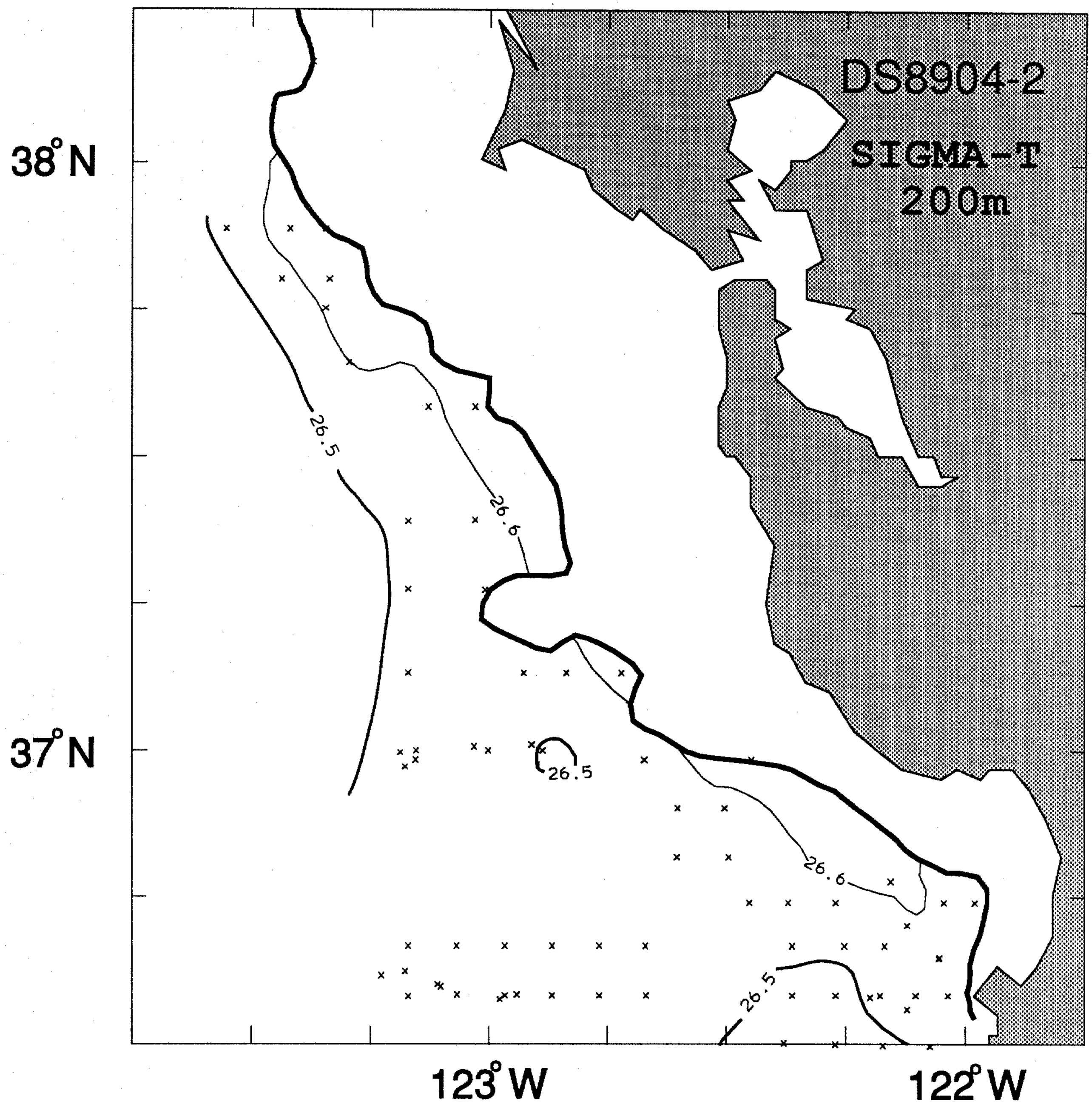

DS8904-2
TEMP-100m
38°N
37°N
123°W
122°W
8.4
8.8
9.

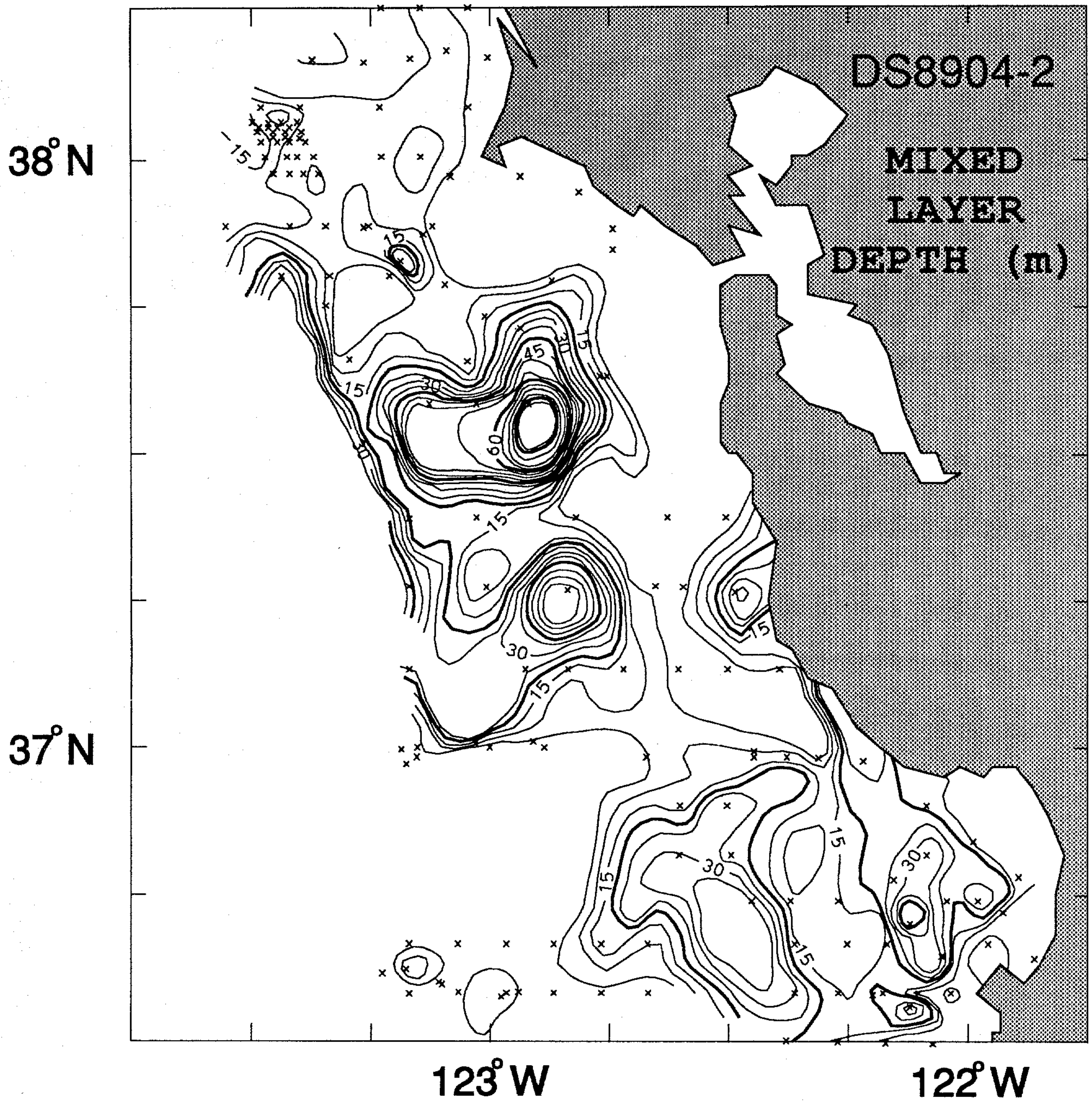

DS8904-2
SALINITY
100m
38°N
37°N
123°W
122°W
34.
33.9

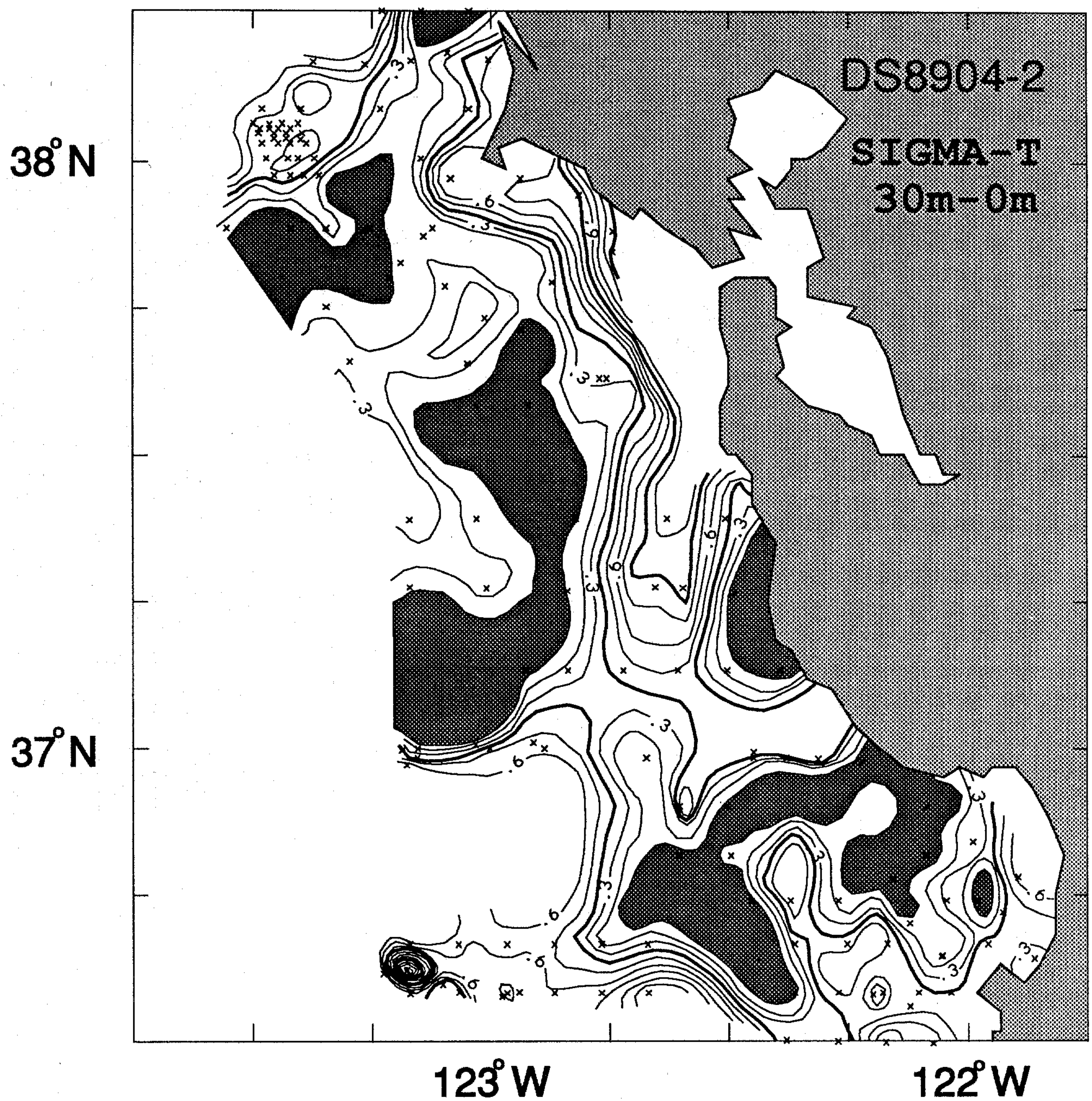

DS8904-2
SIGMA-T
100m
38° N
37° N
123° W
122° W
26.1
26.4
26.3
26.4
26.4
26.3
26.4
26.4
26.3
26.1

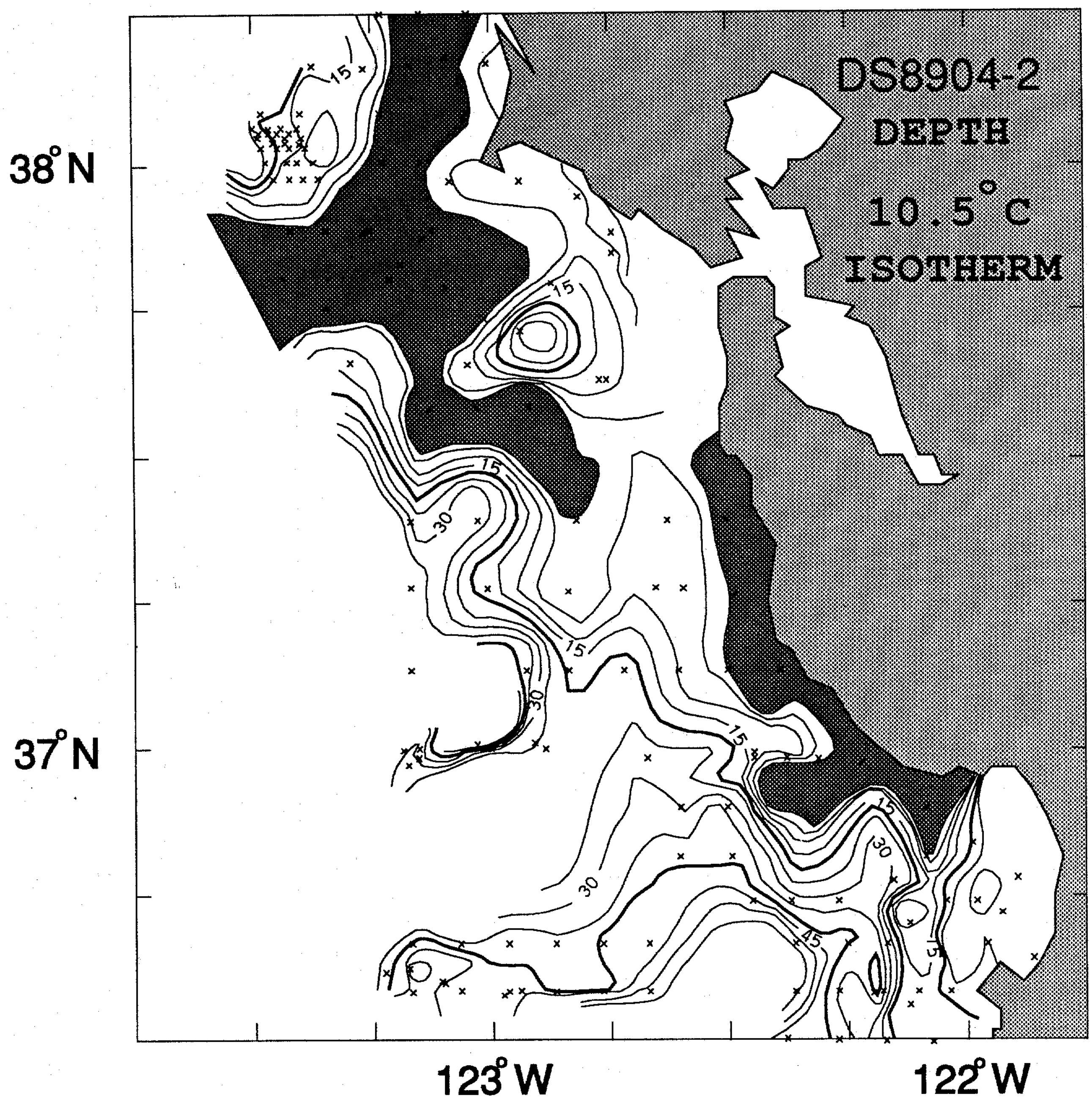

DS8904-2
TEMP-200m
38° N
37° N
123° W
122° W
8.
7.6
7.8

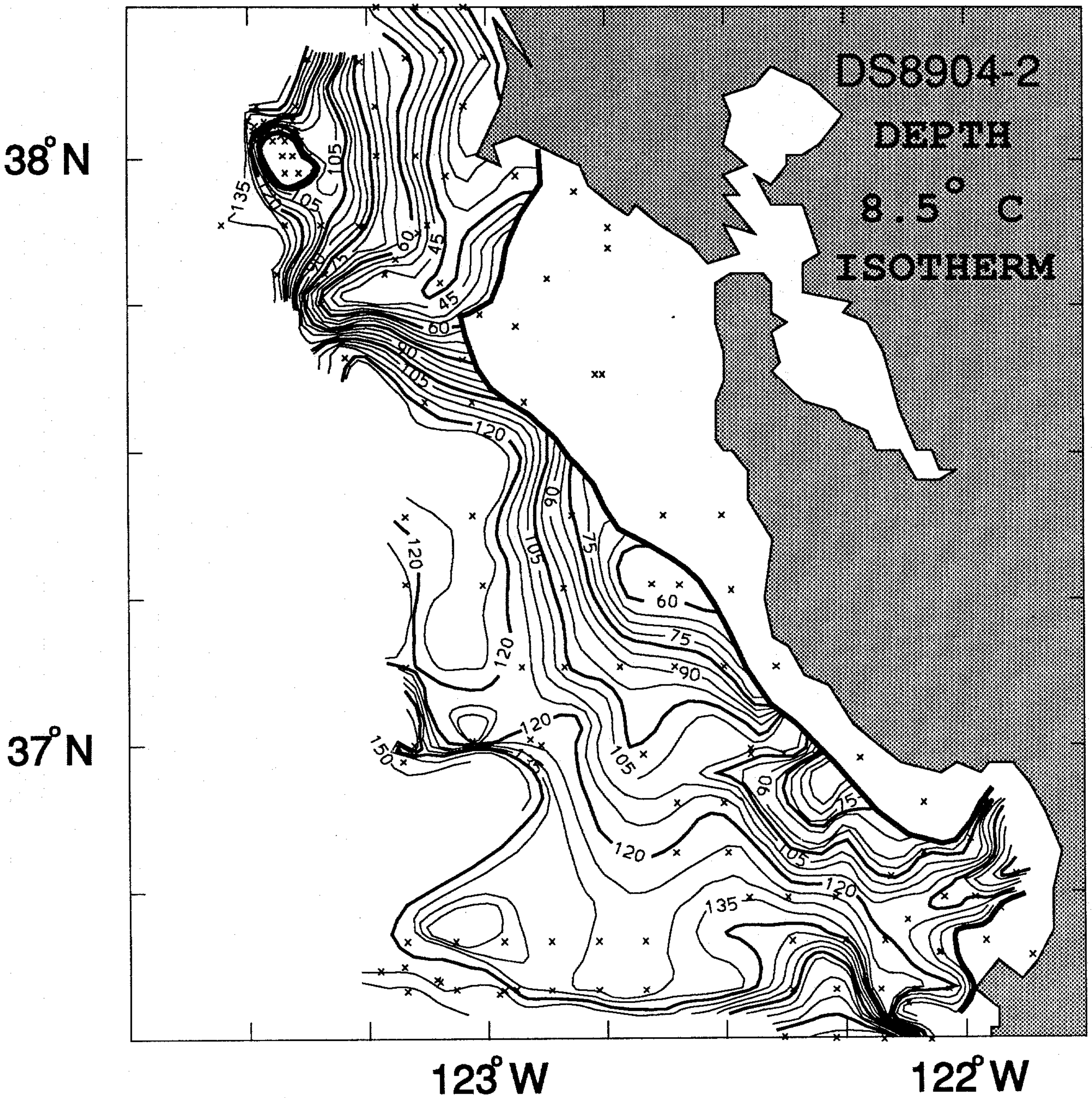

DS8904-2
SALINITY
200m
38°N
37°N
123°W
122°W
34.1
<34.1
34.1
<34.1
34.1

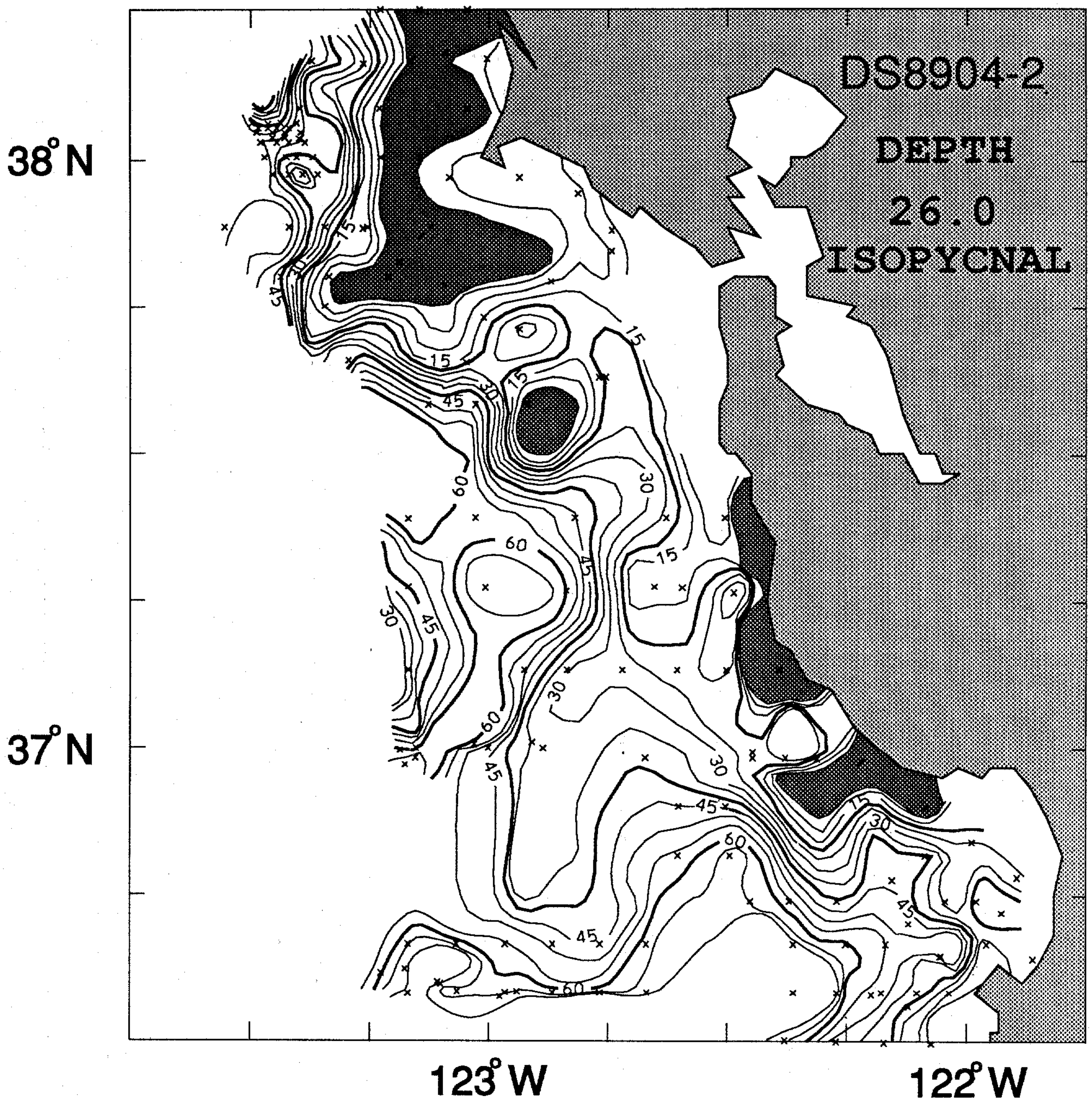

DS8904-2
SIGMA-T
200m
38° N
37° N
123° W
122° W
26.5
26.6
26.5
26.6
26.5

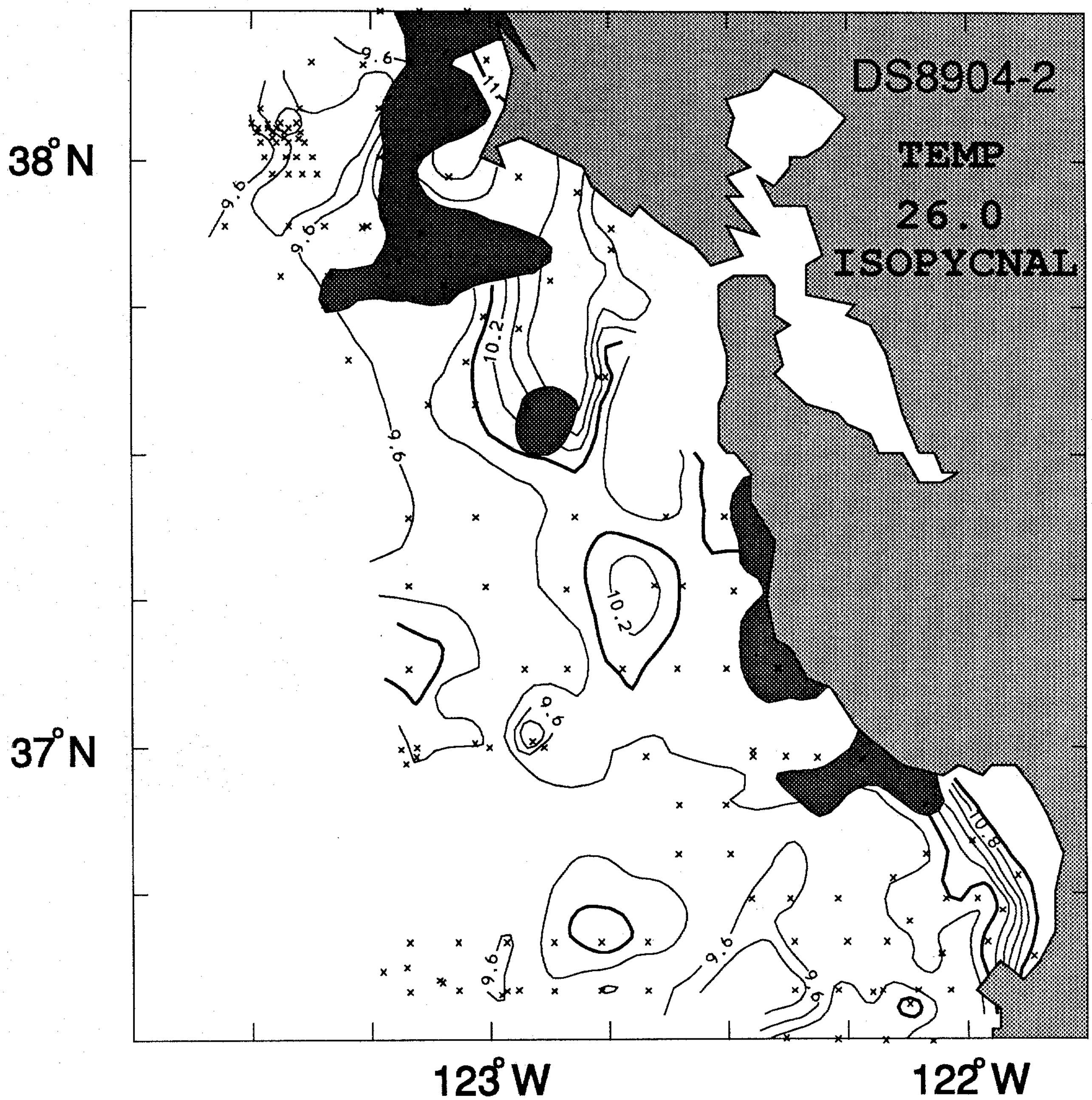

DS8904-2
MIXED
LAYER
DEPTH (m)
38°N
37°N
123°W
122°W
15
30
45
60


DS8904-2
SIGMA-T
30m-0m
38°N
37°N
123°W
122°W

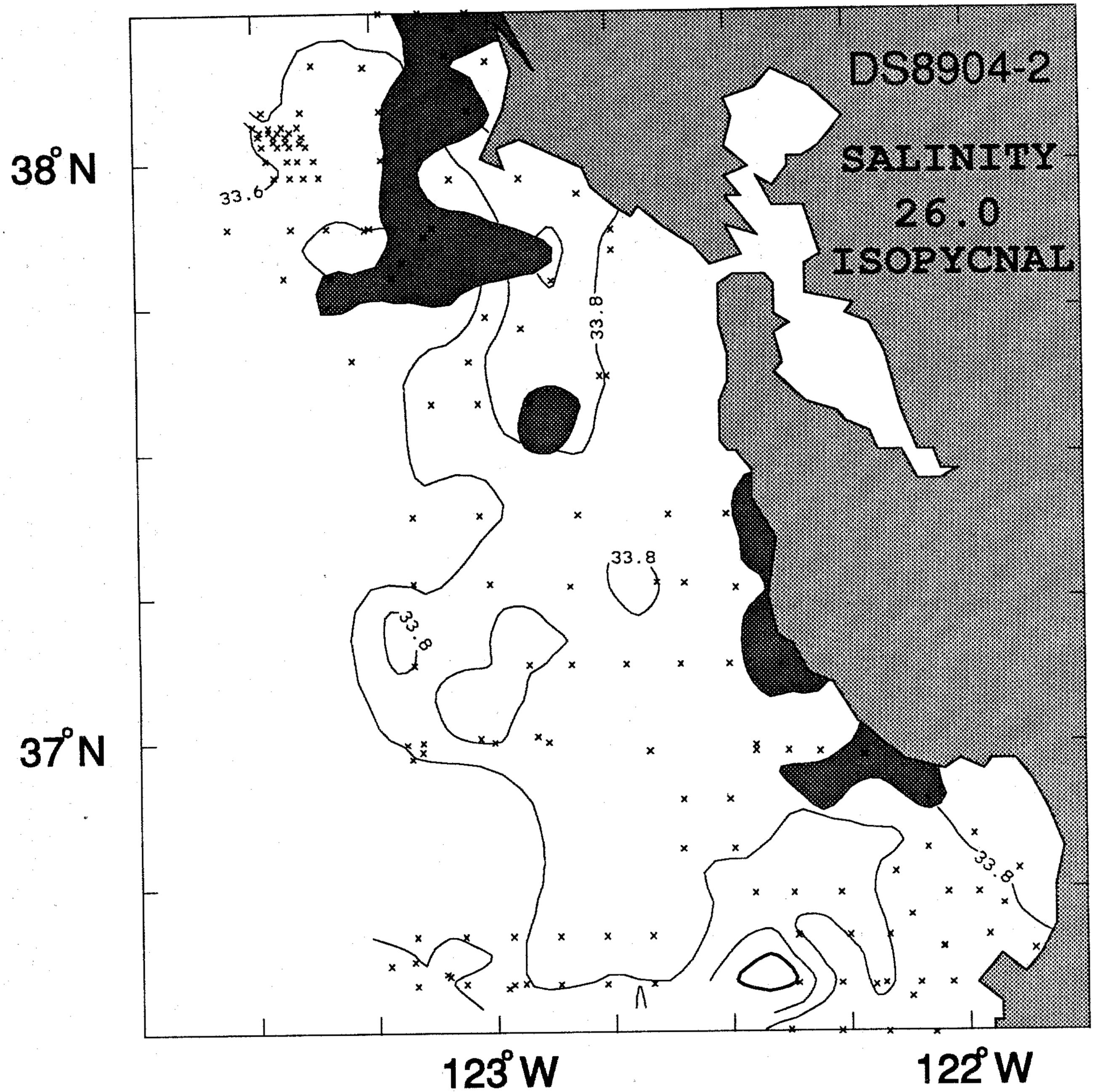

DS8904-2
DEPTH
10.5°C
ISOTHERM
38°N
37°N
123°W
122°W
15
30
45


DS8904-2
DEPTH
8.5° C
ISOTHERM
38° N
37° N
123° W
122° W

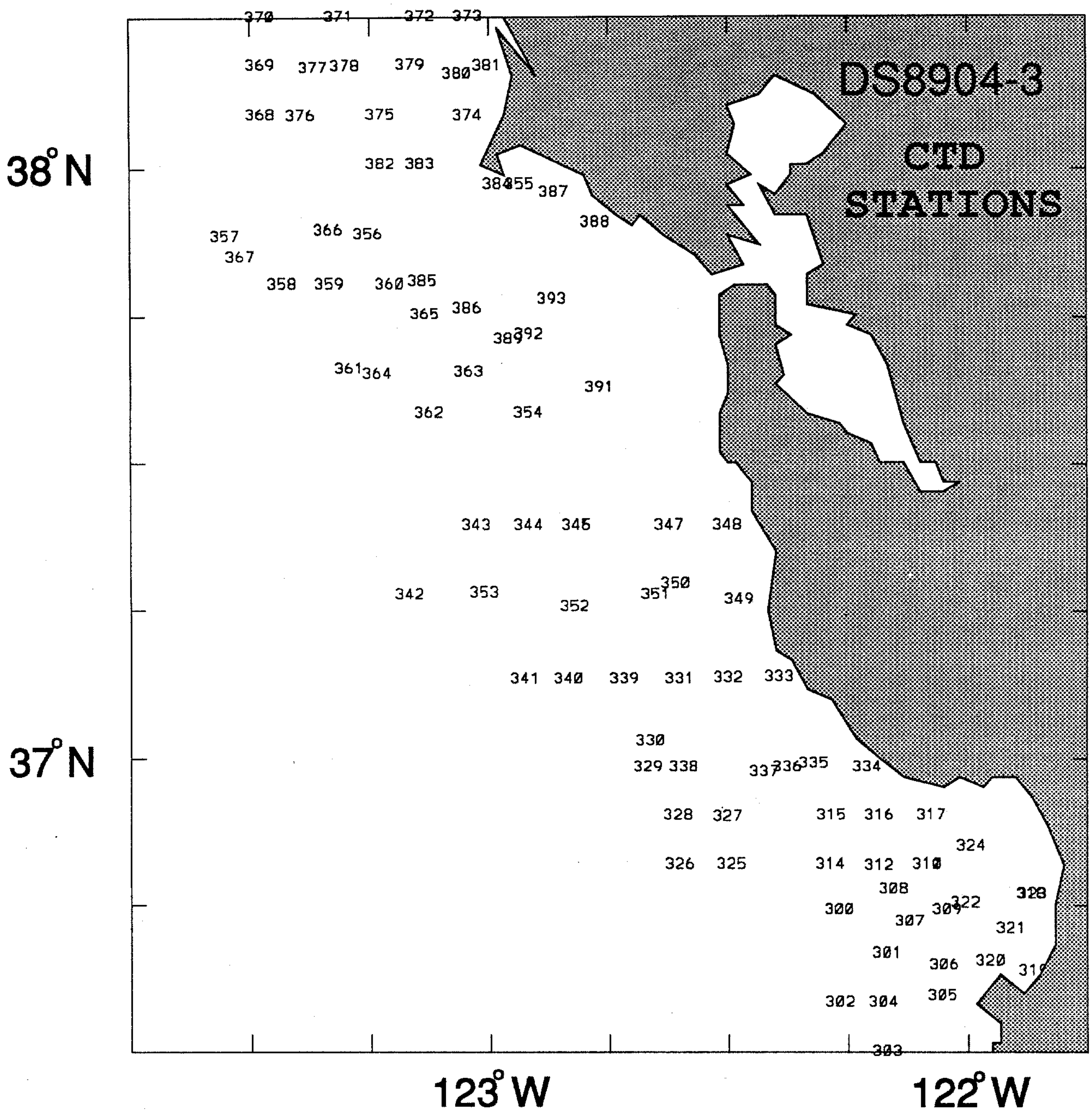

DS8904-2
DEPTH
26.0
ISOPYCNAL
38°N
37°N
123°W
122°W



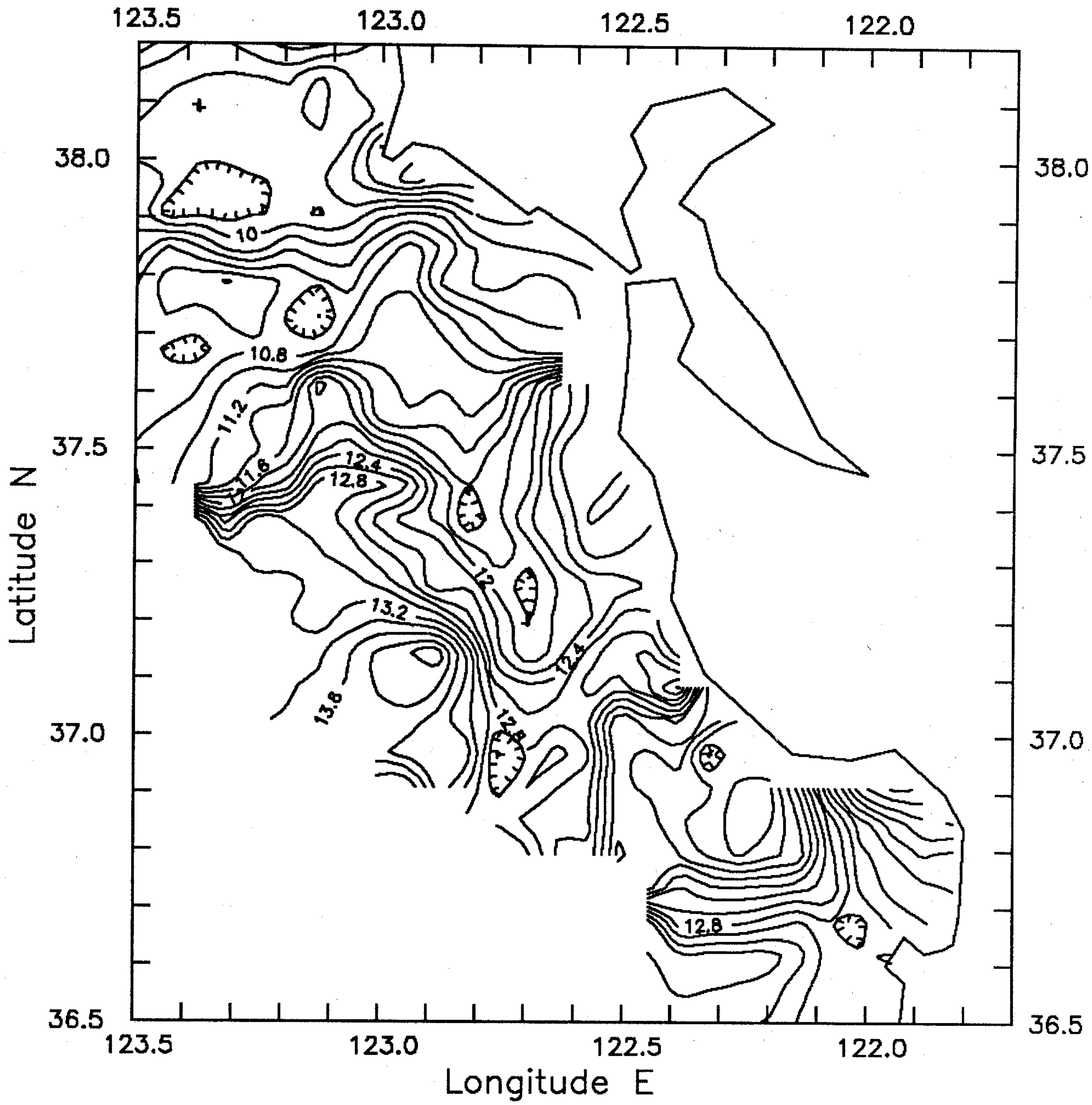
DS8904-2
TEMP
26.0
ISOPYCNAL
38°N
37°N
123°W
122°W
9.6
10.2
10.8
11

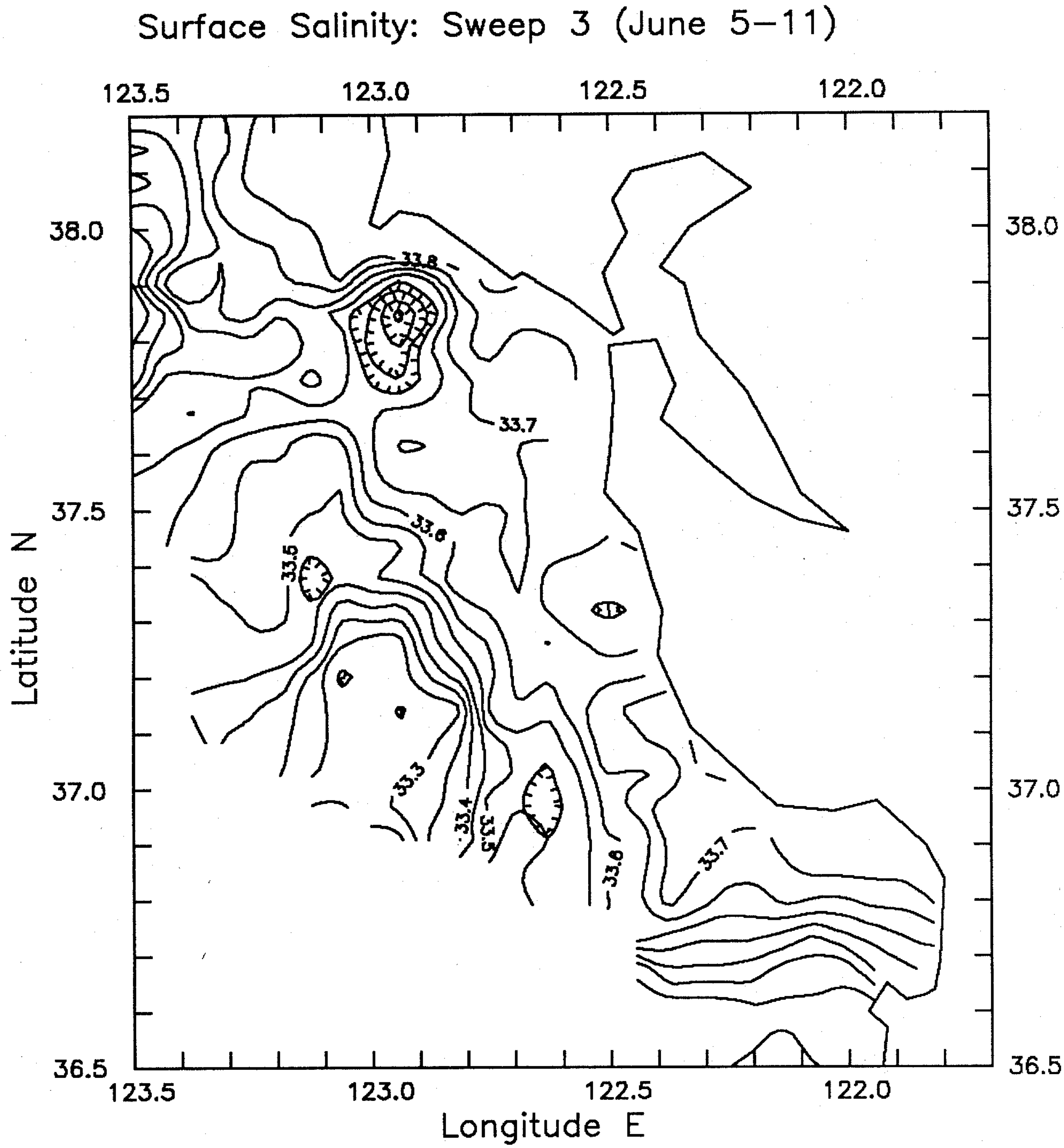

DS8904-2
SALINITY
26.0
ISOPYCNAL
38° N
37° N
123° W
122° W
33.6
33.8
33.8
33.8
33.8

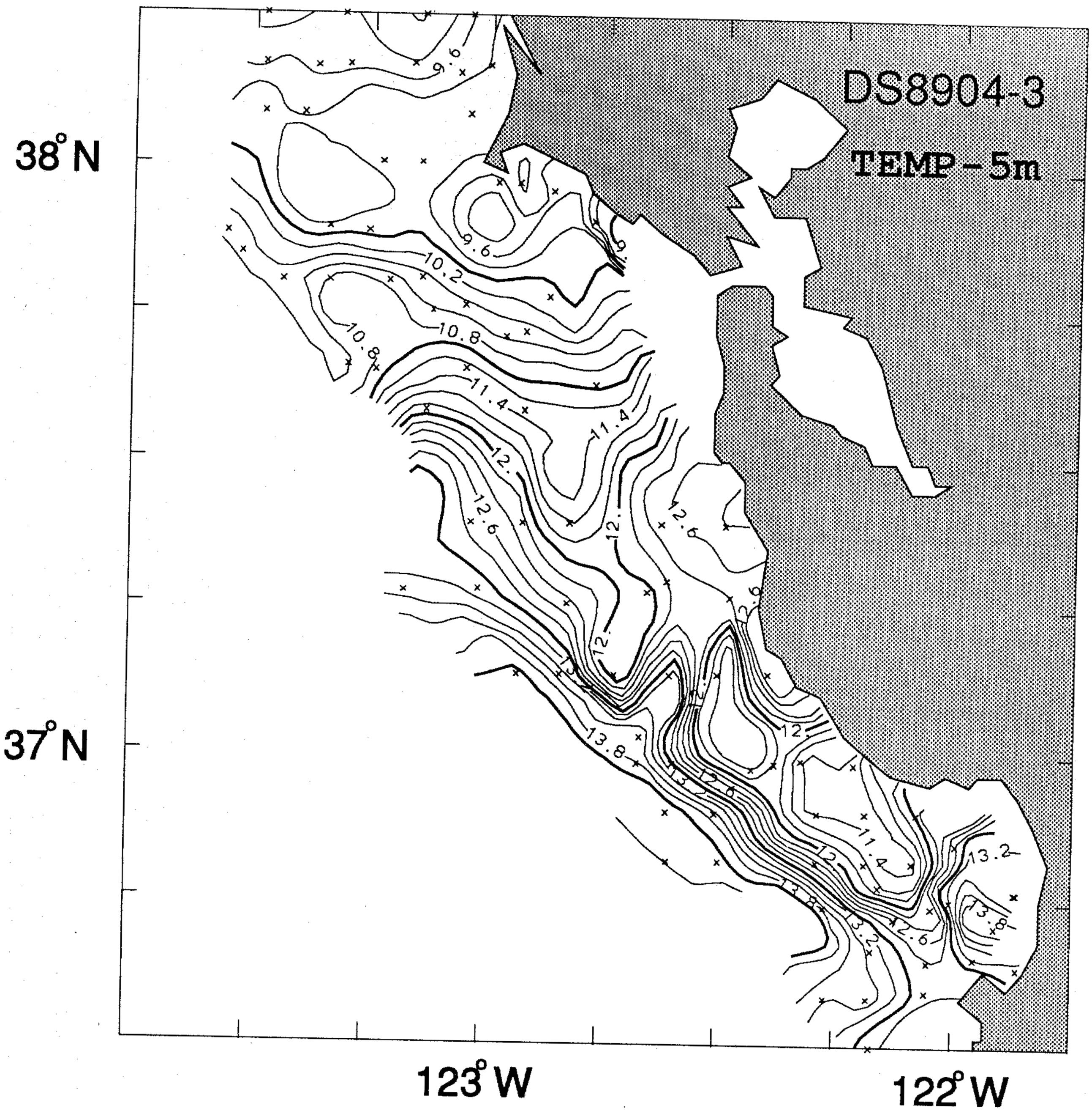
APPENDIX 4.3: HORIZONTAL MAPS- SWEEP 3

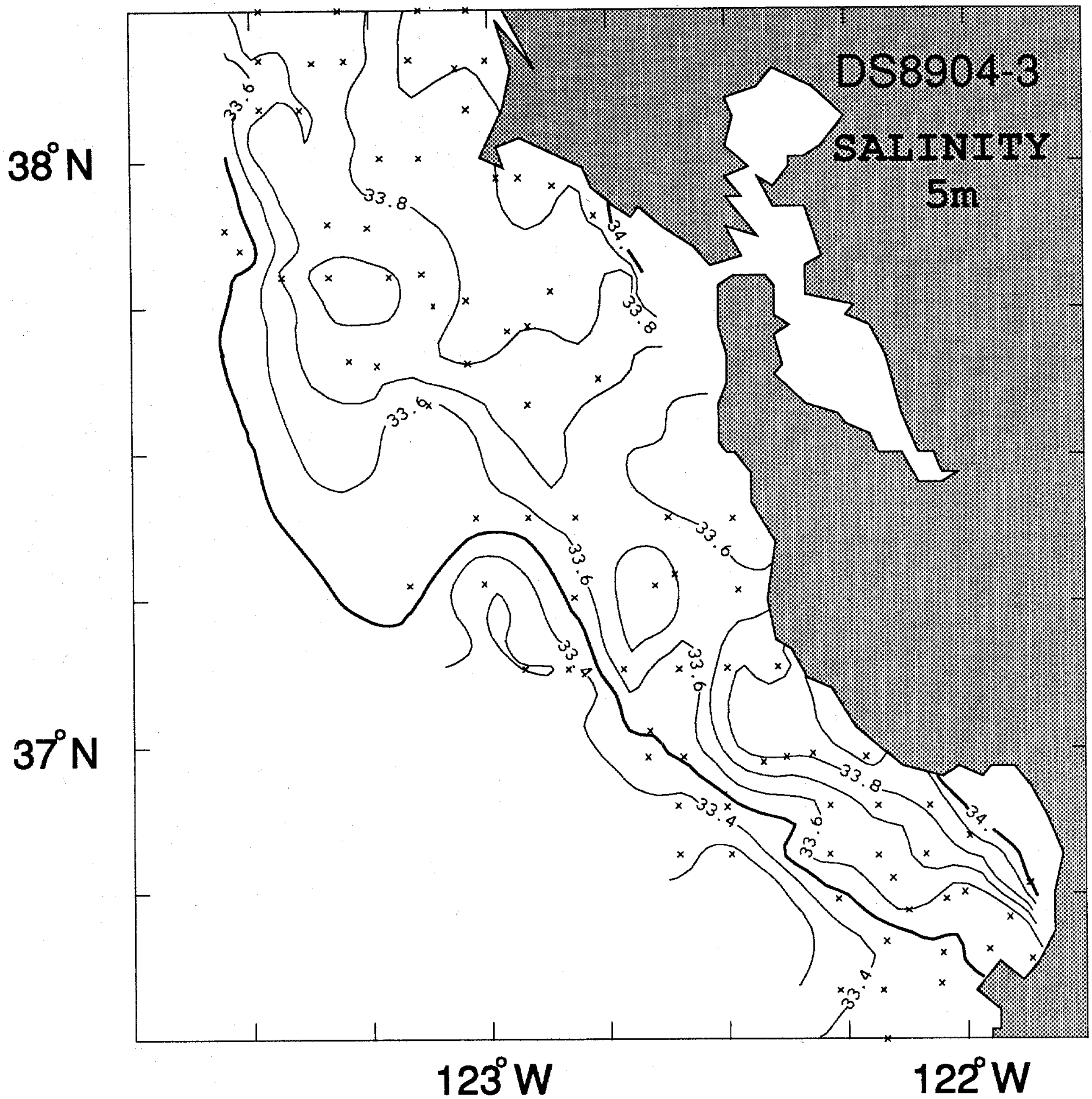

DS8904-3
CTD
STATIONS
38° N
37° N
123° W
122° W

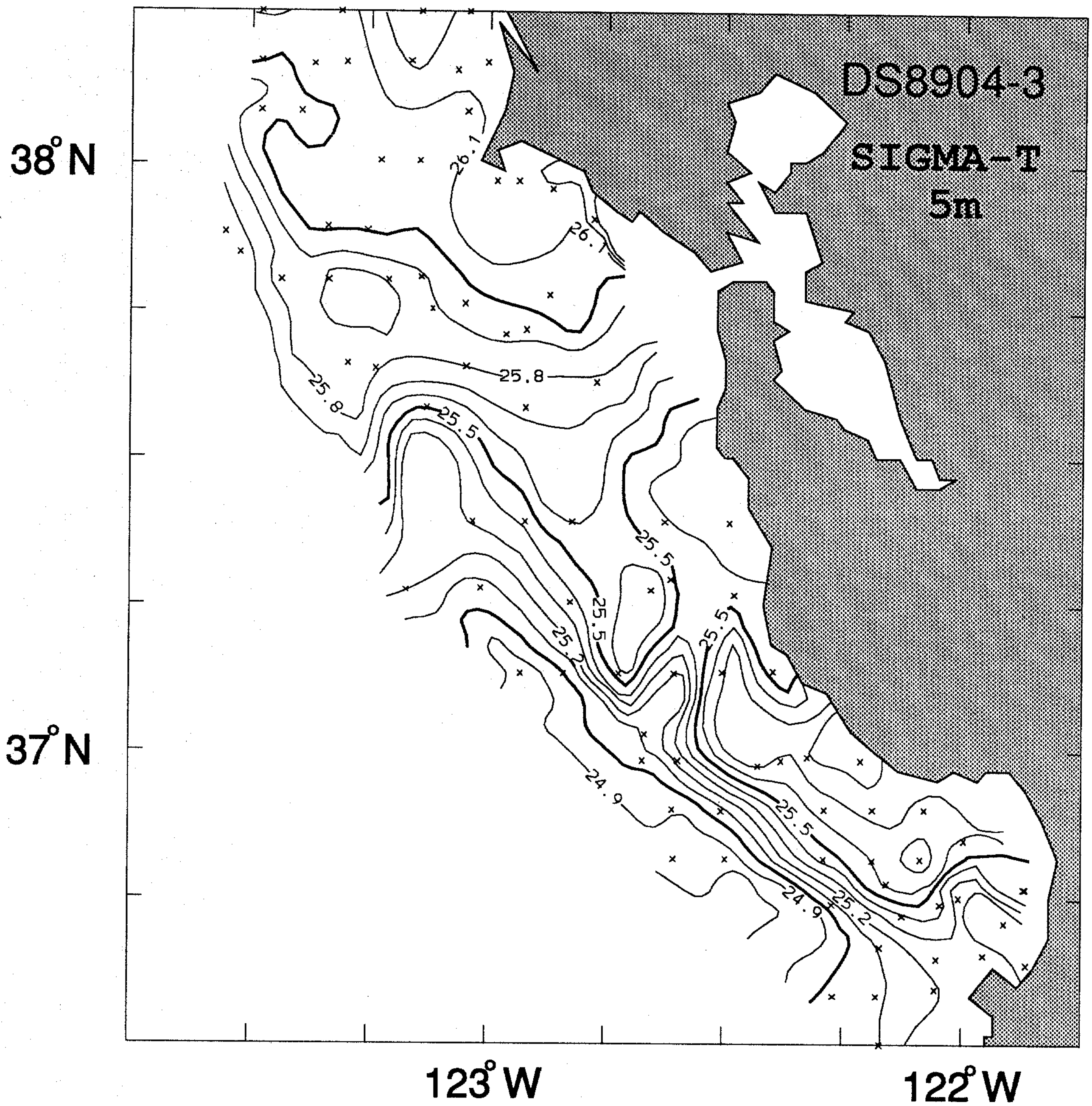
Surface Temperature: Sweep 3 (June 5–11)

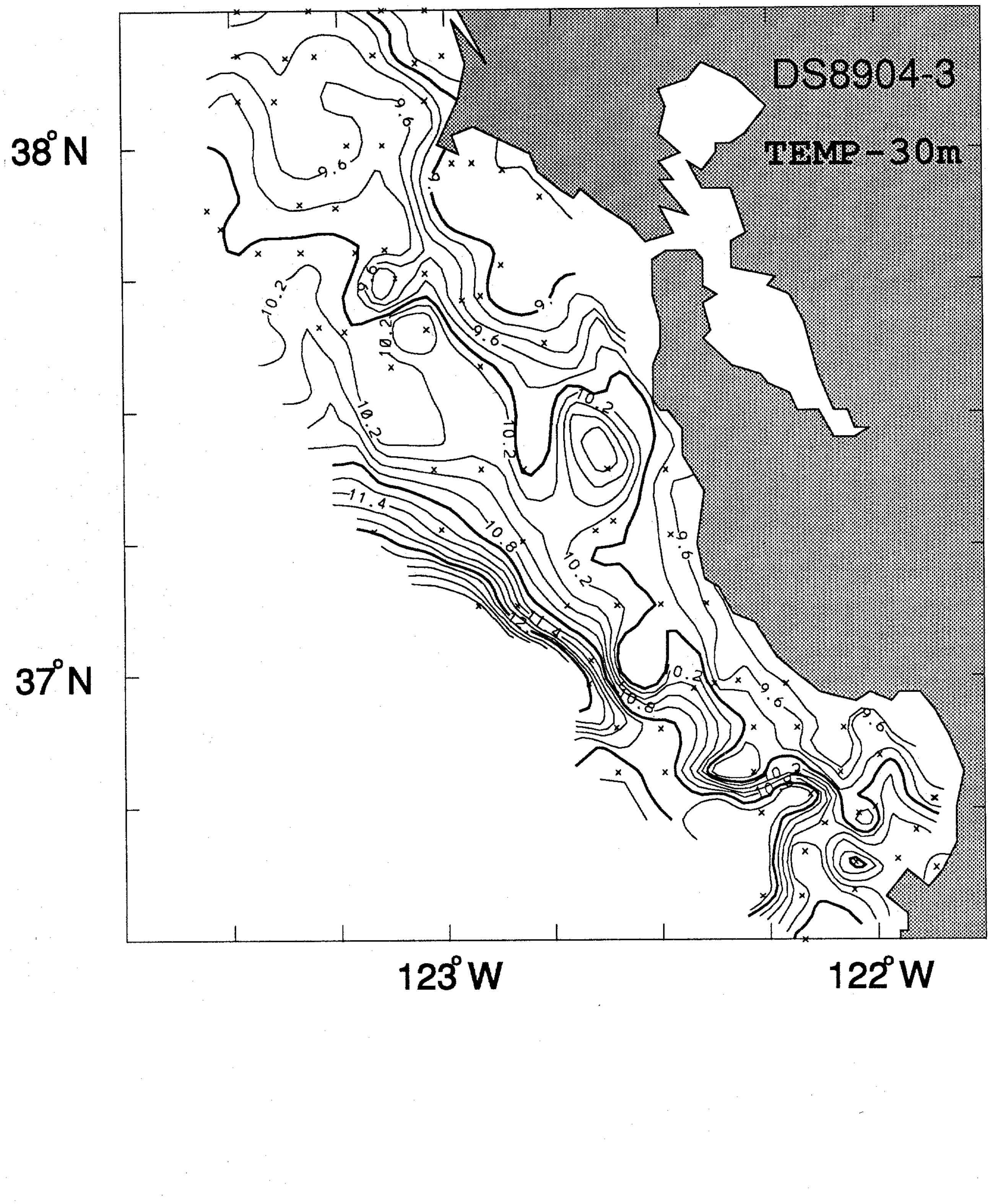



Surface Salinity: Sweep 3 (June 5–11)
123.5
123.0
122.5
122.0
38.0
37.5
37.0
36.5
Latitude N
Longitude E
33.8
33.7
33.6
33.5
33.3
33.4
33.5
33.6
33.7

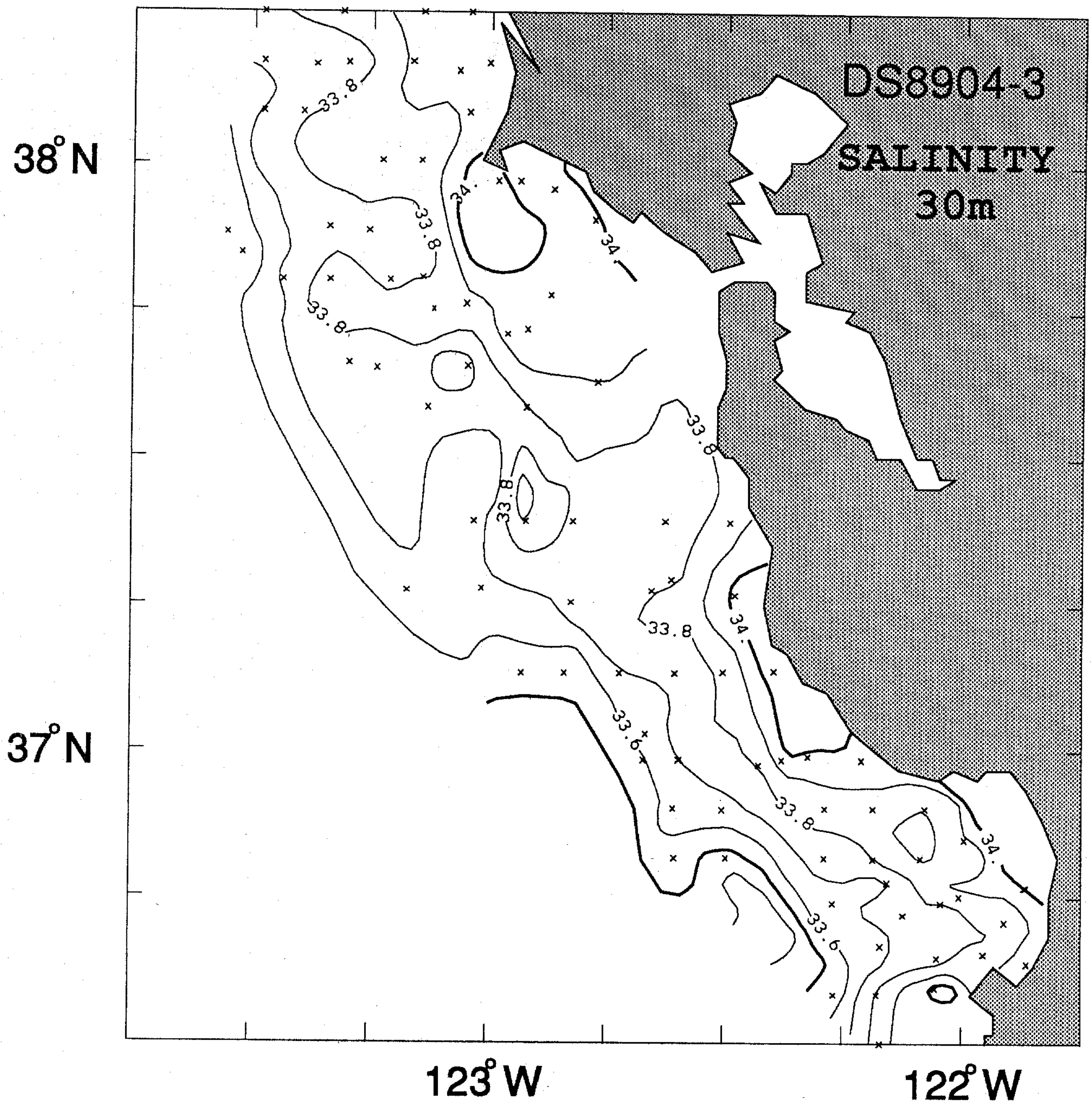

DS8904-3
TEMP-5m
38°N
37°N
123°W
122°W
9.6
10.2
10.8
11.4
12.
12.6
13.2
13.8

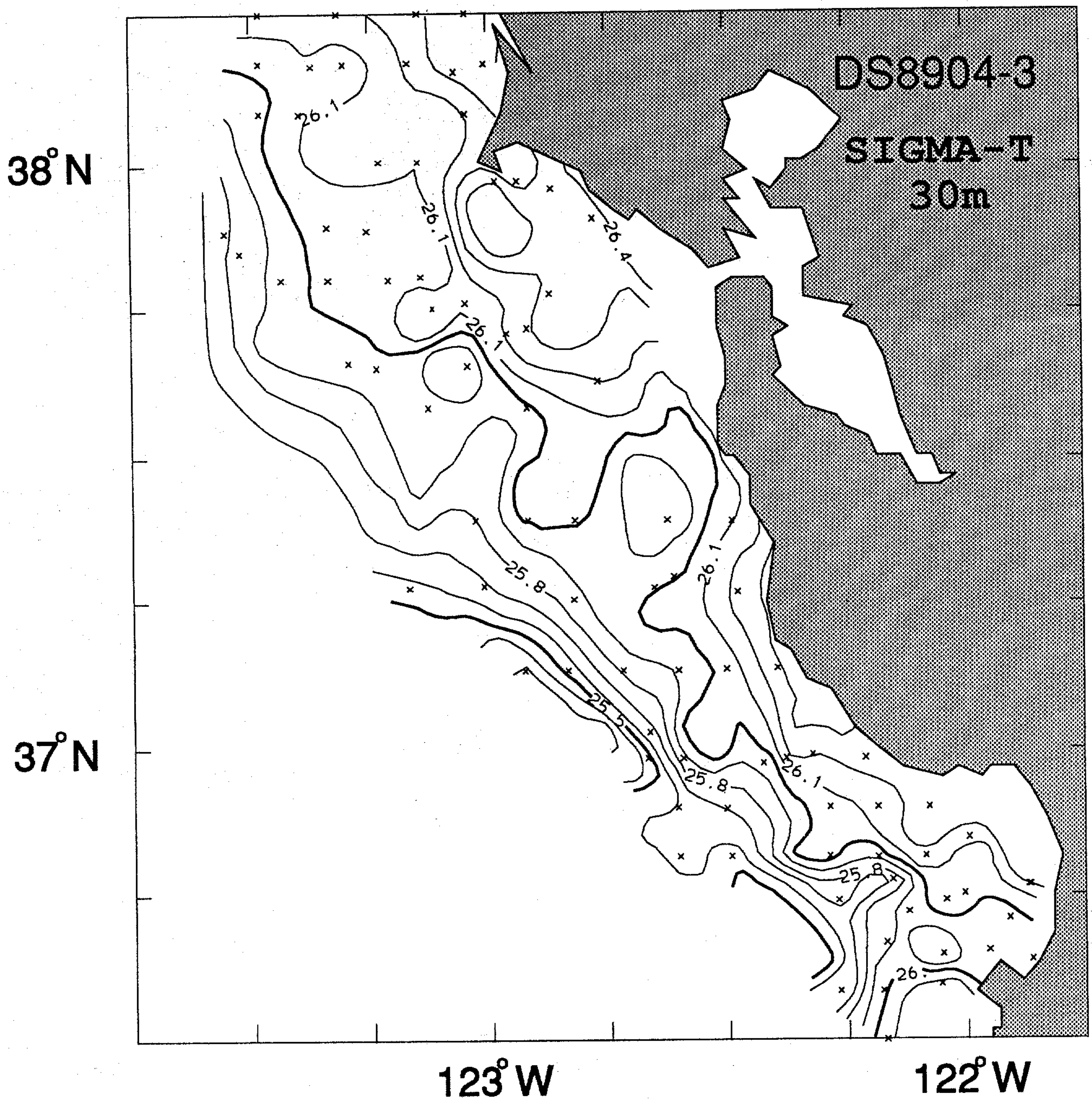

DS8904-3
SALINITY
5m
38°N
37°N
123°W
122°W
33.6
33.8
34.
33.4


DS8904-3
SIGMA-T
5m
38° N
37° N
123° W
122° W
26.1
26.1
25.8
25.8
25.5
25.5
25.5
25.5
25.2
24.9
25.5
24.9
25.2

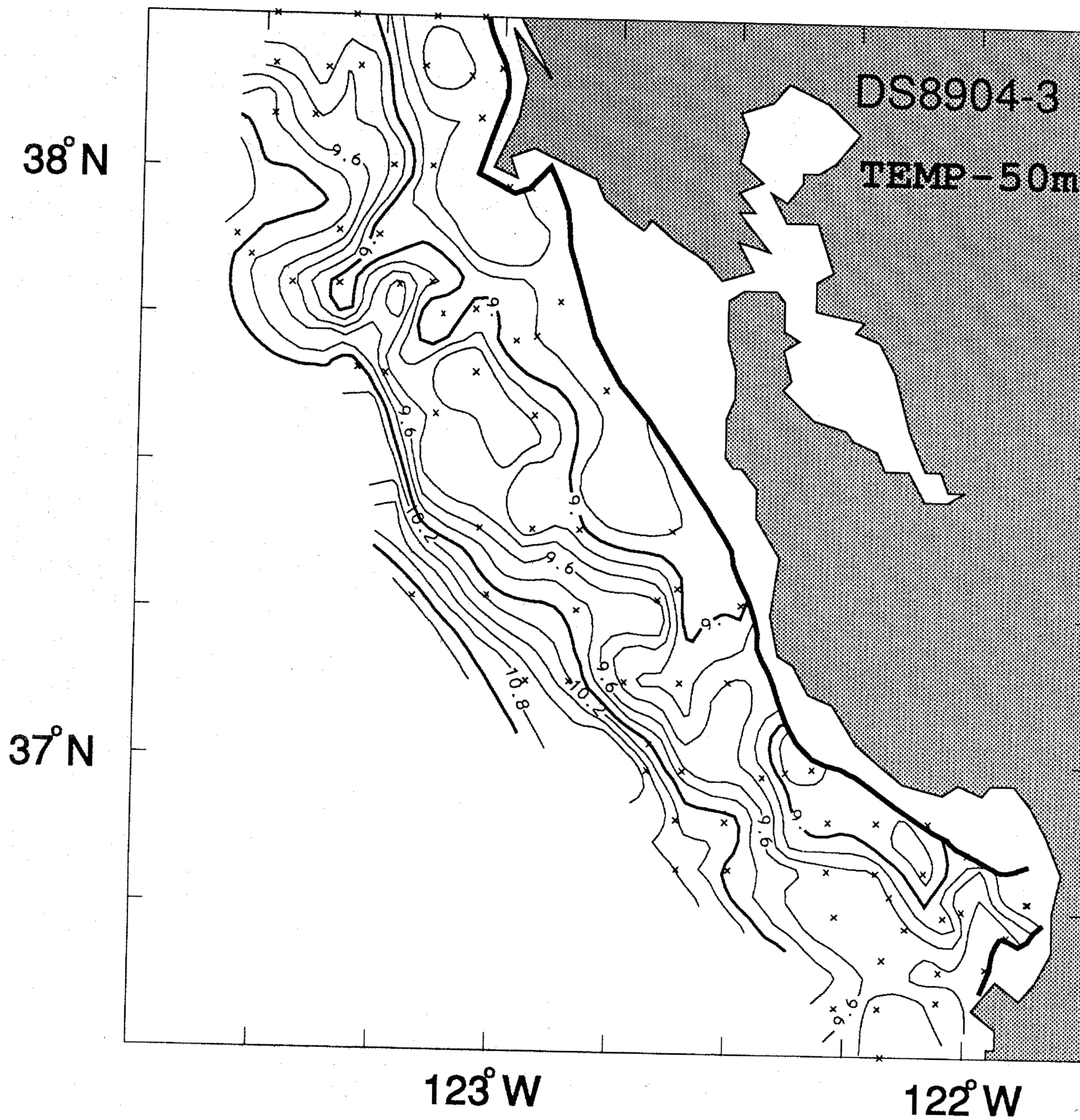


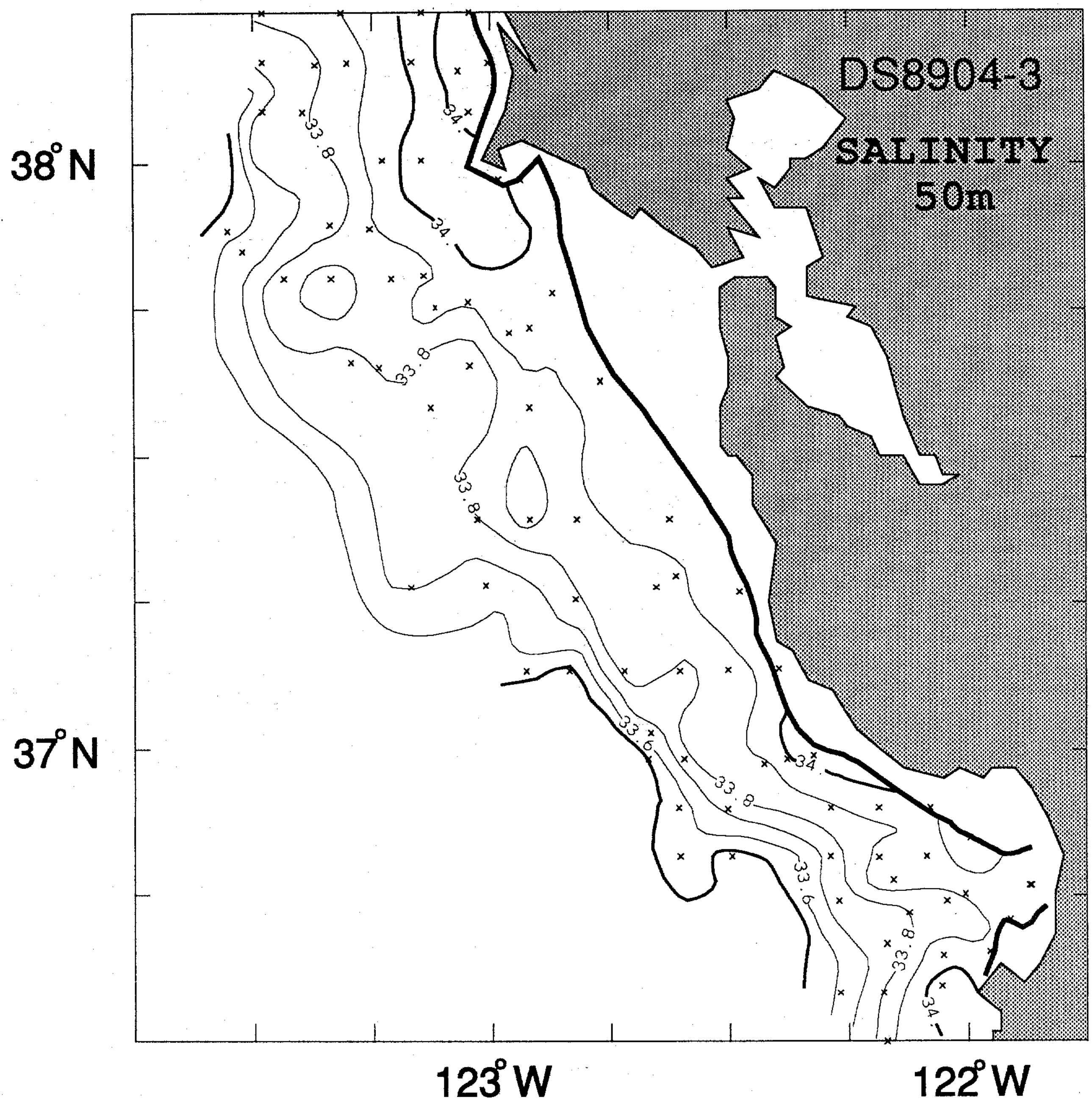
DS8904-3
TEMP - 30m
38° N
37° N
123° W
122° W

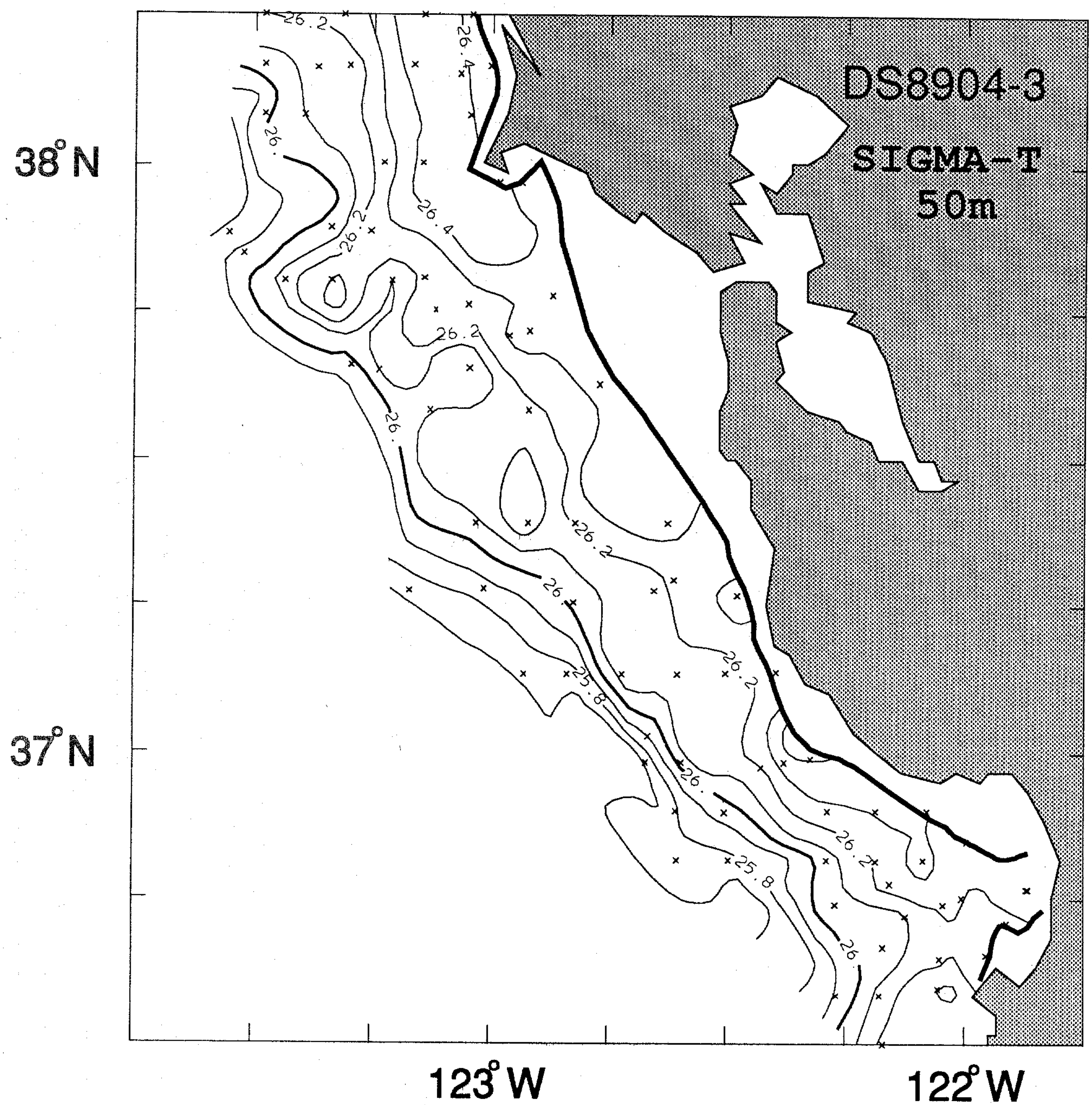

DS8904-3
SALINITY
30m
38°N
37°N
123°W
122°W
33.8
34.
33.6

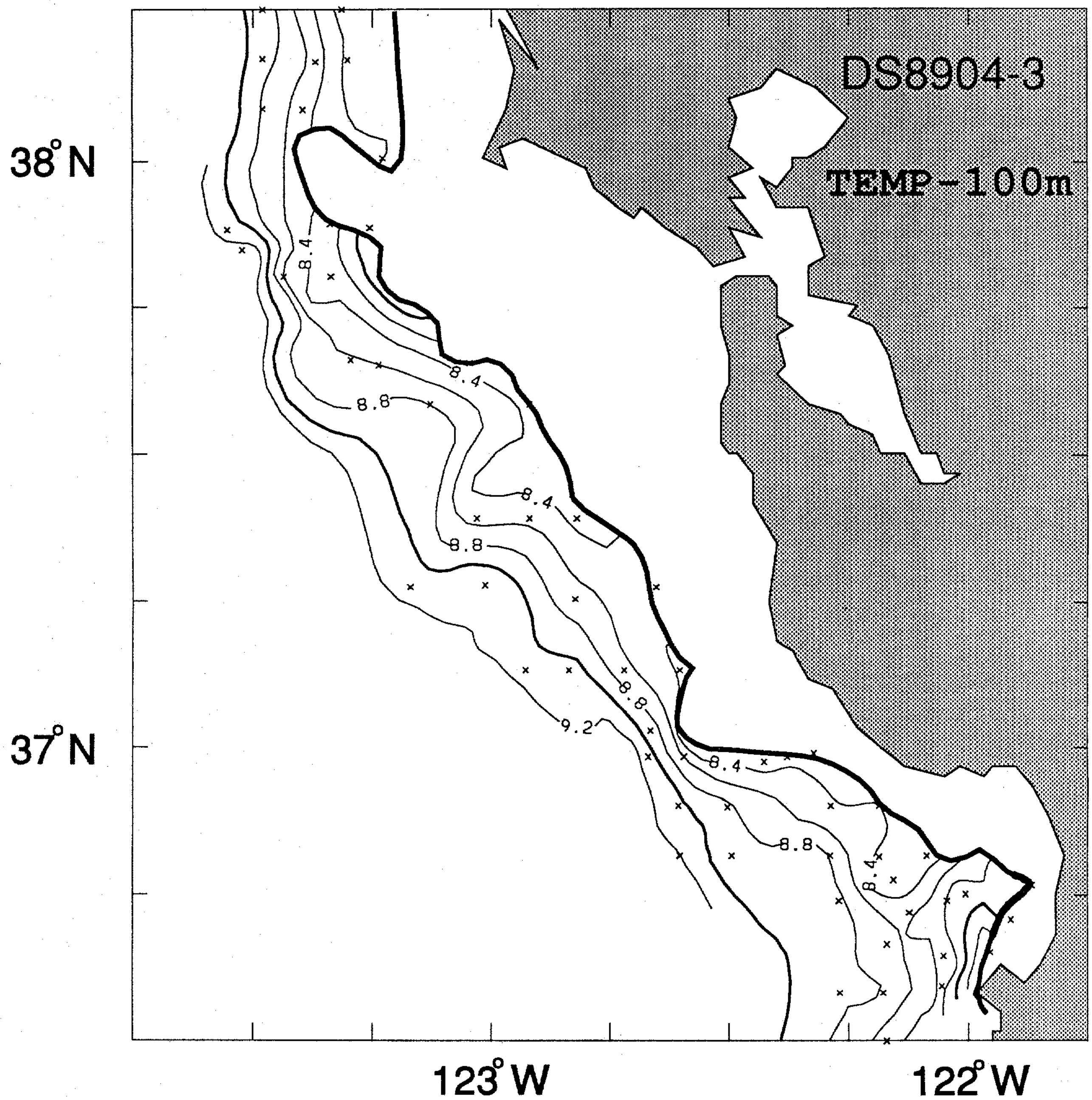


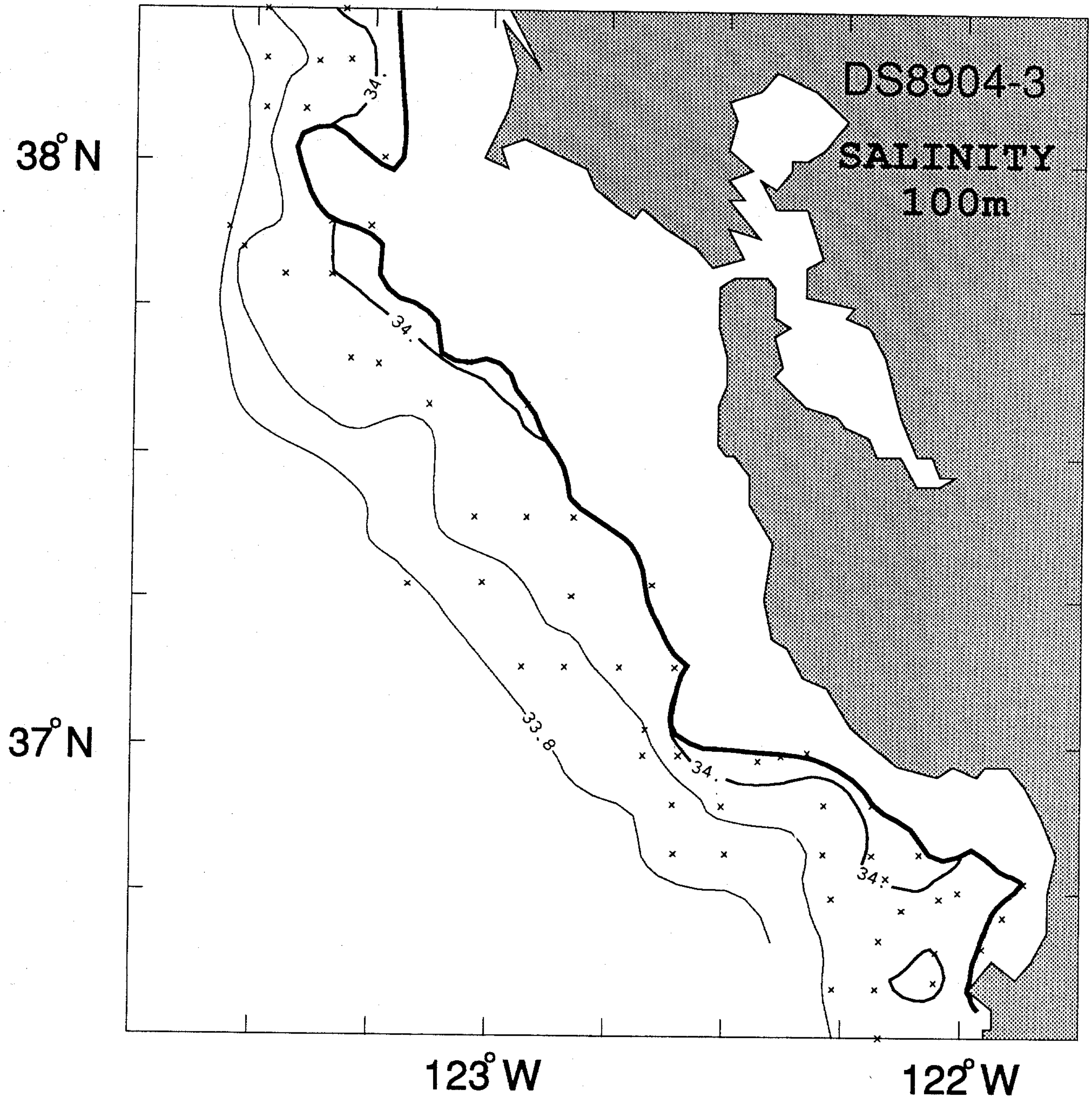
DS8904-3
SIGMA-T
30m
26.1
26.1
26.4
26.1
25.8
26.1
25.5
25.8
26.1
25.8
26.
38° N
37° N
123° W
122° W

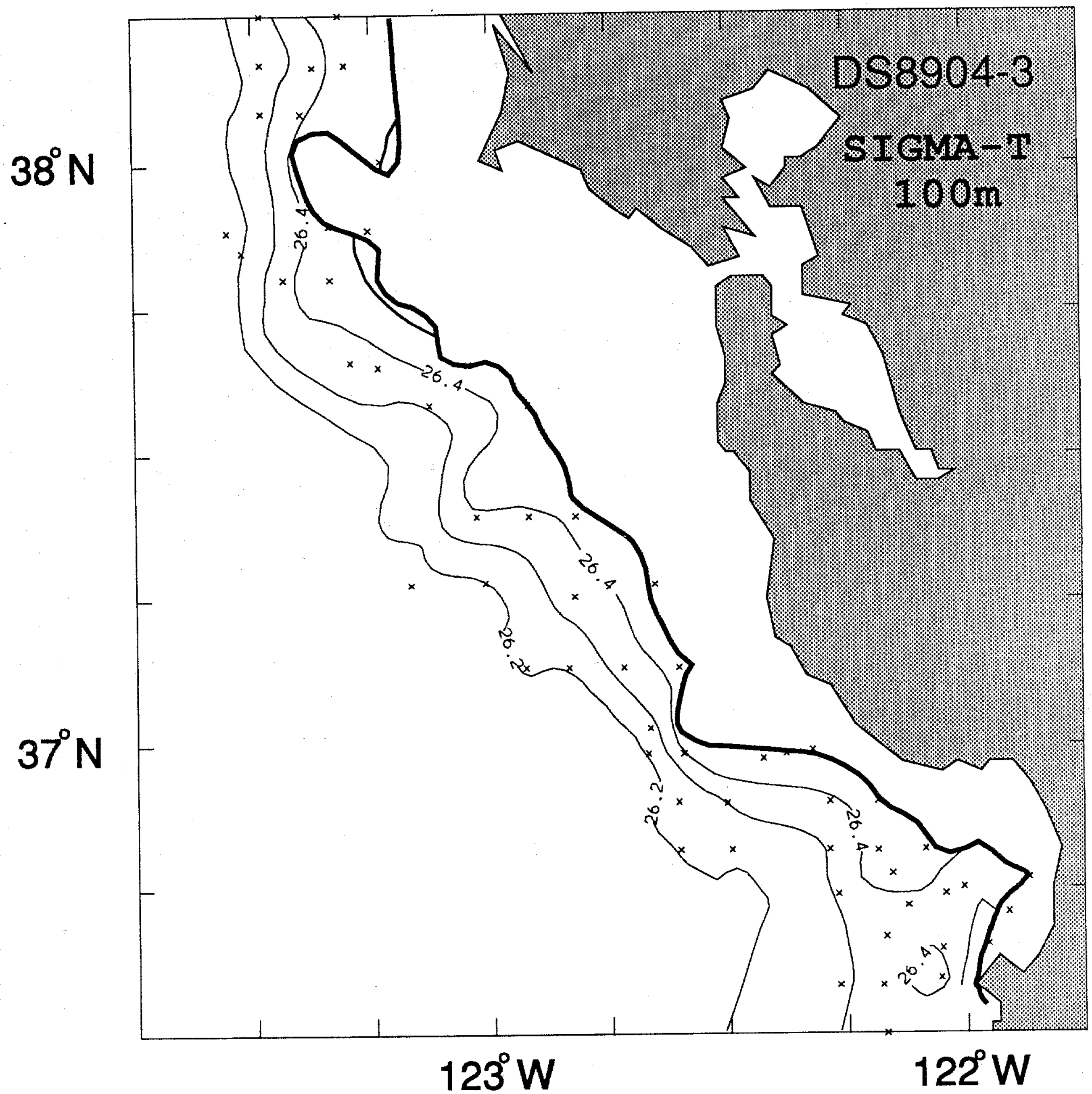

DS8904-3
TEMP-50m
38°N
37°N
123°W
122°W
9.6
10.2
10.8

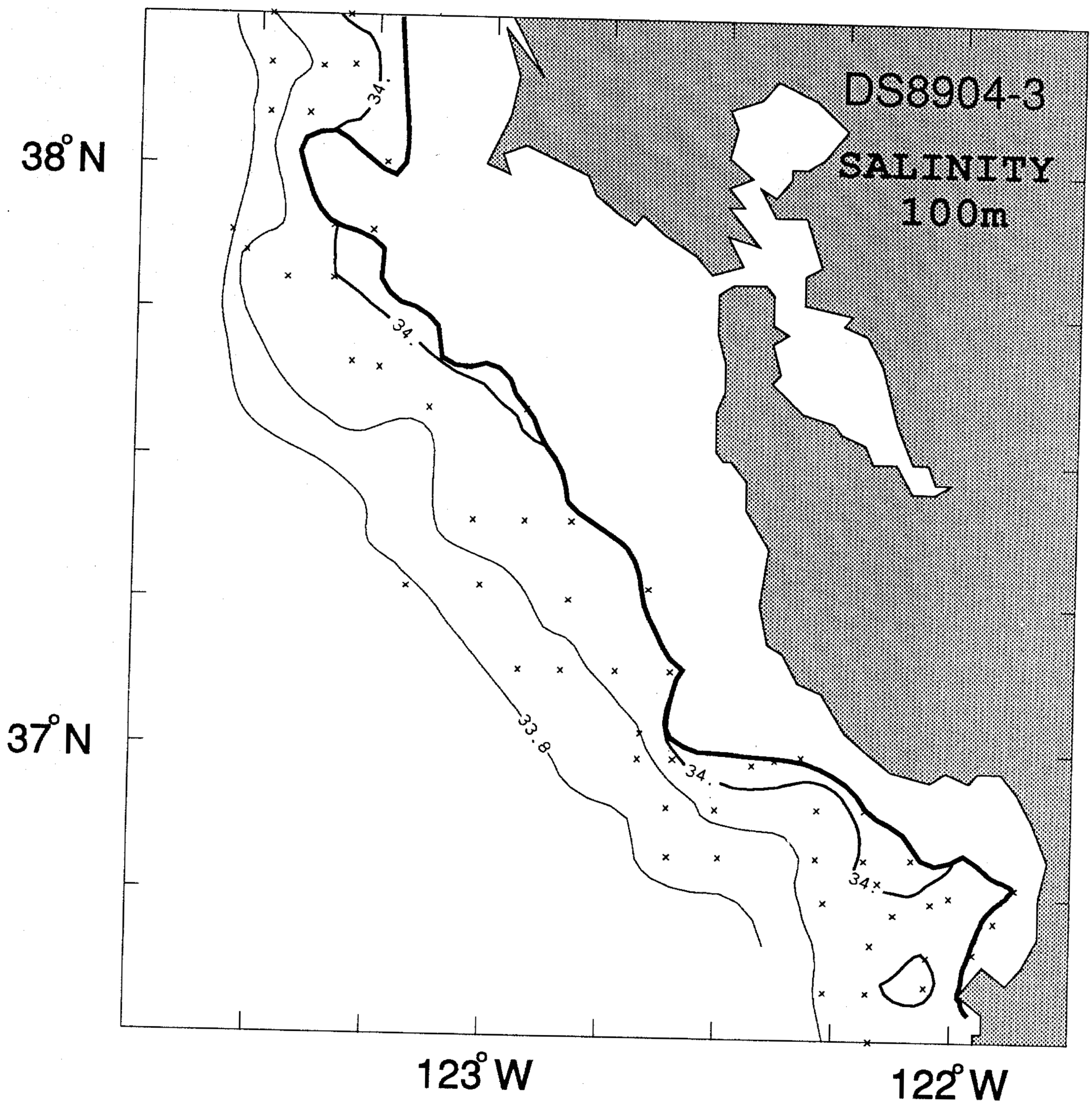

DS8904-3
SALINITY
50m
38°N
37°N
123°W
122°W
33.8
34.
33.6


DS8904-3
SIGMA-T
50m
38° N
37° N
123° W
122° W
26.2
26.4
26.
25.8
26

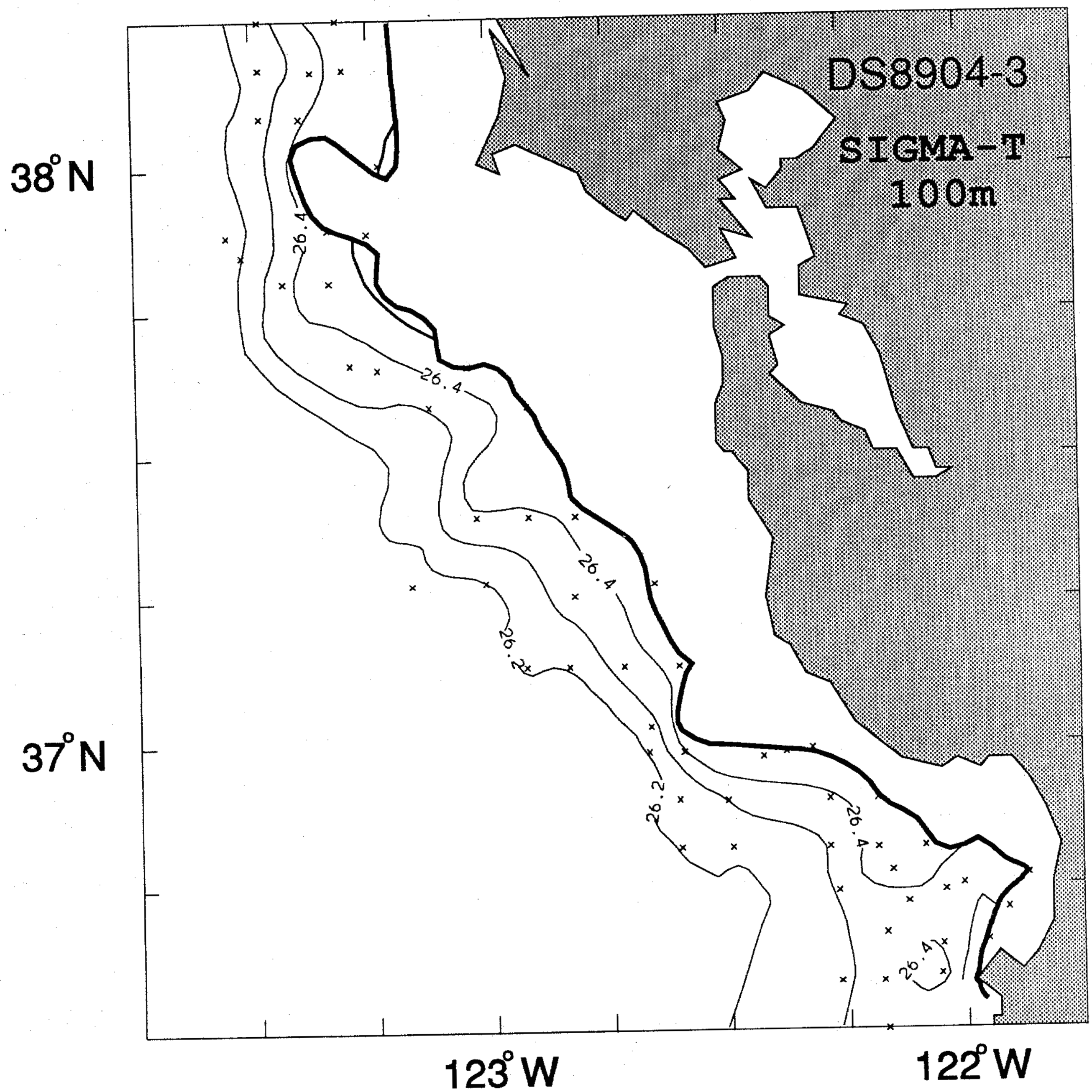

DS8904-3
TEMP-100m
38°N
37°N
123°W
122°W
8.4
8.8
9.2

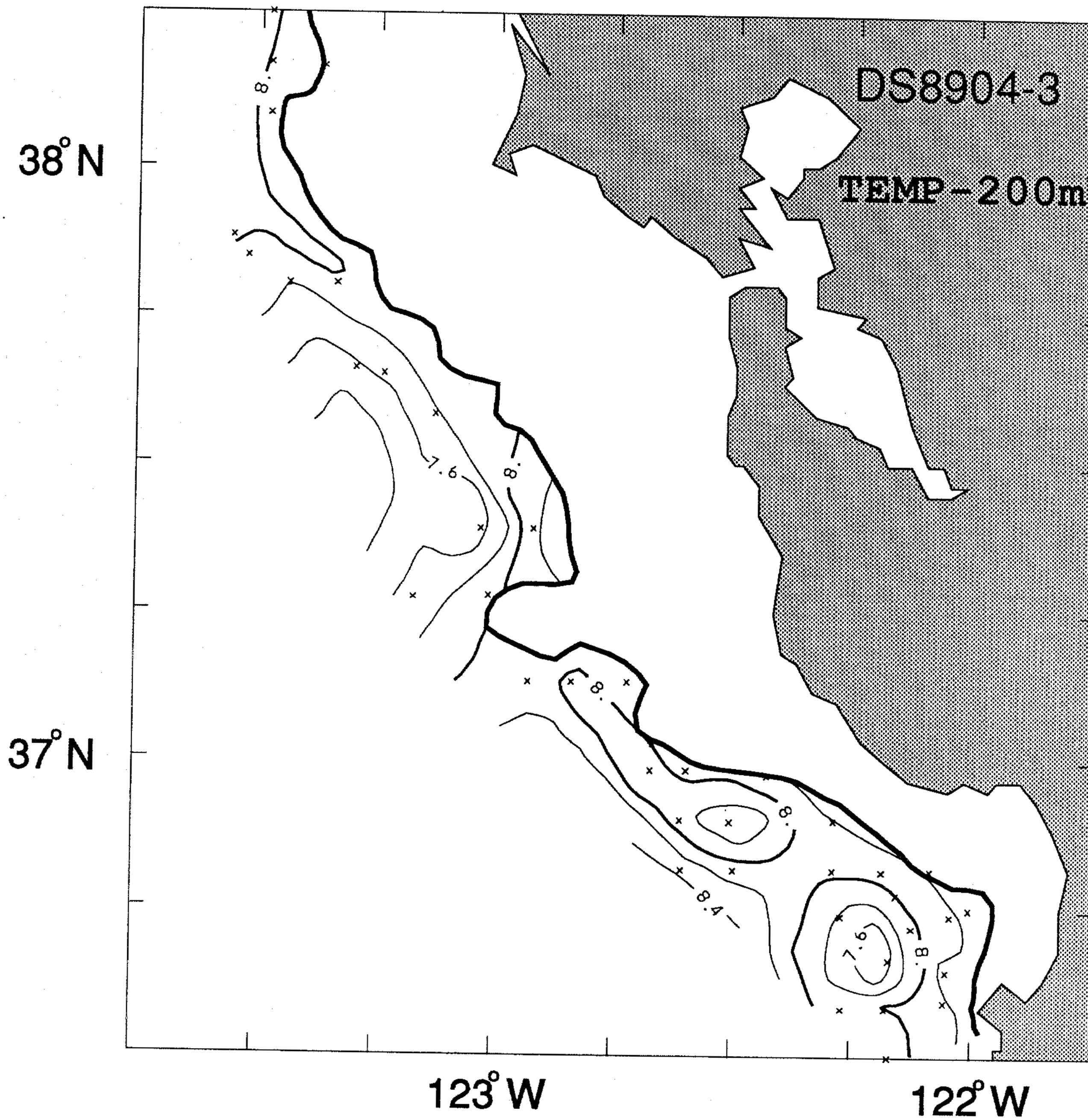

DS8904-3
SALINITY
100m
38°N
37°N
123°W
122°W
34.
34.
34.
34.
33.8

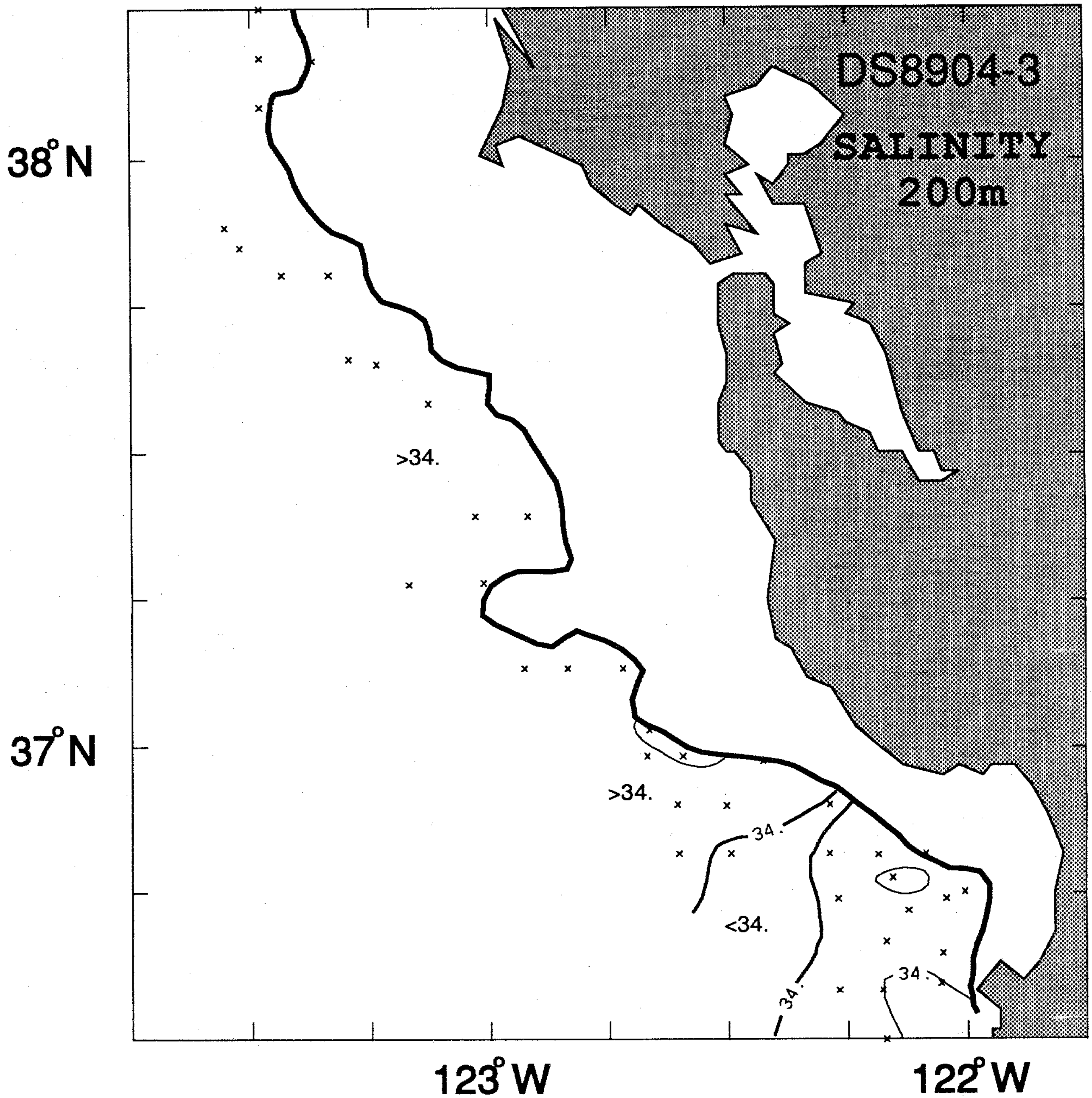

DS8904-3
SIGMA-T
100m
38°N
37°N
123°W
122°W
26.4
26.4
26.4
26.4
26.4
26.2
26.2

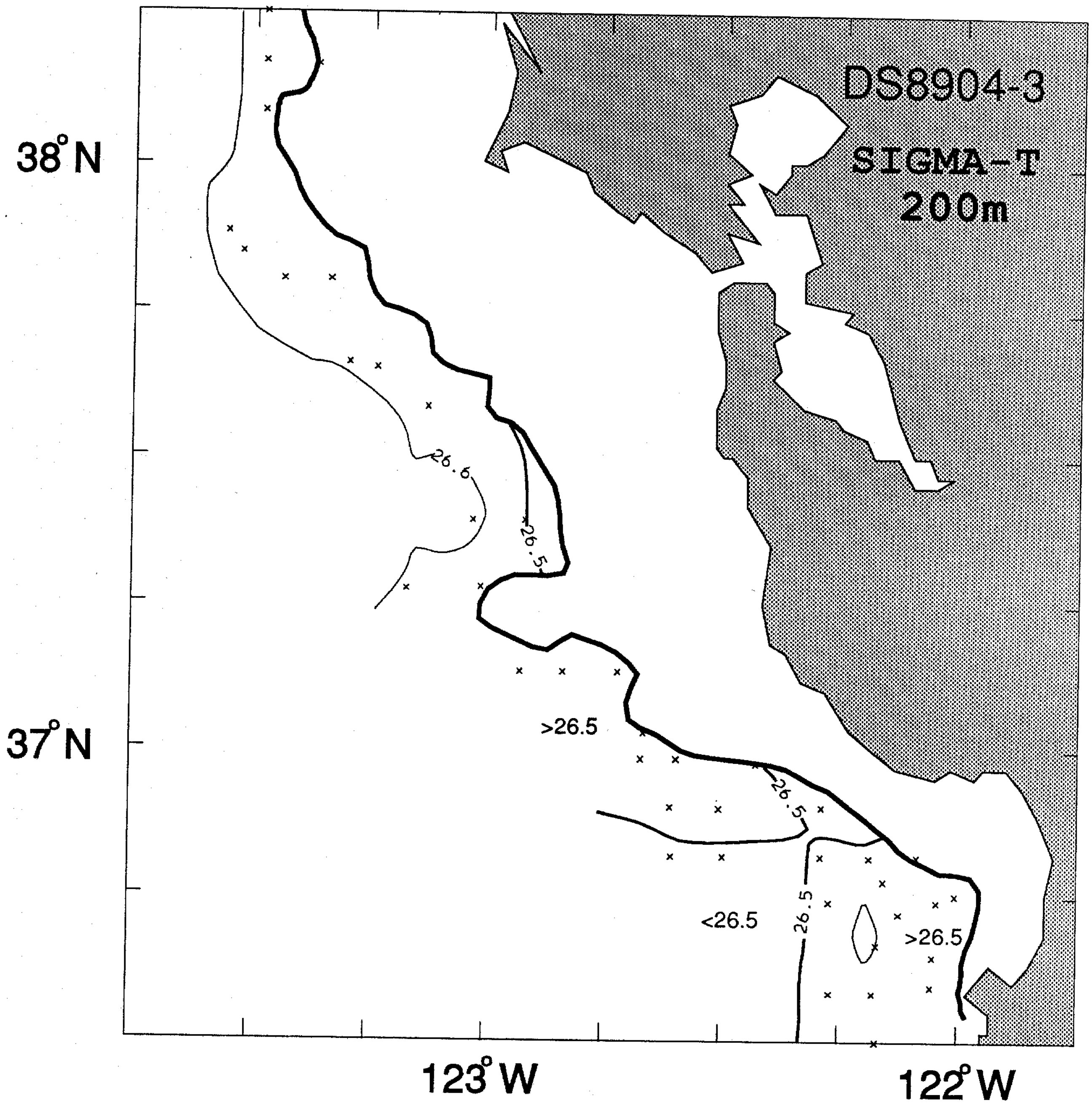


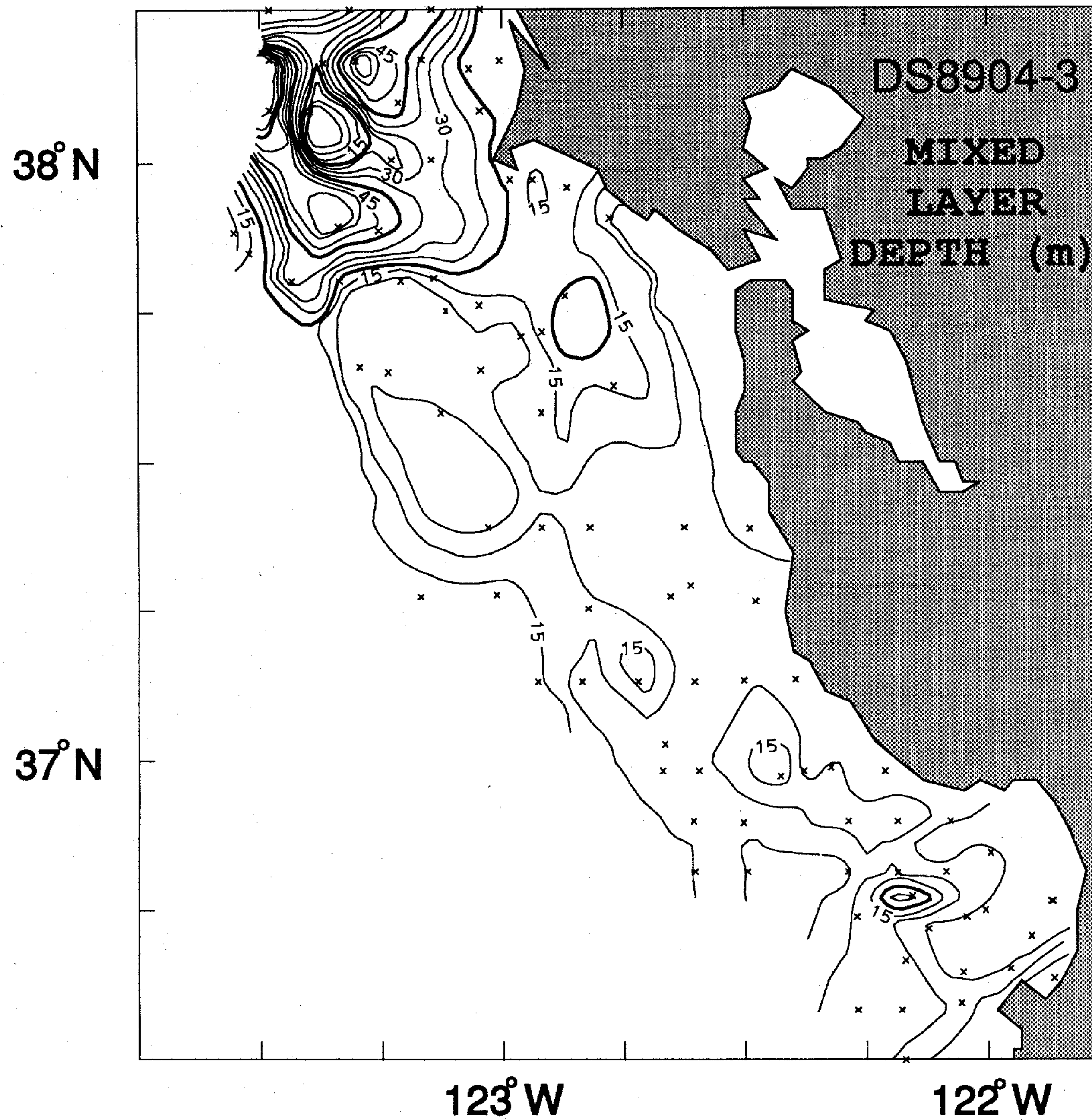
DS8904-3
SALINITY
100m
34.
34.
34.
34.
33.8
38° N
37° N
123° W
122° W

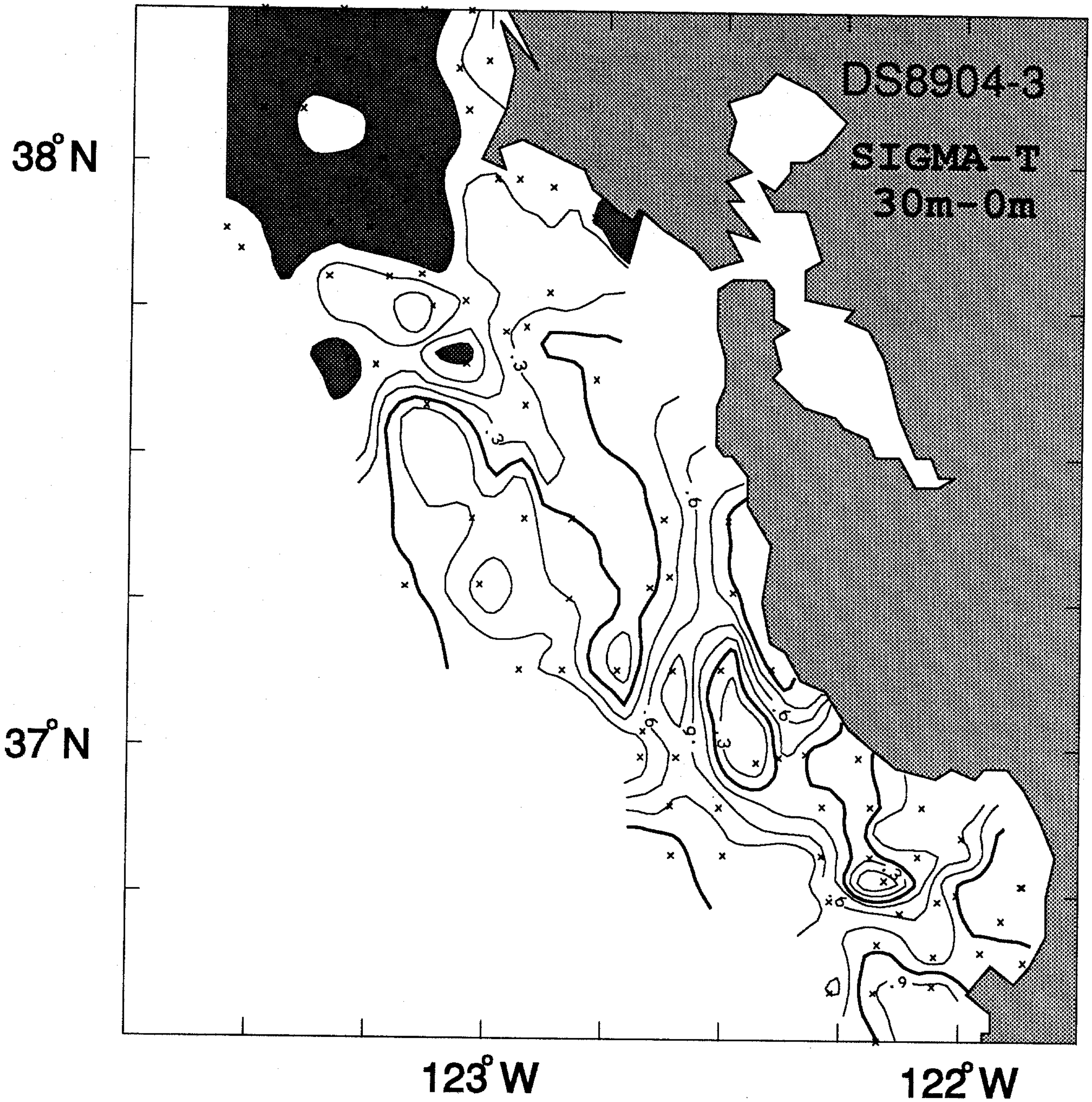

DS8904-3
SIGMA-T
100m
38° N
37° N
123° W
122° W
26.4
26.4
26.4
26.2
26.2
26.4
26.4

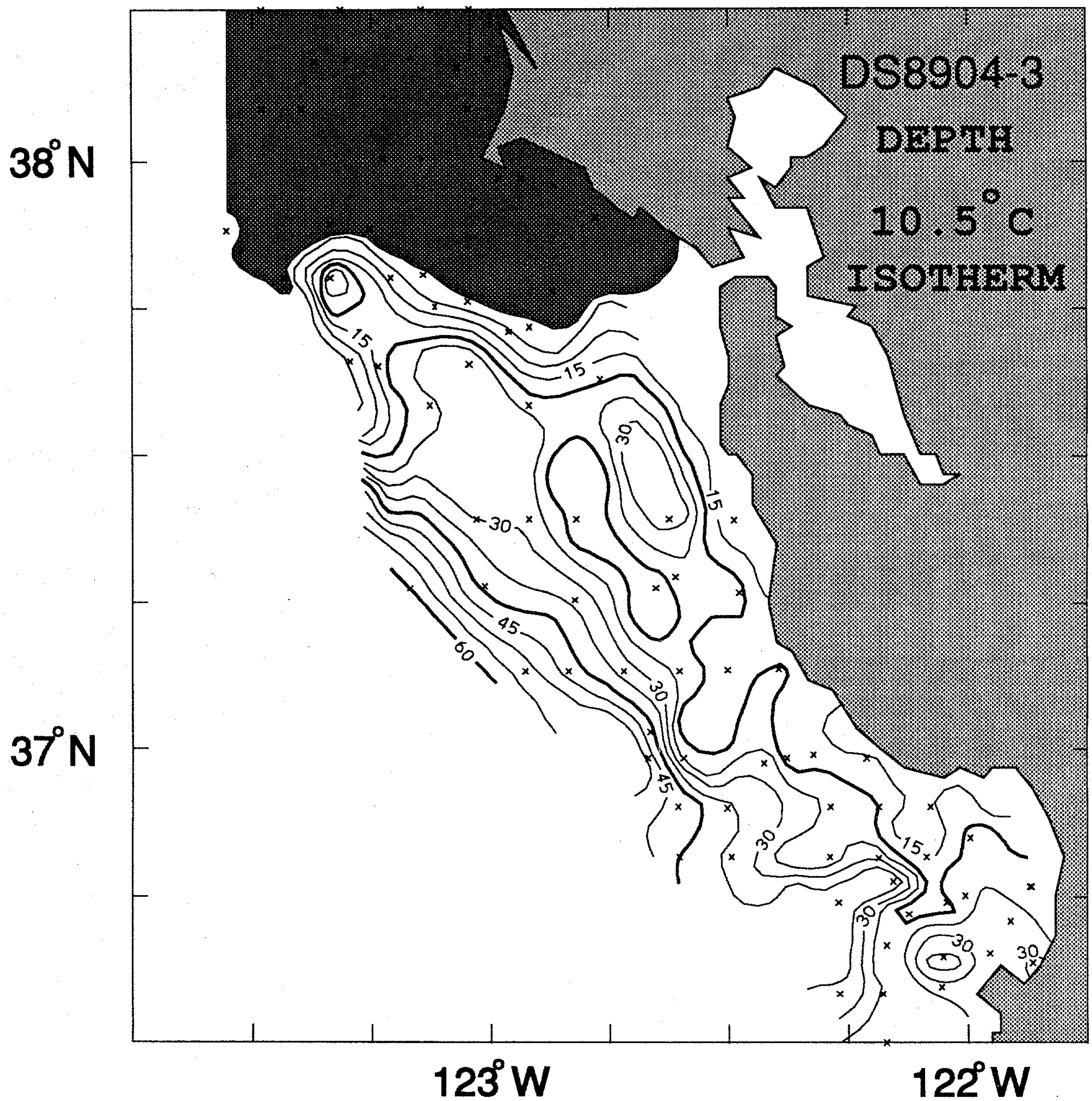

DS8904-3
TEMP-200m
38° N
37° N
123° W
122° W
8.
7.6
8.4

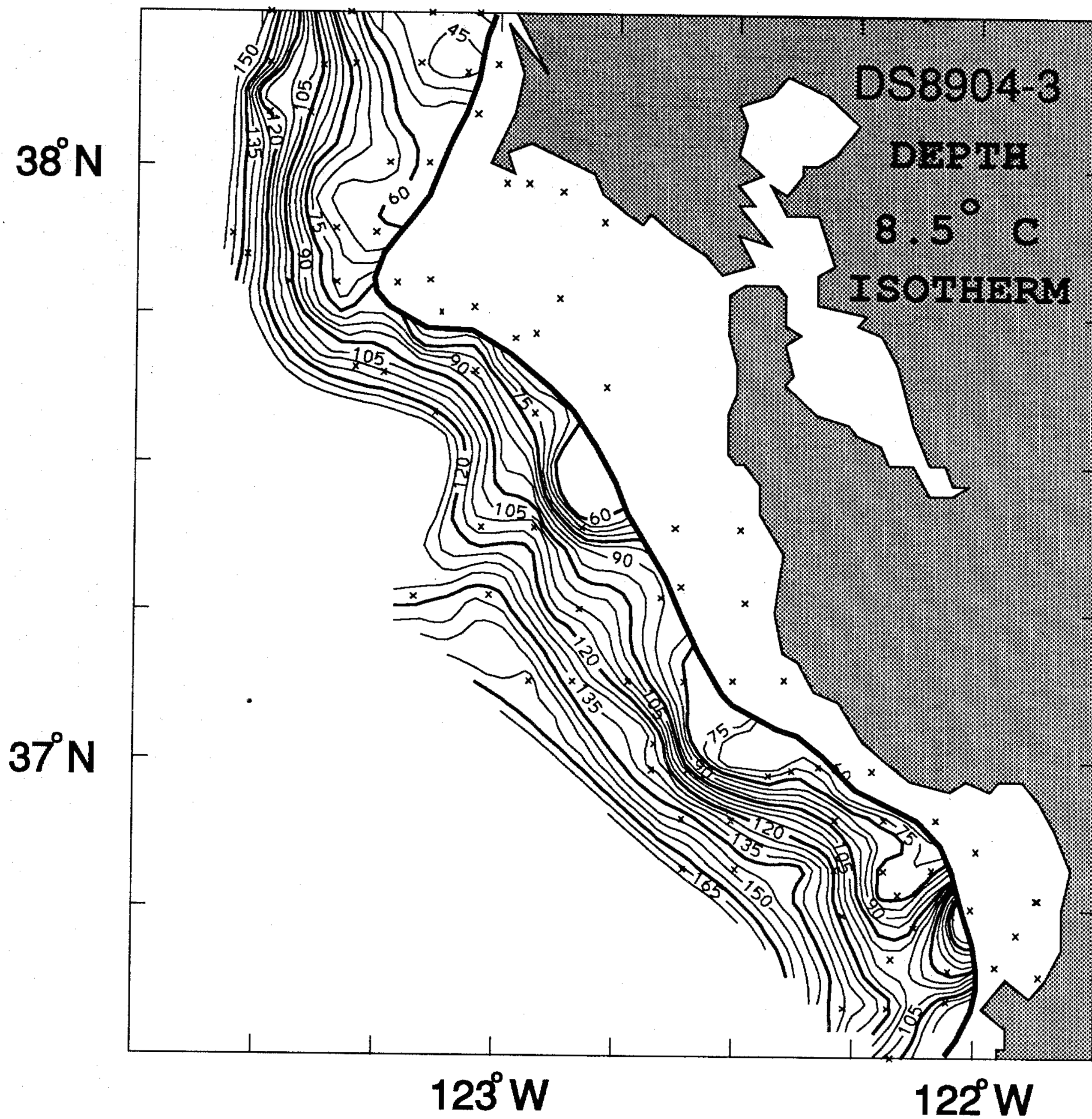

DS8904-3
SALINITY
200m
38°N
37°N
123°W
122°W
>34.
>34.
34.
<34.
34.
34.

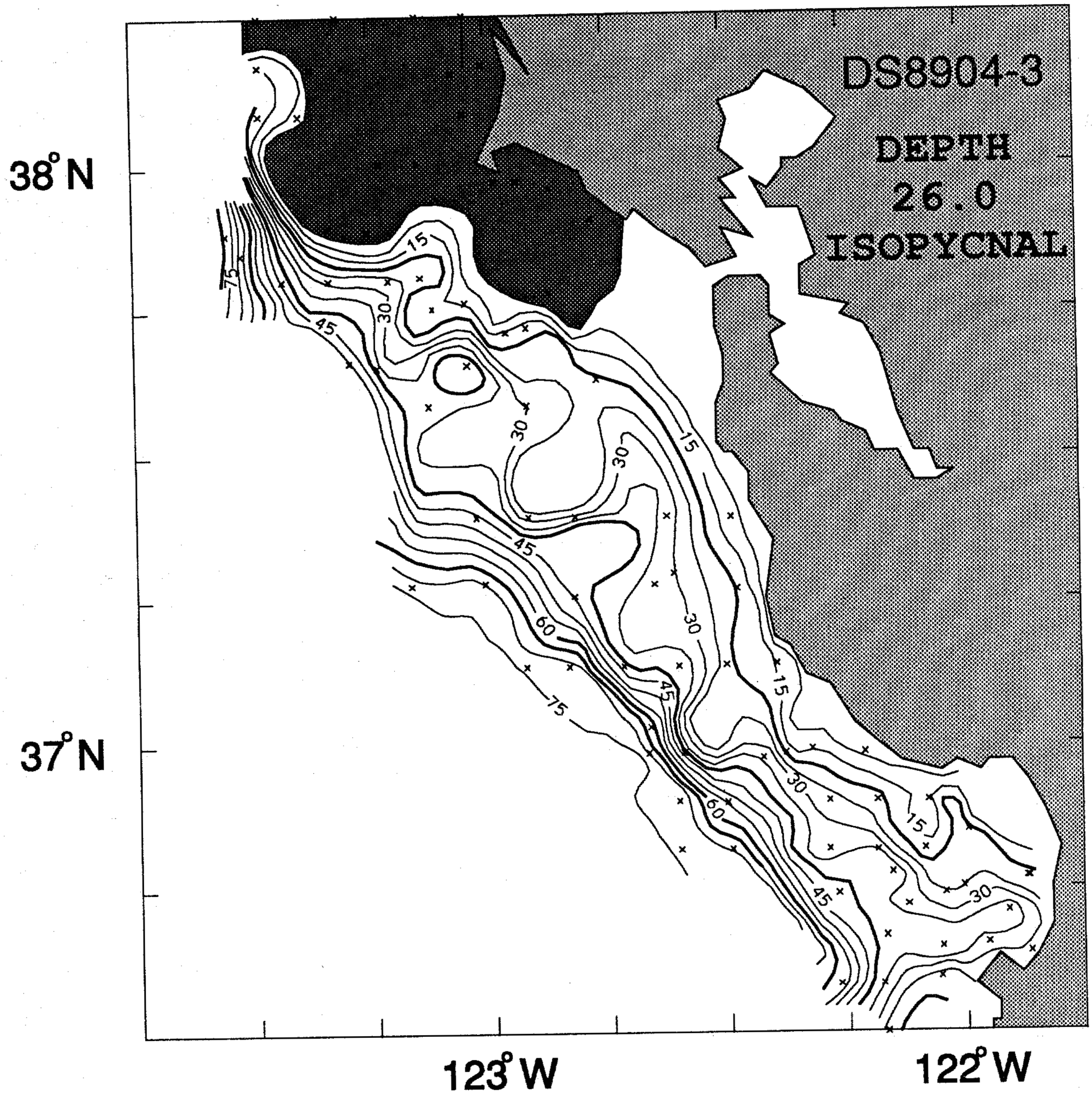

DS8904-3
SIGMA-T
200m
38°N
37°N
123°W
122°W
26.6
26.5
>26.5
26.5
<26.5
26.5
>26.5

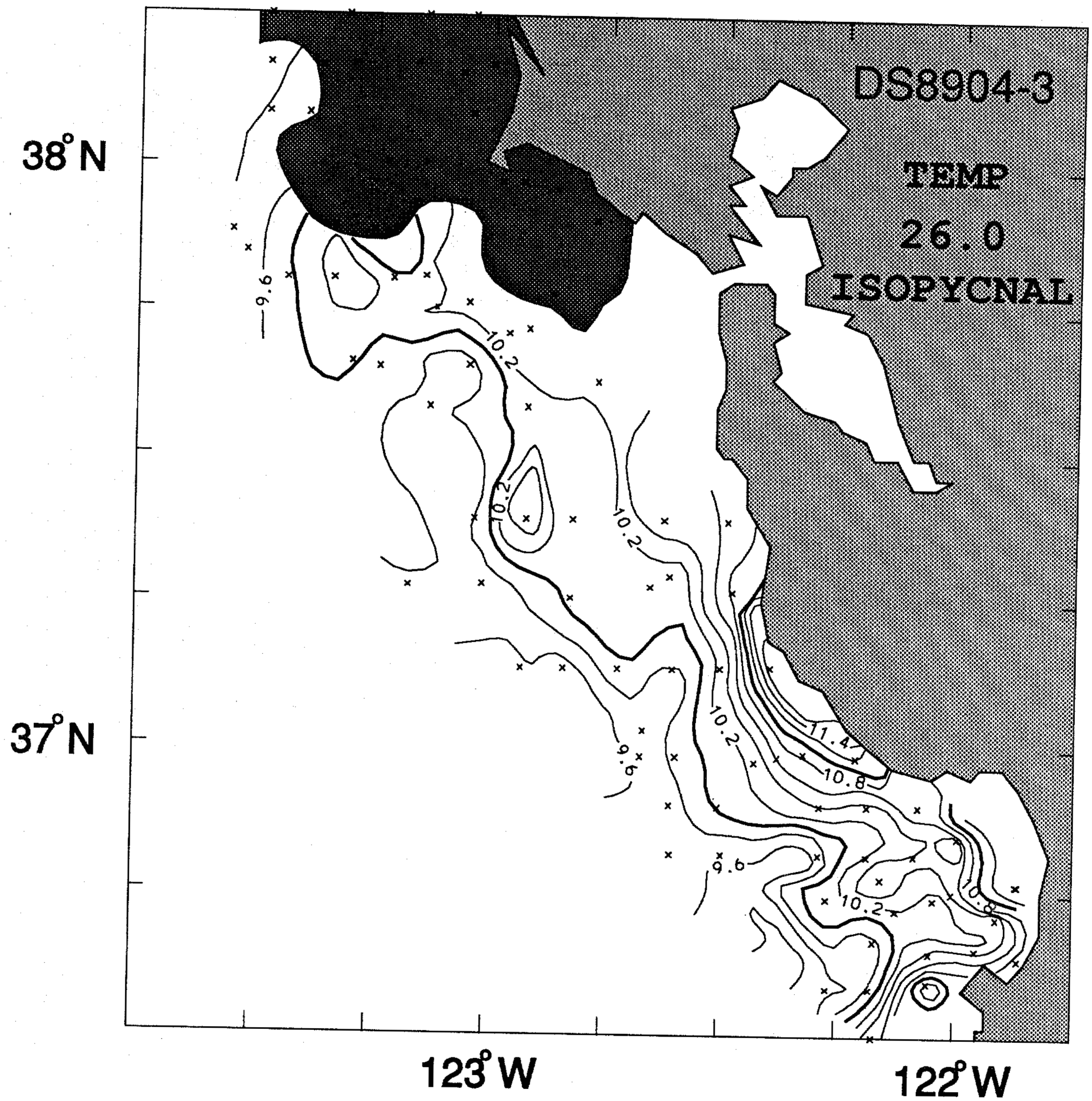

DS8904-3
MIXED
LAYER
DEPTH (m)
38°N
37°N
123°W
122°W
45
30
15


DS8904-3
SIGMA-T
30m-0m
38° N
37° N
123° W
122° W
.3
.6
.9

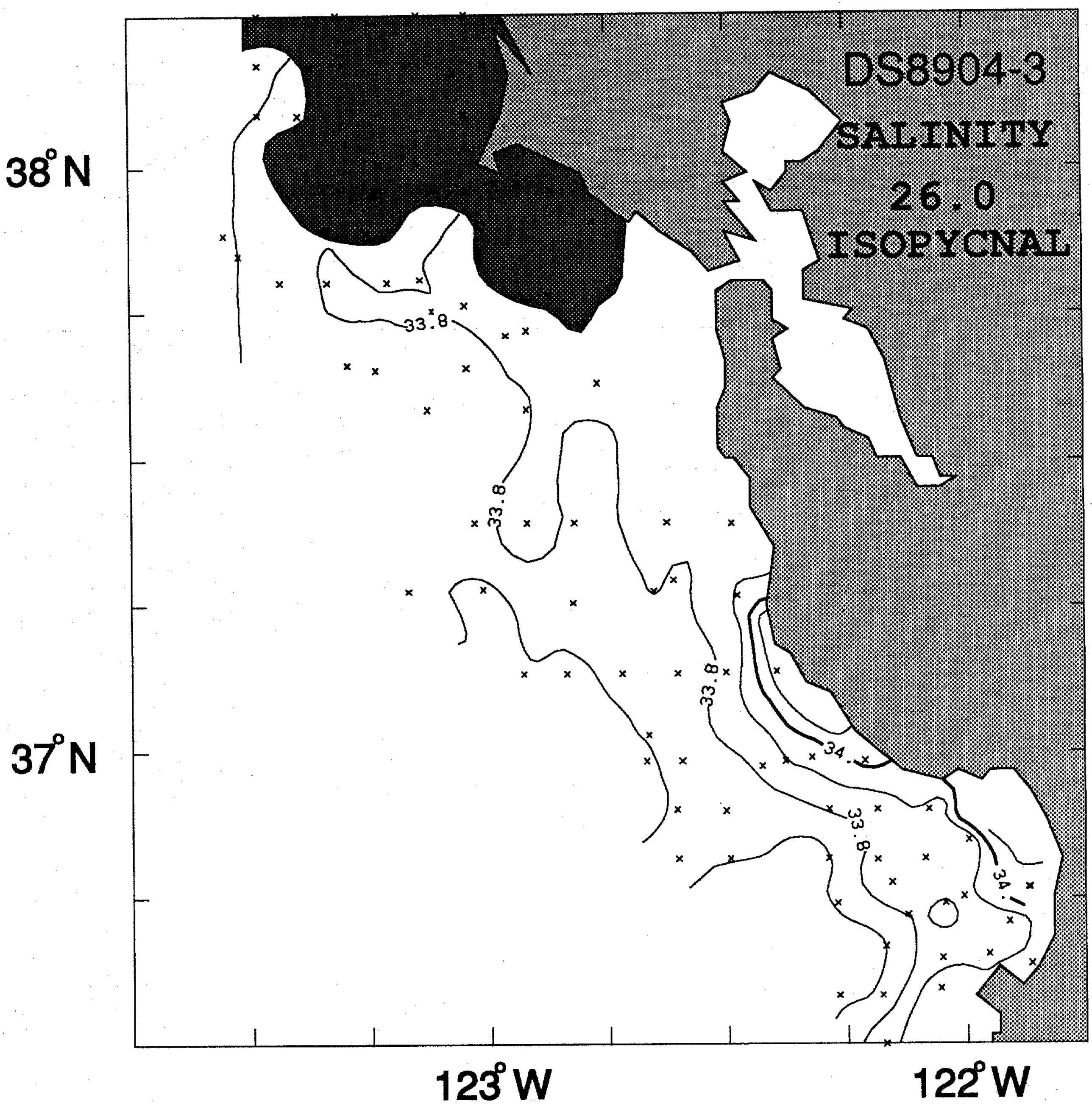

DS8904-3
DEPTH
10.5°C
ISOTHERM
38°N
37°N
123°W
122°W
15
30
45
60


DS8904-3
DEPTH
8.5° C
ISOTHERM
38° N
37° N
123° W
122° W

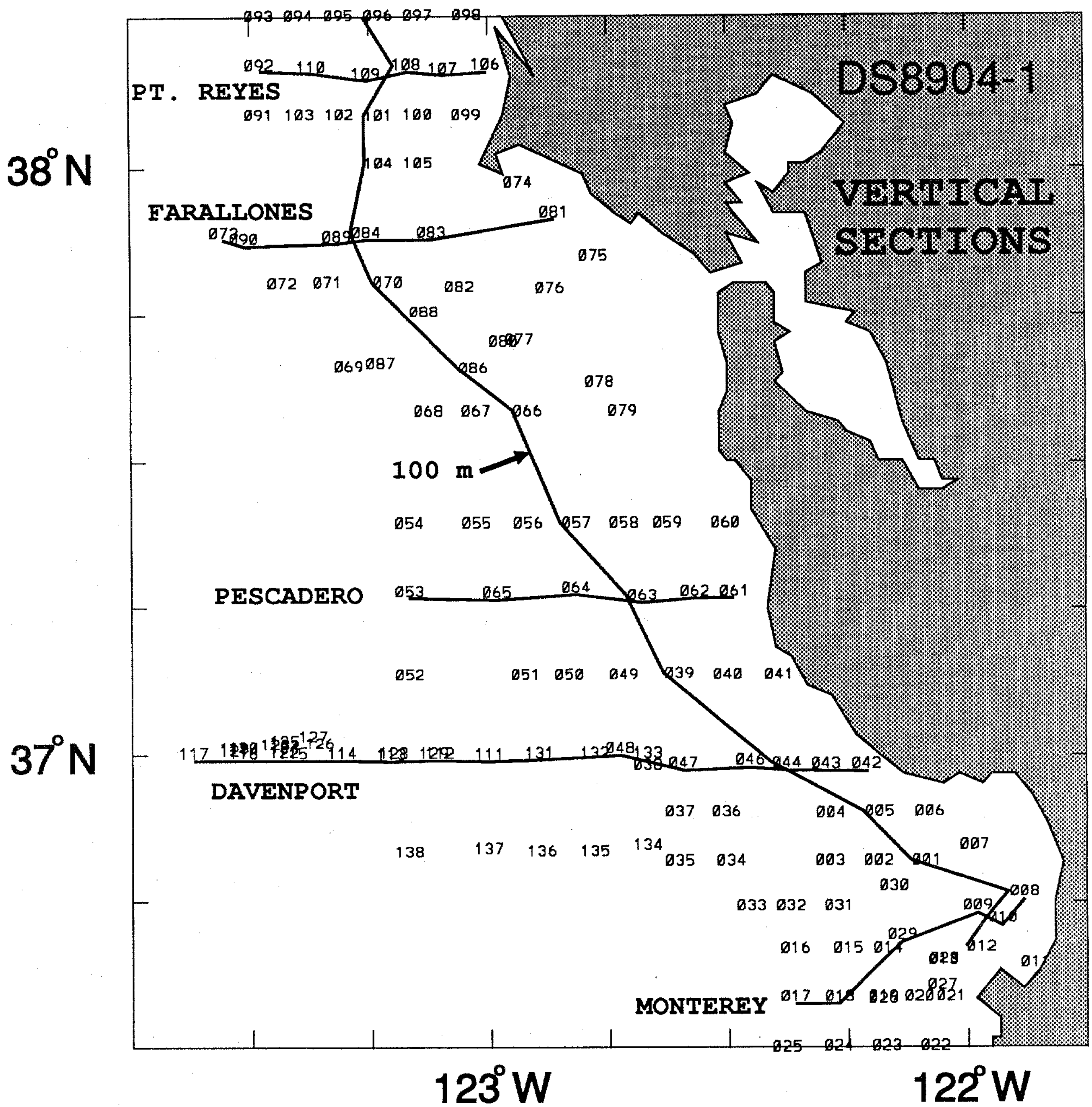

DS8904-3
DEPTH
26.0
ISOPYCNAL
38° N
37° N
123° W
122° W
15
30
45
60
75

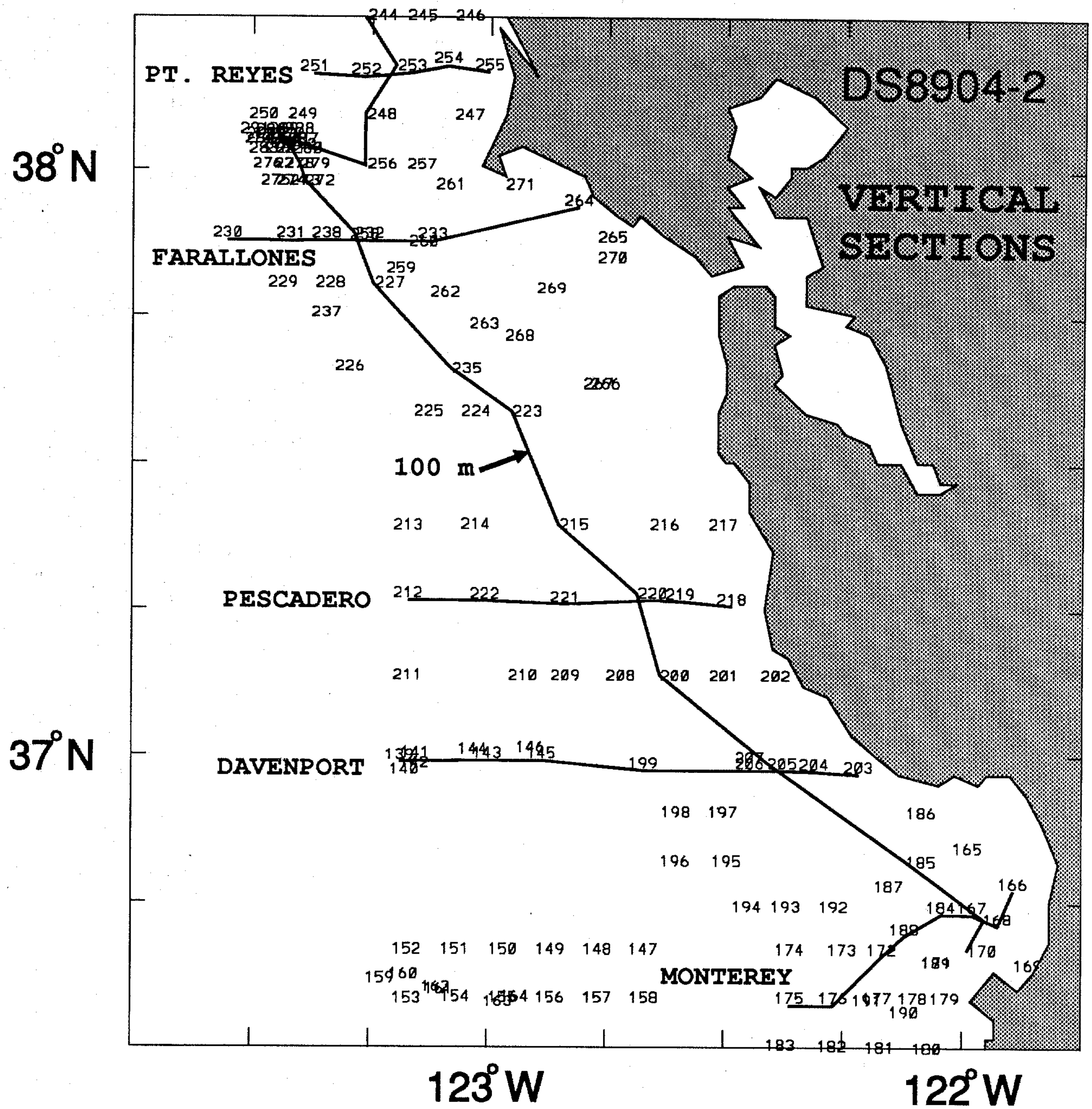


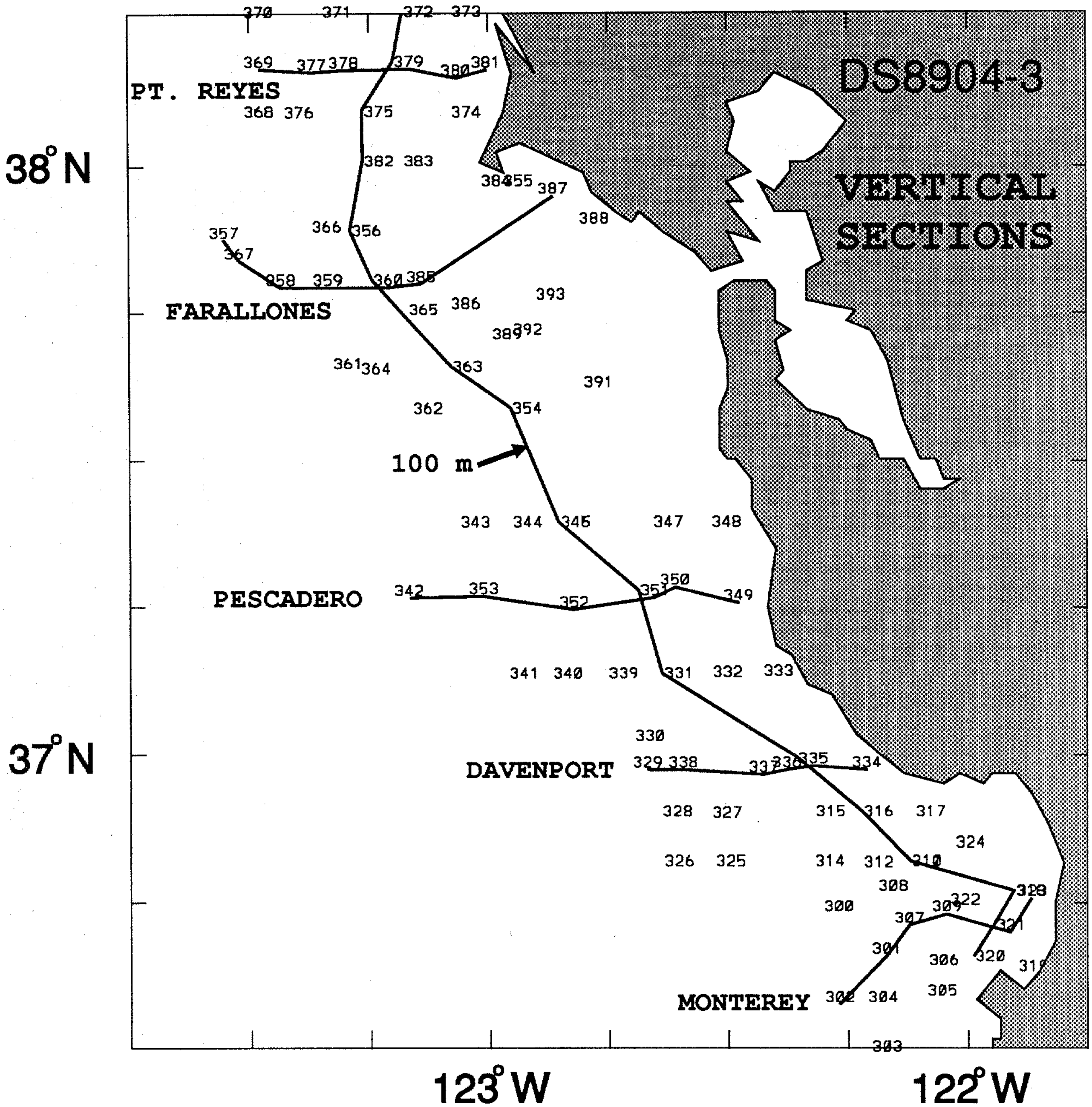
DS8904-3
TEMP
26.0
ISOPYCNAL
38°N
37°N
123°W
122°W
9.6
10.2
10.2
10.2
10.2
11.4
10.8
9.6
9.6
10.2

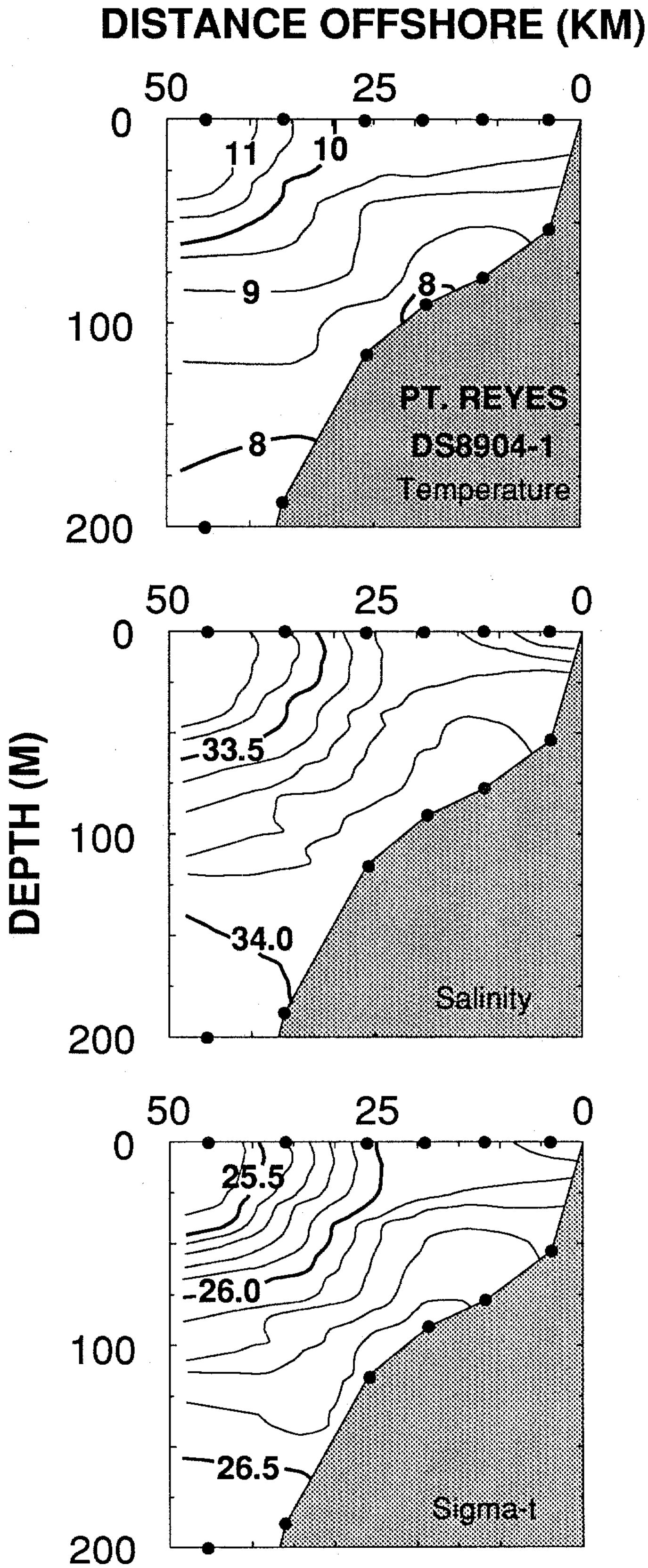

DS8904-3
SALINITY
26.0
ISOPYCNAL
33.8
33.8
33.8
33.8
34.
34.
38° N
37° N
123° W
122° W

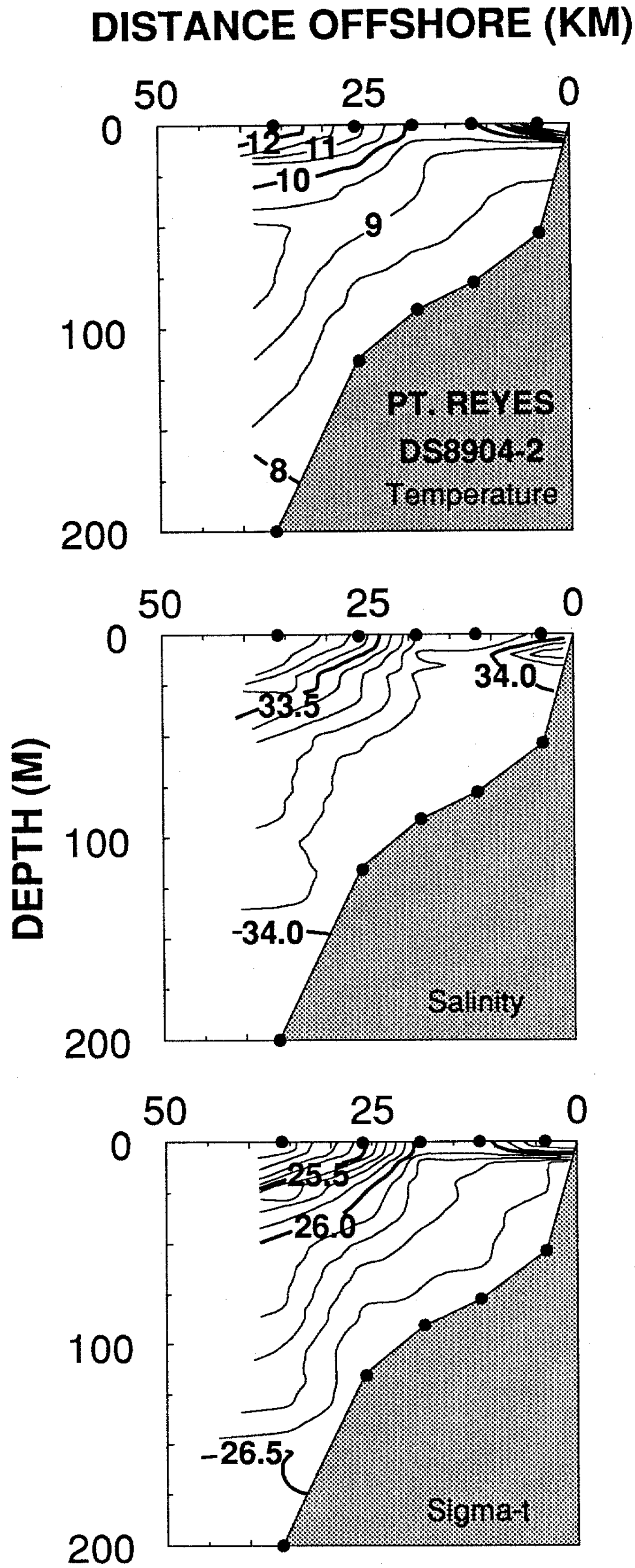
APPENDIX 5: VERTICAL TRANSECTS

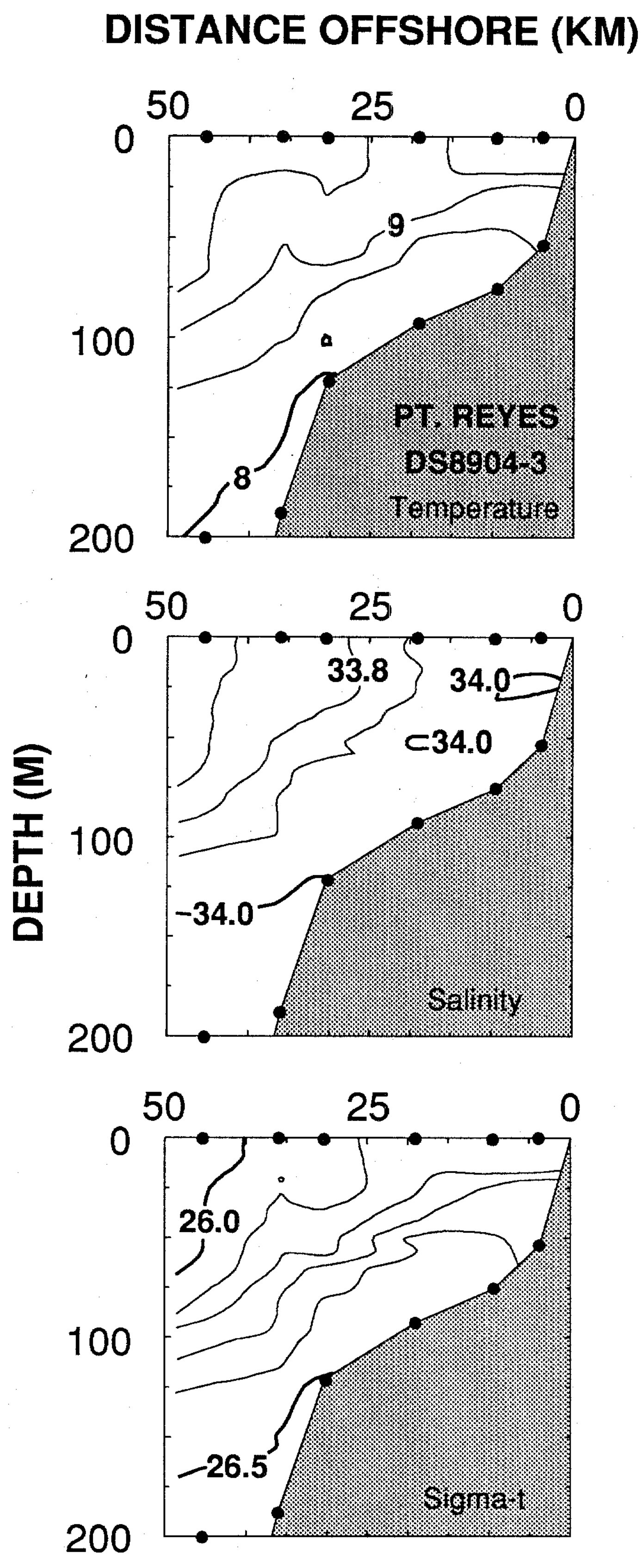

DS8904-1
VERTICAL SECTIONS
PT. REYES
FARALLONES
PESCADERO
DAVENPORT
MONTEREY
100 m
38° N
37° N
123° W
122° W

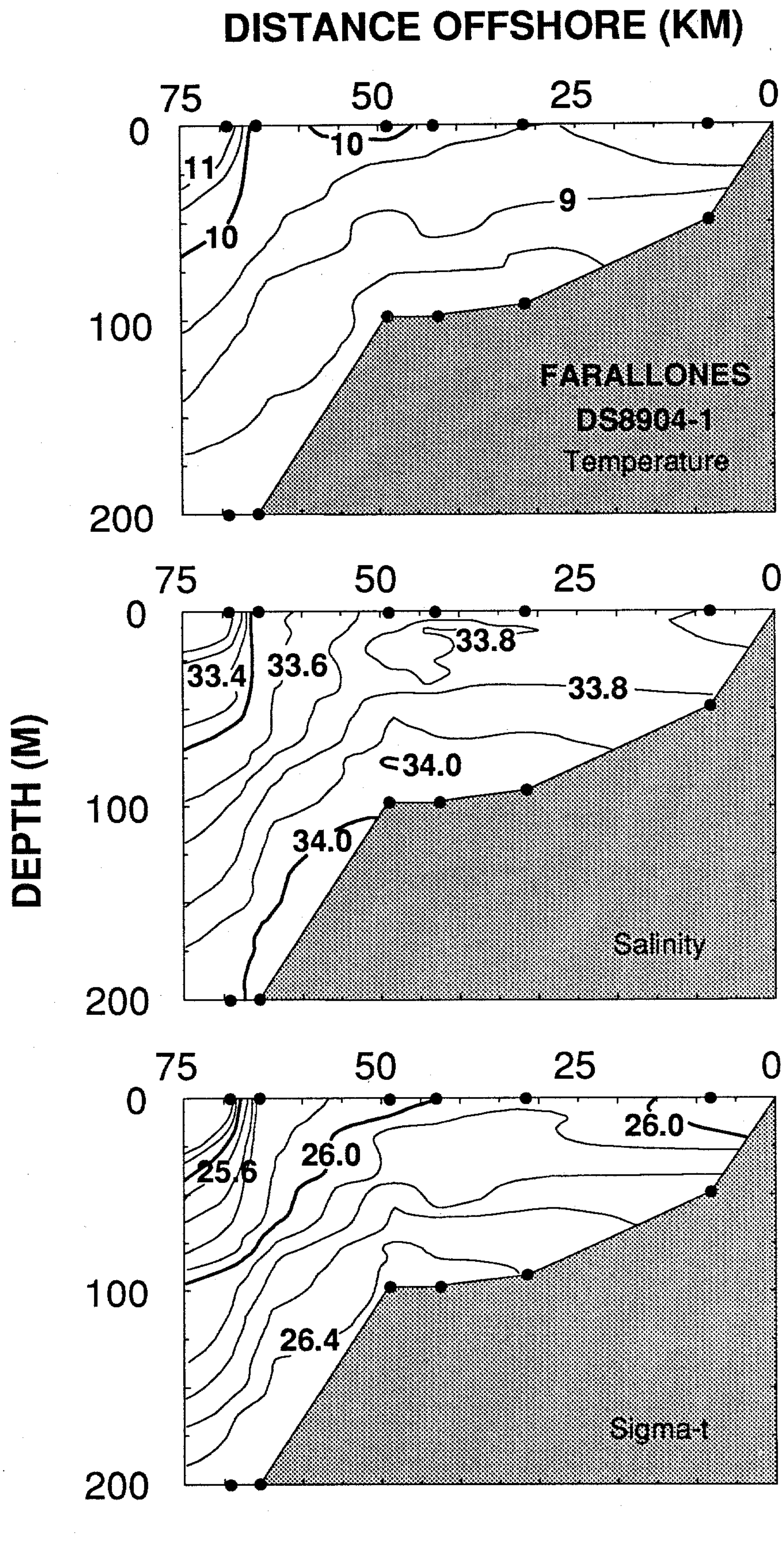

DS8904-2
VERTICAL SECTIONS
PT. REYES
FARALLONES
PESCADERO
DAVENPORT
MONTEREY
100 m
38° N
37° N
123° W
122° W

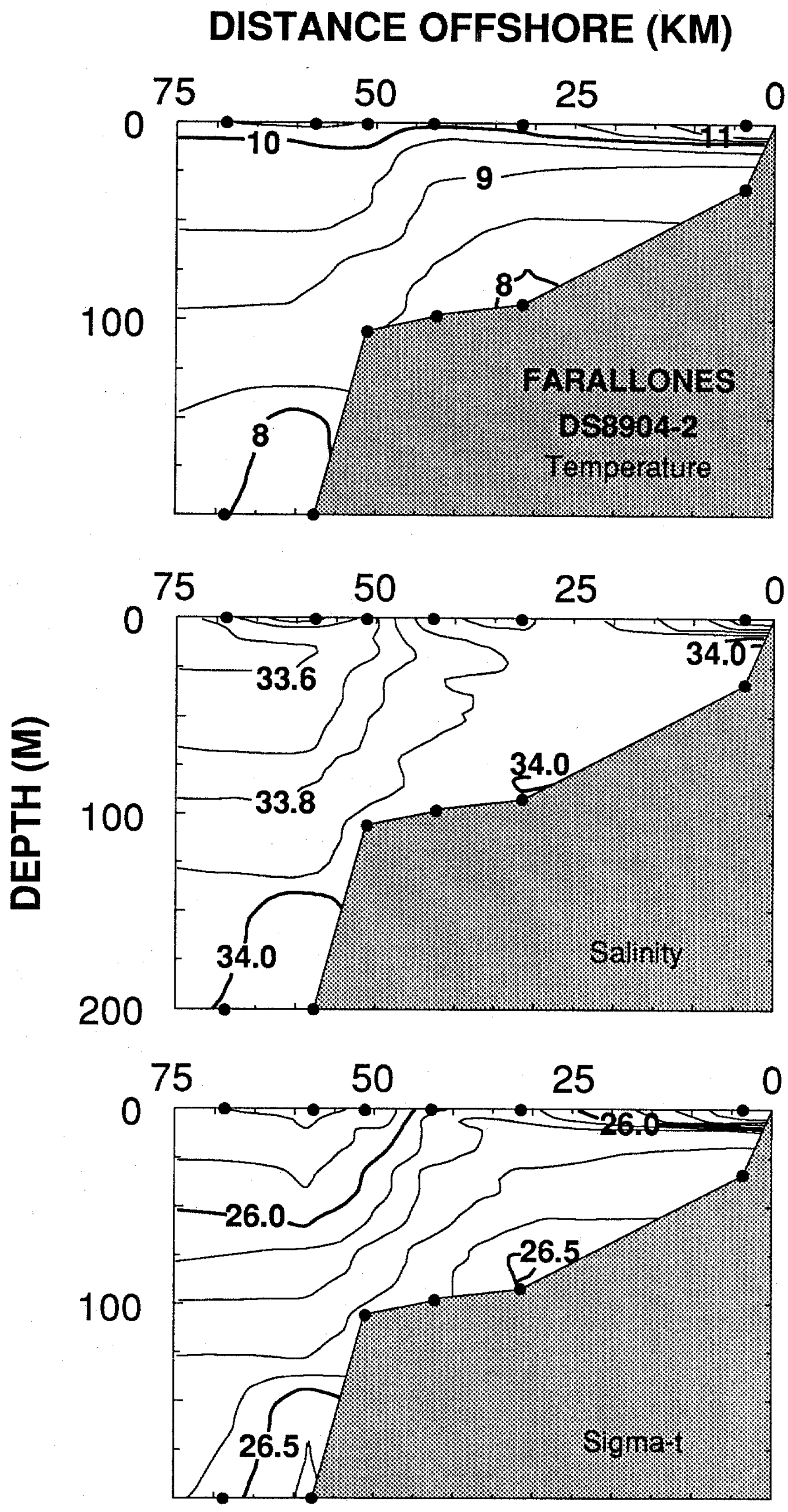

DS8904-3
VERTICAL SECTIONS
PT. REYES
FARALLONES
PESCADERO
DAVENPORT
MONTEREY
100 m
38°N
37°N
123°W
122°W


DISTANCE OFFSHORE (KM)
DEPTH (M)
50
25
0
100
200
11
10
9
8
PT. REYES
DS8904-1
Temperature
33.5
34.0
Salinity
25.5
26.0
26.5
Sigma-t

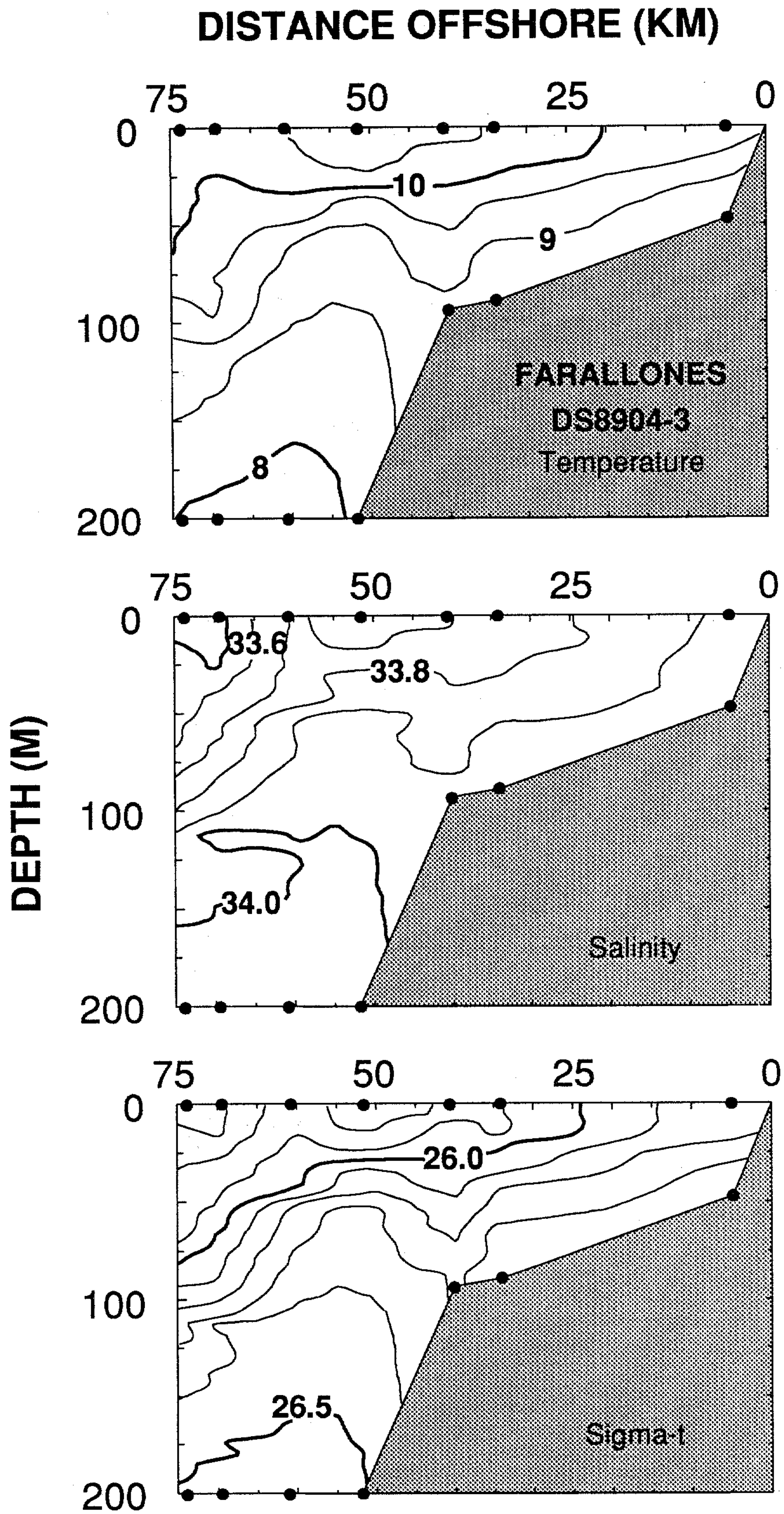

DISTANCE OFFSHORE (KM)
50
25
0
0
100
200
12
11
10
9
8
PT. REYES
DS8904-2
Temperature
DEPTH (M)
33.5
34.0
34.0
Salinity
25.5
26.0
26.5
Sigma-t

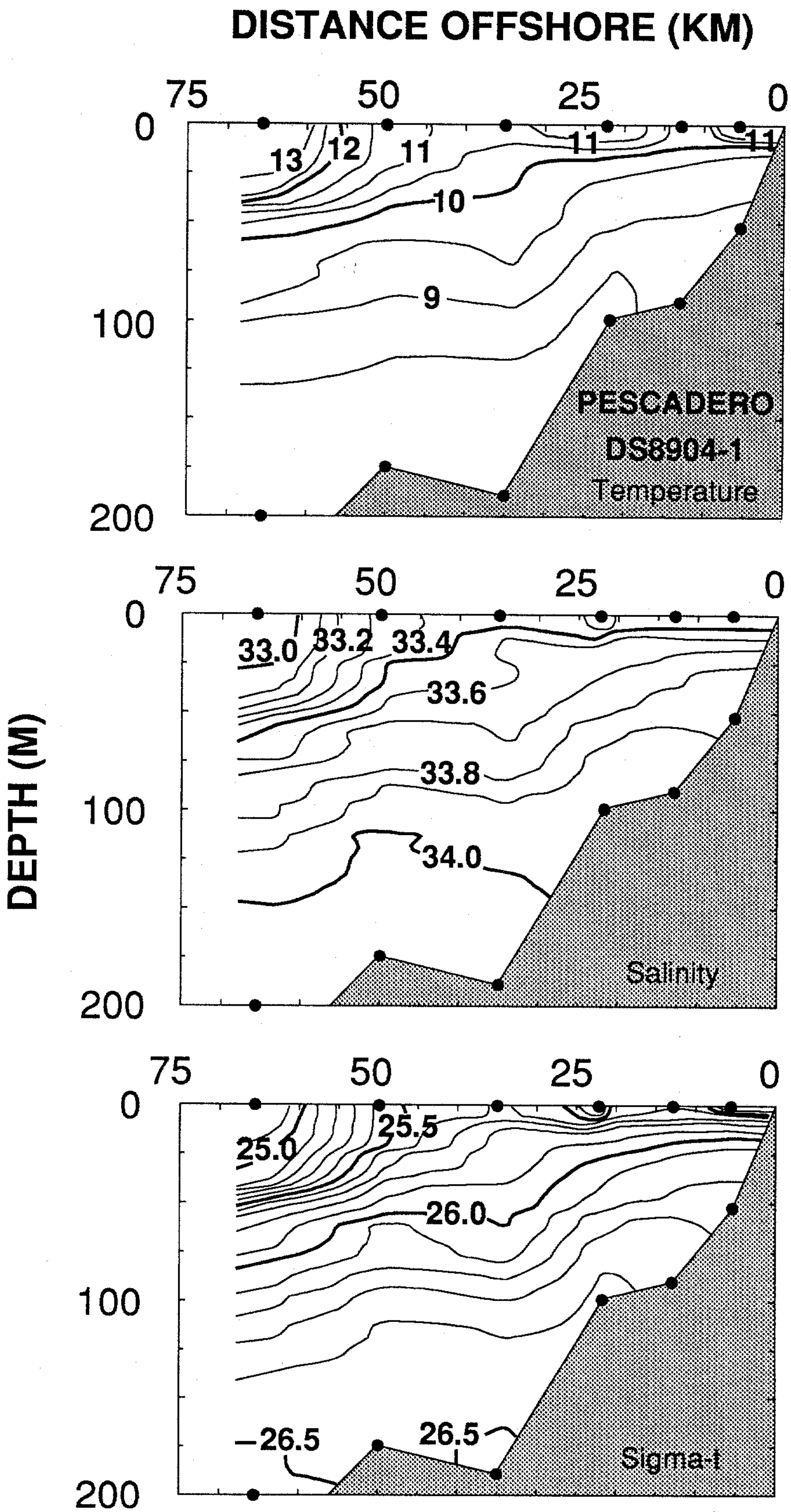

DISTANCE OFFSHORE (KM)
DEPTH (M)
50
25
0
100
200
9
8
PT. REYES
DS8904-3
Temperature
33.8
34.0
34.0
34.0
Salinity
26.0
26.5
Sigma-t

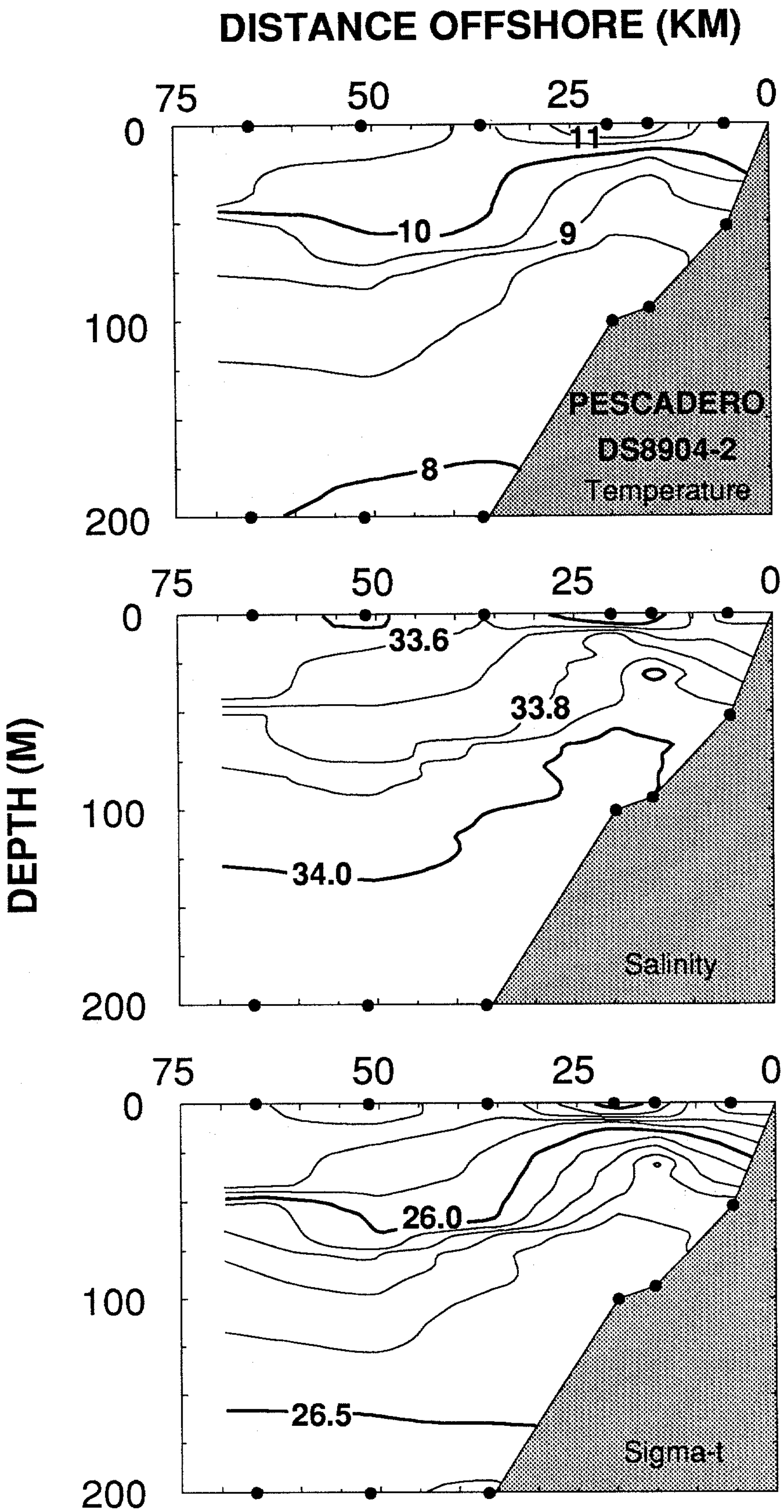

DISTANCE OFFSHORE (KM)
DEPTH (M)
75
50
25
0
100
200
11
10
9
FARALLONES
DS8904-1
Temperature
33.4
33.6
33.8
34.0
Salinity
25.6
26.0
26.4
Sigma-t

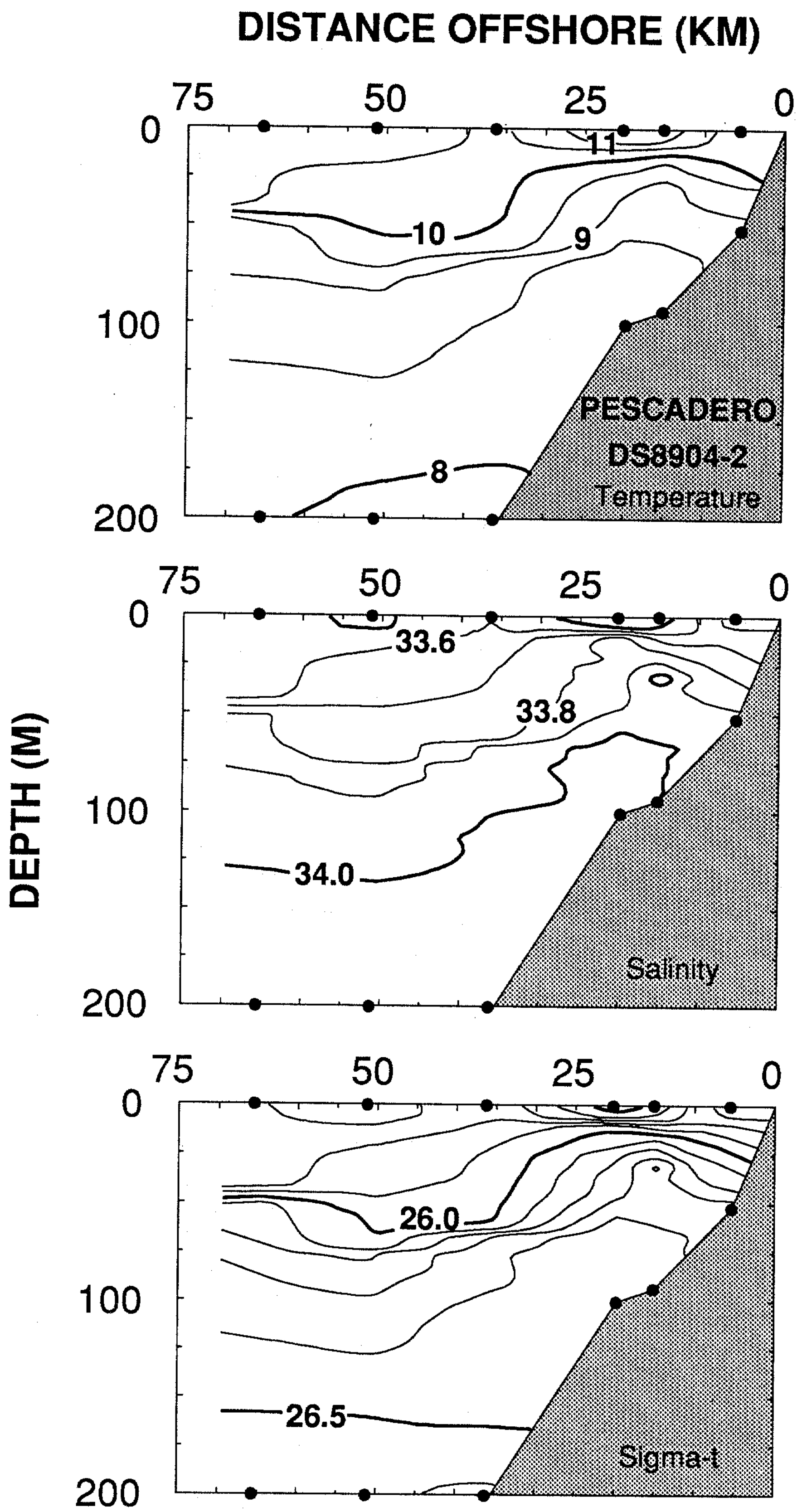


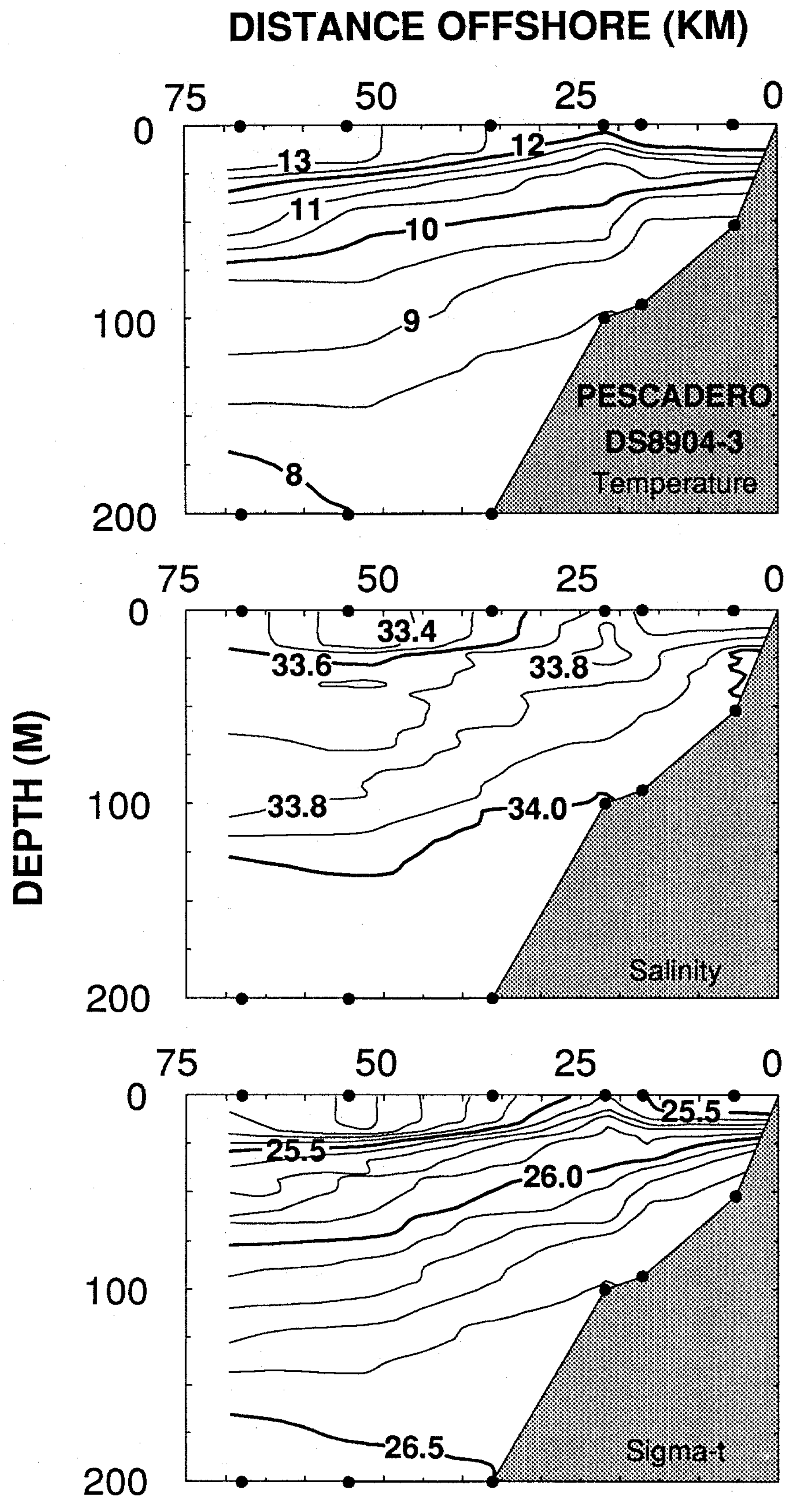
DISTANCE OFFSHORE (KM)
75
50
25
0
0
100
10
11
9
8
8
FARALLONES
DS8904-2
Temperature
75
50
25
0
0
100
200
33.6
34.0
34.0
33.8
34.0
Salinity
DEPTH (M)
75
50
25
0
0
100
26.0
26.0
26.5
26.5
Sigma-t

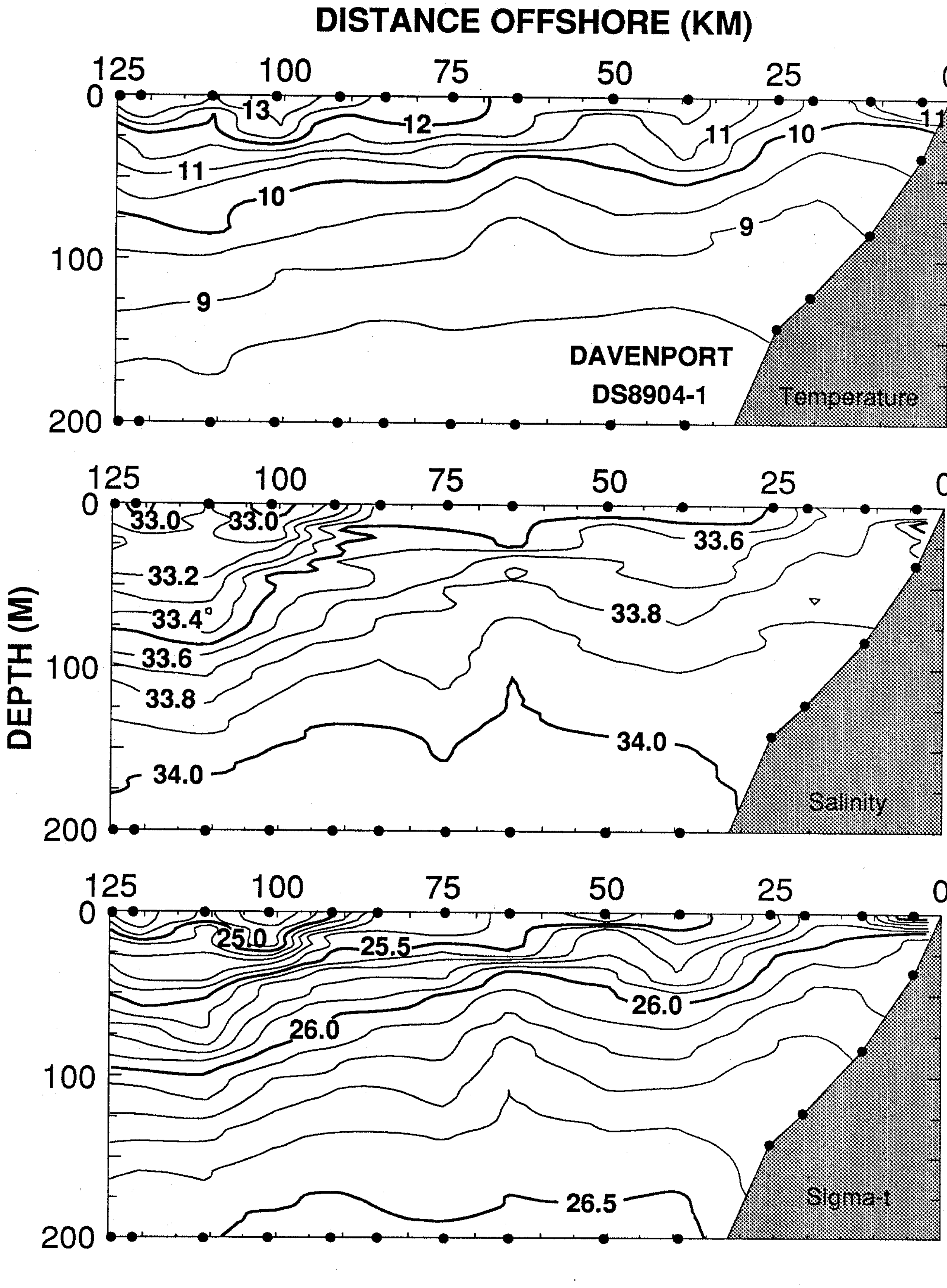

DISTANCE OFFSHORE (KM)
DEPTH (M)
75
50
25
0
0
100
200
10
9
8
FARALLONES
DS8904-3
Temperature
33.6
33.8
34.0
Salinity
26.0
26.5
Sigma-t

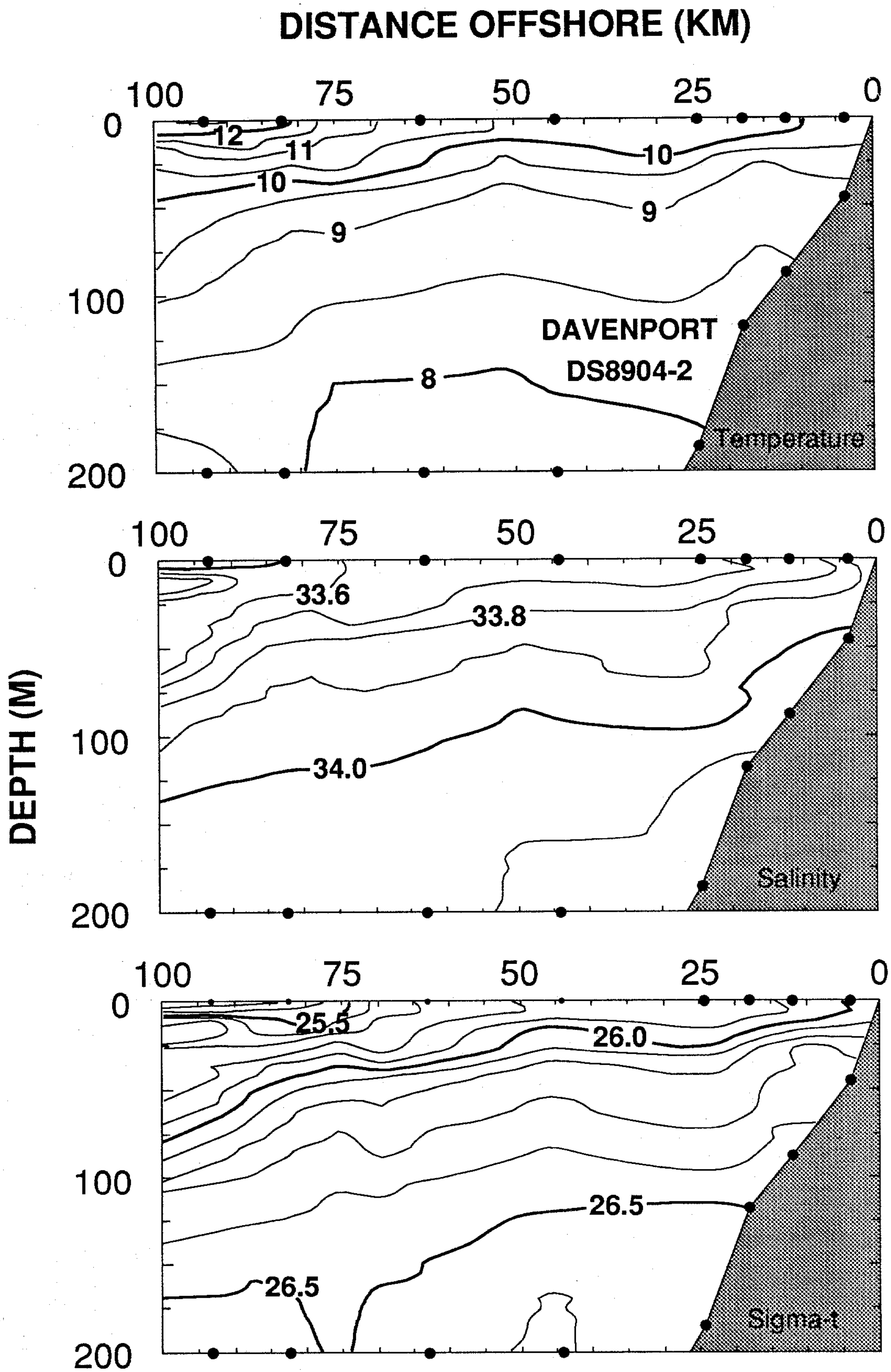

DISTANCE OFFSHORE (KM)
DEPTH (M)
PESCADERO
DS8904-1
Temperature
Salinity
Sigma-t

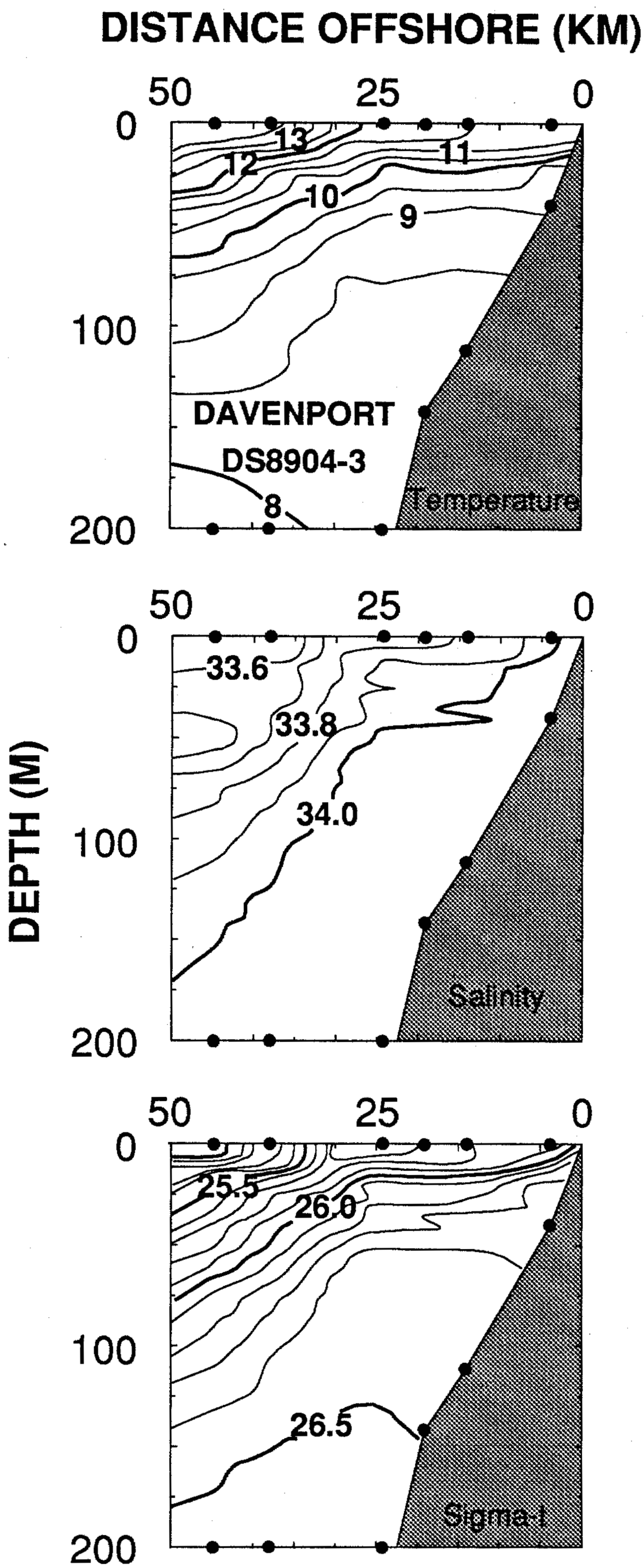

DISTANCE OFFSHORE (KM)
DEPTH (M)
75
50
25
0
100
200
11
10
9
8
PESCADERO
DS8904-2
Temperature
33.6
33.8
34.0
Salinity
26.0
26.5
Sigma-t

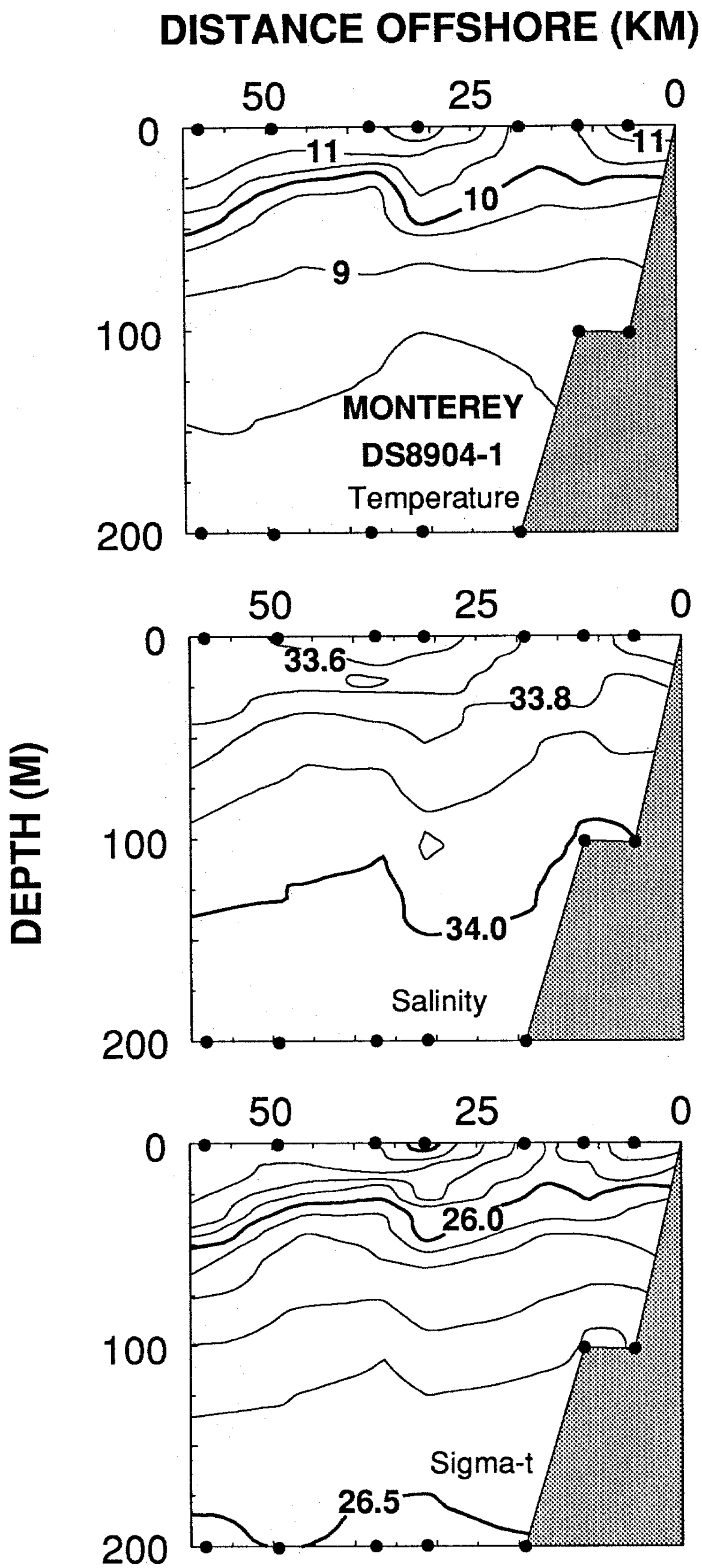

DISTANCE OFFSHORE (KM)
DEPTH (M)
75
50
25
0
0
100
200
11
10
9
8
PESCADERO
DS8904-2
Temperature
33.6
33.8
34.0
Salinity
26.0
26.5
Sigma-t

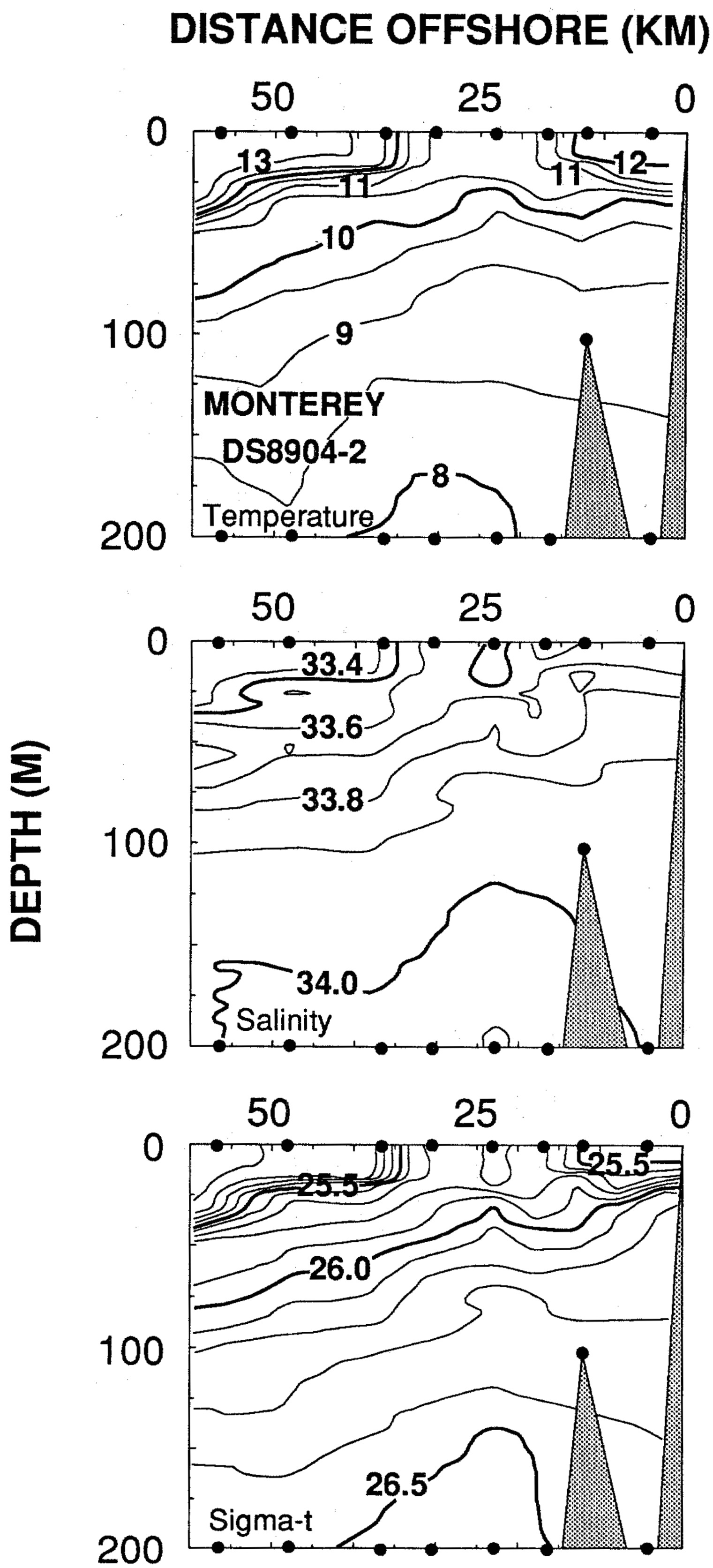

DISTANCE OFFSHORE (KM)
DEPTH (M)
75
50
25
0
0
100
200
13
12
11
10
9
8
PESCADERO
DS8904-3
Temperature
33.4
33.6
33.8
33.8
34.0
Salinity
25.5
25.5
26.0
26.5
Sigma-t

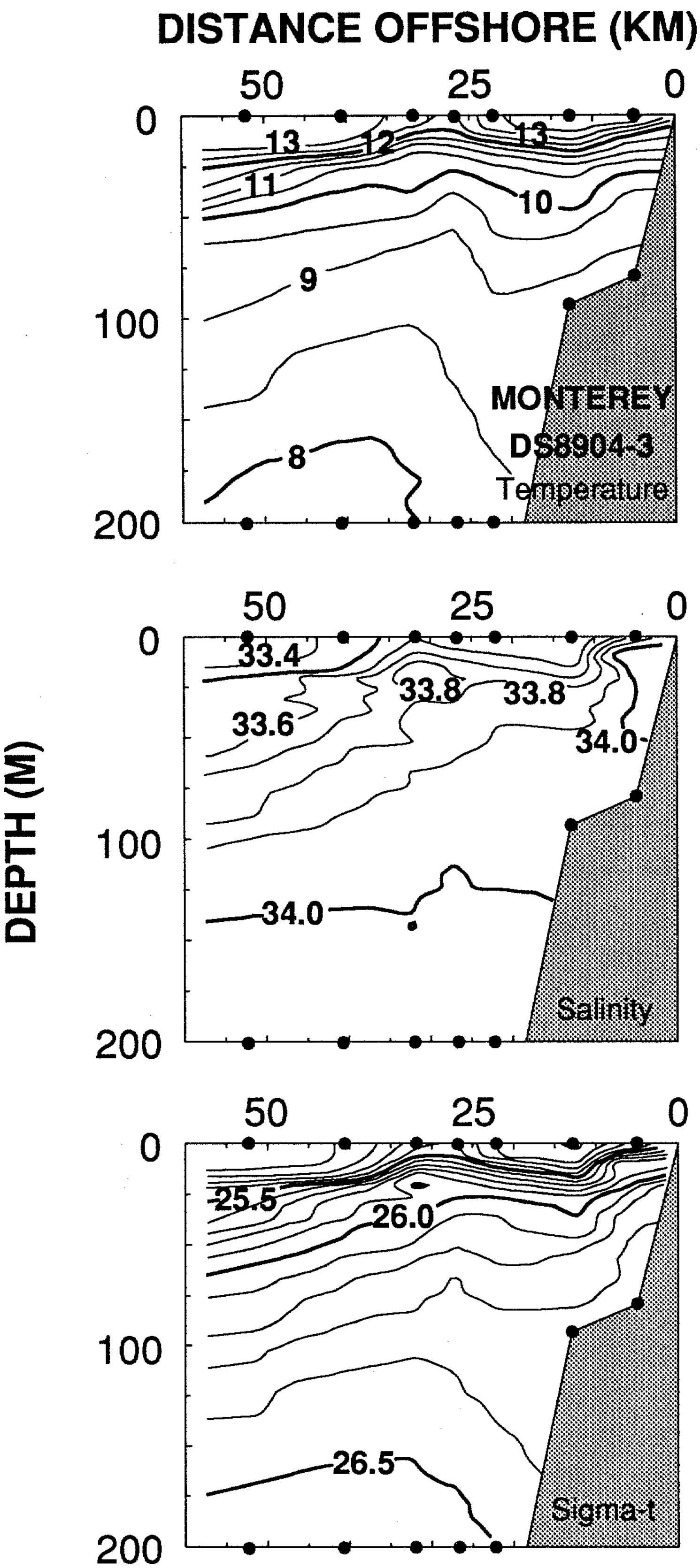

DISTANCE OFFSHORE (KM)
DEPTH (M)
125
100
75
50
25
0
200
13
12
11
10
9
DAVENPORT
DS8904-1
Temperature
33.0
33.2
33.4
33.6
33.8
34.0
Salinity
25.0
25.5
26.0
26.5
Sigma-t


DISTANCE OFFSHORE (KM)
DEPTH (M)
100
75
50
25
0
0
100
200
12
11
10
10
9
9
8
DAVENPORT
DS8904-2
Temperature
33.6
33.8
34.0
Salinity
25.5
26.0
26.5
26.5
Sigma-t

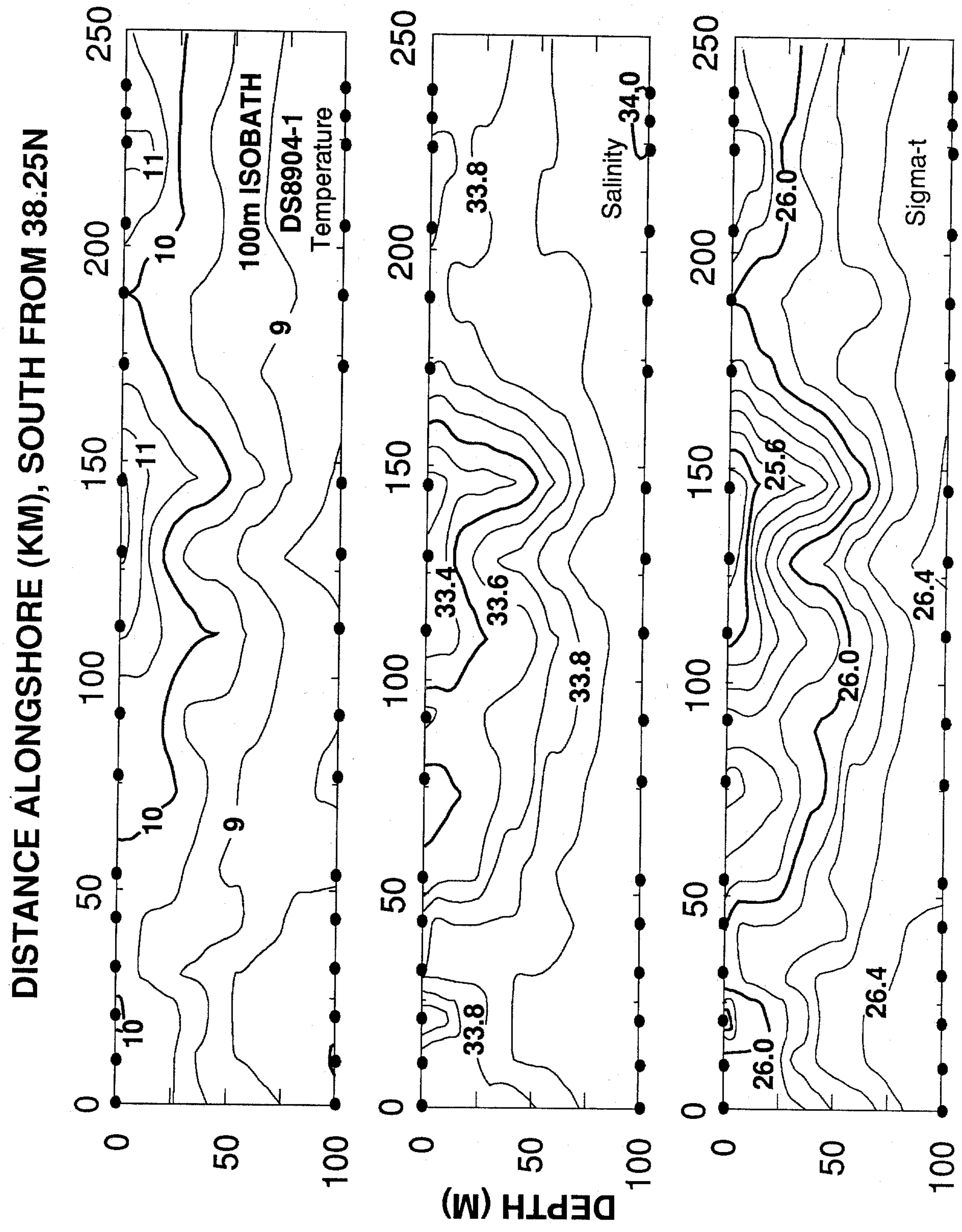

DISTANCE OFFSHORE (KM)
50
25
0
0
100
200
13
12
11
10
9
8
DAVENPORT
DS8904-3
Temperature
50
25
0
0
100
200
33.6
33.8
34.0
Salinity
DEPTH (M)
50
25
0
0
100
200
25.5
26.0
26.5
Sigma-t

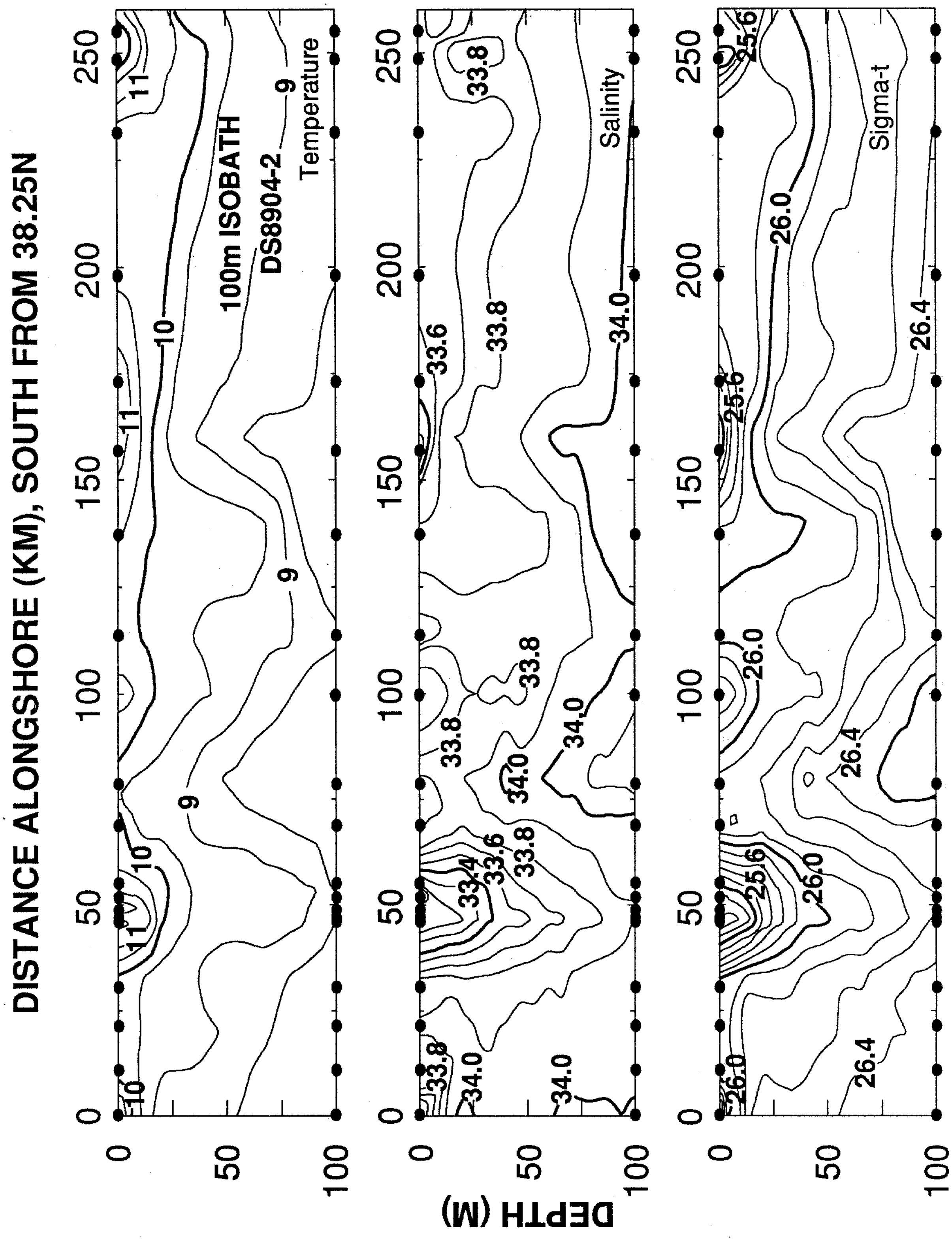

DISTANCE OFFSHORE (KM)
DEPTH (M)
MONTEREY
DS8904-1
Temperature
11
10
9
Salinity
33.6
33.8
34.0
Sigma-t
26.0
26.5


DISTANCE OFFSHORE (KM)
DEPTH (M)
50
25
0
0
100
200
13
11
11
12
10
9
8
MONTEREY
DS8904-2
Temperature
33.4
33.6
33.8
34.0
Salinity
25.5
25.5
26.0
26.5
Sigma-t

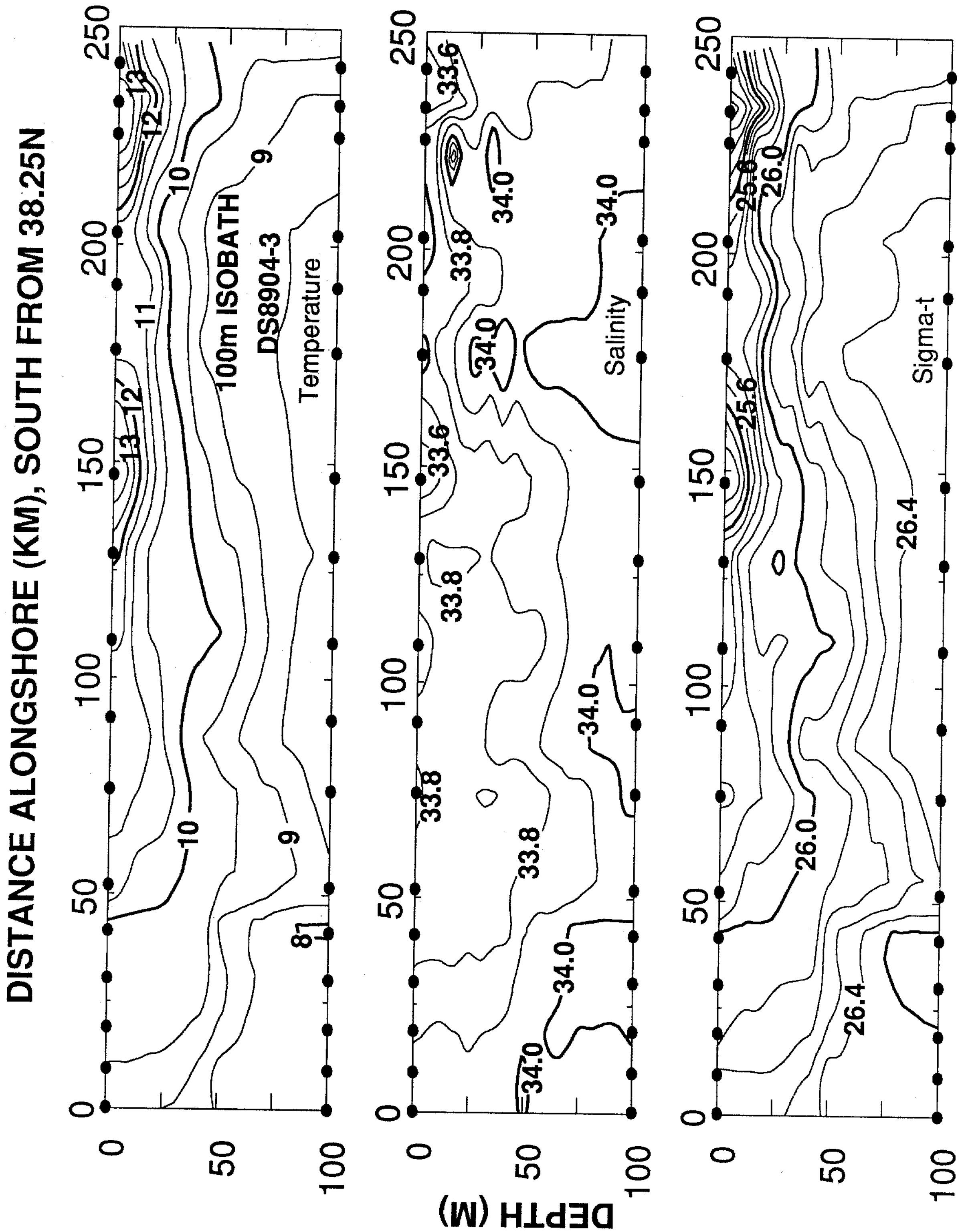


DISTANCE OFFSHORE (KM)
50
25
0
DEPTH (M)
100
200
13
12
13
11
10
9
8
MONTEREY
DS8904-3
Temperature
33.4
33.8
33.8
33.6
34.0
34.0
Salinity
25.5
26.0
26.5
Sigma-t


DISTANCE ALONGSHORE (KM), SOUTH FROM 38.25N
DEPTH (M)
100m ISOBATH
DS8904-1
Temperature
Salinity
Sigma-t
0
50
100
150
200
250
9
10
11
33.4
33.6
33.8
34.0
25.6
26.0
26.4

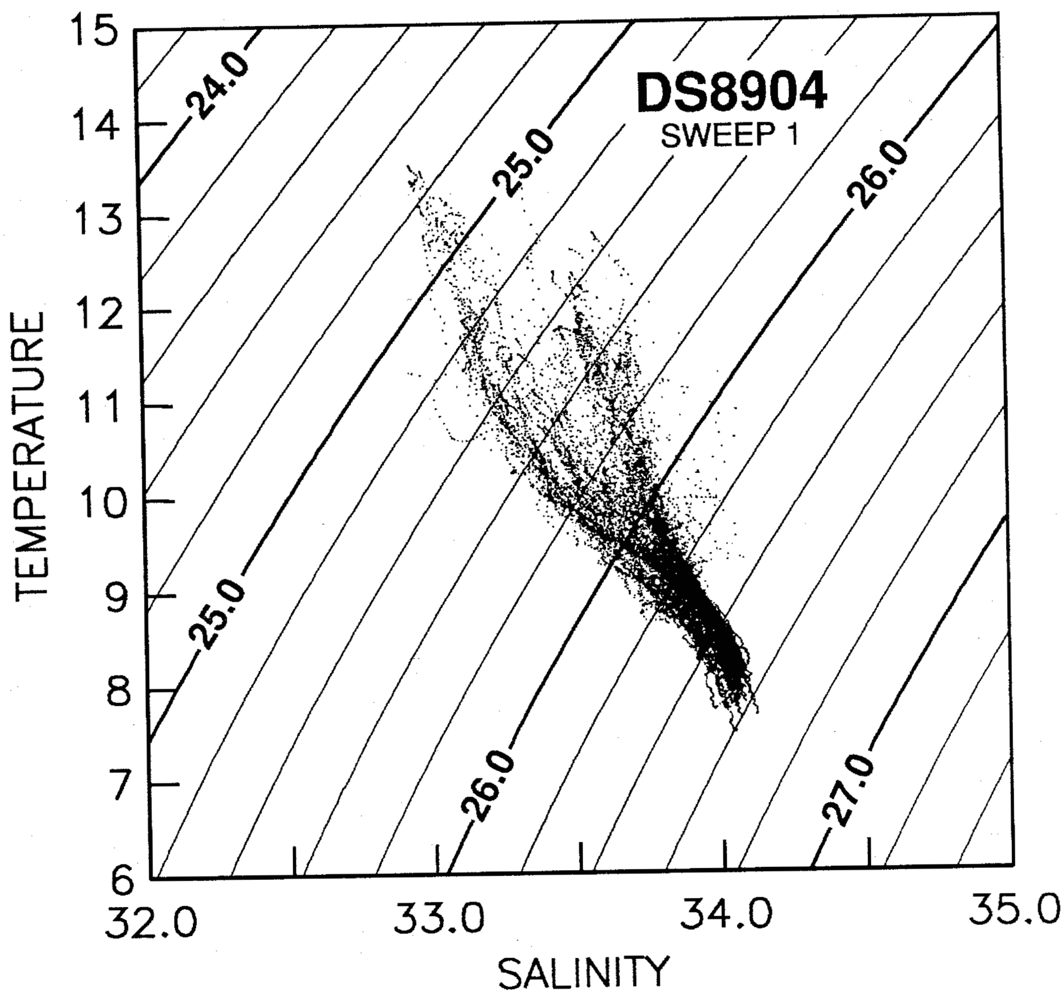


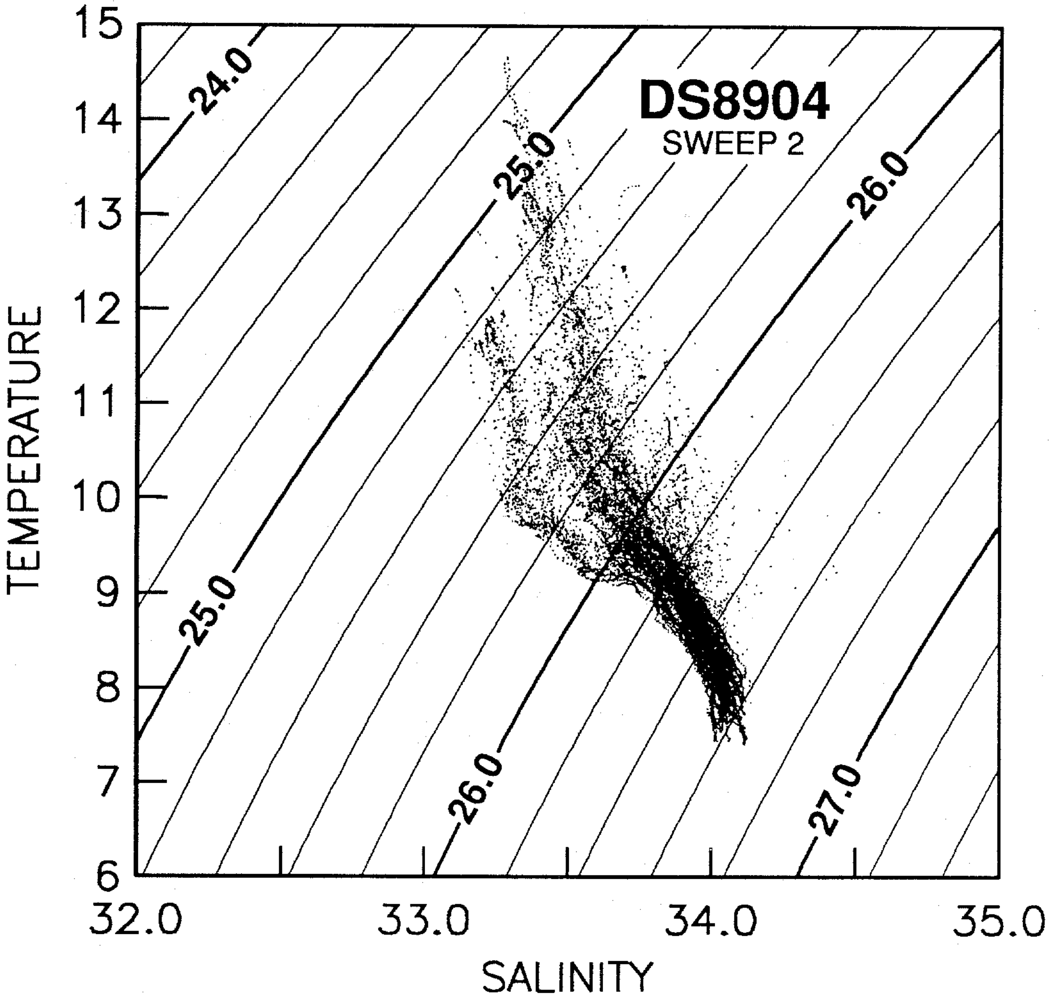
DISTANCE ALONGSHORE (KM), SOUTH FROM 38.25N
DEPTH (M)
100m ISOBATH
DS8904-2
Temperature
Salinity
Sigma-t

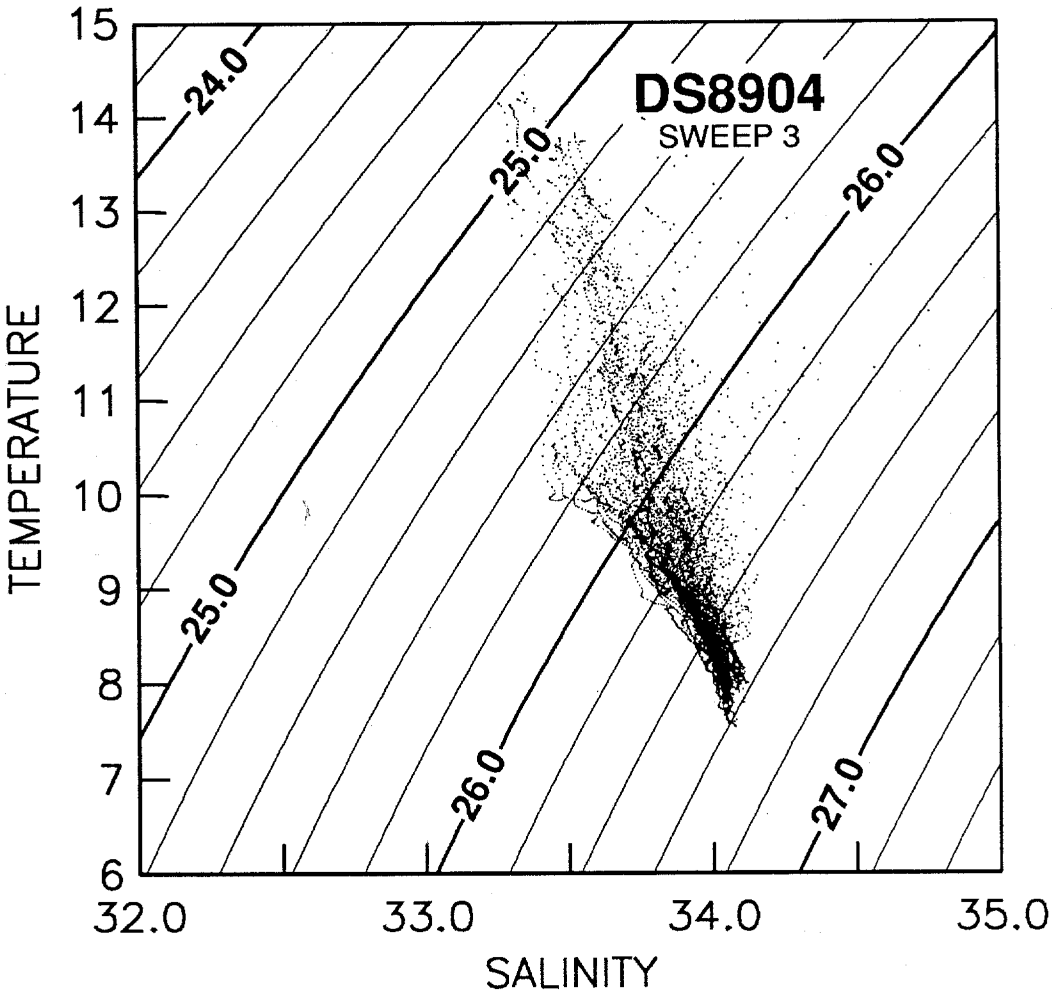


DISTANCE ALONGSHORE (KM), SOUTH FROM 38.25N
100m ISOBATH
DS8904-3
Temperature
Salinity
Sigma-t
DEPTH (M)
0
50
100
150
200
250
13
12
11
10
9
8
33.6
33.8
34.0
25.6
26.0
26.4

APPENDIX 6: TEMPERATURE-SALINITY PLOTS


DS8904
SWEEP 1
TEMPERATURE
SALINITY
24.0
25.0
25.0
26.0
26.0
27.0
15
14
13
12
11
10
9
8
7
6
32.0
33.0
34.0
35.0


DS8904
SWEEP 2
24.0
25.0
25.0
26.0
26.0
27.0
15
14
13
12
11
10
9
8
7
6
TEMPERATURE
32.0
33.0
34.0
35.0
SALINITY


DS8904
SWEEP 3
TEMPERATURE
SALINITY
15
14
13
12
11
10
9
8
7
6
32.0
33.0
34.0
35.0
24.0
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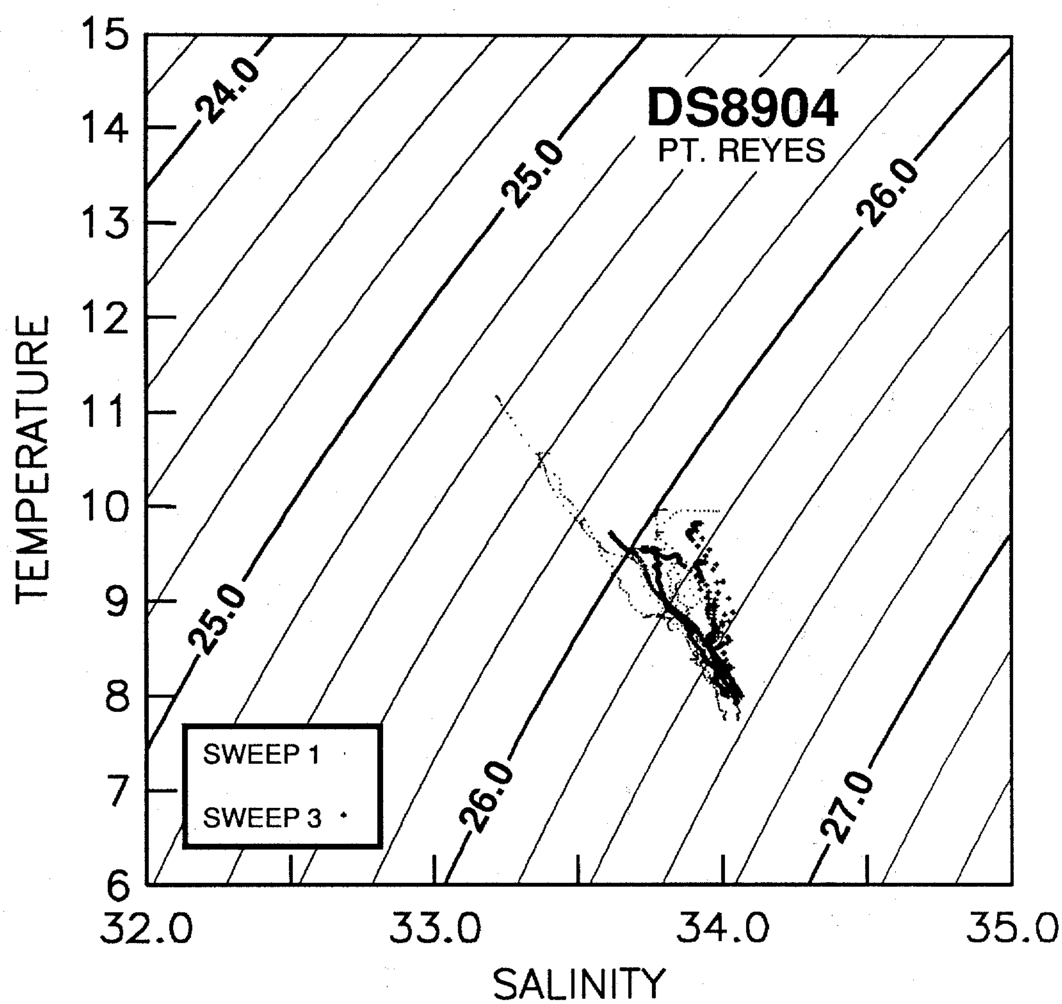
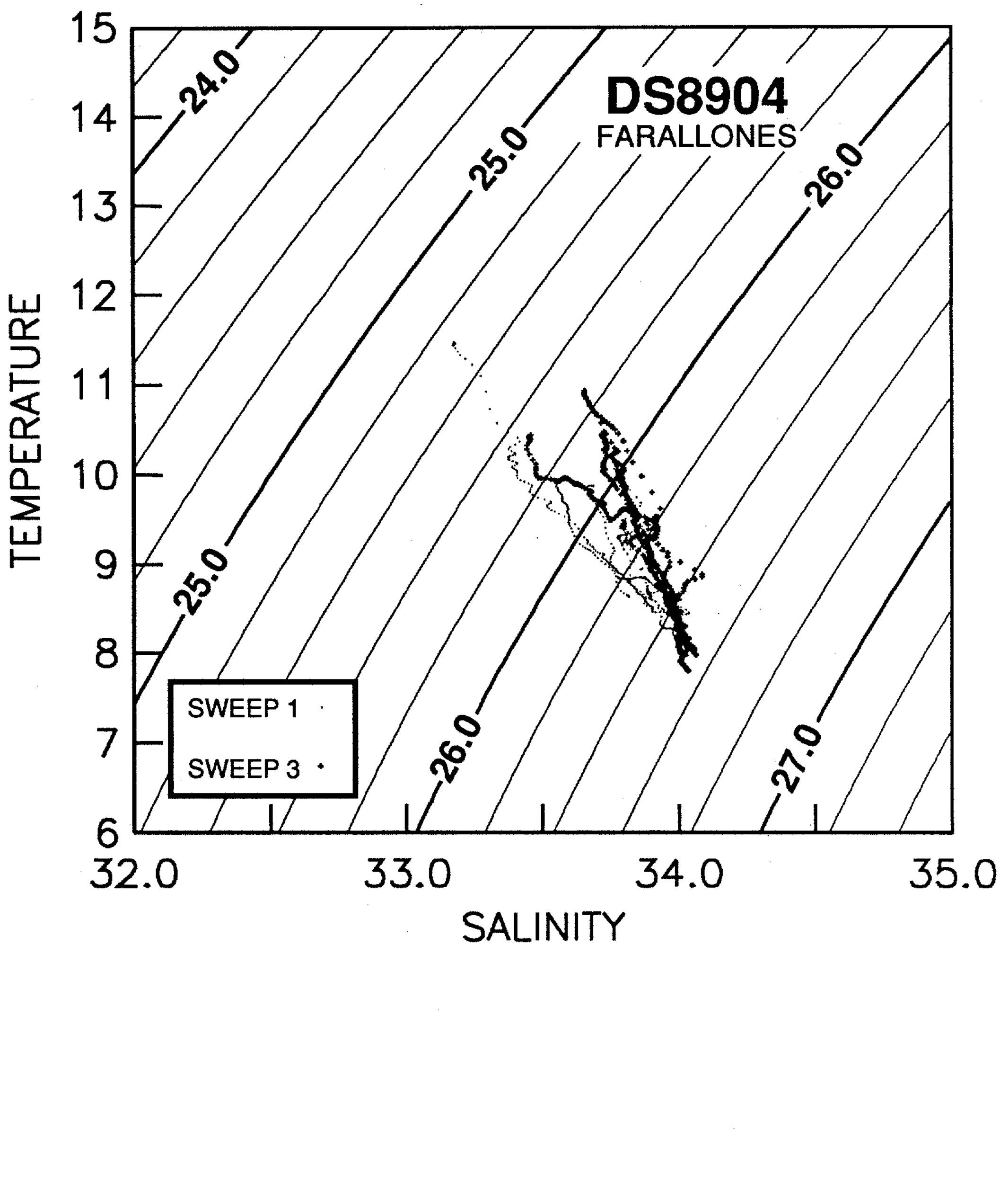
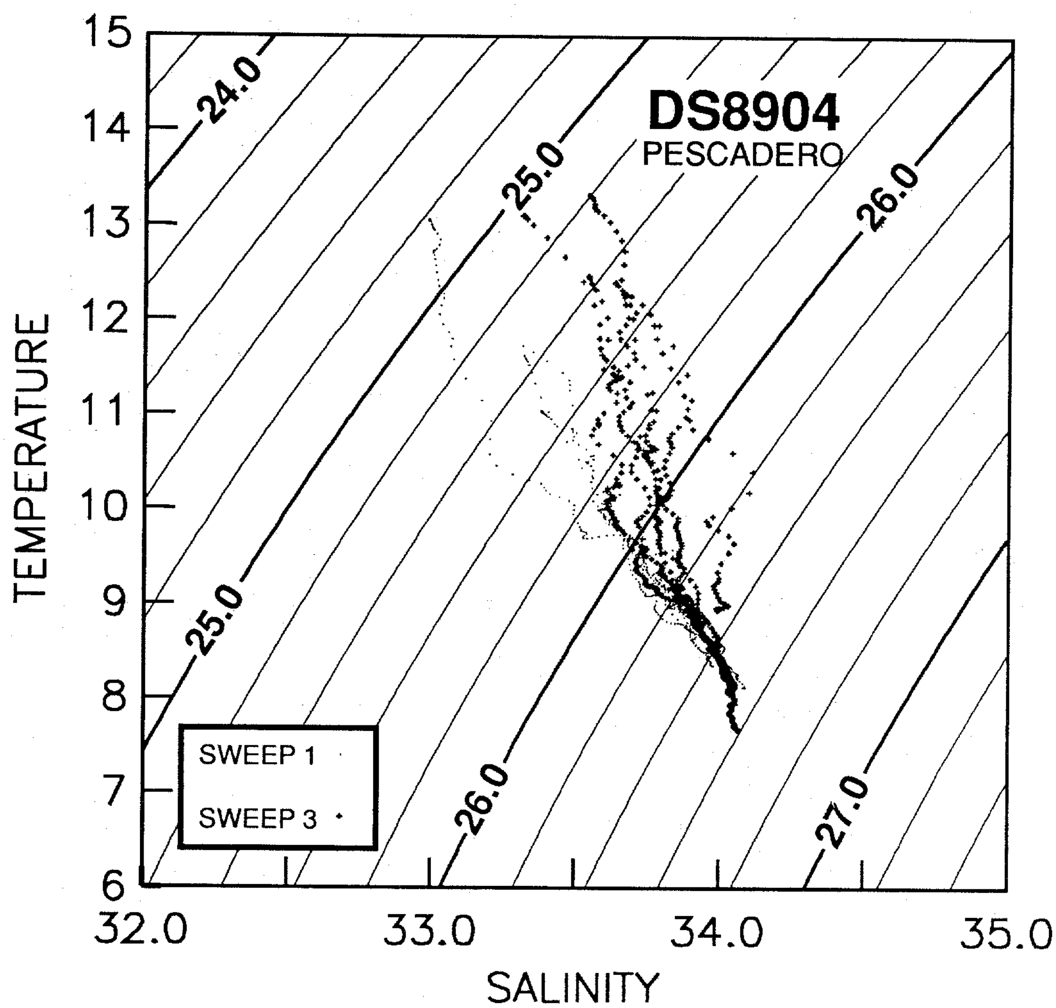
25.0
26.0
26.0
27.0

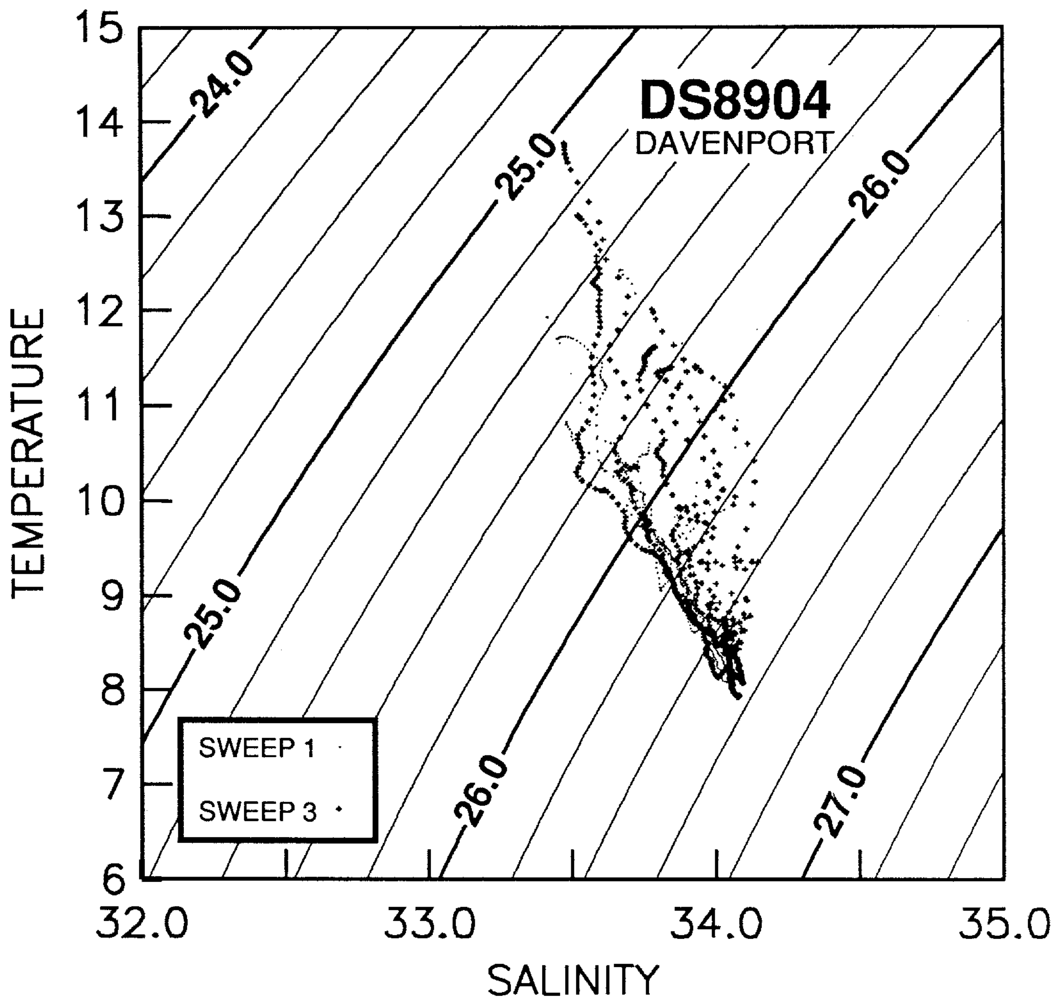


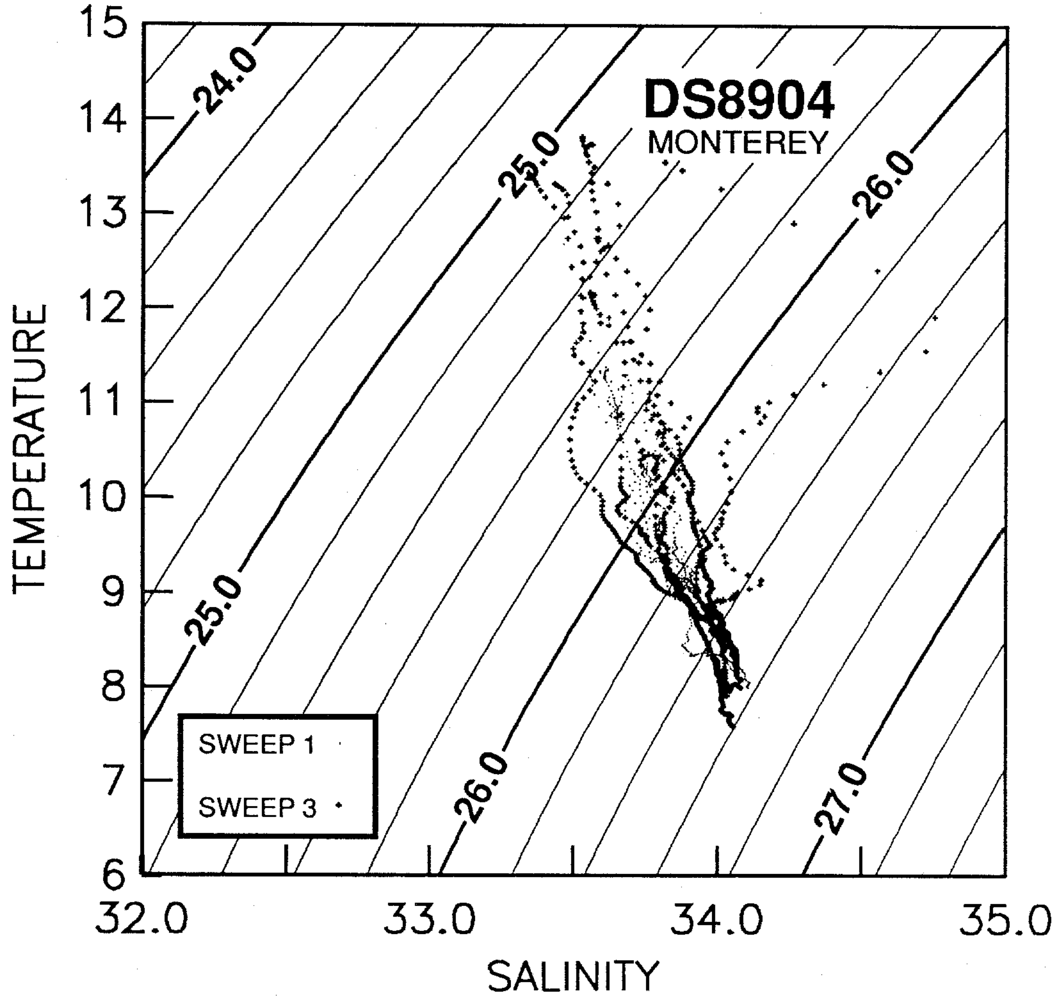
DS8904
PT. REYES
TEMPERATURE
SALINITY
15
14
13
12
11
10
9
8
7
6
32.0
33.0
34.0
35.0
24.0
25.0
26.0
27.0
SWEEP 1
SWEEP 3

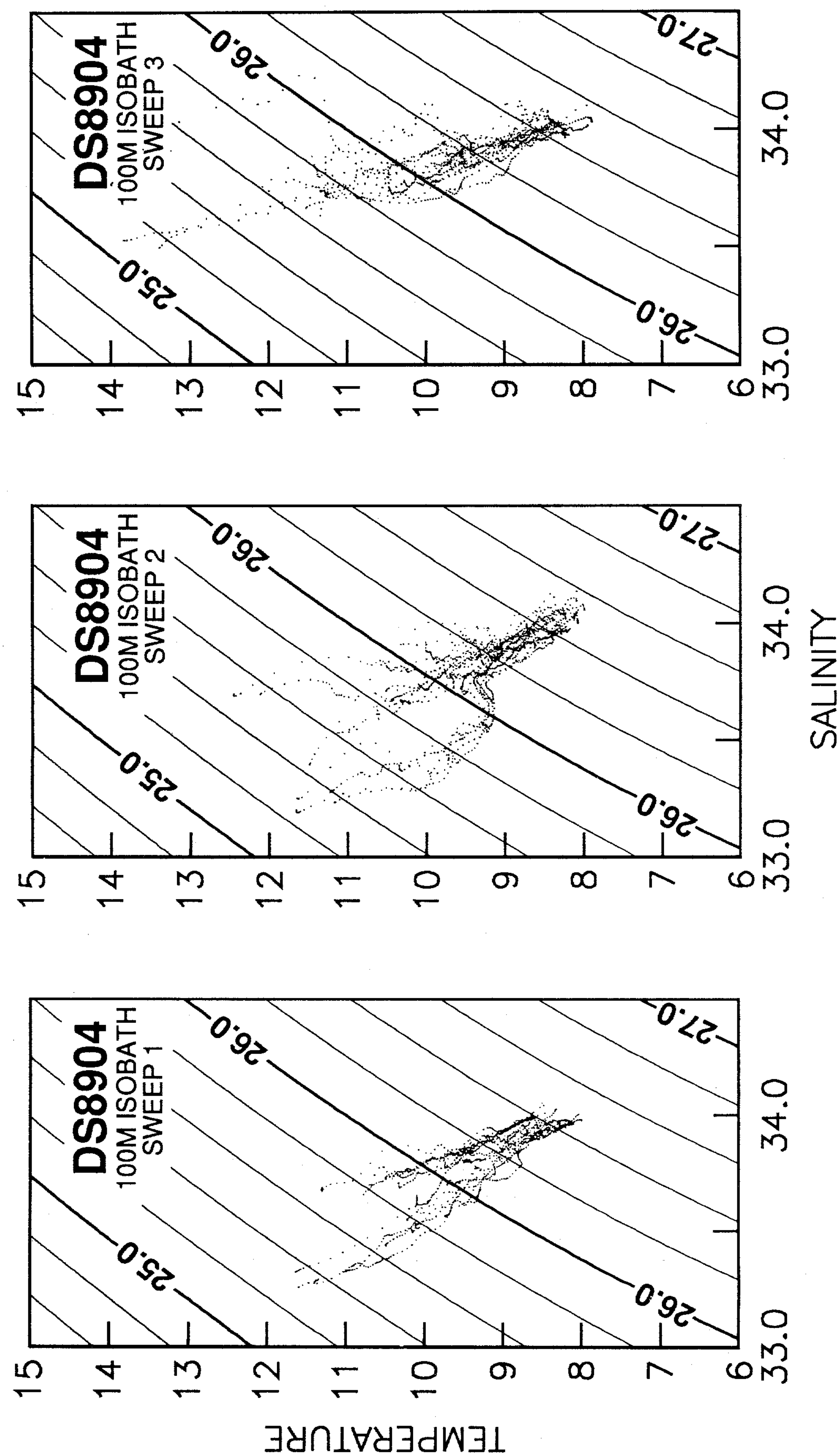

DS8904
FARALLONES
24.0
25.0
26.0
25.0
26.0
27.0
SWEEP 1
SWEEP 3
15
14
13
12
11
10
9
8
7
6
TEMPERATURE
32.0
33.0
34.0
35.0
SALINITY

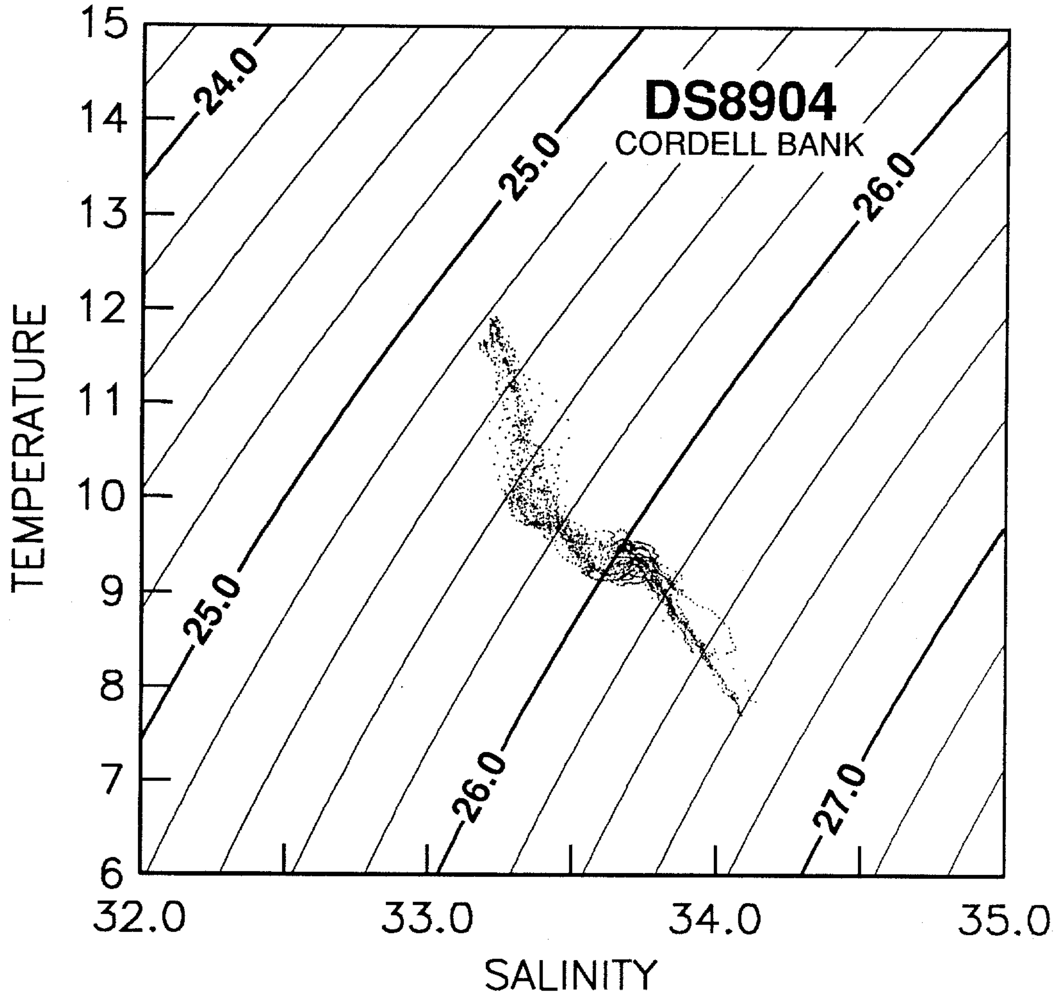


DS8904
PESCADERO
24.0
25.0
25.0
26.0
26.0
27.0
SWEEP 1
SWEEP 3
15
14
13
12
11
10
9
8
7
6
TEMPERATURE
32.0
33.0
34.0
35.0
SALINITY


DS8904
DAVENPORT
24.0
25.0
25.0
26.0
26.0
27.0
SWEEP 1
SWEEP 3
15
14
13
12
11
10
9
8
7
6
TEMPERATURE
32.0
33.0
34.0
35.0
SALINITY


DS8904
MONTEREY
TEMPERATURE
SALINITY
15
14
13
12
11
10
9
8
7
6
32.0
33.0
34.0
35.0
24.0
25.0
25.0
26.0
26.0
27.0
SWEEP 1
SWEEP 3


DS8904
100M ISOBATH
SWEEP 1
DS8904
100M ISOBATH
SWEEP 2
DS8904
100M ISOBATH
SWEEP 3
25.0
26.0
26.0
27.0
TEMPERATURE
SALINITY
15
14
13
12
11
10
9
8
7
6
33.0
34.0


DS8904
CORDELL BANK
TEMPERATURE
SALINITY
24.0
25.0
25.0
26.0
26.0
27.0
15
14
13
12
11
10
9
8
7
6
32.0
33.0
34.0
35.0

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