ASSESSMENT OF LONG-TERM CHANGES IN BIOLOGICAL COMMUNITIES IN THE SANTA MARIA BASIN AND WESTERN SANTA BARBARA CHANNEL - PHASE I

Volume II. Synthesis of Findings

SAIC

Science Applications International Corporation

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Volume II. Synthesis of Findings

Prepared by

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Prepared for

United States Department of the Interior
Minerals Management Service
Pacific OCS Region
1340 West Sixth Street
Los Angeles, CA 90017

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1.0 INTRODUCTION

This report presents the results, conclusions and recommendations from Phase I of a three phase program sponsored by U.S. Department of the Interior, Minerals Management Service (MMS), Pacific OCS Region, entitled "Assessment of Long-Term Changes in Biological Communities in the Santa Maria Basin and Western Santa Barbara Channel." The program was conducted by Science Applications International Corporation (SAIC; La Jolla, CA) along with subcontractors MBC Applied Environmental Sciences (MBC; Costa Mesa, CA), and EcoAnalysis, Inc. (Ojai, CA), from September 1983 to September 1985 under MMS Contract No. 14-12-001-30032 with SAIC. This program consisted of three primary tasks:

- Catalogue and statistically analyze data from previous benthic studies conducted in regions offshore southern and central California to determine the spatial and temporal variability of benthic macrofauna within and between major habitats, and bathymetric regimes (e.g., shelf and slope). This information was used in the development of monitoring recommendations, including the number of replicate samples necessary to detect specific levels of change in the benthos for Phase II monitoring studies.

- Identify sources and develop a directory of archived benthic macrofauna samples collected from the California OCS during previous studies; this information was intended as an aid in locating historical samples which may be useful for evaluating or comparing specimens collected during future studies in the region.

- Conduct a benthic reconnaissance survey of soft-bottom and hard-bottom areas of the Santa Maria Basin and western Santa Barbara Channel to (1) identify and map benthic habitats and biological assemblages, (2) describe and list any new species; (3) characterize existing sediment hydrocarbon, barium, and chromium levels, and (4) identify candidate sites and species for future long-term monitoring studies (Phase II).

- Additionally, SAIC recently conducted (April/May, 1985) a remotely operated vehicle (ROV) survey of selected hard-bottom areas of the Pt. Conception to Pt. Arguello region, focusing on high relief features that occur near Platforms Harvest, Hermosa, and Hidalgo, to provide supplementary baseline biological information. This task was not part of the original Phase I scope of work, and the analysis and interpretation of these data will be conducted as part of the Phase II program.

The Phase II-III program will consist of a multi-year monitoring program to evaluate long-term changes to benthic communities associated with oil and gas development in the study region, particularly as related to changes in sediment physical and chemical characteristics.

Results from the Phase I benthic reconnaissance survey program are presented in total in this report. The analysis of historical benthic data was submitted to MMS as a separate report prepared by SAIC and EcoAnalysis (dated 31 May 1984), and the directory of archived benthic samples also was submitted in a report prepared by SAIC and MBC (dated 21 March 1984). Results presented in these two previous reports are included, as appropriate, in this report along with discussions of results from the reconnaissance program, particularly as related to monitoring recommendations and taxonomic identifications, respectively.

Sections 1.1, 1.2, and 1.3 of this report present the program objectives and a summary of potential impacts associated with oil and gas development, previous studies, and an environmental overview of the study area, respectively. Methods and materials used during the field surveys, laboratory analyses, and data analyses for the reconnaissance program are detailed in Section 2. Section 3 contains results and discussions of data for the soft-bottom environment (Section 3.1) and the hard-bottom environment (Section 3.2) along with comparisons with historical data, summaries of bird and mammal observations and fishing activity observed during the surveys, and discussions of environmental sensitivity and recommendations for long-term monitoring. A summary of program results and conclusions relative to the program objectives are presented in Section 4. References cited in the report are listed in Section 5. In addition, station and transect locations, data methods, and summary data for the soft-bottom and hard-bottom surveys are presented in Appendices A through J. A summary of the information included in this

Synthesis of Findings (Volume II), is presented in the Executive Summary (Volume I).

1.1 PROGRAM OBJECTIVES AS RELATED TO SOURCES OF POTENTIAL IMPACTS

The U.S. Department of the Interior, Minerals Management Service is endowed with the authority, pursuant to the Outer Continental Shelf Lands Act, the Submerged Lands Act, and OCS Lands Amendments, to develop oil and gas resources on the outer continental shelf while providing for the protection of the marine and coastal environment. As part of this responsibility, MMS has sponsored numerous studies through the OCS Environmental Studies Program to develop sufficient baseline information for evaluating potential environmental impacts, including project specific and cumulative effects, resulting from OCS development. The present study was intended to provide baseline biological, chemical, and geological information for characterizing a broad region of the Santa Maria Basin and western Santa Barbara Channel that has been identified as the site of extensive, future oil and gas development. Exploratory drilling operations which occurred throughout the period of the present study have delineated many of these resources.

Present development plans for OCS waters in Santa Maria Basin and the western Santa Barbara Channel include:

- Exxon-Santa Ynez Unit: three new platforms with subsea pipelines in the Santa Ynez field off Gaviota;

- Chevron/Texaco-Pt. Arguello to Pt. Conception: three platforms with subsea pipelines leading to near Pt. Conception;
- Union/Exxon-Pt. Pedernales: two platforms with subsea pipeline off Pt. Pedernales;
- Cities Services-Pt. Sal: one platform with subsea pipeline to an onshore facility north of Pt. Sal.

Additionally, several developments requiring new platforms or re-drilling in State waters, including Arco-Coal Oil Pt., Union Oil-Cojo Bay, and Shell California-Molina, are presently in the planning or permit approval stages. Bureau of Land Management (1980), predicted that a total of 13 new platforms, 351 development wells, 52 exploratory wells, 2 subsea completions, and 16 miles of offshore pipeline would be installed in Santa Maria Basin between the years 1981 to 1993 as a result of Lease Sale 53. This development may result in discharges of approximately 500,000 bbls of cuttings, 200,000 bbls of spent drilling muds, 100 million bbls of formation waters, and 60,000 yd^3 of displaced sediments. An additional three new platforms and 119 wells in Santa Barbara Channel from Lease Sale 80 would produce an estimated 200,000 bbls of cuttings, 300,000 bbls of drilling muds, and 130 million bbls of produced waters and displace 96,000 yd^3 of bottom sediments (MMS, 1983).

The first of several planned production platforms (Platform Harvest) was installed in the Pt. Conception/Pt. Arguello region in Spring 1985. Thus, some initial development activities already have occurred in the study area, although installation of fixed platforms and production operations had not been initiated prior to completion of the soft-bottom and hard-bottom surveys for the reconnaissance program. Future monitoring studies (Phase II/III) will assess the long-term effects of continued exploration and production/ development activities in the study area.

Potential impacts to the benthos as considered in this report are related to discharge of drilling muds, cuttings, and produced water; pipeline and platform installation; and oil spills. Recent reviews of the potential impacts associated with OCS drilling and production operations (e.g., NRC, 1983; Boesch et al., 1985; Boehm, 1985; Payne et al., 1985; Menzie, 1982) indicate that most long-term (greater than two years) effects typically are associated with the benthic environment, while effects to the water column generally are localized and of short duration.

Water Column Effects

Routine discharges of drilling muds and cuttings from OCS oil and gas operations can contribute significantly to the mass input of petroleum hydrocarbons and trace metals to the water column. Predictions of the fate and effects of post-discharge concentrations of drilling mud constituents in the water column are particularly difficult because of the possible effects of variable current fields, density stratification, pre-discharge dilution, variable discharge rates, and variations in the composition and characteristics of the discharged material. However, results from previous monitoring programs consistently demonstrate rapid dispersion of drilling related discharges in OCS waters. Discharge plumes typically are diluted to background levels within a period of several hours and/or within several hundred meters of the discharge. Thus, operational discharges would not result in an accumulation of trace metals and hydrocarbons in receiving waters or long-term degradation of the water quality (Payne et al., 1985; NRC, 1983).

Discharges of produced waters represent an additional input source of trace metals and hydrocarbons to the water column. Similar to the drilling mud discharges, produced waters are diluted rapidly within the immediate vicinity of the discharge or diffuser. Minor, site-specific differences in dilution rates may reflect the density characteristics of the produced waters and the receiving waters, the local current regime, and wake effects. Nevertheless, significant increases in water concentrations of hydrocarbons and trace metals due to produced water discharges are not expected outside of the initial mixing zone. However, variable discharge volumes will be released continuously throughout the production phases of operation; thus long-term effects to water column processes, consisting of localized increases in particulate metal and soluble lower molecular weight aromatic hydrocarbons, may occur within the mixing zone of the discharge. In addition, trace metals and hydrocarbons associated with the discharge may be scavenged from the water column and subsequently deposited within the sediments near the discharge point (Payne et al., 1985).

Benthic Effects

Bottom sediments near the point of discharge can represent an immediate area of accumulation for bulk drilling muds and cuttings as well as an unknown portion of the chemical components scavenged or sedimented from discharges of produced water. Subsequent accumulation, resuspension, mixing, transport, and deposition processes will affect the long-term fate and effects of these discharges. Rates of dispersion, dilution, or accumulation will reflect the physical and geological characteristics, such as bottom shear velocities and sedimentation rates, of the sedimentary environment. The rates of these processes are not known for many areas including the present study area, thus predictions of residency times of discharged materials and possible exposures to benthic organisms are not presently feasible.

Potential effects to biota from operational discharges of drilling muds and cuttings can include: localized burial of sessile organisms; increased water column turbidity resulting in fouling of feeding structures of filter and suspension feeding organisms; increased amounts of inorganic or refractory organic material which may reduce the percentage of utilizable organic material available to filter, suspension, and deposit feeders; and chronic, low-level exposure to metals (particularly barium and chromium) and petroleum and mineral based additives from deposition of spent drilling fluids, cuttings, or produced water constituents that may result in some bioaccumulation. Neff (1985) concluded that impacts to biota, in areas developed by non-oil based drilling fluids, were due mainly to reef effects which enhanced bottom scouring, increased the biomass of the fouling community and organisms attracted to the platform structure (nekton), and alterations of the infaunal populations that reflected changes in sediment texture characteristics and the increased numbers of predatory nektonic species. Adverse impacts due to the presence of discharge-related petroleum hydrocarbon contaminants in bottom sediments were also apparent in some cases. The degree of impact from these sources will depend on local environmental factors, including the species present, water depth, current structure, substrate type, and platform operational factors including discharge volume and frequency, and proximity of other platforms. The greatest potential impacts generally are associated with low-energy environments having low potential for dispersal of muds and cutting or sedimented produced water components (e.g., Zingula, 1975; Boesch et al., 1985). However, even in these environments, most effects are localized (<150 m from the discharge site) and short-term (e.g., reviewed by Boesch et al., 1985; NRC, 1983). Many of these conclusions are based on observations from single exploratory wells, and unresolved issues are related to potential cumulative and long-term impacts from multiple-well, multiple-platform discharges (NRC, 1983) which may occur eventually in the Santa Maria Basin and western Santa Barbara Channel. Boesch et al. (1985), however, concluded that there is a high potential for resolving impact issues through implementation of carefully designed studies.

Potential impacts from platform and pipeline installation generally are restricted to the immediate vicinity of the pipeline (associated with pipe laying and burial) or platform (including anchors and anchor chain). Effects are highly correlated with substrate type and biological communities present. Hard-bottom communities typically are more sensitive than soft-bottom communities, however, particularly sensitive communities can be avoided by careful routing or placement of these structures. Areas of overlapping anchor patterns from adjacent platforms (as will occur for some platforms in the Pt. Conception/Pt. Arguello region) will provide one study example of cumulative effects from habitat disruption on some hard-bottom areas.

The potential impacts from oil spills will also be greatly influenced by local and regional environmental factors including current structure, substrate type, type and volume of oil spilled, and species present. Impacts from large spills (including blowouts) or intermittent small spills from oil and gas operations can include physical fouling of organisms and long-term build-up of persistent hydrocarbons in sediments, resulting in chronic effects to benthic organisms and associated food chains (e.g., reviewed by Boesch et al., 1985). In general, the most pronounced ecological impacts occur when oil is spilled in shallow, enclosed areas with restricted mixing and limited dispersion. Incorporation of fresh oil into fine-grained sediments in low energy environments may cause the oil to persist for periods of several years and act as source of chronic contamination (Spies, 1985). In this case, detrimental impacts to organisms may reflect the composition of the spilled crude or refined oil and, particularly, the concentrations of intermediate molecular weight aromatic compounds and their availability to local organisms. In contrast, open ocean spills typically have few deletarious, long-term effects on benthic fauna. Operational discharges of petroleum hydrocarbons associated with spent drilling fluids or produced waters are not expected to cause appreciable impacts to benthic organisms, although subtle effects due to accumulation of polynuclear aromatic hydrocarbons or chronic exposure to produced water hydrocarbons are conceivable (Boesch et al., 1985).

Several monitoring studies have been attempted during the past several years to measure or quantify environmental impacts associated with OCS exploration, development, and production operations (reviewed by NRC, 1983; Boesch et al., 1985; Menzie, 1982). For many of these studies, no baseline or pre-drilling data were available and/or no control or reference stations were sampled to provide sufficient information for characterizing the natural variability of environmental conditions. Consequently, it was not possible to distinguish effects due to OCS operations from the natural variations. Additionally, several studies were conducted without adequate sample replication, sufficient analytical sensitivity, or measurements of the appropriate variables, and the studies were not designed to test specific hypotheses or specific levels of change in biological or chemical parameters. Therefore, possible subtle effects due to OCS operations would be difficult to detect.

For the present Phase I program, the analysis of historical benthic data provides a direct method to assess the statistical power and number of sample replicates required to detect change (50%) in benthic populations from the Southern California Bight as compared to populations from the Santa Maria Basin and the western Santa Barbara Channel. These data are particularly important in the design of long-term monitoring studies, including survey design (station location and replication), selection of variables to monitor, and statistical methodology.

The directory of archived benthic samples was applied directly to species identifications for the program and comparisons of taxonomic data from different studies.

The objectives of the benthic reconnaissance surveys were of much broader scope, and included characterization of the benthic biological assemblages and physical/chemical environment of the study area, and assessment of these data as related to potential impacts from oil and gas development.

The present Phase I program provides biological, geological, and chemical data for characterizing the baseline or pre-drilling conditions of the survey region for comparisons with conditions observed during Phase II monitoring. Additionally, data from the reconnaissance surveys are used to identify possible experimental and reference or non-affected stations, possible sensitive (indicator) species, and geochemical parameters which are appropriate for long-term monitoring. Discussion of these results and recommendations for long-term monitoring are presented in Sections 3.4 and 3.5.

1.2 PREVIOUS STUDIES IN THE SANTA MARIA BASIN/WESTERN SANTA BARBARA CHANNEL AREAS

The Phase I study included survey areas (e.g., the western Santa Barbara) for which biological, physical, and chemical information have been provided from several previous studies, and the Santa Maria Basin for which little information on the benthic environment and biological assemblages was known. Results from the previous studies provide data and observations on biological assemblages and community structure, benthic variability, and substrate characteristics which are used for comparisons with the results from the present study. These comparisons are presented in Section 3.0 (Results and Discussion) along with the discussion of the soft-bottom and hard-bottom survey results.

One of the first large-scale studies of the benthos of the southern California borderland was initiated in 1952 by the Allan Hancock Foundation. Results from this study were published in a series of papers dealing with the overall program (Barnard et al., 1959; Allan Hancock Foundation, 1959, 1965), as well as the habitats and biota of basins (Hartman, 1955, 1966; Hartman and Barnard, 1958, 1960), canyons (Hartman, 1963), and the shelf off Santa Barbara (Barnard and Hartman, 1959). The community structure and distributional patterns of the benthic macrofauna collected were analyzed extensively by Jones (1969).

Following this study, systematic sampling of the sea bottom offshore of southern California continued primarily in nearshore areas, in association with surveys of sewage disposal sites (e.g., biannual SCCWRP reports); comparable studies were limited on the outer continental shelf. The blowout of Union Platform "A" off Santa Barbara in 1969 provided a major focus for additional systematic study of the offshore benthos. An intensive one-time investigation of the area potentially exposed to the discharged oil was conducted in 1969-1970 with results reported by several investigators including Emerson (1971), Fauchald (1971), and Wintz and Fauchald (1971). As more attention was focused further offshore, occasional sampling was performed in support of academic thesis work (e.g., Jumars, 1974).

In 1975 and 1976, an extensive investigation of the entire continental borderland was performed by a variety of investigators during the Southern California Baseline Program coordinated by Science Applications, Inc. (SAIC), and funded by the Bureau of Land Management (Fauchald and Jones, 1978a; Balcolm, 1981). The study continued on a smaller scale in 1976 and 1977 ("Benchmark" program) to further define benthic variability (Fauchald and Jones, 1978b), to examine undersampled areas ("Descriptive" program; Fauchald and Jones, 1978c), and to investigate the hard-bottom communities of Tanner and Cortes Banks (Wolfson et al., 1978; IEC, 1979).

Extensive oil and gas reserves identified in the Pt. Conception to Pt. Arguello region and further north in the Santa Maria Basin led to a series of site-specific reconnaissance surveys of soft-bottom and hard-bottom biological habitats potentially affected by planned development activities. Environmental studies conducted prior to 1980 in regions north of Pt. Conception primarily concerned inshore (State Lands) areas (e.g., Hancock, 1977). More recent studies have been conducted off Pt. Sal (Hooks, McCloskey and Associates, 1982; Engineering Science, 1984), Purisima Pt. (Nekton, 1981), Pt. Arguello (Dames and Moore, 1982), between Pt. Arguello and Pt. Conception (Dames and Moore, 1983; Engineering Science, 1984; Nekton, 1983), and in western Santa Barbara Channel (Exxon, 1982; Dames and Moore, 1983). These data have been analyzed and interpreted in review documents (MMS, 1983; ADL, 1984a/b; SAIC, 1984) associated with offshore oil development and its environmental consequences. The present study integrates and greatly expands the information available for this region.

1.3 ENVIRONMENTAL OVERVIEW

Geological Environment

The study area consists of a portion of the California continental margin that includes the western part of the Santa Barbara Channel and the offshore terrain from Point Conception northward to Point Estero (Figure 1-1). The two main segments of the area are separated by a sill at the western entrance of the Santa Barbara Channel and by the tributaries of the Arguello submarine canyon west-southwest of Point Arguello. East of the sill the sea floor slopes eastward into the Santa Barbara Basin.

The major features of the sea floor in the region north of Point Arguello are shown in the bathymetric profile in Figure 1-2. The continental shelf extends from 2 to 10 nmi from the shore, with the widest areas off bays and the narrowest off headlands. The shelf edge is located at a depth of approximately 360 ft. Deeper than 360 ft, the sea floor steepens to form the continental slope including a particularly steep area west of Point Arguello. The tributaries of the Arguello submarine canyon dissect the scarp but are not evident on the inner shelf. North of Point Arguello the slope is interrupted by the Santa Lucia Bank, a positive feature that rises to depths between 1320 and 1500 ft. The west side of the Santa Lucia Bank slopes steeply westward to

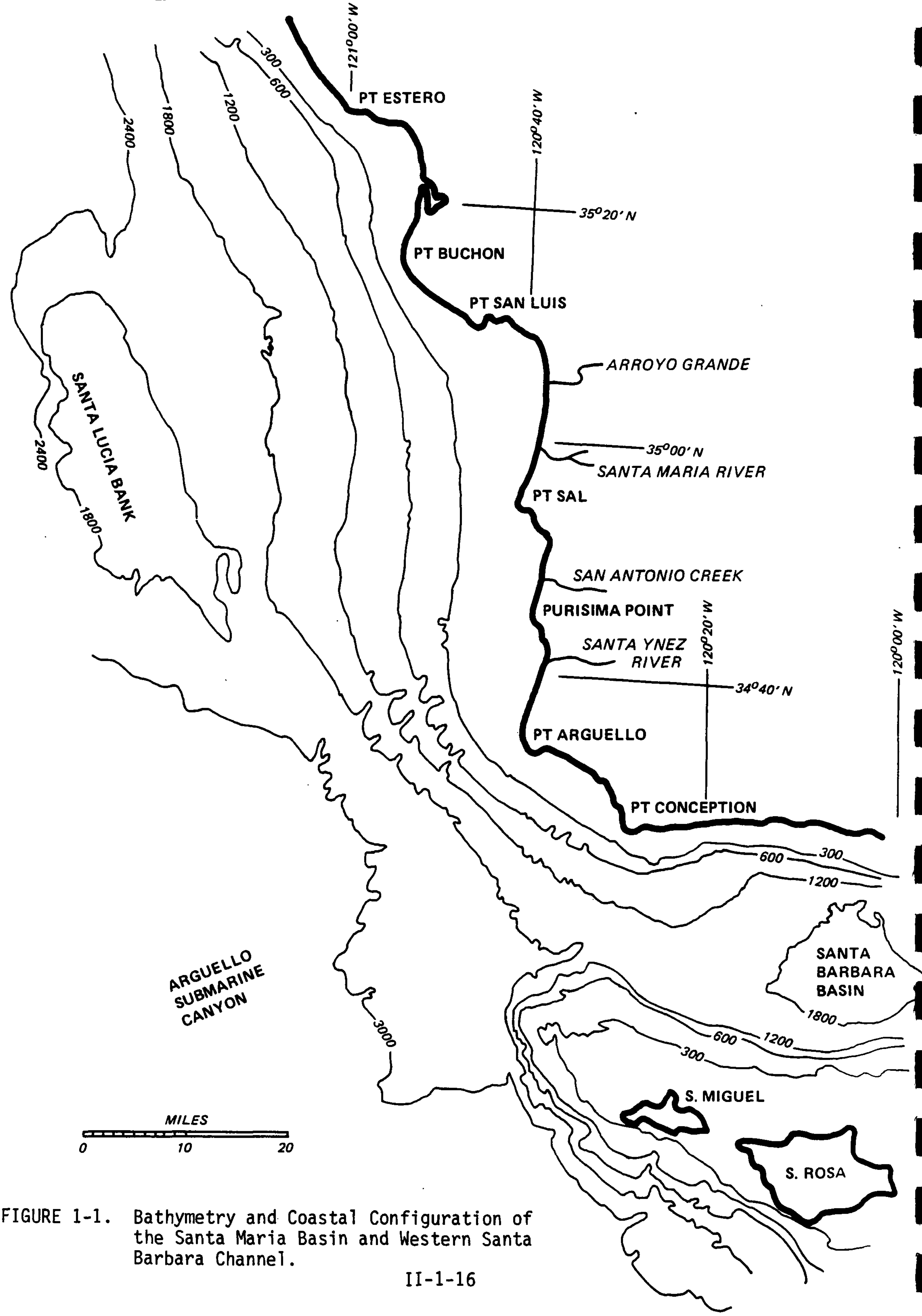


FIGURE 1-1. Bathymetry and Coastal Configuration of the Santa Maria Basin and Western Santa Barbara Channel.

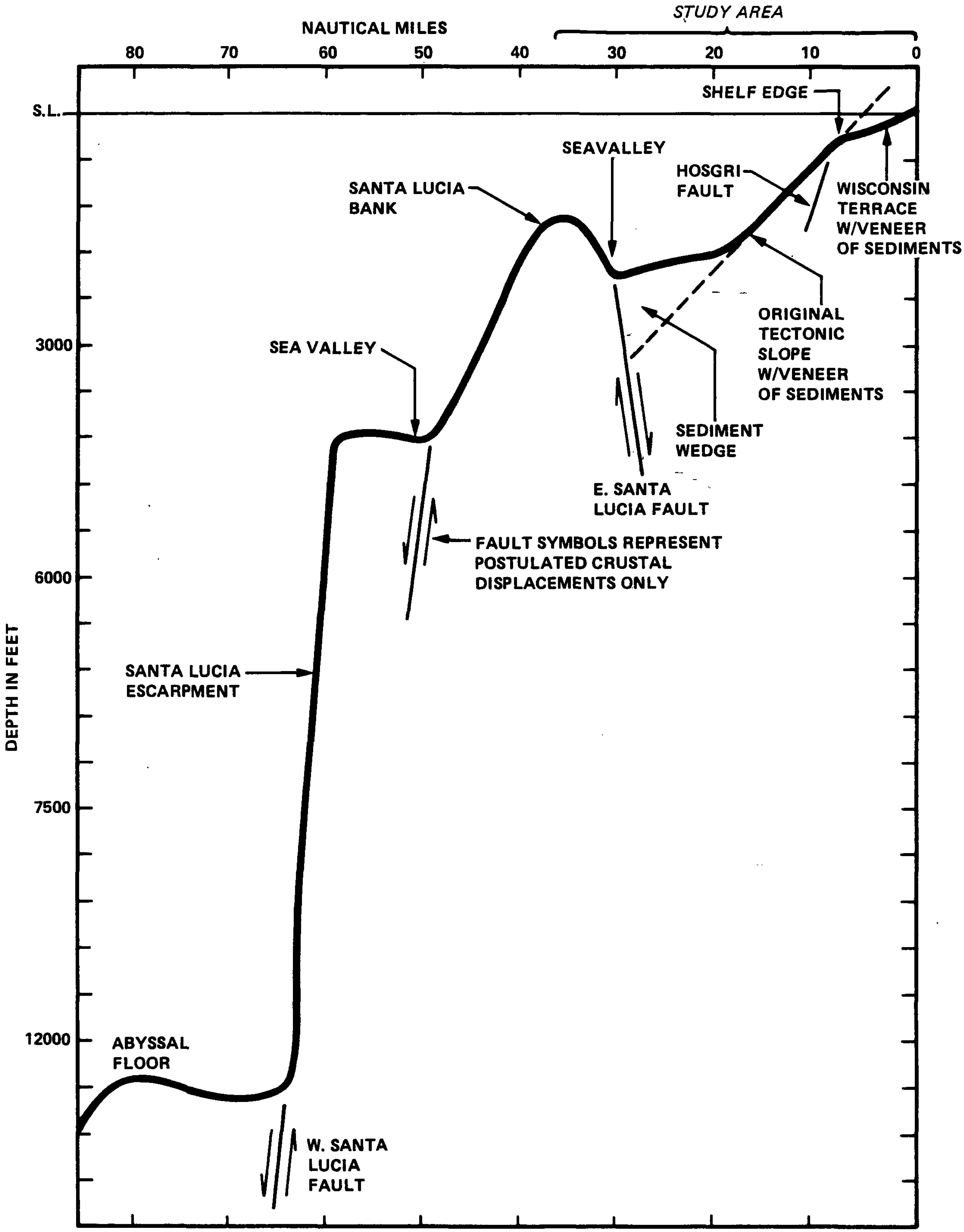


FIGURE 1-2. Bathymetric Profile of Santa Maria Basin Along Transect Running Southwest from Estero Bay, with Postulated Tectonics and Sedimentation.

form the Santa Lucia Escarpment, and to the east forms a sea valley that drains northward. The sea valley slopes from a depth of about 1860 ft at the south end of the Santa Lucia Bank to about 2400 ft at the north end of the bank.

Overall geologic trends indicate the greatest occurrence of hard-bottom features within three areas of the survey region: (1) nearshore and offshore of Pt. Conception to Pt. Arguello (e.g., SAIC, 1985; Dames and Moore, 1982 and 1983); (2) shallow (generally less than 100 ft), nearshore areas from at least Goleta to Pt. Estero (BLM, 1980); and (3) nearshore to offshore of the Northern Channel Islands (BLM, 1980).

The coast consists of a series of headlands separated by broad arcuate embayments north of Point Arguello (see Figure 1-1). East of Point Arguello the coast is virtually linear. The headlands are fronted by bedrock outcrops to depths of about 60 to 120 ft. The embayments are generally floored with sand. Further details of the distribution of lithologic types in the nearshore region are presented by Welday and Williams (1975).

Several major streams are located along the coast north of Point Arguello (see Figure 1-1). From north to south they are Arroyo Grande, the Santa Maria River, San Antonio Creek, and the Santa Ynez River. Arroyo Grande drains the San Luis mountains and the Santa Lucia Mountains. These mountains are formed of Miocene marine sedimentary rocks with minor volcanic rocks. The Santa Maria river drains the south flank of the San Rafael Mountains which are formed of similar rocks. San Antonio Creek drains the Casmalia Hills and the Purisima Hills, both of which are formed from largely Plio-Pleistocene marine shales and marls. The Santa Ynez river drains the Santa Ynez Mountains, formed of Miocene and Oligocene sedimentary rocks and the Franciscan melange of Jurassic age. Sediments introduced into the study area offshore are derived from the rock types listed above. In addition, littoral transport from the north introduces an undetermined flux of sand from sources to the north; small streams and bluffs along the coast in the study area contribute lesser amounts of sediment into the study area.

Discharges of fluvial materials from the coastal rivers and streams represent a source of natural trace metals to bottom sediments within the study area. For example, the mineral chromite is derived from erosion of ultrabasic rocks such as are found in the Franciscan formation in the area. The Franciscan formation crops out along the coast north of Point Estero and in the Santa Ynez Mountains. Erosion of materials from these formations and fluvial transport may account for inputs of natural chromium to nearshore areas off Point Estero. Similarly, lag material derived from erosion of the Santa Lucia Bank may represent an additional source of chromite to offshore areas, although this cannot be stated with certainty until the bedrock geology of the bank is known.

The areal distribution of the barium content of the sediments reflects riverine inputs of the mineral barite. Barite occurs in outcrops in the Santa Ynez Mountains and might be expected to be present in sediments discharged by the Santa Ynez River. Subsequent transport and deposition processes will affect the distribution of barium-enriched sediments within the Santa Maria Basin and Pt. Arguello to Pt. Conception areas (see Section 3.1.2.1). Barite is also introduced into the marine environment by discharges of drilling mud from offshore oil platforms.

Approximately 20 oil and gas seeps were cataloged by Wilkinson (1972) within the State and OCS waters of the western Santa Barbara Channel between Coal Oil Pt. and Pt. Conception. Burdick and Richmond (1982) identified an additional 66 seeps near San Miguel Island and approximately 20 seeps between Pt. Conception to Pt. Arguello (Figure 1-3). Additional, undocumented seeps likely exist in the Pt. Arguello and Santa Maria Basin areas. The estimated flow rate of oil from natural seeps to Santa Barbara Channel waters ranges from a minimum of 16 cubic meters to a maximum of 160 cubic meters per day (Wilson, 1973). Some seeps discharge on an intermittent basis; therefore, considerable variability in daily discharge volumes would be expected (Allen et al., 1970). Oil seeps represent a relatively large point source for sediment hydrocarbons in the western Santa Barbara Channel. The degree to which localized seeps can contribute to areal petroleum hydrocarbon distributions is not well known, but may depend on sediment redistribution, surface currents and turbulence, and volumes of discharge.

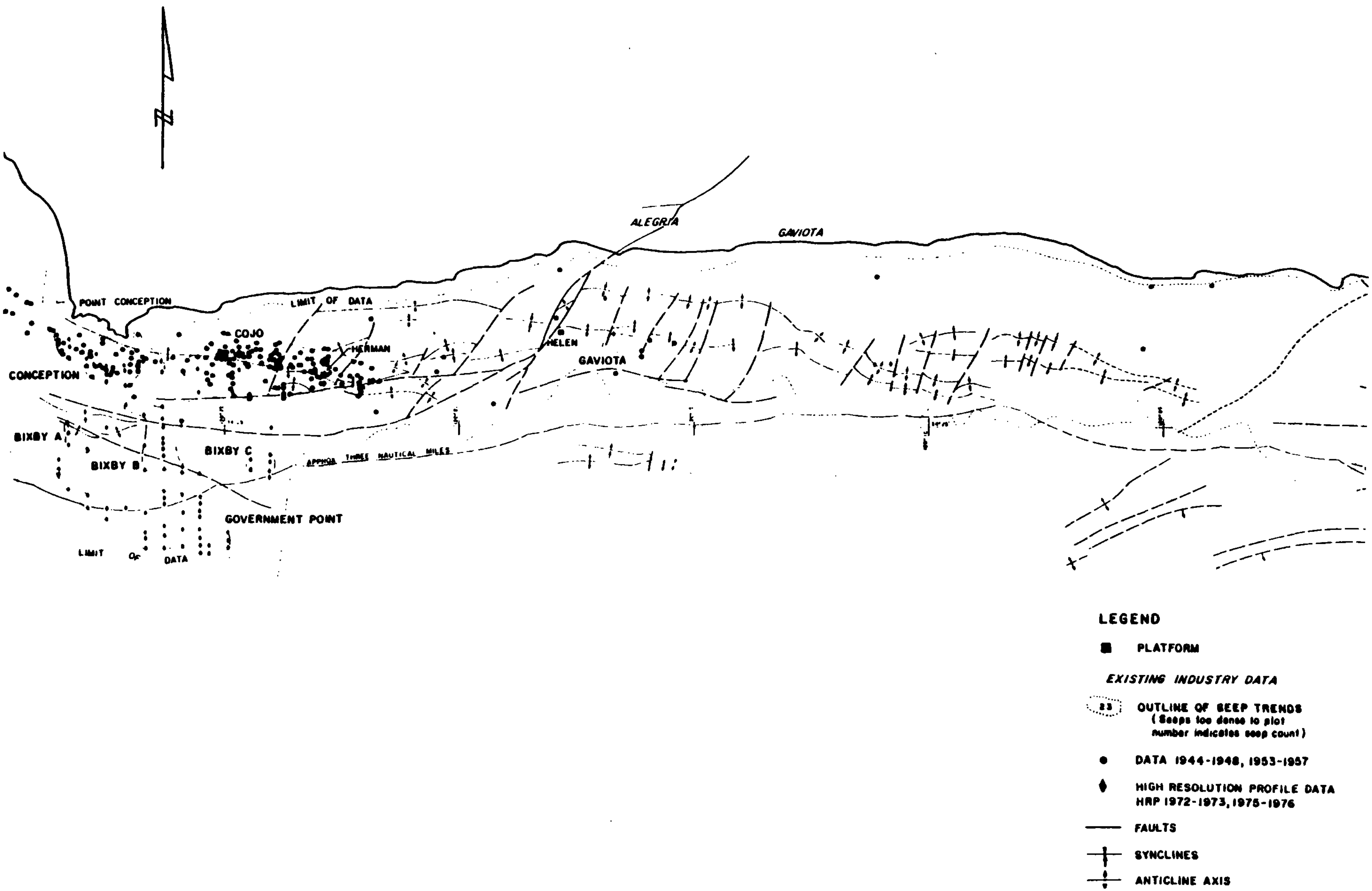


FIGURE 1-3. Locations of Reported Oil and Gas Seeps in the Western Santa Barbara Channel.

Circulation

Available information on the circulation patterns in Santa Maria Basin and western Santa Barbara Channel is summarized below to provide a context for interpreting the biological and geochemical data obtained during this study. MMS presently is conducting physical oceanography studies in the Santa Barbara Channel, Pt. Arguello to Pt. Conception, and Santa Maria Basin areas. However, to date the data available from the Central California Coastal Circulation Program are preliminary and have not been published or released, and few historical data are available to characterize the regional current patterns (Jones and Stokes, 1980). Results from the Santa Barbara Channel Circulation Study - Pilot Program are reported in Blumberg et al. (1985) and in Brink and Muench (in review).

The general circulation along the California coast is dominated by the southward flowing California Current, the northward flowing California Undercurrent, and the Davidson Current. The California Current is a typical eastern boundary current with relatively low velocities (10 to 20 cm sec^{-1}) and considerable mesoscale variability which flows parallel to the coastline off central California (Hickey, 1979). The California Undercurrent flows northward along the coast and seaward of the Continental Shelf with velocities of 5 to 10 cm sec^{-1}, typically at depths between 650 to 1650 ft. The Davidson Current represents the surface expression of the California Undercurrent and flows northward at velocities between 16 to 47 cm sec^{-1} (Reid and

Schwartzlose, 1962). This general circulation system is influenced by local and remotely driven processes, wind forcing, and large scale meteorological patterns. Seasonal and episodic changes in the magnitudes of these factors can result in considerable variability in the typical circulation patterns. Recent data have indicated the presence of significant small scale variability in the circulation patterns in this area. These features include mesoscale eddies, upwelling events, frontal structures, and subtidal fluctuations which may persist for periods of days to weeks. Upwelling events are particularly intense within the Pt. Arguello to Pt. Conception region.

Oceanographic conditions are characterized in terms of three seasons: oceanic (July to November); Davidson Current (December to February); and upwelling (March to June). During the oceanic season, southward flow associated with the California Current predominates, although regions near the coast and in western portions of the Santa Barbara Channel can experience northward flows. The effects of the southward flowing California Current diminish during the Davidson Current period, and northerly flow along the coast intensifies. The upwelling period is characterized by strong northwesterly winds which reestablish a general southerly flow with localized regions of upwelling events. These seasons refer to long-term mean conditions; however, short-term and small-scale events can result in considerable variability in localized and instantaneous conditions.

Circulation patterns within the western Santa Barbara Channel and Southern California Bight behave somewhat independently from areas immediately north of Point Conception, and the effects or roles of large scale current features may be slightly diminished (Blumberg et al., 1985). The mean surface flow within the Santa Barbara Channel is cyclonic (counterclockwise), with westward flow along the northern mainland coast and eastward flow along the Channel Islands. Mean velocity of the westward flow exceeds 20 cm sec^{-1}, and current speeds exceeding 50 cm sec^{-1} have been observed (Brink and Muench, in review). The mean velocity of the eastward flow is slightly lower (15 cm sec^{-1}). In addition, a westerly jet flows out of the western portion of the Channel at velocities greater than 20 cm sec^{-1}. This flow proceeds offshore from Point Conception but does not appear to continue north of Pt. Arguello (Blumberg et al., 1985). Interactions between the southward flowing coastal currents and the westward flowing jet in the region offshore Pt. Arguello to Pt. Conception are complex and not well understood (Brink and Muench, in review).

Several short-term and small scale processes are superimposed on the large scale features of the California Current and Davidson Current system within the Santa Maria Basin/Santa Barbara Channel area. This variability in the mean currents is related to the magnitude of local and remotely driven circulation components and large scale meteorological patterns. Local wind forcing with both seasonal and diurnal components affects water movement within the surface 50 meters (Blumberg et al, 1985). Diurnal winds are associated only with small scale features (20 to 30 km), whereas the large scale (predominant) wind forcing is responsible for larger scale circulation patterns and may influence current velocity fields at depths greater than 50 meters (Blumberg et al., 1985). Large scale wind forcing due to meteorological events may also be responsible for the presence of frontal structures, eddies, or coastal trapped waves with spatial scales of tens of kilometers and residence times of several days (Blumberg et al., 1985; Brink and Muench, in review). However, the dynamic relationship between time-varying currents and regional scale winds are not well understood (Brink and Muench, in review).

Tidal currents in Santa Barbara Channel are largely barotropic or related to a sloping sea surface. Tidal-induced currents propagate from the east to west at approximately 10 cm sec^{-1} in open portions of the Channel, but they may accelerate near Point Conception due to constrictions in the Channel topography (Blumberg et al., 1985). Tides within the Channel are energetic but spatially variable, and the tidal current components contribute to the dispersion and flushing characteristics of the Channel (Blumberg et al., 1985).

Bottom circulation patterns in the Santa Maria Basin and western Santa Barbara Channel presumably are affected by combined effects from large scale currents, tidal currents, wave-induced flow, and density flows, as well as the effects of the complex bottom topography. Velocities of bottom currents are expected to vary with respect to bathymetry, bottom topography, and tidal influences; currents within the submarine canyon may reach velocities of 25 to 35 cm sec^{-1} (Shepard, 1973).

Upwelling events occur at irregular intervals throughout the year. Upwelling is more frequent during Spring when two to five major events may occur within the March to June upwelling season. Single events may last from two to ten days; upwelled waters from the Pt. Arguello-Pt. Conception area typically are advected past or into the Santa Barbara Channel on a time scale of one to two weeks (Blumberg et al., 1985). Upwelling events are responsible for transporting nutrient-enriched deeper waters into the euphotic zone, thereby stimulating biological productivity.

The relationship between the large and small scale circulation patterns and events observed in the western Santa Barbara Channel and Pt. Arguello to Pt. Conception areas and the biological, chemical, and geological processes in the study area are poorly known. Kolpack (1983) reported that the shoreward portion of the southerly California Current flows along the inner shelf between Pt. Estero and Pt. Conception. This southward flow may be responsible for a net southerly transport of suspended materials and bottom sediments in this region. A nearshore component of the California Current also may transport littoral and riverine materials around Pt. Conception and easterly in the Santa Barbara Channel. Sediment transport processes within the Santa Maria Basin, Arguello Canyon, and Santa Barbara Channel will have important effects on the distribution of biological communities and dispersion of discharged materials from oil and gas exploration and drilling operations. Recommendations for future studies and monitoring programs which involve investigations of circulation patterns and sediment transport processes are presented in Section 3.5 (Recommendations for Long-Term Monitoring).

2.0 MATERIALS AND METHODS

This section describes the survey areas and methods employed for the field surveys (Section 2.1), laboratory analyses (Section 2.2), and data analyses (Section 2.3) tasks. Additional detailed information on soft-bottom and hard-bottom station and transect locations, and data analysis methods is presented in Appendices A, B and C, respectively.

2.1 FIELD SURVEYS

Separate field surveys were conducted to investigate soft-bottom and hard-bottom environments. Discussions of sampling areas and methods for each survey are presented in Sections 2.1.1 and 2.1.2, respectively.

2.1.1 Soft-Bottom Survey

The soft bottom survey was conducted to sample the soft-bottom infauna and bottom sediments in the western Santa Barbara Channel and Santa Maria Basin. This survey provided baseline information on previously unsampled areas in the region and can be considered spatial continuation of previous studies (e.g., Fauchald and Jones, 1978a) conducted in the Southern California Bight and eastern Santa Barbara Channel. The soft-bottom survey was conducted during the fall/winter of 1983-1984. Four survey legs totaling 19 days were conducted from October 30 to November 6, November 8 to November 11, and November 27 to December 1, 1983, and from January 4 to January 10, 1984.

Sampling was conducted at 107 stations between Pt. Estero to the north and Gaviota to the southeast, with bottom depths ranging from 165 ft to 3000 ft. Station locations are described in Section 2.1.1.1. Samples were collected from each of 142 cores for analysis of benthic infauna and selected chemical and physical sediment parameters. Photographs were also taken of the sea bottom and of the surface and sides of the cores. Other observations included sea surface and weather conditions, surface water temperature, birds and mammals, and fishing activity.

Detailed descriptions of the survey area, major equipment, personnel, and sample collection and procssing are presented in Sections 2.1.1. through 2.1.1.4, respectively.

2.1.1.1 Survey Area

The soft-bottom survey was conducted primarily within the Santa Maria Basin, Pt. Arguello to Pt. Conception, and western Santa Barbara Channel regions of the central and southern California outer continental shelf. The survey was designed to provide an overall reconnaissance of benthic communities over a broad range in latitude and bottom depths (165 ft to 3000 ft). Selection of the soft-bottom survey stations was based on an evaluation of substrate, bottom depths, potentials for oil and gas development, and geographic location within the study area which would provide data for comparing experimental versus reference (control) sites. Based on these criteria, a grid of 107 stations was delineated along 18 transects which ran approximately perpendicular to shore and parallel with depth contours (Figures 2-1 through 2-4). Locations (latitude and longitude) of all soft-bottom survey stations are presented in Appendix A. At the majority of the stations (87 of 107), single grabs (BSS) were taken to provide reconnaissance type information within the study area. Three replicate grabs (BSR) were attempted at 19 other sites to assess spatial variability. At one station (Station 42-BSV), nine replicate cores were collected, eight of which were divided into quarters and processed separately for geochemical and biological parameters; these samples were intended to provide data to assess within-core variability.

2.1.1.2 Major Equipment

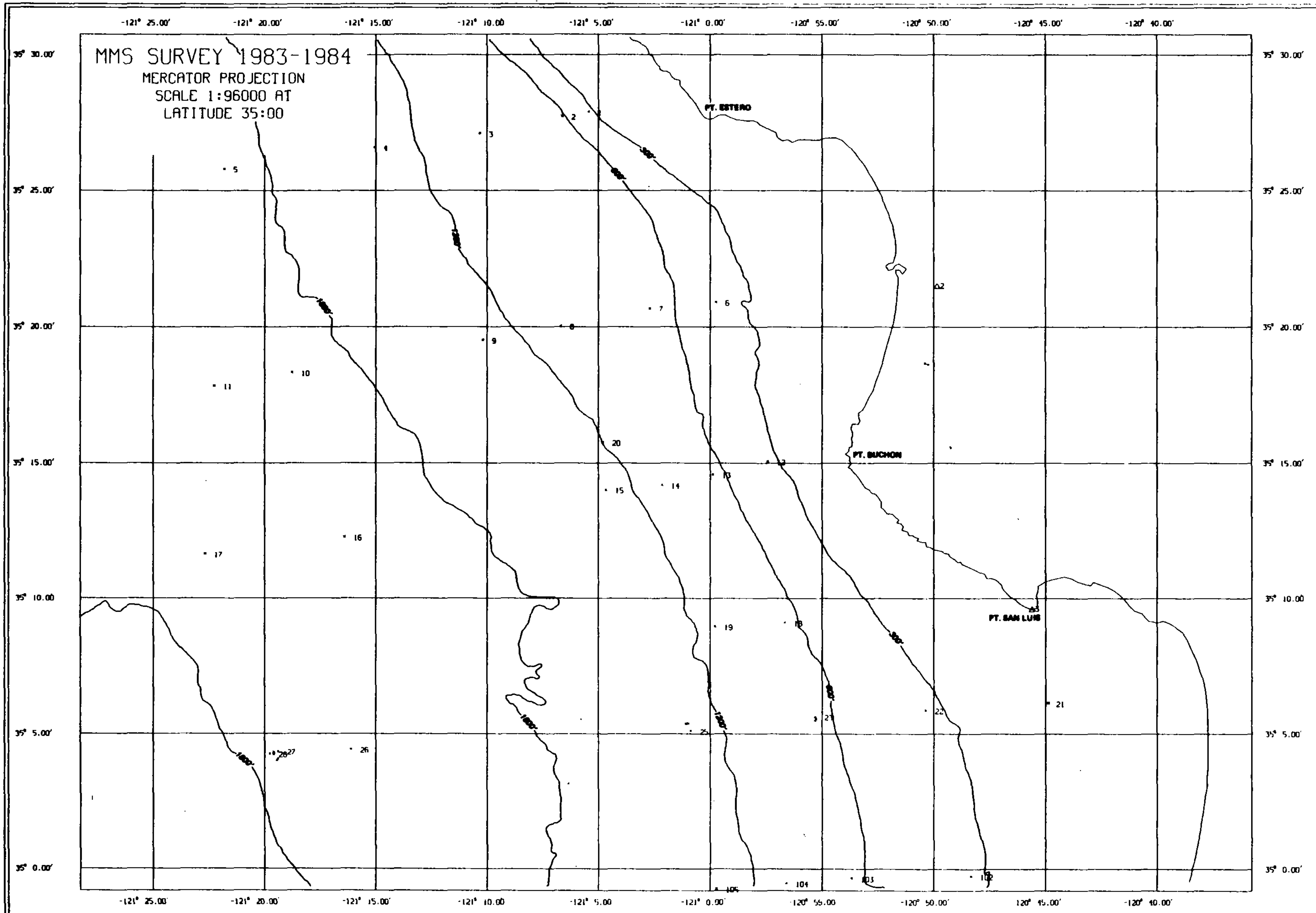
The soft-bottom survey was conducted using the 137 ft research vessel R/V SWAN, owned and operated by Maripro, a subsidiary of SAIC (Goleta, CA). Bottom depths at each station were recorded using an EDO fathometer. Launch and recovery of the sampling gear (box corer) was conducted using a 27 ft monorail "A" frame extending 10 ft over the stern with a 10-ton hydraulic hoist.

The navigational system consisted of the SAIC Navigation and Oceanographic Data Acquisition System (NODAS) interfaced to a Del Norte Model 545 digital distance measuring unit (DDMU). This sytem was interfaced to an Apple II microcomputer. Distance from shore-based trisponders were transmitted from the Del Norte DDMU into the Apple II as RS 232C serial data. Nine

MINERALS MANAGEMENT SERVICE

SANTA MARIA BASIN

SOFT BOTTOM BENTHIC SURVEY STATIONS



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MINERALS MANAGEMENT SERVICE

SANTA MARIA BASIN

SOFT BOTTOM BENTHIC SURVEY STATIONS

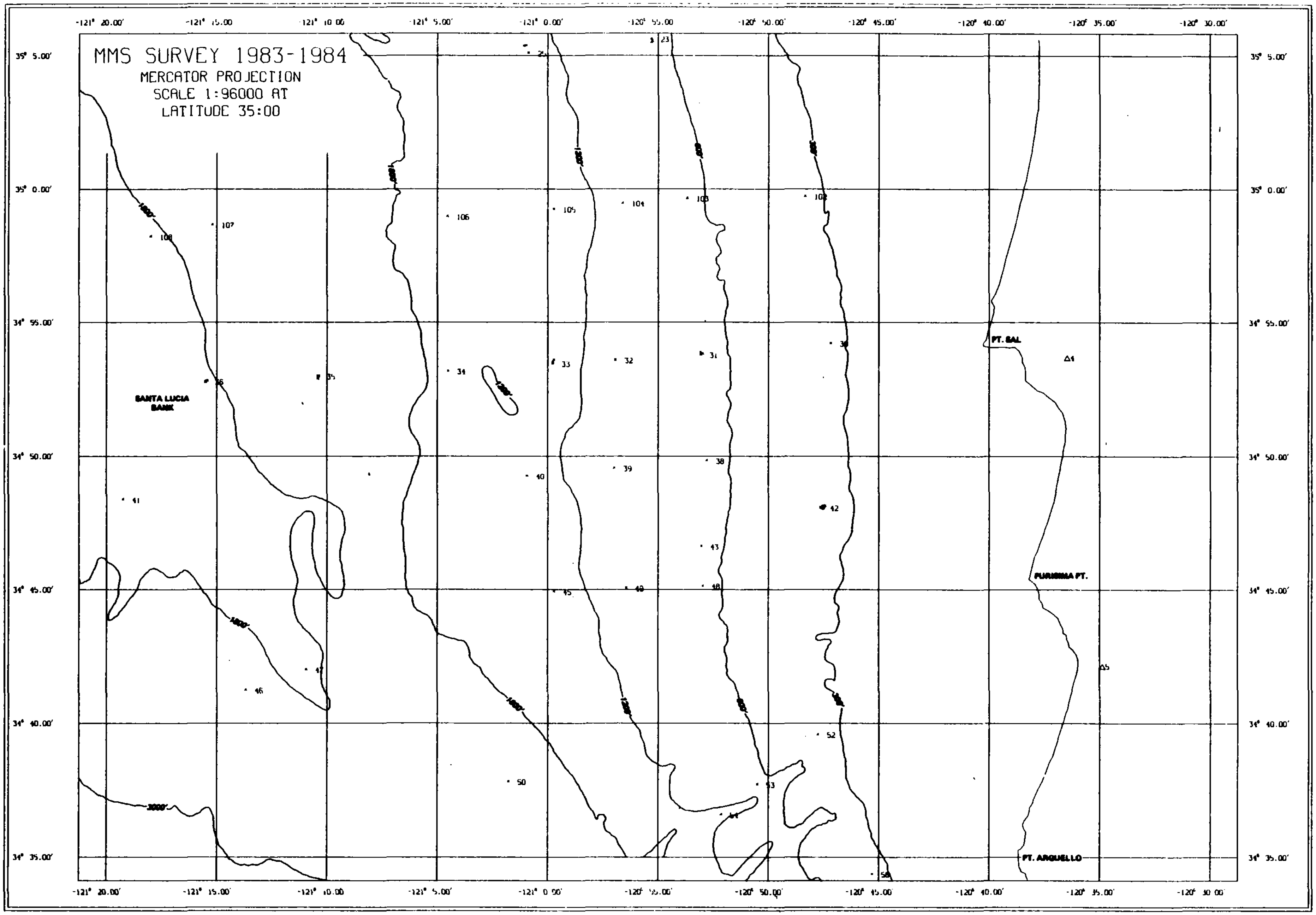

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FIGURE 2-2. Soft-Bottom Benthic Survey Station Locations

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SANTA MARIA BASIN

SOFT BOTTOM BENTHIC SURVEY STATIONS

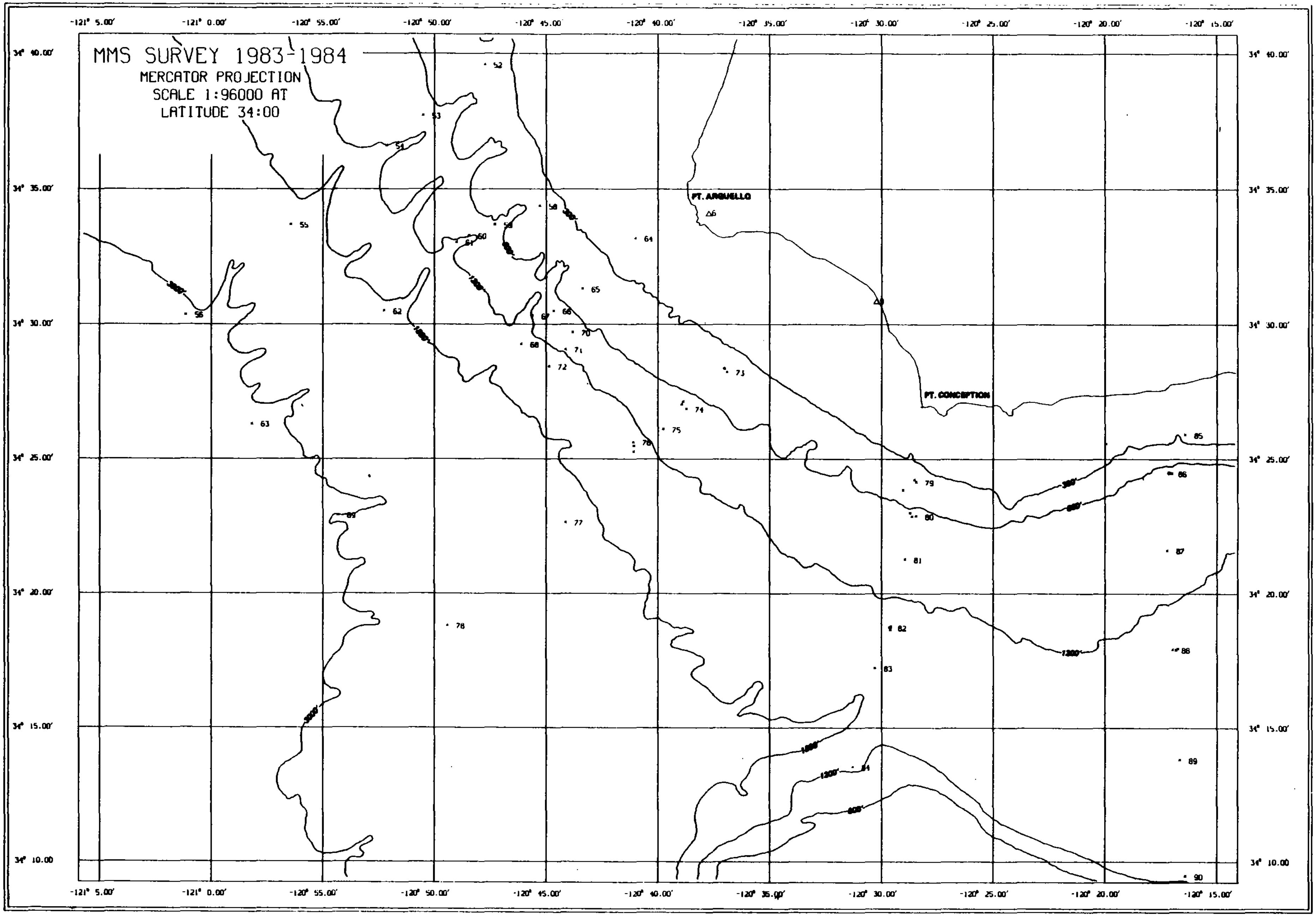

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FIGURE 2-3. Soft-Bottom Benthic Survey Station Locations

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SANTA MARIA BASIN
SOFT BOTTOM BENTHIC SURVEY STATIONS

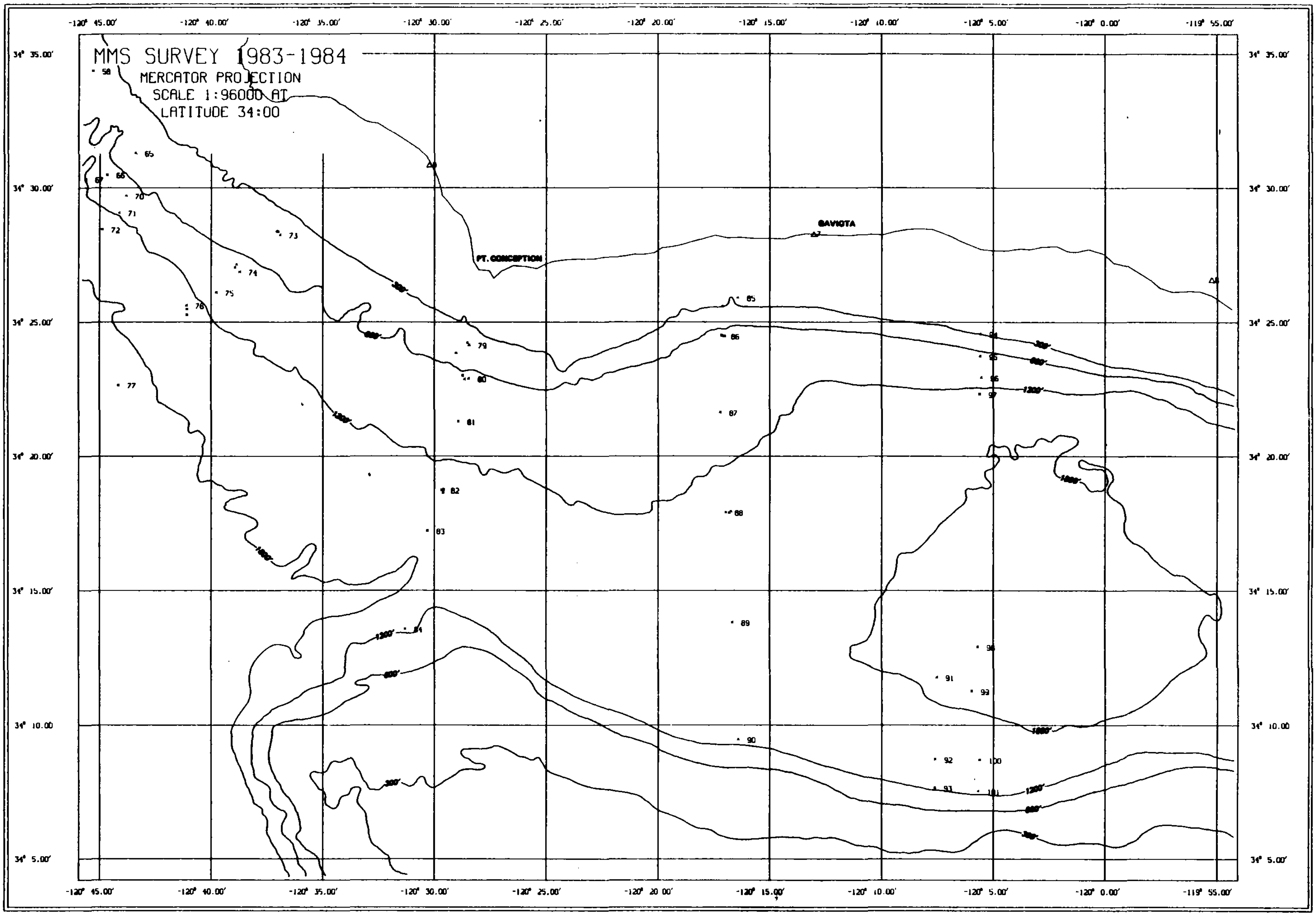

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FIGURE 2-4. Soft-Bottom Benthic Survey Station Locations

Del Norte shore stations were established to provide navigation coverage over the entire survey area. At least three shore stations were online for most stations. This configuration permitted estimation of the error for the range measurements, which, generally did not exceed 2 to 3 m; errors for multiple fix measurements did not exceed 5 m. The Apple II computer processed this information and displayed the ship's position on a CRT display; a second display was maintained at all times in the pilot house as an aid to the helmsman. Both videos displayed the ship's position, range and bearing to the station specified and time of day. A Northstar 6000 Loran-C (resolution of approximately 78 m in the survey area) with time delays input was integrated into the system to provide an internal check on the maintenance of the NODAS calibration.

Bottom sediment samples were collected during the cruise using a Scripps Institution of Oceanography (SIO) - MLRG box corer and the SIO - MLRG modified Van Veen grab. These samplers have been used previously during the BLM-sponsored Southern California Baseline Study (Fauchald and Jones, 1978a). Both the box corer and the grab sampler have a 0.1 m^2 surface area, and are fully vented to minimize sample disturbance during collection. Both devices are constructed of aluminum, with bearing surfaces of Teflon and stainless steel to minimize potential contamination of geochemical samples. The box corer was used for collecting finer substrates, whereas the Van Veen grab is more effective collecting coarse sandy substrates. Due to the predominance of fine-grained substrates over most of the survey area, the box corer obtained satisfactory samples at all but the shallowest stations.

A Benthos Model 371 camera system was mounted on the box corer to obtain photographs of the ocean bottom prior to penetration. The system included the camera, strobe, and a bottom-contact triggering mechanism. Photographs were taken to document a 1 m^2 area at each station including benthic epifauna and the general physical characteristics of the bottom. The Benthos camera used during Legs 1, 2, and 3 was from Scripps Institution of Oceanography; the cameras used during Leg 4 were from the University of Southern California Marine Facility (Terminal Island, CA).

2.1.1.3 Personnel

Operation of the survey vessel was provided by Maripro of Goleta, California, a subsidiary of SAIC. Deployment and servicing of the shore stations used for navigation was conducted by Marinav of Santa Barbara, California. Continuous watches were used so that sampling could proceed 24 hrs per day. Each watch consisted of five scientific personnel consisting of two biologists, one chemist, one navigator and one technician (Table 2-1).

2.1.1.4 Sample Collection and Processing

After the vessel was positioned on station the sampler was launched and recovered. The suitability of the samples was evaluated based on the degree of surface disturbance to the core using ranking criteria developed

Table 2.1. Scientific Personnel for the Soft-Bottom Survey.

Personnel/Responsibility	Leg 1	Leg 2	Leg 3	Leg 4
Science Applications International Corporation				
Andrew Lissner[1]/Cruise Leader			x	x
Wilson Hom[1]/Cruise Leader/Chemistry	x	x		
Navigation			x	x
Fred Blesch/Chemistry				x
Jack Cutler/Navigation	x	x	x	x
Scott Denzer/Chemistry			x	
Brian Kennedy/Chemistry	x	x		
Alan Massey/Navigation	x	x		
Lisa Priebe/Chemistry			x	x
Jim Stratton/Technician	x	x		
MBC Applied Environmental Sciences				
Joe Belanger/Biology	x	x	x	x
Dave Connally[1]/Biology	x	x	x	x
Chris Foley/Biology	x	x	x	x
Scripps Institution of Oceanography				
Jim Singleton/Technician	x	x	x	x
Consultant				
Rick Wright/Technician			x	x

[1]Watch Leader

during the Southern California Baseline Program (Table 2-2). Unacceptable samples were discarded and additional cores were collected as necessary. The station was abandoned after the third attempt if logistic considerations or the bottom type (rocks or coarse material) made further attempts impractical.

The following procedures were followed for single core and three core replicate stations. Once the sampler was secured on deck, supernatent water was removed and filtered through a 0.5 mm screen; organisms retained on the screen were later combined with the rest of the processed biological samples. The sides of box core were removed and cores evaluated as acceptable were photographed with a 35 mm camera. Color photographs were taken of the surface of the core to document depositional characteristics, epifaunal organisms, and tubes or burrows visible on the surface. Photographs of the side of the core provided documentation of sediment layering and holes or burrows from organisms, and were taken immediately after the doors were removed to minimize slumping of the sediments. The doors were left in place for taller cores until geochemical samples were obtained.

Redox potential of the sediments was measured using a Corning pH meter (Model 125) and probe. Triplicate measurements were made in a corner of the core at depths 2, 5, and 10 cm below the sediment surface. No measurements were made at Stations 089 through 101 due to probe malfunction.

Table 2-2. Ranking Criteria for Benthic Cores Collected During the 1983-1984 Soft-Bottom Survey.

5	EXCELLENT	Surface 1 mm appears essentially present over entire sample. Supernatant relatively clear. Subsample recovery essentially faultless.
4	VERY GOOD	Surface 1 mm appears present over most of sample. Supernatant water has some turbidity. Minor problems in subsample recovery.
3	GOOD	Material representative of surface 1 cm appears present over entire sample. Supernatant water has moderate turbidity. Minor to some problems in subsample recovery.
2	FAIR	Material representative of surface 1 cm appears present over most of sample, supernatant water moderately turbid. Moderate problems in subsample recovery.
1	POOR	Material representative of surface 1 cm appears present in sufficient area to warrant subsampling. Turbid supernatant water associated with rapid drainage and surface 1 cm erosion. Major problems in subsampling.
F	OTHER	Not rated for extenuating circumstances.

Following the redox measurement, sediment samples for geological, physical, and chemical analyses were collected. A template was placed on the surface of the core to serve as a guide for sample collection. Samples for total organic carbon (TOC), trace metals (Ba and Cr), and hydrocarbons were collected within designated areas of the template; samples for grain size and sediment cohesiveness or compressive strength measurements were made outside of the template. The following protocol was used for sampling all geochemical cores:

1) Trace metal samples were collected using Teflon utensils from the top 2 cm of the core and transferred into labeled, acid-washed polyethylene containers. Samples were frozen on board at 0°C.

2) Samples for hydrocarbon analyses were collected from a depth of 0 to 4 cm using aluminum utensils. Samples were placed in hexane-rinsed glassware and stored at 0°C.

3) Total organic carbon samples were collected using blood dilution vials which were scooped along the surface 2 cm of the core. Samples were frozen on board at 0°C.

4) Sediment samples for grain size characterization were obtained by inserting a plexiglass coring tube 10 cm into an undisturbed portion of the box core sample. Capping and careful withdrawal permitted removal of an intact core. The core was then frozen

until analysis. During survey Legs 1, 2, and 3, a 3-1/2 cm (ID) core was used; a 5 1/2 cm (ID) core was used during Leg 4 to provide larger samples for laboratory analysis.

5) Sediment cohesiveness was measured during the first three survey legs using a torsional vane shear device (torvane), which was placed on the surface of the core and rotated to provide a measure of cohesiveness. However, due to the high water content and fine grain size (silts and clays) of many of the cores collected, the sediment cohesiveness (resistance) was too low to be quantified. During Leg 4 a penetrometer and a 3 inch diameter adapter foot was used with better results. The penetrometer is a hand-held mechanical device that measures compressive strength of sediments, and although these data are not directly comparable with torvane measurements, qualitative comparisons and spatial trends can be determined.

The remaining contents of the box core sample were transferred to a high volume, low pressure tiered sieving apparatus designed by Oregon State University. This device has several advantages over previously used "overflow barrel" techniques, including minimal damage to soft-bodied organisms and relatively rapid processing of the large volume of material. The unit consists of tiers of cascading, multiple sieve/sediment washer screens with 5.0, 1.0 and 0.5 mm openings. Specimens retained on the 5.0 and 1.0 mm screens were grouped separately from specimens retained on the 0.5 mm screen.

When sieving was complete, all specimens were relaxed by transferring into polyethylene trays containing 6% magnesium chloride for at least 20 minutes. Specimens then were transferred to jars and fixed in 10% buffered formalin in sea water. The sample containers were labeled and catalogued with all pertinent collection data including station, fraction and date and time of collection. After 48 hrs in formalin, specimens were rinsed and transferred to 70% alcohol for preservation.

The procedures described above were followed for all samples collected at single core and three replicate core stations. At Station 42, nine replicates were obtained to assess within-core variability. At this station, the supernatant water was siphoned into a holding bucket and retained. The core was then transferred intact and upright into a large tub, cut vertically into quarters using a stainless steel partition, and placed in separate labeled tubs. The inside quarters of the box corer were also rinsed into the respective tubs. The supernatant water was stirred during the sieving process to mix the sample; one quarter of the water was then sieved along with each of the quarter samples. The quarter cores were processed separately as previously described. The first core collected at Station 42 was processed for infauna and chemistry samples as described for the other stations. The second core was processed solely for chemical samples and the third solely for biological samples. This sequence was followed until four cores had each been processed each for chemistry and biology samples. Chemistry samples for metals, hydrocarbons, and TOC were collected from each quarter of the core surface as previously described. Grain size samples were not collected due to the lack of surface area for sampling.

Each sample was assigned an identification code which included a station number, sample type, replicate number, and analysis type. The range of descriptions for each category are listed below.

Station Number

001-200 (range of station numbers)

Sample Type

BSS - benthic sediment single (single cores)
BSR - benthic sediment replicate (three replicates)
BSV - benthic sediment variance (subsamples)

Replicate Number

01-09

Analysis Type

TX - taxonomy
OC - total organic carbon
GS - grain size
TM - trace metal
HC - petroleum hydrocarbon

All sample tracking sheets were checked prior to leaving a survey station to ensure that all samples and subsamples had been collected. The cruise leader and watch leaders were responsible for ensuring that all information was properly recorded during the survey. At the completion of each survey leg, removal of all samples from the ship for distribution to the laboratory (SAIC or MBC) was conducted under the control of a formal inventory document. At the completion of the cruise, all data recording sheets were transferred to the SAIC Data Manager for verification and entry into the project data base.

2.1.2 Hard-Bottom Survey

A biological reconnaissance survey of selected hard-bottom areas of the Santa Maria Basin and western Santa Barbara Channel was conducted by SAIC with support from MBC and other biological consultants from July 7 to August 2, 1984. The primary objectives of the study were to (1) characterize the hard-bottom biological assemblages and associated environmental parameters in the survey region, (2) identify potential sites and taxa for long-term monitoring studies; and (3) refine photographic survey techniques and sample collection methods, particularly as related to manned submersible operations.

During the survey, submersible dives using the manned submersible DIAPHUS were conducted along 23 transects representing 15 stations extending from near Goleta to Pt. Estero, CA. Survey depths ranged from 180 to 790 ft, with average depths from approximately 300 to 400 ft. Data collected included color video and commentary from biological observers, 35 mm bottom photographs, observer photographs, rock samples with associated epifaunal organisms, and voucher specimens. Additionally, a photographic techniques dive was conducted near Coho Anchorage to test the feasibility of taking standardized photographs of permanent quadrats during future monitoring studies.

Detailed descriptions of the survey area, major equipment, personnel, and data/sample collection and processing are presented in Sections 2.1.2.1 to 2.1.2.4, respectively.

2.1.2.1 Survey Area

Potential sites for the hard-bottom survey were selected based on (1) review of geophysical records (particularly side scan sonar) for the survey region; (2) results from the earlier soft-bottom survey conducted by SAIC (1984a), which indicated hard-bottom conditions at several stations; and (3) data obtained from local fisherman, indicating uncharted hard-bottom and "snag" areas in the survey region. Sites were then categorized according to depth and geographic location, and a representative range of these sites selected as final stations. Thirty-two potential stations ranging in depth from 200 to 1,000 ft initially were considered for the survey, with approximately two - one-half to one nmi transects planned at each station (SAIC, 1984b). Twenty-three of the stations represented new areas that had not been previously surveyed, while the remaining nine stations had been studied in part during earlier surveys (Dames and Moore, 1982 and 1983; Nekton, Inc., 1983 and 1984). At these latter sites, the present survey attempted to locate new areas, extend the boundaries of known features, and provide information for temporal comparisons. Final survey planning and logistics constraints resulted in single transects being surveyed at each of 13 stations and two transects at each of five stations, representing 20 new transects and three previously surveyed areas from approximately Goleta to Pt. Estero (Figures 2-5 through 2-7 and Table 2-3). A summary of the general locations of the transects and the source(s) used to identify these features is presented in Table 2-4. The data from two transects conducted at each of five sites

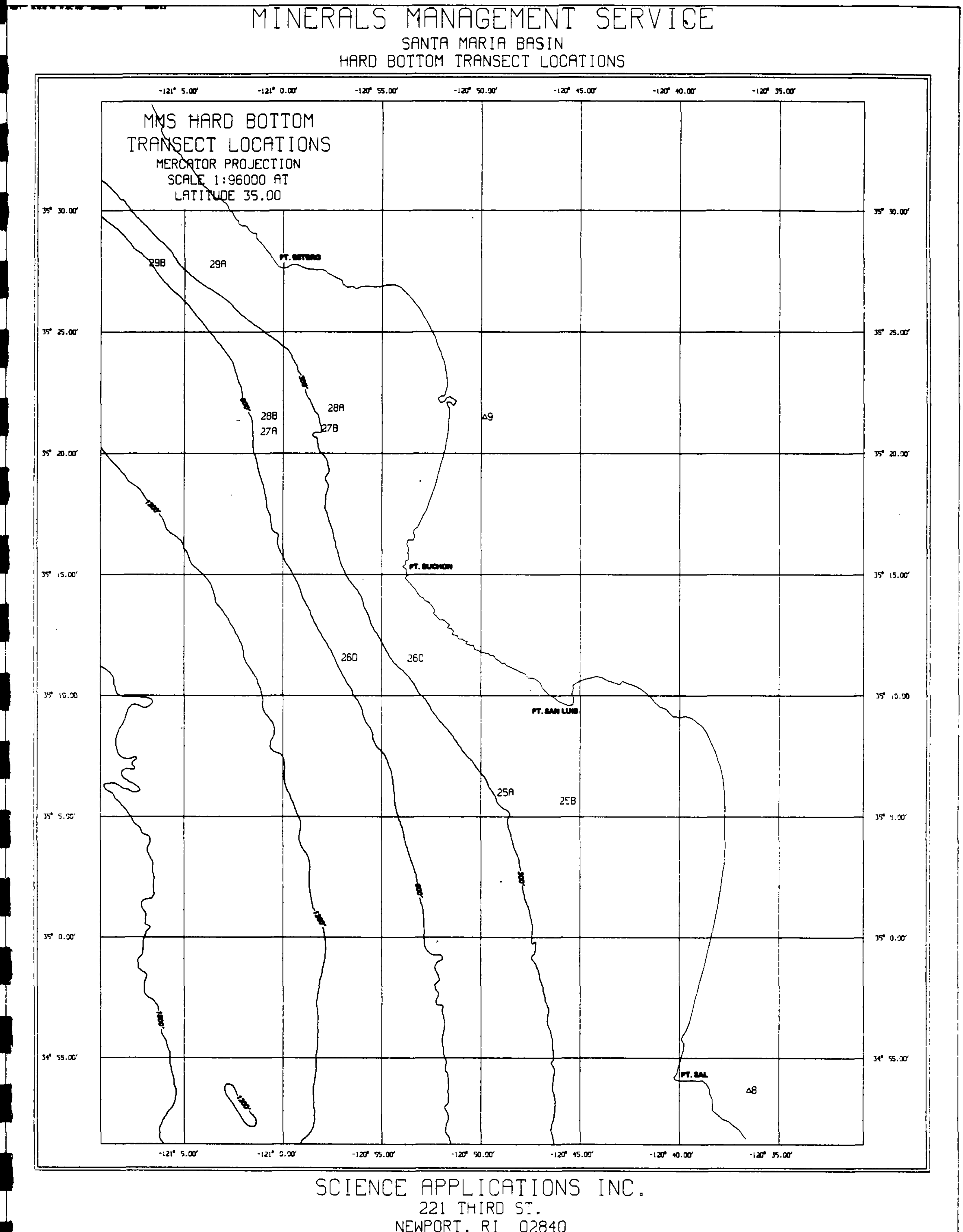


FIGURE 2-5. Hard-Bottom Survey Transect Locations Between Pt. Estero and Pt. Sal

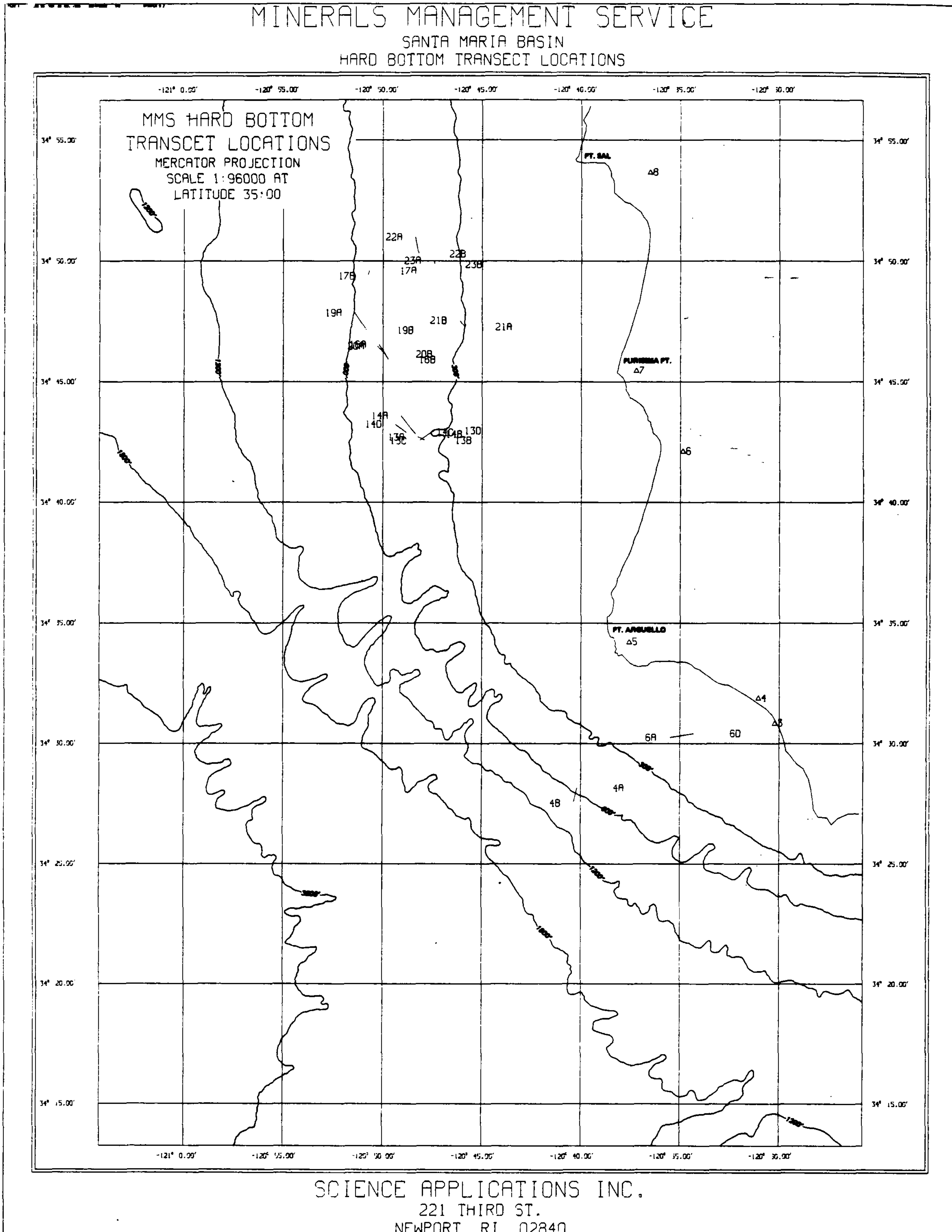


FIGURE 2-6. Hard-Bottom Survey Transect Locations Between Pt. Sal and Pt. Conception

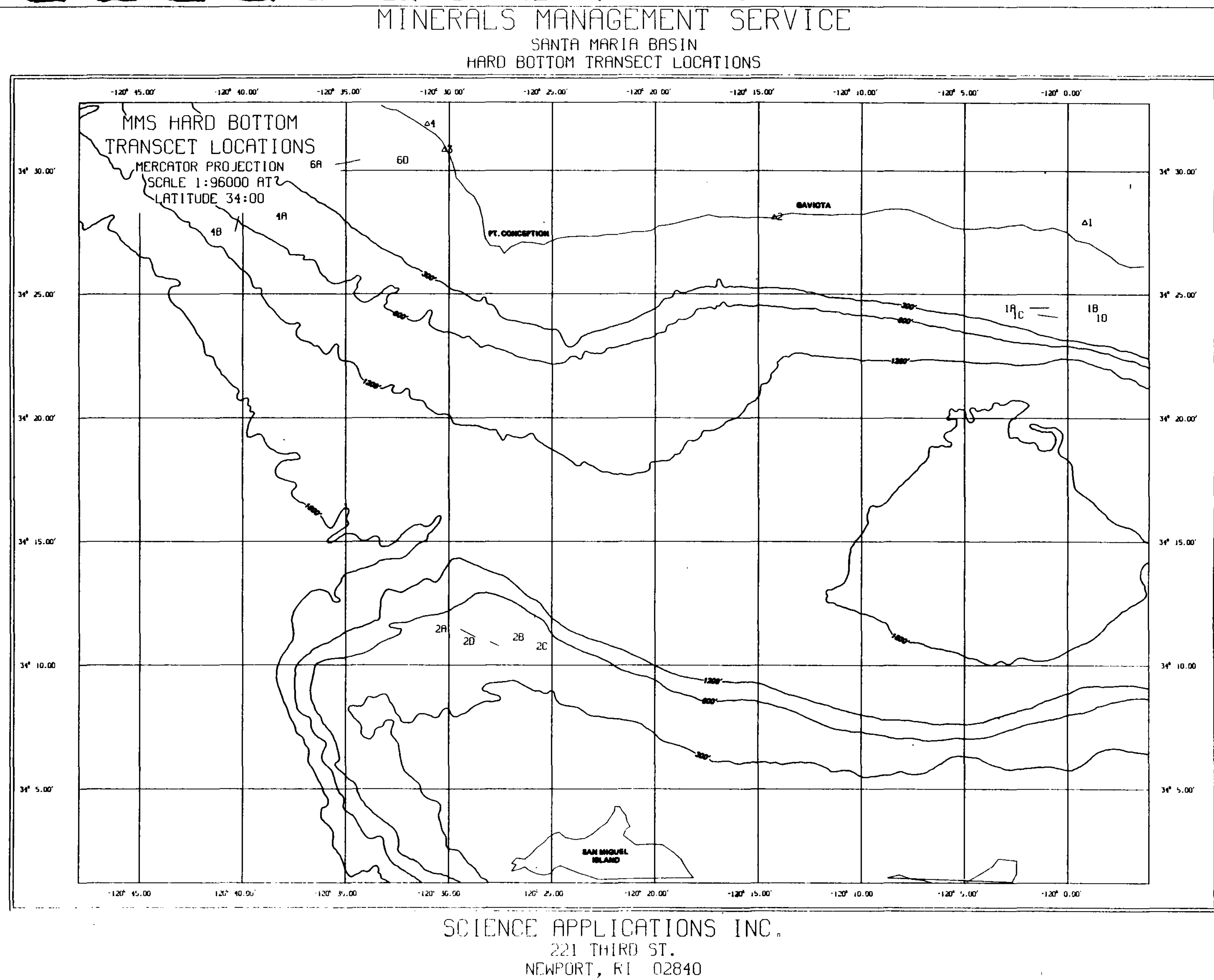


FIGURE 2-7. Hard-Bottom Survey Transect Locations Between Pt. Conception and Goleta

Table 2-3. MMS Hard-Bottom Survey Transect Locations (July/August 1984)

Sta. No.	Beginning Latitude (N)	Beginning Longitude (W)	End Latitude (N)	End Longitude (W)	Dist.[4] (nmi)	Depth Range (Ft)
1 A/B	34 24.454	120 01.876	34 24.464	120 00.878	0.83	230-245
1 C/D	34 24.076	120 00.443	34 24.184	120 01.480	0.86	245-260
2 A/B	34 11.377	120 29.318	34 11.289	120 28.774	0.46	330-420
2 C/D	34 10.984	120 28.094	34 10.780	120 27.554	0.49	400-410
4 A/B[1]	34 27.539	120 40.364	34 28.162	120 40.189	0.64	560-790
6 A/B	34 30.246[3]	120 35.555[3]	-- --.---	--- --.---	-.--	180-210
6 C/D	-- --.---	--- --.---	34 30.421[3]	120 34.315[3]	1.04	180-210
13 A/B	34 42.570	120 47.899	34 42.707	120 48.253	0.32	307-332
13 C/D	34 42.556	120 48.147	34 42.974	120 47.424	0.73	295-335
14 A/B	34 43.589	120 49.093	34 42.826	120 48.370	0.97	320-350
14 C/D	34 43.244	120 49.406	34 42.893	120 48.822	0.60	345-390
16 A/B[1]	34 46.544	120 50.197	34 45.912	120 49.726	0.74	305-410
17 A/B[2]	34 49.382	120 50.768	34 49.600	120 50.688	0.23	535-560
19 A/B	34 47.833	120 51.425	34 47.097	120 50.793	0.90	495-590
20 A/B[1]	34 46.470	120 50.289	34 46.140	120 49.885	0.47	300-435
21 A/B	34 47.335	120 45.903	34 47.548	120 46.123	0.28	250-300
22 A/B	34 50.365	120 48.221	34 50.990	120 48.365	0.64	380-385
23 A/B	34 49.868	120 47.393	34 50.003	120 47.480	0.15	330-340
25 A/B[2]	35 05.662	120 47.562	35 06.036	120 47.652	0.38	215-240
26 C/D[2]	35 11.586	120 55.556	35 11.555	120 55.233	0.27	360-370
27 A/B	35 20.906	120 59.657	35 21.035	120 59.603	0.14	320-420
28 A/B	35 21.539	120 59.641	35 21.867	120 59.299	0.43	320-350
29 A/B	35 27.864	121 05.331	35 27.805	121 05.277	0.07	340-355
				Total	11.64	

1 Previously surveyed.

2 Location obtained from interviews of local fishermen.

3 Two transects completed on a single dive.

4 Straight line distance (beginning to end of transect); actual distances are estimated to be at least two times longer due to lateral movement.

Table 2-4. General Location and Hard-Bottom Areas from the July/August 1984 Hard-Bottom Survey.

Transect No.	General Location*	Comments
1A/B and 1 C/D	P - 0460	Geophysical record indicates potential outcrop/sedimentary rock extending over broad (approximately 1 x 3 nmi) area.
2 A/B and 2 C/D	P - 0179	Charted (NOAA) outcrop area extending north of San Miguel Island
4 A/B	P - 0315	Charted (geophysical record), intermittent outcrop area approximately 1 nmi x 0.01 nmi. General region previously surveyed by Nekton, Inc., 1983 and 1984.
6 A/B and 6 C/D	P - 0453	Geophysical record indicates potential outcrop feature extending over broad (approximately 1 x 2 nmi) area.
13 A/B	P - 0434	Geophysical record indicates potential outcrop feature extending over approximately 1/2 x 1 nmi area.
13 C/D	P - 0434	Same as 13 A/B but potential feature is an intermittent outcrop extending over approximately 1/4 x 1/2 nmi area.
14 A/B and 14 C/D	P - 0433	Geophysical record indicates potential outcrop feature extending over intermittent, broad (approximately 3/4 x at least 2 nmi) area.
16 A/B	P - 0425/0430	Geophysical record indicates broad (> 2 x 2 nmi) potential hard-bottom area. General region previously surveyed by Nekton, Inc. (1981)
17 A/B		Fishermen's record localized rock piles, "hole", and spot prawn.
19 A/B	P - 0424	Geophysical record indicates narrow (approximately 0.1 x 1.5 nmi) region of "irregular" topography.
20 A/B	P - 0425/0430	Geophysical record indicates very broad (> 2 x 2 nmi) potential hard-bottom area. General region previously surveyed by Nekton, Inc. (1981).
21 A/B	P - 0426	Geophysical record indicates small (approximately 1/4 x 1/2 nmi) potential outcrop area.
22 A/B	P - 0421	Geophysical record indicates narrow (approximately 0.1 x 0.5 nmi), intermittent potential outcrop area.
25 A/B	Pt. San Luis	Fishermen's record; "Seven Mile Reef" outcrop area.
26 A/B	Pt. San Luis	Fishermen's record; outcrop area offshore of Lion Rock.
27 A/B	Pt. Estero	Localized hard-bottom area indicated by rock collection at soft-bottom survey Station 006 BSS.
28 A/B	P - 0374	Geophysical record indicates narrow (approximately 1/8 x 1/2 nmi) potential outcrop area.
29 A/B	Pt. Estero	Localized hard-bottom area indicated by rock collection at soft-bottom survey Station 001 BSS.

*P - OXXX refers to lease block number.

(1 A/B - 1 C/D, 2 A/B - 2 C/D, 6 A/B - 6 C/D, 13 A/B - 13 C/D and 14 A/B - 14 C/D) are used to assess within site variability (Section 3.2.2). Overall transect distances ranged from 1.04 to 0.07 nmi in length, although each transect was estimated to be at least two times longer due to lateral movement and planned excursions away from the transect lines. The overall depth range was from 180 to 790 ft, with the majority of the transect coverage occurring from 300 to 400 ft. Three of the transects (4 A/B, 16 A/B, and 20 A/B) represent areas previously surveyed by Nekton, Inc. (1983 and 1984, and 1981, respectively); data from these surveys are compared with the results from the present survey (Section 3.2). Three transects (17 A/B, 25 A/B, and 26 C/D) were conducted in potential hard-bottom areas recommended by local fishermen; survey results indicated that 17 A/B and 25 A/B were predominately hard-bottom, however 26 A/B was characterized as soft-bottom. Overall, 17 of the 23 total transects were characterized by > 50% hard-bottom, while six transects were determined to be primarily (> 90%) soft-bottom. Detailed descriptions of each transect are presented in Section 3.2.1.

In addition to the transect surveys, an additional dive was made in Coho Anchorage as part of an assessment of photographic techniques for long-term monitoring surveys (Section 2.1.2.4).

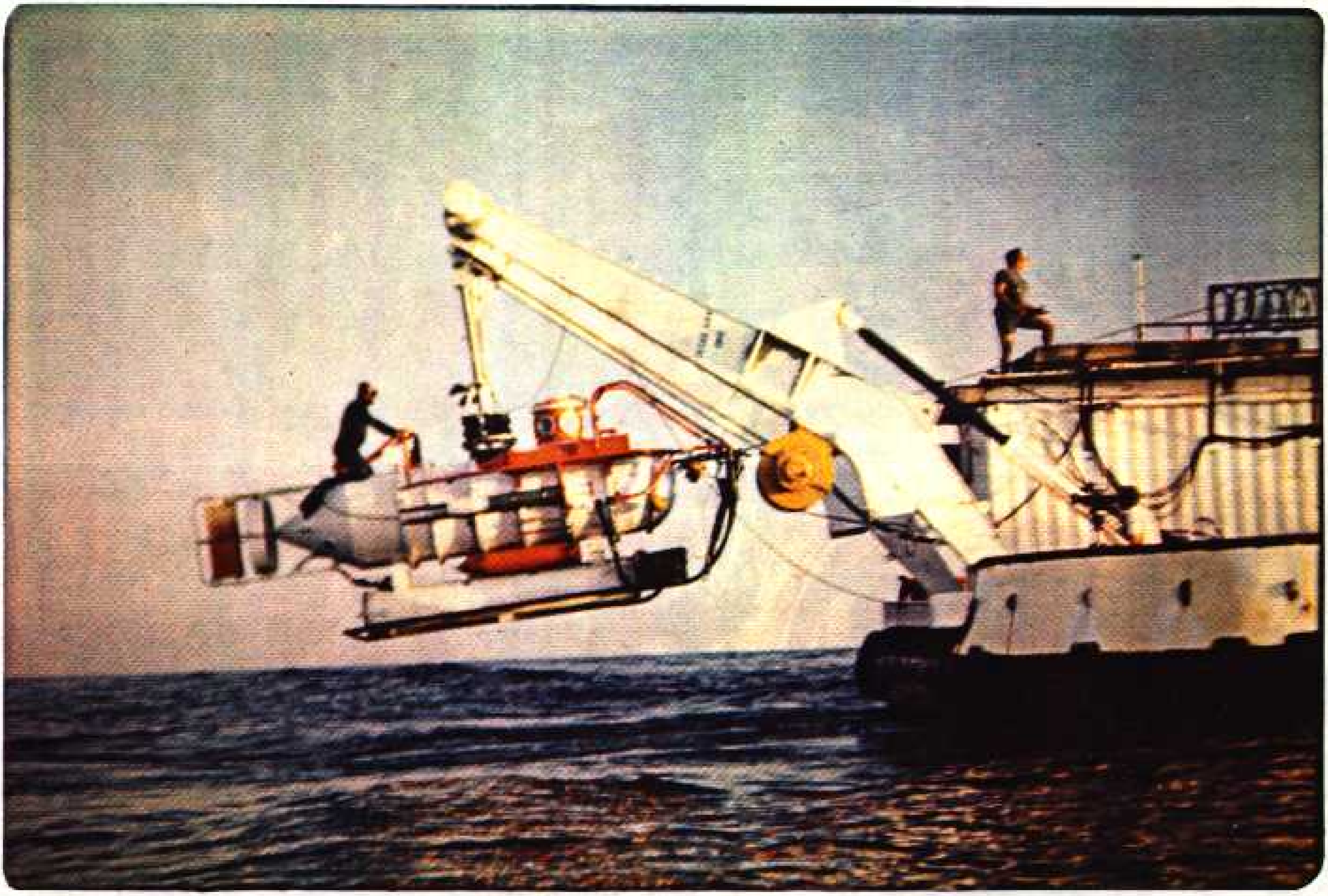
2.1.2.2 Major Equipment

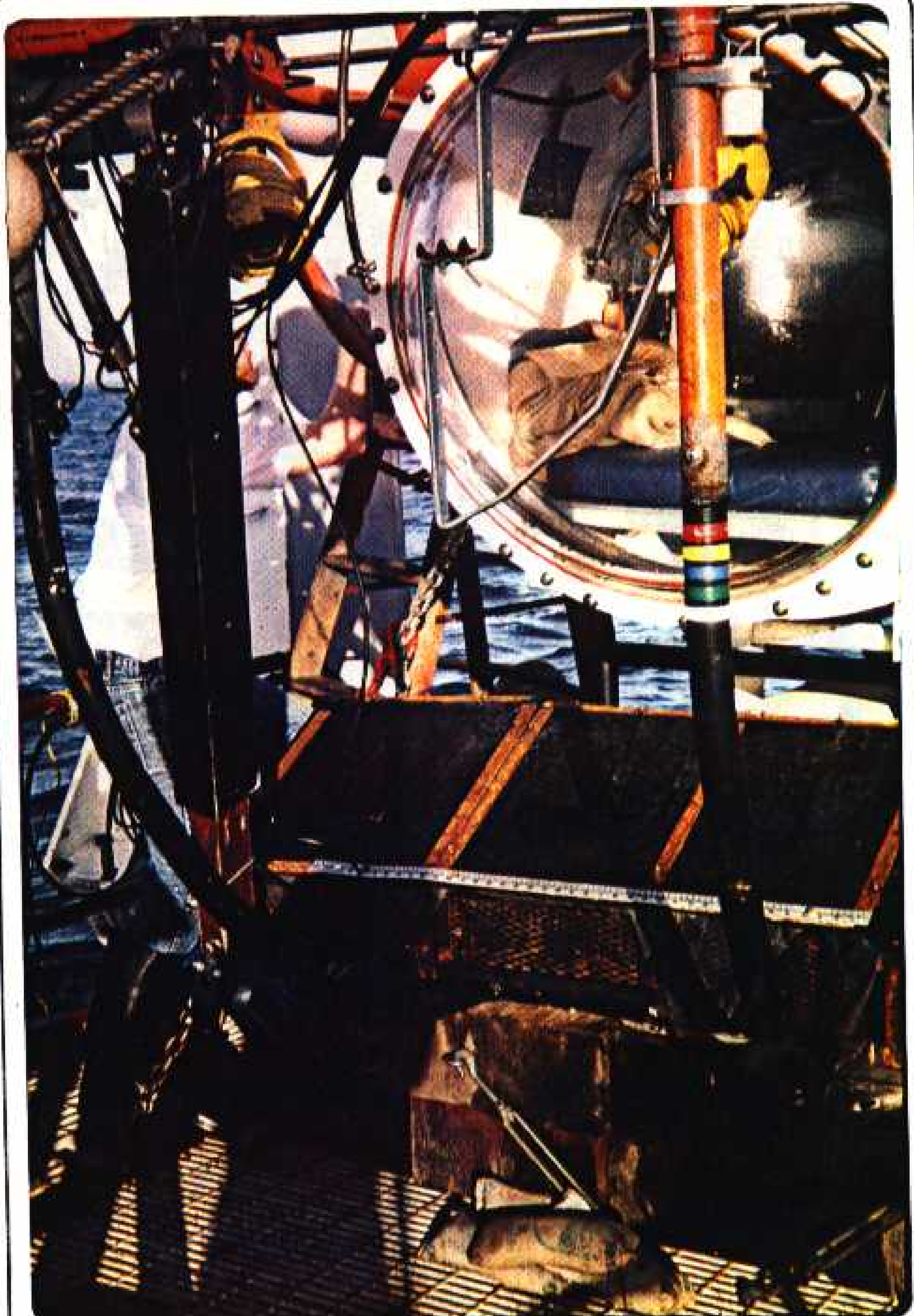
Manned Submersible and Support Systems

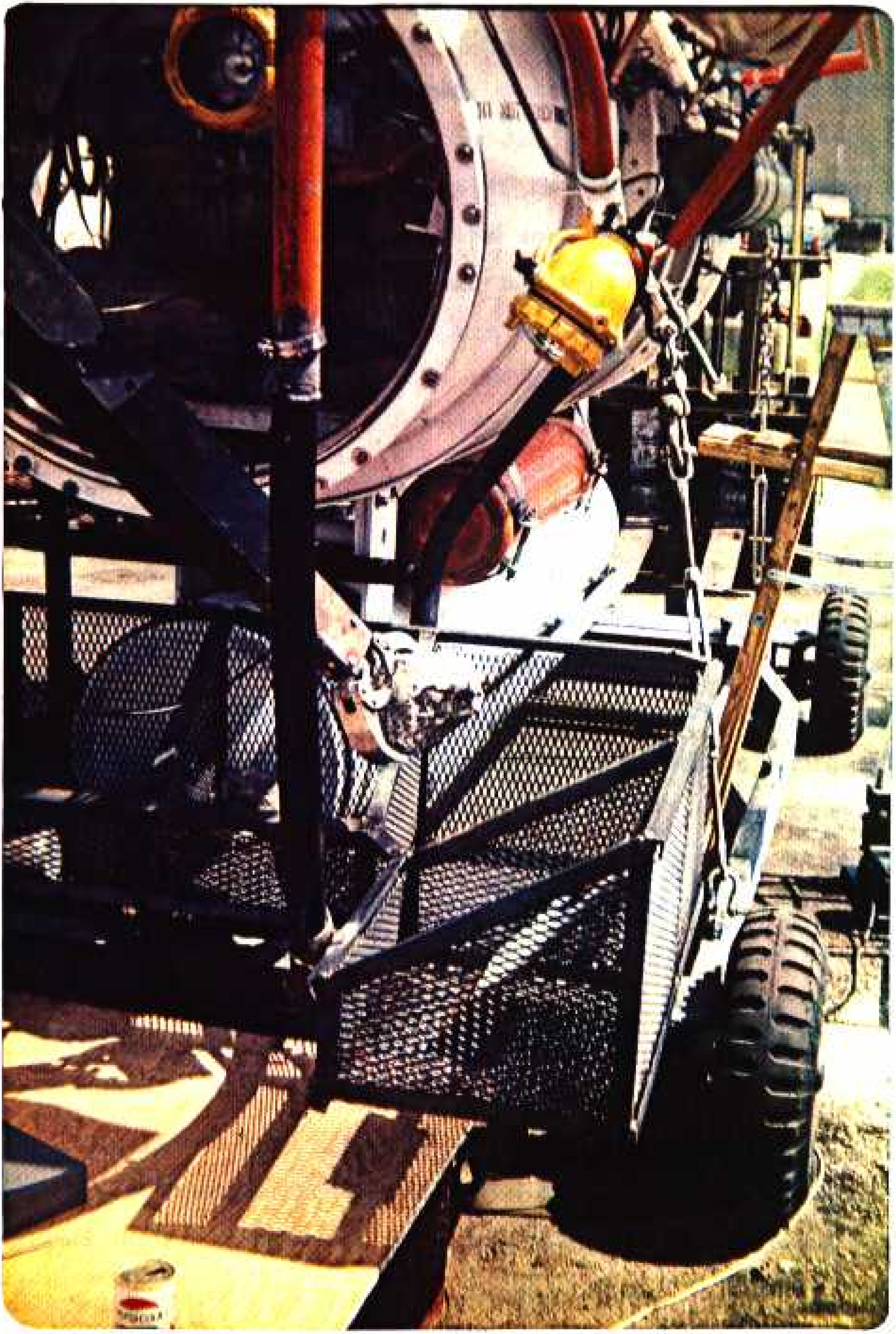
The DRV DIAPHUS, owned and operated by Texas A&M University (Galveston, TX), was the manned submersible used during survey operations (Figure 2-8). DIAPHUS is equipped to carry a crew of two (pilot and one observer), and is rated to a depth of 1200 ft. A three ft diameter bow dome is used for viewing by the observer. The handling system for launch and recovery of the submersible is a hydraulically operated U-frame, which was installed onboard the support vessel M/V BONNE CHANCE. The handling system generally allowed survey operations to be conducted in calm to moderate sea conditions (approximately up to eight foot swells), depending on wind speed and surface chop; however, during calm wind conditions, several dives were made in 10 to 15 foot swells.

DIAPHUS has a four-function manipulator arm with an opening width of 7" for collection of voucher specimens and rock samples. In addition, SAIC incorporated a design modification to the collecting basket so that the new configuration consisted of four approximately 12" x 12" x 12" (sloping to 6" in the front) baskets, each opening at the top through slotted rubber mats (Figures 2-9 and 2-10). This design incorporates (1) large volume for sample storage; (2) allows partitioning of samples from different sites along a transect; and (3) protects the samples from loss or damage during recovery

Figure 2-8. DRV DIAPHUS.







shadow that became diffuse at offsets greater than 5 ft. Quantitative analysis of the photographs (see Section 2.2.3) was therefore restricted to the range of photographs taken from 4 ft to 5 ft; other photographs were judged to be too variable in surface area and were assessed for qualitative information only. For the photographic techniques dives, a bottom contact switch was used to trigger the camera at a set distance (5 ft) off the bottom (see Section 2.1.2.4).

Survey Vessel

The M/V BONNE CHANCE, owned and operated by Richill Marine (Ventura, CA), was used as the support vessel for survey operations. The vessel is a 165-ft cargo/supply boat, having ample deck space (>20 x 20 ft) and clearance to accomodate the U-frame handling system for DIAPHUS. The BONNE CHANCE is equipped with a bow thruster, to facilitate station-keeping during survey operations and launch and recovery of the submersible. For the survey, SAIC supplemented the vessel's capabilities by adding a precision depth recorder (EDO Western), and navigation systems for ship-to-shore and ship-to-submersible positioning (see Navigation, this section).

Navigation

The survey vessel's position was determined using SAIC's integrated Navigation and Oceanographic Data Acquisition System interfaced to a Del Norte Model 545 digital distance measuring unit (DDMU). The navigation system centers around a Hewlett Packard Model 9816 micro-computer, which was interfaced to a plotter, a printer, a Honeywell HydroStar submarine navigation system and the Del Norte DDMU. Range measurements from shore-based transponders were input into the computer, which in turn calculated the ship's position, as well as a range and bearing to an operator input destination. For the survey, three shore-based transponders were set up and maintained by Oceaneering International (Santa Barbara, CA). Accuracy of the ship-to-shore system was approximately one to three meters.

The geodetic position of the submersible, relative to the survey vessel, was determined using a Honeywell HydroStar navigation system interfaced to the SAIC navigation system, and a transducer attached to DIAPHUS. This system requires periodic input of the submersible's depth (provided by the submersible crew via radio), and provided accuracy of approximately three to five meters.

2.1.2.3 Personnel

The scientific survey party during each of the two survey legs consisted of three biological observers, one navigator and one biologist/technician provided by SAIC and MBC, and four submersible support crew, including two pilots from Texas A&M (Table 2-5). Cruise leaders were Drs. Andrew Lissner and Robert Shokes (SAIC) for Legs I and II, respectively. Senior biologists for Legs I and II were Drs. Lissner and Jack Engle (CMSC),

TABLE 2-5. Scientific Survey Party - Hard-Bottom Cruise

Responsibility (affiliation)	Leg I[1]	Leg II[2]
Dr. Andrew Lissner/Cruise Leader, Senior Biologist (SAIC)	X	X
Dr. Robert Given/Biological Observer (CMSC)	X	
Donald Cadien/Biological Observer, Sample Processing (MBC)	X	
Jack Cutler/Navigator (SAIC)	X	X
Richard Wright/Technician, Sample Processing (Consultant)	X	X
William Green/Chief Submersible Pilot (Texas A&M)	X	X
David Barrow/Submersible Pilot (Texas A&M)	X	X
Ken Bottom/Submersible Crew (Texas A&M)	X	X
Mark Spears/Submersible Crew (Texas A&M)	X	
David Reid/Submersible Crew (Texas A&M)		X
Dr. Robert Shokes/Cruise Leader (SAIC)		X
Dr. Jack Engle/Senior Biologist (CMSC)		X
Suzanne Benech/Biological Observer (Consultant)		X
Laurence (Bud) Laurent/Biological Observer (Consultant)		X

SAIC (Science Applications International Corporation)
MBC (MBC Applied Environmental Sciences)
CMSC (Catalina Marine Science Center)

[1] July 7 to July 19, 1984
[2] July 20 to August 2, 1984

respectively. Dr. Lissner also participated during the first part of Leg II to ensure standardization of observers and methodology between legs. MMS observers were Dr. Fred Piltz (Leg I) and Dr. Robert Gillard (Leg II).

2.1.2.4 Data/Sample Collection and Processing

Data and samples collected during the transect surveys consisted of continuous color video and observer commentary, 35 mm bottom photograhs, 35 mm observer documentation photographs, rock samples for epifaunal analysis, and voucher specimens. All data records were referenced to the time of collection to allow cross-correlation with corresponding navigational positions along a transect. Navigational positions (fixes) were determined every 20 seconds and averaged to minute intervals for final data presentation (transect plots at scales of 1:96,000, 1:12,000 and 1:2,000; and tables of time and latitude/longitude).

The biological observers were all experienced taxonomists/ecologists familiar with the taxa of the survey region; however, prior to and during the survey, standardization and review sessions were conducted to exchange information on species observed during previous surveys, characteristic features for field identification of species, format for the observer commentary, and potential problems. Pre-survey species lists were developed from several sources including Dames and Moore (1982 and 1983), Engineering-Science (1984), and Nekton Inc. (1983 and 1984). Additionally, a species reference file (5" x

8" index cards) was developed containing photographs, identification characteristics, similar species and ecological notes for each taxon. The species lists and reference file were updated during the survey as additional species were noted; a polaroid camera was used to provide photo-documentation of voucher specimens not already represented in the reference file.

During the survey the observers were requested to identify all taxa possible, providing estimates of the number of individuals per m^2 for organisms such as anemones or cup corals for which discrete individuals could be distinguished, or percent cover for colonial or encrusting organisms, e.g. sponges. Abundance estimates relative to surface area were visually calibrated using a scaler attached to the back frame of the collecting baskets, within view of the observer. Limitations in the field identifications and abundance estimates made from the submersible are related to three primary factors: inability to identify some taxa without collecting a specimen for laboratory study, inability to resolve key features on many small taxa less than one centimeter in length or diameter, and observer inaccuracies in areal estimates and abundances within these areas. All of these factors were critically discussed among the observers, and conservative identification limits were established for each taxon. For example, "encrusting orange sponge" probably represents the lowest practical observer identification level for these type of sponges. During survey operations, submersible speed over hard-bottom features generally was very slow (0 to 1/4 kt) to increase the time available to make accurate observations. Subsequent analysis of photographic and observer data attempted to further standardize the data by elevating some species identifications to a higher taxonomic level (e.g., from genus to family) if there appeared to be taxonomic uncertainties or inconsistencies among observers. In practice this was rarely necessary except for groups such as sponges to which only descriptive names (e.g., encrusting orange sponge) could be applied due to incomplete taxonomic information.

Substrate type, including soft-bottom versus hard-bottom (boulders, outcrop, etc.), and relief, and percent sediment cover on hard-bottom features also were noted by the observers. Horizontal visibility, water temperature (DIAPHUS temperature probe) and bottom current (DIAPHUS current meter and pilot estimates based on headway into the current at various engine speeds) were estimated at the beginning of the dive and as significant changes occurred. Time and depth observations were recorded at approximately one minute intervals.

In addition to the verbal data record, rock samples from representative habitats along the transects, and voucher specimens of dominant taxa were collected using the submersibles manipulator arm. Attempts were made to photograph the rock samples in place prior to collection using the observer camera. All rocks and specimens were carefully placed in the numbered bins of the collecting basket to allow the samples to be distinguished and catalogued at the surface. Samples were relaxed in 6% $MgCl_2$ for approximately one hour and then transferred to 10% buffered formalin for preservation and transfer to the shore based laboratory (MBC).

At the completion of each transect dive a debriefing session was conducted by the senior scientist to discuss species and assemblages observed, standardization of species identifications, and any problems encountered.

A modified method of conducting photographic surveys, using a bottom contact system to trigger the externally mounted Photosea camera, was assessed during a survey of five photographic quadrat stations occupied in Coho Anchorage. The bottom contact system consisted of a weighted line attached to the camera and suspended approximately five feet below the submersible. Photographs were taken by ballasting the submersible up and down, thereby touching the weight to the seabottom (releasing the line tension) and triggering one photograph for each drop. During the survey, five quadrats were marked using the submersible's manipulator arm to place a 0.5 m^2 frame on the bottom. The submersible first moved away from the quadrat, repositioned and then attempted to touch the bottom contact weight near the center of the quadrat. This process was repeated five times for each quadrat. The camera was positioned at a sufficient height above the bottom so that the surface area of the photograph was larger than the quadrat frame. This aided in obtaining replicate photographs of the quadrat that were somewhat independent of the accuracy with which the bottom contact weight could be positioned by the submersible.

This method allowed photographs to be taken at the same relative distance off the bottom, resulting in photographs showing approximately the same surface area for standardization of abundance counts. Lack of standardization during previous surveys has limited the types of statistical tests that could be applied, and could limit temporal comparisons during future monitoring studies.

2.1.3 Supplementary Observations

Visual observations of marine birds, mammals, and fishing activity were conducted at each station or transect during the soft-bottom and hard-bottom surveys, respectively. Approximately half of the soft-bottom survey observations probably were biased (lowered) due to night survey operations, since bird and mammal activity and observer visibility is reduced. All hard-bottom observations were made during daylight hours. For the soft-bottom survey, observations were pooled over the length of time (generally 30 minutes) required to sample a station, and were made by the watch leaders (see Personnel Section 2.1.1.3) from the rear deck of the survey vessel. For the hard-bottom survey, the surveys were accomplished by an observer standing on the support vessel's upper deck; the observer turned slowly in a 360° radius over a 10-minute period, identifying and counting the birds, mammals and fishing vessels within the range of field binoculars. Significant events, such as large schools of dolphins observed at other times also were noted. During Leg 1 of the hard-bottom survey, the surveys were conducted primarily by A. Lissner; during Leg II, S. Benech conducted the bird and mammal observations, and L. Laurent conducted the fisheries surveys.

2.2 LABORATORY METHODOLOGY

Laboratory methods used for analyzing biological (infauna and epifauna), chemical (hydrocarbons, trace metals, and TOC), and geological (grain size) samples are presented in Sections 2.2.1 through 2.2.5.

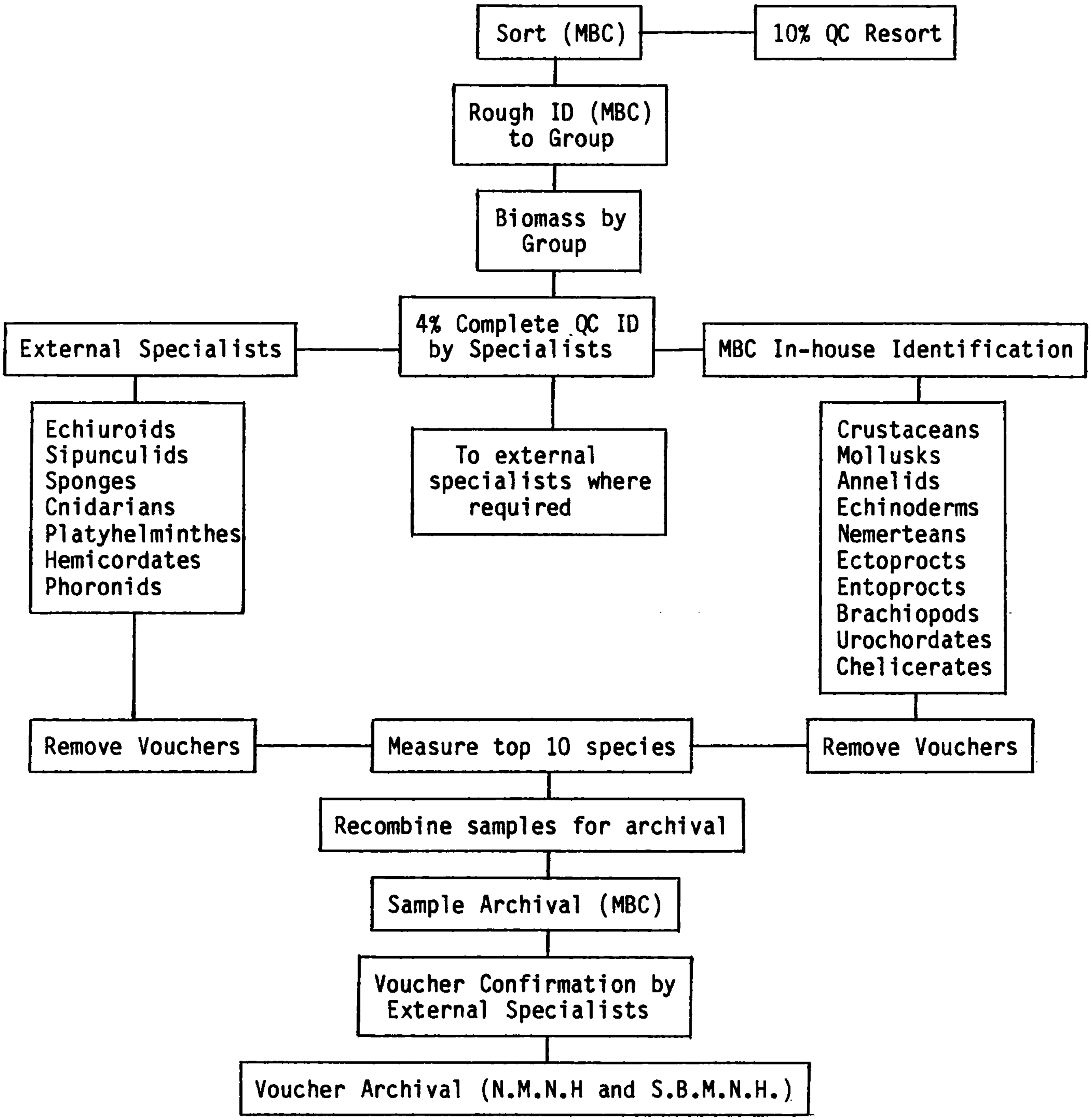
2.2.1 Infauna

Infaunal samples consisted of both 0.5 mm and 1.0 mm size fractions for each of the 142 separate grabs collected, for a total of 284 samples. The organisms and data generated during laboratory analyses of the two size fractions were maintained separately except during data analysis when the two fractions were combined (see Section 2.3). Laboratory methodologies for processing infaunal samples were the same for each of the two size fractions (Figure 2-11) as described in Sections 2.2.1.1 to 2.2.1.4.

2.2.1.1 Sorting

Samples were sorted under dissecting microscopes at 6X magnification into the following major groups: annelids, crustaceans, echinoderms, mollusks, and others. A non-random, quality control resort was conducted by supervisory personnel on 10% of the samples. One sample processed by an individual sorter was selected for initial resort. If the removal efficiency in any sample was less than 95%, the sorter was advised of the types of organisms missed.

Figure 2-11. Laboratory Biological Analysis Flow.



Organisms recovered during resort were recombined with the remainder of the sample. Samples subsequently sorted by this individual were monitored to ensure the 95% sorting efficiency level.

2.2.1.2 Biomass Measurements

Organisms within each major group were wet-weighed on small, wire-mesh screens. Each screen was pre-weighed after submersing in alcohol, shaking three times, and blotting on a paper towel for five minutes. Screens were weighed on a Mettler balance to the nearest 0.001 gm. Animals were then placed on the screen and the above procedure was repeated. The total weight minus the tare weight provided the wet weight of the animals. Sea cucumbers and other organisms whose weight consisted mainly of trapped fluid were punctured, drained, and blotted for five minutes before weighing. Biomass data were recorded on standard code sheets.

2.2.1.3 Identifications

Specimens were distributed to the respective MBC taxonomists and specialists from other institutions (Table 2-6). Attempts were made to consult taxonomists involved in the previous MMS Southern California Baseline Study whenever possible. In addition, a complete quality control identification of 4% of the samples were performed by external specialists to ensure consistency of taxonomic identification. All data were recorded on standard code sheets.

Table 2-6. Taxonomic Specialists Participating in Identification of Biological Samples.

Taxonomic Group	Specialist	Affiliation
Porifera	K. Green	MEC
Cnidaria	F. G. Hochberg	SBMNH
	J. Ljubenkov	LaMer
Platyhelminthes	B. Thompson	SCCWRP
Nemertea	B. Thompson	SCCWRP
	D. Tsukada	SCCWRP
Annelida	J. Dorsey	LACSD
	K. Green	MEC
	L. Lovell	MEC
	D. Montagne	JWPCF-LACo
	J. Shisko	LACSD
	R. Velarde	CSD-PL
	S. Williams	AHF
Echiura	B. Thompson	SCCWRP
Sipunculida	B. Thompson	SCCWRP
Arthropoda	J. L. Bernard	NMNH
	R. C. Brusca	LACMNH
	J. Chapman	USEPA
	B. Myers	IND
	M. Wicksten	TAMU
	R. Winn	IND
Mollusca	W. K. Emerson	AMNH
	F. G. Hochberg	SBMNH
	P. Scott	SBMNH
	J. Shrake	MEC
Echinodermata	M. Bergen	IND
	A. Lissner	SAIC
	A. Muscat	CMSC
Phoronida	R. Zimmer	USC
"Bryozoa"	J. Soule	SOS
	D. Soule	SOS

Table 2-6. (cont'd)

KEY:

AHF	Allan Hancock Foundation
AMNH	American Museum of Natural History, New York
CSD-PL	City of San Diego, Pt. Loma Sanitation Facility
CMSC	Catalina Marine Science Center
IND	Independent
JWPCF-LACo	Joint Water Pollution Control Facility, Los Angeles County
LACMNH	Los Angeles County Museum of Natural History
LACSD	Los Angeles City Sanitary District, Hyperion Treatment Plant
LaMer	LaMer Taxonomic Consultants
MEC	Marine Ecological Consultants
NMNH	National Museum of Natural History, Smithsonian Institution, Washington D.C.
SAIC	Science Applications International Corporation
SBMNH	Santa Barbara Museum of Natural History
SCCWRP	Southern California Coastal Water Research Project
SOS	SOS Consultants
TAMU	Texas A&M University
USC	University of Southern California
USEPA	U.S. Environmental Protection Agency, Newport Marine Center, Oregon

Voucher specimens were prepared for all identified species. Voucher specimens for previously undescribed species were supplemented by a brief diagnosis and/or drawings of diagnostic characters. Voucher collections were deposited in the United States National Museum, the primary archival institution. The Santa Barbara Museum of Natural History was chosen as the secondary archival institution because a considerable amount of regional taxonomic and ecological research is performed at this institution.

2.2.1.4 Size Frequency

In addition to wet weight biomass and abundance values, selected soft-bottom species were measured to provide length-frequency data. This information was collected to provide an additional basis for assessing changes in biota associated with future oil and gas activities. Selected species were chosen on the basis of the following five criteria: 1) the species had to be sufficiently abundant (>10 animals) in both the 0.5 mm and 1.0 mm size fractions; 2) the species had to be present at a number of stations and over a broad geographic range in the study area; 3) species should represent different phyla, feeding modes, and habitats in order to obtain a diversity of species with perhaps a range of responses; 4) the species should be large, long-lived, "K" selected species that tend to be relatively constant in their abundance and size distribution; and 5) species should have been studied previously to provide conservative external structures that can be easily measured.

The eight selected species and characteristics for which they were selected along with the results of size dimension measurements are provided in Appendix F. Each specimen was examined under dissecting microscope using an ocular micrometer. The size of the structure measured was recorded on a standard data sheet.

2.2.2 Epifauna

Voucher specimens of epifaunal organisms and rock samples for analysis of epifauna were collected during the hard-bottom survey (Section 2.1.2). All samples initially were removed from the submersible collecting baskets, relaxed in 6% MgCl for approximately three hours and then fixed in 10% buffered formalin. Laboratory methodologies are described in Sections 2.2.2.1 and 2.2.2.2, respectively.

2.2.2.1 Hard-Bottom Voucher Specimens

Voucher specimens were transported to the laboratory, logged in, rinsed to remove formaldehyde, and transferred to 70% alcohol for preservation. Identifications were performed by MBC personnel and taxonomic consultants as specified in Section 2.2.1.

2.2.2.2 Rock Scrapings

Rock samples collected during the submersible dives were transported to the laboratory, removed from the sample bucket, and rinsed to remove formaldehyde. Animals dislodged by these washings, as well as those that had fallen into the buckets, were collected and processed with the rest of the sample. All solitary animals were then removed from the rock and placed in a sample jar. Solitary organisms were identified by MBC personnel and taxonomic consultants as specified in Section 2.2.1. Identification vouchers and voucher sheets also were completed as described in Section 2.2.1. Data on the number of specimens for each species were recorded on coding sheets.

Abundance values for the remaining colonial organisms were determined using a standard point contact method adapted for a multidimensional surface. The surface of each rock was divided according to the major faces, and the size of each face was measured. One hundred total points were designated for each rock, and were stratified or divided so that each face had a number proportional to its area. Abundance values were determined by placing each rock in a large tub, and a clear plastic sheet with a grid of points was placed over each rock face. The points to be examined on the grid were determined from a random numbers table. Each point was examined from above with a dissecting scope and a high intensity light source. Unidentifiable specimens were given descriptive names and removed from the rock for subsequent identification by the taxonomists.

After all points from a particular face were examined, the rock was rotated to examine the next face. This process was repeated until all faces and all 100 points were examined. Observations were expressed as percent cover and recorded on data sheets. Other species observed but which did not occur under a grid point were recorded as present and generally represented <1% cover.

2.2.3 Photographic Analysis

Analysis of photographic data was performed on 35 mm slides (bottom photographs) from the hard-bottom survey, and 8" x 10" black and white photographs (bottom photographs) and 35 mm slides (sediment core profiles and surface views) from the soft-bottom survey. Discussion of recording and cataloguing methods for the soft-bottom and hard-bottom photographic data are presented in Sections 2.2.3.1 and 2.2.3.2, respectively.

2.2.3.1 Soft-Bottom Photographic Data

The slides of the sediment cores were projected onto a viewing screen and qualitative information on color, texture, layering and bioturbation was noted and tabulated by a geologist (Dr. W. Anikouchine, Santa Barbara, CA). The 8" x 10" photographs were analyzed for species, relative abundance and bioturbation and the data tabulated by two biologists (Dr. A Lissner - SAIC and D. Cadien - MBC). Interpretation of these data and discussion of trends and patterns was conducted as part of the general analysis of sedimentology (Section 3.1.1) and soft-bottom biological assemblages (Section 3.1.3).

2.2.3.2 Hard-Bottom Photographic Data

The 35 mm bottom photographs were projected onto a viewing screen and each slide was completely analyzed by two biologists (Dr. A. Lissner - SAIC and Dr. Jack Engle - CMSC) for several parameters including (1) species; (2) abundance (density or percent cover per slide); (3) bottom type (hard-bottom or soft-bottom) and percentage of predominant bottom type; (4) percentage of sediment cover of hard-bottom features; (5) substrate relief, if feasible to estimate from the orientation of the photograph, defined as low (0-3 ft), medium (3-10 ft), or high (>10 ft); (6) hard-bottom substrate type (outcrop, boulder, cobble, pebble, rubble); (7) quality of the photographic exposure (correct, underexposed = partly dark or dark, or overexposed = "burned" or in rare occasions "partial light leak" near the end of a film roll); and (8) distance off the bottom (4 to 5 ft = standard distance, >5 ft = partly dark or dark, and <4 ft = close-up or blurred). The distance estimates were significant in the calculation of surface area as applied to estimates of species density per slide, and in practice only those slides classified as "standard distance" (4 to 5 ft off the bottom) were used in quantitative comparisons. The standard distance slides could be recognized by the presence of a distinct shadow from part of the mounting frame of the submersible, corresponding to observer notations that the submersible was "on-bottom", "just off-bottom" or "one foot off-bottom". The shadow became diffuse at distances greater than 5 feet off the bottom, also corresponding to progressively darker (underexposed) photographs as the illumination from the strobe was attenuated at greater distances off the bottom. Photographs taken closer than four feet generally were blurred and overexposed. Using known geometric relationships for the Photosea camera utilized (optimum focal distance set for 4 to 6 feet off the bottom) and four to five foot distances from the camera to the subject (sea bottom), the surface area for the standard distance slides was determined to be 0.9 m^2 and 1.4 m^2, respectively. Since the difference between four and five foot distances could not be determined in all cases from the shadow and the quality of the exposure, the density estimates were assumed to be within the range of 0.9 to 1.4 m^2. Abundance estimates were made for all slides independent of the quality (standard distance, too close, or too far) to provide data for potential comparisons of relative abundance; however, only the standard distance slides were planned for use in the statistical analyses by assuming a potential range in density estimates from 0.9 to 1.4 m^2. Data from the remaining slides were only used in presence/absence calculations and analyses. For the photographic analyses, the data for each slide were coded and tabulated for computer entry and subsequent analysis along with the observer data. Combination of the photographic and observer data for the same minute interval into a single record for each data type (e.g., density estimates for discrete taxa, or substrate relief) required assignment of a priority of data usage per data type where differences existed between the observer and the photographic record. Observer records were assigned priority for physical parameters (e.g., susbstrate type and relief) because of the broader perspective possible compared with downward looking photographs, and large, generally lower density taxa (e.g., fish, feather stars and barrel sponges). The photographic data were assigned priority for high density, generally small taxa (e.g., cup corals) which are more difficult for observers to identify within a generally limited time frame and still provide accurate density estimates. The coded raw data for the hard-bottom analyses are presented in Appendix H.

2.2.4 Chemistry

2.2.4.1 Hydrocarbons in Sediments

Sediment samples were transported frozen to SAIC's Trace Environmental Chemistry Laboratory (La Jolla, CA), and then logged and stored frozen until the initial preparation of sediments for analysis. Prior to extraction, samples were thawed and warmed to room temperature.

Sediment samples were extracted using a shaker-table procedure described by Payne et al. (1978a) and Brown et al. (1980) which yields results comparable to those obtained by Soxhlet extraction (MacLeod et al., 1982; MacLeod and Fischer, 1980; Payne et al., 1979). For this extraction procedure 50 to 100g of thawed sediment were placed in tared, 500 ml Teflon jars and a wet weight was determined. Samples were spiked with 50 μl of surrogate standard n-decylcyclohexane. Sediment water was removed during two successive drying cycles by adding approximately 50 ml of methanol to the sediment, agitating the samples on a shaker table for 15 minutes, and then centrifuging at 2,000 rpm for 10 minutes at room temperature. After the second drying cycle, 150 ml of methylene chloride and methanol (65:35 v/v) were added and agitation was continued for 12 hours. The samples were centrifuged, and the procedure repeated with agitation for six hours. Percent dry weight was determined separately by placing 10g wet sediment in a tared tin, weighing the wet sediment, drying the sample overnight at 80°C, and then reweighing the dried sediments.

The methanol-water washes and the methanol-methylene chloride extracts were combined in a separatory funnel and back-extracted with 400 ml of 3% sodium chloride in distilled water which had been previously extracted with hexane. The methylene chloride layer was removed and the water phase back-extracted with three additional 100-ml aliquots of methylene chloride. The combined methylene chloride extracts were poured slowly through sodium sulfate to remove water, concentrated to approximately 10 ml using a Kuderna-Danish (K-D) apparatus, solvent exchanged three times into hexane, and concentrated to a final volume of 1 ml.

A three-part fractionation scheme was employed to remove lipids and to separate the aliphatic, aromatic, and polar compounds from the sample (Payne et al., 1980; Brown et al., 1980). A 10-mm I.D. x 23-cm long column with a 16-ml pore volume was packed with a hexane slurry of 100/200-mesh silica gel which had been thermally cleaned at 500°C for four hours and activated at 210°C for 24 hours. The packed column was then pre-eluted with

60 ml of hexane, and the sample charged to the column in 1 ml of hexane. The following elution scheme was used:

Fraction/Solvent	Amount	Compound Class
1. Hexane	30 ml	Aliphatic hydrocarbons
2. Hexane:Benzene 50:50	45 ml	Aromatic hydrocarbons
3. 50% methanol in methylene chloride	60 ml	Polar compounds

The aliphatic and aromatic fractions were further concentrated to a final sample volume of 1.0 ml using a K-D apparatus. Activated copper was added to the final extract to remove elemental sulfur.

Hydrocarbon analyses were performed using Hewlett-Packard 5840A gas chromatograph (GC) equipped with 18835B glass capillary inlet systems and flame ionization detectors (FID). A 30-meter, wall-coated, open tubular, fused silica capillary column was utilized for chromatographic separations. The injection port and detector were maintained at 280° and 350°C, respectively, and all injections were made in the splitless mode of operation with an injection port backflush 1 minute into the run. The gas chromatograph was recalibrated after every eight to ten injections.

Hydrocarbon concentrations for individual resolved peaks in each gas chromatogram were calculated using Equation 1.

(1) Concentration (μg/g dry sediment) = $(A_Z) \times (R.F.) \times$

$$\left[\frac{P.I.V. + 1}{Inj.S.Vol.} \times \frac{Pre\text{-}C.S.\ Vol.}{Post\text{-}C.S.Vol.} \times \frac{100}{\%NSL\ on\ LC\%} \times \frac{100}{DW/FW} \times \frac{1}{gms\ wet\ sediment} \right]$$

where:

A_Z	=	the area of peak Z as integrated by the gas chromatograph (in arbitrary GC area units)
R.F.	=	the response factor (in units of μg/GC area unit)
P.I.V. + 1	=	The post-injection volume (in μl) from which a 1-μl aliquot had been removed for analysis by GC (measured by syringe immediately following sample injection
Inj.S.Vol.	=	the volume of sample injected into the GC (always 1.0 μl)
Pre-C.S.Vol. & Post-C.S. Vol.	=	the total solvent volumes before and after an aliquot is removed for gravimetric analysis
%NSL on LC	=	the percent of sample non-saponifiable lipid used for SiO_2 column chromatography
%DW/FW	=	the percent dry weight of wet weight in the sample
gm sediment	=	initial wet sample weight.

Individual response factors were calculated for all detected even and odd n-alkanes between nC_8 and nC_{32}. Concentrations of other components (e.g., branched and cyclic) that elute between the major n-alkanes were calculated by linear interpolation of the adjacent n-alkane response factors and the unknown compound peak's KOVAT index (Kovats, 1958). By incorporating the post-injection volume (PIV) into the calculation, the amount of hydrocarbons measured in the injected sample were converted to the total hydrocarbon concentration in the sample.

Unresolved complex mixtures (UCM) were measured in triplicate by planimetry; the planimeter area was converted to the gas chromatograph's standard area units at a given attenuation and then quantified using the average response factors of all the n-alkanes occurring within the range of the UCM (as shown in Equation 2).

$$(2) \quad \frac{\mu g \text{ UCM}}{\text{dry wt sediment (g)}} = \text{Area}_p \times (\text{Conv. F}) \times \frac{\text{S. Att.}}{\text{Ref. Att.}} \times (\text{R.F.}_{a-b}) \times [\ldots]$$

where:

Area_p	=	UCM area in arbitrary planimeter units
Conv. F.	=	a factor for converting arbitrary planimeter units to GC area units at a specific GC attenuation
S. Att. and Ref. Att.	=	the GC attenuation at which the sample chromatogram was run and the reference attenuation to determine the conversion factor (Conv. F.), respectively
R.F._{a-b}	=	the mean response factor for all sequential n-alkanes (with carbon numbers a to b) whose retention times fall within the retention time window of the UCM
[...]	=	the same parameters enclosed in brackets in Equation 1.

Assignment of a KOVAT index to each branched or cyclic compound eluting between the n-alkanes was accomplished by interpolation using the unknown compound and adjacent n-alkane retention times. Assignment of KOVAT indices to peaks in the aromatic fraction was made by direct correlation of unknown peaks with retention times from the n-alkane and aromatic standard runs completed prior to sample injection (Payne et al., 1978b).

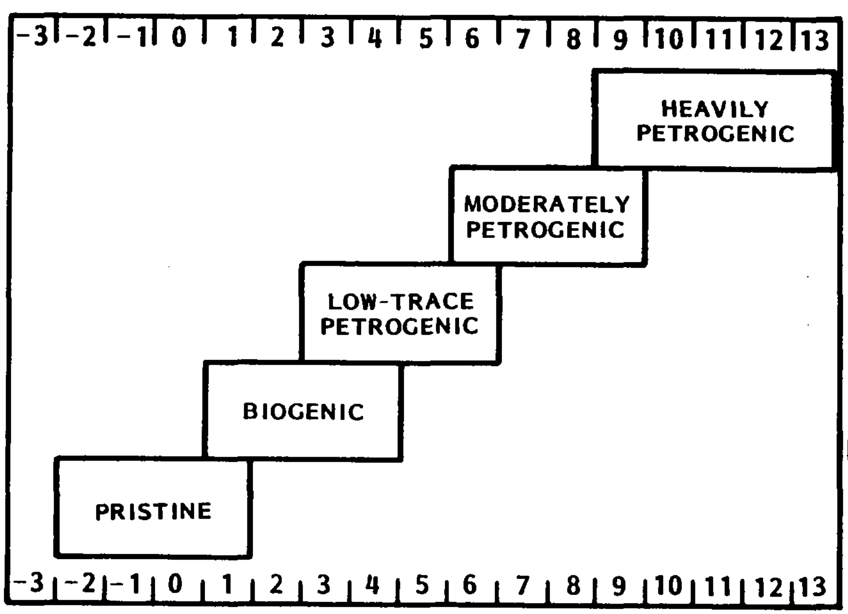
Data obtained from these procedures were used to determine values for the following parameters:

- Total hydrocarbons
- Total aromatics
- Total alkanes and total aliphatics
- Total unresolved components (UCM)
- Pristane/phytane ratio
- Pristane/nC_{17} ratio
- Phytane/nC_{18} ratio
- Odd alkanes/even alkanes ratio
- Resolved/unresolved complex ratio

Additionally, these data were used in the calculation of Marine Oil Pollution Index (MOPI) values (Payne et al., in press). The Marine Oil Pollution Index was developed during the BLM (MMS) - sponsored Southern California Baseline Study to characterize hydrocarbon burdens in marine tissues and sediments. MOPI values were calculated for all sediment samples collected during this study to characterize areal trends in the magnitude of petroleum hydrocarbon inputs to the benthic environment. The index equation, shown in Figure 2-12, incorporates the ratios of unresolved to resolved components, even n-alkanes to odd n-alkanes, and branched hydrocarbons to n-alkane plus the total recoverable aliphatic and aromatic hydrocarbon concentrations from gas chromatographic analyses. Index values may range between -2 and 15; higher values

MARINE OIL POLLUTION INDEX EQUATION

$$\text{MOPI} = \ln\left[\left(\frac{UCM_H}{RES_H} + 1\right)\left(\frac{EVEN}{ODD} + 1\right)\left(\frac{\text{BRANCHED HYDROCARBONS}}{n\text{-ALKANES}} + 1\right)\left(RES_H + UCM_H + UCM_B\right)\right]$$



UCM_H = UNRESOLVED COMPLEX MIXTURE IN THE HEXANE FRACTION IN $\mu g/g$ DRY WEIGHT OF SAMPLE

RES_H = TOTAL RESOLVED HYDROCARBONS IN THE HEXANE FRACTION IN $\mu g/g$ DRY WEIGHT

EVEN = EVEN NUMBERED n-ALKANES IN $\mu g/g$ DRY WEIGHT

ODD = ODD NUMBERED n-ALKANES IN $\mu g/g$ DRY WEIGHT

BRANCHED HC = TOTAL RESOLVED HC IN THE HEXANE FRACTION MINUS TOTAL n-ALKANES IN HEXANE FRACTION

UCM_B = UNRESOLVED COMPLEX MIXTURE IN THE BENZENE FRACTION

FIGURE 2-12. Marine Oil Pollution Index (MOPI) Equation indicate progressively greater hydrocarbon contamination. Subranges of MOPI values represent oil contamination levels corresponding to pristine, biogenic, low-level petrogenic, moderately petrogenic, and heavily petrogenic conditions. These classifications are intended for characterizing the magnitude of petroleum contamination, and overlap between adjacent subranges reflects the artificial nature of the oil pollution classifications.

2.2.4.2 Barium and Chromium in Sediments

Frozen sediment samples for barium and chromium analysis first were thawed and allowed to warm to room temperature. The thawed samples were wet homogenized, and approximately 75g aliquots of each sample were transferred to labeled, pre-weighed 60 ml polyproplene jars, and wet weighed. The unused portions of the samples were refrozen and stored. The wet sample aliquots were taken to a constant dry weight using a Virtis Unitrap II freeze dryer, the dry weights were recorded, and dry/wet ratios (% moisture) values were determined. Following the drying process, the samples were ground in the original container to a homogenous powder using a Spex mixer-mill.

Approximately 5g aliquots of dried powdered sediment were transferred into 30 ml polythylene bottles and stored for later analysis by instrumental neutron activation analysis (INAA) at the University of Missouri Research Reactor Facility. Prior to irradiation, 0.05-0.1g aliquots of the sediment samples were weighed into small quartz vials and then loaded into larger irradiation containers. The irradiation containers were inserted into the core of a light water cooled, flux trap type reactor and irradiated with a neutron flux 4.8×10^{13} n/cm^2-sec for 20 to 50 hours.

Following irradiation, the samples were "cooled" (using a steel water bath) and allowed to decay for seven days. The outside of the quartz vials containing the irradiated samples was cleaned in aqua regia and deionized water to remove any metal contamination encountered during the cooling step. Samples were then counted with a Nuclear Data 6700 series multi-channel analyzer equipped with a high resolution intrinsic Ge or Ge/Li detector. Gamma radiation was monitored at the 373 or 496 KeV line for Ba and the 320 KeV line for Cr, and the samples were counted for 1,800 to 7,200 seconds, depending upon the activity. A minimum of 500 to 1,000 counts were obtained to reduce statistical counting errors to less than 5%. Data reduction was performed using an NAA software package supplied by Nuclear Data; barium and chromium concentrations were determined by the standard comparator method. Sample method blanks, replicates, and NBS standards (Basalt (SRM-688) and Plastic Clay (SRM-98a)) were processed and analyzed in the same manner.

2.2.4.3 Total Organic Carbon Analysis

Sediment samples were analyzed for organic carbon and calcium carbonate ($CaCO_3$) content by combustion in a LECO carbon analyzer according to procedures described by Kolpack and Bell (1968). The organic fraction of the total carbon content was determined by subtracting the inorganic $CaCO_3$ value from the total carbon value. Carbon values were expressed as percent dry weight of the total sample weight.

2.2.5 Sediment Grain Size Analyses

Analyses of sediment samples for grain size characteristics were performed using two techniques. The size distribution of sediments in the sand size range -1 phi through 4 phi (2 mm through 0.63 mm) was determined using an automatic settling tube similar to that described by Gibbs (1974). The method is based on the differential settling rate of various sized particles in an aqueous medium. The settling tube device measures the load exerted by released sediment accumulating on a tray. A strip chart connected to a transformer records the output from the load sensor in the form of a cumulative frequency plot. Quantities of sediment in each size interval are taken from the strip chart and entered into a computer for calculations of size distribution characteristics based on the formula of Inman (1952). The size distribution in the silt-clay fraction (4 phi through 15 phi) was analyzed by suspending the sediments and hydrometrically measuring changes in water density produced by differential settling rates of different size particles (ASTM, 1963).

Analysis of the cumulative size frequency curves was performed according to methods described by Inman (1952). The median, 16th, and 84th percentiles of the sediment distribution curves were used to calculate mean grain size diameter, sorting coefficient, and skewness. Where sediment distribution curves coincide with normal distribution curves, the 16th and 84th percentiles represent diameters one standard deviation on either side of the mean. Prior to calculating the above parameters, the median, 16th, and 84th percentiles were converted to phi notation as follows:

$$\text{phi } \phi = \log_2 \text{ (diameter in millimeters)}$$

Sediment grain size characteristics were described in terms of the following descriptive parameters.

<u>Mean diameter</u> (M_ϕ): the average particle size in the central 68% of the distribution:

$$M_\phi = 1/2 \, (\phi_{16} + \phi_{84})$$

Sediment size groups were characterized according to the following classification:

Gravel: Md_ϕ -5.0 to -1.0 units.
Sand: Md_ϕ -0.5 to 4.0 units.
Silt: Md_ϕ 4.5 to 8.0 units.
Clay: Md_ϕ 9.5 to 15.0 units.

<u>Sorting</u> (Dispersion) σ: measures the uniformity or non-uniformity of particle quantities in each size category of the sediment distribution.

$$\sigma_\phi = 1/8\ (\phi_{84} - \phi_{16})$$

<u>Sharp and Fan Sorting</u> (Sharp and Fan, 1963): uses a broader spectrum of size classes (-10 to 15ϕ) to establish 25ϕ-intervals. Their formula considers both the number of classes occupied and evenness between classes. The maximum value of 1.0 indicates all particles fall into a single class; the minimum of 0.0 occurs when all 25 classes have equal populations.

<u>Skewness</u> (α_ϕ): measures the direction and extent of departure of the mean from the median (in a normal or symmetrical curve they coincide). In symmetrical curves, α_ϕ=0.00 with limits of -1.00 and +1.00. Negative values indicate that the particle distribution is skewed toward larger particle diameters, whereas positive values indicate that the distribution is skewed toward smaller particle diameters.

$$\alpha_\phi = M_\phi - \frac{Md_\phi}{\sigma_\phi} \qquad \text{(1st skewness)}$$

$$\alpha_\phi = \frac{1/2\ (\phi_5 + \phi_{95}) - Md}{\sigma_\phi} \qquad \text{(2nd skewness)}$$

<u>Kurtosis</u>: expresses the ratio of the average spread in the tails of the distribution to the phi deviation, therefore, representing an index of relative peakedness. In normal distributions β_ϕ = 0.65, and in less peaked curves β_ϕ is less than 0.65.

$$\beta_\phi = \frac{1/2\ (\phi_{95} - \phi_5) - \sigma_\phi}{\sigma_\phi}$$

2.3 DATA ANALYSIS

All data analyses and data management for the study were done using SAS (SAS, 1982) and the Ecological Analysis Package (EAP; Smith, 1982). EAP is a set of procedures which run from SAS. All multivariate analyses except the principal components analysis were done using EAP procedures. Analysis methods for the environmental data, biological data, and correlations among the parameters are presented in Sections 2.3.1, 2.3.2, and 2.3.3, respectively.

2.3.1 Environmental Data

Analysis of the environmental data included:

1. Mapping of the data values.

The data values for each measured variable (grain size, trace metals, hydrocarbons, and total organic carbon) were converted to single character symbols and then plotted on a computer-generated map of the sampling area. The symbol is placed at the position (on the map) of the station from which the measurement was taken. The symbols correspond to chosen intervals of data values. The lowest interval is symbolized by a "1", the next lowest interval by a "2", etc. These maps were then used to assess geographic patterns of the environmental parameters (Section 3.1).

2. Correlation analysis and principal components analysis

The relationships between the variables were studied by examination of the inter-variable correlations. In addition, standard principal components analysis (PCA) was used to find intercorrelated subsets of data variables. One valuable outcome of these studies is the selection of a subset of environmental variables to be used with the multivariate biological analyses. Extraneous variables and redundancy in the variables can cause computational and interpretive problems when using these multivariate methods. Results from these analyses, including a description of the derived factors are presented in Sections 3.1.1 and 3.1.2.

2.3.2 Biological Data Analysis

Statistical analysis of soft-bottom and hard-bottom biological data consisted of ordination analysis, cluster analysis, and discriminant analysis. An overview of these methods is presented in this section, with a more detailed discussion provided in Appendix C.

Ordination Analysis

Ordination normally is used as a tool to observe the major biological patterns in the data. An ordination technique called nonmetric multidimensional scaling was used to analyze data from this program. Appendix C details the steps in the computational procedure.

In ordination analysis the samples are represented as points in a multidimensional space. The distance between a pair of points in the space should be proportional to the degree of biological dissimilarity (or similarity of the pair of points. For the present application, biological dissimilarity is defined in terms of differences in species abundances and composition. The dimensions of the space are called axes, and the coordinates (projections of the points onto the axes) of the points are called scores. Each point will have a position (or score) on each axis.

The axes are ordered according to the amount of variation in their scores; the first axis has the greatest variation, and the last axis the least. The greater the amount of variation in the scores for an axis, the more the points are "spread out" along the axis. Major environmental gradients which are associated with biological change will tend to correlate with the axes associated with the largest proportions of the variability.

The axes are usually positioned so that the scores on the different axes are uncorrelated. This minimizes the amount of redundancy of information on the various axes, and is helpful when analyzing the patterns of points in the space.

Cluster Analysis

Like ordination analysis, cluster analysis is a tool to observe the major patterns of biological change in the data. Here, the samples are divided into biologically similar groups. These groups will often correspond to different habitats in the sampling area.

An agglomerative, hierarchical clustering technique called flexible sorting or clustering (Clifford and Stephenson, 1975) was used during the present study. The flexible coefficient beta is set at the standard value of -0.25.

Hierarchical clustering involves displaying the relationships between the entities being clustered (samples or species) with a two-dimensional hierarchical structure called a dendrogram. Agglomerative clustering includes successive fusion of the most similar entities (or groups of entities) to form larger and larger groups of clusters. The similarity of the pairs of entities are measured with a distance index. Similar samples will be associated with low distance index values. In addition to clustering the samples, species were clustered to define groups of species found in similar habitats.

Two-way Coincidence Tables

The dendrograms from a sample and a species cluster analysis can be used to construct a two-way coincidence table, which is the biological data matrix with the rows (species) and columns (samples) arranged in the same order as appears on the corresponding dendrograms. The data values are standardized and converted to symbols for compactness and ease of interpretation. The symbols in the two-way table are based on species mean (of values > 0) standardized data. The values corresponding to each symbol are:

SYMBOL	RANGE OF VALUES
*	>2
+	>1 to 2
-	>.5 to 1
.	>0 to .5
(blank)	0

Reference to the two-way table is useful when choosing groups from the clustering dendrogram. These tables are informative because similar samples and species are grouped on the dendrogram; thus they will apear in contiguous positions on the two-way table. However, the specific order of entities along a dendrogram can be quite arbitrary since any one node on the dendrogram can be rotated 180 degrees without changing any groupings. The clustering algorithm used is modified to create a maximally informative order of entities along the dendrogram. To accomplish this, the order of entities along the dendrogram is made to approach the order of the entities along the first axis from the ordination analysis.

Ecological Distances

An index which measures the biological dissimilarity of two samples is called an ecological distance index. The biological dissimilarity is based on species importance values (abundance, percent cover, presence/absence, frequency, etc.). Most ordination and clustering techniques, including those used in the present study, utilize ecological distances in their calculations.

All ecological distance indices are based on the assumption that species importance values vary linearly as biological change occurs. In practice, this assumption is rarely met (Beals, 1973; Austin, 1980), since species abundances tend to change in a non-linear, non-monotonic fashion as overall biological change occurs, usually along pertinent environmental gradients. In addition, the species abundances are truncated, i.e., species counts reach a value of zero and remain zero as environments more unfavorable to the species in question are sampled (Swan, 1970). As a result, distance indices lose their sensitivity as they attempt to measure larger and larger magnitudes of actual biological change.

Another hidden assumption in most if not all distance indices is that each species changes at the same rate as overall biological change takes place. This assumption is rarely met, and the result is greater variability in the distance values (given a constant amount of actual biological change).

We directly utilize ecological distances in the cluster analyses, and in the hypothesis (power) testing to assess impacts (change). It is important that the ecological distances reflect true biological change in order to obtain optimal results in these analyses.

Smith and Bernstein (1985) discuss in detail a combination of techniques which together should result in an accurate ordination space. Parts of this discussion are included in Appendix C. If a good ordination space can be computed, then the Euclidean distances between the points (samples) in that space should be good ecological distances. This was the method used to compute ecological distances in the present study. This technique is designed to overcome the shortcomings of distance indices discussed above.

Calculation of Inter-Species Distances

Inter-species distances are required for the species cluster analysis. The desired result is an inter-species distance index which results in relatively small distances between species found in the same or very similar habitats, and increasing distances between species which are found in increasingly different habitats. In other words, the distance index should be sensitive to the relative habitat preferences of the species.

Austin and Belbin (1982) discuss some reasons why this approach is preferred. The conventional distance indices measure the reciprocal of inter-species overlap instead of relative habitat preference. When such distances are used, several species can have long distances between themselves and all other species, even species which are found in similar habitats. When clustering the species, these species will cluster with each other in a "junk" group. They have nothing in common except their generally low overlap with the other species. If the inter-species distances measure relative habitat preferences, there will not be a "junk" group of species, since each species will cluster with other species found in similar habitats.

To calculate distances measuring relative habitat preference, we calculate the inter-species distances following two primary steps:

1. Using the ordination scores from the ordination of the samples, the weighted mean sample score for each species is calculated. Specifically,

$$Sia = \sum_{j=1}^{m} (Nji(Tja)) \Big/ \sum_{j=1}^{m} (Nji),$$

where Sia is the weighted mean sample score for species i on axis a, m is the number of samples, Nji is the abundance of species i in sample j, and Tja is the sample score of sample j on axis a. Prior to these calculations, the species abundance data are transformed by a square root to prevent overemphasis on one or a few large data values.

This process results in a score for each species. In fact, this defines a species ordination space which is based on the weighted average positions of the species in the sample space. Species found in similar parts of this space are found in similar parts of the sample space. Different positions in the sample space usually will be associated with different habitats. Thus, the species scores should be related to the species habitat preferences.

2. Euclidean distances between points (species) in this species space are then calculated. Since the scores of the species are a reflection of habitat preferences, these distances will likewise reflect habitat preferences.

Elimination of Data Prior to Analysis

Prior to the ordination analysis, several of the species were eliminated since there were a large number of rare species which would have little effect on the results. Keeping such species in the analyses would greatly increase the computation time and make presentation of the results cumbersome.

Species were eliminated according to their number of occurrences in data being analyzed. The minimum numbers of occurrences for a species to be retained in the different analyses are shown in Table 2-7.

For the hard-bottom data observations were taken at numerous locations along each hard-bottom transect, along with relative measures of substrate characteristics. At each location, three types of species abundance data could be collected: presence/ absence, density, percent cover. The goal

Table 2-7. Minimum Number of Occurrences for Inclusion in the Various Analyses.

ANALYSIS	MINIMUM NO. OCCURRENCES
Infauna	
Reidentified RIP data plus 1 mm (present survey)	5
1 mm data (present survey)	4
0.5 mm data (present survey)	6
0.5 mm date (present survey), outliers removed	6
Hard Bottom	
Observer/photographic data	4
Rock scraping - % cover data	5
Rock scraping - abundance data	8

of the analysis was to identify biological patterns of distribution, and to relate these to physical parameters (depth, substrate characteristics, geographic location).

The three types of biological data posed a potential problem because of their incompatibility. It was not possible to include presence/absence, density, and percent cover data in the same analysis, because the same species was often represented by quantitative as well as qualitative (presence/ absence) data. Since density and percent cover data only were available for a subset of the species, and since these data had potentially higher error (due to uncertainty in determining sizes of plots from photographs; see methods Section 2.2.3), we determined that converting all data to presence/absence would make the most data available for the analysis.

We also decided to focus the analysis on the description of broad, transect-scale patterns of distribution, rather than fine-scale, within-transect, patterns. This approach was followed because the qualitative nature of the presence/absence data was not as useful for elucidating fine-scale differences among individual locations on a transect, and many of the organisms were identifiable only to broad taxonomic categories, and not to species. Consequently, prior to the analysis the data were summarized to include only presence/absence data, and to focus on transect-scale patterns.

Substrate types were identified by each unique combination of the five qualitative substrate variables (bottom type, percent of the plot that was of the primary bottom type, percent cover of silt, type of hard bottom substrate, and relief). Each observation for a transect was accompanied by an associated substrate type. Initially, the substrate types from all observations on all transects were inspected. Those observations with substrate types that occurred only once, and which were dissimilar from all other substrate types (18 observations out of 934), were deleted. We then identified additional substrate types that occurred only a few times, and were similar to more common substrate types. These rare substrate types were modified to equal the most similar of the more common ones.

All biological data were then converted to presence/absence data. This was accomplished by simply making the presence/absence variable equal to "1" if an organism was present, and "0" if it was absent. The mean of the presence/absence values was then calculated for each taxon, for each substrate type within a transect. For example, if a particular taxon occurred in three out of the four observations with a particular substrate type for a transect, the mean occurrence value for that transect would be 0.75. This resulted in at least one observation for each substrate type in each transect (139 transect/substrate combinations). One major advantage of calculating the mean occurrence value is that it makes it possible to derive a semi-quantitative measure of the abundance, or frequency of occurrence, of each taxon.

Finally, we trimmed the species list to those taxa that occurred a minimum of four times in the 139 transect-substrate combinations. Using this criterion, 101 of the original 177 taxa were retained for analysis.

2.3.3 Correlations Among Biological and Environmental Parameters

As noted in Section 2.3.2 and Appendix C, the scores on the first few axes from an ordination analysis should be correlated with the environmental gradients associated with large-scale biological changes. For the present study multiple regression was used to assess which measured environmental variables were related to the scores of each axis. Here the scores for an axis are the dependent variables and the environmental variables are the independent variables. In this analysis, a variable selection technique which considers all possible combinations of the measured environmental variables (SAS, 1982; RSQUARE procedure). For each combination of variables, an R-squared value is computed. The variable combinations with the higher R-squared values are considered for further interpretation.

The groups from the cluster analysis may also correspond to certain habitat features in the environment. These relationships can be studied with discriminant analysis (Bernstein et al, 1978; Green and Vascotto, 1978). With this technique, a theoretical multidimensional space with the dimensions or axes corresponding to the environmental variables is set up. The axes are then rotated so that projections onto the axes will maximally separate the groups of stations defined in the cluster analysis. More than one axis may be required to accomplish this separation. The scores on the different axes will be uncorrelated. Standardized discriminant coefficients, called coefficients of separate determination (Hope, 1969), indicate which environmental are correlated with these axes. Such variables may be related to features in the environment which caused the biological differences and similarities associated with the stations in the various cluster groups (which were defined using biological data). As with the ordination, the first axis will account for the most group separation, and the last axis the least.

For the analyses, a modified version of discriminant analysis called weighted discriminant analysis was used (Smith, 1976; Smith, 1979). Here, the usual calculations are modified to utilize within and between-group biological information. This makes the analysis more sensitive to the biological patterns in the data. Regular discriminant analysis only considers which stations are in which group; no further within and between-group information is utilized.

3.0 RESULTS AND DISCUSSION

This section presents the results from the reconnaissance soft-bottom and hard-bottom surveys with discussions of the physical, chemical, and biological characteristics of the Santa Maria Basin and western Santa Barbara Channel. The soft-bottom survey results (Section 3.1) include separate discussions of sedimentological, chemical, and biological observations (Sections 3.1.1, 3.1.2, and 3.1.3). Similarly, the hard-bottom survey results (Section 3.2) include discussions of environmental data (Section 3.2.1) and biological assemblages (Section 3.2.2) observed during the surveys. Supplemental observations on marine birds and mammals, and fishing activity observed during the surveys are summarized in Section 3.3. Data obtained and observations recorded during these surveys are compared with relevant historical data whenever appropriate.

A summary of soft-bottom and hard-bottom assemblages and species having the greatest sensitivity to potential impacts associated with OCS oil and gas development operations in the survey region is presented in Section 3.4. Recommendations of environmental parameters, survey design, and survey methods that are appropriate for long-term monitoring programs are presented in Section 3.5.

3.1 SOFT-BOTTOM ENVIRONMENT

Soft-bottom survey operations were conducted at 107 stations from approximately Goleta in the western Santa Barbara Channel to Pt. Estero, CA

(Figures 2-1 to 2-4), resulting in the collection of 142 sediment cores for analysis of infaunal organisms (0.5 and 1.0 mm fractions), grain size, total organic carbon (TOC), barium, chromium, petroleum hydrocarbons, redox potential, and sediment cohesiveness/compressive strength. Navigational coordinates and bottom depths for all stations are presented in Appendix A.

Laboratory analysis of infaunal samples consisted of taxonomic identification, abundance counts, biomass measurements, and length/frequency analysis of eight selected species. Barium and chromium samples were analyzed using neutron activation; petroleum hydrocarbon samples were analyzed using gas chromatography. Standard sieve and pipette analyses were performed on the grain size samples; TOC samples were analyzed using a LECO carbon analyzer. Detailed descriptions of laboratory methodology are presented in Sections 2.2.1 (Infauna), 2.2.4 (Chemistry), and 2.2.5 (Grain Size).

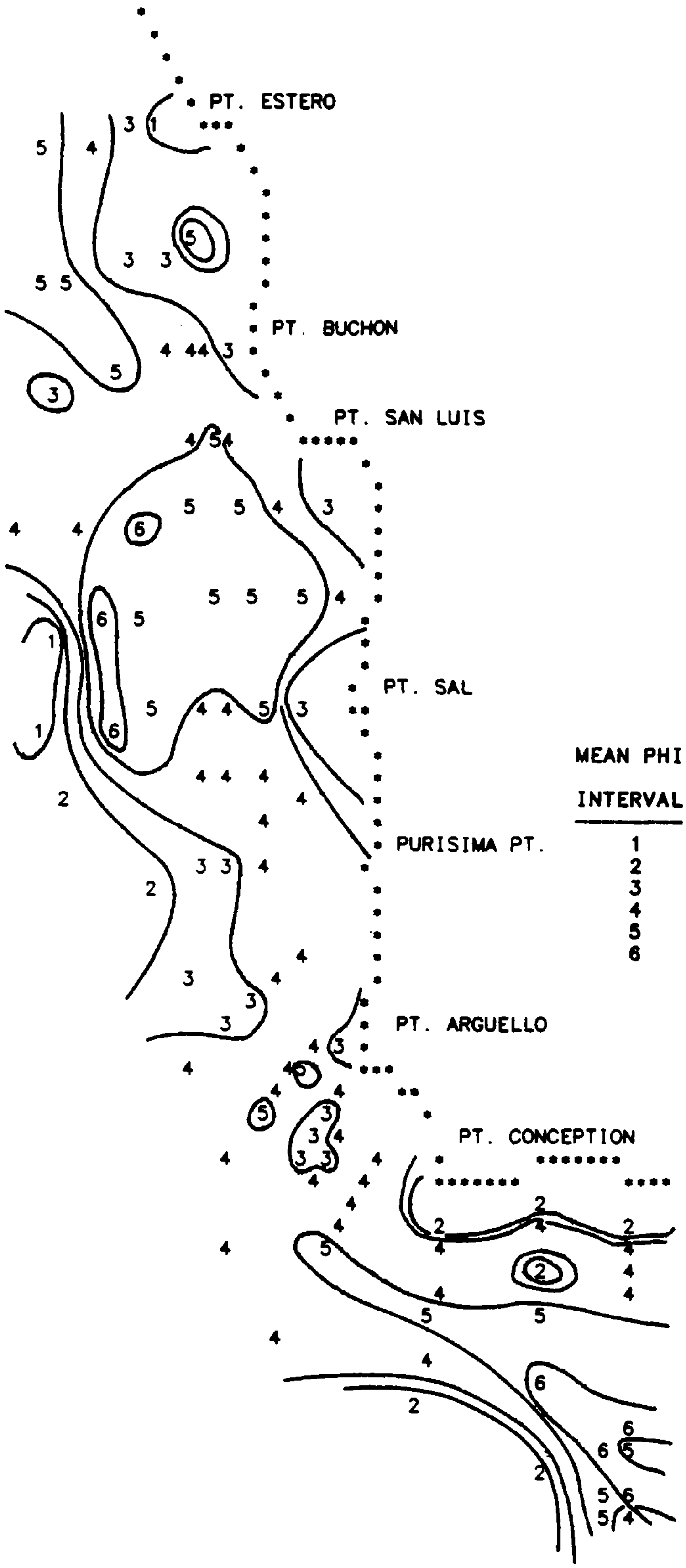
Statistical analysis of the infaunal data consisted of (1) cluster analysis by site (station) and species; (2) ordination analysis to display relationships among the site groups defined by the cluster analysis, and the relationship to environmental parameters (grain size, depth, TOC); and (3) discriminant analysis to further define environmental correlations with biological data. Principal components analysis was performed on the physical/chemical data to display groups of intercorrelated variables, and to define factors for use in the analysis of the infaunal data. A detailed discussion of the data analysis methods is presented in Section 2.3.

The types of analysis methods were designed to (1) aid in defining species assemblages within the survey area; (2) assess the relationship of these assemblages to environmental variables including geographic location, bottom depth, and sedimentary regime; (3) assess spatial trends or patterns in the biological and environmental data; and (4) compare these results to previous studies of the region. Using these results the data are compared with regional scenarios of oil and gas development, including information on potential impacts from these activities, and recommendations are made of sensitive species and assemblages, and geographic areas of interest that should be considered in long-term monitoring studies (Sections 3.4 and 3.5).

3.1.1 Sedimentology

Granulometric Properties - The mean grain size (phi) of the sediments from the survey is plotted in Figure 3-1. Please note that an overlay transparency of bathymetric contours for the survey area is included in the pouch at the end of this report. Raw data values are presented in Tables 3-1 and 3-2. The coarsest sediments occur off Point Estero and on the Santa Lucia Bank. Coarse sediments also occur along the most shoreward stations particularly east of Point Conception and on the shoal north of San Miguel Island. The finest sediments occur in the sea valley east of the Santa Lucia Bank and in the Santa Barbara Basin. Fine sediments occur on the continental slope north of Point Sal and on the sill at the western entrance to the Santa Barbara Channel. Silt-sized material occurs in patches interspersed with fine sediments at the head of the Arguello submarine canyon. An anomalously fine sediment was sampled just off Estero Bay.

MEAN PHI



MEAN PHI INTERVAL	INTERVAL MINIMUM	INTERVAL MAXIMUM	N
1	> 2	3	3
2	> 3	4	8
3	> 4	5	17
4	> 5	6	42
5	> 6	7	22
6	> 7	8	7

FIGURE 3-1. Mean Phi of Bottom Sediments

TABLE 3-1. MMS SOFT-BOTTOM SURVEY (1983-1984)
GRAIN SIZE DATA-SUMMARY STATISTICS

STATION	REP	GRAVEL	SAND	SILT	CLAY	MEDIAN	MODE	MEAN	DISPRSN	SKEW	KURT
002-BSS	1	0.69	75.15	19.39	4.77	1.25	2.63	2.98	2.56	0.61	1.78
003-BSS	1	0.00	53.12	40.35	6.33	2.00	3.13	4.59	2.16	0.96	4.61
004-BSS	1	0.00	14.80	81.59	3.59	1.75	4.24	5.09	1.41	0.94	6.20
005-BSS	1	0.00	1.87	84.59	12.98	2.00	5.10	6.41	2.26	0.89	3.33
007-BSS	1	0.00	2.86	84.43	12.71	2.00	4.26	6.14	1.86	0.71	2.49
008-BSS	1	0.00	23.39	72.90	3.72	1.75	4.23	4.86	1.50	0.71	3.57
009-BSS	1	0.00	20.12	77.48	2.19	0.00	4.21	4.77	1.19	0.67	2.48
010-BSS	1	0.00	0.00	84.04	15.49	0.00	4.21	6.56	2.13	0.83	3.27
011-BSS	1	0.00	4.93	79.29	15.32	1.75	4.21	6.22	2.31	0.79	2.77
012-BSS	1	0.00	57.59	39.57	2.82	0.00	3.13	4.15	1.39	1.04	5.22
013-BSS	1	0.00	6.19	85.99	7.82	2.00	4.28	5.56	1.68	0.92	4.54
014-BSS	1	0.00	13.73	77.67	8.53	2.00	4.29	5.59	1.94	0.87	4.08
015-BSS	1	0.00	6.79	82.85	9.98	2.00	5.12	5.82	2.10	1.08	5.15
016-BSS	1	0.00	1.55	85.50	12.50	1.75	4.19	6.30	2.19	0.86	3.42
017-BSS	1	0.00	31.35	62.16	6.28	1.75	4.20	4.85	1.96	1.17	7.09
018-BSS	1	0.56	25.18	67.19	7.07	-0.50	4.26	5.56	1.78	0.34	4.96
019-BSS	1	0.00	4.18	83.15	12.21	2.00	4.23	6.11	2.20	0.95	3.90
020-BSS	1	0.00	3.21	87.32	9.13	1.75	5.15	5.91	1.99	1.13	5.92
021-BSR	1	0.00	28.00	67.47	4.34	1.75	4.26	4.84	1.70	1.58	12.66
021-BSR	2	0.00	13.48	83.28	3.18	2.00	4.24	4.90	1.34	1.44	12.55
021-BSR	3	0.00	20.87	74.72	4.32	0.94	4.29	4.94	1.49	1.32	10.12
022-BSS	1	0.00	10.32	83.53	6.14	0.94	4.25	5.21	1.58	1.06	6.12
023-BSR	1	0.00	2.21	84.74	12.85	1.75	5.25	6.16	1.75	0.73	2.14
023-BSR	2	0.00	2.31	87.11	10.26	2.00	4.30	6.01	1.94	1.04	5.40
023-BSR	3	0.00	2.03	82.45	15.02	2.25	5.21	6.31	2.23	0.89	3.27
025-BSR	1	0.00	2.28	82.32	14.91	1.75	4.33	6.25	2.26	0.91	3.28
025-BSR	2	0.00	1.89	80.61	16.89	2.25	4.34	6.45	2.41	0.85	2.46
025-BSR	3	0.00	2.05	81.98	15.84	2.00	4.33	6.30	2.16	0.82	2.48
026-BSS	1	0.00	3.18	65.91	30.91	0.94	5.86	7.21	2.31	0.37	-0.02
027-BSR	1	0.00	21.27	56.75	21.97	1.75	4.31	6.16	2.52	0.46	0.16
027-BSR	2	0.00	27.46	55.23	16.85	2.25	4.26	5.81	2.57	0.68	1.69
027-BSR	3	0.00	27.97	50.28	21.60	1.75	4.26	5.96	2.74	0.52	0.43
028-BSR	1	0.00	43.95	39.79	16.26	1.50	4.67	5.02	2.81	0.43	0.14
028-BSR	2	0.00	51.32	33.71	14.72	1.50	1.63	4.66	2.82	0.44	-0.06
028-BSR	3	0.00	32.66	45.54	21.80	1.75	4.26	5.81	2.73	0.45	-0.06
030-BSS	1	0.00	45.53	44.74	9.37	1.19	3.38	4.99	2.32	1.09	4.85
031-BSR	1	0.00	9.45	74.48	15.55	1.75	4.31	6.03	2.43	0.86	2.69
031-BSR	2	0.00	6.68	73.65	18.97	2.00	4.30	6.33	2.65	0.76	1.58
031-BSR	3	0.00	8.92	72.67	17.79	2.25	4.32	6.23	2.53	0.79	2.02
032-BSS	1	0.00	11.15	73.90	14.06	1.75	4.33	5.88	2.44	0.92	3.00
033-BSR	1	0.00	8.62	78.53	12.47	2.00	4.30	5.71	2.20	1.07	4.59
033-BSR	2	0.00	8.85	76.32	14.35	2.00	4.33	5.99	2.34	0.93	3.25
033-BSR	3	0.00	6.54	79.64	13.33	1.75	4.28	5.92	2.36	0.96	3.42
034-BSS	1	0.00	3.54	78.26	17.61	2.00	4.39	6.40	2.41	0.77	2.29
035-BSR	1	0.00	1.45	65.11	33.16	1.75	4.38	7.39	2.53	0.41	0.04
035-BSR	2	0.00	2.44	70.12	27.44	1.50	4.35	7.01	2.26	0.42	0.22
035-BSR	3	0.00	2.56	69.81	27.63	1.75	4.40	6.99	2.30	0.41	0.12
036-BSR	1	0.00	89.47	6.33	4.19	1.00	1.63	2.40	2.01	1.33	7.04
036-BSR	2	0.00	80.56	5.12	13.78	1.75	1.63	3.40	3.40	0.96	2.45
036-BSR	3	0.00	85.43	8.29	6.19	1.50	1.38	2.66	2.38	1.23	5.81
038-BSS	1	0.00	37.33	51.30	10.98	1.19	4.66	5.19	2.44	0.98	3.70
039-BSS	1	0.00	32.74	56.97	9.93	2.00	4.67	5.21	2.30	1.10	4.75
040-BSS	1	0.00	18.37	70.79	10.12	0.00	4.25	5.42	2.28	1.14	4.98
041-BSS	1	0.00	72.84	20.20	6.82	1.75	1.88	3.52	2.38	0.99	4.28

TABLE 3-1. MMS SOFT-BOTTOM SURVEY (1983-1984)
GRAIN SIZE DATA-SUMMARY STATISTICS (cont.)

STATION	REP	GRAVEL	SAND	SILT	CLAY	MEDIAN	MODE	MEAN	DISPRSN	SKEW	KURT
042-BSS	1	0.00	19.33	68.77	11.49	2.00	4.27	5.48	2.30	1.07	4.50
043-BSS	1	0.00	27.26	58.41	13.84	1.19	4.26	5.55	2.54	0.91	2.87
045-BSS	1	0.00	42.32	50.72	6.85	0.00	3.38	4.70	1.80	1.27	7.00
046-BSS	1	0.00	83.13	7.25	9.27	1.75	1.38	3.03	2.94	1.17	4.70
048-BSS	1	0.00	42.67	45.90	11.34	1.19	3.38	5.05	2.31	0.99	3.55
049-BSS	1	0.00	51.77	40.14	7.93	1.06	3.38	4.69	2.01	1.21	5.99
050-BSS	1	0.00	69.71	23.06	7.08	0.94	3.38	4.24	2.01	1.34	7.18
052-BSS	1	0.00	28.46	59.74	11.36	1.19	4.25	5.34	2.39	1.07	4.29
053-BSS	1	0.00	44.88	40.99	13.63	2.25	3.38	5.26	2.66	0.89	2.65
054-BSS	1	0.00	58.96	32.77	8.27	0.94	3.38	4.53	2.04	1.09	4.67
055-BSS	1	0.00	51.31	38.93	9.67	0.00	3.38	4.83	2.20	1.11	4.60
056-BSS	1	0.00	33.33	46.56	19.48	2.00	3.38	5.88	2.83	0.67	1.09
058-BSS	1	0.00	20.30	67.94	11.31	1.75	4.25	5.44	2.39	1.05	4.18
059-BSS	1	0.00	9.09	66.10	23.97	2.00	4.31	6.61	2.81	0.60	0.72
060-BSS	1	0.00	32.90	51.42	15.14	2.25	4.53	5.51	2.66	0.86	2.37
061-BSS	1	0.00	28.23	61.91	9.70	1.50	5.16	5.20	2.02	0.64	2.02
062-BSS	1	0.00	14.56	69.53	15.26	2.00	4.24	6.01	2.67	0.79	1.90
063-BSS	1	0.00	12.29	72.08	15.62	2.00	4.19	5.85	2.18	0.64	1.34
064-BSS	1	0.00	67.93	26.49	5.50	0.00	3.13	4.16	1.79	1.36	8.15
065-BSS	1	0.00	15.25	70.30	14.45	1.75	4.30	5.67	2.12	0.73	1.99
066-BSS	1	0.00	39.67	50.57	9.46	2.25	3.38	4.99	2.22	1.09	5.05
067-BSS	1	0.00	55.53	36.62	7.78	1.19	3.38	4.57	2.01	1.18	5.97
068-BSS	1	0.00	54.97	35.98	9.04	0.00	3.38	4.48	1.87	1.15	5.44
069-BSS	1	0.00	15.75	68.98	14.86	1.75	4.15	5.84	2.46	0.65	1.99
070-BSS	1	0.00	25.10	66.37	8.43	0.00	4.22	5.10	1.81	0.78	2.56
071-BSS	1	0.00	43.62	45.77	10.31	2.00	3.38	4.97	2.31	1.03	4.45
072-BSS	1	0.00	31.88	54.36	13.21	2.25	4.24	5.52	2.63	0.89	2.63
073-BSR	1	0.00	39.13	49.78	10.74	2.00	3.38	5.13	2.33	1.02	4.22
073-BSR	2	0.00	39.31	50.09	10.53	1.75	3.38	5.00	2.16	0.99	4.09
073-BSR	3	0.00	37.54	50.56	11.50	1.31	3.38	5.20	2.43	1.01	3.84
074-BSR	1	0.00	27.59	57.22	15.09	1.75	4.24	5.55	2.38	0.74	1.92
074-BSR	2	0.00	27.57	55.77	16.53	1.75	4.28	5.64	2.52	0.65	1.46
074-BSR	3	0.00	25.07	58.90	15.76	1.50	4.26	5.62	2.30	0.58	0.61
075-BSS	1	0.00	27.30	59.85	12.75	1.75	4.22	5.30	2.35	0.81	2.48
076-BSR	1	0.00	18.65	73.75	7.37	2.00	4.21	5.30	2.00	1.04	5.58
076-BSR	2	0.00	15.75	74.39	9.78	2.00	4.17	5.44	2.08	0.92	3.72
076-BSR	3	0.00	15.70	74.01	9.98	1.75	4.21	5.55	2.18	0.93	4.13
077-BSS	1	0.00	3.21	78.53	18.26	2.00	5.05	6.48	2.09	0.59	1.23
078-BSS	1	0.00	5.66	84.43	9.64	1.75	4.20	5.56	2.01	1.09	5.55
079-BSR	2	0.00	83.66	10.74	5.41	2.00	2.63	3.59	2.12	1.49	9.22
079-BSR	3	0.00	85.12	11.70	3.11	0.94	2.63	3.37	1.60	1.76	14.10
080-BSR	2	0.00	28.03	60.48	11.50	2.00	4.27	5.32	2.17	0.73	1.98
081-BSS	1	0.00	26.48	56.45	16.41	2.25	4.23	5.83	2.81	0.73	1.50
082-BSR	1	0.00	9.62	69.74	19.89	2.25	4.22	6.42	2.74	0.67	1.14
082-BSR	2	0.00	8.48	81.56	9.55	0.00	4.25	5.56	1.67	0.54	0.72
082-BSR	3	0.00	9.62	69.61	19.97	1.75	4.72	6.56	2.75	0.62	1.03
083-BSS	1	0.00	5.71	89.65	4.64	1.50	4.21	5.22	1.44	0.87	4.09
084-BSS	1	0.00	83.51	14.89	1.60	0.69	3.13	3.33	1.10	1.62	16.29
085-BSR	1	0.00	65.14	29.57	5.25	1.50	3.13	4.00	1.73	0.99	3.81
085-BSR	2	0.00	78.43	16.88	4.60	2.00	2.63	3.51	1.91	1.39	8.53
086-BSR	1	0.00	5.85	83.64	10.11	1.25	4.23	5.69	1.67	0.47	0.40
086-BSR	2	0.00	73.47	19.40	6.88	2.00	2.63	3.83	2.37	1.22	6.01
086-BSR	3	0.00	6.27	77.88	15.74	2.00	4.29	6.17	2.15	0.69	2.07
087-BSS	1	0.00	55.77	39.90	4.31	1.75	4.16	3.98	1.99	0.76	2.84
088-BSR	1	0.00	1.53	82.33	15.69	2.00	4.24	6.42	2.22	0.78	2.75

TABLE 3-1. MMS SOFT-BOTTOM SURVEY (1983-1984)
GRAIN SIZE DATA-SUMMARY STATISTICS (cont.)

STATION	REP	GRAVEL	SAND	SILT	CLAY	MEDIAN	MODE	MEAN	DISPRSN	SKEW	KURT
088-BSR	2	0.00	1.52	86.34	11.77	1.75	5.58	6.21	2.05	0.95	4.29
088-BSR	3	0.00	0.00	87.94	11.98	0.00	4.17	5.97	2.01	0.82	3.02
089-BSS	1	0.00	1.87	67.85	29.38	2.00	4.19	7.29	2.64	0.46	0.53
090-BSS	1	0.00	54.55	41.26	4.11	1.50	4.13	3.79	1.94	0.97	5.74
091-BSS	1	0.00	4.72	60.07	35.20	2.00	7.44	7.43	2.36	0.25	-0.23
092-BSS	1	0.00	1.98	76.97	21.05	1.75	4.18	6.56	2.22	0.45	0.48
093-BSS	1	0.00	7.10	76.37	16.05	2.00	4.66	6.22	2.38	0.76	2.30
094-BSS	1	0.00	78.09	18.80	3.09	1.00	3.13	3.58	1.69	0.77	3.83
095-BSS	1	0.00	12.63	73.72	13.57	2.00	4.30	5.77	2.13	0.77	2.57
096-BSS	1	0.00	3.80	81.96	14.24	1.50	4.23	5.99	1.84	0.51	0.63
097-BSS	1	0.00	1.63	86.94	11.15	2.00	4.17	5.87	2.00	0.92	4.33
098-BSS	1	0.00	0.00	63.93	35.01	0.00	4.14	7.45	2.82	0.38	-0.03
099-BSS	1	0.00	3.49	76.89	19.36	1.50	4.15	6.35	2.15	0.36	0.00
100-BSS	1	0.00	1.88	65.82	32.30	1.25	4.19	7.21	2.42	0.29	-0.26
101-BSS	1	0.00	5.99	83.26	10.65	1.75	4.20	5.87	2.06	0.81	3.08
102-BSS	1	0.00	30.30	58.50	10.81	2.00	4.26	5.29	2.35	1.02	4.25
103-BSS	1	0.00	3.18	77.77	18.45	2.00	4.30	6.43	2.45	0.79	2.07
104-BSS	1	0.00	4.10	81.20	14.58	1.75	4.34	6.12	2.17	0.81	2.62
105-BSS	1	0.00	1.60	76.81	20.82	2.00	4.37	6.71	2.56	0.72	1.45
106-BSS	1	0.00	4.44	76.01	19.43	1.06	4.35	6.54	2.20	0.65	1.65
107-BSS	1	0.00	3.91	68.59	27.27	1.06	4.38	7.04	2.48	0.49	0.40
108-BSS	1	0.00	86.38	5.88	7.74	1.25	1.63	2.73	2.28	1.21	5.71

TABLE 3-2. MMS SOFT-BOTTOM SURVEY (1983-1984)
GRAIN SIZE DATA-PHI VALUES

STATION	REP	PHI-1	PHI0	PHI1	PHI2	PHI3	PHI4	PHI5	PHI6	PHI7	PHI8	PHI9	PHI10	PHI11	PHI12	PHI13	PHI14	PHI15
002-BSS	1	0.69	5.66	16.55	12.51	28.87	11.55	4.82	5.88	5.94	2.75	1.33	0.53	1.54	0.33	0.79	0.14	0.12
003-BSS	1	0.00	0.00	0.16	0.48	19.35	33.14	14.15	12.69	9.35	4.15	1.85	0.43	1.67	0.40	1.13	0.26	0.58
004-BSS	1	0.00	0.00	0.00	0.03	0.27	14.50	39.40	27.45	11.51	3.22	0.28	1.74	0.11	1.05	0.06	0.36	0.00
005-BSS	1	0.00	0.00	0.04	0.11	0.64	1.08	22.04	28.24	25.51	8.80	2.10	0.21	4.30	1.20	2.91	0.76	1.51
007-BSS	1	0.00	0.00	0.00	0.06	0.24	2.56	24.04	27.99	22.60	9.81	4.56	1.53	3.36	0.88	1.74	0.38	0.27
008-BSS	1	0.00	0.00	0.00	0.23	5.13	18.02	38.28	20.37	10.93	3.32	0.34	2.03	0.13	1.03	0.06	0.14	0.00
009-BSS	1	0.00	0.00	0.00	0.00	0.15	19.97	45.20	21.77	7.16	3.35	1.05	1.14	0.00	0.00	0.00	0.00	0.00
010-BSS	1	0.00	0.00	0.00	0.00	0.00	0.00	21.56	23.43	25.78	13.27	6.03	0.36	3.67	1.01	2.48	0.64	1.29
011-BSS	1	0.00	0.00	0.10	0.36	0.62	3.85	28.58	23.20	20.65	6.86	4.46	1.45	3.88	0.95	2.62	0.60	1.35
012-BSS	1	0.00	0.00	0.00	0.12	5.20	52.27	23.68	9.22	4.41	2.26	0.31	1.80	0.10	0.61	0.00	0.00	0.00
013-BSS	1	0.00	0.00	0.00	0.02	0.31	5.86	39.19	26.55	15.14	5.10	2.65	0.87	2.25	0.50	1.16	0.22	0.17
014-BSS	1	0.00	0.00	0.00	0.08	1.57	12.08	30.76	24.69	16.18	6.04	2.06	1.08	2.39	0.65	1.46	0.36	0.53
015-BSS	1	0.00	0.00	0.00	0.06	0.12	6.61	32.08	31.25	15.04	4.49	1.99	0.46	3.11	0.76	2.10	0.48	1.08
016-BSS	1	0.00	0.00	0.03	0.11	0.40	1.02	27.73	23.73	23.30	10.75	2.63	0.80	3.76	0.90	2.53	0.58	1.31
017-BSS	1	0.00	0.00	0.16	0.32	4.00	26.87	38.55	13.38	7.04	3.19	1.89	0.29	1.65	0.45	1.12	0.29	0.58
018-BSS	1	0.56	0.56	2.68	21.95	0.00	0.00	12.90	31.53	16.32	6.44	2.47	0.80	1.98	0.45	1.02	0.19	0.15
019-BSS	1	0.00	0.00	0.00	0.03	0.23	3.92	29.46	27.97	19.26	6.46	2.63	0.88	3.50	0.99	2.36	0.63	1.23
020-BSS	1	0.00	0.04	0.04	0.05	0.16	2.93	31.24	34.93	14.67	6.48	1.65	0.54	2.87	0.70	1.93	0.45	1.00
021-BSR	1	0.00	0.00	0.05	0.16	1.41	26.38	45.79	15.42	4.98	1.29	0.54	0.15	1.48	0.41	1.00	0.26	0.52
021-BSR	2	0.00	0.00	0.00	0.05	0.35	13.08	52.12	23.75	5.56	1.85	0.12	1.44	0.09	0.96	0.06	0.49	0.03
021-BSR	3	0.00	0.00	0.00	0.10	0.52	20.24	41.50	26.33	5.14	1.75	0.44	1.77	0.17	1.18	0.11	0.60	0.05
022-BSS	1	0.00	0.00	0.00	0.04	0.47	9.82	46.61	23.10	10.86	2.96	2.18	0.69	1.71	0.39	0.88	0.17	0.13
023-BSR	1	0.00	0.00	0.00	0.03	0.15	2.03	21.64	35.50	19.55	8.05	4.04	1.87	4.39	0.96	1.59	0.00	0.00
023-BSR	2	0.00	0.00	0.02	0.05	0.30	1.95	27.38	33.71	18.06	7.96	3.40	0.84	2.42	0.68	1.64	0.43	0.85
023-BSR	3	0.00	0.00	0.00	0.06	0.47	1.50	25.12	31.73	17.69	7.91	4.32	1.37	3.74	1.07	2.53	0.68	1.31
025-BSR	1	0.00	0.00	0.01	0.09	0.17	2.01	28.26	31.29	16.45	6.32	3.89	1.08	4.13	0.98	2.78	0.62	1.44
025-BSR	2	0.00	0.00	0.00	0.02	0.08	1.79	25.71	31.04	17.78	6.09	3.22	1.34	5.05	1.29	3.41	0.82	1.76
025-BSR	3	0.00	0.00	0.00	0.05	0.18	1.83	26.45	30.89	17.67	6.97	3.79	1.76	4.63	1.16	2.83	0.65	1.03
026-BSS	1	0.00	0.00	0.00	0.03	0.09	3.06	13.40	18.50	19.81	14.19	9.74	3.84	8.78	2.32	4.55	0.99	0.69
027-BSR	1	0.00	0.00	0.00	0.42	1.67	19.19	21.19	15.63	11.08	8.86	6.58	2.96	6.27	1.69	3.26	0.72	0.50
027-BSR	2	0.00	0.00	0.00	0.44	2.40	24.63	22.73	13.65	10.34	8.51	6.59	1.18	3.70	0.98	2.50	0.62	1.29
027-BSR	3	0.00	0.00	0.00	0.68	3.39	23.89	21.21	12.10	9.53	7.44	6.83	2.23	5.67	1.38	3.46	0.77	1.26
028-BSR	1	0.00	0.00	0.79	12.49	11.70	18.97	15.89	8.86	8.52	6.53	5.47	2.11	4.44	1.12	2.30	0.48	0.35
028-BSR	2	0.00	0.00	0.53	18.95	14.48	17.37	13.43	7.55	6.71	6.03	4.41	2.25	5.04	1.18	1.84	0.00	0.00
028-BSR	3	0.00	0.00	0.00	0.63	8.48	23.56	18.06	11.80	8.33	7.34	6.27	2.55	6.72	1.59	3.47	0.68	0.52
030-BSS	1	0.00	0.00	0.00	0.00	0.56	44.97	15.83	21.21	5.62	2.09	1.67	0.75	2.84	0.74	1.92	0.47	0.99
031-BSR	1	0.00	0.00	0.05	0.11	0.21	9.08	32.53	25.56	11.89	4.50	3.57	1.57	4.27	1.08	2.88	0.68	1.49
031-BSR	2	0.00	0.00	0.00	0.05	0.14	6.50	34.24	22.64	11.12	5.65	3.08	1.92	5.70	1.49	3.84	0.95	1.99
031-BSR	3	0.00	0.00	0.00	0.00	0.21	8.71	28.72	25.95	12.03	5.98	4.12	1.75	4.81	1.33	3.25	0.85	1.68
032-BSS	1	0.00	0.00	0.00	0.14	0.43	10.58	37.31	23.14	9.45	4.00	0.87	4.75	1.31	3.54	0.91	2.16	0.51
033-BSR	1	0.00	0.00	0.00	0.17	0.34	8.10	39.55	29.89	6.52	2.56	3.40	1.21	3.23	0.81	2.18	0.52	1.13
033-BSR	2	0.00	0.00	0.00	0.06	0.13	8.65	33.75	26.29	11.79	4.48	3.19	1.67	3.84	1.04	2.59	0.66	1.34
033-BSR	3	0.00	0.00	0.03	0.06	0.23	6.21	39.45	12.11	23.61	4.48	2.48	0.71	4.21	1.00	2.84	0.64	1.46
034-BSS	1	0.00	0.00	0.00	0.55	0.55	2.44	26.14	28.10	16.28	7.74	4.96	1.56	4.44	1.27	3.00	0.81	1.56
035-BSR	1	0.00	0.00	0.00	0.02	0.09	1.35	16.38	17.15	18.31	13.27	9.76	3.96	8.41	2.55	5.16	1.42	1.91
035-BSR	2	0.00	0.00	0.02	0.11	0.27	2.04	15.87	20.77	19.87	13.62	8.58	3.36	8.01	1.91	4.14	0.82	0.62
035-BSR	3	0.00	0.00	0.00	0.05	0.30	2.21	18.33	18.17	20.39	12.92	8.34	3.69	7.94	2.05	4.12	0.88	0.62
036-BSR	1	0.00	0.00	7.23	55.45	20.89	5.89	0.96	1.60	0.36	3.41	0.31	2.28	0.20	1.16	0.09	0.16	0.00
036-BSR	2	0.00	0.00	2.89	49.54	23.57	4.57	1.13	2.19	0.53	1.28	2.23	1.27	4.16	1.14	2.81	0.73	1.45
036-BSR	3	0.00	0.00	5.43	54.30	19.55	6.15	2.99	1.82	2.05	1.43	1.21	1.98	0.84	1.23	0.46	0.47	0.00
038-BSS	1	0.00	0.00	0.00	0.00	0.62	36.71	27.10	14.80	5.52	3.88	1.72	1.23	3.30	0.83	2.22	0.53	1.15
039-BSS	1	0.00	0.00	0.00	0.17	0.51	32.06	33.19	15.64	4.67	3.47	1.34	0.95	3.18	0.74	2.14	0.47	1.11
040-BSS	1	0.00	0.00	0.00	0.00	0.11	18.26	44.17	18.39	5.10	3.13	0.36	3.05	0.99	2.89	0.69	1.76	0.38
041-BSS	1	0.00	0.00	1.12	27.46	22.97	21.29	11.23	5.03	2.41	1.53	0.33	2.97	0.28	1.99	0.18	1.01	0.08

TABLE 3-2. MMS SOFT-BOTTOM SURVEY (1983-1984)
GRAIN SIZE DATA-PHI VALUES (cont.)

STATION	REP	PHI-1	PHI0	PHI1	PHI2	PHI3	PHI4	PHI5	PHI6	PHI7	PHI8	PHI9	PHI10	PHI11	PHI12	PHI13	PHI14	PHI15
042-BSS	1	0.00	0.00	0.00	0.09	0.27	18.97	38.23	22.34	5.72	2.49	2.39	0.84	3.39	0.85	2.29	0.54	1.18
043-BSS	1	0.00	0.00	0.00	0.00	0.31	26.95	31.06	17.06	6.40	3.88	2.89	1.13	4.02	1.03	2.71	0.66	1.40
045-BSS	1	0.00	0.00	0.00	0.00	0.57	41.76	35.19	10.15	3.54	1.84	1.34	2.19	0.93	1.36	0.52	0.52	0.00
046-BSS	1	0.00	0.00	5.73	47.09	24.98	5.32	3.44	1.42	0.30	2.09	1.53	0.65	2.91	0.73	1.96	0.46	1.01
048-BSS	1	0.00	0.00	0.00	0.00	0.84	41.83	25.76	13.07	4.16	2.90	2.33	1.23	3.55	0.83	2.17	0.46	0.78
049-BSS	1	0.00	0.00	0.00	0.00	0.73	51.04	25.75	8.57	3.43	2.38	0.24	3.51	0.33	2.35	0.21	1.19	0.09
050-BSS	1	0.00	0.00	0.00	0.33	5.34	64.04	14.65	4.53	1.81	2.07	0.22	3.14	0.30	2.10	0.19	1.06	0.08
052-BSS	1	0.00	0.00	0.00	0.00	0.52	27.93	32.79	20.58	4.29	2.09	1.85	0.82	3.57	0.91	2.40	0.58	1.24
053-BSS	1	0.00	0.00	0.00	0.00	1.67	43.21	18.31	14.03	5.50	3.14	3.02	0.76	4.02	1.05	2.71	0.67	1.40
054-BSS	1	0.00	0.00	0.00	0.30	5.75	52.91	19.37	7.93	3.29	2.19	1.91	1.18	2.67	0.65	1.38	0.28	0.21
055-BSS	1	0.00	0.00	0.00	0.00	0.35	50.97	24.40	7.37	4.05	3.11	2.03	1.15	2.92	0.74	1.78	0.41	0.65
056-BSS	1	0.00	0.00	0.00	0.21	0.41	32.72	19.89	11.94	8.61	6.13	5.10	2.15	4.97	1.33	3.35	0.85	1.74
058-BSS	1	0.00	0.00	0.11	0.43	0.65	19.11	41.22	19.00	4.83	2.88	1.34	0.86	3.73	0.95	2.52	0.60	1.30
059-BSS	1	0.00	0.00	0.04	0.13	0.27	8.65	26.75	21.05	12.28	6.03	5.57	2.02	6.67	1.76	4.50	1.12	2.33
060-BSS	1	0.00	0.00	0.00	0.00	0.87	32.04	27.77	14.71	5.10	3.84	3.72	0.63	4.44	1.10	3.00	0.70	1.55
061-BSS	1	0.00	0.00	0.26	2.07	1.81	24.08	24.29	24.82	8.34	4.45	2.89	1.31	3.46	0.79	1.26	0.00	0.00
062-BSS	1	0.00	0.00	0.00	0.09	0.26	14.20	33.13	18.56	11.24	6.60	1.48	0.91	5.24	1.38	3.53	0.88	1.83
063-BSS	1	0.00	0.00	0.00	0.13	0.52	11.64	33.99	15.18	16.36	6.55	5.59	1.68	4.31	1.04	2.23	0.44	0.33
064-BSS	1	0.00	0.00	0.00	0.00	7.76	60.16	16.03	6.70	1.97	1.79	1.07	1.77	0.74	1.09	0.41	0.42	0.00
065-BSS	1	0.00	0.00	0.00	0.15	0.75	14.35	34.69	20.50	8.73	6.38	5.78	1.76	3.30	1.12	1.73	0.48	0.28
066-BSS	1	0.00	0.00	0.00	0.00	1.16	38.52	29.35	11.81	6.59	2.82	2.92	0.61	2.43	0.62	1.64	0.39	0.85
067-BSS	1	0.00	0.00	0.00	0.00	1.87	53.66	21.60	8.22	4.10	2.70	2.71	0.88	1.76	0.61	1.08	0.34	0.41
068-BSS	1	0.00	0.00	0.00	0.00	1.20	53.77	23.05	8.69	3.77	0.48	4.12	0.31	2.76	0.20	1.39	0.08	0.18
069-BSS	1	0.00	0.00	0.08	0.98	4.33	10.36	28.78	16.72	14.88	8.61	5.35	1.31	3.37	0.84	2.28	0.53	1.18
070-BSS	1	0.00	0.00	0.00	0.00	0.53	24.56	36.94	15.61	8.43	5.39	3.69	1.02	2.35	0.51	0.85	0.00	0.00
071-BSS	1	0.00	0.00	0.00	0.65	1.09	41.87	25.37	11.84	5.48	3.08	3.26	0.74	2.59	0.66	1.74	0.42	0.90
072-BSS	1	0.00	0.00	0.00	0.13	0.67	31.08	28.29	13.99	7.59	4.49	1.76	0.67	4.38	1.16	2.96	0.74	1.53
073-BSR	1	0.00	0.00	0.00	0.47	1.25	37.40	27.04	13.72	5.21	3.81	2.96	0.94	2.79	0.73	1.88	0.47	0.97
073-BSR	2	0.00	0.00	0.00	0.67	1.67	36.98	29.28	13.14	4.74	2.92	3.52	0.99	2.70	0.68	1.65	0.38	0.60
073-BSR	3	0.00	0.00	0.00	0.00	0.48	37.05	28.36	13.14	5.77	3.29	2.49	1.02	3.26	0.85	2.20	0.54	1.14
074-BSR	1	0.00	0.00	0.00	0.61	1.40	25.58	27.40	15.21	8.58	6.02	5.34	1.43	3.72	0.96	2.27	0.54	0.83
074-BSR	2	0.00	0.00	0.22	1.74	2.17	23.44	25.01	16.45	8.92	5.40	5.26	1.71	4.25	1.13	2.60	0.63	0.95
074-BSR	3	0.00	0.00	0.00	0.59	1.03	23.46	27.67	16.21	8.12	6.90	3.94	2.54	5.80	1.36	2.12	0.00	0.00
075-BSS	1	0.00	0.00	0.09	0.86	1.81	24.54	35.03	12.55	7.52	4.75	3.56	1.39	3.53	0.86	2.16	0.48	0.78
076-BSR	1	0.00	0.00	0.00	0.25	0.50	17.89	38.46	18.23	11.60	5.47	1.97	0.52	2.03	0.48	1.36	0.31	0.70
076-BSR	2	0.00	0.00	0.00	0.10	0.67	14.99	39.73	17.03	12.76	4.87	2.18	1.12	2.95	0.70	1.80	0.39	0.65
076-BSR	3	0.00	0.00	0.06	0.31	0.56	14.77	36.89	17.73	12.59	6.80	2.93	0.58	2.68	0.64	1.81	0.41	0.93
077-BSS	1	0.00	0.00	0.00	0.02	0.34	2.86	21.58	22.95	23.88	10.12	5.38	2.16	5.60	1.26	2.89	0.54	0.43
078-BSS	1	0.00	0.00	0.05	0.14	0.34	5.13	46.73	20.57	12.66	4.46	3.23	0.61	2.40	0.57	1.62	0.36	0.84
079-BSR	2	0.00	0.00	0.00	0.28	66.21	17.18	3.44	2.80	1.90	2.60	1.22	0.51	1.49	0.41	1.00	0.26	0.52
079-BSR	3	0.00	0.00	0.00	0.50	63.72	20.91	6.57	1.44	2.20	1.49	0.22	1.35	0.10	0.90	0.06	0.46	0.03
080-BSR	2	0.00	0.00	0.00	0.20	2.58	25.24	31.23	12.04	10.53	6.68	3.70	1.37	3.24	0.88	1.68	0.38	0.26
081-BSS	1	0.00	0.00	0.00	0.00	1.93	24.55	26.87	14.50	9.06	6.03	2.66	0.77	5.28	1.40	3.56	0.89	1.84
082-BSR	1	0.00	0.00	0.00	0.06	0.45	9.11	29.46	19.31	12.95	8.02	3.97	1.00	6.09	1.59	4.11	1.01	2.13
082-BSR	2	0.00	0.00	0.00	0.05	0.49	7.94	39.42	19.77	14.43	7.93	4.40	1.68	3.46	0.00	0.00	0.00	0.00
082-BSR	3	0.00	0.00	0.05	0.33	1.14	8.10	23.03	21.81	15.32	9.46	3.25	1.05	6.37	1.70	4.30	1.08	2.23
083-BSS	1	0.00	0.00	0.00	0.09	0.38	5.24	51.70	19.37	12.98	5.60	0.47	2.51	0.16	1.27	0.07	0.17	0.00
084-BSS	1	0.00	0.00	0.00	4.32	27.93	51.26	12.03	1.37	1.06	0.42	0.75	0.27	0.40	0.12	0.06	0.00	0.00
085-BSR	1	0.00	0.00	0.00	0.56	26.95	37.62	17.67	5.11	3.50	3.28	0.63	3.28	0.21	1.12	0.00	0.00	0.00
085-BSR	2	0.00	0.00	0.00	1.24	59.52	17.67	8.85	3.55	2.88	1.60	0.31	2.01	0.14	1.34	0.09	0.68	0.04
086-BSR	1	0.00	0.00	0.00	0.04	0.34	5.47	35.69	22.45	15.51	9.98	4.71	1.75	3.64	0.00	0.00	0.00	0.00
086-BSR	2	0.00	0.00	0.00	0.22	63.79	9.46	8.63	4.22	4.00	2.55	1.65	0.29	2.03	0.51	1.37	0.32	0.71
086-BSR	3	0.00	0.00	0.00	0.06	0.59	5.62	28.69	21.64	17.55	9.99	5.95	1.67	3.57	1.00	2.19	0.55	0.80
087-BSS	1	0.00	0.00	0.00	6.97	35.44	13.36	20.70	8.49	7.59	3.13	0.37	2.06	0.14	1.24	0.08	0.42	0.00
088-BSR	1	0.00	0.00	0.00	0.03	0.25	1.25	29.20	20.07	19.56	13.50	5.80	0.75	3.77	0.93	2.54	0.59	1.31

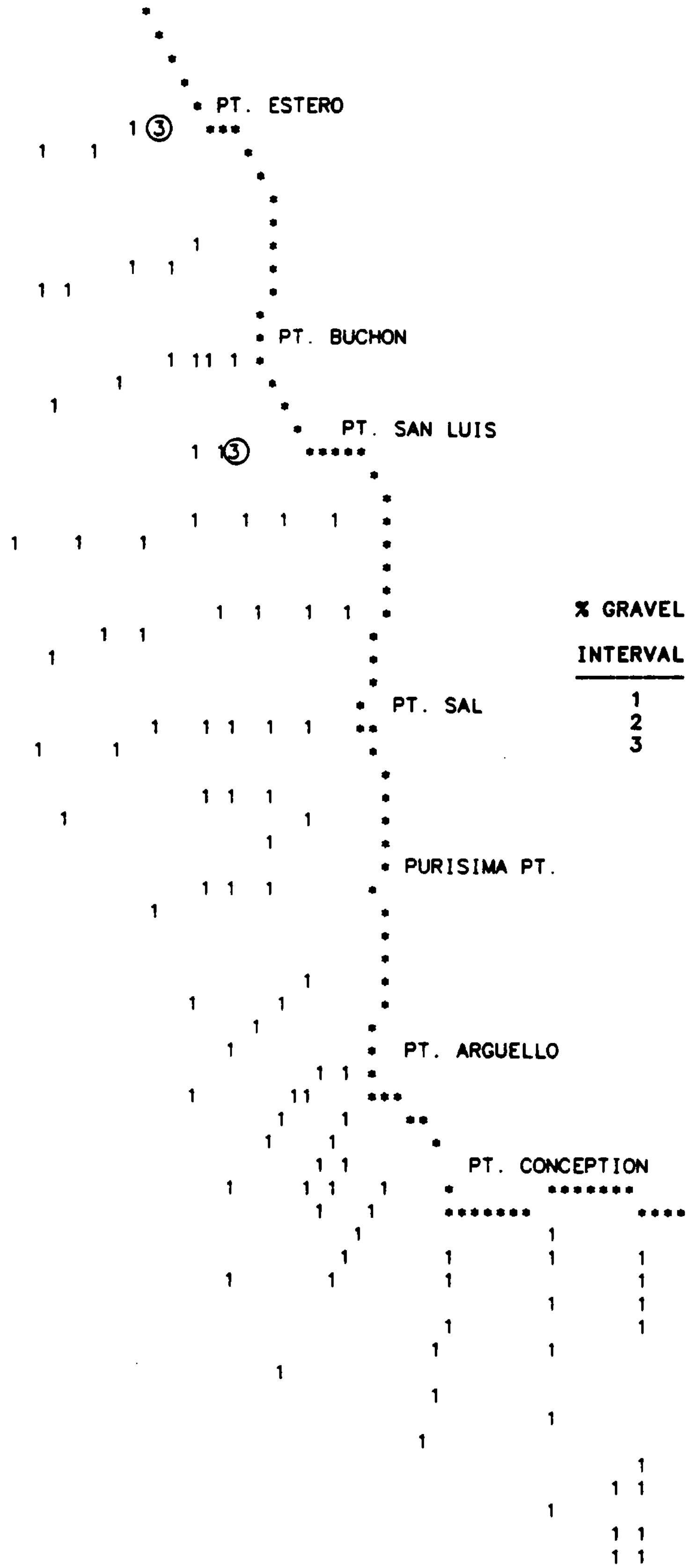
TABLE 3-2. MMS SOFT-BOTTOM SURVEY (1983-1984)
GRAIN SIZE DATA-PHI VALUES (cont.)

STATION	REP	PHI-1	PHI0	PHI1	PHI2	PHI3	PHI4	PHI5	PHI6	PHI7	PHI8	PHI9	PHI10	PHI11	PHI12	PHI13	PHI14	PHI15
088-BSR	2	0.00	0.00	0.02	0.07	0.18	1.25	27.87	27.14	21.80	9.53	3.32	0.82	3.16	0.76	2.13	0.48	1.10
088-BSR	3	0.00	0.00	0.00	0.00	0.00	0.00	40.15	18.51	20.02	9.27	3.86	1.20	3.14	0.75	1.92	0.42	0.69
089-BSS	1	0.00	0.00	0.00	0.06	0.38	1.43	22.14	8.07	19.10	18.54	10.13	2.25	6.82	1.95	4.60	1.24	2.39
090-BSS	1	0.00	0.00	0.16	14.31	22.90	17.18	28.96	7.53	3.61	1.15	0.12	1.87	0.12	1.25	0.08	0.63	0.03
091-BSS	1	0.00	0.00	0.00	0.02	0.68	4.02	9.97	15.77	16.59	17.74	11.15	4.37	10.24	2.36	5.29	1.01	0.79
092-BSS	1	0.00	0.00	0.00	0.13	0.34	1.52	28.66	13.36	19.97	14.98	7.36	2.19	6.04	1.32	3.12	0.56	0.46
093-BSS	1	0.00	0.00	0.00	0.06	0.77	6.27	32.14	19.89	13.08	11.26	4.95	1.33	4.03	1.00	2.71	0.63	1.40
094-BSS	1	0.00	0.49	3.41	6.81	17.76	49.63	8.50	4.67	2.61	3.02	0.35	1.96	0.12	0.67	0.00	0.00	0.00
095-BSS	1	0.00	0.00	0.00	0.05	0.36	12.22	32.91	21.02	12.43	7.36	5.46	1.27	3.08	0.77	1.88	0.43	0.68
096-BSS	1	0.00	0.00	0.03	0.14	0.35	3.28	35.16	19.50	17.90	9.40	5.30	2.06	5.19	0.93	0.76	0.00	0.00
097-BSS	1	0.00	0.00	0.00	0.12	0.17	1.34	39.42	21.99	16.73	8.81	4.96	0.55	2.34	0.56	1.57	0.36	0.81
098-BSS	1	0.00	0.00	0.00	0.00	0.00	0.00	25.71	10.78	10.43	17.01	12.27	2.37	8.22	2.28	5.55	1.45	2.88
099-BSS	1	0.00	0.00	0.00	0.18	1.06	2.26	30.61	13.93	16.18	16.17	6.91	2.61	6.31	1.26	2.27	0.00	0.00
100-BSS	1	0.00	0.02	0.01	0.12	0.23	1.49	18.83	14.58	15.66	16.76	10.16	3.62	9.48	2.38	4.91	1.02	0.74
101-BSS	1	0.00	0.00	0.00	0.15	0.70	5.14	36.38	18.99	18.71	9.18	2.31	1.31	3.12	0.84	1.91	0.46	0.70
102-BSS	1	0.00	0.00	0.00	0.58	1.02	28.70	31.24	18.25	6.13	2.87	2.20	0.87	3.15	0.84	2.12	0.53	1.10
103-BSS	1	0.00	0.00	0.00	0.07	0.14	2.98	28.46	27.16	15.64	6.52	4.57	1.61	5.08	1.23	3.42	0.78	1.77
104-BSS	1	0.00	0.00	0.03	0.36	0.39	3.32	31.16	27.11	16.40	6.53	3.41	1.63	4.29	1.07	2.62	0.60	0.95
105-BSS	1	0.00	0.00	0.00	0.06	0.17	1.38	24.27	28.58	15.79	8.17	3.91	2.58	5.74	1.65	3.88	1.05	2.01
106-BSS	1	0.00	0.00	0.00	0.00	0.14	4.30	20.04	24.73	20.82	10.41	6.77	1.84	4.93	1.15	3.01	0.64	1.09
107-BSS	1	0.00	0.00	0.00	0.00	0.14	3.77	17.54	19.51	19.29	12.25	7.52	3.20	7.31	2.02	4.47	1.12	1.64
108-BSS	1	0.00	0.00	7.28	45.62	22.81	10.68	2.88	1.95	0.79	0.26	3.52	0.27	2.35	0.17	1.19	0.07	0.16

Sorting measures obtained for the sediment samples indicated that the sediments are all poorly sorted to very poorly sorted. No meaningful pattern was discerned from the plots of sorting values. The skewness measure indicated that the sediments are all strongly skewed to the fines; no meaningful pattern was perceived in plots of these data. The skewness results suggest that the coarse fractions of the sediments are better sorted than the fine fractions; this pattern can occur when the coarse fraction is contributed by littoral sands and gravel or authigenic mineral grains of uniform size.

The areal distribution of the gravel-sized sediment fraction (Figure 3-2) shows that the coarseness of the sediment off Point Estero and Point San Luis is caused by the occurrence of gravel. The lithology of this size fraction was not studied, so it is uncertain what material forms the gravel fraction in these sediments. The map of surficial sediments prepared by Welday and Williams (1975) indicates that bedrock and shell deposits occur out to depths between 180 and 240 ft off Point Estero and particularly between Point Buchon and Point San Luis. It is possible that the gravel off Point Estero is lithic and the gravel off Point San Luis is largely shell debris.

The areal distribution of the sand-sized sediment fraction (Figure 3-3) is very similar to the distribution of mean grain size. The abundant sand fraction on the Santa Lucia Bank is caused by the presence of granular phosphorite (or glauconite). The abundance of sand fraction at nearshore



% GRAVEL

INTERVAL	INTERVAL MINIMUM	INTERVAL MAXIMUM	N
1	> 0	0	97
2	> 0	1	0
3	> 1	1	2

FIGURE 3-2. Percent Gravel in Bottom Sediments

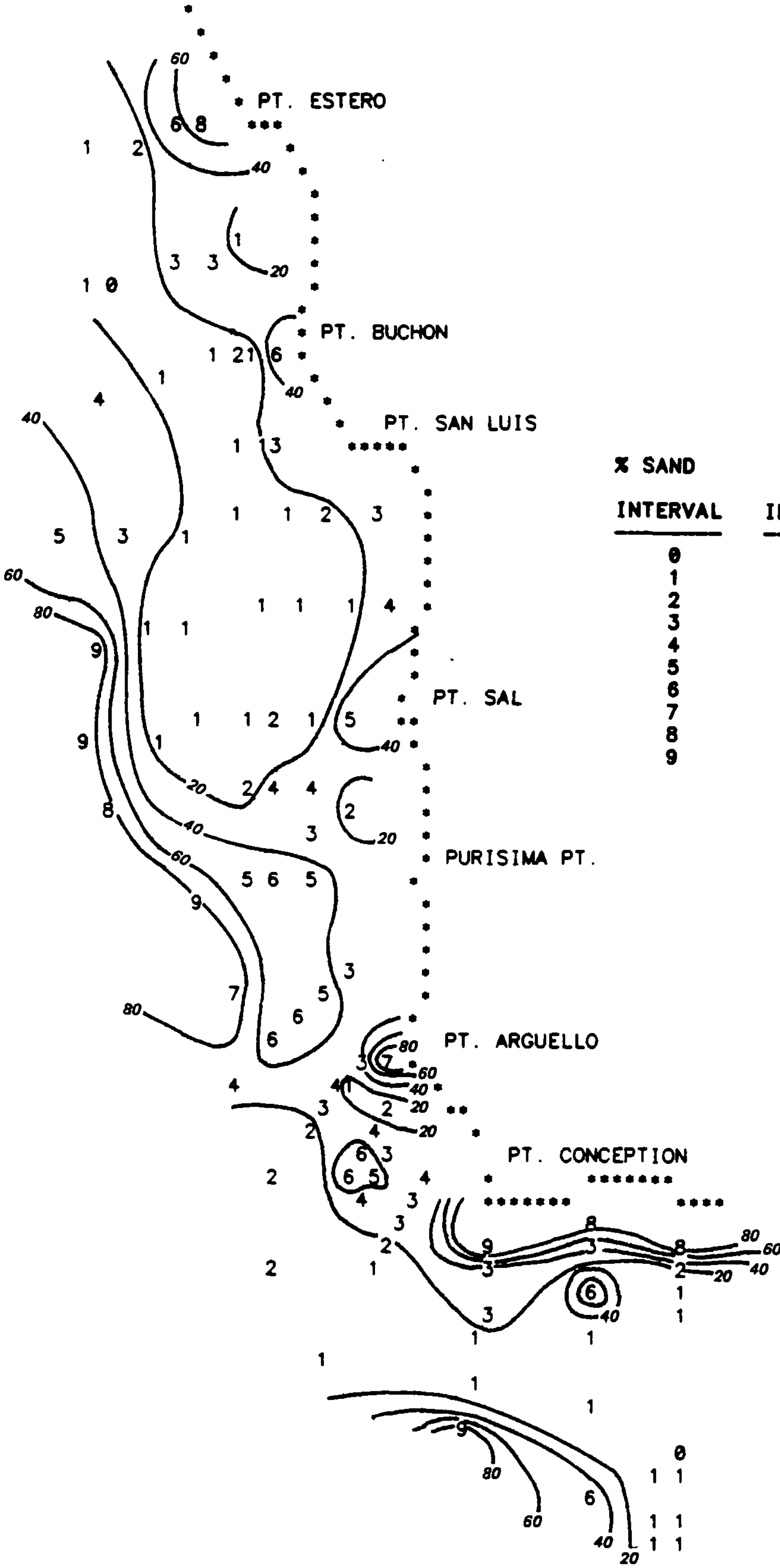
stations near headlands is probably caused by lithic fragments and sand introduced by seaward loss from littoral transport in shallower water. The sand fraction on the shoal north of San Miguel Island might represent lag material as well as being derived by littoral processes. The slope area north of Point Sal is characterized by very low amounts of the sand-sized fraction, and conforms with the pattern seen in the areal distribution of mean grain size. The head of the Point Arguello submarine canyon is marked by a patchy distribution of sand-size percentage.

The areal distribution of the silt-sized fraction of the sediments (Figure 3-4) shows relatively low levels of silt-sized material in nearshore samples taken off headlands, on the shoal north of San Miguel Island, and on the Santa Lucia Bank. The greatest abundance of silt-sized material occurs in the slope area north of Point Sal and in the Santa Barbara Channel. Patchiness of sediment properties at the head of the Arguello submarine canyon also is evident in the silt distribution.

The areal distribution of the clay-sized fraction of the sediments (Figure 3-5) shows a concentration of the clay fraction on the lower slope north of Point Sal and in the Santa Barbara Channel. A moderate concentration of the clay fraction occurs in the head of the Arguello submarine canyon. The smallest concentrations of the clay-sized fraction is found east of Point Conception, on the shoal north of San Miguel Island, and close to shore at stations north of Point Sal. In general, the silt and clay fractions show distributions that are the inverse of the sand and gravel distributions except that clay is not as deficient on Santa Lucia Bank.

SAS
% SAND

16:38

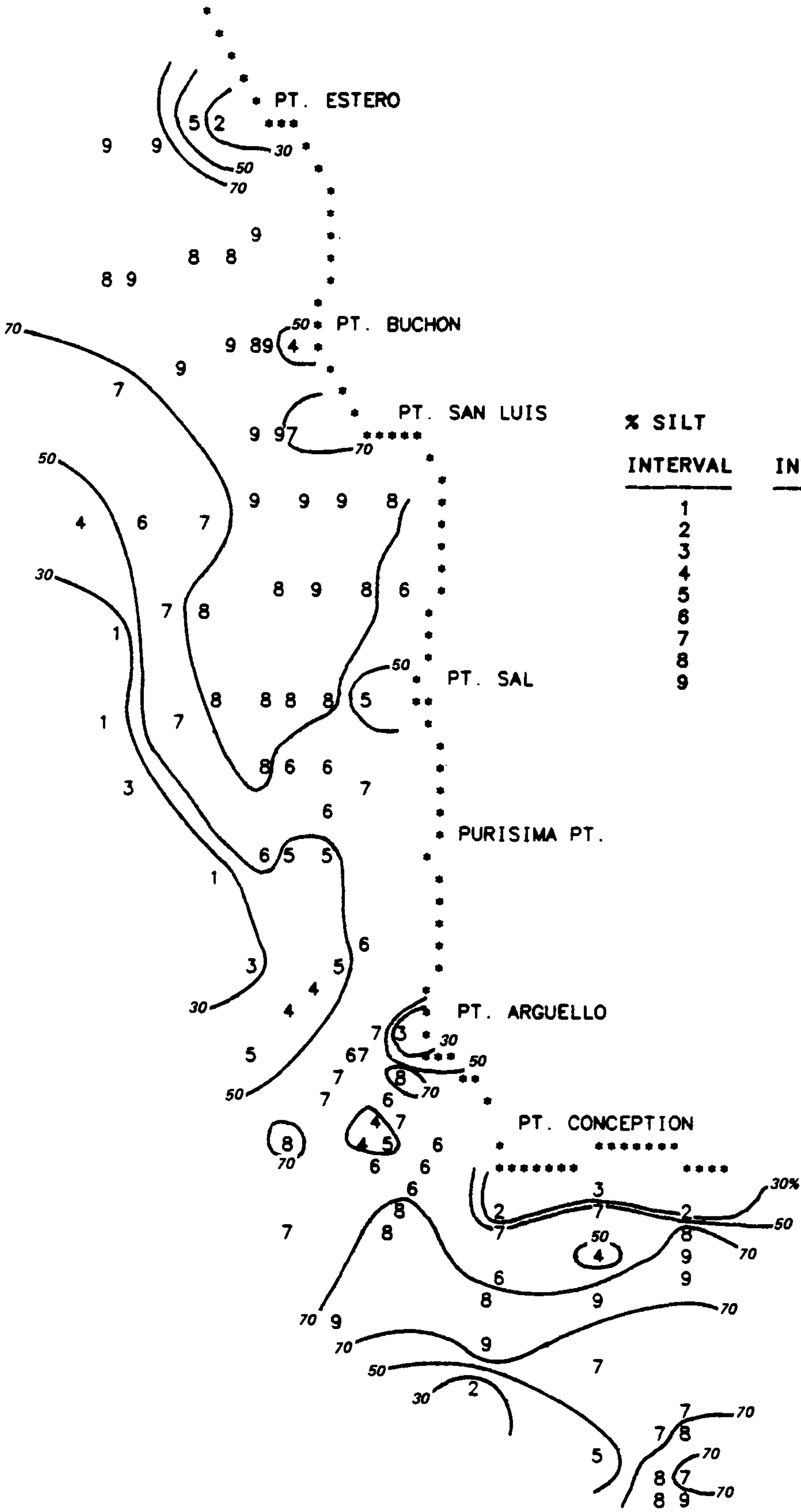


% SAND

INTERVAL	INTERVAL MINIMUM	INTERVAL MAXIMUM	N
0	0	0	2
1	> 0	10	35
2	> 10	20	12
3	> 20	30	15
4	> 30	40	9
5	> 40	50	6
6	> 50	60	9
7	> 60	70	2
8	> 70	80	4
9	> 80	90	5

FIGURE 3-3. Percent Sand in Bottom Sediments

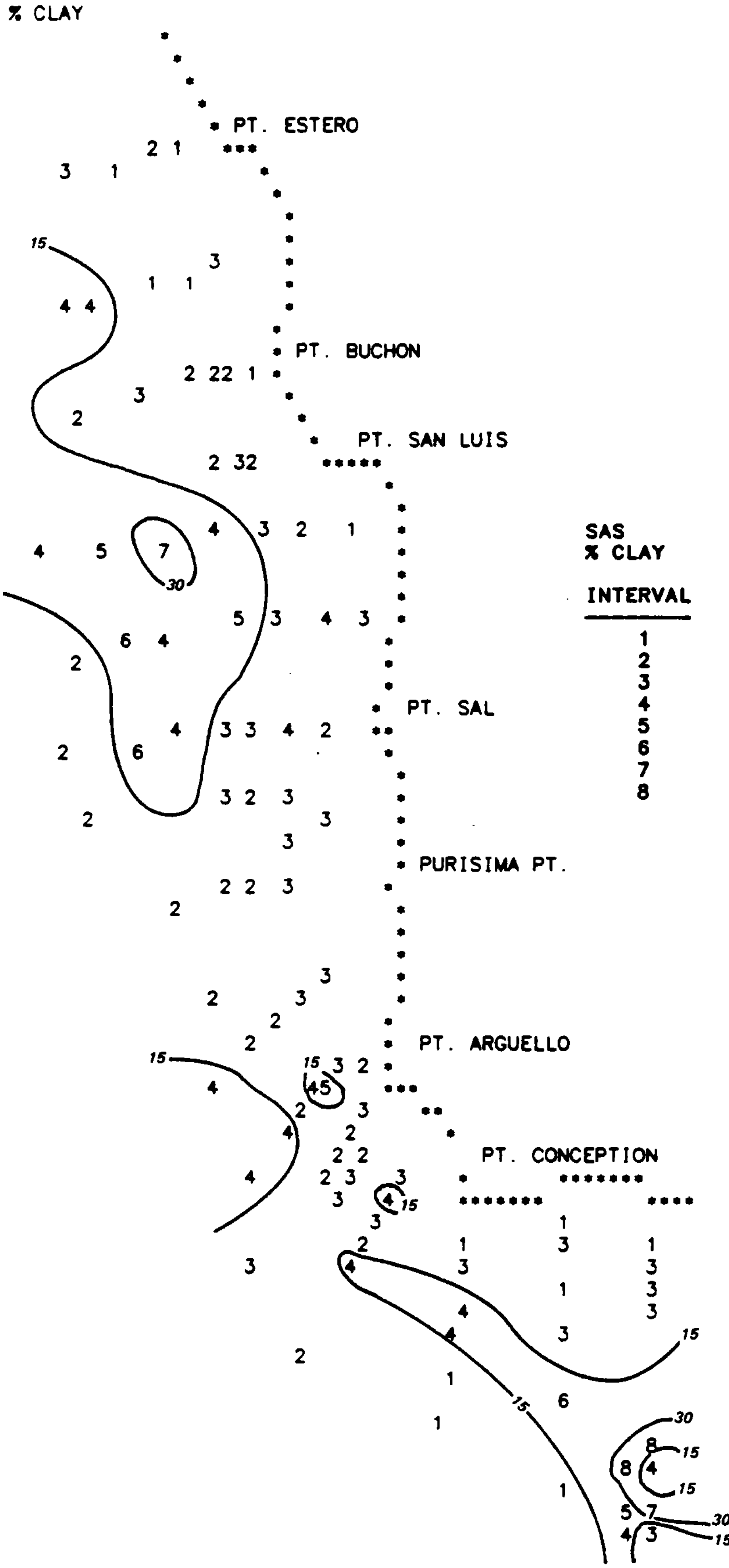
% SILT



% SILT

INTERVAL	INTERVAL MINIMUM	INTERVAL MAXIMUM	N
1	> 0	10	3
2	> 10	20	4
3	> 20	30	4
4	> 30	40	7
5	> 40	50	8
6	> 50	60	14
7	> 60	70	18
8	> 70	80	22
9	> 80	90	19

FIGURE 3-4. Percent Silt in Bottom Sediment



SAS
% CLAY

INTERVAL	INTERVAL MINIMUM	INTERVAL MAXIMUM	N
1	> 0	5	13
2	> 5	10	27
3	> 10	15	30
4	> 15	20	18
5	> 20	25	4
6	> 25	30	3
7	> 30	35	2
8	> 35	40	2

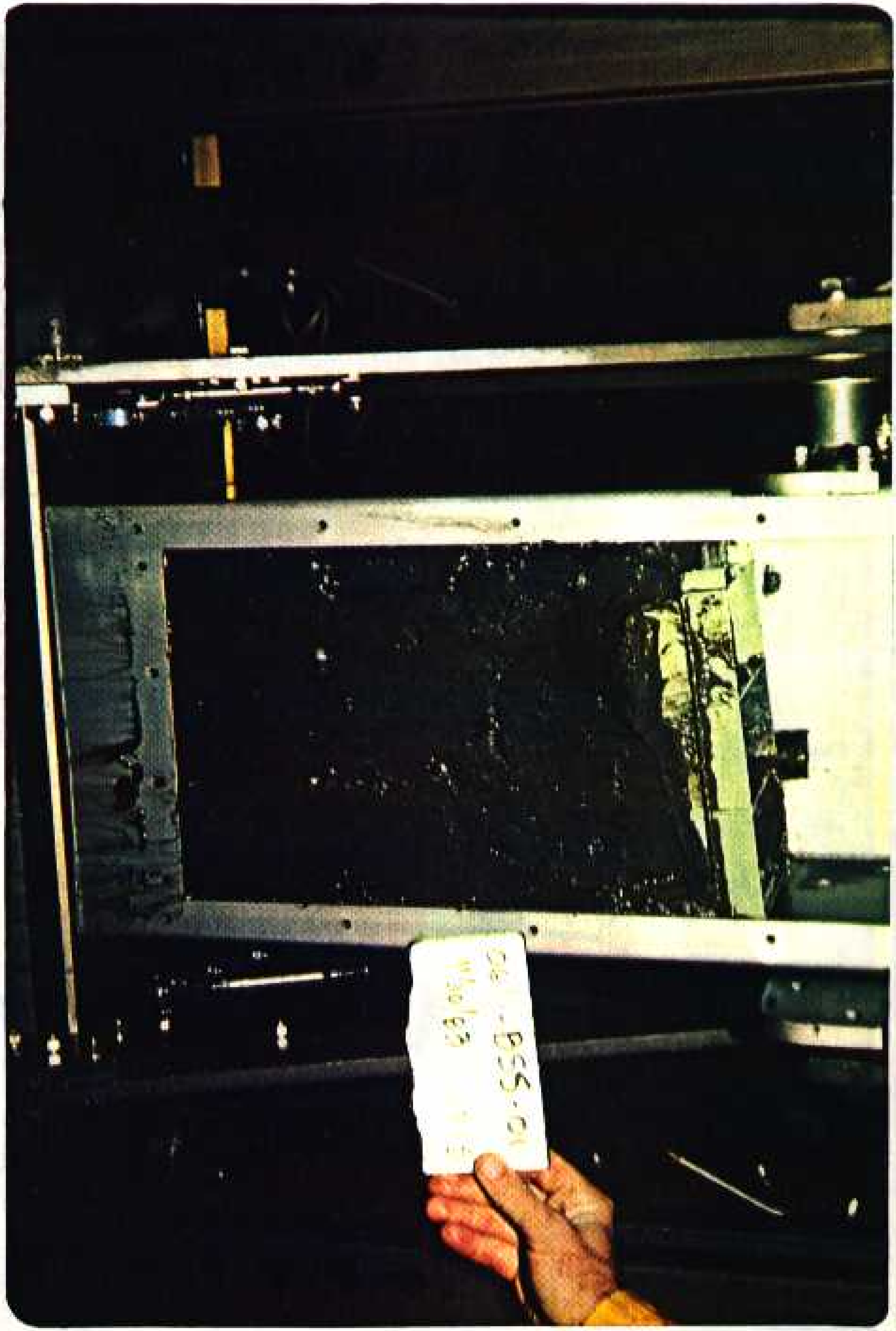
FIGURE 3-5. Percent Clay in Bottom Sediments

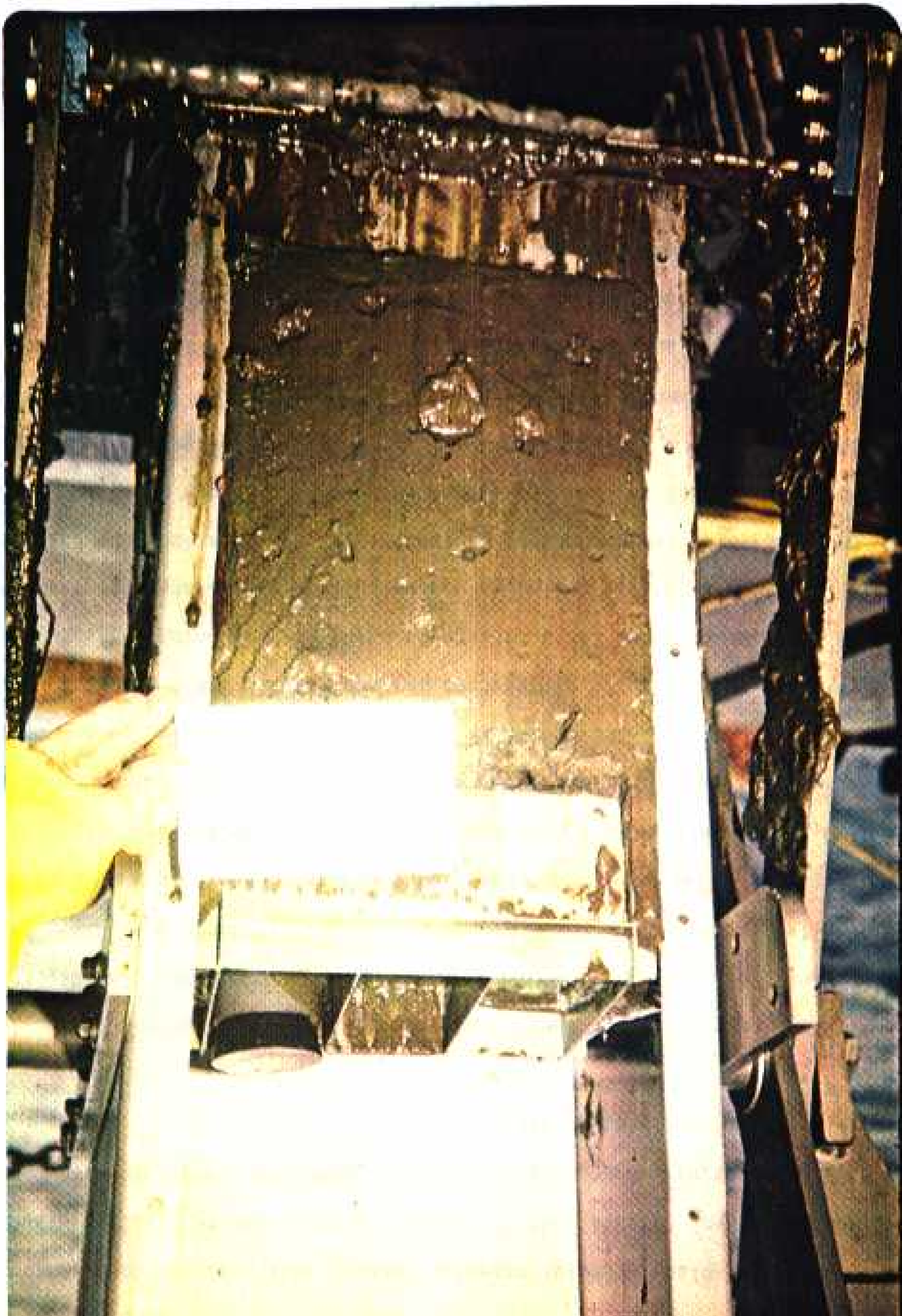
Sedimentology

Sediment Bulk Appearance - Photographs of sediment cores from the soft-bottom survey were taken of the top and side of each core to provide qualitative information on sediment layering and stratification, color, and bioturbation (see Methods Section 2.1.1.4). However, due to camera malfunction (improper exposures) data were only available from cores collected north of Pt. Conception to Pt. San Luis. Descriptions of the photographs of these cores are presented in Atlas 1 (Sediment Core Photographs). Interpretations of these data suggest the occurrence of two sediment types: (1) an olive green sapropel, and (2) a brown to tan mud. Each sediment type was characterized as unstratified silty clay (mud) with varying amounts of bioturbation and evidence of burrowing by the infauna. Examples of these two characteristic sediment types are presented in Figures 3-6 and 3-7. The distribution of these sediment types, shown on Figure 3-8, appears to be determined by the amount of oxidized brown mud overlying olive green mud. Oxidized mud was present in about half the cores examined, corresponding to cores that were either all oxidized mud or contained an oxidized surface layer.

The olive green mud probably represents a pelagic, organic-rich reduced sediment resulting from high productivity induced by upwelling in the area. The brown mud is probably oxidized pelagic material of fluviatile origin. Carbonaceous material is present in the cores taken off Point Sal and off Point Arguello. This component probably also results from biological productivity induced by upwelling in those areas.

Figure 3-6. Sediment Core from Station 061 Containing Olive Green Sapropel.





An olive-black granular material present in the top of cores taken on the Santa Lucia Bank (Figure 3-8) is probably phosphorite or possibly glauconite. These materials are characteristic of sediments found on bathymetric highs in areas of high productivity.

The distribution of these sediment types showed no pronounced pattern based on qualitative interpretation from the core photographs. The distribution of olive green mud is probably caused by scour of surface oxidized sediment. Cores of olive green mud with a surface layer of oxidized mud probably came from areas where scour by bottom currents was of lesser severity. Cores containing completely oxidized brown mud probably came from areas of rapid sedimentation. However, the sediments in the study area can be grouped roughly into facies having subtle differences in properties. These facies include: 1) Santa Lucia Bank facies characterized by oxidized mud containing authigenic phosphorite (or glauconite) grains, a medium to fine sand mean grain size, and a low total organic carbon content; 2) continental shelf facies in depths less than approximately 360 ft, and characterized by mud (probably oxidized) with a fine sand mean grain size, low clay content, high sand content, and low total organic carbon content; and 3) continental slope facies at depths below approximately 360 ft and characterized by olive green mud with varying amounts of surface oxidization, having a silt mean grain size, high clay and silt content, low sand content, and a high total organic carbon content. This facies also occurs in the deeper parts of the Santa Barbara Basin.

The area at the head of the Arguello submarine canyon is characterized by a patchy distribution of the Shelf and Slope facies. Elsewhere the facies are segregated by depth or bathymetric morphology. Results of a principal component analysis of the sediment data and correlation analyses showed maximum correlations between sediment variables and an axis representing the sediment size factor (Table 3-3). The distribution of the axis scores yields a pattern resembling the areal distribution of the sediment facies discussed above.

The sediment facies suggest some relationship to the oceanographic conditions prevailing in the area. The coast is exposed to vigorous wave activity from Pacific storms, particularly at headlands, and currents in the area are occasionally swift and extremely variable. Bottom investigations have revealed that areas of mass movement, hummocky bottom terrain, and scarps caused by Recent fault movement characterize the sea floor.

The Santa Lucia Bank facies reflects the effects of high productivity and scour by currents. The patchiness of the facies distribution at the head of Arguello submarine canyon, on the continental slope north of Point Sal, and on the slope on the north side of the Santa Barbara Channel might be caused by mass movement at the sea floor (e.g., Figure 3-8) as well as by episodic strong bottom currents. The Continental Slope facies muds show evidence of recent deposition, where they have an oxidized upper layer, and of recent scour where the oxidized layer is absent. Dilution of the Continental Shelf facies by sand-sized material reflects the introduction of littoral materials from longhsore transport caused by vigorous wave activity.

Table 3-3. Factor Matrix Correlations between Variables and the Axis Scores (* indicates values $\geq \pm 0.5$)

Sediment Variables	SED1[A]	SED2	SED3
	PCA Axes		
1. PHI -1	-0.13	0.38	-0.72*
2. PHI 0	-0.16	0.46	-0.67*
3. PHI 1	-0.31	0.65*	-0.59*
4. PHI 2	-0.38	0.58*	-0.13
5. PHI 3	-0.58*	0.44	-0.01
6. PHI 4	-0.63*	0.02	0.42
7. PHI 5	0.18	-0.79*	-0.05
8. PHI 6	0.54*	-0.60*	-0.34
9. PHI 7	0.76*	-0.26	-0.34
10. PHI 8	0.85*	0.11	-0.08
11. PHI 9	0.80*	0.27	0.03
12. PHI 10	0.37	0.26	0.43
13. PHI 11	0.87*	0.29	0.08
14. PHI 12	0.50*	0.27	0.53*
15. PHI 13	0.86*	0.28	0.14
16. PHI 14	0.51*	0.23	0.52*
17. PHI 15	0.62*	0.13	0.17
18. % SAND	-0.85*	0.48	0.17
19. % SILT	0.68*	-0.66*	-0.27
20. % CLAY	0.89*	0.32	0.21
21. MEDIAN PHI	0.31	-0.02	-0.02
22. MODE PHI	0.70*	-0.45	-0.08
23. MEAN PHI	0.96*	-0.23	0.04
24. SD PHI	0.49	0.60*	0.19
25. SKEWNESS PHI	-0.79*	-0.26	0.28
26. KURTOSIS PHI	-0.79*	-0.29	0.13
27. SHARP & FAN SORTING N INT	-0.83*	-0.35	0.13
28. SHARP & FAN SORTING 25 INT	-0.81*	-0.40	0.19

[A]Sediment Size Factor

Virtually all of the sediment samples contained evidence of biological activity in the form of burrows, bioturbation, or carbonaceous material. It is apparent that none of the facies exclude the development of benthic or infaunal communities. However, community structure might respond to the sediment facies distribution.

The primary mechanisms of sediment transport through the study area are suspension and mass movement of particles introduced as suspended load and bed load in river discharge. Suspended particles are deposited on the shelf and slope. Bed load particles enter the littoral transport system and are carried along the shore and onto the continental shelf. Resuspended sediment that moves near the sea floor can leave the area southward via the Arguello submarine canyon or northward via the sea valley east of the Santa Lucia Bank. The bank forms a barrier to direct downslope transport, thus sediment accumulation in the sea valley area is expected. Suspended particles carried eastward around Point Conception eventually will be trapped in the Santa Barbara Basin.

Measurements of bottom sediment cohesiveness were conducted during Legs 1, 2, and 3 of the soft-bottom survey with a torsional vane shear device. In most cases, the core sediments were too fine and contained large amounts of water which prevented accurate measurements of sediment cohesiveness. The large number of zero values obtained from the Torvane measurements preclude discerning any spatial trends in this sediment characteristic. During Leg 4 of the survey, a pocket penetrometer was used in lieu of the

Torvane to measure compressive strength. Estimated compressive strength values for samples from Santa Maria Basin ranged from zero (< 0.001 ton/ft^2) at the majority of the stations to 0.02 ton/ft^2 (Station 46), although most values were between 0.002 to 0.004 ton/ft^2. In general, the higher compressive strength values were associated with sediments containing relatively greater amounts of sand-sized sediments. For example, sediments from Station 46 contained greater than 80% sand and provided the highest observed values. The low values were measured for sediments from depositional environments containing higher percentages of fine-grained materials. The relative magnitude of the compressive strength values generally is consistent with visual observations of the composition and quality of the sediment core (as noted on field sampling records).

Redox measurements were made in triplicate at each of three depths within the sediment cores; however, very poor agreement was observed in most cases between the replicate values. Despite efforts to rinse the probe with de-ionized water and re-calibrate between successive measurements, the probe apparently retained a "memory" of the previous measurements which influenced values obtained during the subsequent measurements. Thus, the absolute values obtained from the measurement are questionable. No measurements were made for sediments collected from Stations 89 through 101, due to probe malfunction. Nevertheless, some general trends of the relative magnitude of the data values were observed. The range in E_h values obtained during the survey were from approximately -400 to 500 millivolts (mV). Sverdrup et al. (1942) suggested that most sediments from areas offshore California have E_h values ranging from

-120 to -500 mV, although slightly positive values may occur in certain areas. In addition, the oxidation-reduction potentials of most sediments collected during this survey decreased with increased depth in the sediment core. Sverdrup et al., also noted that decreases in redox potentials with depth in the core are typical for marine sediment layers, and that the most rapid changes in E_h occur within the upper few centimeters of the core. Strong hydrogen sulfide odors were noted for samples from Stations 091, 098, and 099 from the Santa Barbara Basin. The presence of sulfides reflects the low oxygen levels in bottom waters and indicates reducing conditions in the sediments. Unfortunately, the probe was broken at these stations and redox measurements were not made for these samples.

3.1.2 Chemistry

Sediment chemistry data are summarized in the following section to characterize concentrations, spatial patterns and trends, and significant environmental correlations for sediment trace metals, hydrocarbons, and total organic carbon.

3.1.2.1 Trace Metals

Operational discharges of spent drilling fluids and cuttings from OCS exploration and production operations represent a potential input source for trace metals, particularly barium and chromium, to the marine environment. Discharged materials may accumulate in bottom sediments, and benthic organisms exposed to elevated trace metal levels may be subject to acute or sublethal toxic effects (NRC, 1983). Thus, monitoring changes in benthic biological communities which may be related to alterations in sediment chemistry is an important objective of OCS monitoring programs. Sediment trace metal concentrations were measured during this study to determine the existing levels in Santa Maria Basin and western Santa Barbara Channel sediments. Results from the Southern California Baseline Program suggest that trace metal levels in sediments typically are determined by (1) the nature of the source rock; (2) environmental source area; (3) nature of the transporting medium; (4) the environment at the depositional site; (5) the nature and activity of fauna; (6) tectonic activity; and (7) diagenetic redistribution. Of these factors the nature of the source rock and the environments at the source and at the site of deposition are thought to be the most important factors (Shokes and Callahan, 1978).

Barium

Barium is the most abundant trace metal in drilling fluids; concentrations up to 141,000 parts per million (ppm) may be present in generic muds (NRC, 1983). Due to its high initial concentration and low solubility in seawater, barium levels in sediments represent the most sensitive indicator of discharged drilling fluid accumulation or dispersion in the benthic environment. However, areal differences in sediment barium levels may also reflect the presence of barium enriched clays (barite), pelagic sediments, or materials derived from submarine volcanism, as well as variations in natural sources such as surface biological productivity, deposition of planktonic organism tests and exoskeletons of zooplankton (Chow, 1976; Chow and Goldberg, 1960; Dehairs et al., 1980). Diatoms and other planktonic organisms accumulate significant quantities of barium in their tests and skeletal materials. For example, phytoplankton may contain up to 500 μg/g dry wt, and radiolarians up to 250 μg/g dry wt of barium (Martin and Knauer, 1973). Eventual deposition of this biogenic material may account for the enriched barium levels in sediments underlying biologically productive waters, such as the Point Conception area (Dehairs et al., 1980). Barite also occurs in outcrops in the Santa Ynez Mountains; thus discharges of sediments from the Santa Ynez River, which drains the Santa Ynez Mountains, may provide a source of barium to the coastal shelf sediments (see Section 1.3, Environmental Overview). Barium levels measured during this study in Santa Maria Basin and western Santa Barbara Channel sediments are presented below and compared with historical values for the Southern California Bight to characterize the possible sources and magnitudes of barium inputs to the benthic environment.

Concentrations of sediment barium from the survey are presented in Table 3-4. Observed concentrations for barium ranged from 162 μg/g (Station 36) to 1,180 μg/g (Station 96). The mean concentration for all samples was 709 μg/g (s.d. = ± 163 μg/g). Most of the concentration values for areas north of Point Arguello were from 500 μg/g to 840 μg/g, with the exception of some relatively low levels (less than 200 μg/g) at Stations 36 and 108 located furthest offshore Point Sal/Purisima Point and containing relatively high percentages of sand in sediments. In areas south of Point Conception, high

TABLE 3-4. MMS SOFT-BOTTOM SURVEY (1983-1984)
TRACE METAL DATA IN UG/GM (cont.)

OBS	STATION	REP	CR	BA
1	002-BSS	1	248.00	290.00
2	002-BSS	1	254.00	363.00
3	002-BSS	1	359.00	363.00
4	002-BSS	1	325.00	312.00
5	002-BSS	1	349.00	434.00
6	003-BSS	1	415.00	477.00
7	004-BSS	1	328.00	714.00
8	005-BSS	1	135.00	605.00
9	007-BSS	1	157.00	568.00
10	009-BSS	1	288.00	616.00
11	010-BSS	1	113.00	584.00
12	011-BSS	1	109.00	597.00
13	015-BSS	1	162.00	606.00
14	016-BSS	1	114.00	627.00
15	017-BSS	1	141.00	562.00
16	018-BSS	1	96.30	519.00
17	019-BSS	1	116.00	647.00
18	020-BSS	1	118.00	645.00
19	021-BSR	1	82.20	778.00
20	021-BSR	2	73.10	737.00
21	021-BSR	3	87.10	755.00
22	021-BSR	3	83.40	756.00
23	021-BSR	3	90.30	788.00
24	021-BSR	3	84.50	747.00
25	021-BSR	3	84.40	750.00
26	022-BSS	1	129.00	642.00
27	023-BSR	1	104.00	689.00
28	023-BSR	2	98.00	598.00
29	023-BSR	3	98.80	595.00
30	025-BSR	1	102.00	634.00
31	025-BSR	2	100.00	621.00
32	025-BSR	3	96.30	646.00
33	026-BSS	1	114.00	713.00
34	027-BSR	1	113.00	655.00
35	027-BSR	2	124.00	646.00
36	027-BSR	3	122.00	607.00
37	028-BSR	1	178.00	575.00
38	028-BSR	2	160.00	475.00
39	028-BSR	3	142.00	643.00
40	030-BSS	1	66.70	897.00
41	030-BSS	1	71.10	914.00
42	030-BSS	1	64.50	782.00
43	030-BSS	1	68.20	874.00
44	030-BSS	1	73.80	845.00
45	031-BSR	1	92.60	685.00
46	031-BSR	2	91.10	662.00
47	031-BSR	3	95.50	719.00
48	032-BSS	1	92.70	684.00
49	033-BSR	1	90.20	655.00
50	033-BSR	2	100.00	743.00
51	033-BSR	3	99.20	704.00
52	034-BSS	1	104.00	617.00
53	035-BSR	1	106.00	609.00
54	035-BSR	2	114.00	606.00
55	035-BSR	3	102.00	514.00
56	036-BSR	1	182.00	180.00
57	036-BSR	2	185.00	162.00
58	036-BSR	3	174.00	244.00
59	038-BSS	1	115.00	721.00
60	039-BSS	1	96.00	734.00
61	040-BSS	1	92.10	740.00
62	041-BSS	1	175.00	416.00
63	042-BSS	1	86.80	835.00
64	042-BSV	11	85.60	812.00
65	042-BSV	12	90.00	782.00
66	042-BSV	13	81.30	789.00
67	042-BSV	14	85.90	775.00
68	042-BSV	31	90.40	795.00
69	042-BSV	32	85.50	791.00
70	042-BSV	32	96.10	830.00
71	042-BSV	34	79.20	713.00
72	042-BSV	51	88.60	778.00
73	042-BSV	52	88.00	833.00
74	042-BSV	53	84.80	811.00
75	042-BSV	54	90.00	808.00
76	042-BSV	71	78.50	685.00
77	042-BSV	72	86.60	774.00
78	042-BSV	73	86.50	802.00
79	042-BSV	74	84.30	830.00
80	043-BSS	1	103.00	787.00
81	045-BSS	1	98.20	814.00
82	046-BSS	1	225.00	344.00
83	048-BSS	1	118.00	766.00
84	049-BSS	1	72.40	558.00
85	050-BSS	1	134.00	903.00
86	052-BSS	1	97.30	810.00
87	053-BSS	1	131.00	826.00
88	054-BSS	1	126.00	832.00
89	055-BSS	1	99.40	768.00
90	056-BSS	1	108.00	727.00
91	058-BSS	1	95.40	777.00
92	059-BSS	1	111.00	826.00
93	061-BSS	1	105.00	705.00
94	062-BSS	1	111.00	755.00
95	063-BSS	1	105.00	705.00
96	064-BSS	1	98.00	806.00
97	065-BSS	1	111.00	770.00
98	066-BSS	1	120.00	923.00
99	067-BSS	1	116.00	929.00
100	068-BSS	1	108.00	797.00
101	069-BSS	1	106.00	678.00
102	070-BSS	1	105.00	714.00
103	070-BSS	1	98.00	844.00
104	070-BSS	1	99.60	800.00
105	070-BSS	1	107.00	832.00
106	070-BSS	1	106.00	858.00
107	071-BSS	1	103.00	900.00
108	072-BSS	1	107.00	724.00

TABLE 3-4. MMS SOFT-BOTTOM SURVEY (1983-1984)
TRACE METAL DATA IN UG/GM (cont.)

OBS	STATION	REP	CR	BA
109	073-BSR	1	103.00	829.00
110	073-BSR	2	103.00	890.00
111	073-BSR	3	105.00	869.00
112	074-BSR	1	101.00	798.00
113	074-BSR	1	106.00	790.00
114	074-BSR	2	106.00	913.00
115	074-BSR	3	102.00	765.00
116	075-BSS	1	107.00	798.00
117	076-BSR	1	103.00	685.00
118	076-BSR	2	112.00	736.00
119	076-BSR	3	103.00	712.00
120	077-BSS	1	104.00	609.00
121	078-BSS	1	103.00	666.00
122	079-BSR	1	173.00	1040.00
123	079-BSR	3	112.00	996.00
124	080-BSR	2	107.00	945.00
125	081-BSS	1	115.00	789.00
126	082-BSR	2	118.00	716.00
127	083-BSS	1	118.00	606.00
128	084-BSS	1	127.00	545.00
129	085-BSR	1	94.70	892.00
130	085-BSR	2	66.00	854.00
131	086-BSR	1	104.00	1040.00
132	086-BSR	2	65.40	974.00
133	086-BSR	2	77.90	1020.00
134	086-BSR	2	71.50	972.00
135	086-BSR	2	83.50	979.00
136	086-BSR	2	60.70	1000.00

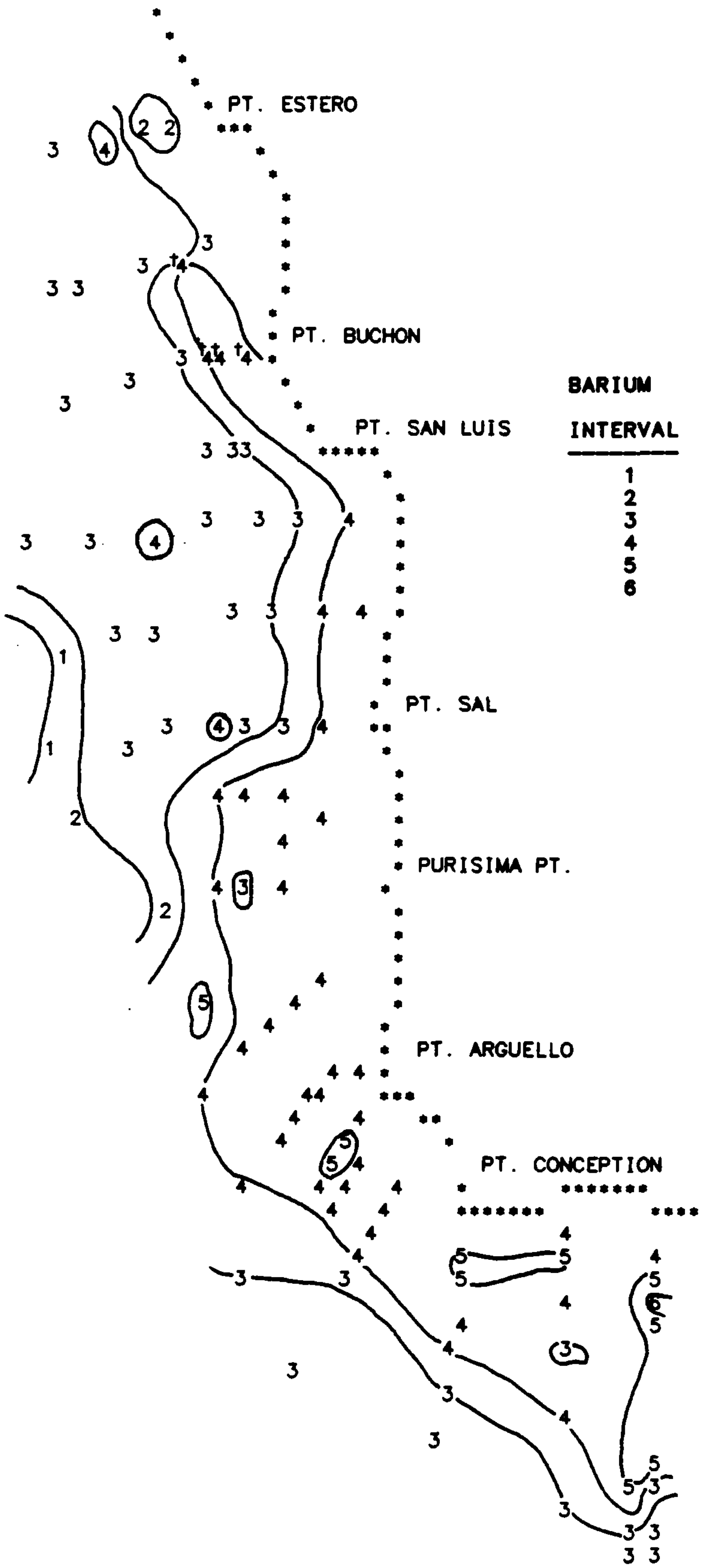
OBS	STATION	REP	CR	BA
136	086-BSR	2	60.70	1000.00
137	086-BSR	3	99.10	974.00
138	087-BSS	1	87.90	727.00
139	088-BSR	1	101.00	620.00
140	088-BSR	2	102.00	658.00
141	088-BSR	3	97.60	568.00
142	089-BSS	1	109.00	799.00
143	090-BSS	1	127.00	511.00
144	091-BSS	1	96.40	971.00
145	092-BSS	1	104.00	642.00
146	093-BSS	1	98.40	585.00
147	094-BSS	1	120.00	900.00
148	095-BSS	1	93.90	1020.00
149	096-BSS	1	93.90	1180.00
150	097-BSS	1	92.20	947.00
151	098-BSS	1	90.30	940.00
152	099-BSS	1	98.70	689.00
153	100-BSS	1	104.00	613.00
154	101-BSS	1	97.40	560.00
155	102-BSS	1	80.30	878.00
156	103-BSS	1	91.60	704.00
157	104-BSS	1	97.10	598.00
158	105-BSS	1	96.00	650.00
159	106-BSS	1	108.00	624.00
160	107-BSS	1	98.40	556.00
161	108-BSS	1	160.00	171.00

levels between 870 to 1,180 μg/g occurred at several nearshore stations and in the southeast portion of the Santa Barbara Basin. The remaining barium concentrations within the Santa Barbara Channel were between 500 to 840 μg/g. Correlations between sediment barium levels and total organic carbon, or sediment grain size parameters were all low (< 0.5), with the exception of phi 2 for which r = -0.60.

The observed geographical pattern in the barium concentrations are shown in Figure 3-9. The relatively high sediment barium levels off Point Conception correspond closely to the locations of established oil platforms (Herman, Helen, and Hondo) and to areas of previous exploration and production drilling operations. Barium levels in these sediment samples could reflect the presence of either drilling fluid residues (barite) or barite-enriched riverine clays. Similarly, the relatively higher barium levels in the Santa Barbara Basin could be due to transport and deposition of barite from discharged spent drilling fluids or from riverine materials. This pathway was suggested by Kolpack (1983) to predict the fate of barite in spent drilling fluids discharged during exploratory and production drilling operations in the Pt. Arguello to western Santa Barbara Channel area. Other isolated occurrences of high barium concentrations in sediments southwest of Pt. Arguello may reflect inputs of detrital barite from the Santa Ynez River. Low sediment barium levels at stations on the Santa Lucia Banks probably represent a general absence of barite due to a relatively small input of riverine materials

SAS

BARIUM



BARIUM

INTERVAL	INTERVAL MINIMUM	INTERVAL MAXIMUM	N
1	> 100	300	2
2	> 300	500	4
3	> 500	700	37
4	> 700	900	45
5	> 900	1100	10
6	>1100	1300	1

FIGURE 3-9. Barium Concentrations in Bottom Sediments (μg/g dry wt)

or to scouring of barite particles by bottom currents (see Section 1.3, Environmental Overview). Further geographic variability in sediment barium levels also could be due to spatial differences in plankton productivity and sedimentation patterns. Localized differences in plankton productivity, incorporation of plankton tests into fecal pellets, and subsequent deposition in the bottom sediments, may affect larger scale patterns in sediment geochemistry (Soutar et al., 1977; Dunbar and Berger, 1981; Crisp et al., 1979).

Barium levels measured previously in Southern California Bight sediments have been summarized by Chow and Earl (1978) and Chow and Snyder (1980). The average barium concentration in nearshore sediments was 637 µg/g, with a range in the observed values from 43 to 1,899 µg/g. The inner shelf and inner basin sediments contained an average 835 µg/g and 686 µg/g, respectively, whereas the outer shelf and outer basin sediments contained an average of 370 µg/g and 714 µg/g, respectively. The relatively low barium levels in the outer shelf sediments were attributed to the comparatively large distances between the sampling sites and sources of natural and anthropogenic barium. In general, specific barium levels were associated with high carbonate sediments (100 to 200 µg/g), clay rich sediments (> 800 µg/g), heavy mineral rich sediments (400 to 600 µg/g), and polluted sediments (600 to 900 µg/g). However, levels of approximately 1,100 µg/g Ba were observed in nearshore sediments off Coal Oil Point, an area of natural petroleum seeps and active oil exploration and production operations. These barium concentrations were similar to levels observed during this program in nearshore areas off Pt. Conception (Figure 3-9), also located near natural seeps and oil production operations. Consequently, barium levels measured in sediments from Santa

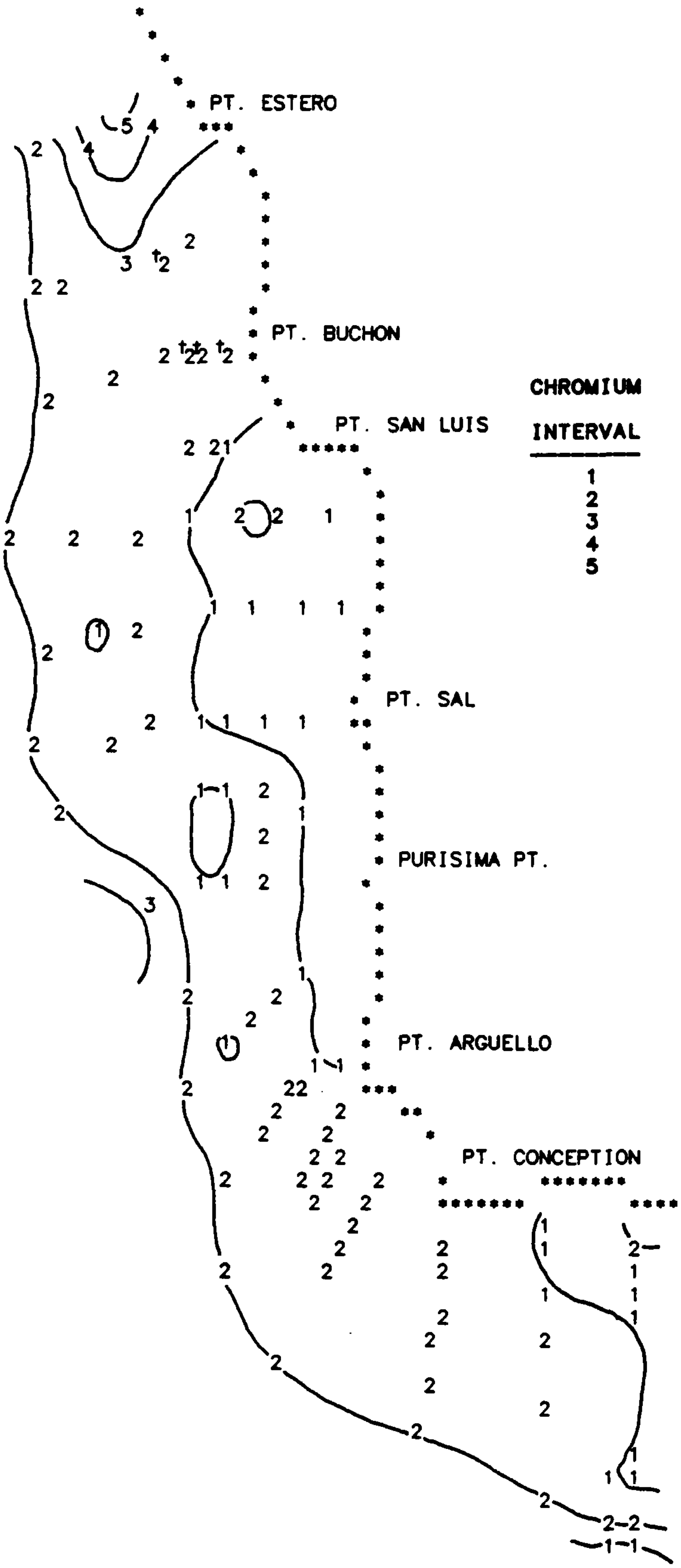
Maria Basin and the western Santa Barbara Channel are consistent with corresponding concentrations in Southern California Bight bottom sediments. Furthermore, the relatively high barium values associated with samples from Santa Barbara Basin and nearshore areas close to drilling operations were well within the range observed for other inner shelf sediments.

Chromium

Chromium often is used with lignosulfonate as an additive in drilling fluids to control viscosity by acting as a thinning agent and to deflocculate clay particles. Chromium concentrations in generic drilling fluids reportedly range from 2-260 μg/g (NRC, 1983). Thus, chromium levels in bulk drilling fluids are not consistently enriched with chromium relative to corresponding levels in bottom sediments, and consequently are not as useful as barium as a tracer of spent drill muds.

Chromium concentrations in sediments from Santa Maria Basin and western Santa Barbara Channel are presented in Table 3-4. Values for sediment chromium ranged from 66 μg/g (Station 085) to 415 μg/g (Station 003). The mean value for all samples was 120 μg/g. Most of the sediment chromium levels were between 80 to 120 μg/g, with the exception of slightly higher concentrations at stations furthest offshore along the Purisima Point and Point Sal - Pt. San Luis transects, and the higher levels (300-415 μg/g) in a localized area off Pt. Estero (Figure 3-10).

CHROMIUM



CHROMIUM INTERVAL	INTERVAL MINIMUM	INTERVAL MAXIMUM	N
1	> 0	100	32
2	> 100	200	62
3	> 200	300	2
4	> 300	400	2
5	> 400	500	1

FIGURE 3-10. Chromium Concentrations in Bottom Sediments (μg/g dry wt)

For comparison, mean chromium values during the Southern California Bight Program were 53 µg/g and 56 µg/g for the outer and inner shelf sediments, and 120 µg/g for both inner and outer basin sediments (Chow and Earl, 1978). The associated range in observed values for all sediment samples was from 12 to 370 µg/g (Chow and Earl, 1978). Bruland et al. (1974) measured chromium concentrations of approximately 120 µg/g in recently deposited sediments within the Santa Barbara Basin. The major portion of this sediment chromium was associated with the mineral phase and resistant to chemical (both 25% acetic acid in hydroxylamine hydrochloride, and 30% hydrogen peroxide) breakdown. Furthermore, the natural chromium flux to the Santa Barbara Basin was estimated to be three times greater than the flux associated with anthropogenic input sources (Bruland et al., 1974). Chow and Earl (1978) suggested that anomolously high levels of sediment chromium in areas surrounding the Santa Barbara Basin were due to presence of the heavy minerals chromite, magnetite, and ilmenite.

Reasons for the elevated chromium levels in sediment samples from off Pt. Estero during this study are not immediately apparent. The correlation coefficients between chromium and all other environmental parameters were low, although correlations with the large sediment size phi intervals, percent sand and gravel, and sediment factors one (sediment size factor) and three (gravel factor) were generally higher (range of 0.26 to 0.44) than correlations between chromium and other sedimentological and chemical parameters. These relatively higher coefficient values may reflect a general trend between chromium and larger sediment grain size due to the presence of chromite minerals in sand sized sediments from the northern portion of the Santa Maria Basin. Chromite minerals occur in the Franciscan formation along the coast north of Pt. Estero and in the Santa Ynez Mountains (Section 1.3). Erosion, transport, and deposition of chromite from these formations may account for the relatively elevated sediment chromium levels at these stations.

3.1.2.2 Hydrocarbons

Hydrocarbons in marine sediments off California are derived from a variety of natural biogenic, petrogenic, and anthropogenic sources of diverse origin (Venkatesan et al., 1980). Based upon the results from the BLM-sponsored Southern California Baseline Program (Shokes and Callahan, 1978), observed patterns in sediment hydrocarbon concentrations are expected to reflect the magnitude of input sources, proximity to these sources, and the physical characteristics of the site and site sediments. Probable sources of hydrocarbons to the Southern California Bight and Santa Maria Basin sediments include: (1) natural hydrocarbon seeps; (2) geochemically mature, organic-rich, tertiary shales; (3) shipping losses and tanker operations; (4) municipal and industrial wastewater discharges; (5) chemical dumps; (6) spills from platforms, (7) atmospheric deposition; and (8) natural biogenic sources (Reed et al., 1977; Reed and Kaplan, 1977). Several of these sources may contribute simultaneously to the hydrocarbon flux to the benthic environment of the southern California borderlands. The relative magnitude of hydrocarbon contributions from various sources generally can be inferred from several characteristics of gas chromatograms of samples (described below) and from the proximity of the sample collection site to known point sources for hydrocarbons. Sediment hydrocarbon concentrations, component ratios, and other chromatographic features of the Santa Maria Basin/western Santa Barbara Channel samples are discussed in the following section and compared to results from previous studies conducted in the Southern California Bight. This information is used to characterize the magnitude and sources of hydrocarbons to the benthic environment of this region.

Biogenic and petrogenic sources of hydrocarbons to the Santa Maria Basin and Santa Barbara Channel benthic environments can be differentiated by evaluating characteristic features of the sediment sample chromatograms following analysis by FID-GC (refer to Methods Section 2.2.4.2). Chromatographic features used to evaluate hydrocarbon sources are summarized below.

Odd/Even n-Alkane Ratio: Marine and terrestrial plants synthesize n-alkanes with a predominance of odd carbon number chains. For example, marine phytoplankton synthesize compounds with 15, 17, 19, and 21 carbons, whereas marsh grasses contain odd carbon compounds in the nC_{21} to nC_{29} range, and terrestrial vascular plants contain odd carbon compounds in the nC_{27} to nC_{31} range. In contrast, crude oils or petroleum products contain homologous series of even and odd n-alkanes (Farrington and Meyers, 1975). Therefore, a predominance of odd-numbered carbon compounds of biogenic origin yields higher odd/even ratio values than for non-contaminated samples. Ratios closer to unity typically are associated either with petroleum or petroleum contaminated samples. However, an odd/even ratio value of unity may not always implicate an oil source as a few bacteria also produce n-alkanes between nC_{25} and nC_{33} with similar ratios (Davis, 1968).

Resolved/Unresolved Compound Ratio: High concentrations of an unresolved complex mixture (UCM) of co-eluting compounds are often associated with oiled samples. Jones et al. (1983) suggested that the UCM 'hump' in sediment sample chromatograms also reflects post-depositional microbial degradation of petroleum-derived aromatic hydrocarbons. Several investigators have estimated petroleum hydrocarbon concentrations from the unresolved envelope of compounds in the chromatograms of extracted samples from polluted areas (Farrington et al., 1972; Burns and Teal, 1971; Farrington and Quinn, 1973; Farrington and Tripp, 1977; Boehm and Quinn, 1978). Samples containing only biogenic materials do not generate unresolved complex mixtures. Thus, high resolved/unresolved values reflect biogenic inputs, whereas low values reflect greater contributions from petrogenic sources.

Pristane/Phytane Ratio: Pristane and phytane are the predominant isoprenoids in crude oil. Pristane is also present in calanoid copepods, whereas phytane has no significant biogenic source. Therefore, pristane/phytane values are much greater than one for biogenic sources, but closer to unity for petrogenic sources.

Pristane/nC_{17}, Phytane/nC_{18}: These ratios provide an indication of the extent of biological degradation since the corresponding isoprenoid and n-alkanes have similar solubilities, and the n-alkanes are microbially degraded much more rapidly than the isoprenoids. Higher values indicate a relatively greater state of degradation.

Marine Oil Pollution Index: This index, described in Section 2.3.1, incorporates the ratios of unresolved to resolved components, even n-alkanes to odd n-alkanes, and branched hydrocarbons to n-alkanes with the total recoverable aliphatic and aromatic hydrocarbon concentrations. This results in a single value that can be used to compare the relative magnitude of oil contamination in a series of tissue or sediment samples (Payne et al., in press).

Sediment Hydrocarbon Concentrations

Levels of total hydrocarbons, total aliphatic (F_1) and aromatic (F_2) hydrocarbons, and resolved and unresolved components in the F_1 and F_2 fractions of sediment samples collected during this study are presented in Table 3-5. Total hydrocarbon concentrations ranged from 14 µg/g dry wt (Station 21) to 237 µg/g dry wt (Station 86). Concentrations in sediments from stations north of Pt. Arguello (Stations 1 to 62 and 102 to 108) typically were within a range of 40 to 100 µg/g dry wt, with the exception of slightly higher levels (120 to 160 µg/g dry wt) at stations within a bathymetric low (sea valley) offshore from Pt. San Luis to Pt. Sal. Relatively low hydrocarbon levels were associated with the coarser grained sediments collected at stations on the Santa Lucia Banks. At stations between Pt. Arguello and Pt. Conception (Stations 65 to 78) sediment hydrocarbon levels typically were within the range of

Table 3-5. Concentrations of Aliphatic, Aromatic, and Total Hydrocarbons in Sediments from Santa Maria Basin and Western Santa Barbara Channel. Concentrations (µ g/g dry wt)

		Aliphatic (F_1)			Aromatic (F_2)			Total
Obs.	Station	Resolv	Unresolv	Total	Resolv	Unresolv	Total	Hydrocarbons
1	002						6.97	26.8
2	003						11.5	45.9
3	004	3.84	17.4	21.2	2.76	9.24	12.0	48.8
4	005	7.48	24.8	32.3	5.27	14.4	19.6	80.4
5	007	4.87	22.7	27.6	6.90	22.9	29.8	85.2
6	008	2.51	23.2	25.7	3.70	10.8	14.5	60.6
7	009	3.38	15.3	18.7	4.98	11.2	16.2	51.6
8	010	—	—	—	—	—	—	—
9	011	8.68	33.0	41.7	7.03	25.2	32.3	92.9
10	012	2.77	6.07	8.84	0.693	6.48	7.17	18.4
11	013	7.62	24.9	32.6	5.16	15.3	20.4	71.6
12	014	—	—	—	9.98	30.5	23.4	93.8
13	015	4.82	22.4	27.3	6.13	15.7	21.8	68.5
14	016	15.9	44.6	60.5	4.99	14.7	19.7	98.5
15	017	7.89	25.7	33.6	2.53	12.2	14.8	85.3
16	018	—	—	—	3.76	16.6	20.3	89.0
17	019	7.94	25.1	33.0	5.63	14.5	20.1	94.2
18	020	2.47	13.0	15.4	4.29	9.22	13.5	48.3
19	021	1.22	5.53	6.75	—	—	6.25	14.0
20	021	2.44	6.36	8.80	0.637	2.69	3.33	21.0
21	021	3.00	6.78	9.78	0.626	2.43	3.05	18.1
22	022	3.25	16.2	19.4	1.11	9.68	10.8	31.5
23	023	—	—	—	—	—	12.1	61.4
24	023	—	—	—	—	—	28.3	75.8
25	023	3.87	21.3	25.2	4.90	11.8	16.7	88.0
26	025	10.4	25.7	36.1	14.2	0	14.2	55.1
27	025	—	—	—	—	—	—	—
28	025	8.06	18.0	26.1	9.72	0	9.72	57.6
29	026	14.9	24.9	39.8	9.42	6.94	16.4	139
30	027	14.9	27.6	42.5	10.1	13.0	23.1	118
31	027	20.7	27.3	48.0	19.8	17.3	37.2	159
32	027	12.2	19.8	31.9	7.46	8.48	15.9	75.5
33	028	6.85	13.7	20.6	11.1	8.48	19.5	84.6
34	028	9.79	12.2	21.9	7.44	0	7.44	56.2
35	028	4.31	21.8	26.1	22.2	6.40	28.6	—
36	030	2.28	7.21	9.49	9.27	1.67	10.9	21.3
37	031	4.16	9.42	13.6	17.4	9.02	26.4	41.0
38	031	3.57	18.3	21.8	16.9	9.58	26.5	61.6
39	031	3.21	18.4	21.6	15.2	9.18	24.4	50.6
40	032	3.52	18.7	22.2	9.71	5.54	15.2	46.3
41	033	3.34	28.0	31.3	18.1	7.69	25.8	81.9

Table 3-5 (Cont.)

		Aliphatic (F_1)			Aromatic (F_2)			Total
Obs.	Station	Resolv	Unresolv	Total	Resolv	Unresolv	Total	Hydrocarbons
42	033	3.66	22.7	26.3	15.0	8.37	23.4	70.5
43	033	2.57	13.2	15.8	19.1	5.37	24.5	71.3
44	034	4.34	19.4	23.7	15.4	7.24	22.6	47.6
45	035	5.00	21.5	26.5	19.9	8.05	28.0	72.8
46	035	15.1	26.6	41.8	11.5	18.8	30.3	140
47	035	14.7	37.8	52.5	14.6	6.09	20.6	156
48	036	6.72	6.68	13.4	5.70	0	5.70	44.6
49	036	1.36	4.15	5.51	8.30	0	8.30	21.3
50	036	1.64	13.3	15.0	7.26	15.2	22.4	46.2
51	038	1.85	14.4	16.3	10.7	9.51	20.2	52.2
52	039	1.92	12.6	14.6	13.3	12.4	25.7	58.2
53	040	1.55	12.2	13.7	14.3	10.4	24.8	52.6
54	041	1.36	6.86	8.22	12.0	4.74	16.8	39.5
55	042	1.88	14.6	16.5	9.87	3.82	13.7	44.2
56	042	1.67	9.72	11.4	11.7	2.37	14.1	42.8
57	042	2.04	11.8	13.8	9.81	3.49	13.3	33.3
58	042	2.34	13.9	16.2	12.1	3.45	15.5	50.3
59	042	1.69	7.54	9.23	8.52	5.73	14.2	30.1
60	042	2.11	9.93	12.0	8.81	5.26	14.1	35.0
61	042	1.92	12.0	13.9	9.39	6.78	16.2	37.7
62	042	1.89	5.49	7.38	9.94	5.87	15.8	23.2
63	042	2.05	6.48	8.53	8.39	5.84	14.2	24.9
64	042	2.17	10.5	12.6	10.4	7.47	17.8	31.7
65	042	2.49	15.2	17.7	6.89	5.29	12.2	31.1
66	042	1.77	7.64	9.41	4.22	3.06	7.28	17.2
67	042	2.39	15.1	17.5	7.35	4.43	11.8	31.3
68	042	2.44	10.7	13.1	5.69	4.52	10.2	25.4
69	042	2.27	9.61	11.8	7.29	4.51	11.8	36.2
70	042	2.17	11.4	13.6	8.52	10.4	18.9	34.2
71	042	2.62	8.75	11.4	1.14	7.54	8.68	47.5
72	043	2.35	9.13	11.5	1.91	11.2	13.1	57.8
73	045	1.70	13.8	15.5	3.20	6.98	10.2	62.8
74	046	0.773	0	0.773	0.378	0	0.378	25.8
75	048	2.07	6.86	8.93	1.54	9.51	11.0	51.3
76	049	1.82	5.63	7.45	1.81	8.55	10.4	53.2
77	050	2.08	13.2	15.2	1.08	5.99	7.06	45.2
78	052	2.97	10.9	13.8	1.10	10.9	12.0	64.3
79	053	2.54	15.0	17.5	1.54	7.84	9.38	61.1
80	054	1.74	8.35	10.1	1.15	8.36	9.51	49.0
81	055	1.83	10.6	12.4	11.3	5.37	16.6	41.8
82	056	3.44	11.3	14.8	1.03	9.43	10.5	83.8
83	058	3.10	9.41	12.5	0.913	10.4	11.3	46.6
84	059	4.09	35.6	39.7	19.2	12.4	31.6	107

Table 3-5 (Cont.)

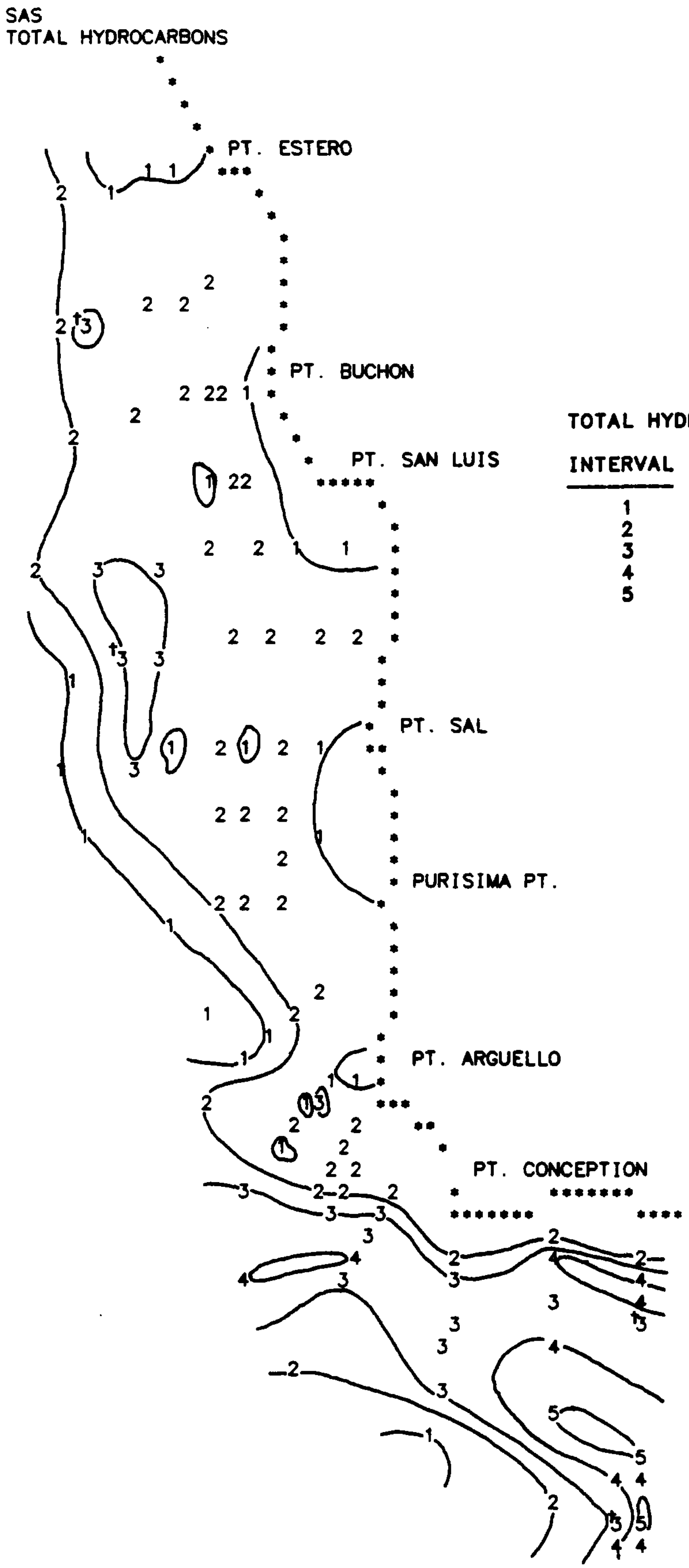
		Aliphatic (F_1)			Aromatic (F_2)			Total
Obs.	Station	Resolv	Unresolv	Total	Resolv	Unresolv	Total	Hydrocarbons
85	060	3.17	23.8	27.0	8.15	8.76	16.9	44.6
86	061	7.03	46.0	53.0	5.08	18.5	23.6	95.0
87	062	3.62	23.4	27.0	7.47	9.38	16.8	44.7
88	063	15.8	29.5	45.2	6.91	8.40	15.3	100
89	064	1.16	9.83	11.0	9.22	6.27	15.5	27.2
90	065	9.40	21.8	31.2	8.08	10.9	19.0	73.4
91	066	6.26	26.4	32.6	11.4	15.8	27.1	73.5
92	067	8.13	25.0	33.1	—	—	25.0	76.6
93	068	7.30	16.8	24.1	9.23	13.9	23.1	65.3
94	069	16.5	34.7	51.2	18.8	23.7	42.5	175
95	070	5.37	30.6	36.0	4.48	17.6	20.1	70.8
96	071	7.81	24.8	32.6	7.54	15.8	23.3	85.8
97	072	—	—	—	—	—	43.9	112
98	073	6.98	44.3	51.2	3.45	27.4	30.9	90.3
99	073	—	—		—	—	—	—
100	073	7.63	52.4	60.0	2.80	22.7	25.5	92.6
101	074	8.14	61.8	69.9	5.70	25.1	30.8	101
102	074	9.66	70.0	79.7	6.23	31.3	37.6	118
103	074	9.72	72.2	82.0	6.70	30.3	37.0	101
104	075	12.5	65.7	78.2	11.6	14.5	26.1	108
105	076	10.6	61.9	72.6	19.6	23.7	43.2	173
106	076	11.8	52.3	64.1	23.3	24.1	47.4	149
107	076	12.0	59.2	75.8	15.2	13.0	28.3	138
108	077	13.8	63.8	77.5	18.5	19.4	37.8	115
109	078	12.6	42.7	55.3	13.5	0	13.6	70.6
110	079	2.28	25.2	27.4	1.96	10.8	12.8	40.6
111	079	1.83	18.4	20.3	5.16	20.6	25.8	51.1
112	079	—	—		—	—	23.0	75.7
113	080	3.49	25.9	29.4	3.84	30.6	34.4	80.6
114	080	7.27	57.2	64.4	7.22	45.8	53.0	172
115	080	8.21	62.9	71.1	6.35	48.2	54.8	132
116	081	—	—		—	—	33.1	110
117	082	6.56	41.0	47.6	5.77	30.0	35.7	150
118	082	—	—		—	—	42.2	134
119	082	6.44	49.2	55.7	5.76	23.5	29.2	129
120	083	7.45	52.5	60.0	6.24	29.2	35.4	150
121	084	—	—		—	—	9.66	35.6
122	085	3.30	38.0	41.3	3.59	25.5	29.1	98.2
123	085	2.24	20.9	23.1	1.70	13.6	15.3	60.1
124	086	8.86	78.4	87.2	9.99	55.9	65.9	237
125	086	3.18	29.0	32.2	4.15	19.5	23.6	81.5
126	086	9.88	90.3	100	11.3	54.9	66.2	235
127	087	3.46	36.3	39.8	7.98	28.9	36.8	115

Table 3-5 (Cont.)

		Aliphatic (F_1)			Aromatic (F_2)			Total
Obs.	Station	Resolv	Unresolv	Total	Resolv	Unresolv	Total	Hydrocarbons
128	088	—	—		—	—	32.5	145
129	088	6.26	50.2	56.4	10.7	27.9	38.6	160
130	088	6.73	48.6	55.3	9.98	32.5	42.5	157
131	089	9.12	61.6	70.7	13.0	41.2	54.3	227
132	090	3.78	28.1	31.8	9.16	18.3	27.4	96.7
133	091	5.56	51.5	57.1	10.0	67.6	77.7	162
134	092	—	—		—	—	—	—
135	093	9.65	58.9	68.5	2.44	42.0	44.5	152
136	094	2.63	28.3	30.9	1.71	13.4	15.1	63.2
137	085	7.43	72.4	79.9	4.33	37.6	41.9	151
138	096	8.14	68.2	76.3	6.91	33.8	40.7	162
139	097	—	—		—	—	—	—
140	098	3.66	47.5	51.2	12.6	38.5	51.1	230
141	099	6.73	59.1	65.9	4.65	43.1	47.8	182
142	100	9.66	67.7	77.3	9.90	52.8	62.7	212
143	101	9.15	63.4	72.5	9.21	28.1	37.3	170
144	102	3.17	6.41	9.58	0.90	3.55	4.45	54.1
145	103	3.63	14.2	17.8	3.74	5.21	8.94	83.1
146	104	4.41	11.1	15.5	6.48	8.31	14.8	85.0
147	105	4.58	16.1	20.6	5.84	15.7	21.5	78.6
148	106	4.94	23.9	28.8	6.29	14.4	20.6	138
149	107	4.12	11.0	15.1	3.11	7.62	10.7	
150	108	1.30	5.78	7.08	1.31	5.43	6.74	39.8

70 to 170 μg/g dry wt, and slightly higher than levels north of Pt. Arguello. Sediments from areas south of Pt. Conception (Stations 79 to 101) contained total hydrocarbon concentrations from 36 to 240 μg/g dry wt. Relatively higher levels (180 to 230 μg/g dry wt) occurred within Santa Barbara Basin (Stations 89, 98-100) and at nearshore Station 86. Patterns in total hydrocarbon concentrations are shown in Figure 3-11.

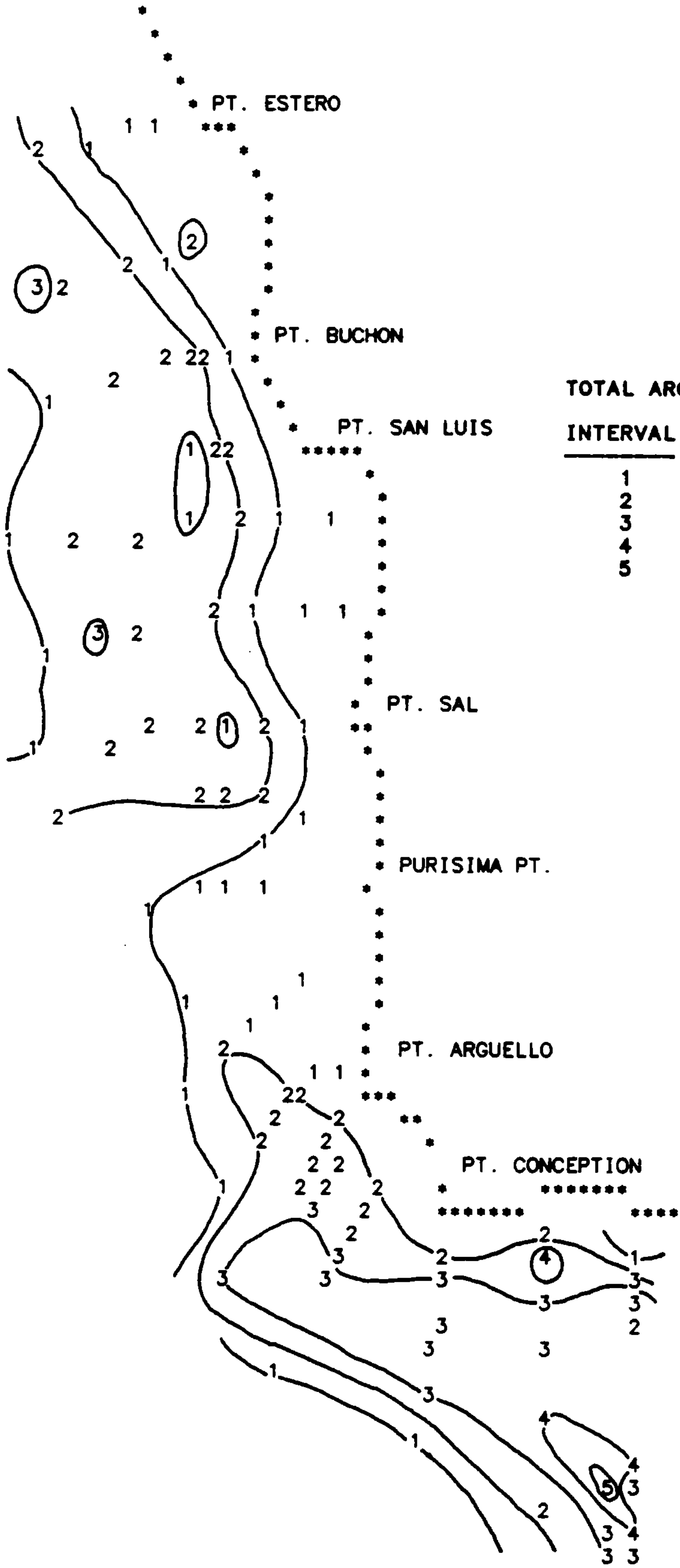
The geographical pattern for total aromatic hydrocarbons (F_2 or benzene fraction), presented in Figure 3-12, was similar to that observed for total hydrocarbons. Specifically, values for total aromatics for samples from stations north of Pt. Arguello generally ranged from 5 to 30 μg/g dry wt, with slightly higher levels or bathymetric low off Pt. Sal, and lower values for sediments offshore of Pt. Buchon/Pt. San Luis and the southern region of the Santa Lucia Banks. Samples from the Pt. Arguello to Pt. Conception area ranged from approximately 20 to 50 μg/g dry wt, whereas values for areas south of Pt. Conception were between 9.7 to 78.0 μg/g dry wt. Off Pt. Conception, the highest values corresponded to stations in the middle of the Santa Barbara Basin, and to a lesser extent at nearshore stations along the 330 ft. isobath. The correlation coefficient between total aromatic and total hydrocarbon concentrations was 0.86 and reflects the contribution of the residual aromatic components to the total hydrocarbon levels measured in the sediments (Table 3-6).



TOTAL HYDROCARBONS

INTERVAL	INTERVAL MINIMUM	INTERVAL MAXIMUM	N
1	> 0	50	23
2	> 50	100	44
3	> 100	150	19
4	> 150	200	10
5	> 200	250	3

FIGURE 3-11. Concentrations of Total Hydrocarbons in Bottom Sediments (μg/g dry wt)



TOTAL AROMATICS

INTERVAL	INTERVAL MINIMUM	INTERVAL MAXIMUM	N
1	> 0	16	35
2	> 16	32	41
3	> 32	48	18
4	> 48	64	4
5	> 64	80	1

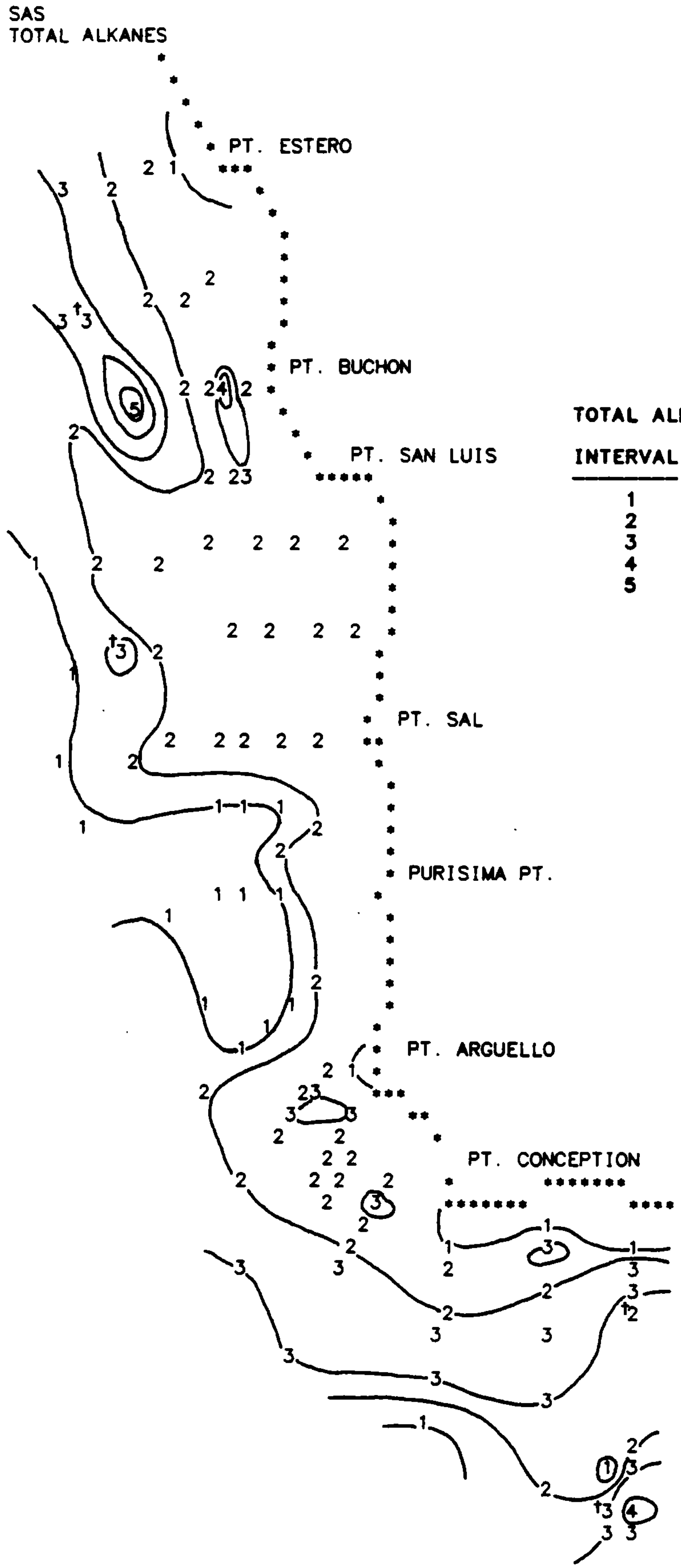
FIGURE 3-12. Concentrations of Total Aromatic Hydrocarbons in Bottom Sediments

Table 3.6. Correlation Coefficients Between Hydrocarbon Variables (* indicates values $\geq$ 0.5)

Correlations	PP Rat	PC17 Rat	PC18 Rat	OE Rat	RU Rat	Tot Alk	Tot Arom	Tot Hyd	Index Op
PP Rat	--								
PC17 Rat	0.8812*	--							
PC18 Rat	0.0716	0.2710	--						
OE Rat	0.0309	0.0593	-.0699	--					
RU Rat	-.0185	-.0749	-.3732	0.4261	--				
Tot Alk	0.0229	0.0097	0.1585	0.0201	0.0127	--			
Tot Arom	-.2771	-.2988	0.2401	-.2761	-.3462	0.3964	--		
Tot Hyd	-.2401	-.2984	0.0804	-.0992	-.1695	0.5519*	0.8565*	--	
Index Op	-.2734	-.3317	0.3067	-.2587	-.3047	0.3760	0.7223*	0.7094*	--

PP Rat - pristane/phytane; PC17 Rat - pristane/nC_{17}; PC18 - phytane/nC_{18}; OE Rat - odd alkanes/even alkanes; RU Rat - resolved/unresolved; Tot Alk - total alkanes; Tot Arom - total aromatics; Tot Hyd - total hydrocarbons; Index Op - MOPI values

In contrast, patterns in the observed levels of total alkanes and total aliphatics (F_1 or hexane fraction) did not correspond consistently to patterns for total and total aromatic hydrocarbons (Figure 3-13). The correlation coefficient between total alkanes and total hydrocarbons was 0.55 suggesting a weaker relationship than that between total aromatics and total hydrocarbons. The total alkane concentrations are expected to reflect inputs from biogenic and petrogenic sources. For example, Santa Barbara Channel seep oils may contain low percentages (< 5%) of n-alkanes in the aliphatic fraction relative to concentrations of branched and cyclic alkanes (Reed and Kaplan, 1977). Therefore, the presence of seep oils in bottom sediments may contribute to the total hydrocarbon levels, whereas their contribution to levels of n-alkanes may be minor. In areas influenced by substantial inputs of weathered petroleum, biogenic materials may comprise primary sources of resolved alkanes but contribute only minor amounts to the total hydrocarbon concentration (Mankiewicz et al., 1979). Thus, the relatively lower correlation coefficient observed during this study probably reflects spatially and temporally variable amounts of biogenic alkanes relative to petrogenic inputs (discussed below in Component Ratios Section). Similarly, correlation coefficients of 0.53 and 0.98 were reported by Mankiewicz et al. (1979) for regression plots between concentrations of plant wax paraffins ($nC_{27,29,31}$) and total hydrocarbon levels for sediment samples from nearshore basins (Santa Barbara and San Pedro) and from offshore stations, respectively. In this case, the lower correlation coefficient associated with samples from the nearshore basins was attributed to inputs of petrogenic materials such as natural seepage from Coal Oil Point.



TOTAL ALKANES

INTERVAL	INTERVAL MINIMUM	INTERVAL MAXIMUM	N
1	> 0	1	22
2	> 1	2	51
3	> 2	3	23
4	> 3	4	2
5	> 4	5	1

FIGURE 3-13. Concentrations of Total Alkanes in Bottom Sediments

In general, the highest values for total alkane concentrations (approximately 4.0 - 4.4 μg/g dry wt) occurred at two isolated areas (Stations 13 and 16) off Pt. Buchon. Total alkane levels between 0.5 and 2.0 μg/g dry wt occurred throughout broad areas from Pt. Arguello and Pt. Sal and out to the Santa Lucia Banks, and in nearshore areas south of Pt. Conception. Patterns for total aliphatic concentrations exhibited general trends of increasing levels from Pt. Estero south to Pt. Conception, and with distance offshore in areas south of Pt. Conception. Total aliphatic levels typically were less than 30 μg/g dry wt for areas north of Pt. Arguello, except for the region of higher levels (up to 60 μg/g dry wt) off Pt. Buchon. Within the Pt. Arguello to Pt. Conception area, values increased from approximately 20 to 70 μg/g dry wt. A similar range in values was observed at stations south of Pt. Conception.

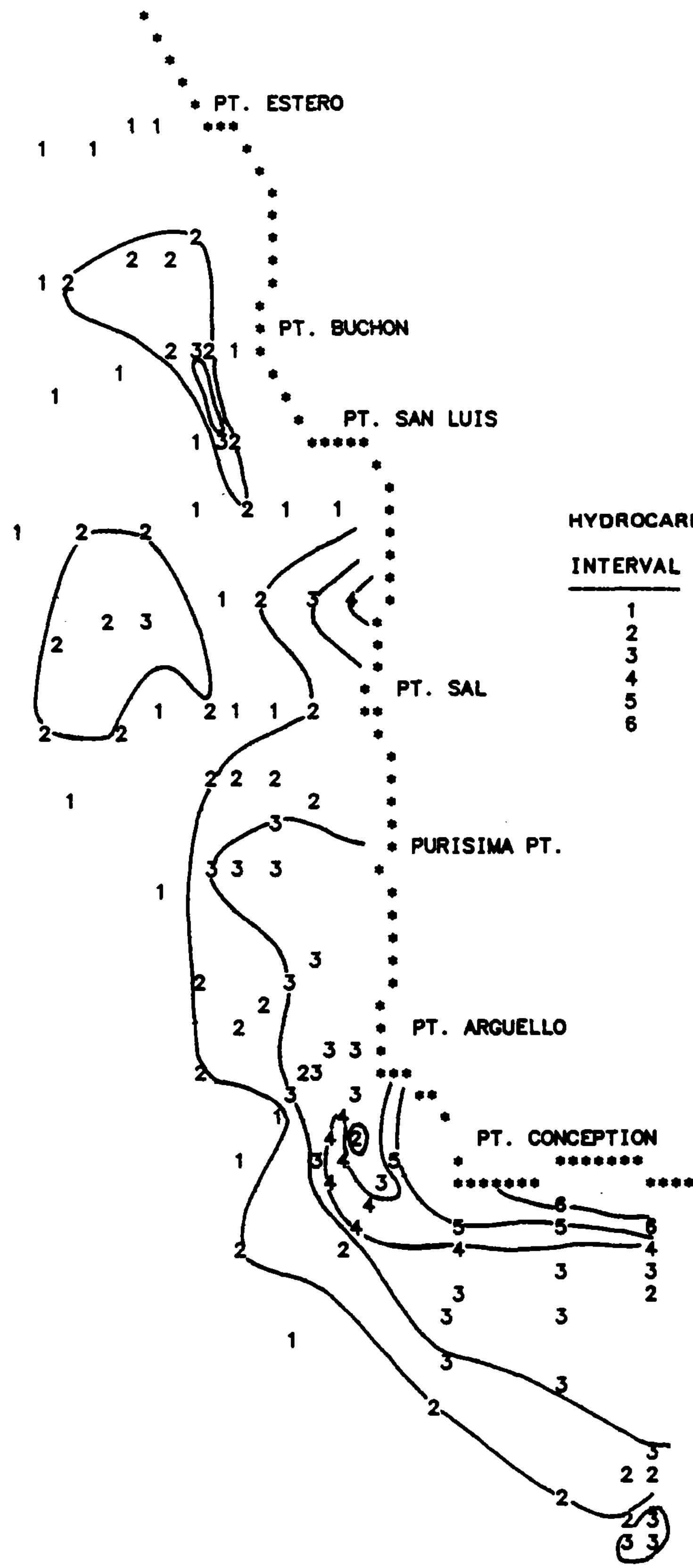
The observed values for total aromatic and total aliphatic hydrocarbon concentrations in bottom sediments from Santa Maria Basin and western Santa Barbara Channel generally were consistent with values reported for hydrocarbons in sediments from the Southern California Bight. For example, Reed et al. (1977) and Reed and Kaplan (1977) reported levels of total hydrocarbons in surficial sediments from approximately 10 to 700 μg/g dry wt and total aromatics from 2 to 330 μg/g dry wt. Similarly, Simoneit and Kaplan (1980) reported typical total hydrocarbon concentrations from 60 to 430 μg/g dry wt in surficial borderland sediments. Mankiewicz et al. (1979) measured concentrations of total hydrocarbons from 120 to 220 μg/g dry wt, total aliphatics from 70 to 150 μg/g dry wt, and total aromatics from 40 to 97 μg/g dry wt in sediments from a series of stations off Pt. Conception. In contrast, relatively higher values for total hydrocarbons (4,870 μg/g dry wt) were reported by Stuermer et al. (1982) for bottom sediments near natural seeps off Coal Oil Point, and Venkatesan et al. (1980) reported concentrations of total hydrocarbons up to 3,900 μg/g dry wt in recent sediments within San Pedro Basin characterized as a depositional sink for anthropogenic materials discharged through nearshore ocean outfalls. In addition, Venkatesan et al. noted that hydrocarbon levels decreased with increased depth in the sediment core. Sediments deposited in San Pedro Basin prior to the year 1920 contained less than 50 μg/g dry wt total hydrocarbons. Consequently, hydrocarbon levels within Santa Maria Basin sediments may be slightly lower than levels characteristic of similar nearshore Southern California Bight environments, but are still higher than levels in sediments from the outer basins which are further from sources of seep oils or anthropogenic inputs (i.e., Mankiewicz et al., 1979).

Additionally, Crisp et al. (1979) measured concentrations of 119 μg/g aromatics and 177 μg/g total hydrocarbons in sinking particulate material within the Santa Barbara Basin. Chemical evidence from gas chromatographic analyses suggested that the bulk of the petrogenic hydrocarbons associated with the particles was derived from anthropogenic sources, with smaller contributions from natural seeps. Contributions from biogenic sources were relatively greater in nearshore than in offshore areas. Deposition of sinking particulates within Santa Barbara Basin resulted in an estimated hydrocarbon flux of 73 $g/m^2/yr$ to the bottom sediments. Similarly, input fluxes to specific areas within Santa Maria Basin or Santa Barbara Channel are expected to vary with respect to proximity to point sources, biological productivity, and sediment transport characteristics.

In most cases, hydrocarbon concentration values were consistent among replicate samples collected during this study from the Santa Maria Basin and western Santa Barbara Channel. Coefficients of variation (CV; standard deviation divided by the mean) for total hydrocarbon, total aromatics, and total aliphatics ranged from 5 to 48%, 4.5 to 74%, and 8.3 to 49%, respectively, with three replicates per station. For 17 replicate samples (Station 46) CVs for total hydrocarbons, total aromatics, and total aliphatics were 26%, 22%, and 24%, respectively. Similar coefficients of variation were reported by Mankiewicz et al. (1979) for stations within a depositional environment and with minor variation in input sources. The corresponding CVs for hydrocarbon levels in replicate samples from other shelf environments were relatively higher, reflecting the proximity to and magnitude of point input sources, sedimentological characteristics, and the extent of bioturbation.

As part of the analysis for the present study, total hydrocarbon concentrations were normalized to TOC levels (total HC/TOC). Relatively higher organic carbon levels typically are associated with fine grained sediments within depositional environments (Trask, 1932, see Section 3.1.2.3). Normalizing total HC to TOC minimizes intra- and inter-station variability due to differences in grain size and sediment texture parameters and provides an indication of non-biogenic contamination because the ratio is sensitive to small inputs of total hydrocarbons which do not add significantly to measured TOC levels (Boehm, 1984; Mankiewicz et al., 1979). Higher ratio values indicate the presence of relatively greater amounts of non-biogenic hydrocarbons. Palacas et al. (1976) suggested that values less than 10 are characteristic of "clean" sediments. The ratio values calculated for the Santa Maria Basin sediments ranged from 22 (Station 78) to 131 (Station 94). The calculated total HC/TOC values are plotted in Figure 3-14. The highest values (approximately 120 to 130) were associated with the nearshore stations south of the Pt. Conception-Gaviota area, which contained total hydrocarbon concentrations less than 100 μg/g dry wt, but also relatively low TOC levels (0.3-0.7%). These stations are located near natural petroleum seeps; thus, the high total hydrocarbon/TOC values may represent inputs of petrogenic hydrocarbons which contribute to the total hydrocarbon levels but do not affect significantly the sediment TOC levels. Calculated ratio values decrease with increased distance offshore and with distance north from Pt. Arguello. For comparison, Mankiewicz et al. (1979) calculated ratio values from 36 to 74 for samples from a series of stations off Pt. Conception, and from 55 to 180 for samples from stations off Coal Oil Point. In contrast, values less than 20 were associated with sediment samples collected from the outer basins and from locations on the insular shelf of the Channel Islands. Venkatesan et al. (1980) reported total HC/TOC values of 205 to 750 for sediments collected from San Pedro Basin.

HYDROCARBON/TOC



HYDROCARBON/TOC

INTERVAL	INTERVAL MINIMUM	INTERVAL MAXIMUM	N
1	> 20	40	22
2	> 40	60	35
3	> 60	80	28
4	> 80	100	9
5	> 100	120	3
6	> 120	140	2

FIGURE 3-14. Total Hydrocarbon/Total Organic Carbon Ratio Values for Bottom Sediment Samples

Relationships between hydrocarbon concentration parameters and other physical and chemical variables were evaluated using principal component analysis (Section 2.3.1). Concentrations of total hydrocarbons were correlated positively with levels of total organic carbon (0.74), as well as with specific sediment phi intervals for clay/silt sized sediments and with percent clay (0.62). Levels of total aromatics in bottom sediments also were positively correlated with TOC (0.60), specific phi intervals, and percent clay (0.54); however, the relationships were weaker than those for total hydrocarbon levels. Similarly, total alkane concentrations were positively correlated with TOC (0.54), percent silt (0.68), and several fine sediment phi intervals. Both total hydrocarbon and total alkane levels were negatively correlated with percent sand (-.51 and -.67, respectively). Similar relationships between sediment hydrocarbon levels, organic carbon loadings, and sediment phi sizes have been observed previously (Trask, 1932; Jordan and Payne, 1980) for several marine environments, including the Southern California Bight (Mankiewicz et al., 1979), Georges Bank (Phillips et al., in review; Boehm, 1984), and the New York Bight (Boehm, 1983).

Mankiewicz et al. (1979) reported that correlation coefficients for total hydrocarbon concentrations with depth, with TOC, and with percent clay were much higher (0.90, 0.82, and 0.89, respectively) for offshore stations than for nearshore stations (0.57, 0.54, and 0.47, respectively). The lower correlation values for the nearshore station samples reflected the proximity of some of the sampling sites to natural petroleum seeps and to sewage outfall sources, as well as the greater heterogeneity of bottom sediments in this nearshore environment.

Component Ratios

Component ratios for all sediment samples analyzed during this study are presented in Table 3-7. The odd/even ratio values ranged from 1.3 to 14. The observed distributional patterns for this ratio were complex and not consistent with patterns for any of the concentration parameters (total hydrocarbons, alkanes, and aromatics). Nevertheless, the low ratio values for samples from areas south of Pt. Conception may reflect petrogenic inputs from natural seeps and/or oil and gas production operations, whereas the relatively higher values for sediments from areas north of Pt. Sal suggest relatively greater contributions from biogenic sources (or a smaller petrogenic input). The remaining variability in the areal patterns may reflect smaller scale differences in the magnitude of biogenic inputs of hydrocarbons to bottom sediments.

Values for the resolved/unresolved component ratio ranged from 0.08 to 0.66, and the distribution patterns generally were similar to patterns for odd/even ratio values. In particular, the low values associated with stations south of Pt. Conception reflect the large UCM characteristic of the chromatograms of sediment sample extracts. This same feature was noted for sediment samples from much of the nearshore Bight area during the BLM study (Reed et al., 1977; Mankiewicz et al., 1979; Simoneit and Kaplan, 1980; Venkatesan et al., 1980), and reflects the presence of large amounts of weathered petroleum. Patterns for resolved/unresolved values for stations throughout the Santa Maria Basin were quite variable and may reflect differential inputs of

TABLE 3-7. MMS SOFT-BOTTOM SURVEY (1983-1984)

HYDROCARBON DATA

WT=GRAMS, CONC=UG/G-DRY WT

OBS	STATION	REP	PRISTANE PHYTANE RATIO	PRISTANE C17 RATIO	PHYTANE C18 RATIO	ODD EVEN RATIO	RESOLVED UNRESOLVED RATIO	MARINE OIL POLLUTION INDEX
1	002-BSS	1	1.12	1.57	2.32	6.83	0.21	4.99
2	003-BSS	1	1.34	1.78	2.29	5.79	0.20	6.27
3	004-BSS	1	0.00	0.00	2.33	4.58	0.22	6.19
4	005-BSS	1	1.60	2.16	2.50	5.74	0.30	6.71
5	007-BSS	1	1.39	2.07	2.81	5.73	0.21	6.75
6	008-BSS	1	1.20	2.02	2.74	4.85	0.11	6.80
7	009-BSS	1	1.40	2.29	2.63	4.97	0.22	5.99
8	011-BSS	1	0.00	0.00	2.28	5.15	0.26	7.39
9	012-BSS	1	0.89	3.10	4.78	5.91	0.46	5.06
10	013-BSS	1	1.22	2.20	3.06	3.87	0.31	6.21
11	014-BSS	1	1.33	2.09	2.76	4.92	0.22	6.77
12	015-BSS	1	0.00	0.00	2.54	5.32	0.21	6.61
13	016-BSS	1	1.84	2.29	2.25	5.77	0.36	7.10
14	017-BSS	1	1.49	1.47	1.90	3.78	0.31	7.18
15	018-BSS	1	1.26	2.29	2.96	6.30	0.24	6.41
16	019-BSS	1	1.49	2.10	2.55	3.65	0.32	6.94
17	020-BSS	1	1.64	2.51	2.56	5.72	0.19	6.00
18	021-BSR	1	1.36	3.23	3.15	6.97	0.22	4.60
19	021-BSR	2	1.30	3.59	3.12	8.34	0.38	4.20
20	021-BSR	3	1.21	2.89	2.94	7.54	0.44	4.21
21	022-BSS	1	1.41	3.07	3.10	8.19	0.20	5.84
22	023-BSR	1	1.31	2.19	2.78	5.41	0.25	6.15
23	023-BSR	2	1.35	2.20	2.21	6.43	0.22	6.27
24	023-BSR	3	1.33	2.18	2.50	6.12	0.18	6.38
25	025-BSR	1	0.00	0.00	2.44	11.29	0.40	6.84
26	025-BSR	3	0.00	0.00	2.31	9.35	0.45	6.52
27	026-BSS	1	0.00	0.00	0.00	9.54	0.60	7.05
28	027-BSR	1	1.36	2.24	2.30	6.50	0.54	7.40
29	027-BSR	2	2.03	1.98	1.65	8.63	0.76	7.72
30	027-BSR	3	0.00	0.00	1.63	10.05	0.62	7.11
31	028-BSR	1	0.00	0.00	.	10.86	0.50	6.89
32	028-BSR	2	0.00	0.00	0.00	1.70	0.81	8.22
33	030-BSS	1	1.36	3.10	2.72	4.07	0.32	4.74
34	031-BSR	1	1.16	2.13	2.60	3.14	0.44	5.33
35	031-BSR	2	1.27	2.21	2.29	3.66	0.20	6.22
36	031-BSR	3	1.25	1.73	1.72	3.69	0.17	6.21
37	032-BSS	1	1.26	2.12	2.28	2.71	0.19	6.24
38	033-BSR	1	1.58	2.30	2.32	2.87	0.12	7.25
39	033-BSR	2	1.47	2.11	2.11	3.01	0.16	6.68
40	033-BSR	3	1.48	2.54	2.45	2.93	0.19	5.94
41	034-BSS	1	1.55	2.55	2.18	3.02	0.22	6.34
42	035-BSR	1	1.78	2.31	2.00	3.03	0.23	6.39
43	035-BSR	2	0.00	0.00	2.20	8.46	0.57	7.63
44	035-BSR	3	1.67	2.47	2.02	8.06	0.39	7.30
45	036-BSR	1	0.00	0.00	0.00	32.88	1.01	6.46
46	036-BSR	2	.	0.89	0.00	1.57	0.33	4.42
47	036-BSR	3	2.35	0.12	0.50	1.64	0.12	7.24
48	038-BSS	1	1.19	2.12	2.45	3.12	0.13	6.41
49	039-BSS	1	1.16	2.08	2.46	2.21	0.15	6.53
50	040-BSS	1	1.23	2.30	2.53	2.55	0.13	6.47
51	041-BSS	1	2.31	2.03	1.20	1.34	0.20	6.32

TABLE 3-7. MMS SOFT-BOTTOM SURVEY (1983-1984)
HYDROCARBON DATA (cont.)
WT=GRAMS, CONC=UG/G-DRY WT

OBS	STATION	REP	PRISTANE PHYTANE RATIO	PRISTANE C17 RATIO	PHYTANE C18 RATIO	ODD EVEN RATIO	RESOLVED UNRESOLVED RATIO	MARINE OIL POLLUTION INDEX
52	042-BSS	1	1.24	2.47	2.67	3.81	0.13	5.97
53	042-BSV	11	1.20	2.86	2.79	4.18	0.17	5.28
54	042-BSV	12	1.08	2.32	2.61	3.90	0.17	5.51
55	042-BSV	13	1.28	2.41	2.24	3.74	0.17	5.84
56	042-BSV	14	1.18	2.31	2.34	3.53	0.22	5.34
57	042-BSV	31	1.19	2.01	2.16	3.58	0.21	5.55
58	042-BSV	32	1.31	2.53	2.13	3.81	0.16	5.91
59	042-BSV	33	1.16	2.44	2.66	4.05	0.35	4.82
60	042-BSV	34	1.10	2.10	2.50	4.15	0.32	4.93
61	042-BSV	51	1.26	3.05	2.92	3.90	0.21	5.69
62	042-BSV	52	1.18	3.12	2.87	3.93	0.16	6.04
63	042-BSV	53	1.10	2.59	2.77	4.46	0.23	5.02
64	042-BSV	54	1.43	2.01	2.12	3.81	0.16	6.00
65	042-BSV	71	1.25	2.03	2.38	3.29	0.23	5.44
66	042-BSV	72	1.22	2.47	2.51	3.10	0.24	5.37
67	042-BSV	73	1.25	2.45	2.54	3.20	0.19	5.92
68	042-BSV	74	1.21	2.95	2.76	4.86	0.30	5.15
69	043-BSS	1	1.26	2.18	2.03	3.32	0.26	5.72
70	045-BSS	1	1.22	2.32	2.42	10.19	0.12	6.38
71	046-BSS	1	0.00	0.00	0.00	.	.	1.10
72	048-BSS	1	1.12	2.27	2.33	12.23	0.30	5.37
73	049-BSS	1	1.07	2.26	.	13.70	0.32	5.30
74	050-BSS	1	0.00	0.00	2.43	1.97	0.16	6.26
75	052-BSS	1	1.05	2.60	3.02	14.27	0.27	5.50
76	053-BSS	1	0.00	0.00	0.00	4.52	0.17	6.31
77	054-BSS	1	1.28	3.10	.	3.74	0.21	5.63
78	055-BSS	1	1.35	3.06	2.63	2.30	0.17	5.81
79	056-BSS	1	1.05	2.29	2.61	2.73	0.30	5.89
80	058-BSS	1	1.02	2.81	3.30	4.70	0.33	5.40
81	059-BSS	1	1.04	2.55	4.93	3.04	0.12	7.13
82	060-BSS	1	0.94	2.44	3.04	6.26	0.13	6.63
83	061-BSS	1	1.45	2.41	2.94	6.01	0.15	7.53
85	062-BSS	1	1.29	2.71	2.95	7.26	0.15	6.57
86	063-BSS	1	1.28	2.18	2.59	8.56	0.53	7.55
87	064-BSS	1	0.85	2.60	3.23	6.91	0.12	5.72
84	065-BSS	1	0.86	2.48	4.20	5.10	0.43	6.36
88	066-BSS	1	0.00	0.00	0.00	2.74	0.24	7.49
89	067-BSS	1	0.00	0.00	4.08	3.61	0.33	7.25
90	068-BSS	1	0.00	0.00	3.82	3.80	0.43	6.66
91	069-BSS	1	0.00	0.00	0.00	5.17	0.48	7.37
92	070-BSS	1	0.71	2.30	4.82	9.02	0.26	7.57
93	070-BSS	1	0.83	2.01	5.02	6.39	0.18	7.15
94	071-BSS	1	0.00	0.00	0.00	4.39	0.32	7.10
95	072-BSS	1	0.00	0.00	0.00	3.00	0.25	7.80
96	073-BSR	1	0.67	2.23	6.84	5.87	0.16	7.79
97	073-BSR	3	0.69	2.10	6.78	2.24	0.15	8.98
98	074-BSR	1	0.82	1.86	4.83	7.24	0.13	8.11
99	074-BSR	2	0.76	1.74	5.79	5.82	0.14	8.29
100	074-BSR	3	0.80	1.77	5.27	6.02	0.13	7.89
101	075-BSS	1	0.00	0.00	3.88	9.13	0.19	8.30
102	076-BSR	1	0.89	2.45	3.79	9.37	0.17	8.09
103	076-BSR	2	1.00	2.55	4.82	7.82	0.23	8.20

TABLE 3-7. MMS SOFT-BOTTOM SURVEY (1983-1984)
HYDROCARBON DATA (cont.)
WT=GRAMS, CONC=UG/G-DRY WT

OBS	STATION	REP	PRISTANE PHYTANE RATIO	PRISTANE C17 RATIO	PHYTANE C18 RATIO	ODD EVEN RATIO	RESOLVED UNRESOLVED RATIO	MARINE OIL POLLUTION INDEX
104	076-BSR	3	0.00	0.00	3.91	8.83	0.20	8.30
105	077-BSS	1	0.00	0.00	2.99	8.38	0.22	8.28
106	078-BSS	1	0.00	0.00	3.24	11.41	0.29	7.36
107	079-BSR	1	0.68	2.17	6.01	2.07	0.09	7.90
108	079-BSR	2	0.00	0.00	.	2.63	0.10	7.64
109	079-BSR	3	0.00	0.00	6.19	3.28	0.15	7.25
110	080-BSR	1	0.85	2.40	5.01	6.77	0.13	7.69
111	080-BSR	2	0.00	0.00	6.16	7.52	0.13	8.26
112	080-BSR	3	0.78	1.78	6.33	7.88	0.13	8.25
113	081-BSS	1	0.94	2.04	4.44	3.44	0.12	8.10
114	082-BSR	1	1.21	2.39	3.48	6.89	0.16	7.61
115	082-BSR	2	1.26	2.43	3.51	7.17	0.14	7.79
116	082-BSR	3	1.23	2.43	3.55	6.35	0.13	7.81
117	083-BSS	1	1.19	2.34	3.21	6.71	0.14	7.82
118	084-BSS	1	0.91	1.48	.	3.05	0.12	7.59
119	085-BSR	1	0.95	1.95	4.00	2.19	0.09	8.75
120	085-BSR	2	0.00	0.00	5.13	3.80	0.11	7.20
121	086-BSR	1	1.21	1.96	5.68	2.38	0.11	8.63
122	086-BSR	2	1.11	2.07	3.87	2.27	0.11	7.73
123	086-BSR	3	1.11	1.91	4.22	4.65	0.11	8.67
124	087-BSS	1	0.86	1.76	3.82	1.86	0.10	8.24
125	088-BSR	1	1.11	2.03	2.81	5.39	0.12	7.84
126	088-BSR	2	1.18	1.74	2.74	4.51	0.12	7.88
127	088-BSR	3	1.18	2.05	2.82	4.56	0.14	7.76
128	089-BSS	1	1.87	3.29	3.10	3.13	0.15	8.45
129	090-BSS	1	1.25	1.77	3.37	2.17	0.13	7.59
130	091-BSS	1	0.00	0.00	5.56	4.77	0.11	7.72
131	093-BSS	1	1.15	1.78	3.75	5.53	0.16	8.11
132	094-BSS	1	1.03	1.49	3.66	3.25	0.09	7.61
133	095-BSS	1	0.00	0.00	6.09	4.99	0.10	8.41
134	096-BSS	1	0.00	0.00	3.04	4.24	0.12	8.17
135	098-BSS	1	0.00	0.00	0.00	3.07	0.08	8.20
136	099-BSS	1	0.00	0.00	0.00	4.10	0.11	8.15
137	100-BSS	1	0.00	0.00	2.75	4.15	0.14	8.17
138	101-BSS	1	0.00	0.00	3.98	4.54	0.14	8.01
139	102-BSS	1	1.63	2.88	2.40	13.24	0.49	4.29
140	103-BSS	1	1.41	2.58	2.10	9.68	0.26	5.58
141	104-BSS	1	1.65	2.61	2.32	8.28	0.40	5.42
142	105-BSS	1	1.40	2.40	2.18	8.51	0.29	6.10
143	106-BSS	1	1.88	2.35	1.90	6.91	0.21	6.65
144	108-BSS	1	0.00	0.00	0.00	.	0.22	5.73

petrogenic materials, and subsequent sediment transport and accumulation patterns (see Section 3.1.1), as well as rates of in situ degradative weathering.

The pristane/phytane ratio values for the sediment samples ranged from zero (no pristane detected) to 2.3. The large number of zero values obscures large-scale patterns in the component ratio values. Nevertheless, the low values associated with most of the samples from areas south of Pt. Conception and between Pt. Conception to Purisima Point suggest a larger scale presence of petrogenic materials. Values greater than 1.3 for stations north of Pt. Sal suggest relatively greater contributions from biogenic sources.

In comparison, Reed et al. (1977) analyzed sediment samples from areas near the Northern Channel Islands that were considered to be non-contaminated with respect to hydrocarbon inputs. Resolved/ unresolved values ranged from 0.22 to 0.47; phytane/nC_{18} ranged from 1.3 to 1.4; and n-alkane/ total resolved aliphatics ranged from 0.47 to 0.68. Corresponding values associated with sediment samples from inner basins heavily influenced by anthropogenic hydrocarbons were 0.04 to 0.51 for resolved/unresolved, 2.0 to 2.3 for phytane/nC_{18}, and from 0.47 to 0.68 for n-alkanes/total resolved aliphatics. Similarly, Crisp et al. (1979) reported a pristane/phytane value of 7.0, n-alkane/total hydrocarbon of 0.06, and total hydrocarbon/total organic carbon of 0.003 for sinking particles collected in Santa Barbara Basin.

In summary, patterns for the component ratio values suggest that sediments in areas south of Pt. Conception receive a relatively greater amount of petrogenic hydrocarbons than the sediments from areas within the Santa Maria Basin area. Nevertheless, some petrogenic materials are deposited within the benthic environment of the Santa Maria Basin, and the complex patterns for the ratio values may reflect large scale sediment transport and deposition processes.

Additional evidence for petroleum in sediment extracts was apparent in selected sample chromatograms. For example, chromatograms of the aliphatic fraction of a sediment sample for Station 86 (Figure 3-15), southeast of Pt. Conception in the Santa Barbara Channel, contain a large UCM hump, a repeating series of odd and even n-alkanes superimposed on the UCM, pristane and phytane levels approximately equal to the corresponding n-alkanes (nC_{17} and nC_{18}, respectively), and a general absence of lower molecular weight n-alkanes (below nC_{12}). Chromatograms of the aromatic fraction also contain a large UCM which comprise 83% of the total aromatic hydrocarbon concentration. All of these chromatographic features are indicative of the presence of weathered petroleum (Farrington and Meyers, 1975).

Several of the sample chromatograms also exhibited prominant resolved peaks corresponding to the n-alkanes nC_{27}, nC_{29}, and nC_{31} that are probably derived from terrestrial plant waxes. These n-alkanes were also observed by Mankiewicz et al. (1979) in extracts of sediment samples collected in several locations throughout the Southern California Bight, and by Crisp et al. (1979) in sinking particulates collected in nearshore basins. Additionally, Mankiewicz et al. determined that the concentrations of these three compounds

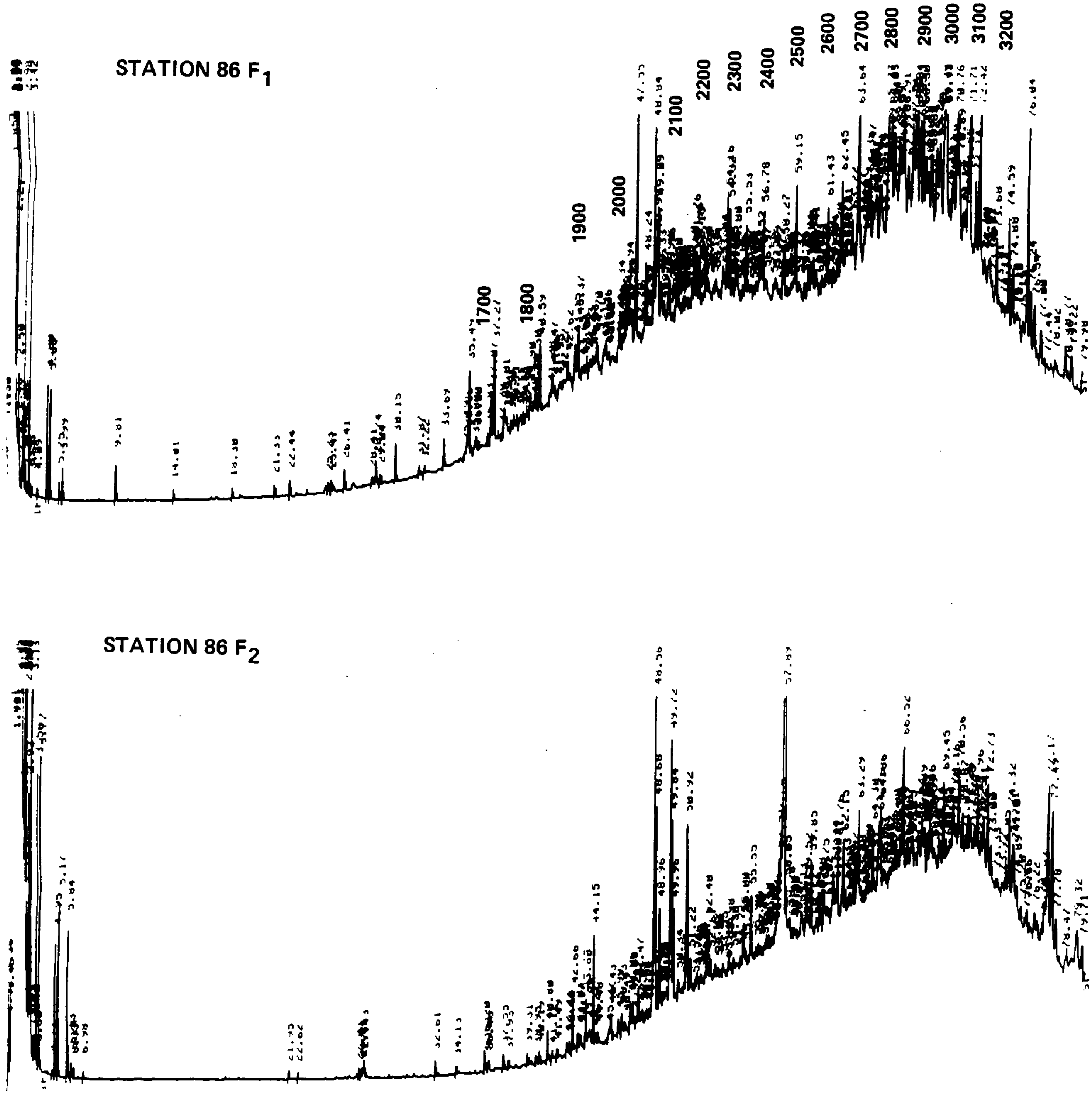


FIGURE 3-15. FID-GC Chromatograms of the Aliphatic (F_1) and Aromatic (F_2) Fractions of Station 086 Sediment Extracts. Kovat Retention Indices are Shown Above Selected Peaks.

correlated significantly ($r > 0.9$) with the concentration of total resolved components in the aliphatic fraction. Other resolved peaks in the aliphatic fractions of samples from Santa Barbara Basin area included a series of cyclic and acyclic olefins eluting between nC_{20} and nC_{22}, corresponding to KOVAT index values of 2043, 2068, and 2090. The peak at 2043 is probably heneicosahexaene, a biogenic compound common in marine plankton (Youngblood et al., 1971), which was also present in numerous mussel tissue samples collected during the Southern California Bight Program (Payne et al., 1978). The other peaks may correspond to mono-, di-, or tri-olefins which are present in marine copepods or fish (Farrington and Meyers, 1975). Similar peaks were observed in chromatograms of sediments collected from San Pedro Basin by Venkatesan et al. (1980). Consequently, most of the sediment samples contained evidence of petrogenic, as well as several biogenic, sources. The absence of many lower molecular weight alkanes, and the general comparability of pristane and phytane to the corresponding n-alkane peaks, indicates substantial biodegradative weathering.

Several of these same features were also apparent in chromatograms of sediments from Santa Maria Basin that contained lower levels of total and total aromatic hydrocarbons relative to sediments from areas south and east of Pt. Conception. Chromatograms of sediments from Station 28, which was typical of those from many of the Santa Maria Basin stations, are presented in Figure 3-16. The aliphatic fraction contained a UCM between nC_{17} and nC_{33} with a peak between nC_{27} and nC_{31}, a predominance of odd carbon numbered compounds between nC_{19} to nC_{33}, biogenic olefins between nC_{20} and nC_{21}, and the

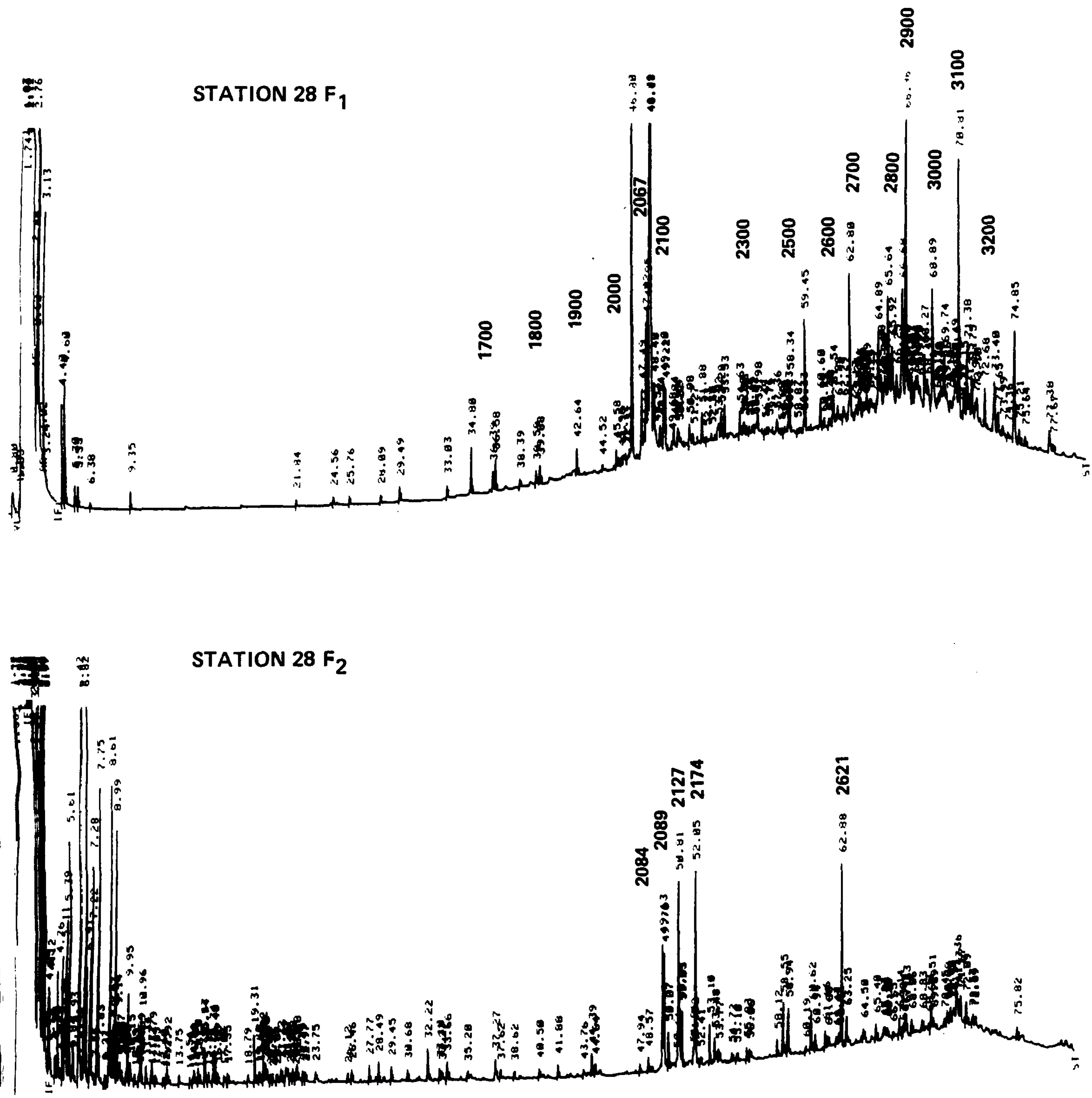


FIGURE 3-16. FID-GC Chromatograms of the Aliphatic (F_1) and Aromatic (F_2) Fractions of Station 028 Sediment Extracts. Kovat Retention Indices are Shown Above Selected Peaks.

characteristic series of plant wax alkanes. The aromatic fraction also contained a small UCM that accounted for 22% of total aromatic hydrocarbon concentration, a series of resolved peaks at KOVAT indices 2084, 2089, 2127, and 2174 that possibly correspond to fatty acid methyl esters, and several, small, unidentified peaks. Chromatograms of other sediment samples from Santa Maria Basin contained similar features, although some may have been more or less prominant depending upon the relative magnitude of various hydrocarbon input sources. These characteristics are similar to features described by Reed et al. (1977) for sediments from the northern Channel Islands area which are relatively free from anthropogenic contaminants, such as chlorinated hydrocarbons, including DDE, PCBs, and phthalates, but still receive petrogenic materials transported by regional circulation patterns.

Chromatograms of the aliphatic and aromatic fraction of extracts from Station 46 sediment samples, shown in Figure 3-17, contained no UCM, and a series of small resolved peaks which probably correspond to biogenic n-alkanes, polyolefins, and fatty acid methyl esters. This sample contained relatively low levels of total hydrocarbons (26 μg/g dry wt), total aromatics (0.4 μg/g dry wt), and total aliphatics (0.77 μg/g dry wt), with undetectable levels of unresolved compounds, indicating a general absence of petrogenic materials. The high sand content and low percentage of sediment fines suggests that this station may be an erosional site; thus, an accumulation of petroleum-derived hydrocarbons is minimized due to rapid transport of fine-grained, organic-enriched materials. Similar relationships between sediment

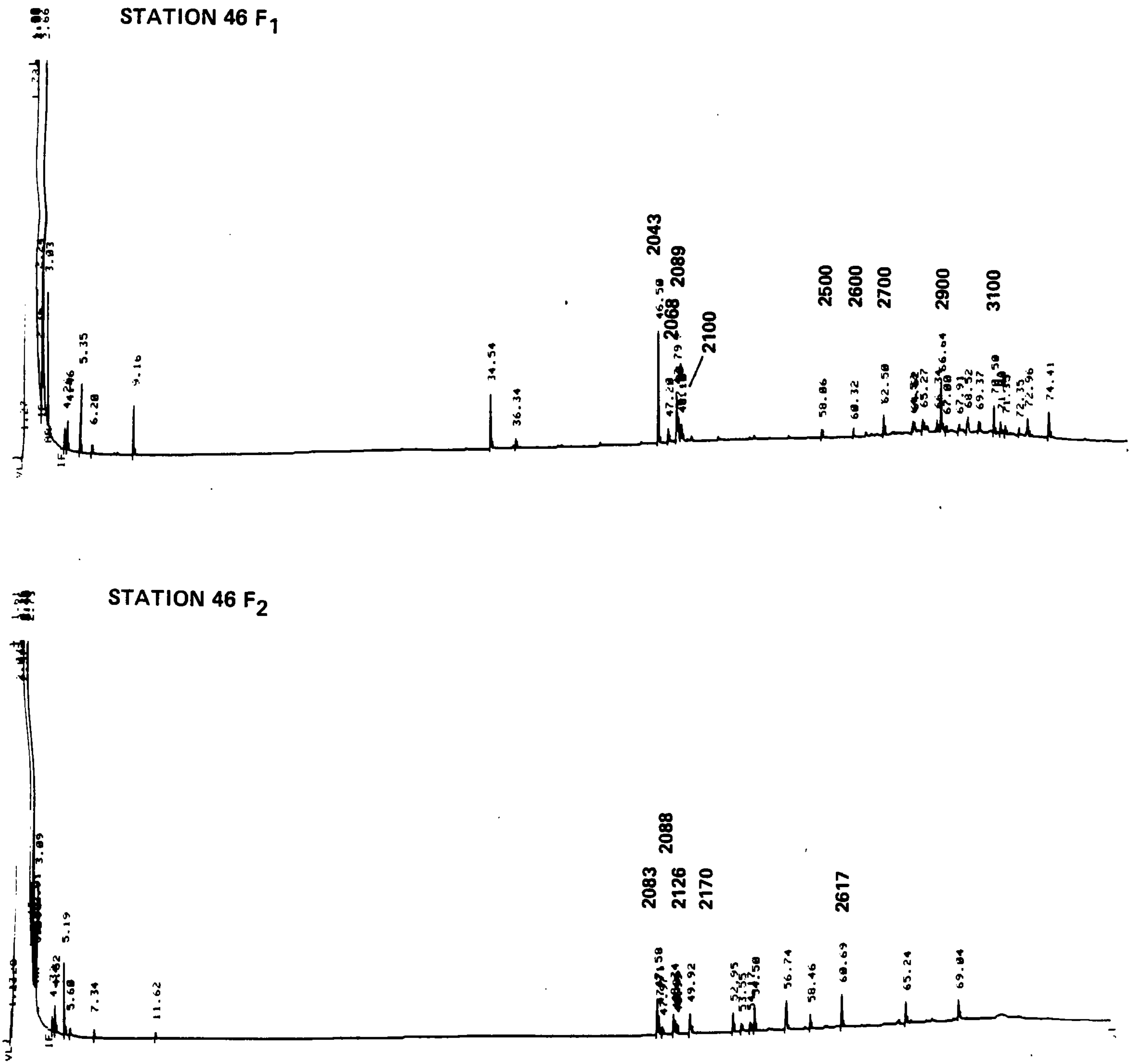
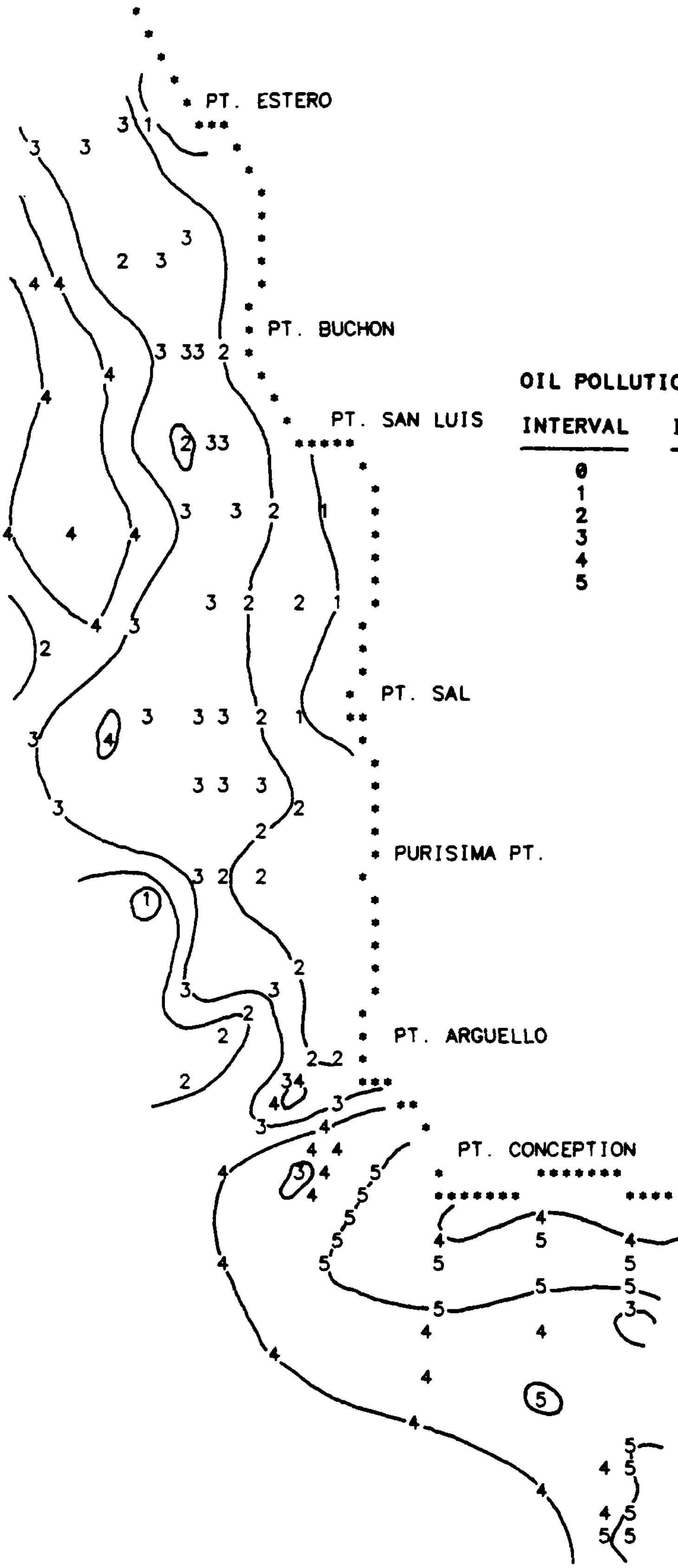


FIGURE 3-17. FID-GC Chromatograms of the Aliphatic (F_1) and Aromatic (F_2) Fractions of Station 046 Sediment Extracts. Kovat Retention Indices are Shown Above Selected Peaks.

transport and depositional processes and spatial differences in benthic hydrocarbon levels were observed during the Georges Bank Monitoring Program (Phillips et al., in review), where low hydrocarbon levels (< 20 μg/g dry wt) occur in coarse grained sediments from shallow erosional areas.

Marine Oil Pollution Index (MOPI) values calculated for sediment samples from Santa Maria Basin and the western Santa Barbara Channel are listed in Table 3-7 and shown in Figure 3-18. The majority of the index values range from approximately 4.5 to 8.5, indicative of trace levels to moderate levels of petroleum contamination. One index value of 1.1 was calculated for a sediment sample from Station 46 that contained only low levels of biogenic compounds (discussed above). In general, the higher index values for areas south and east of Point Conception correspond to the relatively higher concentrations and lower component ratio values which reflect the magnitude and proximity to natural seeps and anthropogenic sources of hydrocarbons to bottom sediments. Broad scale trends of increasing values with closer proximity to the Santa Barbara Basin and with increased distance from shore reflect proximity to input sources and sediment transport/deposition patterns, which were also indicated by the patterns for calculated total hydrocarbon/TOC values. Nevertheless, the magnitudes of the MOPI values indicate that appreciable levels of petroleum hydrocarbons are distributed throughout the Santa Maria Basin and Santa Barbara Channel areas. These results are consistent with findings from the BLM Southern California Baseline Study (Shokes and Callahan, 1978), and also are reasonable based on the magnitude of

OIL POLLUTION INDEX



OIL POLLUTION INDEX

INTERVAL	INTERVAL MINIMUM	INTERVAL MAXIMUM	N
0	> 1	4	1
1	> 4	5	5
2	> 5	6	18
3	> 6	7	30
4	> 7	8	29
5	> 8	9	17

FIGURE 3-18. Marine Oil Pollution Index Values for Bottom Sediment Samples

known input sources and the presence of substantial sediment fines throughout much of the study area. In particular, results from similar baseline and environmental monitoring programs (e.g., Georges Bank and the Southern California Baseline Program) suggest that accumulations of weathered petroleum and biogenic hydrocarbons would be expected within depositional regimes containing large amounts of fine grained sediments, whereas relatively low hydrocarbon levels, with low MOPI values, are predicted for erosional areas with low percentages of fine sediment.

Results from the present hydrocarbon analyses indicate that broad areas of the benthic environment of Santa Maria Basin and the western Santa Barbara Channel presently contain spatially variable but detectable amounts of petrogenic hydrocarbons. Evidence for the presence of petroleum hydrocarbons in coastal waters off central California was also apparent in results from the California State Mussel Watch Program (Risebrough et al., 1980). Mussels, used as sentinel organisms to monitor environmental pollutant levels along portions of the central California coast, contained detectable amounts of petrogenic hydrocarbons. Simoneit and Kaplan (1980) concluded that all sediments within the Southern California Bight contain petroleum residues, some of which is from recent petrogenic inputs and others from historic (geologic) sources. Risebrough et al. (1980) concluded that chronic oil pollution exists along the entire California coast, although the magnitude is higher within coastal bays, near natural seeps, and within the Southern California Bight than along the central California Coast or areas more remote from anthropogenic inputs. Specific sources for these materials to the Santa Maria Basin and western Santa Barbara Channel could not be identified unequivocally; however, natural seeps, atmospheric deposition, and tanker operations may be contributing factors. Industrial and/or municipal wastewaters plus river discharges are probably minor sources of hydrocarbons to the study area. These sources are also responsible for inputs of petroleum hydrocarbons to the Southern California Bight (Reed et al., 1977; Venkatesan et al., 1980; Simoneit and Kaplan, 1980).

3.1.2.3 Total Organic Carbon

Total organic carbon (TOC) levels in bottom sediments typically are inversely related to grain size (Trask, 1932); thus, TOC measurements can be useful indicators of the characteristics of the sedimentary environment. Furthermore, the distributions of many trace metal and trace organic contaminants are directly correlated to sediment TOC levels (Boehm, 1985). Measured TOC levels also have been used to normalize sediment hydrocarbon concentrations in samples from Southern California Bight to minimize variability due to sediment texture characteristics and provide an indication of non-biogenic hydrocarbon contamination (Mankiewicz et al., 1979).

The TOC values for all samples measured during this study ranged from 0.36 to 3.4%, with an overall mean of 1.6% (±0.84; ± s.d.). TOC data are listed in Table 3-8, with an areal plot of TOC patterns presented in Figure 3-19. The highest TOC levels (≥ 3%) occurred in sediments from the southeastern

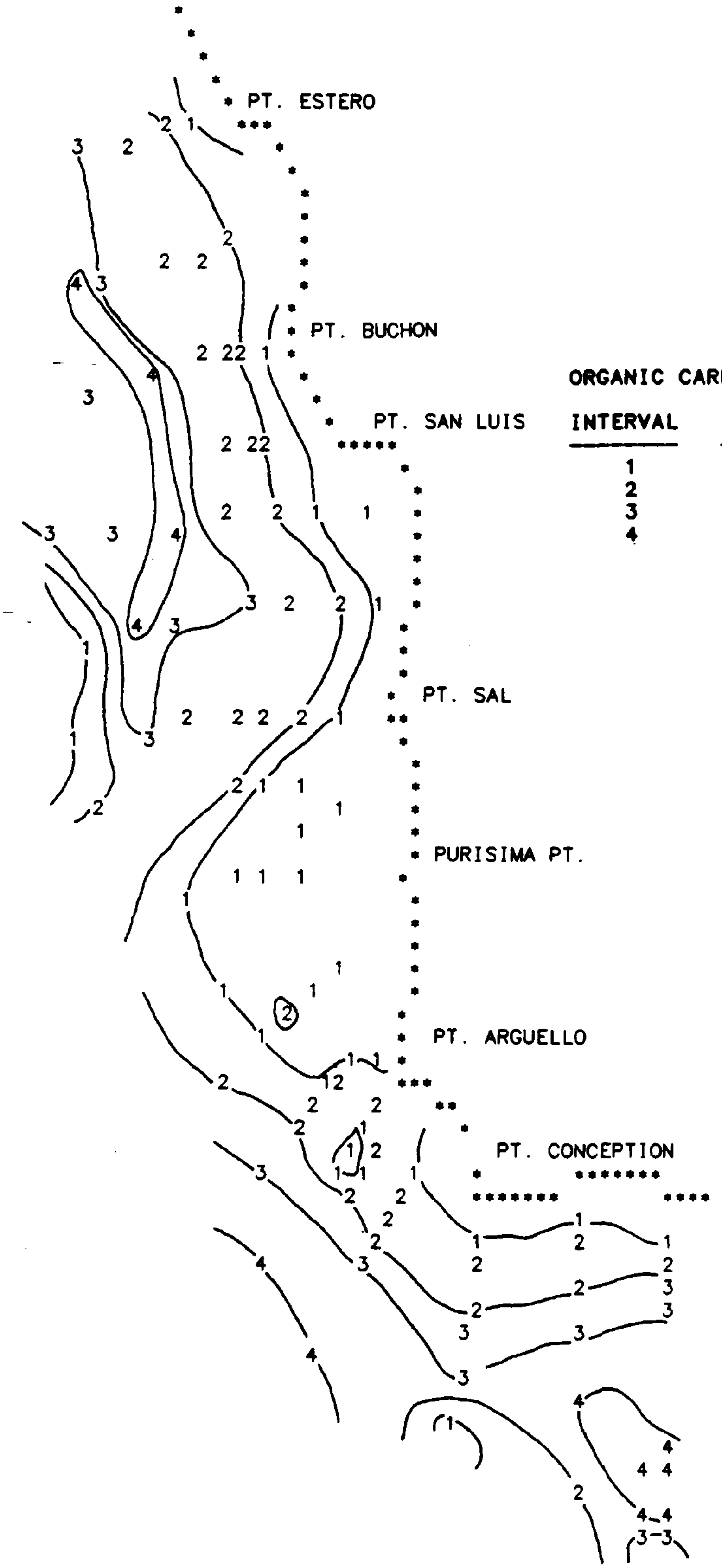
TABLE 3-8. MMS SOFT-BOTTOM SURVEY (1983-1984)
TOTAL ORGANIC CARBON IN PERCENT BY DRY WT

OBS	STATION	REP	TOTAL ORGANIC CARBON
1	002-BSS	1	0.751
2	003-BSS	1	1.271
3	004-BSS	1	1.328
4	005-BSS	1	2.283
5	007-BSS	1	1.806
6	008-BSS	1	1.391
7	009-BSS	1	1.276
8	010-BSS	1	2.955
9	011-BSS	1	3.109
10	012-BSS	1	0.657
11	013-BSS	1	1.527
12	014-BSS	1	1.463
13	015-BSS	1	1.324
14	016-BSS	1	3.178
15	017-BSS	1	2.254
16	018-BSS	1	1.665
17	019-BSS	1	1.289
18	020-BSS	1	1.638
19	021-BSR	1	0.509
20	021-BSR	2	0.503
21	021-BSR	3	0.456
22	022-BSS	1	0.998
23	023-BSR	1	1.410
24	023-BSR	2	1.538
25	023-BSR	3	1.716
26	025-BSR	1	1.757
27	025-BSR	2	1.676
28	025-BSR	3	1.665
29	026-BSS	1	3.399
30	027-BSR	1	2.762
31	027-BSR	2	2.695
32	027-BSR	3	2.182
33	028-BSR	1	2.020
34	028-BSR	2	1.809
35	028-BSR	3	2.553
36	030-BSS	1	0.526
37	031-BSR	1	1.389
38	031-BSR	2	1.490
39	031-BSR	3	1.396
40	032-BSS	1	1.407
41	033-BSR	1	1.433
42	033-BSR	2	1.588
43	033-BSR	3	1.584
44	034-BSS	1	1.916
45	035-BSR	1	2.622
46	035-BSR	2	3.098
47	035-BSR	3	3.177
48	036-BSR	1	0.723
49	036-BSR	2	0.815
50	036-BSR	3	1.025
51	038-BSS	1	0.933
52	039-BSS	1	0.980

OBS	STATION	REP	TOTAL ORGANIC CARBON
53	040-BSS	1	1.076
54	041-BSS	1	1.143
55	042-BSS	1	0.762
56	042-BSV	11	0.691
57	042-BSV	12	0.843
58	042-BSV	13	0.731
59	042-BSV	14	0.838
60	042-BSV	31	0.799
61	042-BSV	32	0.848
62	042-BSV	33	0.804
63	042-BSV	34	0.876
64	042-BSV	51	0.865
65	042-BSV	52	0.746
66	042-BSV	53	0.840
67	042-BSV	54	0.720
68	042-BSV	71	0.729
69	042-BSV	72	0.745
70	042-BSV	73	0.833
71	042-BSV	74	0.725
72	043-BSS	1	0.958
73	045-BSS	1	0.825
74	046-BSS	1	0.829
75	048-BSS	1	0.757
76	049-BSS	1	0.749
77	050-BSS	1	0.772
78	052-BSS	1	0.868
79	053-BSS	1	0.776
80	054-BSS	1	1.016
81	055-BSS	1	0.859
82	056-BSS	1	1.812
83	058-BSS	1	0.752
84	059-BSS	1	1.358
85	060-BSS	1	0.931
86	061-BSS	1	1.528
87	062-BSS	1	1.703
88	063-BSS	1	2.827
89	064-BSS	1	0.356
90	065-BSS	1	1.108
91	066-BSS	1	0.898
92	067-BSS	1	0.803
93	068-BSS	1	0.984
94	069-BSS	1	3.413
95	070-BSS	1	1.180
96	071-BSS	1	0.910
97	072-BSS	1	1.262
98	073-BSR	1	0.950
99	073-BSR	2	0.904
100	073-BSR	3	0.831
101	074-BSR	1	1.294
102	074-BSR	2	1.402
103	074-BSR	3	1.339
104	075-BSS	1	1.350
105	076-BSR	1	1.625
106	076-BSR	2	1.464

OBS	STATION	REP	TOTAL ORGANIC CARBON
107	076-BSR	3	1.851
108	077-BSS	1	2.657
109	078-BSS	1	3.185
110	079-BSR	1	0.642
111	079-BSR	2	0.354
112	079-BSR	3	0.455
113	080-BSR	1	1.623
114	080-BSR	2	1.519
115	080-BSR	3	1.510
116	081-BSS	1	1.738
117	082-BSR	1	2.144
118	082-BSR	2	2.214
119	082-BSR	3	2.214
120	083-BSS	1	2.467
121	084-BSS	1	0.827
122	085-BSR	1	0.593
123	085-BSR	2	0.709
124	086-BSR	1	2.010
125	086-BSR	2	0.894
126	086-BSR	3	2.097
127	087-BSS	1	1.500
128	088-BSR	1	1.296
129	088-BSR	2	2.472
130	088-BSR	3	2.465
131	089-BSS	1	3.264
132	090-BSS	1	1.683
133	091-BSS	1	3.252
134	092-BSS	1	3.103
135	093-BSS	1	2.526
136	094-BSS	1	0.482
137	095-BSS	1	1.700
138	096-BSS	1	2.213
139	097-BSS	1	2.395
140	098-BSS	1	3.068
141	099-BSS	1	3.171
142	100-BSS	1	3.017
143	101-BSS	1	2.736
144	102-BSS	1	0.666
145	103-BSS	1	1.384
146	104-BSS	1	1.820
147	105-BSS	1	2.072
148	106-BSS	1	2.046
149	107-BSS	1	3.339
150	108-BSS	1	0.764

SAS
TOTAL ORGANIC CARBON 16:3



ORGANIC CARBON

INTERVAL	INTERVAL MINIMUM	INTERVAL MAXIMUM	N
1	> 0	1	32
2	> 1	2	38
3	> 2	3	17
4	> 3	4	12

FIGURE 3-19. Total Organic Carbon Levels in Bottom Sediments (% dry wt)

portion of Santa Barbara Basin, the seaward portion of the Arguello Submarine Canyon, and the lower part of the slope north of Point Sal. Broad areas of the nearshore portion of study area, particularly between Pt. San Luis and Pt. Arguello, off the mouth of the Santa Ynez River, at the head of the Arguello submarine canyon, on Santa Lucia Banks, and along the insular shelf area near San Miguel Island contained low TOC levels (< 1%). The areal distribution pattern for TOC levels generally parallel the distribution patterns observed for sediment silt and clay fractions (Section 3.1.1). TOC levels were positively correlated with percent sediment silt and percent sediment clay (0.55 and 0.67, respectively), whereas TOC values were negatively correlated with percent sand (-0.67). These relationships reflect the affinity of finer grain size sediment for organics, described by Trask (1932), and the enriched levels of sediment organics associated with depositional regimes relative to the lower organic levels expected for erosional or high energy benthic environments.

For comparison, Shokes and Callahan (1978) reported TOC levels from 0.64 to 0.88% and from 0.77 to 0.90% in sediments from the outer shelf and from the inner to mid-shelf areas, respectively, near the Northern Channel Islands. Mankiewicz et al., (1979) measured TOC levels from 0.40 to 3.6% in sediments from a series of stations in central and western portions of the Santa Barbara Channel. These historical levels are consistent with TOC levels measured during the present study.

3.1.2.4 Relationship to Sedimentary Environment

The fates of materials discharged into the marine environment are dependent upon several factors including natural dispersion, sedimentation, and weathering processes. Many inorganic and organic compounds added to the water column have high affinities for suspended particulate materials which subsequently sink and are deposited in the bottom sediments. The eventual distribution of these particulate materials, which may include trace metal and hydrocarbon pollutants, is a function of sedimentation, resuspension, and deposition, as well as biological (e.g., bioturbation) and chemical (e.g., solubilization), processes. Erosion, resuspension, and transport processes result in a selective dispersion of sediments, which is affected by bottom shear stresses, particle size and cohesiveness, bottom configuration, and bioturbation characteristics. Accumulation of sediment-associated materials occurs in areas such as offshore basins which are topographically and dynamically suited for deposition of fine-grained particles (NRC, 1985; Boesch et al., 1985). Thus, the characteristics of the sedimentary environment, including the magnitude of resuspension, sedimentation, and sediment transport processes, are expected to affect the distributional patterns and trends of measured chemical parameters. Depositional environments may constitute a sink or site of accumulation for both natural and anthropogenic trace metals and hydrocarbons, whereas the geochemical characteristics of an erosional environment may reflect the elemental composition of non-erodable, locally-derived sediments.

Present information concerning sediment transport and deposition processes within Santa Maria Basin is limited (Kolpack, 1983). Some of the potential relationships between chemical concentrations measured during the present study and sediment characteristics were investigated using correlation and principal component analyses. A factor matrix listing calculated correlation coefficients between geochemical and sedimentological parameters is presented in Table 3-9. Results from these analyses suggest that several of the hydrocarbon parameters may co-vary with sediment grain size characteristics, whereas the concentrations of the trace metals barium and chromium do not. Furthermore, the weak negative correlation between concentrations of barium and chromium ($r = -.126$) suggests that the processes responsible for the observed distribution and levels of these two metals are not necessarily the same.

Fairly consistent positive correlations between the concentrations of total alkanes, total aromatics, and total hydrocarbons with mean sediment phi size ($0.517 < r < 0.603$) and negative correlations with percent sand sediments ($-.667 < r < -.427$) and sediment size factor ($-.651 < r < -.503$) were observed. Similar relationships were observed between TOC levels and these sediment parameters. These relationships are consistent both with previous observations concerning the greater affinity of hydrocarbons and other organic materials for finer grained sediments (e.g., Boehm, 1985) and with the results from previous monitoring or benchmark studies (e.g., Georges Bank, New York Bight, and Southern California Baseline Program) which investigated the

Table 3-9. Correlation Coefficients between Selected Sediment Grain Size and Chemical Parameters
(x indicate values $\geq \pm 0.5$)

	TOC	Ba	Cr	TOT ALK	TOT AROM	TOT HC	INDEX	HYD 1	HYD 2	HYD 3
TOC	--									
Ba	-.126	--								
Cr	-.147	-.408	--							
TOT ALK	0.539x	0.096	-.200	--						
TOT AROM	0.598x	0.274	-.270	0.396	--					
TOT HC	0.745x	0.204	-.278	0.552x	0.856x	--				
INDEX	0.500x	0.294	-.243	0.376	0.722x	0.709x	--			
HYD 1	0.589x	0.333	-.231	0.501x	0.905x	0.868x	0.864x	--		
HYD 2	-.124	0.187	-.174	0.208	0.109	0.015	0.100	0.000	--	
HYD 3	0.491	-.168	-.186	0.629x	0.060	0.336	0.023	0.000	0.000	--
PP RAT	-.129	-.220	-.008	0.023	-.277	-.240	-.273	-.465	0.744x	0.259
OE RAT	0.042	-.203	-.028	0.020	-.276	-.099	-.259	-.330	-.249	0.632x
RU RAT	0.142	-.264	0.032	0.013	-.346	-.170	-.305	-.388	-.498	0.577x
GRAVEL	-.079	-.248	0.261	0.009	-.109	-.100	-.144	-.111	0.025	0.010
SAND	-.672x	-.110	0.292	-.667x	-.427	-.515x	-.290	-.382	-.176	-.559x
SILT	0.552x	0.097	-.240	0.679x	0.313	0.388	0.241	0.296	0.244	0.534x
CLAY	0.672x	0.090	-.292	0.267	0.544x	0.623x	0.288	0.438	-.132	0.331
MEAN	0.715x	0.196	-.366	0.565x	0.517x	0.603x	0.340	0.446	0.106	0.504x
SED 1	-.760x	-.087	0.292	-.503x	-.564x	-.651x	-.349	-.471	-.027	-.487

TOC - total organic carbon; Ba - barium; Cr - chromium; Tot Alk - total alkanes; Tot Arom - total aromatics; Tot HC - total hydrocarbons; Index - MOPI values; Hyd 1 - hydrocarbon factor 1, Hyd 2 - hydrocarbon factor 2; Hyd 3 - hydrocarbon factor 3 PP Rat - pristane/phytane; OE Rat - odd alkanes/even alkanes; RU Rat - resolved/unresolved; Gravel - percent gravel; Sand - percent sand; silt - percent silt; clay - percent clay; Mean Ø - mean phi; Sed 1 - sediment factor 1 environmental fate of discharged materials containing hydrocarbons and/or trace metal contaminants (Phillips et al., in review; Boehm, 1984; Mankiewicz et al., 1979). However, the calculated values for the relationships between hydrocarbon and sediment parameters indicate only moderate correlations. The absence of stronger correlations probably reflects spatially variable inputs of seep oils to nearshore and to Santa Barbara Basin bottom sediments (Mankiewicz et al., 1979). Correlation coefficients values for mean phi and sediment sorting factor 1 with TOC are slightly higher than those for the hydrocarbon parameters probably because TOC levels were not as sensitive to variable inputs of seep hydrocarbons. Nevertheless, the values of the TOC and sediment parameters correlations also reflect the considerable spatial variability observed for these geochemical measurements (i.e., Mankiewicz et al., 1979).

Levels of sediment chromium observed during this study may reflect proximity to localized sources of chromite minerals from fluvial discharge or natural erosion of exposed ultrabasic rocks. There was no indication that chromium was accumulating with finer grained sediments within depositional regimes, such as Santa Barbara Basin or in the sea valley east of Santa Lucia Bank. However, chromium concentrations were only weakly correlated ($r < .45$) with the low phi values (phi -1 to +3), suggesting that chromium containing minerals were not uniformly distributed with coarser grained materials throughout the study area, but instead the sources were localized. Transport of coarser grained materials containing chromite probably is minimal, and dilution may occur by gradual mixing with non-chromite sediments.

Similarly, the sediment barium concentrations were not correlated with any of the sediment parameters or PCA factors, although relatively high levels of barium were observed in sediments from Santa Barbara Basin which is probably a depositional site for riverine materials and spent drilling muds containing barite as well as for sinking biogenic barium. Thus, the patterns for sediment barium may reflect transport and deposition of barite during episodic inputs from non-uniformly distributed sources.

Conclusions regarding possible relationships between geochemical parameters and characteristics of the sedimentary environment have important implications for monitoring discharges from OCS oil and gas operations. The majority of the mass of bulk drilling mud and cutting discharges sink rapidly and reach the bottom within horizontal distances of tens of meters from the point of discharge (NRC, 1983). Subsequent dispersion of these materials will be a function of transport, mixing, and sedimentation rates, and may determine the magnitude of near-field or far-field effects (Menzie, 1982). In the Santa Maria Basin, drill cuttings may be transported as bedload following deposition within erosional regimes, characterized by high bottom shear velocities, or within the Arguello submarine canyon. Lighter drilling fluid residues may be resuspended and transported by bottom currents out to the slope, through the Arguello Canyon or the sea valley east of the Santa Lucia Bank, or transported around Pt. Conception and eventually deposited in the Santa Barbara Basin (see Section 1.3). At sites with strong bottom currents and rapid sediment transport within Santa Maria Basin, the residency times of discharged materials may be relatively short. Residency times of the discharged material residues also will affect rates of biological uptake or bioaccumulation. However, after reaching depositional areas trace metals and hydrocarbon associated with these residues may be well-diluted by mixing with other sediments, as observed during the Georges Bank Monitoring Program (Phillips et al., in review; Bothner et al., 1985). Nevertheless, cumulative discharges from multiple oil and gas development operations may accumulate within depositional areas. Thus, for purposes of monitoring long-term effects, depositional environments represent logical sites for assessing rates of accumulation of discharge-related contaminants (Menzie, 1982; NRC, 1983).

3.1.3 Biological Assemblages

This section presents the results and discussion of the biological data from the 1983-1984 soft-bottom survey. A general introduction, discussion of infaunal assemblages, historical comparisons, community parameters, species composition, taxonomy, and biotic-abiotic relationships are presented in Sections 3.1.3.1 through 3.1.3.7, respectively.

3.1.3.1 Introduction

This section presents the objectives of the study and the overall organization of Section 3.1.3.

3.1.3.1.1 Objectives

The general objectives of the reconnaissance survey included:

1. Improve the taxonomy of soft-bottom organisms in the survey area;

2. Broadly characterize the benthic biological assemblages and several associated abiotic factors;

3. Statistically analyze data collected previously in the area and data from similar habitats in southern California; and

4. Identify in a preliminary manner areas for future monitoring (platform sites and comparison sites).

All four topics are addressed in this section, however, the primary emphasis is on the characterization and analysis of the biotic and abiotic data of the Santa Maria Basin and western Santa Barbara Channel.

3.1.3.1.2 Organization

The characterization of the infaunal assemblages and benthic habitats is presented in Section 3.1.3.2; these data are particulary important since they provide the basis for comparisons with data from future monitoring studies. These results are then compared with previous studies conducted in central and southern California (Section 3.1.3.3) to provide information on spatial and temporal trends in biotic and abiotic variables. Section 3.1.3.4 discusses community parameters including species richness, density, diversity indices, and standing crop. Section 3.1.3.5 presents species composition by site group, habitat, natural history parameters, and geographic distribution. Section 3.1.3.6 discusses new species and geographic range extensions. The final section (3.1.3.7) provides a discussion of biotic-abiotic relationships.

3.1.3.2 Infaunal Assemblages

This section presents data sources and results of the cluster analyses of infaunal data and associated abiotic parameters.

3.1.3.2.1 Data Sources

Biological assemblages of the study area were examined using two main data bases: 150 box cores collected in 1983 and 1984 as part of the present study, and 14 samples which had been collected in 1976 as part the MMS-sponsored baseline survey of the southern California borderland.

The 150 cores collected in 1983 and 1984 soft-bottom survey yielded 24,600 specimens representing 996 taxa, of which 732 (73%) were identified to the species level. Approximately one-third of the specimens were retained on the 1.0 mm screen. Half of the taxa were identified as described species, and

27% could only be identified to genus or higher taxonomic levels. The remaining 23% were new species or similar to described species (Table 3-10). Undescribed species are discussed in Section 3.1.3.6, and diagnosed and/or keyed in Appendix D.

In order to intercalibrate the present database with historical data from contiguous areas in southern California, 14 samples collected from the 1976 baseline survey were reanalyzed. These samples were from (1) the island shelf of the northern sides of Santa Cruz Island and Anacapa Island, (2) from the channel separating Anacapa Island from the mainland, and (3) from the mainland shelf off Port Hueneme. The samples had been previously subjected to the Rapid Identification Procedure (RIP, as detailed in Fauchald and Jones, 1978), and therefore not all species were identified. Data from these samples are summarized in Table 3-11. The 14 RIP samples contained 499 taxa, of which 387 (78%) were identified to species (Table 3-11); 71 (18%) of these species were either undescribed, or similar to described species. Approximately 40% of the taxa identified in the RIP samples were not encountered in 1983/1984 survey. In both sets of samples, most of the taxa identified were annelid worms (primarily polychaetes), with the phyla Crustacea, Mollusca, Cnidaria, and Echinodermata contributing successively smaller percentages of total taxa (Figure 3-20). These five groups contributed 96% of the 1983/1984 biota and 92% of the 1976 RIP biota.

Table 3-10. Number of Taxa by Major Group in Soft-Bottom Samples from 1983/1984 MMS Survey.

Major Group	Total Taxa	Described	Near Described	Recognized/ Undescribed	Newly Recognized
Cnidaria	40	9	2	4	8
Platyhelminthes	1*	-	-	-	-
Nemertea	16	9	0	1	0
Kinorhyncha	1	0	0	1	0
Nematoda	1*	-	-	-	-
Annelida	434	192	40	22	62
Mollusca	154	94	5	14	5
Chelicerata	4	1	1	0	0
Crustacea	288	167	7	24	29
Sipunculida	6	2	0	1	1
Echiura	5	3	0	0	0
Phoronida	1*	-	-	-	-
Ectoprocta	4	3	0	0	0
Brachiopoda	1	1	0	0	0
Echinodermata	39	22	0	1	1
Hemichordata	1*	-	-	-	-
Totals	996	503	55	68	106

* = not identified to species

Table 3-11. Numbers of Taxa by Major Group in Samples from RIP Soft-Bottom Survey (BLM Yr I)

Major Group	Total Taxa	Described	Near Described	Recognized/ Undescribed	Newly Recognized
Porifera	1*	0	0	0	0
Cnidaria	28	15	0	2	0
Platyhelminthes	1*	0	0	0	0
Nemertea	13	9	0	1	0
Nematoda	1*	0	0	0	0
Annelida	230	127	15	7	26
Mollusca	60	49	2	1	0
Chelicerata	4	2	0	0	1
Crustacea	121	91	1	8	5
Sipunculida	4	2	0	1	0
Echiura	2	1	0	0	0
Phoronida	1*	0	0	0	0
Ectoprocta	9	8	0	0	0
Echinodermata	21	11	0	1	0
Hemichordata	1*	0	0	0	0
Urochordata	2	1	0	0	0
Totals	499	316	18	21	32

* = not identified to species

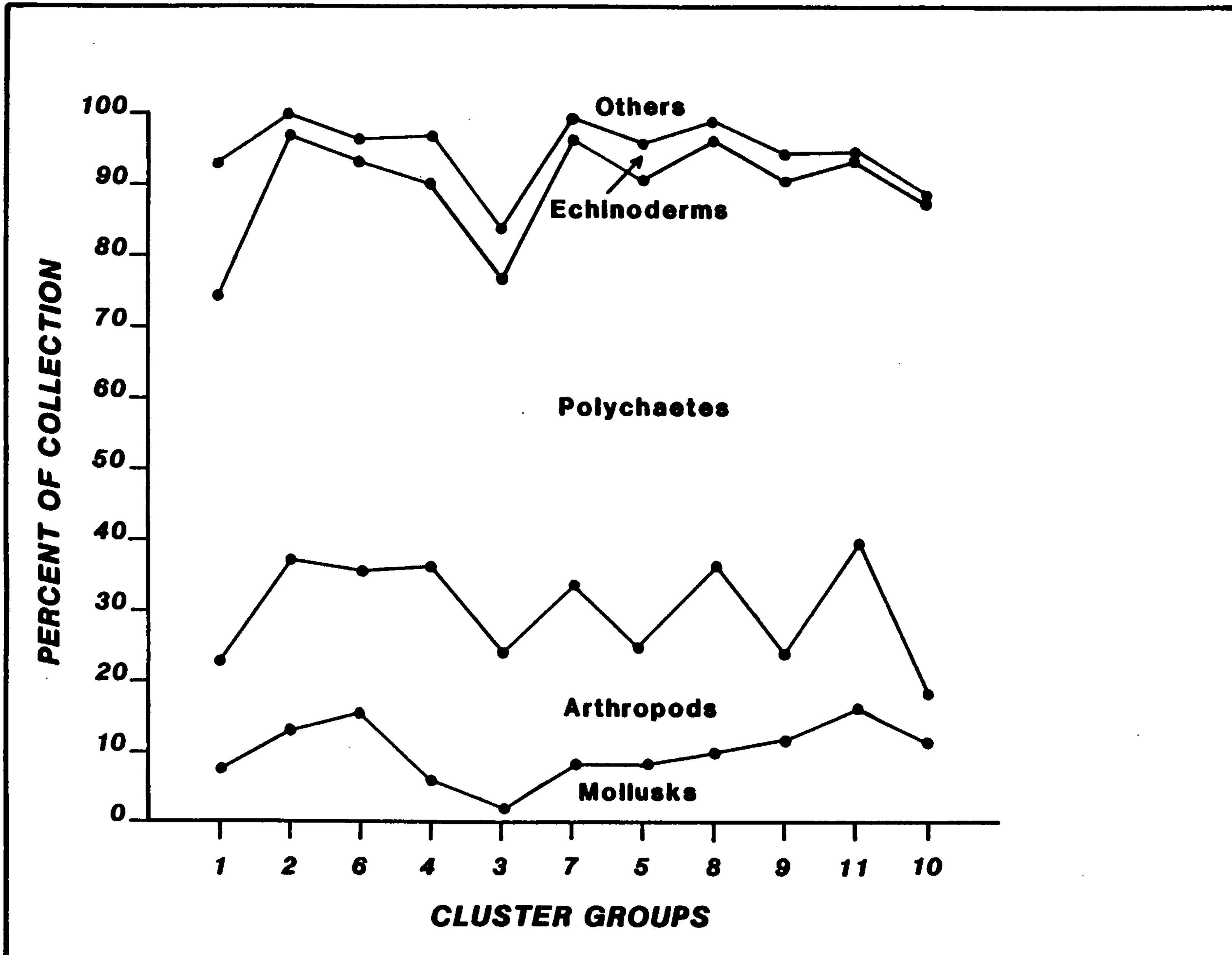


FIGURE 3-20. Relative Proportions of Collected Individuals in Each of the Major Invertebrate Groups at Sites Organized by Similarity Cluster Groups.

3.1.3.2.2 Cluster Analysis

The primary method used to describe the various infaunal assemblages was cluster (or classification) analysis. Following laboratory identification and data reduction, cluster analyses were performed using data from a single replicate from each station. All analyses were based on a Bray-Curtis dissimilarity matrix. The clustering strategy used flexible sorting with beta = -0.25 and alpha = 0.625. Separate analyses were performed on the following databases:

1983/1984 data - 1.0 mm fraction only

1976 and 1983/1984 - 1.0 mm fraction only

1983/1984 data - 1.0 + 0.5 mm fractions combined

The results of these analyses indicated that the fauna at four stations in the Santa Barbara Basin and one station off Purisima Point were depauperate and therefore probably anomolous relative to the other stations. To allow better discrimination of habitat differences among other stations, these five sites were excluded as outliers, and the analyses were repeated using the remaining 104 stations. Samples excluded were 046-BSS off Purisima Point (2,000 ft depth), 091-BSS and 099-BSS off the north side of Santa Rosa Island (1,800 ft depth), 089-BSS on the northwestern Santa Barbara Basin Slope (1,560 ft depth), and 098-BSS on the south central Santa Barbara Basin (1,900 ft depth).

In general, the results of all analyses were similar; two of the analyses are discussed in detail: analyses based on 1983/1984 1.0 + 0.5 mm combined data, and analyses including 1976 and 1983/1984 1.0 mm data. Since the 1976 samples were collected on a 1.0 mm screen, 1983/1984 0.5 mm data were excluded. The overall pattern in distribution of the benthic organisms were depth related. However, whether depth was the controlling variable or merely a co-variate with the effective parameter(s) could not be determined from the present data.

1983-1984, 0.5 mm Data Base

The first dichotomy in the site group (Figure 3-21) dendrogram separated the inshore shallow shelf and shelf break stations (site group 1) from the remaining slope, basin, and bank stations (site groups 2 through 11). Two sites east of Point Conception were more similar to each other than to the remaining 12 shelf sites. Two 165 ft depth sites (off Pismo Beach and west of Point Arguello) grouped loosely with more southerly shelf sites, probably because they were different from the majority of the shelf sites along the 330 ft contour. This separation is interpreted as evidence that sites with the same basic habitat differ in species composition north and south of Point Conception. A latitudinal trend was also visible in those sites between Point Estero and Point Conception, with the four northernmost sites grouping together, and with each station grouping most closely to its nearest southern neighbor.

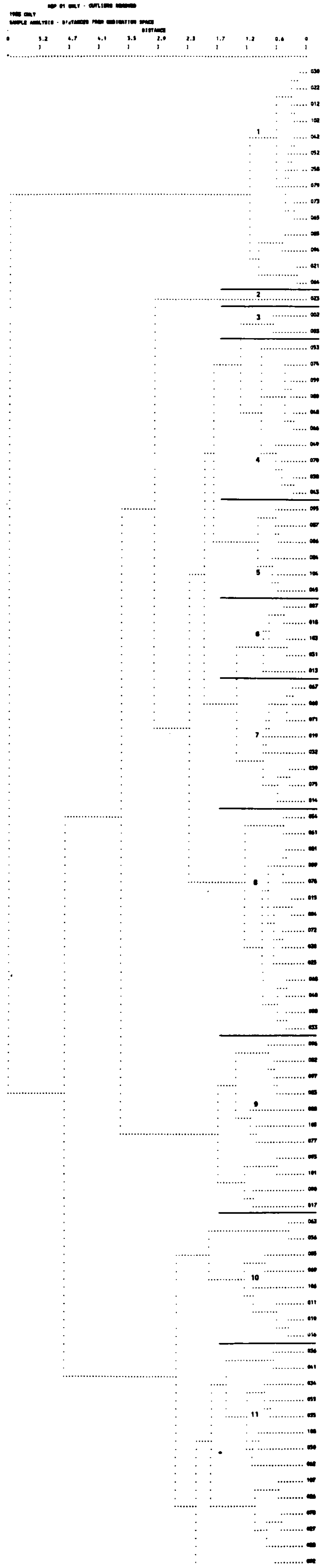


FIGURE 3-21. Cluster Analysis for 1983/1984 1.0 + 0.5 mm Soft-Bottom Infauna Samples.

The second major dichotomy separated 23 sites in groups 10 and 11 from the remaining 57 sites. Stations in site groups 10 and 11 (Figure 3-21) included all but one of the sites in depths over 1,500 ft north of Point Conception, and two sites at 1,500 ft from the southern slope of the Santa Barbara Basin, all of which represent sites from the northern Channel Islands slope. Sites from Santa Lucia Bank, Santa Lucia Sea Valley, deeper sites in the Arguello Submarine Canyon complex, and the lower slope sites at 3,030 to 3,120 ft on the Arguello Plateau also were included with this group.

Within the large cluster group (site groups 2 through 9), two main clusters were indicated. One included four sites from the northernmost area in the Santa Maria Basin, the three 2,950+ ft deep slope stations, and one site from the shoreward slope of the central Santa Maria Basin; the second group included the remaining 15 sites. The faunal differences separating these two clusters can best be seen in the two-way table from the analysis (Figure 3-22). Species correlates of the Cluster 10 vs. 11 separation included:

- Lack of species group 12 in site group 11 and their presence in site group 10 (e.g., the polychaetes Sternaspis fossor and Cossura rostrata and the hydroid Monobrachium parasitum);

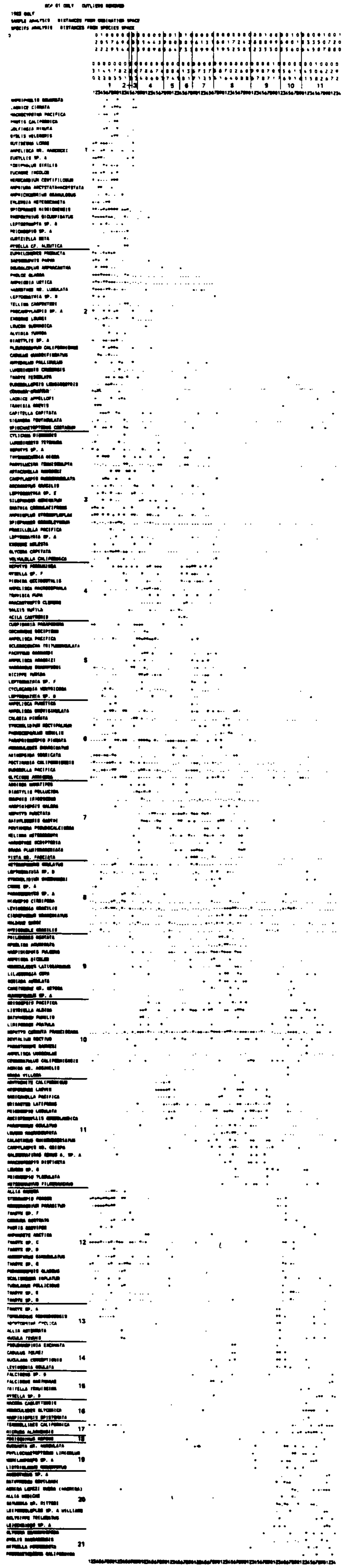


FIGURE 3-22. Two-Way Table for 1983/1984 Soft-Bottom Species and Station Groups from Cluster Analysis.

- Lack of species group 15 and 16 species in site group 10 and their presence in site group 11 (e.g., the clam Mysella sp. D, the skeleton shrimp Tritella tenuissima, and the amphipod Monoculodes glyconica);

- Absence of species group 21 species in site group 10 versus their presence in site group 11 (e.g., the amphipod Byblis barbarensis, the snail Mitrella permodesta, and the solenogaster Prochaetoderma californica).

The biota of species group 12 has a clearly bimodal distribution, occurring at sites in site groups 1 and 3 from shallow depths as well as at the greater depths of site group 10. This indicates either that there is some physical similarity between these deep and shallow sites where the species occur, or that the species are unable to survive at detectable densities at intervening depths. This phenomenon is discussed further in Section 3.1.3.7 (Biotic/Abiotic Relationships).

The 11 stations in site group 9 were mid to lower slope locations with a depth range of 1,000 to 2,200 ft (average depth 1,400 ft). The sites form a "wishbone" which includes the north and south slopes of the Santa Barbara Basin and extends westward along the slope past Point Conception and midway to Point Arguello (Figure 3-23). Two northern stations from the slopes of the Santa Maria Basin also were included in this group, but were mixed

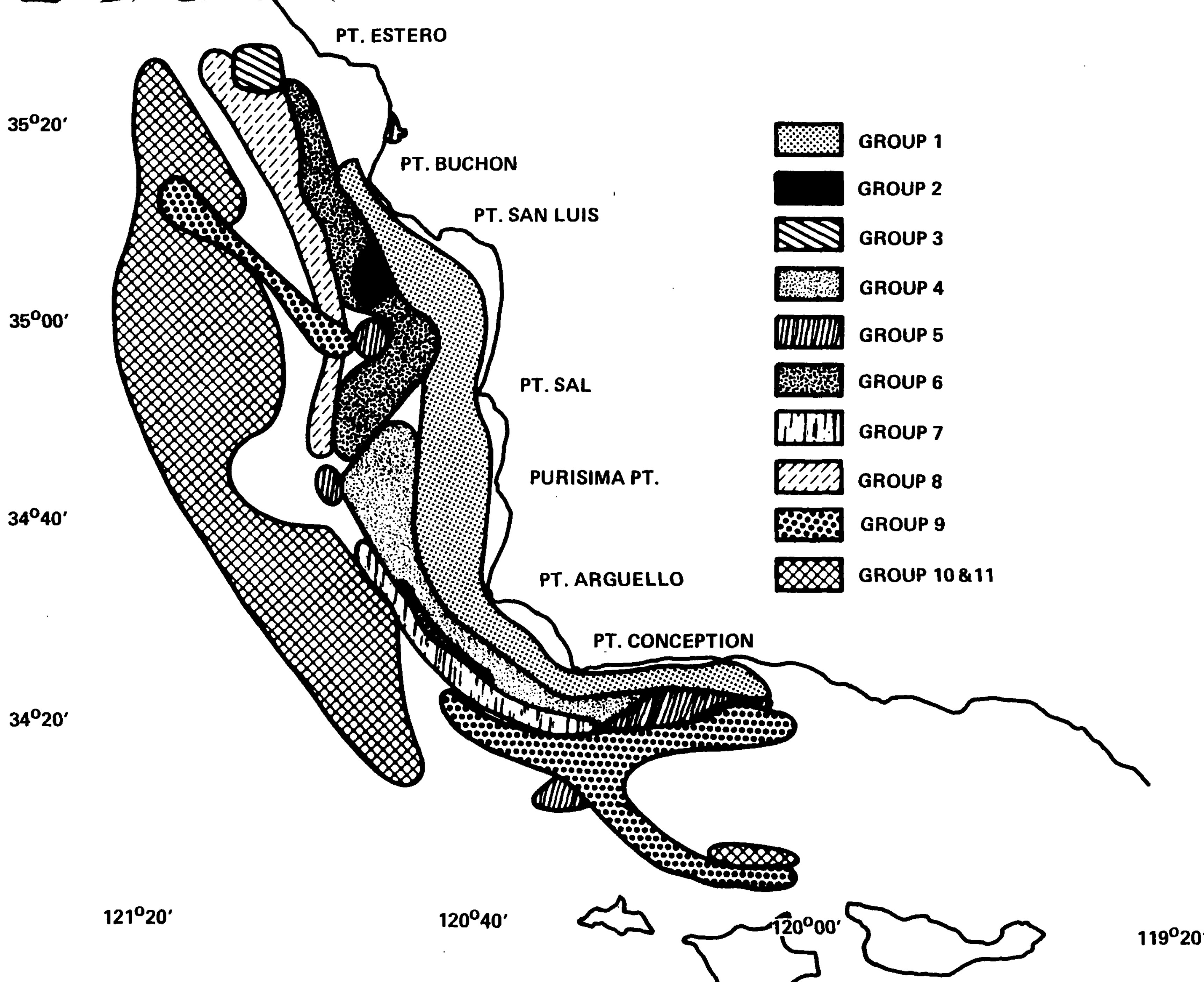


Figure 3-23. Cluster Groups for 0.5 + 1.0 mm Samples from the 1983/1984 Soft-Bottom Survey (outliers excluded).

within geographically discontinuous southern basin sites. These two northern sites along with additional southern Stations 077 and 088 were four of the seven stations with the lowest species richness. The three stations with fewer species were among the excluded outliers, leaving these four as the most depauperate sites in the analysis. The species which characterized these sites were primarily in species group 11 of the two-way table (Figure 3-22).

A single station (023-BSS, depth 670 ft) off Pt San Luis formed site group 2; it was characterized by a population of the pelagic red crab, Pleuroncodes planipes. During El Nino episodes, the pelagic phase of this species occurs as far north as Monterey Bay. The present record is the farthest north that a benthic population has been reported (see discussion in Section 3.1.3.6).

Fourteen sites along the 1,300 ft isobath (depth range 900 to 1,300 ft) formed site group 8. Species in species group 11 of the two-way table characterized these sites, as well as those of site group 9. The presence of medium to high abundances of species in species groups 5 and 7 through 10 also characterized site group 8 (Figure 3-22). At the northern and southern ends of the sampling grid, sites from the 980 ft isobath were also included in this group. The polychaetes Levensenia gracilis, Ophelina acuminata, and Nephtys cornuta franciscana occurred at all sites within the cluster, and high constancy (occurrence at all or most of the sites in a cluster) was observed for many species from site group 8.

Site groups 6 and 7 were separated from groups 3, 4 and 5 at the next level of similarity. Groups 6 and 7 contained 13 sites at depths from 660 ft to 1,030 ft (mean = 860 ft) along the upper slope between Morro Bay and Point Conception. Sites in the two clusters were geographically intermingled but differed in depth; those in group 6 averaged 660 ft, whereas those in group 7 averaged 980 ft. The groups generally were separated from one another based on species differences, particularly the presence of species in species group 5 which were more abundant at sites in group 7 than in group 6 (Figure 3-22).

Differences among the remaining site groups (3, 4, and 5 in Figure 3-22) are less apparent. Sites in group 5 are best characterized by high relative abundances of the scaleworm Hesperonae laevis, and constancy of occurrence of the spoon worm Arhynchite californicus and the clam Saxicavella pacifica. The polychaete Nephtys ferruginea and the amphipods Ampelisca careyi, Ampelisca pacifica, and Nicippe tumida were all present at most group 4 sites (often in high relative abundances), but absent at group 5 sites. The two sites in group 3 were separated from those in groups 4 and 5 by high relative abundances of the polychaete Laonice cirrata, the ostracods Rutiderma lomae and Harbansus bradmyersi, and the tanaid Leptognathia sp. E. The absence of species characteristic of the other two groups at group 3 sites also contributed to their separation. Group 3 stations occurred at depths of 680 ft and 980 ft, whereas those in group 4 averaged 700 ft (range 660 ft to 885 ft), and those in group 5 averaged 1,000 ft (range 660 ft to 1,330 ft).

1976, 1983-1984, 1.0 mm Data Base

When the RIP samples from 1976 were included in the similarity analysis, the general patterns seen in the 1983/1984 0.5 mm data set were repeated, (Figure 3-24). The major separations between groups still appeared to be related to depth, and the same major groups formed; levels of similarity varied slightly and a few sites changed group affiliation.

The 1976 RIP sites along the inner shelf of the northern Channel Islands chain and across the Channel onto the mainland shelf near Ventura formed two clusters that grouped with site group 1 of the 1983/1984 survey (Figure 3-21). The first cluster contained six sites in two disjunct geographic areas: three sites along the western and northern shelf around Santa Cruz Island in depths between 130 and 330 ft, and three in the center to northern side of the Santa Barbara channel at depths between 80 and 790 ft. Species which characterized these sites were all amphipods, in particular Gammaropsis ociosa, Photis lacia, P. californica, and P. brevipes. Although occurring elsewhere, these species were much more common at sites in this group. These sites were also characterized by an absence of all species in species group 4 and of some species from other species groups. Species absent from the first cluster included the polychaetes Sarsonuphis parva, Spiophanes missionensis, Lumbrineris cruzensis, and Harmothoe nr. lunulata, the isopod Gnathia crenula tifrons, the cumacean Procampylaspis sp. A., and the clam Axinopsida serricata.

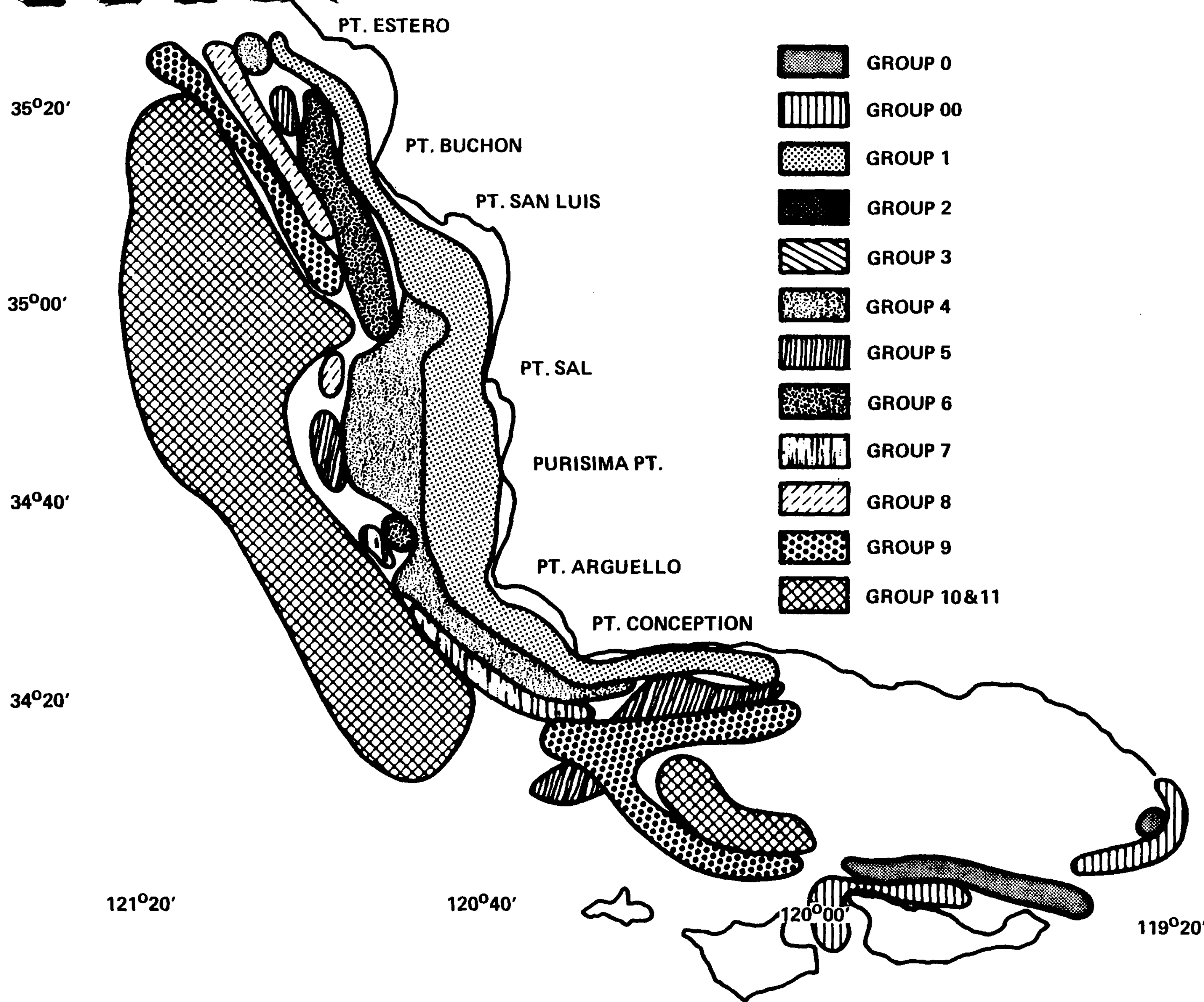


Figure 3-24. Cluster Groups for the 1.0mm Samples from the 1983/1984 Soft-Bottom Survey and the 1976 Survey (outliers excluded).

The second new cluster contained the remaining eight RIP sites and five sites classified in site groups 1 and 3 of the 1983/1984 analysis. Sites in this group averaged 380 ft in depth (range 160 to 700 ft) and were located from the farthest north (Station 002-BSS off Point Estero) to the farthest east (Station 851RIP off Ventura) of the study area. Species characteristic of sites in this site group were from species groups 1, 2, and 3. No single species from these groups was restricted to sites from the second cluster, and none occurred at more than 60% of the sites in the cluster. In other words, while many species were found at high relative abundances at the sites, either their fidelity or constancy in the cluster was low.

Of the remaining groups in the 1983/1984 combined analysis (Figure 3-21), the most altered were group 2 which was included in one of the upper-mid slope clusters, and group 3 which became divided between the second new cluster and group 2 of the analysis that included the 1.0 mm RIP data.

Basic Assemblages

The two analyses discussed above were sufficiently similar that six broad, infaunal assemblages can be described. Because these site groups separated primarily on the basis of depth, they are named using a depth reference, except for one which supported a very characteristic species of scaleworm:

Shelf - The most distinctive of the infaunal assemblages encountered was that of the continental shelf at depths of 400 ft or less; this included samples from 1976 from the Northern Channel Islands' shelf.

Deep - The next most distinctive infaunal assembly was that of the lower slope/bank/canyon/sea valley complex around Santa Lucia Bank and the mid to lower slope near the Arguello Submarine Canyon.

1,300 ft - A mid-slope assemblage was present centered on the 1,300 ft isobath.

660 ft/980 ft - Two intergrading assemblages were present in the upper to mid portions of the slope; one predominantly at 660 ft but extending deeper, and one predominantly at 980 ft but extending shallower.

"Hesperonoe" - A small group of sites in the western Santa Barbara Channel, off Purisima Point and a few other less constant sites was characterized by the scaleworm *Hesperonoe laevis*.

Basin Slope - A group of sites, primarily on the slopes of the Santa Barbara Basin, was characterized by reduced species richness and density compared to other 1,300 ft sites. Analysis of 1976 RIP data demonstrated considerable similarity between the biota of many northern Channel Islands shelf sites and those sites at the same depth north of Point Conception, but also indicated a northern Channel Islands assemblage which lacked many wide-ranging and abundant shelf species.

These patterns are dominated by changes in bathymetry, with latitude usually a minor component. Deviations from the overall pattern usually were associated with local geomorphology or depth (e.g., Arguello Canyon).

3.1.3.3 Historical Comparison

Several previous studies have described broad habitat and community distribution patterns in the southern California Bight, with several investigations using the same data base. The six major data bases of interest are:

- "State Survey" collections made between 1952 and 1959;
- BLM Year I "Baseline Program" of 1975-1976;
- BLM Year II "Descriptive Program" of 1976-1977;
- Santa Ynez Unit collections from the western Santa Barbara Channel of 1981-1982;
- "Arguello Field" collections of 1982-1983;
- "Orange County Deep Slope" samples of 1981-1982.

These historical studies employed a variety of analytical approachs to identify infaunal assemblages, including qualitative estimates through semiquantitive clustering techniques to classification analyses similar to those used in the present study. The primary goal of an historical comparison is to establish common descriptions of the assemblage(s) and/or the characteristic habitat(s). The second goal is to broaden, in a spatial and temporal context, the applicability of the "community" concept to the marine environment.

Samples from the "State Survey" and associated studies by the Allan Hancock Foundation in the 1950s, were collected primarily from shallow to mid-shelf depths throughout the southern California Bight. These samples were analyzed extensively by Jones (1969) who employed recurrent group analysis to delimit a series of macrofaunal associations and distributions on the shelf. He incorporated several associations designated earlier by others (Barnard and Hartman, 1959; Barnard et al. 1959; Barnard and Ziesenhenne, 1961; Barnard, 1963; Barnard, 1966; AHF, 1965), and expanded on the relatively limited taxonomic or geographic coverage of these studies. Of the materials analyzed by Jones, only 6 stations from Point Conception to Santa Barbara Point at depths of 300 to 600 ft are appropriate for comparison with the present study. Two-thirds of these sites were characterized as supporting the *Amphiodia-Cardita* or *Amphiodia-Onuphis* associations. Prominent members of those associations (per Barnard and Ziesenhenne, 1961) are included in Species Groups 1, 3, 5, 11, and 12 of the present analysis. Jones noted that the objective recurrent group analysis seldom corresponded entirely to the subjectively defined associations or communities of previous workers; this observation is equally appropriate to this study. Nevertheless, the shelf site group of the present analysis is suggestive of the Amphiodia-Cardita association at member sites south of Point Arguello. North of Point Arguello, Cyclocardia ventricosa (the Cardita of Jones) was not present and the sites resembled the Amphiodia association. At two shallow "sand sites" (Stations 021 and 064), the association included increased numbers of spionid polychaetes and the clams Mysella cf. aleutica and Parvilucina tenuisculpta.

The relatively poor correspondence between cluster analyses based on abundance (as in Jones, 1969 and the present study) and those based on biomass (i.e., Barnard et al., 1959; Barnard and Hartman, 1959), or more subjective estimates of co-occurrence or importance (i.e., Barnard and Ziesenhenne, 1961; Barnard, 1963; Barnard, 1966), stems from both the method, and the data considered. Group identified produced by cluster analyses such as the present one can not be interpreted according to prior community or association categories without distortion. At slope depths, where bottom sediments and oceanographic conditions are somewhat more uniform, patterns of biotic association are somewhat simpler and the present and earlier methods yield results which are more consistent.

Barnard (1966) discussed the species associations in submarine canyons at slope depths off southern California. He indicated a series of Pectinaria associations (with various subdominants) between 330 and 1,330 ft, a Maldane association in 1,150 to 1,480 ft, a Heteromastus association in

1,230 to 1,800 ft, and a *Lysippe* association below 1,800 ft. Although both Barnard (1966) and Hartman (1963) indicated that the biota of submarine canyons frequently differed markedly from that of the adjacent shelf or slope, the associations delineated by Barnard are all identifiable in the present analysis of data from the western Santa Barbara Channel and the slope off central California. General equivalences between the present study and Barnard (1966) include:

Barnard (1966) Associations	Present Data (Figure 3-22) Site Clusters
Pectinaria variants	4, 7
Pectinaria-*Dentalium*	6
Maldane	8
Heteromastus	9
Lysippe	10

The remaining site groups have no equivalents in the submarine canyon data, probably because they represent a more refined analysis of finer-scale differences within larger, corresponding groups.

More recent reports on slope biota that are based on the BLM "Baseline" database (Fauchald and Jones, 1978) have been summarized by Balcolm (1981). Regardless of the location studied, the "Baseline" data tended to be resolved into three groups which varied with bathymetry: a shallow-water shelf group; a slope group which was occasionally subdivided into shelf and transitional (into basin) subgroups; and a deep or basin group. On outer banks and ridges, several unique assemblages were noted in addition to the general pattern.

The BLM "Descriptive" program database was analyzed in a manner similar to that used in the present study. In the Descriptive program, two of six areas investigated were located in the Santa Barbara Channel. Transects of five stations along a gradient from shallow shelf to deep slope depths were sampled off Point Conception and across the eastern Santa Barbara Channel from Santa Cruz Island to the mainland. Cluster analysis of samples from all six areas was performed to evaluate the similarity of widely separated sites. A two-way table allowed determination of the species that were responsible for the observed site groups.

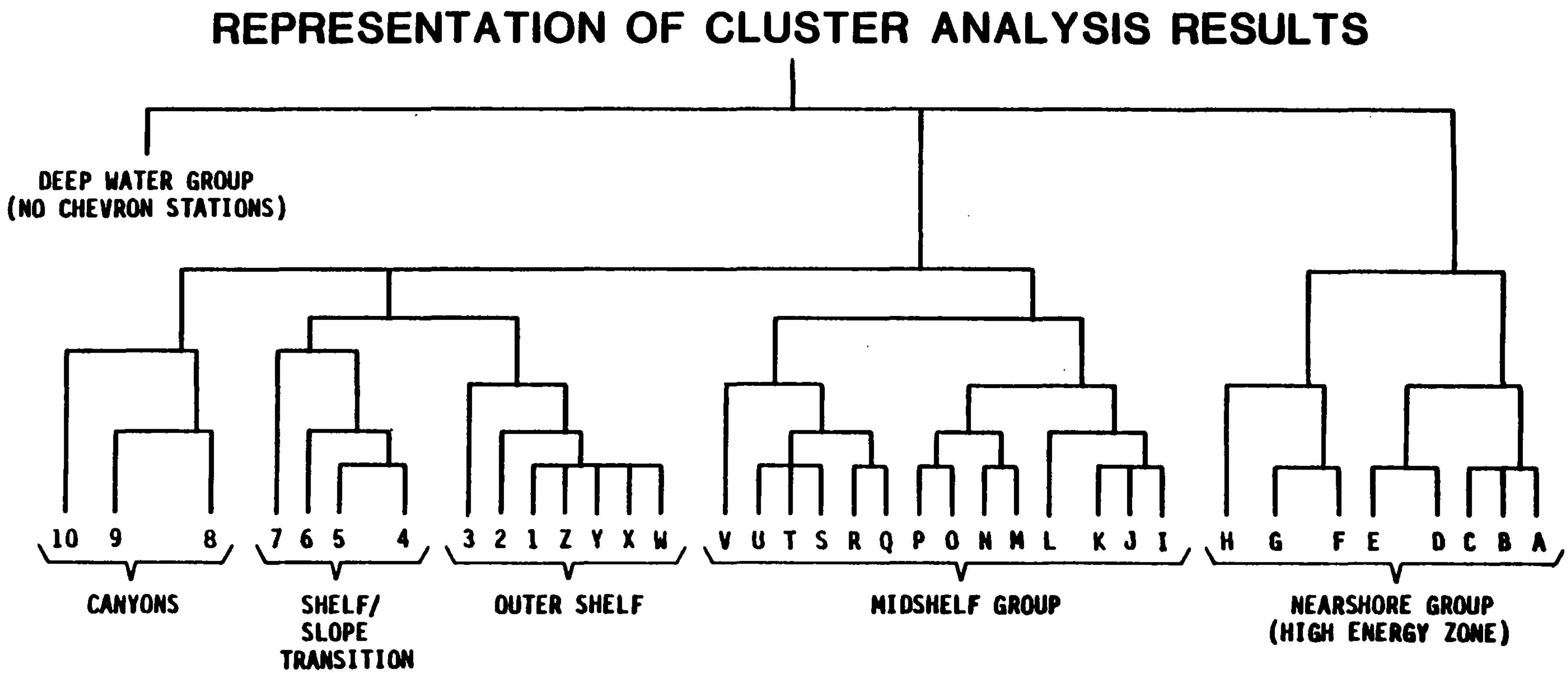
Point Conception sites at depths between 115 and 610 ft clustered with the main shallow shelf group, generally typified by Amphiodia dominance. These sites were very similar to sites off San Diego, also reinforcing the notion of the shelf biota as an Amphiodia association with local variations throughout the continental borderland. Station 832 at a depth of 690 ft off Point Conception was most similar to a sample from 590 ft off Oceanside. This pair was joined at a somewhat lower similarity by three sites in the eastern Santa Barbara Channel (depths 620, 950 and 1,140 ft), and then by three additional sites off Point Conception (depths 1,115, 1,190 and 1,380 ft). Sites in this group were characterized by the heart urchin Brisaster latifrons, the polychaetes Nephtys cornuta franciscana, and (off Point

Conception only) Prionospio lobulata. The remaining Point Conception sample (Station 834 in 1,485 ft) grouped with two similar depth sites from off Oceanside. The biota of these sites appeared to be dominated by Maldane sarsi, and corresponded to an impoverished Maldane association. The remainder of the eastern Santa Barbara Channel stations clustered into the main shelf group (depths ranging from 120 to 510 ft).

In a recent reexamination of data from all BLM studies in the continental borderland, Thompson and Jones (1985) concluded that there are only four separable slope biotopes in the borderland: two associated with inshore basins and two associated with offshore basins. For both inshore and offshore stations, slope biota could only be resolved into upper and lower components. The inshore slope was divided into an upper zone (520 to 2,070 ft) dominated by polychaete assemblages which were transitional between the shelf and lower slope habitats (1,570 to 2,790 ft). This interpretation could also be applied to the present data, where the similarity analysis isolated dissimilar inshore (shallow) and offshore (deep slope/basin/bank) clusters from the upper and middle slope sites.

The "Orange County Deep Slope" database provides slope community characterizations from regions outside the immediate vicinity of Point Conception. Cluster analysis of data collected over a three-year period off Huntington Beach and Point Dume grouped the samples into four major groups (Thompson et al., 1984): the outer shelf (340 to 1,120 ft), upper slope (925 to 1,270 ft), transition (1,300 to 1,600 ft), and lower slope (1,380 to 2,060 ft) stations. From the list of abundant species in each group (Thompson et al., 1984, pg. 49), it appears that none of their groups corresponds directly to those observed in the present study. Because no significant difference was found in site clustering between the sites near the Orange County outfall and the Point Dume "control" site, it is probable that the zonation of slope biota has not been altered by sewage discharges. Alternatively, it may indicate that the Point Dume sites have received equivalent exposure to sewage from outfalls in Santa Monica Bay.

Recent investigations conducted for the petroleum industry in the vicinity of Point Conception provide additional information on faunal distributions and associations. Of particular interest is cluster analysis of 36 sites at depths of 20 ft to 200 ft near the site selected for installation of Platform Hermosa off Point Conception (Figure 3-25). This study area extends shoreward from the outer shelf examined in the other analyses and allows evaluation of the associations on the shelf. As with analyses discussed previously, this analysis separated the biota first into deep water and shallow water groups, with the majority of the sites at intermediate depths clustering into a single group. This central group was then separated into a sequence of four subgroups: a midshelf group (60 to 300 ft), an outer shelf group (240 to 300 ft); a transition or shelf break group (300 to 610 ft); and several canyon stations (300 to 705 ft). These groups follow a general bathymetric gradient, but there is considerable overlap in depth between groups.



A. CAPITAN 20'SYU
B. GAVIOTA 20'SYU
C. SACATE 20'SYU
D. V-1 20'
E. IV-1 20'
F. I-3 120'
G. II-3 120'
H. GAVIOTA 60' COARSE SAND SYU
I. CAPITAN 60'SYU
J. CAPITAN 120'SYU
K. SACATE 120'SYU
L. SACATE 60'SYU

M. SACATE 120'SYU
N. CAPITAN 120'SYU
O. V-2 60'
P. V-3 120'
Q. CAPITAN 220'SYU
R. V-4 220'
S. I-4 220'
T. II-4 220'
U. I-5 300'
V. CAPITAN 300'SYU
W. GAVIOTA 240'SYU
X. V-5 300'

Y. GAVIOTA 240'SYU
Z. CAPITAN 240'SYU
1. GAVIOTA 300'SYU
2. SACATE 240'SYU
3. SACATE 300'SYU
4. I-6 300'
5. I-7 330'
6. I-8 350'
7. P 600'
8. GAVIOTA 300' CANYON EDGE SYU
9. GAVIOTA 600' CANYON HEAD SYU
10. SACATE 700' CANYON HEAD SYU

DAMES & MOORE

FIGURE 3-25. Dendrogram of Between-Site Similarity Among Stations in the Santa Ynez Unit (SYU) and the Proposed Platform Hermosa Site (with various alternate pipeline routes). (Source: Dames and Moore, 1983).

The "Arguello Field" database is derived from the results of three environmental surveys conducted in support of applications by oil companies for production permits (Dames and Moore, 1983; Nekton, 1983; Engineering Science, 1984). Clustering analyses were not performed on this database, but data have been reduced so that species characteristic of the sites (by their frequency of occurrence and abundance) could be identified (Table 3-12). The sites considered ranged in depth from 400 ft to 700 ft. There is a general correspondence between those species listed as both common and representative at sites between 400 ft and 700 ft and major components of the *Amphiodia* association which characterized sites in site group 1 of the present survey. Three geographically adjacent sites at depths of approximately 330 ft in the present study (Stations 065, 073 and 079) grouped together near the center of site group 1. The remaining sites (at depths of 500 to 705 ft), while still showing a strong *Amphiodia* influence, appear to correspond to one of the *Pectinaria* community variants, with strong representation of the amphipods *Ampelisca careyi* and *A. pacifica*, and the polychaetes *Spiophanes kroyeri* and *Maldane sarsi*. Geographically adjacent sites along the 660 ft isobath in the present study (Stations 070, 074, and 080) were all in site group 4 and supported comparable biota. The ophiuroid *Amphiodia* was not as well represented and the polychaete *Pectinaria* was more prominent in the present study than in the earlier collections.

Table 3-12. Characteristic, Common and Representative Benthic Infaunal Species from Upper Slope Depths in the Arguello Field Area Offshore between Point Arguello and Point Conception (as indicated by prior studies).

		Platform, Depth (ft), Station																
		Hi 395 7	Hi 416 1	Hi 416 4	Hi 416 5	Hi 416 6	Ha 422 7	Ha 446 5	Hi 446 2	Ha 495 8	Ha 512 6	Ha 531 9	Ha 571 4	He 597 1	Hi 650 3	Ha 653 3	Ha 700 2	Ha 700 1
(S)	Golfingia minuta	++		++	++	++	++		+	++	+	+	+	+				
(P)	Spiophanes kroyeri	++	++	++	++	++	++	+	++	+	+		+	++	++		+	+
(O)	Amphiodia urtica	++	++	++	++	++	+		++				++	++				
(P)	Spiophanes missionensis	++	+	++	++	++		+	++	+	+			+	+			
(P)	Exogone lourei	++	+	+	++	+	+	+	+	+			+				+	+
(P)	Maldane sarsi/cristata	++		++	++	++	++	+	++	+	+	+	+		+	++	+	+
(P)	Chloeia pinnata	++	++	+	+	++	++		++				+		+	++	+	+
(P)	Lumbrineris cruzensis	++	+	++	++	++	+		+	+	+	+			+			
(P)	Myriochele heeri	++	+	+	+	++	+		++									
(P)	Pectenaria califoriensis	++	+	++	++	+	+	+	++	+	+	+	+	+	+	++		
(P)	Sarsonuphis parva	++		++	++	+			++					+				
(P)	Sternaspis fossor	++	+	++	+	++	+	+		+		+	+	+		+		
(A)	Ampelisca careyi	++	++	++	++	+	++	+	++	+		+	+		++	++	+	
(A)	Ampelisca pacifica	++	+	+	+	+	++	+	+			+	+	++	++	++	+	+
(A)	Heterophoxus oculatus	++	++	++	++	++	++		++	+	+	+	+	+	+	+		
(A)	Photis californica	++	++	+	++	+	+		+	+	+				+			
(A)	Phoxocephalus homilis	++	++		+	+	++		++	+	+	+	+			+		
(C)	Diastylis sp. A	++	++	++	++	+			+					+				
(C)	Eudorella pacifica	++	+	++	+	++	+	+	++		+		+		++	+		
(M)	Amygdalum pallidulum	++	+	+	++	++	+		+					+				
(M)	Axinopsida serricata	++		+	+		++	+	+	+	+				+		+	
(O)	Amphiodia digitata	++	+	++	++	++	+	+	++	+	+	+	+		++	++	+	+
(A)	Ampelisca romigi		++	+	+	+	+		++	+								
(D)	Axiopsis spinulicauda		++	+		++			+					+				
(M)	Tomburchus redondoensis		+	++	+	+			+	+								
(E)	Brisaster latifrons		+	++	+	+			++			+	+		+	++	+	+
(O)	Amphioplus hexacanthus		+	++	+				+						++			
(P)	Glycera capitata			+	++	+		+		++	+		+	+		+		
(P)	Glycinde armigera		+	+	++	++	++		+	+		+	+		+	++	+	
(P)	Nephtys ferruginea			+	++	+	+		+		+	+	+	++	+	++	+	+
(A)	Ampelisca agassizi		+	+	++	+		+	+	+				+	+	+	+	
(P)	Lumbrineris cruzensis		+	++	+	+						+	+		+	+		
(P)	Prionospio cirrifera				+		++		+			+				++	+	+

Table 3-12. (Cont'd)

	Platform, Depth (ft), Station																
	Hi 395 7	Hi 416 1	Hi 416 4	Hi 416 5	Hi 416 6	Ha 422 7	Ha 446 5	Hi 446 2	Ha 495 8	Ha 512 6	Ha 531 9	Ha 571 4	He 597 1	Hi 650 3	Ha 653 3	Ha 700 2	Ha 700 1
(P) Cossura candida		+		+		++	+	+	+		+	+			++	+	+
(P) Pholoe glabra			+	+	+	+	+	++	+	+	$\underline{+}$	+	+	+	+	+	
(A) Westwoodilla caecula			+	+	+	+		++				+					
(I) Silophasma geminata		+	+	+	+	+		++	+	+	+			++	+	+	+
(A) Protomedeia articulata			+	+					+			+		++	+		+
(C) Diastylis paraspinulosa			+	+	+	+		+	+	+		+		$\underline{++}$	+		
(D) Pinnixa occidentalis		+	+		+			+						++			
(P) Tauberia gracilis		+	+	+	+		+	+		+	+	$\underline{+}$			++	+	+

Source: MBC 1984
Compiled from Dames & Moore 1983a, Nekton, 1983, and Engineering Science 1983

Hi = Hidalgo; Ha = Harvest; He = Hermosa
P = Polychaeta; S = Sipuncula; A = Amphipoda; C = Cumacea; M = Mollusca;
O = Ophiuroides; E = Echinoides; D = Decapoda; I = Isopoda

Legend: + = present
++ = representative species found in all replicates
__ = common, in densities >100 per m2

3.1.3.4 Community Parameters

The clustering process helps to define site and species groups on the basis of a mathematically established similarity between samples which includes both the species and their count. A particular station (or group of stations) can be described more fully if several community parameters are computed or applied. Because clustering was already employed to condense stations into groups (in effect averaging them) the community parameters below are summarized and discussed by the site groups established.

Community Parameters

The site groups identified in the cluster analysis can also be examined in terms of the numbers of species, community density, Shannon-Wiener species diversity (H'), Gleason's species richness (D), and Pielou's evenness (J'). These parameters (Table 3-13) represent varying degrees of compression of the database. Although some information is lost in the compression process, some of the "noise" caused by the natural variability of the system also is suppressed. The data analysis methods used in calculation of these parameters and some comments on their utility and meaning are presented in Section 2.3.

Table 3-13. Community Parameters of the Biota of the 11 Site Cluster Groups Defined by the 0.5+1.0 mm 1983-84 Similarity Analysis (Outliers Excluded)

				Mean/0.1m^2				
Cluster Group	No. Sites (N =)	Designation	Z (ft)	Nsp	NIND	H'	D	J'
1	14	shelf	315	110	624	3.72	16.96	0.795
2	1	red crab	670	32	80	2.99	7.20	0.868
3	2	sandy, 660 ft	830	104	619	3.62	16.03	0.781
4	10	central/southern upper slope group (660 ft)	660	74	283	3.68	13.07	0.860
5	6	Hesperonoe laevis	1,000	51	170	3.30	9.99	0.845
6	5	northern upper slope group (660 ft)	660	44	128	3.34	8.95	0.888
7	8	upper-mid (980 ft)	980	55	176	3.40	10.61	0.850
8	14	mid-slope (1,300 ft)	1,270	53	241	3.18	9.51	0.806
9	11	southern & depauperate basin slope	1,420	22	63	2.54	5.18	0.840
10	8	deep slope + Santa Lucia Sea Valley	2,400	56	285	3.13	9.88	0.782
11	15	Santa Lucia Bank/Arguello Canyon	1,860	40	146	2.91	7.90	0.796

z = depth (ft)
Nsp = number of taxa
NIND = number of individuals
H' = Shannon-Weiner Diversity Index (base 10)
D = Gleason's Richness
J' = Pielou's Eveness

3.1.3.4.1 Number of Species (Richness)

Approximately 996 invertebrate taxa were identified from the 1.0 mm fraction, including 207 found only from the RIP reanalysis; an additional 211 taxa occurred only in the 0.5 mm fraction. The number of taxa per sample ranged from 0 at Station 098 to 110 at Station 065 on the 1.0 mm screen, and from 0 at Station 098 to 143 at Station 065 on the 0.5 mm screen (which included the 1.0 mm fraction).

The distribution of these values is most easily seen by considering only the mean number of species in each of the 11 site groups (Figure 3-26) identified in the clustering analysis (Figure 3-21). The patterns of the two fractions were very similar. Mean numbers of species declined sharply between the shelf (Group 1) and upper slope, remained relatively constant between 660 and 1,840 ft, and then increased at the lower slope and Santa Lucia Sea Valley sites in Group 10. Site group 9 sites, which were grouped in part because of their joint species absences, averaged fewer species than expected for their depth. Variability of species numbers (as a percentage of the mean) between sites in a group was not completely related to depth, and was highest in groups 9, 5 and 1 with the lowest coefficient of variation in group 4 (midway between group 5 and 1 in bathymetry). Within group variability was not related to the coefficient of variation of depth within a group.

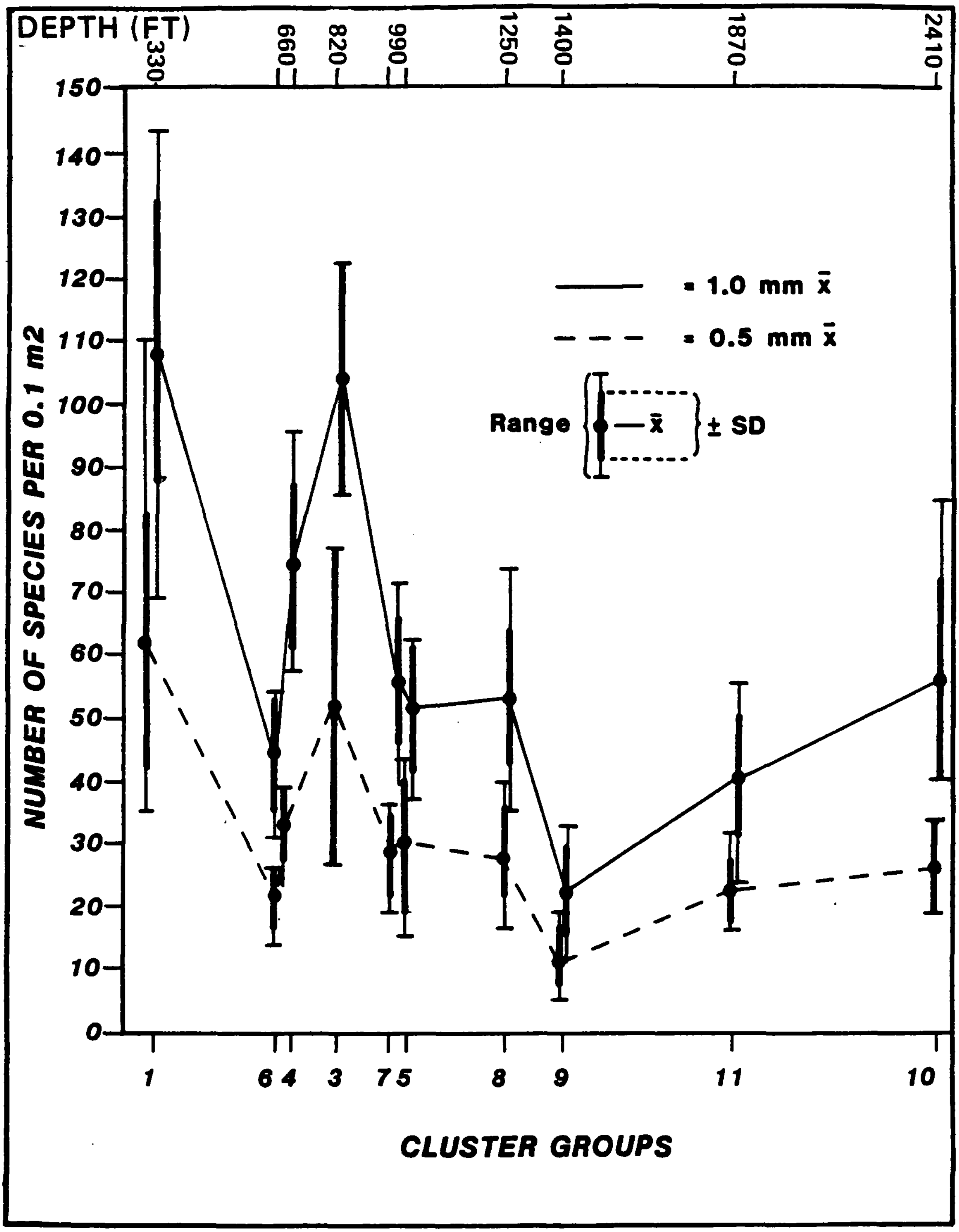


FIGURE 3-26. Mean Richness in Site Groups as a Function of Water Depth.

3.1.3.4.2 Numbers of Individuals (Density)

The number of individual specimens per sample ranged from 5 (Station 091) to 437 (Station 065) on the 1.0 mm screen, and from 9 (Station 099) to 1,137 (Station 065) on the 0.5 mm screen (including the 1.0 mm fraction). Mean density by cluster (Table 3-13) ranged over an order of magnitude, from 63 per site in group 9 (the southern and depauperate, basin slope group) to 624 per site in group 1 (the shelf group). Density distribution by depth (Figure 3-27) closely matched that of richness: a sharp decline between shelf and upper slope, similar values in groups between 660 and 1,310 ft and an increase at depths greater than 1,310 ft. Exceptions to this overall pattern were:

- o Much higher mean density at group 3 at 660 ft and 980 ft with sandy sediments, than in either the 660 ft or 980 ft clusters. Density at group 3 sites was similar to those from shallower sandy sediments on the mainland shelf.

- o Lower mean density at group 9 southern basin slope sites than in all other slope site clusters.

The apparent difference in ratios between density on the 0.5 mm and 1.0 mm screens are of note as indicated by the differences in the slopes of the lines between groups 5 and 8 and 11 and 10. This change reflects either a

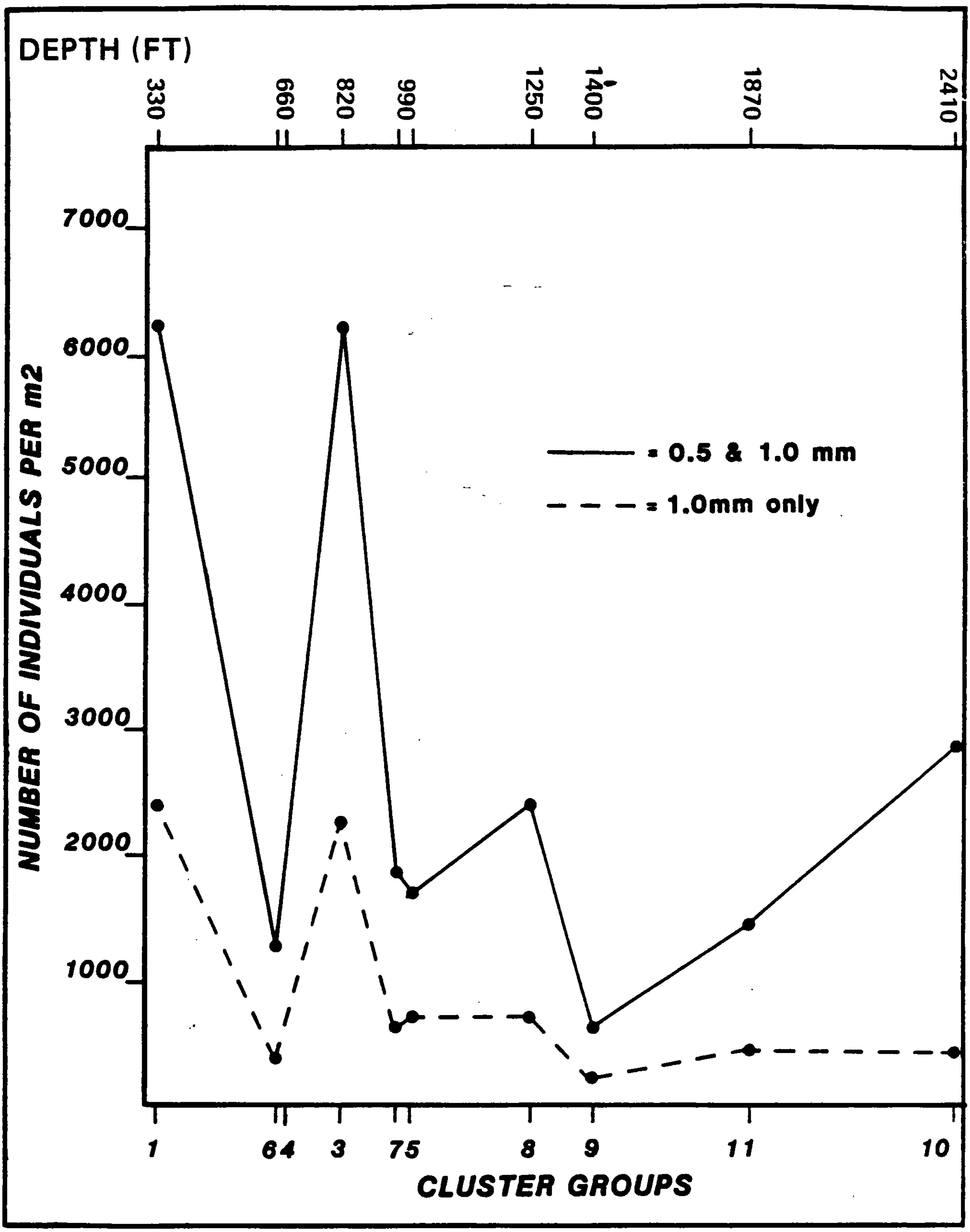


FIGURE 3-27. Mean Density by Group as a Function of Water Depth.

greater contribution from small-sized adults than in other clusters along the depth gradient, or recent or intensive recruitments at the group 8 and 10 sites.

3.1.3.4.3 Species Indices

Shannon-Wiener species diversity ranged from 0.60 (Station 099) to 4.01 (Station 064) for the 1.0 mm fraction and from 0.46 (Station 091) to 4.12 (Station 079) for the combined 0.5 and 1.0 mm fractions. When examined as the mean of site groups (Figure 3-28) species diversity declined relatively evenly as depth increased in both collections.

Gleason's Index of species richness closely matched the mean number of species per site cluster (Figure 3-26) in its distribution between site clusters (Figure 3-28). Richness values ranged between 0.51 (Station 099) and 17.93 (Station 065) in 1.0 mm screen collections, and from 1.37 (Station 099) to 20.18 (Station 065) on the 0.5 mm screen.

Pielou's evenness index (J') is constrained to values from 0 to 1; consequently the values varied within a much narrower range than either diversity or richness. All values in the present study were above 0.5 except for 0.236 from the 0.5 mm fraction at Station 091. The highest evenness values observed from the 0.5 mm fraction was 0.981 at 017, and 0.975 from the 1.0 fraction at Station 005. The high eveness values noted for almost all samples

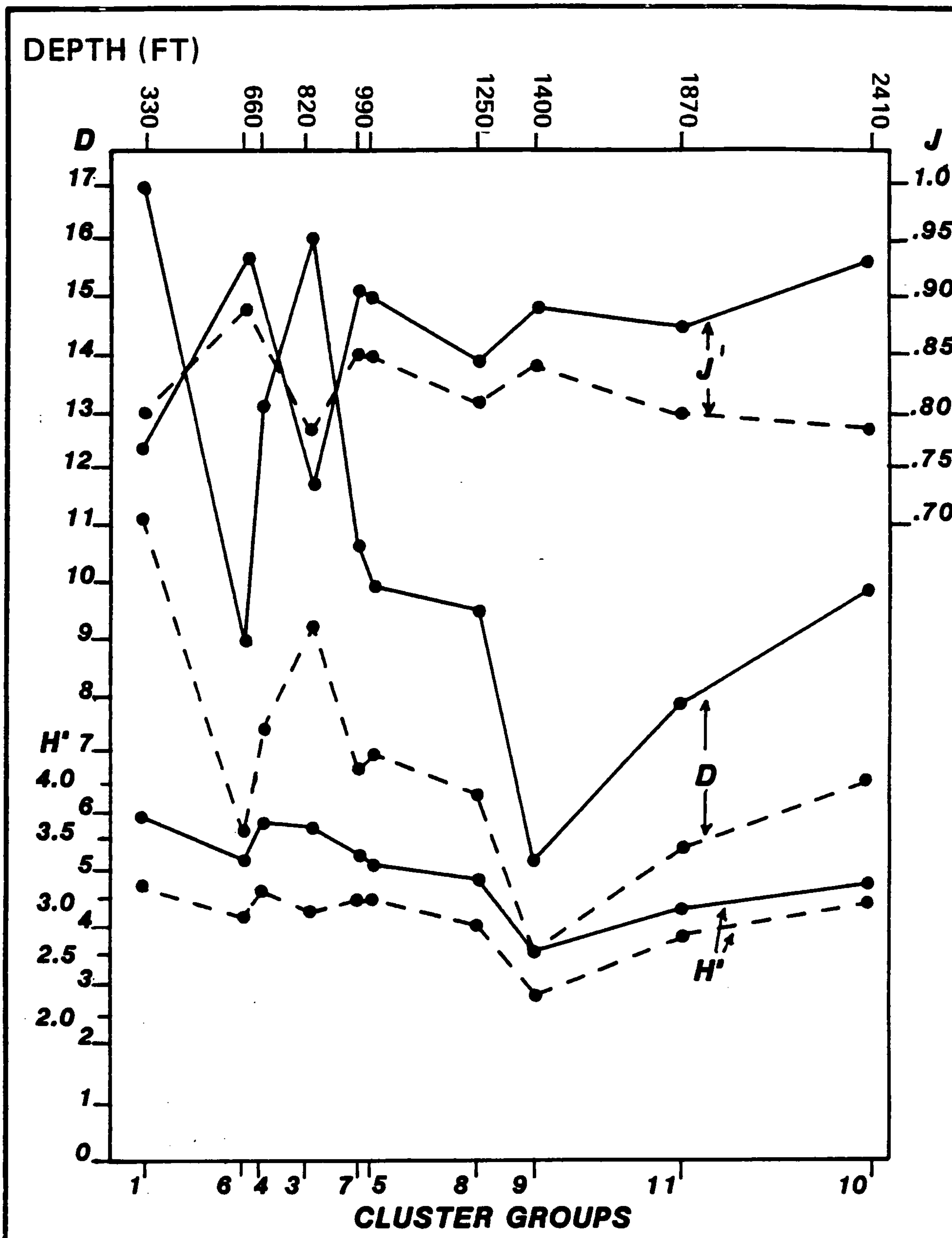


FIGURE 3-28. Species Diversity (H'), Evenness (J') and Richness (D) by Site Group as a Group Function of Water Depth.
(1.0 mm = "--"; 0.5 + 1.0 mm = "__")

collected during the survey (Appendix E) indicate little tendency for one or a few species to be numerically dominant. Mean evenness indices (Figure 3-28) showed little variation with depth and no obvious trends.

3.1.3.4.4 Standing Crop

The standing crop at each station was estimated by weighing the collected organisms (shell-on wet weight). The results are summarized in Table 3-14 as per sample values for major phyla and an "other" category, and as standing crop/m^2 in Figure 3-29. Data by phylum are presented in Appendix E.

In all but one of the site clusters, the aggregate biomass was dominated by echinoderm weight. On the shelf this weight is due primarily to numerous small ophiuroids. On the slope, ophiuroid biomass is reduced and major contributors are large sea urchins (*Allocentrotus fragilis*) or heart urchins (*Brissopsis pacifica* and *Brisaster latifrons*).

The relatively low echinoderm standing crop at the two sites in site group 3 (Figure 3-29) probably is related to the sandiness of the sediments at those stations. Total standing crop generally follows the same bathymetric trend as echinoderm standing crop, increasing between the shelf and the upper slope then declining with depth; this is a direct result of the dominance in biomass represented by the echinoderms. Polychaete standing crop tended to be higher at mid slope depths (except those in site group 6) between 200 and 400

Table 3-14. Biomass by Taxonomic Groups, 0.5 mm Screen (1.0 + 0.5 mm).

Site Group		N*	Depth (ft)	Total wt. (grams/0.1m^2)	Annelida	Arthopoda	Mollusca	Echinodermata	Others
1	Mean	14	315	16.76	2.08	7.28	0.74	5.05	0.36
	S.D.			27.61	1.26	26.50	1.02	5.40	1.15
2	Mean	1	665	80.77	1.85	63.00	0.13	15.60	0.11
	S.D.		---	---	---	---	---	---	---
3	Mean	2	830	6.42	2.61	0.97	0.21	2.13	0.51
	S.D.			2.14	5.52	1.08	0.15	8.36	0.24
4	Mean	10	695	19.89	4.12	0.26	2.48	9.91	1.21
	S.D.			12.71	2.84	2.11	2.91	12.24	2.46
5	Mean	6	995	17.57	2.51	0.12	1.48	8.08	5.38
	S.D.			5.34	3.31	0.12	2.26	3.56	3.66
6	Mean	5	665	19.74	1.48	1.16	0.47	15.65	0.45
	S.D.			19.03	1.26	2.06	0.43	20.43	0.96
7	Mean	8	985	12.70	5.33	0.15	0.45	6.27	0.34
	S.D.			9.32	7.64	0.15	0.98	5.49	0.70
8	Mean	14	1,270	12.06	2.21	0.22	0.60	7.99	0.72
	S.D.			7.58	1.77	0.20	0.89	9.09	2.60
9	Mean	11	1,420	13.66	0.79	0.33	0.14	11.45	0.60
	S.D.			12.02	0.54	0.44	0.16	11.41	1.22
10	Mean	8	2,400	4.65	1.07	0.50	0.23	1.79	0.47
	S.D.			5.37	0.48	1.05	0.20	4.42	1.07
11	Mean	15	1,865	7.14	1.04	0.57	1.87	2.87	0.86
	S.D.			7.55	0.93	1.59	5.87	4.84	0.92

* N = number of observations, i.e., stations

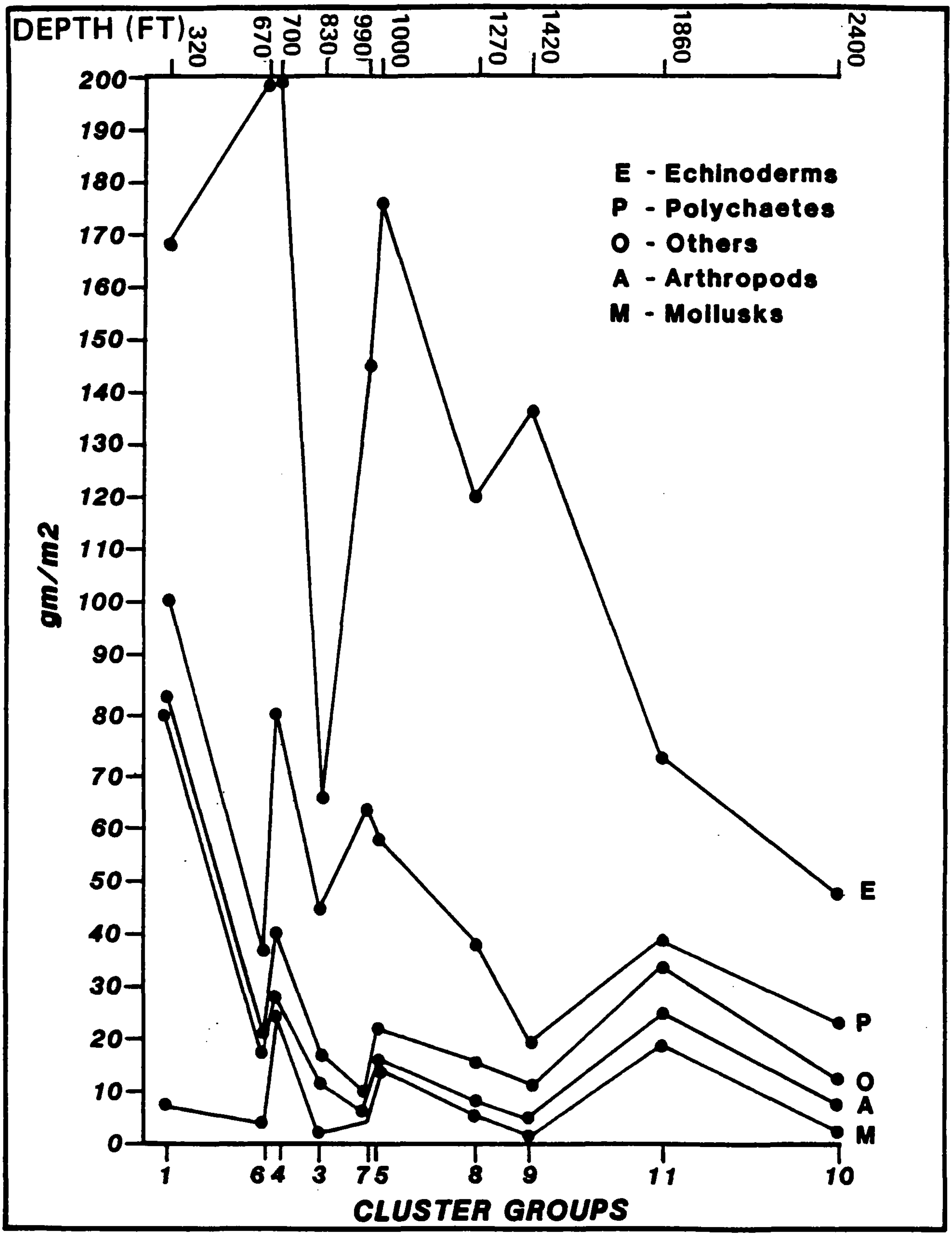


FIGURE 3-29. Standing Crop of Mollusks, Arthropods, Polychaetes, Echinoderms, and Others by Site Group as a Function of Water Depth.

m than at either deeper or shallower sites. Mean polychaete standing crop was proportionally highest in site group 7, forming 44% of the aggregate standing crop. Approximately one half of the total polychaete biomass was at only one of the eight sites in the group. Without this high value, group 7 polychaete standing crop is about the same as that in other slope groups.

The chance collections of very large individuals of uncommon species, or numerous adult specimens of a species usually encountered only as small juveniles, also explain other large values in the biomass data. For example, the mean arthropod standing crop of 7.28/0.1 m^2 in site group 1 (Table 3-14) is a result a value of 99.34 gm/0.1 m^2 from Station 102 where a benthic population of the pelagic red crab Pleuroncodes planipes was encountered. Excluding this one value would have reduced the group mean arthropod biomass to 0.18 gm/0.1 m^2, a value more comparable to that of other clusters. The relatively high standing crop of organisms in the "other" category at sites in Clusters 4 and 5 are similarly related to the inclusion of large echiuroid or sipunculid worms. The random nature of these collections is reflected in standard deviations equal to or greater than the mean for nearly all values in Table 3-14.

3.1.3.4.5 Community Parameter Comparisons

Several previous studies provide information on community parameters for comparison with the present study. Only data from 0.1 m^2 samples processed through a 1.0 mm screen were considered.

Richness on the shelf (Site group 1) averaged 62 taxa per sample in the present study, which was somewhat higher than reported off Point Arguello (57; n = 9; Engineering Science, 1984) and off Oceanside (46; n = 1, Fauchald and Jones, 1979). Samples from Santa Cruz Island shelf averaged more species (83; n = 2; Fauchald and Jones, 1979), than for the mainland shelf; however they reported 94 species in a sample from 277 ft depth off Point Conception.

Total density in the present study averaged 243/0.1 m^2 for the 1.0 mm fraction, representing the low end of the range of 197 to 490 reported for comparable depths elsewhere off California (Fauchald and Jones, 1979). Diversity and evenness values were similar to those reported from the same areas. Biomass in the present study was higher than at comparable shelf depths, averaging 159.4 gm/m^2. However, if the weight from Station 102 (where red crabs were collected) is excluded, the resulting average of 87.8 gm/m^2 is very similar to other reports from the outer shelf (84, 73 and 93 gm/m^2; Fauchald and Jones, 1979). The mean of 132 gm/m^2 for 27 samples collected off Point Arguello is somewhat higher than the overall average, and may reflect similar inclusions of unusually high biomass from the occassional collection of large specimens.

Stations centered on the 660 ft isobath from this study averaged 33 species per sample, which is very near the midpoint of the range from comparable depths in the Southern California Bight (Fauchald and Jones, 1979; Dames and Moore, 1982; Engineering Science, 1984). Other community parameters also follow the same pattern except for species diversity, which was higher in the present study.

Fewer comparative data were available at depths greater than 700 ft. At depths around the 990 ft isobath, a mean of 28 species was reported in the present study; in the western Santa Barbara Channel Dames and Moore (1982) reported an average of 9 species/0.1 m^2 sample. If only the two sites sampled in the immediate vicinity of the Dames and Moore site are considered, the difference is less but still significant 9 as compared to 23 species/0.1 m^2. Samples from off Huntington Beach and Point Dume contained about the same average number of species/sample (Thompson et al., 1984) as the present study, but the numbers of individuals at 990 ft were much greater and average biomass was also higher (125 gm/m^2 as compared to 11 and 20 gm/m^2) at the present study sites.

Data from stations centered on the 1,320 ft isobath at mid-slope in the present study were compared with data from two stations off Point Conception and two off Oceanside (Fauchald and Jones, 1979), two off Point Dume and two off Huntington Beach (Thompson et al., 1984), and with nine samples from the Santa Ynez Unit (Dames and Moore, 1982). Mean richness in the present study was higher (28 as compared to 23, 21, 17 and 18) than sites off Point Conception, Oceanside, Point Dume, and Huntington Beach, respectively, and represented a much higher average (28 as compared to 4) than at 1,320 ft sites in the Santa Ynez Unit. Data obtained from these sites for the present study averaged 10 species/sample and were very similar to the results of previous studies.

Average numbers of individuals per sample were essentially the same as reported by Fauchald and Jones (1979) from Point Conception and Oceanside, 50% higher than off Point Dume or Huntington Beach, and an order of magnitude higher than reported for the Santa Ynez Unit. Stations 088 and 097 from the present study (both in the vicinity of the Santa Ynez Unit) show a fourfold increase in density over the previous report. Species diversity of the present samples tended to be greater on the average than in any previous southern California studies at comparable depths.

3.1.3.4.6 Temporal Comparisons - Pt. Conception Region

Temporal variability in the Pt. Conception area was assessed by reoccupying (in November 1983) three stations off Point Conception that had been sampled in 1977 (Fauchald and Jones, 1979). The 1983 stations and the corresponding 1977 stations are:

1983			1977	
Station	Depth (ft)		Station	Depth (ft)
079-BSR	333	=	831	340
080-BSR	663	=	832	696
083-BSS	1,501	=	834	1,495

Data from these six samples and seven samples obtained near these locations in 1977 were clustered using the same statistical approach as previously described. Prior to the analysis, the biological data were brought into conformity by updating the 1977 identifications to 1983 designations;

this update was based on reexamination of 1976 RIP samples. In some cases, 1983 taxonomic categories were lumped to avoid ambiguities and make the identifications more comparable. Only the first replicates of the 1983 stations were used.

Clustering initially produced a separation of shelf and slope groups independent of collection year. Within the shelf group, 1983 Station 079-BSR (333 ft depth) grouped most closely with its 1977 equivalent and an 294 ft station from the parallel 1977 transect. On the upper slope, 1983 Station 080-BSR (663 ft depth) also grouped with its 1977 counterpart. These two sites then were joined to a group including 1983 samples from 997 ft on the mainland slope (081-BSS) and 1,333 ft on the northern islands slope (084-BSS). The remaining 1983-1977 reoccupation pair did not group together until a much greater level of dissimilarity. The 1983 member (Station 083-BSS, 1,502 ft) grouped first with two shallower 1977 sites (1,195 and 1,122 ft) and then with the next shallower 1983 site (082-BSR at 1,340 ft). The 1977 member of the reoccupation pair grouped first with a shallower site on the 1977 parallel transect (839 at 1,393 ft).

Ordination analysis (with nonmetric multidimensional scaling) showed that although variation between years was relatively unimportant compared to depth (R^2 depth = 0.85), variation between years became greater with increasing depth. This observation is contrary to ecological theory which predicts less biotic variability in more stable abiotic environments; however, these apparent trends may be an artifact related to:

- Decreased density at deeper sites leading to greater variability among samples; and/or

- Reduced accuracy of replication due to greater difficulties in positioning the survey vessel at greater depths.

3.1.3.5 Species Composition

Analysis of the soft bottom infaunal samples resulted in the identification of 1203 taxa. However, most of these species occurred rarely or only occasionally in the samples. The two-way table of site and species groups (Figure 3-22) includes taxa identified to species level which were prominent in the 1983/1984 collections; a subset of this list was utilized in the analysis (Section 2.3) because of the significance of particular species relative abundance or standing crop. These species are discussed below, organized by the site groups delimited by clustering (Figure 3-21).

3.1.3.5.1 Dominant Species

Although a large number of infaunal taxa was collected during the survey, few contributed significant numbers of animals to the total collection and fewer still were significant in terms of standing crop. "Dominant", as used herein, refers to a species numerical abundance or high standing crop; the potential importance as a predator, prey, species or competitor cannot automatically be inferred from these data.

Shelf Group (Site Group 1). This group was numerically dominated by Amphiodia urtica, with the polychaetes Spiophanes berkeleyorum and/or S. missionensis, and the peanut worm Golfingia minuta subdominant at some sites. Even though they were an order of magnitude more abundant than any of the remaining species collected, these four species represented only one third of the collected individuals. The pelagic red crab Pleuroncodes planipes represented the majority of the biomass. Its occurrence at a single station accounted for 51% of the total biomass of the 14 sites in the cluster.

Red Crab (Site Group 2). The three replicates at Station 023 all contained Pleuroncodes planipes which dominated in abundance and biomass. The polychaete Onuphis iridescens was the numerical subdominant, while heart urchins (Brisaster latifrons and Brissopsis pacifica) were important secondary contributors to biomass.

Sandy Group, 660 ft (Site Group 3). Seven species accounted for almost 50% of the total number of specimens, however, the dominance structure between the two sites forming this group differed considerably. The polychaete Chloeia pinnata clearly dominated Station 003 (deeper of the two sites), with Amphiodia urtica a subdominant. At Station 002 there was no clear numerical dominant, although the polychaetes Notoproctus pacificus and Pectinaria californiensis were co-subdominants with Amphiodia urtica. The three other relatively common species were the polychaete Pista sp. B, the ostracod Philomedes dentata and the brittle star Amphiodia squamata.

Central/Southern, 660 ft upper slope group (Site Group 4). The polychaete Chloeia pinnata dominated in abundance, with the brittle star Amphiodia urtica and the polychaetes Spiophanes berkeleyorum and Maldane sarsi as co-subdominants. The heart urchin Brissopsis pacifica was the biomass dominant for the four sites at which it occurred. At the remaining six sites in the cluster there was no obvious biomass dominant.

Hesperonoe laevis group (Site Group 5). This cluster represents a subset of the Maldane sarsi association, with Maldane as the dominant in abundance. No subdominant species were evident, but the polychaetes Chloeia pinnata and Myriochele gracilis, the brittle star Amphiodia urtica, the clam Axinopsida serricata and the ostracod Philomedes dentata were numerically important at individual sites within the cluster. Hesperonoe laevis occurred at low density at five of the six sites. The heart urchin Brisaster latifrons and the spoon worm Arhynchite californica dominant biomass contributors. The sea urchin Allocentrotus fragilis dominated the biomass at the one station where it occurred.

Northern, 660 ft upper slope group (Site Group 6). No species were particularly abundant at these sites. The crab Pinnixa occidentalis, the clams Acila castrensis and Parvilucina tenuiscuplta, the polychaetes Nephtys punctata and Melinna heterodonta, and the heart urchin Brisaster latifrons were numerical subdominants. Brisaster dominated in terms of biomass.

Upper-mid, 980 ft slope group (Site Group 7). The polychaete Pista nr. fasciata and the snail Amphissa bicolor were numerical co-dominants in this group, with the polychaetes Maldane sarsi and Pectinaria californiensis as co-subdominants. The heart urchins Brisaster latifrons and Brissopsis pacifica and Pista nr. fasciata were all major contributors to biomass as dominant or co-dominant species at some of the eight sites.

Mid-slope, 1,310 ft group (Site Group 8). The snail Amphissa bicolor was the numerical dominant in this group, with the ostracod Philomedes dentata, and the polychaeates Maldane sarsi and Chloeia pinnata as co-subdominants. Biomass was dominated by the heart urchins Brissopsis pacifica or Brisaster latifrons over all the stations.

Southern basin and depauperate slope (Site Group 9). The polychaetes Maldane sarsi and Prionospio lobulata were co-dominants in this group, although neither species was particularly abundant. The polychaetes Myriochele gracilis, Nepthys cornuta franciscana, and Pectinaria californica, and the heart urchin Brisaster latifrons were numerical subdominants. Brisaster latifrons also dominated in biomass.

Deep slope and Santa Lucia Valley group (Site Group 10). No species numerically dominated the sites in this group, although the clam Saturnia nr. ritteri might be accorded subdominant status. Brisaster latifrons was the biomass dominant, accounting for approximately 33% of the biomass although it occurred at only two sites.

Santa Lucia Bank and Arguello Canyon group (Site Group 11). The polychaete *Maldane sarsi* and the amphipods *Byblis barbarensis*, *Ampelisca unsocalae*, and *Harpiniopsis epistomata* were all numerical co-dominants. The sub-dominant polychaetes *Terebellides californica* and *Anobothrus* sp. A were nearly as abundant as the dominant species. The clam *Macoma carlottensis* contributed more than any other species to the biomass although it was collected at only one site within the cluster.

Two trends in these data were evident: polychaetes dominated abundance, while heart urchins dominated biomass. Aside from the large influence to some stations of benthic populations of pelagic red crabs, arthropods were overshadowed in importance by polychaetes (in abundance) and echinoderms (in biomass). Mollusks, sipunculids, and echiuroids were occasionally important in particular habitats either in terms of abundance or biomass.

Photographs of Epifaunal Organisms

Approximately 75 photographs, representing 37 of the 108 stations were reviewed to assess the epifaunal community. The quality of about 30 of the 75 photos (representing about 12 stations) was compromised by poor focus, overexposure or resuspended sediments. Thus, about 45 photos from 25 stations formed the photographic database. The area of coverage of each photograph was approximately 1 m^2.

In general, the photographs revealed enough of the bottom to detect some bioturbation and potential evidence of the effects of current patterns on the bottom. For example, a photograph at station 73 showed distinct ripple marks at a depth of 320 feet. Overall, echinoderms were the most frequently seen group of organisms and included the ophiuroid Asteronyx loveni, the asteroid Myxoderma platyacanthum, the sea urchin Allocentrotus fragilis, the heart urchins Brisaster and/or Brissopsis, and the holothuriod Laitmogone sp. Four to five species of fish were observed in the photographs; a flatfish (probably Glyptocephalus zachirus), was most common. Rockfish were seen in several photos and a skate (Raja sp.) was observed from station 38 (650 ft). At least two species of sea pens (Ptilosarcus and Stylatula) were quite abundant at some sites. Snails and trails probably from snails were also seen in many photographs; only one species (Amphissa bicolor) could be identified. Several species of unidentifiable shrimp and galatheid crabs also were observed.

In general, no obvious trends in the photographic data could be determined probably due to the incomplete nature of this record. Overall abundance appeared to be quite low as compared to photographic data from the Southern California Bight Baseline Program; however, common taxa were very similar between the studies. Additional data and discussion of epifaunal organisms observed during the hard-bottom survey are presented in Section 3.2.2.

3.1.3.5.2 Life History Characteristics

The infaunal species identified as dominants (as well as those species characterized by low density populations with low standing crops) have evolved complex relationships with co-occurring species and to the physical environment. Each species has physical limitations and behavioral adaptations which allow it to live in a particular abiotic environment and co-exist with other species. These various attributes include two broad life history categories: feeding and reproduction.

Determining feeding type and food preference in benthic invertebrates is often very difficult and is complicated by the fact that many species can utilize a variety of available resources, although most species have a characteristic or normal feeding pattern. Distinctions in feeding types among carnivores, omnivores, and scavengers are in large part academic for many species, as are distinctions between different types of filter feeders and surface deposit feeders.

Similarly, reproduction may vary within a single species to reflect prevailing conditions. Species which normally produce pelagic larval stages for long range dispersal may, under special environmental conditions, produce larval forms which develop directly in an egg case and bypass the pelagic phase (Rasmussen, 1951). Despite these problems, the natural history traits of a species are important to an understanding of its role in the marine environment. The following information for selected species describes "typical" behavior.

Because polychaetes were so numerically important, feeding and reproductive information on key species is summarized in Table 3-15. Other important species are dealt with in narrative fashion; size-frequency data for selected species are presented in Table 3-16, and size frequency histograms for each species by cluster group is presented in Appendix F.

Nephtys cornuta franciscana - A small polychaete (mean length from prostomium to end of 12th setiger of 1.97 mm for n = 1185) which had a unimodal size frequency distribution in the study area. The species is a motile burrower and a carnivore. Although reproductive information for this particular species is not available, some other Nephtys have been observed to swarm as adults, presumably for reproductive purposes. The subspecies Nephtys cornuta cornuta also occurred in the samples, but was much less common. The species was ubiquitous within the study area, occurring at virtually every station and at every depth. Its highest relative abundances were at sites in site group 8 along the 1,300 ft isobath.

Spiophanes berkeleyorum - A small polychaete (mean width across body at 6th setiger of 0.66 mm for n = 786) which also exhibited a unimodal size-frequency distribution in the study area. It is discretely motile (moves between feeding episodes but feeds while stationary) and is a filter feeder. It produces planktonic, planktotrophic larvae and is thus capable of broad larval dispersal. Within the study area the species was characteristic of shelf depths, with lower densities on the upper slope and occasional records from other habitats. Its congener S. missionensis is assumed to have similar traits, but was found almost exclusively on the shelf.

Table 3-15. Life History Characteristics of Important Infaunal Species.

Commonly Occurring Species	Relative Motility[a]	Feeding Type[b]	Larval Feeding Type[c]	Larval Development[d]	Comments
Polychaetes					
Nephtys cornuta franciscana	Family Motile(1) Burrower	C	**		**Some Nephtys sp. adults swarm
Nephtys ferruginea	Family Motile(1) Burrower	C	**		**Some Nephtys sp. adults swarm
Glycera capitata*	Family(1) DM	subsurface detritus(3)			
Glycinde armigera	Family(1) DM	C Family(1)			
Chloeia pinnata*	Family Motile(1)	C Family(1) Scavenger		**	**Family some brooding young(5)
Pholoe glabra*	Family(1) Motile	C Family(1) Scavenger	P(6)	Pelagic(6)	
Hesperonoe laevis	Family(1)	C Family(1)	P(6)**	Pelagic(6)	**Harmothoe broods young
Pectinaria californiensis*	Family(1) Motile	Surface detrital(2)	P	Pelagic	
Sternaspis* fossor	M Burrowing	Subsurface detrital(6)			
Maldane sarsi	DM(1)	C Surface deposit Subsurface detrital(2)	**	**	Axiothella L-larvae D-direct
Myriochele* gracilis	DM(1)	Surface depositi Surface detritus(2)	**	**	Owenia(5) P-pelagic

Table 3-15 (cont'd)

Commonly Occurring Species	Relative Motility[a]	Feeding Type[b]	Larval Feeding Type[c]	Larval Development[d]	Comments
Levinsenia gracilis	DM(1)	Surface(1) deposit			
Cirrophorus branchiatus	DM(1)	Surface(1) deposit			
Minuspio cirrifera*	DM1	Filter(1) feeding	P(7)	Pelagic(7)	Family(2) Stationary surface detritus
Prionospio* lobulata	DM(1)	Filter(1) feeding	P7**	Pelagic(7)	*Asexual Reproduction -fission this genus
Paraprionospio pinnata	DM(1)	Filter(1) feeder	P	Pelagic	
Spiophanes* berkeleyorum	DM(1)	Filter(1) feeder	P(7)	Pelagic(7)	

* this name was used in references
** see comment column
a M - motile; DM - discretely motile
b C - carnivore
c L - lecithotrophic; P - planktotrophic
d pelagic vs. direct

Polychaete References:

(1). Fauchald, K., and P. A. Jumars. 1979. The diet of worms: A study of polychaete feeding guilds. Oceanogr. Mar. Biol. Ann. Rev. 17:193-284.

(2). Word, J. Q. 1979. Classification of benthic invertebrates into infaunal trophic index feeding groups. Pages 103-121 in Coastal Water Research Project biennial report, 1979-1980.

Table 3-15 (cont'd)

(3) Hartmann-Schroder, G. 1971. Die tierwelt Deutschlands. 58: 594 pp.

(4). Fauchald, K., and G. Jones. 1977. Benthic macrofauna. In: Southern California baseline study final report, Vol. III, Report 2.4. Prepared for the Bureau of Land Management, Washington, D.C. (SAI-76-809-LJ).

(5). Schroeder, P. C., and C. O. Hermans. 1975. Annelida: Polychaeta Pages 1-213 in A. C. Giese and J. S. Pearse (eds)., Reproduction of marine invertebrates, Vol. III. Academic Press, NY.

(6). MacGinitie, G. E., and N. MacGinitie. 1968. Natural history of marine animals, 2nd ed. McGraw-Hill, NY. 120 pp.

(7). Hannerez, L. 1956. Larval development of the polychaete family Spionidae Sars; Disomidae Mesnil; and Poecilochaetidae n. family in the Gullmar Fjord (Sweden). Zool. Bidrag, Upsala Bd. 31:1-204.

Table 3-16. Measured Species.

Species	Parameter Measured	n=	Comparative Data
Maldane sarsi polychaete	width of cephalic plaque at widest point	442	
Spiophanes berkeleyorum polychaete	width across dorsum at 6th setiger	790	
Pectinaria californica polychaete	width of palae	315	
Nephthys cornuta franciscana polychaete	length: tip of prostomium to end of 12th setiger	1185	
Leucon magnadentata cumacea	carapace length	140	Given, 1970
Amphiodia urtica ophuiroid	oral width	1022	Lie, 1968
Amphissa bicolor snail	distance across body whorl across center of outer lip	190	
Parvilucina tenuisculpta clam	greatest height	246	Fabrikant 1984

Pectinaria californica - This polychaete, known as the ice-cream cone worm because of the shape of its tube, was widely distributed throughout in the study area, but was most abundant in the sandy shelf and upper slope habitats. This species is a motile deposit feeder which produces planktonic, planktotrophic larvae. Its occurrence may be limited by availability of fine sands with which to construct its tube. The size frequency (mean cephalic width at palae of 1.42 mm for n = 315) in the study area probably is bimodal with modes at 0.8 mm and 2.0 mm.

Maldane sarsi - This polychaete occurred throughout the study area, with the apparent center of the population along the 1,300 ft isobath at mid-slope. It is a temporary mud-tube builder, but is discretely motile and can feed either on surface or subsurface deposits. Reproduction in *M. sarsi* is undescribed, but the related genus *Axiothella* has lecithotrophic larvae which undergo direct development within the egg. Measurements of this species were taken across the cephalic plaque at its widest part (mean of 0.57 mm for n = 442) and appear to be unimodal.

Amphiodia urtica - This species is a small, red (in life) ophiuroid which occurs in large numbers in many areas. It is probably the single most abundant infaunal macroinvertebrate at shelf depths in the Southern California Bight (Barnard and Ziesenhenne, 1961), and is also abundant further north in the Oregonian province (Lie, 1969). It can apparently feed both by suspension feeding with its arms (Word, 1980) and on surface detritus. Although its reproduction has not been described, it probably involves pelagic development via lecithotrophic larvae. Its size-frequency in the study area population was unimodal (mean oral width of 1.22 mm for n = 1022). This differs from the distribution found by Lie in Puget Sound populations, suggesting that his reported growth rate of 0.25 mm increase in oral width/year may not apply to the southern population. If it does, the estimated average age of the population would be three years. Although it occurs as deep as 980 ft in the study area, A. urtica was more characteristic of shelf depths, where it dominated. Amphiodia urtica was the most abundant echinoderm in the present collections.

Leucon magnadentata - Little is known about Leucon magnadentata, a peracarid crustacean which broods its young, releasing them from the brood pouch as miniature adults lacking only reproductive structures. It probably lives at the sediment surface shallowly buried in the sediments and consumes bacterial films off coarse grains. The adults are motile, and the reproductive males are particularly good swimmers. It was distributed primarily at mid-slope depths (1,300 ft) with occasional shallower and deeper records. The size frequency plot (mean carapace length of 1.15 mm for n = 130) was bimodal with the modes at 0.96 and 1.76 mm, presumably representing two annual cohorts. This species has rarely been reported since its original description.

Amphissa bicolor - The present interpretation of life history traits of this species is largely based on inference from morphologically similar species. It is probably a surface macrodetritivore ingesting the largest organic particles available or scavenging carcasses. It is highly motile and was seen in several of the bottom photographs "plowing" through surface sediments. Reproduction probably involves deposition of egg capsules on available hard substrates. Both direct development to hatching of juveniles or release of planktonic larvae are possible. Size frequency of the present population was measured as width of body whorl since most of the speciments had spires truncated by mechanical or chemical erosion. Two cohorts were visible (mean width of 2.83 mm for n = 190) with modes at 1.0 and 7.0 mm. The Amphissa population was centered at sites on the 1,300 ft isobath at mid-slope, with scattered collections above and below that depth. It was the most abundant gastropod collected.

Parvilucina teniusculpta - This speices is a relatively small bivalve under most circumstances, however, it may grow much larger where organic material is abundant (e.g., around sewage outfalls; Word et al., 1977). It feeds either by ingesting detrital aggregates in silty organic rich areas, or by surface sediment ingestion in sandier, less organic rich areas (Jones and Thompson, 1984). It may also be able to feed in sulphide rich reducing sediments by farming endosymbiotic chemautotrophic bacteria (Felbeck et al., 1981). There is no evidence that Parvilucina broods its larvae, as do several of the smaller bivalves with which it occurs (Jones, 1963); thus, free larval development is probable. Although Fabrikant (1984) measured Parvilucina at right angles to the greatest height measurement used here, the species is orbicular and the two measurements should be similar for each specimen. Height was chosen as measurement parameter in the present study since most shell damage occurred along either the anterior or posterior margins. The present population (mean height of 1.35 mm for n = 246) was unimodal in the first size class, with declining abundances in each subsequent class. Only the largest of the clams collected in the present study (maximum measured height 4.12 mm) exceeded the mean size of those from unpolluted habitats off Palos Verdes (Fabrikant, 1984). The modal size was approximately one-third that of the Palos Verdes unpolluted "controls". In the present study, Parvilucina was most abundant at sites on the shelf, but occurred at lower densities from upper slope to 980 ft depths. It was the most abundant bivalve collected.

3.1.3.6 Taxonomy

A primary objective of the present study was to improve on the taxonomy of hard-bottom and soft-bottom organisms of the area as an important step in understanding the detailed ecology of these organisms. The taxonomic work accomplished for the present study was considerable, but for many phyla represents only a beginning to understanding the fauna of this region.

A considerable number of specimens encountered during the soft bottom survey could not be identified as described species; this can result from any one of several reasons:

1. Incompleteness of the specimen and lack of key characters. Fragments were observed during handling despite efforts to minimize damage (see Section 2.1.1.3).

2. Stage of growth of the specimen; the young of some closely related species are indistinguishable.

3. Sex; separation ofsome closely-related species require specimens of both sexes.

4. Reproductive immaturity; some organisms can only be identified using short-lived reproductive structures.

5. Tediousness of identification; the identification of some organisms requires inordinate amounts of time.

6. Lack of available expertise; e.g., free-living marine nematodes are only studied by a few taxonomists worldwide.

7. Incomplete fixation; partial decay and/or loss of the structure(s) necessary for identification.

8. Undefined variation in natural populations.

9. Poor, incomplete, or incorrect original descriptions making a described species unrecognizable.

10. The organism is "new to science," i.e., has not been formally described.

The first eight of these factors result in the identification of specimens to taxonomic levels higher than species (e.g., Nematoda LPIL, Lysianassidae LPIL, Cossura LPIL), and the use of an LPIL (Lowest Permissible Identification Level) designation. In some cases, a taxon such as Phyllodoce ? groenlandica is used to indicate an identification which is uncertain because of an inadequacy in the specimen or the species description. The ninth category results in descriptions such as Pholoe nr. minuta and Philine cf. quadrata. These designations indicate some uncertainty by the taxonomist regarding the degree of variability (nr. for near) or meaning of the original description (cf. for "certificandum": something which requires verification by comparison with the type specimens). Within the tenth category, we distinguish between two types of "new" species: those which have been seen and/or reported previously but not officially described, and those which are newly recognized as different species. The number of new species in each of these categories is listed in Table 3-10 for the 1983/1984 soft bottom collection and in Table 3-11 for the reidentified 1976 RIP samples.

3.1.3.6.1 New Species

Many of the species which have been known for some time but remain undescribed are widespread in southern California (Fauchald and Jones 1976, 1979; Given, 1971). Use of these designation (e.g., Diastylis n. sp. A) has become relatively standardized and consistent among local taxonomists especially through the activities of the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT). This group offers a forum for information exchange, representing a continuation and expansion of the activities of the Taxonomic Standardization Program of the Southern California coastal Water Research Project (SCCWRP) between 1974 and 1979.

Intercalibrations meetings and the rapid accumulation of samples from poorly known offshore habitats have resulted in a "black market" of known but undescribed species. Although the description of new species resulting from offshore exploration and nearshore environmental monitoring is a stated goal of many agencies, there continues to be a lag of several years between collection of sufficient specimens and their official description. In the interim, provisional designations are employed to denote species without formal names.

Of the 227 undescribed soft-bottom species collected during the present survey, over 60% were previously unknown. These 148 species (32 from RIP samples and 106 from 1983-84 reconnaissance survey samples) were primarily polychaete worms (64%) or crustaceans (25%), the two most species-rich groups in the collection. The percentage of the total number of taxa collected (18.9%) which were undescribed was not especially large considering the relatively unexplored status of the Santa Maria Basin. Over half of the undescribed species probably are either rare, or were taken at depths shallower than their optimal depth range.

The undescribed species are far too numerous to be detailed here. Voucher sheets with capsule descriptions, illustrations and keys are on file at the Pacific Outer Continental Shelf Office of the Minerals Management Service (POCS-MMS) in Los Angeles. A complete set of voucher specimens is deposited at the National Museum of Natural History, Smithsonian Institution, Washington, D.C. A secondary voucher set is deposited at the Department of Invertebrate Biology, Santa Barbara Museum of Natural History. Both collections include examples of the undescribed species; however, when a new species was represented by a single lot (i.e., one or more specimens from a single replicate), that lot was sent to the Smithsonian.

3.1.3.6.2 Variant Species

Many taxa considered as being "near described" are listed in Tables 3-10 and 3-11. This refers to specimens which could not be identified as known species, but were sufficiently similar for the taxonomists to consider them variants rather than new species. Voucher sheets describing the characters to distinguish these taxa from the described species (holotypes) are on file at the POCS-MMS office in Los Angeles. Some of these taxa are abundant and widely distributed, but differ from well-characterized, described species in so few details that their distinctness is questionable (e.g., *Ampelisca* nr. *hancocki*). Further study of additional specimens may indicate that such species are distinct and merit description as new species, or that they do not differ sufficiently from the described species to warrant separation.

3.1.3.6.3 Zoogeographic Considerations

The principal feature of the distribution of marine populations in the study area is the California Transition Zone. This zone, as defined by Newman (1979), extends over five degrees of latitude centered on Point Conception (34.5°N) and includes the coastline of North America between Ensenada and Santa Cruz. The zone contains the range endpoints for large numbers of species whose populations are centered either to the north in the Oregonian Faunal Province or to the south in the Californian Faunal Province. It also supports a sizeable group of species which appear to be endemic to the zone. Newman examined barnacle distributions and noted close correspondence with the results of zoogeographic studies based on mollusks (Newell, 1948; Valentine, 1966), fishes, (Horn and Allen 1978) and seaweeds (Abbott and Hollenberg, 1976). Analysis of other groups, notably ostracods (Valentine, 1976), suggest that although Point Conception is a nodal point on a gradient of faunal change, the transition between provinces is more abrupt than the five degree latitude California Transition Zone.

Newman's conception of the transition zone is that it represents a relict temperate water province whose boundaries are much narrower at present than they were in Coenozoic times. The species encountered in the present collections are a mixture of wide- and short-ranging species which fit the Transition Zone concept, but neither support nor refute it. Numerous Californian and Oregonian species were present, with the former predominating. Since sampling in the southern California borderland has been more intense than sampling in the northern portion of the transition, it is not surprising that "southern species" (i.e. species well known from southern California) seem dominant.

One of the most conspicuous southern forms represented in the present collections was the pelagic red crab Pleuronocodes planipes. This species occurred in dense benthic populations both at Station 21 and Station 102. The biology of the species is complex, involving both pelagic and benthic populations of adults, although all individuals over two years of age are benthic (Longhurst, 1966; Boyd, 1977). The present records represent the farthest north that a benthic population of this species has been verified. Pelagic populations may reach as far north as Monterey Bay during the warm water years of El Nino events (Glynn, 1961; Radovich, 1961). This species also was observed in its pelagic phase and as a solitary benthic individual during submersible dives in July 1984 (see Section 3.2.2).

Other southern species were found to range into the study area even during years without El Nino influence. A species of amphipod (Garosyrrhoe disjuncta) was originally described from Bahia de Los Angeles in the Gulf of California (Barnard, 1969) at depths up to 80 ft, and was not reported again until 1976 in a BLM Year I RIP sample. A partial list of other northward range extensions is presented in Table 3-17. In at least two of the listed cases, the present records represent the only report of the species since its original description.

Table 3-17. Northward Extensions of Species Geographic Range.

	Northward Extensions	Previous Limit	Reference	New Limit
P	Leiochrides sp. A of Hartman	Tanner Banks	Hartman, 1963	Off Pt. San Luis
P	Aglaophamus paucilamellata	Bahia de San Cristobal Baja CA	Fauchald, 1972	Santa Lucia Sea Valley
P	Ceratocephale hartmanae	Off Huntington Bch	Harris, unpub.	Santa Lucia Sea Valley
P	Laonice apelloff	Off Pt. Dume	Harris, unpub.	Off Purisima Pt.
P	Prionospio lobulata	So. California	Fauchald, 1972	Santa Lucia Sea Valley
C	Procampylaspis sp. A	Pt. Conception	Cadien, unpub.	Pt. Estero
I	Nannoniscónus latipleonus	Redondo Canyon	Schultz, 1966	Pt. Conception
A	Stegocephalus hancocki	Off Huntington Bch	Hurley, 1956	Off Pismo Beach
E	Bissopsis pacifica	So. California	Thompson et al. (MS)	Off Pt. Estero

P = Polychaete; A = Arthropod; C = Cumacean; I = Isopod; E = Echinoid

Southward range extensions into the area (partially listed in Table 3-18) were usually from more distant locales than the northward range extensions. This reflects the greater intensity of sampling to the south than to the north of the study area.

At least two species were previously known only from the Atlantic Ocean; the polychaete Pholoe anoculata from off New England (Hartman, 1965) and the cumacean Cumella egregia from Davis Strait (Hansen, 1920). Many other range extensions will probably be found as the specimens are examined by group specialists.

3.1.3.7 Biotic-Abiotic Relationships

The distribution and abundance of populations are regulated by two general phenomena: biotic interactions such as competition and predation, and abiotic factors such as temperature, salinity and sediment type. Biological interactions generally are species specific, often localized, and therefore are difficult to elucidate. Reconnaissance surveys generally concentrate on identifying broad trends in multi-species parameters which correlate with physical-chemical gradients in the environment.

Table 3-18. Southward Extensions of Species Geographic Range.

	Southward Extensions	Previous Limit	Reference	New Limit
	Apistobranchus tullbergi	Puget Sound	Banse, 1972	off Purisima Pt.
	Antinoella macrolepida	Monterey	Hartman, 1968	Pt. Arguello
	Chone duneri	Puget Sound	Banse, 1972	Pt. Conception
	Lepidepecreum kastka	Kuriles Is., USSR	Gurjanova, 1951	off Purisima Pt.
	Photis parvidons	Mukkaw Bay, WA	Conlan, 1983	off Santa Cruz Is.
	Pardaliscella yaquina	Oregon	Barnard, 1971	off Pt. Arguello
A	Melphidipiella macruroides	Sea of Okhotsk	Gurjanova, 1951	off Pt. Arguello

[illegible] = Polychaete A = Arthropod

As discussed in Section 3.1.3.2, community structure within the study area appeared to change most consistently with depth; biological assemblages along a particular isobath were more similar to one another than to those at different depths. This type of relationship is generally observed for most of the world's nearshore marine benthic communites. However, whether depth or some covariate parameter is the operating factor is more difficult to demonstrate. In addition to the potential depth related gradient, the study area also lies within a transition zone where substantial zoogeographic changes have been demonstrated along a latitudinal gradient. This section discusses possible relationships between the observed distribution of biota and the measured physical and chemical parameters and the general geomorphology of the study area.

During the study design it was assumed that benthic samples would be collected from a variety of habitats within the study area. Unlike the southern California borderland, the present study area is relatively uniform. Geomorphologic features of the study area and the sampling effort (stations and replicates) associated with each of the major habitats include:

General Features	No. St.	No. Rep.
Mainland shelf	14	37
Mainland slope	63	81

Special Features	No. St.	No. Rep.
Santa Barbara Basin	1	1
Northern Channel Islands shelf	9	9
Arguello Canyon complex	9	9
Santa Lucia Bank	4	8
Santa Lucia Sea Valley	7	11

The greatest sampling effort was expended on the outer mainland shelf and the mainland slope. Only a single site was sampled within the sub-sill portion of the Santa Barbara Basin because prior data were adequate (Hartman and Barnard, 1963). The remaining special habitats all received approximately the same intensity of sampling (8 to 11 replicates). Consequently, both normal (on the shelf and slope) and variant (associated with special topographic features) ranges of the measured physical parameters are included in the data base.

Distribution patterns and general trends for physical, chemical sediment parameters were presented in Sections 3.1.1 and 3.1.2. The relationships between these parameters and the biota were examined using two analytic methods: weighted multiple discriminant analysis (MDA) and ordination analysis with non-metric multi-dimensional scaling (MDS). In the MDA analysis, site groups from the biotic analysis were plotted in a multi-dimensional space defined by the physical parameters using the loadings of each station along each axis as a measure of distance. In the MDS analysis, the space is biologically defined, and although it has physical correlates, they do not define the axes. Details of these techniques are presented in Section 2.3. Multiple regression analyses were also performed to test the degree to which various combinations of parameters explain the variability in the dependent variable.

In the MDS ordination analysis the first three axes accounted for 69% of the total variation, with 35% on Axis I, 24% on Axis II, and 10% on Axis III. The clearest separation of the site groups in the ordination space was achieved along axes one and two of the analysis of the 1.0 + 0.5 mm 1983-84 data (Figure 3-30). Groups formed a horseshoe shape which indicated a bimodal distribution of a number of the species.

Only Species Group 1 (shelf habitat) was completely separated by these two axes; the other groups overlap one other to some extent. The primary physical parameters associated with these axes were: depth, organic carbon, mean phi of sediments, total aromatic hydrocarbon compounds, total hydrocarbons, percent sand, and percent clay in sediments. When the ordination space was rotated to a view along Axes I and III (Figure 3-31), additional separation between Groups 3 and 4, and Groups 5 and 6, and 7 was observed.

REP 01 ONLY - OUTLIERS REMOVED

1983 ONLY

NONMETRIC MULTIDIMENSIONAL SCALING SCORES

PLOT # 1

GROUP SYMBOLS

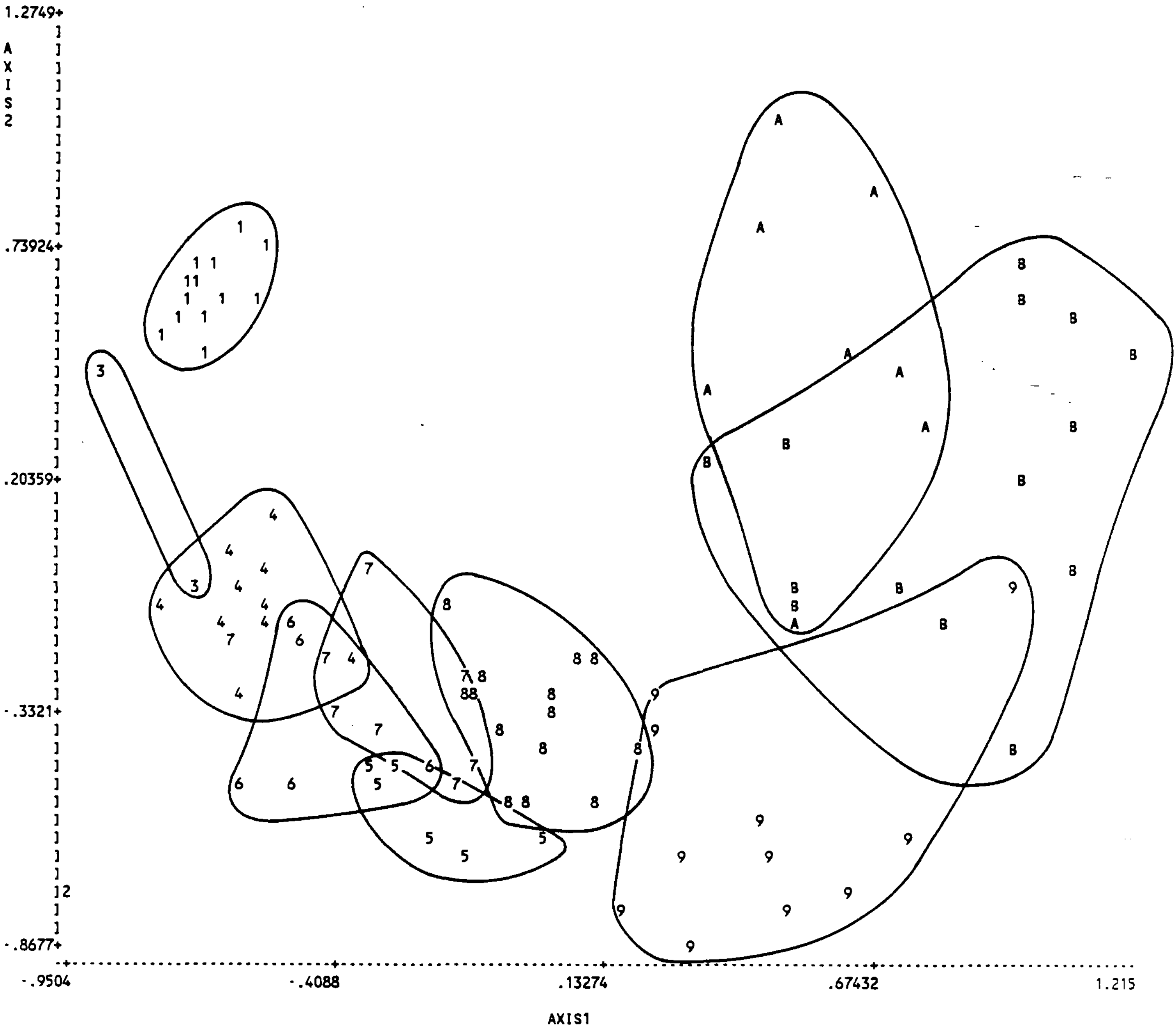


FIGURE 3-30. Group Symbol Plot (Axis 1/Axis 2) for Multi-Dimensional Scaling Analysis of Soft-Bottom Data.

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1983 ONLY

NONMETRIC MULTIDIMENSIONAL SCALING SCORES

PLOT # 2

GROUP SYMBOLS

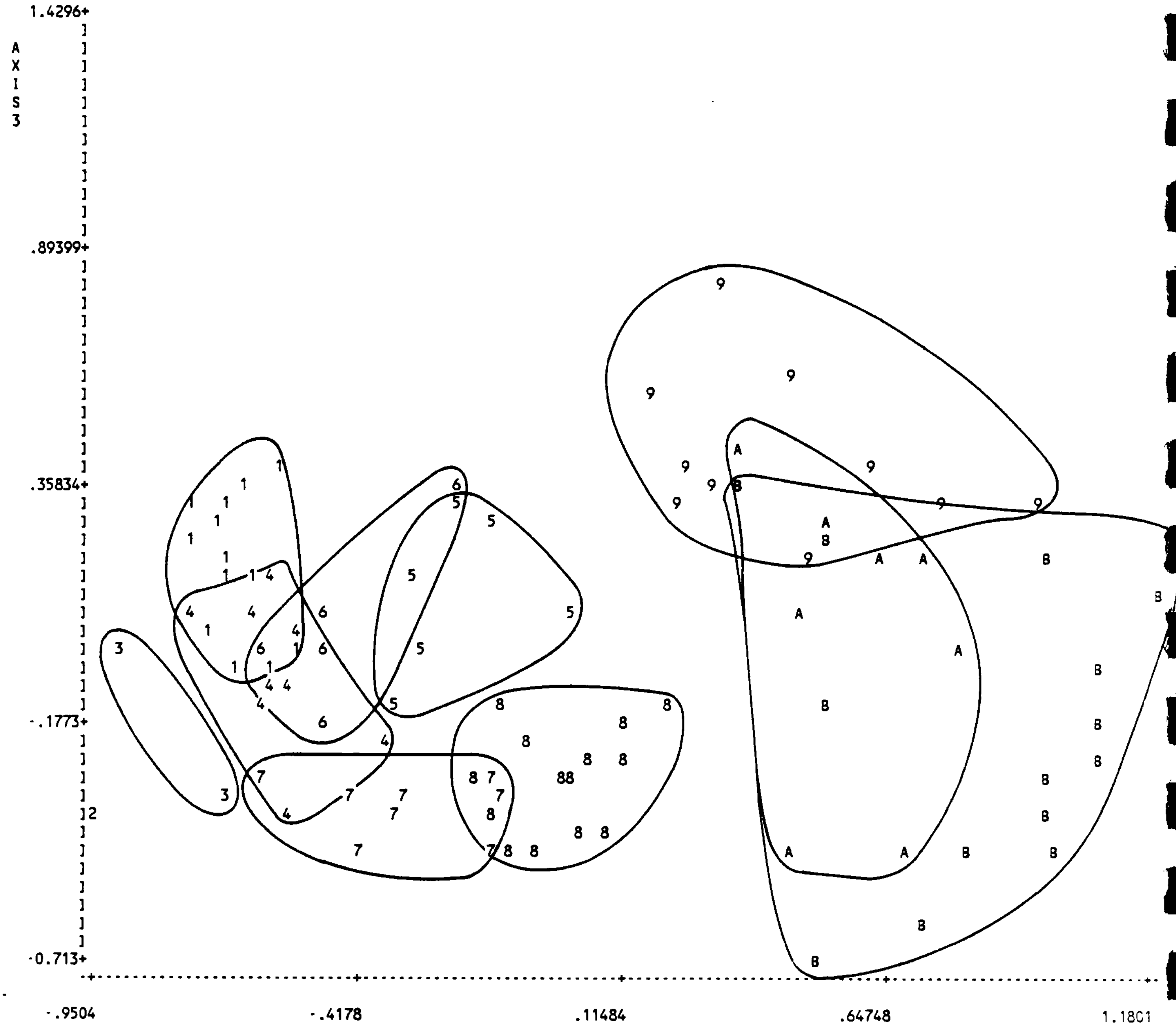

FIGURE 3-31. Group Symbol Plot (Axis 1/Axis 3) for Multi-Dimensional Scaling Analysis of Soft-Bottom Data.

Correlations between the biological groups in the ordination space and the measured physical parameters were examined with a series of regression models with up to five variables for each axis. On Axis I, depth was the dominant variable (R^2 = 0.72). Expansion to multivariate regression models added little to the R^2, although the two variable depth-organic carbon model increased the R^2 to 0.76. On Axis II, all correlations were relatively weak, with the greatest R^2 of a three variable model being only 0.29 (including % sand, % clay, and total aromatic hydrocarbons). On Axis II the combinations of parameters which increased the R^2 of the models were very inconsistent, indicating that no single parameter was much more correlated than any other. In other words, there was no clear cut pattern of correlation between biological variables and environmental parameters on Axis II or any subsequent axis.

The horseshore shape of the cluster distribution in the ordination space was a real data pattern and not an analytical artifact. Analysis methods used to exclude artifactual arcs were discussed in Section 2.3 (Data Analysis). Additional evidence that the bimodality in distribution of species in groups 12, 13, 14, and 17 was responsible for the arc data shape in Figure 3-30 is the absence of such a shape once those species were deleted from the analysis (Figure 3-32).

Two conclusions are supportable from the ordination analysis. First, most of the biotic variability correlated primarily with depth, and secondarily to total organic carbon concentration. However, it should be noted that

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BIMODAL SPECIES REMOVED

NONMETRIC MULTIDIMENSIONAL SCALING SCORES

PLOT # 1

GROUP SYMBOLS

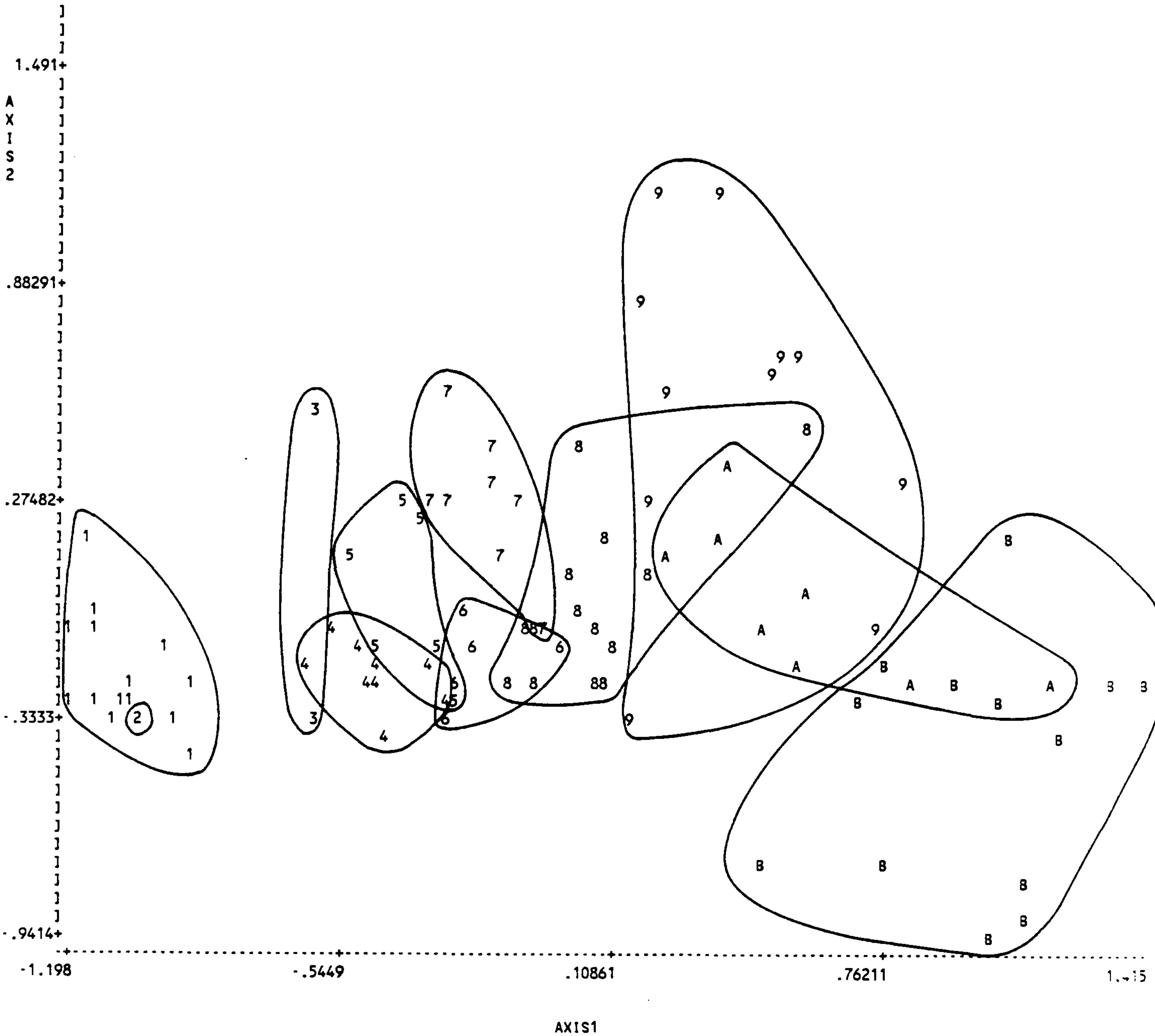

FIGURE 3-32. Group Symbol Plot (Axis 1/Axis 2) for Multi-Dimensional Scaling Analysis of Soft-Bottom Data.

this trend generally was limited to depths less than appoximately 1,300 ft, as can be seen in the increased scatter of points along Axis I (Figure 3-32). Secondly, the lack of patterns in variations of physical parameters on Axis II, combined with the degree to which the groups most affected by bimodal species varied along Axis II, indicate that the primary causes of the bimodality were not among measured physical parameters. Thus, either some unmeasured physical factor or some biological factor was operating.

The weighted multiple discriminant analysis (MDA) places the biologically defined site groups in a discriminant space formed by physical parameters. If there is strong correlation between the biological variables and the physical parameters, the pattern of distribution of the clusters should approximate the pattern found in the biologically defined ordination space of the MDS. Since relatively good correlation with depth, but weak correlations with other parameters were found, close MDS and MDA correspondence was not anticipated. This was especially true along any axis where depth did not have a high coefficient of separate determination.

Coefficients of separate determination (CSD) are analogous to variance percentages in other analyses. A high CSD for a parameter on an axis indicates the relative importance of that parameter in the total separation between groups. Those parameters whose CSD values are underlined in Table 3-19 are considered to be the most important parameters in group separation along the axis.

Table 3-19. Coefficients of Separate Determination on the First Three Axes of the Weighted Discriminant Analyses (MDA).

Variable	Axis I	Axis II	Axis III
1. Depth	37.8	0.2	18.1
2. Organic carbon	25.0	17.0	31.9
3. Barium	1.2	3.9	0.5
4. Chromium	0.0	0.0	21.8
5. Mean phi	13.0	15.1	2.2
6. Mode phi	0.3	6.4	0.0
7. % Sand	5.6	10.1	2.8
8. % Clay	10.8	2.0	0.4
9. Sharp & fan sorting 25 int	3.3	1.5	0.8
10. SD phi	0.8	2.1	2.1
11. Total hydrocarbons	0.9	16.6	11.8
12. Total aromatics	0.7	13.1	4.8
13. Total alkanes	0.4	4.3	1.3
14. Oil pollution index	0.1	7.7	1.3

Although group overlap was greater in the MDA analysis, the distribution of parameter values in the space was more linear. The general data structure (Figure 3-33) lacked the pronounced bimodality found in the MDS plots and was characterized by groups that were more cohesive along Axis I than along Axis II. Except for Station 054 (the lowest member of group 8 on Axis II), the groups formed an arc like that of the MDS, but inverted and much weaker. In the plot of Axis I/Axis III (Figure 3-34) the groups were tighter and more linear. Parameters used for defining the discriminant space and their coefficients of separate determination on each axis are presented in Table 3-19. Of the 14 parameters considered in the analysis, eight accounted for 10% or more of the group separation along one or more of the three plotted axes. Since Axis I accounted for over 75% of the total group separation in the space, the parameters which were most important along that axis were parameters that explained the group separations. Axis II accounted for another 17% of the total group separation, while Axis III represented only 2.7% of the total group separation. Cumulative group separation along the first three axes was 96.5%.

Correspondence Between MDS and MDA

In general, the correspondence in group distribution patterns between the ordination and discriminant spaces was fairly good along Axis I where depth was the most important parameter. Along Axes II and III, where less static parameters were more highly weighted, correspondence between the MDS

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WEIGHTED DISCRIMINANT ANALYSIS SCORES

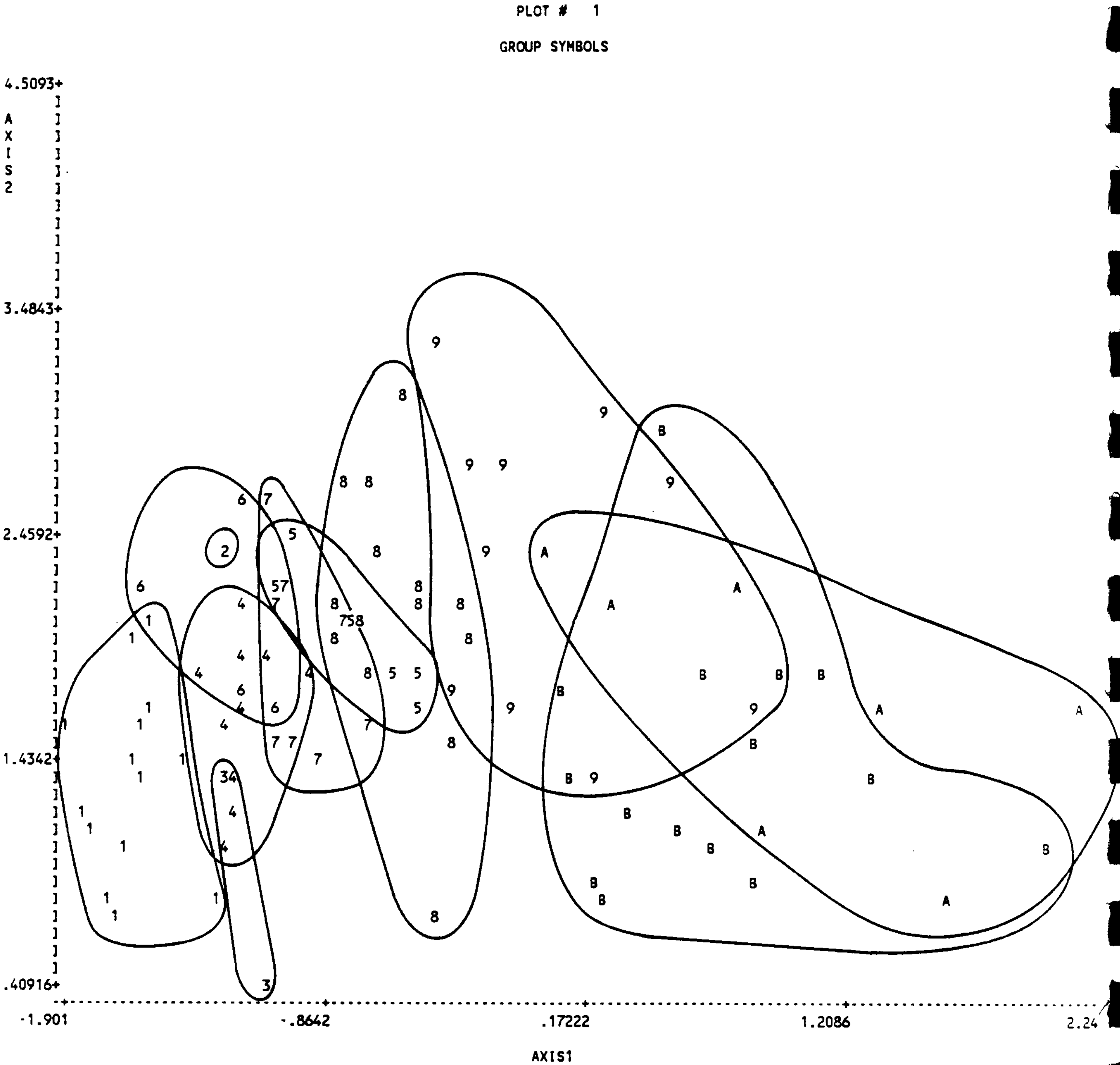


FIGURE 3-33. Group Symbol Plot (Axis 1/Axis 2) for Weighted Discriminant Analysis of Soft-Bottom Data (1.0 + 0.5 mm; outliers removed).

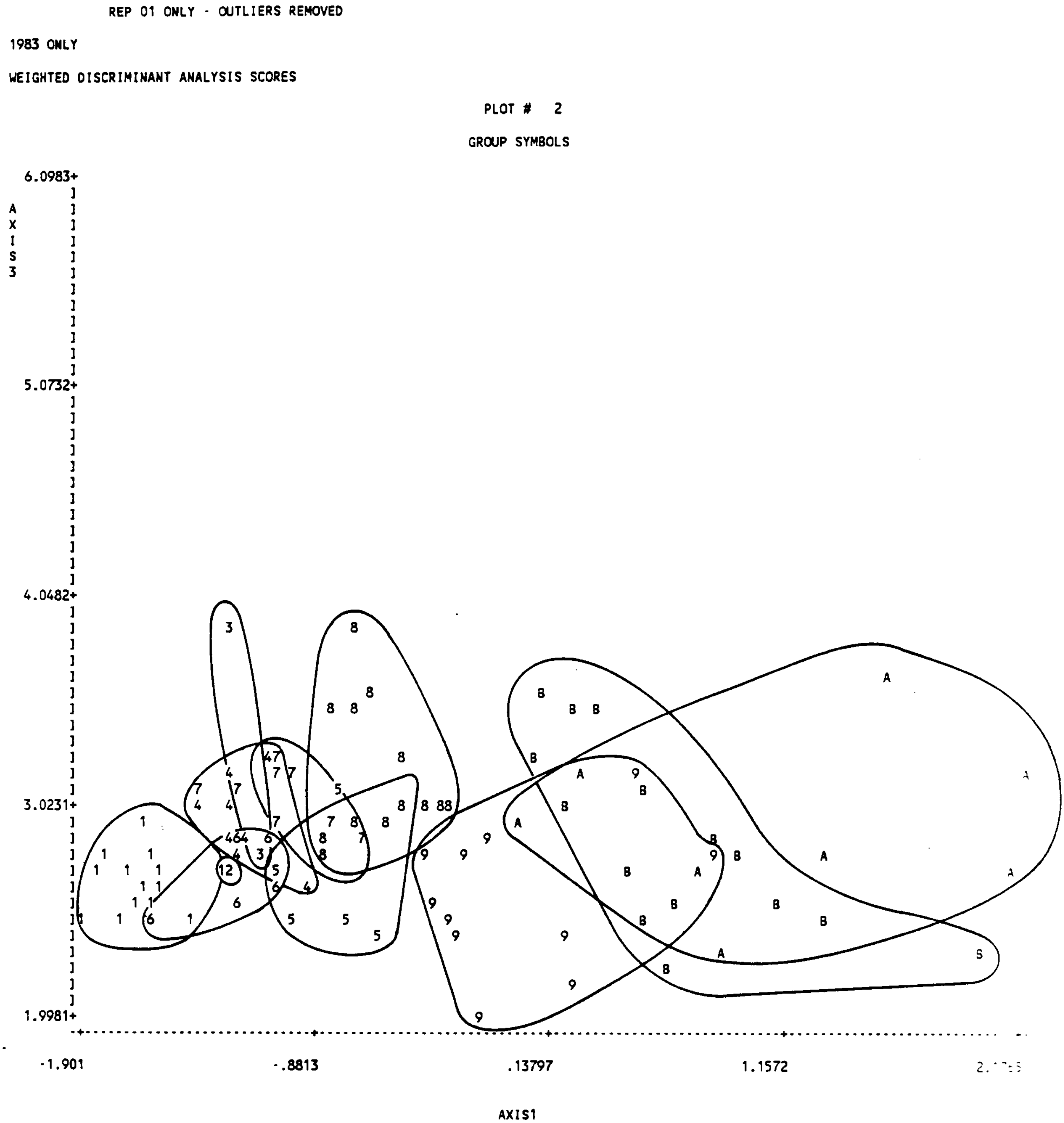


FIGURE 3-34. Group Symbol Plot (Axis 1/Axis 3) for Weighted Discriminant Analysis of Soft-Bottom Data (1.0 + 0.5 mm; outliers removed).

and MDA was poor. Examination of the individual parameter plots from the MDA indicated that even for the most highly weighted parameters, high values were not well concentrated in the space. This further supports the lack of strong correlation between physical and biological spaces.

The weak correlations indicated by the analyses suggest three alternative hypotheses:

1. Measured physical parameters were only secondarily related to the major physical determinants of biotic distributions; or

2. Biotic distributions in the study area are a result of biological interactions rather than physical parameters, particularly for those species with bimodal depth distributions; or

3. Hypotheses 1 and 2 may each apply to particular species.

3.2 HARD-BOTTOM ENVIRONMENT

Hard-bottom survey operations were conducted along 23 transects from approximately Goleta in the western Santa Barbara Channel to Pt. Estero, CA (Figures 2-5 to 2-7), resulting in the collection of over 1200 35 mm bottom photographs, 55 hours of color video recording and observer commentary, 44 rock samples for epifaunal scraping and analysis, and 29 voucher specimens (Table 3-20). General transect locations (1:96,000 scale) and navigational coordinates are presented in Section 2.1.2.1 (Survey Area) and Appendix B, respectively. Smaller scale (1:12,000 and 1:2,000) plots showing locations of hard-bottom and soft-bottom areas, substrate relief and biological assemblages along each transect are included as Appendix G.

Laboratory analysis and cataloging of the photographic and observer data consisted of species identification and enumeration, and characterization of substrate type, relief and sediment overburden. Rock samples were first scraped or picked to remove organisms, and abundance estimates were determined using a point contact method adapted for multidimensional surfaces. Detailed laboratory methods for the rock scraping data, and the photographic and observer data, are presented in Sections 2.2.2 and 2.2.3, respectively.

Statistical analysis of the photographic and observer data consisted of (1) cluster analysis by site (transect/substrate type) and taxa; and (2) ordination analysis to display relationships among the site groups defined by

Table 3-20. Data Collected During the July/August 1984 Hard-Bottom Survey

Station (Transect)	Rocks	Voucher Specimens	Bottom Photographs (35mm)	Color Video/ Observer Commentary (hrs)
1 A/B	1	6	93	3
1 C/D	3	3	97	2.5
2 A/B	2	1	18*	2.5
2 C/D	2	0	46*	2.5
4 A/B	2	0	61	2.5
6 A/D	3	1	125	5
13 A/B	4	1	30	2
13 C/D	3	3	90	3
14 A/B	1	3	68	2.5
14 C/D	4	0	95	2
16 A/B	5	2	90	3
17 A/B	2	2	57	2.5
19 A/B	0	0	41	2
20 A/B	4	1	82	2.5
21 A/B	4	2	27*	2
22 A/B	0	1	54*	1
23 A/B	0	0	9	2.5
25 A/B	2	0	59	2
26 C/D	0	2	0	2.5
27 A/B	2	0	38	2.5
28 A/B	0	1	32	2.5
29 A/B	0	0	6	2.5
Total	44	29	1218	55

* Camera malfunction, observer photos only.

the cluster analysis. Discriminant analysis also was performed on the data, however, these results were inclusive (see Data Analysis, Section 2.3). Tabular listings of frequency of occurrence of common taxa by substrate relief and depth interval also were prepared. All analyses were performed using taxa presence-absence data to allow maximum comparability among transects (see Data Analysis, Section 2.3). All substrates of the same type were consolidated for each transect for the analyses, resulting in analysis of 139 transect/ substrate combinations. The taxonomic list also was reduced from 177 to 101 taxa by eliminating rare species (less than four occurrences), and means calculated for the species presence/absence values. The rock scraping data were analyzed using cluster analysis of species abundance data. A detailed discussion of these analysis methods is presented in Section 2.3.

The types of analysis methods employed were designed to (1) aid in defining species assemblages within the survey area; (2) assess the relationship of individual taxa and species assemblages to environmental variables, including geographic location, bottom depth, substrate type and relief, and sediment overburden; (3) assess spatial trends or patterns in the biological and environmental data; and (4) compare these results to previous studies of the region. Using these results, the data are compared with regional scenarios of oil and gas development, including information on potential impacts from these activities, and recommendations are made of sensitive species and assemblages, and geographic areas of interest that should be considered in long-term monitoring studies (Sections 3.4 and 3.5).

3.2.1 Spatial Trends in Environmental Data

Environmental data from the hard-bottom survey included substrate type (hard-bottom or soft-bottom and overall percentage), sediment overburden (%) of hard-bottom areas, substrate relief (low, medium or high), and bottom depth. Data on substrate relief and associated biological assemblages (discussed in Section 3.2.2.) were plotted on 1:2,000 scale charts of each transect; substrate type, sediment overburden, and bottom depth were plotted on 1:12,000 scale charts (Appendix G). Hard-bottom substrate type (outcrop, boulder, rubble, cobble, or pebble) also was catalogued but did not show any discernable pattern or relationship to the other variables and consequently was not plotted on the charts; a coded listing of all hard-bottom data including substrate and species information is included as Appendix H.

Hard-bottom features comprising at least 50% of a transect were observed along 17 of the 23 transects surveyed (Table 3-21); however, extensive hard-bottom areas comprising $\geq$ 90% of a transect were only observed at five transects (2A/B, 17 A/B, 16 A/B, 20A/B and 27A/B) extending over the range of the survey area. Examples of three transects representing continuous hard-bottom (Transect 14 A/B), alternating hard-bottom and soft-bottom areas (Transect 1 A/B), and continuous soft-bottom (Transect 19 A/B) are presented in Figures 3-35, 3-36 and 3-37, respectively; plots of these type of data for each transect are presented in Appendix G on the 1:12,000 scale charts. Results from the study conducted by Nekton, Inc. (1981) in the vicinity of

Table 3-21. Summary of Transect/Bottom Types from the July/August 1984 Hard-Bottom Survey. (Raw data are presented on 1:12,000 scale plots, Appendix G).

Hard-Bottom (H-B)*	Soft-Bottom (S-B)*	Alternating H-B/S-B**
2 A/B	4 A/B (0.1 H-B)	1 A/B
14 A/B	19 A/B	1 C/D
16 A/B	22 A/B	2 C/D
20 A/B	23 A/B	6 A/D
27 A/B (0.1 S-B)	26 C/D	13 A/B
	28 A/B	13 C/D
		14 C/D
		17 A/B
		21 A/B
		25 A/B
		29 A/B

* Approximately 100% except as noted

** Approximately 50%/50%

Dive 14A-B

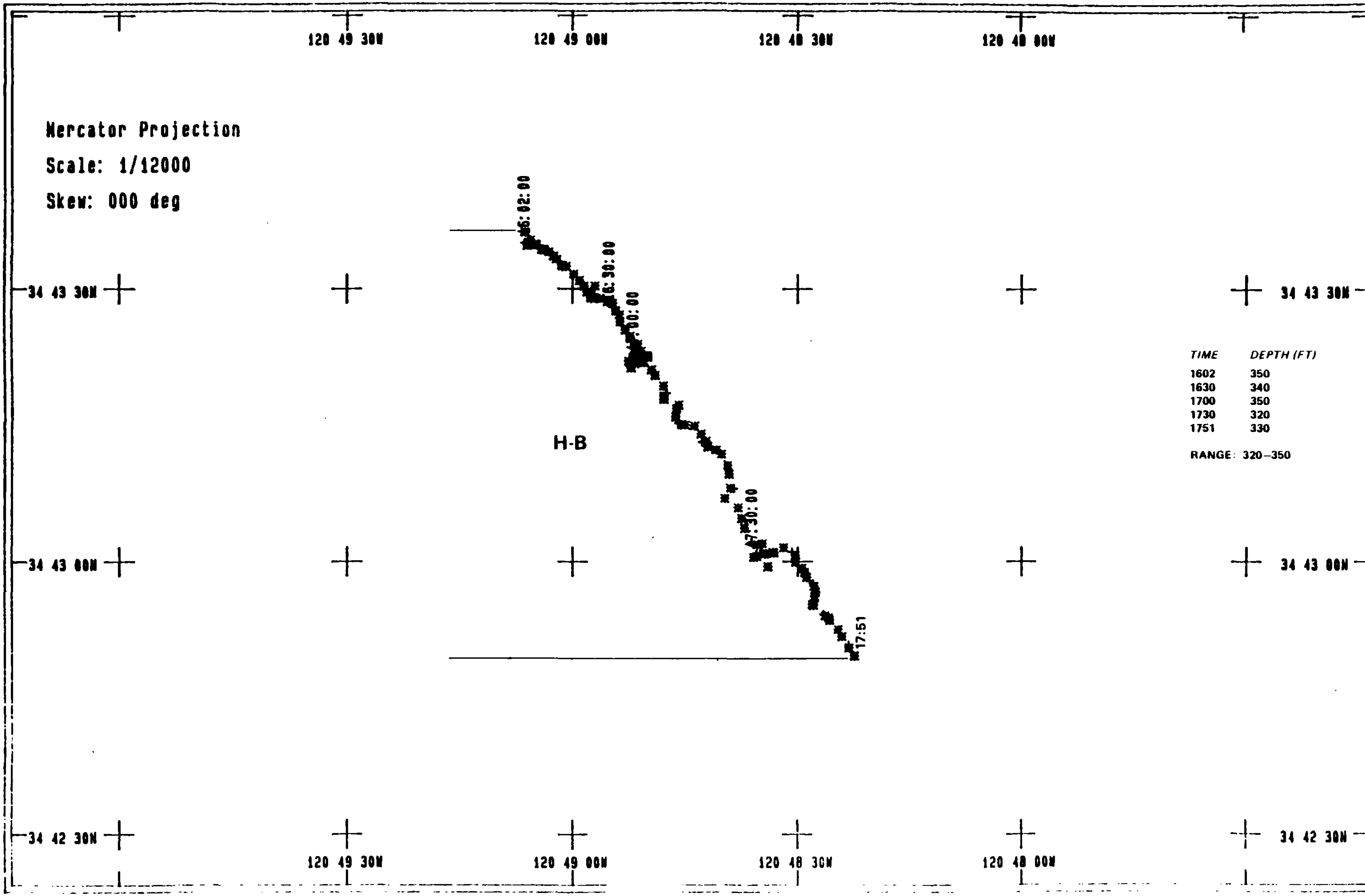


FIGURE 3-35. Dive (Transect) 14 A-B Showing Example of Continuous Hard-Bottom (H-B) Site

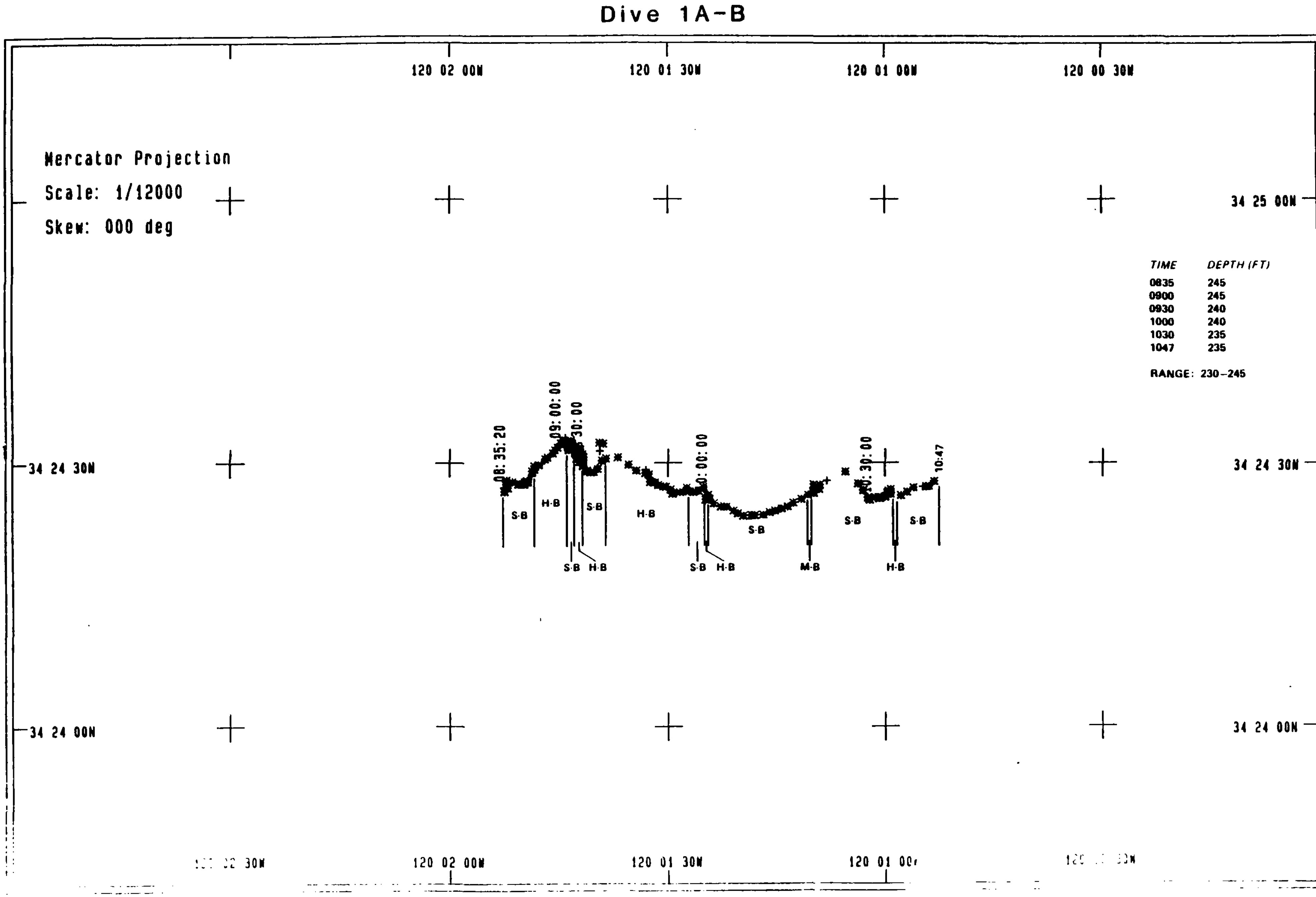


FIGURE 3-36. Dive (Transect) 1 A-B Showing Example of Alternating Hard-Bottom (H-B) and Soft-Bottom (S-B) Site; M-B Refers to Closely Alternating (Mixed) Bottom Types.

Dive 19A-B

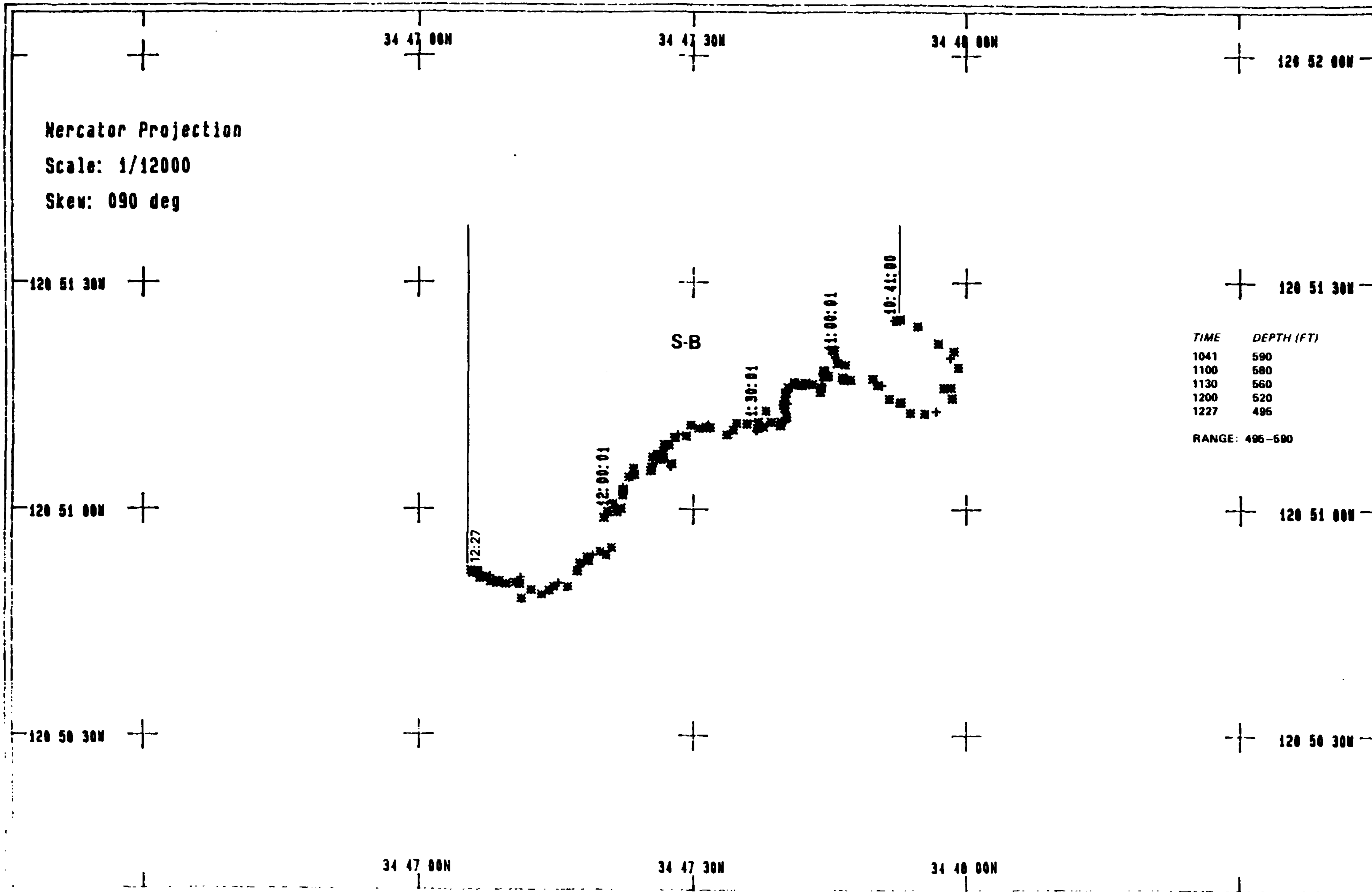


FIGURE 3-37. Dive (Transect) 19 A/B Showing Example of Continuous Soft-Bottom (S-B) Site

Transects 16 A/B and 20 A/B (Lease Blocks P-0425/P-0430) delineated several hard-bottom transect regions within a potentially broader hard-bottom area predicted from geophysical records (see description of Survey Area, Section 2.1.2.1). Transects 16 A/B and 20 A/B were located between Nekton Transects 45 and 48/64; the results from the present survey indicated continuous hard-bottom features (primarily low relief with intermittent medium to high relief) throughout the transect region (Tables 3-21, and 3-22, and Appendix G), similar to the broad hard-bottom region suggested from the geophysical records. Transect 4 A/B (Lease Block P-0315) corresponded to a previously unsurveyed, potential hard-bottom feature located east of Platform Harvest (SAIC, 1985, proposed transect "Harvest F"), and near a broader area previously surveyed by Nekton, Inc. (1983). Similar types of substrate were noted from both surveys, consisting of large areas of soft-bottom and low relief hard-bottom, with scattered areas of high to medium relief (Appendix G).

The location of each of the hard-bottom features was predicted based on information from geophysical records, previous surveys, or fishing records (see Methods Section 2.1.2.1), and include areas located in the Santa Barbara Channel, Pt. Conception to Pt. Arguello region, south to north of Purisima Pt., and Pt. San Luis to Pt. Estero. Overall geologic trends indicate a high occurrence of hard-bottom features within three broad areas of the survey region: (1) nearshore and offshore Pt. Conception to Pt. Arguello (e.g., SAIC, 1985; Dames and Moore, 1982 and 1983; Nekton, Inc., 1983 and 1984, and Engineering Science, 1984), (2) shallow (generally less than 100 ft),

Table 3-22. Summary of Transect Areas Characterized by Medium (3-10 ft) to High (> 10 ft) Relief, and/or ≤ 75% Sediment Cover Over Hard-Bottom Surfaces.*

Transect	Sediment Cover (fraction of transect length; location	Relief (fraction of transect length)		
		High		Medium
2 A/B	0 - 25% (0.2; W end and near center)	(x	0.2	x)
4 A/B				x (0.04)
13 C/D	> 50 - 75% (0.05; near SW end)			x (0.02)
14 A/B				x (<0.01)
16 A/B		(x	0.05	x)
20 A/B		x (0.08)		
21 A/B		x (0.2)		
25 A/B		(x	0.2	x)
27 A/B	0 - 50% (0.5; N end)	(x	0.7	x)

* Remaining transect areas are low relief (0-3 ft) with > 75% sediment cover.

nearshore areas from at least Goleta to Pt. Estero (NOAA Charts 18700 and 18720, BLM, 1980) and (3) nearshore to offshore of the Northern Channel Islands (NOAA Chart 18720, BLM, 1980). During the present study, the hard-bottom areas observed north of Pt. Arguello to Pt. Estero generally were less extensive (areal coverage from geophysical and survey records) with lower relief (0 to 3 ft) than many areas of the Pt. Conception to Pt. Arguello region and the Northern Channel Islands at comparable depths (300 to 800 ft; e.g., SAIC, 1985; Dames and Moore, 1982 and 1983). Additionally, inspection of geophysical records from the general survey region suggests that the hard-bottom features located near Pt. Conception to Pt. Arguello and the Northern Channel Islands extend over a broader depth range (nearshore to at least 800 ft) compared to areas north of Pt. Arguello which were most common at depths less than 600 ft. These deeper (600 to 800 ft) features also appear to be associated with more diverse and abundant biological assemblages as discussed in Section 3.2.2.

Sediment cover of hard-bottom features for the majority of each transect area was approximately 90% to 100% (Table 3-22), representing coverage depths of an estimated few millimeters to 10 cm of fine grained "silty" material. This trend was apparent over the entire range of survey depths, substrate relief and hard-bottom type (outcrop, boulders, etc.) and appeared to be a major factor influencing the biological assemblages. The only exceptions to this trend were observed for transects 2 A/B, 13 C/D, and 27 A/B characterized by localized areas of 0 to 75% sediment cover (i.e., relatively reduced sediment cover) associated with higher relief areas for Transects 13 C/D and 27 A/B (Table 3-22 and Appendix G). Similar trends of extensive sediment cover of many hard-bottom features were noted by most of the previous studies of the general survey region, including Dames and Moore (1982 and 1983) in the Pt. Conception to Pt. Arguello region, and Nekton, Inc. (1981) offshore of Purisima Pt. Comparion of data for Transect 4 A/B (Lease Block P-0315) and Transects 16 A/B and 20 A/B (Lease Blocks P-0425/P-0430) with previous surveys of these areas (Nekton, Inc., 1983 and 1981, respectively) indicate very similar observations of moderate to deep sediment cover, particularly in low relief areas.

Transects 19 A/B, 22 A/B, 23 A/B, 26 C/D and 28 A/B were located in areas predicted from geophysical records to be extensive hard-bottom regions; however, the survey results indicated predominantly soft-bottom conditions. Probing with the submersible's manipulator arm suggested (scraping noise) hard-bottom approximately 15 cm below the sediment surface at two locations (time 1055 and 1120) along Transect 19 A/B; similar shallow sediment cover may be associated with the other "soft-bottom" transects. The majority of the biological assemblages, particularly the attached epifauna (e.g., sponges, bryozoans and hydroids), observed on all the transects appeared to be lightly to moderately covered with silty material and probably are limited to a large extent by this natural overburden, potentially as related to several factors including fouling of feeding structures, burial, and decreased area for larval settlement or attachment. Survey examples that indicate burial of some attached organisms include: (1) numerous cup corals observed buried up to the edge of the cup; and (2) a living epifaunal assemblage on the upper (exposed) four inches, but a dead assemblage on the lower (buried) four inches of a rock pulled from the sediment using the manipulator arm.. Dames and Moore (1982) also noted examples of buried rock sections that contained skeletons of cup corals (Paracyathus) and other attached organisms. All of these examples suggest relatively recent burial of these organisms that may be related to naturally high levels of sediment transport. Detailed information on bottom currents, particularly for the Santa Maria Basin area, are not presently available, but are being studied in part by the ongoing Central California Circulation Study Program funded by MMS. Measurements of 1 to 2 and occasionally up to 3 kt bottom currents were estimated along several transects during the survey (Table 3-23), thereby suggesting a large potential for sediment transport, although the frequency and duration of these events is presently unknown. The majority of the transects surveyed, including those within the Santa Barbara Channel (1 A/B, 1 C/D, 2 A/B and 2 C/D) were characterized by lower bottom currents (0 to 1/4 kt).

Substrate relief was generally low (0 to 3 ft) for most of the transects with notable exceptions of medium (4 to 10 ft) and high (> 10 ft) relief for some segments of Transects 2 A/B, 4 A/B, 13 C/D, 14 A/B, 16 A/B, 20 A/B, 21 A/B, 25 A/B, and 27 A/B (Table 3-22 and Appendix G); however, five of these transects were characterized by very restricted ($\leq$ 0.08 of the transect length) medium to high relief areas, with significant (0.2 to 0.7 of the transect length) areas of relief only observed on Transects 2 A/B, 21 A/B, 25 A/B, and 27 A/B. Differences in biological assemblages associated with different

Table 3-23. Bottom Currents During the July/August 1984 Hard-Bottom Survey

Current Speed (kt)	Transect(s)
0 - 1/4	1 A/B, 1 C/D, 6 A/D, 13 A/B, 13 C/D, 17 A/B, 20 A/B, 21 A/B, 22 A/B
> 1/4 - 1/2	2 C/D, 14 A/B, 14 C/D, 25 A/B
> 1/2 - 1	4 A/B, 16 A/B
> 1 - 2	2 A/B, 19 A/B, 23 A/B, 26 A/B, 28 A/B, 29 A/B
> 2 - 3	27 A/B

substrate relief have been documented by several previous surveys including Lissner and Dorsey (in press), Dames and Moore (1982 and 1983), and Nekton (1983 and 1984). These differences may be related to several factors including sensitivity to turbid water conditions and/or sediment cover that may be increased in lower relief areas, differential larval settlement and survival, or biological factors such as predation and competition. None of these factors have been studied directly for organisms characteristic of the survey region; however, there is some evidence that the biological assemblages observed (see discussion under Biological Assemblages, Section 3.2.2) are distinguished in part by differences in sediment cover as a function of substrate relief (higher relief is associated with a reduced percentage of sediment cover for some transects).

The predominant hard-bottom substrate types were outcrops (isolated or extensive) and boulders which probably provide very similar habitats for many of the organisms observed. No trends in the biological assemblages related to substrate type were apparent from the cluster analyses (Section 3.2.2), probably due to the predominance of these two substrate types (outcrops and boulders).

3.2.2 Biological Assemblages

A total of 177 hard-bottom and soft-bottom taxa were identified from the photographic and observer data and the voucher specimens from the hard-bottom survey (Table 3-24 and Appendix H). Invertebrate taxa were dominated

Table 3-24. Species List from Photographic and Observer Data from the July/August 1984 Hard-Bottom Survey. (*Indicates voucher specimen collected).

Taxon

PORIFERA (sponges)

*Pachastrellidae sp. B
*Polymastia pachymastia
*Raspailiidae sp.
*Sigmadocia c.f. edaphus
*c. f. Sphinctrella sp. A
*Staurocalyptus solidus
Staurocalyptus sp.
Verongia aurea
"Aphrocallistes" sp.
"Leucetta" sp.
"Poecillastra" sp.

CNIDARIA

Hydrozoa (hydroids)

Aglaophenia sp.

Anthozoa (anemones, corals, sea fans)

Acanthoptilum gracile
Actinostola sp. A
Allopora californica
Anemone sp. A
*Balanophyllia elegans
*Caryophyllidae

Table 3-24. (cont'd)

Cerianthidae
*Coenocyathus bowersi
Corynactis californica
*Desmophyllum crista-galli
Epizoanthus leptoderma
*Eugorgia c. f. rubens
Lophelia californica
Lophogorgia sp.
*Metridium senile
Muricea sp.
*Paracyathus stearnsii
"Philogella" sp.
Ptilosarcus gurneyi
Stachyptilum superbum
Tealia sp.
Zoanthidae

MOLLUSCA

Gastropoda (snails, nudibranchs)

Berthella californica
Cadlina flavomaculata
Cadlina luteomarginata
Cadlina sp.
Calliostoma gloriosum
Calliostoma sp.
Dendronotus irus
Eolidoidea
Flabellinopsis iodinea
Fusinus babarensis
Fusinus sp.

Table 3-24. (cont'd)

Megasurcula sp.
Megasurcula carpenteriana
Mitra idae
Neptunea tabulata
Neosimnia sp.
Pleurobranchea californica
Tritonia diomedia
Tritonia sp.

Cephalopoda (Octopus)

Octopus sp.

BRACHIOPODA (lamp shells)

Laqueus californica
Terebratulina sp.

BRYOZOA (moss animals)

*Diaperoecia californica
Phidolopora pacifica

ECHINODERMATA

Crinoidea (feather stars)

*Florometra serratissima

Table 3-24. (cont'd)

Ophiuroidea (brittle stars)

*Gorgonocephalus eucnemis
Ophiacantha diplasia
"Ophionereis" sp.

Asteroidea (sea stars)

*Astropecten verrilli
Crossaster papposus
Dermasterias imbricata
Henricia laeviuscula annectens
Henricia sp.
Hippasteria spinosa
Luidia foliolata
Mediaster aequalis
Orthasterias koehleri
Patiria miniata
Peridontaster crassus
Pisaster brevispinus
Pteraster tesselatus
Pycnopodia helianthoides
Rathbunaster californicus
Stylasterias forreri

Echinoidea (sea urchins)

Allocentrotus fragilis
Brisaster latifrons
Brissopsis pacifica

Table 3-24. (cont'd)

*Lytechinus pictus
Strongylocentrotus franciscanus

Holothuroidea (sea cucumbers)

*Parastichopus californicus
P. parvimensis
P. c. f. johnsoni
Psolidae

ANNELIDA

Polychaeta (segmented worms)

Protula superba
Sabellidae
Serpulidae

ARTHROPODA

Crustacea (shrimp, crabs, lobsters)

*Arcoscallpellum californicum
Cancer productus
Cancer sp.
Galatheidae
Lopholithodes foraminatus
Loxorhynchus crispatus
Paguristes sp.
Paguristes ulreyi
Pandalus platyceros

Table 3-24. (cont'd)

Pandalus sp.
Paralithodes sp.
*Paramola faxoni

CHORDATA

Urochordata (tunicates)

Halocynthia hilgendorfi igaboja
Pyura haustor

Pisces (Fish, Sharks, and Rays)

Agonidae
Cephaloscyllium ventriosum
Chilara taylori
Citharichthys sp.
Clinidae
Coryphopterus nicholsii
Cottidae
Damalichtys vaca
Embiotocidae
Eptatretus sp.
Gibbonsia sp.
Hydrolagus collei
Lyconema barbatum
Ophidiidae
Ophiodon elongatus
Oxylebius pictus
Porichthys sp.

Table 3-24. (cont'd)

Raja binoculata
Raja stellulata
Raja sp.
Rathbunella sp.
Sebastes auriculatus
S. caurinus
S. chlorostictus
S. chrysomelas
S. constellatus
S. diploproa
S. elongatus
S. goodei
S. hopkinsi
S. miniatus
S. mystinus
S. nebulosus
S. ovalis
S. paucispinis
S. pinniger
S. rosaceus
S. ruberrimus
S. rubrivinctus
S. semicinctus
S. serranoides/flavidus
S. zacentrus
Sebastes sp.
Symphurus atricauda
Zalembius rosaceus
Zaniolepis latipinnis
Zaniolepis sp.
Zoarcidae

by echinoderms (33) and coelenterates (31), followed by molluscs (22), arthropods (16), sponges (16), annelids (4) and bryozoans (3). Chordates were represented by fish and sharks (48) and tunicates (4). Of these taxa, several phyla, including sponges (Porifera), coelenterates, bryozoans, and annelids are represented by various taxa that only could be identified to higher taxonomic levels (e.g., Family or Phylum) due to the lack of taxonomic information on certain groups (e.g., sponges), and limitations in identifying some taxa from photographic and observer records (i.e., without a collected sample). However, the majority of the common taxa observed during the survey represent distinct species that could be identified in the field.

The taxa were grouped into three hard-bottom assemblages (generalists, high/medium relief, and medium/low relief) defined on the basis substrate relief, and one soft-bottom assemblage, as detailed in Section 3.2.2.2. The generalist assemblage was characterized by numerous taxa including crinoids (Florometra) anemones (e.g., Metridium), cup corals (e.g., Paracyathus and caryophylliids) and sea stars (e.g., Mediaster and Stylasterias) occurring commonly throughout the range of depths, substrate type and relief present in the survey area; some of these taxa often comprised a sub-assemblage or co-assemblage associated with the high/medium or low/medium relief assemblages. The high/medium assemblage generally was characterized by a few taxa including the anemone Corynactis and the coral Lophelia which occurred primarily in higher relief areas, and some of the generalist taxa. The low/medium assemblage was comprised of numerous taxa including ophiuroids (e.g., Ophiacantha), brachiopods (e.g., Terebratulina), and anemones (Actinostola) that typically occurred in low relief areas. The soft-bottom assemblage was characterized by numerous soft-bottom organisms including sea pens (e.g., Stylatula and Acanthoptilum), Octopus, and sea urchins (e.g., Allocentrotus and Lytechinus). The majority of the transect areas were characterized as either low relief outcrops with extensive sediment cover, or as soft-bottom (Section 3.2.1), corresponding to a predominance of low/medium relief and generalist assemblages, and the soft-bottom assemblage, respectively observed in these areas (Appendix G). High to medium relief areas and associated taxa were present along nine of 23 transects but were common occurred along only three transects (2 A/B, 25 A/B and 27 A/B; Section 3.2.1). Photographs showing examples of some of the common organisms and assemblages observed during the survey are presented in Figures 3-38 to 3-41 "Photosea 1" to "Photosea 4". A summary of the major habitats and species observed along each transect is presented in Table 3-25.

Differences among the three hard-bottom assemblages may be related in part to differences in the tolerance of the various taxa to potentially high natural sediment loads. Taxa occurring in low to moderate relief areas may be exposed to much greater natural variation in turbidity and sedimentation than those occurring in higher relief areas, and may exhibit greater tolerance of these conditions.

Figure 3-38. Bottom Photograph (35 mm) of Low Relief Hard-Bottom Assemblages (Transect 20A/B) Including Brittle Stars (Ophiacantha), Anemone (Actinostola), and Tunicates (Halocynthia).

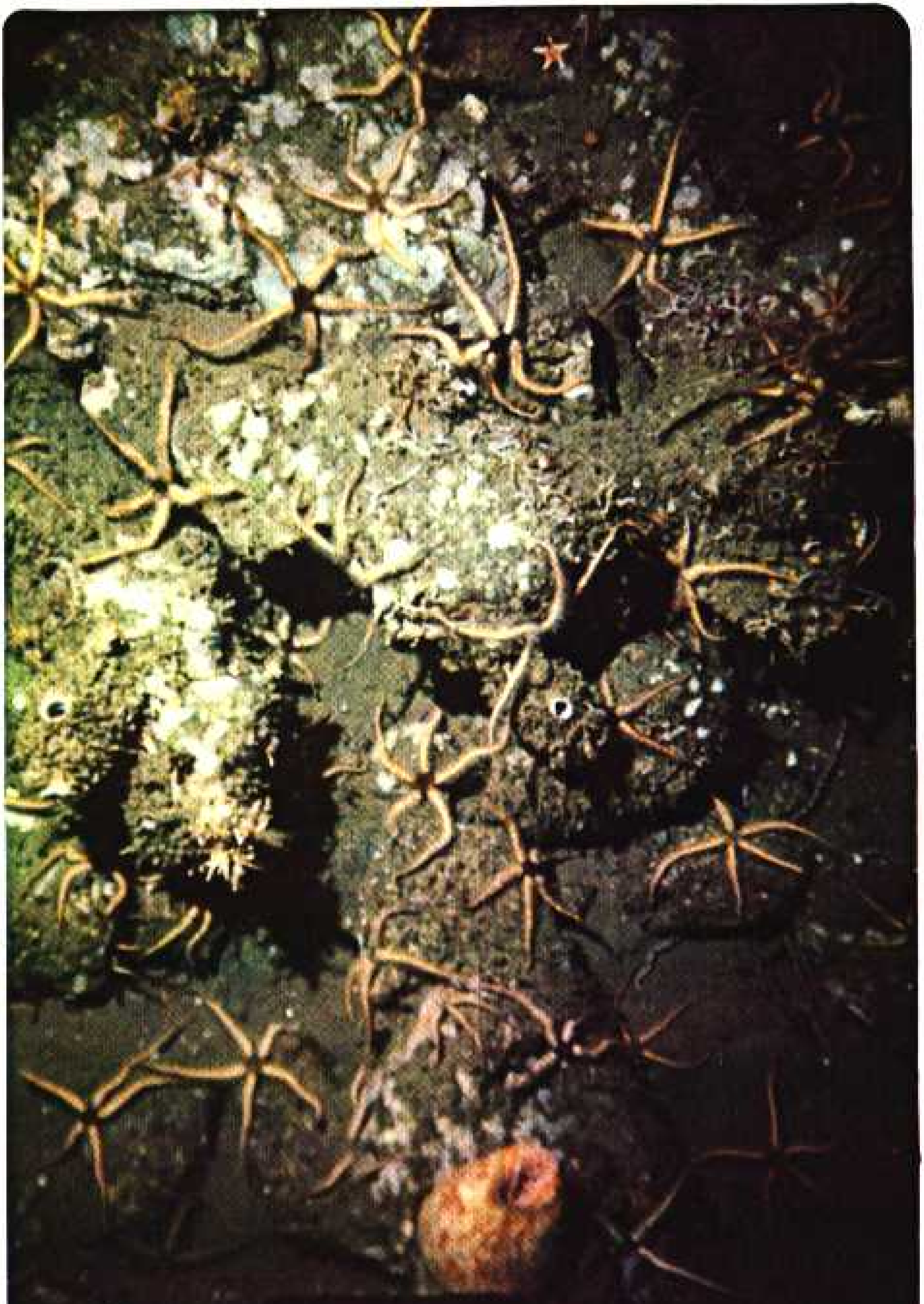


Figure 3-39. Bottom Photograph (35 mm) of Low Relief Hard-Bottom Assemblage (Transect 16 A/B) Including Brittle Stars (Ophiacantha) and Generalist Taxa Characterized by Crinoids (Florometra) and Cup Corals (e.g., Paracyathus).

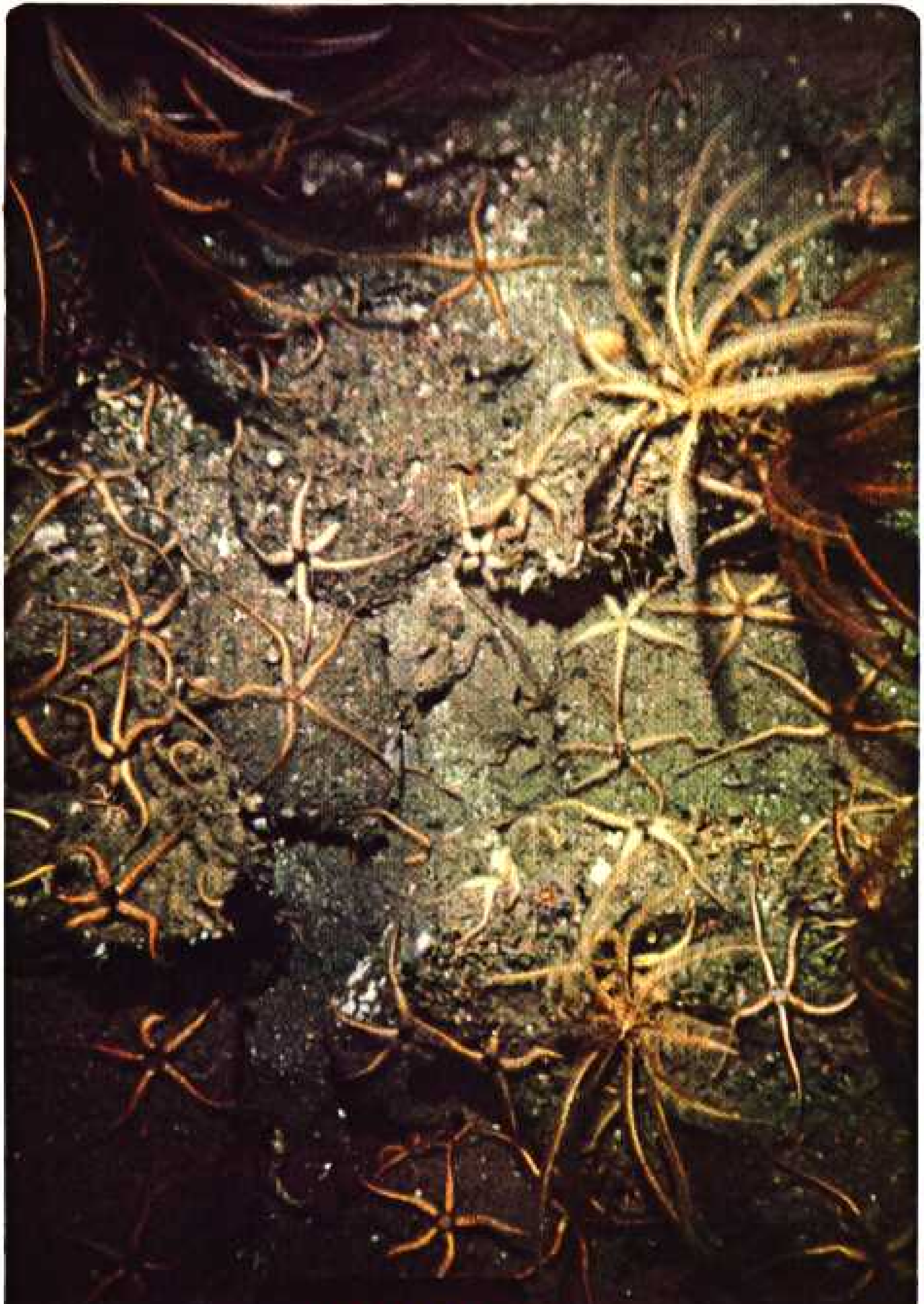


Figure 3-40. Representative Bottom Photograph (35 mm macro) of High Relief Hard-Bottom Assemblage (Hermosa Transect E; SAIC, 1985) Including Corals (Lophelia) and Cup Corals (Desmophyllum), and Galatheid Crab.

Figure 3-41. Representative Bottom Photograph (35 mm macro) of High Relief Hard-Bottom Assemblage (Hermosa Transect M; SAIC, 1985) Including Anemones (Corynactis) Bryozoans (Phidolopora), and Associated Epifaunal Organisms.

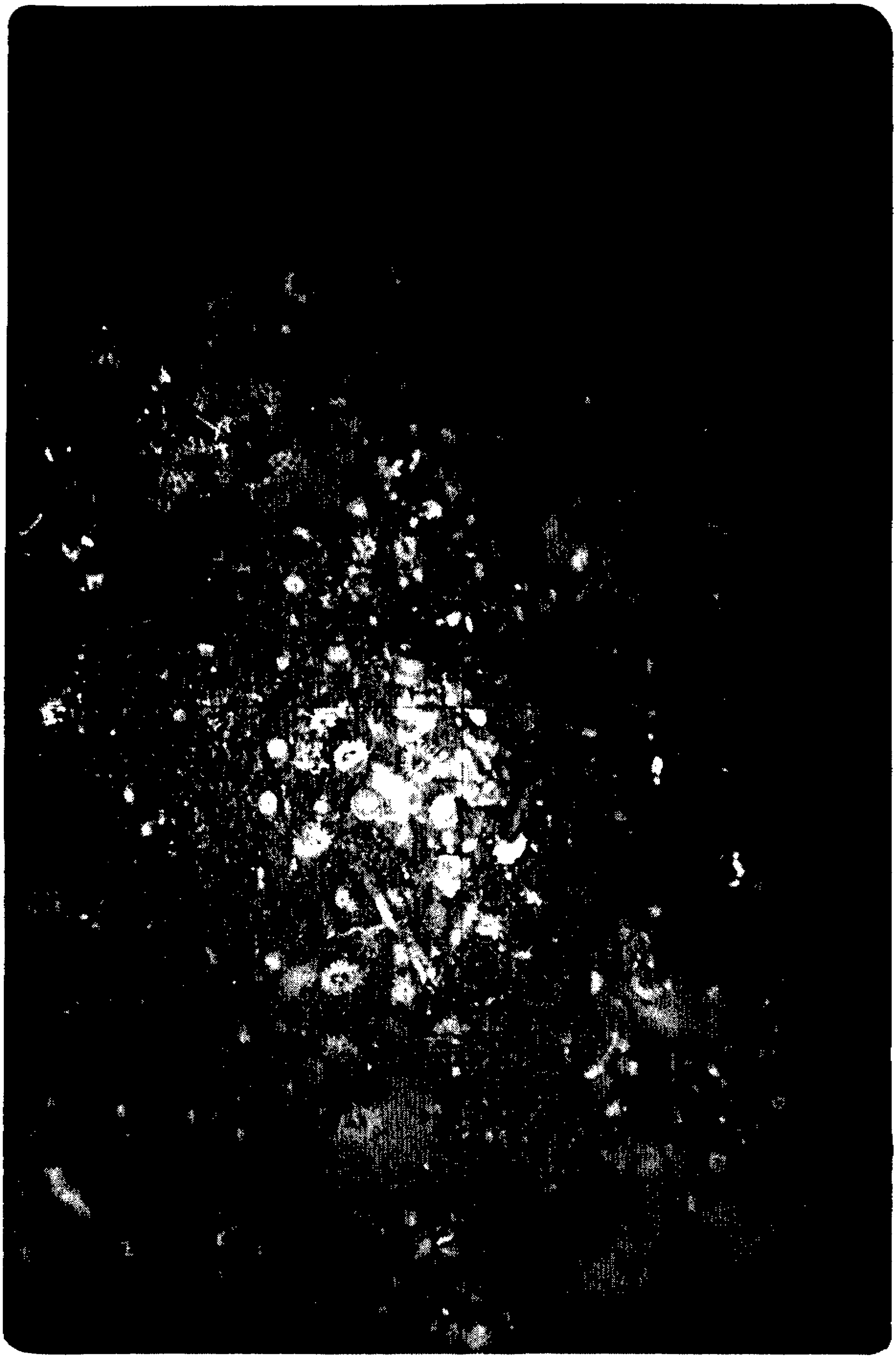


Table 3-25. Summary of Transect Observations from the July/August 1984 Hard-Bottom Survey.

Transect	Comments
1(A/B)	Primarily (85%) mud bottom, much of which may be relatively thin layer (3' to > 6" deep) over rock. Low relief outcrops 15% dominated by hydroids, bryozoans, *Paracyathus*, and *Eugorgia*.
1(C/D)	Transect composed of nearly equal amounts of low-medium relief rock boulders and mud flat habitats. Mud dominated by *Octopus*. Rock characterized by *Eugorgia*, *Paracyathus* (and other cup corals), and *Polymastia*.
2(A/B)	Steep pinnacles and canyons characterized by *Florometra*, ophiuroids, and sponges, and occasionally *Allopora*, and *Lophelia*.
2(C/D)	Similar to 2A/B but lower relief and sparser assemblage.
4(A/B)	Mud bottom (90%) characterized by *Brisaster*, *Allocentrotus*, and *Stylatula*. Main rocky area found at shallow end comprised of low to medium relief outcrops with Metridium, *Actinostola*, *Ophiacantha*, and *Terebratulina*.
6(A/B) and 6(C/D)	Combined two transects on single dive. Low relief, heavily silted outcrops with *Paracyathus*, *Metridium*, sponges, *Coryphopterus*, *Sebastes* spp., and some *Corynactis*).

Table 3-25. (cont'd)

Transect	Comments
13(A/B)	Low relief rocky rubble with light to moderate siltation characterized by _Paracyathus_, _Stylasterias_, and _Parastichopus_.
13(C/D)	Variety of mud flats, low relief silted rocks, and medium relief boulder piles. Mud dominated by _Octopus_, _Mediaster_, _Stylatula_, and _Citharichthys_. Rocks dominated by cup corals, Mediaster, _Lophogorgia_, _Ophiacantha_, and _Stylasterias_. Rock piles with great diversity of fishes, and _Metridium_ on highest rocks.
14(A/B)	Entire transect is low-medium relief silted rock habitat. At least 50% of the rocks (pebbles, bedrock shelves) are covered with $\geq$ 1/2" silt. Community dominants include solitary cup corals, _Florometra_, and ophiuroids.
14(C/D)	Overall low relief. First third of transect was fine fine mud characterized by small _Octopus_, brittle stars, juvenile rockfish, and _Mediaster_. Last 2/3 of transect was rock cobble dominated by small cup corals, _Terebratulina_, _Ophiacantha_, _Halocynthia_, _Pyura_, _Actinostola_, and _Florometra_.
16(A/B)	Uniform cobble/boulder slope except for 2 small mud flat areas. Low relief rocks except for one 10 ft high pinnacle. Dominants include _Ophiacantha_, _Florometra_, _Mediaster_, _Actinostola_, cup corals, _Terebratulina_, _Halocynthia_, juv. rockfish, and starry rockfish.

Table 3-25. (cont'd)

Transect	Comments
17(A/B)	Rocky outcrop on slope overlain with silt, and exposed, "hummocky" ridges characterized by Metridium, Pandalus, and Ophiacantha.
19(A/B	Soft-bottom characterized by Allocentrotus, Octopus, Zaniolepis, flatfish, and Lopholithodes.
20(A/B)	Rubble slope with Florometra, Ophiacantha, and brachiopods; vertical wall with Corynactis, Eugorgia, and cup corals; plateau with Florometra, ophiuroids, and sponges.
21(A/B)	Steep outcrops/ledges with intervening silt pockets and moderate siltations characterized by Metridium, Corynactis, Paracyathus, Balanophyllia, and Stylasterias.
22(A/B)	Soft-bottoms characterized by Stylatula and other sea pens, and Octopus.
23(A/B)	Soft-bottoms characterized by Octopus, sea pens (e.g., Acanthoptilum) and Citharichtys.
25(A/B)	"Seven-Mile Reef"; fractured, silty reef with intervening mud-bottom; rocks characterized by Metridium, cup corals, Parastichopus, and Stylasterias. Community generally silted over. Rockfish common.

Table 3-25. (cont'd)

Transect	Comments
26(A/B)	Mud bottom characterized by sea pens, Luidia, and Octopus.
27(A/B)	"Soft-bottom Station 006 to 32 fm mark". High currents, steep relief. Rocks characterized by Metridium, Florometra, and cup corals. Some siltation but much exposed rock.
28(A/B)	Silty bottom; high currents and low abundance of Octopus and sea pens (Stylatula, Stachyptilum, and Ptilosarcus.
29(A/B)	Flat rock bottom overlain with silt, occasional low rubble prominances; silted areas dominated by Laqueus; "exposed" rock dominated by Metridium and Florometra.

Potential effects from high levels of turbidity or sedimentation are expected to be greater for sessile organisms such as sponges that cannot move from an area of sediment intrusion, as compared to highly motile species such as fish, and for filter feeding organisms (also including sponges) that can be sensitive to fouling of feeding structures. A broad range of motility types is represented by the survey taxa including sessile/attached organisms such brachiopods, sponges, tunicates, hydroids, bryozoans, cup corals, and anemones; organisms of limited motility including crinoids, ophiuroids, and asteroids; and highly motile fish species. A broad range of general feeding types also is represented including filter/suspension feeders (e.g., sponges, crinoids, brachiopods, tunicates, and some anemones and corals), deposit feeders (e.g., some holothuroids), and predators/scavengers (e.g., rockfish, some ophiuroids, asteroids, and some anemones and corals). A discussion of environmental sensitivity including species and assemblages is presented in Section 3.4.

Interpretation of the biological assemblages and associated environmental variables were based on the results of cluster and ordination analyses, and ecological and life history data as available for some key taxa. Detailed discussion of these results is presented in Sections 3.2.2.1 (Cluster Analysis of Site and Species Groups), 3.2.2.2 (Biological Assemblage Groups), 3.2.2.3 (Relationship to Environmental Variables), and 3.2.2.4 (Comparison with Historical Data).

3.2.2.1 Cluster Analysis of Site and Species Groups

Cluster analysis of species presence-absence data was used to define site groups based on transect location and substrate type, and associated species groups (inverse classification).

Site Groups

Inspection of the cluster diagram of transect/substrate types (Figure 3-42) and the two-way table for the analysis (Table 3-26) suggests the occurrence of eight site (transect/substrate) groups. The major separation among the groups is based on differences between major bottom types: soft-bottom Groups 7 and 8 are separated from hard-bottom Groups 1 through 6. Differences among Groups 1 through 6 are less distinct, however contributing factors include substrate relief (low relief Groups 2 and 5 as compared to predominately medium to high relief Groups 1 and 3), and geographic location (Santa Barbara Channel Group 5 as compared to Transect 13 A/B and 13 C/D Group 4, Pt. Sal to Purisima Pt. Group 2, and Groups 1, 3 and 6 representing broad geographic ranges), as well as differences in the frequency of occurrence of key taxa. Less distinct trends among the hard-bottom groups are expected due to the relatively low relief observed over the majority of the survey area, and the broad range of occurrence (Generalist Assemblage) that was characteristic of many of the taxa. Replicate transects (e.g., 13 A/B and 13 C/D) for a site generally showed a high degree of similarity in group occurrences. Characteristics of the eight site groups include:

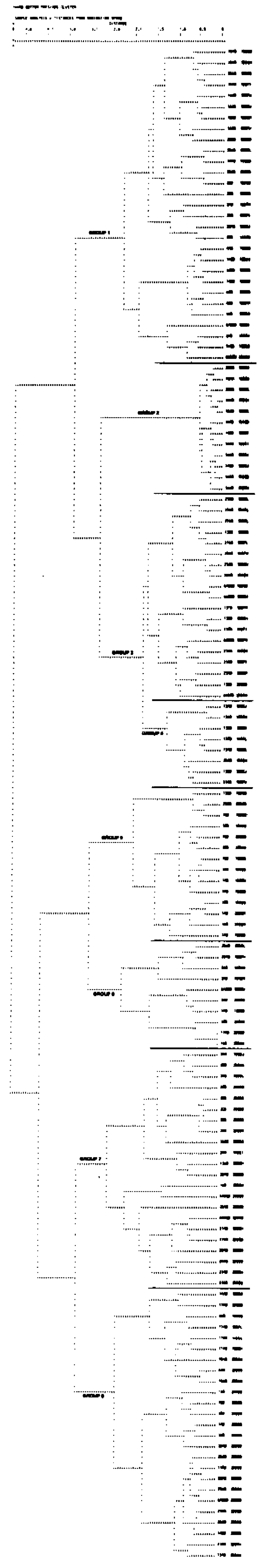
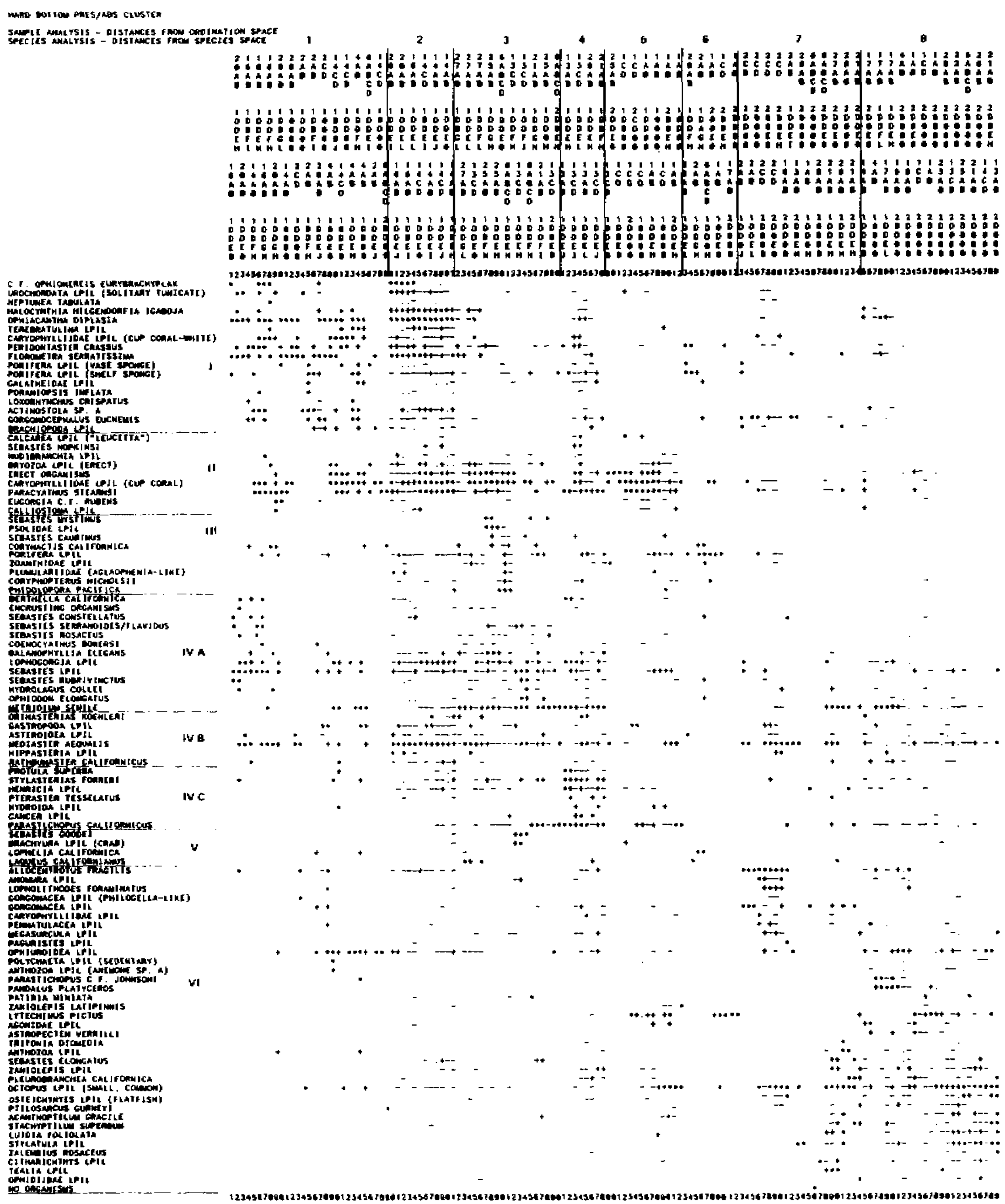


Figure 3-42. Cluster Analysis of Transect/Substrate (Site) Groups from the July/August 1984 Hard-Bottom Survey.

TABLE 3-26. Two-Way Table from Cluster Analysis of Hard-Bottom Data.



Group 1

Numerous taxa are represented including sponges (e.g., vase and shelf sponges), crinoids (Florometra), cup corals (Paracyathus and caryophylliids), ophiuroids (Ophiacantha, c.f. Ophionereis, and Gorgonocephalus), anemones (Actinostola, Metridium, and in high relief areas, Corynactis), rockfish (Sebastes spp.), asteroids (Mediaster and Peridontaster), tunicates (Halocynthia), brachiopods (Terebratulina), and occasionally gorgonians (e.g., Lophogorgia). In general, the group represents a broad geographic range of hard-bottom transects from near San Miguel Island (Transects 2 A/B and 2 C/D) to Pt. Sal (Transect 20 A/B), and a broad range of substrate relief (low, medium and high), although two subgroups probably are represented. Subgroup 1A represents higher relief transect areas characterized by greater occurrences of rockfish (Sebastes constellatus, S. rosaceus, and S serranoides/flavidus), sponges, and the anemone Corynactis. Subgroup 1B corresponds to low relief transect areas and decreased occurrences of these taxa. The majority of the transect/substrate types are represented by single records with a range from one to four records.

Group 2

Numerous taxa in common with Group 1, but overall this group represents lower relief transect areas associated with a decrease in occurrence of some taxa (e.g., sponges, rockfish, and Corynactis) similar to Subgroup 1B. Group 2 represents a narrow geographic range of hard-bottom transects (14 A/B and C/D, 16 A/B and 20 A/B) from approximately Pt. Sal to Purisima Pt. The group is strongly represented by numerous records for most transect/substrate types, ranging from 6 to 33 records.

Group 3

The number of taxa and occurrences is reduced relative to Groups 1 and 2, and primarily is characterized by cup corals (Paracyathus and caryphylliids), anemones (Metridium, and occasionally Corynactis in higher relief areas), asteroids (Mediaster), and sea cucumbers (Parastichopus). Other occasionals include the cup coral Balanophyllia, and the gorgonian Lophogorgia. The group represents a broad geographic range of hard-bottom transects from approximately Pt. Conception (Transect 6 A/B, C/D) to Morro Bay (Transect 27 A/B), and a broad range of substrate relief (low, medium and high) similar to Group 1. The main difference between Groups 1 and 3 is the reduced occurrence of several key taxa in Group 3 including Florometra, Halocynthia, Ophiacantha, Terebratulina, and sponges. The group is represented by moderate numbers of records for most transect/substrate types, ranging from one to 27.

Group 4

Taxa are similar to Group 3, consisting of fewer taxa than Groups 1 or 2; however, there are greater occurrences of some taxa (Ophiacantha, Peridontaster, and sponges) compared to Group 3, and a few taxa including the polychaete Protula, and some asteroids (Stylasterias, Henricia, and Pteraster) have their greatest occurrence in Group 4. The group represents a narrow geographic range of hard-bottom transects near Purisima Pt. represented mainly by Transects 13 A/B and C/D. The number of transect/substrate records is moderate to low, ranging from one to 18 records.

Group 5

Fewer taxa are represented than for Groups 1 through 4, and mainly consist of upper level taxa including Bryozoa LPIL (erect), Porifera LPIL, and cup corals (Caryophylliidae LPIL and Paracyathus); and the sea cucumber Parastichopus. Greater evidence of soft-bottom environments is indicated by the occurrence of Octopus and the sea urchin Lytechinus. The group primarily is comprised of Transects 1 A/B and 1 C/D from the Santa Barbara Channel, consisting of low relief to unspecified relief areas. The number of transect/substrate records is moderate to low, ranging from one to 16 records.

Group 6

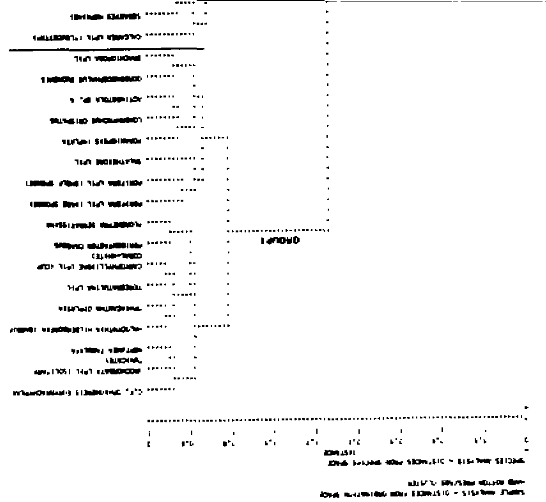
Reduced number of taxa and occurrences relative to Group 5, mainly represented by sponges (Porifera LPIL, vase sponges, and shelf sponges), cup corals, and occasionally Corynactis and Lophelia in high relief areas. The group represents a broad geographic range of transects from the Santa Barbara Channel (Transects 1 A/B and C/D) and San Miguel Island (2 A/B) to Pt. Estero (29 A/B), and a broad range of substrate relief (low, medium, high). The number of transect/substrate records is low, ranging from one to three records.

Group 7

Taxa generally represent transition or soft-bottom, epifaunal organisms including echinoids (Allocentrotus and Lytechinus), Octopus, asteroids (Mediaster), the crab Lopholithodes, and unidentified, sparsely branched gorgonians. Occasionals in the group include Metridium, Gorgonocephalus and cup corals. The group represents a broad geographic range of transects from San Miguel Island (Transect 2 A/B and 2 C/D) to Pt. Estero (29 A/B). The number of transect/substrate records generally is low (one to five) with the greatest number of records for Transect 2 C/D (range 5 to 12).

Group 8

Taxa generally consist of soft-bottom, epifaunal organisms including echinoids (Allocentrotus and Lytechinus), Octopus, sea pens (Ptilosarcus, Acanthoptilum, Stachyptilum and Stylatula), asteroids (Luidia, Mediaster and Astropecten), flatfish, sea cucumbers (Parastichopus c.f. johnsoni), and unidentified ophiuroids. Occasionals include Metridium and the spot prawn Pandalus platyceros. The group represents a broad range of transects, similar to Group 7, ranging from the Santa Barbara Channel to Pt. Estero, and represents the majority of the soft-bottom records from the survey. The majority of the transect/substrate records ranged from four to 42 records.



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indicated by the broad-separation between taxa associated with hard-bottom Groups I through V, and soft-bottom Group VI. Some differences among the hard-bottom groups appear to be based on geographic location, substrate relief, and to a lesser degree depth; however, most of the groups include several generalist species and a broad geographic range of transect/ substrate groups suggesting a high degree of overlap. Characteristics of the six species groups include:

Group I

Hard-bottom taxa occurring most frequently in transect/substrate Groups 1, 2 and 4, and representing a broad geographic range of transects (Santa Barbara Channel to Pt. Estero) and range of substrate relief (low, medium, and high). Several taxa including Florometra, Gorgonocephalus, and caryophylliids are generalists over these ranges, while others including Ophiacantha, Halocynthia, and Actinostola are more common (higher density) in low to medium relief areas (Appendix H).

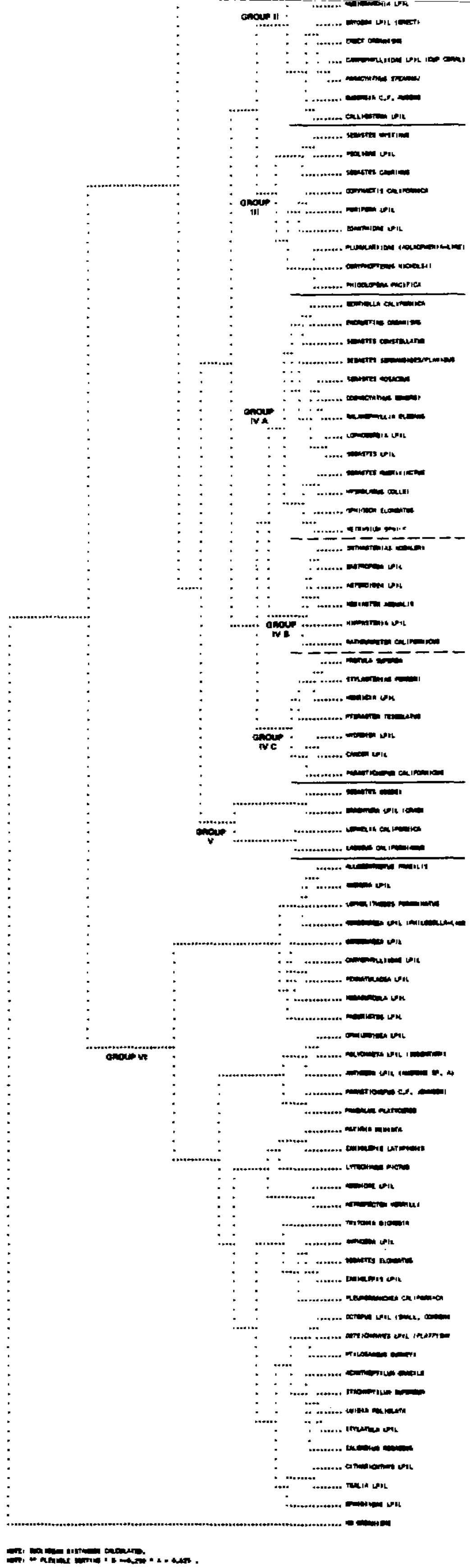

Figure 3-43. Cluster Analysis of Species Groups from July/August 1984 from the Hard-Bottom Survey.

Group II

Hard-bottom taxa generally occurring in the same transect/substrate groups as species Group I, but additionally in transect/substrate Groups 3 and 5. Group 3 is characterized by a broad geographic range of transects and range of substrate relief; Group 5 is comprised of low relief areas from the Santa Barbara Channel. Group I also consists of some generalist taxa including Paracyathus and caryphylliids.

Group III

Hard-bottom taxa primarily occurring in transect/substrate Group 3 (broad range of geographic location and substrate relief) and 5 (low relief, Santa Barbara Channel). Taxa include some species (e.g., Corynactis) associated with high to medium relief areas, and others (e.g., Coryphopterus) which occur more typically in low relief habitats (Table 3-27); a common element among these taxa appears to be occurrence at relatively shallow survey depths, generally less than 400 ft (Table 3-28).

Group IV

Hard-bottom taxa occurring over a broad geographic range of transects and range of substrate relief, including transect/substrate Groups 1, 2, 3, 5, but also represented by two taxa (Metridium and Mediaster) occurring in

Table 3-27. Frequency of Occurrence of Hard-Bottom Taxa by Cluster Group on Low (0-3 ft.), Medium (4-10 ft.) and High (> 10 ft) Relief Features.

CLUSTER GROUP	SPECIES	LOW	MEDIUM	HIGH
	1. C.F. OPHIONEREIS EURYBRACHYPLAX	17.2	2.2	2.4
	2. UROCHORDATA LPIL (SOLITARY TUNICATE)	13.6	0.0	4.9
	3. NEPTUNEA TABULATA	2.0	2.2	0.0
	4. HALOCYNTHIA HILGENDORFIA IGABOJA	24.0	4.3	9.8
	5. OPHIACANTHA DIPLASIA	49.0	19.6	7.3
	6. TEREBRATULINA LPIL	11.3	6.5	0.0
	7. CARYOPHYLLIIDAE LPIL (CUP CORAL-WHITE)	11.3	2.2	4.9
I	8. PERIDONTASTER CRASSUS	13.8	17.4	19.5
	9. FLOROMETRA SERRATISSIMA	26.8	19.6	17.1
	10. PORIFERA LPIL (VASE SPONGE)	3.4	4.3	2.4
	11. PORIFERA LPIL (SHELF SPONGE)	13.6	19.6	4.9
	12. GALATHEIDAE LPIL	2.9	8.7	2.4
	13. PORANIOPSIS INFLATA	2.0	2.2	0.0
	14. LOXORHYNCHUS CRISPATUS	0.9	2.2	0.0
	15. ACTINOSTOLA SP. A	11.8	15.2	2.4
	16. GORGONOCEPHALUS EUCNEMIS	10.7	15.2	7.3
	17. BRACHIOPODA LPIL	4.3	4.3	0.0
	18. CALCAREA LPIL ("LEUCETTA")	0.7	0.0	0.0
	19. SEBASTES HOPKINSI	0.9	0.0	0.0
	20. NUDIBRANCHIA LPIL	4.3	2.2	2.4
	21. BRYOZOA LPIL (ERECT)	11.8	10.9	4.9
II	22. ERECT ORGANISMS	23.8	26.1	22.0
	23. CARYOPHYLLIIDAE LPIL (CUP CORAL)	47.6	41.3	36.6
	24. PARACYATHUS STEARNSI	29.5	17.4	29.3
	25. EUGORGIA C.F. RUBENS	2.9	0.0	7.3
	26. CALLIOSTOMA LPIL	0.9	0.0	2.4
	27. SEBASTES MYSTINUS	0.0	4.3	4.9
	28. PSOLIDAE LPIL	0.5	2.2	2.4
	29. SEBASTES CAURINUS	1.4	2.2	2.4
	30. CORYNACTIS CALIFORNICA	2.3	4.3	36.6
III	31. PORIFERA LPIL	13.4	10.9	41.5
	32. ZOANTHIDAE LPIL	5.0	6.5	4.9
	33. PLUMULARIIDAE (AGLAOPHENIA-LIKE)	1.6	0.0	0.0
	34. CORYPHOPTERUS NICHOLSII	5.4	0.0	0.0
	35. PHIDOLOPORA PACIFICA	1.1	0.0	0.0
	36. BERTHELLA CALIFORNICA	2.7	2.2	0.0
	37. ENCRUSTING ORGANISMS	2.7	0.0	7.3
	38. SEBASTES CONSTELLATUS	3.4	4.3	2.4
	39. SEBASTES SERRANOIDES/FLAVIDUS	1.8	10.9	4.9
	40. SEBASTES ROSACEUS	2.3	4.3	7.3
	41. COENOCYATHUS BOWERSI	0.2	8.7	4.9
IV A	42. BALANOPHYLLIA ELEGANS	7.0	17.4	36.6
	43. LOPHOGORGIA LPIL	24.7	19.6	12.2
	44. SEBASTES LPIL	17.9	26.1	34.1
	45. SEBASTES RUBRIVINCTUS	4.1	6.5	4.9
	46. HYDROLAGUS COLLEI	2.7	6.5	2.4
	47. OPHIODON ELONGATUS	2.7	4.3	4.9
	48. METRIDIUM SENILE	20.2	50.0	46.3
	49. ORTHASTERIAS KOEHLERI	1.8	2.2	2.4
	50. GASTROPODA LPIL	6.3	4.3	0.0
	51. ASTEROIDEA LPIL	8.2	8.7	2.4
IV B	52. MEDIASTER AEQUALIS	39.2	37.0	34.1
	53. HIPPASTERIA LPIL	2.5	0.0	0.0

Table 3-27. Frequency of Occurrence of Hard-Bottom Taxa by Cluster Group on Low (0-3 ft.), Medium (4-10 ft.) and High (> 10 ft) Relief Features. (Continued)

CLUSTER GROUP	SPECIES	LOW	MEDIUM	HIGH
IV B	54. RATHBUNASTER CALIFORNICUS	5.4	6.5	0.0
IV C	55. PROTULA SUPERBA	3.9	2.2	0.0
	56. STYLASTERIAS FORRERI	10.9	10.9	17.1
	57. HENRICIA LPIL	10.0	6.5	4.9
	58. PTERASTER TESSELATUS	1.1	2.2	0.0
	59. HYDROIDA LPIL	1.4	0.0	0.0
	60. CANCER LPIL	1.1	0.0	0.0
	61. PARASTICHOPUS CALIFORNICUS	13.6	17.4	17.1
V	62. SEBASTES GOODEI	0.5	4.3	0.0
	63. BRACHYURA LPIL (CRAB)	0.5	2.2	0.0
	64. LOPHELIA CALIFORNICA	0.0	4.3	12.2
	65. LAQUEUS CALIFORNIANUS	2.3	19.6	9.8
VI	66. ALLOCENTROTUS FRAGILIS	11.6	0.0	0.0
	67. ANOMURA LPIL	2.7	2.2	0.0
	68. LOPHOLITHODES FORAMINATUS	1.6	0.0	0.0
	69. GORGONACEA LPIL (PHILOGELLA-LIKE)	0.7	0.0	0.0
	70. GORGONACEA LPIL	4.1	4.3	2.4
	71. CARYOPHYLLIIDAE LPIL	3.2	2.2	0.0
	72. PENNATULACEA LPIL	2.3	0.0	0.0
	73. MEGASURCULA LPIL	3.9	4.3	0.0
	74. PAGURISTES LPIL	1.4	0.0	0.0
	75. OPHIUROIDEA LPIL	11.8	8.7	7.3
	76. POLYCHAETA LPIL (SEDENTARY)	0.7	0.0	0.0
	77. ANTHOZOA LPIL (ANEMONE SP. A)	0.7	0.0	0.0
	78. PARASTICHOPUS C.F. JOHNSONI	0.5	4.3	0.0
	79. PANDALUS PLATYCEROS	3.2	6.5	0.0
	80. PATIRIA MINIATA	0.5	2.2	0.0
	81. ZANIOLEPIS LATIPINNIS	0.7	0.0	0.0
	82. LYTECHINUS PICTUS	4.1	0.0	0.0
	83. AGONIDAE LPIL	1.4	0.0	0.0
	84. ASTROPECTEN VERRILLI	0.7	0.0	0.0
	85. TRITONIA DIOMEDIA	0.7	0.0	0.0
	86. ANTHOZOA LPIL	1.8	4.3	2.4
	87. SEBASTES ELONGATUS	4.5	2.2	4.9
	88. ZANIOLEPIS LPIL	5.2	6.5	0.0
	89. PLEUROBRANCHEA CALIFORNICA	4.1	2.2	0.0
	90. OCTOPUS LPIL (SMALL, COMMON)	17.0	4.3	2.4
	91. OSTEICHTHYES LPIL (FLATFISH)	2.3	0.0	0.0
	92. PTILOSARCUS GURNEYI	2.0	0.0	0.0
	93. ACANTHOPTILUM GRACILE	2.0	2.2	0.0
	94. STACHYPTILUM SUPERBUM	3.6	0.0	0.0
	95. LUIDIA FOLIOLATA	2.5	0.0	0.0
	96. STYLATULA LPIL	2.7	0.0	0.0
	97. ZALEMBIUS ROSACEUS	0.2	0.0	0.0
	98. CITHARICHTHYS LPIL	0.7	0.0	0.0
	99. TEALIA LPIL	1.1	0.0	0.0
	100. OPHIDIIDAE LPIL	0.2	2.2	0.0
	101. NO ORGANISMS	0.5	0.0	0.0

Table 3-28. Frequency of Occurrence of Hard-Bottom Taxa Per Fifty Foot Depth Interval. (Each Depth Listed in a Depth Column is the Maximum Depth for that Interval).

SPECIES	200	250	300	350	400	450	500	550	600	650	700	750	800
1. C.F. OPHIONEREIS EURYBRACHYPLAX	0.0	0.0	4.3	14.6	17.0	14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2. UROCHORDATA LPIL (SOLITARY TUNICATE)	5.4	1.9	8.6	12.0	8.5	14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. NEPTUNEA TABULATA	0.0	0.0	0.0	1.5	2.6	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4. HALOCYNTHIA HILGENDORFIA IGABOJA	0.0	0.0	1.4	22.6	26.1	16.1	0.0	0.0	4.9	0.0	0.0	0.0	0.0
5. OPHIACANTHA DIPLASIA	0.0	0.0	11.4	51.5	34.6	30.6	0.0	24.0	17.1	30.8	0.0	0.0	0.0
6. TEREBRATULINA LPIL	0.0	0.9	0.0	9.9	13.7	3.2	0.0	0.0	7.3	7.7	0.0	0.0	0.0
7. CARYOPHYLLIIDAE LPIL (CUP CORAL-WHITE)	0.0	0.0	2.9	13.5	8.5	6.5	0.0	0.0	4.9	7.7	0.0	0.0	0.0
8. PERIDONTASTER CRASSUS	0.0	3.3	14.3	14.6	10.5	11.3	0.0	4.0	4.9	7.7	0.0	0.0	0.0
9. FLOROMETRA SERRATISSIMA	0.0	0.0	11.4	27.0	26.8	24.2	0.0	6.0	7.3	0.0	0.0	0.0	0.0
10. PORIFERA LPIL (VASE SPONGE)	2.7	0.5	4.3	2.2	4.6	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0
11. PORIFERA LPIL (SHELF SPONGE)	10.8	1.9	1.4	14.6	9.8	9.7	0.0	0.0	4.9	7.7	0.0	0.0	0.0
12. GALATHEIDAE LPIL	0.0	0.0	2.9	4.7	0.7	0.0	0.0	0.0	4.9	7.7	0.0	0.0	0.0
13. PORANIOPSIS INFLATA	0.0	0.0	0.0	1.8	2.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14. LOXORHYNCHUS CRISPATUS	0.0	0.0	1.4	0.7	0.7	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0
15. ACTINOSTOLA SP. A	0.0	0.0	0.0	10.6	11.8	12.9	0.0	6.0	4.9	23.1	0.0	0.0	0.0
16. GORGONOCEPHALUS EUCNEMIS	0.0	0.0	7.1	10.2	6.5	24.2	0.0	0.0	7.3	7.7	0.0	0.0	0.0
17. BRACHIOPODA LPIL	0.0	0.0	0.0	2.6	7.2	11.3	0.0	0.0	2.4	0.0	0.0	0.0	0.0
18. CALCAREA LPIL ("LEUCETTA")	0.0	1.9	0.0	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19. SEBASTES HOPKINSI	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20. NUDIBRANCHIA LPIL	10.8	1.9	1.4	4.0	0.7	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21. BRYOZOA LPIL (ERECT)	18.9	10.4	2.9	7.3	11.1	1.6	0.0	0.0	2.4	0.0	0.0	0.0	0.0
22. ERECT ORGANISMS	18.9	24.2	14.3	19.3	21.6	3.2	0.0	0.0	4.9	23.1	0.0	12.5	0.0
23. CARYOPHYLLIIDAE LPIL (CUP CORAL)	45.9	36.0	21.4	48.5	30.1	16.1	0.0	2.0	7.3	15.4	0.0	0.0	0.0
24. PARACYATHUS STEARNSI	13.5	28.9	15.7	33.2	17.6	6.5	0.0	0.0	0.0	7.7	0.0	0.0	0.0
25. EUGORGIA C.F. RUBENS	5.4	2.8	5.7	2.6	0.7	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26. CALLIOSTOMA LPIL	0.0	1.9	0.0	1.1	0.7	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27. SEBASTES MYSTINUS	2.7	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28. PSOLIDAE LPIL	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29. SEBASTES CAURINUS	5.4	1.9	2.9	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30. CORYNACTIS CALIFORNICA	16.2	4.7	1.4	4.0	0.0	0.0	0.0	0.0	0.0	7.7	0.0	0.0	0.0
31. PORIFERA LPIL	16.2	11.8	10.0	15.0	3.9	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32. ZOANTHIDAE LPIL	18.9	1.4	1.4	1.5	4.6	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33. PLUMULARIIDAE (AGLAOPHENIA-LIKE)	0.0	1.9	0.0	0.0	0.7	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34. CORYPHOPTERUS NICHOLSII	18.9	3.8	4.3	3.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3-28. Frequency of Occurrence of Hard-Bottom Taxa Per Fifty Foot Depth Interval. (Each Depth Listed in a Depth Column is the Maximum Depth for that Interval). (Continued)

SPECIES	200	250	300	350	400	450	500	550	600	650	700	750	800
35. PHIDOLOPORA PACIFICA	5.4	1.4	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36. BERTHELLA CALIFORNICA	0.0	0.5	1.4	3.6	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37. ENCRUSTING ORGANISMS	0.0	0.9	1.4	3.3	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38. SEBASTES CONSTELLATUS	0.0	0.0	1.4	4.4	3.9	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39. SEBASTES SERRANOIDES/FLAVIDUS	8.1	1.9	4.3	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40. SEBASTES ROSACEUS	5.4	4.3	0.0	1.5	2.0	3.2	0.0	0.0	2.4	0.0	0.0	0.0	0.0
41. COENOCYATHUS BOWERSI	0.0	3.3	1.4	0.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42. BALANOPHYLLIA ELEGANS	5.4	8.1	8.6	6.9	5.9	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43. LOPHOGORGIA LPIL	18.9	8.5	15.7	24.5	10.5	1.6	0.0	12.0	9.8	0.0	0.0	0.0	0.0
44. SEBASTES LPIL	5.4	9.0	27.1	20.8	15.7	9.7	0.0	6.0	2.4	7.7	0.0	0.0	0.0
45. SEBASTES RUBRIVINCTUS	0.0	1.9	8.6	3.3	0.7	4.8	0.0	2.0	0.0	0.0	0.0	0.0	0.0
46. HYDROLAGUS COLLEI	0.0	0.9	10.0	1.8	0.7	3.2	0.0	0.0	4.9	0.0	0.0	25.0	0.0
47. OPHIODON ELONGATUS	0.0	0.5	8.6	2.9	0.7	0.0	0.0	4.0	0.0	0.0	0.0	12.5	0.0
48. METRIDIUM SENILE	5.4	11.8	40.0	14.6	13.7	11.3	0.0	32.0	24.4	53.8	0.0	0.0	20.0
49. ORTHASTERIAS KOEHLERI	0.0	0.0	0.0	3.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50. GASTROPODA LPIL	2.7	1.9	1.4	5.5	3.3	14.5	0.0	2.0	4.9	15.4	0.0	0.0	0.0
51. ASTEROIDEA LPIL	0.0	0.5	10.0	9.9	5.9	8.1	0.0	2.0	4.9	0.0	0.0	0.0	0.0
52. MEDIASTER AEQUALIS	13.5	16.1	27.1	40.9	28.1	59.7	0.0	4.0	9.8	15.4	0.0	12.5	0.0
53. HIPPASTERIA LPIL	0.0	0.0	0.0	1.5	1.3	6.5	0.0	2.0	0.0	0.0	0.0	0.0	0.0
54. RATHBUNASTER CALIFORNICUS	0.0	0.0	2.9	5.5	5.9	0.0	0.0	8.0	2.4	15.4	0.0	0.0	0.0
55. PROTULA SUPERBA	0.0	0.0	4.3	5.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56. STYLASTERIAS FORRERI	0.0	3.3	10.0	13.9	2.0	4.8	0.0	2.0	9.8	7.7	0.0	0.0	0.0
57. HENRICIA LPIL	5.4	4.7	5.7	9.1	7.8	1.6	0.0	4.0	0.0	0.0	0.0	0.0	0.0
58. PTERASTER TESSELATUS	0.0	0.0	2.9	1.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59. HYDROIDA LPIL	0.0	1.9	1.4	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60. CANCER LPIL	5.4	0.5	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61. PARASTICHOPUS CALIFORNICUS	18.9	16.1	24.3	10.9	3.3	1.6	0.0	8.0	12.2	7.7	50.0	12.5	0.0
62. SEBASTES GOODEI	0.0	0.0	4.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63. BRACHYURA LPIL (CRAB)	0.0	0.9	2.9	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64. LOPHELIA CALIFORNICA	0.0	0.0	0.0	1.8	0.7	0.0	0.0	0.0	0.0	7.7	0.0	0.0	0.0
65. LAQUEUS CALIFORNIANUS	0.0	0.0	0.0	0.4	10.5	9.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
66. ALLOCENTROTUS FRAGILIS	0.0	0.5	0.0	8.4	5.2	46.8	0.0	38.0	31.7	0.0	0.0	12.5	40.0
67. ANOMURA LPIL	0.0	0.0	5.7	0.4	0.0	17.7	0.0	0.0	4.9	0.0	0.0	12.5	60.0
68. LOPHOLITHODES FORAMINATUS	0.0	0.0	0.0	0.4	0.0	12.9	0.0	16.0	0.0	0.0	0.0	0.0	0.0

Table 3-28. Frequency of Occurrence of Hard-Bottom Taxa Per Fifty Foot Depth Interval. (Each Depth Listed in a Depth Column is the Maximum Depth for that Interval).

SPECIES	200	250	300	350	400	450	500	550	600	650	700	750	800
69. GORGONACEA LPIL (PHILOGELLA-LIKE)	0.0	0.0	0.0	0.0	4.6	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70. GORGONACEA LPIL	2.7	0.9	8.6	3.3	1.3	9.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71. CARYOPHYLLIIDAE LPIL	0.0	0.5	2.9	2.9	0.7	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
72. PENNATULACEA LPIL	0.0	0.5	1.4	1.5	0.7	6.5	0.0	6.0	2.4	0.0	0.0	0.0	0.0
73. MEGASURCULA LPIL	0.0	0.9	8.6	2.2	0.7	16.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74. PAGURISTES LPIL	0.0	0.5	1.4	1.1	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0
75. OPHIUROIDEA LPIL	2.7	1.9	2.9	17.2	24.2	11.3	100.0	36.0	36.6	76.9	50.0	37.5	0.0
76. POLYCHAETA LPIL (SEDENTARY)	0.0	0.5	0.0	0.7	1.3	0.0	0.0	0.0	4.9	7.7	0.0	0.0	0.0
77. ANTHOZOA LPIL (ANEMONE SP. A)	0.0	0.0	1.4	1.8	0.0	0.0	0.0	4.0	7.3	7.7	0.0	0.0	0.0
78. PARASTICHOPUS C.F. JOHNSONI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	4.9	15.4	0.0	12.5	0.0
79. PANDALUS PLATYCEROS	0.0	0.9	0.0	0.0	0.0	0.0	0.0	30.0	17.1	0.0	0.0	50.0	0.0
80. PATIRIA MINIATA	8.1	0.5	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81. ZANIOLEPIS LATIPINNIS	0.0	1.4	1.4	0.7	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0
82. LYTECHINUS PICTUS	0.0	25.6	14.3	3.6	9.2	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0
83. AGONIDAE LPIL	0.0	1.4	0.0	1.5	0.7	0.0	0.0	8.0	0.0	7.7	0.0	0.0	0.0
84. ASTROPECTEN VERRILLI	0.0	1.9	1.4	0.4	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0
85. TRITONIA DIOMEDIA	0.0	0.0	0.0	1.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
86. ANTHOZOA LPIL	2.7	0.0	4.3	3.3	0.0	0.0	0.0	4.0	14.6	0.0	0.0	12.5	0.0
87. SEBASTES ELONGATUS	0.0	0.9	5.7	5.5	6.5	1.6	0.0	4.0	4.9	0.0	0.0	0.0	0.0
88. ZANIOLEPIS LPIL	2.7	3.8	11.4	6.6	5.2	4.8	100.0	16.0	14.6	0.0	0.0	0.0	0.0
89. PLEUROBRANCHEA CALIFORNICA	2.7	3.3	5.7	2.6	3.9	6.5	0.0	8.0	9.8	0.0	0.0	0.0	0.0
90. OCTOPUS LPIL (SMALL, COMMON)	13.5	24.6	12.9	18.2	27.5	29.0	100.0	32.0	19.5	7.7	0.0	0.0	40.0
91. OSTEICHTHYES LPIL (FLATFISH)	2.7	3.3	2.9	4.4	3.9	4.8	0.0	4.0	7.3	7.7	50.0	0.0	40.0
92. PTILOSARCUS GURNEYI	2.7	1.9	2.9	3.6	7.8	4.8	100.0	2.0	9.8	0.0	0.0	0.0	0.0
93. ACANTHOPTILUM GRACILE	0.0	6.6	7.1	4.4	11.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
94. STACHYPTILUM SUPERBUM	0.0	1.9	5.7	2.9	3.9	1.6	0.0	10.0	2.4	0.0	0.0	0.0	0.0
95. LUIDIA FOLIOLATA	13.5	3.8	5.7	4.4	9.8	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0
96. STYLATULA LPIL	2.7	9.5	8.6	5.5	18.3	0.0	0.0	4.0	9.8	15.4	50.0	12.5	40.0
97. ZALEMBIUS ROSACEUS	0.0	1.4	0.0	1.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
98. CITHARICHTHYS LPIL	2.7	0.9	1.4	2.2	3.9	1.6	0.0	2.0	0.0	0.0	0.0	0.0	0.0
99. TEALIA LPIL	0.0	0.5	2.9	3.3	0.0	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100. OPHIDIIDAE LPIL	0.0	0.0	1.4	0.0	2.6	0.0	0.0	0.0	2.4	0.0	50.0	0.0	0.0
101. NO ORGANISMS	8.1	10.4	8.6	3.6	2.6	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0

predominately soft-bottom (transect/substrate Groups 7 and 8) as well as hard-bottom areas. Group IV is comprised of several generalist taxa including Metridium, Mediaster, and Stylasterias, but also consists of several taxa including Coenocyanthus, Balanophyllia and Sebastes spp. (Group IV A) that occur most frequently and abundantly (Appendix H) in medium to high relief areas (Table 3-27). Group IV C consists of a subset of one common species (Parastichopus californicus) and four low density taxa (Appendix H) primarily occurring in transect/substrate Group 4 (Transect 13 A/B and 13 C/D); no obvious, unique features are associated with these two transects to explain the relatively limited occurrence of these taxa.

Group V

Small group of four hard-bottom taxa occurring over a broad geographic range of transects, and characterized by a low frequency of occurrence for each taxon. The significance of this group is presently unexplained; however, the occurrence of the coral Lophelia as a indicator of high to medium relief conditions is notable (Table 3-27).

Group VI

Primarily soft-bottom taxa occurring most frequently in soft-bottom transect/substrate Groups 7 and 8. Common taxa include Allocentrotus, Lytechinus, Luidia, Octopus, various flatfish, Zaniolepis, unidentified ophiuroids, and sea pens (Stylatula, Acanthoptilum, Stachyptilum, and Ptilosarcus).

3.2.2.2 Biological Assemblage Groups

Results from the cluster analyses, and information on the ecology and natural history of the taxa observed suggested the occurrence of three hard-bottom assemblages (A = Generalists; B = Medium to High Relief and C = Low to Medium Relief), and one soft-bottom assemblage (D). No apparent trends with depth or geographic location were noted for these assemblages, and they appeared to be common throughout the survey area. The generalist assemblage was characterized by numerous taxa including crinoids (Florometra), cup corals (Paracyathus, Balanophyllia and caryophylliids), asteriods (Mediaster, Peridontaster and Stylasterias), rockfish (Sebastes spp.), various sponges, and many unidentified erect and encrusting organisms (e.g., hydroids and bryozoans), that occurred commonly throughout the range of survey depths, location, and substrate relief for the survey (Tables 3-27 and 3-28). This group commonly constituted a sub-assemblage or co-assemblage with the medium/high relief or low/medium relief assemblages as estimated from abundance information (density or percent cover) presented in Appendix H.

The high to medium relief assemblage was characterized by several prominent taxa including colonial corals (Lophelia and Coenocyathus), an anemone (Corynactis), and several rockfish (Sebastes mystinus, S. serranoides/flavidus, and S. rosaceus). The corals and the anemone generally were restricted to relatively steep features ("vertical" walls to ridge tops) greater than four feet in relief (Table 3-27) and did not occur near sediment/rock interfaces, presumably related to a low tolerance of turbid conditions or sediment movement that may be increased along these boundaries. The rockfish should not be restricted to medium or high relief areas, and their association with this assemblage probably is related to behavioral orientation towards higher relief features and greater food availability.

The low to medium relief assemblage was characterized by numerous taxa including ophiuroids (Ophiacantha, and c.f. Ophionereis), cup corals (Paracyathus and caryophylliids, from Assemblage A), brachiopods (Terebratulina and Laqueus), tunicates (Halocynthia), and occasionally spot prawn (Pandalus platyceros). These taxa primarily occurred in low relief areas (Table 3-27) characterized by high percentages of sediment cover and presumably increased sediment transport. Other taxa in this assemblage included an anemone Actinostola and a shelf sponge ("Sigmadocia") that commonly occurred in both low and medium relief areas (Table 3-27).

The soft-bottom assemblage consisted primarily of Octopus (small, common, c.f. O. rubescens), holothuroids (Parastichopus californicus and P. c.f. johnsoni), echinoids (Allocentrotus and Lytechinus), sea pens Acanthoptilum, Stylatula, Stachyptilum, and Ptilosarcus), asteroids (Luidia), miscellaneous flatfish, and combfish (Zaniolepis), and was widespread but in generally low abundances (Appendix H) throughout the survey area.

Overall, the assemblages observed were highly similar to those observed during previous surveys of the general region including Dames and Moore (1982 and 1983), and Nekton Inc., (1981, 1983, and 1984) as discussed in Section 3.2.2.4.

The differences observed for the species assemblages correspond reasonably well to the eight site groups defined from the cluster analyses. Site Groups 7 and 8 represent soft-bottom habitats characterized by soft-bottom assemblage D, and are distinct from Site Groups 1 through 6 which primarily are characterized by hard-bottom bottom assemblages A, B and C. Site Groups 5 and 6 are distinguished in part from Groups 1 through 4 in that they are characterized by higher percentages of soft-bottom and low relief hard-bottom transect areas characterized by C/D type biological assemblages. Differences among Site Groups 1 through 4 are less distinct, however, Groups 1 and 3 both are characterized by higher percentages of medium to high relief areas and associated biological assemblages (Assemblage B) in addition to the C/A (Low to Medium Relief/Generalist) Assemblages characteristic of Site Groups 2 and 4.

Abundances of common taxa were estimated from photographs and observer records, according to the methods presented in Sections 2.1.2.4 and 2.2.3. Abundance data are included in Appendix H; a summary of the range of density estimates for common taxa is presented in Table 3-29. Taxa occurring in the highest densities included cup corals (caryophylliids and

Table 3-29. Abundance Estimates (number of individuals/0.9 m^2 to 1.4 m^2, or percent cover) of Common Taxa Observed During the July/August 1984 Hard-Bottom Survey. Data Represent Abundance Estimates on Hard-Bottom or Soft-Bottom Substrate Depending on the Taxon, and are not Overall Estimates.

Taxon	Density		Percent Cover	
HARD-BOTTOM	Common	Maximum	Common	Maximum
Florometra	1-3	6-10		
Metridium	1-2	5-10		
Mediaster	<1-1	3		
Encrusting Sponges			1-5	20-30
Vase Sponge	<<1	<1		
Shelf Sponge			1	10-20
Gorgonocephalus	<<1	1-2		
Caryophylliidae	10-30	100-220		
Paracyathus	5-20	30-50		
Peridontaster	<1	1-2		
Stylasterias	<<1	5-10		
Lophogorgia	<<1-1	5-10		
Balanophyllia	1-2	10		
Terebratulina	1-4	5-10		
Ophiacantha	1-20	40-50		
Halocynthia	1	5-8		
Parastichopus	1	2		
Actinostola	1	2-3		
Lophelia			<<1	50-80
Pandalus	<<1	3-5		
Corynactis			<1	50-80
SOFT-BOTTOM				
Lytechinus	<1	10-25		
Allocentrotus	1	10		
Sea Pens	<1	1-3		
Octopus	<1	1-2		

Paracyathus) and the ophiuroid Ophiacantha. Taxa that were locally abundant (maximum values on Table 3-29) included crinoids (Florometra), anemones (Metridium and Actinostola), brachiopods (Terebratulina), echinoids (Allocentrotus) and tunicates (Halocynthia). Other taxa that were uncommon overall but reached high local abundances included Lophelia, Lophogorgia, Corynactis, and Pandalus.

The coral Lophelia californica and the spot prawn Pandalus platyceros represent species that are of potential ecological and commercial significance, respectively. Initial records of the occurrence of Lophelia were reported by Nekton (1983 and 1984) in vicinity of Lease Block P-0315; however, the ecological significance and sensitivity of this species to oil and gas development activities was virtually unknown. Preliminary results from the 1985 SAIC ROV survey conducted over a broader study area (Pt. Arguello to Pt. Conception) suggest that the species is relatively widespread over the region, occurring on many medium to high relief features from large outcrops to isolated boulders. Little is known of the life history of Lophelia, however the highly branched growth form and typical association of large amounts of coral rubble, noted for even robust looking colonies, as well as the widespread and often isolated occurrences of this species, may be indicative of an efficient colonizer characterized by relatively fast growth rates. During the July/ August 1984 hard-bottom survey Lophelia was relatively common along only two transects (2 A/B and 4 A/B) located in the Santa Barbara Channel and the Pt. Arguello region, respectively, but also was observed from Transect 27 A/B offshore of Morro Bay (Appendix G). The isolated occurrence of this species north of Pt. Arguello may indicate a limit to the geographic distribution. In addition to Lophelia, limited occurrence of the purple hydrocoral Allopora californica was noted along Transect 2 A/B near San Miguel Island (Appendix G).

The spot prawn P. platyceros is a relatively common species that is commercially fished in the survey region. However, the species was only observed along four transects (1 A/B, 4 A/B, 17 A/B and 19 A/B) within the survey area, with significant numbers of individuals (3 to 5/m^2) only observed at Transect 17 A/B.

Many of the previous studies of the general survey region did not provide abundance estimates for the majority of the taxa; however, visual comparison of photographic and videotype data from these surveys suggests very similar densities of the common taxa.

Comparisons which are possible indicate (1) similar maximum densities (50/m^2) of Ophiacantha (present study, and Dames and Moore, 1982); (2) similar maximum densities (approximately 200/m^2) of cup corals (present study; Dames and Moore, 1982 and 1983; Nekton, Inc., 1983); (3) relatively low maximum densities of Florometra (6 to 10) from the present study as compared to estimates from Lissner and Dorsey (in press) of 10 to > 30; and (4) similar maximum densities of Mediaster (3/m^2) and Lytechinus (approximately 20/m^2) from the present survey and Lissner and Dorsey (in press). Locally high abundances of some taxa including Florometra, Metridium, and Gorgonocephalus were associated with high to medium relief areas including localized prominances such as ridge tops and pinnacles; these features may represent optimal habitats from feeding and reduced exposure to near-bottom turbidity or sediment intrusion. Aggregations of Metridium can be common due to reproductive budding of new individuals from established individuals (e.g., Hoffman, 1976). Aggregations of Florometra may optimize fertilization success (Mladenov and Chia, 1983), however persistent aggregations may indicate regions of relatively high feeding success (Lissner and Dorsey, in press); high relief features associated with increased current flow probably represent areas of increased availability of suspended food.

3.2.2.3 Relationship to Environmental Variables

Ordination analysis of the hard-bottom environmental data was conducted to aid in defining relationships among the site groups defined by the cluster analysis (Figure 3-42). Separate plots with symbols indicating bottom type (hard-bottom or soft-bottom), bottom depth, relief (low, medium or high), percentage of sediment cover, and substrate type (outcrop, boulders, etc.) were performed for Axis 1/Axis 2 and Axis 1/Axis 3 of the ordination analysis. Examination of Figures 3-44 and 3-45 for Axis 1/Axis 2 suggests a partial separation of the site groups based on bottom type, and to a lesser degree by substrate relief and depth. Figure 3-45 shows a broad separation between Group 6 and Groups 1 through 5, corresponding to a range of sites

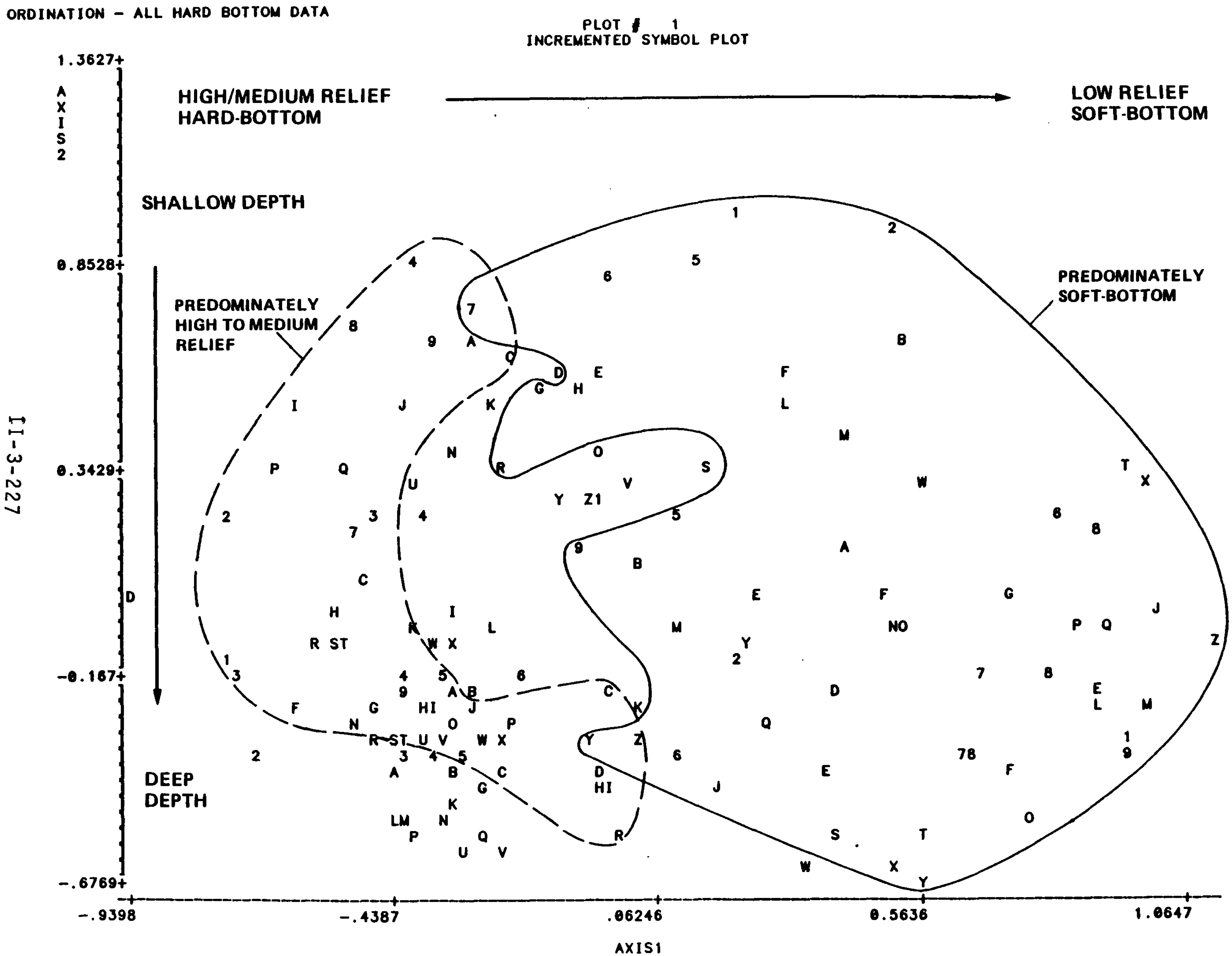

FIGURE 3-44 . Incremented Symbol Plot from Ordination of Hard-Bottom Data (see text for explanation).

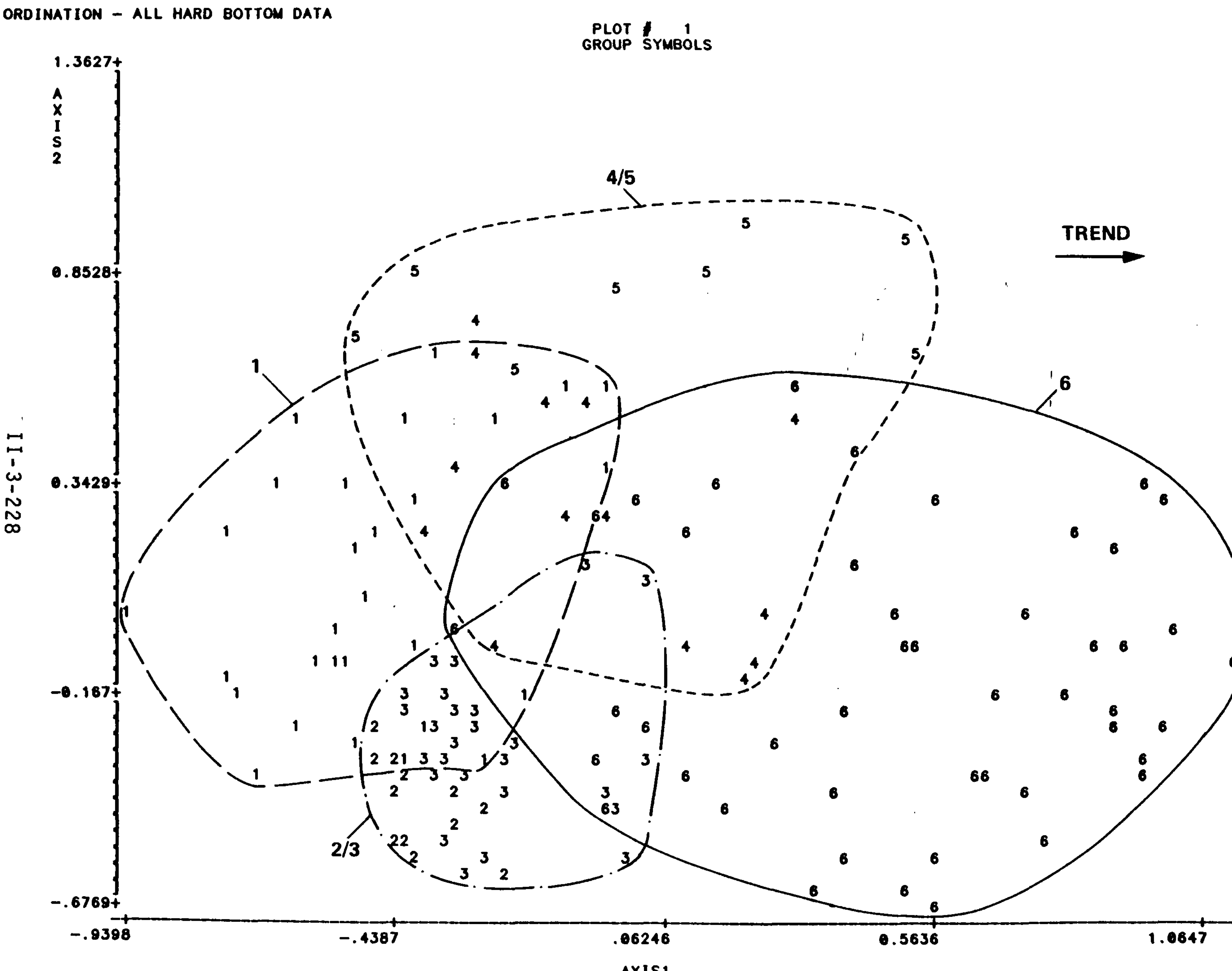

FIGURE 3-45. Group Symbol Plot from Ordination of Hard-Bottom Data (see text for explanation).

from low relief at the right of the ordination space to medium to high relief sites at the left, respectively. A subset of medium to high relief sites including some of the deeper areas surveyed (e.g., Transect 4A/B) is represented in part by Groups 2 and 3. There appears to be a general trend of deeper sites (e.g., Transects 19 A/B and 17 A/B) occurring towards the lower portion of the space, continuing from Groups 2 and 3 (hard-bottom, high/medium relief) towards the right and including the lower portion of Group 6 (soft-bottom low relief). These trends are also suggested by the individual plots of bottom type, depth and relief (Figures 3-46 to 3-48, respectively). The bottom plot indicates a broad separation from left to right between hard-bottom (Symbol 1) and soft-bottom (Symbol 2); the broad central area of overlap probably is related to inherent difficulties in distinguishing some hard-bottom areas due to the extensive sediment cover and the overlap of some common species (e.g., Mediaster and Parastichopus) on both types of substrate. The depth plot suggests a slight trend downward in the space from shallow to deeper depths; however, there is extensive overlap among the values (scaled from 1 to 9) probably due to the somewhat narrow survey depth range (mean of approximately 300 to 400 ft). The relief plot indicates a general trend from left to right between medium (Symbol 5)/high relief (Symbol 9) and low relief (Symbol 1); the broad area of overlap to the left of the space probably is related to the large number of taxa (e.g., Metridium, Paracyathus, Florometra, and Sebastes) which are generalists over the range of substrate relief. The plots of silt cover and substrate type (Figures 3-49 and 3-50) did not exhibit any obvious trends, and probably was related to the

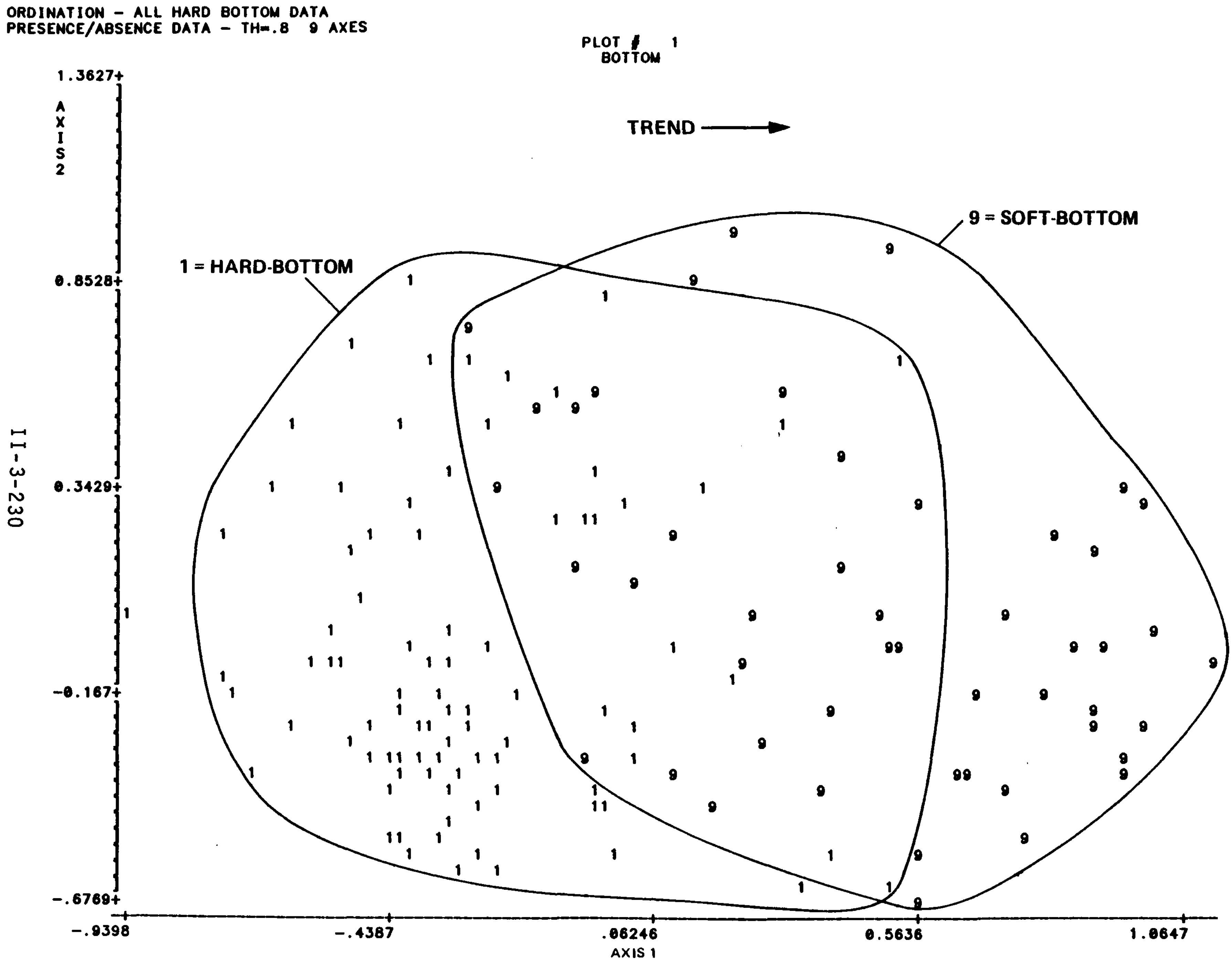

FIGURE 3-46. Bottom Type Plot from Ordination of Hard-Bottom Data.

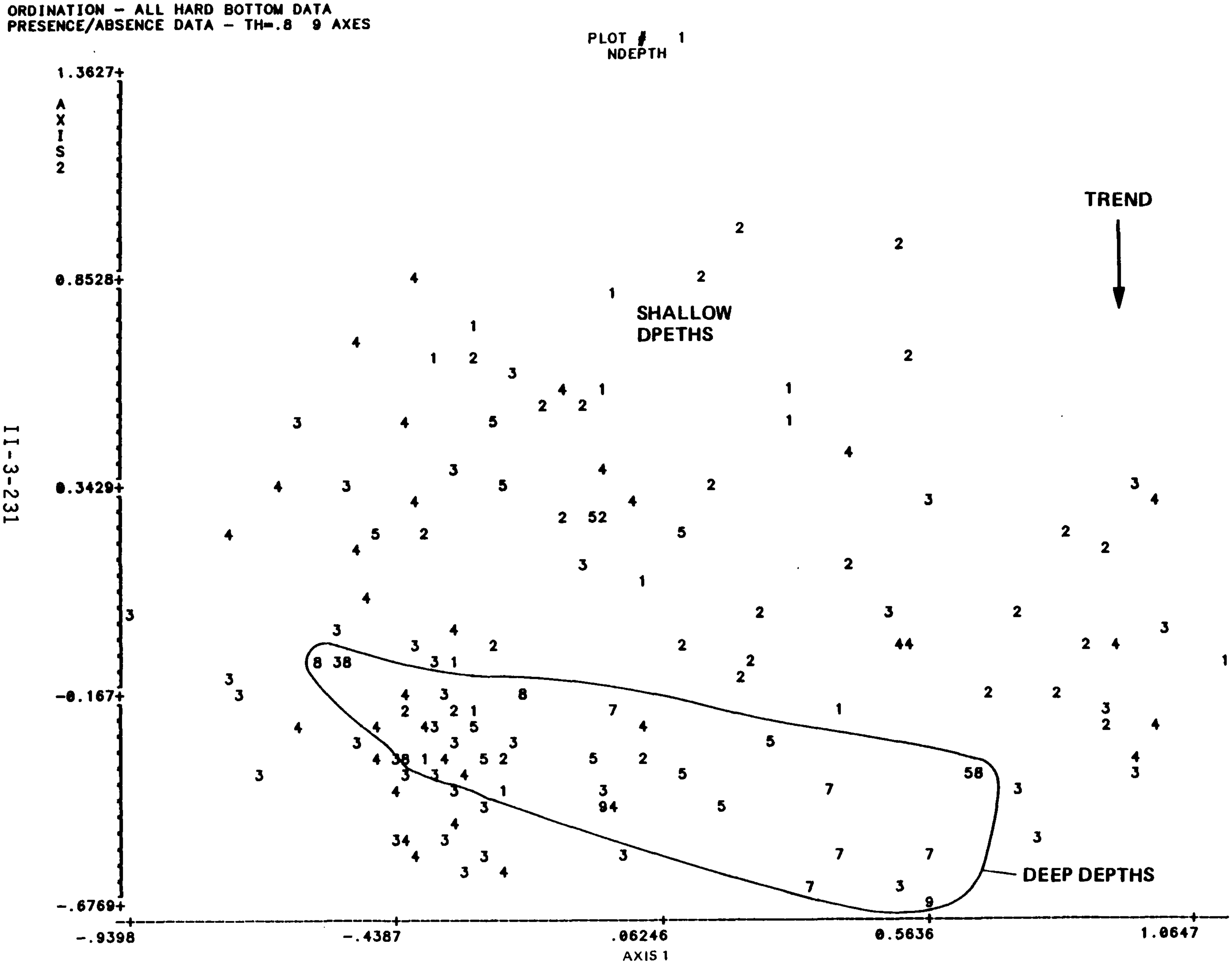

FIGURE 3-47. Depth Plot from Ordination of Hard-Bottom Data.

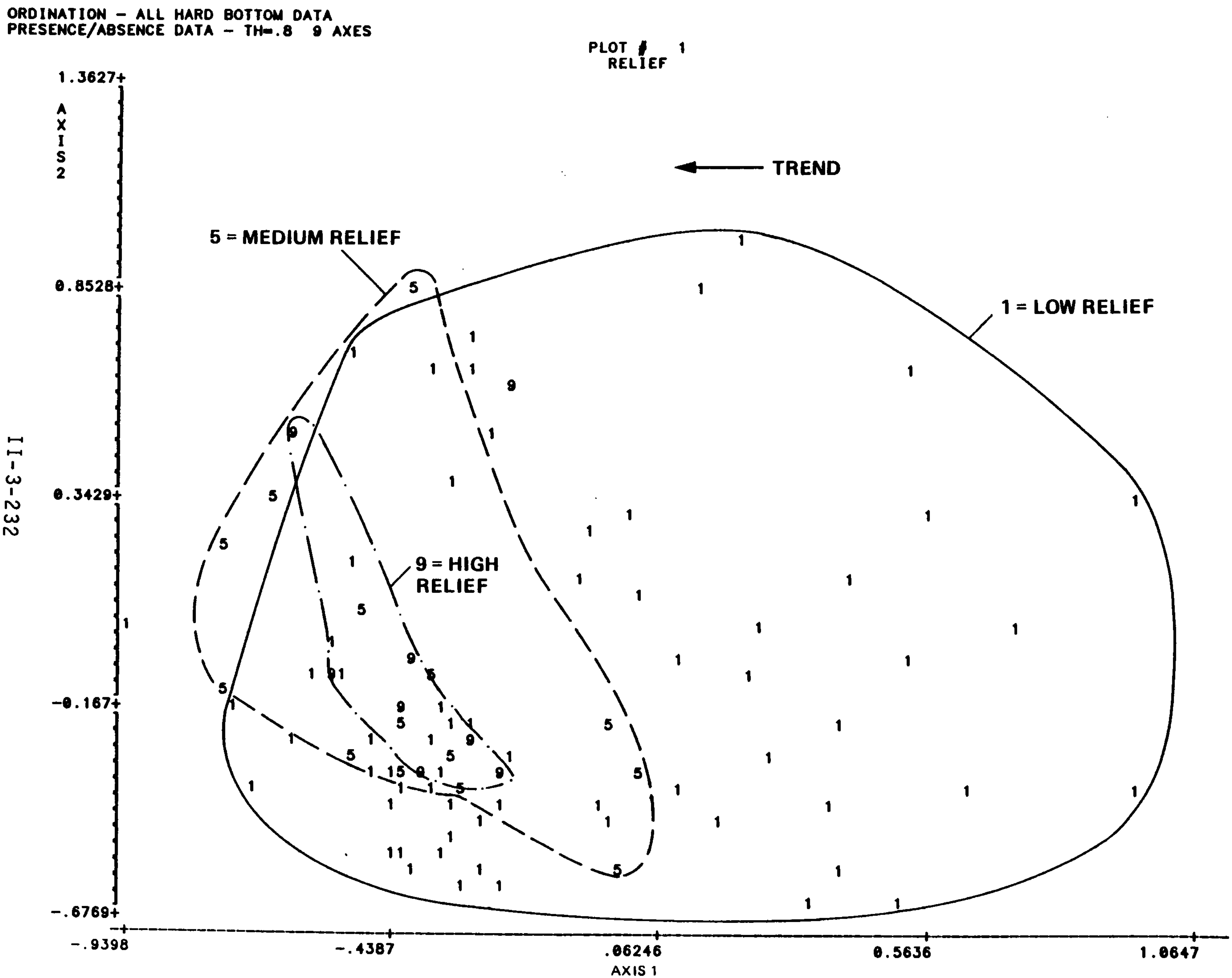

FIGURE 3-48. Substrate Relief Plot from Ordination of Hard-Bottom Data.

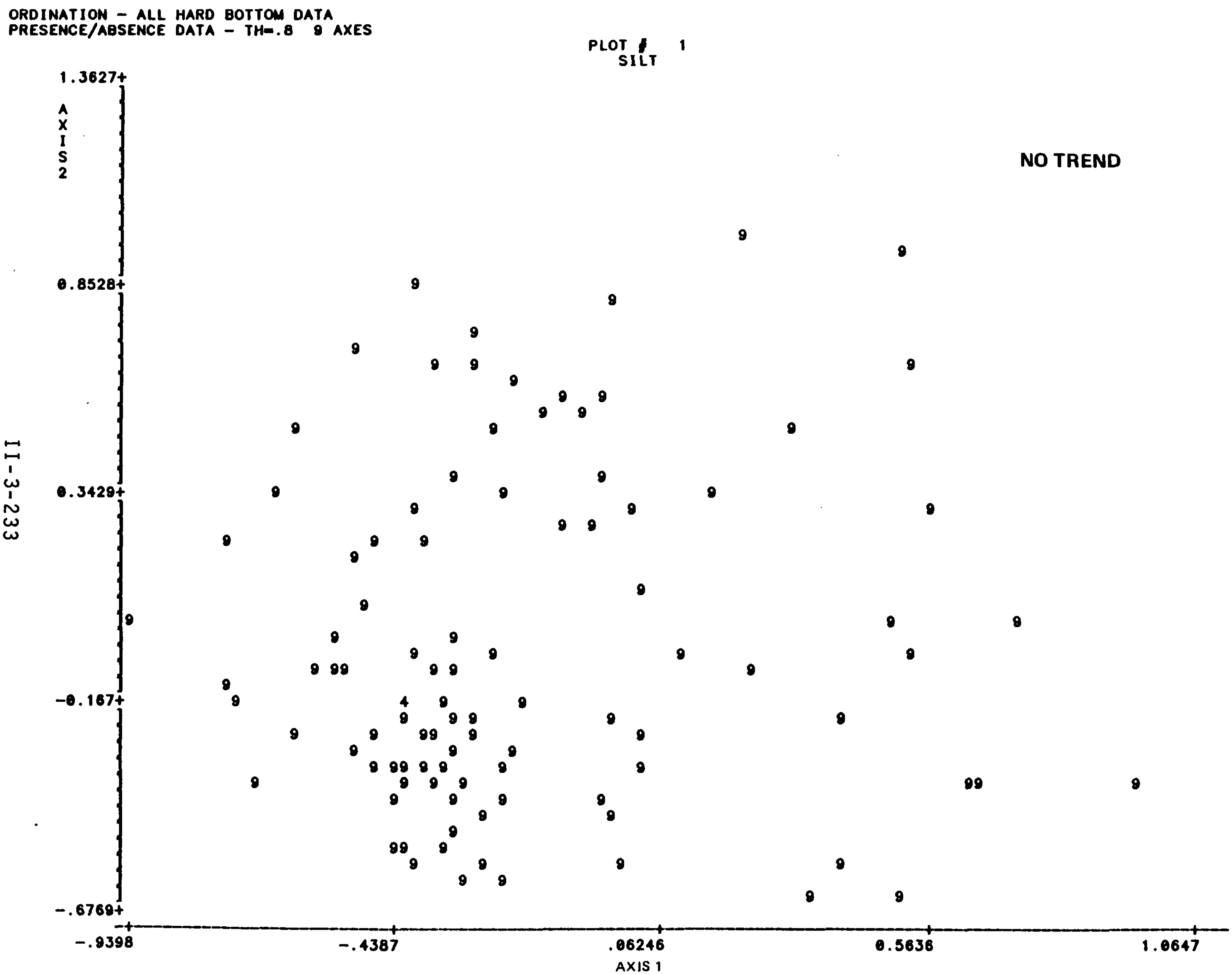

FIGURE 3-49. Percentage of Sediment ("Silt") Cover Plot from Ordination of Hard-Bottom Data.

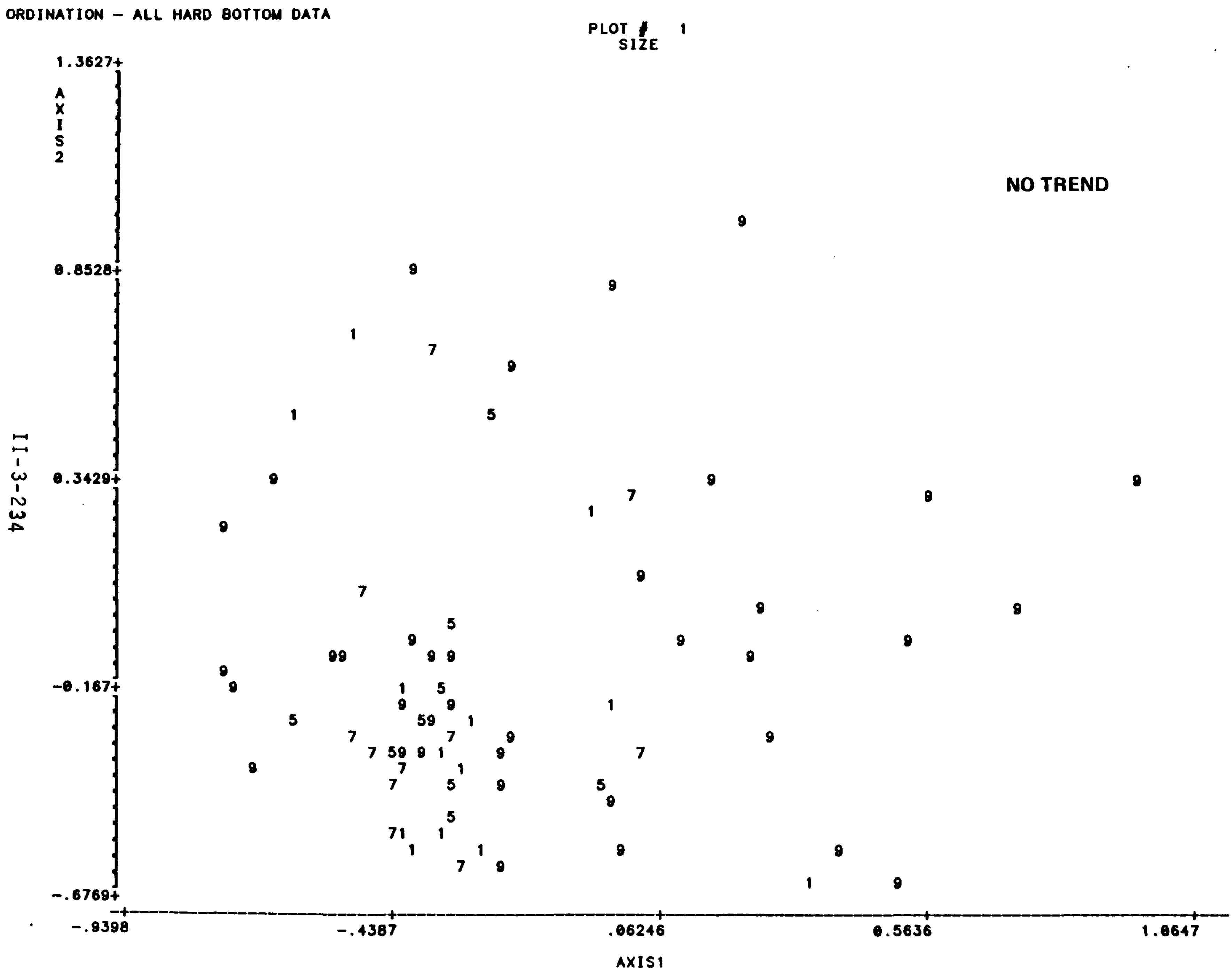

FIGURE 3-50 . Substrate Size (Outcrop, Boulders, Cobble, Pebble, Rubble) Plot from Ordination of Hard-Bottom Data.

high percentage (90 to 100%) of silt observed covering most hard-bottom areas, and the generalist nature of many of the hard-bottom taxa, respectively. Similar trends for bottom type, depth, and substrate relief are indicated by ordination plots for Axis 1/Axis 3; these data are included in Appendix I.

3.2.2.4 Comparison with Historical Data

General Trends

The taxa and assemblages of hard-bottom and soft-bottom organisms observed from the present survey are very similar to those observed during previous studies of the general survey region conducted by Dames and Moore (1982 and 1983), Nekton, Inc., (1981, 1983 and 1984) and Engineering Science (1984). These earlier studies focused on selected features from the southern to central portion of the survey area (Pt. Conception to approximately Purisima Pt.) and did not extend into the northern portion (approximately Purisima Pt. to Pt. Estero) also surveyed during the present study. However, results from the present study indicate that the biological assemblages observed are common throughout the general survey area (western Santa Barbara Channel to at least Pt. Estero, CA) and did not exhibit any significant trends with geographic location (latitude) or depth over the majority of the depth ranges surveyed (180 to 600 ft).

The depth range from approximately 600 to 790 ft was not extensively studied during the present survey and primarily corresponded to soft-bottom areas of Transects 4 A/B and 19 A/B. Consequently, the hard-bottom data from these depths should be considered provisional. Results from the present study suggest that naturally high levels of sediment cover, and presumably sediment transport, are major factors influencing the shallow (to approximately 600 ft) hard-bottom asemblages in the survey region. Types of effects may include fouling of filter feeding structures, burial, and decreased area for larval settlement or attachment. These sediment loads should have the greatest potential effect in low relief areas, and potentially on most horizontal surfaces including broad ridge tops, and should be moderated in higher relief areas, particularly vertical walls where sedimentation levels are reduced. This relationship was observed for the three hard-bottom assemblages (generalist, high/medium relief and medium/low relief) noted throughout the survey area, and was concluded to a primary factor influencing the assemblages observed during previous studies of the region (Dames and Moore, 1982 and 1983; Nekton, 1981, 1983 and 1984). Nekton (1983) noted an apparent "band" of increased diversity, beginning approximately 6 ft up from the base and extending to the top of high relief features, that probably was related to sedimentation effects. Similar bands were not observed during the present survey although local differences in current structure and sediment transport are likely to occur. Dames and Moore (1982) noted that hard-bottom assemblages occurring deeper than approximately 500 ft appeared to be characterized by greater diversity, perhaps as related to a lower suspended sediment load at these and greater depths. Few data on bottom currents and sediment transport in the region are available and will be necessary to adequately assess the relationship between these variables and the long-term stability and diversity of the biological assemblages.

Patterns of abundance suggesting zonation with depth were observed for several common taxa. Dames and Moore (1983) noted that crinoids (Florometa) and basket stars (Gorgonocephalus) occurred most commonly at depths greater than approximately 350 ft; Dames and Moore (1982) noted that Gorgonocephalus was more common below 500 ft. Similar trends were observed from the present survey with Florometra occurring most frequently and abundantly below approximately 350 ft, and Gorgonocephalus present from at least 300 ft with increased abundance beginning at 450 ft (Table 3-28 and Appendix H). Other trends in common between the present survey and Dames and Moore (1982 and 1983) included (1) increased frequency and abundance of Paracyathus and Corynactis at depths shallower than 450 ft, and 350 ft (Dames and Moore, 1983, < 250 ft), respectively, and (2) increased abundance of caryophilliid cup corals at deeper depths (present survey > 350 ft; Dames and Moore, 1982, > 500 ft). Similar broad patterns of species zonation with depth were defined by Lissner and Dorsey (in press) for Tanner and Cortes Banks offshore of Southern California.

Previous studies (e.g., Nekton, Inc., 1983) generally defined two types of hard-bottom asemblages associated with (1) low relief/high sedimentation and (2) high relief/low sedimentation. These assemblages correspond very closely to the medium/low relief and the high/medium relief assemblages from the present survey except that we have defined an additional (generalist) assemblage to emphasize the local differences in abundance that may occur for many of these taxa.

The taxonomic lists of common organisms and general habitats defined from the present and earlier studies (Dames and Moore, 1982 and 1983; and Nekton, Inc., 1981, 1983 and 1984) are very similar and include:

Low Relief Habitat: ophiuroids (*Ophiacantha* and "*Ophiopholis*"/"*Ophionereis*"), cup corals (*Paracyathus* and caryophylliids), anemones (*Actinostola* and *Metridium*), various sponges, brachiopods (e.g., *Terebratulina*), unidentified hydroids and bryozoans, asteroids (*Mediaster*, *Peridontaster*, and *Stylasterias*), crinoids (*Florometra*) holothuroids (*Parastichopus*), tunicates (*Halocynthia*), and rockfish (*Sebastes* spp.).

High/Medium Relief Habitat: anemones (*Metridium*, *Actinostola*, and several undescribed species), cup corals (*Paracyathus*, *Desmophyllum*, and caryophylliids), occasionally colonial corals (*Lophelia*), crinoids (*Florometra*), ophiuroids (*Gorgonocephalus*), galatheid crabs (*Galathea* and *Munida*), sponges (increased density and variety), asteroids (*Mediaster*, *Peridontaster*), and rockfish (*Sebastes* spp.).

Similar to the hard-bottom assemblages, the soft-bottom epifaunal organisms observed during the present and previous surveys (Dames and Moore, 1982 and 1983; Nekton, Inc., 1981, 1983, and 1984) also were very similar.

Common taxa included Octopus sp. (small, common), sea pens (Stylatula, Acanthoptilum, Stachyptilum, and Ptilosarcus), echinoids (Allocentrotus, Lytechinus, Brissopsis, and Brisaster), asteroids (Mediaster and Liudia) holothuroids (Parastichopus), unidentified ophiuroids, combfish (Zaniolepis), and various flatfish (e.g., Citharichthys). Although sea pens as a group were present throughout most of the soft-bottom area, individual taxa were uncommon (< 1/20 m^2) along many transects, and were reported as rare by Nekton, Inc., (1983). Additionally, Dames and Moore (1982) noted that where they occurred, sea pens were most common at depths less than approximately 500 ft, with a corresponding increase in cerianthid anemones below this depth. All of the taxa observed were present throughout the survey region from the Santa Barbara Channel to at least Pt. Estero, CA. The assemblage is typical of the shelf/slope fauna described by Fauchald and Jones (1978).

Some differences in taxonomy among the various surveys are expected due to increased knowledge and descriptions of new species following earlier surveys. Notable taxonomic differences between the present and previous surveys include:

- Rathbunaster californicus (asteroid) probably is the equivalent of Pycnopodia helianthoides identified by Nekton, Inc., (1981, 1983). Some P. helianthoides were observed from the present survey however not in the frequency and at the depths reported by Nekton.

- Octopus sp. (small, common) observed primarily over soft-bottom probably is the equivalent of O. c.f. dofleini identified by Nekton, Inc. (1983), and Octopus rubescens correctly identified by Dames and Moore (1982 and 1983). Octopus dofleini is the largest Octopus species, inhabiting shallow-water, hard-bottom areas.

- Gorgonocephalus eucnemis (basket star) is the equivalent of G. caryi specified by previous surveys (Dames and Moore, 1982 and 1983; Nekton, Inc., 1981, 1983, and 1984); G. eucnemis has taxonomic precedence over G. caryi.

- Parastichopus c.f. johnsoni ("red" sea cucumber) probably is the equivalent of most Parastichopus sp. noted by Nekton (1983), and the "second" Parastichopus species noted by Dames and Moore (1982, and 1983).

- Lophogorgia sp. (stunted, red gorgonian) probably is the equivalent of the stunted Eugorgia rubens identified by Nekton (1983, and 1981). Stunted Lophogorgia were relatively common in most transect areas from the present survey as verified from rock sample scrapings; E. rubens was uncommon.

- *Actinostola* sp. A is the equivalent of *Actinostola callosa* from Dames and Moore (1982 and 1983) and Nekton, Inc., (1983 and 1984), and probably some of the *Tealia* spp. referenced by Nekton Inc., (1981).

Site Specific Comparisons

Transects 4 A/B, and 16 A/B and 20 A/B from the present study were located near hard-bottom features previously surveyed by Nekton (1983, 1984), and Nekton (1981) respectively. The transect area for 4 A/B (Lease Block P-0315) was located west of the Nekton (1983, 1984) survey area (dive areas 7 and 8), and corresponds to proposed transect "Harvest F" from the 1985 SAIC ROV survey of the region. Comparison of these data indicated a high degree of similarity in the taxa observed for medium relief hard-bottom areas and soft-bottom areas; low relief hard-bottom areas were not present in the region covered by Transect 4 A/B. Medium relief areas from both surveys were characterized by biolgical Assemblage C/A type organisms including *Metridium*, cup corals (*Desmophyllum*, *Paracyathus*, and caryophylliids), basket stars (*Gorgononcephalus*), various sponges, some occurrences of the coral *Lophelia* and the anemone *Corynactis*, and rockfish (*Sebastes* spp). Soft-bottom areas were dominated by Assemblage D type organisms including various sea pens, *Octopus*, asteroids (*Mediaster*), unidentified ophiuroids, and combfish (*Zaniolepis*). Both surveys noted extensive sediment cover of hard-bottom features, decreasing somewhat in association with higher relief features. The biological assemblages observed are typical of those occurring throughout the general survey region; however, the depth ranges studied (approximately 600 to 800 ft) are deeper than the majority of the areas surveyed north of Pt. Arguello, and may represent a more favorable zone for some organisms (e.g., sponges) due to reduced sediment transport, as suggested by Dames and Moore (1982).

Transects 16 A/B and 20 A/B (Lease Blocks P-0425 and P-0430) were located adjacent to three transects (45, 48, and 64) previously surveyed by Nekton, Inc. (1981), with some overlap of two Transects (48 and 64) by Transect 16 A/B. Results from the present survey indicate an extensive low relief hard-bottom area characterized by Assemblage C and C/A type organisms located between the Nekton transects, and intermittent areas of high to medium relief characterized by Assemblage B type organisms, including Florometra, Metridium, Gorgonocophalus, cup corals, and Corynactis. Results from the Nekton survey indicated similar biological assemblages over areas of comparable relief along Transects 48 and 64. Many of the species records from this earlier survey were only listed by general taxonomic level (e.g., brittle stars or rockfish), however, based on inspection of stereophotographs and video data descriptions from the survey, no large-scale differences between the surveys were observed.

3.2.2.5 Biological Assemblages of Rock Microepifauna

The microepifauna of rock surfaces was examined by field collection and laboratory analysis of rock samples (see Methods Sections 2.1.2.4 and 2.2.2.2, respectively). Virtually all of the 786 taxa encountered in the laboratory analysis were too small to have been detected and identified *in situ* by the biological observers from the submersible. Other larger voucher specimens which were collected during the survey also were returned to the laboratory for confirmation/identification (Table 3-30).

Forty-four rocks were collected during the survey, however, some rocks from the same transect were combined in analysis to form a single sample (Table 3-31). This was necessary along some transects where several rocks were placed into the same collecting basket, affording their associated motile fauna the possibility of moving between rocks. In several cases the majority of the specimens of motile species were collected from the basket's screen lining, and not from the rocks themselves, making determinations of which rock they had been associated with impossible.

Retrieved rocks came primarily from 280 to 430 ft off Purisima Point. Eight different transects in this area contacted rocky substrate and as many as five rocks were retrieved from a single transect. All of the rocks were relatively small, with the maximum single rock surface area 892 cm^2. All samples were collected either from rubble fields, or from talus accumulations in depressions or at the base of outcrops or large boulders. As such they primarily represent low relief hard-bottom habitats within the study area.

Table 3-30. Hard-Bottom Voucher Specimens.

Station	Transect/ Replicate	Date	Time	Depth	Field Identification	Final Identification
1	A/B 3	07/28	0902	240'	Gorgonian	Eugorgia cf. rubens
1	A/B 3	07/28	0909	240'	Henricia	Henricia laeviuscula annectus
1	A/B 3	07/28	0913	240'	Sponge	Pachastrellidae sp. B
1	A/B 3	07/28	0926	240'	Bryozoan	Diaperoecia californica
1	A/B 2	07/28	1046	235'	Astropecten	Astropecten verrilli
1	A/B 2	07/28	1048	235'	Lytechinus	Lytchinus pictus
1	C/D 3	07/28	1708	250'	Parastichopus	Parastichopus californicus
1	C/D 2	07/28	1718	250'	crab-Telmessus?	Paramola faxoni
1	C/D 4	07/28	1814	245'	Coencyathus	Coenocyathus bowersi
2	A/B 2	07/08	1340	420'	Gorgonocephalus	Gorgonocephalus eucnemis
6	A/B					
	C/D 3	07/11	1121	180'	bracket sponge	Sigmadocia cf. edaphus
13	A/B 4	07/18	1648	320'	Pycnopodia helianthodes	Pycnopodia helianthodes
13	C/D 3	07/30	0901	325'	yellow/orange branching sponge	Raspailiidae LPIL
13	C/D 2	07/30	1054	300'	Paguristes	Paguristes ulreyi
13	C/D 3	07/30	1115	300'	skate egg case	catshark egg case
14	A/B 3	07/30	1652	340'	Henricia	Henricia laeviuscula annectens
14	A/B 3	07/30	1759	330'	plate sponge	?Sphinctrella sp. A
14	A/B 3	07/30	1759	330'	Florometra	Florometra serratissima
16	A/B 3	07/23	0918	320'	staurocalyptus-like sponge	Staurocalyptus solidus
17	A/B 3	07/18	1226	540'	red sea cucumber	Parastichopus cf. johnsoni
17	A/B 2	07/18	1251	540'	Scalpellum	Arcoscalpellum californicus
20	A/B 3	07/15	1055	410'	Hippasterias	Hippasteria spinosa
21	A/B 1	07/14	1707	280'	Hippasterias	Poraniopsis inflata
21	A/B 1	07/14	1708	280'	-	Pteraster tesselatus arctuatus
22	A/B 2	07/13	1442	380'	Luidia	Luidia foliolata
26	A/B 1	07/17	1536	310'	Luidia	Luidia foliolata
26	A/B 2	07/17	1541	310'	Rathbunaster	Rathbunaster californicus
28	A/B 1	07/17	1040	320'	Metridium	Metridium "senile"

Table 3-31. General Descriptions of the Rock Samples Collected During the July/August 1984 Hard-Bottom Survey.

Transect/Sample	Depth (ft)	Surface Area (cm^2)	No. Rocks	No. Faces	Rugosity Index[1]
001-BRA-03	240	621	1	6	2
001-BRC-01	250	504	1	6	2
001-BRC-02	250	755	1	10	3
002-BRA-01	380	749	1	5	2
002-BRA-02	420	655	1	4	5
002-BRC-01	400	1383	2	10	4
004-BRA-02	750	799	1	5	2
004-BRA-04	750	503	1	6	4
006-BRA-02	200	1291	2	11	6
006-BRA-04	200	355	1	5	1
013-BRA-01	320	683	3	16	2
013-BRA-04	320	473	1	7	5
013-BRC-01	315	311	1	6	5
013-BRC-02	335	200	1	5	5
013-BRC-03	300	349	1	6	3
014-BRA-02	340	489	1	5	5
014-BRC-01	370	548	1	3	1
014-BRC-02	385	445	1	5	2
014-BRC-03	370	124	1	6	5
014-BRC-04	365	405	1	6	3
016-BRA-01	320	1185	2	9	5
016-BRA-02	400	892	1	6	5
016-BRA-04	315	624	2	14	5
017-BRA-01	535	240	2	4	5
020-BRA-03	430	250	1	4	5
020-BRA-03	380	507	1	5	3
020-BRA-04	320	1138	2	10	5
021-BRA-01	280	1023	2	11	4
021-BRA-02	285	944	2	13	5

Table 3-31. (cont'd)

Depth Transect/Sample	Surface Area (ft)	No. (cm2)	No. Rocks	Rugosity[1] Faces	Index
025 BRA-01	230	404	1	5	1
025-BRA-02	235	478	1	7	1
027-BRA-01	380	590	1	7	2
027-BRA-02	340	303	1	5	3

[1]RUGOSITY INDEX:

1 low; 2 medium/low; 3 medium; 4 medium/high; 5 high; 6 high/very high

Species Overview

The 786 taxa from the 44 analyzed rocks were distributed among 17 phyla (Table 3-32 and Appendix D). Several phyla which were poorly represented in the soft bottom collections were very important and diverse components of the rock microfauna. Chief among these were the Ectoprocta and Porifera, with large diversity increases in Cnidaria and Urochordata. Forty-three percent of the collected epifaunal taxa occurred only once in the database, and 16% occurred twice. Although uncommon and rare taxa were of considerable interest since many were undescribed, they were of little interest or utility in data analysis. Such records contribute only to the "noise" which may obscure patterns in the data. Both taxa evaluated as individuals and those quantified as percent of rock surface occupied were used to classify the sites. The former were either colonial (e.g., bryozoans) or of indeterminate growth form (i.e. sponge crusts). Thirty species were sufficiently abundant and widespread to occur in more than one-half of the samples (Table 3-33). These included 13 species quantified by percent cover and 17 counted species. Eleven of the percent cover species were ectoprocts; the remaining two were sponges. Counted species represented a greater variety of groups, primarily dominated by polychaete worms. However, other measures of species importance (total cover, Table 3-34; total abundance, Table 3-35) indicated that other less evenly distributed species also were dominant. Four additional dominants represented by percent cover species were all erect bryozoans of either reticulate plate (Phidolopora pacifica) or branching (Scrupocellaria

Table 3-32. Species Complement of Hard-Bottom Samples.

Major Group	Total Taxa	Described	Near Described	Recognized Undescribed	Newly Recognized
Porifera	108	13	6	18	62[b]
Cnidaria	49	9	8	3	13
Platyhelminthes	1[a]	-	-	-	-
Nemertea	11	3	0	0	0
Kinorhyncha	-	-	-	-	-
Nematoda	1[a]	-	-	-	-
Annelida	232	99	18	1	29
Mollusca	87	55	1	0	5
Chelicerata	9	5	1	0	1
Crustacea	118	74	3	3	8
Sipunculida	4	1	1	0	0
Echiura	-	-	-	-	-
Phoronida	1[a]	-	-	-	-
Ectoprocta	107	78	3	1	13[b]
Entoprocta	1	1	0	0	0
Brachiopoda	4	4	0	0	0
Echinodermata	20	10	1	0	0
Hemichordata	1[a]	-	-	-	-
Urochordata	32	4	1	0	25[b]
Total	786	356	43	26	156

a = not identified to species
b = potential variants of described species

Table 3-33. Dominant Species by Occurrence in Samples (16 or more occurrence = 50%).

Rank	% Cover Species	Number of Occurrence	Rank	Number/m^2 Species	Number of Occurrence
1	Anguinella palmata (E)	30	1	Pholoides aspera (P)	33
2	Micropora coriacea (E)	26	2	Hiatella arctica (B)	30
3*	Sponge #75 (S)	26	3	Pherusa papillata (P)	30
6*	Porella porifera (E)	23	4	Hanleyella oldroydi (C)	28
7	Proboscina sigmata (E)	22	5	Amphipholis squamata (O)	27
8	Fenestrulina malusi (E)	22	6	Lepidonotus squamatus (P)	26
11	Puellina setosa (E)	19	7	Glycera tesselata (P)	25
14	Cellaria diffusa (E)	17	8	Ophiopholis bakeri (O)	24
15	Sponge #78 (S)	17	10	Delectopecten vancouverensis (B)	22
16	Trypostega claviculata (E)	16	11	Chelyosoma columbianum (U)	21
17	Parasmittina californica (E)	16	15	Lepidozona retiporosa (C)	19
18	Hinksina alba (E)	16	16	Paracyathus stearnsii (Cc)	17
19	Emballotheca latifrons (E)	16	17	Exogone lourei (P)	17
			18	Exogone gemmifera (P)	17
			21	Gnathia sanctaecrucis (I)	16
			22	Eulalia ?bilineata (P)	16
			23	Clymenura columbiana (P)	16

* missing ranks were occupied by taxa not identified to species level

B = bivalve mollusk C = chiton mollusk Cc = cup coral E = ectoproct (bryozoan)
I = isopod crustacean P = polychaete worm S = porifera (sponge) U = urochordate (sea-squirt)

Table 3-34. Dominant Species by Total Cover.

	Total % Cover	Rank by % Occurrence	Major Group
Scrupocellaria varians	176*	56	E
Crisia maxima	102	24	E
Micropora coriacea	86	2	E
Diaperoecia californica	83	37	E
Trypostega claviculata	76	16	E
Phidolopora pacifica	66	29	E
Sponge #75	45	3	S
Anguinella palmata	42	1	E
Porella porifera	37	6	E
Puellina setosa	36	11	E

* maximum possible value 3300

E = Ectoprocta S = Porifera

Table 3-35. Dominant Counted Species (based on rank by total abundance).

	Species	Total Abundance*	Mean Occurrence	Rank
P	Pholoides aspera	13005.70	394.112	1
B	Hiatella arctica	12430.20	414.341	2
O	Amphipholis squamata	7874.20	291.636	5
P	Perusa papillata	7035.75	234.525	3
Br	Platidia hornii	5692.60	474.383	32
O	Ophiopholis bakeri	5408.02	225.334	8
P	Glycera tesselata	3480.17	139.207	7
Cc	Paracyathus stearnsii	3140.83	184.755	16
P	Lepidonotus squamatus	3009.74	115.759	6
B	Delectopecten vancouverensis	2203.10	100.141	10

* aggregate count after standardization to individuals/m^2

B = bivalve　Br = brachiopod　Cc = cup coral
O = ophiuroid　P = polychaete worm

varians, Crisia maxima, Diaperoecia californica) colony morphology. The only additional counted species was the small pedunculate brachiopod Platidia hornii.

Cluster Analysis of Microepifaunal Data

The same cluster analysis methods applied to the soft-bottom data (see Section 3.1.3.1) was performed on the rock microepifauna database. Each of the 33 separate collections was included in an initial analysis, rather than each rock separately. Both percentage cover data and count data were included in the analysis with records of both types standardized as percentage of species total collection. As in the soft-bottom analysis one of the sites proved so different from the others that its inclusion reduced the distinctions between the remaining sites. Consequently, the analysis, using a flexible sorting strategy with beta set at -0.25 and alpha at 0.625, was rerun with the outlier (006-BRA-04) excluded.

Sites did not cluster along recognizable gradients in environmental parameters and there was no grouping by depth over the range of survey depths (200 to 750 ft). Groups were not geographically uniform over the range of sampled locations from the western Santa Barbara Channel (Transect 1 A/B) to to offshore of Morro Bay (Transect 27 A/B). The 33 sites grouped into 11 clusters in five main groups:

Group 1

3 clusters: 240 to 750 ft depths between Gaviota and Purisima Point.

Group 2

2 clusters: 340 to 385 ft depths between Purisima Point and Morro Bay.

Group 3

1 cluster: 380 to 750 ft depths between San Miguel Island and Point Sal/ Purisima Point.

Group 4

3 clusters: 230 to 380 ft depths between Gaviota and Pt. San Luis.

Group 5

2 clusters: 200 to 750 ft depths between Gaviota and Morro Bay.

Inspection of the two-way table also did not suggest any patterns in the data. Some differences between groups were distinct, however, both constancy and fidelity were low throughout the table.

Evaluation of species composition at the sites within the five groups showed some differences which helped explain the group separations. Group 1 sites were primarily characterized by encrusting percent cover species, in contrast to all other site clusters. The ratio of mean number of percent cover taxa to mean number of counted taxa within the group was 1.19. In other groups the ratio was less than one, ranging from 0.37 in site Group 3 to 0.72 in site Group 2.

Group 2 sites generally were less characterized by fewer taxa than sites in other groups. The mean number of taxa per sample at Group 2 stations was approximately one-third of that at Group 5 sites (54.4 ± 20.1 vs. 148.9 ± 40.9), and just over half the 32 sample average (97.5 ± 45.1 taxa per sample).

The Group 3 site was characterized by relatively low numbers of encrusting species (counted/encrusting ratio 0.37), although several percent cover dominants occurred in the Group 3 sample at high relative abundances (i.e., the bryozoans Fenestrulina malusi and Diaperoecia californica). Species richness (measured as number of taxa) at the site was intermediate between that at Group 1 and 2 and Group 4 and 5 sites.

Groups 4 and 5 represented sites whose average counted/encrusting species ratios were very similar (Group 4 = 0.47, Group 5 = 0.49). Average species richness was much greater at Group 5 sites, although the standard deviations of the group means overlapped. Differences in species richness between these groups may, however, be related to sample size (mean 434 cm^2 at

Group 4 sites and 803 cm^2 at Group 5 sites) although biotic variables were not well correlated with sample size.

The inverse classification separated the biota into seven main groups. Species Group 1 contained seven encrusting taxa which occurred at high relative (and low absolute) density in most of the site clusters. Species Group 2 contained a mixture of 72 count and percent cover species including most (69%) of the dominant species. Most species in this group were both widely distributed and relatively high in percent cover or density per occurrence.

Species Group 3 contained 26 taxa which were characteristic of samples from site Groups 10 and 11 and occurred infrequently at other sites. The percent cover dominant Phidolopora pacifica (bryozoan) was a member of this species group.

Species Group 4 taxa were characteristic of sites in Clusters 6, 7, 8 and 9, but also occurred frequently at sites in Clusters 10 and 11. One percent cover dominant, the bryozoan Parasmittina californica, and four dominant counted species were members of this species group. The dominant count species were the polychaetes Exogone gemmifera and Exogone lourei, the clam Hiatella arctica, and the cup coral Paracyathus stearnsii.

Virtual absence from sites in Clusters 1, 3 and 4 and maximum relative abundance at site Clusters 7, 9 and 11 was typical of taxa in species

Group 5. None of the dominants were members of this group, which consisted of 9 counted species and 3 percent cover species.

Species Group 6 taxa were most characteristic of site Cluster 3. They also occurred in medium to high relative abundances at sites in Clusters 10 and 11. Two percent cover dominants, the bryozoans *Diaperoecia californica* and *Scrupocellaria varians* were members of this group. Only six of the 16 taxa in this group were count species.

The taxa in species Group 7 were mainly counted species (7 of 11 taxa), none of the 11 were among the dominants. These taxa were characteristic of sites in Clusters 5 and 11, were absent from sites in Cluster 4, and were very infrequent at Clusters 1, 2, 3, 8 and 9 sites.

In summary, the results of the cluster analysis suggest:

- No recognizable bathymetric gradient over the range of survey depths examined (200 to 750 ft).

- Rock samples from sites throughout the study area did not group consistently by transect.

- Sites with similar species richness and/or similar ratios of encrusting and motile count species tended to group together.

The rock scraping data from the present survey are not directly comparable to the results from previous studies (Dames and Moore, 1982; Nekton, Inc., 1983) since the present analysis involved a more detailed scraping and analysis of the microepifauna. However, several species in common were noted among the surveys including the bryozoans Emballotheca, Cellaria, Diaperoecia, and Phidolopora; brachiopods Platidia; polychaetes Lepidonotus and Glycera; corals Paracyathus; ophiuroids Ophiopholis, and bivalves Hiatella and Delectopecten.

New Species

Analysis of the microepifauna of the collected rocks yielded specimens of 156 newly recognized, undescribed species, 26 of which were previously known but still undescribed, and 43 species which are probable variants of described species. A discussion of the general criteria used to distinguish new species from unidentifiable specimens is presented in Section 3.1.3.2.

Many of the newly recognized species are in the phyla Porifera, Ectoprocta and Urochordata (Table 3-32). No satisfactory key to ectoproct families exists (D. Soule, personal communication, 1985); consequently, undescribed species represented either by small numbers of specimens or incomplete representation of life history stages (i.e., no reproductive adults collected) are identified only as "Bryozoa" and a corresponding species number (e.g., Bryozoa 217). An extremely wide range of test morphology is known for some eurytopic ectoproct species, and it is probable that some of the forms currently considered as new species will prove to be only extreme variants of recognized species.

Variability in growth form also is extensive in sponges and urochordates and it is likely that some specimens considered to represent new species also will prove to represent described species. In some cases the present collections have provided material which invalidates previously accepted described species. The growth series of small cup corals collected in this study, for example, indicated that Paracyathus montereyensis was only a growth stage of Paracyathus stearnsii (Ljubenkov, personal communication, 1985). In at least two cases, species initially considered undescribed have been described since their collection (the snail Iothia lindbergi, Mclean, 1985; and the isopod Tridentella glutospina, Delaney and Brusca, 1985).

Far too many undescribed species were encountered in the present program for even a concise list to be presented. Voucher sheets providing a brief discussion of key characters, illustrations where possible, comparison with similar species in the area, and citations of appropriate references are on file at the Pacific Outer Continental Shelf Office of the Minerals Management Service (Los Angeles, CA). Voucher specimens for each species are deposited in the National Museum of Natural History, Smithsonian Institution. If more than one specimen lot of the species was collected, a duplicate voucher was deposited in the Invertebrate Biology Section, Santa Barbara Museum of Natural History.

3.2.2.6 Photographic Techniques Survey

A single photographic techniques dive was made at Coho Anchorage on July 27, 1984 to test the feasibility of taking standardized photographs of permanent quadrants during future monitoring surveys of hard-bottom areas. Five replicate photographs of a 0.5 m^2 quadrat were taken at each of five locations; each location was randomly selected by dropping the quadrat frame using the submersible's manipulator arm (see Methods Sections 2.1.2.4). Three types of data were assessed from the photographs:

- o Percentage of the quadrat visible; used to indicate the precision with which the submersible and bottom contact weight could be positioned over the quadrat.

- o Distance from camera to bottom; used as a secondary indication of submersible positioning accuracy, but also as a more direct measure of differences in the angle of the bottom contact wire (vertical or angled) that can result in a photograph being correctly exposed or overexposed, respectively. Photographs could not be "underexposed" because the camera shutter was triggered only after the weight contacted the bottom, and the height of the camera off the bottom was equal to or less than the length of the wire for the bottom weight. Differences in wire angle were assessed from differences in quadrat size and photographic exposure quality.

o Comparability of the features and organisms observed.

Data on the percentage of the quadrat visible and organisms observed are presented in Table 3-36. The distance from the camera to the bottom was determined to be the same (5 ft) for each photograph, indicating that the angle of the bottom contact wire was not significantly different among replicates based on the quadrat size and photographic exposure data.

The percentage of quadrat visible data indicate low variability among replicates for Tests 2 and 3, suggesting high precision in positioning the submersible. Data from the remaining tests are much more variable; however, at least two accurate (100% visible) photographs were accomplished during each test suggesting that the required positioning accuracy can be accomplished using a manned submersible (or remotely operated vehicle) although several replicate photographs may be necessary to obtain standardized photographs of a selected location or quadrat. Additionally, although the angle of the bottom contact wire did not cause any significant differences in exposure (= distance off the bottom) of the photographs for this survey, higher relief areas will likely result in greater wire angles with correspondingly shortened camera to subject distances.

The data on organisms observed were relatively consistent for each test, however, too few organisms were present to allow a rigorous test of this method. Additional tests in areas characterized by more diverse, low relief

Table 3-36. Summary of Photographic Techniques Survey Data (data are expressed as mean ± standard deviation; n = 5 for all tests).

Test	Percentage of Quadrat Visible	Observed Organisms
1	79 ± 36	Algae (%); 4 ± 2.2
2	100 ± 0	None observed
3	99 ± 1	None observed
4	89 ± 14	Algae (%); 0.6 ± 0.5
5	71 ± 40	Algae (%); 0.8 ± 0.4

communities are not expected to significantly decrease the comparability among replicate photographs due to the relatively high accuracy that can be accomplished in locating and photographing selected features. Higher relief areas will be increasingly more difficult to photograph, with reduced comparability among replicates, as precise camera angles and positioning become more difficult to accomplish.

Maneuvering and positioning the submersible during the survey was very efficient, requiring only one to two minutes between replicate photographs over a low relief bottom with few obstructions. However, time between replicate photographs will likely increase with increased substrate relief and complexity. Replicate photographs for each test were conducted in a small area (estimated 20 ft radius), and the distance between quadrat drops for successive tests was also small (20 to 30 ft). Consequently, the submersible was not required to maneuver over large distances while suspending the bottom contact weight. Increased distance between study sites would significantly increase the effort required to maneuver the submersible, and was judged to make the bottom contact method impractical for taking continuous, random photographs along a transect. Other methods to control camera distance off the bottom were suggested during discussions with the submersible crew and observers. These methods include (1) manually triggering the camera from inside the submersible, using an externally mounted "feeler" to indicate a standard distance off the bottom, and (2) triggering the camera using bottom finding sonar mounted on the submersible. General results from the present tests indicate that time series photographs of fixed quadrats probably are feasible, at least for low relief areas, by controlling the distance off the bottom that a photograph is taken, and thereby standardizing the surface area sampled in the photographs. However, additional testing will be necessary to develop methods for use in high relief areas.

3.3 SUPPLEMENTARY OBSERVATIONS

Observations of marine birds and mammals and fishing activity were conducted during the soft-bottom (October 1983 to January 1984) and hard-bottom (July/August 1984) surveys, generally corresponding to fall/winter and summer seasons, respectively. Results and general comparisons with historical data are presented in Section 3.3.1 for birds and mammals, and Section 3.3.2 for fishing activity; however, these data are only compared in a qualitative manner due to differences in the duration and total observation time for each leg, and the short time intervals (generally 10 to 30 minutes) allocated for these observations as compared to broader scale surveys such as BLM (1976 and 1982).

3.3.1 Birds and Mammals

Birds

Fourteen species and 10 species of marine birds were observed during the fall/winter and summer surveys, respectively (Table 3-37 and 3-38). Of these species, brown pelicans and gulls (particularly Western gulls) were widespread throughout the survey area but generally occurred in low numbers of less than 20 individuals per observation. The brown pelican was the only endangered species observed. Species occurring in the highest abundances (hundreds to thousands per observation) were shearwaters (sooty and pink-footed), primarily in the northern part of the survey area in the summer. Sooty and pink-footed shearwaters breed in the southern hemisphere during the austral spring/summer and migrate to offshore areas including the survey area during the northern hemisphere's summer. Observations of large numbers of sooty shearwaters along Transects 27 A/B and 28 A/B were associated with large schools of unidentified fish (anchovies?) observed offshore of Morro Bay. Other species observed in low numbers included fulmars, phalaropes, cormorants, murres, and terns. Four of the species observed (brown pelican, common murre, cormorant, and Western gull) nest along the central and northern California coast. All of the species observed are relatively common throughout the survey area; high abundances of several species including shearwaters are common in offshore areas within the Santa Maria Basin particularly during spring and autumn migrations (BLM, 1976 and 1982).

Dolphins and Whales

Dolphins and whales were only rarely observed during the surveys. Pacific white-sided dolphins occurred along only one transect (summer) and three stations (fall/winter), with observations of common dolphins along one transect in the summer (Table 3-37 and 3-38). Numbers of individuals also

Table 3-37. Marine Birds and Mammals Observed During the July/August 1984 Hard-Bottom Survey (a = 1-5 individuals, b = 6-10; c = 11-25; d = 26-50; e = 51-100; f = >100).

Species	Transect(s)
MARINE BIRDS	
Larus occidentalis (Western gull)	1 A/B (a); 13 C/D (a); 14 A/B (c); 19 A/B (a); 20 A/B (a); 21 A/B (a); 22 A/B (a); 27 A/B (b)
Larus argentatus (Herring gull)	13 C/D (a); 14 C/D (a)
Larus heermani Heerman's gull)	1 C/D (a); 21 A/B (a); 27 A/B (a)
Larus sp. (Unidentified gulls)	1 A/B (a); 1 C/D (a); 2 A/B (b); 6 (A/D (a); 14 C/D (a); 21 A/B (a)
Pelicanus occidentalis (Brown pelican)	1 A/B (a); 6 A/D (c); 14 C/D (a); 26 A/B (a); 27 A/B (a)
Fulmarus glacialis (Fulmar)	4 A/B (a); 14 C/D (a); 19 A/B (a); 20 A/B (b); 22 A/B (b); 23 A/B (a)
Phalacrocorax sp. (Unidentified cormorants)	6 A/D (c)
Puffinus griseus (Sooty shearwater)	13 C/D (f); 27 A/B (f); 28 A/B (f)
Puffinus puffinus (Manx shearwater)	27 A/B (b)
Puffinus creatopus (Pink-footed shearwater)	13 C/D (f)
Puffinus sp. (Unidentified shearwaters)	14 A/B (ff); 14 C/D (b); 16 A/B (a)
Sterna sp. (Unidentified terns)	14 A/B (c)
Lobipes lobatus (Northern phalarope)	14 C/D (c); ?25 A/B (b); 28 A/B (c)
Steganopus tricolor (Wilson's phalarope)	13 C/D (a)

Table 3-37. (cont'd)

Species	Transect(s)
SEALS AND SEA LIONS	
Mirounga angustirostris (Elephant Seal)	1 A/B (a)
Zalophus californianus (California sea lion)	2 A/B (a); 2 C/D (a), 4 A/B (a), 6 A/D (a); 13 A/B (a); 13 C/D (a); 14 C/D (a); 16 A/B (a); 20 A/B (a); 21 A/B (a); 25 A/B (a); 26 A/B (a); 27 A/B (b); 28 A/B (a)
DOLPHINS	
Lagenorhynchus obliquidens (Pacific white-sided dolphin)	2 C/D (c)
Delphinus delphis (Common dolphin)	1 A/B (e)
Dolphin - unidentified	2 A/B (a)
WHALES	
Balaenoptera borealis (Sei whale)	2 A/B (a); 27 A/B (a)
Balaenoptera acutorostrata (Minke whale)	14 C/D (a); 16 A/B (a)
Whale - unidentified	19 A/B (a); 28 A/B (a)

Table 3-38. Marine Birds and Mammals Observed During the October/November/December 1983 and January 1984 Soft-Bottom Survey (a = 1-5 individuals; b = 6-10; c = 12-25; d - 26-50; e = 51-100; f = > 100).

Species	Station(s)
MARINE BIRDS	
Larus californicus (California gull)	3 (e), 15 (f), 21 (a) , 23 (c), 80 (a), 91 (a) 67 (a), 102 (d)
Larus occidentalis (Western gull)	25 (b), 35 (c), 42 (a), 46 (a), 47 (a), 50 (b), 104 (c)
Larus atricilla (Laughing gull)	105 (a)
Larus delawarensis (Ring-billed gull)	4 (a)
Larus sp. (Unidentified gull)	4 (e), 12 (c), 13 (e), 14 (f), 21 (a) 80 (b), 100 (a), 65 (a), 63 (a), 35 (a), 25 (c), 26 (c), 27 (a)
Pelicanus occidentalis (Brown pelican)	2 (a), 3 (a), 4 (c), 13 (b), 14 (c), 15 (d), 21 (a), 23 (a), 35 (a), 42 (a), 65 (a), 80 (b), 88 (a)
Phalacrocorax sp. (Unidentified cormorant)	15 (a)
Fulmarus sp. (Unidentified fulmar)	35 (a), 46 (a), 49 (a), 50 (a), 58 (a), 65 (a), 66 (a), 72 (a)
Uria aalge (Common murre)	42 (c)
Uria spp. (Unidentified murre)	42 (a), 64 (b)
Unidentified birds	2 (e)

Table 3-38. (cont'd)

Species	Transect(s)
	SEALS and SEA LIONS
Zalophus californianus (California sea lion)	3 (a), 8 (a), 23 (a), 33 (a), 72 (a), 77 (a), 98 (a)
	DOLPHINS
Lagenorhynchus obliquidens (Pacific white-sided dolphin)	25 (c), 66 (d), 67 (a),
	WHALES
Eschrichtius robustus (Gray whale)	42 (b) headed south

were relatively low with less than 50 individuals per observation for the white-sided dolphin, and less than 100 individuals for the common dolphin. The summer observations were both from the Santa Barbara Channel, while fall/winter observations occurred from Pt. Arguello north. Both the white-sided and common dolphin are widespread throughout the survey area and typically occur in schools from a few to thousands of individuals (BLM, 1976 and 1982). The relatively few observations of dolphins from the survey are presently unexplained but are probably influenced by the short time intervals allocated for these observations.

Six single sightings of sei, minke and unidentified whales occurred during the summer survey, primarily along the northern transects, with one sighting of a pod of approximately six California gray whales observed heading south near Purisima Point during the fall/winter survey (Table 3-37 and 3-38). All the species observed can extend throughout the survey area; the gray whale siting probably was part of the yearly southern migration of this species (BLM, 1976 and 1982). The gray whale and sei whales are both considered endangered species. The sighting of sei whales (Transect 27 A/B) was associated with large schools of unidentified fish offshore of Morro Bay as noted in the marine bird discussion.

Sea Lions

Seal and sea lion abundances were relatively low throughout the survey area. California sea lions were widespread but occurred in low numbers (generally one to four individuals) during summer and fall/winter; a single elephant seal was sighted during the summer survey in the Santa Barbara Channel (Table 3-37 and 3-38). Both species commonly occur throughout the survey area, with the California sea lion particularly common in nearshore areas (BLM, 1976 and 1982).

3.3.2 Fishing Activity

Fishing activity was only rarely observed during the summer and fall/winter surveys, consisting of low numbers of vessels (one to three per observation) represented by trawlers, trollers, seiners, long liners, party boats, and several unidentified fishing vessels (Table 3-39). The majority of the observations were from the northern part of the survey area from Pt. Sal to offshore Morro Bay, and represent most of the major types of fishing conducted in California. Commercial and recreational fisheries are a multi-million dollar industry in California, supporting thousands of fishermen and support industries within the Monterey and Santa Barbara fishing districts (BLM, 1980). The low number of vessels observed during the surveys probably is related to the short time intervals allocated for these observations.

Species of commercial interest observed during the hard-bottom survey included rockfish (*Sebastes* spp.), flatfish (several species) and spot prawn (*Pandalus platyceros*). Discussion of the distribution of these species is presented in Section 3.2 (Hard-Bottom Environment).

Table 3-39. Fishing Activity Observed During the July/August (Summer) 1984 Hard-Bottom Survey, and the October/November/December 1983 and January 1984 (Fall/Winter) Soft-Bottom Survey (one boat unless noted).

Type	Transect(s)-Summer	Station(s)-Fall/Winter
Trawler	1 A/B(2); 26 A/B(2)	12, 21
Party Boat	20 A/B(2); 27 A/B	--
Long Line	21 A/B	--
Troller	25 A/B(2)	64
Seiner	--	21, 42*, 105*
Unidentified Fishing Vessel	14 C/D, 16 A/B(3)*	23, 64

*Transiting

3.4 SENSITIVITY OF BENTHIC ORGANISMS

Potential impacts to relatively deep water (present survey) soft-bottom and hard-bottom organisms from oil and gas development primarily are related to discharges of drilling muds and cuttings, with shorter term or lower risk effects associated with platform and pipeline installations, and oil spills, respectively (see Section 1.1.). An important goal of the study was to identify soft-bottom and hard-bottom organisms and assemblages from the survey region having the greatest potential sensitivity to impacts from this development. In general, potential impacts are expected to be greater for hard-bottom than for soft-bottom organisms, which, by nature of their morphological and physiological adaptations to hard substrates, are potentially more sensitive to increases in turbidity and sediment coverage that may accompany operational discharges of drilling muds and cuttings.

Impacts from platform anchors and anchor chains also are expected to be greater in hard-bottom areas due to the higher relief profile of features that may be exposed to abrasion or breakage, and the relatively rigid growth forms of some attached hard-bottom organisms (e.g., corals). Additionally, although direct comparisons between hard-bottom and soft-bottom communities in the survey region have not been made, hard-bottom environments typically are characterized by a greater variety and abundance of organsims (e.g., Paine, 1966; Thorson, 1957) which may be more sensitive to potential impacts from oil and gas development.

Potential effects to hard-bottom organisms from discharges of drilling muds and cuttings can include; (1) habitat alteration due to increased sediment cover, resulting in burial or smothering, particularly of sessile organisms (e.g., cup corals or hydroids) which may occur in the immediate vicinity of a drilling operation, (2) slight to moderate increases in particulate material deposition that may influence the fitness and health of various taxa, habitat suitability, or larval settlement; (3) fouling of feeding structures of filter/suspension feeding organisms (e.g., sponges) due to increased turbidity (suspended particulates) from discharge plumes or resuspension of fine-grained fractions deposited on the bottom; and (4) bioaccumulation of trace metals and hydrocarbons from the discharged material.

Two general types of hard-bottom habitats were observed in the survey region: (1) low relief featues associated with extensive sediment cover, and (2) higher relief features associated with continuous but relatively decreased (thinner) sediment cover. As discussed in Section 3.2, these habitats are characterized by somewhat distinct biological assemblages that may be distinguished in part by differences in their sensitivity to turbidity and/or sediment cover. Specific studies on the tolerance of various taxa within these assemblages to sedimentation or high turbidity have not been conducted, however, some predictions can be made based on general knowledge of the ecology of similar types of organisms.

Sessile organisms including cup corals (e.g., Paracyathus and caryophylliids) and brachiopods (e.g., Terebratulina) generally were common throughout most low relief hard-bottom areas of the survey region (Section 3.2.2). Due to the inability of these taxa to migrate from areas of disturbance, they potentially are exposed to relatively high natural variability in sediment loads, which may include burial from sediment intrusion and increased turbidity near rock-mud interfaces. The sensitivity of these taxa to light to moderate sediment cover is unknown, however, the relatively small height (generally < 1 inch for the cup corals) suggests a high vulnerability to potential burial and smothering. Other taxa such as the anemone Metridium can attain sufficient height (1 to 2 ft) to extend above most sediment cover. Potential impacts from drill muds and cuttings to low relief hard-bottom areas will be extremely difficult to distinguish from the potentially high natural variability in sediment loads; however, monitoring of some representative low relief areas and associated species (e.g., Paracyathus) should provide valuable information to begin defining the natural changes in these habitats.

More motile taxa including ophiuroids (e.g., Ophiacantha) associated with low relief features should have the ability to migrate from areas of accumulating sediment, particularly along extensive hard-bottom features characterized by somewhat higher relief "refuges". Consequently, these types of taxa should be less sensitive to potential impacts than sessile taxa characteristic of those areas.

The general survey region was characterized by extensive sediment cover of both low relief and higher relief hard-bottom features (Section 3.2.1); consequently, it is likely that most taxa are tolerant of at least short-term increases in turbidity and sediment cover. Higher relief areas should be exposed to fewer changes associated with sediment intrusion and turbidity, thereby representing a more favorable habitat for some species. Several taxa, including corals (e.g., Lophelia and Coenocyathus), anemones (e.g., Corynactis), and various sponges were strongly associated with higher relief areas, thereby suggesting greater sensitivity to sediment effects that may be associated with low relief areas. Filter feeders such as sponges may be particularly sensitive to fouling under conditions of high turbidity. The occurrence of large sponges (e.g., vase sponges or shelf sponges) may indicate regions of relatively low, natural suspended sediment loads; monitoring changes in these types of organisms through time may be particularly useful in identifying long-term impacts. Gorgonians, including Lophogorgia and Eugorgia, also may be potential indicators of changes in suspended sediment loads. Grigg (1977) noted reduced survival of the gorgonian Muricea from abrasion by suspended particulates and smothering. The majority of the Lophogorgia and Eugorgia observed during the present study were extremely small (less than 3 inches tall) and sparsely branched; similar patterns noted by Dames and Moore (1982) for Lophogorgia from the Pt. Arguello region were suggested as representing low tolerance to conditions of high suspended particulate loads.

Present information on species distributions within the survey region, and assumptions of high natural sediment loads, suggest that the greatest potential impacts from oil and gas development may be associated with taxa in high relief areas. However, restrictions in monitoring these types of long-term effects are related to limited knowledge of (1) natural sediment loads as compared to anticipated levels from oil and gas development; (2) the taxonomy of many key groups such as sponges, bryozoans, hydroids, and anemones; and (3) the ecology and sensitivity of those species that can be identified. A detailed study of these factors will be critical during Phase II monitoring efforts.

Other potential impacts including abrasion or breakage of hard-bottom substrate and associated organsims due to anchor and anchor chain setting and dragging also may be greater in high relief areas characterized by more diverse assemblages. However, these effects are likey to be very localized, and can be minimized by normal precautions in determining anchor patterns and placement.

Studies on potential bioaccumulation of trace metals and hydrocarbons in hard-bottom and soft-bottom organisms initially should be conducted on a range of organisms representing different feeding types (e.g., deposit feeders, filter/suspension feeders, and scavengers/predators). Ideally the taxa selected would be sessile or of limited motility to reduce the possibility of movement between study areas. Sessile, filter/suspension feeders such as sponges are likely to be exposed to relatively high volumes of suspended material during normal feeding; however, isolation of uncontaminated tissue samples for laboratory analysis generally is impractical. Alternate species that could be collected include crinoids (Florometra) and basket stars (Gorgonocephalus); these species are somewhat mobile, however, it is unlikely that they would move large distances, particularly across broad soft-bottom areas separating study areas. Soft-bottom filter feeding organisms that might be collected incude sea pens such as Stylatula and Ptilosarcus. The relative sensitivity of these taxa to accumulation of trace metals and hydrocarbons is presently unknown.

Common scavengers/predators occurring in hard-bottom areas include three species of asteroid (Mediaster, Stylasterias, and Peridontaster). All these species are of limited mobility; however, Mediaster also occurs in soft-bottom areas, and conceivably could undergo some movement between hard-bottom features. Soft-bottom organisms that could be predictably collected include the sea urchins Allocentrotus and Lytechinus. Finally, a common deposit feeding organism which can be collected from both hard-bottom and soft-bottom areas to assess potential bioaccumulation is the sea cucumber Parastichopus. The sensitivity of these species to metals and hydrocarbons effects also is unknown.

3.5 RECOMMENDATIONS FOR LONG-TERM MONITORING

Offshore oil and gas exploration, development, and production operations represent a potential source for discharges of contaminants such as petroleum hydrocarbons and trace metals to the marine environment. The fates and effects of some of these discharges may be predicted with reasonable accuracy, whereas more subtle effects associated with long-term chronic discharges may be more difficult to detect and evaluate. The ability to detect and quantify impacts greatly relies on an appropriate design for the sampling program. Therefore, an important goal of this program was to identify specific parameters, stations, and survey methods that would be appropriate for a long-term monitoring program conducted in the Santa Maria Basin/western Santa Barbara Channel area. Recommendations for the Phase II monitoring program are presented for environmental and biological parameters; survey design, including power tests of the number of replicate samples required for infaunal sampling; and survey methods in Sections 3.5.1 through 3.5.3, respectively.

3.5.1 Parameters

Recommended parameters for long-term monitoring studies are presented for the physical/chemical environment and the biological environment in Sections 3.5.1.1 and 3.5.1.2, respectively.

3.5.1.1 Physical/Chemical Environment

Petroleum hydrocarbons and the trace metals barium and chromium were sampled during this Phase I program to characterize pre-drilling levels for parameters that may be affected by operational and accidental discharge from oil and gas operations. Based on the results from the reconnaissance program, it is recommended that several of these parameters be modified or deleted for future monitoring programs (Tables 3-40). The specific hydrocarbon concentrations and component ratios measured during this program were useful for evaluating spatial distributions of hydrocarbon levels and the relative contributions from petrogenic and biogenic sources. In addition to the standard component ratios, we also calculated Marine Oil Pollution Index (MOPI) values for all sediment samples collected during the soft-bottom survey. The index incorporates several component ratios which reflect the relative petrogenic inputs, including concentrations of resolved and unresolved compounds, and yields a single value for characterizing the amount of oil pollution present at different sites within the study area. The observed distribution of MOPI values, discussed in Section 3.1.2.2, was consistent with the locations of known or suspected sources of seep hydrocarbons and transport and depositional environments representing probable sites of accumulation for sediment associated hydrocarbons. The MOPI parameter is useful for integrating the component ratio values and eliminating much of the noise or variability associated with the ratio values that otherwise obscure longer scale trends. In this respect, the index values provide

Table 3-40. Recommended Physical/Chemical Parameters for Long-Term Monitoring

(1) Petroleum Hydrocarbons in Sediments:

- <u>Concentrations</u> - total hydrocarbons
  total aromatic (resolved and unresolved)
  total aliphatics (resolved and unresolved)

- <u>Specific Components Classes</u> - alkylated PAHs (by GC/MS)
  total alkanes

- <u>Index and Ratio Values</u> - MOPI
  Total hydrocarbons/total organic carbon

(2) Trace Metals in Sediments:

- <u>Concentrations</u> - Barium

(3) Other Sediment Parameters:

- <u>Concentrations</u> - Total Organic Carbon

(4) Discharge Sources:

- Drilling Muds - Petroleum hydrocarbons and trace metals as in #1 and 2 above.

- Produced Waters - Petroleum hydrocarbons as in #1 above.

- Cuttings - Petroleum hydrocarbons as in #1 above.

more information on spatial and time-series trends than the individual component ratios; therefore, calculation of MOPI values is recommended in lieu of individual ratios for the purpose of a long-term monitoring program.

Gas chromatography/mass spectrometry (GC/MS) and selected ion monitoring GC/MS are additional tools that are useful for identifying and quantifying specific hydrocarbon compounds in a complex sample matrix, and are particularly valuable for detecting individual polynuclear aromatic hydrocarbons (PAHs). In particular, alkyl-substituted PAHs may be present in spent drilling fluids containing oil-based lubricants or in formation-derived hydrocarbons; their presence in sediment samples can provide diagnotic evidence for identifying source inputs. Additionally, PAHs in sediments may be biologically available, and thus represent a source for possible long-term effects to biota or, for species consumed by man, potential carcinogens (NAS, 1985). For these reasons, levels of PAHs in environmental samples may also represent an important monitoring parameter (Boehm, 1985), and GC/MS analyses of selected samples to identify and quantify specific aromatic compounds could provide useful information for "fingerprinting" sources.

Measurements of sediment barium provide another useful tracer for evaluating the dispersion of discharged drilling fluids. Barium is present as barite in high concentrations in generic drill muds and has a low solubility in seawater. Time series measurements of barium represent a useful tool for detecting accumulations of barite from drilling muds (Chow, 1976). Changes in barium levels in seawater (Trocine and Trefry, 1983) and in bottom sediments

(Bothner et al., 1982) have been used previously as indicators of drilling fluid dispersion following discharges from a drilling operation. Additionally, Bothner et al. fractionated the bottom sediment samples and analyzed barium levels both in bulk sediments and in the fine sediment fraction (< 60 µm diameter) to increase the sensitivity of the measurements. Accumulations of drilling fluid associated barium are much more apparent in the fine sediment fraction than in bulk sediment because the barite particles typically are small (< 63 µm) and their concentrations are diluted by the presence of greater amounts of coarse grained sediments. However, this approach would not be particularly useful for monitoring metal levels in sediments from the Santa Maria Basin that are primarily silts and clays.

Monitoring the concentrations of other trace metals, such as chromium would not be particularly informative. Levels of metals other than barium are not sufficiently elevated in generic drilling muds to distinguish discharge accumulation from natural variability. In addition, recent revisions of NPDES permit regulations prohibit discharges of chromium present as an additive (with lignosulfonate) in generic drilling mud configurations. Thus, long-term monitoring for sediment chromium, or metals other than barium, is not recommended.

Previous attempts to use organic components of the drilling fluids, such as lignosulfonate polymers, as a tracer for dispersion in seawater and in sediments adjacent to an active drilling operation were unsuccessful (Pierce et al., in press). Organic polymers present in drilling fluids may partially dissolve when discharged into seawater and rapid dispersion in open coastal waters would rapidly dilute concentrations to undetectable levels. Furthermore, the short-term presence of organic polymers should not constitute an environmental hazard. Therefore, monitoring for the concentrations of non-hydrocarbon organics in bottom sediments is not recommended.

In addition to monitoring levels of petroleum hydrocarbons and barium in bottom sediments we recommend routine chemical analyses of several discharge sources, including representative drilling muds, cuttings, and produced waters. Chemical analyses of discharge sources may provide diagnostic fingerprints, such as the presence of alkylated PAHs or a homologous n-alkane series, which improve the sensitivity of the measurements and increase the probability of detecting the presence of discharge residues in bottom sediments. In the absence of chemical data for the discharged materials, the presence of residues generally can only be inferred from analyses of time series trends in levels of the target parameters in sediments.

The fate and effects of contaminants released through chronic operational sources as well as episodic and accidental sources and deposited with bottom sediments will depend on physical and geological conditions in the sedimentary environment (see Section 3.1.2.4). NRC (1983) concluded that the effects of drilling fluids and cuttings on benthic and epifaunal communities are related to the amount of material accumulating on the substrate particularly as determined by current speeds and related hydrographic factors. Additionally, predictions concerning the fates of discharged materials have important implications for the susceptibility or sensitivity of specific biological habitats or assemblages, such as hard bottom epifauna exposed to drilling-related contaminants (NRC, 1983).

Little generic information presently is available to predict dispersion of drilling fluids and cuttings in the benthic boundary layer (NRC, 1983). Likewise, insufficient information is available to predict the specific fate of discharges in the Santa Maria Basin and western Santa Barbara Channel. Additional studies are necessary to provide information on general sediment transport patterns, sites of erosion and deposition, deposition rates, bottom shear stresses and their relationships to sediment resuspension and transport processes, residency times for different grain size sediments on the shelf, and rates of sediment layer mixing. Much of this information could be provided through synoptic sediment transport studies using instrument systems similar to those described by Butman and Folger (1979) and Sternberg et al. (1973). Similar types of studies were developed for the Georges Bank Monitoring Program that enabled predictions to be made about sediment transport dynamics throughout several different sedimentary environments.

3.5.1.2 Biological Environment

In general, the biological parameters measured during the reconnaissance survey were very appropriate for characterizing the benthic communities, and were useful for making comparisons with historical databases. Infaunal abundance and biomass data are standard parameters that can be easily obtained; most concerns associated with these parameters are related to station selection and sample replication as discussed in Section

3.5.2. Size-frequency measurements can be reliably obtained for several shelf depth species; however, the reduced abundance of even the dominant slope depth species presented significant problems in obtaining enough specimens to describe the populations' size-frequency distribution. Population size-frequency likely will be a useful indicator of sublethal stress, thus special efforts towards collection of an adequate sample size are warranted. Recommendations on alternate sampling methods are presented in Section 3.5.3.

In addition to these biological parameters, we recommend that a measurement of organic nitrogen (for calculations of carbon/nitrogen ratio values) in sediments be incorporated into future investigations. This is particularly important because the labile organic material currently available for consumption by infaunal organisims will be increasingly diluted with non-nutritive particulates over the production drilling phase.

Abundance estimates from photographic and observer records of hard-bottom organisms also are standard parameters that are recommended for future monitoring studies; however, standardized methods for obtaining photographic data and utilization of permanent photographic quadrats will be critical for detecting long-term changes. Some potential approaches to standardizing these methods are discussed in Section 3.5.3. In addition to abundance estimates, the use of macro-photography (e.g., SAIC, 1985) may be important for improving taxonomic identifications, and in determining size-frequency distributions of key organisms (e.g., cup corals). The size frequency-data may provide some indication of changes in sediment cover of hard-bottom features as related to size (age) classes represented, and the general health of attached organisms.

3.5.2 Survey Design

Recommendations for the design of surveys which could be implemented in a long-term monitoring program are based on the results of power tests performed on data collected during the present reconnaissance surveys. Specific recommendations for survey design are summarized in this section including a discussion of the power test results for the soft-bottom survey data (Section 3.5.2.1), and study areas for the hard-bottom survey (Section 3.5.2.1).

3.5.2.1 Soft-Bottom Survey

The results of power tests performed on the present survey data corroborate and extend the results of the analysis of historical data presented previously by SAIC and EcoAnalysis (1984). Power (the ability to detect impacts) is extremely low when individual species are used as the independent variable. Power is considerably higher for community parameters (e.g., diversity and evenness); however, these parameters are relatively insensitive indicators of biological change resulting from impacts. The wide differences in power among species within the same habitat, and in the same species among different habitats, indicate that it would be extremely difficult to select a subset of "indicator" species that have both high power and biological sensitivity to impacts.

In contrast, power tests using ecological distances can detect very small changes with high power. In many cases, the power associated with differences in biologial parameters are so high that environmentally inconsequential changes can be detected. Therefore, it is important that the objectives of a long-term monitoring program include a statement regarding the magnitude of change which should be detected. Without such an objective, the greater sensitivity of power tests with distances will make it difficult to distinguish between the statistical significance of a particular test and the biological significance of the results.

This distinction between biological and statistical significance is a primary reason for standardizing the distance values used in the power analyses to biologically meaningful units (half-changes). The amounts of change (in the standardized units) that are associated with different degrees of disturbance in the various habitats can be predicted based on experience and familiarity with the database. When a change is detected, the magnitude of the change can be put into perspective before any management decisions are made. For example, Smith and Bernstein (1985) found that biological communities associated with sites highly enriched with organic materials from a sewage outfall were about 1.6 or more half-changes different from communities of clean control sites. A moderately enriched area was associated with about 0.6 half-changes, and a slightly enriched area was associated with about 0.4 half-changes. If a statistical test detected a change of 0.03 half-changes (presumably due to organic enrichment from an outfall), this difference would be judged as inconsequential in light of the known values for the different levels of enrichment.

Spatial Scale of Sampling

Results of parallel power analyses with replicate and stratum data indicate that geographic separation of sampling stations within a stratum does not lead to a decrease in power that is of any practical consequence. In fact, the minimum detectable difference on the stratum scale, using ecological distances, is low enough to ensure that even very small changes can be detected. This means that resources normally spent on obtaining multiple replicates at each station could instead be used to obtain better spatial coverage. Where hypotheses of impact involve questions about larger areas rather than single stations, replication within strata rather than within stations would be more appropriate. In these situations, the perception of larger scale patterns can often enhance understanding and hypothesis formation about causal mechanisms responsible for observed impacts.

Sampling Design Recommendations

There was no marked difference between power levels derived from the 1.0 and 0.5 mm size fractions, and the two size fractions did not lead to important differences in the pattern analysis results. We therefore recommend that future monitoring be performed on the 1.0 mm size fraction of the benthic infauna to reduce the costs and time required for the smaller size fraction. We also recommend that the monitoring design use the concept of ecological distances, and that spatial coverage is emphasized in favor of multiple replication at individual stations. The spatial scale of sampling should, however, be adjusted to reflect the predicted spatial scale of impact. Specifying the target level of change to be detected and the spatial scale of sampling requires some predictions about the expected scale and magnitude of impacts. The sampling design also should account for the major biological patterns in the benthic community. For example, sampling strata should not overlap the groups described in the cluster analysis, since this would unnecessarily increase the background variability against which changes will be measured. Finally, the specific sampling design should be subjected to optimization and power analyses to ensure that the maximum information will be obtained per effort expended.

Detailed Discussion of Statistical Approach

Power tests were performed on univariate parameters (community parameters and abundances of individual species) to assess probable ranges of sampling effort needed to detect changes in the benthic infaunal community. The methodology for these tests is described in further detail in SAIC and EcoAnalysis (1984). Power tests estimate the probability that a particular sampling design will detect a change that has actually occurred, and permit a determination of whether a proposed monitoring program has a reasonable chance of detecting predicted impacts.

Two statistical models were evaluated previously (SAIC and EcoAnalysis, 1984). One model (termed Model 1) included samples collected at one time before and one time after impact at effect and control locations. The second model (termed Model 2) incorporated repeated sampling events both before and after impact at both effect and control locations. Model 2 power tests require that data be available from pairs of stations sampled concurrently over time. Such data were not planned as part of this reconnaissance study; therefore, the present power tests concentrate primarily on an evaluation of Model 1, with secondary focus on temporal variability.

The two-way ANOVA used for the Model 1 power tests is only one of many possible monitoring designs. This approach was used during this study because the model is easily understood, widely applicable, and fits the available data. Power test results based on this model should therefore be considered as indicative of trends and patterns of power, not as absolute parameters applicable to all potential monitoring designs.

Data from the infaunal study were available from three spatial scales: 1) the within-core scale of the cores divided into quarters (see Methods Section 2.1.1.4); 2) the between-core scale of replicate stations; and 3) the between-station scale of the entire sampling grid. The within-core analysis was performed on data from Station 42. Table 3-41 shows the station groupings for the replicate and stratum (between-station) analyses. Paired replicate stations at the same depth were grouped together, and the replicate variance calculated from the replicates at each station. This grouping was based on the assumption that stations at the same depth and in the same geographical area have similar communities. Station groupings for the stratum

TABLE 3-41. Stations used in the replicate and stratum power analyses.

REPLICATE ANALYSIS:

GROUP ID	STATIONS	DEPTH IN FEET
1	21	155-162
2	73 79 85	320-375
3	25	650-665
4	31 74 80 86	645-670
5	25 33 76	1290-1344
6	82 88	1310-1318
7	27 28 35 36	1640-2040

STRATUM ANALYSIS:

STRATUM ID	STATIONS	DEPTH IN FEET
1A	12 22 30 42 102	328-332
1B	52 58 65 73 79 85 94	320-375
4A	38 43 48 53	654-658
4B	59 66 70 74 80	654-720
5A	86 95	656-660
6A	7 13 18	656-658
6B	31 103	655-665
7A	14 19	985-995
7B	32 39	980-990
7C	60 67 71 75	915-1020
8C	4 9 15 20 25 33 40	1300-1325
8B	54 61 68 72 76	1150-1135
9A	82 83 88 97	1310-1480
9B	93 101	1190
10A	5 10 16	1950-1970
10B	56 63 69	3000-3100
11A	26 27	1300-1315
11B	28 35 107	1910-2030
11C	36 41 108	1640-1650
11D	50 55 62	1940-1970
11E	92 100	1475-1480

analysis were based on the site groups derived from the cluster analysis. These site groups were sub-divided, where necessary, to create stratum groups that were contiguous, at similar depths, and in the same geographical area. Power tests were then performed separately for each stratum.

Parallel analyses were performed separately for the 1.0 mm and 0.5 mm size fractions to determine whether one fraction gave consistently higher power than the other. Species selected in the power tests were the most widespread and abundant species in each stratum or depth group, and representing the species which should have the highest power.

Univariate Power Test Results

Results of power tests for species in the within-core, replicate, and stratum analyses, for both the 1.0 mm and 0.5 mm size fractions, are presented in Tables 3-42 through 3-45. Several features are immediately apparent in the results. Species do not occur consistently throughout either the depth or stratum groups, but typically occur only in a small proportion of the tests. For those species which do occur more than once, power varies widely among depth groups and strata. Power also varies widely from one species to the next. The average power is not markedly different in the 1.0 and 0.5 mm size fractions in all three analyses (vegematic, replicate, stratum), and the power is not markedly different in the replicate and stratum analyses.

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TABLE 3-42. The 1.0mm size fraction of the replicate and within core power analyses. Power values are given as the probability of detecting a 50% reduction in the mean of each variable at 10 replicates for species and 4 for community parameters. Stations in each depth group are listed in Table 3-41. (W.C. = within core)

VARIABLE	DEPTH GROUP 1	2	3	4	5	6	7	W.C.
Acila castrensis			.14					
Ampelisca brevisimulata	.88	.22						
Ampelisca macrocephala				.33				
Ampelisca pacifica				.16				
Amphiodia urtica	1.00	.38		.13				.96
Amphioplus strongyloplax				.24				.11
Amphissa bicolor					.32			
Anobothrus sp. A							.13	
Asychis disparidentata	.83							
Balcis rutila			.11					
Brisaster latifrons			.10	.18	.34	.14		
Brissopsis pacifica					.27			
Byblis barbarensis							.14	
Cadulus fusiformis	.46							
Compsomyax subdiaphana	1.00							
Cyclocardia ventricosa		.17						
Dentalum rectius			.44					
Eudorella pacifica				.12	.10			
Euphilomedes producta		.17						
Exogone Lourei								.48
Glycera capitata		.45						
Glycinde armigera						.06		
Golfingia minuta								.07
Kurtziella beta	.23							
Leiochrides sp. A							.29	
Leitoscoloplos sp. A							.22	
Leucon magnadentata					.28	.08		
Listriolobus hexamyotus							.08	
Lumbrineris cruzensis		.14						
Leptosynapta sp. B								.13
Maldane sarsi				.20				
Micrura alaskensis							.13	
Munidion pleurocondis			.14					
Myriochele gracilis					.15			.26
Nemocardium centifilosum		.39						
Nephtys cornuta fran.					.14	.10	.12	
Nuculana taphria	.19							
Onuphis iridescens			.10		.14	.13		
Paraphoxus oculatus					.10	.22		
Parvilucina tenuisculpta	1.00			.25				

TABLE 3-42 (continued)

VARIABLE	DEPTH GROUP 1	2	3	4	5	6	7	W.C.
Pectinaria californiensis		.83		.22	.19			.13
Pentamera pseudocalcigera				.10				
Pleuroncodes planipes			.23					
Prionospio lobulata					.10	.21	.19	
Rhepoxynius bicuspidatus	1.00	.15						
Saturnia nr. ritteri							.14	
Scleroconcha trituberculata				.61				
Spiophanes berkeleyorum		.49		.14				.47
Spiophanes missionensis	.26	.22						.19
Sternaspis fossor	.37							
Terebellides californica							.21	
MEAN POWER: ALL SPECIES	.58	.33	.18	.22	.19	.13	.17	.31
EVENNESS	1.00	1.00	.98	1.00	.95	.92	1.00	1.00
GLEASON DIVERSITY	1.00	1.00	.38	.80	.59	.43	.62	.92
NUMBER OF SPECIES	1.00	1.00	.24	.71	.53	.35	.55	.80
S/W DIVERSITY	1.00	1.00	.74	.99	.93	.81	.86	1.00
TOTAL ABUNDANCE	1.00	.72	.19	.50	.45	.26	.47	.40

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TABLE 3-43. The 1.0mm size fraction of the stratum power analysis. Power values are given as the probability of detecting a 50% reduction in the mean of each variable at 10 replicates for species and 4 for community parameters.

VARIABLE	STRATUM GROUP 1A	1B	4A	4B	5A	6A	6B	7A
Acila castrensis							.11	
Ampelisca macrocephala			.45					
Ampelisca pacifica				.23				
Ampelisca unsocalae								
Amphiodia urtica	.90	.31	.36	.10			1.00	
Amphissa bicolor								
Anobothrus sp. A								
Arhynchite californicus					1.00			
Axinopsida serricata							.50	
Bathymedon covilhani								
Brisaster latifrons						.16		.38
Brissopsis pacifica								
Byblis barbarensis								
Eclysippe trilobatus								
Harpiniopsis epistomata								
Hesperonoe laevis					1.00			
Huxleyia minuta								
Leucon magnadentata								
Maldane sarsi				.16	.21			
Melinna heterodonta						.27		
Micrura alaskensis								
Mitrella permodesta								
Myriochele gracilis								.38
Mysella sp. D								
Nemocardium centifilosum	.28							
Nephtys cornuta fran.								
Nephtys ferruginea			1.00					
Nephtys punctata			1.00					
Onuphis iridiscens						1.00		.11
Ophelina acuminata								
Parvilucina tenuisculpta							.78	
Pectinaria californiensis		.17						
Phyllochaetopterus limicolus								
Pinnixa occidentalis						.10		.79
Pista nr. fasciata								
Prionospio lobulata								
Rhepoxynius bicuspdatus	.53							

TABLE 3-43 (continued)

VARIABLE	STRATUM GROUP 1A	1B	4A	4B	5A	6A	6B	7A
Saturnia nr. ritteri								
Saxicavella pacifica					1.00			
Spiophanes berkeleyorum	.94	.13		.23				
Spiophanes missionensis		.11						
Sternapsis fossor								
Terebellides californica								
MEAN POWER: ALL SPECIES	.66	.18	.70	.18	.80	.38	.60	.41
EVENNESS	.50	1.00	.64	1.00	1.00	1.00	1.00	1.00
GLEASON DIVERSITY	.27	.60	.35	.96	.36	.53	.99	.64
NUMBER OF SPECIES	.17	.44	.39	.98	.12	.41	1.00	.55
S/W DIVERSITY	.50	.92	.45	1.00	.99	1.00	1.00	1.00
TOTAL ABUNDANCE	.08	.26	.24	.23	.41	.43	1.00	1.00

TABLE 3-43 (continued)

VARIABLE	STRATUM GROUP 7B	7C	8A	8B	9A	9B	10A	10B
Acila castrensis								
Ampelisca macrocephala								
Ampelisca pacifica								
Ampelisca unsocalae							1.00	
Amphiodia urtica	1.00							
Amphissa bicolor				.75				
Anobothrus sp. A								
Arhynchite californicus								
Axinopsida serricata								
Bathymedon covilhani								
Brisaster latifrons					.28	.12		
Brissopsis pacifica			.17					
Byblis barbarensis								
Eclysippe trilobatus								.16
Harpiniopsis epistomata								
Hesperonoe laevis								
Huxleyia minuta								
Leucon magnadentata						.79		
Maldane sarsi	.60	.12		.19				
Melinna heterodonta								
Micrura alaskensis								
Mitrella permodesta								
Myriochele gracilis						.17		.07
Mysella sp. D								
Nemocardium centifilosum								
Nephtys cornuta fran.			.09		.12		.38	
Nephtys ferruginea								
Nephtys punctata		.94						
Onuphis iridiscens	.38		.15	.36	.12			
Ophelina acuminata			.07					
Parvilucina tenuisculpta								
Pectinaria californiensis		.18						
Phyllochaetopterus limicolus							1.00	
Pinnixa occidentalis								
Pista nr. fasciata	1.00	.22		.10				
Prionospio lobulata					.21			
Rhepoxynius bicuspdatus								

TABLE 3-43 (continued)

VARIABLE	STRATUM GROUP							
	7B	7C	8A	8B	9A	9B	10A	10B
Saturnia nr. ritteri								.14
Saxicavella pacifica						.22		
Spiophanes berkeleyorum								
Spiophanes missionensis								
Sternapsis fossor								.17
Terebellides californica							.38	
MEAN POWER: ALL SPECIES	.74	.36	.12	.35	.18	.33	.69	.14
EVENNESS	1.00	1.00	1.00	.94	1.00	1.00	1.00	1.00
GLEASON DIVERSITY	.99	.76	.65	.45	.21	1.00	.50	.98
NUMBER OF SPECIES	1.00	.58	.92	.38	.16	1.00	.29	.71
S/W DIVERSITY	1.00	1.00	.98	.69	.42	1.00	.99	1.00
TOTAL ABUNDANCE	.69	.27	.25	.35	.20	.65	.23	.33

TABLE 3-43 (continued)

VARIABLE	STRATUM GROUP 11A	11B	11C	11D	11E
Acila castrensis					
Ampelisca macrocephala					
Ampelisca pacifica					
Ampelisca unsocalae		.12		.07	
Amphiodia urtica					
Amphissa bicolor					
Anobothrus sp. A			.14		
Arhynchite californicus					
Axinopsida serricata					
Bathymedon covilhani	1.00				
Brisaster latifrons					
Brissopsis pacifica					
Byblis barbarensis	.50				
Eclysippe trilobatus					.38
Harpiniopsis epistomata		.09		.13	
Hesperonoe laevis					
Huxleyia minuta			.13		
Leucon magnadentata					
Maldane sarsi					.52
Melinna heterodonta					
Micrura alaskensis	.50		.56	.21	
Mitrella permodesta		.26		.14	
Myriochele gracilis					
Mysella sp. D					.38
Nemocardium centifilosum					
Nephtys cornuta fran.					
Nephtys ferruginea					
Nephtys punctata					
Onuphis iridiscens					
Ophelina acuminata					
Parvilucina tenuisculpta					
Pectinaria californiensis					
Phyllochaetopterus limicolus					
Pinnixa occidentalis					
Pista nr. fasciata					
Prionospio lobulata					
Rhepoxynius bicuspdatus					

TABLE 3-43 (continued)

VARIABLE	STRATUM GROUP 11A	11B	11C	11D	11E
Saturnia nr. ritteri					
Saxicavella pacifica					
Spiophanes berkeleyorum					
Spiophanes missionensis					
Sternapsis fossor					
Terebellides californica	.30	.12	.33		.19
MEAN POWER: ALL SPECIES	.57	.15	.29	.14	.37
EVENNESS	1.00	1.00	1.00	1.00	1.00
GLEASON DIVERSITY	1.00	.35	.79	.92	1.00
NUMBER OF SPECIES	.94	.24	.34	.24	1.00
S/W DIVERSITY	1.00	.88	.89	1.00	1.00
TOTAL ABUNDANCE	.30	.14	.83	.10	.76

****

TABLE 3-44. The 0.5mm size fraction of the stratum power analysis. Power values are given as the probability of detecting a 50% change in the mean of each variable at 10 replicates for species and 4 for community parameters.

VARIABLE	STRATUM GROUP 1A	1B	4A	4B	5A	6A	6B	7A
Acmira lopezi rubra								
Allia antennata								
Allia monicae								
Ampelisca macrocephala			.20					
Ampelisca unsocalae								
Amphiodia urtica	.87	1.00						
Amphissa bicolor								
Anobothrus sp. A								
Bathyleberis garthi						.40		
Brisaster latifrons								
Byblis barbarensis								
Cadulus tolmei								
Eclysippe trilobatus								
Eudorella pacifica				.42	.39			
Falcidens hartmanae								
Harpiniopsis epistomata								
Harpiniopsis fulgens								
Leucon magnadentata								
Levinsenia gracilis		.46	.16		.30	.14	1.00	.14
Maldane sarsi				.11				
Micrura alaskensis								
Minuspio cirrifera						.17		
Mitrella permodesta								
Myriochele gracilis								
Nephtys cornuta fran.			.23	.49	1.00	.34	.93	.35
Onuphis iridiscens								.11
Ophelina acuminata								
Parvilucina tenuisculpta							1.00	
Pectinaria californiensis								
Pholoe glabra	.37							
Pinnixa occidentalis								.79
Pista nr. fasciata								
Prionospio lobulata								
Rhachotropis clemens							.46	

TABLE 3-44 (continued)

VARIABLE	1A	1B	4A	4B	5A	6A	6B	7A
	STRATUM GROUP							
Saturnia nr. ritteri								
Saxicavella pacifica								
Spiophanes berkeleyorum	.68	.16	.13	.22	1.00			
Spiophanes missionensis	.95	.26						
Terebellides californica								
Tomburchus redondoensis								
MEAN POWER: ALL SPECIES	.72	.47	.18	.31	.67	.26	.85	.35
EVENNESS	.52	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GLEASON DIVERSITY	.35	.71	.97	.96	.45	.56	1.00	.58
NUMBER OF SPECIES	.24	.53	.98	.77	.23	.50	.86	.62
S/W DIVERSITY	.52	1.00	.99	1.00	1.00	1.00	1.00	.99
TOTAL ABUNDANCE	.10	.20	.65	.30	.10	.62	.27	1.00

TABLE 3-44 (continued)

VARIABLE	STRATUM GROUP 7B	7C	8A	8B	9A	9B	10A	10B
Acmira lopezi rubra							.12	
Allia antennata								.10
Allia monicae							.24	
Ampelisca macrocephala								
Ampelisca unsocalae	.97							
Amphiodia urtica								
Amphissa bicolor				.69				
Anobothrus sp. A								
Bathyleberis garthi								
Brisaster latifrons					.28	.13		
Byblis barbarensis								
Cadulus tolmei								1.00
Eclysippe trilobatus								
Eudorella pacifica		.37						
Falcidens hartmanae								
Harpiniopsis epistomata								
Harpiniopsis fulgens								
Leucon magnadentata			.85					
Levinsenia gracilis	.60		.96	.69			.16	
Maldane sarsi	.60			.24				
Micrura alaskensis								
Minuspio cirrifera					.13			
Mitrella permodesta								
Myriochele gracilis						.38		
Nephtys cornuta fran.	.25	.14	.60	.14	.43	.79	1.00	
Onuphis iridiscens								
Ophelina acuminata			.31					
Parvilucina tenuisculpta								
Pectinaria californiensis		.22						
Pholoe glabra								
Pinnixa occidentalis								
Pista nr. fasciata		.22						
Prionospio lobulata					.48			
Rhachotropis clemens								

TABLE 3-44 (continued)

VARIABLE	STRATUM GROUP 7B	7C	8A	8B	9A	9B	10A	10B
Saturnia nr. ritteri								.97
Saxicavella pacifica						.38		
Spiophanes berkeleyorum								
Spiophanes missionensis								
Terebellides californica								
Tomburchus redondoensis								.54
MEAN POWER: ALL SPECIES	.60	.24	.68	.44	.33	.42	.38	.65
EVENNESS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GLEASON DIVERSITY	1.00	.99	.79	.95	.24	1.00	.77	1.00
NUMBER OF SPECIES	1.00	1.00	.60	.65	.16	.81	1.00	.90
S/W DIVERSITY	1.00	1.00	1.00	1.00	.74	1.00	.99	1.00
TOTAL ABUNDANCE	1.00	.46	.24	.20	.10	.18	.10	.39

TABLE 3-44 (continued)

VARIABLE	11A	11B	11C	11D	11E
	STRATUM GROUP				
Acmira lopezi rubra	.72				
Allia antennata					
Allia monicae	1.00				
Ampelisca macrocephala					
Ampelisca unsocalae				.07	
Amphiodia urtica					
Amphissa bicolor					
Anobothrus sp. A			.16		
Bathyleberis garthi					
Brisaster latifrons					
Byblis barbarensis	.31				
Cadulus tolmei					
Eclysippe trilobatus					.19
Eudorella pacifica					
Falcidens hartmanae					.11
Harpiniopsis epistomata		.10			
Harpiniopsis fulgens			.55		
Leucon magnadentata					
Levinsenia gracilis		.64			
Maldane sarsi					.43
Micrura alaskensis			.97	.40	
Minuspio cirrifera		.24			
Mitrella permodesta				.14	
Myriochele gracilis					
Nephtys cornuta fran.	1.00	.18			.79
Onuphis iridiscens					
Ophelina acuminata					
Parvilucina tenuisculpta					
Pectinaria californiensis					
Pholoe glabra					
Pinnixa occidentalis					
Pista nr. fasciata					
Prionospio lobulata					
Rhachotropis clemens					

TABLE 3-44 (continued)

VARIABLE	STRATUM GROUP 11A	11B	11C	11D	11E
Saturnia nr. ritteri				.20	
Saxicavella pacifica					
Spiophanes berkeleyorum					
Spiophanes missionensis					
Terebellides californica			.33		
Tomburchus redondoensis					
MEAN POWER: ALL SPECIES	.76	.29	.50	.20	.38
EVENNESS	.96	.85	1.00	1.00	1.00
GLEASON DIVERSITY	.83	.55	.73	1.00	.93
NUMBER OF SPECIES	.94	.45	.59	1.00	.70
S/W DIVERSITY	.91	.78	1.00	1.00	1.00
TOTAL ABUNDANCE	1.00	.29	.53	.28	.49

****

TABLE 3-45. The 0.5mm size fraction of the replicate power analysis. Power values are given as the probability of detecting a 50% reduction in the mean of each variable at 10 replicates for species and 4 for community parameters. (W.C. = within core)

VARIABLE	DEPTH GROUP 1	2	3	4	5	6	7	W.C.
Acmira lopezi rubra							.38	
Ampelisca brevisimulata		.35						
Ampelisca macrocephala				.37				
Ampelisca unsocalae					.28			
Amphiodia urtica		.39		.13				.96
Amphissa bicolor					.37			
Anobothrus sp. A								.16
Brisaster latifrons				.18	.34	.14		
Byblis barbarensis								.14
Cadulus fusiformis	.31							
Compsomyax subdiaphana	.73							
Dentalum rectius			.44					
Diastylis pellucida				.29				
Eudorella pacifica				.32	.16			.17
Exogone Lourei								.19
Glycera capitata		.29						
Glycinde armigera						.14		
Harbansus bradmyersi				.35				
Harpiniopsis fulgens					.21			
Leptognathia sp. B								.13
leptognathia sp. D					.14			
Leucon magnadentata					.29			
Leucon subnasica								.19
Levinsenia gracilis	.25	.34	.09	.36	.38	.09	.30	.22
Lumbrineris cruzensis		.35						
Maldane sarsi				.23				
Mediomastus LPIL	.54							
Micrura alaskensis							.20	
Minuspio cirrifera	.74	.13		.26			.18	
Myriochele gracilis								.14
Nemocardium centifilosum		.55						
Nephtys cornuta fran.			.15	.39	.47	.47	.44	
Onuphis iridescens			.14		.14	.13		
Paraprionospio pinnata				.28				
Parvilucina tenuisculpta	.79		.61	.28				

TABLE 3-45 (continued)

VARIABLE	DEPTH GROUP 1	2	3	4	5	6	7	W.C.
Pectinaria californiensis					.19			
Pholoe glabra	.97	.86					.51	
Pleuroncodes planipes			.23					
Prionospio lobulata					.12	.36		
Prionospio sp. A		.39						
Rutiderma lomae								.22
Saturnia nr. ritteri							.26	
Spiophanes berkeleyorum		.54		.19				.09
Spiophanes missionensis		.49						.38
Sternaspis fossor		.40						
Sulcoretusa xystrum	.97							
Tellina carpenteri	1.00							
Terebellides californica							.21	
Tharyx sp. C		.16						
Umbrineris tetraura			.07					
MEAN POWER: ALL SPECIES	.69	.40	.25	.28	.24	.22	.28	.27
EVENNESS	1.00	1.00	.99	1.00	1.00	.94	.99	1.00
GLEASON DIVERSITY	1.00	.99	.64	.82	.97	.94	.75	1.00
NUMBER OF SPECIES	1.00	.99	.68	.69	.89	.78	.73	1.00
S/W DIVERSITY	1.00	1.00	.93	1.00	1.00	1.00	.98	1.00
TOTAL ABUNDANCE	1.00	.93	.16	.30	.83	.38	.45	.84

Tables 3-42 through 3-45 suggest that overall the replicate and statum analyses had similar power, although this comparison may not be entirely appropriate or accurate because different species and station groupings were used in the two analyses. A separate analysis was performed that allowed an explicit comparison of the power levels on the two spatial scales. Power was recalculated for those stations and species in the replicate analysis that specifically matched those used in the stratum analysis (Table 3-46 and Figures 3-51 and 3-52). This analysis shows that power generally is similar on the replicate and stratum level scales.

As discussed in the analysis of historical benthic data (SAIC and EcoAnalysis, 1984), power for community parameters such as evenness and diversity is consistently higher than that for individual species. In general, power for individual species is very low, and although individual species occasionally have high power in one depth zone or stratum, this high power is not consistent across all depths and strata.

The analysis of historical data (SAIC and EcoAnalysis, 1984) also indicated that power decreased with depth, probably because of decreased abundances of individual species at greater depths. Figures 3-53 and 3-54 show that results from the replicate power analysis are consistent with this pattern for both the 1.0 and 0.5 mm size fractions. However, there is no corresponding relationship between power and depth for the stratum analysis (Figures 3-55 and 3-56). Similarly, power increases with total abundance of

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TABLE 3-46. Comparison between power values from the replicate and stratum analyses. Variables and stations were selected that overlapped in the the two analyses. All values are for the 1.0mm size fraction.

VARIABLE	STRATUM	POWER	STATIONS	POWER
AMPELISCA PACIFICA	4B	.217	74 80	.207
AMPHIODIA URTICA	1B	.306	73 79 85	.384
	4B	.099	74 80	.164
	6B	1.000	31	.113
AMPHISSA BICOLOR	8B	.753	76	.647
BRISASTER LATIFRONS	9A	.277	82	.139
BRISASTER PACIFICA	8A	.170	25 33	.268
MALDANE SARSI	4B	.159	74 80	.238
	5A	.210	86	.249
NEPHTYS CORNUTA FRAN.	8A	.091	25 33	.161
	9A	.117	82 88	.101
ONUPHIS IRIDESCENS	8A	.150	25 33	.107
	8B	.361	76	.197
	9A	.123	82 88	.126
PARVILUCINA TENUISCULPA	6B	.777	31	.754
PECTINARIA CALIFORNIENSIS	1B	.170	73 79	.829
PROINOSPIO LOBULATA	9A	.214	82 88	.207
SPIOPHANES BERKELEYORUM	1B	.130	73 79 85	.488
	4B	.228	74 80	.178
SPIOPHANES MISSIONENSIS	1B	.109	73 79 85	.222
GLEASON DIVERSITY	1B	.596	73 79 85	1.000
	4B	.958	74 80	.963
	5A	.357	86	.283
	6B	.993	31	.971
	8A	.649	25 33	.453
	8B	.449	76	.868
	9A	.212	82 88	.433
S/W DIVERSITY	1B	.922	73 79 85	1.000
	4B	1.000	74 80	1.000
	5A	.993	86	.947
	6B	1.000	31	1.000
	8A	.981	25 33	.906
	8B	.691	76	.977
	9A	.415	82 88	.807
EVENNNESS	1B	.998	73 79 85	1.000
	4B	1.000	74 80	1.000
	5A	1.000	86	1.000
	6B	1.000	31	1.000
	8A	.996	25 33	.918
	8B	.939	76	1.000
	9A	.996	82 88	.915

TABLE 3-46. (continued)

VARIABLE	STRATUM	POWER	STATIONS	POWER
TOTAL ABUNDANCE	1B	.260	73 79 85	.721
	4B	.230	74 80	.464
	5A	.409	86	.068
	6B	.999	31	1.000
	8A	.245	25 33	.306
	8B	.350	76	.747
	9A	.202	82 88	.261
NUMBERS OF SPECIES	1B	.438	73 79 85	.986
	4B	.977	74 80	.867
	5A	.123	86	.118
	6B	.995	31	.991
	8A	.919	25 33	.316
	8B	.377	76	.950
	9A	.164	82 88	.350

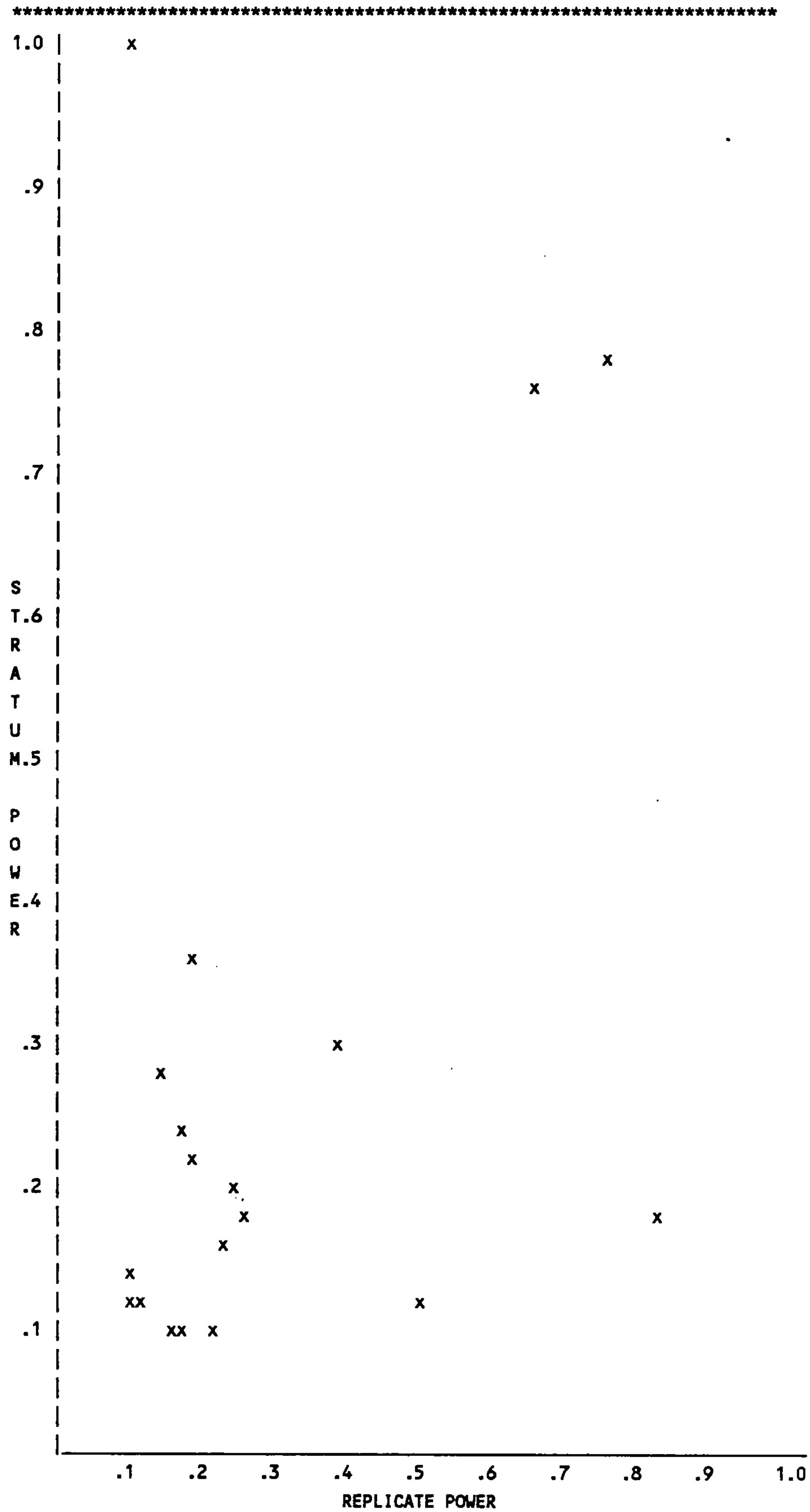

FIGURE 3-51. Relationship between power calculated from replicate samples and that calculated from stratum samples. Data are from the species in TABLE 3-46.

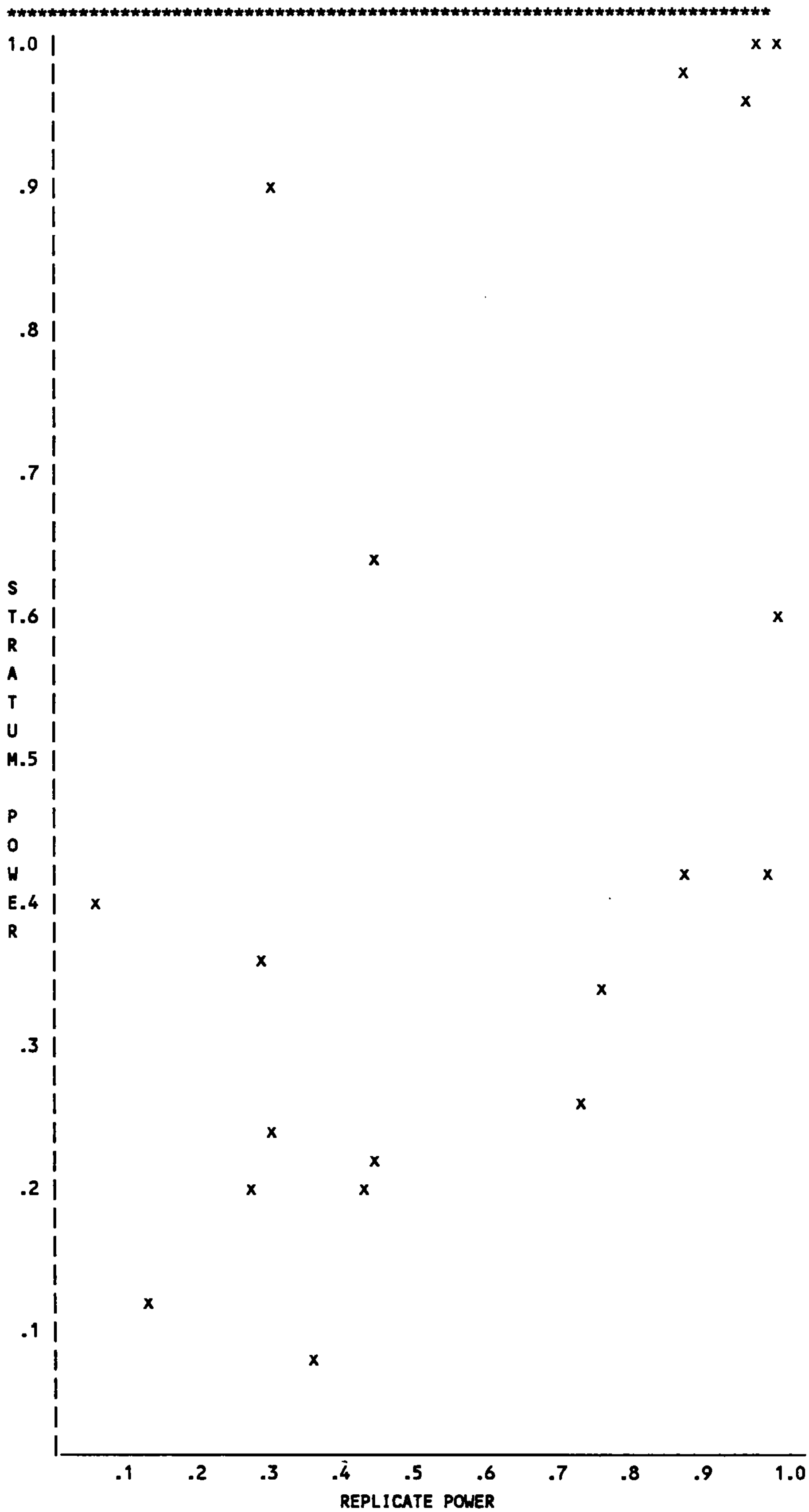

FIGURE 3-52. Relationship between power calculated from replicate samples and that calculated from stratum samples. Data are for the Gleason Diversity, Total Abundance, and Numbers of Species in TABLE 3-46.

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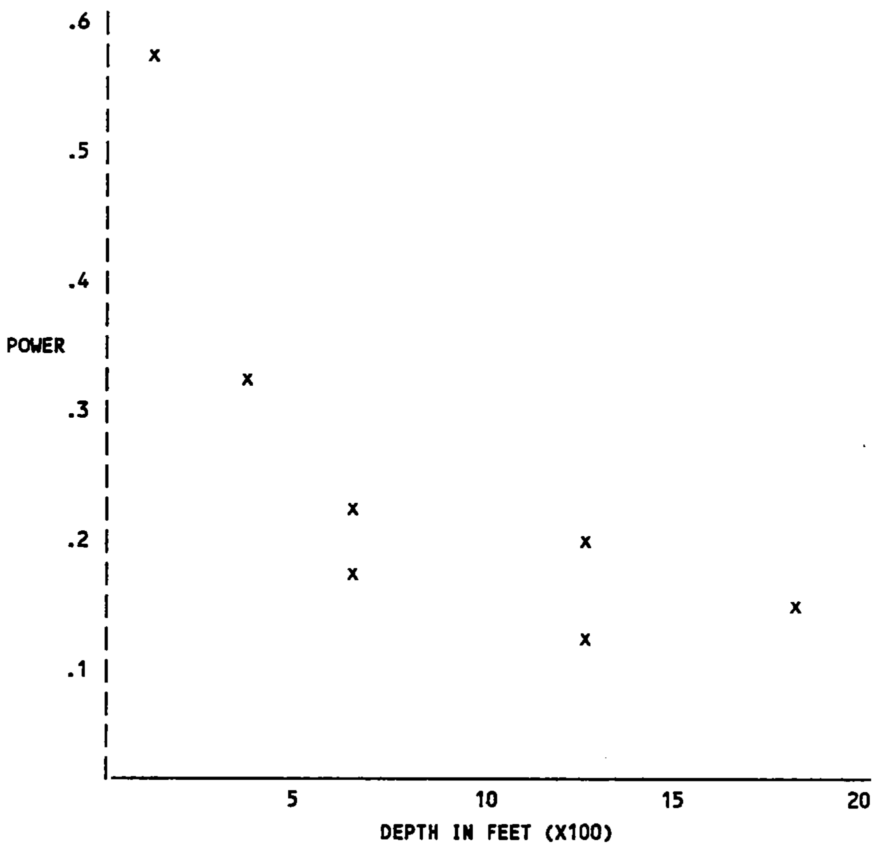

FIGURE 3-53. The relationship between the mean power for all species and depth. Data are from the 1.0mm size fraction of the replicate power analysis (see TABLE 3-42).

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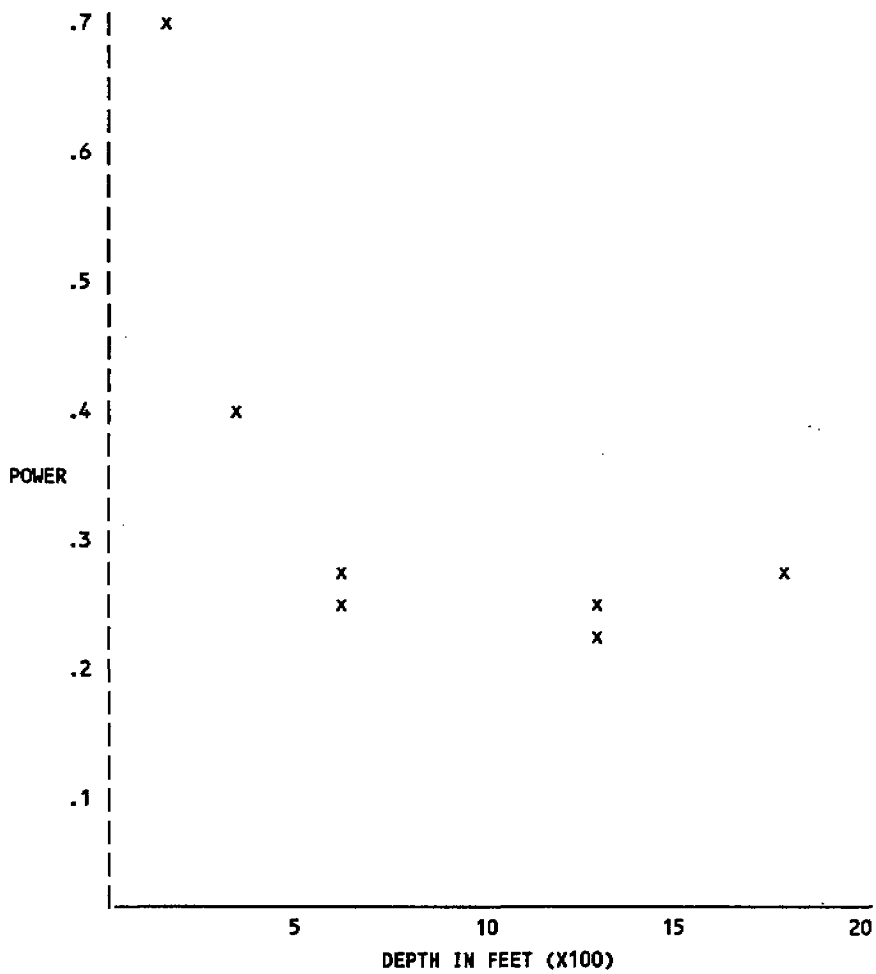

FIGURE 3-54. The relationship between the mean power for all species and depth. Data are from the 0.5mm size fraction of the replicate power analysis (see TABLE 3-45).

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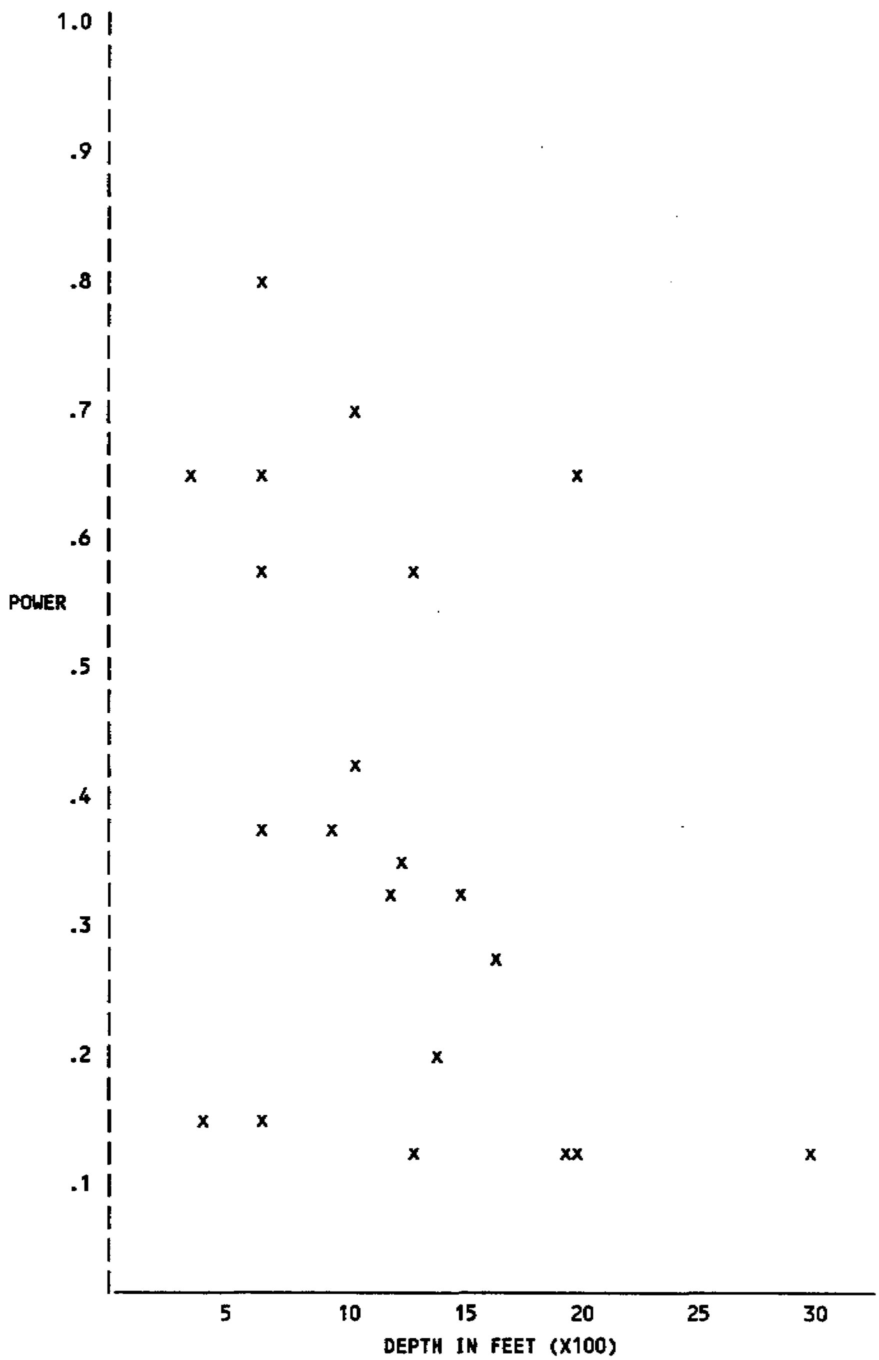

FIGURE 3-55. The relationship between the mean power for all species and depth. Data are from the 1.0mm size fraction of the stratum power analysis (see TABLE 3-43).

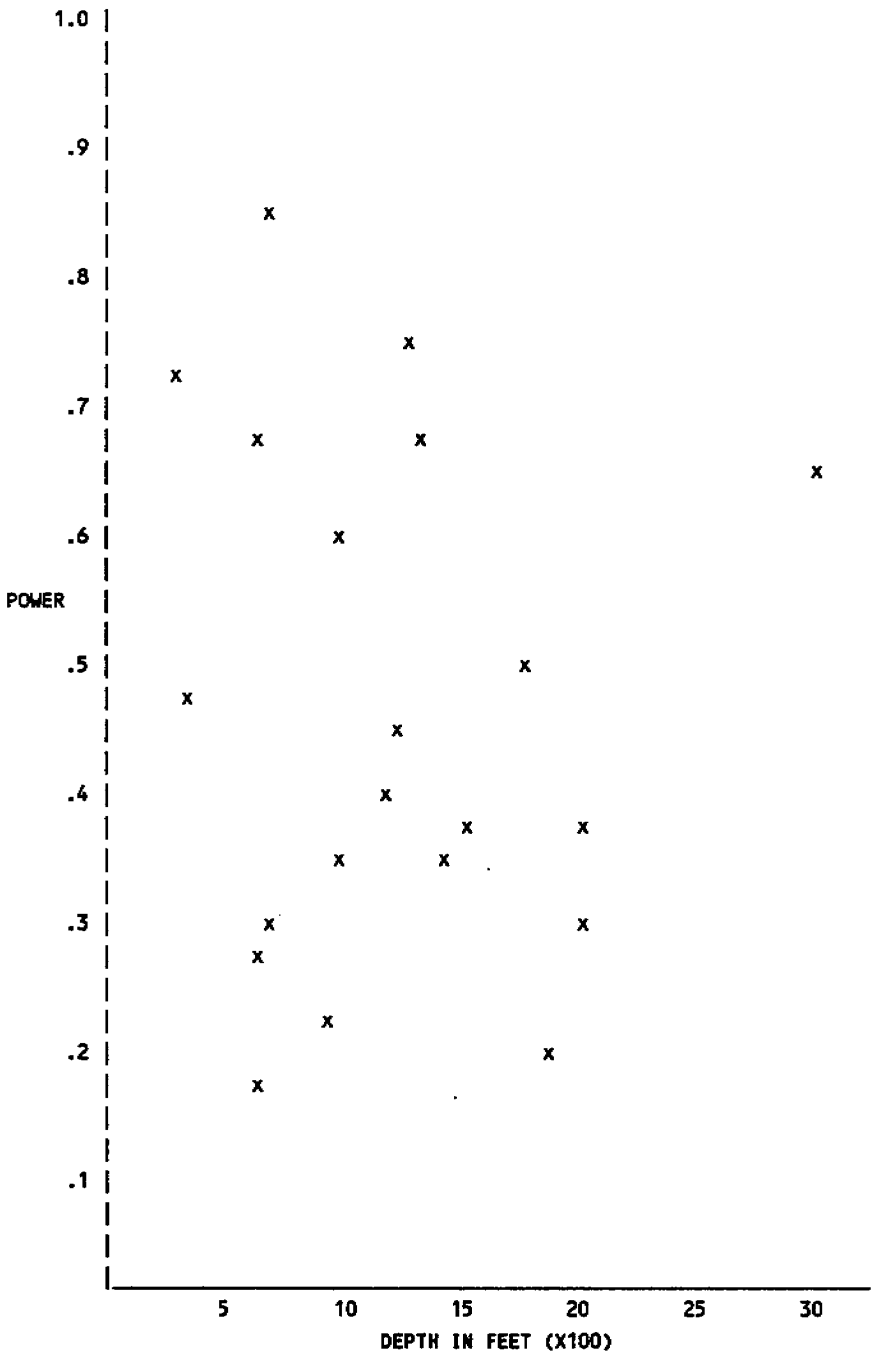

FIGURE 3-56. The relationship between the mean power for all species and depth. Data are from the 0.5mm size fraction of the stratum power analysis (see TABLE 3-45).

all species in the replicate analysis (Figure 3-57) but not in the stratum analysis (Figure 3-58). Decreases in total abundance with increased depth suggest that the relationship between total abundance and variance differs in the replicate and stratum spatial scales, and the relative proportion of the variance accounted for by these two spatial scales changes at different depths. Tables 3-47 and 3-48 show that the proportion of the variance accounted by replicate variablilty increases with depth, while that accounted for by stratum scale variabililty decreases with depth. The variance structure with depth thus should be well characterized as part of the Phase II monitoring design.

Multivariate Power Test Methods

Hypothesis testing with ecological distances is multivariate in the sense that several species are used simultaneously to compute the distance index values. Thus, distances are a measure of the overall qualitative and quantitative changes in the benthic community.

Statistical Model

Estimations of ecological distances used to test hypotheses with the two-way ANOVA model are explained with reference to the schematic presented below. This schematic describes the two-way ANOVA with interaction termed Model 1 in SAIC and EcoAnalysis (1984). The integers within the cells are

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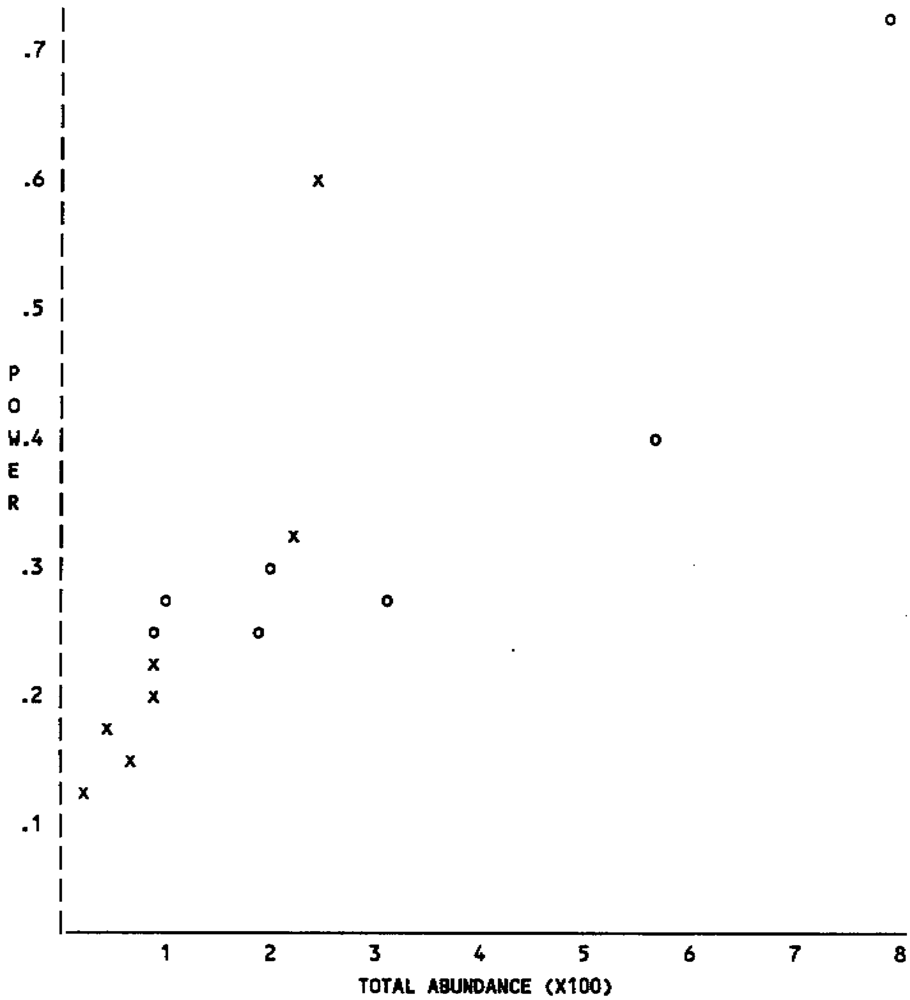


FIGURE 3-57. Relationship between mean power for all species and total abundance for the replicate power analysis. The 1.0mm size fraction is indicated by "x" and the 0.5mm fraction by "o." Within each size fraction, power increases with abundance.

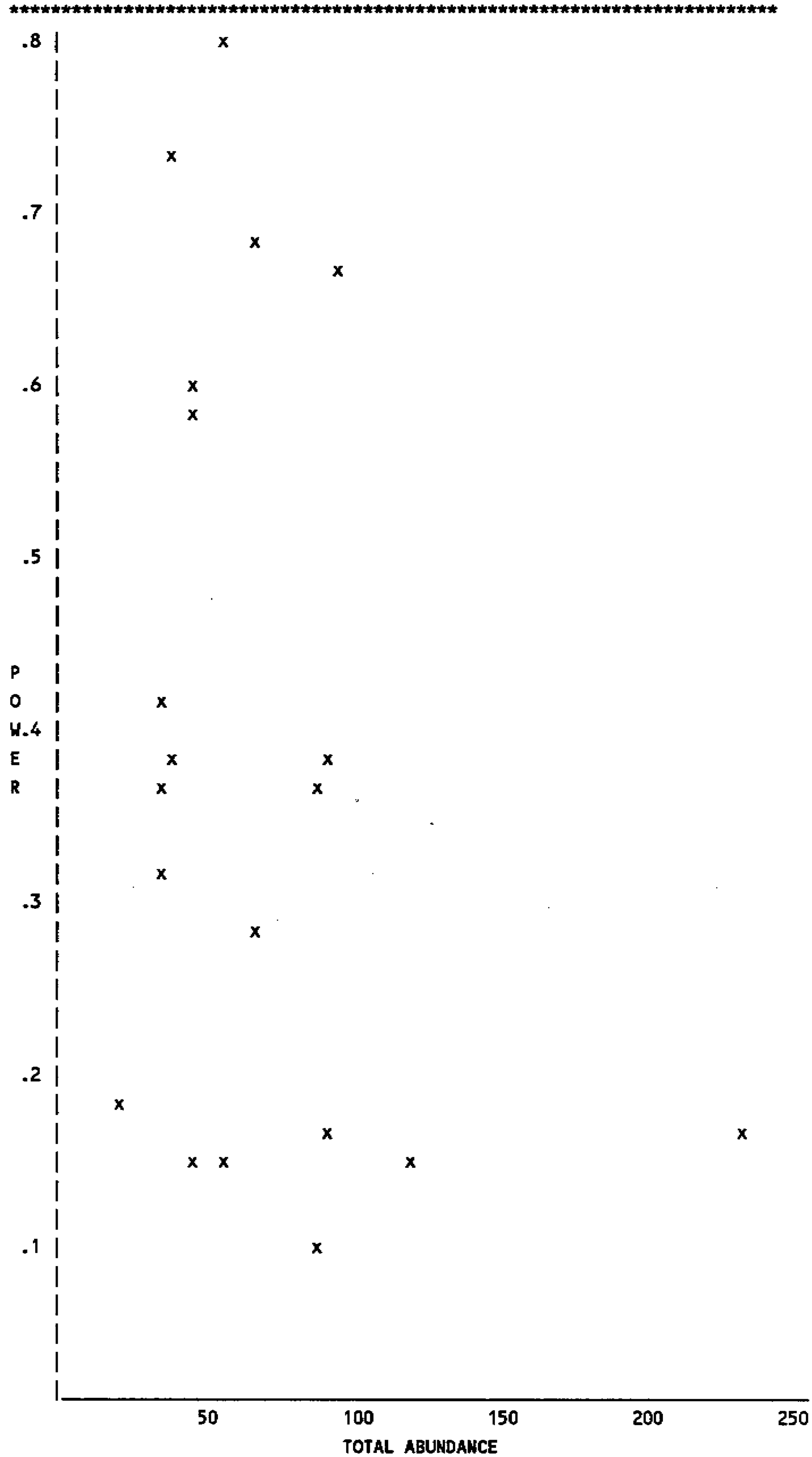


FIGURE 3-58. Relationship between mean power for all species and total abundance for the stratum power analysis. There is no clear-cut trend. A similar pattern was observed for the 0.5mm fraction.

TABLE 3-47. For the 1.0mm size fraction, the relative proportion of the total variance accounted for by the replicate variance (for the depth groups) and the intra-core or subcore variance (for the within-core (W.C.) analysis). The proportion of the total variance accounted for by the between-station variance, or the between-core variance for the within-core analysis, can be obtained by subtracting from 1.0.

VARIABLE	1	4	5	6	7	W.C.
Amphiodia urtica	.43	.22				.50
Brisaster latifrons		.26	.14	.50		
Nephtys cornuta fran.			.25	.66	.75	
Onuphis iridescens			1.00	.80		
Pectinaria californiensis	.04	.24	.48			.75
Prionospio lobulata			.30	.86	.34	
Spiophanes missionensis	.32					.15

TABLE 3-48. For the 0.5mm size fraction, the relative proportion of the total variance accounted for by the replicate variance (for the depth groups) and the intra-core or subcore variance (for the within-core (W.C.) analysis. The proportion of the total variance accounted for by the between-station variance, or the between-core variance for the within-core analysis, can be obtained by subtracting from 1.0.

VARIABLE	2	4	5	6	7	W.C.
Brisaster latifrons		.26	.14	.50		
Eudorella pacifica		.19	.22			.70
Minuspio cirrifera	.35	.54			.64	
Nephtys cornuta fran.		.81	.42	.08	.18	
Onuphis iridescens			1.00	.80		
Parvilucina tenuisculpta		.16				
Pholoe glabra	.25					.81
Spiophanes berkeleyorum	.11	.47				.48

sample numbers representing samples collected at corresponding locations and conditions. Two or more samples (replicates) can be grouped within each cell.

		LOCATION	
		IMPACT	CONTROL
CONDITION	BEFORE	1 2	3 4
	AFTER	5 6	7 8

Distances between samples are used instead of data values; therefore, the analysis does not follow the conventional computational procedures for an ANOVA. Instead, a multiple regression model proposed by Dyer (1978) is used to test hypotheses with distances. These computations are identical to those of a standard multiple regression, except that the error computations are modified to account for the potential lack of independence between distance values (caused by the presence of the same samples in more than a single distance).

Analysis involved three main steps:

1. Computation of the ecological distance index values.

   The index values are placed into a distance matrix which contains the ecological distances between all possible pairs of samples in the analysis. The distance matrix for the sampling scheme in the schematic shown above is presented in Figure 3-59.

   In the present study, distances were computed as Euclidean distances between points in a nonmetric multidimensional scaling (MDS) space. The analyses included all replicates at all stations, except for the outliers in the 0.5 mm size fraction ordination analysis which were excluded. The within-core analysis samples were also excluded. The configuration in the ordination space used here is very similar to that found in the pattern analysis, since the inclusion of the replicates did not alter the main patterns.

   The MDS ordination scores are not scaled to any biologically meaningful scale. The distances from an MDS space likewise lack a meaningful scale. It is important for hypothesis testing to be able to judge the magnitude of the biological changes being

Figure 3-59. The ecological distance matrix for the data in the Model 1 sampling design with two replicates per cell. The integers following the "D" indicate which samples are being compared, e.g., D42 represents the distance between samples 4 and 2. Only the bottom half of the symmetric matrix is shown, since Dij is equal to Dji. The diagonal values, which have a value of zero, are not used.

		SAMPLE							
		1	2	3	4	5	6	7	8
	1								
	2	D21							
	3	D31	D32						
	4	D41	D42	D43					
SAMPLE	5	D51	D52	D53	D54				
	6	D61	D62	D63	D64	D65			
	7	D71	D72	D73	D74	D75	D76		
	8	D81	D82	D83	D84	D85	D86	D87	

observed. This requires that the measurements used (i.e., the distances) be in interpretable biological units. For this reason, the ordination space (and the distances) were rescaled to half-changes, which are units of beta diversity (Gauch, 1982).

Complete turnover of all species can be expected at a beta diversity of about 4 half-changes. The computations involved in the rescaling are discussed in Appendix C.

2. Set up dummy independent variables for the multiple regression analysis.

Three dummy independent variables are required for the basic model. They are LOCATION, CONDITION, and INTERACTION. The dependent variable is the distance index. The value of the dummy variables will depend on the locations and conditions of the samples being compared by the corresponding distance value. If the samples being compared were collected at t e same location, then the LOCATION dummy variable will equal 0, otherwise it will equal 1. Likewise, if the samples being compared were taken under the same condition, then the CONDITION dummy variable will equal 0, otherwise it will equal 1.

The test for impact involves a test for significant interaction between LOCATION and CONDITION; the INTERACTION dummy variable will measure the degree of this interaction. Dyer (1978) recommended a method for setting the value of the interaction dummy variable (the maximum of LOCATION and CONDITION), but our tests have shown that this method does not work with the impact hypothesis. An alternate method has been devised which works well in practice. The rule for setting the value of the INTERACTION dummy variable is: if the distance index value contrasts a sample within the impact-after cell (e.g., contains samples 5 and 6 in the LOCATION/CONDITION schematic) with a sample outside the impact-after cell, then the INTERACTION value is set equal to 1, otherwise it is set equal to 0.

The data values which would be used in the multiple regression computations would appear as shown in Table 3-49.

3. Interpretation of results.

The multiple regression output will test whether the regression slopes for the independent variables are significantly different from zero. This will involve either a t-test or an F-test on each independent variable. If the slope for the INTERACTION variable is significantly different from zero, then an impact is

Table 3-49. Data for the Multiple Regression Computations. The Distance Values are the Same Values which would be in the Distance Matrix (Figure 3-59).

DEPENDENT VARIABLE	INDEPENDENT VARIABLES		
DISTANCE	LOCATION	CONDITION	INTERACTION
D21	0	0	0
D31	1	0	0
D32	1	0	0
D41	1	0	0
D42	1	0	0
D43	0	0	0
D51	0	1	1
D52	0	1	1
D53	1	1	1
D54	1	1	1
D61	0	1	1
D62	0	1	1
D63	1	1	1
D64	1	1	1
D65	0	0	0
D71	1	1	0
D72	1	1	0
D73	0	1	0
D74	0	1	0
D75	1	0	1
D76	1	0	1
D81	1	1	0
D82	1	1	0
D83	0	1	0
D84	0	1	0
D85	1	0	1
D86	1	0	1
D87	0	0	0

indicated. Since the slopes are partial regression coefficients, the interaction measured is variation over and above the LOCATION and CONDITION variation associated with contrasts with the impact-after cell.

Estimation of Power

The power of multiple regression depends on the following parameters (Cohen, 1977):

1. The type-1 error level (alpha); set at alpha = .05 for the present study.

2. The number of independent variables being tested for significance (u). With the above model, u = 1, since the main interest is in testing whether the INTERACTION regression slope is significantly larger than zero.

3. The number of other independent variables not tested for significance (w). Here w = 2, for the LOCATION and CONDITION independent variables.

4. The number of observations used in the multiple regression (N). For the model shown in the schematic above, N = 28 (see Table 3-49). N will, of course, vary with the number of replicates in the cells of the model. In general, if m equals the number of samples

used, then N = m (m-1)/2, which is the number of entries in the lower (or upper) half of the distance matrix (e.g., see Figure 3-59). It should be emphasized that N is NOT the number of replicates per cell.

5. The signal-to-noise ratio in the test to be performed (f2, called f squared in Cohen, 1977). Specifically,

$$f2 = PVs/PVe,$$

where PVs is the proportion of the total variance accounted for by the source of interest (here the INTERACTION variance), and PVe is the proportion of the total variance accounted for by the error or residual variance.

To determine the power of a specific test, the parameter L is computed as follows.

$$L = f2(N-u-w-1) = f2(N-4).$$

Using the calculated value of L, Table 9.3.2 in Cohen (1977) is consulted to find the power of the test.

For each situation of interest (different strata and replicate station pairs), power tables can be constructed, as shown in the example in Table 3-50. The power values are obtained as follows.

1. The f2 parameter is defined as

$$
\begin{aligned}
f2 &= PVs/PVe \\
&= (Vs/TV)/(Ve/TV) \\
&= Vs/Ve,
\end{aligned}
$$

where PVs is the proportion of the total variance accounted for by the INTERACTION parameter, PVe is the proportion of the total variance accounted for by the error variance, TV is the total variance, Vs is the INTERACTION variance, and Ve is an estimate of the error variance.

2. The error variance (Ve) is estimated using the method of Dyer (1978). Computation of the error variance estimate takes into account the potential lack of independence between some of the distance values. As the dependency between distance values involving the same sample increases, the magnitude of the error variance estimate will increase (when compared to the error variance estimate from standard multiple regression).

Table 3-50. Power Table for the 1 mm Size Fraction in Strata 8A and 8B. The Error Variance (Ve) for this Analysis is .040. For Two Samples/Cell (2 replicates) a Power of 0.8 occurs at an Interaction Standard Deviation (STD DEV) of Approximately 0.12 (from interpolation). See Text for Further Explanation.

# SAMPLES/CELL	N	INTERACTION STD DEV .03 / INTERACTION VARIANCE .001	.10 / .01	.16 / .025	.22 / .05	.32 / .10
2	28	.09	.70	.97	1.00	1.00
3	66	.23	.98	1.00	1.00	1.00
4	120	.40	1.00	1.00	1.00	1.00
5	190	.59	1.00	1.00	1.00	1.00

3. The columns of the power table (Table 3-50) correspond to a range of levels of the INTERACTION variance (Vs). Each entry of the power table corresponds to a combination of Vs and N values. Given values for Vs and Ve, f2 can be estimated. The resulting value of L can used to find the power (in Table 9.3.2 of Cohen, 1977).

The INTERACTION variance (Vs) used to calculate the power (p) is the minimum detectable variance (presumably caused by the impact) which will be detected 100 x p percent of the time such a test is made. The square root of the INTERACTION variance is the INTERACTION standard deviation (STD DEV). The use of standard deviation units converts the INTERACTION variablity into units of the original data, the input distance index values. The INTERACTION standard deviation can also be called the minimum detectable difference.

Estimation of Ve

As noted above, the error variance is estimated using Dyer's (1978) method. The 2-way ANOVA model outlined is not used in these calculations because there is not yet an "after" condition in the present data. Instead, a 1-way ANOVA test is used to obtain a Ve estimate. The specific 1-way ANOVA tests performed are discussed below (Scale of Replication).

As with the univariate power tests, the error variance in a simple 1-way ANOVA is assumed to be the same as that in the 2-way model. The error variation ultimately is dependent upon the variation within each location-condition. Assumimg that the variance within each location-condition is statistically equal, than the pooled variation would not change appreciably by adding more conditions.

One of the assumptions of statistical tests and power tests with multiple regression is that the residuals (predicted values minus the actual values of the dependent variable) are normally distributed. The error variance (Ve) would be equal to the variance of the residuals if the distances were independent observations. However, with adjustments for dependency, the calculated Ve will be larger than the variance of the residuals. For each calculation of Ve, a test for normality is applied to the residuals of regression analysis (SAS, 1982; UNIVARIATE procedure). If the number of distances (N) is less than 51, the Shapiro-Wilk W statistic is applied (Shapiro and Wilk, 1965). For a larger N, the Kolmogorov D statistic is computed (Stephens, 1974).

The Scale of Replication

Power will be estimated at two different levels of replication.

1. Instantaneous replication. Power is calculated at each pair of stations on adjacent replicate transects. Here, samples within

the cells are replicates taken at the same station. One of the stations in the pair is considered an impact site and the other a control site. To estimate the error variance for a station pair, the Dyer (1978) method is used in a 1-way ANOVA test contrasting the impact and control sites. This involves a test with only the LOCATION dummy variable (see Table 3-49).

2. Within-stratum replication. Power is calculated for each group from the cluster analysis which contains two or more strata. Here, samples within the cells are samples within the same stratum. To estimate the error variance, the Dyer method is used in a 1-way ANOVA contrasting the different strata within the cluster group. Again, this involves a test with only a LOCATION dummy variable.

Multivariate Power Test Results

Normality Tests of the Regression Residuals

Table 3-51 shows the results of the normality tests on the regression residuals. Only seven out of 36 tests show evidence of non-normality. The statistical tests and power tests with multiple regression are fairly "robust", i.e., moderate departures from the normality assumption will generally have little effect on the validity of the results (Cohen, 1977). At any rate, there is no evidence of widespread deviations from normality among the residuals.

Table 3-51. Normality Tests on the Regression Residuals. The Values in the Table are a Test of the Null Hypothesis that the Residuals are a Random Sample from a Normal Distribution. Values Showing Evidence of Non-Normality (< = 0.05) are Marked with an Asterisk.

	SCREEN SIZE	
COMPARISON	1 mm	0.5 mm
Adjacent replicate stations		
23 31	<.01*	<.01*
25 33	.943	.824
27 35	.015*	.041*
28 36	.658	.378
73 79	.460	.412
74 80	.387	.125
76 82	.434	.646
79 85	.312	.018*
80 86	.256	.208
82 88	.484	.920
Strata		
1A 1B	<.01*	<.01*
4A 4B	.694	.303
6A 6B	.427	.774
7A 7B 7C	.496	.478
8A 8B	.150	.150
9A 9B	.342	.542
10A 10B	.989	.751
11A-11E	.067	.061

Power Tests

Figure 3-60 shows the minimum detectable differences (at power = .80 and 2 replicates/cell) of the various replicate station pairs vs. the average depth of the station pairs. The plotted values were interpolated from the power tables (see Table 3-50).

Three patterns are evident in Figure 3-60. First, there is no clear-cut trend with depth. Some of the station pairs toward the shallower end show a relatively higher minimum detectable difference (less power), but others in the same depth range show an extremely low minimum detectable difference.

Secondly, the minimum detectable differences generally are quite low. The minimum detectable differences can be put into perspective by reference to Figure 3-61. The extent of a distance or minimum detectable difference of 0.2 is shown in the ordination space (from which the distances were derived). Such a distance is quite small compared to the extent of the variation along the first two axes. Fourteen out of the 20 minimum detectable differences are 0.1 or below. This means that with only two replicates/cell, small changes in the benthic community will have a high probability of being be detected.

Finally, for the station pairs which have the higher error variance values, the error variance of the 0.5 mm data is lower than the 1 mm data. However, the differences are not large enough to be of importance, and the power is sufficiently high with either type of data.

Figure 3-60. Error variances and minimum detectable differences (with .8 power and two replicates/cell) for the replicate station pairs on adjacent transects, plotted vs. the average depth of the station pair.

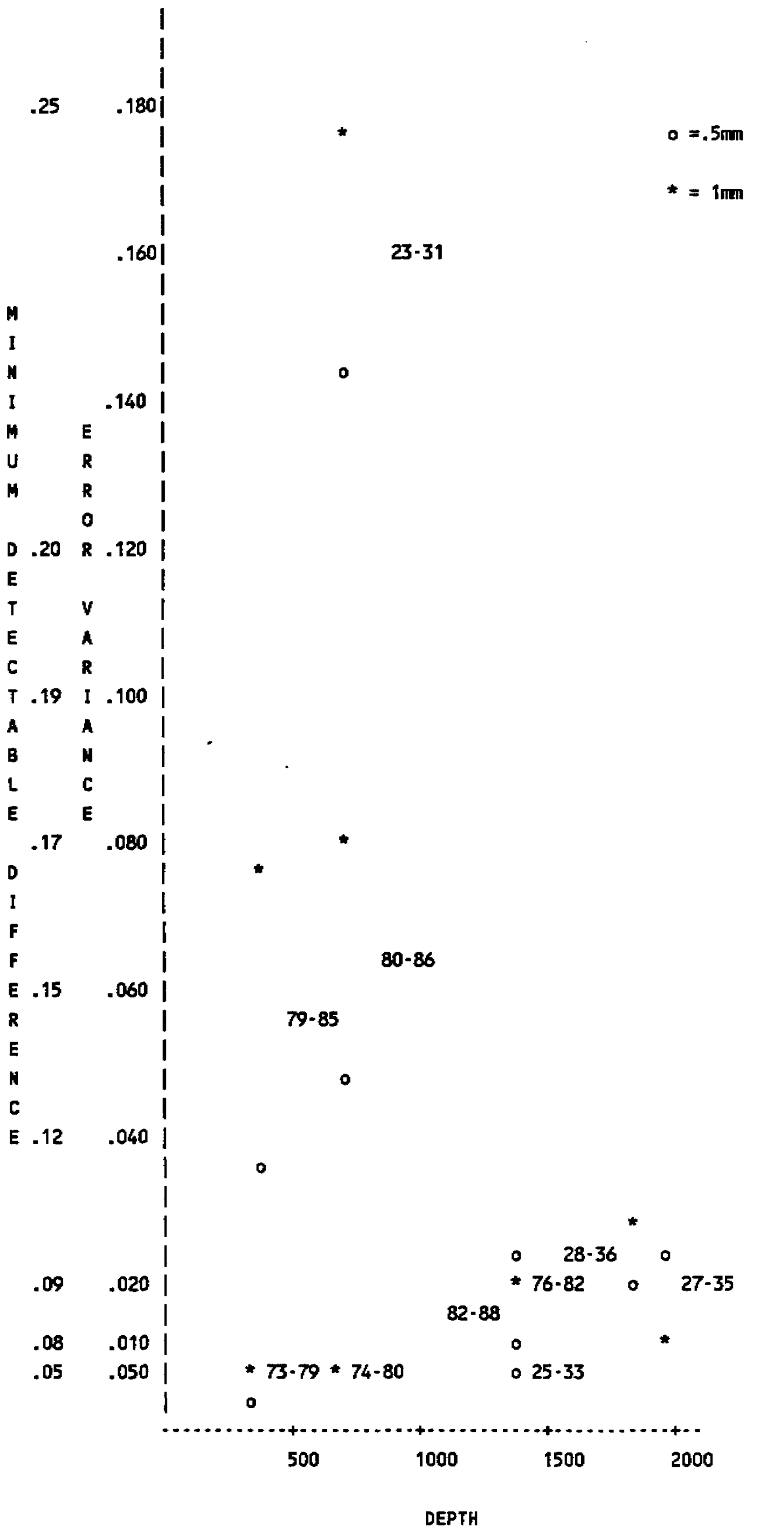


Figure 3-61. The first two axes of the MDS ordination space from which the distances used in the power tests are calculated. The scores are scaled in half-change units of beta diversity. The symbols correspond to the group numbers from the cluster analysis of the .5 mm data. A distance scale of .20 is shown to give perspective to the magnitudes of the calculated minimum detectable differences.

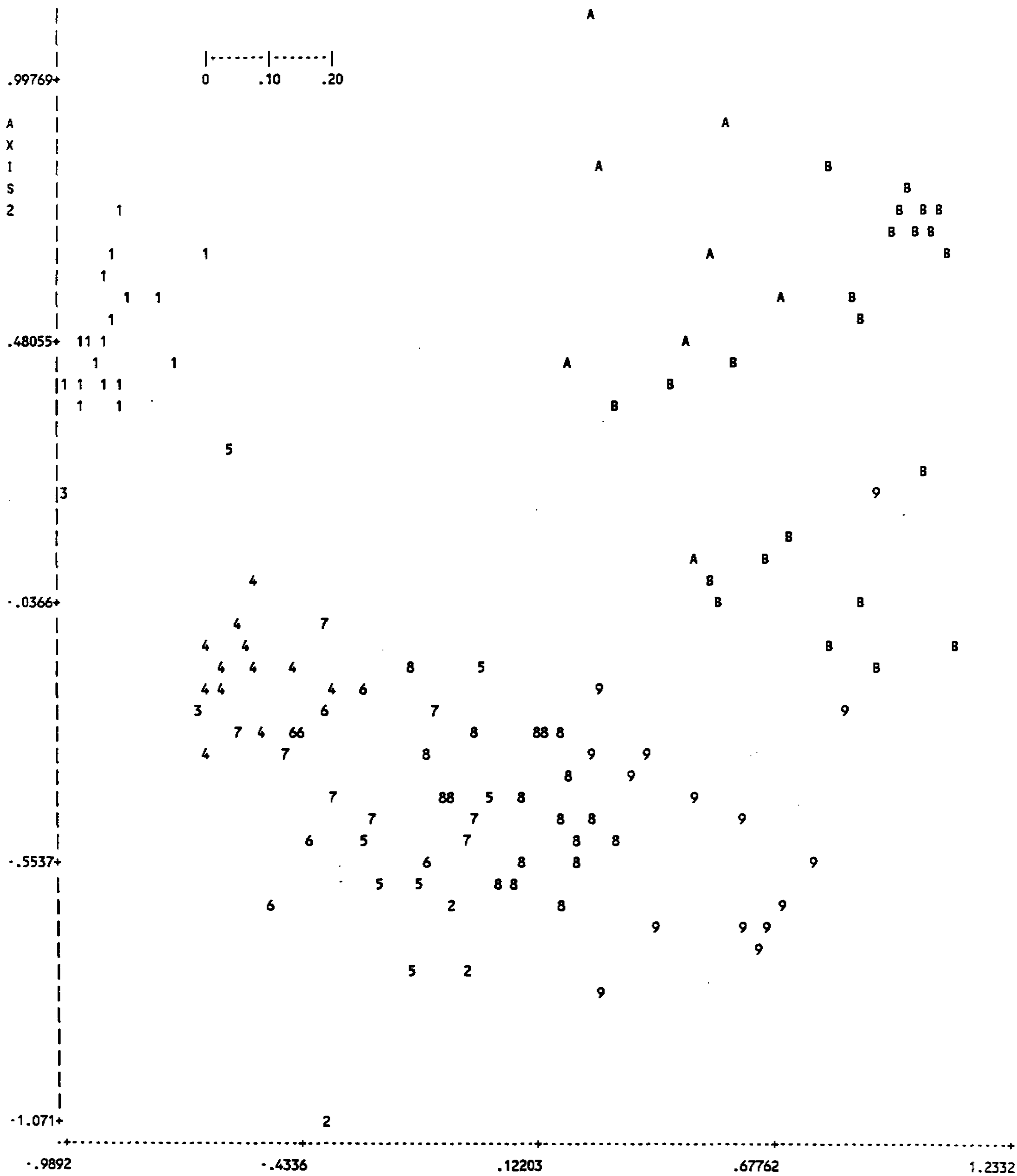
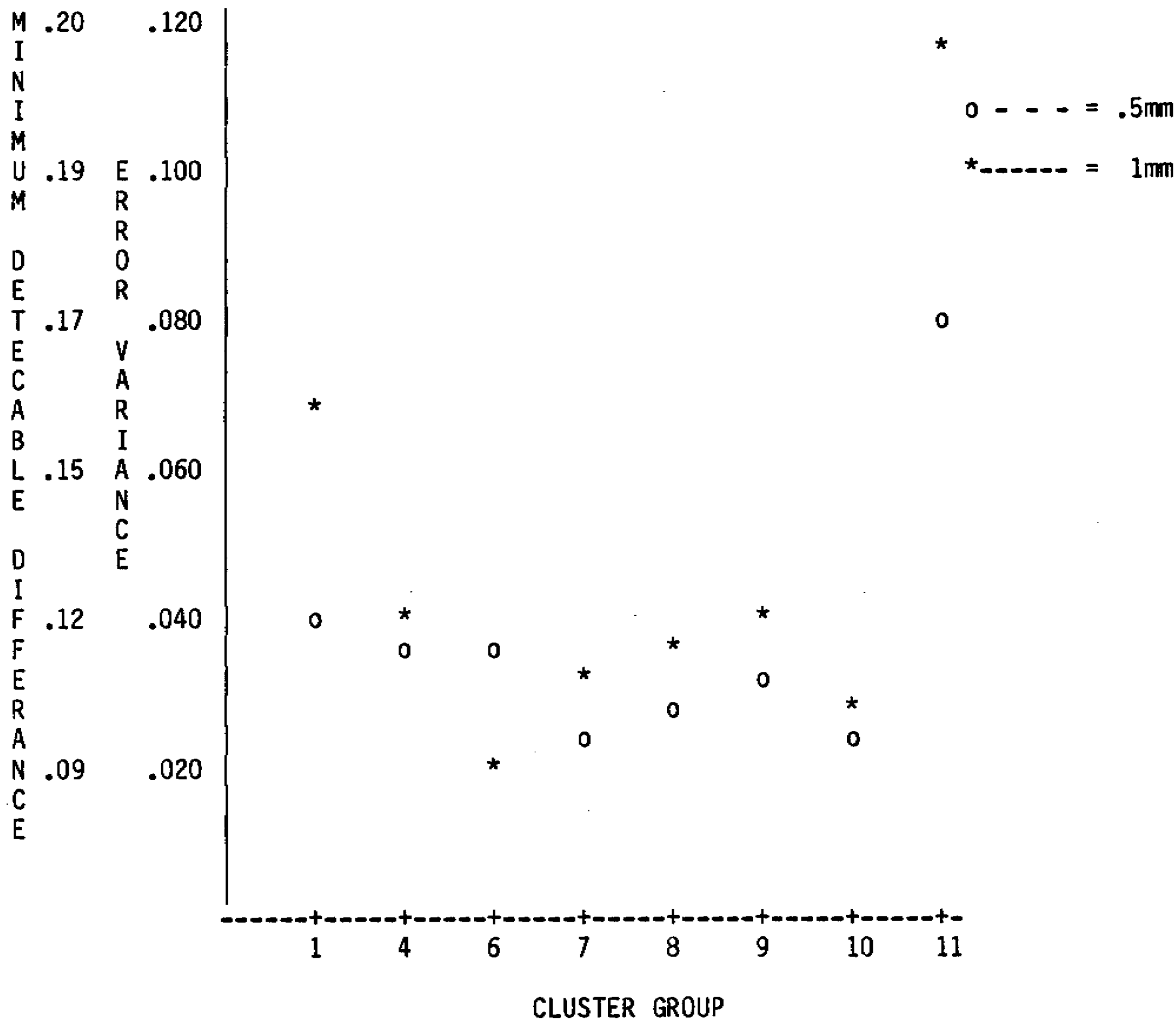


Figure 3-60 shows the pattern of the minimum detectable differences (at power = .80 and 2 replicates/cell) of the strata within the cluster groups. Four patterns should be noted. First, there is no strong pattern with depth. The cluster groups generally go from shallower stations at cluster group 1 to deeper stations toward the higher cluster group numbers. Secondly, with the exception of cluster group 6, the power with the 1 mm size fraction is slightly lower. Thirdly, the power is again quite high. The worst minimum detectable difference is less than 0.2. Most of the minimum detectable differences are approximately 0.12 or less (see Figure 3-61). Finally, the lowest minimum detectable differences with the strata are higher than the lowest minimum detectable differences with the replicate stations (compare Figures 3-60 and 3-62). This difference is not important since the detectable differences for the lowest replicate stations are much lower than will be required in practice.

The high power associated with inter-sample distance is not suprising since information from several species is used simultaneously to calculate the distance values. Similar high power has been found using distance values from other benthic studies (Bernstein et al., 1984). Instead of using the standard power calculations to estimate power, bootstrap simulations which directly determine the power levels were used (Bernstein et al, 1984). Therefore, it is unlikely that the present results (extremely high power with ecological distances) are due to mistaken assumptions in the calculation of the error variances or in the application of the power test.

Figure 3-62. Error variances and minimum detectable differences (with .8 power and two replicates/cell) for the strata within groups from the cluster analysis.



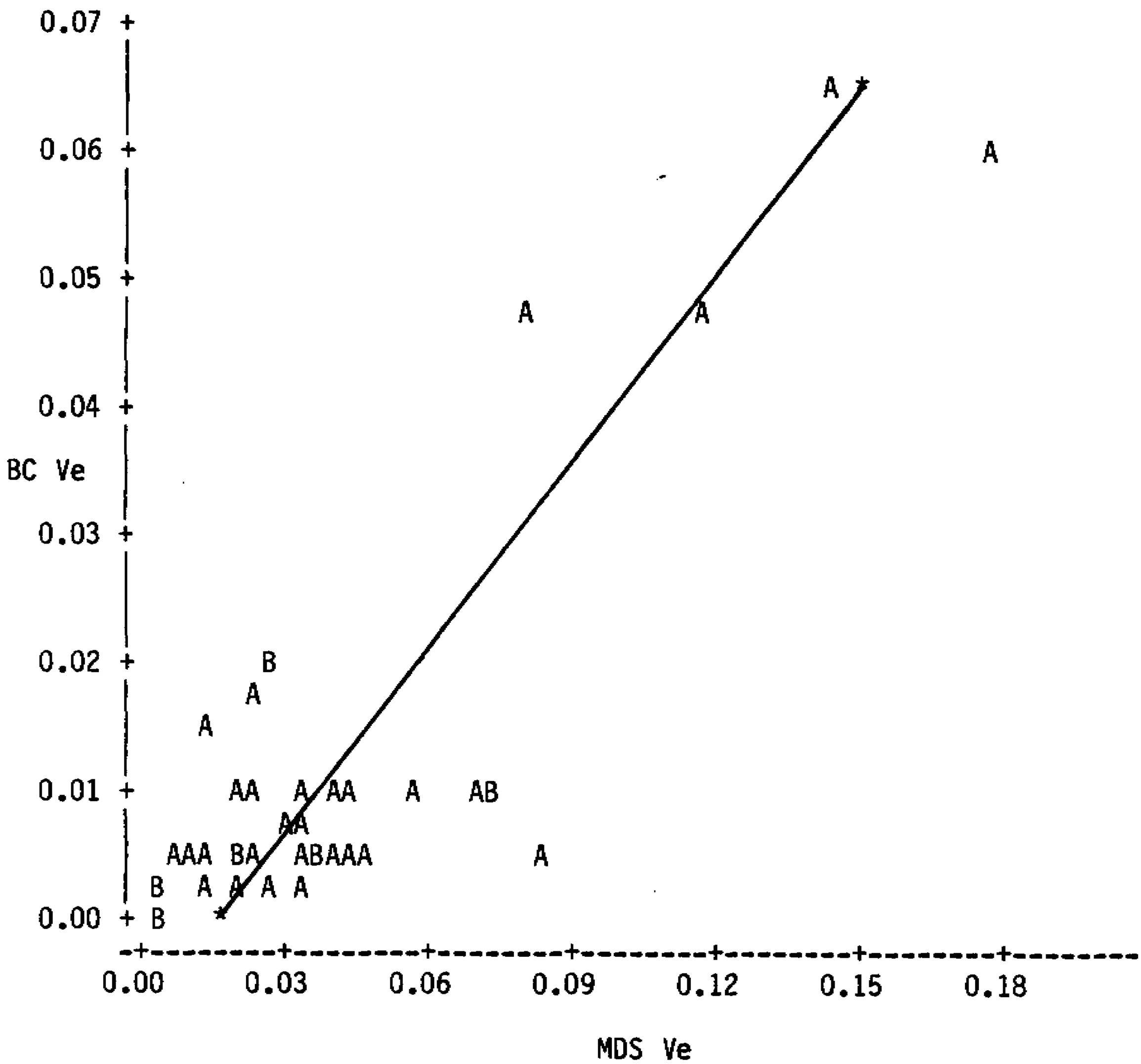
Power With the Bray-Curtis Distance Index Values

Error variances and power tables were also calculated for the Bray-Curtis distances the original Bray-Curtis distance index values (used in the MDS calculations; see Appendix C). In general, similar patterns of power resulted. Figure 3-63 shows the relationship between the error variances of the MDS distances and the Bray-Curtis distances. The higher MDS error variances correspond to the higher Bray-Curtis error variances, although the error variances of the Bray-Curtis distances are generally lower than that of the MDS distances. This is partly due to the fact that the range of the Bray-Curtis distances is about 50% smaller than the range of MDS distances. In any case, the low error variances indicate that the power with either method of distance calculation is very high.

3.5.2.2 Hard-Bottom Survey

Several features of the hard bottom community will influence the design of any long-term monitoring survey program. These features include: 1) difficulties obtaining quantitative data and identifying some taxa to species level; 2) the general lack of distinct trends in community structure with either depth or latitude (Section 3.2.2); (3) the relatively slight correlation of physical environmental characteristics that are easily measurable (e.g., substrate relief) with the biological patterns. Plots

Figure 3-63. The relationship between the error variances of the distances derived from the MDS space (MDS Ve) and the error variances from Bray-Curtis distance index values (BC Ve). The Bray-Curtis values are the same distance values used in the creation of the MDS space. The least squares regression line is shown.



Plots of the environmental variables in the ordination space thus appear almost random, with few trends in the space. These features imply that it will be extremely difficult to select sampling areas or strata a priori, on the basis of substrate type and relief.

This "noise" in the system may result from historical events, such as sediment transport and burial, such that various regions of the habitat are in different stages of burial or recovery (see Section 3.2). A monitoring program must therefore be designed to minimize the noise and account for these hard-bottom community features as much as possible. We recommend that long-term monitoring include the following: (1) studies to better understand the natural physical processes, such as sediment transport and sedimentation, that influence the structure of the hard-bottom community; (2) a model of potential impacts that defines the relationship of these impacts to natural processes; for example, impacts may be similar to changes due to natural processes only larger or smaller in scale; (3) an assessment of which portions of the hard-bottom community will be most sensitive to the impact(s) and/or easiest to monitor (for example, high relief areas that are relatively free of the effects of natural sediment transport may be a useful focus of monitoring efforts); and (4) an explicit sampling and analysis design that specifies what and where to sample, what hypotheses are being tested, and what analytical approaches will be used to test them. Since the sources of greatest potential impact (the platforms) will be point sources, the most effective monitoring design may be one in which stations are grouped into affected and control treatments, with the affected stations at various distances from the impact source. Based on the results from the hard-bottom survey, two general habitat types were observed: low relief features associated with extensive sediment cover, and higher relief features associated with relatively decreased sediment cover. These habitats are characterized by somewhat distinct biological assemblages potentially representing different sensitivies to impacts from oil and gas development. Therefore it is recommended that both types of habitats be surveyed during long-term monitoring studies. Low relief hard-bottom features were relatively common over most transects surveyed, whereas extensive high relief features were only observed along four transets (see Section 3.2.1).

3.5.3 Methods

Recommended methods from the soft-bottom and hard-bottom surveys are presented in Sections 3.5.3.1 and 3.5.3.2, respectively.

3.5.3.1 Soft-Bottom Survey

The survey methods used during this program, particularly as regards the use of precise navigation and the box coring device, provided an effective mechanism for conducting the soft-bottom survey and are highly recommended for future studies in the region. Due to the high winds and seas that may be encountered in the survey area a sufficiently large (e.g., >140 feet) survey vessel having good station keeping ability is required for efficient survey operations.

Subsequent surveys of stations identified as having coarse, hard sand should plan to use the SIO-MLRG grab sampler (or equivalent) or a more heavily weighted box corer to achieve adequate sampler penetration and sample recovery.

Bottom sediments in the survey region generally are fine-grained silts, clays and fine sand. Due to the relatively high water content of these sediments, the torvane device did not provide a good measure of sediment cohesiveness and is not recommended for future studies. In contrast, the penetrometer used during Leg 4 did provide an adequate method for measuring sediment compressive strength and is recommended as an alternate method. Future studies could additionally test the use of a 4" diameter adapter foot with the penetrometer as an improvement to the 3" adapter used during the present survey.

More efficient acquisition of infaunal specimens for size-frequency analysis could be accomplished using an epibenthic sled or similar device. The larger sample provided by such gear would offset reduced population densities at some depths and allow size-frequency efforts to be concentrated into examination of adequate sample sizes from only a few test sites.

Data resulting from the present reconnaissance suggest that continued analyses of biological materials retained on the 0.5 mm screen is not warranted. Use of the finer screen does result in collection of more specimens and taxa (see Table 3-52), but does not modify the structural interpretation of the community. Dendrograms based on 0.5+1.0 mm and 1.0 mm only screens

Table 3-52. Group Biotic Parameters for Different Screen Sizes.

Group	n =	N sp 1.0	N sp 0.5	NIND/0.1m² 1.0	NIND/0.1m² 0.5	H' 1.0	H' 0.5	D 1.0	D 0.5	J' 1.0	J' 0.5
1 Mean	14	62.07	109.64	243.07	624.00	3.14	3.72	11.12	16.96	0.766	0.795
S.D.		19.75	22.09	76.79	235.63	0.48	0.28	3.12	2.62	0.067	0.034
2 Mean	1	17.00	32.00	33.00	80.00	2.41	2.99	4.62	7.20	0.859	0.868
S.D.		-	-	-	-	-	-	-	-	-	-
3 Mean	2	51.50	104.00	225.50	619.00	2.88	3.63	9.24	16.03	0.730	0.782
S.D.		24.75	18.38	85.56	179.61	1.04	0.13	3.93	2.14	0.173	0.001
4 Mean	10	33.10	73.80	80.80	283.50	3.07	3.68	7.45	13.07	0.879	0.860
S.D.		5.67	12.58	2.91	133.22	0.46	0.24	1.34	1.56	0.011	0.058
5 Mean	6	30.00	51.17	71.83	170.33	2.98	3.30	7.04	9.99	0.897	0.845
S.D.		10.16	9.83	52.10	100.37	0.37	0.25	1.81	1.21	0.077	0.066
6 Mean	5	21.40	44.00	37.20	128.20	2.84	3.34	5.65	8.95	0.936	0.888
S.D.		4.56	8.80	9.60	53.96	0.20	0.20	0.99	1.45	0.020	0.046
7 Mean	8	28.25	55.38	61.75	186.13	2.99	3.40	6.75	10.61	0.904	0.850
S.D.		6.63	10.10	33.48	73.93	0.25	0.29	1.03	1.51	0.056	0.051
8 Mean	14	27.86	52.71	74.50	241.50	2.79	3.18	6.31	9.52	0.843	0.806
S.D.		5.61	10.37	20.21	97.17	0.41	0.22	1.20	1.45	0.096	0.048
9 Mean	11	12.00	21.91	22.82	63.00	2.16	2.54	3.58	5.18	0.889	0.840
S.D.		4.65	6.88	9.45	36.03	0.55	0.42	1.24	1.15	0.124	0.110
10 Mean	8	25.88	55.50	45.38	285.25	2.99	3.13	6.55	9.88	0.929	0.782
S.D.		7.41	15.72	18.72	160.41	0.27	0.56	1.28	2.94	0.038	0.094
11 Mean	15	21.86*	39.00	48.86	146.40	2.66	2.91	5.38	7.90	0.870	0.796
S.D.		4.83*	9.44	14.22	57.85	0.29	0.38	1.04	1.72	0.061	0.078

* n = 14 for 1.0 mm screen alone

showed similar but not identical patterns of biotic similarity between sites (see Section 3.1.3.2). Multiple discriminant analysis and ordination analysis of 1.0 mm data differed only slightly from those based on 0.5+1.0 mm data. Both analyses indicated the same relative importance of physical parameters in accounting for biotic variability. Power was often higher when only the 1.0 mm screen data were used.

Thirty-two of the new species encountered (including those previously known and those newly recognized) were only encountered on the 0.5 mm screen. A total of 70 taxa were only detected on the 0.5 mm screen. Only nine of these met the abundance and occurrence criteria for inclusion in the cluster analysis. Since the site groups used in other analyses are based on the cluster results, over 80% of the elements unique to the 0.5 mm screen were excluded from the analyses.

We therefore recommend that 0.5 mm screen fractions be collected, preserved, and archived from each sample collected during the monitoring phase. Samples needed for special analyses (e.g., specimens for size-frequency determinations) could be processed as needed. In lieu of processing the 0.5 mm screen materials, efforts to better define either spatial or temporal variability at test sites or to experimentally assess system dynamics would be more effective.

3.5.3.2 Hard-Bottom Survey

All major survey equipment, including the submersible, support vessel, camera and navigation systems used during the hard-bottom survey was very reliable and provided an efficient mechanism for conducting the study. The few mechanical problems experienced were not unexpected due to the rigorous nature of the survey operations, and were not related to limitations in the type or model of equipment utilized. In particular, the support vessel and launch and recovery system for the submersible were highly effective under operating conditions of relatively high winds and seas characteristic of the survey area. These types of limitations, particularly as regards the conduct of seasonal surveys or field operations in the Pt. Conception to Pt. Arguello area, should be carefully considered in the design of monitoring programs for this region.

The design modifications to DIAPHUS' collecting basket were very successful in providing a large volume for several rocks and/or specimens per basket, sample segregation and sample protection during recovery of the submersible. This design could be adapted to other submersibles, however, it may have limited application to ROV's due to the reduced weight and ballast requirements of these systems. Rock collection has characteristically been a time consuming process during previous surveys; however, collection of rocks during the present survey, using the new basket design and a standard manipulator arm, was extremely efficient requiring less than five minutes for most samples.

The results from the photographic techniques survey suggest that time series photographs of fixed quadrats are probably feasible, at least for low relief areas, by controlling the distance off the bottom that a photograph is taken, thereby standardizing the surface area in the resultant photographs. However, the bottom contact switch method used during the survey has only limited application because of difficulties in maneuvering the submersible with the attached weight. Several new methods to control camera distance off the bottom were suggested during discussions with the submersible crew and observers. These methods include (1) manually triggering the camera from inside the submersible, using an externally mounted "feeler" to indicate a standard distance off the bottom, and (2) triggering the camera using bottom finding sonar mounted on the submersible.

4.0 SUMMARY AND CONCLUSIONS

This section presents a summary of major conclusions and recommendations from the soft-bottom and hard-bottom reconnaissance surveys; summaries are presented separately for biological, chemical, and geological parameters (Sections 4.1, 4.2, and 4.3 respectively). A summary of supplementary observations is presented in Section 4.4. Conclusions regarding the sensitivity of benthic organisms to potential effects from oil and gas development are presented in Section 4.5; recommendations for long-term monitoring are presented in Section 4.6.

4.1 BIOLOGY

Summaries and conclusions from the soft-bottom and hard-bottom biological data are presented in Sections 4.1.1 and 4.1.2, respectively.

4.1.1 Soft-Bottom

Results from the soft-bottom survey conducted between November 1983 and January 1984 provided a broad scale view of the outer shelf and slope habitats of the Santa Maria Basin and western Santa Barbara Channel, with finer resolution in areas of sample replication. Overall the invertebrate assemblages in the study area were similar to those observed previously near Point Conception and Point Arguello and in the Southern California Bight. The assemblages were distributed primarily along a depth gradient, although north-south components were visible north of Point Conception, particularly at upper slope and shelf depths.

Variants of the association characterized by the ophiuroid Amphiodia urtica predominated on the outer shelf as they do throughout southern California borderland. With increasing depth on the mainland slope, a succession of polychaete associations replaced the ophiuroid dominant assemblage of the outer shelf. These polychaete associations included Pectinaria californica, Pectinaria-Chloeia, Heteromastus filobranchus, Lysippe, and Maldane sarsi associations which are also observed in submarine canyons in the Southern California Bight. The heart urchins Brisaster and/or Brissopsis dominated the standing crop in these slope associations, although the sea urchin Allocentrotus and the spoonworm Arhynchite also made occasional significant contributions to the total standing crop. At several sites off Pismo Beach and Pt. San Luis benthic populations of Pleuroncodes planipes (pelagic red crab) were sampled, and their presence was probably related to the recent El Nino conditions as this species normally occurs no farther north than Baja California.

At shelf and upper to mid-slope depths numbers of species and specimens per sample decreased with increasing depth. Shannon-Wiener species diversity and Gleason's richness index values followed the same trend, whereas Pielou's evenness index remained relatively constant over the shelf and slope. All gradients in community parameters reversed at the deepest sampled sites, with diversity, richness, and density increasing with depth on the lower slope. Biomass generally declined with depth, with no trend reversal at the deepest sites.

Echinoderms generally contributed the major portion of the infaunal biomass, although at two sites with relatively sandy sediments, polychaete biomass exceeded that of echinoderms. Polychaete worms were the dominant group of organisms in terms of abundance and richness at most sites. Roughly 40% of the taxa encountered were polychaetes in both the reidentified 1976 samples and, in samples collected in 1983-84. The majority of the collected specimens were also polychaetes.

Cluster analysis among sites reflected a depth dominated gradient; at depths greater than approximately 1,300 ft the strength of the relationship declined. Several species have bimodal depth distributions, with populations on the mainland shelf and lower slope but few or no individuals occurring on the upper and mid-slope region. This distribution was only weakly correlated with measured physical factors. Hypotheses to account for this pattern include control by biological factors, by unmeasured physical factors, or by a combination of both.

Approximately 20% of the 996 soft-bottom taxa collected were considered new species. Many of these species have been previously reported, but over 100 constituted organisms not previously encountered; most of these species were uncommon to rare and were collected at the deeper stations. The high proportion of new species reflects the large size of the study area, the range of habitats examined, and the lack of previous studies in the Santa Maria Basin area.

Detailed identification of samples collected along the northern Channel Islands shelf in 1976 as part of the BLM Southern California Baseline Study was performed to help standardize the taxonomy of the present database with those from southern California. Cluster analysis using both 1976 and 1983-84 data showed both unique island shelf elements and broad correspondence between the 1976 samples and 1983-84 collections. A similar analysis of samples taken in 1983-84 from stations occupied in 1977 showed that at shelf depths the biota had changed little over the intervening six years, while at slope depths more change was apparent.

Results of the soft bottom reconnaissance survey indicate that the Santa Maria Basin contains habitats and biota similar to those of the more extensively studied Southern California Bight. However, parameters other than those measured during the reconnaissance study apparently are affecting the distribution of soft-bottom biota within the Santa Maria Basin region.

4.1.2 Hard-Bottom

Hard-bottom survey operations were conducted along 23 transects from approximately Goleta to Pt. Estero, CA; survey depths ranged from 180 to 790 ft. Data collected included over 1200 35 mm bottom photographs, 55 hours of color video recording and observer commentary, 44 rock samples for epifanual scraping and analysis, and 29 voucher specimens.

Hard-bottom features were observed along 17 of 23 transects; however, extensive outcrop areas comprising $\geq$ 90% of a transect were only observed along five transects extending over the range of the survey area. Two hard-bottom transects (16 A/B and 20 A/B) were located between transects previously surveyed by Nekton, Inc. (1981) offshore of Pt. Sal, and suggested a broad, relatively continuous outcrop area located in this region. General areas of extensive hard-bottom features include (1) the Pt. Conception to Pt. Arguello region; (2) shallow (generally > 100 ft), nearshore areas throughout the survey region; and (3) nearshore to offshore of the Northern Channel Islands.

Sediment cover (estimated fraction of an inch to several inches deep) was extensive along most transects generally ranging from 90% to 100%, and appeared to be a major factor influencing biological assemblages. Some localized areas of higher relief were associated with reduced sediment cover. Similar trends of extensive sediment cover were noted by most of the previous studies of the general survey region.

Substrate relief was generally low (0 to 3 ft) over most of the transect areas. Areas of medium (4 to 10 ft) to high (> 10 ft relief) were noted for some segments of nine of the 23 transects; however, significant areas of relief representing at least 0.2 of a transect length were only observed along four transects (2 A/B, 21 A/B, 25 A/B and 27 A/B). Results from several previous studies suggest that some differences in biological assemblages may be associated with differences in substrate relief. Several factors including sediment cover and suspended particulates potentially may be increased in lower relief areas; however, the sensitivity of organisms of the survey region to these types of effects is presently unknown.

Approximately 177 taxa were observed during the survey from the photographic and observer data. Dominant invertebrate phyla inlcuded echinoderms (33 taxa) and coelenterates (31 taxa); however, numerous groups such as sponges were probably underestimated due to lack of information on taxonomy and limitations in identifying some taxa without a collected sample. Fish were dominated by rockfish (22 taxa). Based on the results of cluster analysis, ordination analysis and information of the ecology and life history of key species, these taxa were grouped into three hard-bottom assemblages (generally defined on the basis of substrate relief) and one soft-bottom assemblage. A hard-bottom, generalist assemblage was characterized by numerous taxa including crinoids (Florometra), anemones (Metridium) cup corals, and sea stars (Mediaster and Stylasterias) occurring throughout the range of bottom depths and substrate type and relief present in the survey area; some of these taxa often comprised a sub-assemblage or co-assemblage associated with low/medium or high/medium relief assemblages. The hard-bottom low/medium relief assemblage was characterized by ophiuroids (Ophiacantha), brachiopods (e.g., Terebratulina), and anemones (Actinostola) typically occurring in lower relief areas. The high/medium relief assemblage was characterized by a few taxa including anemones (e.g., Corynactis), corals (Lophelia) which primarily occurred in higher relief areas, and some generalist taxa. The soft-bottom assemblage ws characterized by numerous soft-bottom organisms including sea pens (e.g., Stylatula and Acanthoptilum), *Octopus*, and sea urchins (*Allocentrotus* and *Lytechinus*). The predominant assemblages observed during the survey were the low/medium/generalist and soft-bottom assemblages, corresponding to the primary bottom and substrate relief types characteristic of the study area. Overall, these assemblages were highly similar to those observed during previous studies of the general region, and extended throughout the entire geographic range of the survey area.

Potential effects from high levels of turbidity or sedimentation are expected to be greatest for sessile organisms that cannot move from an area of impact, as compared to highly motile species such as fish. A broad range of motility types is represented by the survey taxa, and includes sessile/ attached organisms such as sponges, brachiopods, tunicates, hydroids, bryozoans, cup corals, corals, and anemones; organisms of limited motility such as crinoids, ophiuroids, and asteroids; and very motile species such as rockfish. A broad range of feeding types also is represented, and includes filter/suspension feeders such as sponges, crinoids, and tunicates; deposit feeders such as some holothurians; and predators/scavengeres such as rockfish, asteroids, some ophiuroids, and some anemones. Filter/suspension feeders such as sponges may be particularly sensitive to fouling of feeding structures from increased levels of suspended particulates; deposit feeders, because of their potential for ingestion of contaminated bottom sediments, may be used to study effects of bioaccumulation.

Results from cluster analysis of the photographic and observer data suggest the occurrence of eight site (transect/substrate) groups and six species groups. The site groups were primarily distinguished based on differences between major bottom types: hard-bottom as compared to soft-bottom transect areas. Differences among the hard-bottom site groups were less distinct, however, contributing factors included substrate relief (low relief as compared to medium to high relief groups), and to a lesser extent geographic location, although several groups were characterized by transects representing a broad geographic range. Less distinct trends among these hard-bottom groups are expected due to the predominance of low relief features observed over most of the survey area and the broad range of occurrence of many taxa (generalist assemblage). Similar to the site groups, the major differences among the species cluster groups was associated with broad-scale differences between hard-bottom as compared to soft-bottom areas. Additionally, some minor differences among the hard-bottom species groups appeared to be related to substrate relief, geographic location, and to a lesser degree depth; however, most of the groups included several generalist species and represented a broad geographic range of site groups suggesting a high degree of overlap among the site and species groups. The results of ordination analyses also indicated a broad degree of overlap among site groups, with the primary separation based on bottom type (hard-botom as compared to soft-bottom), and slight trends based on substrate relief and depth.

Common taxa occurring in the highest densities include cup corals (to at least 200/m^2) and the ophiuroid Ophiacantha (to at least 50/m^2). Other common taxa that were locally abundant included crinoids (Florometra), anemones (Metridium and Actinostola) brachiopods (Terebratulina), echinoids (Allocentrotus) and tunicates (Halocynthia). Uncommon taxa that occasionally reached high local abundances included the coral Lophelia, sea anemones (Corynactis), gorgonians (Lophogorgia) and spot prawn (Pandalus platyceros). Densities of species observed from the present survey were generally similar to records from previous studies of the general region.

Lophelia was recently suggested to be an ecologically significant species in the survey region (e.g., Nekton, Inc., 1983 and 1984). The distribution of this species was restricted to only three of the present transects, but is relatively common in the Pt. Conception to Pt. Arguello area based on observations from the ROV survey (SAIC, 1985) and previous studies of the region. Little is known of the life history or potential sensitivity of this species to oil and gas development.

The spot prawn is a commercially important shrimp species fished in the survey region; however, only isolated occurrences were noted along four transects, with maximum densities of 3 to 5/m^2 along one transect (17 A/B).

General conclusions from the present study indicate that the biological assemblages observed were common throughout the general survey region (western Santa Barbara Channel to at least Pt. Estero, CA), and were similar to results from previous studies. The majority of the observations from this study were conducted at depths from approximately 180 to 600 ft, with limited coverage from 600 to 800 ft. Present results indicate relatively high levels of sediment cover at these shallower depths, suggesting high natural levels of sediment transport that may influence the distribution and abundance of biological assemblages. Dames and Moore (1982) noted that hard-bottom assemblages occurring deeper than approximatley 500 ft appeared to be characterized by greater diversity, perhaps as related to lower suspended sediment loads and transport at these deeper depths. Few data on bottom currents and sediment transport in the region are available and will be necessary to adequately assess the relationship among these variables during future monitoring programs.

Microepifauna from rocks collected along the transects were represented by 786 taxa, comprising 17 phyla. Colonial or encrusting organisms were best represented by ectoprocts and secondarily by sponges; organisms that could be individually counted were dominated by polychaetes and secondarily by bivalves.

Results of cluster analysis of the rock scraping data did not suggest any obvious trends in the data related to depth or geographic location. The 33 sample collection sites grouped into 11 clusters representing five main groups; however, the five groups were broadly overlapping in depth range and/ or geographic location. Inspection of the two-way table similarly did not suggest any trends in the data. Evaluation of species composition among the five site groups indicated some differences related to the ratio of encrusting organisms as compared to those that could be individually counted. Group 1 was primarily characterized by encrusting species, while Group 3 was characterized by a low percentage of encrusting species. Groups 4 and 5 had approximately equal percentages of encrusting and individual organisms; Group 2 was characterized by relatively few taxa. Additional common elements within these groups appeared to be related to similarities or differences in the number of species (richness). The results from the present study are not directly comparable to previous studies in the region due to the much more detailed analysis done for this study; however, similar commmon taxa were observed during the present and earlier studies. Results of the taxonomic analysis of these samples indicated 156 undescribed species primarily represented by sponges, ectprocts and urochordates.

4.2 CHEMISTRY

Oil and gas exploration and production operations represent a potential source of input of trace metals (barium and chromium) and petroleum hydrocarbons to the marine environment. Barium typically is present at very high concentrations in drilling fluids and is significantly enriched relative to average bottom sediment concentrations. Due to its high concentrations in drilling muds and its low solubility in seawater, barium represents a useful tracer for monitoring dispersion of discharged drilling fluids. Chromium also has been used as a drilling mud additive, although levels in generic muds are not necessarily elevated relative to natural levels in marine sediments.

Furthermore, recent permit restrictions have eliminated the use of chromium as an approved additive. Therefore, further measurement of sediment chromium may not be as useful as measurements of barium for monitoring long-term effects of OCS operations in the study region. Petrogenic materials may be released with spent drilling fluids, either as refined petroleum products, such as diesel fuel used as a mud additive, or as a residue of crude oil from downhole sources. Petroleum hydrocarbons also may be released during an accidental spill or blowout, or discharged with produced waters. Concentrations of barium, chromium, and hydrocarbons were measured during this study to characterize baseline or pre-drilling levels for comparison with post-drilling levels.

In general, values for chemical parameters (barium, chromium, petroleum hydrocarbons, and TOC) in sediments collected during this study were consistent with corresponding values reported for sediments from other areas of the southern California borderland studied during the Southern California Baseline Program. Both natural and anthropogenic sources likely contribute to input of trace metals and petroleum hydrocarbons to Santa Maria Basin/western Santa Barbara Channel area. Spatial variability in concentrations of trace organics or metals in bottom sediments reflect the magnitude of the inputs, proximity to input sources, and the depositional or erosional characteristics of the site.

The range of sediment concentrations of barium (162 to 1,180 μg/g) from the survey was consistent with values observed during the Southern California Baseline Program (Chow and Earl, 1978). In general, relatively higher barium levels were noted at the nearshore stations, in the Santa Barbara Basin, and in the Arguello Canyon head. This pattern is consistent with a process in which barite is discharged into the nearshore zone in association with riverine materials, and subsequently transported and dispersed by littoral and bottom currents. Additionally, barium enrichment within the Santa Barbara Basin may reflect transport and deposition of barite associated with drilling fluid material. The relatively low barium levels in sediments from Santa Lucia Banks may reflect rapid erosion of finer-grained materials containing barium as well as the relatively greater distance between the Banks and onshore sources of barite minerals. Additional spatial variability may be related to differences in biological productivity and depositional patterns of biogenic materials.

The range in sediment concentrations of chromium (66 to 415 μg/g) from the survey was slightly higher than the corresponding range in values observed during Southern California Baseline Program (12 to 370 μg/g) reported by Chow and Earl (1978). However, the mean value obtained during this study (120 μg/g) was similar to mean chromium levels observed in nearshore basin sediments by Chow and Earl (1978) and by Bruland (1974). Nevertheless, no large scale spatial trends in sediment chromium levels were apparent in the samples from Santa Maria Basin and western Channel areas. The relatively high concentration observed in the northern portions of the study area may be due to the presence of natural chromite materials in the sand size fraction of the bottom sediment. Additional relationships between chromium levels and the sedimentary environment were not apparent.

Results of analyses of bottom sediment for petroleum hydrocarbons were also consistent with the results from the Southern California Baseline Study (e.g., Reed et al., 1977; Reed and Kaplan, 1977; Simoneit and Kaplan, 1980; Venkatesan et al., 1980; Mankiewicz et al., 1979; Crisp et al., 1979). At most of the sampling stations within Santa Maria Basin and western Santa Barbara Channel, both petrogenic and biogenic sources contribute to inputs of sediment hydrocarbons. Possible sources include natural hydrocarbon seeps, erosion of oil-bearing shales, shipping losses and tanker operations, atmospheric deposition, OCS oil and gas operations, discharges of municipal and industrial wastewaters, and deposition of allochthonous (terrestrial plants) and autochthonous (marine diatoms, zooplankton, fish, and macroalgae) biogenic sources. The relative contributions from component sources, and the total sediment hydrocarbon levels, probably reflect the magnitude of individual sources, proximity to the sources, sediment transport and deposition, and microbial degradation processes.

Concentrations of total hydrocarbons within sediment sample ranged from 14 to 240 μg/g dry wt. Relatively higher levels (> 100 μg/g dry wt) occurred at stations in nearshore areas south of Pt. Conception, within the Santa Barbara Basin, in the Arguello submarine canyon, and in the sea valley east of Santa Lucia Bank. These stations appear to be close to natural petroleum seeps, particularly in the nearshore area off Pt. Conception, or coincide with natural depositional regimes which are sinks for fine-grained, organic enriched sediments. Relatively lower total hydrocarbon levels were typical of coarser grained sediments from nearshore areas not affected by natural seeps, and from erosional regimes (e.g., Santa Lucia Banks).

Areal differences in concentrations of total aromatics are similar to the distribution pattern observed for total hydrocarbons, as reflected in the strong correlation (0.86) between the two parameters. In contrast, the distribution patterns for total alkanes and total aliphatics were not consistent with patterns for total hydrocarbons or total aromatics; the correlation coefficient between concentrations of total alkanes and total hydrocarbons was 0.55. This lower correlation may reflect, in part, spatially variable hydrocarbon inputs to bottom sediments from seep oils which contribute to the total hydrocarbon concentration but contain low percentages (< 5%) of n-alkanes (e.g., Reed and Kaplan, 1979).

Hydrocarbon levels in Santa Maria Basin bottom sediments typically were lower than levels in sediments from areas of the Southern California Bight which are not close to natural petroleum seeps (e.g., Coal Oil Point) or within nearshore basins heavily influenced by anthropogenic inputs (e.g., San Pedro Basin). However, the Santa Maria Basin sediments contained hydrocarbon concentrations which were higher than expected background levels (approximately 50 $\mu g/g$) that were measured previously in sediments from offshore basins or in sediments deposited in basins prior to 1920 (Venkatesan et al., 1980).

Marine Oil Pollution Index (MOPI) values calculated for bottom sediments also suggested the presence of trace to moderate levels of petroleum pollution within the Santa Maria Basin and western Santa Barbara Channel.

Chromatograms of sediment sample extracts and calculated values for several component ratios demonstrated the presence of both petrogenic and biogenic materials from diverse sources. For example, most sample chromatograms typically contained a UCM hump, illustrating the presence of weathered petroleum, as well as several resolved n-alkane peaks with a maximum at nC_{29} that reflected the presence of terrestrial plant waxes. These features were also observed during chromatographic analyses of bottom sediments during the Southern California Baseline Program (Reed et al., 1977; Simoneit and Kaplan, 1980; Venkatesan et al., 1980), suggesting that several of the generic sources of hydrocarbons to benthic environments within the Bight also contribute hydrocarbons to sediments within Santa Maria Basin.

Hydrocarbon concentrations in bottom sediments were positively correlated with fine-grained sediments (silt and clay) and corresponding phi intervals, and levels of total organic carbon, and negatively correlated with percentages of coarser (sand-sized) sediments. Similar relationships have been reported for other coastal environments, including the Southern California Bight (e.g., Mankiewicz et al., 1979). Principal component analyses identified four primary variable axes which accounted for 84% of the variance. Hydrocarbon factor one was strongly correlated with concentrations of total aromatics, total hydrocarbons, and MOPI values; patterns for this factor were similar to observed patterns of hydrocarbon concentrations and MOPI values. Hydrocarbon factors two, three, and four generally were correlated with component ratio values, but the patterns of these factors were extremely noisy and did not reflect any obvious areal trends.

The total organic carbon levels in sediment samples measured during this study ranged from 0.36% to 3.4% with an overall mean value of 1.6% (±0.84) dry wt sediment. Highest organic carbon levels (≥3%) occurred in sediments collected from the southeastern portion of Santa Barbara Basin, the seaward portion of Arguello submarine canyon, and the lower part of the slope north of Pt. Sal; these areas probably are depositional sites for fine-grained, organic-rich sediments and biogenic materials. Broad areas of the nearshore regions in the study area, particularly between Pt. San Luis and Pt. Arguello, off the mouth of the Santa Ynez River, and at the head of the Arguello Canyon, on Santa Lucia Banks, and along the shelf near San Miguel Island, contained TOC levels of <1% dry wt sediments. Sediments from these areas typically had a lower mean phi size characteristic of higher energy, erosional sites, relative to sediments collected from depositional regimes. The areal distribution pattern for TOC levels generally corresponded to the distribution patterns for levels of sediment clay and silt fractions.

4.3 GEOLOGY

Results from grain size analyses of sediment samples indicated that the coarsest sediments within the study area occur off Pt. Estero, on the

Santa Lucia Banks, and at nearshore areas, particularly east of Pt. Conception and north of San Miguel Island. Coarse grained sediments at nearshore areas may be lithic fragments and sand introduced by seaward loss from littoral transport in shallow water, whereas the coarse material on the Santa Lucia Banks may be granular phosphorite (glauconite). Fine sediments within the study area occurred in the sea valley east of the Santa Lucia Bank, Santa Barbara Basin, seaward portion of the Arguello submarine canyon system, and on the slope area north of Pt. Sal. Most of the sediment samples were poorly sorted to very poorly sorted, and all sediments were strongly skewed to the fine sediment fractions. No geographical patterns were apparent for the skewness or sorting characteristics of the sediment samples.

Information provided from photographs of the sediment cores suggested the occurrence of two sediment types, an olive green sapropel and a brown to tan mud. The areal distribution of these two sediment types probably is determined by the amount of oxidized brown mud overlying olive green mud. The oxidized mud likely is pelagic material of fluviatile origin, whereas the olive green mud consists of a pelagic, organic-rich reduced sediment which reflects high fluxes of biogenic material, particularly in areas characterized by high biological productivity associated with upwelling events. Layering of mud types also reflect the depositional characteristics of the site. Cores containing only olive green mud suggest current scour of surface oxidized sediments, whereas cores of olive green mud with a layer of oxidized mud reflect current scour of lesser severity. Cores which contained only oxidized brown mud probably were collected from areas of rapid sedimentation, such as the sea valley east of the Santa Lucia Banks.

Sediment types within the study area were grouped into three facies with subtle differences in properties. These facies include: (1) Santa Lucia Bank facies characterized by oxidized mud containing phosphorite grains, a medium to fine grain size and a low total organic carbon content; (2) continental shelf facies characterized by oxidized mud with a fine sand mean grain size, high sand and low clay contents, and low organic carbon levels at bottom depths less than 360 feet; and (3) a continental slope facies at depths greater than 360 feet with olive green mud characterized by varying degrees of surface oxidation, a silt mean grain size, low sand content, and relatively high organic carbon levels.

The distribution of these facies also reflect influences from physical and biological processes, including bottom scour, sedimentation rates, littoral transport, and biological productivity. The Santa Lucia Bank facies reflect inputs of biogenic materials and scour by bottom currents; the patchiness of this facies within areas of the Arguello Canyon and the continental may indicate mass movement of the sea floor. Dilution of the continental shelf facies with coarse grained sediments suggests inputs of littoral sands from longshore transport processes. The continental slope facies show evidence of recent deposition in areas where an oxidized mud layer is present, or of recent scour where the oxidized layer is absent.

Primary mechanisms for sediment transport within the study area probably are resuspension and mass movement of particles introduced as suspended materials or as riverine bed load. Suspended materials typically are transported and deposited further offshore on the shelf and slope, whereas the heavier bed load materials are transported along the shore and eventually onto the shelf. Much of the finer grained sediments, and some of the coarser grained sands may accumulate within the depositional regimes of the study area, particularly the Santa Barbara Basin, the sea valley east of Santa Lucia Banks, and in portions of the Arguello submarine canyon system.

4.4 SUPPLEMENTARY OBSERVATIONS

Supplementary observations of birds and mammals and of fishing activities within the Santa Maria Basin and western Santa Barbara Channel were recorded during the October 1983 to January 1984 soft-bottom surveys and the July/August 1984 hard bottom survey. Observations were made over a 10 to 30 minute period from the rear deck of or upper deck of the survey vessel. All birds and mammals within the visual range of field binoculars were identified and counted, and all fishing activities were noted.

During these observation periods, 19 species of birds and seven species of marine mammals, including three whale species, were identified. Three of these species, brown pelican (Pelicanus occidentalis), gray whale (Eschrichtius robustus), and sei whale (Balaenoptera borealis), are considered endangered. Many of the bird species are common throughout Santa Maria Basin, although the populations of many of the migratory species will vary throughout the season. Dolphins and whales were rarely observed, and the numbers of individuals per observation were relatively low. Whale sightings consisted of single individuals, with the exception of one sighting of a small pod of grey whales. California sea lions occurred throughout the survey area in low numbers (generally one to four individuals), whereas only a single elephant seal was sighted in the Santa Barbara Channel.

Fishing activities were only rarely observed during the summer and fall/winter surveys. Fishing vessels noted during these periods were represented by trawlers, trollers, seiners, long liners, and party boats. The majority of the fishing operations observed occurred in the northern portion of the survey area, particularly from Pt. Sal to Morro Bay. Fisheries species observed during the hard-bottom survey included rockfish and spot prawn.

4.5 SENSITIVITY OF BENTHIC ORGANISMS

An important goal of this study was to identify soft-bottom and hard-bottom biota within the survey region whcih are potentially sensitive to environmental effects associated with OCS oil and gas operations. Specific effects may be related to (1) settling and accumulation of particulate materials; (2) exposure to increased suspended particulate loads; (3) abrasion or breakage from pipeline and platform installations; or (4) exposure and potential bioaccumulation of trace metals and hydrocarbons associated with operational discharges or accidental spills. Identification of particularly sensitive benthic organisms will facilitate the sampling design strategy for the Phase II Monitoring Program (as discussed in Section 3.5).

In general, hard bottom organisms are expected to be more sensitive than soft-bottom assemblages to impacts from OCS oil and gas development operations. The greater sensitivity is related to general morphological and physiological adaptations to hard substrates, and corresponding lower tolerances (relative to soft-bottom organisms) to increases in turbidity, suspended particulate loads, and sediment coverage that may accompany discharges of drilling muds and cuttings. Furthermore, due to the rigid morphology and relatively high profile of some hard-bottom organisms, they may be more susceptible to mechanical damage from platform anchors, anchor chains, and pipeline installation operations. Degradation of the suitability of the hard-bottom habitat can be caused by increased sediment cover, increased particulate material deposition, interferences with filter/suspension feeding organisms, and exposure to materials containing elevated levels of trace metals and hydrocarbons. These conditions may reduce the habitat suitability for sessile organisms and reduce the amount of substrate suitable for larval settlement. Specific studies have not been conducted previously on the tolerance of various taxa within the biological assemblages characteristic of low relief and higher relief substrates of the survey area. However, some predictions can be made based on general knowledge of the ecology of similar types of organisms.

Small sessile organisms, such as cup corals and brachiopods, are common in many low relief, hard-bottom areas. These types of environments may be subject to relatively high, natural sediment loads, thus exposing the organisms to episodic burial or high suspended particulate loads. The sensitivity of these species to sediment coverage is unknown; however, their small body size suggests a pontentially higher vulnerability to burial and smothering. In contrast, more motile organisms (e.g., ophiuroids and rockfish) associated with hard-bottom features are capable of migrating from areas of accumulating sediments. Consequently, these types of organisms should be less sensitive than small sessile organisms to these types of potential impacts.

Organisms associated with higher relief features may be less tolerant of episodic particulate deposition, elevated particulate loads, and sediment intrusion than organisms characteristic of low relief substrates. Several taxa including the corals Lophelia and Coenocyathus were associated with high relief areas. However, the sensitivity of these species to oil and gas development operations is virtually unknown. Monitoring changes in these corals, large sponges, or gorgonians associated with high relief areas may be particularly useful for identifying long-term impacts, although present restrictions are related to limited knowledge of natural sediment loads, the taxonomy of key groups, and the ecology and sensitivity of the species identified in potentially affected areas.

4.6 RECOMMENDATIONS FOR LONG-TERM MONITORING

An important goal of the present study was to develop recommendations for long-term monitoring of the effects of oil and gas development in the Santa Maria Basin and western Santa Barbara Channel. These recommendations include specific physical, chemical, and biological parameters; sampling stations and survey design, including replicate analyses; comparisons with historical data, and evaluation of the conclusions and recommendations from other monitoring programs.

The majority of the physical/chemical parameters measured during the reconnaissance program are appropriate for continued analyses during the Phase II monitoring program. Specifically, measurements of petroleum hydrocarbon and trace metal levels in bottom sediments will provide indications of the dispersion or accumulation of discharged material residues in the benthic environment and possible exposure of benthic organisms to potentially harmful pollutants. Recommendations were presented for gas chromatography/mass spectometry analyses of alkylated PAHs that may be present in oil-based additives in spent drilling muds. Additionally, we recommend calculation of the Marine Oil Pollution Index and total hydrocarbon to total organic carbon ratio values for sediment samples to provide an indication of time series changes in levels of petroleum hydrocarbons that might be related in drilling and/or production operations. Similarly, levels of sediment barium should be measured at near-field and far-field sites to assess dispersal, transport, and deposition of drilling mud residues. In contrast, continued measurements of sediment chromium are not likely to provide useful information on the long-term fate and effects.

Routine chemical analyses of the discharge sources are important in order to relate the measured changes in sediment chemistry parameters to operational discharges from platforms. Similar types of chemical analyses should be performed on the discharged material samples as on the bottom sediment samples. In particular, GC/MS analyses of the aromatic fraction of extracts from spent drilling fluids and evaluations of the chromatographic traces for the aliphatic and aromatic fractions, may provide a "fingerprint" for identifying the specific source of petroleum hydrocarbons in bottom sediments. Similarly, analyses of barium levels in spent drilling muds provide useful information for later tracing the dispersion of mud residues in the benthic environment.

Further predictions regarding the long-term fates of operational discharges will require specific information on sediment resuspension, transport, mixing, and deposition processes in Santa Maria Basin and Santa Barbara Channel. Measurements of sediment grain size, sediment core layering, bottom current velocities, and sediment resuspension and deposition rates will be necessary for predictions concerning the physical and chemical fates of discharged material.

Biological parameters including standard species abundance and biomass measures studied during the reconnaissance program were appropriate for characterizing the benthic communities within the study area and for making comparisons with historical data. Assessments of the amounts of biologically available organic material in bottom sediments, such as from measurements of carbon/nitrogen ratio values, may be useful for evaluating changes in food availability relative to deposition of inorganic particulate materials discharged from drilling platforms. Additionally, population size-frequency measurements will likely be a useful indicator of sublethal stress; however, alternate methods (e.g., epibenthic sleds) for collecting adequate numbers of benthic organisms will be necessary. Standarized methods for obtaining photographic data for abundance estimates in hard-bottom areas will be critical for detecting long-term changes. The use of macro-photography also is recommended to improve taxonomic identifications and in determining size-frequency distributions of key organisms (e.g., cup corals).

Recommendations for the design of surveys for a long-term monitoring program were based upon the results from power tests using data collected during the present study. The ability to detect changes in biological parameters is low when individual species are used as the independent variable; however, the statistical power is higher when community parameters are used, although parameters such as diversity and evenness typically are not sensitive indicators of biological responses to impacts. In contrast, power tests using ecological distances are much more sensitive for detecting small changes associated with impacts.

No appreciable differences in power levels derived from the 1.0 and 0.5 mm size fractions were apparent, and the two size fractions did not produce differences in pattern analyses results. Therefore, monitoring studies of the benthic infauna should be performed using the 1.0 mm size fraction organisms; the 0.5 mm size fraction may be saved and archived for future analysis if desired. The survey design should also incorporate the concept of ecological distances for detecting change, and spatial coverage in the station placement should be emphasized in lieu of multiple replication at individual stations. Perception of larger scale patterns can often enhance understanding and hypotheses formation about causal mechanisms that are responsible for observed impacts. The spatial scale of the sampling should reflect the predicted spatial scale of the impact. Additionally, levels of change that can be detected should be specified prior to initiation of the monitoring program.

The monitoring program for hard-bottom areas must be designed to minimize the "noise" in the community features due to historical events, such as natural sediment transport and burial. Therefore, as part of a long-term monitoring program we recommend studies to define the influences of natural physical processs on hard-bottom communities, a model of potential impacts that account for effects due to natural processes, further assesments of the specific sensitivity of hard-bottom organisms to impacts, and an explicit sampling and analyses design that specifies locations and target organisms, identifies what hypothesis is being tested, and the analytical approach most efficient for testing the hypothesis. The most effective approach for monitoring will be to group sampling stations into affected and control treatments with affected stations located at various distances from the source of the impact.

The major equipment and survey methods used during the reconnaissance program were effective, and are recommended for use during future monitoring programs. It was also apparent from the reconnaissance program that any additional studies on monitoring approaches planned for the Phase II program must take into consideration the high winds and seas that are characteristic of this area during certain times of the year. Therefore, use of sufficiently large survey vessels and proven sampling equipment are mandatory for reliable sample collection.

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APPENDIX A

Station Locations from the
October/November/December 1983
and January 1984 Soft-Bottom Survey

MMS SOFT-BOTTOM SURVEY (1983-1984)
STATION LOCATION DATA

OBS	STATION	REP	DATE MMDDYY	TIME HHMMSS	LATDEG	LATMIN	LATDIR	LNGDEG	LNGMIN	LNGDIR	DEPTH FT	HEADING
51	036-BSR	2	010784	074504	34	52.738	N	121	15.399	W	1640	66
52	036-BSR	3	010784	093518	34	52.795	N	121	15.312	W	1665	60
53	038-BSS	1	010684	232502	34	49.805	N	120	52.663	W	656	142
54	039-BSS	1	010784	004530	34	49.527	N	120	56.850	W	980	180
55	040-BSS	1	010784	020332	34	49.235	N	121	0.811	W	1305	200
56	041-BSS	1	010784	042400	34	48.352	N	121	19.138	W	1650	80
57	042-BSS	1	010684	202243	34	48.038	N	120	47.504	W	332	242
58	042-BSV	11	010984	020205	34	48.098	N	120	47.318	W	328	75
59	042-BSV	12	010984	020205	34	48.098	N	120	47.318	W	328	75
60	042-BSV	13	010984	020205	34	48.098	N	120	47.318	W	328	75
61	042-BSV	14	010984	020205	34	48.098	N	120	47.318	W	328	75
62	042-BSV	21	010984	025007	34	48.049	N	120	47.523	W	335	73
63	042-BSV	22	010984	025007	34	48.049	N	120	47.523	W	335	73
64	042-BSV	23	010984	025007	34	48.049	N	120	47.523	W	335	73
65	042-BSV	24	010984	025007	34	48.049	N	120	47.523	W	335	73
66	042-BSV	31	010984	041328	34	48.046	N	120	47.431	W	330	98
67	042-BSV	32	010984	041328	34	48.046	N	120	47.431	W	330	98
68	042-BSV	33	010984	041328	34	48.046	N	120	47.431	W	330	98
69	042-BSV	34	010984	041328	34	48.046	N	120	47.431	W	330	98
70	042-BSV	41	010984	045953	34	48.011	N	120	47.443	W	330	220
71	042-BSV	42	010984	045953	34	48.011	N	120	47.443	W	330	220
72	042-BSV	43	010984	045953	34	48.011	N	120	47.443	W	330	220
73	042-BSV	44	010984	045953	34	48.011	N	120	47.443	W	330	220
74	042-BSV	51	010984	063726	34	48.031	N	120	47.444	W	333	204
75	042-BSV	52	010984	063726	34	48.031	N	120	47.444	W	333	204
76	042-BSV	53	010984	063726	34	48.031	N	120	47.444	W	333	204
77	042-BSV	54	010984	063726	34	48.031	N	120	47.444	W	333	204
78	042-BSV	61	010984	074302	34	48.009	N	120	47.402	W	330	106
79	042-BSV	62	010984	074302	34	48.009	N	120	47.402	W	330	106
80	042-BSV	63	010984	074302	34	48.009	N	120	47.402	W	330	106
81	042-BSV	64	010984	074302	34	48.009	N	120	47.402	W	330	106
82	042-BSV	71	010984	094402	34	48.062	N	120	47.368	W	329	78
83	042-BSV	72	010984	094402	34	48.062	N	120	47.368	W	329	78
84	042-BSV	73	010984	094402	34	48.062	N	120	47.368	W	329	78
85	042-BSV	74	010984	094402	34	48.062	N	120	47.368	W	329	78
86	042-BSV	81	010984	102727	34	48.086	N	120	47.422	W	332	99
87	042-BSV	82	010984	102727	34	48.086	N	120	47.422	W	332	99
88	042-BSV	83	010984	102727	34	48.086	N	120	47.422	W	332	99
89	042-BSV	84	010984	102727	34	48.086	N	120	47.422	W	332	99
90	043-BSS	1	010684	183118	34	46.587	N	120	52.917	W	658	159
91	045-BSS	1	010684	154119	34	44.905	N	120	59.592	W	1318	192
92	046-BSS	1	010684	123137	34	41.224	N	121	13.558	W	1990	205
93	047-BSS	1	010684	140841	34	41.994	N	121	10.808	W	1260	237
94	048-BSS	1	010684	034616	34	45.108	N	120	52.854	W	654	346
95	049-BSS	1	010684	165341	34	45.032	N	120	56.314	W	965	171
96	050-BSS	1	010684	092947	34	37.803	N	121	1.658	W	1970	78
97	052-BSS	1	010684	003800	34	39.563	N	120	47.642	W	328	174
98	053-BSS	1	010584	230834	34	37.691	N	120	50.380	W	654	110
99	054-BSS	1	010584	214337	34	36.574	N	120	52.019	W	1320	89
100	055-BSS	1	010584	200729	34	33.659	N	120	56.311	W	1968	172

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OBS	STATION	REP	DATE MMDDYY	TIME HHMMSS	LATDEG	LATMIN	LATDIR	LNGDEG	LNGMIN	LNGDIR	DEPTH FT	HEADING
1	001-BSS	1	110183	104847	35	27.859	N	121	5.329	W	327	57
2	002-BSS	1	110183	113632	35	27.697	N	121	6.515	W	665	263
3	003-BSS	1	110183	132200	35	27.071	N	121	10.198	W	970	161
4	004-BSS	1	110183	154704	35	26.564	N	121	14.929	W	1310	41
5	005-BSS	1	110183	173633	35	25.765	N	121	21.685	W	1950	61
6	006-BSS	1	110283	051652	35	20.879	N	120	59.619	W	362	169
7	007-BSS	1	110283	032205	35	20.651	N	121	2.573	W	656	354
8	008-BSS	1	110283	015249	35	19.995	N	121	6.575	W	1025	203
9	009-BSS	1	110283	002143	35	19.483	N	121	10.058	W	1325	202
10	010-BSS	1	110183	223821	35	18.280	N	121	18.645	W	1970	205
11	011-BSS	1	110183	201716	35	17.804	N	121	22.134	W	2300	224
12	012-BSS	1	110283	064539	35	15.028	N	120	57.312	W	328	130
13	013-BSS	1	110283	071845	35	14.543	N	120	59.768	W	658	254
14	014-BSS	1	110283	101127	35	14.150	N	121	2.039	W	995	249
15	015-BSS	1	110283	115937	35	13.980	N	121	4.537	W	1310	67
16	016-BSS	1	110283	140809	35	12.230	N	121	16.288	W	1970	72
17	017-BSS	1	110283	200415	35	11.608	N	121	22.549	W	2180	76
18	018-BSS	1	110383	040448	35	9.077	N	120	56.552	W	656	78
19	019-BSS	1	110383	021401	35	8.931	N	120	59.662	W	985	80
20	020-BSS	1	110283	232911	35	15.720	N	121	4.675	W	1320	226
21	021-BSR	1	110383	103508	35	6.112	N	120	44.819	W	162	216
22	021-BSR	2	110383	114800	35	6.114	N	120	44.796	W	160	213
23	021-BSR	3	110383	124940	35	6.122	N	120	44.737	W	155	147
24	022-BSS	1	110383	141336	35	5.847	N	120	50.232	W	330	30
25	023-BSR	1	110383	161702	35	5.604	N	120	55.184	W	650	222
26	023-BSR	2	110383	184644	35	5.474	N	120	55.191	W	665	80
27	023-BSR	3	110383	204546	35	5.515	N	120	55.136	W	660	98
28	025-BSR	1	010884	074303	35	5.072	N	121	0.747	W	1300	77
29	025-BSR	2	010884	085548	35	5.337	N	121	0.968	W	1315	60
30	025-BSR	3	010884	101839	35	5.350	N	121	0.852	W	1312	96
31	026-BSS	1	010884	132727	35	4.380	N	121	15.985	W	1968	232
32	027-BSR	1	010884	150353	35	4.295	N	121	19.270	W	2035	180
33	027-BSR	2	010884	163741	35	3.979	N	121	19.325	W	2040	155
34	027-BSR	3	010884	175717	35	4.021	N	121	19.276	W	2040	165
35	028-BSR	1	010884	193514	35	4.216	N	121	19.650	W	2010	74
36	028-BSR	2	010884	205708	35	4.272	N	121	19.747	W	2010	84
37	028-BSR	3	010884	222750	35	4.189	N	121	19.478	W	2030	84
38	030-BSS	1	010884	042758	34	54.185	N	120	47.067	W	328	225
39	031-BSR	1	010884	002521	34	53.759	N	120	52.954	W	665	220
40	031-BSR	2	010884	013851	34	53.845	N	120	52.954	W	665	206
41	031-BSR	3	010884	024915	34	53.787	N	120	52.854	W	665	66
42	032-BSS	1	010784	225947	34	53.558	N	120	56.808	W	990	203
43	033-BSR	1	010784	185353	34	53.432	N	120	59.663	W	1320	155
44	033-BSR	2	010784	203223	34	53.511	N	120	59.661	W	1320	204
45	033-BSR	3	010784	214703	34	53.559	N	120	59.603	W	1315	211
46	034-BSS	1	010784	172132	34	53.145	N	121	4.399	W	1640	257
47	035-BSR	1	010784	121243	34	52.961	N	121	10.300	W	1825	78
48	035-BSR	2	010784	135112	34	52.956	N	121	10.243	W	1825	211
49	035-BSR	3	010784	152117	34	52.869	N	121	10.292	W	1825	210
50	036-BSR	1	010784	061910	34	52.765	N	121	15.372	W	1640	130

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OBS	STATION	REP	DATE MMDDYY	TIME HHMMSS	LATDEG	LATMIN	LATDIR	LNGDEG	LNGMIN	LNGDIR	DEPTH FT	HEADING
101	056-BSS	1	010584	180055	34	30.323	N	121	1.022	W	3000	171
102	058-BSS	1	010584	131400	34	34.347	N	120	45.181	W	330	218
103	059-BSS	1	010584	153404	34	33.651	N	120	47.177	W	720	206
104	060-BSS	1	113083	063842	34	33.245	N	120	48.336	W	915	334
105	061-BSS	1	113083	030250	34	33.008	N	120	48.892	W	1150	307
106	062-BSS	1	113083	010849	34	30.463	N	120	52.125	W	1940	252
107	063-BSS	1	112983	222118	34	26.285	N	120	58.053	W	3100	58
108	064-BSS	1	112983	100817	34	33.150	N	120	40.896	W	195	77
109	065-BSS	1	112983	112612	34	31.271	N	120	43.266	W	355	148
110	066-BSS	1	112983	142639	34	30.456	N	120	44.549	W	670	175
111	067-BSS	1	112983	154928	34	30.287	N	120	45.500	W	940	68
112	068-BSS	1	112983	182727	34	29.241	N	120	45.988	W	1300	321
113	069-BSS	1	112983	202310	34	22.882	N	120	54.196	W	3090	58
114	070-BSS	1	111083	101724	34	29.670	N	120	43.697	W	665	312
115	071-BSS	1	112983	063951	34	29.040	N	120	44.013	W	1020	120
116	072-BSS	1	112983	075149	34	28.411	N	120	44.760	W	1335	103
117	073-BSR	1	112883	200856	34	28.206	N	120	36.799	W	328	73
118	073-BSR	2	112883	214910	34	28.347	N	120	36.951	W	322	74
119	073-BSR	3	112883	233921	34	28.326	N	120	36.895	W	320	59
120	074-BSR	1	112983	012918	34	26.841	N	120	38.612	W	670	72
121	074-BSR	2	112983	030400	34	27.112	N	120	38.752	W	648	59
122	074-BSR	3	112983	044459	34	26.998	N	120	38.818	W	668	75
123	075-BSS	1	111083	081732	34	26.075	N	120	39.654	W	975	296
124	076-BSR	1	111083	022725	34	25.591	N	120	40.982	W	1290	323
125	076-BSR	2	111083	040049	34	25.236	N	120	40.971	W	1344	298
126	076-BSR	3	111083	054254	34	25.451	N	120	40.963	W	1312	34
127	077-BSS	1	111083	004812	34	22.617	N	120	44.024	W	1925	40
128	078-BSS	1	110983	224054	34	18.775	N	120	49.301	W	2540	15
129	079-BSR	1	110983	022500	34	24.117	N	120	28.321	W	328	73
130	079-BSR	2	110983	030600	34	23.818	N	120	28.915	W	360	278
131	079-BSR	3	110983	035528	34	24.201	N	120	28.400	W	336	331
132	080-BSR	1	110983	052600	34	22.860	N	120	28.340	W	654	68
133	080-BSR	2	110983	063812	34	22.840	N	120	28.528	W	670	69
134	080-BSR	3	110983	082730	34	22.971	N	120	28.615	W	645	359
135	081-BSS	1	110983	101251	34	21.263	N	120	28.827	W	980	335
136	082-BSR	1	110983	114639	34	18.709	N	120	29.552	W	1312	145
137	082-BSR	2	110983	134900	34	18.734	N	120	29.461	W	1318	160
138	082-BSR	3	110983	152732	34	18.615	N	120	29.491	W	1315	155
139	083-BSS	1	110983	172110	34	17.198	N	120	30.195	W	1480	51
140	084-BSS	1	110983	193344	34	13.536	N	120	31.188	W	1312	115
141	085-BSR	1	110483	174137	34	25.878	N	120	16.313	W	375	46
142	085-BSR	2	110483	221216	34	25.551	N	120	17.002	W	355	221
143	086-BSR	1	110583	021532	34	24.452	N	120	17.018	W	656	168
144	086-BSR	2	110583	035206	34	24.444	N	120	16.894	W	656	219
145	086-BSR	3	110583	051304	34	24.484	N	120	17.050	W	652	203
146	087-BSS	1	110583	074104	34	21.600	N	120	17.108	W	995	123
147	088-BSR	1	110583	092602	34	17.887	N	120	16.856	W	1310	98
148	088-BSR	2	110583	105759	34	17.873	N	120	16.705	W	1310	135
149	088-BSR	3	110583	124329	34	17.915	N	120	16.620	W	1312	128
150	089-BSS	1	110583	143544	34	13.788	N	120	16.553	W	1570	152

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OBS	STATION	REP	DATE MMDDYY	TIME HHMMSS	LATDEG	LATMIN	LATDIR	LNGDEG	LNGMIN	LNGDIR	DEPTH FT	HEADING
151	090-BSS	1	110583	165748	34	9.440	N	120	16.295	W	1250	141
152	091-BSS	1	110583	192015	34	11.734	N	120	7.433	W	1800	138
153	092-BSS	1	110583	222231	34	8.697	N	120	7.493	W	1480	98
154	093-BSS	1	110683	001215	34	7.630	N	120	7.506	W	1190	115
155	094-BSS	1	110683	164838	34	24.542	N	120	5.469	W	320	79
156	095-BSS	1	110683	144006	34	23.702	N	120	5.469	W	660	90
157	096-BSS	1	110683	132215	34	22.906	N	120	5.415	W	985	105
158	097-BSS	1	110683	115305	34	22.282	N	120	5.494	W	1310	155
159	098-BSS	1	110683	091450	34	12.870	N	120	5.586	W	1870	7
160	099-BSS	1	110683	050655	34	11.224	N	120	5.863	W	1800	103
161	100-BSS	1	110683	033707	34	8.670	N	120	5.502	W	1475	103
162	101-BSS	1	110683	020028	34	7.505	N	120	5.563	W	1190	167
163	102-BSS	1	010984	122528	34	59.709	N	120	48.219	W	330	155
164	103-BSS	1	010984	134526	34	59.632	N	120	53.562	W	655	74
165	104-BSS	1	010984	150504	34	59.446	N	120	56.487	W	980	256
166	105-BSS	1	010984	163051	34	59.228	N	120	59.599	W	1305	123
167	106-BSS	1	010984	180156	34	58.949	N	121	4.424	W	1640	182
168	107-BSS	1	010984	213333	34	58.647	N	121	15.075	W	1910	129
169	108-BSS	1	010984	200800	34	58.213	N	121	17.878	W	1640	57

APPENDIX B

Transect Navigational Positions from the July/August 1984 Hard-Bottom Survey

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/28/84	08:35:20	34 24 28.140N	120 01 51.660W	34 24 27.180N	120 01 52.560W
07/28/84	08:36:01	34 24 28.080N	120 01 51.180W	34 24 27.180N	120 01 52.320W
07/28/84	08:37:00	34 24 28.140N	120 01 50.760W	34 24 26.700N	120 01 52.500W
07/28/84	08:38:00	34 24 28.680N	120 01 50.400W	34 24 27.120N	120 01 52.020W
07/28/84	08:39:00	34 24 29.460N	120 01 50.400W	34 24 27.480N	120 01 52.200W
07/28/84	08:40:00	34 24 29.520N	120 01 50.100W	34 24 27.840N	120 01 52.260W
07/28/84	08:41:00	34 24 29.400N	120 01 49.260W	34 24 27.840N	120 01 51.420W
07/28/84	08:42:00	34 24 29.340N	120 01 48.360W	34 24 27.540N	120 01 50.580W
07/28/84	08:43:00	34 24 29.280N	120 01 47.640W	34 24 27.600N	120 01 50.400W
07/28/84	08:44:00	34 24 29.220N	120 01 47.160W	34 24 27.540N	120 01 49.860W
07/28/84	08:45:00	34 24 29.100N	120 01 46.740W	34 24 27.660N	120 01 49.620W
07/28/84	08:46:00	34 24 29.040N	120 01 46.440W	34 24 27.780N	120 01 49.500W
07/28/84	08:47:00	34 24 28.980N	120 01 46.200W	34 24 27.960N	120 01 49.440W
07/28/84	08:48:00	34 24 28.980N	120 01 45.840W	34 24 27.840N	120 01 49.320W
07/28/84	08:49:00	34 24 28.860N	120 01 45.540W	34 24 27.780N	120 01 49.320W
07/28/84	08:50:00	34 24 29.340N	120 01 45.420W	34 24 28.500N	120 01 48.780W
07/28/84	08:51:00	34 24 30.000N	120 01 46.020W	34 24 29.220N	120 01 48.420W
07/28/84	08:52:00	34 24 30.300N	120 01 46.920W	34 24 29.640N	120 01 48.420W
07/28/84	08:53:00	34 24 30.240N	120 01 47.940W	34 24 29.580N	120 01 48.360W
07/28/84	08:54:00	34 24 30.060N	120 01 48.300W	34 24 29.760N	120 01 47.820W
07/28/84	08:55:00	34 24 30.240N	120 01 48.240W	34 24 29.940N	120 01 47.400W
07/28/84	08:56:00	34 24 30.840N	120 01 48.000W	34 24 30.600N	120 01 46.620W
07/28/84	08:57:00	34 24 31.320N	120 01 47.700W	34 24 31.080N	120 01 45.900W
07/28/84	08:58:00	34 24 31.920N	120 01 47.460W	34 24 31.440N	120 01 45.600W
07/28/84	08:59:01	34 24 32.100N	120 01 47.280W	34 24 31.740N	120 01 45.240W
07/28/84	09:00:00	34 24 32.400N	120 01 47.040W	34 24 32.100N	120 01 44.940W
07/28/84	09:01:00	34 24 32.520N	120 01 46.860W	34 24 32.280N	120 01 44.340W
07/28/84	09:02:00	34 24 32.580N	120 01 46.800W	34 24 32.520N	120 01 44.460W
07/28/84	09:03:01	34 24 32.520N	120 01 46.500W	34 24 32.460N	120 01 44.160W
07/28/84	09:04:00	34 24 32.400N	120 01 46.440W	34 24 32.100N	120 01 44.340W
07/28/84	09:05:00	34 24 32.580N	120 01 46.140W	34 24 32.880N	120 01 44.160W
07/28/84	09:06:20	34 24 32.640N	120 01 45.960W	34 24 32.220N	120 01 43.560W
07/28/84	09:07:00	34 24 32.760N	120 01 45.960W	34 24 31.800N	120 01 43.740W
07/28/84	09:08:00	34 24 33.000N	120 01 45.900W	34 24 32.040N	120 01 43.740W
07/28/84	09:09:00	34 24 33.300N	120 01 45.720W	34 24 31.740N	120 01 43.680W
07/28/84	09:10:00	34 24 33.840N	120 01 45.480W	34 24 31.920N	120 01 43.740W
07/28/84	09:11:00	34 24 34.200N	120 01 45.360W	34 24 32.220N	120 01 43.560W
07/28/84	09:12:00	34 24 34.380N	120 01 45.180W	34 24 32.160N	120 01 43.200W
07/28/84	09:13:00	34 24 34.500N	120 01 45.060W	34 24 32.520N	120 01 43.380W
07/28/84	09:14:00	34 24 34.380N	120 01 44.820W	34 24 32.280N	120 01 43.440W
07/28/84	09:15:00	34 24 33.780N	120 01 44.700W	34 24 31.920N	120 01 43.260W
07/28/84	09:16:00	34 24 33.360N	120 01 44.760W	34 24 31.740N	120 01 43.320W
07/28/84	09:17:00	34 24 33.480N	120 01 44.520W	34 24 31.440N	120 01 43.620W
07/28/84	09:18:00	34 24 33.840N	120 01 44.160W	34 24 31.500N	120 01 43.680W
07/28/84	09:19:01	34 24 34.200N	120 01 43.980W	34 24 31.560N	120 01 43.200W
07/28/84	09:20:00	34 24 34.320N	120 01 43.860W	34 24 31.800N	120 01 42.720W
07/28/84	09:21:00	34 24 34.200N	120 01 43.740W	34 24 31.500N	120 01 42.660W
07/28/84	09:22:00	34 24 33.780N	120 01 44.040W	34 24 31.500N	120 01 42.060W
07/28/84	09:23:00	34 24 33.600N	120 01 44.340W	34 24 31.500N	120 01 42.300W
07/28/84	09:24:01	34 24 33.300N	120 01 44.580W	34 24 31.020N	120 01 42.240W
07/28/84	09:25:00	34 24 32.640N	120 01 44.700W	34 24 31.020N	120 01 41.760W
07/28/84	09:26:01	34 24 31.860N	120 01 44.820W	34 24 30.600N	120 01 41.580W
07/28/84	09:27:00	34 24 30.720N	120 01 44.940W	34 24 30.660N	120 01 41.700W
07/28/84	09:28:00	34 24 30.120N	120 01 45.300W	34 24 31.440N	120 01 42.120W
07/28/84	09:29:01	34 24 29.760N	120 01 45.720W	34 24 30.180N	120 01 41.640W
07/28/84	09:30:00	34 24 29.640N	120 01 45.660W	34 24 29.760N	120 01 41.940W
07/28/84	09:31:01	34 24 29.040N	120 01 45.360W	34 24 30.480N	120 01 42.540W
07/28/84	09:32:00	34 24 28.800N	120 01 43.980W	34 24 30.420N	120 01 42.420W
07/28/84	09:33:00	34 24 28.860N	120 01 42.180W	34 24 29.640N	120 01 41.640W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/28/84	09:34:00	34 24 29.220N	120 01 40.500W	34 24 29.040N	120 01 41.040W
07/28/84	09:35:00	34 24 29.640N	120 01 40.140W	34 24 28.920N	120 01 40.560W
07/28/84	09:36:00	34 24 30.120N	120 01 39.960W	34 24 28.920N	120 01 40.140W
07/28/84	09:37:00	34 24 30.240N	120 01 40.800W	34 24 29.280N	120 01 39.600W
07/28/84	09:38:00	34 24 30.060N	120 01 42.180W	34 24 30.240N	120 01 39.060W
07/28/84	09:39:00	34 24 29.880N	120 01 43.140W	34 24 30.480N	120 01 38.460W
07/28/84	09:40:00	34 24 30.300N	120 01 43.020W	34 24 31.320N	120 01 39.360W
07/28/84	09:41:00	34 24 30.780N	120 01 41.820W	34 24 32.160N	120 01 38.880W
07/28/84	09:42:01	34 24 30.900N	120 01 40.500W	34 24 30.600N	120 01 36.840W
07/28/84	09:43:00	34 24 30.720N	120 01 38.520W	34 24 29.760N	120 01 35.340W
07/28/84	09:44:00	34 24 30.180N	120 01 36.600W	34 24 29.100N	120 01 34.260W
07/28/84	09:45:00	34 24 29.940N	120 01 35.400W	34 24 29.220N	120 01 33.000W
07/28/84	09:46:00	34 24 29.760N	120 01 34.620W	34 24 28.680N	120 01 32.580W
07/28/84	09:47:00	34 24 29.280N	120 01 33.900W	34 24 27.780N	120 01 32.400W
07/28/84	09:48:00	34 24 28.920N	120 01 33.360W	34 24 27.780N	120 01 31.740W
07/28/84	09:49:00	34 24 28.560N	120 01 33.000W	34 24 27.480N	120 01 31.320W
07/28/84	09:50:00	34 24 28.740N	120 01 32.580W	34 24 27.480N	120 01 31.380W
07/28/84	09:51:00	34 24 28.320N	120 01 32.160W	34 24 27.240N	120 01 30.240W
07/28/84	09:52:00	34 24 27.960N	120 01 31.680W	34 24 26.940N	120 01 29.640W
07/28/84	09:53:00	34 24 28.080N	120 01 31.200W	34 24 26.460N	120 01 29.400W
07/28/84	09:54:00	34 24 28.140N	120 01 30.720W	34 24 26.640N	120 01 28.380W
07/28/84	09:55:00	34 24 28.200N	120 01 30.180W	34 24 26.820N	120 01 27.720W
07/28/84	09:56:00	34 24 28.080N	120 01 29.640W	34 24 26.700N	120 01 27.120W
07/28/84	09:57:00	34 24 27.840N	120 01 29.100W	34 24 26.640N	120 01 26.520W
07/28/84	09:58:00	34 24 27.540N	120 01 28.560W	34 24 26.760N	120 01 25.800W
07/28/84	09:59:00	34 24 27.420N	120 01 28.140W	34 24 27.180N	120 01 25.140W
07/28/84	10:00:00	34 24 27.120N	120 01 28.020W	34 24 26.100N	120 01 24.780W
07/28/84	10:01:00	34 24 26.100N	120 01 28.200W	34 24 25.800N	120 01 24.300W
07/28/84	10:02:00	34 24 24.840N	120 01 28.020W	34 24 26.220N	120 01 24.600W
07/28/84	10:03:00	34 24 23.940N	120 01 26.640W	34 24 26.280N	120 01 24.480W
07/28/84	10:04:01	34 24 23.100N	120 01 24.660W	34 24 25.320N	120 01 23.700W
07/28/84	10:05:00	34 24 22.620N	120 01 23.220W	34 24 25.020N	120 01 22.740W
07/28/84	10:06:00	34 24 22.260N	120 01 22.080W	34 24 24.960N	120 01 21.960W
07/28/84	10:07:00	34 24 21.960N	120 01 21.060W	34 24 24.480N	120 01 21.000W
07/28/84	10:08:01	34 24 21.720N	120 01 19.860W	34 24 24.180N	120 01 20.400W
07/28/84	10:09:01	34 24 21.600N	120 01 18.780W	34 24 23.880N	120 01 19.680W
07/28/84	10:10:00	34 24 21.600N	120 01 17.640W	34 24 23.880N	120 01 18.780W
07/28/84	10:11:00	34 24 21.660N	120 01 16.800W	34 24 23.940N	120 01 18.060W
07/28/84	10:12:20	34 24 21.840N	120 01 15.720W	34 24 24.000N	120 01 16.920W
07/28/84	10:13:01	34 24 22.020N	120 01 15.180W	34 24 24.300N	120 01 16.020W
07/28/84	10:14:00	34 24 22.320N	120 01 14.460W	34 24 24.480N	120 01 15.300W
07/28/84	10:15:00	34 24 22.740N	120 01 13.860W	34 24 24.660N	120 01 14.520W
07/28/84	10:16:00	34 24 23.040N	120 01 13.260W	34 24 24.960N	120 01 13.500W
07/28/84	10:17:00	34 24 23.340N	120 01 12.720W	34 24 25.380N	120 01 12.720W
07/28/84	10:18:01	34 24 23.760N	120 01 12.180W	34 24 25.800N	120 01 11.580W
07/28/84	10:19:00	34 24 24.300N	120 01 11.760W	34 24 26.280N	120 01 10.680W
07/28/84	10:20:00	34 24 24.780N	120 01 11.220W	34 24 26.520N	120 01 09.900W
07/28/84	10:21:00	34 24 25.200N	120 01 10.680W	34 24 27.000N	120 01 09.120W
07/28/84	10:22:01	34 24 25.740N	120 01 10.620W	34 24 27.480N	120 01 09.000W
07/28/84	10:23:00	34 24 26.580N	120 01 11.040W	34 24 26.640N	120 01 10.020W
07/28/84	10:24:00	34 24 27.180N	120 01 10.800W	34 24 27.480N	120 01 09.900W
07/28/84	10:25:01	34 24 27.300N	120 01 09.420W	34 24 27.960N	120 01 08.040W
07/28/84	10:26:00	34 24 27.360N	120 01 07.500W	34 24 28.380N	120 01 04.980W
07/28/84	10:27:00	34 24 27.480N	120 01 05.400W	34 24 27.600N	120 01 03.720W
07/28/84	10:28:00	34 24 27.540N	120 01 03.600W	34 24 26.820N	120 01 03.000W
07/28/84	10:29:00	34 24 27.600N	120 01 02.220W	34 24 25.980N	120 01 02.340W
07/28/84	10:30:00	34 24 27.900N	120 01 01.320W	34 24 25.800N	120 01 02.040W
07/28/84	10:31:00	34 24 28.500N	120 01 00.960W	34 24 26.040N	120 01 01.380W
07/28/84	10:32:00	34 24 28.980N	120 01 00.660W	34 24 26.040N	120 01 00.600W
07/28/84	10:33:00	34 24 29.460N	120 01 00.300W	34 24 26.580N	120 00 59.580W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/28/84	10:34:00	34 24 29.580N	120 00 59.700W	34 24 26.940N	120 00 59.220W
07/28/84	10:35:00	34 24 29.160N	120 00 59.160W	34 24 26.820N	120 00 59.280W
07/28/84	10:36:01	34 24 28.500N	120 00 58.800W	34 24 26.520N	120 00 59.700W
07/28/84	10:37:00	34 24 27.600N	120 00 58.440W	34 24 26.100N	120 01 00.060W
07/28/84	10:38:00	34 24 26.940N	120 00 58.320W	34 24 25.980N	120 01 00.660W
07/28/84	10:39:01	34 24 26.160N	120 00 58.020W	34 24 25.920N	120 01 00.780W
07/28/84	10:40:00	34 24 25.680N	120 00 57.840W	34 24 26.160N	120 01 00.300W
07/28/84	10:41:00	34 24 25.440N	120 00 57.480W	34 24 26.400N	120 00 59.220W
07/28/84	10:42:00	34 24 25.140N	120 00 56.820W	34 24 26.220N	120 00 57.780W
07/28/84	10:43:00	34 24 26.820N	120 00 56.520W	34 24 26.640N	120 00 56.940W
07/28/84	10:44:00	34 24 27.240N	120 00 56.340W	34 24 27.120N	120 00 56.040W
07/28/84	10:45:00	34 24 27.840N	120 00 56.040W	34 24 27.240N	120 00 54.780W
07/28/84	10:46:00	34 24 28.320N	120 00 55.560W	34 24 27.300N	120 00 53.940W
07/28/84	10:47:00	34 24 28.980N	120 00 55.020W	34 24 27.840N	120 00 53.220W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/28/84	16:46:20	34 24 04.440N	120 00 25.740W	34 24 04.560N	120 00 26.520W
07/28/84	16:47:00	34 24 03.600N	120 00 26.040W	34 24 04.560N	120 00 26.700W
07/28/84	16:48:00	34 24 02.460N	120 00 26.280W	34 24 04.440N	120 00 27.180W
07/28/84	16:49:00	34 24 01.500N	120 00 26.220W	34 24 03.840N	120 00 28.200W
07/28/84	16:50:00	34 24 00.480N	120 00 26.400W	34 24 03.240N	120 00 28.800W
07/28/84	16:51:00	34 24 00.060N	120 00 27.420W	34 24 02.460N	120 00 29.400W
07/28/84	16:52:00	34 24 00.660N	120 00 28.800W	34 24 03.660N	120 00 30.540W
07/28/84	16:53:00	34 24 01.200N	120 00 29.880W	34 24 03.360N	120 00 30.420W
07/28/84	16:54:01	34 24 01.140N	120 00 30.360W	34 24 03.300N	120 00 30.780W
07/28/84	16:55:00	34 24 01.020N	120 00 30.660W	34 24 03.540N	120 00 31.140W
07/28/84	16:56:00	34 24 00.960N	120 00 30.900W	34 24 03.720N	120 00 31.380W
07/28/84	16:57:00	34 24 00.960N	120 00 31.440W	34 24 04.080N	120 00 31.920W
07/28/84	16:58:00	34 24 01.020N	120 00 32.280W	34 24 04.740N	120 00 31.920W
07/28/84	16:59:00	34 24 01.320N	120 00 33.000W	34 24 05.040N	120 00 32.340W
07/28/84	17:00:01	34 24 02.220N	120 00 33.780W	34 24 05.700N	120 00 33.240W
07/28/84	17:01:00	34 24 03.420N	120 00 34.500W	34 24 06.480N	120 00 33.540W
07/28/84	17:02:01	34 24 04.320N	120 00 34.920W	34 24 07.320N	120 00 33.540W
07/28/84	17:03:00	34 24 05.160N	120 00 35.220W	34 24 07.320N	120 00 34.020W
07/28/84	17:04:00	34 24 06.360N	120 00 36.180W	34 24 07.860N	120 00 34.560W
07/28/84	17:05:00	34 24 06.900N	120 00 37.020W	34 24 07.740N	120 00 34.740W
07/28/84	17:06:01	34 24 07.080N	120 00 37.500W	34 24 07.740N	120 00 34.680W
07/28/84	17:07:00	34 24 07.140N	120 00 37.740W	34 24 07.740N	120 00 34.740W
07/28/84	17:08:00	34 24 07.080N	120 00 37.020W	34 24 08.040N	120 00 34.860W
07/28/84	17:09:00	34 24 06.960N	120 00 36.480W	34 24 08.040N	120 00 34.860W
07/28/84	17:10:00	34 24 07.140N	120 00 36.540W	34 24 07.800N	120 00 35.040W
07/28/84	17:11:00	34 24 07.500N	120 00 36.960W	34 24 07.680N	120 00 35.580W
07/28/84	17:12:00	34 24 07.740N	120 00 37.560W	34 24 07.560N	120 00 36.600W
07/28/84	17:13:01	34 24 08.100N	120 00 38.520W	34 24 07.560N	120 00 37.320W
07/28/84	17:14:00	34 24 08.340N	120 00 39.780W	34 24 07.860N	120 00 37.440W
07/28/84	17:15:01	34 24 08.460N	120 00 40.200W	34 24 07.620N	120 00 37.620W
07/28/84	17:16:00	34 24 08.400N	120 00 40.020W	34 24 07.740N	120 00 37.560W
07/28/84	17:17:01	34 24 08.040N	120 00 39.180W	34 24 07.680N	120 00 37.500W
07/28/84	17:18:00	34 24 07.440N	120 00 37.920W	34 24 07.500N	120 00 37.680W
07/28/84	17:19:01	34 24 07.020N	120 00 37.260W	34 24 07.500N	120 00 37.620W
07/28/84	17:20:00	34 24 06.840N	120 00 37.380W	34 24 07.500N	120 00 37.440W
07/28/84	17:21:00	34 24 06.600N	120 00 37.560W	34 24 07.440N	120 00 37.260W
07/28/84	17:22:00	34 24 06.420N	120 00 37.260W	34 24 07.500N	120 00 37.440W
07/28/84	17:23:01	34 24 06.060N	120 00 36.240W	34 24 07.260N	120 00 37.680W
07/28/84	17:24:00	34 24 05.580N	120 00 35.700W	34 24 07.080N	120 00 37.860W
07/28/84	17:25:00	34 24 05.580N	120 00 36.060W	34 24 06.780N	120 00 38.700W
07/28/84	17:26:00	34 24 05.640N	120 00 36.300W	34 24 06.840N	120 00 39.300W
07/28/84	17:27:00	34 24 05.940N	120 00 37.140W	34 24 06.900N	120 00 40.140W
07/28/84	17:28:01	34 24 06.120N	120 00 37.860W	34 24 07.020N	120 00 41.040W
07/28/84	17:29:00	34 24 06.300N	120 00 38.520W	34 24 07.080N	120 00 41.400W
07/28/84	17:30:00	34 24 06.480N	120 00 39.240W	34 24 07.020N	120 00 42.060W
07/28/84	17:31:00	34 24 06.660N	120 00 40.020W	34 24 07.140N	120 00 42.900W
07/28/84	17:32:01	34 24 06.540N	120 00 40.140W	34 24 06.960N	120 00 43.200W
07/28/84	17:33:00	34 24 07.020N	120 00 41.520W	34 24 07.140N	120 00 44.760W
07/28/84	17:34:00	34 24 07.140N	120 00 41.640W	34 24 06.660N	120 00 44.820W
07/28/84	17:35:00	34 24 07.320N	120 00 41.940W	34 24 07.140N	120 00 45.300W
07/28/84	17:36:00	34 24 07.620N	120 00 42.960W	34 24 07.260N	120 00 45.960W
07/28/84	17:37:00	34 24 07.920N	120 00 43.680W	34 24 07.260N	120 00 46.500W
07/28/84	17:38:00	34 24 08.100N	120 00 44.220W	34 24 07.440N	120 00 46.980W
07/28/84	17:39:01	34 24 08.280N	120 00 44.760W	34 24 07.500N	120 00 47.400W
07/28/84	17:40:00	34 24 08.400N	120 00 45.300W	34 24 07.620N	120 00 48.120W
07/28/84	17:41:00	34 24 08.460N	120 00 45.840W	34 24 07.560N	120 00 48.720W
07/28/84	17:42:00	34 24 08.580N	120 00 46.320W	34 24 07.440N	120 00 49.260W
07/28/84	17:43:01	34 24 08.580N	120 00 46.740W	34 24 07.860N	120 00 49.920W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/28/84	17:44:00	34 24 08.760N	120 00 47.580W	34 24 07.620N	120 00 50.400W
07/28/84	17:45:00	34 24 09.000N	120 00 49.020W	34 24 07.860N	120 00 51.420W
07/28/84	17:46:00	34 24 09.060N	120 00 50.040W	34 24 07.740N	120 00 51.540W
07/28/84	17:47:00	34 24 09.060N	120 00 50.820W	34 24 07.740N	120 00 51.840W
07/28/84	17:48:00	34 24 09.060N	120 00 51.300W	34 24 07.740N	120 00 51.720W
07/28/84	17:49:00	34 24 08.940N	120 00 50.820W	34 24 07.740N	120 00 51.600W
07/28/84	17:50:00	34 24 08.640N	120 00 50.040W	34 24 07.500N	120 00 51.600W
07/28/84	17:51:00	34 24 08.460N	120 00 49.920W	34 24 07.620N	120 00 51.600W
07/28/84	17:52:00	34 24 08.400N	120 00 50.040W	34 24 07.680N	120 00 51.840W
07/28/84	17:53:00	34 24 08.280N	120 00 49.800W	34 24 07.740N	120 00 51.960W
07/28/84	17:54:00	34 24 08.100N	120 00 49.500W	34 24 07.680N	120 00 52.320W
07/28/84	17:55:00	34 24 07.980N	120 00 49.920W	34 24 07.440N	120 00 53.100W
07/28/84	17:56:00	34 24 07.980N	120 00 50.460W	34 24 07.080N	120 00 53.580W
07/28/84	17:57:01	34 24 07.980N	120 00 51.060W	34 24 07.140N	120 00 54.360W
07/28/84	17:58:00	34 24 07.980N	120 00 51.960W	34 24 07.500N	120 00 55.020W
07/28/84	17:59:00	34 24 08.040N	120 00 53.160W	34 24 07.740N	120 00 56.160W
07/28/84	18:00:00	34 24 08.100N	120 00 54.180W	34 24 07.740N	120 00 57.060W
07/28/84	18:01:00	34 24 08.100N	120 00 55.080W	34 24 07.740N	120 00 57.960W
07/28/84	18:02:00	34 24 08.160N	120 00 55.680W	34 24 07.800N	120 00 58.500W
07/28/84	18:03:00	34 24 08.280N	120 00 56.220W	34 24 08.280N	120 00 56.580W
07/28/84	18:04:01	34 24 08.400N	120 00 57.120W	34 24 07.980N	120 01 00.120W
07/28/84	18:05:00	34 24 08.640N	120 00 58.260W	34 24 07.860N	120 01 00.900W
07/28/84	18:06:00	34 24 08.820N	120 00 59.340W	34 24 07.980N	120 01 01.680W
07/28/84	18:07:01	34 24 08.820N	120 00 59.760W	34 24 07.980N	120 01 02.400W
07/28/84	18:08:00	34 24 08.940N	120 00 59.880W	34 24 07.860N	120 01 02.460W
07/28/84	18:09:00	34 24 08.880N	120 01 00.060W	34 24 07.920N	120 01 02.280W
07/28/84	18:10:01	34 24 08.940N	120 01 00.120W	34 24 07.800N	120 01 02.580W
07/28/84	18:11:00	34 24 08.940N	120 01 00.420W	34 24 07.920N	120 01 02.580W
07/28/84	18:12:00	34 24 08.880N	120 01 00.900W	34 24 08.040N	120 01 02.820W
07/28/84	18:13:00	34 24 08.760N	120 01 01.440W	34 24 07.980N	120 01 03.000W
07/28/84	18:14:00	34 24 08.760N	120 01 02.160W	34 24 07.980N	120 01 03.180W
07/28/84	18:15:00	34 24 08.700N	120 01 02.760W	34 24 07.980N	120 01 03.120W
07/28/84	18:16:00	34 24 08.640N	120 01 03.180W	34 24 08.100N	120 01 03.000W
07/28/84	18:17:00	34 24 08.520N	120 01 03.600W	34 24 07.980N	120 01 03.240W
07/28/84	18:18:00	34 24 08.280N	120 01 04.140W	34 24 07.980N	120 01 03.120W
07/28/84	18:19:00	34 24 08.220N	120 01 04.500W	34 24 08.040N	120 01 03.180W
07/28/84	18:20:00	34 24 08.100N	120 01 04.680W	34 24 08.220N	120 01 03.240W
07/28/84	18:21:00	34 24 07.920N	120 01 05.100W	34 24 08.220N	120 01 03.180W
07/28/84	18:22:00	34 24 07.860N	120 01 05.340W	34 24 08.160N	120 01 03.180W
07/28/84	18:23:00	34 24 07.800N	120 01 05.640W	34 24 08.460N	120 01 03.360W
07/28/84	18:24:00	34 24 07.680N	120 01 05.700W	34 24 08.280N	120 01 03.360W
07/28/84	18:25:00	34 24 07.440N	120 01 05.460W	34 24 08.160N	120 01 03.300W
07/28/84	18:26:00	34 24 07.440N	120 01 05.040W	34 24 08.400N	120 01 03.540W
07/28/84	18:27:00	34 24 07.320N	120 01 04.920W	34 24 08.160N	120 01 03.840W
07/28/84	18:28:00	34 24 07.320N	120 01 04.740W	34 24 08.100N	120 01 04.620W
07/28/84	18:29:00	34 24 07.200N	120 01 05.040W	34 24 08.040N	120 01 05.460W
07/28/84	18:30:00	34 24 07.080N	120 01 04.920W	34 24 08.040N	120 01 06.360W
07/28/84	18:31:00	34 24 06.900N	120 01 04.320W	34 24 07.200N	120 01 07.020W
07/28/84	18:32:00	34 24 06.660N	120 01 04.080W	34 24 07.380N	120 01 07.260W
07/28/84	18:33:00	34 24 06.660N	120 01 04.200W	34 24 07.380N	120 01 07.440W
07/28/84	18:34:00	34 24 06.900N	120 01 04.620W	34 24 07.200N	120 01 08.400W
07/28/84	18:35:00	34 24 07.500N	120 01 06.120W	34 24 07.680N	120 01 09.780W
07/28/84	18:36:00	34 24 07.980N	120 01 08.280W	34 24 07.500N	120 01 11.280W
07/28/84	18:37:00	34 24 08.400N	120 01 09.900W	34 24 07.680N	120 01 12.540W
07/28/84	18:38:00	34 24 08.640N	120 01 10.860W	34 24 07.920N	120 01 13.440W
07/28/84	18:39:01	34 24 08.700N	120 01 11.400W	34 24 07.860N	120 01 14.160W
07/28/84	18:40:01	34 24 08.820N	120 01 11.940W	34 24 08.100N	120 01 15.060W
07/28/84	18:41:00	34 24 08.880N	120 01 12.480W	34 24 08.460N	120 01 15.780W
07/28/84	18:42:00	34 24 08.940N	120 01 13.560W	34 24 08.340N	120 01 16.680W
07/28/84	18:43:01	34 24 09.240N	120 01 15.600W	34 24 08.700N	120 01 18.180W

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Date	Time	Ship Position Latitude			Ship Position Longitude			Submersible Position Latitude			Submersible Position Longitude		
07/28/84	18:44:00	34	24	09.420N	120	01	17.040W	34	24	08.820N	120	01	19.200W
07/28/84	18:45:00	34	24	09.660N	120	01	17.880W	34	24	08.940N	120	01	20.160W
07/28/84	18:46:01	34	24	09.780N	120	01	18.720W	34	24	09.180N	120	01	21.180W
07/28/84	18:47:01	34	24	09.960N	120	01	19.740W	34	24	09.360N	120	01	22.140W
07/28/84	18:48:00	34	24	10.200N	120	01	20.880W	34	24	09.480N	120	01	22.920W
07/28/84	18:49:00	34	24	10.380N	120	01	22.140W	34	24	09.540N	120	01	23.820W
07/28/84	18:50:00	34	24	10.560N	120	01	23.220W	34	24	09.720N	120	01	25.080W
07/28/84	18:51:00	34	24	10.740N	120	01	24.360W	34	24	09.780N	120	01	25.860W
07/28/84	18:52:01	34	24	10.920N	120	01	25.500W	34	24	10.080N	120	01	26.640W
07/28/84	18:53:00	34	24	11.040N	120	01	25.860W	34	24	10.140N	120	01	27.120W
07/28/84	18:54:00	34	24	11.160N	120	01	26.220W	34	24	10.500N	120	01	27.720W
07/28/84	18:55:00	34	24	11.340N	120	01	26.880W	34	24	10.680N	120	01	28.500W
07/28/84	18:56:00	34	24	11.640N	120	01	27.600W	34	24	11.040N	120	01	28.740W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/08/84	11:39:00	34 11 25.620N	120 29 24.300W	00 00 00.000N	000 00 00.000E
07/08/84	11:49:00	34 11 26.160N	120 29 20.340W	00 00 00.000N	000 00 00.000E
07/08/84	12:06:40	34 11 22.980N	120 29 17.400W	34 11 25.020N	120 29 22.200W
07/08/84	12:16:40	34 11 19.200N	120 29 01.560W	34 11 20.880N	120 29 10.260W
07/08/84	12:23:21	34 11 16.200N	120 28 51.960W	34 11 15.840N	120 28 57.300W
07/08/84	12:24:00	34 11 15.840N	120 28 51.120W	34 11 15.360N	120 28 56.160W
07/08/84	12:25:00	34 11 15.480N	120 28 49.260W	34 11 13.380N	120 28 58.320W
07/08/84	12:26:01	34 11 15.420N	120 28 47.760W	34 11 13.020N	120 28 58.380W
07/08/84	12:27:41	34 11 15.000N	120 28 44.940W	34 11 14.280N	120 28 50.760W
07/08/84	12:29:20	34 11 16.740N	120 28 44.460W	34 11 17.700N	120 28 54.300W
07/08/84	12:30:20	34 11 15.360N	120 28 40.320W	34 11 20.880N	120 28 50.640W
07/08/84	12:31:40	34 11 16.020N	120 28 39.240W	34 11 23.520N	120 28 39.960W
07/08/84	12:33:00	34 11 15.840N	120 28 38.580W	34 11 20.700N	120 28 34.320W
07/08/84	12:34:00	34 11 15.360N	120 28 38.760W	34 11 23.340N	120 28 34.920W
07/08/84	12:35:00	34 11 14.940N	120 28 38.940W	34 11 24.480N	120 28 36.120W
07/08/84	12:36:00	34 11 14.820N	120 28 39.660W	34 11 24.120N	120 28 38.040W
07/08/84	12:37:00	34 11 14.820N	120 28 40.860W	34 11 24.300N	120 28 40.200W
07/08/84	12:38:00	34 11 15.120N	120 28 41.400W	34 11 24.360N	120 28 41.820W
07/08/84	12:39:00	34 11 15.540N	120 28 41.880W	34 11 24.000N	120 28 42.240W
07/08/84	12:40:00	34 11 15.720N	120 28 42.600W	34 11 25.080N	120 28 43.500W
07/08/84	12:41:00	34 11 16.140N	120 28 43.260W	34 11 27.000N	120 28 43.860W
07/08/84	12:42:00	34 11 16.380N	120 28 43.800W	34 11 23.940N	120 28 44.700W
07/08/84	12:43:00	34 11 16.740N	120 28 44.340W	34 11 23.940N	120 28 45.780W
07/08/84	12:44:00	34 11 16.980N	120 28 44.520W	34 11 24.960N	120 28 43.860W
07/08/84	12:45:00	34 11 17.040N	120 28 45.360W	34 11 25.500N	120 28 43.500W
07/08/84	12:46:00	34 11 16.920N	120 28 45.660W	34 11 24.660N	120 28 45.540W
07/08/84	12:47:00	34 11 16.740N	120 28 45.840W	34 11 24.120N	120 28 46.260W
07/08/84	12:48:00	34 11 16.860N	120 28 46.200W	34 11 23.640N	120 28 47.340W
07/08/84	12:49:00	34 11 16.860N	120 28 46.200W	34 11 24.600N	120 28 47.160W
07/08/84	12:50:00	34 11 16.800N	120 28 46.080W	34 11 22.980N	120 28 46.500W
07/08/84	12:51:00	34 11 16.380N	120 28 45.720W	34 11 25.260N	120 28 44.700W
07/08/84	12:52:00	34 11 15.840N	120 28 45.060W	34 11 23.460N	120 28 40.620W
07/08/84	12:53:40	34 11 14.520N	120 28 42.960W	34 11 20.220N	120 28 35.820W
07/08/84	12:56:00	34 11 12.780N	120 28 40.320W	34 11 17.760N	120 28 30.660W
07/08/84	12:57:20	34 11 12.120N	120 28 38.520W	34 11 15.480N	120 28 30.060W
07/08/84	12:58:00	34 11 11.940N	120 28 37.740W	34 11 14.400N	120 28 30.360W
07/08/84	12:59:00	34 11 11.340N	120 28 35.700W	34 11 12.420N	120 28 30.540W
07/08/84	13:00:00	34 11 10.980N	120 28 34.200W	34 11 11.580N	120 28 30.000W
07/08/84	13:01:00	34 11 10.560N	120 28 32.460W	34 11 11.580N	120 28 30.000W
07/08/84	13:02:00	34 11 10.320N	120 28 31.140W	34 11 11.340N	120 28 23.700W
07/08/84	13:03:00	34 11 10.020N	120 28 29.400W	34 11 11.340N	120 28 23.700W
07/08/84	13:04:01	34 11 09.900N	120 28 28.260W	34 11 11.340N	120 28 23.700W
07/08/84	13:05:20	34 11 09.360N	120 28 26.040W	34 11 10.680N	120 28 19.680W
07/08/84	13:06:00	34 11 08.940N	120 28 25.440W	34 11 10.680N	120 28 19.680W
07/08/84	13:07:00	34 11 08.520N	120 28 24.840W	34 11 10.680N	120 28 19.680W
07/08/84	13:10:00	34 11 08.760N	120 28 27.660W	34 11 18.300N	120 28 27.840W
07/08/84	13:11:01	34 11 09.240N	120 28 29.040W	34 11 18.240N	120 28 29.580W
07/08/84	13:12:00	34 11 09.600N	120 28 30.600W	34 11 17.820N	120 28 30.180W
07/08/84	13:13:00	34 11 09.720N	120 28 32.040W	34 11 18.780N	120 28 31.980W
07/08/84	13:14:20	34 11 09.840N	120 28 34.200W	34 11 20.280N	120 28 34.380W
07/08/84	13:15:40	34 11 10.920N	120 28 37.140W	34 11 19.200N	120 28 38.460W
07/08/84	13:17:00	34 11 11.700N	120 28 39.300W	34 11 18.600N	120 28 40.620W
07/08/84	13:18:00	34 11 11.880N	120 28 40.200W	34 11 16.140N	120 28 40.440W
07/08/84	13:19:00	34 11 12.060N	120 28 41.940W	34 11 15.540N	120 28 42.840W
07/08/84	13:20:20	34 11 12.540N	120 28 43.800W	34 11 18.360N	120 28 47.040W
07/08/84	13:21:00	34 11 12.540N	120 28 43.800W	34 11 19.080N	120 28 47.820W
07/08/84	13:22:00	34 11 12.660N	120 28 44.160W	34 11 17.820N	120 28 47.460W
07/08/84	13:23:00	34 11 12.360N	120 28 43.680W	34 11 18.540N	120 28 46.260W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/08/84	13:24:00	34 11 12.060N	120 28 43.140W	34 11 15.780N	120 28 43.440W
07/08/84	13:25:00	34 11 11.580N	120 28 43.140W	34 11 19.560N	120 28 42.600W
07/08/84	13:26:01	34 11 11.280N	120 28 43.200W	34 11 19.380N	120 28 44.640W
07/08/84	13:27:01	34 11 10.980N	120 28 43.560W	34 11 18.420N	120 28 45.060W
07/08/84	13:28:00	34 11 11.040N	120 28 44.100W	34 11 16.560N	120 28 44.280W
07/08/84	13:29:00	34 11 10.260N	120 28 44.220W	34 11 16.920N	120 28 42.000W
07/08/84	13:30:00	34 11 09.900N	120 28 44.820W	34 11 16.800N	120 28 43.620W
07/08/84	13:31:00	34 11 09.660N	120 28 44.940W	34 11 17.520N	120 28 46.680W
07/08/84	13:32:00	34 11 09.540N	120 28 44.760W	34 11 16.980N	120 28 47.100W
07/08/84	13:33:00	34 11 09.720N	120 28 45.240W	34 11 17.340N	120 28 46.560W
07/08/84	13:46:08	34 11 19.200N	120 29 05.400W	34 11 15.120N	120 28 44.640W
07/08/84	13:48:00	34 11 07.320N	120 28 44.220W	34 11 16.380N	120 28 44.760W
07/08/84	13:49:00	34 11 07.800N	120 28 45.660W	34 11 11.700N	120 28 46.080W
07/08/84	13:50:00	34 11 08.640N	120 28 47.340W	34 11 12.480N	120 28 47.040W
07/08/84	13:51:01	34 11 08.580N	120 28 47.760W	34 11 12.300N	120 28 47.760W
07/08/84	13:52:01	34 11 08.400N	120 28 47.400W	34 11 11.040N	120 28 47.160W
07/08/84	13:53:01	34 11 07.920N	120 28 46.680W	34 11 09.780N	120 28 45.960W
07/08/84	13:54:00	34 11 07.260N	120 28 45.120W	34 11 09.180N	120 28 43.560W
07/08/84	13:55:00	34 11 06.900N	120 28 43.500W	34 11 08.640N	120 28 41.760W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/08/84	17:11:08	34 10 52.200N	120 28 08.400W	34 11 00.480N	120 28 05.220W
07/08/84	17:13:00	34 10 58.800N	120 27 59.940W	34 10 59.400N	120 28 04.020W
07/08/84	17:14:00	34 10 58.740N	120 27 59.580W	34 11 00.300N	120 28 03.480W
07/08/84	17:15:00	34 10 58.440N	120 28 00.000W	34 11 00.960N	120 28 02.340W
07/08/84	17:16:00	34 10 57.900N	120 28 00.840W	34 10 59.700N	120 28 04.080W
07/08/84	17:17:00	34 10 58.020N	120 28 01.200W	34 10 57.780N	120 28 05.040W
07/08/84	17:18:01	34 10 58.980N	120 28 02.520W	34 10 59.820N	120 28 06.120W
07/08/84	17:19:00	34 10 58.680N	120 28 03.180W	34 11 00.960N	120 28 10.500W
07/08/84	17:20:00	34 10 58.740N	120 28 05.340W	34 11 01.320N	120 28 14.040W
07/08/84	17:21:00	34 10 58.320N	120 28 07.980W	34 10 58.380N	120 28 16.260W
07/08/84	17:22:00	34 10 57.840N	120 28 10.200W	34 10 57.480N	120 28 17.400W
07/08/84	17:23:01	34 10 56.760N	120 28 11.400W	34 10 55.800N	120 28 17.880W
07/08/84	17:24:00	34 10 55.800N	120 28 11.700W	34 10 54.480N	120 28 17.340W
07/08/84	17:25:00	34 10 54.840N	120 28 11.460W	34 10 54.660N	120 28 13.140W
07/08/84	17:26:00	34 10 53.700N	120 28 10.320W	34 10 53.640N	120 28 12.060W
07/08/84	17:27:00	34 10 52.560N	120 28 09.600W	34 10 52.380N	120 28 10.740W
07/08/84	17:28:00	34 10 51.720N	120 28 09.000W	34 10 51.540N	120 28 09.120W
07/08/84	17:29:00	34 10 50.700N	120 28 08.400W	34 10 50.280N	120 28 08.400W
07/08/84	17:30:01	34 10 49.500N	120 28 08.220W	34 10 48.900N	120 28 07.440W
07/08/84	17:31:00	34 10 49.140N	120 28 08.700W	34 10 48.900N	120 28 07.500W
07/08/84	17:32:00	34 10 48.480N	120 28 08.100W	34 10 48.180N	120 28 06.960W
07/08/84	17:33:00	34 10 48.120N	120 28 07.980W	34 10 48.180N	120 28 03.120W
07/08/84	17:34:01	34 10 47.760N	120 28 07.320W	34 10 48.660N	120 28 01.800W
07/08/84	17:35:00	34 10 47.520N	120 28 06.780W	34 10 49.260N	120 28 01.140W
07/08/84	17:36:00	34 10 47.100N	120 28 05.820W	34 10 50.040N	120 28 00.360W
07/08/84	17:38:00	34 10 46.080N	120 28 02.700W	34 10 51.420N	120 27 56.580W
07/08/84	17:39:00	34 10 45.960N	120 28 01.500W	34 10 52.740N	120 27 56.280W
07/08/84	17:40:00	34 10 46.560N	120 28 01.140W	34 10 52.200N	120 27 56.280W
07/08/84	17:41:00	34 10 47.460N	120 28 00.360W	34 10 54.240N	120 27 58.320W
07/08/84	17:42:00	34 10 49.080N	120 27 59.160W	34 10 54.720N	120 28 01.560W
07/08/84	17:43:00	34 10 50.700N	120 27 57.720W	34 10 55.620N	120 27 59.220W
07/08/84	17:44:00	34 10 51.900N	120 27 56.580W	34 10 56.400N	120 27 56.520W
07/08/84	17:45:00	34 10 52.260N	120 27 55.260W	34 10 56.700N	120 27 54.480W
07/08/84	17:46:00	34 10 52.680N	120 27 54.240W	34 10 57.060N	120 27 53.040W
07/08/84	17:47:00	34 10 52.320N	120 27 52.560W	34 10 57.120N	120 27 50.700W
07/08/84	17:48:00	34 10 51.900N	120 27 51.120W	34 10 57.060N	120 27 48.480W
07/08/84	17:49:00	34 10 51.540N	120 27 50.400W	34 10 57.300N	120 27 48.600W
07/08/84	17:50:00	34 10 51.060N	120 27 49.440W	34 10 57.240N	120 27 47.760W
07/08/84	17:51:00	34 10 51.060N	120 27 49.320W	34 10 57.900N	120 27 49.560W
07/08/84	17:52:00	34 10 51.480N	120 27 48.780W	34 10 58.200N	120 27 52.860W
07/08/84	17:53:00	34 10 52.500N	120 27 48.120W	34 10 56.820N	120 27 53.400W
07/08/84	17:54:01	34 10 54.120N	120 27 47.520W	34 10 58.500N	120 27 52.080W
07/08/84	17:55:00	34 10 55.080N	120 27 47.160W	34 10 59.280N	120 27 51.180W
07/08/84	17:56:00	34 10 55.080N	120 27 46.020W	34 11 00.600N	120 27 48.660W
07/08/84	17:57:00	34 10 54.840N	120 27 45.120W	34 10 59.880N	120 27 46.800W
07/08/84	17:58:00	34 10 54.900N	120 27 45.840W	34 10 59.760N	120 27 47.160W
07/08/84	17:59:00	34 10 54.000N	120 27 44.940W	34 10 58.560N	120 27 47.160W
07/08/84	18:00:00	34 10 53.280N	120 27 44.100W	34 10 58.320N	120 27 46.080W
07/08/84	18:01:00	34 10 53.340N	120 27 44.280W	34 10 57.540N	120 27 48.720W
07/08/84	18:02:00	34 10 54.120N	120 27 43.800W	34 10 56.460N	120 27 50.160W
07/08/84	18:03:00	34 10 55.860N	120 27 44.100W	34 10 59.280N	120 27 49.800W
07/08/84	18:04:00	34 10 56.220N	120 27 43.920W	34 11 00.000N	120 27 47.880W
07/08/84	18:05:01	34 10 56.160N	120 27 43.800W	34 11 01.020N	120 27 47.580W
07/08/84	18:06:00	34 10 56.040N	120 27 43.860W	34 10 59.340N	120 27 49.680W
07/08/84	18:07:00	34 10 55.740N	120 27 43.440W	34 10 58.680N	120 27 47.340W
07/08/84	18:08:00	34 10 55.380N	120 27 42.720W	34 11 00.180N	120 27 47.400W
07/08/84	18:09:00	34 10 54.780N	120 27 41.760W	34 11 00.300N	120 27 45.780W
07/08/84	18:10:00	34 10 54.120N	120 27 40.860W	34 11 00.180N	120 27 42.180W
07/08/84	18:11:00	34 10 53.580N	120 27 40.800W	34 10 59.940N	120 27 42.240W

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		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/08/84	18:12:00	34 10 53.100N	120 27 40.860W	34 10 58.680N	120 27 44.580W
07/08/84	18:13:00	34 10 52.920N	120 27 40.500W	34 10 58.020N	120 27 44.880W
07/08/84	18:14:00	34 10 52.500N	120 27 39.720W	34 10 58.500N	120 27 43.860W
07/08/84	18:15:00	34 10 52.440N	120 27 39.360W	34 10 58.200N	120 27 43.440W
07/08/84	18:16:00	34 10 52.440N	120 27 39.300W	34 10 58.980N	120 27 43.740W
07/08/84	18:17:00	34 10 52.020N	120 27 38.400W	34 10 57.660N	120 27 42.840W
07/08/84	18:18:00	34 10 52.320N	120 27 39.060W	34 10 57.840N	120 27 43.800W
07/08/84	18:19:01	34 10 52.200N	120 27 38.760W	34 10 57.060N	120 27 43.860W
07/08/84	18:20:00	34 10 52.560N	120 27 39.600W	34 10 57.120N	120 27 44.340W
07/08/84	18:21:00	34 10 52.560N	120 27 40.140W	34 10 56.940N	120 27 45.660W
07/08/84	18:22:00	34 10 52.920N	120 27 42.180W	34 10 56.760N	120 27 47.040W
07/08/84	18:23:01	34 10 52.620N	120 27 42.720W	34 10 55.140N	120 27 47.760W
07/08/84	18:24:00	34 10 52.320N	120 27 43.260W	34 10 55.980N	120 27 48.300W
07/08/84	18:25:00	34 10 51.420N	120 27 42.600W	34 10 55.260N	120 27 46.680W
07/08/84	18:26:01	34 10 50.700N	120 27 42.720W	34 10 53.340N	120 27 47.760W
07/08/84	18:27:00	34 10 50.100N	120 27 42.120W	34 10 52.860N	120 27 47.040W
07/08/84	18:28:00	34 10 49.200N	120 27 41.460W	34 10 52.020N	120 27 44.760W
07/08/84	18:29:01	34 10 48.420N	120 27 40.860W	34 10 52.080N	120 27 44.460W
07/08/84	18:30:00	34 10 47.880N	120 27 40.980W	34 10 50.100N	120 27 44.760W
07/08/84	18:31:00	34 10 47.100N	120 27 40.260W	34 10 49.680N	120 27 43.680W
07/08/84	18:32:00	34 10 46.440N	120 27 39.780W	34 10 48.300N	120 27 42.720W
07/08/84	18:33:00	34 10 45.840N	120 27 39.660W	34 10 47.460N	120 27 42.060W
07/08/84	18:34:00	34 10 45.180N	120 27 39.240W	34 10 47.340N	120 27 40.080W
07/08/84	18:35:00	34 10 44.580N	120 27 38.880W	34 10 46.860N	120 27 38.160W
07/08/84	18:36:01	34 10 43.920N	120 27 38.280W	34 10 46.380N	120 27 36.060W
07/08/84	18:37:00	34 10 43.260N	120 27 37.860W	34 10 46.800N	120 27 36.360W
07/08/84	18:38:01	34 10 42.960N	120 27 37.380W	34 10 47.760N	120 27 37.560W
07/08/84	18:39:01	34 10 42.960N	120 27 35.880W	34 10 47.280N	120 27 39.660W
07/08/84	18:40:00	34 10 43.860N	120 27 34.200W	34 10 48.360N	120 27 39.300W
07/08/84	18:41:00	34 10 44.580N	120 27 32.580W	34 10 46.800N	120 27 33.240W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/21/84	09:58:00	34 27 32.820N	120 40 20.700W	34 27 32.400N	120 40 21.540W
07/21/84	09:59:01	34 27 32.760N	120 40 20.340W	34 27 32.280N	120 40 21.540W
07/21/84	10:00:01	34 27 32.460N	120 40 19.920W	34 27 32.040N	120 40 21.480W
07/21/84	10:01:01	34 27 32.400N	120 40 19.620W	34 27 32.580N	120 40 21.780W
07/21/84	10:02:01	34 27 31.920N	120 40 19.380W	34 27 33.060N	120 40 22.680W
07/21/84	10:03:00	34 27 31.380N	120 40 19.740W	34 27 34.080N	120 40 23.160W
07/21/84	10:04:00	34 27 30.960N	120 40 20.280W	34 27 33.840N	120 40 22.740W
07/21/84	10:05:00	34 27 30.840N	120 40 21.060W	34 27 34.920N	120 40 23.280W
07/21/84	10:06:00	34 27 30.720N	120 40 21.540W	34 27 35.340N	120 40 23.520W
07/21/84	10:07:01	34 27 30.720N	120 40 22.200W	34 27 35.640N	120 40 24.900W
07/21/84	10:08:01	34 27 30.840N	120 40 22.620W	34 27 36.180N	120 40 24.840W
07/21/84	10:09:00	34 27 31.320N	120 40 22.860W	34 27 36.480N	120 40 26.340W
07/21/84	10:10:01	34 27 32.220N	120 40 23.100W	34 27 37.740N	120 40 25.920W
07/21/84	10:11:00	34 27 33.360N	120 40 23.400W	34 27 38.700N	120 40 25.440W
07/21/84	10:12:00	34 27 33.960N	120 40 23.400W	34 27 39.120N	120 40 26.220W
07/21/84	10:13:01	34 27 34.380N	120 40 23.280W	34 27 39.600N	120 40 26.280W
07/21/84	10:14:00	34 27 34.980N	120 40 23.160W	34 27 40.380N	120 40 26.640W
07/21/84	10:15:00	34 27 35.520N	120 40 22.980W	34 27 40.860N	120 40 26.400W
07/21/84	10:16:00	34 27 36.360N	120 40 23.100W	34 27 41.880N	120 40 25.740W
07/21/84	10:17:00	34 27 37.320N	120 40 23.280W	34 27 42.900N	120 40 25.860W
07/21/84	10:18:00	34 27 38.040N	120 40 23.580W	34 27 43.680N	120 40 25.080W
07/21/84	10:19:00	34 27 38.760N	120 40 23.760W	34 27 44.460N	120 40 27.120W
07/21/84	10:20:00	34 27 39.360N	120 40 23.820W	34 27 44.820N	120 40 27.300W
07/21/84	10:21:00	34 27 40.020N	120 40 23.880W	34 27 45.480N	120 40 26.100W
07/21/84	10:22:00	34 27 40.680N	120 40 23.940W	34 27 46.680N	120 40 26.580W
07/21/84	10:23:00	34 27 41.760N	120 40 24.300W	34 27 47.460N	120 40 26.160W
07/21/84	10:24:00	34 27 42.420N	120 40 24.540W	34 27 48.420N	120 40 25.800W
07/21/84	10:25:00	34 27 43.080N	120 40 24.600W	34 27 50.100N	120 40 26.400W
07/21/84	10:26:00	34 27 43.980N	120 40 24.780W	34 27 49.920N	120 40 25.800W
07/21/84	10:27:00	34 27 44.760N	120 40 25.080W	34 27 50.520N	120 40 24.900W
07/21/84	10:28:00	34 27 45.600N	120 40 25.260W	34 27 51.960N	120 40 24.900W
07/21/84	10:29:00	34 27 46.260N	120 40 25.380W	34 27 52.740N	120 40 24.600W
07/21/84	10:30:00	34 27 47.280N	120 40 25.380W	34 27 53.880N	120 40 24.660W
07/21/84	10:31:00	34 27 48.000N	120 40 25.140W	34 27 54.120N	120 40 25.320W
07/21/84	10:32:00	34 27 48.540N	120 40 24.900W	34 27 54.900N	120 40 24.780W
07/21/84	10:33:00	34 27 48.840N	120 40 24.420W	34 27 56.880N	120 40 25.620W
07/21/84	10:34:00	34 27 49.500N	120 40 23.940W	34 27 56.520N	120 40 24.720W
07/21/84	10:35:20	34 27 50.940N	120 40 23.340W	34 27 58.260N	120 40 21.840W
07/21/84	10:36:00	34 27 51.840N	120 40 23.280W	34 27 58.200N	120 40 21.480W
07/21/84	10:37:01	34 27 52.860N	120 40 23.220W	34 27 59.040N	120 40 21.660W
07/21/84	10:38:00	34 27 53.400N	120 40 22.920W	34 28 00.240N	120 40 21.180W
07/21/84	10:39:00	34 27 54.180N	120 40 22.500W	34 28 02.940N	120 40 20.400W
07/21/84	10:40:00	34 27 55.200N	120 40 22.020W	34 28 01.980N	120 40 20.040W
07/21/84	10:41:00	34 27 56.100N	120 40 21.600W	34 28 02.400N	120 40 19.560W
07/21/84	10:42:00	34 27 56.280N	120 40 21.000W	34 28 02.640N	120 40 20.340W
07/21/84	10:43:00	34 27 55.800N	120 40 20.340W	34 28 01.680N	120 40 20.520W
07/21/84	10:44:00	34 27 55.860N	120 40 19.800W	34 28 02.820N	120 40 21.060W
07/21/84	10:45:00	34 27 56.580N	120 40 19.140W	34 28 03.120N	120 40 18.060W
07/21/84	10:46:01	34 27 57.480N	120 40 18.720W	34 28 03.900N	120 40 17.760W
07/21/84	10:47:00	34 27 57.960N	120 40 18.240W	34 28 03.600N	120 40 18.060W
07/21/84	10:48:00	34 27 58.200N	120 40 17.820W	34 28 03.660N	120 40 17.160W
07/21/84	10:49:01	34 27 58.620N	120 40 17.460W	34 28 03.900N	120 40 17.100W
07/21/84	10:50:00	34 27 59.220N	120 40 17.400W	34 28 04.200N	120 40 16.320W
07/21/84	10:51:00	34 27 59.760N	120 40 17.340W	34 28 04.620N	120 40 16.080W
07/21/84	10:52:00	34 28 00.000N	120 40 17.040W	34 28 04.920N	120 40 15.780W
07/21/84	10:53:00	34 28 00.000N	120 40 16.620W	34 28 05.280N	120 40 15.780W
07/21/84	10:54:01	34 28 00.060N	120 40 16.380W	34 28 05.640N	120 40 16.200W
07/21/84	10:55:00	34 28 00.240N	120 40 16.440W	34 28 05.280N	120 40 16.020W
07/21/84	10:56:00	34 28 00.540N	120 40 16.320W	34 28 04.980N	120 40 16.440W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/21/84	10:57:00	34 28 00.720N	120 40 15.960W	34 28 06.180N	120 40 17.940W
07/21/84	10:58:01	34 28 00.900N	120 40 15.420W	34 28 06.540N	120 40 18.000W
07/21/84	10:59:00	34 28 01.560N	120 40 15.000W	34 28 07.080N	120 40 16.500W
07/21/84	11:00:00	34 28 02.580N	120 40 14.940W	34 28 08.400N	120 40 16.020W
07/21/84	11:01:00	34 28 03.420N	120 40 15.000W	34 28 09.660N	120 40 16.080W
07/21/84	11:02:00	34 28 04.080N	120 40 14.940W	34 28 10.020N	120 40 15.540W
07/21/84	11:03:01	34 28 04.560N	120 40 14.880W	34 28 11.340N	120 40 16.020W
07/21/84	11:04:00	34 28 04.800N	120 40 14.400W	34 28 10.800N	120 40 16.500W
07/21/84	11:05:00	34 28 05.400N	120 40 14.100W	34 28 11.340N	120 40 15.120W
07/21/84	11:06:01	34 28 06.120N	120 40 13.980W	34 28 12.240N	120 40 13.500W
07/21/84	11:07:00	34 28 06.840N	120 40 13.680W	34 28 11.280N	120 40 12.660W
07/21/84	11:08:01	34 28 07.380N	120 40 13.380W	34 28 10.680N	120 40 12.060W
07/21/84	11:09:00	34 28 07.740N	120 40 13.020W	34 28 10.140N	120 40 11.820W
07/21/84	11:10:01	34 28 08.400N	120 40 12.600W	34 28 10.200N	120 40 11.820W
07/21/84	11:11:00	34 28 08.760N	120 40 12.240W	34 28 09.960N	120 40 11.700W
07/21/84	11:12:00	34 28 09.240N	120 40 11.940W	34 28 09.780N	120 40 11.580W
07/21/84	11:13:00	34 28 09.660N	120 40 11.580W	34 28 09.840N	120 40 11.640W
07/21/84	11:14:00	34 28 09.960N	120 40 11.160W	34 28 09.660N	120 40 11.340W
07/21/84	11:15:00	34 28 10.020N	120 40 10.740W	34 28 09.720N	120 40 11.400W
07/21/84	11:16:00	34 28 10.020N	120 40 10.200W	34 28 09.600N	120 40 11.460W
07/21/84	11:17:00	34 28 09.840N	120 40 09.600W	34 28 09.360N	120 40 11.160W
07/21/84	11:18:00	34 28 09.660N	120 40 08.940W	34 28 08.940N	120 40 11.400W
07/21/84	11:19:00	34 28 09.960N	120 40 08.640W	34 28 09.300N	120 40 11.400W
07/21/84	11:20:00	34 28 10.260N	120 40 08.580W	34 28 09.540N	120 40 11.400W
07/21/84	11:21:00	34 28 10.440N	120 40 08.820W	34 28 09.600N	120 40 11.040W
07/21/84	11:22:00	34 28 10.620N	120 40 09.480W	34 28 10.080N	120 40 11.400W
07/21/84	11:23:00	34 28 10.620N	120 40 10.200W	34 28 09.900N	120 40 11.100W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/11/84	09:19:00	34 30 17.760N	120 35 27.120W	34 30 15.180N	120 35 31.200W
07/11/84	09:20:00	34 30 16.200N	120 35 27.240W	34 30 14.760N	120 35 33.300W
07/11/84	09:21:00	34 30 15.660N	120 35 25.680W	34 30 18.480N	120 35 29.100W
07/11/84	09:22:00	34 30 16.140N	120 35 22.860W	34 30 19.020N	120 35 26.760W
07/11/84	09:23:00	34 30 16.680N	120 35 19.560W	34 30 19.440N	120 35 22.380W
07/11/84	09:27:00	34 30 19.560N	120 35 17.520W	34 30 22.560N	120 35 13.080W
07/11/84	09:28:01	34 30 19.980N	120 35 17.100W	34 30 23.940N	120 35 12.960W
07/11/84	09:29:00	34 30 20.220N	120 35 16.620W	34 30 23.160N	120 35 14.400W
07/11/84	09:31:00	34 30 20.640N	120 35 15.900W	34 30 23.220N	120 35 14.520W
07/11/84	09:32:00	34 30 20.700N	120 35 15.660W	34 30 24.180N	120 35 13.920W
07/11/84	09:33:01	34 30 20.700N	120 35 15.360W	34 30 24.360N	120 35 13.620W
07/11/84	09:34:00	34 30 20.580N	120 35 15.060W	34 30 23.760N	120 35 13.740W
07/11/84	09:35:00	34 30 20.640N	120 35 14.760W	34 30 23.520N	120 35 13.740W
07/11/84	09:36:01	34 30 20.760N	120 35 14.460W	34 30 23.880N	120 35 13.560W
07/11/84	09:37:00	34 30 20.940N	120 35 14.220W	34 30 23.820N	120 35 12.600W
07/11/84	09:38:00	34 30 21.120N	120 35 13.920W	34 30 23.880N	120 35 11.760W
07/11/84	09:39:00	34 30 21.420N	120 35 13.680W	34 30 24.180N	120 35 10.920W
07/11/84	09:40:01	34 30 21.660N	120 35 13.320W	34 30 23.760N	120 35 10.980W
07/11/84	09:41:00	34 30 21.900N	120 35 12.900W	34 30 24.120N	120 35 10.200W
07/11/84	09:42:00	34 30 22.140N	120 35 12.420W	34 30 24.300N	120 35 09.840W
07/11/84	09:43:00	34 30 22.380N	120 35 11.940W	34 30 24.180N	120 35 09.240W
07/11/84	09:44:00	34 30 22.620N	120 35 11.520W	34 30 23.940N	120 35 08.880W
07/11/84	09:45:00	34 30 22.800N	120 35 10.980W	34 30 24.120N	120 35 08.040W
07/11/84	09:46:00	34 30 23.040N	120 35 10.500W	34 30 23.700N	120 35 07.800W
07/11/84	09:47:00	34 30 23.220N	120 35 10.080W	34 30 23.640N	120 35 06.840W
07/11/84	09:48:01	34 30 23.400N	120 35 09.660W	34 30 23.220N	120 35 06.720W
07/11/84	09:49:01	34 30 23.580N	120 35 09.480W	34 30 22.920N	120 35 06.300W
07/11/84	09:50:00	34 30 23.340N	120 35 09.180W	34 30 22.740N	120 35 06.480W
07/11/84	09:51:00	34 30 22.740N	120 35 08.940W	34 30 23.100N	120 35 06.420W
07/11/84	09:52:01	34 30 22.200N	120 35 08.880W	34 30 23.280N	120 35 06.900W
07/11/84	09:53:01	34 30 21.900N	120 35 08.760W	34 30 22.980N	120 35 07.320W
07/11/84	09:54:00	34 30 21.840N	120 35 08.700W	34 30 22.800N	120 35 07.320W
07/11/84	09:55:00	34 30 21.840N	120 35 08.400W	34 30 22.620N	120 35 07.140W
07/11/84	09:56:00	34 30 21.960N	120 35 08.100W	34 30 22.500N	120 35 06.780W
07/11/84	09:57:00	34 30 22.020N	120 35 07.800W	34 30 22.020N	120 35 06.660W
07/11/84	09:58:00	34 30 22.200N	120 35 07.500W	34 30 21.780N	120 35 06.480W
07/11/84	09:59:00	34 30 22.200N	120 35 06.960W	34 30 21.720N	120 35 06.420W
07/11/84	10:00:00	34 30 22.080N	120 35 06.360W	34 30 21.480N	120 35 06.060W
07/11/84	10:01:00	34 30 22.260N	120 35 05.760W	34 30 21.300N	120 35 05.820W
07/11/84	10:02:00	34 30 23.280N	120 35 05.040W	34 30 21.360N	120 35 05.700W
07/11/84	10:03:00	34 30 24.180N	120 35 04.620W	34 30 21.840N	120 35 06.120W
07/11/84	10:04:00	34 30 24.780N	120 35 04.140W	34 30 22.560N	120 35 05.940W
07/11/84	10:05:00	34 30 25.320N	120 35 03.660W	34 30 22.680N	120 35 05.760W
07/11/84	10:06:01	34 30 25.800N	120 35 03.060W	34 30 23.040N	120 35 04.980W
07/11/84	10:07:01	34 30 26.160N	120 35 02.400W	34 30 22.920N	120 35 04.380W
07/11/84	10:08:00	34 30 26.340N	120 35 01.680W	34 30 22.740N	120 35 02.880W
07/11/84	10:09:00	34 30 26.520N	120 35 01.020W	34 30 22.680N	120 35 01.980W
07/11/84	10:10:00	34 30 26.760N	120 35 00.480W	34 30 23.220N	120 35 01.440W
07/11/84	10:11:00	34 30 26.880N	120 35 00.120W	34 30 23.280N	120 35 01.380W
07/11/84	10:12:00	34 30 26.940N	120 34 59.580W	34 30 23.100N	120 35 00.840W
07/11/84	10:13:00	34 30 27.060N	120 34 59.160W	34 30 22.380N	120 35 00.240W
07/11/84	10:14:00	34 30 27.060N	120 34 58.740W	34 30 23.100N	120 34 59.880W
07/11/84	10:15:00	34 30 27.120N	120 34 58.200W	34 30 22.980N	120 34 59.760W
07/11/84	10:16:00	34 30 27.000N	120 34 57.780W	34 30 22.740N	120 34 59.940W
07/11/84	10:17:00	34 30 26.940N	120 34 57.300W	34 30 23.280N	120 34 58.560W
07/11/84	10:18:00	34 30 26.940N	120 34 56.820W	34 30 22.200N	120 34 58.140W
07/11/84	10:19:00	34 30 26.820N	120 34 56.340W	34 30 22.080N	120 34 57.540W
07/11/84	10:20:00	34 30 26.880N	120 34 55.980W	34 30 22.320N	120 34 57.720W
07/11/84	10:21:00	34 30 26.760N	120 34 55.620W	34 30 24.600N	120 34 55.260W

Date	Time	Ship Position Latitude			Ship Position Longitude			Submersible Position Latitude			Submersible Position Longitude		
07/11/84	10:22:01	34	30	26.640N	120	34	55.140W	34	30	22.980N	120	34	57.480W
07/11/84	10:23:00	34	30	26.580N	120	34	54.720W	34	30	22.920N	120	34	57.000W
07/11/84	10:24:00	34	30	26.520N	120	34	54.240W	34	30	23.100N	120	34	56.400W
07/11/84	10:25:00	34	30	26.520N	120	34	53.760W	34	30	22.620N	120	34	55.860W
07/11/84	10:26:00	34	30	26.400N	120	34	53.340W	34	30	22.500N	120	34	55.920W
07/11/84	10:27:00	34	30	26.280N	120	34	52.860W	34	30	22.260N	120	34	55.560W
07/11/84	10:28:00	34	30	26.220N	120	34	52.380W	34	30	22.500N	120	34	54.720W
07/11/84	10:29:01	34	30	26.100N	120	34	52.020W	34	30	22.200N	120	34	54.360W
07/11/84	10:30:00	34	30	26.040N	120	34	51.660W	34	30	22.860N	120	34	53.760W
07/11/84	10:31:01	34	30	25.860N	120	34	51.240W	34	30	22.080N	120	34	53.940W
07/11/84	10:32:00	34	30	25.680N	120	34	50.760W	34	30	22.620N	120	34	53.100W
07/11/84	10:33:00	34	30	25.500N	120	34	50.340W	34	30	22.320N	120	34	53.460W
07/11/84	10:34:00	34	30	25.320N	120	34	49.860W	34	30	21.720N	120	34	52.860W
07/11/84	10:35:00	34	30	25.080N	120	34	49.440W	34	30	22.200N	120	34	51.360W
07/11/84	10:36:00	34	30	24.960N	120	34	48.960W	34	30	21.240N	120	34	51.540W
07/11/84	10:37:00	34	30	24.780N	120	34	48.540W	34	30	21.060N	120	34	50.580W
07/11/84	10:38:00	34	30	24.660N	120	34	48.300W	34	30	21.720N	120	34	50.280W
07/11/84	10:39:00	34	30	24.420N	120	34	47.880W	34	30	21.360N	120	34	50.400W
07/11/84	10:40:00	34	30	24.300N	120	34	47.460W	34	30	20.640N	120	34	49.980W
07/11/84	10:41:01	34	30	24.000N	120	34	47.040W	34	30	20.280N	120	34	49.200W
07/11/84	10:42:00	34	30	23.880N	120	34	46.620W	34	30	20.040N	120	34	48.660W
07/11/84	10:43:00	34	30	23.700N	120	34	46.200W	34	30	19.440N	120	34	48.120W
07/11/84	10:44:01	34	30	23.460N	120	34	45.900W	34	30	19.680N	120	34	47.520W
07/11/84	10:45:00	34	30	22.980N	120	34	45.840W	34	30	17.940N	120	34	47.160W
07/11/84	10:46:01	34	30	22.320N	120	34	46.020W	34	30	18.540N	120	34	45.960W
07/11/84	10:47:00	34	30	21.900N	120	34	46.500W	34	30	18.180N	120	34	45.660W
07/11/84	10:48:00	34	30	21.420N	120	34	47.100W	34	30	13.440N	120	34	45.120W
07/11/84	10:49:01	34	30	21.060N	120	34	47.820W	34	30	14.880N	120	34	45.900W
07/11/84	10:50:00	34	30	20.700N	120	34	48.480W	34	30	15.480N	120	34	47.280W
07/11/84	10:51:01	34	30	20.400N	120	34	49.140W	34	30	15.060N	120	34	47.940W
07/11/84	10:56:00	34	30	19.560N	120	34	48.180W	34	30	23.280N	120	34	49.680W
07/11/84	10:57:00	34	30	19.320N	120	34	47.640W	34	30	16.260N	120	34	51.480W
07/11/84	11:05:07	34	30	14.100N	120	34	12.300W	34	30	16.440N	120	34	51.120W
07/11/84	11:07:40	34	30	21.060N	120	34	53.520W	34	30	23.940N	120	34	51.840W
07/11/84	11:09:01	34	30	20.880N	120	34	53.820W	34	30	23.700N	120	34	51.480W
07/11/84	11:10:01	34	30	20.940N	120	34	53.820W	34	30	24.420N	120	34	51.480W
07/11/84	11:11:00	34	30	20.760N	120	34	53.340W	34	30	24.120N	120	34	51.600W
07/11/84	11:12:01	34	30	20.640N	120	34	52.800W	34	30	24.000N	120	34	52.980W
07/11/84	11:13:00	34	30	20.520N	120	34	52.140W	34	30	23.220N	120	34	54.420W
07/11/84	11:14:00	34	30	20.220N	120	34	51.480W	34	30	22.080N	120	34	54.600W
07/11/84	11:15:00	34	30	19.800N	120	34	50.940W	34	30	21.600N	120	34	55.020W
07/11/84	11:16:00	34	30	19.500N	120	34	50.520W	34	30	20.760N	120	34	54.420W
07/11/84	11:17:00	34	30	19.200N	120	34	50.160W	34	30	21.120N	120	34	54.420W
07/11/84	11:18:01	34	30	18.960N	120	34	49.800W	34	30	21.180N	120	34	54.480W
07/11/84	11:19:00	34	30	18.780N	120	34	49.500W	34	30	19.680N	120	34	50.700W
07/11/84	11:20:00	34	30	18.540N	120	34	49.200W	34	30	19.980N	120	34	51.120W
07/11/84	11:21:00	34	30	18.180N	120	34	48.840W	34	30	20.040N	120	34	51.480W
07/11/84	11:22:00	34	30	18.300N	120	34	48.480W	34	30	19.680N	120	34	51.360W
07/11/84	11:23:20	34	30	19.500N	120	34	48.540W	34	30	23.940N	120	34	47.580W
07/11/84	11:24:00	34	30	20.520N	120	34	48.780W	34	30	21.960N	120	34	48.480W
07/11/84	11:25:01	34	30	22.920N	120	34	49.920W	34	30	24.180N	120	34	49.500W
07/11/84	11:26:00	34	30	25.260N	120	34	51.240W	34	30	28.500N	120	34	50.160W
07/11/84	11:27:00	34	30	26.940N	120	34	51.720W	34	30	29.580N	120	34	51.240W
07/11/84	11:28:01	34	30	27.360N	120	34	51.360W	34	30	30.300N	120	34	50.820W
07/11/84	11:29:00	34	30	27.240N	120	34	50.580W	34	30	29.280N	120	34	51.480W
07/11/84	11:30:00	34	30	27.000N	120	34	49.920W	34	30	29.340N	120	34	52.020W
07/11/84	11:31:00	34	30	26.700N	120	34	49.320W	34	30	28.560N	120	34	51.960W
07/11/84	11:32:01	34	30	26.460N	120	34	48.780W	34	30	28.740N	120	34	51.900W
07/11/84	11:33:00	34	30	26.220N	120	34	48.360W	34	30	28.620N	120	34	50.820W
07/11/84	11:34:00	34	30	26.100N	120	34	48.000W	34	30	29.280N	120	34	50.340W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/11/84	11:35:00	34 30 25.740N	120 34 47.460W	34 30 29.400N	120 34 49.320W
07/11/84	11:36:01	34 30 26.040N	120 34 46.740W	34 30 28.920N	120 34 48.600W
07/11/84	11:37:00	34 30 26.700N	120 34 45.780W	34 30 29.640N	120 34 47.400W
07/11/84	11:38:00	34 30 28.140N	120 34 45.060W	34 30 30.600N	120 34 45.720W
07/11/84	11:39:00	34 30 29.100N	120 34 44.460W	34 30 31.500N	120 34 44.100W
07/11/84	11:40:00	34 30 29.640N	120 34 43.980W	34 30 32.220N	120 34 42.540W
07/11/84	11:41:00	34 30 30.120N	120 34 43.260W	34 30 32.700N	120 34 42.000W
07/11/84	11:42:00	34 30 30.300N	120 34 42.420W	34 30 32.820N	120 34 41.520W
07/11/84	11:43:00	34 30 30.360N	120 34 41.580W	34 30 32.700N	120 34 40.920W
07/11/84	11:44:01	34 30 30.300N	120 34 40.920W	34 30 32.760N	120 34 39.900W
07/11/84	11:45:00	34 30 30.240N	120 34 40.440W	34 30 33.660N	120 34 38.520W
07/11/84	11:46:00	34 30 30.120N	120 34 39.900W	34 30 32.580N	120 34 38.460W
07/11/84	11:47:00	34 30 29.940N	120 34 39.360W	34 30 31.860N	120 34 38.040W
07/11/84	11:48:00	34 30 29.700N	120 34 38.820W	34 30 32.520N	120 34 36.840W
07/11/84	11:49:00	34 30 30.240N	120 34 37.800W	34 30 33.000N	120 34 35.100W
07/11/84	11:50:20	34 30 31.380N	120 34 36.240W	34 30 33.540N	120 34 33.180W
07/11/84	11:51:01	34 30 31.920N	120 34 35.040W	34 30 33.660N	120 34 33.300W
07/11/84	11:52:00	34 30 32.160N	120 34 33.360W	34 30 34.380N	120 34 32.880W
07/11/84	11:53:00	34 30 32.160N	120 34 32.760W	34 30 34.500N	120 34 32.760W
07/11/84	11:54:00	34 30 31.980N	120 34 31.980W	34 30 34.140N	120 34 32.460W
07/11/84	11:55:01	34 30 31.860N	120 34 31.380W	34 30 31.320N	120 34 31.200W
07/11/84	11:56:00	34 30 32.100N	120 34 31.380W	34 30 34.380N	120 34 31.080W
07/11/84	11:57:00	34 30 32.460N	120 34 31.320W	34 30 34.680N	120 34 30.360W
07/11/84	11:58:00	34 30 32.280N	120 34 30.360W	34 30 34.500N	120 34 29.700W
07/11/84	11:59:00	34 30 31.680N	120 34 28.980W	34 30 33.120N	120 34 28.500W
07/11/84	12:00:01	34 30 30.900N	120 34 27.960W	34 30 31.680N	120 34 27.360W
07/11/84	12:01:00	34 30 30.480N	120 34 27.180W	34 30 30.600N	120 34 26.400W
07/11/84	12:02:00	34 30 29.880N	120 34 26.820W	34 30 29.880N	120 34 25.800W
07/11/84	12:03:00	34 30 29.340N	120 34 26.700W	34 30 29.400N	120 34 25.500W
07/11/84	12:04:00	34 30 28.860N	120 34 26.700W	34 30 29.100N	120 34 25.200W
07/11/84	12:05:00	34 30 28.320N	120 34 26.880W	34 30 28.440N	120 34 25.260W
07/11/84	12:06:00	34 30 27.780N	120 34 27.480W	34 30 27.840N	120 34 25.200W
07/11/84	12:07:00	34 30 27.360N	120 34 28.080W	34 30 29.160N	120 34 29.460W
07/11/84	12:08:01	34 30 27.300N	120 34 28.380W	34 30 27.960N	120 34 25.980W
07/11/84	12:09:00	34 30 27.360N	120 34 28.620W	34 30 28.200N	120 34 26.400W
07/11/84	12:10:00	34 30 27.720N	120 34 28.920W	34 30 28.440N	120 34 26.880W
07/11/84	12:11:00	34 30 28.680N	120 34 29.520W	34 30 28.740N	120 34 27.660W
07/11/84	12:12:00	34 30 29.580N	120 34 29.760W	34 30 28.800N	120 34 28.200W
07/11/84	12:13:00	34 30 30.000N	120 34 29.460W	34 30 29.040N	120 34 28.380W
07/11/84	12:14:00	34 30 30.300N	120 34 28.800W	34 30 29.460N	120 34 28.380W
07/11/84	12:15:00	34 30 30.420N	120 34 28.140W	34 30 29.640N	120 34 28.260W
07/11/84	12:16:01	34 30 30.420N	120 34 27.480W	34 30 29.880N	120 34 28.260W
07/11/84	12:17:01	34 30 30.420N	120 34 26.820W	34 30 30.300N	120 34 28.080W
07/11/84	12:18:00	34 30 30.660N	120 34 26.460W	34 30 30.900N	120 34 28.080W
07/11/84	12:19:00	34 30 31.020N	120 34 26.100W	34 30 31.560N	120 34 27.900W
07/11/84	12:20:01	34 30 31.140N	120 34 25.740W	34 30 31.980N	120 34 27.480W
07/11/84	12:21:00	34 30 31.020N	120 34 25.740W	34 30 31.800N	120 34 27.120W
07/11/84	12:22:01	34 30 30.600N	120 34 25.800W	34 30 30.840N	120 34 26.640W
07/11/84	12:23:00	34 30 30.060N	120 34 25.860W	34 30 29.400N	120 34 26.340W
07/11/84	12:24:00	34 30 29.460N	120 34 25.500W	34 30 28.140N	120 34 25.800W
07/11/84	12:25:00	34 30 29.040N	120 34 24.900W	34 30 27.360N	120 34 25.140W
07/11/84	12:26:00	34 30 28.500N	120 34 24.360W	34 30 26.220N	120 34 24.420W
07/11/84	12:27:00	34 30 27.960N	120 34 24.060W	34 30 25.320N	120 34 23.400W
07/11/84	12:28:00	34 30 27.540N	120 34 23.400W	34 30 24.840N	120 34 22.200W
07/11/84	12:29:01	34 30 27.420N	120 34 22.500W	34 30 24.600N	120 34 20.760W
07/11/84	12:30:00	34 30 27.480N	120 34 21.540W	34 30 25.260N	120 34 19.500W
07/11/84	12:31:00	34 30 27.300N	120 34 20.820W	34 30 25.260N	120 34 18.900W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/18/84	16:32:40	34 42 34.080N	120 47 48.720W	34 42 34.200N	120 47 53.940W
07/18/84	16:34:00	34 42 34.380N	120 47 51.000W	34 42 34.740N	120 47 55.320W
07/18/84	16:35:00	34 42 34.200N	120 47 52.380W	34 42 34.800N	120 47 56.400W
07/18/84	16:36:00	34 42 33.900N	120 47 53.160W	34 42 34.620N	120 47 57.060W
07/18/84	16:37:00	34 42 33.840N	120 47 54.000W	34 42 34.200N	120 47 57.660W
07/18/84	16:38:00	34 42 34.320N	120 47 54.540W	34 42 33.120N	120 47 58.200W
07/18/84	16:39:00	34 42 34.800N	120 47 54.900W	34 42 34.740N	120 47 58.620W
07/18/84	16:40:00	34 42 35.280N	120 47 55.740W	34 42 35.040N	120 47 59.100W
07/18/84	16:41:00	34 42 35.160N	120 47 55.860W	34 42 35.220N	120 47 59.160W
07/18/84	16:42:00	34 42 35.040N	120 47 55.800W	34 42 34.740N	120 47 59.100W
07/18/84	16:43:00	34 42 34.980N	120 47 55.500W	34 42 34.680N	120 47 59.160W
07/18/84	16:44:00	34 42 35.100N	120 47 55.740W	34 42 34.860N	120 47 59.040W
07/18/84	16:45:00	34 42 35.160N	120 47 55.740W	34 42 34.500N	120 47 58.800W
07/18/84	16:46:00	34 42 35.340N	120 47 55.860W	34 42 34.740N	120 47 59.040W
07/18/84	16:47:00	34 42 35.640N	120 47 55.920W	34 42 35.280N	120 47 59.100W
07/18/84	16:48:01	34 42 35.580N	120 47 55.740W	34 42 34.920N	120 47 59.160W
07/18/84	16:49:00	34 42 35.520N	120 47 55.560W	34 42 35.100N	120 47 59.400W
07/18/84	16:50:00	34 42 35.400N	120 47 55.320W	34 42 34.740N	120 47 59.040W
07/18/84	16:51:00	34 42 35.520N	120 47 55.500W	34 42 34.620N	120 47 58.920W
07/18/84	16:52:00	34 42 35.640N	120 47 55.860W	34 42 34.680N	120 47 59.280W
07/18/84	16:53:00	34 42 35.820N	120 47 56.520W	34 42 35.400N	120 48 00.060W
07/18/84	16:54:00	34 42 35.580N	120 47 57.000W	34 42 35.580N	120 48 00.720W
07/18/84	16:55:01	34 42 35.340N	120 47 57.420W	34 42 35.460N	120 48 01.380W
07/18/84	16:56:00	34 42 35.280N	120 47 58.020W	34 42 34.980N	120 48 01.920W
07/18/84	16:57:00	34 42 35.460N	120 47 58.680W	34 42 35.700N	120 48 02.400W
07/18/84	16:58:00	34 42 35.880N	120 47 59.460W	34 42 36.000N	120 48 02.220W
07/18/84	16:59:00	34 42 36.060N	120 48 00.120W	34 42 36.780N	120 48 03.360W
07/18/84	17:00:00	34 42 36.000N	120 48 00.420W	34 42 36.900N	120 48 03.960W
07/18/84	17:01:01	34 42 36.000N	120 48 00.840W	34 42 36.540N	120 48 04.560W
07/18/84	17:02:00	34 42 36.120N	120 48 01.260W	34 42 36.180N	120 48 05.160W
07/18/84	17:03:01	34 42 36.780N	120 48 01.560W	34 42 36.900N	120 48 05.460W
07/18/84	17:04:00	34 42 37.320N	120 48 02.160W	34 42 37.680N	120 48 05.760W
07/18/84	17:05:00	34 42 37.560N	120 48 02.820W	34 42 37.980N	120 48 06.480W
07/18/84	17:06:00	34 42 37.740N	120 48 03.540W	34 42 38.160N	120 48 06.960W
07/18/84	17:07:00	34 42 37.680N	120 48 04.260W	34 42 38.040N	120 48 07.800W
07/18/84	17:08:00	34 42 37.860N	120 48 04.680W	34 42 38.340N	120 48 08.460W
07/18/84	17:09:00	34 42 38.040N	120 48 04.980W	34 42 38.700N	120 48 08.700W
07/18/84	17:10:00	34 42 38.340N	120 48 05.700W	34 42 38.940N	120 48 08.880W
07/18/84	17:11:00	34 42 38.700N	120 48 06.720W	34 42 39.480N	120 48 09.720W
07/18/84	17:12:00	34 42 38.940N	120 48 07.500W	34 42 39.660N	120 48 10.380W
07/18/84	17:13:00	34 42 39.060N	120 48 07.980W	34 42 40.020N	120 48 10.860W
07/18/84	17:14:00	34 42 39.060N	120 48 08.280W	34 42 39.960N	120 48 12.000W
07/18/84	17:15:00	34 42 39.300N	120 48 08.760W	34 42 38.460N	120 48 12.300W
07/18/84	17:16:00	34 42 39.900N	120 48 09.480W	34 42 40.560N	120 48 12.960W
07/18/84	17:17:00	34 42 40.380N	120 48 10.560W	34 42 41.580N	120 48 13.140W
07/18/84	17:18:00	34 42 40.440N	120 48 11.040W	34 42 41.340N	120 48 13.500W
07/18/84	17:19:00	34 42 40.260N	120 48 10.440W	34 42 41.340N	120 48 13.260W
07/18/84	17:20:00	34 42 40.260N	120 48 10.440W	34 42 40.980N	120 48 13.260W
07/18/84	17:21:01	34 42 40.320N	120 48 10.440W	34 42 40.920N	120 48 13.800W
07/18/84	17:22:00	34 42 40.920N	120 48 10.920W	34 42 41.340N	120 48 14.100W
07/18/84	17:23:00	34 42 41.160N	120 48 11.520W	34 42 41.760N	120 48 14.340W
07/18/84	17:24:00	34 42 41.580N	120 48 12.600W	34 42 42.240N	120 48 15.120W
07/18/84	17:27:19	34 42 40.620N	120 48 16.380W	34 42 42.240N	120 48 15.180W
07/18/84	17:28:00	34 42 41.580N	120 48 14.280W	34 42 42.720N	120 48 16.800W
07/18/84	17:29:00	34 42 41.700N	120 48 14.400W	34 42 42.660N	120 48 17.280W
07/18/84	17:30:00	34 42 42.300N	120 48 14.520W	34 42 42.420N	120 48 15.180W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/30/84	08:35:40	34 42 32.160N	120 48 10.200W	34 42 33.420N	120 48 08.700W
07/30/84	08:37:00	34 42 32.040N	120 48 09.660W	34 42 33.360N	120 48 08.820W
07/30/84	08:38:00	34 42 31.980N	120 48 09.240W	34 42 33.180N	120 48 08.880W
07/30/84	08:39:01	34 42 31.800N	120 48 08.940W	34 42 33.780N	120 48 08.580W
07/30/84	08:40:00	34 42 31.320N	120 48 08.640W	34 42 34.380N	120 48 08.400W
07/30/84	08:41:00	34 42 30.720N	120 48 08.100W	34 42 34.500N	120 48 08.520W
07/30/84	08:42:00	34 42 30.480N	120 48 07.500W	34 42 33.660N	120 48 09.900W
07/30/84	08:43:00	34 42 30.420N	120 48 07.020W	34 42 33.240N	120 48 09.540W
07/30/84	08:44:00	34 42 30.420N	120 48 06.840W	34 42 33.540N	120 48 08.880W
07/30/84	08:45:00	34 42 30.540N	120 48 06.540W	34 42 33.240N	120 48 08.700W
07/30/84	08:46:01	34 42 31.020N	120 48 05.940W	34 42 33.420N	120 48 07.920W
07/30/84	08:47:00	34 42 31.500N	120 48 05.580W	34 42 33.480N	120 48 07.620W
07/30/84	08:48:00	34 42 31.800N	120 48 05.220W	34 42 33.660N	120 48 07.200W
07/30/84	08:49:00	34 42 32.040N	120 48 04.800W	34 42 33.360N	120 48 07.260W
07/30/84	08:50:00	34 42 32.280N	120 48 04.320W	34 42 33.180N	120 48 07.200W
07/30/84	08:51:00	34 42 32.580N	120 48 03.900W	34 42 33.300N	120 48 06.960W
07/30/84	08:52:01	34 42 32.760N	120 48 03.360W	34 42 33.300N	120 48 06.900W
07/30/84	08:53:00	34 42 32.880N	120 48 02.820W	34 42 33.240N	120 48 06.540W
07/30/84	08:54:01	34 42 33.180N	120 48 02.340W	34 42 33.180N	120 48 06.540W
07/30/84	08:55:00	34 42 33.660N	120 48 01.980W	34 42 33.600N	120 48 06.060W
07/30/84	08:56:00	34 42 34.200N	120 48 01.740W	34 42 33.600N	120 48 06.060W
07/30/84	08:57:00	34 42 34.680N	120 48 01.560W	34 42 34.140N	120 48 05.760W
07/30/84	08:58:00	34 42 34.980N	120 48 01.560W	34 42 34.740N	120 48 05.340W
07/30/84	08:59:00	34 42 35.340N	120 48 02.100W	34 42 35.220N	120 48 05.760W
07/30/84	09:00:01	34 42 35.580N	120 48 03.060W	34 42 35.340N	120 48 05.940W
07/30/84	09:01:00	34 42 35.580N	120 48 03.900W	34 42 35.400N	120 48 06.120W
07/30/84	09:02:00	34 42 35.220N	120 48 04.320W	34 42 35.520N	120 48 06.360W
07/30/84	09:03:01	34 42 34.920N	120 48 04.620W	34 42 35.400N	120 48 06.180W
07/30/84	09:04:00	34 42 34.320N	120 48 03.840W	34 42 36.000N	120 48 06.060W
07/30/84	09:05:00	34 42 34.200N	120 48 02.520W	34 42 35.940N	120 48 05.880W
07/30/84	09:06:00	34 42 33.960N	120 48 02.640W	34 42 35.700N	120 48 06.000W
07/30/84	09:07:00	34 42 33.660N	120 48 02.760W	34 42 35.820N	120 48 05.580W
07/30/84	09:08:00	34 42 33.720N	120 48 03.420W	34 42 36.060N	120 48 05.940W
07/30/84	09:09:00	34 42 33.840N	120 48 04.140W	34 42 36.840N	120 48 05.760W
07/30/84	09:10:00	34 42 34.080N	120 48 04.620W	34 42 37.380N	120 48 05.940W
07/30/84	09:11:00	34 42 34.380N	120 48 05.040W	34 42 37.800N	120 48 05.400W
07/30/84	09:12:00	34 42 34.920N	120 48 05.460W	34 42 38.400N	120 48 05.700W
07/30/84	09:13:00	34 42 35.760N	120 48 05.820W	34 42 38.640N	120 48 05.580W
07/30/84	09:14:00	34 42 36.480N	120 48 05.940W	34 42 38.700N	120 48 05.520W
07/30/84	09:15:00	34 42 36.900N	120 48 06.060W	34 42 39.000N	120 48 05.400W
07/30/84	09:16:00	34 42 37.080N	120 48 05.880W	34 42 39.000N	120 48 05.400W
07/30/84	09:17:00	34 42 37.140N	120 48 05.520W	34 42 39.060N	120 48 05.040W
07/30/84	09:18:00	34 42 37.140N	120 48 05.100W	34 42 39.120N	120 48 04.680W
07/30/84	09:19:00	34 42 37.080N	120 48 04.560W	34 42 39.540N	120 48 04.500W
07/30/84	09:20:00	34 42 37.140N	120 48 04.260W	34 42 39.720N	120 48 03.780W
07/30/84	09:21:00	34 42 37.140N	120 48 03.900W	34 42 39.840N	120 48 03.180W
07/30/84	09:22:00	34 42 37.560N	120 48 04.200W	34 42 40.080N	120 48 03.180W
07/30/84	09:23:00	34 42 37.620N	120 48 04.500W	34 42 39.840N	120 48 02.340W
07/30/84	09:24:01	34 42 37.800N	120 48 05.040W	34 42 40.320N	120 48 03.060W
07/30/84	09:25:00	34 42 37.800N	120 48 05.460W	34 42 40.440N	120 48 03.660W
07/30/84	09:26:00	34 42 37.680N	120 48 05.760W	34 42 40.260N	120 48 03.540W
07/30/84	09:27:00	34 42 37.620N	120 48 05.940W	34 42 40.440N	120 48 03.780W
07/30/84	09:28:01	34 42 37.560N	120 48 05.820W	34 42 39.900N	120 48 04.680W
07/30/84	09:29:00	34 42 37.860N	120 48 05.520W	34 42 40.860N	120 48 03.780W
07/30/84	09:30:00	34 42 38.700N	120 48 05.100W	34 42 40.860N	120 48 03.600W
07/30/84	09:31:01	34 42 39.900N	120 48 04.800W	34 42 41.160N	120 48 02.460W
07/30/84	09:32:00	34 42 41.040N	120 48 04.500W	34 42 41.460N	120 48 01.800W
07/30/84	09:33:00	34 42 41.820N	120 48 04.320W	34 42 41.520N	120 48 01.320W
07/30/84	09:34:01	34 42 42.600N	120 48 04.020W	34 42 42.480N	120 48 00.540W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/30/84	09:35:00	34 42 42.960N	120 48 03.540W	34 42 42.780N	120 48 00.060W
07/30/84	09:36:00	34 42 42.540N	120 48 03.180W	34 42 43.080N	120 48 00.180W
07/30/84	09:37:00	34 42 42.300N	120 48 02.700W	34 42 43.440N	120 47 59.160W
07/30/84	09:38:00	34 42 42.180N	120 48 02.100W	34 42 43.920N	120 47 59.160W
07/30/84	09:39:01	34 42 42.480N	120 48 01.380W	34 42 44.160N	120 47 58.380W
07/30/84	09:40:00	34 42 42.840N	120 48 00.780W	34 42 43.980N	120 47 57.480W
07/30/84	09:41:00	34 42 43.320N	120 48 00.120W	34 42 44.520N	120 47 56.940W
07/30/84	09:42:00	34 42 43.620N	120 47 59.340W	34 42 45.060N	120 47 56.520W
07/30/84	09:43:01	34 42 44.280N	120 47 58.680W	34 42 45.300N	120 47 55.800W
07/30/84	09:44:00	34 42 45.240N	120 47 57.840W	34 42 45.240N	120 47 55.020W
07/30/84	09:45:00	34 42 46.080N	120 47 57.120W	34 42 45.480N	120 47 54.240W
07/30/84	09:46:00	34 42 46.980N	120 47 56.460W	34 42 45.900N	120 47 53.340W
07/30/84	09:47:00	34 42 47.640N	120 47 55.920W	34 42 46.020N	120 47 52.440W
07/30/84	09:48:01	34 42 48.180N	120 47 55.140W	34 42 46.860N	120 47 51.720W
07/30/84	09:49:01	34 42 48.480N	120 47 54.360W	34 42 47.340N	120 47 50.760W
07/30/84	09:50:00	34 42 48.480N	120 47 53.580W	34 42 48.120N	120 47 50.160W
07/30/84	09:51:00	34 42 48.120N	120 47 52.860W	34 42 48.660N	120 47 49.860W
07/30/84	10:18:20	34 42 54.120N	120 47 41.940W	34 42 52.740N	120 47 38.940W
07/30/84	10:19:01	34 42 54.180N	120 47 42.180W	34 42 51.420N	120 47 41.100W
07/30/84	10:20:01	34 42 54.000N	120 47 42.120W	34 42 51.420N	120 47 41.640W
07/30/84	10:21:00	34 42 53.700N	120 47 41.820W	34 42 51.420N	120 47 41.880W
07/30/84	10:22:00	34 42 53.340N	120 47 41.160W	34 42 51.060N	120 47 42.120W
07/30/84	10:23:00	34 42 53.160N	120 47 40.200W	34 42 51.420N	120 47 41.340W
07/30/84	10:24:00	34 42 52.980N	120 47 39.720W	34 42 51.720N	120 47 41.280W
07/30/84	10:25:00	34 42 52.740N	120 47 39.900W	34 42 51.420N	120 47 41.820W
07/30/84	10:26:00	34 42 52.500N	120 47 39.540W	34 42 51.660N	120 47 41.520W
07/30/84	10:27:00	34 42 52.320N	120 47 39.420W	34 42 51.240N	120 47 41.040W
07/30/84	10:28:00	34 42 51.960N	120 47 39.120W	34 42 51.300N	120 47 40.980W
07/30/84	10:29:00	34 42 51.900N	120 47 39.180W	34 42 51.240N	120 47 40.980W
07/30/84	10:30:00	34 42 51.600N	120 47 39.060W	34 42 51.300N	120 47 41.100W
07/30/84	10:31:00	34 42 51.420N	120 47 38.820W	34 42 51.240N	120 47 41.040W
07/30/84	10:32:00	34 42 51.240N	120 47 38.760W	34 42 51.240N	120 47 40.920W
07/30/84	10:33:00	34 42 51.180N	120 47 38.940W	34 42 51.360N	120 47 40.620W
07/30/84	10:34:00	34 42 51.180N	120 47 39.060W	34 42 51.480N	120 47 39.960W
07/30/84	10:35:00	34 42 51.240N	120 47 39.060W	34 42 52.020N	120 47 39.180W
07/30/84	10:36:00	34 42 51.360N	120 47 38.940W	34 42 52.260N	120 47 38.760W
07/30/84	10:37:00	34 42 51.660N	120 47 39.060W	34 42 52.380N	120 47 38.460W
07/30/84	10:38:00	34 42 52.020N	120 47 38.880W	34 42 52.740N	120 47 37.560W
07/30/84	10:39:00	34 42 52.440N	120 47 38.880W	34 42 53.340N	120 47 37.020W
07/30/84	10:40:00	34 42 52.800N	120 47 38.880W	34 42 53.820N	120 47 36.120W
07/30/84	10:41:00	34 42 53.040N	120 47 38.580W	34 42 54.060N	120 47 35.580W
07/30/84	10:42:00	34 42 53.280N	120 47 38.220W	34 42 54.180N	120 47 34.560W
07/30/84	10:43:00	34 42 53.460N	120 47 37.920W	34 42 54.540N	120 47 34.020W
07/30/84	10:44:00	34 42 53.760N	120 47 37.620W	34 42 54.960N	120 47 33.960W
07/30/84	10:45:00	34 42 54.180N	120 47 37.560W	34 42 54.660N	120 47 33.600W
07/30/84	10:46:01	34 42 54.540N	120 47 37.260W	34 42 54.780N	120 47 33.480W
07/30/84	10:47:00	34 42 54.720N	120 47 37.020W	34 42 54.780N	120 47 33.540W
07/30/84	10:48:00	34 42 55.020N	120 47 36.720W	34 42 54.900N	120 47 33.420W
07/30/84	10:49:00	34 42 55.140N	120 47 36.420W	34 42 54.840N	120 47 33.420W
07/30/84	10:50:00	34 42 55.140N	120 47 36.000W	34 42 54.600N	120 47 33.360W
07/30/84	10:51:00	34 42 55.020N	120 47 35.400W	34 42 54.240N	120 47 33.540W
07/30/84	10:52:00	34 42 55.020N	120 47 34.980W	34 42 54.480N	120 47 33.240W
07/30/84	10:53:00	34 42 54.960N	120 47 34.440W	34 42 54.420N	120 47 33.300W
07/30/84	10:54:00	34 42 54.780N	120 47 33.840W	34 42 54.420N	120 47 33.360W
07/30/84	10:55:00	34 42 54.660N	120 47 33.420W	34 42 54.660N	120 47 33.540W
07/30/84	10:56:00	34 42 54.720N	120 47 33.180W	34 42 54.300N	120 47 33.180W
07/30/84	10:57:00	34 42 54.660N	120 47 33.000W	34 42 54.420N	120 47 33.180W
07/30/84	10:58:00	34 42 54.720N	120 47 33.120W	34 42 54.420N	120 47 33.060W
07/30/84	10:59:00	34 42 54.900N	120 47 33.180W	34 42 54.720N	120 47 32.700W
07/30/84	11:00:00	34 42 54.960N	120 47 32.880W	34 42 55.080N	120 47 32.520W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/30/84	11:01:00	34 42 54.780N	120 47 32.280W	34 42 55.260N	120 47 31.920W
07/30/84	11:02:01	34 42 54.660N	120 47 31.620W	34 42 55.440N	120 47 31.380W
07/30/84	11:03:00	34 42 54.660N	120 47 31.320W	34 42 55.680N	120 47 31.140W
07/30/84	11:04:00	34 42 54.720N	120 47 31.260W	34 42 55.740N	120 47 30.660W
07/30/84	11:05:01	34 42 54.780N	120 47 30.960W	34 42 55.800N	120 47 30.120W
07/30/84	11:06:00	34 42 54.780N	120 47 30.540W	34 42 55.980N	120 47 29.280W
07/30/84	11:07:00	34 42 54.720N	120 47 30.060W	34 42 56.100N	120 47 28.440W
07/30/84	11:08:00	34 42 54.660N	120 47 29.520W	34 42 56.460N	120 47 27.600W
07/30/84	11:09:00	34 42 54.540N	120 47 28.920W	34 42 56.820N	120 47 26.940W
07/30/84	11:10:00	34 42 54.420N	120 47 28.380W	34 42 57.360N	120 47 26.580W
07/30/84	11:11:00	34 42 54.660N	120 47 27.960W	34 42 57.600N	120 47 26.400W
07/30/84	11:12:01	34 42 55.320N	120 47 28.260W	34 42 58.020N	120 47 25.440W
07/30/84	11:13:00	34 42 56.040N	120 47 28.440W	34 42 58.440N	120 47 25.440W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/30/84	16:02:00	34 43 33.540N	120 49 01.740W	34 43 35.160N	120 49 05.880W
07/30/84	16:03:00	34 43 33.420N	120 49 02.220W	34 43 35.340N	120 49 05.580W
07/30/84	16:04:01	34 43 33.780N	120 49 02.760W	34 43 36.180N	120 49 06.360W
07/30/84	16:05:00	34 43 34.560N	120 49 03.180W	34 43 34.980N	120 49 06.420W
07/30/84	16:06:00	34 43 35.760N	120 49 03.480W	34 43 35.040N	120 49 05.880W
07/30/84	16:07:00	34 43 36.480N	120 49 03.420W	34 43 34.860N	120 49 05.100W
07/30/84	16:08:00	34 43 36.720N	120 49 03.180W	34 43 34.800N	120 49 04.800W
07/30/84	16:09:01	34 43 36.540N	120 49 02.760W	34 43 34.260N	120 49 04.140W
07/30/84	16:10:00	34 43 36.000N	120 49 02.580W	34 43 34.380N	120 49 03.960W
07/30/84	16:11:00	34 43 35.220N	120 49 03.000W	34 43 34.260N	120 49 03.780W
07/30/84	16:12:01	34 43 34.440N	120 49 03.540W	34 43 34.020N	120 49 03.180W
07/30/84	16:13:00	34 43 33.540N	120 49 03.420W	34 43 33.540N	120 49 02.520W
07/30/84	16:14:00	34 43 32.820N	120 49 02.460W	34 43 33.240N	120 49 02.100W
07/30/84	16:15:00	34 43 32.100N	120 49 01.500W	34 43 32.940N	120 49 01.680W
07/30/84	16:16:01	34 43 31.380N	120 49 00.480W	34 43 32.520N	120 49 01.320W
07/30/84	16:17:00	34 43 30.840N	120 48 59.400W	34 43 32.460N	120 49 00.840W
07/30/84	16:18:00	34 43 30.180N	120 48 58.140W	34 43 31.620N	120 48 59.820W
07/30/84	16:19:00	34 43 29.400N	120 48 56.880W	34 43 30.900N	120 48 59.040W
07/30/84	16:20:00	34 43 28.860N	120 48 55.800W	34 43 30.540N	120 48 58.740W
07/30/84	16:21:00	34 43 28.500N	120 48 54.540W	34 43 30.300N	120 48 57.000W
07/30/84	16:22:00	34 43 27.720N	120 48 54.300W	34 43 29.640N	120 48 58.020W
07/30/84	16:23:00	34 43 27.240N	120 48 54.480W	34 43 29.400N	120 48 57.540W
07/30/84	16:24:01	34 43 27.060N	120 48 54.720W	34 43 29.040N	120 48 57.540W
07/30/84	16:25:00	34 43 27.240N	120 48 55.380W	34 43 28.920N	120 48 57.480W
07/30/84	16:26:00	34 43 27.780N	120 48 56.040W	34 43 28.980N	120 48 57.120W
07/30/84	16:27:00	34 43 28.620N	120 48 56.820W	34 43 28.920N	120 48 56.340W
07/30/84	16:28:01	34 43 29.100N	120 48 56.820W	34 43 28.560N	120 48 55.320W
07/30/84	16:29:00	34 43 29.160N	120 48 56.340W	34 43 28.380N	120 48 54.600W
07/30/84	16:30:00	34 43 28.800N	120 48 55.440W	34 43 27.960N	120 48 54.540W
07/30/84	16:31:00	34 43 28.080N	120 48 54.420W	34 43 27.120N	120 48 53.700W
07/30/84	16:32:00	34 43 26.940N	120 48 53.340W	34 43 26.340N	120 48 53.580W
07/30/84	16:33:00	34 43 25.860N	120 48 52.080W	34 43 25.440N	120 48 52.920W
07/30/84	16:34:01	34 43 25.980N	120 48 51.060W	34 43 24.720N	120 48 52.260W
07/30/84	16:35:01	34 43 25.800N	120 48 50.040W	34 43 24.060N	120 48 51.720W
07/30/84	16:36:01	34 43 25.020N	120 48 48.780W	34 43 23.100N	120 48 50.820W
07/30/84	16:37:00	34 43 24.060N	120 48 47.460W	34 43 22.560N	120 48 50.220W
07/30/84	16:38:01	34 43 23.280N	120 48 46.560W	34 43 22.440N	120 48 49.980W
07/30/84	16:39:00	34 43 22.860N	120 48 46.800W	34 43 22.620N	120 48 49.980W
07/30/84	16:40:00	34 43 22.320N	120 48 48.000W	34 43 22.080N	120 48 50.460W
07/30/84	16:41:00	34 43 21.840N	120 48 49.080W	34 43 21.960N	120 48 51.000W
07/30/84	16:42:00	34 43 21.420N	120 48 49.320W	34 43 22.320N	120 48 50.940W
07/30/84	16:43:00	34 43 20.820N	120 48 49.260W	34 43 22.260N	120 48 50.940W
07/30/84	16:44:00	34 43 20.160N	120 48 49.080W	34 43 22.020N	120 48 50.940W
07/30/84	16:45:00	34 43 19.680N	120 48 49.140W	34 43 22.020N	120 48 50.700W
07/30/84	16:46:00	34 43 19.440N	120 48 49.740W	34 43 22.140N	120 48 51.000W
07/30/84	16:47:00	34 43 19.500N	120 48 50.640W	34 43 22.200N	120 48 51.480W
07/30/84	16:48:01	34 43 20.160N	120 48 51.180W	34 43 22.260N	120 48 51.900W
07/30/84	16:49:00	34 43 20.640N	120 48 50.760W	34 43 22.020N	120 48 52.500W
07/30/84	16:50:00	34 43 19.860N	120 48 49.920W	34 43 22.020N	120 48 52.260W
07/30/84	16:51:00	34 43 19.500N	120 48 48.600W	34 43 21.300N	120 48 52.140W
07/30/84	16:52:00	34 43 19.920N	120 48 47.400W	34 43 22.200N	120 48 51.120W
07/30/84	16:53:00	34 43 20.220N	120 48 46.860W	34 43 22.320N	120 48 50.880W
07/30/84	16:54:01	34 43 20.160N	120 48 46.980W	34 43 22.620N	120 48 50.640W
07/30/84	16:55:00	34 43 20.220N	120 48 47.760W	34 43 22.080N	120 48 51.300W
07/30/84	16:56:00	34 43 20.580N	120 48 48.660W	34 43 21.960N	120 48 51.540W
07/30/84	16:57:01	34 43 21.240N	120 48 49.260W	34 43 22.260N	120 48 51.540W
07/30/84	16:58:00	34 43 21.900N	120 48 49.200W	34 43 22.140N	120 48 51.780W
07/30/84	16:59:00	34 43 22.500N	120 48 49.380W	34 43 23.400N	120 48 51.660W
07/30/84	17:00:00	34 43 22.500N	120 48 49.920W	34 43 22.440N	120 48 51.300W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/30/84	17:01:01	34 43 21.960N	120 48 50.160W	34 43 21.900N	120 48 50.880W
07/30/84	17:02:00	34 43 20.760N	120 48 49.800W	34 43 21.060N	120 48 49.440W
07/30/84	17:03:01	34 43 19.680N	120 48 48.960W	34 43 20.460N	120 48 48.960W
07/30/84	17:04:00	34 43 18.420N	120 48 47.940W	34 43 19.320N	120 48 47.880W
07/30/84	17:05:00	34 43 17.100N	120 48 47.520W	34 43 18.540N	120 48 47.520W
07/30/84	17:06:00	34 43 16.080N	120 48 47.100W	34 43 17.880N	120 48 47.820W
07/30/84	17:07:00	34 43 14.700N	120 48 46.260W	34 43 17.220N	120 48 45.840W
07/30/84	17:08:00	34 43 13.560N	120 48 45.660W	34 43 16.860N	120 48 46.140W
07/30/84	17:09:00	34 43 12.540N	120 48 45.840W	34 43 15.960N	120 48 46.260W
07/30/84	17:10:00	34 43 12.240N	120 48 45.900W	34 43 15.240N	120 48 45.840W
07/30/84	17:11:00	34 43 12.420N	120 48 45.420W	34 43 15.060N	120 48 45.000W
07/30/84	17:12:00	34 43 12.900N	120 48 44.580W	34 43 14.940N	120 48 43.740W
07/30/84	17:13:00	34 43 13.320N	120 48 44.100W	34 43 14.040N	120 48 42.840W
07/30/84	17:14:00	34 43 13.440N	120 48 43.860W	34 43 13.260N	120 48 42.180W
07/30/84	17:15:01	34 43 12.960N	120 48 43.440W	34 43 13.140N	120 48 42.660W
07/30/84	17:16:00	34 43 11.880N	120 48 42.060W	34 43 12.300N	120 48 40.860W
07/30/84	17:17:01	34 43 10.860N	120 48 41.040W	34 43 11.820N	120 48 40.140W
07/30/84	17:18:00	34 43 09.780N	120 48 40.320W	34 43 10.620N	120 48 39.300W
07/30/84	17:19:00	34 43 08.640N	120 48 40.080W	34 43 09.660N	120 48 39.120W
07/30/84	17:20:01	34 43 07.620N	120 48 39.780W	34 43 08.040N	120 48 38.520W
07/30/84	17:21:00	34 43 06.480N	120 48 39.360W	34 43 06.960N	120 48 39.720W
07/30/84	17:22:00	34 43 05.100N	120 48 38.880W	34 43 05.940N	120 48 37.920W
07/30/84	17:23:00	34 43 03.780N	120 48 38.340W	34 43 04.740N	120 48 37.440W
07/30/84	17:24:00	34 43 02.520N	120 48 38.040W	34 43 03.660N	120 48 37.080W
07/30/84	17:25:00	34 43 00.960N	120 48 36.960W	34 43 02.100N	120 48 36.120W
07/30/84	17:26:00	34 43 00.060N	120 48 35.460W	34 43 01.980N	120 48 34.680W
07/30/84	17:27:00	34 42 58.920N	120 48 34.380W	34 43 00.840N	120 48 34.380W
07/30/84	17:28:00	34 42 57.780N	120 48 34.260W	34 42 59.460N	120 48 33.960W
07/30/84	17:29:00	34 42 56.640N	120 48 34.500W	34 43 00.900N	120 48 34.560W
07/30/84	17:30:00	34 42 56.340N	120 48 34.680W	34 43 00.840N	120 48 35.520W
07/30/84	17:31:00	34 42 56.460N	120 48 33.840W	34 43 00.600N	120 48 35.460W
07/30/84	17:32:00	34 42 57.000N	120 48 32.820W	34 43 00.960N	120 48 33.120W
07/30/84	17:33:00	34 42 58.140N	120 48 31.860W	34 43 01.080N	120 48 33.300W
07/30/84	17:34:00	34 42 59.340N	120 48 31.260W	34 43 01.560N	120 48 31.860W
07/30/84	17:35:00	34 43 00.480N	120 48 31.140W	34 43 01.080N	120 48 30.720W
07/30/84	17:36:00	34 43 00.300N	120 48 31.080W	34 42 59.940N	120 48 30.240W
07/30/84	17:37:00	34 42 59.580N	120 48 30.660W	34 42 59.280N	120 48 29.460W
07/30/84	17:38:00	34 42 58.500N	120 48 30.060W	34 42 58.800N	120 48 29.100W
07/30/84	17:39:01	34 42 57.360N	120 48 29.700W	34 42 58.260N	120 48 28.800W
07/30/84	17:40:00	34 42 56.340N	120 48 29.400W	34 42 57.600N	120 48 27.960W
07/30/84	17:41:00	34 42 55.080N	120 48 29.100W	34 42 56.640N	120 48 27.600W
07/30/84	17:42:01	34 42 54.000N	120 48 28.800W	34 42 56.160N	120 48 27.720W
07/30/84	17:43:00	34 42 53.100N	120 48 28.560W	34 42 55.200N	120 48 27.840W
07/30/84	17:44:01	34 42 52.560N	120 48 27.900W	34 42 55.320N	120 48 28.020W
07/30/84	17:45:00	34 42 52.680N	120 48 27.180W	34 42 54.180N	120 48 26.520W
07/30/84	17:46:00	34 42 52.860N	120 48 26.700W	34 42 53.880N	120 48 25.800W
07/30/84	17:47:00	34 42 52.800N	120 48 26.280W	34 42 53.580N	120 48 25.620W
07/30/84	17:48:00	34 42 52.200N	120 48 25.740W	34 42 52.560N	120 48 24.480W
07/30/84	17:49:00	34 42 51.600N	120 48 25.020W	34 42 51.780N	120 48 24.000W
07/30/84	17:50:00	34 42 50.760N	120 48 24.000W	34 42 50.820N	120 48 23.100W
07/30/84	17:51:00	34 42 49.680N	120 48 22.920W	34 42 49.620N	120 48 22.320W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/23/84	14:50:00	34 43 17.520N	120 49 25.260W	34 43 14.520N	120 49 24.120W
07/23/84	14:51:00	34 43 16.860N	120 49 25.200W	34 43 14.460N	120 49 24.060W
07/23/84	14:52:01	34 43 15.960N	120 49 25.320W	34 43 14.100N	120 49 24.780W
07/23/84	14:53:00	34 43 15.060N	120 49 25.560W	34 43 13.860N	120 49 25.260W
07/23/84	14:54:00	34 43 14.460N	120 49 25.860W	34 43 13.800N	120 49 25.260W
07/23/84	14:55:00	34 43 14.160N	120 49 25.620W	34 43 13.680N	120 49 25.560W
07/23/84	14:56:00	34 43 14.460N	120 49 25.080W	34 43 13.980N	120 49 24.660W
07/23/84	14:57:00	34 43 14.880N	120 49 24.780W	34 43 13.980N	120 49 23.460W
07/23/84	14:58:00	34 43 15.360N	120 49 24.540W	34 43 14.220N	120 49 22.500W
07/23/84	14:59:01	34 43 15.960N	120 49 24.780W	34 43 14.880N	120 49 21.780W
07/23/84	15:00:00	34 43 16.440N	120 49 25.140W	34 43 15.240N	120 49 21.420W
07/23/84	15:01:00	34 43 16.440N	120 49 25.260W	34 43 15.660N	120 49 20.040W
07/23/84	15:02:00	34 43 16.020N	120 49 24.480W	34 43 15.180N	120 49 19.620W
07/23/84	15:03:00	34 43 15.120N	120 49 22.740W	34 43 13.920N	120 49 18.540W
07/23/84	15:04:00	34 43 14.340N	120 49 20.940W	34 43 13.020N	120 49 17.700W
07/23/84	15:05:00	34 43 13.680N	120 49 19.500W	34 43 12.300N	120 49 16.800W
07/23/84	15:06:00	34 43 13.020N	120 49 18.120W	34 43 11.640N	120 49 16.140W
07/23/84	15:07:00	34 43 12.600N	120 49 16.860W	34 43 10.800N	120 49 15.240W
07/23/84	15:08:38	34 43 11.280N	120 49 15.000W	34 43 10.440N	120 49 14.940W
07/23/84	15:10:01	34 43 11.220N	120 49 13.860W	34 43 09.300N	120 49 13.260W
07/23/84	15:11:01	34 43 10.800N	120 49 12.960W	34 43 08.760N	120 49 12.600W
07/23/84	15:12:01	34 43 10.620N	120 49 12.420W	34 43 08.640N	120 49 12.180W
07/23/84	15:13:01	34 43 10.380N	120 49 11.760W	34 43 08.520N	120 49 11.340W
07/23/84	15:14:00	34 43 10.200N	120 49 11.160W	34 43 08.160N	120 49 10.380W
07/23/84	15:15:00	34 43 09.720N	120 49 10.440W	34 43 07.620N	120 49 09.840W
07/23/84	15:16:00	34 43 09.300N	120 49 09.660W	34 43 07.200N	120 49 09.420W
07/23/84	15:17:00	34 43 08.580N	120 49 08.460W	34 43 06.720N	120 49 09.060W
07/23/84	15:18:00	34 43 07.980N	120 49 07.260W	34 43 06.120N	120 49 08.580W
07/23/84	15:19:00	34 43 07.140N	120 49 05.820W	34 43 05.460N	120 49 07.980W
07/23/84	15:20:00	34 43 06.180N	120 49 04.080W	34 43 04.440N	120 49 07.680W
07/23/84	15:21:01	34 43 05.220N	120 49 02.460W	34 43 03.420N	120 49 06.600W
07/23/84	15:22:01	34 43 04.560N	120 49 01.320W	34 43 03.120N	120 49 06.240W
07/23/84	15:23:00	34 43 04.440N	120 49 00.900W	34 43 03.060N	120 49 05.940W
07/23/84	15:24:01	34 43 04.560N	120 49 01.020W	34 43 03.840N	120 49 05.700W
07/23/84	15:25:00	34 43 04.380N	120 49 01.980W	34 43 04.140N	120 49 05.820W
07/23/84	15:26:01	34 43 03.840N	120 49 03.300W	34 43 04.860N	120 49 06.360W
07/23/84	15:27:00	34 43 02.820N	120 49 04.800W	34 43 05.040N	120 49 06.840W
07/23/84	15:28:00	34 43 02.640N	120 49 05.280W	34 43 05.220N	120 49 06.720W
07/23/84	15:29:00	34 43 03.660N	120 49 05.220W	34 43 05.460N	120 49 06.240W
07/23/84	15:30:00	34 43 05.220N	120 49 05.280W	34 43 05.700N	120 49 05.700W
07/23/84	15:31:00	34 43 06.300N	120 49 05.400W	34 43 05.880N	120 49 05.400W
07/23/84	15:32:00	34 43 06.960N	120 49 05.520W	34 43 05.880N	120 49 05.160W
07/23/84	15:33:00	34 43 07.320N	120 49 05.760W	34 43 05.820N	120 49 04.680W
07/23/84	15:34:00	34 43 07.560N	120 49 05.880W	34 43 05.760N	120 49 04.200W
07/23/84	15:35:00	34 43 07.560N	120 49 05.880W	34 43 05.640N	120 49 03.480W
07/23/84	15:36:00	34 43 07.440N	120 49 05.760W	34 43 05.520N	120 49 03.000W
07/23/84	15:37:00	34 43 07.200N	120 49 05.580W	34 43 05.160N	120 49 03.120W
07/23/84	15:38:01	34 43 06.720N	120 49 04.740W	34 43 04.920N	120 49 02.640W
07/23/84	15:39:00	34 43 06.360N	120 49 03.660W	34 43 04.500N	120 49 02.400W
07/23/84	15:40:00	34 43 06.600N	120 49 02.340W	34 43 04.080N	120 49 01.620W
07/23/84	15:41:00	34 43 07.260N	120 49 01.620W	34 43 04.980N	120 49 00.600W
07/23/84	15:42:00	34 43 06.720N	120 49 01.560W	34 43 04.380N	120 49 00.780W
07/23/84	15:43:00	34 43 05.700N	120 49 01.800W	34 43 04.620N	120 49 01.380W
07/23/84	15:44:00	34 43 05.340N	120 49 01.680W	34 43 04.260N	120 49 01.560W
07/23/84	15:45:01	34 43 04.920N	120 49 01.680W	34 43 04.320N	120 49 01.680W
07/23/84	15:46:00	34 43 04.440N	120 49 01.680W	34 43 04.200N	120 49 01.620W
07/23/84	15:47:00	34 43 03.960N	120 49 01.740W	34 43 04.200N	120 49 01.980W
07/23/84	15:48:00	34 43 03.780N	120 49 01.440W	34 43 04.200N	120 49 01.680W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/23/84	15:49:00	34 43 03.540N	120 49 01.140W	34 43 03.900N	120 49 01.320W
07/23/84	15:50:00	34 43 03.360N	120 49 00.960W	34 43 03.360N	120 49 00.540W
07/23/84	15:51:00	34 43 03.120N	120 49 00.840W	34 43 03.120N	120 49 00.120W
07/23/84	15:52:00	34 43 02.880N	120 49 00.600W	34 43 03.300N	120 48 59.640W
07/23/84	15:53:00	34 43 03.060N	120 49 00.240W	34 43 02.940N	120 49 00.180W
07/23/84	15:54:00	34 43 03.300N	120 49 00.000W	34 43 02.820N	120 49 00.120W
07/23/84	15:55:00	34 43 03.300N	120 48 59.820W	34 43 02.820N	120 49 00.120W
07/23/84	15:56:01	34 43 03.060N	120 48 59.640W	34 43 02.760N	120 49 00.060W
07/23/84	15:57:01	34 43 03.000N	120 48 59.340W	34 43 02.640N	120 49 00.120W
07/23/84	15:58:00	34 43 03.240N	120 48 59.100W	34 43 02.640N	120 48 59.700W
07/23/84	15:59:00	34 43 02.940N	120 48 58.980W	34 43 02.640N	120 48 59.460W
07/23/84	16:00:02	34 43 02.460N	120 48 58.800W	34 43 02.400N	120 48 58.980W
07/23/84	16:01:00	34 43 01.920N	120 48 58.680W	34 43 01.800N	120 48 58.560W
07/23/84	16:02:00	34 43 01.620N	120 48 58.380W	34 43 01.560N	120 48 58.500W
07/23/84	16:03:01	34 43 01.740N	120 48 58.020W	34 43 01.380N	120 48 58.200W
07/23/84	16:04:01	34 43 01.500N	120 48 57.840W	34 43 01.200N	120 48 57.900W
07/23/84	16:05:00	34 43 01.500N	120 48 57.420W	34 43 01.080N	120 48 57.480W
07/23/84	16:06:00	34 43 01.560N	120 48 57.120W	34 43 00.840N	120 48 56.580W
07/23/84	16:07:00	34 43 01.260N	120 48 56.820W	34 43 00.420N	120 48 56.340W
07/23/84	16:08:01	34 43 01.020N	120 48 56.580W	34 43 00.120N	120 48 55.620W
07/23/84	16:09:00	34 43 00.540N	120 48 56.400W	34 42 59.820N	120 48 55.800W
07/23/84	16:10:00	34 43 00.000N	120 48 56.220W	34 42 59.760N	120 48 55.800W
07/23/84	16:11:00	34 42 59.640N	120 48 55.980W	34 42 59.580N	120 48 56.100W
07/23/84	16:12:00	34 42 59.760N	120 48 55.680W	34 42 59.520N	120 48 56.100W
07/23/84	16:13:00	34 42 59.760N	120 48 55.500W	34 42 59.340N	120 48 55.980W
07/23/84	16:14:00	34 42 59.760N	120 48 55.380W	34 42 59.460N	120 48 56.100W
07/23/84	16:15:00	34 42 59.700N	120 48 55.260W	34 42 59.280N	120 48 55.920W
07/23/84	16:16:00	34 42 59.520N	120 48 55.020W	34 42 59.160N	120 48 55.980W
07/23/84	16:17:00	34 42 59.760N	120 48 54.840W	34 42 59.100N	120 48 55.920W
07/23/84	16:18:01	34 42 59.880N	120 48 54.660W	34 42 58.920N	120 48 55.560W
07/23/84	16:19:00	34 43 00.240N	120 48 54.540W	34 42 59.100N	120 48 55.620W
07/23/84	16:20:00	34 43 00.180N	120 48 54.420W	34 42 58.920N	120 48 55.500W
07/23/84	16:21:00	34 43 00.120N	120 48 54.180W	34 42 58.920N	120 48 55.740W
07/23/84	16:22:00	34 42 59.700N	120 48 53.940W	34 42 58.680N	120 48 55.380W
07/23/84	16:23:00	34 42 59.340N	120 48 53.700W	34 42 58.380N	120 48 55.260W
07/23/84	16:24:00	34 42 59.040N	120 48 53.580W	34 42 58.140N	120 48 55.680W
07/23/84	16:25:01	34 42 58.800N	120 48 53.520W	34 42 58.320N	120 48 55.980W
07/23/84	16:26:00	34 42 58.080N	120 48 53.760W	34 42 58.320N	120 48 55.740W
07/23/84	16:27:01	34 42 57.360N	120 48 54.060W	34 42 57.840N	120 48 55.260W
07/23/84	16:28:01	34 42 56.940N	120 48 54.120W	34 42 57.540N	120 48 55.020W
07/23/84	16:29:00	34 42 56.700N	120 48 53.940W	34 42 57.420N	120 48 54.420W
07/23/84	16:30:00	34 42 56.580N	120 48 53.580W	34 42 57.120N	120 48 53.940W
07/23/84	16:31:00	34 42 56.400N	120 48 53.280W	34 42 56.880N	120 48 53.460W
07/23/84	16:32:00	34 42 56.100N	120 48 52.920W	34 42 56.640N	120 48 52.740W
07/23/84	16:33:00	34 42 55.860N	120 48 52.560W	34 42 56.340N	120 48 52.620W
07/23/84	16:34:00	34 42 55.680N	120 48 52.140W	34 42 56.040N	120 48 52.140W
07/23/84	16:35:00	34 42 55.680N	120 48 51.540W	34 42 55.680N	120 48 51.720W
07/23/84	16:36:00	34 42 55.980N	120 48 50.940W	34 42 55.320N	120 48 51.180W
07/23/84	16:37:00	34 42 55.620N	120 48 50.460W	34 42 55.020N	120 48 50.820W
07/23/84	16:38:00	34 42 55.140N	120 48 50.100W	34 42 54.660N	120 48 50.520W
07/23/84	16:39:00	34 42 54.720N	120 48 49.860W	34 42 54.360N	120 48 50.280W
07/23/84	16:40:01	34 42 54.060N	120 48 49.680W	34 42 54.120N	120 48 50.220W
07/23/84	16:41:00	34 42 53.400N	120 48 49.200W	34 42 53.940N	120 48 50.160W
07/23/84	16:42:00	34 42 52.860N	120 48 48.540W	34 42 53.700N	120 48 50.280W
07/23/84	16:43:01	34 42 52.620N	120 48 47.460W	34 42 53.340N	120 48 50.040W
07/23/84	16:44:00	34 42 52.740N	120 48 46.320W	34 42 53.700N	120 48 49.980W
07/23/84	16:45:00	34 42 52.980N	120 48 45.180W	34 42 51.600N	120 48 49.020W
07/23/84	16:46:00	34 42 52.440N	120 48 44.640W	34 42 53.100N	120 48 48.660W
07/23/84	16:47:00	34 42 52.440N	120 48 44.400W	34 42 53.160N	120 48 48.960W
07/23/84	16:48:00	34 42 52.380N	120 48 44.940W	34 42 53.520N	120 48 48.660W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/23/84	16:49:01	34 42 52.680N	120 48 46.500W	34 42 53.640N	120 48 49.380W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/23/84	08:04:00	34 46 30.060N	120 50 13.560W	34 46 32.460N	120 50 11.580W
07/23/84	08:05:00	34 46 29.940N	120 50 14.220W	34 46 31.800N	120 50 10.920W
07/23/84	08:06:01	34 46 29.700N	120 50 14.760W	34 46 32.400N	120 50 12.420W
07/23/84	08:07:00	34 46 29.580N	120 50 14.700W	34 46 32.820N	120 50 12.600W
07/23/84	08:08:00	34 46 29.700N	120 50 14.280W	34 46 32.040N	120 50 10.920W
07/23/84	08:09:00	34 46 30.240N	120 50 13.380W	34 46 31.920N	120 50 10.440W
07/23/84	08:10:00	34 46 30.900N	120 50 12.720W	34 46 31.800N	120 50 09.780W
07/23/84	08:11:00	34 46 31.440N	120 50 12.540W	34 46 31.500N	120 50 09.420W
07/23/84	08:12:00	34 46 31.380N	120 50 12.660W	34 46 31.500N	120 50 09.240W
07/23/84	08:13:00	34 46 31.200N	120 50 12.600W	34 46 31.740N	120 50 09.060W
07/23/84	08:14:00	34 46 30.900N	120 50 12.660W	34 46 31.560N	120 50 09.480W
07/23/84	08:15:00	34 46 30.540N	120 50 12.600W	34 46 31.200N	120 50 09.180W
07/23/84	08:16:00	34 46 30.180N	120 50 12.720W	34 46 30.720N	120 50 09.480W
07/23/84	08:17:00	34 46 29.880N	120 50 12.660W	34 46 30.060N	120 50 09.000W
07/23/84	08:18:01	34 46 29.640N	120 50 12.480W	34 46 29.520N	120 50 09.240W
07/23/84	08:19:00	34 46 29.400N	120 50 12.360W	34 46 28.740N	120 50 08.640W
07/23/84	08:20:00	34 46 29.340N	120 50 12.540W	34 46 28.020N	120 50 08.760W
07/23/84	08:21:00	34 46 29.100N	120 50 12.660W	34 46 27.420N	120 50 09.000W
07/23/84	08:22:01	34 46 28.860N	120 50 12.780W	34 46 26.940N	120 50 08.820W
07/23/84	08:23:00	34 46 28.440N	120 50 12.960W	34 46 26.520N	120 50 08.880W
07/23/84	08:24:01	34 46 27.960N	120 50 13.080W	34 46 25.500N	120 50 09.000W
07/23/84	08:25:00	34 46 27.600N	120 50 13.440W	34 46 26.160N	120 50 08.040W
07/23/84	08:26:00	34 46 27.060N	120 50 13.200W	34 46 26.220N	120 50 08.340W
07/23/84	08:27:20	34 46 26.280N	120 50 12.360W	34 46 24.300N	120 50 08.160W
07/23/84	08:28:00	34 46 25.920N	120 50 11.880W	34 46 24.180N	120 50 08.760W
07/23/84	08:29:01	34 46 25.200N	120 50 11.040W	34 46 23.220N	120 50 08.160W
07/23/84	08:30:01	34 46 24.600N	120 50 10.560W	34 46 22.860N	120 50 07.980W
07/23/84	08:31:00	34 46 24.540N	120 50 10.800W	34 46 22.740N	120 50 07.680W
07/23/84	08:32:00	34 46 24.360N	120 50 10.920W	34 46 22.500N	120 50 07.740W
07/23/84	08:33:00	34 46 23.640N	120 50 10.920W	34 46 21.900N	120 50 07.500W
07/23/84	08:34:01	34 46 22.980N	120 50 10.920W	34 46 21.420N	120 50 06.900W
07/23/84	08:35:00	34 46 22.080N	120 50 10.920W	34 46 21.720N	120 50 07.560W
07/23/84	08:36:00	34 46 21.300N	120 50 10.980W	34 46 20.520N	120 50 06.840W
07/23/84	08:37:01	34 46 20.700N	120 50 11.220W	34 46 19.980N	120 50 06.720W
07/23/84	08:38:00	34 46 20.220N	120 50 11.160W	34 46 19.740N	120 50 06.420W
07/23/84	08:39:00	34 46 19.020N	120 50 11.100W	34 46 19.020N	120 50 06.720W
07/23/84	08:40:00	34 46 17.820N	120 50 10.620W	34 46 18.120N	120 50 06.420W
07/23/84	08:41:00	34 46 16.620N	120 50 09.540W	34 46 17.700N	120 50 06.240W
07/23/84	08:42:00	34 46 15.900N	120 50 07.920W	34 46 16.500N	120 50 05.760W
07/23/84	08:43:00	34 46 16.140N	120 50 07.260W	34 46 16.140N	120 50 05.220W
07/23/84	08:44:00	34 46 15.960N	120 50 07.380W	34 46 16.080N	120 50 05.340W
07/23/84	08:45:01	34 46 15.420N	120 50 07.500W	34 46 16.080N	120 50 05.460W
07/23/84	08:46:00	34 46 15.060N	120 50 07.380W	34 46 15.900N	120 50 06.540W
07/23/84	08:47:00	34 46 14.760N	120 50 07.200W	34 46 15.720N	120 50 05.880W
07/23/84	08:48:00	34 46 15.300N	120 50 06.420W	34 46 15.660N	120 50 05.760W
07/23/84	08:49:00	34 46 15.780N	120 50 05.940W	34 46 15.360N	120 50 05.340W
07/23/84	08:50:00	34 46 16.260N	120 50 05.460W	34 46 15.300N	120 50 05.040W
07/23/84	08:51:00	34 46 16.140N	120 50 05.400W	34 46 15.180N	120 50 04.860W
07/23/84	08:52:00	34 46 15.420N	120 50 05.160W	34 46 15.180N	120 50 04.860W
07/23/84	08:53:00	34 46 14.820N	120 50 05.100W	34 46 15.120N	120 50 05.280W
07/23/84	08:54:00	34 46 14.460N	120 50 05.040W	34 46 15.000N	120 50 05.040W
07/23/84	08:55:01	34 46 14.400N	120 50 04.800W	34 46 15.240N	120 50 04.680W
07/23/84	08:56:00	34 46 14.460N	120 50 04.620W	34 46 15.180N	120 50 03.960W
07/23/84	08:57:01	34 46 15.120N	120 50 04.140W	34 46 15.240N	120 50 03.480W
07/23/84	08:58:01	34 46 15.780N	120 50 04.020W	34 46 15.180N	120 50 02.940W
07/23/84	08:59:01	34 46 16.320N	120 50 03.960W	34 46 15.240N	120 50 02.880W
07/23/84	09:00:00	34 46 16.380N	120 50 04.080W	34 46 15.360N	120 50 03.000W
07/23/84	09:01:00	34 46 16.140N	120 50 03.900W	34 46 15.540N	120 50 02.460W
07/23/84	09:02:00	34 46 15.780N	120 50 03.900W	34 46 15.840N	120 50 02.400W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/23/84	09:03:00	34 46 15.060N	120 50 04.320W	34 46 16.020N	120 50 02.700W
07/23/84	09:04:00	34 46 14.700N	120 50 04.440W	34 46 16.080N	120 50 02.580W
07/23/84	09:05:00	34 46 14.940N	120 50 04.020W	34 46 16.080N	120 50 02.100W
07/23/84	09:06:00	34 46 15.540N	120 50 03.240W	34 46 16.440N	120 50 00.720W
07/23/84	09:07:01	34 46 16.200N	120 50 02.640W	34 46 15.720N	120 49 59.880W
07/23/84	09:08:00	34 46 15.720N	120 50 03.000W	34 46 15.660N	120 49 59.640W
07/23/84	09:09:00	34 46 14.880N	120 50 03.540W	34 46 16.080N	120 49 59.160W
07/23/84	09:10:01	34 46 14.460N	120 50 03.480W	34 46 15.960N	120 49 59.880W
07/23/84	09:11:00	34 46 13.920N	120 50 02.940W	34 46 15.960N	120 49 59.700W
07/23/84	09:12:00	34 46 13.200N	120 50 01.680W	34 46 15.000N	120 49 58.320W
07/23/84	09:13:00	34 46 12.240N	120 50 00.060W	34 46 13.920N	120 49 57.660W
07/23/84	09:14:01	34 46 12.180N	120 49 58.560W	34 46 13.080N	120 49 56.580W
07/23/84	09:15:00	34 46 12.540N	120 49 56.940W	34 46 12.720N	120 49 55.740W
07/23/84	09:16:00	34 46 12.960N	120 49 56.340W	34 46 12.540N	120 49 55.200W
07/23/84	09:17:00	34 46 13.320N	120 49 56.160W	34 46 12.300N	120 49 55.080W
07/23/84	09:18:01	34 46 13.380N	120 49 56.160W	34 46 12.540N	120 49 55.320W
07/23/84	09:19:00	34 46 13.080N	120 49 56.520W	34 46 12.600N	120 49 55.320W
07/23/84	09:20:00	34 46 12.480N	120 49 57.120W	34 46 12.660N	120 49 55.620W
07/23/84	09:21:00	34 46 11.820N	120 49 57.660W	34 46 12.780N	120 49 56.520W
07/23/84	09:22:00	34 46 11.340N	120 49 57.720W	34 46 12.900N	120 49 57.000W
07/23/84	09:23:00	34 46 11.640N	120 49 57.120W	34 46 12.540N	120 49 56.220W
07/23/84	09:24:00	34 46 12.180N	120 49 56.580W	34 46 12.180N	120 49 55.680W
07/23/84	09:25:00	34 46 12.720N	120 49 56.400W	34 46 12.300N	120 49 55.560W
07/23/84	09:26:00	34 46 12.720N	120 49 56.460W	34 46 12.180N	120 49 54.840W
07/23/84	09:27:00	34 46 12.300N	120 49 56.520W	34 46 12.180N	120 49 54.180W
07/23/84	09:28:01	34 46 11.220N	120 49 57.060W	34 46 12.300N	120 49 54.060W
07/23/84	09:29:00	34 46 10.140N	120 49 57.660W	34 46 12.180N	120 49 55.020W
07/23/84	09:30:00	34 46 09.660N	120 49 57.540W	34 46 11.940N	120 49 54.960W
07/23/84	09:31:00	34 46 09.720N	120 49 57.060W	34 46 11.640N	120 49 53.640W
07/23/84	09:32:01	34 46 09.960N	120 49 56.160W	34 46 11.640N	120 49 53.100W
07/23/84	09:33:00	34 46 10.080N	120 49 54.960W	34 46 11.040N	120 49 52.020W
07/23/84	09:34:00	34 46 09.900N	120 49 53.400W	34 46 10.500N	120 49 50.520W
07/23/84	09:35:00	34 46 09.780N	120 49 52.800W	34 46 10.260N	120 49 49.500W
07/23/84	09:36:00	34 46 10.020N	120 49 53.160W	34 46 09.780N	120 49 49.200W
07/23/84	09:37:00	34 46 10.020N	120 49 54.180W	34 46 10.080N	120 49 48.960W
07/23/84	09:38:00	34 46 09.600N	120 49 53.940W	34 46 12.060N	120 49 50.460W
07/23/84	09:39:00	34 46 08.520N	120 49 53.460W	34 46 09.180N	120 49 49.140W
07/23/84	09:40:00	34 46 06.720N	120 49 52.980W	34 46 08.880N	120 49 49.800W
07/23/84	09:41:01	34 46 05.100N	120 49 52.500W	34 46 07.620N	120 49 49.740W
07/23/84	09:42:00	34 46 04.800N	120 49 52.380W	34 46 07.620N	120 49 50.760W
07/23/84	09:43:00	34 46 04.800N	120 49 52.260W	34 46 07.380N	120 49 50.640W
07/23/84	09:44:00	34 46 05.340N	120 49 51.660W	34 46 07.260N	120 49 49.740W
07/23/84	09:45:00	34 46 06.420N	120 49 50.400W	34 46 07.260N	120 49 48.900W
07/23/84	09:46:00	34 46 07.380N	120 49 49.500W	34 46 06.960N	120 49 48.000W
07/23/84	09:47:00	34 46 07.740N	120 49 49.560W	34 46 07.140N	120 49 48.060W
07/23/84	09:48:00	34 46 07.920N	120 49 49.560W	34 46 07.260N	120 49 47.880W
07/23/84	09:49:00	34 46 07.680N	120 49 49.920W	34 46 06.000N	120 49 50.400W
07/23/84	09:50:01	34 46 07.920N	120 49 49.140W	34 46 06.480N	120 49 46.980W
07/23/84	09:51:00	34 46 07.920N	120 49 49.560W	34 46 05.220N	120 49 47.400W
07/23/84	09:52:00	34 46 07.320N	120 49 51.120W	34 46 04.740N	120 49 47.880W
07/23/84	09:53:00	34 46 07.140N	120 49 51.120W	34 46 05.100N	120 49 46.620W
07/23/84	09:54:00	34 46 07.800N	120 49 49.740W	34 46 04.620N	120 49 45.600W
07/23/84	09:55:00	34 46 07.500N	120 49 47.940W	34 46 03.780N	120 49 45.180W
07/23/84	09:56:00	34 46 06.420N	120 49 46.380W	34 46 01.920N	120 49 44.640W
07/23/84	09:57:00	34 46 04.680N	120 49 45.540W	34 46 00.540N	120 49 46.140W
07/23/84	09:58:00	34 46 02.460N	120 49 44.760W	34 45 58.980N	120 49 47.220W
07/23/84	09:59:00	34 46 00.480N	120 49 45.660W	34 45 59.460N	120 49 48.840W
07/23/84	10:00:00	34 45 59.340N	120 49 47.280W	34 45 59.460N	120 49 49.080W
07/23/84	10:01:00	34 45 58.440N	120 49 49.380W	34 45 59.100N	120 49 48.240W
07/23/84	10:02:00	34 45 58.020N	120 49 50.220W	34 45 58.080N	120 49 47.520W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/23/84	10:03:01	34 45 57.900N	120 49 50.760W	34 45 58.800N	120 49 47.880W
07/23/84	10:04:00	34 45 57.720N	120 49 52.080W	34 45 58.200N	120 49 47.040W
07/23/84	10:05:00	34 45 57.000N	120 49 51.780W	34 45 57.120N	120 49 46.260W
07/23/84	10:06:00	34 45 56.520N	120 49 51.180W	34 45 56.640N	120 49 46.200W
07/23/84	10:07:00	34 45 56.340N	120 49 50.580W	34 45 57.060N	120 49 45.360W
07/23/84	10:08:00	34 45 56.040N	120 49 50.340W	34 45 58.320N	120 49 46.440W
07/23/84	10:09:00	34 45 55.500N	120 49 49.980W	34 45 57.840N	120 49 46.560W
07/23/84	10:10:00	34 45 54.780N	120 49 49.080W	34 45 57.540N	120 49 46.800W
07/23/84	10:11:00	34 45 53.820N	120 49 47.400W	34 45 56.580N	120 49 45.600W
07/23/84	10:12:01	34 45 53.400N	120 49 44.880W	34 45 55.740N	120 49 44.220W
07/23/84	10:13:00	34 45 53.940N	120 49 42.660W	34 45 54.780N	120 49 43.740W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/18/84	11:22:41	34 49 28.200N	120 50 49.440W	34 49 22.860N	120 50 46.500W
07/18/84	11:24:01	34 49 27.600N	120 50 48.900W	34 49 21.840N	120 50 48.180W
07/18/84	11:25:00	34 49 27.240N	120 50 48.600W	34 49 21.660N	120 50 48.720W
07/18/84	11:26:00	34 49 26.700N	120 50 48.600W	34 49 21.000N	120 50 49.200W
07/18/84	11:27:00	34 49 27.060N	120 50 48.000W	34 49 21.480N	120 50 51.420W
07/18/84	11:28:00	34 49 27.660N	120 50 47.340W	34 49 21.060N	120 50 46.620W
07/18/84	11:29:01	34 49 28.500N	120 50 46.560W	34 49 21.060N	120 50 44.700W
07/18/84	11:30:00	34 49 28.620N	120 50 45.780W	34 49 20.400N	120 50 44.700W
07/18/84	11:31:00	34 49 28.440N	120 50 45.600W	34 49 22.320N	120 50 48.060W
07/18/84	11:32:00	34 49 27.960N	120 50 45.900W	34 49 22.800N	120 50 49.200W
07/18/84	11:33:01	34 49 27.120N	120 50 46.440W	34 49 22.740N	120 50 49.740W
07/18/84	11:34:00	34 49 26.460N	120 50 47.160W	34 49 23.280N	120 50 50.220W
07/18/84	11:35:01	34 49 26.220N	120 50 47.700W	34 49 23.160N	120 50 50.820W
07/18/84	11:36:00	34 49 26.580N	120 50 47.820W	34 49 23.940N	120 50 51.300W
07/18/84	11:37:00	34 49 26.880N	120 50 47.940W	34 49 23.760N	120 50 51.600W
07/18/84	11:38:00	34 49 27.180N	120 50 48.240W	34 49 24.300N	120 50 51.960W
07/18/84	11:39:00	34 49 27.360N	120 50 48.660W	34 49 24.180N	120 50 51.720W
07/18/84	11:40:00	34 49 27.660N	120 50 48.900W	34 49 24.840N	120 50 52.080W
07/18/84	11:41:00	34 49 28.020N	120 50 48.840W	34 49 24.960N	120 50 51.540W
07/18/84	11:42:01	34 49 28.200N	120 50 48.720W	34 49 25.080N	120 50 51.720W
07/18/84	11:43:00	34 49 28.380N	120 50 48.600W	34 49 25.260N	120 50 51.600W
07/18/84	11:44:00	34 49 28.680N	120 50 48.540W	34 49 25.560N	120 50 51.720W
07/18/84	11:45:00	34 49 29.100N	120 50 48.480W	34 49 26.280N	120 50 52.080W
07/18/84	11:46:00	34 49 29.340N	120 50 48.840W	34 49 26.520N	120 50 52.200W
07/18/84	11:47:00	34 49 29.700N	120 50 49.200W	34 49 27.180N	120 50 52.800W
07/18/84	11:48:01	34 49 29.940N	120 50 49.440W	34 49 27.780N	120 50 52.560W
07/18/84	11:49:00	34 49 30.180N	120 50 49.680W	34 49 28.620N	120 50 52.080W
07/18/84	11:50:00	34 49 30.540N	120 50 49.740W	34 49 28.680N	120 50 52.920W
07/18/84	11:51:00	34 49 30.720N	120 50 49.680W	34 49 28.980N	120 50 53.460W
07/18/84	11:52:00	34 49 31.020N	120 50 49.680W	34 49 29.400N	120 50 53.280W
07/18/84	11:53:00	34 49 31.260N	120 50 49.740W	34 49 29.640N	120 50 53.640W
07/18/84	11:54:00	34 49 31.680N	120 50 49.740W	34 49 30.360N	120 50 52.980W
07/18/84	11:55:00	34 49 31.920N	120 50 49.980W	34 49 30.240N	120 50 53.400W
07/18/84	11:56:00	34 49 32.460N	120 50 50.340W	34 49 31.080N	120 50 53.880W
07/18/84	11:57:00	34 49 33.120N	120 50 50.520W	34 49 31.920N	120 50 53.880W
07/18/84	11:58:00	34 49 33.600N	120 50 50.820W	34 49 32.820N	120 50 54.360W
07/18/84	11:59:00	34 49 33.960N	120 50 51.360W	34 49 33.060N	120 50 54.240W
07/18/84	12:00:00	34 49 34.380N	120 50 51.480W	34 49 33.480N	120 50 54.600W
07/18/84	12:01:00	34 49 34.920N	120 50 51.300W	34 49 33.300N	120 50 54.000W
07/18/84	12:02:00	34 49 35.460N	120 50 51.000W	34 49 33.240N	120 50 53.040W
07/18/84	12:03:00	34 49 36.000N	120 50 50.460W	34 49 33.720N	120 50 53.160W
07/18/84	12:04:01	34 49 36.360N	120 50 50.100W	34 49 34.140N	120 50 52.440W
07/18/84	12:05:00	34 49 36.720N	120 50 50.040W	34 49 34.800N	120 50 52.080W
07/18/84	12:06:00	34 49 37.020N	120 50 49.680W	34 49 34.980N	120 50 51.600W
07/18/84	12:07:00	34 49 37.560N	120 50 49.320W	34 49 35.220N	120 50 51.600W
07/18/84	12:08:00	34 49 37.920N	120 50 49.020W	34 49 35.460N	120 50 50.640W
07/18/84	12:09:01	34 49 38.400N	120 50 49.020W	34 49 35.580N	120 50 50.520W
07/18/84	12:10:00	34 49 38.820N	120 50 49.080W	34 49 34.860N	120 50 50.580W
07/18/84	12:11:00	34 49 39.360N	120 50 49.020W	34 49 35.340N	120 50 51.060W
07/18/84	12:12:00	34 49 39.660N	120 50 49.140W	34 49 35.040N	120 50 51.420W
07/18/84	12:13:00	34 49 39.480N	120 50 49.500W	34 49 34.980N	120 50 51.660W
07/18/84	12:14:00	34 49 39.000N	120 50 50.100W	34 49 34.320N	120 50 51.060W
07/18/84	12:15:00	34 49 38.640N	120 50 50.460W	34 49 34.080N	120 50 51.600W
07/18/84	12:16:00	34 49 38.220N	120 50 50.700W	34 49 33.480N	120 50 50.760W
07/18/84	12:17:00	34 49 37.800N	120 50 50.820W	34 49 33.780N	120 50 51.600W
07/18/84	12:18:00	34 49 37.560N	120 50 50.940W	34 49 33.360N	120 50 51.180W
07/18/84	12:19:00	34 49 37.800N	120 50 50.520W	34 49 33.180N	120 50 50.220W
07/18/84	12:20:00	34 49 37.860N	120 50 50.280W	34 49 33.180N	120 50 49.920W
07/18/84	12:21:01	34 49 37.800N	120 50 50.160W	34 49 33.240N	120 50 49.740W

Date	Time	Ship Position Latitude			Ship Position Longitude			Submersible Position Latitude			Submersible Position Longitude		
07/18/84	12:22:00	34	49	37.560N	120	50	50.100W	34	49	33.060N	120	50	50.400W
07/18/84	12:23:01	34	49	37.320N	120	50	50.040W	34	49	33.060N	120	50	50.580W
07/18/84	12:24:00	34	49	37.320N	120	50	49.860W	34	49	33.180N	120	50	50.460W
07/18/84	12:25:00	34	49	37.440N	120	50	49.560W	34	49	33.060N	120	50	49.980W
07/18/84	12:26:00	34	49	37.620N	120	50	49.380W	34	49	33.120N	120	50	50.400W
07/18/84	12:27:00	34	49	37.620N	120	50	49.320W	34	49	33.480N	120	50	50.580W
07/18/84	12:28:00	34	49	37.620N	120	50	49.380W	34	49	32.880N	120	50	50.160W
07/18/84	12:29:00	34	49	37.620N	120	50	49.380W	34	49	32.760N	120	50	50.100W
07/18/84	12:30:00	34	49	37.200N	120	50	49.680W	34	49	32.940N	120	50	50.040W
07/18/84	12:31:00	34	49	36.720N	120	50	49.680W	34	49	32.820N	120	50	49.260W
07/18/84	12:32:00	34	49	36.780N	120	50	49.320W	34	49	32.700N	120	50	48.420W
07/18/84	12:33:00	34	49	37.200N	120	50	48.540W	34	49	32.940N	120	50	47.640W
07/18/84	12:34:00	34	49	37.140N	120	50	48.180W	34	49	32.700N	120	50	47.640W
07/18/84	12:35:00	34	49	36.960N	120	50	47.940W	34	49	32.640N	120	50	47.100W
07/18/84	12:36:00	34	49	36.720N	120	50	47.880W	34	49	32.280N	120	50	46.620W
07/18/84	12:37:00	34	49	36.660N	120	50	47.820W	34	49	32.940N	120	50	46.620W
07/18/84	12:38:00	34	49	37.020N	120	50	47.220W	34	49	33.360N	120	50	45.780W
07/18/84	12:39:00	34	49	37.380N	120	50	46.740W	34	49	33.780N	120	50	44.580W
07/18/84	12:40:00	34	49	37.620N	120	50	46.440W	34	49	34.200N	120	50	44.820W
07/18/84	12:41:00	34	49	37.860N	120	50	45.900W	34	49	34.380N	120	50	43.680W
07/18/84	12:42:00	34	49	38.340N	120	50	45.540W	34	49	34.860N	120	50	43.980W
07/18/84	12:43:00	34	49	38.340N	120	50	45.360W	34	49	35.160N	120	50	43.320W
07/18/84	12:44:00	34	49	38.460N	120	50	45.180W	34	49	35.580N	120	50	43.380W
07/18/84	12:45:00	34	49	38.820N	120	50	44.700W	34	49	35.700N	120	50	43.140W
07/18/84	12:46:00	34	49	39.240N	120	50	44.400W	34	49	36.060N	120	50	42.120W
07/18/84	12:47:00	34	49	39.660N	120	50	43.980W	34	49	35.760N	120	50	42.900W
07/18/84	12:48:00	34	49	40.140N	120	50	43.740W	34	49	35.220N	120	50	42.540W
07/18/84	12:49:00	34	49	40.500N	120	50	43.800W	34	49	36.240N	120	50	44.220W
07/18/84	12:50:00	34	49	40.440N	120	50	43.620W	34	49	36.120N	120	50	42.360W
07/18/84	12:51:01	34	49	40.500N	120	50	43.200W	34	49	36.300N	120	50	41.940W
07/18/84	12:52:00	34	49	40.500N	120	50	42.780W	34	49	36.300N	120	50	41.760W
07/18/84	12:53:00	34	49	40.560N	120	50	42.240W	34	49	36.360N	120	50	41.820W
07/18/84	12:54:00	34	49	40.440N	120	50	41.760W	34	49	36.180N	120	50	41.640W

Date	Time	Ship Position Latitude			Ship Position Longitude			Submersible Position Latitude			Submersible Position Longitude		
07/14/84	10:41:00	34	47	50.220N	120	51	21.900W	34	47	52.023N	120	51	25.037W
07/14/84	10:42:00	34	47	50.640N	120	51	21.060W	34	47	52.676N	120	51	25.215W
07/14/84	10:43:00	34	47	51.360N	120	51	20.520W	34	47	54.609N	120	51	24.260W
07/14/84	10:44:00	34	47	52.200N	120	51	20.280W	34	47	56.883N	120	51	22.014W
07/14/84	10:45:01	34	47	52.800N	120	51	20.040W	34	47	58.193N	120	51	20.065W
07/14/84	10:46:01	34	47	53.580N	120	51	20.340W	34	47	59.065N	120	51	18.834W
07/14/84	10:47:01	34	47	54.000N	120	51	20.880W	34	47	57.510N	120	51	16.132W
07/14/84	10:48:00	34	47	54.360N	120	51	21.120W	34	47	58.297N	120	51	16.168W
07/14/84	10:49:01	34	47	54.780N	120	51	20.940W	34	47	58.440N	120	51	14.751W
07/14/84	10:50:00	34	47	54.780N	120	51	20.700W	34	47	56.630N	120	51	13.015W
07/14/84	10:51:00	34	47	54.600N	120	51	20.700W	34	47	53.747N	120	51	12.803W
07/14/84	10:52:01	34	47	54.300N	120	51	21.000W	34	47	52.605N	120	51	14.157W
07/14/84	10:53:00	34	47	53.700N	120	51	21.480W	34	47	52.754N	120	51	14.227W
07/14/84	10:54:00	34	47	53.100N	120	51	21.960W	34	47	51.443N	120	51	14.686W
07/14/84	10:55:00	34	47	52.380N	120	51	22.560W	34	47	50.599N	120	51	16.418W
07/14/84	10:56:00	34	47	51.480N	120	51	23.160W	34	47	49.700N	120	51	17.317W
07/14/84	10:57:00	34	47	50.400N	120	51	23.460W	34	47	46.691N	120	51	19.189W
07/14/84	10:58:00	34	47	49.380N	120	51	23.520W	34	47	45.477N	120	51	21.002W
07/14/84	10:59:00	34	47	48.960N	120	51	23.220W	34	47	45.256N	120	51	21.135W
07/14/84	11:00:01	34	47	48.900N	120	51	22.680W	34	47	45.630N	120	51	20.112W
07/14/84	11:01:00	34	47	48.900N	120	51	22.500W	34	47	47.319N	120	51	17.189W
07/14/84	11:02:00	34	47	48.600N	120	51	22.560W	34	47	46.632N	120	51	17.232W
07/14/84	11:03:00	34	47	48.060N	120	51	22.620W	34	47	46.576N	120	51	17.172W
07/14/84	11:04:00	34	47	47.520N	120	51	22.980W	34	47	46.381N	120	51	17.450W
07/14/84	11:05:00	34	47	47.220N	120	51	22.680W	34	47	44.788N	120	51	17.937W
07/14/84	11:06:00	34	47	47.040N	120	51	22.320W	34	47	44.361N	120	51	18.414W
07/14/84	11:07:00	34	47	46.980N	120	51	21.900W	34	47	44.858N	120	51	17.651W
07/14/84	11:08:00	34	47	46.800N	120	51	21.420W	34	47	44.628N	120	51	17.584W
07/14/84	11:09:00	34	47	46.620N	120	51	21.000W	34	47	44.314N	120	51	17.638W
07/14/84	11:10:00	34	47	46.560N	120	51	20.460W	34	47	44.178N	120	51	16.327W
07/14/84	11:11:00	34	47	46.380N	120	51	20.040W	34	47	44.098N	120	51	16.151W
07/14/84	11:12:00	34	47	46.140N	120	51	19.560W	34	47	43.157N	120	51	16.613W
07/14/84	11:13:01	34	47	45.660N	120	51	19.080W	34	47	42.358N	120	51	16.772W
07/14/84	11:14:00	34	47	45.240N	120	51	18.720W	34	47	41.988N	120	51	16.460W
07/14/84	11:15:00	34	47	45.000N	120	51	18.240W	34	47	41.301N	120	51	16.894W
07/14/84	11:16:01	34	47	44.640N	120	51	17.700W	34	47	41.288N	120	51	16.570W
07/14/84	11:17:01	34	47	44.160N	120	51	17.340W	34	47	40.511N	120	51	16.162W
07/14/84	11:18:00	34	47	43.860N	120	51	16.980W	34	47	40.280N	120	51	15.405W
07/14/84	11:19:00	34	47	43.320N	120	51	16.800W	34	47	40.196N	120	51	15.442W
07/14/84	11:20:00	34	47	43.260N	120	51	16.440W	34	47	40.408N	120	51	14.036W
07/14/84	11:21:01	34	47	43.200N	120	51	16.080W	34	47	39.968N	120	51	13.864W
07/14/84	11:22:00	34	47	42.960N	120	51	15.840W	34	47	40.137N	120	51	13.442W
07/14/84	11:23:00	34	47	42.480N	120	51	15.780W	34	47	40.318N	120	51	12.241W
07/14/84	11:24:00	34	47	42.000N	120	51	15.840W	34	47	39.709N	120	51	11.683W
07/14/84	11:25:00	34	47	41.760N	120	51	15.660W	34	47	40.113N	120	51	11.593W
07/14/84	11:26:00	34	47	41.340N	120	51	15.300W	34	47	38.654N	120	51	11.588W
07/14/84	11:27:00	34	47	40.860N	120	51	15.120W	34	47	37.770N	120	51	10.930W
07/14/84	11:28:00	34	47	40.080N	120	51	15.060W	34	47	37.216N	120	51	11.558W
07/14/84	11:29:00	34	47	39.480N	120	51	14.940W	34	47	37.147N	120	51	10.726W
07/14/84	11:30:01	34	47	39.000N	120	51	14.880W	34	47	36.990N	120	51	10.399W
07/14/84	11:31:00	34	47	38.520N	120	51	14.220W	34	47	34.813N	120	51	11.382W
07/14/84	11:32:00	34	47	38.040N	120	51	13.680W	34	47	34.412N	120	51	10.544W
07/14/84	11:33:01	34	47	37.680N	120	51	13.200W	34	47	33.729N	120	51	09.885W
07/14/84	11:34:20	34	47	37.020N	120	51	12.780W	34	47	35.970N	120	51	11.329W
07/14/84	11:35:00	34	47	36.600N	120	51	12.600W	34	47	31.641N	120	51	11.242W
07/14/84	11:36:00	34	47	35.640N	120	51	12.240W	34	47	31.386N	120	51	10.942W
07/14/84	11:37:00	34	47	34.620N	120	51	12.180W	34	47	30.644N	120	51	10.786W
07/14/84	11:38:00	34	47	33.600N	120	51	11.760W	34	47	29.733N	120	51	11.183W
07/14/84	11:39:00	34	47	32.700N	120	51	11.580W	34	47	29.212N	120	51	09.702W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/14/84	11:40:00	34 47 31.980N	120 51 11.220W	34 47 28.285N	120 51 09.863W
07/14/84	11:41:00	34 47 31.320N	120 51 10.920W	34 47 27.870N	120 51 09.480W
07/14/84	11:42:00	34 47 30.960N	120 51 10.560W	34 47 27.275N	120 51 08.516W
07/14/84	11:43:00	34 47 30.300N	120 51 10.260W	34 47 26.738N	120 51 08.579W
07/14/84	11:44:01	34 47 29.880N	120 51 09.900W	34 47 26.634N	120 51 07.710W
07/14/84	11:45:00	34 47 29.280N	120 51 09.780W	34 47 27.524N	120 51 05.678W
07/14/84	11:46:01	34 47 28.320N	120 51 09.900W	34 47 26.705N	120 51 06.808W
07/14/84	11:47:01	34 47 27.540N	120 51 09.660W	34 47 26.401N	120 51 06.599W
07/14/84	11:48:00	34 47 27.000N	120 51 09.300W	34 47 25.978N	120 51 07.327W
07/14/84	11:49:00	34 47 26.640N	120 51 08.820W	34 47 25.506N	120 51 06.938W
07/14/84	11:50:00	34 47 26.520N	120 51 08.280W	34 47 25.538N	120 51 05.928W
07/14/84	11:51:01	34 47 26.520N	120 51 07.440W	34 47 25.293N	120 51 05.095W
07/14/84	11:52:01	34 47 26.460N	120 51 06.600W	34 47 23.450N	120 51 05.433W
07/14/84	11:53:00	34 47 26.340N	120 51 06.060W	34 47 23.587N	120 51 04.588W
07/14/84	11:54:00	34 47 25.800N	120 51 05.580W	34 47 22.934N	120 51 04.260W
07/14/84	11:55:00	34 47 25.320N	120 51 05.220W	34 47 22.284N	120 51 02.914W
07/14/84	11:56:00	34 47 24.960N	120 51 04.860W	34 47 22.239N	120 51 01.916W
07/14/84	11:57:01	34 47 24.900N	120 51 04.440W	34 47 22.080N	120 51 00.145W
07/14/84	11:58:00	34 47 24.960N	120 51 03.300W	34 47 21.209N	120 51 00.823W
07/14/84	11:59:00	34 47 25.440N	120 51 02.220W	34 47 21.615N	120 50 59.718W
07/14/84	12:00:01	34 47 25.500N	120 51 01.200W	34 47 20.581N	120 50 59.502W
07/14/84	12:01:00	34 47 24.960N	120 51 00.060W	34 47 20.172N	120 50 58.915W
07/14/84	12:02:00	34 47 24.060N	120 50 58.800W	34 47 21.060N	120 50 54.980W
07/14/84	12:03:00	34 47 22.860N	120 50 57.720W	34 47 20.424N	120 50 53.909W
07/14/84	12:04:00	34 47 22.140N	120 50 56.880W	34 47 19.770N	120 50 54.403W
07/14/84	12:05:00	34 47 21.660N	120 50 56.160W	34 47 18.993N	120 50 53.935W
07/14/84	12:06:00	34 47 21.420N	120 50 55.200W	34 47 18.361N	120 50 53.684W
07/14/84	12:07:00	34 47 21.240N	120 50 54.000W	34 47 17.578N	120 50 52.858W
07/14/84	12:08:00	34 47 20.820N	120 50 52.920W	34 47 17.290N	120 50 51.758W
07/14/84	12:09:01	34 47 20.220N	120 50 51.660W	34 47 16.251N	120 50 49.688W
07/14/84	12:10:00	34 47 19.560N	120 50 50.520W	34 47 15.203N	120 50 50.183W
07/14/84	12:11:00	34 47 18.780N	120 50 49.440W	34 47 14.195N	120 50 49.203W
07/14/84	12:12:00	34 47 17.760N	120 50 48.360W	34 47 13.363N	120 50 48.678W
07/14/84	12:13:00	34 47 16.620N	120 50 47.580W	34 47 12.239N	120 50 49.306W
07/14/84	12:14:00	34 47 15.480N	120 50 46.860W	34 47 11.158N	120 50 48.074W
07/14/84	12:15:00	34 47 14.280N	120 50 46.680W	34 47 11.082N	120 50 50.931W
07/14/84	12:16:00	34 47 13.200N	120 50 46.620W	34 47 10.477N	120 50 50.239W
07/14/84	12:17:00	34 47 12.060N	120 50 46.740W	34 47 09.494N	120 50 50.072W
07/14/84	12:18:00	34 47 10.980N	120 50 46.980W	34 47 08.765N	120 50 50.464W
07/14/84	12:19:00	34 47 09.840N	120 50 47.400W	34 47 07.771N	120 50 50.385W
07/14/84	12:20:00	34 47 08.760N	120 50 48.000W	34 47 07.730N	120 50 51.150W
07/14/84	12:21:00	34 47 08.040N	120 50 48.720W	34 47 06.797N	120 50 51.020W
07/14/84	12:22:00	34 47 07.440N	120 50 49.380W	34 47 06.429N	120 50 51.585W
07/14/84	12:23:00	34 47 06.660N	120 50 50.160W	34 47 06.384N	120 50 51.793W
07/14/84	12:24:00	34 47 06.060N	120 50 51.120W	34 47 05.664N	120 50 51.879W
07/14/84	12:25:01	34 47 05.760N	120 50 51.240W	34 47 05.985N	120 50 51.626W
07/14/84	12:26:00	34 47 06.000N	120 50 50.220W	34 47 06.631N	120 50 50.861W
07/14/84	12:27:00	34 47 07.020N	120 50 49.560W	34 47 08.509N	120 50 50.196W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/15/84	09:59:00	34 46 30.420N	120 50 20.580W	34 46 28.734N	120 50 17.563W
07/15/84	10:00:00	34 46 30.780N	120 50 19.740W	34 46 29.143N	120 50 16.831W
07/15/84	10:01:00	34 46 31.020N	120 50 19.080W	34 46 29.036N	120 50 16.255W
07/15/84	10:02:00	34 46 31.200N	120 50 18.540W	34 46 28.796N	120 50 16.582W
07/15/84	10:03:00	34 46 31.440N	120 50 18.120W	34 46 28.766N	120 50 15.437W
07/15/84	10:04:01	34 46 31.620N	120 50 18.180W	34 46 28.803N	120 50 15.547W
07/15/84	10:05:00	34 46 31.800N	120 50 18.540W	34 46 28.417N	120 50 16.553W
07/15/84	10:06:00	34 46 31.620N	120 50 19.140W	34 46 28.685N	120 50 17.134W
07/15/84	10:07:00	34 46 30.660N	120 50 19.980W	34 46 28.458N	120 50 17.600W
07/15/84	10:08:01	34 46 29.880N	120 50 20.220W	34 46 27.966N	120 50 18.405W
07/15/84	10:09:00	34 46 29.220N	120 50 19.740W	34 46 28.069N	120 50 18.490W
07/15/84	10:10:01	34 46 28.680N	120 50 19.260W	34 46 28.244N	120 50 18.467W
07/15/84	10:11:00	34 46 28.200N	120 50 18.900W	34 46 28.180N	120 50 18.635W
07/15/84	10:12:00	34 46 27.900N	120 50 18.780W	34 46 28.113N	120 50 18.722W
07/15/84	10:13:00	34 46 27.840N	120 50 18.900W	34 46 28.190N	120 50 18.638W
07/15/84	10:14:01	34 46 28.080N	120 50 19.500W	34 46 28.843N	120 50 18.489W
07/15/84	10:15:00	34 46 28.560N	120 50 20.640W	34 46 29.426N	120 50 18.394W
07/15/84	10:16:00	34 46 29.160N	120 50 21.420W	34 46 28.110N	120 50 17.830W
07/15/84	10:17:00	34 46 29.580N	120 50 22.200W	34 46 28.660N	120 50 16.904W
07/15/84	10:18:00	34 46 29.700N	120 50 22.500W	34 46 28.668N	120 50 16.956W
07/15/84	10:19:00	34 46 29.820N	120 50 22.800W	34 46 28.046N	120 50 17.515W
07/15/84	10:20:00	34 46 29.580N	120 50 22.920W	34 46 27.989N	120 50 17.109W
07/15/84	10:21:00	34 46 29.280N	120 50 23.040W	34 46 28.115N	120 50 16.419W
07/15/84	10:22:00	34 46 28.920N	120 50 23.100W	34 46 27.969N	120 50 16.963W
07/15/84	10:23:00	34 46 28.560N	120 50 23.220W	34 46 27.813N	120 50 17.146W
07/15/84	10:24:00	34 46 28.140N	120 50 23.280W	34 46 27.622N	120 50 16.663W
07/15/84	10:25:01	34 46 27.840N	120 50 23.400W	34 46 27.314N	120 50 16.619W
07/15/84	10:26:00	34 46 27.540N	120 50 23.460W	34 46 27.431N	120 50 16.729W
07/15/84	10:27:00	34 46 27.180N	120 50 23.640W	34 46 27.071N	120 50 16.681W
07/15/84	10:28:01	34 46 26.700N	120 50 23.640W	34 46 26.680N	120 50 16.092W
07/15/84	10:29:00	34 46 26.280N	120 50 23.820W	34 46 25.229N	120 50 16.488W
07/15/84	10:30:00	34 46 25.680N	120 50 23.880W	34 46 23.548N	120 50 16.921W
07/15/84	10:31:00	34 46 24.960N	120 50 23.520W	34 46 24.018N	120 50 16.525W
07/15/84	10:32:00	34 46 24.480N	120 50 23.040W	34 46 25.135N	120 50 16.682W
07/15/84	10:33:00	34 46 24.120N	120 50 22.800W	34 46 24.904N	120 50 15.540W
07/15/84	10:34:00	34 46 23.700N	120 50 22.680W	34 46 24.017N	120 50 16.442W
07/15/84	10:35:00	34 46 23.340N	120 50 22.620W	34 46 22.943N	120 50 15.733W
07/15/84	10:36:00	34 46 22.740N	120 50 22.440W	34 46 22.730N	120 50 15.985W
07/15/84	10:37:00	34 46 22.320N	120 50 22.200W	34 46 22.201N	120 50 16.082W
07/15/84	10:38:00	34 46 21.960N	120 50 21.960W	34 46 21.167N	120 50 15.542W
07/15/84	10:39:00	34 46 21.480N	120 50 21.600W	34 46 20.687N	120 50 14.196W
07/15/84	10:40:00	34 46 21.000N	120 50 21.180W	34 46 20.722N	120 50 15.988W
07/15/84	10:41:00	34 46 20.820N	120 50 20.700W	34 46 21.822N	120 50 14.918W
07/15/84	10:42:00	34 46 20.940N	120 50 20.220W	34 46 21.446N	120 50 14.234W
07/15/84	10:43:00	34 46 21.120N	120 50 19.560W	34 46 21.576N	120 50 13.574W
07/15/84	10:44:00	34 46 21.420N	120 50 18.780W	34 46 22.005N	120 50 13.119W
07/15/84	10:45:00	34 46 21.780N	120 50 18.000W	34 46 22.276N	120 50 12.423W
07/15/84	10:46:00	34 46 22.020N	120 50 17.280W	34 46 22.268N	120 50 11.823W
07/15/84	10:47:00	34 46 22.200N	120 50 16.560W	34 46 22.785N	120 50 10.995W
07/15/84	10:48:00	34 46 22.260N	120 50 16.080W	34 46 22.488N	120 50 10.082W
07/15/84	10:49:00	34 46 22.080N	120 50 15.660W	34 46 22.437N	120 50 10.071W
07/15/84	10:50:00	34 46 21.900N	120 50 15.240W	34 46 21.622N	120 50 10.216W
07/15/84	10:51:00	34 46 21.600N	120 50 14.760W	34 46 22.354N	120 50 09.784W
07/15/84	10:52:00	34 46 21.540N	120 50 14.280W	34 46 22.224N	120 50 09.316W
07/15/84	10:53:00	34 46 21.780N	120 50 13.620W	34 46 22.207N	120 50 09.245W
07/15/84	10:54:00	34 46 22.140N	120 50 12.900W	34 46 21.981N	120 50 08.585W
07/15/84	10:55:00	34 46 22.500N	120 50 12.060W	34 46 21.478N	120 50 08.647W
07/15/84	10:56:00	34 46 22.800N	120 50 11.400W	34 46 21.213N	120 50 08.407W
07/15/84	10:57:00	34 46 22.560N	120 50 10.800W	34 46 21.439N	120 50 07.795W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/15/84	10:58:01	34 46 22.260N	120 50 10.560W	34 46 21.275N	120 50 08.220W
07/15/84	10:59:00	34 46 22.200N	120 50 10.440W	34 46 20.870N	120 50 08.430W
07/15/84	11:00:01	34 46 22.320N	120 50 10.140W	34 46 20.987N	120 50 08.106W
07/15/84	11:01:00	34 46 22.440N	120 50 09.720W	34 46 20.680N	120 50 08.351W
07/15/84	11:02:00	34 46 22.260N	120 50 09.480W	34 46 20.436N	120 50 08.088W
07/15/84	11:03:00	34 46 22.080N	120 50 09.120W	34 46 20.317N	120 50 07.873W
07/15/84	11:04:00	34 46 21.600N	120 50 09.120W	34 46 20.290N	120 50 08.216W
07/15/84	11:05:00	34 46 21.120N	120 50 09.360W	34 46 19.858N	120 50 08.580W
07/15/84	11:06:01	34 46 20.580N	120 50 09.840W	34 46 20.399N	120 50 08.805W
07/15/84	11:07:00	34 46 20.220N	120 50 10.020W	34 46 20.250N	120 50 09.276W
07/15/84	11:08:01	34 46 20.160N	120 50 09.960W	34 46 20.259N	120 50 09.323W
07/15/84	11:09:01	34 46 20.400N	120 50 09.480W	34 46 20.073N	120 50 09.408W
07/15/84	11:10:00	34 46 20.580N	120 50 08.760W	34 46 19.876N	120 50 09.120W
07/15/84	11:11:00	34 46 20.700N	120 50 07.920W	34 46 19.589N	120 50 08.389W
07/15/84	11:12:01	34 46 20.820N	120 50 07.260W	34 46 19.401N	120 50 07.777W
07/15/84	11:13:00	34 46 20.640N	120 50 06.660W	34 46 19.043N	120 50 06.732W
07/15/84	11:14:00	34 46 20.220N	120 50 06.420W	34 46 18.970N	120 50 06.348W
07/15/84	11:15:00	34 46 19.740N	120 50 06.480W	34 46 18.966N	120 50 06.144W
07/15/84	11:16:00	34 46 19.380N	120 50 06.780W	34 46 18.981N	120 50 06.381W
07/15/84	11:17:01	34 46 18.960N	120 50 07.140W	34 46 18.910N	120 50 06.323W
07/15/84	11:18:00	34 46 18.360N	120 50 06.960W	34 46 18.638N	120 50 05.975W
07/15/84	11:19:00	34 46 18.120N	120 50 06.360W	34 46 18.824N	120 50 05.362W
07/15/84	11:20:00	34 46 18.120N	120 50 05.700W	34 46 18.645N	120 50 05.171W
07/15/84	11:21:00	34 46 18.360N	120 50 04.860W	34 46 18.578N	120 50 04.476W
07/15/84	11:22:00	34 46 18.660N	120 50 04.080W	34 46 18.372N	120 50 03.768W
07/15/84	11:23:00	34 46 19.020N	120 50 03.060W	34 46 18.276N	120 50 02.832W
07/15/84	11:24:00	34 46 19.080N	120 50 02.220W	34 46 18.257N	120 50 02.268W
07/15/84	11:25:00	34 46 19.020N	120 50 01.620W	34 46 18.058N	120 50 01.836W
07/15/84	11:26:00	34 46 19.020N	120 50 01.080W	34 46 17.998N	120 50 01.885W
07/15/84	11:27:00	34 46 18.720N	120 50 00.480W	34 46 17.788N	120 50 01.670W
07/15/84	11:28:00	34 46 18.300N	120 50 00.060W	34 46 17.685N	120 50 01.346W
07/15/84	11:29:00	34 46 17.820N	120 49 59.760W	34 46 17.503N	120 50 01.371W
07/15/84	11:30:00	34 46 17.280N	120 49 59.340W	34 46 16.943N	120 50 01.239W
07/15/84	11:31:00	34 46 16.980N	120 49 58.860W	34 46 16.603N	120 50 01.071W
07/15/84	11:32:00	34 46 16.680N	120 49 58.380W	34 46 16.244N	120 50 01.000W
07/15/84	11:33:00	34 46 16.380N	120 49 57.840W	34 46 16.023N	120 50 00.701W
07/15/84	11:34:01	34 46 16.020N	120 49 57.240W	34 46 15.246N	120 50 00.389W
07/15/84	11:35:00	34 46 16.020N	120 49 56.520W	34 46 15.246N	120 49 59.922W
07/15/84	11:36:00	34 46 16.140N	120 49 55.680W	34 46 15.525N	120 50 00.043W
07/15/84	11:37:00	34 46 16.560N	120 49 54.660W	34 46 15.836N	120 49 58.566W
07/15/84	11:38:00	34 46 16.980N	120 49 53.640W	34 46 15.691N	120 49 58.003W
07/15/84	11:39:01	34 46 17.340N	120 49 52.500W	34 46 15.088N	120 49 56.839W
07/15/84	11:40:20	34 46 17.040N	120 49 51.420W	34 46 14.074N	120 49 55.687W
07/15/84	11:41:00	34 46 16.740N	120 49 51.240W	34 46 13.933N	120 49 54.642W
07/15/84	11:42:00	34 46 15.900N	120 49 51.420W	34 46 12.958N	120 49 55.486W
07/15/84	11:43:00	34 46 15.420N	120 49 51.720W	34 46 13.012N	120 49 55.788W
07/15/84	11:44:00	34 46 15.240N	120 49 52.680W	34 46 12.968N	120 49 55.963W
07/15/84	11:45:00	34 46 15.360N	120 49 54.240W	34 46 13.836N	120 49 56.041W
07/15/84	11:46:00	34 46 15.240N	120 49 55.800W	34 46 14.488N	120 49 55.893W
07/15/84	11:47:00	34 46 15.120N	120 49 56.460W	34 46 14.510N	120 49 55.740W
07/15/84	11:48:00	34 46 14.880N	120 49 56.400W	34 46 14.335N	120 49 55.523W
07/15/84	11:49:01	34 46 14.520N	120 49 55.860W	34 46 14.004N	120 49 55.307W
07/15/84	11:50:00	34 46 14.160N	120 49 55.260W	34 46 14.209N	120 49 55.356W
07/15/84	11:51:00	34 46 13.740N	120 49 54.840W	34 46 13.631N	120 49 55.501W
07/15/84	11:52:00	34 46 13.140N	120 49 54.540W	34 46 13.616N	120 49 56.007W
07/15/84	11:53:00	34 46 12.600N	120 49 54.060W	34 46 13.324N	120 49 55.863W
07/15/84	11:54:00	34 46 12.480N	120 49 53.340W	34 46 12.916N	120 49 55.792W
07/15/84	11:55:00	34 46 12.780N	120 49 52.500W	34 46 13.048N	120 49 55.865W
07/15/84	11:56:00	34 46 13.200N	120 49 51.600W	34 46 12.982N	120 49 55.266W
07/15/84	11:57:00	34 46 13.560N	120 49 50.520W	34 46 12.508N	120 49 54.655W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/15/84	11:58:00	34 46 13.980N	120 49 49.560W	34 46 12.433N	120 49 54.464W
07/15/84	11:59:00	34 46 14.160N	120 49 48.540W	34 46 11.611N	120 49 52.951W
07/15/84	12:00:00	34 46 13.800N	120 49 48.060W	34 46 11.548N	120 49 52.255W
07/15/84	12:01:00	34 46 13.020N	120 49 48.000W	34 46 11.512N	120 49 53.216W
07/15/84	12:02:00	34 46 12.000N	120 49 48.120W	34 46 11.583N	120 49 53.325W
07/15/84	12:03:00	34 46 10.680N	120 49 48.120W	34 46 11.573N	120 49 55.152W
07/15/84	12:04:00	34 46 09.660N	120 49 47.820W	34 46 10.622N	120 49 53.758W
07/15/84	12:05:00	34 46 09.180N	120 49 47.160W	34 46 09.160N	120 49 54.011W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/14/84	16:15:01	34 47 18.660N	120 45 54.660W	34 47 17.043N	120 45 53.330W
07/14/84	16:16:00	34 47 18.300N	120 45 54.840W	34 47 15.055N	120 45 52.215W
07/14/84	16:17:00	34 47 17.760N	120 45 55.260W	34 47 14.751N	120 45 53.267W
07/14/84	16:18:01	34 47 17.220N	120 45 55.740W	34 47 14.592N	120 45 53.235W
07/14/84	16:19:00	34 47 17.040N	120 45 56.460W	34 47 15.881N	120 45 53.104W
07/14/84	16:20:00	34 47 17.400N	120 45 56.940W	34 47 19.968N	120 45 54.596W
07/14/84	16:21:00	34 47 17.160N	120 45 56.640W	34 47 17.931N	120 45 57.079W
07/14/84	16:22:00	34 47 15.660N	120 45 55.200W	34 47 19.830N	120 45 56.601W
07/14/84	16:23:00	34 47 14.820N	120 45 54.540W	34 47 18.949N	120 45 54.298W
07/14/84	16:24:00	34 47 15.180N	120 45 55.860W	34 47 19.087N	120 45 55.284W
07/14/84	16:25:00	34 47 16.860N	120 45 59.580W	34 47 20.630N	120 45 59.041W
07/14/84	16:26:01	34 47 17.040N	120 46 02.940W	34 47 17.813N	120 46 00.163W
07/14/84	16:27:00	34 47 17.280N	120 46 03.480W	34 47 16.580N	120 46 00.467W
07/14/84	16:28:00	34 47 17.520N	120 46 03.780W	34 47 16.860N	120 46 00.586W
07/14/84	16:29:00	34 47 17.880N	120 46 03.960W	34 47 17.581N	120 46 00.482W
07/14/84	16:30:00	34 47 18.060N	120 46 03.840W	34 47 17.603N	120 46 00.292W
07/14/84	16:31:00	34 47 18.240N	120 46 03.720W	34 47 17.653N	120 46 00.232W
07/14/84	16:32:00	34 47 18.300N	120 46 03.600W	34 47 17.632N	120 46 00.185W
07/14/84	16:33:00	34 47 18.540N	120 46 03.240W	34 47 17.866N	120 45 59.696W
07/14/84	16:34:00	34 47 19.080N	120 46 02.760W	34 47 21.280N	120 45 58.639W
07/14/84	16:35:00	34 47 18.900N	120 46 01.440W	34 47 23.972N	120 46 00.802W
07/14/84	16:36:00	34 47 17.580N	120 46 01.800W	34 47 21.306N	120 46 00.692W
07/14/84	16:37:00	34 47 17.700N	120 46 02.520W	34 47 20.090N	120 46 05.566W
07/14/84	16:38:00	34 47 17.820N	120 46 02.640W	34 47 17.189N	120 46 06.554W
07/14/84	16:39:00	34 47 17.760N	120 46 02.640W	34 47 18.098N	120 46 06.823W
07/14/84	16:40:01	34 47 17.640N	120 46 03.840W	34 47 18.832N	120 46 07.511W
07/14/84	16:41:00	34 47 17.820N	120 46 04.800W	34 47 19.327N	120 46 08.564W
07/14/84	16:42:00	34 47 17.640N	120 46 05.160W	34 47 18.909N	120 46 08.081W
07/14/84	16:43:00	34 47 17.580N	120 46 05.100W	34 47 18.453N	120 46 08.249W
07/14/84	16:44:00	34 47 17.460N	120 46 05.040W	34 47 17.450N	120 46 08.946W
07/14/84	16:45:00	34 47 17.460N	120 46 04.980W	34 47 17.400N	120 46 08.261W
07/14/84	16:46:00	34 47 17.880N	120 46 05.040W	34 47 17.364N	120 46 07.937W
07/14/84	16:47:00	34 47 18.180N	120 46 04.980W	34 47 17.674N	120 46 08.466W
07/14/84	16:48:00	34 47 18.360N	120 46 04.920W	34 47 17.933N	120 46 07.997W
07/14/84	16:49:01	34 47 18.300N	120 46 04.800W	34 47 18.121N	120 46 08.154W
07/14/84	16:50:00	34 47 18.180N	120 46 04.500W	34 47 17.585N	120 46 07.926W
07/14/84	16:51:00	34 47 18.300N	120 46 05.100W	34 47 18.707N	120 46 08.417W
07/14/84	16:52:00	34 47 18.600N	120 46 04.980W	34 47 17.608N	120 46 07.913W
07/14/84	16:53:00	34 47 18.840N	120 46 05.040W	34 47 17.650N	120 46 07.804W
07/14/84	16:54:00	34 47 19.020N	120 46 05.400W	34 47 18.247N	120 46 08.369W
07/14/84	16:55:00	34 47 19.200N	120 46 05.460W	34 47 18.327N	120 46 08.693W
07/14/84	16:56:00	34 47 19.140N	120 46 05.940W	34 47 19.417N	120 46 09.137W
07/14/84	16:57:00	34 47 19.020N	120 46 05.940W	34 47 18.683N	120 46 09.077W
07/14/84	16:58:00	34 47 18.840N	120 46 06.360W	34 47 19.544N	120 46 09.377W
07/14/84	16:59:00	34 47 18.720N	120 46 06.060W	34 47 19.067N	120 46 09.498W
07/14/84	17:00:00	34 47 18.480N	120 46 06.060W	34 47 19.363N	120 46 09.330W
07/14/84	17:01:00	34 47 18.540N	120 46 06.120W	34 47 20.236N	120 46 09.161W
07/14/84	17:02:00	34 47 19.020N	120 46 05.640W	34 47 19.615N	120 46 09.150W
07/14/84	17:03:00	34 47 19.620N	120 46 06.060W	34 47 21.117N	120 46 09.125W
07/14/84	17:04:00	34 47 19.980N	120 46 05.880W	34 47 20.981N	120 46 09.245W
07/14/84	17:05:01	34 47 20.040N	120 46 05.580W	34 47 20.328N	120 46 10.003W
07/14/84	17:06:01	34 47 20.280N	120 46 06.120W	34 47 21.767N	120 46 09.269W
07/14/84	17:07:01	34 47 20.640N	120 46 05.820W	34 47 20.997N	120 46 09.702W
07/14/84	17:08:00	34 47 21.060N	120 46 05.640W	34 47 21.050N	120 46 09.270W
07/14/84	17:09:00	34 47 21.240N	120 46 06.000W	34 47 22.261N	120 46 09.161W
07/14/84	17:10:00	34 47 21.420N	120 46 05.820W	34 47 21.866N	120 46 09.666W
07/14/84	17:11:00	34 47 21.120N	120 46 05.880W	34 47 22.627N	120 46 09.534W
07/14/84	17:12:00	34 47 21.360N	120 46 05.820W	34 47 22.262N	120 46 09.955W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/14/84	17:13:00	34 47 21.360N	120 46 05.880W	34 47 22.233N	120 46 09.510W
07/14/84	17:14:01	34 47 21.540N	120 46 06.240W	34 47 22.660N	120 46 09.666W
07/14/84	17:15:00	34 47 21.720N	120 46 06.240W	34 47 21.948N	120 46 09.714W
07/14/84	17:16:00	34 47 21.600N	120 46 06.420W	34 47 22.215N	120 46 09.749W
07/14/84	17:17:01	34 47 21.420N	120 46 06.420W	34 47 21.697N	120 46 09.858W
07/14/84	17:18:00	34 47 21.540N	120 46 06.300W	34 47 21.540N	120 46 09.930W
07/14/84	17:19:00	34 47 21.660N	120 46 06.960W	34 47 22.850N	120 46 10.386W
07/14/84	17:20:00	34 47 21.480N	120 46 07.020W	34 47 22.967N	120 46 10.217W
07/14/84	17:21:00	34 47 21.420N	120 46 06.840W	34 47 22.779N	120 46 10.278W
07/14/84	17:22:01	34 47 21.480N	120 46 06.900W	34 47 23.047N	120 46 10.289W
07/14/84	17:23:00	34 47 22.020N	120 46 07.140W	34 47 23.874N	120 46 09.844W
07/14/84	17:24:00	34 47 21.900N	120 46 07.080W	34 47 24.091N	120 46 09.688W
07/14/84	17:25:00	34 47 22.020N	120 46 06.900W	34 47 24.370N	120 46 10.097W
07/14/84	17:26:00	34 47 22.680N	120 46 06.960W	34 47 24.723N	120 46 09.424W
07/14/84	17:27:00	34 47 22.980N	120 46 06.720W	34 47 24.210N	120 46 09.833W
07/14/84	17:28:01	34 47 23.220N	120 46 06.660W	34 47 24.797N	120 46 09.388W
07/14/84	17:29:00	34 47 23.100N	120 46 06.660W	34 47 25.063N	120 46 09.172W
07/14/84	17:30:00	34 47 22.980N	120 46 06.780W	34 47 25.558N	120 46 09.004W
07/14/84	17:31:00	34 47 23.220N	120 46 06.780W	34 47 25.174N	120 46 09.592W
07/14/84	17:32:00	34 47 23.160N	120 46 07.140W	34 47 25.391N	120 46 09.340W
07/14/84	17:33:00	34 47 23.100N	120 46 06.900W	34 47 24.468N	120 46 10.037W
07/14/84	17:34:00	34 47 23.460N	120 46 07.020W	34 47 25.136N	120 46 09.592W
07/14/84	17:35:00	34 47 23.760N	120 46 06.900W	34 47 24.950N	120 46 09.292W
07/14/84	17:36:00	34 47 24.180N	120 46 06.780W	34 47 25.271N	120 46 09.004W
07/14/84	17:37:00	34 47 23.940N	120 46 06.780W	34 47 25.041N	120 46 09.160W
07/14/84	17:38:00	34 47 23.700N	120 46 06.780W	34 47 25.207N	120 46 09.208W
07/14/84	17:39:00	34 47 23.820N	120 46 07.020W	34 47 25.605N	120 46 09.364W
07/14/84	17:40:00	34 47 24.180N	120 46 06.600W	34 47 24.993N	120 46 09.316W
07/14/84	17:41:00	34 47 24.540N	120 46 06.360W	34 47 25.313N	120 46 08.932W
07/14/84	17:42:00	34 47 24.240N	120 46 06.540W	34 47 25.351N	120 46 08.655W
07/14/84	17:43:01	34 47 23.760N	120 46 06.360W	34 47 25.108N	120 46 09.040W
07/14/84	17:44:00	34 47 23.820N	120 46 06.000W	34 47 24.217N	120 46 09.462W
07/14/84	17:45:00	34 47 24.360N	120 46 06.240W	34 47 25.143N	120 46 08.848W
07/14/84	17:46:00	34 47 24.900N	120 46 06.060W	34 47 25.138N	120 46 08.861W
07/14/84	17:47:01	34 47 25.020N	120 46 05.820W	34 47 24.951N	120 46 08.933W
07/14/84	17:48:01	34 47 25.080N	120 46 06.120W	34 47 26.498N	120 46 08.921W
07/14/84	17:49:00	34 47 24.900N	120 46 06.420W	34 47 27.280N	120 46 09.377W
07/14/84	17:50:00	34 47 25.740N	120 46 06.240W	34 47 26.662N	120 46 09.918W
07/14/84	17:51:00	34 47 26.400N	120 46 06.420W	34 47 28.324N	120 46 09.545W
07/14/84	17:52:00	34 47 26.640N	120 46 06.240W	34 47 28.613N	120 46 09.690W
07/14/84	17:53:00	34 47 26.760N	120 46 06.900W	34 47 29.973N	120 46 08.451W
07/14/84	17:54:00	34 47 27.780N	120 46 06.840W	34 47 30.824N	120 46 09.350W
07/14/84	17:55:01	34 47 28.620N	120 46 06.660W	34 47 30.847N	120 46 09.860W
07/14/84	17:56:01	34 47 29.520N	120 46 06.540W	34 47 32.466N	120 46 09.142W
07/14/84	17:57:00	34 47 30.480N	120 46 06.780W	34 47 33.276N	120 46 08.747W
07/14/84	17:58:00	34 47 31.320N	120 46 07.020W	34 47 33.075N	120 46 09.893W
07/14/84	17:59:00	34 47 31.560N	120 46 07.080W	34 47 32.730N	120 46 09.724W
07/14/84	18:00:00	34 47 31.380N	120 46 07.260W	34 47 32.639N	120 46 09.772W
07/14/84	18:01:00	34 47 31.020N	120 46 07.680W	34 47 33.172N	120 46 10.553W
07/14/84	18:02:00	34 47 30.540N	120 46 07.800W	34 47 33.019N	120 46 10.540W
07/14/84	18:03:01	34 47 30.600N	120 46 07.860W	34 47 33.396N	120 46 10.553W
07/14/84	18:04:01	34 47 30.960N	120 46 07.380W	34 47 33.310N	120 46 10.745W
07/14/84	18:05:00	34 47 31.620N	120 46 06.960W	34 47 33.355N	120 46 10.696W
07/14/84	18:06:00	34 47 32.160N	120 46 06.420W	34 47 34.163N	120 46 10.266W
07/14/84	18:07:01	34 47 32.880N	120 46 06.480W	34 47 35.220N	120 46 10.086W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/13/84	13:22:00	34 50 18.720N	120 48 12.540W	34 50 18.220N	120 48 12.043W
07/13/84	13:23:00	34 50 19.440N	120 48 11.700W	34 50 18.411N	120 48 12.087W
07/13/84	13:24:00	34 50 20.280N	120 48 10.860W	34 50 18.755N	120 48 12.344W
07/13/84	13:25:00	34 50 20.940N	120 48 10.440W	34 50 18.792N	120 48 11.361W
07/13/84	13:26:00	34 50 21.660N	120 48 10.380W	34 50 18.844N	120 48 10.704W
07/13/84	13:27:00	34 50 21.180N	120 48 11.160W	34 50 18.607N	120 48 12.531W
07/13/84	13:28:01	34 50 20.820N	120 48 11.700W	34 50 18.662N	120 48 12.014W
07/13/84	13:29:00	34 50 20.520N	120 48 12.060W	34 50 18.302N	120 48 12.200W
07/13/84	13:30:00	34 50 20.580N	120 48 11.940W	34 50 18.210N	120 48 11.065W
07/13/84	13:31:00	34 50 20.760N	120 48 10.800W	34 50 19.022N	120 48 13.640W
07/13/84	13:32:01	34 50 20.520N	120 48 11.100W	34 50 18.772N	120 48 13.040W
07/13/84	13:33:01	34 50 20.340N	120 48 11.340W	34 50 19.421N	120 48 13.698W
07/13/84	13:34:01	34 50 20.460N	120 48 11.460W	34 50 20.541N	120 48 14.504W
07/13/84	13:35:00	34 50 20.460N	120 48 11.700W	34 50 21.064N	120 48 15.234W
07/13/84	13:36:01	34 50 21.300N	120 48 12.060W	34 50 21.547N	120 48 15.638W
07/13/84	13:37:00	34 50 21.840N	120 48 12.780W	34 50 23.039N	120 48 15.842W
07/13/84	13:38:00	34 50 22.560N	120 48 12.900W	34 50 23.492N	120 48 15.940W
07/13/84	13:39:00	34 50 23.040N	120 48 12.960W	34 50 23.432N	120 48 13.933W
07/13/84	13:40:20	34 50 24.060N	120 48 13.380W	34 50 25.697N	120 48 16.531W
07/13/84	13:41:00	34 50 24.720N	120 48 13.680W	34 50 26.177N	120 48 16.684W
07/13/84	13:42:00	34 50 25.500N	120 48 14.040W	34 50 26.941N	120 48 17.375W
07/13/84	13:43:01	34 50 26.100N	120 48 14.400W	34 50 27.502N	120 48 18.072W
07/13/84	13:44:00	34 50 26.700N	120 48 14.700W	34 50 27.948N	120 48 18.467W
07/13/84	13:45:00	34 50 27.240N	120 48 15.420W	34 50 28.594N	120 48 18.686W
07/13/84	13:46:00	34 50 28.140N	120 48 16.320W	34 50 29.915N	120 48 19.691W
07/13/84	13:47:00	34 50 29.040N	120 48 16.920W	34 50 30.832N	120 48 19.772W
07/13/84	13:48:00	34 50 29.640N	120 48 17.340W	34 50 31.938N	120 48 19.520W
07/13/84	13:49:01	34 50 30.660N	120 48 17.520W	34 50 32.311N	120 48 20.673W
07/13/84	13:50:00	34 50 31.500N	120 48 17.820W	34 50 33.563N	120 48 20.334W
07/13/84	13:51:00	34 50 32.580N	120 48 17.820W	34 50 34.851N	120 48 19.981W
07/13/84	13:52:00	34 50 33.360N	120 48 17.940W	34 50 35.612N	120 48 20.167W
07/13/84	13:53:00	34 50 34.140N	120 48 18.000W	34 50 36.543N	120 48 20.371W
07/13/84	13:54:00	34 50 35.340N	120 48 18.600W	34 50 37.541N	120 48 20.753W
07/13/84	13:55:00	34 50 36.300N	120 48 19.200W	34 50 38.161N	120 48 21.292W
07/13/84	13:56:00	34 50 36.960N	120 48 19.320W	34 50 39.184N	120 48 21.544W
07/13/84	13:57:00	34 50 37.560N	120 48 19.440W	34 50 39.189N	120 48 22.112W
07/13/84	13:58:00	34 50 38.160N	120 48 19.320W	34 50 39.844N	120 48 21.623W
07/13/84	13:59:01	34 50 38.640N	120 48 19.200W	34 50 39.550N	120 48 21.412W
07/13/84	14:00:01	34 50 39.360N	120 48 19.440W	34 50 39.614N	120 48 21.284W
07/13/84	14:01:00	34 50 39.900N	120 48 19.680W	34 50 39.952N	120 48 21.494W
07/13/84	14:02:00	34 50 40.500N	120 48 19.740W	34 50 39.984N	120 48 21.332W
07/13/84	14:03:00	34 50 41.160N	120 48 19.680W	34 50 40.888N	120 48 21.494W
07/13/84	14:04:00	34 50 41.700N	120 48 19.620W	34 50 41.565N	120 48 21.594W
07/13/84	14:05:00	34 50 42.180N	120 48 19.440W	34 50 42.509N	120 48 21.804W
07/13/84	14:06:00	34 50 42.600N	120 48 19.260W	34 50 43.292N	120 48 21.756W
07/13/84	14:07:00	34 50 43.080N	120 48 19.320W	34 50 44.035N	120 48 22.066W
07/13/84	14:08:00	34 50 43.740N	120 48 19.200W	34 50 44.608N	120 48 22.082W
07/13/84	14:09:00	34 50 44.340N	120 48 19.560W	34 50 45.738N	120 48 21.824W
07/13/84	14:10:00	34 50 44.880N	120 48 19.860W	34 50 46.582N	120 48 22.302W
07/13/84	14:11:00	34 50 45.480N	120 48 19.860W	34 50 47.367N	120 48 22.850W
07/13/84	14:12:00	34 50 46.020N	120 48 20.160W	34 50 47.687N	120 48 23.280W
07/13/84	14:13:01	34 50 46.980N	120 48 20.760W	34 50 48.376N	120 48 23.545W
07/13/84	14:14:00	34 50 47.400N	120 48 21.000W	34 50 49.319N	120 48 23.644W
07/13/84	14:15:00	34 50 47.880N	120 48 20.820W	34 50 49.858N	120 48 23.624W
07/13/84	14:16:00	34 50 48.600N	120 48 20.640W	34 50 49.408N	120 48 21.733W
07/13/84	14:17:00	34 50 49.500N	120 48 20.700W	34 50 51.472N	120 48 23.196W
07/13/84	14:18:00	34 50 50.220N	120 48 20.760W	34 50 52.434N	120 48 23.213W
07/13/84	14:19:01	34 50 51.060N	120 48 20.760W	34 50 52.736N	120 48 23.071W
07/13/84	14:20:00	34 50 51.780N	120 48 21.000W	34 50 53.725N	120 48 23.288W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/13/84	14:21:00	34 50 52.500N	120 48 21.000W	34 50 54.066N	120 48 23.304W
07/13/84	14:22:00	34 50 53.100N	120 48 21.180W	34 50 54.719N	120 48 23.765W
07/13/84	14:23:00	34 50 53.700N	120 48 21.120W	34 50 55.046N	120 48 24.716W
07/13/84	14:24:00	34 50 54.360N	120 48 20.940W	34 50 55.506N	120 48 24.982W
07/13/84	14:25:00	34 50 55.200N	120 48 21.600W	34 50 57.384N	120 48 24.026W
07/13/84	14:26:00	34 50 55.860N	120 48 22.320W	34 50 58.227N	120 48 23.952W
07/13/84	14:27:00	34 50 56.820N	120 48 22.140W	34 50 58.211N	120 48 25.135W
07/13/84	14:28:01	34 50 57.360N	120 48 22.200W	34 50 59.013N	120 48 25.192W
07/13/84	14:29:01	34 50 58.380N	120 48 22.680W	34 50 59.421N	120 48 24.699W
07/13/84	14:30:00	34 50 59.160N	120 48 22.920W	34 51 00.018N	120 48 23.762W
07/13/84	14:31:00	34 50 59.400N	120 48 22.560W	34 50 59.889N	120 48 22.939W
07/13/84	14:32:00	34 50 59.880N	120 48 22.260W	34 50 59.963N	120 48 22.278W
07/13/84	14:33:00	34 51 00.420N	120 48 22.080W	34 51 00.170N	120 48 22.130W
07/13/84	14:34:00	34 51 00.900N	120 48 21.720W	34 51 00.054N	120 48 21.937W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/13/84	07:25:01	34 49 48.420N	120 47 23.400W	34 49 52.080N	120 47 23.580W
07/13/84	07:26:00	34 49 48.360N	120 47 22.680W	34 49 51.000N	120 47 23.640W
07/13/84	07:27:00	34 49 47.880N	120 47 22.320W	34 49 49.800N	120 47 25.140W
07/13/84	07:28:00	34 49 47.520N	120 47 22.380W	34 49 48.180N	120 47 25.260W
07/13/84	07:29:00	34 49 47.160N	120 47 22.620W	34 49 47.580N	120 47 25.620W
07/13/84	07:30:01	34 49 46.560N	120 47 23.160W	34 49 46.440N	120 47 26.340W
07/13/84	07:31:00	34 49 46.020N	120 47 24.060W	34 49 44.820N	120 47 27.060W
07/13/84	07:32:00	34 49 45.120N	120 47 25.020W	34 49 43.500N	120 47 28.980W
07/13/84	07:33:00	34 49 43.920N	120 47 24.960W	34 49 44.460N	120 47 28.560W
07/13/84	07:34:00	34 49 43.260N	120 47 23.700W	34 49 44.580N	120 47 26.460W
07/13/84	07:35:00	34 49 43.380N	120 47 21.540W	34 49 43.500N	120 47 24.000W
07/13/84	07:36:00	34 49 44.100N	120 47 18.960W	34 49 42.420N	120 47 21.300W
07/13/84	07:37:00	34 49 45.360N	120 47 16.260W	34 49 41.940N	120 47 19.800W
07/13/84	07:38:40	34 49 48.180N	120 47 14.880W	34 49 50.100N	120 47 19.440W
07/13/84	07:40:00	34 49 48.960N	120 47 15.240W	34 49 52.680N	120 47 16.680W
07/13/84	07:41:00	34 49 49.440N	120 47 16.500W	34 49 52.980N	120 47 17.940W
07/13/84	07:42:00	34 49 49.800N	120 47 17.580W	34 49 52.560N	120 47 19.740W
07/13/84	07:43:00	34 49 50.100N	120 47 18.420W	34 49 53.220N	120 47 20.160W
07/13/84	07:44:00	34 49 50.280N	120 47 19.380W	34 49 53.100N	120 47 21.480W
07/13/84	07:45:00	34 49 50.340N	120 47 20.460W	34 49 53.220N	120 47 22.620W
07/13/84	07:46:01	34 49 50.520N	120 47 21.240W	34 49 52.920N	120 47 24.240W
07/13/84	07:47:00	34 49 50.820N	120 47 22.200W	34 49 52.860N	120 47 25.260W
07/13/84	07:48:00	34 49 51.060N	120 47 22.620W	34 49 52.920N	120 47 25.320W
07/13/84	07:49:20	34 49 51.060N	120 47 23.880W	34 49 52.500N	120 47 26.760W
07/13/84	07:50:00	34 49 51.180N	120 47 24.420W	34 49 52.680N	120 47 27.960W
07/13/84	07:51:00	34 49 51.180N	120 47 25.560W	34 49 52.560N	120 47 28.920W
07/13/84	07:52:00	34 49 51.240N	120 47 26.880W	34 49 52.500N	120 47 30.660W
07/13/84	07:53:00	34 49 51.120N	120 47 28.200W	34 49 52.440N	120 47 31.380W
07/13/84	07:54:01	34 49 50.760N	120 47 29.400W	34 49 52.500N	120 47 32.820W
07/13/84	07:55:00	34 49 49.920N	120 47 30.120W	34 49 51.780N	120 47 32.100W
07/13/84	07:56:00	34 49 48.600N	120 47 30.900W	34 49 48.900N	120 47 32.040W
07/13/84	07:57:00	34 49 47.700N	120 47 31.800W	34 49 46.680N	120 47 31.800W
07/13/84	07:58:00	34 49 47.520N	120 47 31.860W	34 49 45.780N	120 47 31.740W
07/13/84	07:59:00	34 49 47.640N	120 47 31.500W	34 49 46.140N	120 47 31.980W
07/13/84	08:00:00	34 49 48.120N	120 47 31.020W	34 49 47.040N	120 47 31.260W
07/13/84	08:01:01	34 49 48.840N	120 47 30.420W	34 49 48.660N	120 47 31.620W
07/13/84	08:02:00	34 49 49.440N	120 47 29.760W	34 49 49.800N	120 47 30.060W
07/13/84	08:03:00	34 49 49.620N	120 47 28.980W	34 49 50.280N	120 47 28.500W
07/13/84	08:04:00	34 49 49.560N	120 47 27.780W	34 49 49.500N	120 47 26.100W
07/13/84	08:05:00	34 49 50.040N	120 47 26.580W	34 49 47.940N	120 47 24.720W
07/13/84	08:06:00	34 49 50.820N	120 47 25.860W	34 49 46.980N	120 47 25.800W
07/13/84	08:07:00	34 49 51.600N	120 47 25.740W	34 49 48.540N	120 47 28.500W
07/13/84	08:08:01	34 49 51.960N	120 47 25.680W	34 49 51.600N	120 47 30.480W
07/13/84	08:09:00	34 49 52.440N	120 47 26.520W	34 49 53.580N	120 47 31.080W
07/13/84	08:10:00	34 49 52.380N	120 47 28.140W	34 49 52.980N	120 47 32.100W
07/13/84	08:11:00	34 49 52.020N	120 47 30.480W	34 49 51.480N	120 47 34.680W
07/13/84	08:12:00	34 49 51.000N	120 47 32.280W	34 49 52.560N	120 47 35.640W
07/13/84	08:13:01	34 49 50.100N	120 47 31.260W	34 49 52.980N	120 47 31.020W
07/13/84	08:14:00	34 49 49.260N	120 47 28.980W	34 49 50.340N	120 47 28.440W
07/13/84	08:15:00	34 49 48.300N	120 47 26.460W	34 49 47.400N	120 47 25.080W
07/13/84	08:16:00	34 49 48.000N	120 47 24.780W	34 49 45.720N	120 47 23.160W
07/13/84	08:17:20	34 49 48.720N	120 47 24.300W	34 49 45.960N	120 47 22.800W
07/13/84	08:18:00	34 49 49.020N	120 47 24.480W	34 49 46.200N	120 47 22.800W
07/13/84	08:19:00	34 49 49.320N	120 47 24.600W	34 49 46.260N	120 47 22.920W
07/13/84	08:20:00	34 49 49.560N	120 47 25.020W	34 49 47.220N	120 47 22.680W
07/13/84	08:21:00	34 49 49.980N	120 47 24.780W	34 49 46.920N	120 47 22.740W
07/13/84	08:22:00	34 49 50.700N	120 47 24.060W	34 49 46.620N	120 47 22.560W
07/13/84	08:23:00	34 49 51.720N	120 47 23.280W	34 49 47.640N	120 47 25.200W
07/13/84	08:24:00	34 49 52.800N	120 47 22.920W	34 49 49.380N	120 47 27.240W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/13/84	08:25:00	34 49 53.640N	120 47 22.380W	34 49 50.520N	120 47 27.720W
07/13/84	08:26:00	34 49 54.120N	120 47 21.840W	34 49 51.120N	120 47 27.180W
07/13/84	08:27:00	34 49 54.840N	120 47 21.420W	34 49 53.100N	120 47 27.240W
07/13/84	08:28:00	34 49 56.160N	120 47 22.080W	34 49 59.580N	120 47 27.180W
07/13/84	08:29:01	34 49 56.700N	120 47 23.820W	34 50 01.500N	120 47 26.640W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/15/84	16:49:00	35 05 42.300N	120 47 35.580W	35 05 40.196N	120 47 33.957W
07/15/84	16:50:00	35 05 42.120N	120 47 34.860W	35 05 40.549N	120 47 32.805W
07/15/84	16:51:00	35 05 41.520N	120 47 34.800W	35 05 40.601N	120 47 33.442W
07/15/84	16:52:01	35 05 41.100N	120 47 34.560W	35 05 39.885N	120 47 32.324W
07/15/84	16:53:00	35 05 40.860N	120 47 34.020W	35 05 39.175N	120 47 32.636W
07/15/84	16:54:20	35 05 40.680N	120 47 33.420W	35 05 36.810N	120 47 30.393W
07/15/84	16:55:00	35 05 41.040N	120 47 32.700W	35 05 36.696N	120 47 31.926W
07/15/84	16:56:00	35 05 40.740N	120 47 32.220W	35 05 36.835N	120 47 31.950W
07/15/84	16:57:01	35 05 39.660N	120 47 32.160W	35 05 36.679N	120 47 30.606W
07/15/84	16:58:01	35 05 38.520N	120 47 32.880W	35 05 37.404N	120 47 31.328W
07/15/84	16:59:00	35 05 37.440N	120 47 34.020W	35 05 38.272N	120 47 32.654W
07/15/84	17:00:00	35 05 37.020N	120 47 34.560W	35 05 38.600N	120 47 33.234W
07/15/84	17:01:00	35 05 37.440N	120 47 34.080W	35 05 39.367N	120 47 33.287W
07/15/84	17:02:00	35 05 38.880N	120 47 33.360W	35 05 40.204N	120 47 33.228W
07/15/84	17:03:01	35 05 40.500N	120 47 32.400W	35 05 40.816N	120 47 32.592W
07/15/84	17:04:00	35 05 41.580N	120 47 31.620W	35 05 41.708N	120 47 32.209W
07/15/84	17:05:00	35 05 42.540N	120 47 30.900W	35 05 42.688N	120 47 31.958W
07/15/84	17:06:00	35 05 43.080N	120 47 30.720W	35 05 42.705N	120 47 32.271W
07/15/84	17:07:00	35 05 43.560N	120 47 30.000W	35 05 43.303N	120 47 32.211W
07/15/84	17:08:01	35 05 43.560N	120 47 29.700W	35 05 44.103N	120 47 32.885W
07/15/84	17:09:00	35 05 43.320N	120 47 29.280W	35 05 44.723N	120 47 32.682W
07/15/84	17:10:01	35 05 43.620N	120 47 29.220W	35 05 45.672N	120 47 32.162W
07/15/84	17:11:00	35 05 44.760N	120 47 28.500W	35 05 45.242N	120 47 31.887W
07/15/84	17:12:00	35 05 46.440N	120 47 28.140W	35 05 46.697N	120 47 31.878W
07/15/84	17:13:00	35 05 48.300N	120 47 27.480W	35 05 47.091N	120 47 29.680W
07/15/84	17:14:00	35 05 49.260N	120 47 27.180W	35 05 46.849N	120 47 30.149W
07/15/84	17:15:00	35 05 49.500N	120 47 26.580W	35 05 47.228N	120 47 29.729W
07/15/84	17:16:00	35 05 48.540N	120 47 26.880W	35 05 47.058N	120 47 30.630W
07/15/84	17:17:00	35 05 47.100N	120 47 27.360W	35 05 46.270N	120 47 31.399W
07/15/84	17:18:00	35 05 45.900N	120 47 28.140W	35 05 45.663N	120 47 32.623W
07/15/84	17:19:00	35 05 44.760N	120 47 29.640W	35 05 47.491N	120 47 33.355W
07/15/84	17:20:00	35 05 43.560N	120 47 30.840W	35 05 47.265N	120 47 32.715W
07/15/84	17:21:00	35 05 43.680N	120 47 31.500W	35 05 46.993N	120 47 33.244W
07/15/84	17:22:20	35 05 46.320N	120 47 32.340W	35 05 48.813N	120 47 33.741W
07/15/84	17:23:00	35 05 47.640N	120 47 32.640W	35 05 48.875N	120 47 33.852W
07/15/84	17:24:00	35 05 49.620N	120 47 31.860W	35 05 49.256N	120 47 32.575W
07/15/84	17:25:00	35 05 50.460N	120 47 31.440W	35 05 49.097N	120 47 32.125W
07/15/84	17:26:00	35 05 50.940N	120 47 30.960W	35 05 49.547N	120 47 32.967W
07/15/84	17:27:00	35 05 50.880N	120 47 30.480W	35 05 50.258N	120 47 33.305W
07/15/84	17:28:01	35 05 50.400N	120 47 30.060W	35 05 49.797N	120 47 33.462W
07/15/84	17:29:00	35 05 49.920N	120 47 29.580W	35 05 49.178N	120 47 33.182W
07/15/84	17:30:00	35 05 49.380N	120 47 29.220W	35 05 49.660N	120 47 33.496W
07/15/84	17:31:00	35 05 48.840N	120 47 29.520W	35 05 49.785N	120 47 34.102W
07/15/84	17:32:00	35 05 48.120N	120 47 29.220W	35 05 49.840N	120 47 33.694W
07/15/84	17:33:01	35 05 47.700N	120 47 29.580W	35 05 50.115N	120 47 33.246W
07/15/84	17:34:00	35 05 48.180N	120 47 29.400W	35 05 50.330N	120 47 32.391W
07/15/84	17:35:01	35 05 48.960N	120 47 30.120W	35 05 51.076N	120 47 33.922W
07/15/84	17:36:00	35 05 50.160N	120 47 31.020W	35 05 51.562N	120 47 34.609W
07/15/84	17:37:01	35 05 51.360N	120 47 32.460W	35 05 52.089N	120 47 35.017W
07/15/84	17:38:00	35 05 52.140N	120 47 34.680W	35 05 52.197N	120 47 35.284W
07/15/84	17:39:00	35 05 53.040N	120 47 36.060W	35 05 52.642N	120 47 35.077W
07/15/84	17:40:00	35 05 53.580N	120 47 36.900W	35 05 53.259N	120 47 34.855W
07/15/84	17:41:00	35 05 54.240N	120 47 36.840W	35 05 53.434N	120 47 34.525W
07/15/84	17:42:00	35 05 55.200N	120 47 36.300W	35 05 53.554N	120 47 34.451W
07/15/84	17:43:00	35 05 55.740N	120 47 36.120W	35 05 53.563N	120 47 34.235W
07/15/84	17:44:00	35 05 56.580N	120 47 35.640W	35 05 53.794N	120 47 34.221W
07/15/84	17:45:00	35 05 57.300N	120 47 35.160W	35 05 54.156N	120 47 34.434W
07/15/84	17:46:00	35 05 57.720N	120 47 34.380W	35 05 54.565N	120 47 33.447W
07/15/84	17:47:00	35 05 57.900N	120 47 33.600W	35 05 54.986N	120 47 33.708W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/15/84	17:48:00	35 05 57.540N	120 47 33.540W	35 05 54.527N	120 47 34.525W
07/15/84	17:49:00	35 05 57.420N	120 47 33.060W	35 05 54.911N	120 47 35.152W
07/15/84	17:50:00	35 05 57.240N	120 47 32.760W	35 05 55.066N	120 47 35.488W
07/15/84	17:51:00	35 05 57.120N	120 47 31.920W	35 05 54.769N	120 47 34.901W
07/15/84	17:52:00	35 05 56.760N	120 47 31.680W	35 05 54.339N	120 47 34.817W
07/15/84	17:53:00	35 05 56.220N	120 47 31.440W	35 05 54.230N	120 47 34.943W
07/15/84	17:54:00	35 05 56.580N	120 47 29.280W	35 05 54.040N	120 47 33.279W
07/15/84	17:55:00	35 05 55.080N	120 47 30.840W	35 05 53.985N	120 47 34.983W
07/15/84	17:56:00	35 05 53.520N	120 47 31.980W	35 05 54.298N	120 47 36.119W
07/15/84	17:57:00	35 05 52.140N	120 47 32.520W	35 05 53.256N	120 47 36.933W
07/15/84	17:58:00	35 05 51.360N	120 47 32.760W	35 05 53.665N	120 47 36.585W
07/15/84	17:59:01	35 05 52.080N	120 47 33.300W	35 05 53.268N	120 47 37.542W
07/15/84	18:00:00	35 05 54.360N	120 47 34.500W	35 05 54.986N	120 47 37.556W
07/15/84	18:01:00	35 05 56.580N	120 47 36.300W	35 05 56.136N	120 47 38.622W
07/15/84	18:02:02	35 05 58.560N	120 47 36.480W	35 05 56.837N	120 47 38.034W
07/15/84	18:03:01	35 05 59.760N	120 47 35.940W	35 05 57.589N	120 47 37.591W
07/15/84	18:04:01	35 06 00.420N	120 47 35.400W	35 05 58.257N	120 47 37.341W
07/15/84	18:05:00	35 05 59.940N	120 47 35.040W	35 05 57.974N	120 47 37.420W
07/15/84	18:06:00	35 05 58.980N	120 47 34.980W	35 05 58.388N	120 47 38.284W
07/15/84	18:07:00	35 05 58.260N	120 47 34.860W	35 05 58.516N	120 47 38.809W
07/15/84	18:08:00	35 05 57.960N	120 47 34.560W	35 05 58.598N	120 47 38.751W
07/15/84	18:09:00	35 05 57.480N	120 47 34.260W	35 05 58.297N	120 47 38.722W
07/15/84	18:10:00	35 05 57.060N	120 47 33.780W	35 05 58.557N	120 47 38.853W
07/15/84	18:11:00	35 05 56.340N	120 47 33.480W	35 05 57.429N	120 47 39.044W
07/15/84	18:12:00	35 05 55.860N	120 47 33.540W	35 05 57.065N	120 47 37.458W
07/15/84	18:13:00	35 05 55.680N	120 47 33.900W	35 05 58.769N	120 47 40.309W
07/15/84	18:14:00	35 05 55.860N	120 47 33.300W	35 05 57.981N	120 47 38.089W
07/15/84	18:15:00	35 05 56.160N	120 47 33.180W	35 05 59.255N	120 47 37.727W
07/15/84	18:16:00	35 05 57.480N	120 47 34.200W	35 05 59.284N	120 47 38.274W
07/15/84	18:17:00	35 05 58.740N	120 47 35.100W	35 06 00.158N	120 47 38.916W
07/15/84	18:18:01	35 05 59.760N	120 47 35.820W	35 06 00.610N	120 47 39.408W
07/15/84	18:19:00	35 06 00.960N	120 47 37.200W	35 06 01.363N	120 47 39.902W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/17/84	14:55:00	35 11 39.900N	120 55 37.860W	35 11 35.160N	120 55 33.360W
07/17/84	14:56:00	35 11 40.440N	120 55 37.080W	35 11 35.760N	120 55 32.520W
07/17/84	14:57:00	35 11 40.380N	120 55 36.060W	35 11 35.700N	120 55 32.220W
07/17/84	14:58:00	35 11 39.900N	120 55 35.400W	35 11 35.100N	120 55 32.460W
07/17/84	14:59:00	35 11 39.000N	120 55 34.980W	35 11 34.740N	120 55 32.340W
07/17/84	15:00:00	35 11 37.920N	120 55 34.680W	35 11 34.140N	120 55 32.400W
07/17/84	15:01:00	35 11 36.480N	120 55 34.320W	35 11 33.540N	120 55 32.040W
07/17/84	15:02:00	35 11 35.340N	120 55 34.080W	35 11 32.820N	120 55 31.800W
07/17/84	15:03:00	35 11 34.740N	120 55 34.020W	35 11 32.820N	120 55 31.500W
07/17/84	15:04:00	35 11 34.620N	120 55 33.660W	35 11 32.880N	120 55 30.900W
07/17/84	15:05:00	35 11 34.680N	120 55 33.360W	35 11 33.300N	120 55 30.060W
07/17/84	15:06:00	35 11 34.680N	120 55 33.180W	35 11 33.540N	120 55 29.460W
07/17/84	15:07:00	35 11 34.560N	120 55 32.700W	35 11 33.360N	120 55 29.100W
07/17/84	15:08:00	35 11 34.440N	120 55 31.920W	35 11 32.520N	120 55 28.620W
07/17/84	15:09:00	35 11 34.080N	120 55 31.020W	35 11 33.060N	120 55 27.480W
07/17/84	15:10:00	35 11 33.420N	120 55 30.240W	35 11 32.520N	120 55 27.240W
07/17/84	15:11:00	35 11 33.300N	120 55 29.640W	35 11 32.280N	120 55 26.760W
07/17/84	15:12:00	35 11 33.900N	120 55 29.100W	35 11 32.340N	120 55 25.980W
07/17/84	15:13:00	35 11 33.960N	120 55 28.620W	35 11 32.700N	120 55 24.840W
07/17/84	15:14:00	35 11 33.960N	120 55 28.020W	35 11 32.880N	120 55 24.420W
07/17/84	15:15:00	35 11 33.720N	120 55 27.060W	35 11 32.580N	120 55 23.640W
07/17/84	15:16:01	35 11 33.240N	120 55 26.340W	35 11 32.400N	120 55 22.980W
07/17/84	15:17:00	35 11 33.000N	120 55 25.980W	35 11 32.040N	120 55 22.860W
07/17/84	15:18:48	35 11 32.580N	120 55 25.200W	35 11 32.100N	120 55 22.200W
07/17/84	15:20:01	35 11 32.520N	120 55 24.000W	35 11 32.040N	120 55 20.460W
07/17/84	15:21:00	35 11 32.280N	120 55 23.280W	35 11 31.920N	120 55 19.440W
07/17/84	15:23:00	35 11 31.860N	120 55 22.200W	35 11 31.440N	120 55 18.960W
07/17/84	15:24:00	35 11 31.860N	120 55 21.540W	35 11 31.440N	120 55 17.940W
07/17/84	15:25:01	35 11 31.740N	120 55 21.000W	35 11 31.440N	120 55 17.400W
07/17/84	15:26:00	35 11 31.620N	120 55 20.400W	35 11 31.320N	120 55 16.740W
07/17/84	15:27:00	35 11 31.560N	120 55 19.680W	35 11 30.900N	120 55 16.200W
07/17/84	15:28:00	35 11 31.560N	120 55 19.140W	35 11 30.900N	120 55 15.300W
07/17/84	15:29:00	35 11 31.440N	120 55 18.540W	35 11 30.900N	120 55 14.700W
07/17/84	15:30:01	35 11 31.380N	120 55 17.820W	35 11 30.540N	120 55 14.280W
07/17/84	15:31:00	35 11 31.080N	120 55 17.340W	35 11 30.300N	120 55 13.800W
07/17/84	15:32:00	35 11 30.780N	120 55 16.920W	35 11 30.180N	120 55 13.320W
07/17/84	15:33:00	35 11 30.480N	120 55 16.200W	35 11 29.640N	120 55 12.600W
07/17/84	15:34:01	35 11 30.360N	120 55 15.660W	35 11 29.640N	120 55 12.180W
07/17/84	15:35:00	35 11 30.480N	120 55 15.240W	35 11 29.520N	120 55 12.120W
07/17/84	15:36:00	35 11 30.600N	120 55 14.880W	35 11 29.460N	120 55 11.580W
07/17/84	15:37:00	35 11 30.540N	120 55 14.460W	35 11 29.400N	120 55 11.460W
07/17/84	15:38:00	35 11 30.480N	120 55 14.340W	35 11 33.360N	120 55 13.620W

Date	Time	Ship Position Latitude	Ship Position Longitude	Submersible Position Latitude	Submersible Position Longitude
07/16/84	12:27:00	35 20 53.400N	120 59 35.940W	35 20 54.360N	120 59 39.420W
07/16/84	12:28:00	35 20 54.360N	120 59 36.060W	35 20 54.960N	120 59 38.520W
07/16/84	12:29:01	35 20 54.300N	120 59 37.680W	35 20 54.720N	120 59 38.880W
07/16/84	12:30:00	35 20 54.060N	120 59 39.120W	35 20 54.060N	120 59 39.780W
07/16/84	12:31:00	35 20 54.480N	120 59 38.280W	35 20 54.720N	120 59 38.280W
07/16/84	12:32:00	35 20 54.540N	120 59 38.880W	35 20 54.540N	120 59 38.520W
07/16/84	12:33:00	35 20 55.080N	120 59 39.180W	35 20 54.720N	120 59 37.740W
07/16/84	12:34:00	35 20 55.140N	120 59 40.200W	35 20 54.720N	120 59 38.340W
07/16/84	12:35:00	35 20 55.560N	120 59 39.240W	35 20 54.900N	120 59 37.740W
07/16/84	12:36:00	35 20 55.560N	120 59 39.060W	35 20 54.660N	120 59 37.680W
07/16/84	12:37:00	35 20 55.200N	120 59 39.720W	35 20 54.300N	120 59 38.280W
07/16/84	12:38:00	35 20 55.140N	120 59 39.240W	35 20 54.240N	120 59 37.920W
07/16/84	12:39:00	35 20 55.380N	120 59 38.100W	35 20 54.420N	120 59 37.020W
07/16/84	12:40:00	35 20 54.840N	120 59 37.860W	35 20 54.000N	120 59 37.140W
07/16/84	12:41:00	35 20 54.780N	120 59 37.500W	35 20 54.000N	120 59 36.480W
07/16/84	12:42:00	35 20 54.660N	120 59 37.260W	35 20 54.180N	120 59 35.880W
07/16/84	12:43:00	35 20 54.540N	120 59 36.900W	35 20 54.120N	120 59 35.700W
07/16/84	12:44:00	35 20 54.960N	120 59 35.520W	35 20 55.560N	120 59 34.740W
07/16/84	12:45:00	35 20 55.020N	120 59 34.920W	35 20 55.500N	120 59 35.460W
07/16/84	12:46:00	35 20 54.660N	120 59 36.060W	35 20 54.360N	120 59 35.400W
07/16/84	12:47:00	35 20 55.380N	120 59 35.580W	35 20 54.780N	120 59 34.320W
07/16/84	12:49:20	35 20 56.820N	120 59 35.220W	35 20 54.840N	120 59 33.600W
07/16/84	12:50:00	35 20 56.880N	120 59 34.560W	35 20 54.780N	120 59 33.540W
07/16/84	12:51:00	35 20 56.460N	120 59 34.320W	35 20 54.660N	120 59 34.020W
07/16/84	12:52:00	35 20 56.280N	120 59 33.300W	35 20 54.720N	120 59 33.300W
07/16/84	12:53:00	35 20 55.380N	120 59 33.600W	35 20 54.120N	120 59 34.560W
07/16/84	12:54:00	35 20 55.020N	120 59 32.940W	35 20 54.540N	120 59 34.260W
07/16/84	12:55:00	35 20 54.960N	120 59 31.920W	35 20 54.780N	120 59 33.540W
07/16/84	12:56:00	35 20 55.200N	120 59 32.160W	35 20 54.840N	120 59 33.540W
07/16/84	12:57:00	35 20 55.500N	120 59 32.640W	35 20 54.960N	120 59 33.780W
07/16/84	12:58:00	35 20 55.800N	120 59 32.580W	35 20 55.200N	120 59 33.180W
07/16/84	12:59:01	35 20 55.680N	120 59 33.900W	35 20 54.720N	120 59 34.020W
07/16/84	13:00:00	35 20 56.040N	120 59 34.680W	35 20 54.540N	120 59 34.140W
07/16/84	13:01:01	35 20 55.680N	120 59 34.740W	35 20 54.780N	120 59 34.320W
07/16/84	13:02:00	35 20 55.920N	120 59 33.180W	35 20 55.080N	120 59 33.480W
07/16/84	13:03:01	35 20 55.500N	120 59 33.420W	35 20 54.480N	120 59 33.600W
07/16/84	13:04:00	35 20 55.560N	120 59 32.280W	35 20 54.720N	120 59 33.420W
07/16/84	13:05:00	35 20 55.560N	120 59 31.080W	35 20 54.960N	120 59 33.180W
07/16/84	13:06:01	35 20 55.080N	120 59 31.140W	35 20 55.320N	120 59 33.540W
07/16/84	13:07:01	35 20 55.080N	120 59 31.680W	35 20 56.940N	120 59 31.560W
07/16/84	13:08:00	35 20 55.800N	120 59 32.160W	35 20 56.040N	120 59 33.420W
07/16/84	13:09:01	35 20 55.800N	120 59 34.020W	35 20 56.400N	120 59 33.780W
07/16/84	13:10:00	35 20 55.980N	120 59 35.280W	35 20 56.520N	120 59 34.320W
07/16/84	13:11:00	35 20 56.520N	120 59 34.980W	35 20 57.480N	120 59 33.660W
07/16/84	13:12:00	35 20 56.700N	120 59 35.340W	35 20 57.540N	120 59 34.080W
07/16/84	13:13:01	35 20 56.580N	120 59 35.580W	35 20 57.480N	120 59 34.200W
07/16/84	13:14:00	35 20 56.820N	120 59 35.400W	35 20 57.840N	120 59 34.320W
07/16/84	13:15:00	35 20 56.820N	120 59 35.580W	35 20 57.360N	120 59 34.320W
07/16/84	13:16:01	35 20 57.240N	120 59 34.860W	35 20 57.600N	120 59 34.320W
07/16/84	13:17:01	35 20 56.940N	120 59 35.760W	35 20 57.060N	120 59 34.920W
07/16/84	13:18:00	35 20 57.300N	120 59 35.100W	35 20 57.240N	120 59 34.620W
07/16/84	13:19:00	35 20 57.780N	120 59 34.140W	35 20 57.540N	120 59 33.780W
07/16/84	13:20:00	35 20 57.780N	120 59 33.600W	35 20 57.540N	120 59 33.720W
07/16/84	13:21:00	35 20 57.540N	120 59 33.960W	35 20 57.480N	120 59 34.260W
07/16/84	13:22:00	35 20 57.840N	120 59 33.960W	35 20 57.360N	120 59 34.080W
07/16/84	13:23:00	35 20 58.740N	120 59 33.720W	35 20 57.780N	120 59 33.600W
07/16/84	13:24:00	35 20 58.560N	120 59 34.920W	35 20 57.480N	120 59 34.620W
07/16/84	13:25:00	35 20 59.820N	120 59 33.720W	35 20 58.140N	120 59 32.940W

Date	Time	Ship Position Latitude			Ship Position Longitude			Submersible Position Latitude			Submersible Position Longitude		
07/16/84	13:26:00	35	20	59.400N	120	59	34.080W	35	20	58.080N	120	59	33.540W
07/16/84	13:27:00	35	20	59.220N	120	59	33.480W	35	20	58.140N	120	59	33.960W
07/16/84	13:28:00	35	20	58.860N	120	59	33.060W	35	20	58.620N	120	59	34.440W
07/16/84	13:29:00	35	20	58.800N	120	59	33.420W	35	20	58.260N	120	59	34.860W
07/16/84	13:30:00	35	20	59.160N	120	59	34.140W	35	20	58.800N	120	59	35.340W
07/16/84	13:31:00	35	20	59.880N	120	59	35.340W	35	20	59.760N	120	59	34.800W
07/16/84	13:32:00	35	21	00.000N	120	59	36.060W	35	20	59.880N	120	59	36.000W
07/16/84	13:33:00	35	21	00.060N	120	59	35.760W	35	21	00.480N	120	59	36.180W
07/16/84	13:34:00	35	20	59.820N	120	59	36.000W	35	21	00.420N	120	59	36.360W
07/16/84	13:35:00	35	21	00.720N	120	59	35.100W	35	21	01.380N	120	59	35.220W
07/16/84	13:36:00	35	21	01.200N	120	59	35.700W	35	21	01.740N	120	59	35.520W
07/16/84	13:37:00	35	21	01.740N	120	59	35.940W	35	21	02.160N	120	59	35.160W
07/16/84	13:38:01	35	21	01.860N	120	59	36.300W	35	21	01.920N	120	59	35.820W
07/16/84	13:39:01	35	21	01.800N	120	59	36.480W	35	21	01.860N	120	59	36.540W
07/16/84	13:40:00	35	21	02.040N	120	59	35.520W	35	21	02.400N	120	59	36.060W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/17/84	09:36:00	35 21 37.380N	120 59 40.800W	35 21 32.340N	120 59 38.460W
07/17/84	09:37:01	35 21 37.620N	120 59 40.620W	35 21 32.100N	120 59 38.280W
07/17/84	09:38:00	35 21 37.800N	120 59 40.980W	35 21 32.700N	120 59 37.800W
07/17/84	09:39:00	35 21 37.860N	120 59 41.400W	35 21 36.000N	120 59 39.540W
07/17/84	09:40:00	35 21 37.800N	120 59 42.060W	35 21 36.120N	120 59 40.500W
07/17/84	09:41:00	35 21 38.220N	120 59 42.360W	35 21 36.600N	120 59 40.560W
07/17/84	09:42:20	35 21 38.700N	120 59 42.660W	35 21 33.480N	120 59 38.580W
07/17/84	09:43:00	35 21 38.880N	120 59 42.840W	35 21 34.020N	120 59 39.060W
07/17/84	09:44:00	35 21 39.060N	120 59 43.260W	35 21 34.200N	120 59 39.660W
07/17/84	09:45:00	35 21 38.880N	120 59 43.620W	35 21 35.160N	120 59 38.520W
07/17/84	09:46:00	35 21 37.920N	120 59 44.280W	35 21 35.700N	120 59 38.220W
07/17/84	09:47:00	35 21 36.780N	120 59 45.000W	35 21 35.700N	120 59 38.880W
07/17/84	09:48:00	35 21 35.820N	120 59 44.940W	35 21 36.840N	120 59 39.240W
07/17/84	09:49:00	35 21 35.400N	120 59 43.920W	35 21 37.080N	120 59 38.640W
07/17/84	09:50:00	35 21 34.860N	120 59 42.240W	35 21 36.780N	120 59 38.160W
07/17/84	09:51:00	35 21 34.860N	120 59 40.500W	35 21 36.900N	120 59 37.320W
07/17/84	09:52:00	35 21 35.040N	120 59 38.820W	35 21 36.780N	120 59 36.480W
07/17/84	09:53:00	35 21 35.160N	120 59 38.100W	35 21 36.720N	120 59 35.880W
07/17/84	09:54:00	35 21 35.700N	120 59 37.740W	35 21 37.320N	120 59 35.520W
07/17/84	09:55:00	35 21 36.180N	120 59 37.560W	35 21 37.560N	120 59 34.980W
07/17/84	09:56:00	35 21 36.900N	120 59 37.140W	35 21 38.400N	120 59 34.440W
07/17/84	09:57:11	35 21 37.740N	120 59 37.080W	35 21 38.640N	120 59 34.560W
07/17/84	09:58:00	35 21 37.800N	120 59 36.180W	35 21 39.300N	120 59 33.780W
07/17/84	09:59:00	35 21 38.280N	120 59 35.880W	35 21 39.720N	120 59 33.000W
07/17/84	10:00:00	35 21 38.820N	120 59 35.520W	35 21 39.960N	120 59 32.880W
07/17/84	10:01:00	35 21 39.180N	120 59 34.980W	35 21 40.620N	120 59 32.340W
07/17/84	10:02:00	35 21 39.660N	120 59 34.560W	35 21 40.980N	120 59 31.860W
07/17/84	10:03:00	35 21 40.080N	120 59 34.140W	35 21 41.220N	120 59 31.260W
07/17/84	10:04:00	35 21 40.560N	120 59 33.600W	35 21 41.880N	120 59 30.780W
07/17/84	10:05:01	35 21 40.860N	120 59 33.000W	35 21 42.000N	120 59 30.540W
07/17/84	10:06:00	35 21 41.460N	120 59 32.760W	35 21 42.660N	120 59 30.060W
07/17/84	10:07:00	35 21 41.940N	120 59 32.280W	35 21 43.380N	120 59 29.580W
07/17/84	10:08:07	35 21 42.060N	120 59 32.160W	35 21 43.440N	120 59 29.580W
07/17/84	10:09:00	35 21 42.780N	120 59 31.500W	35 21 43.800N	120 59 28.800W
07/17/84	10:10:01	35 21 43.260N	120 59 30.960W	35 21 44.760N	120 59 28.920W
07/17/84	10:11:00	35 21 43.500N	120 59 30.660W	35 21 44.940N	120 59 28.320W
07/17/84	10:12:00	35 21 44.040N	120 59 30.480W	35 21 45.420N	120 59 28.080W
07/17/84	10:13:01	35 21 44.460N	120 59 30.360W	35 21 45.660N	120 59 27.720W
07/17/84	10:14:00	35 21 44.940N	120 59 30.000W	35 21 46.140N	120 59 27.480W
07/17/84	10:15:00	35 21 45.420N	120 59 29.640W	35 21 46.200N	120 59 26.760W
07/17/84	10:16:00	35 21 45.960N	120 59 29.460W	35 21 46.800N	120 59 26.520W
07/17/84	10:17:00	35 21 46.440N	120 59 29.040W	35 21 47.340N	120 59 26.040W
07/17/84	10:18:00	35 21 46.860N	120 59 28.860W	35 21 47.460N	120 59 25.620W
07/17/84	10:19:01	35 21 47.340N	120 59 28.680W	35 21 47.880N	120 59 25.260W
07/17/84	10:20:00	35 21 47.820N	120 59 28.380W	35 21 48.480N	120 59 25.080W
07/17/84	10:21:00	35 21 48.060N	120 59 27.780W	35 21 49.140N	120 59 24.720W
07/17/84	10:22:00	35 21 48.300N	120 59 27.180W	35 21 49.200N	120 59 24.120W
07/17/84	10:23:00	35 21 48.540N	120 59 26.760W	35 21 49.260N	120 59 23.760W
07/17/84	10:24:00	35 21 48.960N	120 59 26.640W	35 21 49.440N	120 59 23.460W
07/17/84	10:25:00	35 21 49.320N	120 59 26.640W	35 21 50.040N	120 59 23.400W
07/17/84	10:26:00	35 21 49.680N	120 59 26.340W	35 21 50.580N	120 59 23.040W
07/17/84	10:27:00	35 21 50.100N	120 59 25.980W	35 21 51.060N	120 59 22.560W
07/17/84	10:28:00	35 21 50.460N	120 59 25.800W	35 21 51.240N	120 59 22.080W
07/17/84	10:29:00	35 21 50.760N	120 59 25.620W	35 21 51.420N	120 59 22.080W
07/17/84	10:30:00	35 21 51.060N	120 59 25.260W	35 21 51.900N	120 59 21.540W
07/17/84	10:31:00	35 21 51.420N	120 59 24.840W	35 21 52.140N	120 59 21.120W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/17/84	10:32:00	35 21 51.660N	120 59 24.480W	35 21 52.320N	120 59 20.940W
07/17/84	10:33:01	35 21 51.960N	120 59 24.060W	35 21 52.560N	120 59 20.400W
07/17/84	10:34:01	35 21 52.140N	120 59 23.460W	35 21 52.440N	120 59 19.860W
07/17/84	10:35:00	35 21 52.380N	120 59 22.980W	35 21 52.200N	120 59 19.560W
07/17/84	10:36:00	35 21 52.620N	120 59 22.620W	35 21 52.140N	120 59 19.380W
07/17/84	10:37:00	35 21 52.920N	120 59 22.500W	35 21 51.960N	120 59 19.500W
07/17/84	10:38:00	35 21 53.100N	120 59 22.320W	35 21 52.080N	120 59 18.720W
07/17/84	10:39:00	35 21 53.340N	120 59 21.960W	35 21 52.200N	120 59 18.600W
07/17/84	10:40:01	35 21 53.520N	120 59 21.720W	35 21 52.200N	120 59 17.940W
07/17/84	10:41:01	35 21 53.700N	120 59 21.480W	35 21 56.160N	120 59 19.320W

		Ship Position		Submersible Position	
Date	Time	Latitude	Longitude	Latitude	Longitude
07/16/84	16:59:00	35 27 51.420N	121 05 18.840W	35 27 51.840N	121 05 19.860W
07/16/84	17:00:00	35 27 50.940N	121 05 18.360W	35 27 51.840N	121 05 20.040W
07/16/84	17:01:00	35 27 49.860N	121 05 18.720W	35 27 51.120N	121 05 20.880W
07/16/84	17:02:00	35 27 49.740N	121 05 16.920W	35 27 51.420N	121 05 19.980W
07/16/84	17:03:01	35 27 49.620N	121 05 15.600W	35 27 52.080N	121 05 18.720W
07/16/84	17:04:00	35 27 48.300N	121 05 16.740W	35 27 48.900N	121 05 20.700W
07/16/84	17:05:00	35 27 47.880N	121 05 16.200W	35 27 49.320N	121 05 19.800W
07/16/84	17:06:00	35 27 47.400N	121 05 16.260W	35 27 49.320N	121 05 19.860W
07/16/84	17:07:00	35 27 47.400N	121 05 15.900W	35 27 49.560N	121 05 19.140W
07/16/84	17:08:00	35 27 46.800N	121 05 16.560W	35 27 49.320N	121 05 18.420W
07/16/84	17:09:00	35 27 46.200N	121 05 17.880W	35 27 48.660N	121 05 19.440W
07/16/84	17:10:00	35 27 46.680N	121 05 18.000W	35 27 49.080N	121 05 18.480W
07/16/84	17:11:01	35 27 47.340N	121 05 18.420W	35 27 49.320N	121 05 16.800W
07/16/84	17:12:00	35 27 46.860N	121 05 20.520W	35 27 48.660N	121 05 17.760W
07/16/84	17:13:00	35 27 46.920N	121 05 20.880W	35 27 48.420N	121 05 17.340W
07/16/84	17:14:00	35 27 46.980N	121 05 20.520W	35 27 48.240N	121 05 16.320W
07/16/84	17:15:01	35 27 46.440N	121 05 20.760W	35 27 47.880N	121 05 16.740W
07/16/84	17:16:00	35 27 45.780N	121 05 20.700W	35 27 47.880N	121 05 16.980W
07/16/84	17:17:00	35 27 45.780N	121 05 20.040W	35 27 48.300N	121 05 16.620W

APPENDIX C

Data Analysis Methods

Appendix C

C.1 CREATION OF AN ORDINATION SPACE

Results from Smith and Bernstein (1985) indicate that ordinations from different methods will sometimes produce very different results, which in turn can have a profound effect on the final index values. Good general evaluations of the different ordination methods used in ecology are found in Gauch (1982) and Pimentel (1979). In this section a review is presented of the different ordination techniques available, followed by a discussion of some of the general problems involved in building a good ordination space, along with some possible solutions. Finally, a combination of methods is described which should produce an ordination space with the desired properties.

C.1.1 Currently Available Ordination Techniques

Ordination techniques can be classified into two general categories as described in Section C.1.1.1 and C.1.1.2.

C.1.1.1 Techniques Which Require an Initial Input of a Distance Matrix

A distance matrix is made up of distance index values which compare all possible combinations of sample pairs. A distance index uses the species importance values (abundance, percent cover, presence/absence, etc.) to quantify the biological dissimilarity between a pair of samples (Clifford and Stephenson, 1975; Goodall, 1973).

The ordination techniques in this category include:

1. Principal coordinates analysis (PCA)

Here, the distance matrix is transformed to a covariance-type matrix; the eigenvectors of this matrix, when standardized by the square-root of the eigenvalues, are the scores of the ordination space (Gower, 1966; Gower, 1967; Sneath and Sokal, 1973; Blackith and Reyment, 1971). This method was utilized in Smith and Greene (1976).

2. Position vectors ordination

This is an approximation of principal coordinates ordination (Orloci, 1975). Shortcuts are taken to minimize computational time, but the quality of the results may suffer.

3. Polar ordination.

With this method, the analyst first chooses the endpoints of an ordination axis. Then, using the distances from these endpoints to each other sample, the ordination scores are computed as projections onto a line connecting the two endpoints. The length of the axis is set equal to the distance between the endpoints. More details on polar ordination are found in Bray and Curtis (1957), Beals (1960), Orloci (1975), and Gauch and Scruggs (1979). Since polar ordination only uses the distances between each sample and the endpoint samples, much potentially important information in the other distances is unused. Our tests have shown that the placement of samples in the space suffers because of this weakness (when compared to other methods which utilize all the distance values).

4. Non-metric multidimensional scaling (MDS)

This is an iterative procedure with the following steps:

a. The inter-sample distance matrix is computed.

b. An arbitrary configuration of points (samples) makes up the initial ordination space. The number of dimensions of the space must be chosen by the analyst.

c. The rank order of distances between the points in the configuration is compared with the rank order of the distance index values. A measure of the correspondence between the two rank orders is called stress; the higher the stress, the less the agreement. When the stress is sufficiently low, the ordination space will be a good reflection of the original distance matrix.

d. After the stress is calculated, each point in the space is moved a small amount in a direction which will tend to lower the stress measure. This results in a new configuration.

e. Steps c and d are repeated until the stress is reduced to the desired level. The final configuration is the ordination space to be used.

Of special importance here is the fact that only the rank order of distances is used instead of the actual distance values. There are two basic types of MDS: global and local (Sibson, 1972). With global MDS, the entire distance matrix is ranked at once, whereas with local MDS, each row of the distance matrix is ranked separately. Sibson (1972) and Prentice (1977) propose that there are theoretical advantages with local MDS when using ecological-type data.

There is also metric multidimensional scaling which uses the actual distance values instead of ranks. When using the distance values in this manner, we prefer principal coordinates analysis, since it requires less computation time, and does not require an initial estimate of dimensionality.

For more detail on MDS, see Kruskal (1964a, 1964b), Kruskal and Wish (1978), Sibson (1972), Prentice (1977), Prentice (1980), Orloci (1975), Fasham (1977), and Pimentel (1979).

5. Parametric mapping.

This is similar to multidimensional scaling, except that instead of minimizing a stress measure, a measure of "continuity" in the space is maximized. Noy-Meir (1974) describes the method in detail. In testing the method, he reports some good results, but experienced computational difficulties as the number of samples analyzed became larger. Austin (1976) found unsatisfactory results with some types of data, and Prentice (1977) lodges theoretical objections to the method.

C.1.1.2 Techniques Which Directly Calculate the Ordination Space

1. Principal components analysis (PCA)

Here each species is represented by a single dimension of the ordination space. The sample positions are determined by the species abundances in the samples. The origin of the space is usually moved to the center of all sample points. The dimensions of the space are then rotated so that a maximum amount of variation between points is expressed in a minimun number of final dimensions. In tests comparing ordination techniques, PCA usually fares the worst (Gauch et al., 1977; Fasham, 1977). Unfortunately, PCA has been used frequently in ecological studies because it is a standard statistical technique which is found in most standard statistical computer programs. The results of PCA can be somewhat improved by site standardization of the data (Orloci, 1967; Gauch et al., 1977), but the method still suffers compared to other ordination techniques. Finally, it should be noted that PCA is equivalent to a principal coordinates analysis based on Euclidean distances.

2. Gaussian ordination

This method tries to find ordination axes which maximize the fit of the species to normal curves along the axes. The method proposed by Gauch et al. (1974) only allows for the calculation of a single ordination axis, making it unusable for the current application. In addition, the underlying model is too restrictive for most applications. The method proposed by Ihm and van Groenewoud (1975) allows for more axes. We tested this method using simulated data, with poor results.

3. Reciprocal averaging (RA)

This method computes simultaneous species and sample ordinations. In a species ordination, the points in the space represent species instead of samples. This is an iterative procedure with several steps:

a. Each species is given an arbitrary score in a species ordination space.

b. For each sample, a weighted average species score is calculated. The weights are the species abundance values in the sample.

c. For each species, a weighted average sample score is calculated.

d. Steps b and c are repeated until successive iterations produce very little change in score values.

e. After the scores for an axis are calculated, another axis is calculated in a similar manner, except that an orthogonalization procedure is applied to insure that the axis scores are independent of all other axes already calculated.

For more detail, see Hill (1973), Hill (1974), Fasham (1977), and Gauch et al. (1977). This method is also called correspondence analysis. It is equivalent to noncentered PCA with a preliminary double standardization of the data.

4. Detrended correspondence analysis (DCA)

This technique is a variation of reciprocal avaraging which corrects for some of the deficiencies of reciprocal averaging (and most other ordination techniques). These problems and detrended correspondence analysis are discussed in more detail below. Useful references on the method are Hill and Gauch (1980), and Gauch (1982).

C.1.2 The Problem of Building an Optimal Ordination Space

C.1.2.1 The Distance Problem

There are several different distance indices currently used by ecologists. The accuracy and precision with which biological change is measured varies with the index used and with the preliminary transformations and/or standardizations performed on the data prior to the index calculations. All distance indices lose sensitivity as the actual amount of biological change increases (Swan, 1970; Beals, 1973). Figure C-1 illustrates this property of distances, and Figure C-2 shows how the nature of species data causes this difficulty.

For methods depending on inter-sample distances, the quality of the final ordination space will usually be a direct reflection of the quality of the initial distance values. Principal coordinates ordination (PCO) of the data in Figure C-2 is shown in Figure C-3. Since the longer distances are too short, the ends of the gradient will be "pulled together" toward the middle of the first axis, creating the familiar "horseshoe" pattern often observed in analyses with data containing a single, fairly long gradient (Swan, 1970; Gauch et al., 1977). With more than one gradient in the data, the suboptimal distances can cause other more complex configurations, which in turn can obscure the true biological patterns in the data (Austin and Noy-Meir, 1971; Austin, 1976; Gauch and Whittaker, 1976; Gauch et al., 1977). Additionally,

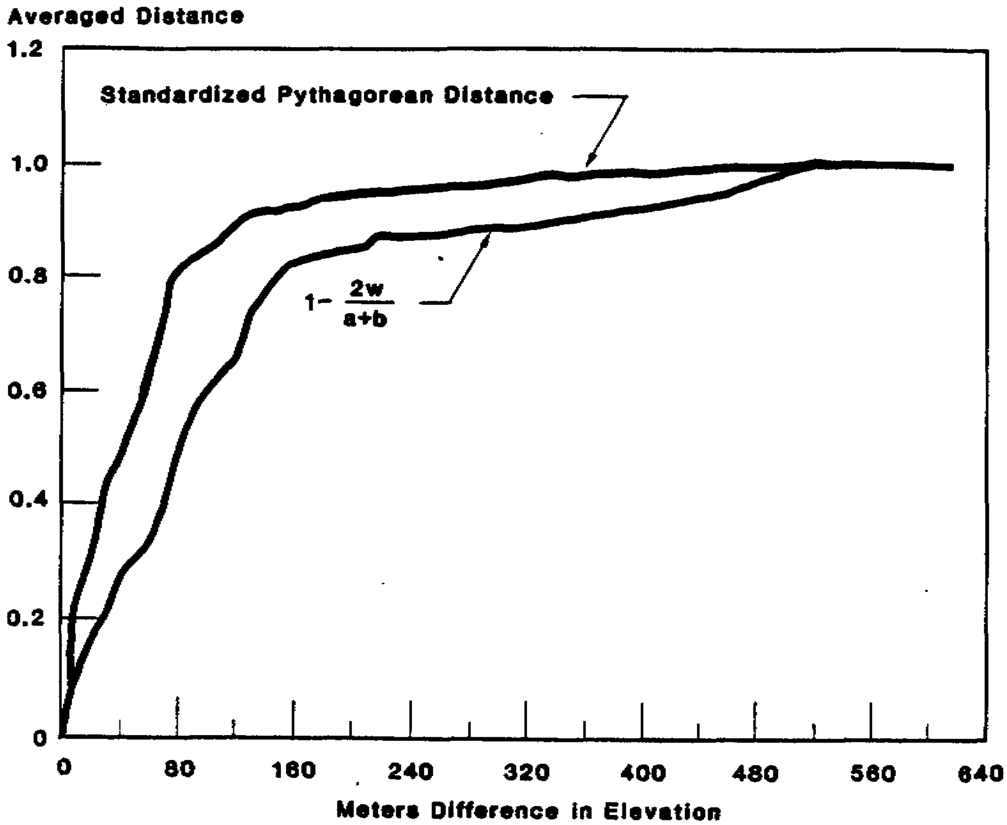
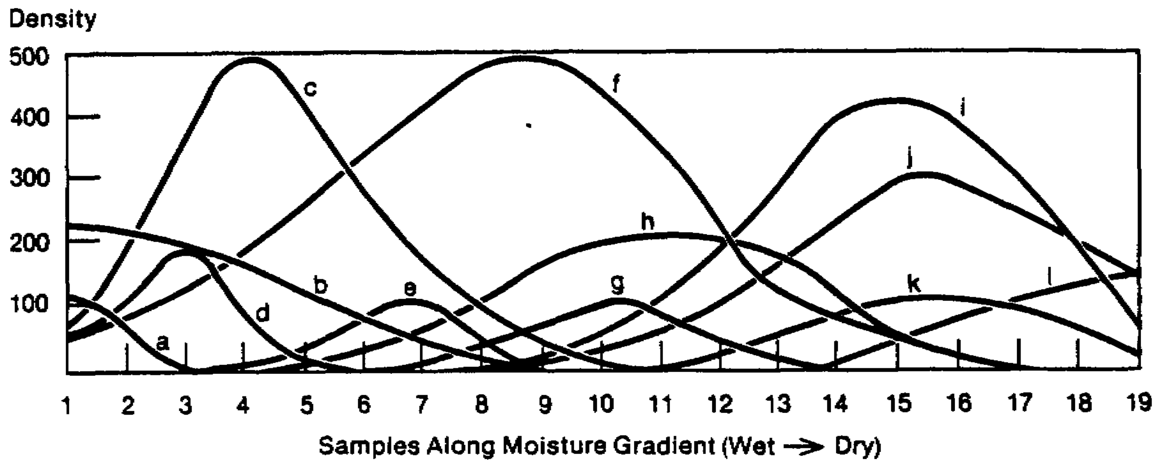


Figure C-1. Figure 3 from Beals (1973) showing the usual relationship between ecological distance index values and changes along long gradients of environmental and biological change. It is known that the biological communities change at a constant rate with changes in elevation, thus the horizontal axis actually represents community change. Note that the distance indices lose sensitivity when measuring larger amounts of biological community change. If the distance indices were measuring community change properly, there would be a straight-line relationship between difference in elevation and average distance.



a. Plant Species Densities Along Environmental Moisture Gradient. After Whittaker (1973).

Figure C-2. The pattern of species change along a moisture gradient (after Whittaker, 1973b: Fig. 1). The positions of 19 sampling sites equally spaced along the gradient are shown (sites 1-19). There are 12 individual species curves (species a-k). Two aspects of the species abundance curves cause problems when using species abundances to measure biological change along the gradient with distance indices (Swan, 1970). First, the species curves are truncated when a value of zero is reached. Once the curve truncates, the species in question supplies no further information on biological differences with sites further along on the gradient. As sites further apart are compared, more and more species curves will truncate, causing the distance values to level off. Secondly, the non-monotonic nature of the species curves means that each species will have the same abundance value at two different positions on the gradient. When comparing sites on opposite sides of a species curve, the species in question will indicate that the sites are more similar than they really are (Beals, 1973).

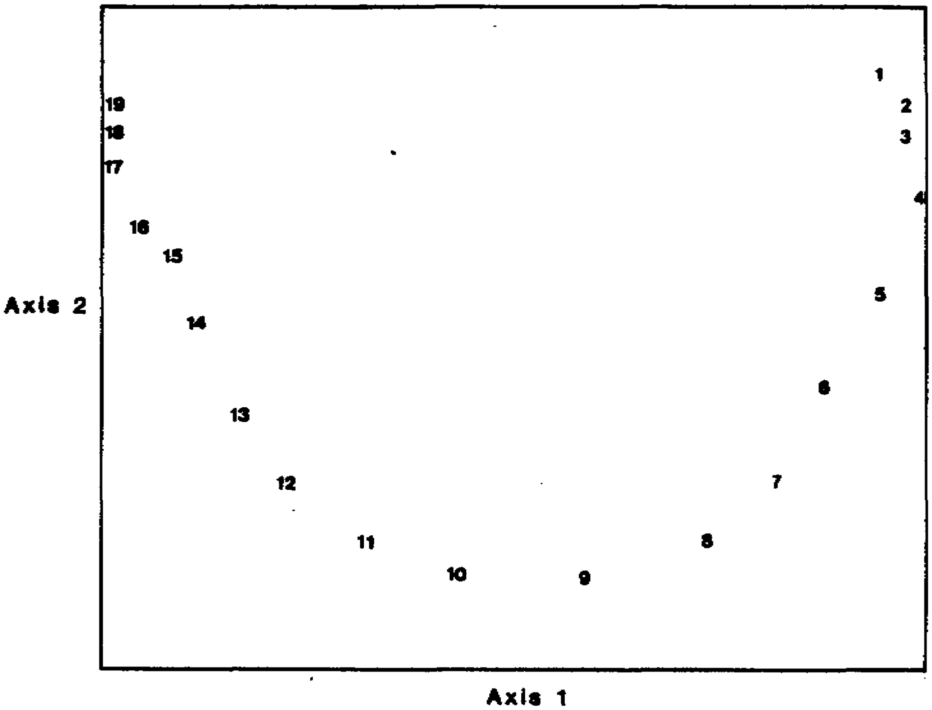


Figure C-3. Principal coordinates analysis (PCO) of the data shown in Figure C-2. The Bray-Curtis distance index was used. The data were first transformed by a square root and standardized by a species mean (of values > 0). The distances are calculated in the same manner in all simulations that follow. Since there is only a single gradient represented in the data, the ideal ordination result would be a straight line of equally spaced points parallel with axis 1. In this pattern, the sites would be in the same order in which they occur along the gradient, and there would be very little variation along axis 2. We instead see a curved 'horseshoe'-shaped pattern with a large amount of variation along axis 2. This result is due to the deficiencies of the distances used as input to the PCO analysis.

the analyst may try to interpret such completely spurious patterns as representative of reality.

The above is true even for ordination techniques not directly dependent on the input of inter-sample distances. As noted, PCA is identical to a PCO with Euclidean distances input; thus, typically poor PCA results are due to the inefficiency of the Euclidean distances. RA is equivalent to a noncentered PCA with a preliminary double standardization of the data. Thus, with the exception of DCA, it appears that all the methods that have not been rejected for other reasons are directly or indirectly susceptible to the shortcomings of the distance indices.

In a sense, however, these types of ordination are relatively accurate. The points in the local vicinity of a given point are spaced and ordered reasonably well (e.g., see Fig. C-3). It is the large-scale, or global pattern which can become distorted. This could be expected, since longer distances are the most distorted, while it is the more numerous shorter distances which determine the local patterns.

C.1.2.2 Possible Solutions to the Distance Problem

1. Develop a better distance index

EcoAnalyis, Inc. has developed a distance index (ZAD) which does not have many of the deficiencies of the other indices. It does not "level off" with larger degrees of biological change (as in Figure C-1). Unfortunately, the calculations are complex, and the compuational time required is quite long when compared to most other distance indices. For these reasons, we continued to search for simpler and more accessible methods which would give similar or better results.

2. Find an Ordination Method Which is Minimally Affected by the Deficiencies of the Distance Indices

MDS results should be more robust and "forgiving" when used with different distance indices, since only the ranks of the distances are used. In fact, the ranks will often be superior to the original distance values (Prentice, 1977). Even though the distance values level off with increasing biological change (as shown in Figure C-1), the ranks will keep increasing as long as there is some increase (however small) in the distance values. Also, the non-monotonic, non-linear nature of species distributions (Figure C-2), along with the usual sampling error, makes it very difficult to quantify biological changes with much precision. Thus, the exact distance values may not be much better (or may be worse) than the ranking of the distance values. Figure C-4 shows an ordination of the data in Figure C-2 with global MDS, and Figure C-5 shows the result for local MDS. Note that the global result is somewhat "bent", but less so than the PCO result (Figure C-3). The local MDS result is the best yet, with very little curvature. Prentice (1980) also found that local MDS gave generally better results than did global MDS.

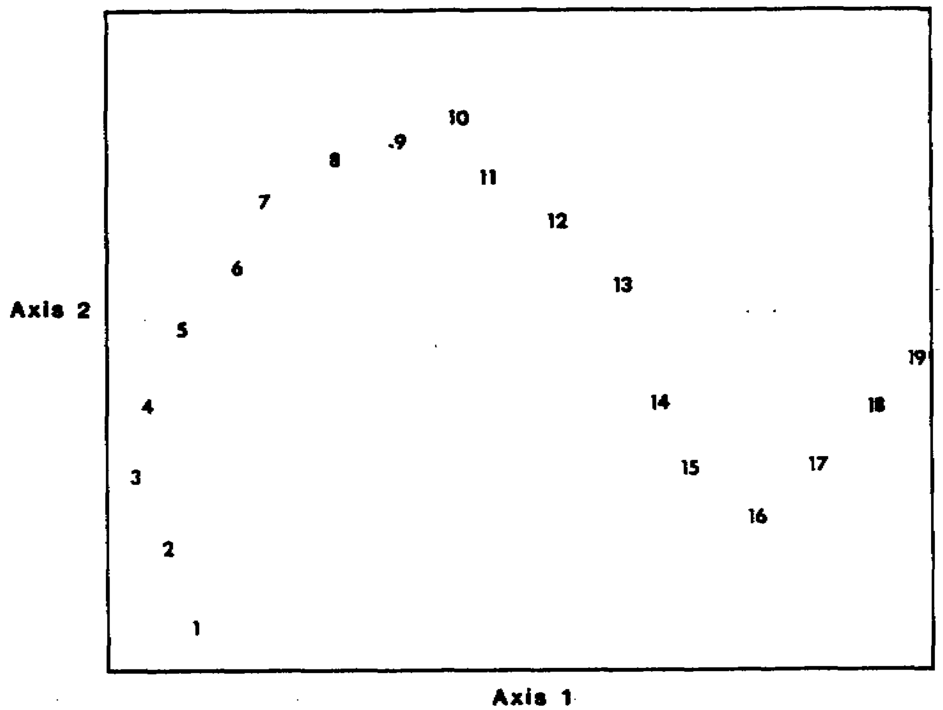


Figure C-4. Global MDS ordination of the data in Figure C-2. The starting configuration is that suggested in Kruskal (1964: page 120). The pattern representing the gradient is still curvilinear in the space, although a little less so than the PCO result in Figure C-3. Our tests found that with more complex data than those used here, global MDS is quite susceptible to the local minimum problem. An initial configuration fairly close to the best result would avoid this problem.

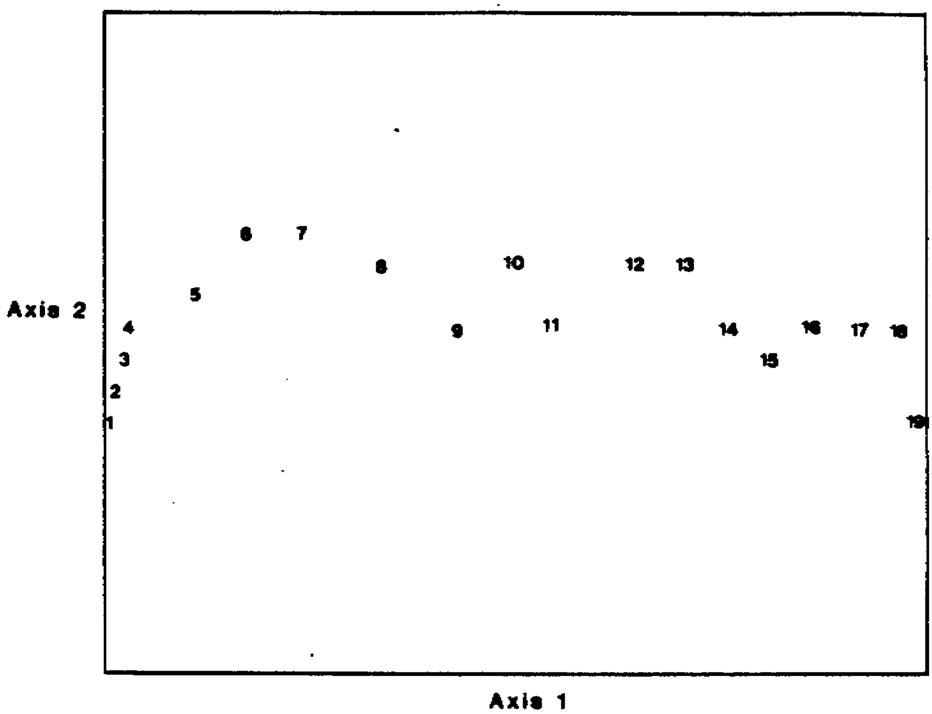


Figure C-5. Local MDS ordination of the data in Figure C-2. The starting configuration is that suggested in Kruskal (1964: page 120). The result is much closer to the ideal, with the sites along the gradient more or less spread out in a linear configuration. The stress for this configuration is 2.4%. A similar result is always obtained when a starting configuration close to the ideal is used. The arbitrary initial configuration used here would not necessarily always guarantee the optimal result.

This difference between the global and local MDA result is interesting in light of the results of Gauch et al. (1981), who found no significant differences between local and global MDS. The reason for these contradictory results became clear as we ran further tests. We found that the MDS result is very sensitive to the initial configuration. Thus, the seemingly contradictory results could have arisen simply from different means of choosing an initial configuration. Figure C-6 shows the local MDS result (using the Figure C-2 data) with the PCO scores shown in Figure C-3 as the initial configuration. The local MDS now produces a result which is little better than the inferior PCO result. The stress (measure of how well the distance ranks fit the final configuration) of the poorer result in Figure C-6 was actually lower than the stress of the better result in Figure C-5, so stress cannot be a guide to which result is better.

We concluded that MDS showed promise if several problems could be solved.

a. The local minimum problem

This is another name for the problem mentioned above, namely that, when given different initial configurations, the method does not always produce the same result. The iterations can become trapped in a configuration which is a "local" stress minimum; however, some other quite different configuration can exist with lower stress (Kruskal, 1964a, 1964b; Kruskal and

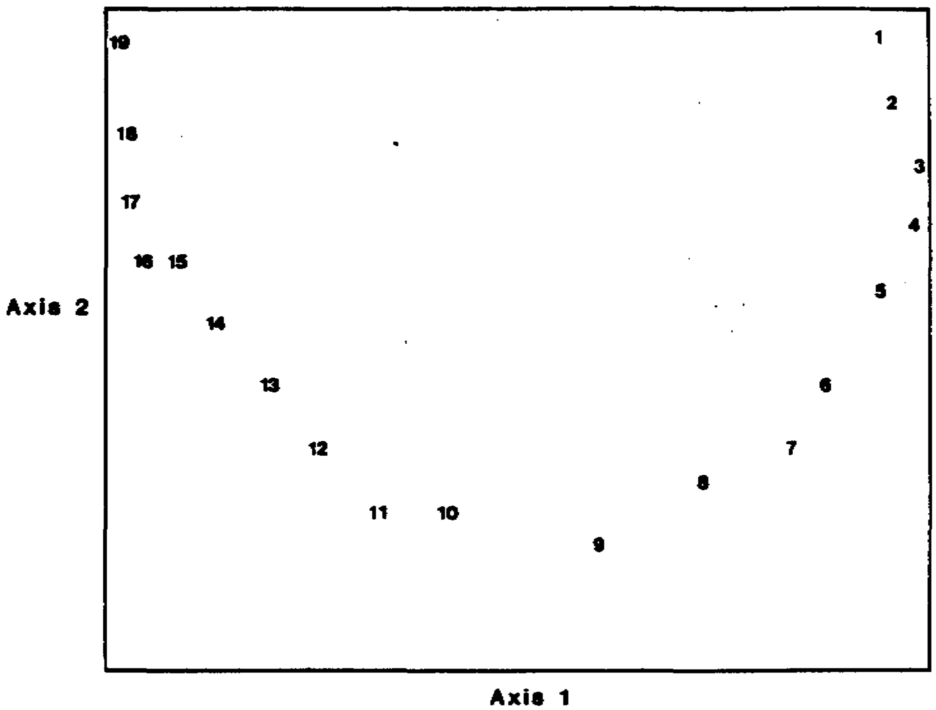


Figure C-6. Local MDS ordination of the data in Figure C-2. The starting configuration is the PCO result shown in Figure C-3. The stress is 1.4%, which is lower than the more ecologically meaningful result in Figure C-5. Thus, the stress measure is not necessarily a measure of the success of the ordination. This result also illustrates the importance of the initial configuration in the quality of the result. To assure the best result, the MDS should start with an initial configuration close to that which is most ecologically meaningful. This will force the method to converge to a result more similar to the one in Figure C-5 than to the one shown here.

Wish, 1978). Traditionally, analysts have used the stress level as a measure of the quality of the configuration. However, we have shown that a poor configuration (in an ecological sense) can have low stress (Figure C-6). Since the distances are flawed, some stress is expected in an ecologically accurate configuration. It is desireable to find a means of directing the method to converge on the most ecologically meaningful configuration, even when this configuration is not associated with the minimal stress.

b. The dimensionality problem

The analyst must choose the number of dimensions or axes beforehand. If the number chosen is too low, important ecological information may be lost, and if too many dimensions are chosen, random error can become prominent in the results (Kruskal and Wish, 1978). We have found that a few extra axes will not harm the quality of the results, but too few axes can cause problems. Often, the analyst will not know the dimensionality to use. In fact, finding the dimensionality (number of ecologically important gradients) is one of the goals of the analysis in the first place.

c. The computational problem

MDS can be computationally demanding. One way to decrease the computation time is to begin with an initial configuration not too different from the final (optimal) configuration.

d. Susceptibility to the distance problem

As seen in Figure C-4, global MDS is still affected by the distance problem, although less so than PCO. It would be advantageous if the global MDS results could be improved, since it requires less computation than local MDS. Local MDS (Figure C-5) produced good results with the test data. When tested with a gradient several times longer (in terms of species turnover) than that in Figure C-2, however, it formed a "horseshoe" shaped configuration even though we started from a configuration close to the correct one. Thus, assuming that the local minimum problem can be solved, local MDS is not immune to the distance problem for very long gradients. Similar results were found by Prentice (1980).

3. Use a Method Which is Unrelated to Distances

Detrended correspondence analysis (DCA) falls into this category. Computationally, DCA is related to RA. However, the way in which the scores for the different axes are made independent differs dramatically from RA and all other ordination techniques. DCA not only makes axes independent (i.e., uncorrelated), but also removes any systematic relationship between axes. For example, with the "horseshoe" pattern (e.g., Figure C-3) the scores of axes 1 and 2 are independent, but a systematic quadratic relationship still exists between them. When calculating axis 2 scores, the "detrending" process of DCA will not allow the formation of the quadratic relationship (Hill and Gauch, 1980). Extensive tests (Hill and Gauch, 1980; Gauch et al., 1981; Gauch,

1982) show that DCA does indeed remove the "horseshoes" and other distortions caused by the distance problem.

Encouraged by these results, we computed index values using DCA ordination spaces. On some data, the results were poor. Upon close examination of the offending ordination spaces, it became clear that the detrending process was "detrending" real biological patterns from the scores. The detrending process does not distinguish between systematic relationships which are real and those which are caused by the distance problem. To test this idea, a data matrix was created which represented a two-dimensional coenoplane (Gauch and Whittaker, 1976) of biological change. These data would contain two independent gradients, and a correct ordination would appear as shown in Figure C-7a. Some of the samples from the pattern were then removed to make the true configuration appear somewhat like a horseshoe (Figure C-7b). The DCA ordination of the Figure C-7b data is shown in Figure C-7c. The result should appear similar to Figure C-7b. In its attempt to destroy the "horseshoe", the DCA somewhat distorted the true pattern.

The DCA result, however, is not without value. The large-scale, or global pattern is satisfactory. For example, in Figure C-7c, the samples that should be on the left are on the left, and the samples toward the top are toward the top, etc. It is the small-scale or local patterns that can become distorted. Interestingly, this is the exact opposite of the problem with the ordinations based on the distances, where the global patterns can become distorted, while the local patterns are preserved.

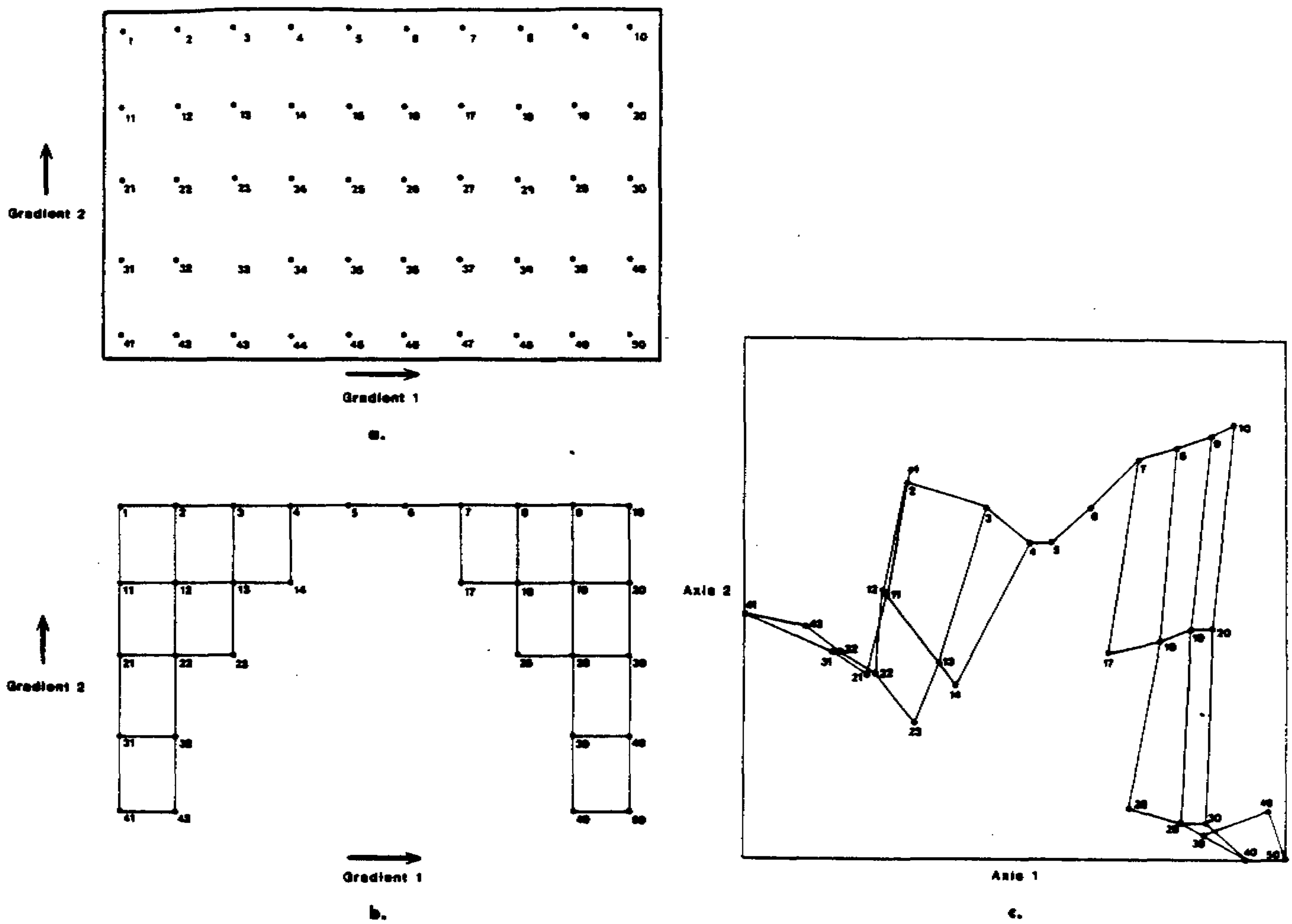


Figure C-7. a) Fifty sampling positions on a simulated coenoplane (data containing two independent gradients). A program based on the techniques of Gauch and Whittaker (1976) was used to create the data. The beta diversity along gradient 1 is 5 SD, and that along gradient 2 is 3 SD. The simulation involved creating data values for forty species at the fifty sampling positions shown. b) The same grid of samples as in (a) above, but with samples removed to make the configuration appear like a 'horseshoe' pattern. A good ordination of these data would recover this 'horseshoe' shape since it is a pattern that actually exists in the data, and is not a result of poor distances. In our experience with actual field data, such configurations with systematic (but independent) relationships between gradients are not uncommon. The lines connecting the samples are intended to facilitate comparison with the ordination results in (c) and Figure C-8. c) DCA ordination of the data shown in (b). Note that the DCA method, in its attempt to eliminate the systematic relationships between axes 1 and 2, has distorted the positions of samples toward the ends of the 'horseshoe' (samples 32-50). The same lines connecting the samples in (b) are shown.

4. Use a Combination of Methods to Preserve Both Global and Local Patterns

As shown, MDS, utilizing inter-sample distances, can give at least a good small-scale representation of the data, and if given a proper initial configuration, can give a good large-scale result as well. DCA, on the other hand, can supply a good large-scale configuration but sometimes will supply a questionable small-scale pattern. We propose to use the DCA scores as the initial configuration in a MDS analysis. This solves all the problems with MDS which were enumerated above and includes:

a. The local minimum problem

The DCA results will be a good initial configuration for the MDS because they are a good representation of the global patterns in the data. As comparison of Figures C-5 and C-6 shows, if given a good initial configuration, the MDS (local type) can produce a satisfactory large-scale result while preserving the small-scale patterns. The MDS will utilize the good small-scale information contained in the distances to "undo" any local distortions caused by the "detrending" in the DCA. Figure C-8 shows MDS results using the Figure C-7b data, with the DCA result shown in Figure C-7c as the initial configuration. This produces is a fairly good representation of the desired pattern (it resembles Figure C-7b).

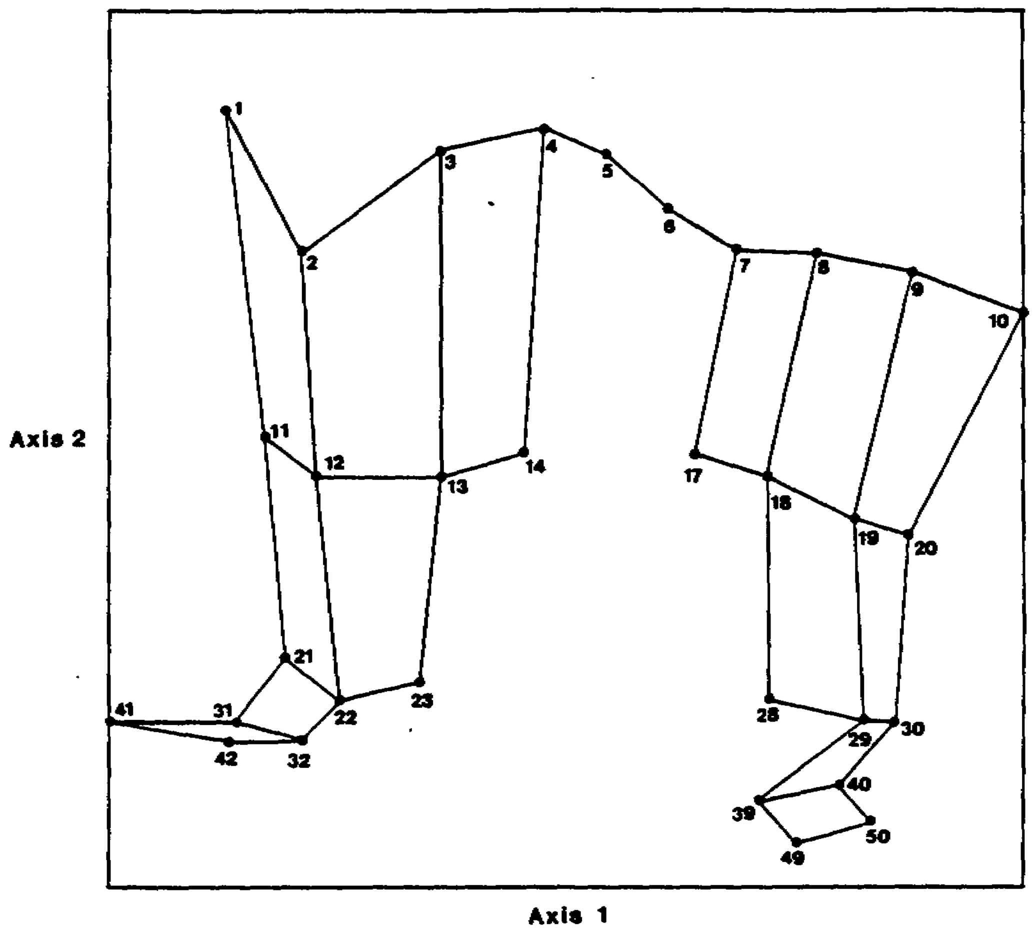


Figure C-8. Local MDS ordination of the data in Figure C-7(b). The DCA ordination result shown in Figure C-7(c) was used as the initial configuration. The MDS improves upon the DCA result. The pattern of sampling positions is closer to the ideal result, which would resemble Figure C-7(b). The same lines connecting the samples in Figure C-7(b) are shown.

There will be times when the DCA solution is already sufficient. We would want to be sure that the application of MDS to such a configuration would not create a less desirable solution. Figure C-9a shows a simulated ceonoplane; Figure C-9b shows the resulting DCA ordination space, and Figure C-9c shows the MDS ordination space (using the DCA result as initial configuration). DCA should perform well with this type of data, since there is no real systematic relationship between axes. As can be seen by comparison of the DCA and MDS results, the MDS actually improved upon the DCA results. In tests with data containing only one gradient, the DCA results alone were quite satisfactory.

b. The dimensionality problem

The results of the DCA can give the analyst a clue to the approximate dimensionality of the data. The eigenvalues from the analysis show the amount of variation associated with each axis. The major trends in the data will correspond to axes with a relatively large amount of variation. We recommend using a few more dimensions than indicated by the DCA. The extra dimensions allow "room" for patterns that may not be well developed in the DCA space. Kruskal and Wish (1978) recommend extra dimensions for similar reasons. After the MDS calculations, the axes will not be in any special order of importance. For example, the main pattern in the data could be along the fourth axis, or some combination of two or more axes. To make the axis order correspond with the importance or size of the different patterns in the data, we perform a PCA

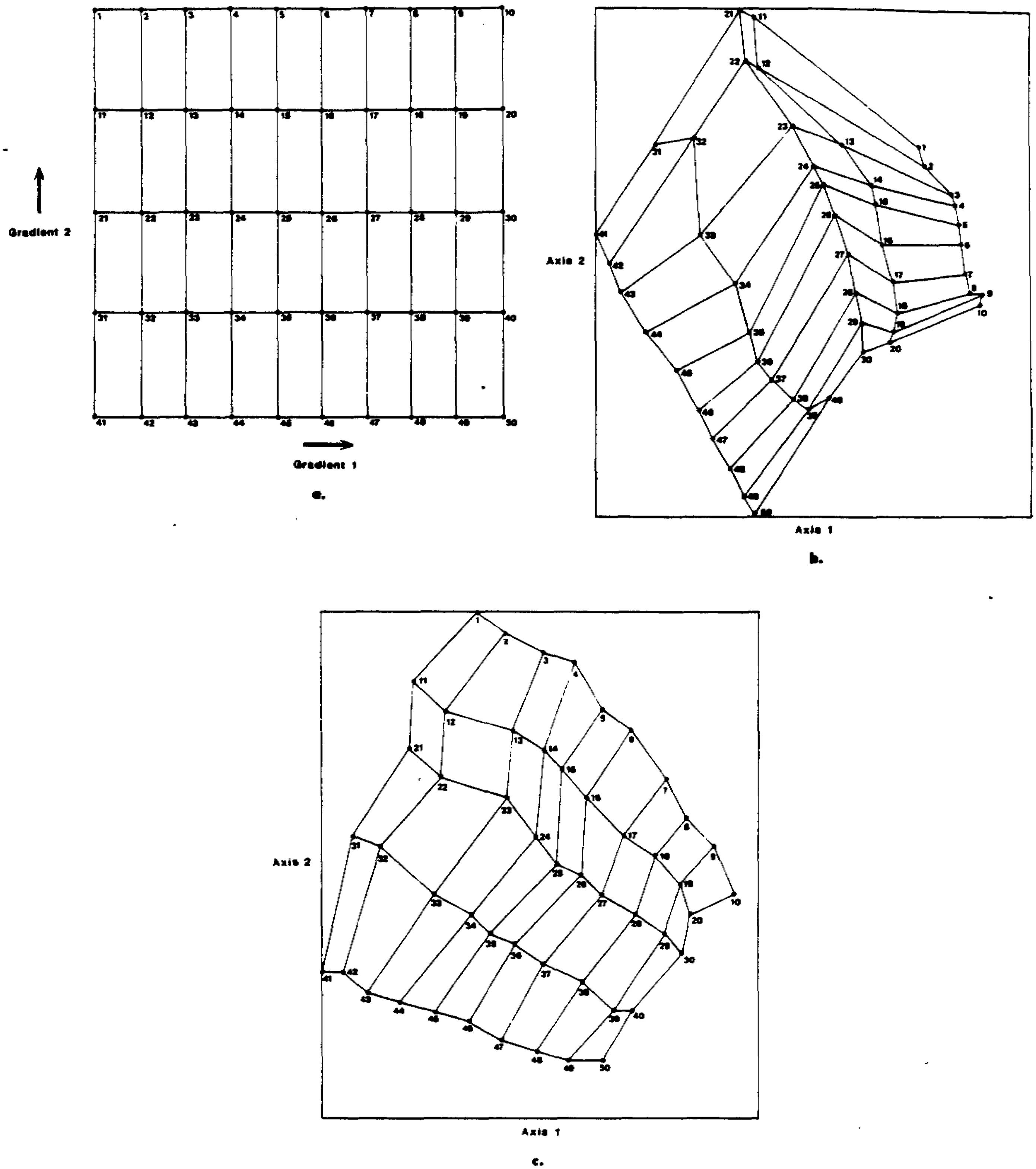


Figure C-9. a) Fifty sampling positions on a simulated coenoplane. The beta diversity along gradient 1 is 5 SD, and that along gradient 2 is also 5 SD. DCA should do well with this pattern, since there are no real systematic relationships between the positions of the samples on the two gradients. b) DCA results using the data in (a). As expected, there are no serious distortions caused by the detrending. c) Local MDS result, using the DCA results as the initial configuration. Note that the MDS actually improves on the DCA result. The spacing between adjacent samples is more consistent and the overall pattern is more 'square'.

analysis of the MDS scores. This does not alter the relationships between the points in the space, but makes it easier to observe and interpret these relationships.

c. The computational problem

The initial configuration (the DCA results) will usually be fairly close to the final result (i.e., the points in the space will not have to move too far). This will decrease the number of iterations required in the MDS computations. For the number of samples used in the present applications, the MDS calculation time was within reason. For example, using an IBM 3081 with the MVS operating system, an analysis with 67 samples required 4.42 seconds for the DCA calculations and 6.84 seconds for the MDS calculations. For another with 224 samples, the DCA took 11.7 seconds and the MDS took 73.5 seconds. With many more samples, the DCA computational time will increase only linearly (Hill and Gauch, 1980), but the time required for MDS may become quite large. Additional methods will be explored to minimize the MDS calculations. It may be possible to select a maximally informative subset of the distances for use in the calculations, since MDS does not require the complete distance matrix. Finally, the use of global MDS instead of local MDS would save computational time, since half the number of distance values are used in the calculations.

d. Susceptibility to the distance problem

Present tests and Prentice (1980) show that with local MDS, the distorted longer distances do not become a problem until the species turnover along the gradients being measured is quite large.

One solution to the distance problem (with MDS as proposed here) when long, potentially problematical, gradients are encountered is the use of the step-across procedure proposed by Williamson (1978) and generalized by Smith (1984). Here, the longer distances are reestimated from the shorter distances. In the present study, we used this procedure to reestimate all distances above a value of 0.8.

C.1.3 Some Computational Details

C.1.3.1. MDS Calculations

For all ordination analyses local MDS was used. The initial configuration in each analysis was the result from a DCA analysis on the same data. Kruskal (1964a, 1964b) describes two approaches to tied distance values, which he terms primary and secondary. We used the primary approach because of its less restrictive assumptions (Prentice, 1980). We assumed that the distances between points in the configuration space are Euclidean. This allowed us to perform PCA on the final axis scores without changing the relationships between points.

Our approach to setting the final dimensionality of the MDS included:

1. Run the MDS calculations with one or two more axes than the number suggested by the DCA results.

2. If the stress was fairly high (>7%), add a dimension and repeat the MDS analysis. If the stress was still too high, repeat the analysis again with an additional dimension. This process has been automated so it is done by the computer until the desired number of dimensions are obtained.

C.1.3.2 Distance Index Calculations

Distances are used in the MDS calculations. For the present study, the Bray-Curtis distance index was used (Bray and Curtis, 1957; Clifford and Stephenson, 1975). The raw species abundance data were first transformed by a square-root and then standardized by a species mean (of values > 0). This combination should make the distances less susceptible to some of the problems caused by the non-monotonic species curves along the gradients (Smith, 1976).

C.1.3.3 The DCA Calculations

The same transformed and standardized data used to calculate the distances were used in the DCA calculations. This should prevent a few numerically abundant species from dominating the calculations.

C.2 RESCALING THE ORDINATION SCORES TO HALF-CHANGE UNITS OF BETA DIVERSITY

Whittaker (1960, 1967), Whittaker and Woodwell (1973), and Gauch (1973) have quantified species changes along a single predefined gradient, or along hypothetical gradients which correspond to simulated species data (Gauch and Whittaker, 1972, 1976). These authors refer to species changes along a gradient as beta diversity, which is measured in terms of number of half-changes or Z- units. Gauch (1982) now prefers to use the term SD units instead of Z-units, due to the lack of ecological meaning in the Z-unit terminology. One half-change is the ecological separation at which the similarity between samples is half the similarity of replicate samples. Similarity is the opposite of distance, and with a distance index scaled from 0 to 1, similarity is simply 1-distance. The similarity between replicate samples is an estimate of the sampling error. A Z-unit or SD unit is length along the gradient divided by the average standard deviation of the species distributions along the gradient. One half-change equals 1.349 times the number of SD units for noiseless data, and is usually about equal in value for field data, which will, of course, contain sampling error. Complete turnover of all species can be expected at a beta diversity of about 4 SD or 4 half-changes.

Figure C-10 shows the relationship between sample similarity and changes along an elevation gradient (from Whittaker and Woodwell, 1973). Figure C-11 shows a similar plot of sample similarity (1-distance) vs. distance in the ordination space from the Sixty Meter Control Survey off the California coast (Word and Mearns, 1979). The plot of data from the present study showed the same type of pattern. The relationships shown in Figures C-10 and C-11 are similar. This would be expected, since distance in the ordination space will generally correspond to gradients in the environment. The fact that only one gradient is represented in Figure C-10 and possibly 2 to 4 gradients in Figure C-11 should make little difference because the gradients and the rates of biological change along these gradients (in Figure C-11) are partially defined by the same set of distance values from which the plot is derived. In other words, in the ordination space, distance in any direction should have the same meaning as far as species changes are concerned. In fact, gradients defined by the species patterns (vs. environmental measurements only) may be better measures of the true gradients from the viewpoints of the organisms involved.

The relationship shown in Figure C-10 is used to translate inter-sample similarity to beta diversity in terms of half-changes (Whittaker and Woodwell, 1973). We have generalized this technique to convert the scores of an ordination space to units of half-changes (Smith and Bernstein, 1985).

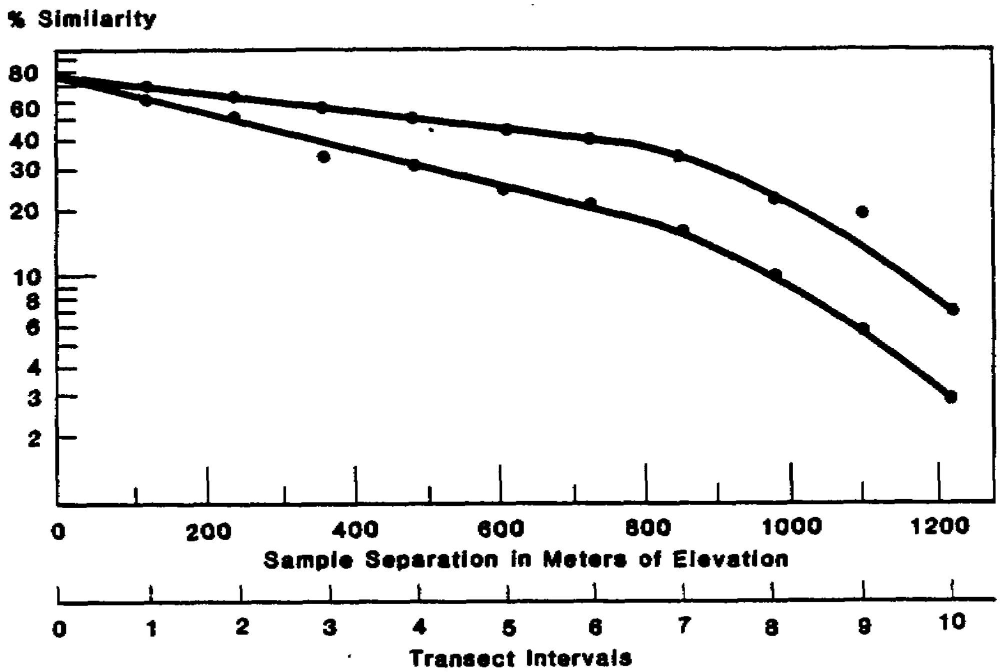


Figure C-10. Decrease in mean sample similarity measurements (from forest tree data) with increasing sample separation along the elevation gradient in the Great Smoky Mountains (From Whittaker and Woodwell, 1973: Fig. 6). The upper curve is from quantitative data, and the lower is from presence/absence data. Samples were taken at transect intervals of 122 meters. The curves are smoothed by averaging the similarities at each point. The percent similarity on the ordinate is on a logarithmic scale, which tends to make the initial part of such curves linear.

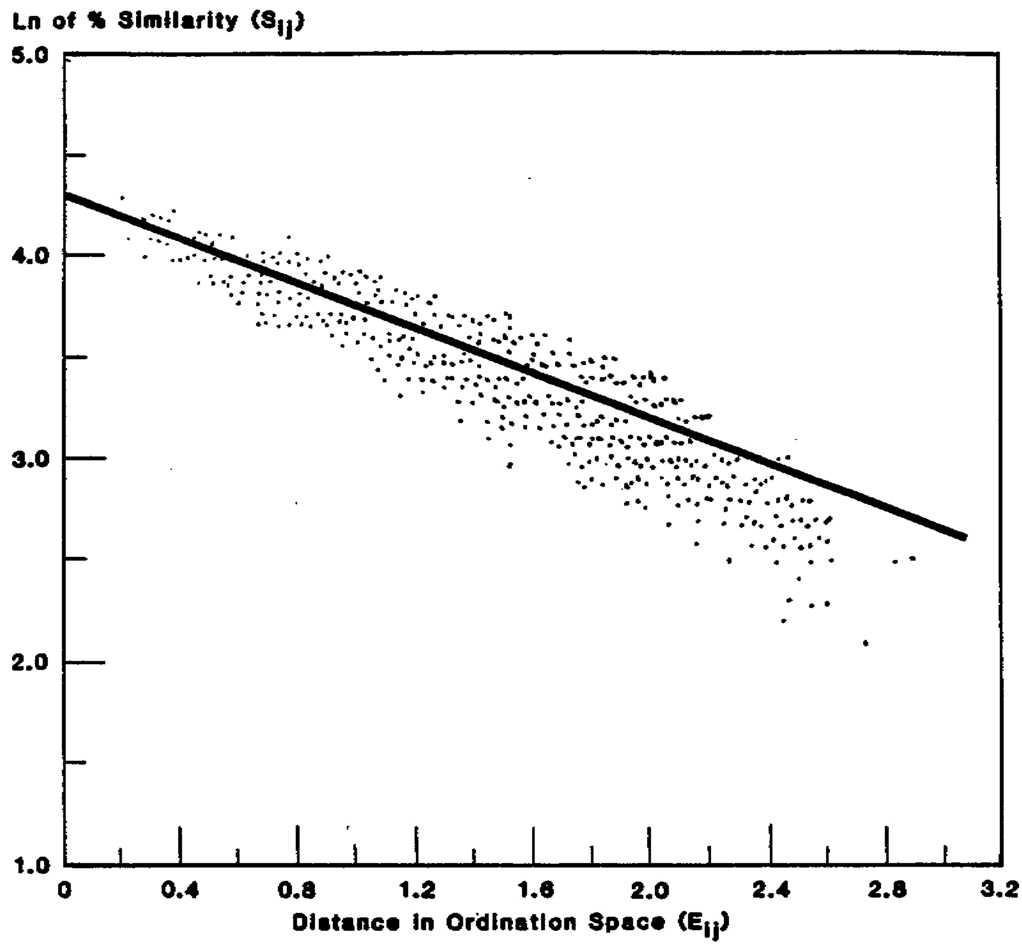


Figure C-11. Relationship between the logarithm of the inter-sample similarity and the distances in the ordination space. All points are shown, along with the line of best fit to the linear portion of the point cluster. The equation of the line (determined by linear regression) is: $S_{ij}=4.27-.53(E_{ij})$. This relationship is similar to that shown in Figure C-10 with an initial linear pattern which drops off at lower similarity values. The similarities were calculated from the distances used in Figure 12 (i.e., similarity = 1 - distance).

Once this is done, any distances derived from the ordination space will be in units of half-changes. This will be an advantage, since beta diversity is a standardized, ecologically meaningful, and frequently-used measure of species change along environmental gradients of biological importance.

An ordination space can be scaled to units of half-changes following several steps:

1. The matrix of inter-sample distance values is converted to the logarithm of the percent similarity, i.e.,

   $$S_{ij} = \ln(100 \times (1 - D_{ij})),$$

where D_{ij} is the inter-sample distance between samples i and j, and ln is the natural log. In the present study, the Bray-Curtis distance index (with square-root transformed, species-mean standardized data) was used to calculate the D_{ij} values. These are the same distances which are the starting point for building the ordination space.

2. S_{ij} is plotted against E_{ij}, which is the distance between samples i and j in the ordination space (e.g., Figure C-11). The logarithm of the percent similarity is used to increase the probability that at least the initial part of this relationship is linear.

3. A straight line is fitted to the initial part of the cluster of points. No attempt is made to fit the points where they start to tail off toward the abcissa, which will usually be around the 20-30% similarity level (3.0-3.4 as a logarithm). This can be automated by using linear regression to estimate the parameters of the following equation.

$$Sij = A + B(Eij),$$

where A is the y intercept and B is the slope of the line. Only data with Sij values greater than 3.22 (the natural log of 25% similarity) are used in the calculations. A is an estimate of the similarity level of the sampling error, or the similarity between replicate samples.

4. Half-changes are computed as,

$$Hij = (A - Sij)/\ln(2),$$

where Hij is the beta diversity corresponding to the similarity of i and j (Sij). Our goal is to scale the ordination space, so we substitute from the regression equation above to put Hij in terms of Eij. Thus,

$$Hij = (A - A - B(Eij))/\ln(2)$$

$$= - B(Eij)/.69315 .$$

5. Multiplying distances between points in the ordination space by -B/.69315 will convert them to half-change units of beta diversity. These are the distances which are used in the cluster analysis and the power tests. Similarly, if the scores for all points in the ordination space are multiplied by -B/.69315, then the scores will be in units of half-changes.

APPENDIX D

Master Species List for Soft-Bottom and Rock Sampling Samples

	SPNAME	.5MM	1MM	REIDRIP	ROCK
PORIFERA					
	SPONGE #80	0	0	0	1
	SPONGE #79	0	0	0	1
	SPONGE #78	0	0	0	1
	SPONGE #83	0	0	0	1
	SPONGE #75	0	0	0	1
	SPONGE #8?	0	0	0	1
	SPONGE #40?	0	0	0	1
	SPONGE #71	0	0	0	1
	SPONGE #70	0	0	0	1
	SPONGE #68	0	0	0	1
	SPONGE #67	0	0	0	1
	SPONGE #66	0	0	0	1
	SPONGE #64	0	0	0	1
	SPONGE #63	0	0	0	1
	SPONGE #62	0	0	0	1
	SPONGE #61	0	0	0	1
	SPONGE #60	0	0	0	1
	SPONGE #59	0	0	0	1
	SPONGE #58	0	0	0	1
	SPONGE #57	0	0	0	1
	SPONGE #55	0	0	0	1
	SPONGE #54	0	0	0	1
	SPONGE #53	0	0	0	1
	SPONGE #52B	0	0	0	1
	SPONGE #52	0	0	0	1
	SPONGE #51A	0	0	0	1
	SPONGE #51	0	0	0	1
	SPONGE #47	0	0	0	1
	SPONGE #46	0	0	0	1
	SPONGE #43	0	0	0	1
	SPONGE #42	0	0	0	1
	SPONGE #41B	0	0	0	1
	SPONGE #41A	0	0	0	1
	SPONGE #41	0	0	0	1
	SPONGE #40	0	0	0	1
	SPONGE #38	0	0	0	1
	SPONGE #37	0	0	0	1
	SPONGE #34	0	0	0	1
	SPONGE #65	0	0	0	1
	SPONGE #32	0	0	0	1
	SPONGE #29	0	0	0	1
	SPONGE #28	0	0	0	1
	SPONGE #27	0	0	0	1
	SPONGE #26	0	0	0	1
	SPONGE #25	0	0	0	1
	SPONGE #24	0	0	0	1
	SPONGE #23	0	0	0	1
	SPONGE #22	0	0	0	1
	SPONGE #21	0	0	0	1
	SPONGE #19	0	0	0	1
	SPONGE #18	0	0	0	1
	SPONGE #14	0	0	0	1
	SPONGE #13	0	0	0	1
	SPONGE #11	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
SPONGE #10	0	0	0	1
SPONGE #9	0	0	0	1
SPONGE #8	0	0	0	1
SPONGE #6	0	0	0	1
SPONGE #5	0	0	0	1
SPONGE #2	0	0	0	1
SPONGE #1	0	0	0	1
SPONGE #82	0	0	0	1
SPONGE #12?	0	0	0	1
CALCAREA				
CALCAREA LPIL	0	0	0	1
CLATHRINIDAE				
CLATHRINA CORIACEA	0	0	0	1
GRANTIIDAE				
LEUCANDRA HEATHI	0	0	0	1
AMPHORISCIDAE				
LEUCILLA NUTTINGI	0	0	0	1
HEXACTINELLIDA				
HEXACTINELLIDA LPIL	0	0	0	1
ROSSELLIDAE				
STAUROCALYPTUS SOLIDUS	0	0	0	1
DEMOSPONGIA				
DYSIDEIDAE				
DYSIDEA AMBLIA	0	0	0	1
HALICLONIIDAE				
HALICLONIIDAE LPIL	0	0	0	1
HALICLONA LPIL	0	0	0	1
HALICLONA SP. F	0	0	0	1
HALICLONA SP. H	0	0	0	1
FAMILY?				
POECILOSCLERIDA SP. B	0	0	0	1
POECILOSCLERIDA SP. A	0	0	0	1
PHORBASIDAE				
CRELLOMIMA SP. A	0	0	0	1
ADOCIIDAE				
SIGMADOCIA CF. EDAPHUS	0	0	0	1
SIGMADOCIA SP. A	0	0	0	1
SIGMADOCIA SP. C	0	0	0	1
COELOSPHAERIDAE				
INFATELLA LPIL	0	0	0	1
CLATHRIIDAE				
MICROCIONA SP. A	0	0	0	1
OPHILITASPONGIA PENNATA	0	0	0	1
RHAPHIDOTHECA SP. A	0	0	0	1
HYMEDESMIIDAE				
HYMEDESMIIDAE SP. A	0	0	0	1
HYMEDESMIA SP. A	0	0	0	1
HYMEDESMIA SP. B	0	0	0	1
?HYMEDESMIA SP. D	0	0	0	1
MYXILLIDAE				
MYXILLIDAE SP. A	0	0	0	1
IOPHON PATTERSONI	0	0	0	1
IOTROCHOTA SP. A	0	0	0	1
LISSODENDORYX CF. KYMA	0	0	0	1
LISSODENDORYX SP. F	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
MYXILLA CF. INCRUSTANS	0	0	0	1
TEDANIA CF. DIRHAPHIS	0	0	0	1
HYMENDECTYON LPIL	0	0	0	1
RASPAILIIDAE				
HEMECTYON HYMANI	0	0	0	1
?HEMECTYON SP. A	0	0	0	1
HEMECTYON CF. HYLE	0	0	0	1
RASPAILIIDAE LPIL	0	0	0	1
MYCALIDAE				
MYCALE LINGUA	0	0	0	1
AMPHILECTIDAE				
BIEMNA RHADIA	0	0	0	1
AXINELLIDAE				
AXINELLA SP. B	0	0	0	1
AXINELLA SP. A	0	0	0	1
?PHAKETTIA SP. A	0	0	0	1
HYMENIACIDONIDAE				
HYMENIACIDON SP. A	0	0	0	1
SUBERITIDAE				
SUBERITIDAE LPIL	0	0	0	1
SUBERITES FICUS	0	0	0	1
POLYMASTIIDAE				
POLYMASTIA LPIL	0	0	0	1
POLYMASTIA PACHYMASTIA	0	0	0	1
CHORISTIDA				
STELLETTIDAE				
STELLATA CLARELLA	0	0	0	1
CARNOSA				
PACHASTRELLIDAE				
PACHASTRELLIDAE SP. B	0	0	0	1
PACHASTRELLIDAE SP. A	0	0	0	1
?SPHINCTRELLA SP. A	0	0	0	1
THENEIDAE				
POECILLASTRA TENULLAMINARIS	0	0	0	1
CNIDARIA				
CNIDARIA LPIL	0	0	0	1
HYDROZOA				
HYDROZOA LPIL	1	1	1	1
HYDROID STALKS	0	0	0	1
ATHECATA LPIL	0	0	0	1
BOUGANVILLIIDAE				
BOUGANVILLIIDAE LPIL	1	1	0	1
PERIGONIMUS LPIL	1	1	0	0
PERIGONIMUS REPENS	1	1	1	0
HYDRACTINIA LPIL	0	0	1	0
CORYNIDAE				
CORYNIDAE LPIL	1	1	0	0
CAMPANULARIIDAE				
CAMPANULARIIDAE LPIL	1	1	0	1
CAMPANULARIA LPIL	1	1	0	0
CAMPANULARIA SP. B	0	0	0	1
CAMPANULARIA SP. A	0	0	0	1
CAMPANULARIA NR. ALTITHECA	0	0	0	1
CAMPANULARIA NR. DENTICULATA	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
CAMPANULARIA GIGANTEA	0	0	1	0
OBELIA LPIL	0	0	1	0
LAFOEIDAE				
ACRYPTOLARIA PULCHELLA	0	0	0	1
CAMPANULINIDAE				
CALYCELLA SYRINGA	0	0	1	1
EGMUNDELLA GRACILIS	0	0	1	0
SERTULARELLIDAE				
SERTULARELLA LPIL	0	0	1	0
SERTULARELLA TRICUSPIDATA	0	0	1	0
SERTULARELLA TURGIDA	0	0	0	1
SERTULARELLA SP. A	0	0	0	1
SERTULARELLA PEDRENSIS	0	0	1	0
SERTULARIA PUMILA	1	1	0	0
ABIETENARIA LPIL	0	0	0	1
ABIETINARIA VARIABILIS	0	0	1	0
ABIETENARIA NR. TRASKI	0	0	0	1
ABIETINARIA NR. AMPHORA	1	1	0	1
SELAGINOPSIS CYLINDRICA	0	0	1	0
HALECIIDAE				
HALECIUM LPIL	0	0	0	1
HALECIUM WASHINGTONI	0	0	1	0
PLUMULARIIDAE				
PLUMULARIA LPIL	0	0	0	1
PLUMULARIA EXILIS	0	0	0	1
PLUMULARIA CORRUGATA	0	0	1	0
CLADOCARPUS VANCOUVERIENSIS	0	0	0	1
AGLAOPHENIA LPIL	0	0	1	0
MONOBRACHIIDAE				
MONOBRACHIUM PARASITUM	1	1	1	0
ANTHOZOA				
ANTHOZOA LPIL	1	1	1	0
CERIANTIPATHARIA				
CERIANTHARIA LPIL	1	1	1	1
CERIANTHARIIDAE				
CERIANTHARIIDAE LPIL	1	1	0	0
PACHYCERIANTHUS FIMBRIATUS	0	0	1	0
OCTOCORALLIA STOLONIFERA				
STOLONIFERA LPIL	0	0	0	1
CLAVULARIIDAE				
CLAVULARIA SP. H	0	0	0	1
OCTOCORALLIA TELESTACEA				
TELESTIDAE				
TELESTO CALIFORNICA	0	0	1	0
OCTOCORALLIA GORGONACEA				
GORGONARIA LPIL	0	0	0	1
PARAMURICIIDAE				
FILIGELLA MITSUKURII	1	1	0	0
GORGONIIDAE				
LOPHOGORGIA LPIL	0	0	0	1
EUGORGIA LPIL	0	0	0	1
EUGORGIA CF. RUBENS	0	0	0	1
OCTOCORALLIA PENNATULACEA				
PENNATULACEA LPIL	1	0	1	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
STACHYPTILIDAE				
STACHYPTILUM LPIL	1	1	0	0
STACHYPTILUM SUPERBUM	1	1	0	0
VIRGULARIIDAE				
STYLATULA LPIL	1	1	0	0
STYLATULA ELONGATA	1	1	0	0
VIRGULARIA LPIL	1	1	0	0
VIRGULARIA BROMLEYI	1	1	0	0
ACANTHOPTILUM LPIL	1	1	0	0
ACANTHOPTILUM GRACILE	0	0	1	0
BALTICINA CALIFORNICA	1	1	0	0
PENNATULIDAE				
PTILOSARCUS GURNEYI	1	1	0	0
ZOANTHARIA ZOANTHINARIA				
EIZOANTHIDAE				
EPIZOANTHUS INDURATUM	0	0	0	1
ZOANTHARIA ACTINIARIA				
ACTINARIA LPIL	1	0	0	1
ATHENARIA LPIL	1	1	0	0
EDWARDSIIDAE				
EDWARDSIIDAE LPIL	1	1	1	0
EDWARDSIA LPIL	0	0	0	1
EDWARDSIA SP. C	0	0	1	0
EDWARDSIA SP. A	1	1	0	0
SCOLANTHUS LPIL	0	0	1	0
SCOLANTHUS SP. A	1	1	1	0
HALCAMPOIDIDAE				
PENTACTINIA CALIFORNICA	0	0	1	0
HALCAMPIDAE				
HALIANTHELLA SP. A	1	1	0	0
THENARIA				
THENARIA LPIL	1	1	1	1
FAMILY UNDETERMINED				
ANEMONE #80	0	0	0	1
TENT ANEMONE	0	0	0	1
ANEMONE #67	1	1	0	0
ANEMONE #79	1	1	0	0
ANEMONE #66	1	1	0	0
ANEMONE #76	0	0	0	1
ANEMONE #75	0	0	0	1
ANEMONE #74	0	0	0	1
ANEMONE #72	0	0	0	1
ANEMONE #71	0	0	0	1
ANEMONE #70	1	1	0	1
ANEMONE #78	1	1	0	0
ANEMONE #8	1	1	0	0
ANEMONE #69	1	1	0	0
ANEMONE #65	1	1	0	0
ANEMONE #68	1	1	0	0
ACTINOSTOLIDAE				
ACTINOSTOLA SP. A	0	0	0	1
HORMATHIIDAE				
CF. STEPHENAUGE ANNULARIS	1	1	0	0
METRIDIIDAE				
METRIDIUM SENILE	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
DIADUMENIDAE				
DIADUMENE SP. A	0	0	0	1
ZOANTHARIA SCLERACTINIA				
FAMILY UNCERTAIN				
CORAL SP. 3	0	0	0	1
CORAL SP. 2	0	0	0	1
CUP CORAL	0	0	0	1
CARYOPHYLLIIDAE				
CARYOPHYLLIA LPIL	0	0	0	1
CARYOPHYLLIA ALASKENSIS	0	0	0	1
CARYOPHYLLIA ARNOLDI	0	0	0	1
CARYOPHYLLIA NR. ARNOLDI	0	0	0	1
CARYOPHYLLIA NR. ALASKENSIS	0	0	0	1
PARACYATHUS LPIL	0	0	0	1
PARACYATHUS STEARNSII	0	0	0	1
COENOCYATHUS BOWERSI	0	0	0	1
FLABELLIDAE				
FLABELLUM NR. TANNERENSE	0	0	0	1
PLATYHELMINTHES				
PLATYHELMINTHES LPIL	1	1	1	0
NEMERTEA				
NEMERTEA LPIL	1	1	1	1
PALEONEMERTEA LPIL	1	1	0	0
TUBULANIDAE				
TUBULANIDAE LPIL	1	0	0	0
TUBULANUS LPIL	1	1	0	0
TUBULANUS CAPISTRATUS	0	0	0	1
TUBULANUS POLYMORPHUS	1	1	0	0
TUBULANUS PELLICIDUS	1	1	1	1
TUBULANUS FRENATUS	1	0	0	0
TUBULANUS NOTHUS	1	1	1	0
CARINOMELLA LACTEA	0	0	1	0
CARINOMIDAE				
CARINOMA MUTABLIS	1	1	1	0
LINEIDAE				
LINEIDAE LPIL	1	1	0	1
CEREBRATULUS LPIL	1	1	1	1
CEREBRATULUS CALIFORNIENSIS	1	1	1	0
LINEUS LPIL	0	0	0	1
LINEUS BILINEATUS	1	1	0	0
LINEUS FLAVESCENS	0	0	0	1
LINEUS RUBESCENS	0	0	1	0
MICRURA LPIL	0	0	1	0
MICRURA ALASKENSIS	1	1	1	0
MICRURA WILSONI	0	0	1	0
MONOSTYLIFERA LPIL	1	0	0	1
EMPLECTONEMATIDAE				
EMPLECTONEMA BURGERI	0	0	1	0
PARANEMERTES LPIL	0	0	0	1
PARANEMERTES SP. A	1	1	1	0
PROSORHOCHMIDAE				
PROSORHOCHMUS ALBIDUS	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
AMPHIDORIDAE				
AMPHIPORUS LPIL	0	0	1	1
AMPHIPORUS ANGULATUS	1	1	0	0
AMPHIPORUS FORMIDABILIS	0	0	0	1
TETRASTEMMATIDAE				
TETRASTEMMA LPIL	1	0	0	0
KINORHYNCHA				
NEOCENTROPHYIDAE				
NEOCENTROPHYES SP. A	1	0	0	0
NEMATODA				
NEMATODA LPIL	1	1	1	1
ANNELIDA				
POLYCHAETA				
POLYCHAETA LPIL	1	0	0	0
APHRODITIDAE				
APHRODITIDAE LPIL	1	0	0	0
APHRODITA PARVA	1	1	0	0
PONTOGENIA SP. A	1	0	0	0
POLYNOIDAE				
POLYNOIDAE LPIL	1	1	0	1
ANTINOE LPIL	1	1	0	0
ANTINOELLA LPIL	1	1	0	0
ANTINOELLA MACROLEPIDA	1	1	0	0
ARCTEOBIA LPIL	1	0	0	0
EUNOE LPIL	1	1	0	1
EUNOE SENTA	0	0	0	1
EUNOE SP. C	1	0	0	0
GATTYANA IPHIONELLOIDES	0	0	0	1
HARMOTHOE LPIL	1	1	0	1
HARMOTHOE HIRSUTA	0	0	0	1
HARMOTHOE SCRIPTORIA	1	1	1	0
HARMOTHOE FRAGILIS	0	0	0	1
HARMOTHOE MULTISETOSA	0	0	0	1
HARMOTHOE FORCIPATA	0	0	1	0
HARMOTHOE NR. LUNULATA	1	1	1	0
HARMOTHOE CRASSICIRRATA	1	1	0	0
HARMOTHOE SP. A	1	1	1	0
LEPIDONOTUS SQUAMATUS	0	0	1	1
HESPERONOE LAEVIS	1	1	0	1
LEPIDASTHENIA BERKELEYAE	1	1	0	0
LEPIDASTHENIA LONGICIRRATA	1	1	1	1
EUCRANTA NR. ANOCULATA	1	1	0	0
SUBADYTE LPIL	1	1	0	0
SUBADYTE SP. B	1	1	0	0
SUBADYTE SP. A	1	1	1	0
HARMOTHOINAE LPIL	1	1	1	1
POLYODONTIDAE				
PANTHALIS PACIFICA	1	1	0	0
PHOLOIDIDAE				
PHOLOIDES ASPERA	1	1	1	1
SIGALONIDAE				
SIGALONIDAE LPIL	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
PHOLOE LPIL	1	0	0	1
PHOLOE NR. MINUTA	0	0	1	0
PHOLOE NR. ANOCULATA	1	1	0	0
PHOLOE GLABRA	1	1	1	1
STHENELAIS LPIL	1	1	0	1
STHENELAIS BERKELEYI	1	1	0	0
STHENELAIS TERTIAGLABRA	1	1	0	0
STHENELAIS VERRUCULOSA	1	1	0	0
SIGALION SP. A	1	1	0	0
THALENESSA SPINOSA	1	1	1	0
STHENELANELLA UNIFORMIS	1	1	1	1
AMPHINOMIDAE				
CHLOEIA PINNATA	1	1	1	0
EUPHROSINE LPIL	0	0	0	1
EUPHROSINE ARCTIA	0	0	0	1
EUPHROSINE BICIRRATA	0	0	0	1
EUPHROSINE SP. A	0	0	0	1
PHYLLODOCIDAE				
PHYLLODOCE CUSPIDATA	1	0	0	1
PHYLLODOCE GROENLANDICA	1	1	0	0
PHYLLODOCE MEDIPAPILLATA	0	0	0	1
PHYLLODOCE PAPILLOSA	0	0	1	0
PHYLLODOCE (ANAITIDES) LPIL	1	0	0	0
PHYLLODOCE NR. MEDIPAPILLATA	0	0	0	1
PHYLLODOCE ?GROENLANDICA	1	1	0	0
ETEONE LPIL	1	0	0	1
ETEONE SP. A	0	0	1	0
EULALIA LPIL	1	0	0	0
EULALIA LEVICORNUTA	1	1	1	1
EULALIA ?BILINEATA	0	0	0	1
MYSTIDES BOREALIS	0	0	0	1
GENETYLLIS SP. B	0	0	0	1
GENETYLLIS ?CASTANEA	0	0	1	1
GENETYLLIS SP. A	0	0	1	0
HESIONURA COINEAUI DIFFICILIS	0	0	1	0
EUMIDA LPIL	1	0	0	0
EUMIDA BIFOLIATA	1	1	1	0
PROTOMYSTIDES SP. A	0	0	1	0
PHYLLODOCE LPIL	1	0	1	1
PHYLLODOCE HARTMANAE	1	1	0	0
PHYLLODOCE SP. A	1	0	0	0
STEGGOA SP. A	0	0	0	1
PHYLLODOCE (APONAITIDES) LPIL	1	1	1	0
PIRAKIA BRUNNEA	1	0	0	0
TYPHLOSCOLECIDAE				
TYPHLOSCOLECIDAE LPIL	1	0	0	1
HESIONIDAE				
HESIONIDAE LPIL	1	1	0	1
AMPHIDUROS BRUNNEA	1	0	0	1
GYPTIS NR. LOBATUS	0	0	1	0
AMPHIDUROS LPIL	0	0	0	1
AMPHIDUROS SP. A	1	1	0	0
HETEROPODARKE HETEROMORPHA	0	0	1	0
OPHIODROMUS PUGETTENSIS	0	0	1	0
PODARKE SP. A	0	0	1	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
HESIONIDAE GEN. A SP. A	0	0	0	1
PODARKEOPSIS LPIL	1	1	0	0
PODARKEOPSIS SP. C	0	0	1	0
PODARKEOPSIS SP. A	1	1	1	0
PODARKEOPSIS ?GLABRUS	1	1	0	0
PODARKEOPSIS SP. B	1	1	0	0
PODARKEOPSIS GLABRUS	1	1	1	0
PILARGIDAE				
PILARGIDAE LPIL	1	0	0	0
ANCISTROSYLLIS GROENLANDICA	1	0	0	0
SIGAMBRA LPIL	1	0	0	0
SIGAMBRA BASSI	1	1	0	0
SIGAMBRA NR. SETOSA	1	0	0	0
SIGAMBRA TENTACULATA	1	1	1	0
SIGAMBRA SETOSA	1	1	0	0
PILARGIS BERKELEYI	1	1	0	0
PARANDALIA OCULARIS	1	1	0	0
SYLLIDAE				
SYLLIDAE LPIL	0	0	0	1
AUTOLYTUS LPIL	0	0	1	1
PIONOSYLLIS LPIL	0	0	0	1
PIONOSYLLIS NR. URAGA	0	0	1	0
?PIONOSYLLIS MAGNIFICA	0	0	0	1
SYLLIS SPONGIPHILA SUBSP. A	0	0	0	1
TRYPANOSYLLIS LPIL	0	0	0	1
TRYPANOSYLLIS ?COELIACA NIPPONICA	0	0	0	1
TRYPANOSYLLIS ?BREVICIRRATA	0	0	0	1
TRYPANOSYLLIS SP. A	0	0	0	1
TYPOSYLLIS LPIL	1	0	1	1
TYPOSYLLIS ARMILLARIS	0	0	0	1
TYPOSYLLIS HYALINA	0	0	0	1
TYPOSYLLIS SP. D	0	0	0	1
TYPOSYLLIS ?HYALINA	0	0	0	1
TYPOSYLLIS ?BELLA	0	0	0	1
EUSYLLIS LPIL	0	0	1	1
EUSYLLIS SP. A	1	1	0	0
EUSYLLIS NR. LONGICIRRATA	0	0	0	1
EUSYLLIS HABEI	0	0	1	1
EXOGONE LPIL	1	1	1	0
EXOGONE GEMMIFERA	0	0	1	1
EXOGONE LOUREI	1	1	1	1
EXOGONE MOLESTA	1	0	1	1
EXOGONE UNIFORMIS	0	0	0	1
EXOGONE SP. C	0	0	1	0
EXOGONE SP. A	1	1	0	0
SPHAEROSYLLIS LPIL	0	0	0	1
SPHAEROSYLLIS PIRIFERA	0	0	0	1
SPHAEROSYLLIS BRANDHORSTI	1	0	1	1
SPHAEROSYLLIS CALIFORNIENSIS	1	0	1	0
SPHAEROSYLLIS ?BRANDHORSTI	1	0	0	0
SPHAEROSYLLIS SP. A	1	0	1	1
BRANIA LPIL	1	0	1	1
BRANIA BREVIPHARYNGEA	0	0	0	1
BRANIA SP. A	0	0	0	1
ODONTOSYLLIS LPIL	0	0	1	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
ODONTOSYLLIS PHOSPHOREA	0	0	0	1
ODONTOSYLLIS SP. A	0	0	0	1
SYLLIDES REISHI	0	0	1	1
STREPTOSYLLIS SP. A	0	0	1	0
OPISTHODONTA LPIL	0	0	0	1
OPISTHODONTA SP. A	0	0	0	1
DIOPLOSYLLIS SP. A	0	0	0	1
EHLERSIA HETEROCHAETA	1	1	1	1
EHLERSIA SP. A	1	0	1	0
OPISTHOSYLLIS LPIL	0	0	1	0
PLAKOSYLLIS NR. AMERICANA	0	0	1	0
EURYSYLLIS SP. A	0	0	0	1
PROCERASTEA LPIL	0	0	0	1
GEMINOSYLLIS OHMA	0	0	0	1
EUSYLLINAE LPIL	0	0	1	1
SYLLINAE LPIL	0	0	0	1
EXOGONINAE LPIL	1	0	0	1
PROCERAEA LPIL	0	0	0	1
NEREIDAE				
NEREIDAE LPIL	1	0	0	1
CERATONEREIS SINGULARIS	0	0	1	0
NEREIS LPIL	1	1	1	1
NEREIS PELAGICA NEONGRIPES	0	0	0	1
NEREIS PROCERA	1	1	0	1
NEREIS NR. PROCERA	1	1	0	1
NEREIS SP. B	1	1	0	0
NEREIS NR. ANOCULIS	1	1	0	0
CERATOCEPHALE HARTMANAE	1	1	0	0
NICON MONILOCERAS	0	0	0	1
GYMNONEREIS CROSSLANDI	1	1	1	0
NEPHTYIDAE				
NEPHTYIDAE LPIL	1	1	1	1
NEPHTYS LPIL	1	1	1	1
NEPHTYS CORNUTA FRANCISCANA	1	1	1	1
NEPHTYS PUNCTATA	1	1	0	0
NEPHTYS SCHMITTI	1	1	0	0
NEPHTYS FERRUGINEA	1	1	1	0
NEPHTYS CALIFORNIENSIS	1	1	0	0
NEPHTYS CAECOIDES	1	1	1	1
NEPHTYS SIMONI	1	1	1	0
NEPHTYS SP. B	1	1	1	0
NEPHTYS ?FERRUGINEA	1	1	0	0
NEPHTYS SP. A	1	1	1	0
AGLAOPHAMUS LPIL	1	0	0	0
AGLAOPHAMUS DICIRRIS	1	1	0	0
AGLAOPHAMUS ERECTENS	1	1	0	0
AGLAOPHAMUS SP. A	0	0	1	0
AGLAOPHAMUS PAUCILAMELLATA	1	1	0	0
SPHAERODORIDAE				
SPHAERODORUM LPIL	1	0	0	0
SPHAERODORUM PAPILLIFER	1	1	0	1
SPHAERODOROPSIS LPIL	1	0	0	0
SPHAERODOROPSIS SPHAERULIFER	1	0	0	1
EPHESIELLA BREVICAPITIS	1	0	0	0
SPHAEREPHESIA SP. A	0	0	1	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
GLYCERIDAE·				
GLYCERA LPIL	1	0	1	0
GLYCERA CAPITATA	1	1	1	1
GLYCERA TESSELATA	0	0	1	1
GLYCERA AMERICANA	1	1	1	0
GLYCERA BRANCHIOPODA	1	1	0	0
GLYCERA SP. A	1	1	0	0
GLYCERA NR. ROUXI	0	0	1	0
GLYCERA SP. B	0	0	1	0
HEMIPODUS BOREALIS	1	0	0	0
GONIADIDAE				
GONIADIDAE LPIL	1	1	0	0
GLYCINDE LPIL	1	0	0	0
GLYCINDE ARMIGERA	1	1	1	0
GONIADA LPIL	1	1	0	0
GONIADA ANNULATA	1	1	0	0
GONIADA MACULATA	1	1	0	0
GONIADA BRUNNEA	1	1	1	0
GONIADA LITTOREA	1	1	1	0
ONUPHIDAE				
ONUPHIDAE LPIL	1	1	1	0
ONUPHIS LPIL	1	1	0	0
ONUPHIS IRIDESCENS	1	1	0	0
ONUPHIS ELEGANS	1	1	0	0
ONUPHIS SP. B	1	1	0	0
ONUPHIS SP. A	1	1	0	0
ONUPHIS NR. GEOPHILIFORMIS	1	1	0	0
ONUPHIS PALLIDA	1	1	0	0
DIOPATRA LPIL	1	1	0	0
RHAMPHOBRACHIUM LONGISETOSUM	1	1	1	0
MOOREONUPHIS LPIL	1	1	1	0
MOOREONUPHIS SP. D	0	0	1	0
MOOREONUPHIS SP. C	0	0	1	0
MOOREONUPHIS SEGMENTISPADIX	1	1	1	0
MOOREONUPHIS NEBULOSA	1	1	1	0
MOOREONUPHIS SP. B	1	1	0	0
MOOREONUPHIS SP. A	1	1	0	0
MOOREONUPHIS NR. NEBULOSA	1	1	0	0
SARSONUPHIS LPIL	1	1	0	0
SARSONUPHIS PARVA	1	1	1	0
EUNICIDAE				
EUNICIDAE LPIL	0	0	0	1
EUNICE LPIL	0	0	0	1
EUNICE AMERICANA	1	1	1	0
EUNICE MULTIPECTINATA	0	0	0	1
EUNICE MULTICYLINDRI	0	0	0	1
EUNICE VITTATOPSIS	0	0	0	1
MARPHYSA LPIL	1	0	0	0
MARPHYSA CONFERTA	0	0	0	1
LUMBRINERIDAE				
LUMBRINERIDAE LPIL	0	0	0	1
LUMBRINERIS LPIL	1	1	0	1
LUMBRINERIS BICIRRATA	1	1	1	1
LUMBRINERIS LATREILLI	1	1	0	1
LUMBRINERIS JAPONICA	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
LUMBRINERIS INFLATA	0	0	0	1
LUMBRINERIS TETRAURA	1	1	1	0
LUMBRINERIS CRUZENSIS	1	1	1	0
LUMBRINERIS LAGUNAE	1	1	0	0
LUMBRINERIS CALIFORNIENSIS	1	1	0	0
LUMBRINERIS INDEX	1	1	0	1
LUMBRINERIS PLATYPYGOS	0	0	1	0
LUMBRINERIS SP. A	1	1	0	1
LUMBRINERIS GROUP D	1	1	0	1
LUMBRINERIS NR. BICIRRATA	1	1	0	0
LUMBRINERIS GROUP B	1	0	1	1
LUMBRINERIS GROUP C	1	1	1	1
LUMBRINERIS GROUP A	1	1	1	1
NINOE LPIL	1	0	0	0
NINOE GEMMEA	1	1	0	0
NINOE SP. C	1	0	0	0
NINOE PALMATA	1	1	0	0
NINOE NR. GEMMEA	1	1	0	0
NINOE SP. A	1	1	1	0
NINOE NR. PALMATA	1	1	0	0
ARABELLIDAE				
ARABELLIDAE, PARASITIC	1	0	0	0
DRILONEREIS LPIL	1	1	1	0
DRILONEREIS NUDA	0	0	0	1
DRILONEREIS FALCATA	1	1	1	0
DRILONEREIS SP. B	1	1	0	0
DRILONEREIS SP. A	1	1	0	0
DRILONEREIS NR. LONGA	1	1	1	0
ARABELLIDAE, GENUS A, SP. A	1	0	0	0
DORVILLEIDAE				
DORVILLEIDAE LPIL	1	0	0	0
PROTODORVILLEA GRACILIS	0	0	1	0
OPHRYOTROCHA LPIL	0	0	0	1
SCHISTOMERINGOS LONGICORNIS	1	1	0	1
SCHISTOMERINGOS ANNULATA	0	0	1	0
SCHISTOMERINGOS NR. ANNULATA	1	1	1	1
PETTIBONEIA SANMATIENSIS	1	0	0	0
MYZOSTOMIDAE				
MYZOSTOMUM LPIL	0	0	0	1
ORBINIIDAE				
LEITOSCOLOPLOS LPIL	1	0	1	0
LEITOSCOLOPLOS PANAMENSIS	1	0	0	0
LEITOSCOLOPLOS PUGETTENSIS	1	1	0	0
LEITOSCOLOPLOS SP. A WILLIAMS	1	1	1	0
LEITOSCOLOPLOS SP. B	1	1	0	0
NAINERIS LPIL	0	0	0	1
NAINERIS UNCINATA	0	0	0	1
SCOLOPLOS LPIL	1	0	1	0
SCOLOPLOS ARMIGER	1	0	1	0
SCOLOPLOS NR. ARMIGERA	1	0	0	0
PHYLO NUDUS	1	1	0	0
PROTOARICIELLA SP. B	0	0	0	1
PARAONIDAE				
PARAONIDAE LPIL	1	1	1	0
AEDICIRA LPIL	1	1	1	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
ALLIA ANTENNATA	1	1	1	0
ACMIRA ?LOPEZI LOPEZI	1	1	0	0
AEDICIRA SP. A	1	1	1	0
ARICIDEA LPIL	1	0	0	0
ARICIDEA WASSI	1	1	0	0
ACMIRA CATHERINAE	1	1	1	0
ACMIRA LOPEZI RUBRA	1	1	1	0
ACMIRA LOPEZI LOPEZI	1	1	0	0
ALLIA RAMOSA	1	1	0	0
CIRROPHORUS BRANCHIATUS	1	1	1	0
CIRROPHORUS FURCATUS	1	0	1	0
ALLIA LPIL	1	0	0	0
ALLIA MONICAE	1	1	1	0
ALLIA NOLANI	1	1	0	0
ALLIA ?NOLANI	1	0	0	0
ALLIA CF. NOLANI	1	1	0	0
LEVINSENIA LPIL	1	1	0	0
LEVINSENIA GRACILIS	1	1	1	1
LEVINSENIA MULTIBRANCHIATA	1	1	0	0
LEVINSENIA OCULATA	1	1	0	0
LEVINSENIA SP. B	1	1	0	0
ACMIRA LPIL	1	1	1	0
ACMIRA SIMPLEX	1	1	1	0
ACMIRA SP. A	1	0	0	0
ACMIRA NR. ASSIMILIS	1	1	1	0
APISTOBRANCHIDAE				
APISTOBRANCHUS LPIL	0	0	1	1
APISTOBRANCHUS TULLBERGI	1	1	0	0
APISTOBRANCHUS ORNATUS	1	0	1	0
SPIONIDAE				
SPIONIDAE LPIL	1	0	0	1
LAONICE LPIL	1	0	0	1
LAONICE CIRRATA	1	1	1	1
LAONICE APPELLOFI	1	1	1	1
POLYDORA LPIL	1	0	1	1
POLYDORA GIARDI	0	0	0	1
POLYDORA SOCIALIS	0	0	0	1
POLYDORA QUADRILOBATA	0	0	0	1
POLYDORA LIGNI	0	0	0	1
POLYDORA LIMICOLA	0	0	0	1
POLYDORA NEOCARDALIA	0	0	0	1
POLYDORA CONVEXA	0	0	0	1
POLYDORA NARICA	0	0	0	1
POLYDORA NR. NEOCARDALIA	0	0	0	1
POLYDORA ?PYGIDIALIS	0	0	0	1
POLYDORA SP. A	0	0	0	1
POLYDORA ?SOCIALIS	0	0	1	0
POLYDORA BIFURCATA	0	0	0	1
PRIONOSPIO LPIL	1	1	1	1
MINUSPIO CIRRIFERA	1	1	1	1
PRIONOSPIO ?LOBULATA	1	1	0	0
PRIONOSPIO SP. B	1	1	0	0
PRIONOSPIO SP. A	1	1	1	0
PRIONOSPIO LOBULATA	1	1	0	0
SCOLECOLEPIDES SP. A	1	1	0	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
SPIO PUNCTATA	1	1	1	0
SPIOPHANES LPIL	1	1	1	1
SPIOPHANES BOMBYX	1	1	1	0
SPIOPHANES KROYERI	1	1	1	0
SPIOPHANES BERKELEYORUM	1	1	1	1
SPIOPHANES MISSIONENSIS	1	1	1	1
SPIOPHANES ?BERKELEYORUM	1	1	0	0
MALACOCEROS SP. A	0	0	1	0
PARAPRIONOSPIO PINNATA	1	1	1	0
AONIDES SP. A	0	0	1	0
MICROSPIO PIGMENTATA	0	0	1	0
MICROSPIO SP. B	0	0	1	0
MICROSPIO SP. A	1	1	0	0
MINUSPIO ?MINOR	1	0	0	0
MINUSPIO SP. A	1	0	1	0
POLYDORID LPIL	1	1	0	0
MAGELONIDAE				
MAGELONA SACCULATA	1	1	0	0
MAGELONA HARTMANAE	1	1	0	0
MAGELONA BERKELEYI	1	1	1	0
POECILOCHAETIDAE				
POECILOCHAETUS LPIL	1	1	0	0
POECILOCHAETUS JOHNSONI	1	0	0	0
POECILOCHAETUS SP. A	1	1	0	0
CHAETOPTERIDAE				
CHAETOPTERIDAE LPIL	1	1	1	1
PHYLLOCHAETOPTERUS LPIL	1	0	0	0
PHYLLOCHAETOPTERUS PROLIFICA	0	0	1	1
PHYLLOCHAETOPTERUS LIMICOLUS	1	1	0	0
SPIOCHAETOPTERUS LPIL	1	1	0	0
SPIOCHAETOPTERUS COSTARUM	1	1	1	1
MESOCHAETOPTERUS TAYLORI	1	1	1	0
CIRRATULIDAE				
CIRRATULIDAE LPIL	1	1	1	1
CIRRATULUS CIRRATUS	0	0	0	1
CAULLERIELLA GRACILIS	0	0	1	0
CAULLERIELLA NR. BIOCULATA	0	0	1	0
THARYX LPIL	1	1	1	1
THARYX TESSELATA	1	1	1	1
THARYX SP. G	1	1	0	0
THARYX SP. F	1	1	0	0
THARYX SP. E	1	1	0	0
THARYX SP. D	1	1	0	0
THARYX NR. C	1	1	0	1
THARYX SP. C	1	1	0	1
THARYX SP. B	1	1	1	1
THARYX SP. A	1	1	0	0
CHAETOZONE LPIL	1	1	1	1
CHAETOZONE CORONA	1	1	0	0
CHAETOZONE MULTIOCULATA	1	1	0	1
CHAETOZONE SPINOSA	1	0	0	0
CHAETOZONE SP. A	0	0	0	1
CHAETOZONE ARMATA	0	0	1	0
CHAETOZONE NR. MULTIOCULATA	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
CHAETOZONE NR. SETOSA	1	1	1	0
DODECACERIA LPIL	0	0	0	1
DODECACERIA CONCHARUM	0	0	1	1
ACROCIRRIDAE				
ACROCIRRIDAE LPIL	0	0	0	1
ACROCIRRUS LPIL	0	0	0	1
ACROCIRRUS SP. A	0	0	0	1
COSSURIDAE				
COSSURA LPIL	1	1	1	0
COSSURA CANDIDA	1	1	1	0
COSSURA ROSTRATA	1	1	0	0
CTENODRILIDAE				
CTENODRILIDAE GENUS A SP. A	0	0	0	1
FLABELLIGERIDAE				
FLABELLIGERIDAE LPIL	1	0	0	0
BRADA LPIL	1	0	0	1
BRADA VILLOSA	1	1	0	0
BRADA PLURIBRANCHIATA	1	1	0	0
FLABELLIGERA INFUNDIBULARIS	0	0	0	1
PHERUSA LPIL	1	0	0	1
PHERUSA PAPILLATA	1	1	0	1
PHERUSA INFLATA	0	0	0	1
PHERUSA NEOPAPILLATA	1	1	1	1
PHERUSA SP. B	0	0	0	1
PIROMIS LPIL	1	0	1	1
PIROMIS SP. A	1	1	1	1
SCALIBREGMIDAE				
SCALIBREGMA INFLATUM	1	1	1	0
ASCLEROCHEILUS BERINGIANUS	0	0	1	1
ASCLEROCHEILUS NR. BERINGIANUS	0	0	1	0
ASCLEROCHEILUS SP. A	0	0	0	1
OPHELIIDAE				
OPHELINA LPIL	1	0	1	0
OPHELINA ACUMINATA	1	1	1	0
OPHELINA BREVIATA	0	0	1	0
OPHELINA PALLIDA	1	0	0	0
ARMANDIA BIOCULATA	0	0	1	0
TRAVISIA LPIL	1	1	0	0
TRAVISIA BREVIS	1	1	1	0
TRAVISIA PUPA	1	1	0	0
TRAVISIA ?PUPA	1	1	0	0
STERNASPIDAE				
STERNASPIS FOSSOR	1	1	1	0
CAPITELLIDAE				
CAPITELLIDAE LPIL	1	1	0	1
CAPITELLA CAPITATA	1	1	0	0
HETEROMASTUS LPIL	1	1	0	0
HETEROMASTUS FILOBRANCHUS	1	1	0	0
NOTOMASTUS LPIL	1	1	1	1
NOTOMASTUS TENUIS	1	1	1	0
NOTOMASTUS LINEATUS	0	0	1	0
NOTOMASTUS LATERICEUS	0	0	1	0
NOTOMASTUS HEMIPODUS	1	1	0	0
NOTOMASTUS SP. A	1	1	0	0
NOTOMASTUS MAGNUS	1	1	0	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
NOTOMASTUS (CLISTOMASTUS) LPIL	1	1	0	0
MEDIOMASTUS LPIL	1	1	1	1
DECAMASTUS LPIL	1	1	0	0
DECAMASTUS GRACILIS	1	1	1	0
DECAMASTUS SP. A	1	1	0	0
BARANTOLLA AMERICANA	1	0	0	0
LEIOCHRIDES SP. A	1	1	0	0
PARHETEROMASTUS LPIL	1	0	0	0
NEOHETEROMASTUS LPIL	1	0	0	0
NEOHETEROMASTUS LINEUS	1	1	0	0
NEOMEDIOMASTUS GLABRUS	1	1	0	0
CAPITELLIDAE GENUS A, SP. A	1	0	1	0
MALDANIDAE				
MALDANIDAE LPIL	1	0	0	1
ASYCHIS DISPARIDENTATA	1	1	0	0
MALDANE SARSI	1	1	1	0
NICOMACHE LPIL	0	0	0	1
NICOMACHE LUMBRICALIS	0	0	0	1
NICOMACHE PERSONATA	0	0	0	1
NOTOPROCTUS PACIFICUS	1	1	0	1
PETALOPROCTUS NEOBOREALIS	0	0	0	1
PRAXILLELLA LPIL	1	1	0	1
PRAXILLELLA GRACILIS	1	1	0	0
PRAXILLELLA PACIFICA	1	1	1	0
RHODINE LPIL	1	0	0	0
RHODINE BITORQUATA	1	1	1	0
EUCLYMENE SP. A	0	0	0	1
CLYMENURA GRACILIS	1	1	1	0
CLYMENURA COLUMBIANA	1	1	1	1
LUMBRICLYMENE SP. B	1	1	0	0
PRAXILLURA MACULATA	0	0	1	0
ISOCIRRUS LONGICEPS	0	0	1	0
EUCLYMENINAE GEN. E SP. A	0	0	0	1
NICOMACHINAE LPIL	0	0	0	1
MALDANINAE LPIL	1	0	0	0
LUMBRICLYMENINAE LPIL	0	0	0	1
EUCLYMENINAE LPIL	1	1	1	1
EUCLYMENINAE SP. D	0	0	1	0
EUCLYMENINAE SP. C	1	1	1	1
OWENIIDAE				
OWENIIDAE LPIL	1	1	0	0
OWENIA LPIL	0	0	1	0
MYRIOCHELE LPIL	1	0	0	0
MYRIOCHELE SP. M	1	1	1	0
MYRIOCHELE ?PYGIDIALIS	1	0	0	0
MYRIOCHELE GRACILIS	1	1	1	0
MYRIOWENIA CALIFORNIENSIS	1	1	0	0
SABELLARIIDAE				
SABELLARIA LPIL	0	0	0	1
SABELLARIA CEMENTARIUM	0	0	0	1
SABELLARIA GRACILIS	0	0	0	1
PECTINARIIDAE				
PECTINARIA CALIFORNIENSIS	1	1	1	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
AMPHARETIDAE				
AMPHARETIDAE LPIL	1	1	0	1
AMAGE LPIL	0	0	1	0
AMAGE ANOPS	1	1	1	0
AMAGE SCUTATA	1	1	0	0
AMAGE ARIETICORNUTA	1	1	0	0
AMPHARETE LPIL	1	1	1	0
AMPHARETE ARCTICA	1	1	1	0
AMPHARETE LABROPS	1	1	0	0
AMPHARETE SP. A	0	0	1	0
AMPHICTEIS LPIL	1	1	1	0
AMPHICTEIS GLABRA	0	0	1	0
AMPHICTEIS SCAPHOBRANCHIATA	1	1	1	0
AMPHICTEIS MUCRONATA	1	1	1	1
LYSIPPE LABIATA	1	1	1	0
LYSIPPE ANNECTANS	1	1	0	0
MELINNA LPIL	1	0	0	1
MELINNA HETERODONTA	1	1	0	0
MELINNA OCULATA	1	1	1	0
ANOBOTRUS LPIL	1	0	0	0
ANOBOTHRUS SP. A	1	1	0	0
ANOBOTHRUS BIMACULATUS	1	1	1	1
ASABELLIDES LINEATA	1	1	1	0
ASABELLIDES SP. B	0	0	0	1
ASABELLIDES SP. A	1	1	0	0
GLYPHANOSTOMUM PALLESCENS	1	1	0	0
SAMYTHA NR. CALIFORNIENSIS	1	1	1	0
AMPHISAMYTHA BIOCULATA	0	0	1	0
ECLYSIPPE TRILOBATUS	1	1	0	0
ANOBOTHRUS LPIL	1	0	0	0
AMPHARETINAE LPIL	1	1	1	0
AMPHARETIDAE, GEN. A SP. A	1	1	0	0
TEREBELLIDAE				
TEREBELLIDAE LPIL	1	1	1	1
EUPOLYMNIA LPIL	0	0	0	1
LEAENA ?CAECA	1	0	0	0
NEOAMPHITRITE LPIL	0	0	0	1
NEOAMPHITRITE ROBUSTA	1	1	0	1
NEOLEPREA NR. CALIFORNICA	0	0	0	1
NEOLEPREA ?JAPONICA	0	0	0	1
PISTA LPIL	1	1	0	1
PISTA ELONGATA	0	0	1	1
PISTA BREVIBRANCHIATA	0	0	0	1
PISTA NR. FASCIATA	1	1	1	0
PISTA DISJUNCTA	1	1	0	0
PISTA SP. B	1	1	1	1
POLYCIRRUS LPIL	1	0	1	1
POLYCIRRUS CALIFORNICUS	0	0	1	1
POLYCIRRUS SP. G	0	0	0	1
POLYCIRRUS SP. F	0	0	0	1
SPINOSPHAERA LPIL	1	0	0	0
SPINOSPHAERA PACIFICA	0	0	0	1
THELEPUS HARMATUS	0	0	1	1
THELEPUS SETOSUS	1	1	1	0
ARTACAMA CONIFERI	0	0	1	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
ARTACAMELLA HANCOCKI	1	1	1	0
LANASSA VENUSTA VENUSTA	1	0	1	1
LANASSA GRACILIS	1	1	0	1
LANASSA SP. D	1	1	1	0
LAPHANIA BOECKI	1	1	0	1
PROCLEA GRAFFI	0	0	1	1
PROCLEA SP. B	0	0	0	1
SCIONELLA JAPONICA	1	1	1	0
LOIMIA MEDUSA	0	0	1	0
TEREBELLA SP. A	0	0	0	1
AMAEANA LPIL	1	1	0	0
AMAEANA OCCIDENTALIS	1	1	0	1
AMAEANA SP. A	1	1	0	0
STREBLOSOMA LPIL	0	0	0	1
STREBLOSTOMA SP. A	1	1	0	0
LANICE CONCHILEGA	1	1	0	0
POLYCIRRINAE LPIL	1	0	0	1
AMPHITRITINAE LPIL	1	1	1	1
THELEPINAE LPIL	0	0	1	0
AMPHITRITINAE GENUS A SP. A	1	1	0	1
TRICHOBRANCHIDAE				
TEREBELLIDES LPIL	1	1	0	0
TEREBELLIDES STROEMI	1	1	0	0
TEREBELLIDES NR. KOBEI	1	0	0	0
TEREBELLIDES SP. C	1	1	1	0
TEREBELLIDES REISHI	1	1	1	1
TEREBELLIDES CALIFORNICA	1	1	1	0
OCTOBRANCHUS SP. A	0	0	0	1
SABELLIDAE				
SABELLIDAE LPIL	1	0	0	1
CHONE LPIL	1	1	1	1
CHONE DUNERI	1	1	1	0
CHONE MAGNA	1	1	0	0
CHONE ALBOCINCTA	1	1	1	0
CHONE VELERONIS	1	1	1	0
CHONE MINUTA	0	0	0	1
CHONE ?MOLLIS	1	0	0	0
CHONE SP. A	1	1	0	1
EUCHONE LPIL	1	0	0	0
EUCHONE INCOLOR	1	0	0	0
EUCHONE ARENAE	1	1	1	0
EUCHONE SP. A	1	0	0	0
EUCHONE VELIFERA	1	0	0	0
MEGALOMMA SPLENDIDA	0	0	0	1
MEGALOMMA CIRCUMSPECTUM	0	0	1	0
MYXICOLA INFUNDIBULUM	0	0	0	1
PSEUDOPOTAMILLA LPIL	0	0	1	1
PSEUDOPOTAMILLA SOCIALIS	1	1	0	1
PSEUDOPOTAMILLA ?SOCIALIS	0	0	0	1
DEMONAX LPIL	1	1	0	0
FABRICIA LPIL	0	0	0	1
FABRICIA SP. C	0	0	0	1
FABRICIA SP. B	0	0	1	0
FABRICIA SP. A	0	0	1	0
JASMINEIRA SP. A	1	1	0	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
FABRISABELLA SP. B	0	0	1	1
FABRICIOLA ?BERKELEYI	0	0	0	1
ORIOPSIS LPIL	0	0	0	1
POTAMETHUS SP. A	1	1	0	0
FABRICINAE LPIL	1	0	0	1
SABELLINAE LPIL	1	1	0	1
SERPULIDAE				
SERPULIDAE LPIL	0	0	0	1
APOMATUS LPIL	0	0	0	1
APOMATUS TIMSII	0	0	0	1
HYDROIDES ELEGANS	1	1	0	0
PROTULA SUPERBA	0	0	0	1
VERMILIOPSIS INFUNDIBULUM	0	0	0	1
VERMILIOPSIS MULTIANNULATA	0	0	0	1
PSEUDOVERMILIA CONCHATA	0	0	0	1
PLACOSTEGUS CALIFORNICUS	0	0	0	1
SPIRORBIDAE LPIL	0	0	0	1
PROTOLAEOSPIRA EXIMIA	0	0	1	1
PROTOLAEOSPIRA CAPENSIS	0	0	0	1
HYALOPOMATUS BIFORMIS	0	0	0	1
OLIGOCHAETA				
OLIGOCHAETA LPIL	1	1	1	1
MOLLUSCA				
GASTROPODA				
STREPTONEURA				
ARCHEOGASTROPODA				
GASTROPODA LPIL	1	1	1	1
SCISSURELLIDAE				
ANATOMA CRISPATA	1	1	0	0
FISSURELLIDAE				
PUNCTURELLA LPIL	0	0	0	1
PUNCTURELLA CUCULLATA	0	0	0	1
LEPETIDAE				
IOTHIA LINDBERGI	0	0	0	1
TROCHIDAE				
TROCHIDAE LPIL	1	1	0	0
CALLIOSTOMA SUPROGRANOSUM	0	0	1	0
CALLIOSTOMA GLORIOSUM	0	0	0	1
CALLIOSTOMA TURBINUM	1	1	0	0
MARGARITES NR. BERINGENSIS	0	0	0	1
SOLARIELLA PERAMABILIS	0	0	1	0
SOLARIELLA NUDA	1	1	0	0
CIDARIA CIDARIS	0	0	0	1
TURBINIDAE				
HOMALOPOMA LPIL	0	0	0	1
HOMALOPOMA LURIDUM	0	0	0	1
HOMALOPOMA PAUCICOSTATA	0	0	0	1
MESOGASTROPODA				
ORBITESTELLIDAE				
ORBITESTELLA DIEGENSIS	0	0	0	1
RISSOIDAE				
ALVINIA ROSANA	1	1	0	1
ALVINIA TUMIDA	1	1	0	0
CINGULA LPIL	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
VITRINELLIDAE				
VITRINELLA OLDROYDI	1	1	0	0
FOSSARIDAE				
MACROMPHALINA CALIFORNICA	0	0	0	1
CAECIDAE				
CAECUM LPIL	0	0	1	0
CAECUM CREBRICINCTUM	0	0	1	0
DIASTOMATIDAE				
ALABA JEANETTAE	0	0	0	1
CERITHIIDAE				
BITTIUM LPIL	1	1	0	0
BITTIUM FETELLUM	1	1	0	0
CERITHIOPSIDAE				
CERITHIOPSIS LPIL	0	0	0	1
CERITHIOPSIS COSMIA	0	0	0	1
EPITONIIDAE				
EPITONIUM LPIL	1	0	0	1
EPITONIUM SAWINAE	1	1	0	1
OPALIA SPONGLOSA	0	0	0	1
EULIMIDAE				
BALCIS LPIL	1	0	0	1
BALCIS RUTILA	1	1	0	0
BALCIS GRIPPI	0	0	0	1
BALCIS MONTEREYENSIS	1	1	0	1
BALCIS OLDROYDI	1	1	1	1
EULIMA CALIFORNICA	1	0	0	0
SABINELLA SP. A	1	1	0	0
CALYPTRAEIDAE				
CALYPTRAEIDAE LPIL	0	0	0	1
CALYPTRAEA FASTIGIATA	0	0	1	0
CREPIDULA LPIL	1	0	0	1
CREPIDULA NUMMARIA	1	1	0	0
CREPIDULA DORSATA	0	0	1	1
VERTICUMBO CHARYBDIS	0	0	0	1
LAMELLARIIDAE				
LAMELLARIA LPIL	0	0	0	1
LAMELLARIA PERSPICUA	0	0	0	1
NATICIDAE				
POLINICES PALLIDUS	0	0	1	0
NEVERITA RECLUZIANA	1	1	0	0
NEOGASTROPODA				
MURICIDAE				
OCENEBRA LPIL	0	0	0	1
OCENEBRA LURIDA	0	0	0	1
OCENEBRA ATROPURPUREA	0	0	0	1
TROPHONOPSIS LPIL	0	0	0	1
TROPHONOPSIS SCITULUS	0	0	0	1
TROPHONOPSIS MULTICOSTATUS	0	0	0	1
COLUMBELLIDAE				
AMPHISSA LPIL	0	0	0	1
AMPHISSA UNDATA	1	1	1	1
AMPHISSA BICOLOR	1	1	1	1
MITRELLA TUBEROSA	1	1	0	0
MITRELLA PERMODESTA	1	1	0	0
MITRELLA AURANTIACA	0	0	1	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
NASSARIIDAE				
NASSARIUS LPIL	0	0	1	0
NASSARIUS FOSSATUS	1	1	0	0
NASSARIUS INSCULPTUS	0	0	1	0
CANCELLARIIDAE				
ADMETE COUTHOUYI	1	1	0	0
CANCELLARIA COOPERI	1	1	0	0
MARGINELLIDAE				
CYSTISCUS SP. A	0	0	0	1
TURRIDAE				
TURRIDAE LPIL	1	1	0	0
OENOPOTA RETICULATA	1	1	0	0
PROPEBELA LPIL	1	1	0	0
ANTIPLANES STRONGI	1	1	0	0
KURTZIELLA BETA	1	1	0	0
DAPHNELLA CLATHRATA	0	0	0	1
RECTIPLANES LPIL	0	0	1	0
CLATHURELLA LPIL	0	0	1	0
KURTZIA ARTEAGA	1	1	1	0
ENTHYNEURA				
PYRAMIDELLIDA				
PYRAMIDELLIDAE				
PYRAMIDELLIDAE LPIL	1	0	0	0
ODOSTOMIA LPIL	1	0	0	0
ODOSTOMIA RITTERI	0	0	1	0
ODOSTOMIA CALLIMENE	1	0	0	0
ODOSTOMIA HETEROCINCTA	0	0	0	1
ODOSTOMIA PRATOMA	1	0	1	0
ODOSTOMIA NR. CORONADOENSIS	1	0	0	0
ODOSTOMIA FARALLONENSIS	1	1	0	0
ODOSTOMIA DINELLA	1	1	0	0
TURBONILLA LPIL	1	0	0	1
TURBONILLA RAYMONDI	1	1	0	0
TURBONILLA NEWCOMBEI	1	0	0	0
TURBONILLA CF. AMBUSTA	1	1	0	0
TURBONILLA MURICATA	0	0	0	1
TURBONILLA SP. L	1	1	0	0
TURBONILLA SANTAROSANA	1	1	0	0
TURBONILLA PAINEI	1	1	0	0
TURBONILLA AMBUSTA	1	1	0	0
TURBONILLA AEPYNOTA	1	0	0	0
CEPHALASPIDEA				
CEPHALASPIDEA LPIL	1	1	0	0
ACTEONIDAE				
RICTAXIS PUNCTOCAELATUS	1	0	1	0
ACTEON TRASKI	1	1	0	0
SCAPHANDRIDAE				
CEPHALASPIDEA SP. A	1	0	0	0
CYLICHNA DIEGENSIS	1	1	1	0
CYLICHNELLA CULCITELLA	1	1	0	0
CYLICHNELLA HARPA	1	1	0	1
PHILINIDAE				
PHILINE SP. A	1	0	0	0
PHILINE LPIL	1	0	0	0
PHILINE CF. QUADRATA	1	1	0	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
AGLAJIDAE				
AGLAJA LPIL	1	1	0	0
AGLAJA OCELLIGERA	1	0	0	0
GASTROPTERIDAE				
GASTROPTERON PACIFICUM	1	0	1	0
DIAPHANIDAE				
DIAPHANA CALIFORNICA	1	0	0	1
RETUSIDAE				
VOLVULELLA LPIL	1	0	0	0
VOLVULELLA CYLINDRICA	1	1	0	0
VOLVULELLA PANAMICA	1	1	1	0
VOLVULELLA CALIFORNICA	1	1	0	0
SULCORETUSA XYSTRUM	1	0	0	0
NOTASPIDEA				
PLEUROBRANCHIDAE				
BERTHELLA CALIFORNICA	0	0	0	1
DORIDOIDEA				
DORID LPIL	0	0	0	1
CHROMODORIDIDAE				
CADLINA FLAVOMACULATA	0	0	0	1
DORIDIDAE				
ALDISA SANGUINEA	0	0	0	1
POLYCERATIDAE				
LIMACIA SP. A	0	0	0	1
GONIODORIDIDAE				
OKENIA SP. B	1	1	0	0
DENDRONOTOIDEA				
TRITONIIDAE				
TRITONIA FESTIVA	0	0	0	1
AEOLIDOIDEA				
AEOLIDOIDA LPIL	1	1	0	1
CUTHONIDAE				
PRECUTHONA DIVAE	0	0	0	1
FLABELLINIDAE				
CORYPHELLA LPIL	0	0	0	1
POLYPLACOPHORA				
POLYPLACOPHORA LPIL	0	0	0	1
LEPIDOPLEURIDAE				
HANLEYELLA OLDROYDI	0	0	0	1
LEPTOCHITON RUGATUS	1	1	1	1
ISCHNOCHITONIDAE				
LEPIDOZONA LPIL	0	0	0	1
LEPIDOZONA RETIPOROSA	0	0	0	1
LEPIDOZONA SP. A	0	0	0	1
CALLISTOPLACIDAE				
CALLISTOCHITON PALMULATUS	0	0	0	1
MOPALIIDAE				
MOPALIA SP. A	0	0	0	1
ACULIFERA				
NEOMENIOMORPHA LPIL	1	0	0	0
DONDERSIIDAE .				
HEATHIA POROSA	1	0	1	1
CAUDOFOREATA				
CAUDOFOVEATA LPIL	1	1	0	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
CHAETODERMATIDAE				
CHAETODERMATIDAE LPIL	1	1	0	0
CHAETODERMA LPIL	1	1	0	0
CHAETODERMA SP. F	1	1	0	0
CHAETODERMA SP. A	1	1	0	0
CHAETODERMA SP. H	1	1	0	0
FALCIDENS LPIL	1	1	0	0
FALCIDENS SP. H	1	0	0	0
FALCIDENS HARTMANAE	1	1	0	0
FALCIDENS SP. B	1	1	0	0
FALCIDENS SP. A	1	1	0	0
LIMIFOSSOR FRATULA	1	1	0	0
PROCHAETODERMATIDAE				
PROCHAETODERMA LPIL	1	0	0	0
PROCHAETODERMA SP. A	1	1	0	0
PROCHAETODERMA CALIFORNICA	1	0	0	0
BIVALVIA				
PELECYPODA LPIL	1	1	1	1
FAMILY UNKNOWN				
PARASITIC CLAM	1	1	0	0
SOLEMYIDAE				
SOLEMYA REIDI	0	0	1	0
NUCINELLIDAE				
HUXLEYIA MUNITA	1	1	1	0
NUCULIDAE				
ACILA CASTRENIS	1	1	1	0
NUCULA LPIL	1	1	0	1
NUCULA TENUIS	1	1	0	0
NUCULA NR. CARDARA	1	1	0	0
NUCULA EXIGUA	1	1	0	0
TINDARIIDAE				
SATURNIA LPIL	1	1	0	0
SATURNIA KENNERLYI	1	1	0	0
SATURNIA NR. RITTERI	1	1	0	0
SATURNIA CALIFORNICA	1	1	0	0
NUCULANIDAE				
NUCULANIDAE LPIL	1	0	0	0
NUCULANA LPIL	1	1	0	0
NUCULANA CONCEPTIONIS	1	1	0	0
NUCULANA LEONINA	1	1	0	0
NUCULANA PONTONIA	1	1	0	0
NUCULANA TAPHRIA	1	1	0	0
YOLDIIDAE				
YOLDIA SCISSURATA	1	1	0	0
MYTILIDAE				
CRENELLA LPIL	1	0	0	1
CRENELLA DIVARICATA	1	1	0	1
MEGACRENELLA COLUMBIANA	0	0	1	1
DACRYDIUM LPIL	1	1	0	0
MODIOLUS LPIL	1	1	1	0
MODIOLUS NEGLECTUS	1	1	1	0
AMYGDALUM PALLIDULUM	1	1	0	1
GREGARIELLA CHENUI	0	0	1	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
PECTINIDAE				
PECTINIDAE LPIL	1	0	0	1
CHLAMYS HASTATA	0	0	0	1
CYCLOPECTEN LPIL	1	1	0	0
CYCLOPECTEN BISTRIATUS	1	1	0	0
DELECTOPECTEN LPIL	0	0	0	1
DELECTOPECTENI RANDOLPHI	0	0	1	1
DELECTOPECTEN VANCOUVERENSIS	0	0	0	1
LEPTOPECTEN LATIAURATUS	1	1	0	0
LIMIDAE				
LIMA HEMPHILLI	0	0	1	0
LIMATULA SUBAURICULATA	1	1	1	0
LUCINIDAE				
PARVILUCINA TENUISCULPTA	1	1	1	1
LUCINOMA ANNULATA	1	1	0	0
THYASIRIDAE				
ADONTORHINA LPIL	1	0	0	0
ADONTORHINA CYCLICA	1	1	1	1
AXINOPSIDA SERRICATA	1	1	1	0
THYASIRA LPIL	1	1	0	0
THYASIRA GOULDI	1	1	0	0
UNGULINIDAE				
FELANIELLA CORNEA	0	0	1	0
KELLIIDAE				
KELLIA LPIL	0	0	0	1
KELLIA LAPEROUSII	0	0	0	1
MONTACUTIDAE				
MYSELLA LPIL	1	0	0	0
MYSELLA GRIPPI	1	1	1	0
MYSELLA SP. E	1	1	0	0
MYSELLA SP. F	1	1	0	0
MYSELLA SP. D	1	1	0	0
MYSELLA SP. C	1	1	0	0
MYSELLA SP. B	1	1	0	0
MYSELLA CF. ALEUTICA	1	1	1	0
TOMBURCHUS REDONDOENSIS	1	1	1	0
MONTACUTIDAE GENUS B SP. A	0	0	0	1
GALEOMMATIDAE				
GALEOMMATIDAE GENUS A, SP. A	1	1	1	0
CARDITIDAE				
CYCLOCARDIA LPIL	1	1	0	0
CYCLOCARDIA VENTRICOSA	1	1	1	0
CYCLOCARDIA BARBARENSIS	1	1	0	0
MILNERIA MINIMA	0	0	0	1
CHAMAIDAE				
CHAMA ARCANA	0	0	0	1
PSEUDOCHAMA EXOGYRA	0	0	0	1
CARDIIDAE				
NEMOCARDIUM CENTIFILOSUM	1	1	1	1
CULTELLIDAE				
SILIQUA LUCIDA	1	1	0	0
TELLINIDAE				
MACOMA LPIL	1	1	0	0
MACOMA YOLDIFORMIS	1	1	0	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
MACOMA CARLOTTENSIS	1	1	1	0
TELLINA CARPENTERI	1	1	1	0
PSAMMOBIIDAE				
GARI CALIFORNICA	0	0	1	0
SCROBICULARIIDAE				
SEMELE INCONGRUA	0	0	1	0
VENERIDAE				
COMPSOMYAX SUBDIAPHANA	1	1	1	0
PSEPHIDIA LPIL	1	1	1	1
PSEPHIDIA OVALIS	0	0	1	0
COOPERELLIDAE				
COOPERELLA SUBDIAPHANA	1	1	0	0
MYIDAE				
PARAMYA SP. A	1	1	0	0
HIATELLIDAE				
HIATELLA ARCTICA	0	0	1	1
SAXICAVELLA PACIFICA	1	1	1	0
PHOLADIDAE				
ZIRFAEA PILSBRYI	0	0	0	1
LYONSIIDAE				
LYONSIA CALIFORNICA	0	0	1	0
PERIPLOMATIDAE				
PERIPLOMA DISCUS	1	1	0	0
THRACIIDAE				
THRACIA TRAPEZOIDES	1	1	0	0
CUSPIDARIIDAE				
CARDIOMYA CALIFORNICA	1	1	1	0
CARDIOMYA PLANETICA	1	1	0	0
CUSPIDARIA PARAPODEMA	1	1	1	0
VERTICORDIIDAE				
LYONSIELLA ALASKANA	1	1	0	0
SCAPHOPODA				
SCAPHOPODA LPIL	1	1	0	0
DENTALIIDAE				
DENTALIUM LPIL	1	1	0	0
DENTALIUM PRETIOSUM	0	0	1	0
DENTALIUM VALLICOLENS	1	1	0	0
DENTALIUM RECTIUS	1	1	0	0
SIPHONODENTALIIDAE				
CADULUS LPIL	1	1	0	0
CADULUS CALIFORNICUS	1	1	0	0
CADULUS TOLMEI	1	1	0	0
CADULUS QUADRIFISSATUS	1	1	0	0
CADULUS FUSIFORMIS	1	1	1	0
ARTHROPODA				
ACARINA				
HALACARIDAE				
HALACARIDAE LPIL	1	0	1	1
PYCNOGONIDA				
PYCNOGONIDA LPIL	0	0	0	1
PALLENIDAE				
DECACHELA SP. A	0	0	0	1
DECACHELA DISCATA	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
AMMOTHEIDAE				
ACHELIA ECHINATA	0	0	0	1
EURYCYDE SPINOSA	0	0	0	1
AMMOTHEIDAE GENUS A SP. A	0	0	1	0
TANYSTYLIDAE				
RHYNCHOTHORAX PHILOPSAMMUM	0	0	0	1
PHOXICHILIDIIDAE				
ANOPLODACTYLUS ERECTUS	1	1	1	0
ANOPLODACTYLUS NR. PACIFICUS	1	1	0	1
PYCNOGONIDAE				
PYCNOGONUM RICKETTSI	0	0	1	1
CRUSTACEA				
OSTRACODA				
MYODOCOPINA				
OSTRACODA LPIL	0	0	0	1
CYPRIDINIDAE				
VARGULA TSUJII	1	0	1	0
CYLINDROLEBERIDIDAE				
CYLINDROLEBERIDIDAE LPIL	1	1	0	1
BATHYLEBERIS LPIL	1	0	0	1
BATHYLEBERIS CALIFORNICA	1	1	0	0
BATHYLEBERIS GARTHI	1	0	0	1
BATHYLEBERIS HANCOCKI	1	1	0	0
PARASTEROPE LPIL	1	0	0	1
PARASTEROPE HULINGSI	1	0	0	1
PARASTEROPE BARNESI	1	1	0	1
DIASTEROPE LPIL	1	0	0	0
DIASTEROPE PILOSA	1	1	1	1
SARSIELLIDAE				
SARSIELLA SP. M	1	1	0	0
SARSIELLA SP. A	1	1	1	0
RUDIDERMATIDAE				
RUTIDERMA ROSTRATA	1	0	0	0
RUTIDERMA LOMAE	1	1	1	1
PHILOMEDIDAE				
HARBANSUS LPIL	1	0	0	0
HARBANSUS BRADMYERSI	1	0	1	0
PHILOMEDES DENTATA	1	1	1	0
EUPHILOMEDES LPIL	1	0	0	0
EUPHILOMEDES CARCHARODONTA	1	1	1	0
EUPHILOMEDES LONGISETA	1	1	0	0
EUPHILOMEDES PRODUCTA	1	1	1	0
SCLEROCONCHA TRITUBERCULATA	1	1	1	0
PODOCOPINA				
PODOCOPIDA LPIL	1	0	0	0
BARDIIDAE				
NEONESIDIA PHLEGERI	0	0	0	1
HEMICYTHERIDAE				
HEMICYTHERE SP. A	1	0	0	0
TRACHYLEBERIDIDAE				
CATIVELLA SP. A	1	0	0	0
CATIVELLA SEMITRANSLUCENS	1	0	0	0
PARACYPRIDIDAE				
MACROCYPRINA LPIL	1	0	0	1
MACROCYPRINA PACIFICA	1	1	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
COPEPODA				
COPEPODA LPIL	1	1	0	1
HARPACTICOIDA				
HARPACTICOIDA LPIL	1	0	0	1
CYCLOPOIDA				
CYCLOPOIDA LPIL	1	1	1	0
SPIOPHANICOLIDAE				
SPIOPHANICOLA SPINULOSUS	1	1	0	0
CIRRIPEDIA				
THORACICA				
CIRRIPEDIA LPIL	1	0	0	1
SCALPELLIDAE				
ARCOSCALPELLUM CALIFORNICUM	0	0	0	1
BALANIDAE				
BALANUS GALEATUS	0	0	0	1
ACROTHORACIOA				
SYNAGOGIDAE				
PARASOTHORAX LPIL	1	1	0	0
PERACARDIA				
MYSIDACEA				
MYSIDAE				
MYSIDAE LPIL 1	1	0	0	0
AMBYLOPS ABBREVIATA 1	1	0	0	0
INUSITATOMYSIS SP. A 1	1	0	0	0
PSEUDOMMA BERKELEYI	1	1	0	0
PSEUDOMMA NR. TRUNCATUM	1	1	0	0
PSEUDOMMA SP. A	1	1	0	0
CUMACEA				
CUMACEA LPIL	1	1	0	0
LAMPROPIDAE				
LAMPROPS SP. F	1	0	0	0
LAMPROPS SP. E	1	0	0	0
HEMILAMPROPS CALIFORNICA	1	1	0	0
HEMILAMPROPS SP. B	1	1	1	0
HEMILAMPROPS SP. A	1	1	0	0
LEUCONIDAE				
LEUCONIDAE LPIL	1	0	0	0
LEUCON LPIL	1	0	0	0
LEUCON SP. A	1	1	0	0
LEUCON SP. I	1	1	0	0
LEUCON SP. H	1	1	0	0
LEUCON SP. G	1	1	0	0
LEUCON SUBNASICA	1	1	0	0
LEUCON SP. B	1	1	0	0
LEUCON MAGNADENTATA	1	1	0	0
LEUCON ARMATUS	1	1	0	0
EUDORELLA PACIFICA	1	1	1	0
EUDORELLOPSIS LONGIROSTRIS	1	1	1	0
DIASTYLIDAE				
DIASTYLIDAE LPIL	1	1	0	0
DIASTYLIS LPIL	1	0	0	0
DIASTYLIS PELLUCIDA	1	1	0	0
DIASTYLIS PARASPINULOSA	1	1	0	0
DIASTYLIS SP. E	1	1	0	0
DIASTYLIS SP. B	1	1	0	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
DIASTYLIS SP. A	1	1	0	1
DIASTYLIS CALIFORNICA	1	1	0	0
LEPTOSTYLIS LPIL	1	1	0	0
LEPTOSTYLIS VILLOSA	1	1	0	0
LEPTOSTYLIS LONGIMANA	1	0	1	0
LEPTOSTYLIS SP. F	1	0	0	0
LEPTOSTYLIS SP. E	1	0	0	0
LEPTOSTYLIS SP. A	1	1	0	0
NANNASTACIDAE				
CAMPYLASPIS LPIL	1	0	0	0
CAMPYLASPIS RUFA	1	1	0	0
CAMPYLASPIS CANALICULATA	1	1	1	0
CAMPYLASPIS HARTAE	1	1	1	0
CAMPYLASPIS RUBROMACULATA	1	1	0	0
CAMPYLASPIS SP. E	1	0	1	0
CAMPYLASPIS SP. P	1	0	0	0
CAMPYLASPIS SP. O	1	1	0	0
CAMPYLASPIS SP. N	1	1	0	0
CAMPYLASPIS SP. B	1	1	0	0
CAMPYLASPIS NR. CRISPA	1	1	0	0
CUMELLA LPIL	0	0	1	0
CUMELLA SP. A	1	0	0	0
CUMELLA SP. H	1	0	0	0
CUMELLA SP. G	1	0	1	0
CUMELLA EGREGIA	1	0	0	0
PROCAMPYLASPIS SP. A	1	1	1	0
BODOTRIIDAE				
CYCLASPIS SP. C	1	0	0	0
VAUNTHOMPSONIA PACIFICA	0	0	1	1
TANAIDACEA				
TANAIDACEA SP. A	0	0	0	1
MONOKONOPHORA				
APSEUDIDAE				
APSEUDES GRACILIS	1	1	0	0
DIKONOPHORA				
TANAIDAE				
TANAIDAE LPIL	1	0	0	1
ANATANAIS PSEUDONORMANI	0	0	1	0
ANATANAIS NR. PSEUDONORMANI	1	1	0	0
PARATANAIDAE				
LEPTOCHELIA LPIL	1	0	1	1
LEPTOCHELIA SAVIGNYI	0	0	0	1
LEPTOCHELIA SP. A	1	1	0	0
PSEUDOLEPTOCHELIA LPIL	1	1	0	0
LEPTOGNATHIIDAE				
LEPTOGNATHIA LPIL	1	1	0	1
LEPTOGNATHIA SP. H	1	1	0	0
LEPTOGNATHIA SP. F	1	1	0	0
LEPTOGNATHIA SP. E	1	1	1	0
LEPTOGNATHIA SP. D	1	1	0	0
LEPTOGNATHIA SP. C	1	0	1	0
LEPTOGNATHIA SP. B	1	1	1	0
LEPTOGNATHIA SP. A	1	1	1	0
PSEUDOTANAIIDAE				
CRYPTOCOPE LPIL	1	1	1	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
ISOPODA				
GNATHIDEA				
GNATHIIDAE				
GNATHIA LPIL	1	1	1	1
GNATHIA CRENULATIFRONS	1	1	1	0
GNATHIA PRODUCTATRIDENS	0	0	0	1
GNATHIA SANCTAECRUCIS	0	0	0	1
GNATHIA TRIDENS	0	0	0	1
ANTHURIDEA				
ANTHURIDAE				
CYATHURA MUNDA	0	0	1	1
APANTHURA CALIFORNIENSIS	0	0	0	1
APANTHURA SP. A	0	0	1	1
SILOPHASMA GEMINATUM	1	1	1	1
HETERANTHURA SP. A	0	0	0	1
PARANTHURIDAE				
PARANTHURA ELEGANS	0	0	0	1
FLABELLIFERA				
CIROLANIDAE				
CIROLANA JOANNEAE	0	0	0	1
TRIDENTELLIDAE				
TRIDENTELLA SP. A	0	0	0	1
TRIDENTELLA GLUTOSPINA	0	0	0	1
SPHAEROMATIDAE				
SPHAEROMATIDAE LPIL	0	0	0	1
DYNAMENELLA DILATATA	0	0	1	0
SEROLIS CARINATA	1	1	0	0
ROCINELLA ANGUSTATA	1	1	0	0
VALVIFERA				
ARCTURIDAE				
IDARCTURUS ALLELLOMORPHUS	0	0	0	1
IDOTEIDAE				
SYNIDOTEA CALCAREA	1	1	0	0
SYNIDOTEA MEDIA	1	1	1	0
ASELLOTA				
ASELLOTA LPIL	1	1	0	0
STENETRIIDAE				
STENETRIUM SP. A	0	0	0	1
JANIRIDAE				
JANIRIDAE LPIL	0	0	0	1
IANIROPSIS MINUTA	0	0	0	1
JANIRALATA LPIL	0	0	0	1
JANIRALATA SOLASTERI	0	0	0	1
JANIRALATA EROSTRATA	0	0	0	1
DESMOSOMATIDAE				
DESMOSOMATIIDAE LPIL	1	0	0	0
MOMEDOSSA SYMMETRICA	1	0	0	0
PROCHELATOR SP. A	1	0	0	0
NANNONISCIDAE				
NANNONISCONUS LATIPLEONUS	1	0	0	0
JAEROPSIDAE				
JAEROPSIS DUBIA DUBIA	0	0	1	1
JAEROPSIS SP. B	0	0	0	1
JAEROPSIS NR. LATA	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
MUNNIDAE				
MUNNA LPIL	0	0	0	1
MUNNA SP. A	0	0	0	1
PLEUROGONIUM CALIFORNIENSE	1	1	1	0
MUNNOGONIUM ERRATUM	1	1	1	1
MUNNOGONIUM TILLERAE	1	0	1	1
ILYARACHNIDAE				
ILYARACHNA LPIL	1	1	0	0
ILYARACHNA ACARINA	1	1	1	0
EURYCOPIDAE				
EURYCOPIDAE LPIL	1	0	0	0
EURYCOPE CALIFORNIENSIS	1	1	0	0
EURYCOPE SP. A	1	0	0	0
MUNNEURYCOPE LPIL	1	1	0	0
MUNNOPSURUS GIGANTEUS OCHOTENSIS	1	1	0	0
MUNNOPSURUS SP. A	1	1	0	0
EPICARIDA				
CRYPTONISCIDAE				
CRYPTONISCIDAE LPIL	1	1	0	0
BOPYRIDAE				
MUNIDION PLEURONCODIS	1	1	0	0
AMPHIPODA				
GAMMARIDEA				
GAMMARIDEA LPIL	1	1	1	1
AMPELISCIDAE				
AMPELISCIDAE LPIL	1	1	0	0
AMPELISCA LPIL	1	1	0	1
AMPELISCA MACROCEPHALA	1	1	1	0
AMPELISCA EOA	1	1	0	0
AMPELISCA AGASSIZI	1	1	1	0
AMPELISCA CRISTATA	0	0	1	0
AMPELISCA PUGETICA	1	1	1	0
AMPELISCA ROMIGI	1	1	1	0
AMPELISCA PACIFICA	1	1	1	0
AMPELISCA NR. HANCOCKI	1	1	0	0
AMPELISCA LOBATA	1	0	0	1
AMPELISCA INDENTATA	1	1	0	0
AMPELISCA UNSOCALAE	1	1	0	0
AMPELISCA BREVISIMULATA	1	1	1	0
BYBLIS LPIL	1	1	1	0
BYBLIS VELERONIS	1	1	1	1
BYBLIS BATHYALIS	1	1	0	0
BYBLIS BARBARENSIS	1	1	0	0
HAPLOOPS TUBICOLA	1	1	0	0
AMPHILOCHIDAE				
AMPHILOCHUS PICADURUS	0	0	0	1
AORIDAE				
AORIDES NR. SECUNDUS	1	1	1	0
LEMBOS AUDBETTIUS	0	0	1	0
MICRODEUTOPUS SCHMITTI	0	0	1	0
AMPHIDEUTOPUS OCULATUS	0	0	1	0
ARGISSIDAE				
ARGISSA HAMATIPES	1	1	1	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
ASTYRIDAE				
ASTYRA ABYSSI	1	0	0	0
COROPHIIDAE				
COROPHIUM LPIL	0	0	0	1
PHOTIS LPIL	1	1	1	1
PHOTIS BREVIPES	1	1	1	1
PHOTIS BIFURCATA	1	0	1	1
PHOTIS LACIA	1	1	1	0
PHOTIS CALIFORNICA	1	1	1	0
PHOTIS PARVIDONS	0	0	0	1
PHOTIS MACROTICA	1	0	1	1
PHOTIS BLIND	1	0	0	0
PROTOMEDEIA LPIL	1	1	1	0
PROTOMEDIA ARTICULATA	1	1	0	0
GAMMAROPSIS LPIL	0	0	0	1
GAMMAROPSIS THOMPSONI	0	0	1	1
PODOCEROPSIS NR. BARNARDI	1	1	0	1
GAMMAROPSIS OCIOSA	0	0	1	0
GAMMAROPSIS MAMOLUS	0	0	0	1
AMPELISCIPHOTIS PODOPTHALMA	1	0	1	0
DEXAMINIDAE				
GUERNEA REDUNCANS	1	0	1	0
EUSIRIDAE				
EUSIRUS LONGIPES	0	0	0	1
RHACHOTROPIS LPIL	1	0	0	0
RHACHOTROPIS DISTINCTA	1	1	0	0
RHACHOTROPIS INFLATA	1	1	0	0
RHACHOTROPIS OCULATUS	1	1	0	0
RHACHOTROPIS CLEMENS	1	1	0	0
EUSIRIDAE GENUS B, SP. A	1	0	0	0
GAMMARIDAE				
CERADOCUS SPINICAUDA	0	0	0	1
MAERA DANAE	1	1	1	0
MAERA SIMILE	1	1	1	1
UROTHOIDAE				
UROTHOE VARVARINI	1	1	1	0
ISCHYROCERIDAE				
ERICTHONIUS DIFFORMIS	1	0	1	1
ERICTHONIUS BRASILIENSIS	0	0	1	0
ISCHYROCERUS PELAGOPS	0	0	0	1
JASSA FALCATA	0	0	0	1
MICROJASSA LITOTES	0	0	1	1
MICROJASSA CLAUSTRIS	0	0	0	1
LEUCOTHOIDAE				
LEUCOTHOE SPINICARPA	0	0	0	1
LILJEBORGIIDAE				
LILJEBORGIA PALLIDA	0	0	0	1
LILJEBORGIA COTA	1	1	0	0
LISTRIELLA ERIOPSA	1	1	1	0
LISTRIELLA ALBINA	1	1	0	0
LYSIANASSIDAE				
LYSIANASSIDAE LPIL	1	1	0	1
ACIDOSTOMA SP. A	1	1	0	0
ACIDOSTOMA HANCOCKI	1	0	0	0
ANONYX LILJEBORGII	1	1	0	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
HIPPOMEDON LPIL	1	1	0	0
HIPPOMEDON TENAX	1	1	0	0
HIPPOMEDON ZETESIMUS	1	0	0	0
HIPPOMEDON COLUMBIANUS	1	1	1	0
LEPIDEPECREUM LPIL	1	0	0	0
LEPIDEPECREUM KASATKA	1	1	0	0
LEPIDEPECREUM GURJANOVAE	1	0	1	1
LEPIDEPECREUM GARTHI	1	1	0	0
OPISA TRIDENTATA	0	0	0	1
LEPIDEPECREUM PACIFICA	1	0	0	0
ORCHOMENE PINGUIS	1	0	0	0
ORCHOMENE DECIPIENS	1	1	1	0
ORCHOMENE ANAQUELA	1	0	0	0
PACHYNUS BARNARDI	1	0	0	0
SCHISTURELLA TRACALERO	1	0	0	0
SCHISTURELLA DOROTHEAE	1	1	0	0
SOCARNOIDES ILLUDENS	0	0	0	1
LYSIANASSA DISSIMILIS	1	0	0	0
LYSIANASSA OCULATA	1	1	0	0
LYSIANASSA HOLMESI	1	1	0	0
LYSIANASSIDAE GENUS A, SP. A	0	0	0	1
VALLETTIETTA SP. A	1	1	0	0
PRACHYNELLA LODO	1	1	0	0
OCOSINGO BORLUS	0	0	0	1
MELPHIDIPPIDAE				
MELPHIDIPPIELLA MACRUROIDES	1	1	0	0
MELPHIDIPPA AMORITA	1	1	0	1
MELPHISANA BOLA	0	0	1	0
OEDICEROTIDAE				
OEDICEROTIDAE LPIL	1	1	1	0
ACEROIDES SP. A	1	1	0	0
BATHYMEDON VULPECULUS	1	1	0	0
BATHYMEDON SP. A	1	1	0	0
BATHYMEDON PUMILIS	1	1	0	0
BATHYMEDON KASSITES	1	1	0	0
BATHYMEDON COVILHANI	1	1	0	0
MONOCULODES LPIL	1	0	1	0
MONOCULODES SPINIPES	1	1	0	0
MONOCULODES NORVEGICUS	1	1	0	0
MONOCULODES LATISSIMANUS	1	1	0	0
MONOCULODES NECOPINUS	1	0	0	0
MONOCULODES HARTMANAE	1	1	1	0
MONOCULODES GLYCONICA	1	1	0	0
MONOCULODES EMARGINATUS	1	1	1	0
SYNCHELIDIUM SHOEMAKERI	1	1	1	0
SYNCHELIDIUM RECTIPALMUM	1	0	1	0
WESTWOODILLA CAECULA	1	1	1	0
PARDALISCIDAE				
PARDALISCIDAE LPIL	1	1	0	0
NICIPPE TUMIDA	1	1	0	0
PARDALISCA MARIONIS	1	1	0	0
PARDALISCELLA YAQUINA	1	1	0	0
PARDALISCELLA SYMMETRICA	1	1	0	0
HALICE SYNOPIAE	0	0	1	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
RHYNOHALICELLA HALONA	1	1	0	1
PRINCAXELLA SP. A	1	1	0	0
PHOXOCEPHALIDAE				
PHOXOCEPHALIDAE LPIL	1	1	1	0
HARPINIOPSIS LPIL	1	0	0	0
PSEUDHARPINIA EXCAVATA	1	1	0	0
HARPINIOPSIS NAIADIS	1	1	0	0
HARPINIOPSIS GALERA	1	1	0	0
HARPINIOPSIS FULGENS	1	1	1	0
HARPINIOPSIS EPISTOMATA	1	1	0	0
HARPINIOPSIS EMERYI	1	1	0	0
HETEROPHOXUS OCULATUS	1	1	1	1
LEPTOPHOXUS FALCATUS ICELUS	1	0	0	0
METAPHOXUS FREQUENS	1	0	1	1
METAPHOXUS FULTONI	1	1	1	1
PHOXOCEPHALUS HOMILIS	1	1	1	0
FOXIPHALUS OBTUSIDENS	1	1	1	0
PARAPHOXUS OCULATUS	1	1	0	1
RHEPOXYNIUS VARIATUS	1	0	0	0
FOXIPHALUS COGNATUS	1	1	0	1
FOXIPHALUS SIMILIS	1	1	1	0
RHEPOYNIUS DABOIUS	0	0	1	0
FOXIPHALUS MAJOR	1	1	0	0
RHEPOXYNIUS LPIL	1	0	0	0
RHEPOXYNIUS MENZIESI	1	1	1	0
RHEPOXYNIUS HETEROCUSPIDATUS	1	1	0	0
RHEPOXYNIUS BICUSPIDATUS	1	1	1	0
FOXIPHALUS LPIL	1	0	0	1
FOXIPHALUS GOLFENSIS	1	0	1	0
PLEUSTIDAE				
PLEUSTIDAE LPIL	0	0	1	0
PARAPLEUSTES PUGETTENSIS	0	0	0	1
PLEUSTES DEPRESSA	0	0	1	0
PLEUSYMPTES SUBGLABER	0	0	1	0
PLEUSYMPTES COQUILLA	1	1	0	0
PODOCERIDAE				
DYOPEDOS LPIL	1	1	0	1
DYOPEDOS ARCTICA	1	0	0	0
DYOPEDOS MONACANTHA	1	0	0	0
PODOCERUS CRISTATUS	0	0	1	0
STEGOCEPHALIDAE				
STEGOCEPHALUS HANCOCKI	1	1	0	0
STENOTHOIDAE				
STENOTHOIDAE LPIL	1	0	0	1
METOPELLA APORPIS	1	0	0	1
PARAMETOPELLA NINIS	1	1	0	1
STENOTHOE FRECANDA	1	0	0	0
STENOTHOIDES BICOMA	0	0	0	1
STENULA MODOSA	1	0	0	1
STENULA INCOLA	0	0	0	1
METOPA DAWSONI	0	0	1	1
SYNOPIIDAE				
BRUZELIA TUBERCULATA	1	1	0	0
SYRRHOE LONGIFRONS	1	1	0	0
SYRRHOE SP. A	1	0	0	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
SYRRHOITES SP. B	1	0	0	0
TIRON BIOCELLATA	0	0	1	0
TIRON TROPAKIS	0	0	1	0
GAROSYRRHOE DISJUNCTA	0	0	1	0
CAPRELLIDEA				
CAPRELLIDAE				
CAPRELLIDAE LPIL	0	0	0	1
CAPRELLA EQUILIBRA	1	1	1	0
CAPRELLA NATALENSIS	0	0	0	1
AEGINELLIDAE				
DEUTELLA CALIFORNICA	0	0	0	1
DEUTELLA VENENOSA	0	0	0	1
MAYERELLA BANKSIA	1	1	1	0
PEROTRIPUS BREVIS	0	0	0	1
TRITELLA LAEVIS	0	0	1	0
TRITELLA TENUISSIMA	1	1	0	0
PHTISCIDAE				
HEMIPROTO SP. A	1	1	1	0
DECAPODA				
DECAPODA LPIL	1	1	0	1
DENDROBRANCHIATA				
PENAEIDEA				
PENAEIDAE				
SICYONIA INGENTIS	1	1	0	0
PLEOCYMATA				
CARIDEA				
CARIDEA LPIL	1	1	0	0
PALAEMONIDAE				
PSEUDOCOUTIERIA ELEGANS	0	0	0	1
ALPHAEIDAE				
ALPHAEIDAE LPIL	1	1	0	0
ALPHEUS BELLIMANUS	0	0	0	1
HIPPOLYTIDAE				
HIPPOLYTIDAE LPIL	0	0	0	1
HIPPOLYTE LPIL	1	1	0	0
SPIRONTOCARIS DALLI	1	1	0	0
SPIRONTOCARIS HOLMESI	1	1	0	0
EUALUS LINEATUS	0	0	0	1
CRANGONIDAE				
CRANGON COMMUNIS	1	1	0	0
CRANGON ZACAE	1	1	0	0
METACRANGON SPINOSISSIMA	1	1	0	0
ANOMURA				
AXIIDAE				
CALASTACUS QUINQUESERIATUS	1	1	0	0
AXIOPSIS SPINULICAUDA	1	1	0	0
CALLIANASSIDAE				
CALLIANASSA LPIL	1	1	0	0
DIOGENIDAE				
PAGURISTES LPIL	1	1	0	1
PAGURISTES ULREYI	1	1	1	1
PAGURIDAE				
PAGURIDAE LPIL	1	1	1	0
ORTHOPAGURUS MINIMUS	0	0	1	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
PARAPAGURODES SP. A	0	0	1	0
PARAPAGURODES LAURENTAE	0	0	1	1
LITHODIDAE				
PARALOMIS MULTISPINA	0	0	0	1
GALATHEIDAE				
MUNIDA QUADRISPINA	0	0	0	1
PLEURONCODES PLANIPES	1	1	0	0
BRACHYURA				
HOMOLIDAE				
PAROMOLA FAXONI	0	0	0	1
DORIPPIDAE				
CLYTHROCERUS PLANUS	0	0	1	0
MAJIDAE				
MAJIDAE LPIL	1	1	0	1
ERILEPTUS SPINOSUS	0	0	0	1
PARTHENOPIDAE				
HETEROCRYPTA OCCIDENTALIS	1	1	0	0
CANCRIDAE				
CANCER LPIL	0	0	1	0
XANTHIDAE				
LOPHOPANOPEUS LPIL	0	0	0	1
LOPHOPANOPEUS BELLUS DIEGENSIS	0	0	0	1
PINNOTHERIDAE				
PINNOTHERIDAE LPIL	0	0	0	1
PINNIXA LPIL	1	1	1	0
PINNIXA OCCIDENTALIS	1	1	1	0
PINNIXA TUBICOLA	0	0	1	0
PINNIXA LONGIPES	0	0	1	0
SIPUNCULIDA				
SIPUNCULIDA LPIL	1	1	1	1
GOLFINGIIDAE				
GOLFINGIA LPIL	1	1	1	1
GOLFINGIA MINUTA	1	1	1	1
THYSANOCARDIA NIGRA	1	1	0	0
GOLFINGIA MISAKIANA	0	0	1	0
ONCHNESOMA SP. A	1	1	1	0
GOLFINGIA SP. D	1	1	0	0
GOLFINGIA NR. CONFUSA	0	0	0	1
ECHIURA				
ECHIURA LPIL	1	1	1	1
ECHIURIDAE				
ECHIURIDAE LPIL	1	1	0	0
ARHYNCHITE CALIFORNICUS	1	1	1	0
LISTRIOLOBUS HEXAMYOTUS	1	1	0	0
LISTRIOLOBUS PELODES	1	1	0	0
PHORONIDA				
PHORONIDA LPIL	1	1	1	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
ECTOPROCTA				
ECTOPROCTA LPIL	0	0	0	1
CTENOSTOMATA				
CTENOSTOMATA LPIL	0	0	1	0
ALCYONIDIIDAE				
ALCYONIDIUM POLYOUM	0	0	0	1
ALCYONIDIUM MAMMILLATUM	0	0	0	1
CLAVOPORIDAE				
CLAVOPORA OCCIDENTALIS	1	1	1	1
VICTORELLIDAE				
ANGUINELLA PALMATA	0	0	0	1
TRITICELLIDAE				
TRITICELLA ELONGATA	0	0	0	1
CYCLOSTOMATA				
CYCLOSTOMATA LPIL	0	0	0	1
CRISIIDAE				
CRISIIDAE LPIL	0	0	0	1
CRISIA LPIL	0	0	0	1
CRISIA OCCIDENTALIS	0	0	0	1
CRISIA MAXIMA	0	0	0	1
CRISIA OPERCULATA	0	0	0	1
FILICRISIA LPIL	0	0	0	1
FILICRISIA FRANCISCANA	0	0	0	1
CRISIDIA CORNUTA	0	0	0	1
TUBULIPORIDAE				
BRYOZOA LIX	0	0	0	1
PLATONEA LPIL	0	0	0	1
PLATONEA VELERONIS	0	0	0	1
PLATONEA EXPANSA	0	0	0	1
ONCOUSOECIIDAE				
PROBOSCINA LPIL	0	0	0	1
PROBOSINA MAJOR	0	0	0	1
PROBOSCINA NR. MAJOR	0	0	0	1
PROBOSCINA SIGMATA	0	0	0	1
STOMATOPORA LPIL	0	0	0	1
STOMATOPORA GRANULATA	0	0	0	1
DIAPEROECILLIDAE				
DIAPEROECIA CALIFORNICA	0	0	0	1
DIAPEROECIA FLORIDANA	0	0	0	1
CYTIDIDAE				
DISCOCYTIS LPIL	0	0	0	1
DISCOCYTIS CANADENSIS	0	0	0	1
DISCOCYTIS CALIFORNICA	0	0	0	1
LICHENOPORA LPIL	0	0	0	1
LICHENOPORA BUSKIANA	0	0	0	1
DISPORELLA LPIL	0	0	0	1
DISPORELLA ASTRAEA	0	0	0	1
DISPORELLA FIMBRIATA	0	0	0	1
CHEILOSTOMATA				
FAMILY UNCERETAIN				
BRYOZOA LXXXIII	0	0	0	1
BRYOZOA LXXV	0	0	0	1
BRYOZOA LXXIII	0	0	0	1
BRYOZOA LIII	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
BRYOZOA LI	0	0	0	1
BRYOZOA XLVI	0	0	0	1
BRYOZOA XL	0	0	0	1
AETEIDAE				
AETEA LIGULATA	0	0	0	1
MEMBRANIPORIDAE				
MEMBRANIPORA PLANA	0	0	0	1
HINCKSINIDAE				
HINCKSINA VELATA	0	0	0	1
HINCKSINA ALBA	0	0	0	1
HINCKSINA PACIFICA	0	0	0	1
CAULORAMPHUS BRUNNEA	0	0	0	1
APLOUSINA MAJOR	0	0	0	1
ANTROPORA TINCTA	0	0	1	0
ELLISINA LEVATA	0	0	0	1
CALLOPORIDAE				
BRYOZOA LXIX	0	0	0	1
CALLOPORA LPIL	0	0	0	1
CALLOPORA CORNICULIFERA	0	0	0	1
TEGELLA LPIL	0	0	0	1
TEGELLA ARMIFERA	0	0	0	1
ALDEREINA SMITTI	0	0	0	1
COPEDOZOUM PROTECTUM	0	0	1	0
COPEDOZOUM PLANUM	0	0	0	1
RETEVIRGULA AREOLATA	0	0	0	1
CHAPPERIIDAE				
CHAPPERIA PATULA	0	0	1	0
CHAPPERIA CALIFORNICA	0	0	0	1
COLLETOSIA RADIATA	0	0	0	1
PUELLINA SETOSA	0	0	0	1
MICROPORIDAE				
MICROPORA CORIACEA	0	0	0	1
CELLARIIDAE				
CELLARIA DIFFUSA	0	0	0	1
BUGULIDAE				
BUGULA NERITINA	1	1	0	0
DENDROBEANIA CURVIROSTRATA	0	0	0	1
DENDROBEANIA LONGSPINOSA	0	0	1	1
CAULIBUGULA OCCIDENTALIS	0	0	0	1
CAULIBUGULA CALIFORNICA	1	1	1	1
SCRUPOCELLARIIDAE				
SCRUPOCELLARIA LPIL	0	0	0	1
SCRUPOCELLARIA REGULARIS	0	0	0	1
SCRUPOCELLARIA NR. REGULARIS	0	0	0	1
SCRUPOCELLARIA VARIANS	0	0	0	1
SCRUPOCELLARIA TALONIS	0	0	0	1
CABEREA ELLISI	0	0	0	1
AMASTIGIA RUDIS	0	0	0	1
AMASTIGIA BISERIATA	0	0	0	1
EPISTOMIIDAE				
SYNNOTUM AEGYPTIACUM	0	0	1	1
CRIBILINIDAE				
REGINELLA NITIDA	0	0	0	1
REGINELLA FURCATA	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
HIPPOTHOIDAE				
HIPPOTHOA HYALINA	0	0	0	1
UMBONULIDAE				
TRYPOSTEGA CLAVICULATA	0	0	0	1
STOMACHETOSELLIDAE				
STOMACHETOSELLA ABYSSICOLA	0	0	0	1
SCHIZOPORELLIDAE				
SCHIZOPORELLA LINEARIS	0	0	0	1
EMBALLOTHECA OBSCURA	0	0	0	1
EMBALLOTHECA LATIFRONS	0	0	0	1
SCHIZOMAVELLA AURICULATA	0	0	0	1
HIPPOPORINIDAE				
STEPHANOSELLA VITREA	0	0	0	1
HIPPOPORINA PORCELLANA	0	0	0	1
HIPPOMENELLA FLAVA	0	0	0	1
HIPPOMONAVELLA LONGIROSTRATA	0	0	0	1
HIPPOMONAVELLA PARVICAPITATA	0	0	0	1
GEMELLIPORELLA INFLATA	0	0	0	1
microporellidae				
MICROPORELLA CILIATA	0	0	0	1
MICROPORELLA VIBRACULIFERA	0	0	0	1
FENESTRULINA MALUSI	0	0	0	1
MUCRONELLIDAE				
BRYOZOA XXVI	0	0	0	1
PORELLA ACUTIROSTRIS	0	0	1	0
PORELLA PORIFERA	0	0	0	1
SMITTINA LANDSBOROVII	0	0	0	1
SMITTINA BELLA	0	0	0	1
SMITTINA MCCULLOCHAE	0	0	0	1
SMITTINA SPATHULIFERA	0	0	0	1
PARASMITTINA TUBULATA	0	0	0	1
PARASMITTINA CALIFORNICA	0	0	0	1
RHAMPHOSTOMELLA NR. SPINIGERA	0	0	0	1
RHAMPHOSTOMELLA CURVIROSTRATA	0	0	0	1
MUCRONELLA VENTRICOSA	0	0	0	1
MUCRONELLA MAJOR	0	0	0	1
RETEPORIDAE				
RHYNCHOZOON ROSTRATUM	0	0	0	1
RHYNCHOZOON TUMULOSUM	0	0	0	1
PHIDOLOPORA PACIFICA	0	0	0	1
PHYLACTELLIDAE				
LAGENIPORA LPIL	0	0	0	1
LAGENIPORA SPINULOSA	0	0	0	1
LAGENIPORA SOCIALIS	0	0	0	1
LAGENIPORA PUNCTULATA	0	0	0	1
LAGENIPORA HIPPOCREPIS	0	0	0	1
CELLEPORIDAE				
COSTAZIA LPIL	0	0	0	1
COSTAZIA ROBERTSONIAE	0	0	0	1
COSTAZIA COSTAZI	0	0	0	1
ENTOPROCTA				
ENTOPROCTA LPIL	1	0	0	1
PEDICELLINIDAE				
BARENTSIA DISCRETA	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
BRACHIOPODA				
LINGULINAE				
GLOTTIDIA ALBIDA	1	1	0	0
CANCELLOTHYRIDIDAE				
TEREBRATULINA UNGUICULA	0	0	0	1
TEREBRATULINA CROSSEI	0	0	0	1
PLATIDIIDAE				
PLATIDIA HORNII	0	0	0	1
DALLINIDAE				
TEREBRATALIA TRANSVERSA	0	0	0	1
ECHINODERMATA				
ASTEROIDEA				
ASTEROIDEA LPIL	1	1	1	1
LUIDIIDAE				
LUIDIA FOLIOLATA	0	0	0	1
ASTROPECTINIDAE				
ASTROPECTEN VERRILLI	1	1	0	1
ODONTASTERIDAE				
PERIDONTASTER CRASSUS	0	0	0	1
GONIASTERIDAE				
HIPPASTERIA SPINOSA	0	0	0	1
PTERASTERIDAE				
PTERASTER TESSELATUS ARCTUATUS	0	0	0	1
ECHINASTERIDAE				
HENRICIA LAEVIUSCULA ANNECTENS	0	0	0	1
PORANIOPSIS INFLATA	1	1	0	1
ASTERIIDAE				
RATHBUNASTER CALIFORNICUS	0	0	0	1
ZOROASTERIDAE				
MYXODERMA PLATYACONTHUM	0	1	0	0
OPHIUROIDEA				
OPHIUROIDEA LPIL	1	1	1	0
ASTERONYCHIDAE				
ASTERONYX LOVENI	1	1	0	0
BORGONOCEPHALIDAE				
GORGONOCEPHALUS EUCNEMIS	0	0	0	1
OPHIURIDAE				
OPHIURIDAE LPIL	1	1	0	1
OPHIURA LUTKENI	1	1	1	1
OPHIOMUSIUM JOLLIENSIS	1	1	0	0
OPHIOMASTUS SP. A	1	1	0	0
OPHIODERMATIDAE				
OPHIUROCONIS BISPINOSA	0	0	1	0
OPHIACANTHIDAE				
OPHIACANTHA LPIL	1	1	0	0
OPHIOPHTHALMUS NORMANI	0	0	0	1
OPHIACANTHA DIPLASIA	0	0	0	1
OPHIACTIDAE				
OPHLOPHOLIS BAKERI	0	0	0	1
AMPHIURIDAE				
AMPHIURIDAE LPIL	1	1	0	0
AMPHIODIA LPIL	1	1	0	0
AMPHIODIA URTICA	1	1	1	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
AMPHIODIA PSARA	1	1	0	0
AMPHIPHOLIS SQUAMATA	1	1	1	1
AMPHIODIA OCCIDENTALIS	1	1	0	0
AMPHIOPLUS STRONGYLOPLAX	1	1	1	0
AMPHIOPLUS SP. A	1	1	0	0
AMPHIOPLUS HEXACANTHUS	1	1	0	0
AMPHIURA LPIL	1	1	0	0
AMPHIURA ACRYSTATA	1	1	1	0
DOUGALOPLUS AMPHACANTHA	1	1	1	0
AMPHICHONDRIUS GRANULOSUS	1	1	0	0
OPHIOTHRICIDAE				
OPHIOTHRIX SPICULATA	0	0	1	1
ECHINOIDEA				
ECHINOIDEA LPIL	1	1	1	0
TOXOPNEUSTIDAE				
LYTECHINUS PICTUS	1	1	1	1
STRONGYLOCENTROTIDAE				
ALLOCENTROS FRAGILIS	1	1	0	0
SCHIZASTERIDAE				
BRISASTER LATIFRONS	1	1	1	0
BRISSIDAE				
BRISSOPSIS PACIFICA	1	1	0	0
HOLOTHUROIDEA				
HOLOTHUROIDEA LPIL	1	1	1	0
DENDROCHIROTIDA				
DENDROCHITROTIDA LPIL	0	0	0	1
PSOLIDAE				
PSOLUS LPIL	0	0	0	1
PSOLUS SQUAMATUS	0	0	0	1
PHYLLOPHORIDAE				
HAVELOCKIA BENTI	0	1	0	0
CUCUMERIIDAE				
CUCUMERIIDAE LPIL	1	1	0	1
PSEUDOCNUS LUBRICUS	0	0	0	1
PENTAMERA LPIL	1	1	0	1
PENTAMERA PSEUDOCALCIGERA	1	1	0	0
PENTAMERA POPULIFERA	0	0	1	0
THYONE LPIL	0	0	1	0
PSEUDOCNUS LPIL	0	0	0	1
NEOTHYONE LPIL	0	0	1	0
PSEUDOTHYONE TRACHYPLACA	0	0	0	1
ASPIDOCHIROTIDA				
STICHOPOPIDAE				
PARASTICHOPUS LPIL	0	0	0	1
PARASTICHOPUS CALIFORNICUS	0	0	0	1
PARASTICHOPUS CF. JOHNSONI	0	0	0	1
ELASTIPODIDA				
LAETMOGONIDAE				
LAETMOGONE LPIL	1	1	0	0
APODIDA				
SYNAPTIDAE				
SYNAPTIDAE LPIL	1	0	0	0
LEPTOSYNAPTA LPIL	1	1	0	1
LEPTOSYNAPTA SP. B	1	1	1	0
CHIRIDOTA LPIL	1	1	1	0

SPNAME	.5MM	1MM	REIDRIP	ROCK
CRINOIDEA				
MOLPADIA INTERMEDIA	1	1	0	0
ANTEDONIDAE				
FLOROMETRA SERRATISSIMA	0	0	0	1
HEMICHORDATA				
HEMICHORDATA LPIL	1	1	1	0
UROCHORDATA				
UROCHORDATA LPIL	0	0	1	1
ASCIDIACEA LPIL	0	0	0	1
FAMILY UNCERTAIN				
ASCIDIAN SP. Y	0	0	0	1
ASCIDIAN SP. X	0	0	0	1
ASCIDIAN SP. W	0	0	0	1
ASCIDIAN SP. V	0	0	0	1
ASCIDIAN SP. U	0	0	0	1
ASCIDIAN SP. T	0	0	0	1
ASCIDIAN SP. S	0	0	0	1
ASCIDIAN SP. R	0	0	0	1
ASCIDIAN SP. Q	0	0	0	1
ASCIDIAN SP. P	0	0	0	1
ASCIDIAN SP. O	0	0	0	1
ASCIDIAN SP. N	0	0	0	1
ASCIDIAN SP. M	0	0	0	1
ASCIDIAN SP. L	0	0	0	1
ASCIDIAN SP. K	0	0	0	1
ASCIDIAN SP. J	0	0	0	1
ASCIDIAN SP. I	0	0	0	1
ASCIDIAN SP. H	0	0	0	1
ASCIDIAN SP. G	0	0	0	1
ASCIDIAN SP. F	0	0	0	1
ASCIDIAN SP. E	0	0	0	1
ASCIDIAN SP. D	0	0	0	1
ASCIDIAN SP. B	0	0	0	1
ASCIDIAN SP. A	0	0	0	1
CLAVELINIDAE				
ARCHIDISTOMA PSAMMION	0	0	0	1
CORELLIDAE				
CHELYOSOMA COLUMBIANUM	0	0	0	1
CHELYOSOMA SP. A	0	0	0	1
DIDEMNIDAE				
DIDEMNUM CARNULENTUM	0	0	0	1
PYURIDAE				
PYURA MIRABILIS?	0	0	0	1
PYURA NR. MIRABILIS	0	0	0	1
HALOCYNTHIA HILGENDORFI IGABOJA	0	0	0	1
MOLGULIDAE				
MOLGULA REGULARIS	0	0	1	0
FAMILY UNDETERMINED				
CORALLINE ALGA	0	0	0	1
ALGAL CRUST	0	0	0	1

SPNAME	.5MM	1MM	REIDRIP	ROCK
NON-PHYLETIC MORPHOLOGICAL TAXA				
UNID. CRUST	0	0	0	1
BROWN RETICULUM	0	0	0	1
UNID. THIN CRUST	0	0	0	1
EGG CASE	0	0	0	1
PURPLE EGG CHAMBER	0	0	0	1

APPENDIX E

Community Parameters for Site Cluster Groups from Soft-Bottom Infaunal Analysis

APPENDIX E

Community Parameters for Site Cluster Group Stations (1.0 and 0.5+1.0 mm fractions separately): Number of Species (N sp.), Number of Individuals (NIND), Species Diversity (H'), Species Richness, and Species Evenness (J'). Average of replicate values = "*". Samples (1.0 and 0.5 mm) combined prior to analysis = "**"

Station	Cluster Group	Depth (ft)	Size (mm)	N sp.	NIND	H'	D	J'
012-BSS-01	1	333	1.0	50	165	2.94	9.60	0.751
			0.5+1.0	98	375	3.73	16.37	0.814
021-BSR*	1	162	1.0	73	243	3.57	13.05	0.833
			0.5+1.0	127	803	4.00	18.79	0.826
022-BSS-01	1	337	1.0	57	277	2.80	9.96	0.692
			0.5+1.0	117	833	3.56	17.25	0.747
102-BSS-01	1	337	1.0	34	177	2.72	6.38	0.772
			0.5+1.0	85	542	3.53	13.34	0.794
030-BSS-01	1	333	1.0	44	184	2.70	8.25	0.713
			0.5+1.0	96	462	3.57	15.48	0.781
042-BSS-01	1	337	1.0	55	314	2.91	9.39	0.727
			0.5+1.0	125	795	3.93	18.57	0.814
052-BSS-01	1	333	1.0	57	326	2.88	9.68	0.711
			0.5+1.0	96	567	3.62	14.98	0.793
058-BSS-01	1	337	1.0	55	183	3.02	10.37	0.754
			0.5+1.0	114	618	3.66	17.58	0.773
064-BSS-01	1	198	1.0	92	269	4.01	16.27	0.887
			0.5+1.0	126	686	4.02	19.14	0.831
065-BSS-01	1	360	1.0	110	437	3.90	17.93	0.830
			0.5+1.0	143	1137	3.97	20.18	0.800
073-BSR*	1	333	1.0	65	192	3.43	12.13	0.823
			0.5+1.0	132	788	3.93	19.62	0.806
079-BSR*	1	333	1.0	73	244	3.56	13.10	0.831
			0.5+1.0	126	507	4.12	20.06	0.853

APPENDIX E (continued)

Station	Cluster Group	Depth (ft)	Size (mm)	N sp.	NIND	H'	D	J'
085-BSR*	1	380	1.0	49	215	2.51	9.07	0.645
			0.5+1.0	81	400	3.18	13.45	0.722
094-BSS-01	1	323	1.0	55	177	3.04	10.43	0.758
			0.5+1.0	69	223	3.30	12.58	0.779
023-BSR*	2	670	1.0	17	33	2.41	4.62	0.859
			0.5+1.0	32	80	2.99	7.20	0.868
002-BSS-01	3	683	1.0	69	286	3.61	12.02	0.852
			0.5+1.0	117	746	3.72	17.54	0.781
003-BSS-01	3	987	1.0	34	165	2.14	6.46	0.607
			0.5+1.0	91	492	3.53	14.52	0.782
038-BSS-01	4	667	1.0	36	56	3.38	8.69	0.942
			0.5+1.0	76	160	4.02	14.78	0.928
043-BSS-01	4	667	1.0	23	44	2.90	5.81	0.923
			0.5+1.0	63	186	3.52	11.86	0.849
048-BSS-01	4	663	1.0	38	72	3.42	8.65	0.939
			0.5+1.0	79	253	3.90	14.10	0.893
049-BSS-01	4	891	1.0	32	53	3.23	7.81	0.931
			0.5+1.0	57	149	3.76	11.19	0.930
053-BSS-01	4	663	1.0	23	101	1.88	4.77	0.599
			0.5+1.0	63	215	3.14	11.54	0.759
059-BSS-01	4	733	1.0	35	158	2.88	6.72	0.810
			0.5+1.0	81	512	3.65	12.82	0.831
066-BSS-01	4	680	1.0	38	76	3.31	8.54	0.909
			0.5+1.0	95	458	3.64	15.34	0.800
070-BSS-01	4	677	1.0	36	97	3.31	7.65	0.923
			0.5+1.0	60	166	3.77	11.54	0.920
074-BSR*	4	680	1.0	33	86	3.07	7.21	0.880
			0.5+1.0	77	384	3.60	12.74	0.830

APPENDIX E (continued)

Station	Cluster Group	Depth (ft)	Size (mm)	N sp.	NIND	H'	D	J'
080-BSR*	4	663	1.0	37	65	3.35	8.62	0.930
			0.5+1.0	87	352	3.84	14.78	0.862
104-BSS-01	5	997	1.0	28	58	2.85	6.65	0.857
			0.5+1.0	58	160	3.50	11.23	0.862
045-BSS-01	5	1340	1.0	39	50	3.55	9.71	0.968
			0.5+1.0	49	82	3.59	10.89	0.922
084-BSS-01	5	1333	1.0	43	171	2.96	8.17	0.786
			0.5+1.0	62	289	3.38	10.77	0.818
086-BSR*	5	663	1.0	24	77	2.60	5.51	0.848
			0.5+1.0	58	300	3.05	9.95	0.762
087-BSS-01	5	1010	1.0	31	56	3.27	7.45	0.951
			0.5+1.0	37	82	3.31	8.17	0.916
095-BSS-01	5	670	1.0	15	19	2.63	4.75	0.969
			0.5+1.0	43	109	2.97	8.95	0.789
007-BSS-01	6	667	1.0	20	39	2.83	5.19	0.943
			0.5+1.0	42	80	3.55	9.36	0.950
013-BSS-01	6	670	1.0	14	23	2.51	4.15	0.951
			0.5+1.0	31	94	3.09	6.60	0.901
018-BSS-01	6	667	1.0	24	34	2.99	6.52	0.941
			0.5+1.0	50	119	3.52	10.25	0.901
103-BSS-01	6	667	1.0	25	41	3.03	6.46	0.942
			0.5+1.0	43	130	3.22	8.63	0.855
031-BSR*	6	677	1.0	24	49	2.86	5.92	0.901
			0.5+1.0	54	218	3.32	9.92	0.832
014-BSS-01	7	1010	1.0	26	34	3.17	7.09	0.973
			0.5+1.0	52	125	3.49	10.56	0.884
019-BSS-01	7	1000	1.0	19	29	2.74	5.35	0.930
			0.5+1.0	39	130	2.98	7.81	0.815

APPENDIX E (continued)

Station	Cluster Group	Depth (ft)	Size (mm)	N sp.	NIND	H'	D	J'
032-BSS-01	7	1007	1.0	27	36	3.21	7.26	0.973
			0.5+1.0	47	105	3.18	9.88	0.825
039-BSS-01	7	997	1.0	25	47	2.92	6.23	0.908
			0.5+1.0	53	122	3.64	10.82	0.916
060-BSS-01	7	927	1.0	22	55	2.52	5.24	0.817
			0.5+1.0	56	262	3.04	9.88	0.755
067-BSS-01	7	954	1.0	36	117	3.15	7.35	0.879
			0.5+1.0	60	210	3.61	11.03	0.881
071-BSS-01	7	1036	1.0	36	106	3.02	7.51	0.842
			0.5+1.0	71	291	3.58	12.34	0.840
075-BSS-01	7	990	1.0	35	70	3.22	8.00	0.907
			0.5+1.0	65	244	3.68	12.56	0.881
004-BSS-01	8	1330	1.0	24	95	2.48	5.05	0.781
			0.5+1.0	51	329	2.97	8.63	0.756
008-BSS-01	8	1040	1.0	29	50	3.18	7.16	0.945
			0.5+1.0	59	257	3.13	10.45	0.767
009-BSS-01	8	1346	1.0	37	84	3.20	8.12	0.885
			0.5+1.0	63	217	3.52	11.52	0.850
015-BSS-01	8	1330	1.0	29	101	2.56	6.07	0.760
			0.5+1.0	36	171	2.79	6.81	0.780
020-BSS-01	8	1346	1.0	30	61	3.16	7.05	0.929
			0.5+1.0	47	217	3.03	8.55	0.786
025-BSR*	8	1320	1.0	25	62	2.90	5.87	0.907
			0.5+1.0	55	224	3.35	10.03	0.838
033-BSR*	8	1346	1.0	29	94	2.69	6.25	0.804
			0.5+1.0	39	126	2.92	7.94	0.794
040-BSS-01	8	1327	1.0	24	40	3.01	6.24	0.947
			0.5+1.0	45	120	3.29	9.19	0.864

APPENDIX E (continued)

Station	Cluster Group	Depth (ft)	Size (mm)	N sp.	NIND	H'	D	J'
054-BSS-01	8	1346	1.0	39	104	3.10	8.18	0.847
			0.5+1.0	73	464	3.07	11.73	0.715
061-BSS-01	8	1168	1.0	17	84	1.69	3.61	0.597
			0.5+1.0	57	301	3.12	9.81	0.772
068-BSS-01	8	1320	1.0	29	76	2.89	6.47	0.859
			0.5+1.0	45	145	3.36	8.84	0.882
072-BSS-01	8	1356	1.0	25	77	2.45	5.53	0.761
			0.5+1.0	56	368	3.23	9.31	0.803
076-BSR*	8	1310	1.0	23	53	2.73	5.66	0.868
			0.5+1.0	47	198	3.23	8.76	0.837
081-BSS-01	8	997	1.0	30	62	3.08	7.03	0.905
			0.5+1.0	65	244	3.53	11.64	0.845
017-BSS-01	9	2211	1.0	7	10	1.89	2.61	0.970
			0.5+1.0	14	17	2.59	4.59	0.981
105-BSS-01	9	1327	1.0	5	28	0.88	1.20	0.548
			0.5+1.0	18	96	1.68	3.72	0.581
077-BSS-01	9	1954	1.0	8	11	2.02	2.92	0.971
			0.5+1.0	15	25	2.54	4.35	0.939
082-BSR*	9	1333	1.0	18	27	2.66	5.16	0.931
			0.5+1.0	33	119	2.74	6.78	0.782
083-BSS-01	9	1502	1.0	19	26	2.86	5.52	0.973
			0.5+1.0	27	71	2.74	6.10	0.832
088-BSR*	9	1330	1.0	7	13	1.65	2.49	0.846
			0.5+1.0	11	26	1.93	3.05	0.828
090-BSS-01	9	1271	1.0	12	18	2.40	3.81	0.966
			0.5+1.0	27	56	3.08	6.46	0.933
093-BSS-01	9	1208	1.0	14	41	2.25	3.50	0.854
			0.5+1.0	29	119	2.98	5.86	0.886

APPENDIX E (continued

Station	Cluster Group	Depth (ft)	Size (mm)	N sp.	NIND	H'	D	J'
096-BSS-01	9	1000	1.0	14	20	2.45	4.34	0.930
			0.5+1.0	21	39	2.59	5.46	0.849
097-BSS-01	9	1330	1.0	14	26	2.23	3.99	0.845
			0.5+1.0	23	61	2.36	5.35	0.753
101-BSS-01	9	1208	1.0	14	31	2.50	3.79	0.946
			0.5+1.0	23	64	2.76	5.29	0.880
005-BSS-01	10	1980	1.0	19	23	2.87	5.74	0.975
			0.5+1.0	52	327	2.74	8.81	0.695
010-BSS-01	10	2000	1.0	19	29	2.79	5.35	0.949
			0.5+1.0	43	660	2.36	6.47	0.626
011-BSS-01	10	2336	1.0	19	29	2.71	5.35	0.919
			0.5+1.0	43	218	2.89	7.80	0.767
016-BSS-01	10	2000	1.0	30	49	3.27	7.45	0.960
			0.5+1.0	48	196	2.95	8.90	0.763
106-BSS-01	10	1667	1.0	22	50	2.65	5.37	0.857
			0.5+1.0	40	193	2.82	7.41	0.765
056-BSS-01	10	3046	1.0	27	46	3.09	6.79	0.936
			0.5+1.0	63	167	3.61	12.11	0.872
063-BSS-01	10	3148	1.0	39	81	3.29	8.65	0.898
			0.5+1.0	84	290	3.87	14.64	0.872
069-BSS-01	10	3171	1.0	32	56	3.26	7.70	0.940
			0.5+1.0	71	231	3.81	12.86	0.894
026-BSS-01	11	2000	1.0	24	64	2.69	5.53	0.848
			0.5+1.0	45	142	3.16	8.88	0.830
027-BSR*	11	2066	1.0	20	41	2.66	5.04	0.895
			0.5+1.0	37	242	2.49	6.59	0.694
028-BSR*	11	2043	1.0	18	34	2.47	4.69	0.891
			0.5+1.0	35	191	2.65	6.58	0.756

APPENDIX E (continued)

Station	Cluster Group	Depth (ft)	Size (mm)	N sp.	NIND	H'	D	J'
107-BSS-01	11	1940	1.0	17	30	2.66	4.70	0.937
			0.5+1.0	31	166	2.49	5.87	0.726
108-BSS-01	11	1667	1.0	20	63	2.40	4.59	0.803
			0.5+1.0	34	93	2.93	7.28	0.831
034-BSS-01	11	1667	1.0	18	38	2.63	4.67	0.908
			0.5+1.0	37	108	3.05	7.69	0.846
035-BSR*	11	1855	1.0	22	71	2.41	4.92	0.786
			0.5+1.0	31	182	2.00	5.84	0.581
036-BSR*	11	1667	1.0	30	72	2.89	6.87	0.850
			0.5+1.0	51	144	3.37	10.07	0.858
041-BSS-01	11	1676	1.0	21	52	2.26	5.06	0.743
			0.5+1.0	39	94	2.99	8.36	0.817
050-BSS-01	11	2000	1.0	31	55	3.22	7.49	0.939
			0.5+1.0	55	152	3.40	10.75	0.848
055-BSS-01**	11	2000	1.0	52	262	3.08	9.16	0.779
			0.5+1.0	52	262	3.08	9.16	0.779
062-BSS-01	11	1970	1.0	28	45	3.12	7.09	0.936
			0.5+1.0	51	158	3.23	9.88	0.823
078-BSS-01	11	2581	1.0	23	46	2.89	5.75	0.921
			0.5+1.0	47	130	3.17	9.45	0.823
092-BSS-01	11	1502	1.0	18	41	2.42	4.58	0.838
			0.5+1.0	30	77	2.96	6.68	0.871
100-BSS-01	11	1498	1.0	16	32	2.45	4.33	0.882
			0.5+1.0	23	55	2.67	5.49	0.853

APPENDIX F

Size Frequency Histograms for Selected Infaunal Species

APPENDIX F

Size Frequency Histograms

Histograms are presented for eight species by cluster group for those groups (1, 2, 3, and 4) characterized by $\geq$ 30 individuals of a particular species, and which represented survey depths of interest ($\leq$ 990 ft) for Phase II monitoring studies. All measured "values" listed on the histograms are in millimeters (mm); "group 01, 02, 03, or 04" corresponds to Cluster group 1, 2, 3, or 4, respectively.

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=AMPHIODIA URTICA   GROUP=01

FREQUENCY BAR CHART

```
FREQUENCY

     ]                                                  *****
 120 +                                                  *****    *****
     ]                                                  *****    *****
     ]                                                  *****    *****
     ]                                                  *****    *****
 100 +                                                  *****    *****
     ]                                                  *****    *****
     ]                                                  *****    *****
     ]                                                  *****    *****
  80 +                                                  *****    *****
     ]                                                  *****    *****
     ]                                                  *****    *****
     ]                                                  *****    *****
  60 +                                                  *****    *****    *****
     ]                                **** *    *****    *****    *****    *****
     ]                                *****    *****    *****    *****    *****
     ]                                *****    *****    *****    *****    *****
  40 +                  *****    *****    *****    *****    *****    *****    *****
     ]                  *****    *****    *****    *****    *****    *****    *****
     ]                  *****    *****    *****    *****    *****    *****    *****
     ]         *****    *****    *****    *****    *****    *****    *****    *****
  20 +         *****    *****    *****    *****    *****    *****    *****    *****
     ]         *****    *****    *****    *****    *****    *****    *****    *****    ****
*
     ]         *****    *****    *****    *****    *****    *****    *****    *****    ****
*
     ]*****    *****    *****    *****    *****    *****    *****    *****    *****    ****
*

-    --------------------------------------------------------------------------------------

        0.60     0.72     0.84     0.96     1.08     1.20     1.32     1.44     1.56     1.6
8

                                   VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=AMPHIODIA URTICA   GROUP=02

FREQUENCY BAR CHART

```
FREQUENCY

 17 +                    *****
    ]                    *****
 16 +                    *****
    ]                    *****
 15 +                    *****
    ]                    *****
 14 +      *****   ***** *****
    ]      *****   ***** *****
 13 +      *****   ***** *****
    ]      *****   ***** *****
 12 +      *****   ***** *****
    ]      *****   ***** *****
 11 +      *****   ***** *****
    ]      *****   ***** *****
 10 +      *****   ***** *****
    ]      *****   ***** *****
  9 +      *****   ***** *****
    ]      *****   ***** *****
  8 +      *****   ***** *****
    ]      *****   ***** *****
  7 +      *****   ***** *****
    ]      *****   ***** *****
  6 +      *****   ***** *****
    ]      *****   ***** *****
  5 +      *****   ***** *****   *****
    ]      *****   ***** *****   *****
  4 +      *****   ***** *****   *****
    ]      *****   ***** *****   *****
  3 +      *****   ***** *****   *****
    ]      *****   ***** *****   *****
  2 +      *****   ***** *****   *****
    ]      *****   ***** *****   *****
  1 +      *****   ***** *****   *****             *****
    ]      *****   ***** *****   *****             *****
    ----------------------------------------------------------
            1.00    1.25  1.50    1.75    2.00      2.25

                        VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=AMPHISSA BICOLOR   GROUP=02

FREQUENCY BAR CHART

FREQUENCY

```
     ]       *****
     ]       *****
  90 +       *****
     ]       *****
     ]       *****
     ]       *****
     ]       *****
  80 +       *****
     ]       *****
     ]       *****
     ]       *****
     ]       *****
  70 +       *****
     ]       *****
     ]       *****
     ]       *****
     ]       *****
  60 +       *****
     ]       *****
     ]       *****
     ]       *****
     ]       *****
  50 +       *****
     ]       *****
     ]       *****
     ]       *****
     ]       *****
  40 +       *****
     ]       *****
     ]       *****
     ]       *****
     ]       *****
  30 +       *****
     ]       *****       *****
     ]       *****       *****
     ]       *****       *****
     ]       *****       *****                                                       *****
  20 +       *****       *****                                                       *****
     ]       *****       *****                                           *****       *****
     ]       *****       *****                                           *****       *****
     ]       *****       *****                                           *****       *****
     ]       *****       *****                                           *****       *****
  10 +       *****       *****                                           *****       *****
     ]       *****       *****                                           *****       *****
     ]       *****       *****       *****                   *****       *****       *****
     ]       *****       *****       *****                   *****       *****       *****
     ]       *****       *****       *****                   *****       *****       *****       *****
```

```
       ---------------------------------------------------------------------------------------------
                1             2             3             4             5             6             7             8

                                                   VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=LEUCON MAGNADENTATA   GROUP=02

FREQUENCY BAR CHART

```
FREQUENCY

      ]                       *****
      ]                       *****
      ]                       *****
   35 +                       *****
      ]                       *****
      ]                       *****
      ]                       *****
      ]                       *****
   30 +                       *****
      ]                       *****
      ]                       *****
      ]                       *****
      ]                       *****
   25 +                       *****
      ]                       *****
      ]                       *****
      ]                       *****
      ]                       *****
   20 +                       *****
      ]                       *****
      ]                       *****
      ]                       *****
      ]                       *****
   15 +                       *****
      ]                       *****
      ]                       *****         *****
      ]                       *****         *****
      ]                       *****         *****
   10 +                       *****         *****
      ]                       *****         *****
      ]         *****         *****         *****
      ]         *****         *****         *****
      ]         *****         *****         *****
    5 +         *****         *****         *****
      ]         *****         *****         *****         *****         *****                       *****
      ]         *****         *****         *****         *****         *****                       *****
      ]         *****         *****         *****         *****         *****         *****         *****
      ]         *****         *****         *****         *****         *****         *****         *****
       -----------------------------------------------------------------------------------------------
                 0.80          0.96          1.12          1.28          1.44          1.60          1.76

                                               VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=MALDANE SARSI   GROUP=01

FREQUENCY BAR CHART

FREQUENCY

```
  11 +                                                       *****
     ]                                                       *****
     ]                                                       *****
     ]                                                       *****
  10 +                                                       *****
     ]                                                       *****
     ]                                                       *****
     ]                                                       *****
   9 +                                                       *****
     ]                                                       *****
     ]                                                       *****
     ]                                                       *****
   8 +                                                       *****
     ]                                                       *****
     ]                                                       *****
     ]                                                       *****
   7 +                                                       *****
     ]                                                       *****
     ]                                                       *****
     ]                                                       *****
   6 +                               *****                   *****
     ]                               *****                   *****
     ]                               *****                   *****
     ]                               *****                   *****
   5 +                               *****                   *****
     ]                               *****                   *****
     ]                               *****                   *****
     ]                               *****                   *****
   4 +                               *****                   *****
     ]                               *****                   *****
     ]                               *****                   *****
     ]                               *****                   *****
   3 +       *****                   *****                   *****
     ]       *****                   *****                   *****
     ]       *****                   *****                   *****
     ]       *****                   *****                   *****
   2 +       *****                   *****                   *****
     ]       *****                   *****                   *****
     ]       *****                   *****                   *****
     ]       *****                   *****                   *****
   1 +       *****                   *****       *****       *****
     ]       *****                   *****       *****       *****
     ]       *****                   *****       *****       *****
     ]       *****                   *****       *****       *****
     -------------------------------------------------------------
              0.20        0.24        0.28        0.32        0.36
```

VALUE MIDPOINT

```
MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=MALDANE SARSI   GROUP=02

FREQUENCY BAR CHART

FREQUENCY

110 +                 *****
    ]                 *****
    ]                 *****
    ]                 *****
100 +                 *****
    ]                 *****
    ]                 *****
    ]                 *****
 90 +                 *****
    ]                 *****
    ]                 *****
    ]                 *****
 80 +                 *****
    ]                 *****
    ]                 *****
    ]                 *****
 70 +                 *****
    ]                 *****
    ]                 *****      *****
    ]                 *****      *****
 60 +                 *****      *****
    ]                 *****      *****
    ]                 *****      *****
    ]                 *****      *****
 50 +                 *****      *****
    ]                 *****      *****
    ]                 *****      *****
    ]                 *****      *****
 40 +                 *****      *****
    ]                 *****      *****
    ]                 *****      *****
    ]                 *****      *****
 30 +                 *****      *****
    ]                 *****      *****
    ]                 *****      *****
    ]      *****      *****      *****
 20 +      *****      *****      *****
    ]      *****      *****      *****
    ]      *****      *****      *****
    ]      *****      *****      *****
 10 +      *****      *****      *****
    ]      *****      *****      *****      *****
    ]      *****      *****      *****      *****
    ]      *****      *****      *****      *****      *****                  *****      *****
    --------------------------------------------------------------------------------------------
            0.2        0.4        0.6        0.8        1.0        1.2        1.4        1.6
```

VALUE MIDPOINT

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=MALDANE SARSI   GROUP=03

FREQUENCY BAR CHART

```
FREQUENCY

 17 +                *****
    ]                *****
 16 +                *****
    ]                *****
 15 +                *****
    ]                *****
 14 +                *****
    ]                *****
 13 +                *****
    ]                *****
 12 +                *****
    ]                *****
 11 +                *****
    ]                *****
 10 +                *****
    ]                *****
  9 +                *****
    ]                *****
  8 +                *****
    ]                *****
  7 +                *****
    ]                *****
  6 +                *****
    ]                *****
  5 +                *****
    ]                *****
  4 +                *****
    ]                *****
  3 +       *****    *****
    ]       *****    *****
  2 +       *****    *****
    ]       *****    *****
  1 +       *****    *****    *****              *****
    ]       *****    *****    *****              *****
    --------------------------------------------------
             0.4      0.6      0.8      1.0      1.2

                       VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=MALDANE SARSI   GROUP=04

FREQUENCY BAR CHART

```
FREQUENCY

 17 +                                           *****
    ]                                           *****
 16 +                                           *****
    ]                                           *****
 15 +                                           *****
    ]                                           *****
 14 +                                           *****
    ]                                           *****
 13 +                                           *****
    ]                                           *****
 12 +                                           *****
    ]                                           *****
 11 +                   *****       *****       *****
    ]                   *****       *****       *****
 10 +                   *****       *****       *****
    ]                   *****       *****       *****
  9 +                   *****       *****       *****
    ]                   *****       *****       *****
  8 +                   *****       *****       *****                   *****
    ]                   *****       *****       *****                   *****
  7 +                   *****       *****       *****       *****       *****
    ]                   *****       *****       *****       *****       *****
  6 +                   *****       *****       *****       *****       *****
    ]                   *****       *****       *****       *****       *****
  5 +                   *****       *****       *****       *****       *****
    ]                   *****       *****       *****       *****       *****
  4 +                   *****       *****       *****       *****       *****
    ]                   *****       *****       *****       *****       *****
  3 +                   *****       *****       *****       *****       *****
    ]                   *****       *****       *****       *****       *****
  2 +                   *****       *****       *****       *****       *****
    ]                   *****       *****       *****       *****       *****
  1 +       *****       *****       *****       *****       *****       *****
    ]       *****       *****       *****       *****       *****       *****
    ------------------------------------------------------------------------
            0.32        0.48        0.64        0.80        0.96        1.12

                              VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=NEPHTYS CORNUTA FRANCISCANA   GROUP=01

FREQUENCY BAR CHART

```
FREQUENCY

  13 +                   *****
     ]                   *****
  12 +                   *****
     ]                   *****
  11 +                   *****
     ]                   *****
  10 +                   *****
     ]                   *****
   9 +                   *****       *****
     ]                   *****       *****
   8 +                   *****       *****
     ]                   *****       *****
   7 +       *****       *****       *****
     ]       *****       *****       *****
   6 +       *****       *****       *****
     ]       *****       *****       *****
   5 +       *****       *****       *****
     ]       *****       *****       *****
   4 +       *****       *****       *****
     ]       *****       *****       *****
   3 +       *****       *****       *****
     ]       *****       *****       *****
   2 +       *****       *****       *****       *****
     I       *****       *****       *****       *****
   1 +       *****       *****       *****       *****       *****
     I       *****       *****       *****       *****       *****
     --------------------------------------------------------------
              1.00        1.25        1.50        1.75        2.00

                             VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=NEPHTYS CORNUTA FRANCISCANA   GROUP=02

FREQUENCY BAR CHART

FREQUENCY

```
      ]                                                       *****
      ]                                                       *****
      ]                                                       *****
  200 +                                                       *****
      ]                                                       *****
      ]                                                       *****
      ]                                                       *****
  180 +                                                       *****
      ]                                                       *****
      ]                                                       *****
      ]                                                       *****
  160 +                                                       *****
      ]                                                       *****
      ]                                                       *****
      ]                                                       *****
  140 +                                                       *****
      ]                                                       *****
      ]                                           *****       *****
      ]                                           *****       *****
  120 +                                           *****       *****
      ]                                           *****       *****
      ]                                           *****       *****
      ]                                           *****       *****       *****
  100 +                                           *****       *****       *****
      ]                                           *****       *****       *****
      ]                                           *****       *****       *****
      ]                                           *****       *****       *****
   80 +                                           *****       *****       *****
      ]                                           *****       *****       *****
      ]                                           *****       *****       *****
      ]                               *****       *****       *****       *****
   60 +                               *****       *****       *****       *****
      ]                               *****       *****       *****       *****
      ]                               *****       *****       *****       *****
      ]                               *****       *****       *****       *****
   40 +                               *****       *****       *****       *****
      ]                               *****       *****       *****       *****
      ]                               *****       *****       *****       *****       *****
      ]                               *****       *****       *****       *****       *****
   20 +                               *****       *****       *****       *****       *****
      ]                               *****       *****       *****       *****       *****
      ]                   *****       *****       *****       *****       *****       *****
      ]                   *****       *****       *****       *****       *****       *****       *****       *****       ****

      ------------------------------------------------------------------------------------------------------------------------

               0.4         0.8         1.2         1.6         2.0         2.4         2.8         3.2         3.6         4.0
```

VALUE MIDPOINT

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=NEPHTYS CORNUTA FRANCISCANA   GROUP=03

FREQUENCY BAR CHART

```
FREQUENCY

  15 +                    *****
     ]                    *****
  14 +                    *****
     ]                    *****
  13 +                    *****
     ]                    *****
  12 +                    *****
     ]                    *****
  11 +                    *****
     ]                    *****
  10 +                    *****
     ]                    *****
   9 +                    *****
     ]                    *****
   8 +                    *****
     ]                    *****
   7 +             *****  *****
     ]             *****  *****
   6 +             *****  *****  *****
     ]             *****  *****  *****
   5 +      *****  *****  *****  *****
     ]      *****  *****  *****  *****
   4 +      *****  *****  *****  *****
     ]      *****  *****  *****  *****
   3 +      *****  *****  *****  *****  *****  *****
     ]      *****  *****  *****  *****  *****  *****
   2 +      *****  *****  *****  *****  *****  *****
     ]      *****  *****  *****  *****  *****  *****
   1 +      *****  *****  *****  *****  *****  *****
     ]      *****  *****  *****  *****  *****  *****
     ----------------------------------------------------
             1.2    1.6    2.0    2.4    2.8    3.2

                        VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=NEPHTYS CORNUTA FRANCISCANA   GROUP=04

FREQUENCY BAR CHART

```
FREQUENCY

     ]                                                       *****
     ]                                                       *****
  70 +                                                       *****
     ]                                                       *****
     ]                                                       *****
     ]                                           *****       *****
     ]                                           *****       *****
  60 +                                           *****       *****
     ]                                           *****       *****
     ]                                           *****       *****
     ]                                           *****       *****
     ]                                           *****       *****
  50 +                                           *****       *****
     ]                                           *****       *****
     ]                                           *****       *****
     ]                                           *****       *****
     ]                                           *****       *****
  40 +                                           *****       *****
     ]                                           *****       *****
     ]                                           *****       *****
     ]                               *****       *****       *****
     ]                               *****       *****       *****
  30 +                               *****       *****       *****
     ]                               *****       *****       *****
     ]                               *****       *****       *****
     ]                               *****       *****       *****
     ]                               *****       *****       *****
  20 +                               *****       *****       *****       *****
     ]                               *****       *****       *****       *****
     ]                               *****       *****       *****       *****
     ]                               *****       *****       *****       *****
     ]                               *****       *****       *****       *****
  10 +                               *****       *****       *****       *****
     ]                               *****       *****       *****       *****
     ]                               *****       *****       *****       *****
     ]                   *****       *****       *****       *****       *****       *****
     ]       *****       *****       *****       *****       *****       *****       *****       *****
     ------------------------------------------------------------------------------------------------

              0.8         1.2         1.6         2.0         2.4         2.8         3.2         3.6

                                             VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=PARVILUCINA TENUISCULPTA   GROUP=01

FREQUENCY BAR CHART

FREQUENCY

```
  18 +                   *****
     ]                   *****
  17 +                   *****
     ]                   *****
  16 +                   *****
     ]                   *****
  15 +                   *****
     ]                   *****
  14 +                   *****
     ]                   *****
  13 +                   *****                               *****
     ]                   *****                               *****
  12 +                   *****                               *****
     ]                   *****                               *****
  11 +                   *****                               *****       *****
     ]                   *****                               *****       *****
  10 +                   *****                               *****       *****
     ]                   *****                               *****       *****
   9 +                   *****       *****                   *****       *****
     ]                   *****       *****                   *****       *****
   8 +       *****       *****       *****                   *****       *****
     ]       *****       *****       *****                   *****       *****
   7 +       *****       *****       *****       *****       *****       *****
     ]       *****       *****       *****       *****       *****       *****
   6 +       *****       *****       *****       *****       *****       *****
     ]       *****       *****       *****       *****       *****       *****
   5 +       *****       *****       *****       *****       *****       *****
     ]       *****       *****       *****       *****       *****       *****
   4 +       *****       *****       *****       *****       *****       *****       *****
     ]       *****       *****       *****       *****       *****       *****       *****
   3 +       *****       *****       *****       *****       *****       *****       *****
     ]       *****       *****       *****       *****       *****       *****       *****
   2 +       *****       *****       *****       *****       *****       *****       *****
     ]       *****       *****       *****       *****       *****       *****       *****
   1 +       *****       *****       *****       *****       *****       *****       *****
     ]       *****       *****       *****       *****       *****       *****       *****
      -------------------------------------------------------------------------------------
              0.80        0.96        1.12        1.28        1.44        1.60        1.76

                                         VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=PARVILUCINA TENUISCULPTA   GROUP=02

FREQUENCY BAR CHART

```
FREQUENCY

  19 +                                   *****
     ]                                   *****
  18 +                                   *****
     ]                                   *****
  17 +                         *****     *****
     ]                         *****     *****
  16 +                         *****     *****
     ]                         *****     *****
  15 +               *****     *****     *****
     ]               *****     *****     *****
  14 +               *****     *****     *****
     ]               *****     *****     *****
  13 +               *****     *****     *****
     ]               *****     *****     *****
  12 +               *****     *****     *****
     ]               *****     *****     *****
  11 +               *****     *****     *****
     ]               *****     *****     *****
  10 +               *****     *****     *****
     ]               *****     *****     *****
   9 +               *****     *****     *****
     ]               *****     *****     *****
   8 +               *****     *****     *****
     ]               *****     *****     *****
   7 +               *****     *****     *****
     ]               *****     *****     *****
   6 +               *****     *****     *****
     ]               *****     *****     *****
   5 +     *****     *****     *****     *****
     ]     *****     *****     *****     *****
   4 +     *****     *****     *****     *****               *****
     ]     *****     *****     *****     *****               *****
   3 +     *****     *****     *****     *****               *****
     ]     *****     *****     *****     *****               *****
   2 +     *****     *****     *****     *****     *****     *****
     ]     *****     *****     *****     *****     *****     *****
   1 +     *****     *****     *****     *****     *****     *****
     ]     *****     *****     *****     *****     *****     *****
     -------------------------------------------------------------
            0.75      1.00      1.25      1.50      1.75      2.00

                              VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=PECTINARIA CALIFORNIENSIS   GROUP=01

FREQUENCY BAR CHART

```
FREQUENCY

     ]       *****
  25 +       *****
     ]       *****
     ]       *****
     ]       *****
     ]       *****
  20 +       *****
     ]       *****
     ]       *****
     ]       *****
     ]       *****
  15 +       *****         *****
     ]       *****         *****
     ]       *****         *****
     ]       *****         *****
     ]       *****         *****
  10 +       *****         *****
     ]       *****         *****                       *****
     ]       *****         *****                       *****         *****
     ]       *****         *****         *****         *****         *****
     ]       *****         *****         *****         *****         *****
   5 +       *****         *****         *****         *****         *****
     ]       *****         *****         *****         *****         *****
     ]       *****         *****         *****         *****         *****
     ]       *****         *****         *****         *****         *****         *****
     ]       *****         *****         *****         *****         *****         *****         *****
     ----------------------------------------------------------------------------------------------------
              0.8           1.2           1.6           2.0           2.4           2.8           3.2

                                         VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=PECTINARIA CALIFORNIENSIS   GROUP=02

FREQUENCY BAR CHART

```
FREQUENCY

 35 +                    *****
    ]                    *****
    ]                    *****
    ]                    *****
    ]                    *****
 30 +                    *****
    ]      *****         *****
    ]      *****         *****
    ]      *****         *****
    ]      *****         *****
 25 +      *****         *****                       *****
    ]      *****         *****                       *****
    ]      *****         *****                       *****
    ]      *****         *****                       *****
    ]      *****         *****                       *****
 20 +      *****         *****                       *****
    ]      *****         *****                       *****
    ]      *****         *****                       *****
    ]      *****         *****                       *****
    ]      *****         *****         *****         *****
 15 +      *****         *****         *****         *****         *****
    ]      *****         *****         *****         *****         *****
    ]      *****         *****         *****         *****         *****
    ]      *****         *****         *****         *****         *****
    ]      *****         *****         *****         *****         *****
 10 +      *****         *****         *****         *****         *****
    ]      *****         *****         *****         *****         *****
    ]      *****         *****         *****         *****         *****
    ]      *****         *****         *****         *****         *****         *****
    ]      *****         *****         *****         *****         *****         *****
  5 +      *****         *****         *****         *****         *****         *****
    ]      *****         *****         *****         *****         *****         *****
    ]      *****         *****         *****         *****         *****         *****         *****
    ]      *****         *****         *****         *****         *****         *****         *****
    ]      *****         *****         *****         *****         *****         *****         *****
    ------------------------------------------------------------------------------------------------
            0.5           1.0           1.5           2.0           2.5           3.0           3.5

                                          VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=PECTINARIA CALIFORNIENSIS   GROUP=03

FREQUENCY BAR CHART

```
FREQUENCY

 7 +     *****
   ]     *****
   ]     *****
   ]     *****
   ]     *****
 6 +     *****
   ]     *****
   ]     *****
   ]     *****
   ]     *****
 5 +     *****
   ]     *****
   ]     *****
   ]     *****
   ]     *****
 4 +     *****
   ]     *****
   ]     *****
   ]     *****
   ]     *****
 3 +     *****
   ]     *****
   ]     *****
   ]     *****
   ]     *****
 2 +     *****               *****     *****
   ]     *****               *****     *****
   ]     *****               *****     *****
   ]     *****               *****     *****
   ]     *****               *****     *****
 1 +     *****               *****     *****
   ]     *****               *****     *****
   ]     *****               *****     *****
   ]     *****               *****     *****
   ]     *****               *****     *****
   ---------------------------------------------
          0.8       1.6       2.4       3.2

                 VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=PECTINARIA CALIFORNIENSIS   GROUP=04

FREQUENCY BAR CHART

```
FREQUENCY

  2 +                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
    ]                *****
  1 +      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    ]      *****     *****
    --------------------------
            0.8       1.6

             VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=SPIOPHANES BERKELEYORUM   GROUP=01

FREQUENCY BAR CHART

FREQUENCY

```
     ]                                   *****
     ]                                   *****
     ]                                   *****
  90 +                                   *****
     ]                                   *****
     ]                                   *****
     ]                                   *****
     ]                                   *****     *****
  80 +                                   *****     *****
     ]                                   *****     *****
     ]                                   *****     *****
     ]                                   *****     *****
     ]                                   *****     *****
  70 +                                   *****     *****
     ]                                   *****     *****
     ]                                   *****     *****
     ]                                   *****     *****
     ]                                   *****     *****
  60 +                                   *****     *****
     ]                                   *****     *****
     ]                         *****     *****     *****
     ]                         *****     *****     *****
     ]                         *****     *****     *****
  50 +                         *****     *****     *****
     ]                         *****     *****     *****
     ]                         *****     *****     *****
     ]                         *****     *****     *****
     ]                         *****     *****     *****
  40 +                         *****     *****     *****
     ]                         *****     *****     *****
     ]                         *****     *****     *****
     ]                         *****     *****     *****
     ]                         *****     *****     *****     *****
  30 +                         *****     *****     *****     *****
     ]                         *****     *****     *****     *****
     ]                         *****     *****     *****     *****
     ]                         *****     *****     *****     *****
     ]                         *****     *****     *****     *****
  20 +                         *****     *****     *****     *****
     ]                         *****     *****     *****     *****
     ]                         *****     *****     *****     *****
     ]                         *****     *****     *****     *****
     ]                         *****     *****     *****     *****
  10 +                         *****     *****     *****     *****
     ]                         *****     *****     *****     *****
     ]               *****     *****     *****     *****     *****
     ]               *****     *****     *****     *****     *****     *****               *****
     ]     *****     *****     *****     *****     *****     *****     *****     *****     *****
     ------------------------------------------------------------------------------------------
```

```
        0.16    0.32    0.48    0.64    0.80    0.96    1.12    1.28    1.44

                                VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=SPIOPHANES BERKELEYORUM   GROUP=02

FREQUENCY BAR CHART

FREQUENCY

```
    ]                   *****
    ]                   *****
    ]                   *****
 40 +                   *****
    ]                   *****
    ]                   *****
    ]                   *****
    ]                   *****
 35 +                   *****
    ]                   *****
    ]                   *****
    ]                   *****
    ]                   *****
 30 +                   *****
    ]                   *****   *****
    ]                   *****   *****
    ]           *****   *****   *****
    ]           *****   *****   *****
 25 +           *****   *****   *****
    ]           *****   *****   *****
    ]           *****   *****   *****
    ]           *****   *****   *****
    ]           *****   *****   *****
 20 +           *****   *****   *****
    ]           *****   *****   *****
    ]           *****   *****   *****
    ]           *****   *****   *****   *****
    ]           *****   *****   *****   *****
 15 +           *****   *****   *****   *****
    ]           *****   *****   *****   *****
    ]           *****   *****   *****   *****
    ]           *****   *****   *****   *****
    ]   *****   *****   *****   *****   *****
 10 +   *****   *****   *****   *****   *****
    ]   *****   *****   *****   *****   *****
    ]   *****   *****   *****   *****   *****
    ]   *****   *****   *****   *****   *****   *****
    ]   *****   *****   *****   *****   *****   *****
  5 +   *****   *****   *****   *****   *****   *****
    ]   *****   *****   *****   *****   *****   *****
    ]   *****   *****   *****   *****   *****   *****           *****
    ]   *****   *****   *****   *****   *****   *****   *****   *****
    ]   *****   *****   *****   *****   *****   *****   *****   *****
    ---------------------------------------------------------------------
        0.36    0.48    0.60    0.72    0.84    0.96    1.08    1.20

                            VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=SPIOPHANES BERKELEYORUM   GROUP=03

FREQUENCY BAR CHART

```
FREQUENCY

  2 +       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
  1 +       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    -------------------------
             0.8       1.6

        VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY
SPNAME=SPIOPHANES BERKELEYORUM   GROUP=04

FREQUENCY BAR CHART

```
FREQUENCY

  2 +       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
    ]       *****
  1 +       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ]       *****     *****
    ------------------------
             0.8       1.2

          VALUE MIDPOINT
```

MEASUREMENT DATA
IN MAJOR CLUSTER GROUPS - .5 + 1 MM - REP 01 ONLY

OBS	SPNAME	GROUP	MEAN	SD	SE	CV	MIN	MAX	N

APPENDIX G

Transect Plots (1:12,000 and 1:2,000 scale) from the July/August 1984 Hard-Bottom Survey

APPENDIX G

Hard-Bottom Survey Transect Plot Legend

1:12,000 Scale Plots

Time

Military time is listed for beginning and end times, and 30 minute intervals; minute intervals are indicated by a "*".

Depth

Bottom depths (ft) are listed for beginning and end times (military) and 30 minute intervals.

Sediment Cover

Estimated sediment cover (%) of hard-bottom substrate is > 75-100% except as noted: E = 0-25%, F = > 25-50%, G = > 50% - 75%.

Substrate

Substrate type is listed as H-B (Hard-Bottom), S-B (Soft-Bottom), or M-B (mixed-bottom) representing closely alternating H-B and S-B. The percentage of a specified bottom type is > 75 - 100% except as noted (e.g., H-B/60%).

1:2,000 Scale Plots

Time

Military time is listed for beginning and end times, and 30 minute intervals; minute intervals are indicated by a "*", and five minute intervals by a "+".

Biological Assemblage

Detailed descriptions of the biological assemblages observed from the survey are presented in Section 3.2.2. Three hard-bottom assemblages and one soft-bottom assemblage were defined:

- A (Generalist) - Hard-bottom taxa occurring throughout the range of transects, depth ranges and substrate relief noted from the survey.

- B (High to Medium Relief - Hard-bottom taxa primarily occurring in high to medium relief areas; some taxa from Assemblage A can occur as a sub-assemblage or co-assemblage.

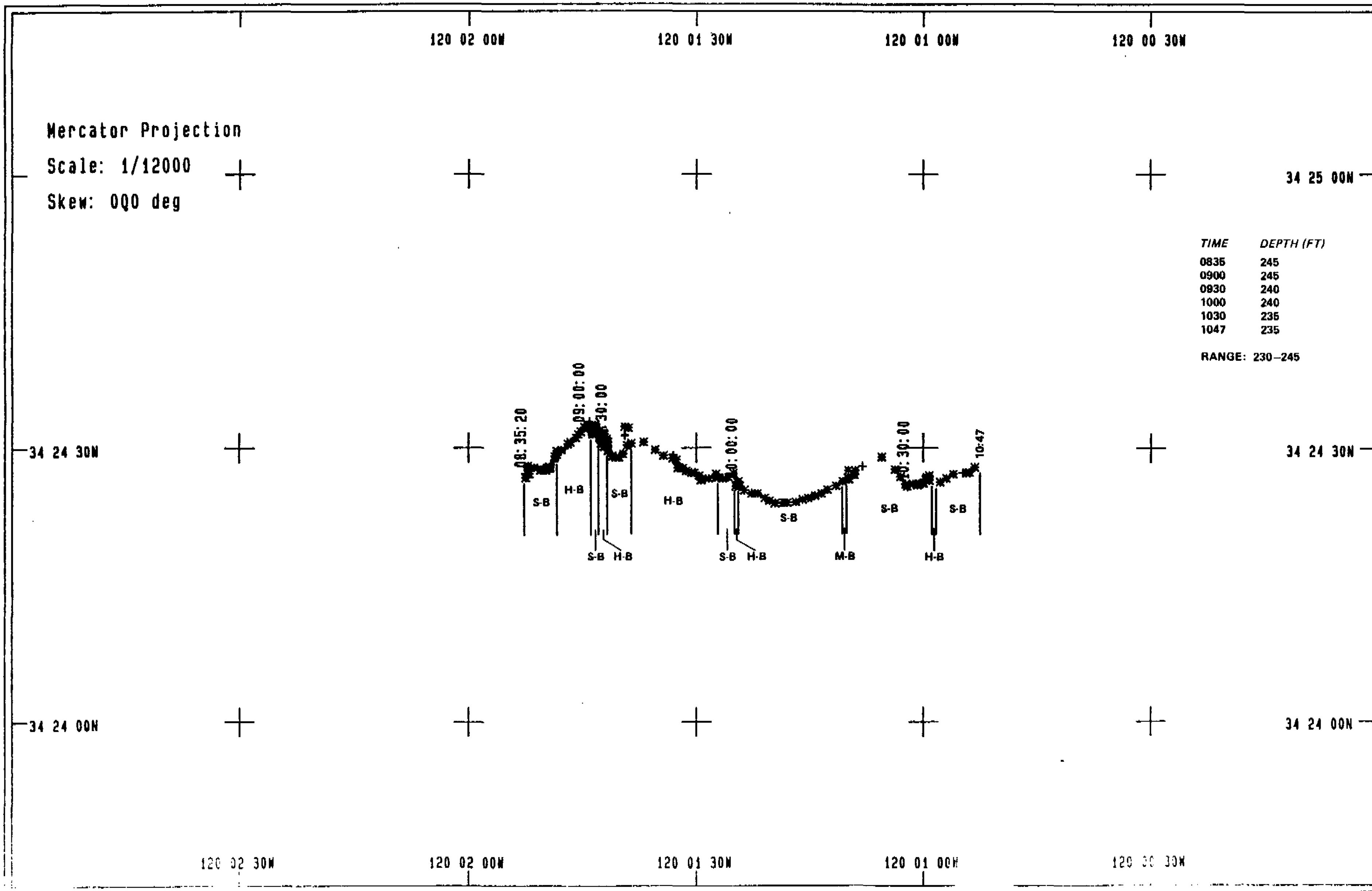
- C (Low to Medium Relief - Hard-bottom taxa primarily occurring in low to medium relief areas; some taxa from Assemblage A can occur as a sub-assemblage or co-assemblage.

- D (Soft-Bottom) - Soft-bottom epifaunal organisms occurring throughout the survey area in soft-bottom areas.

Transect areas characterized by a co-dominance of two assemblages are indicated by a slash mark separating the assemblages (e.g., C/A). Areas primarily characterized by one assemblage, but with notable occurrences of taxa constituting a sub-assemblage are indicated by enclosing the sub-assemblage within parentheses (e.g., C/(D)).

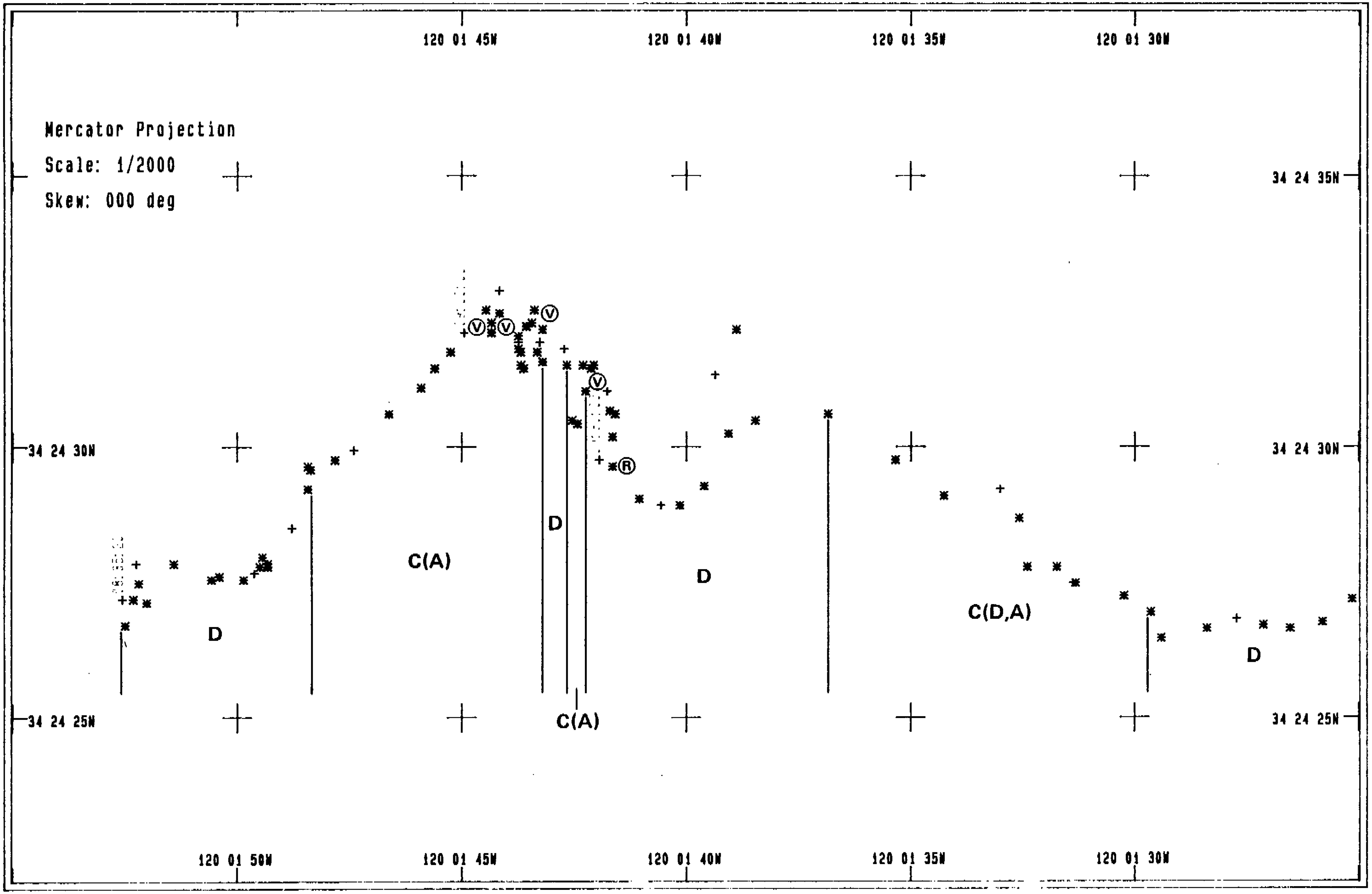
Species of note, the coral *Lophelia californica*, the hydrocoral *Allopora californica*, and the spot prawn *Pandalus platyceros* also are identified on the transect plots as *Lophelia*, *Allpora*, or *Pandalus*, respectively.

Dive 1A-B



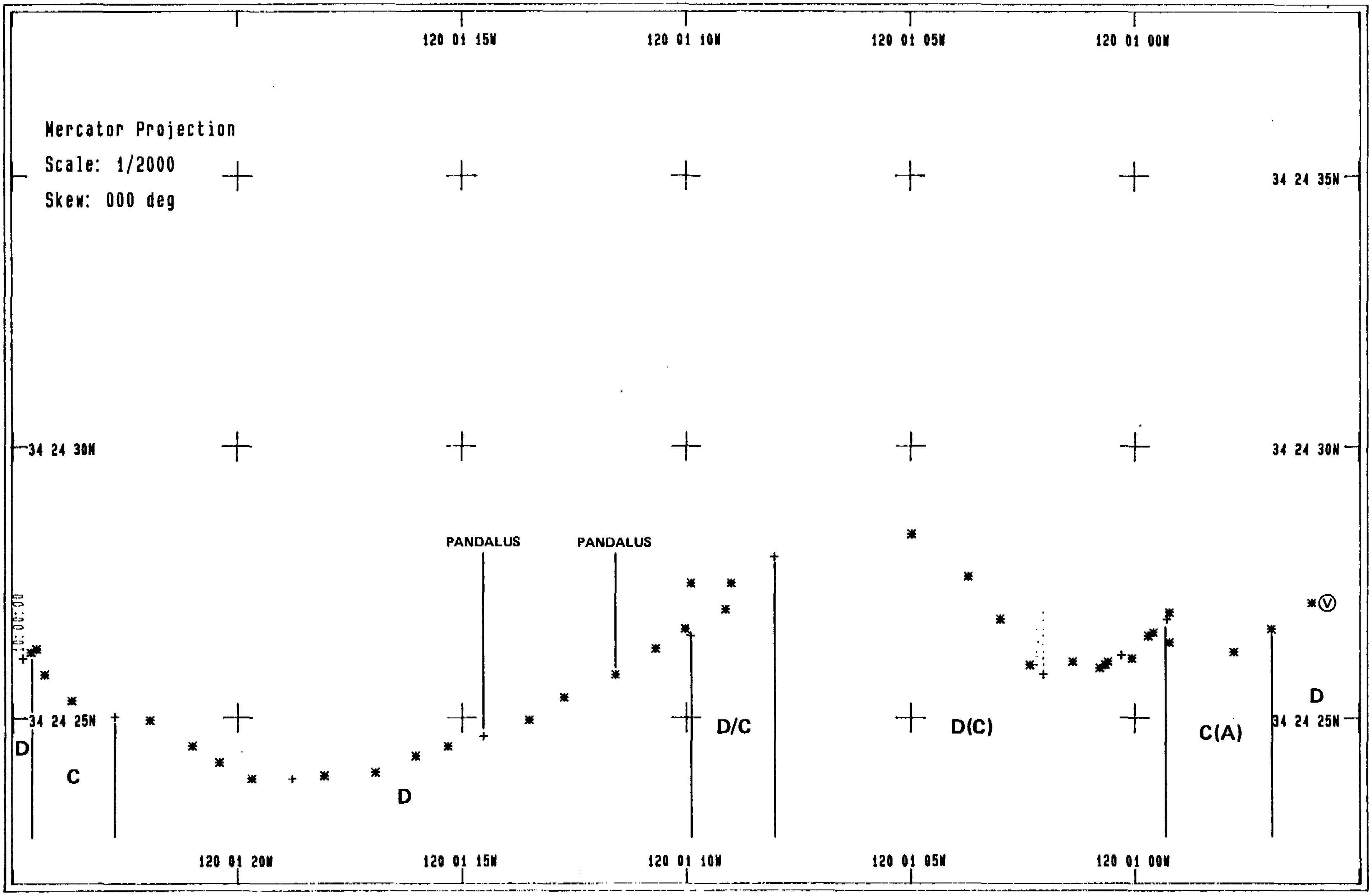
Mercator Projection
Scale: 1/12000
Skew: 0Q0 deg
120 02 00W
120 01 30W
120 01 00W
120 00 30W
34 25 00N
34 24 30N
34 24 00N
120 02 30W
TIME DEPTH (FT)
0835 245
0900 245
0930 240
1000 240
1030 235
1047 235
RANGE: 230-245
08:35:20
09:00:00
30:00
10:47
S-B
H-B
M-B

Dive 1A-B(A)



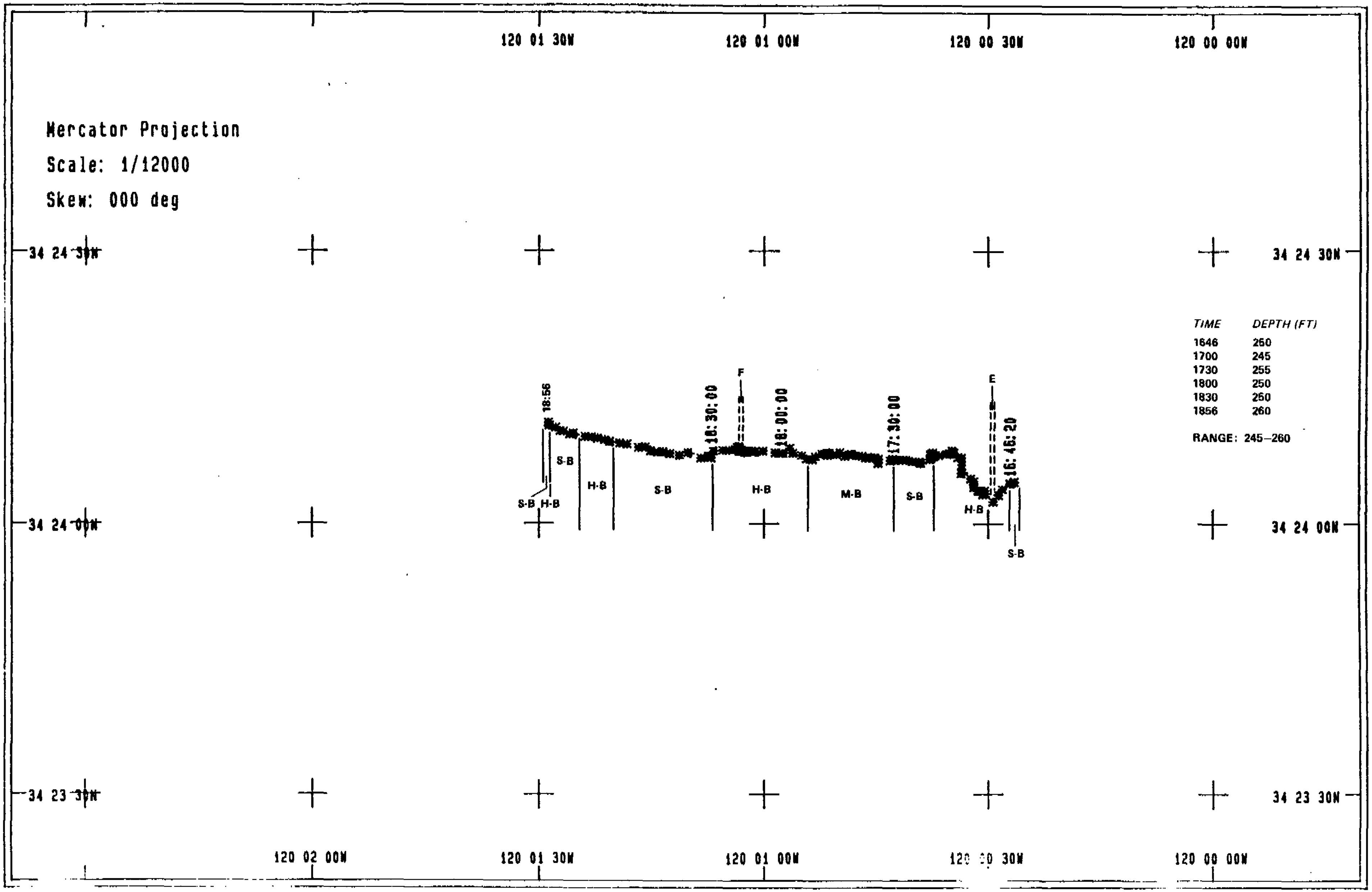
Mercator Projection
Scale: 1/2000
Skew: 000 deg
120 01 50W
120 01 45W
120 01 40W
120 01 35W
120 01 30W
34 24 35N
34 24 30N
34 24 25N
D
C(A)
D
C(A)
D
C(D,A)
D
V
R

Dive 1A-B(B)



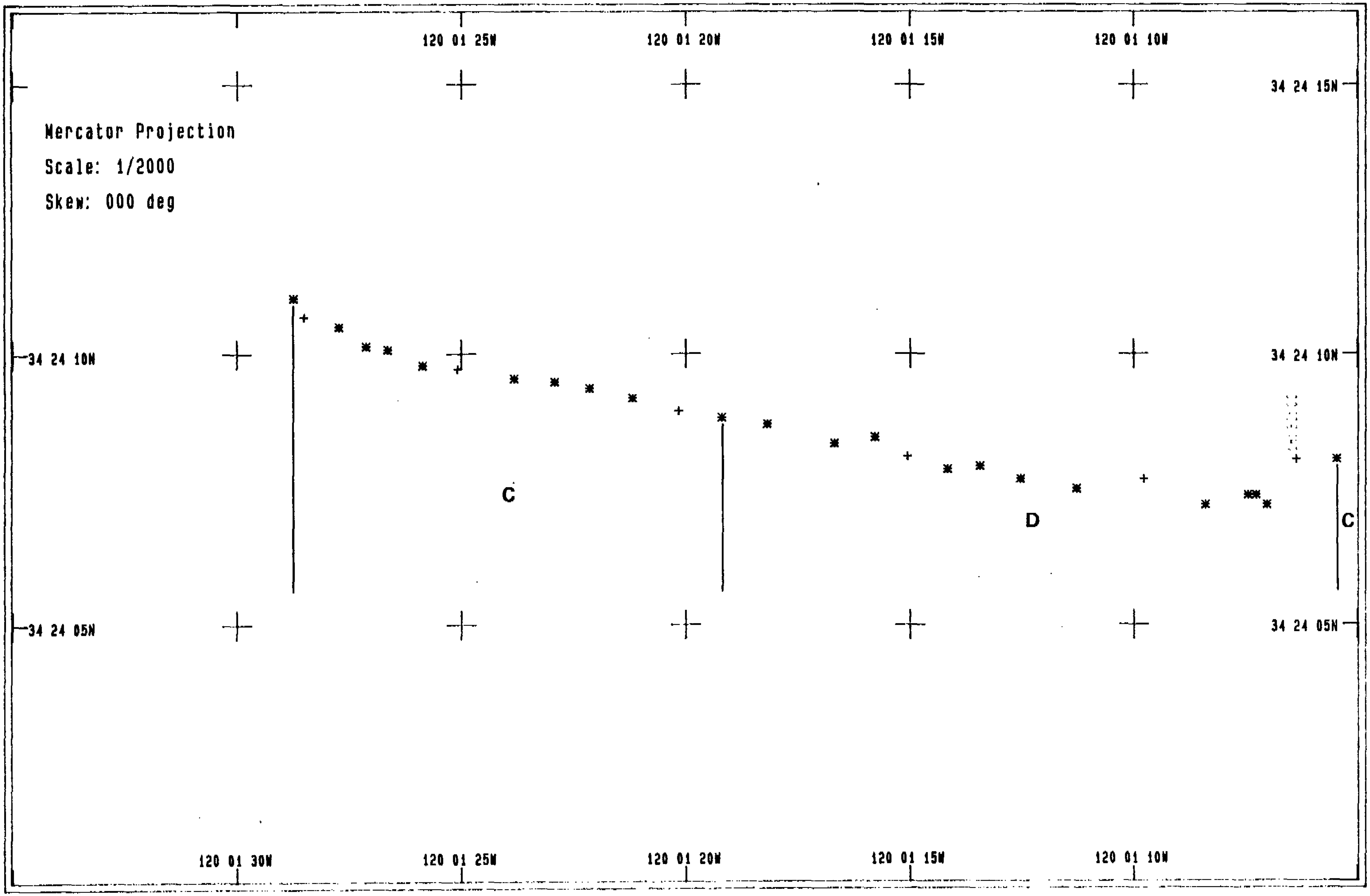
Mercator Projection
Scale: 1/2000
Skew: 000 deg
120 01 15W
120 01 10W
120 01 05W
120 01 00W
120 01 20W
34 24 35N
34 24 30N
34 24 25N
PANDALUS
PANDALUS
D
C
D
D/C
D(C)
C(A)
D

Dive 1D-C

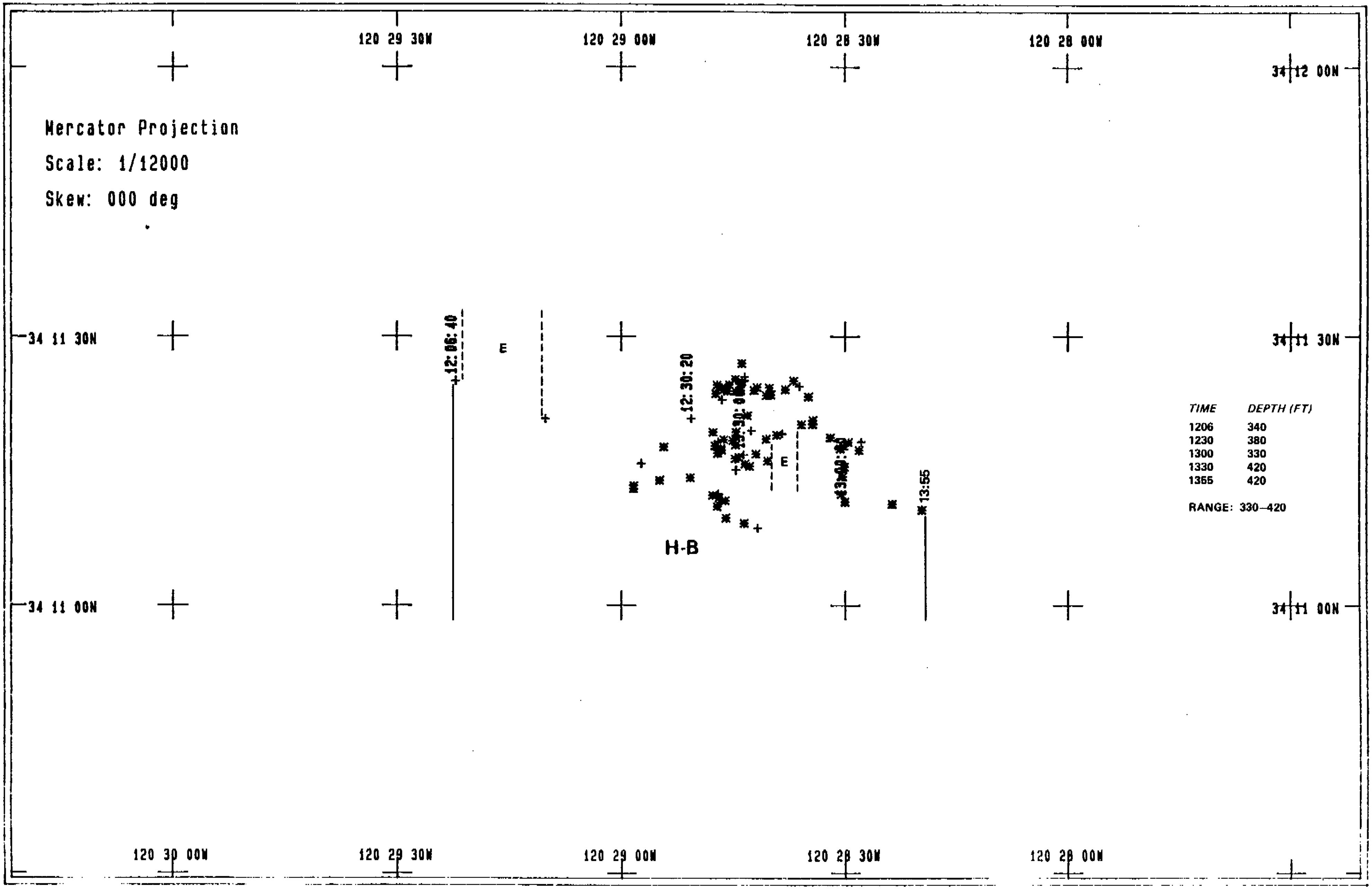


120 01 30W
120 01 00W
120 00 30W
120 00 00W
Mercator Projection
Scale: 1/12000
Skew: 000 deg
34 24 30N
34 24 00N
34 23 30N
TIME DEPTH (FT)
1646 260
1700 245
1730 255
1800 250
1830 260
1856 260
RANGE: 245–260
18:56
18:30:00
18:00:00
17:30:00
16:46:20
F
E
S-B
H-B
M-B
120 02 00W

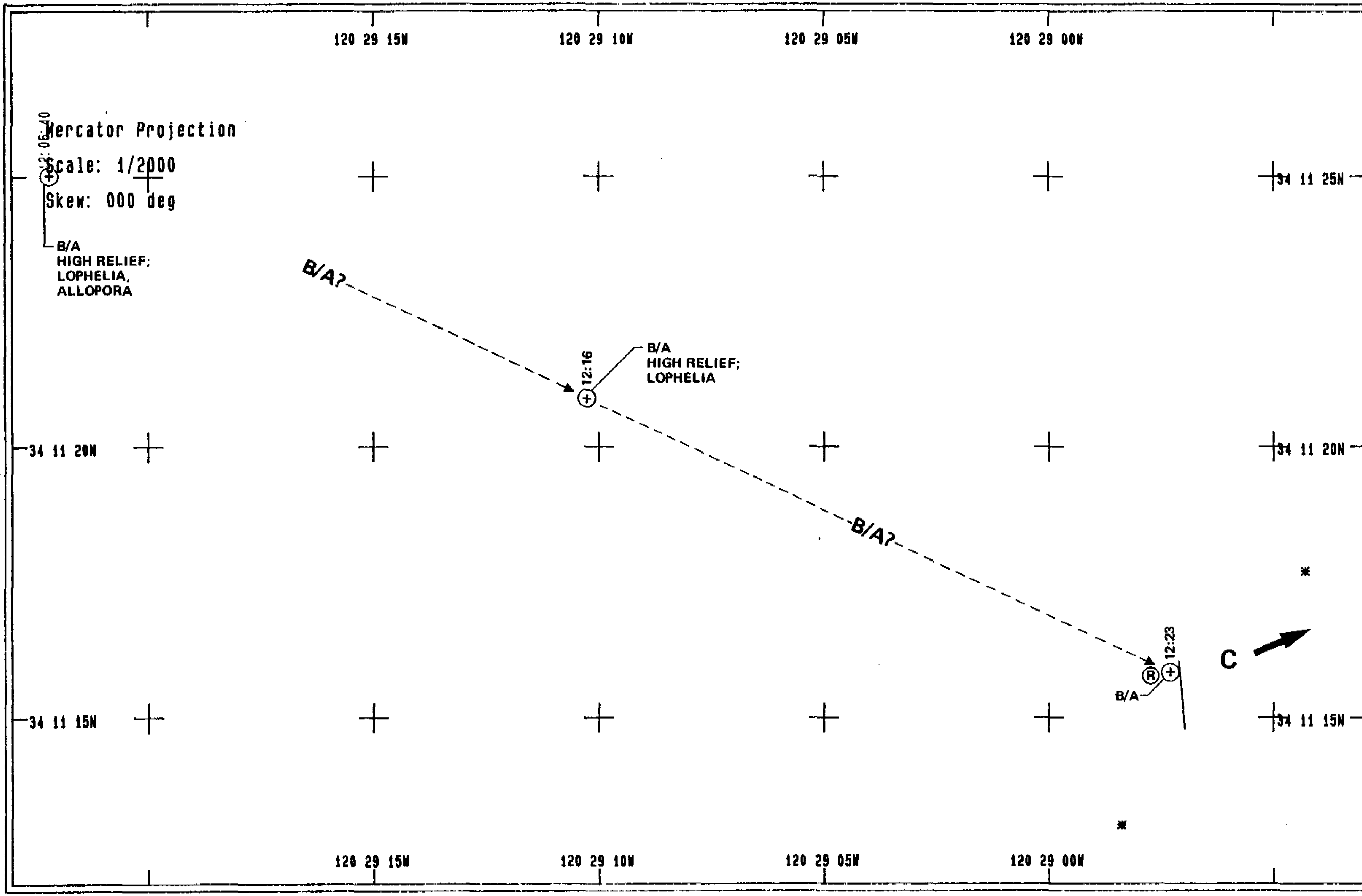
Dive 1D-C(C)


120 01 25W
120 01 20W
120 01 15W
120 01 10W
34 24 15N
Mercator Projection
Scale: 1/2000
Skew: 000 deg
34 24 10N
34 24 10N
C
D
C
34 24 05N
34 24 05N
120 01 30W
120 01 25W
120 01 20W
120 01 15W
120 01 10W

Dive 2A-B

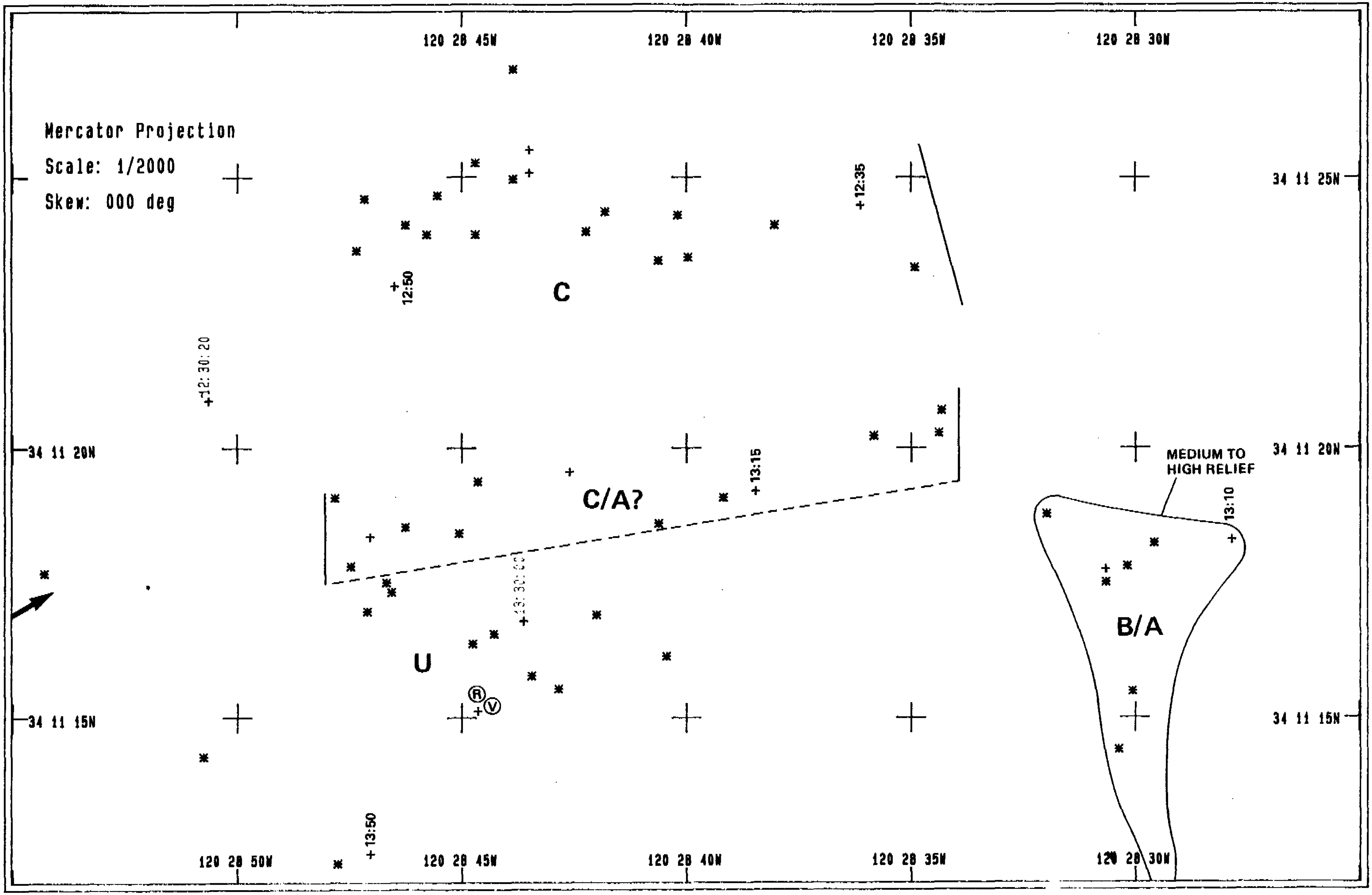

Mercator Projection
Scale: 1/12000
Skew: 000 deg
120 29 30W
120 29 00W
120 28 30W
120 28 00W
34 12 00N
34 11 30N
34 11 00N
120 30 00W
12:06:40
12:30:20
13:55
E
H-B
TIME DEPTH (FT)
1206 340
1230 380
1300 330
1330 420
1355 420
RANGE: 330–420

Dive 2A-B(A)



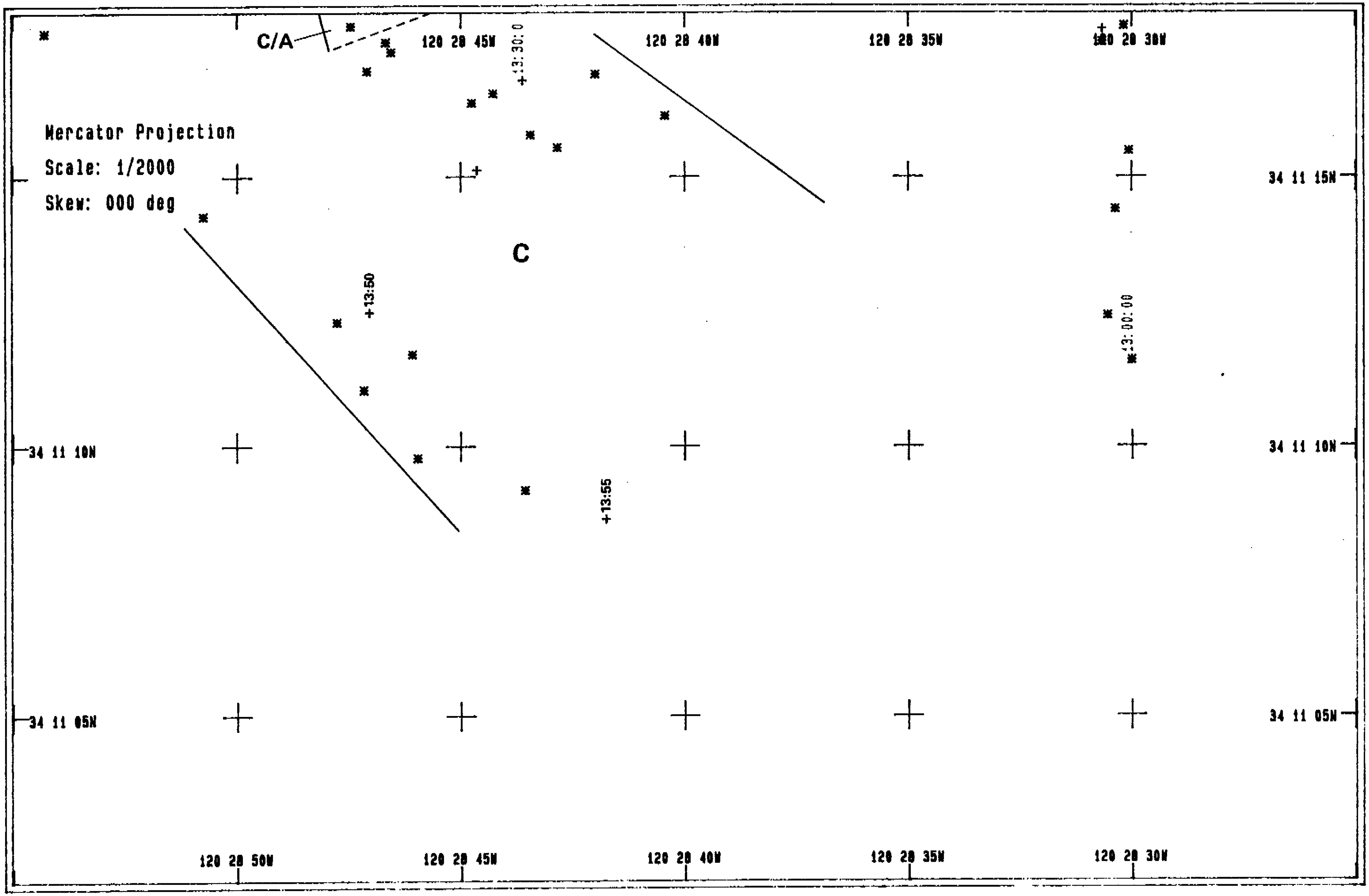
120 29 15W
120 29 10W
120 29 05W
120 29 00W
Mercator Projection
Scale: 1/2000
Skew: 000 deg
12:06:40
B/A
HIGH RELIEF;
LOPHELIA,
ALLOPORA
B/A?
12:16
B/A
HIGH RELIEF;
LOPHELIA
B/A?
12:23
R
B/A
C
34 11 25N
34 11 20N
34 11 15N

Dive 2A-B(B)



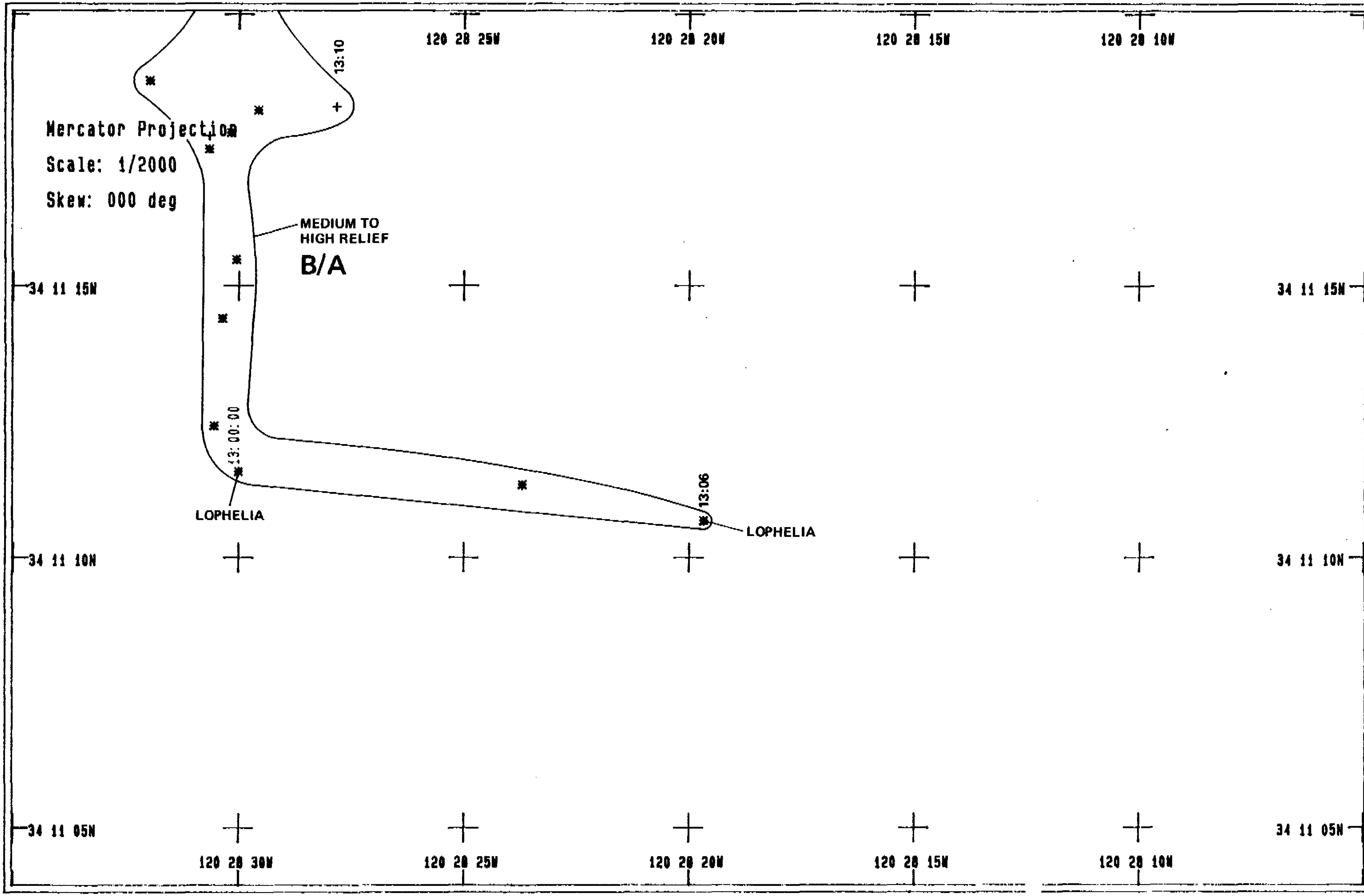
Mercator Projection
Scale: 1/2000
Skew: 000 deg
120 28 45W
120 28 40W
120 28 35W
120 28 30W
120 28 50W
34 11 25N
34 11 20N
34 11 15N
12:35
12:50
12:30:20
13:15
13:30:00
13:10
13:50
C
C/A?
U
B/A
MEDIUM TO
HIGH RELIEF

Dive 2A-B(C)



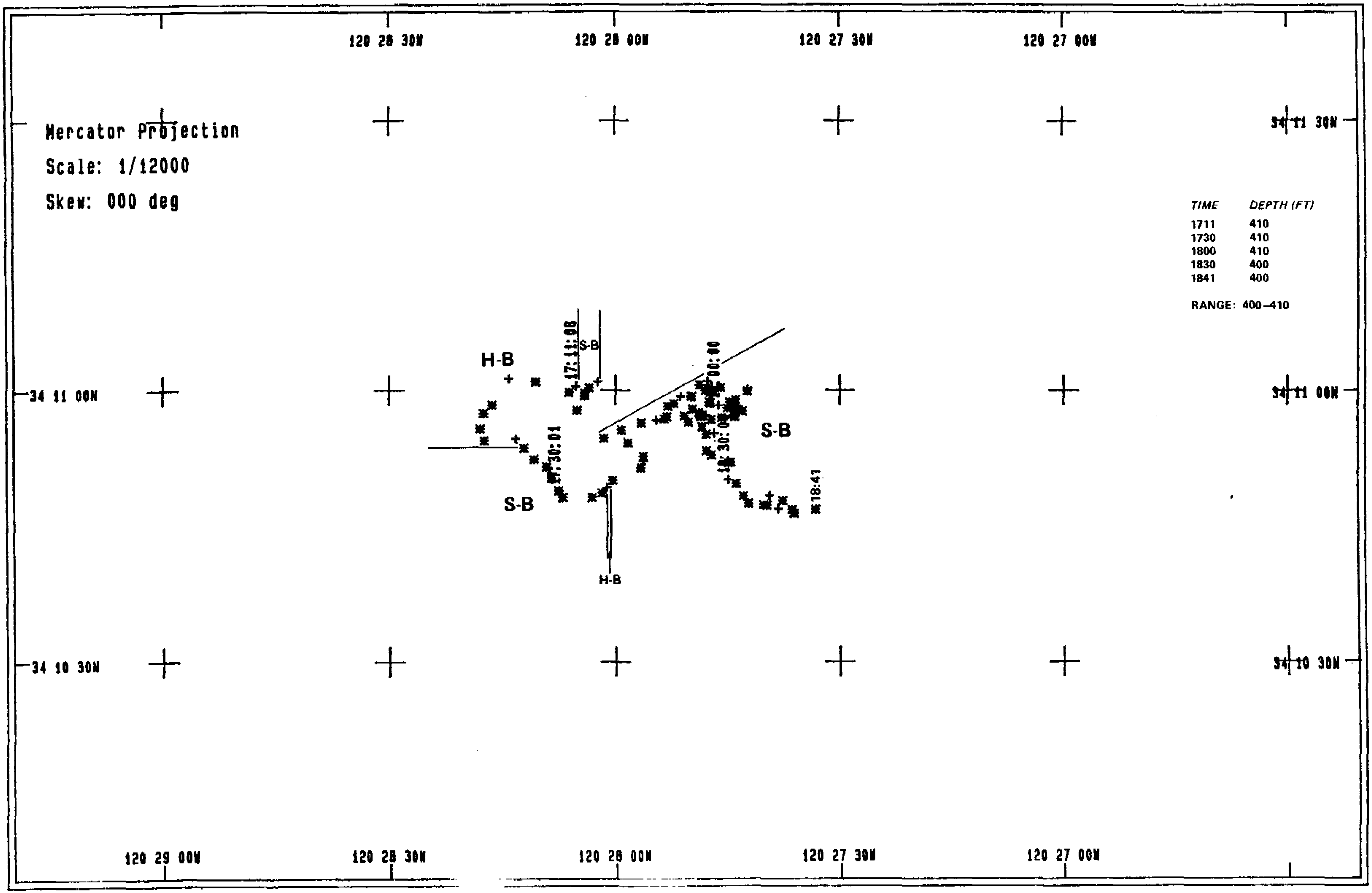
Mercator Projection
Scale: 1/2000
Skew: 000 deg
C/A
C
+13:30:0
+13:50
+13:55
13:00:00
120 28 50W
120 28 45W
120 28 40W
120 28 35W
120 28 30W
34 11 15N
34 11 10N
34 11 05N

Dive 2A-B(D)



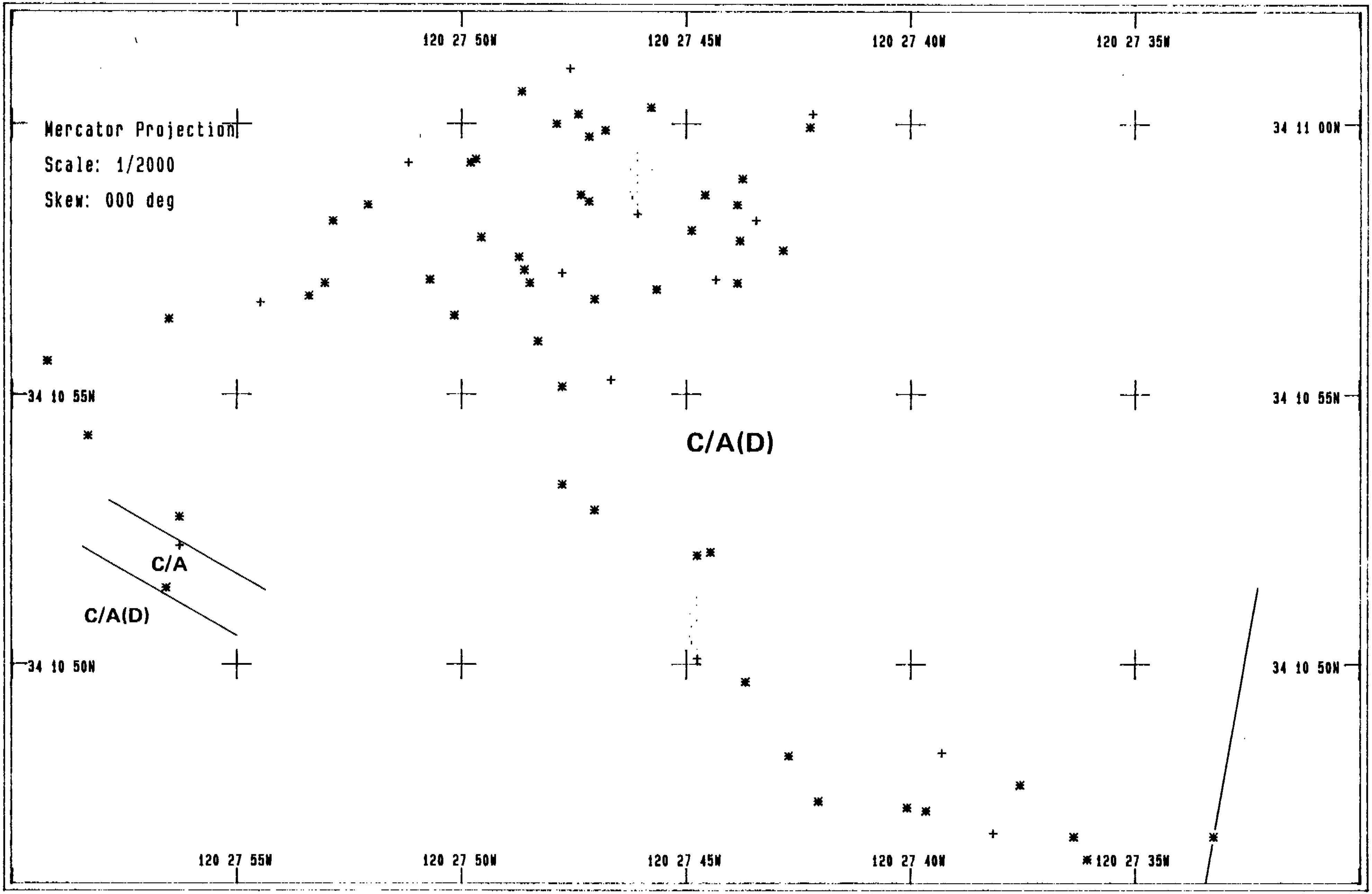
Mercator Projection
Scale: 1/2000
Skew: 000 deg
120 28 30W
120 28 25W
120 28 20W
120 28 15W
120 28 10W
34 11 15N
34 11 10N
34 11 05N
13:10
MEDIUM TO
HIGH RELIEF
B/A
13:00:00
LOPHELIA
13:06
LOPHELIA

Dive 2D-C

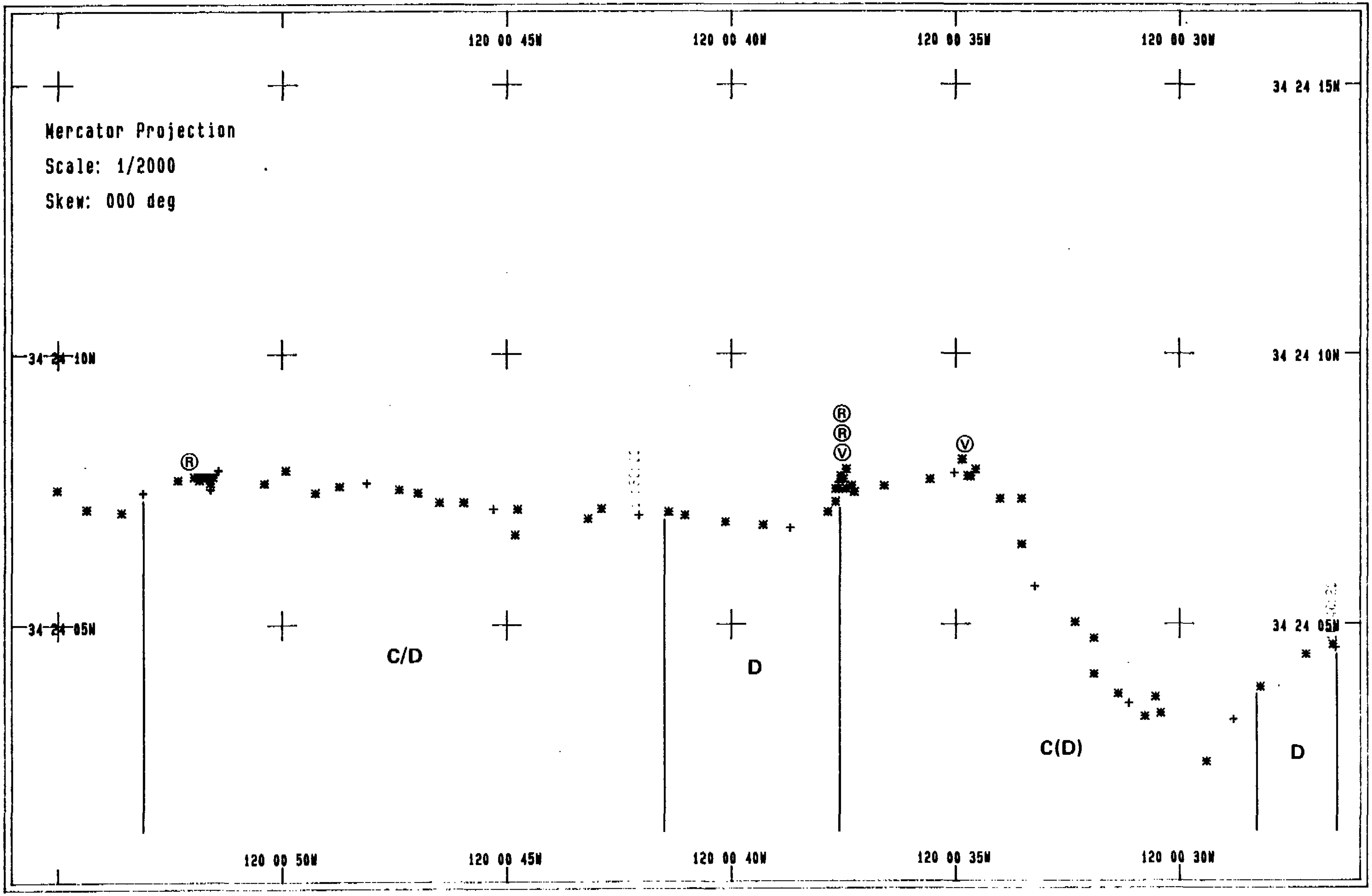


120 28 30W
120 28 00W
120 27 30W
120 27 00W
Mercator Projection
Scale: 1/12000
Skew: 000 deg
34 11 30N
34 11 00N
34 10 30N
TIME DEPTH (FT)
1711 410
1730 410
1800 410
1830 400
1841 400
RANGE: 400–410
H-B
S-B
17:11:08
17:30:01
18:00
18:30:0
18:41
120 29 00W

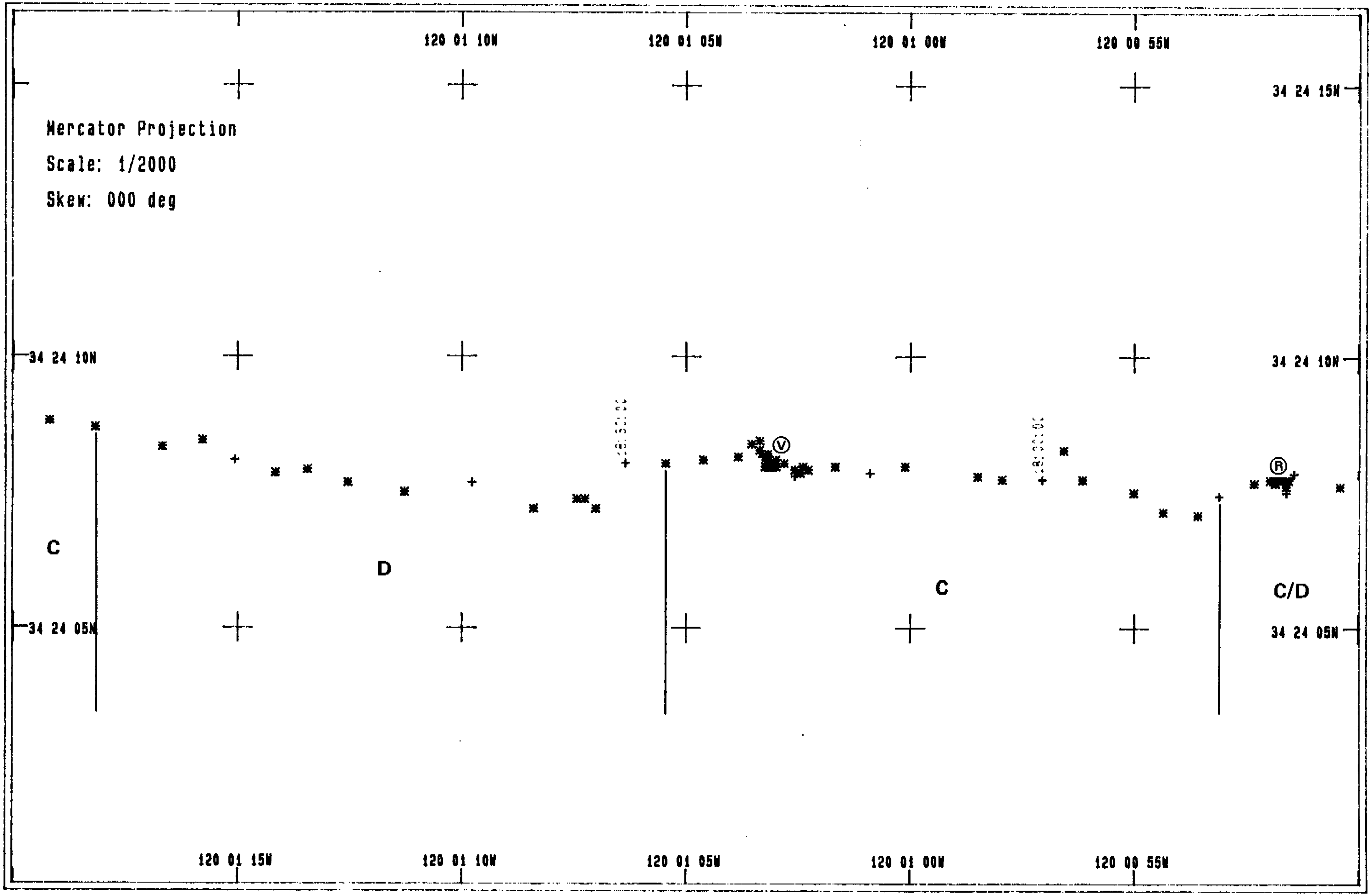
Dive 2D-C(A)


120 27 55W
120 27 50W
120 27 45W
120 27 40W
120 27 35W
34 11 00N
34 10 55N
34 10 50N
Mercator Projection
Scale: 1/2000
Skew: 000 deg
C/A(D)
C/A
C/A(D)

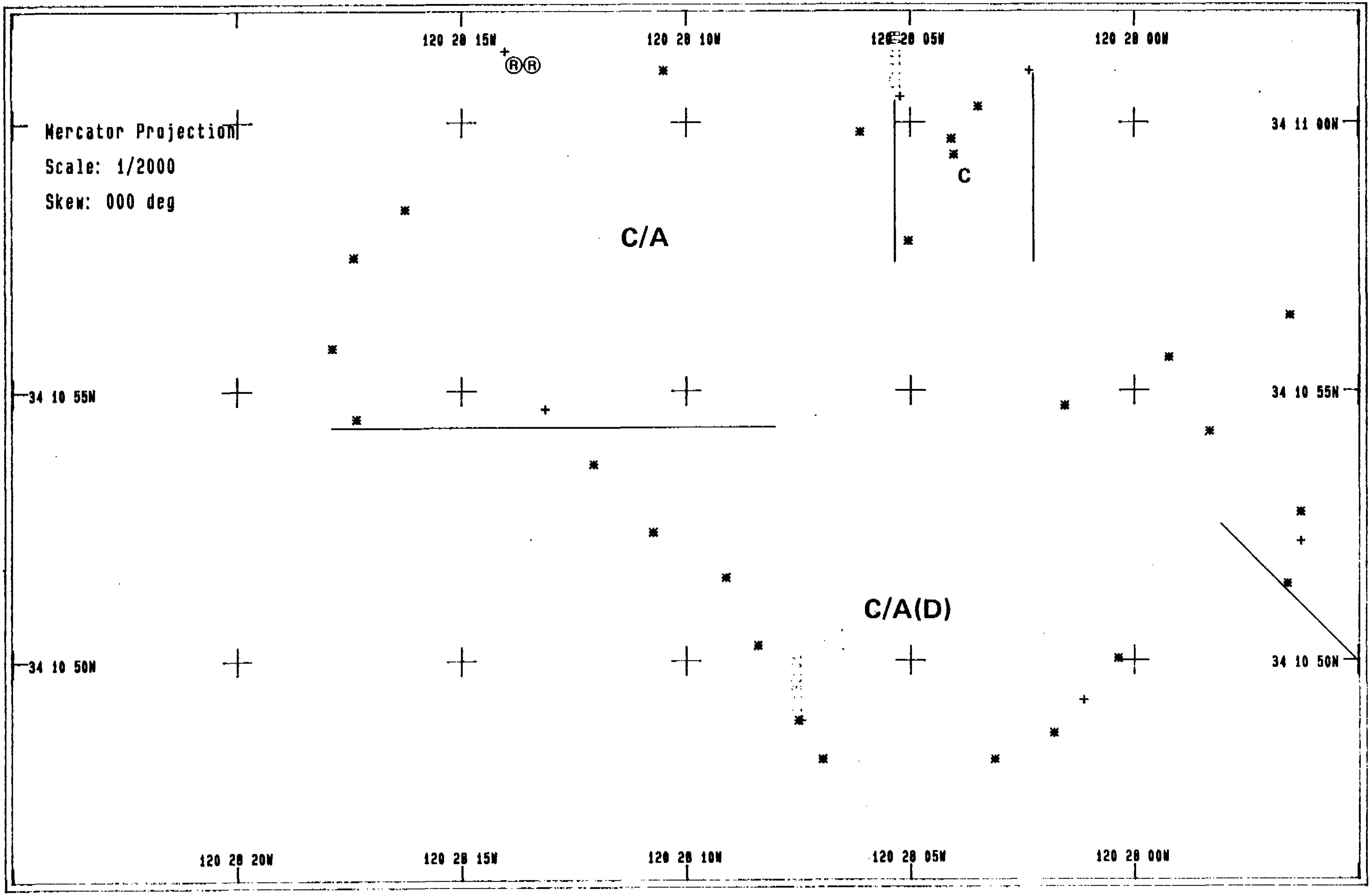
Dive 1D-C(A)


120 00 45W
120 00 40W
120 00 35W
120 00 30W
34 24 15N
Mercator Projection
Scale: 1/2000
Skew: 000 deg
34 24 10N
34 24 10N
34 24 05N
34 24 05N
R
R
R
V
V
C/D
D
C(D)
D
120 00 50W
120 00 45W
120 00 40W
120 00 35W
120 00 30W

Dive 1D-C(B)

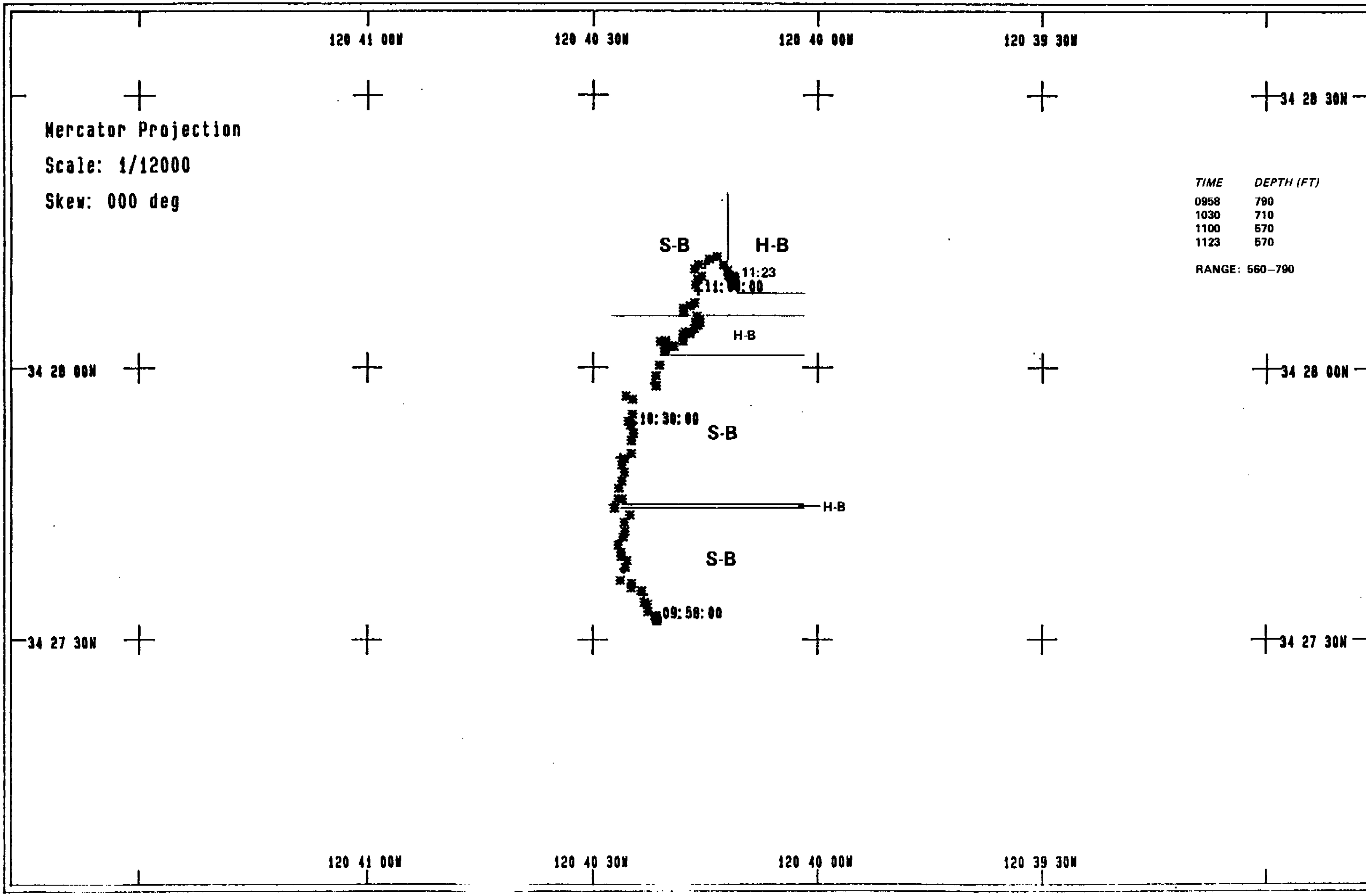

120 01 10W
120 01 05W
120 01 00W
120 00 55W
34 24 15N
Mercator Projection
Scale: 1/2000
Skew: 000 deg
34 24 10N
34 24 10N
C
D
C
C/D
34 24 05N
34 24 05N
120 01 15W
120 01 10W
120 01 05W
120 01 00W
120 00 55W

Dive 2D-C(B)



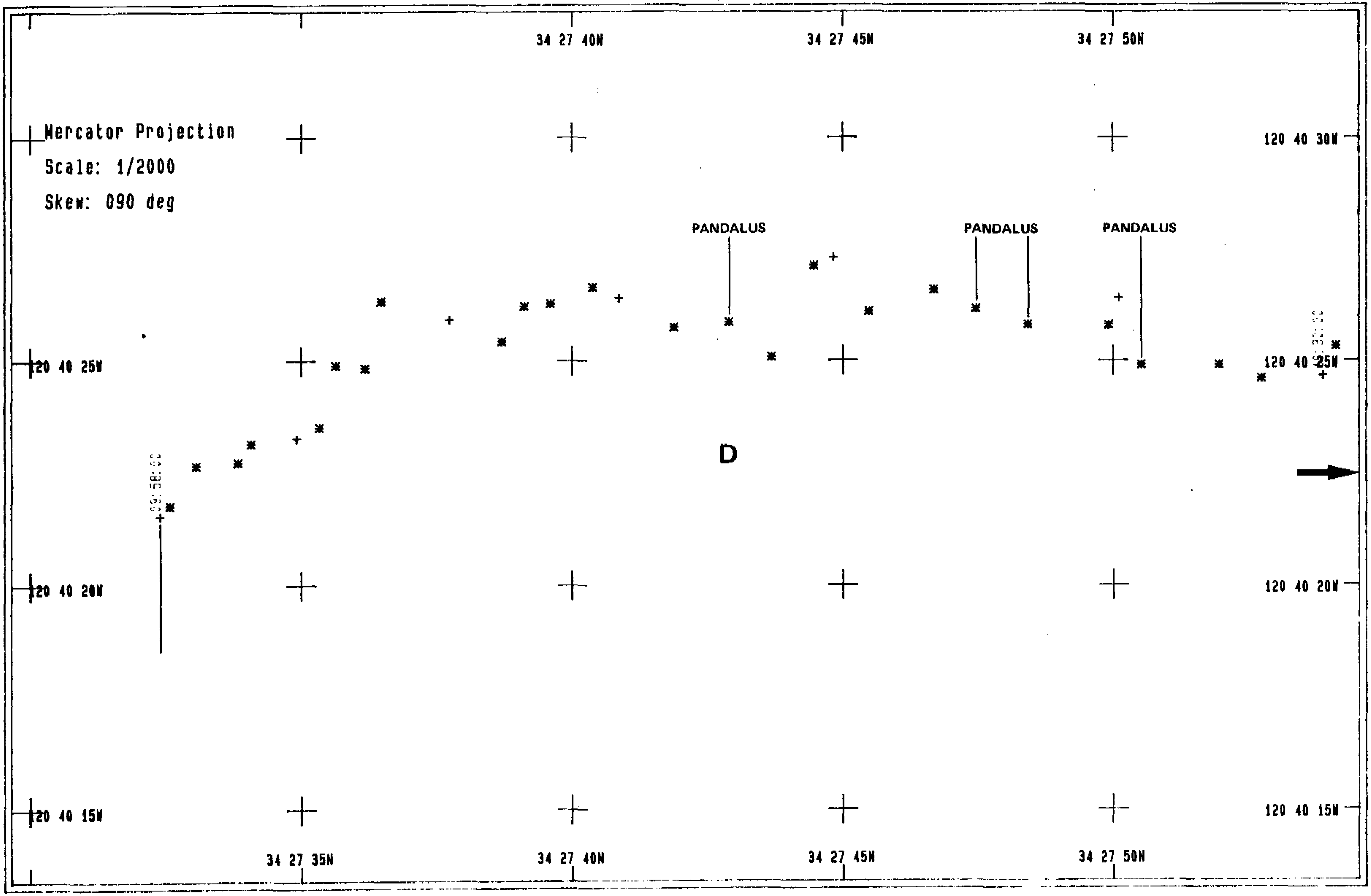
120 28 15W
120 28 10W
120 28 05W
120 28 00W
Mercator Projection
Scale: 1/2000
Skew: 000 deg
34 11 00N
C
C/A
34 10 55N
34 10 55N
C/A(D)
34 10 50N
34 10 50N
120 28 20W
120 28 15W
120 28 10W
120 28 05W
120 28 00W

Dive 4B-A



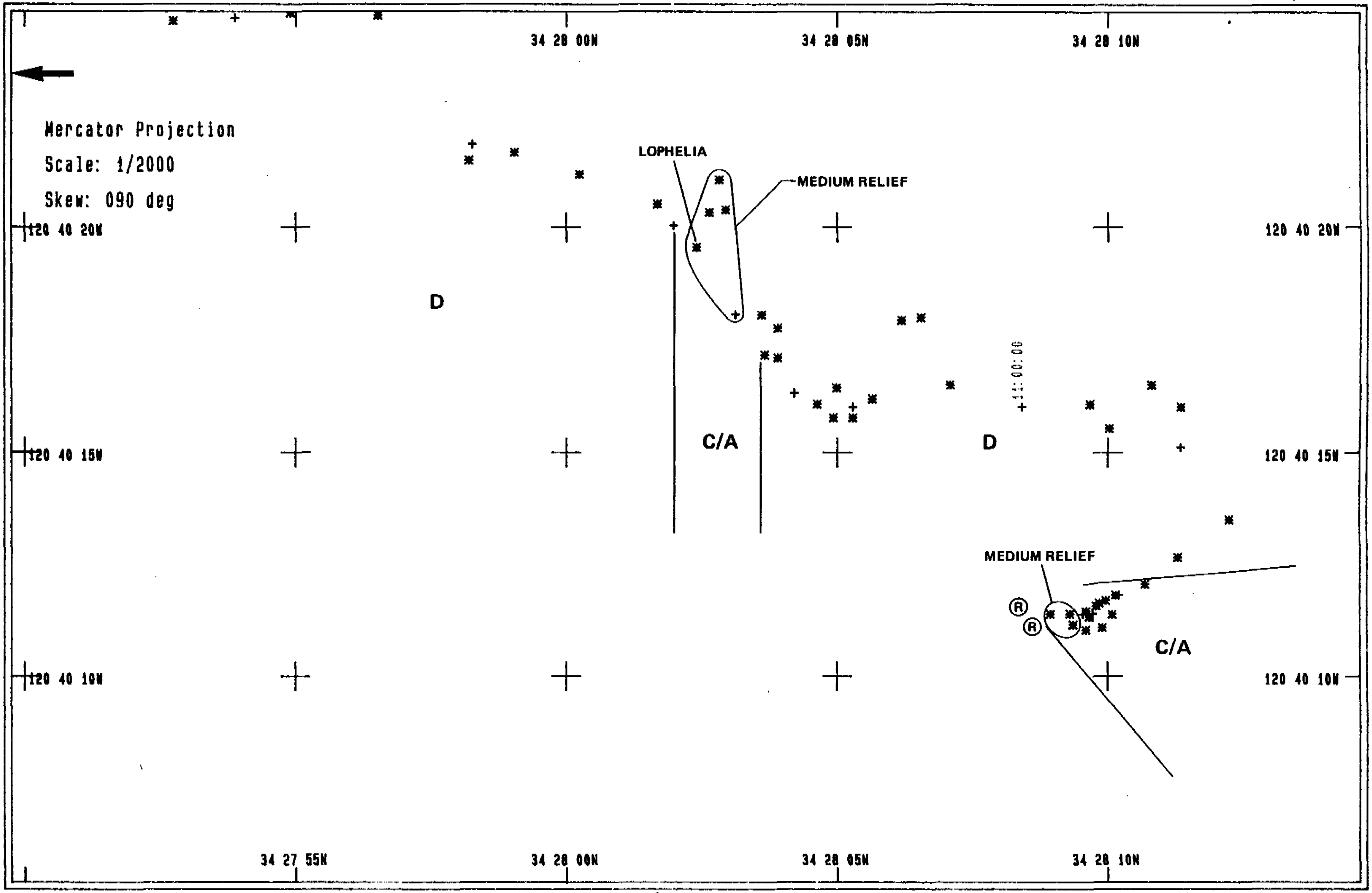
120 41 00W
120 40 30W
120 40 00W
120 39 30W
34 28 30N
34 28 00N
34 27 30N
Mercator Projection
Scale: 1/12000
Skew: 000 deg
TIME DEPTH (FT)
0958 790
1030 710
1100 570
1123 570
RANGE: 560–790
S-B
H-B
11:23
H-B
10:30:00
S-B
H-B
S-B
09:58:00

Dive 4B-A(A)



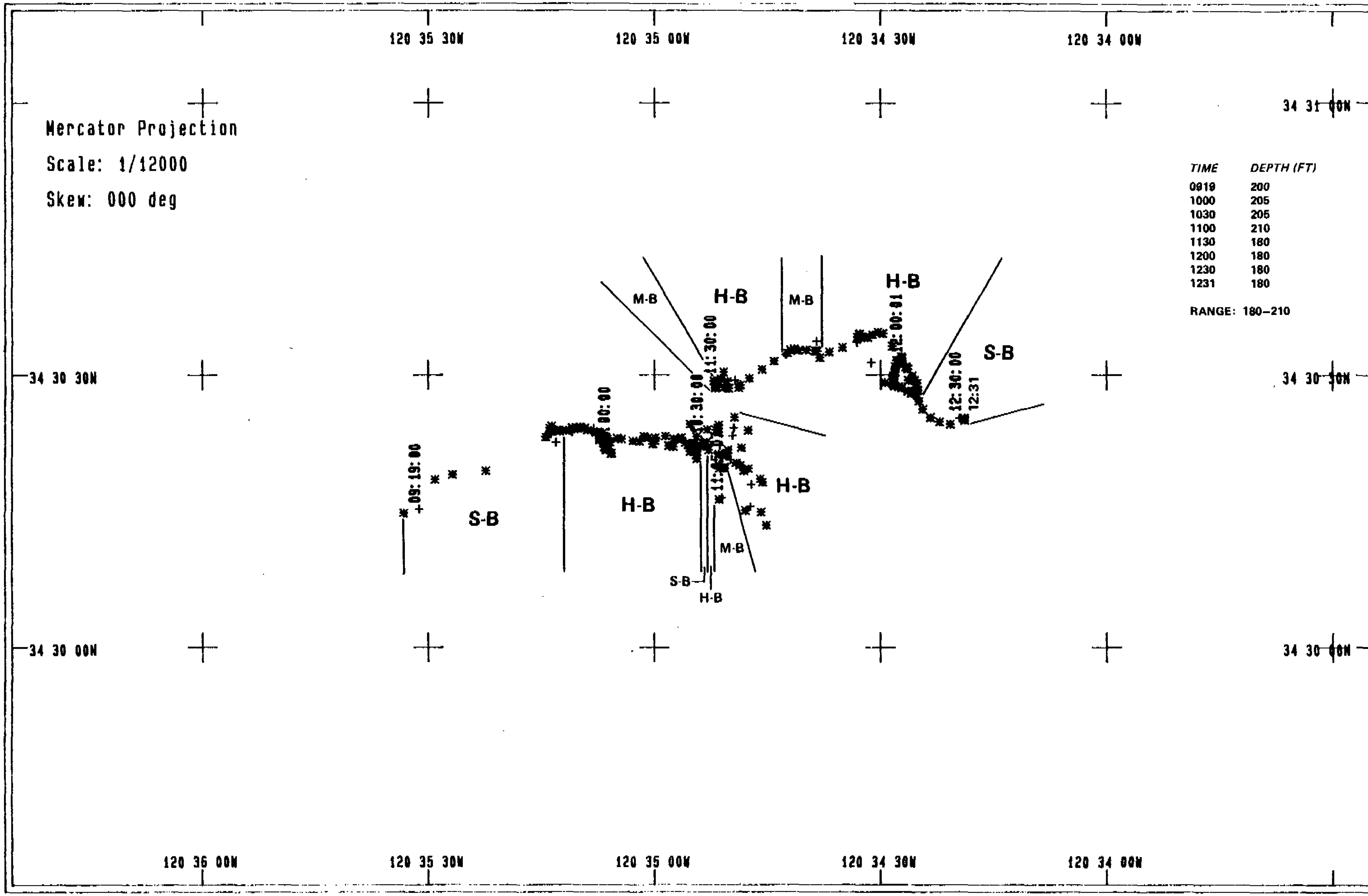
Mercator Projection
Scale: 1/2000
Skew: 090 deg
34 27 35N
34 27 40N
34 27 45N
34 27 50N
120 40 30W
120 40 25W
120 40 20W
120 40 15W
PANDALUS
PANDALUS
PANDALUS
PANDALUS
D

Dive 4B-A(B)



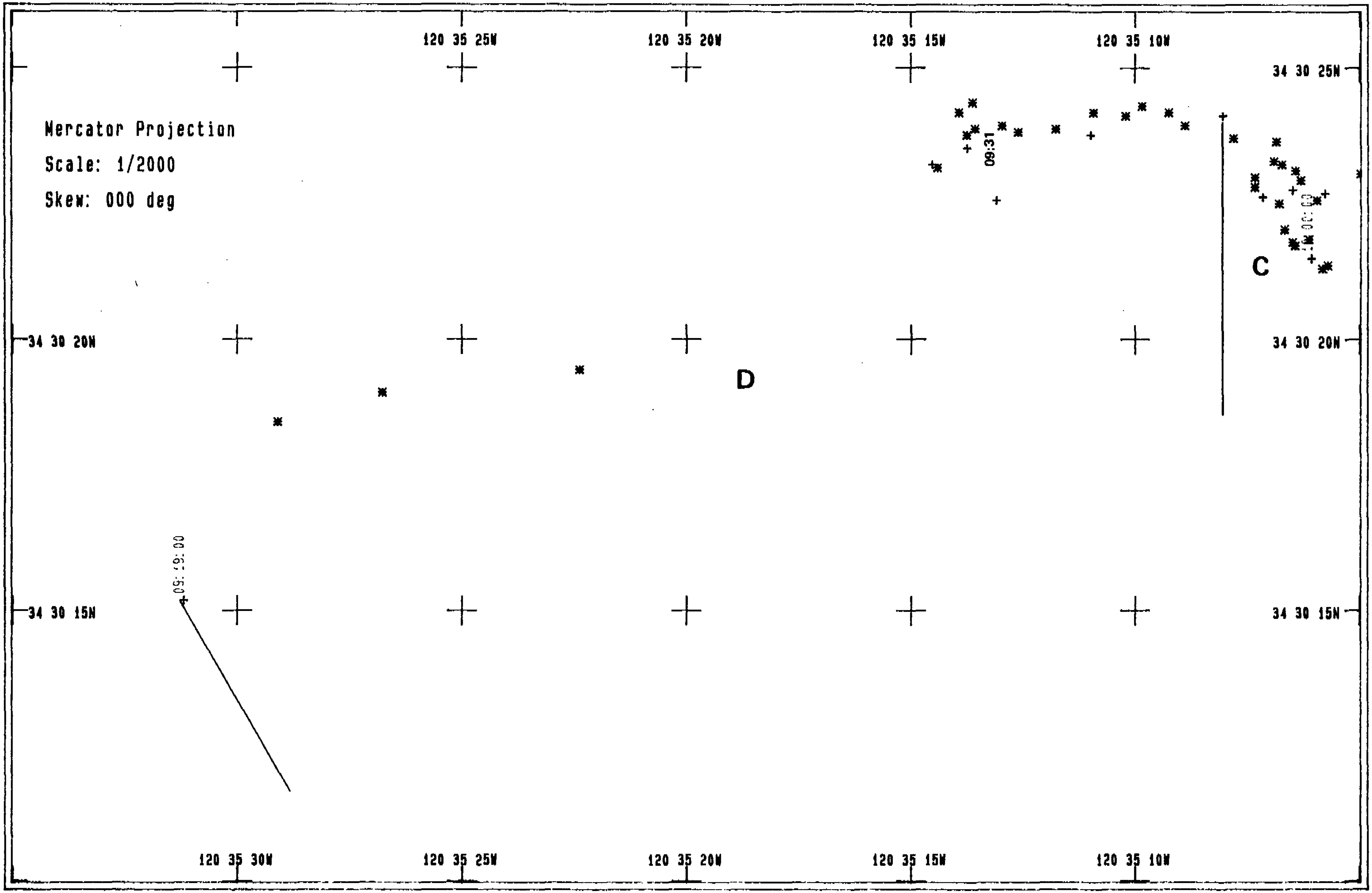
34 28 00N
34 28 05N
34 28 10N
Mercator Projection
Scale: 1/2000
Skew: 090 deg
LOPHELIA
MEDIUM RELIEF
120 40 20W
D
C/A
D
11:00:00
120 40 15W
MEDIUM RELIEF
R
R
C/A
120 40 10W
34 27 55N
34 28 00N
34 28 05N
34 28 10N

Dive 6A–D



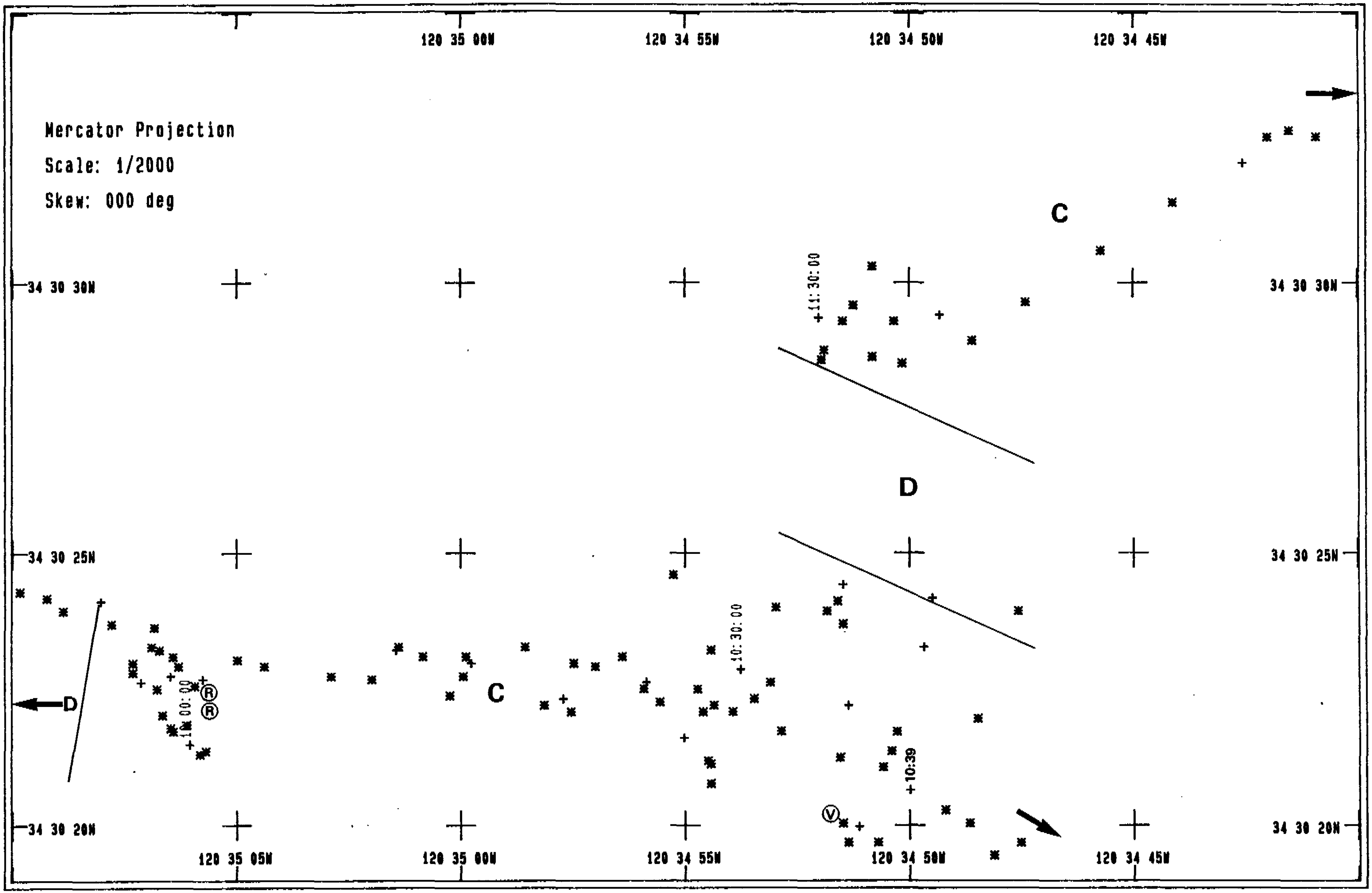
Mercator Projection
Scale: 1/12000
Skew: 000 deg
TIME DEPTH (FT)
0919 200
1000 205
1030 205
1100 210
1130 180
1200 180
1230 180
1231 180
RANGE: 180–210
120 36 00W
120 35 30W
120 35 00W
120 34 30W
120 34 00W
34 31 00N
34 30 30N
34 30 00N
09:19:00
S-B
H-B
M-B
11:30:00
12:00:01
12:30:00
12:31

Dive 6A-D(A)



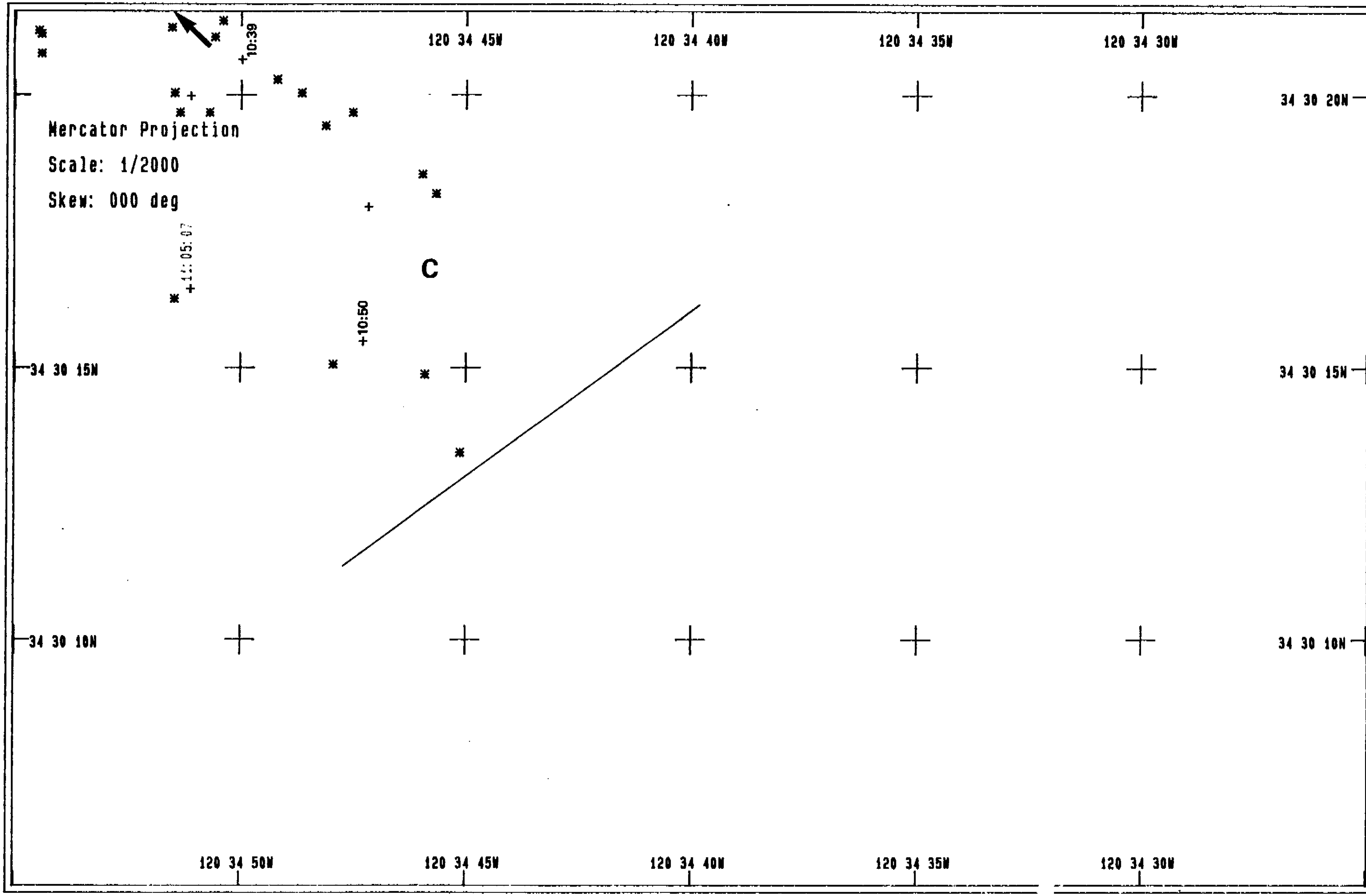
120 35 25W
120 35 20W
120 35 15W
120 35 10W
34 30 25N
Mercator Projection
Scale: 1/2000
Skew: 000 deg
09:31
C
34 30 20N
34 30 20N
D
34 30 15N
34 30 15N
120 35 30W
120 35 25W
120 35 20W
120 35 15W
120 35 10W

Dive 6A-D(B)



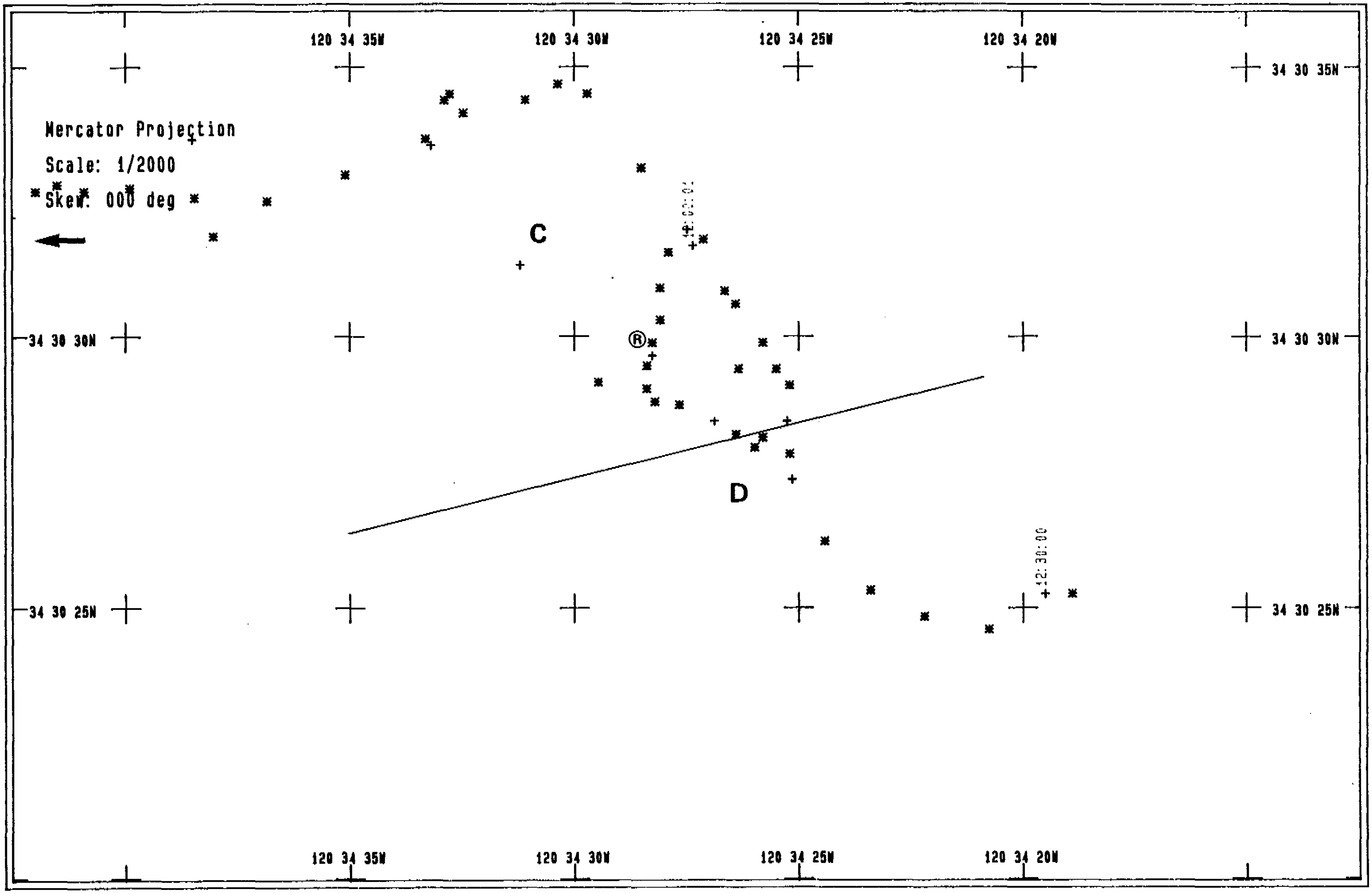
Mercator Projection
Scale: 1/2000
Skew: 000 deg
120 35 00W
120 34 55W
120 34 50W
120 34 45W
120 35 05W
34 30 30N
34 30 25N
34 30 20N
C
D
C
D
11:30:00
10:30:00
10:00:00
10:39
R
R
V

Dive 6A-D(C)



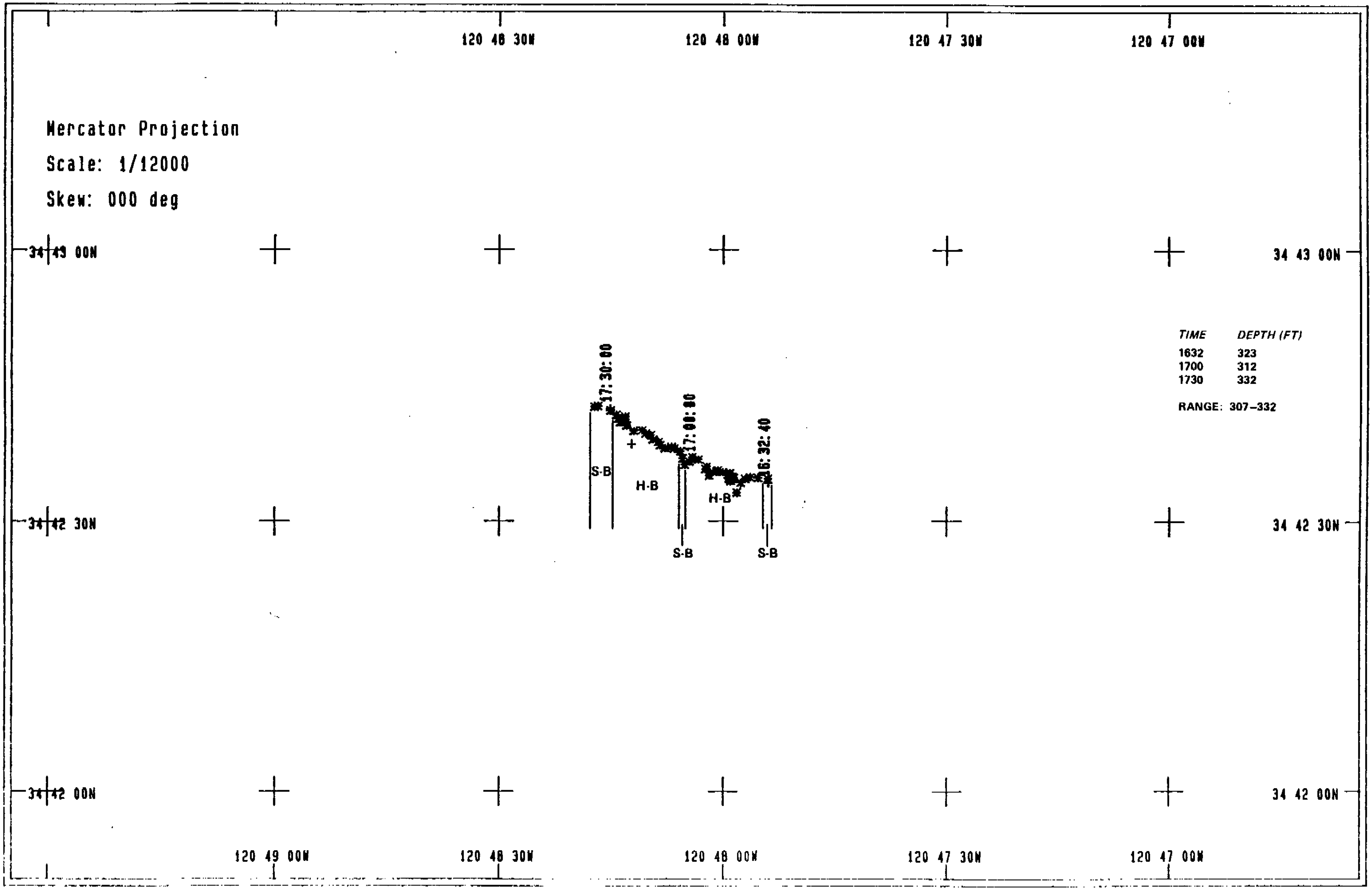
10:39
120 34 45W
120 34 40W
120 34 35W
120 34 30W
34 30 20N
Mercator Projection
Scale: 1/2000
Skew: 000 deg
11:05:07
C
+10:50
34 30 15N
34 30 15N
34 30 10N
34 30 10N
120 34 50W
120 34 45W
120 34 40W
120 34 35W
120 34 30W

Dive 6A-D(D)



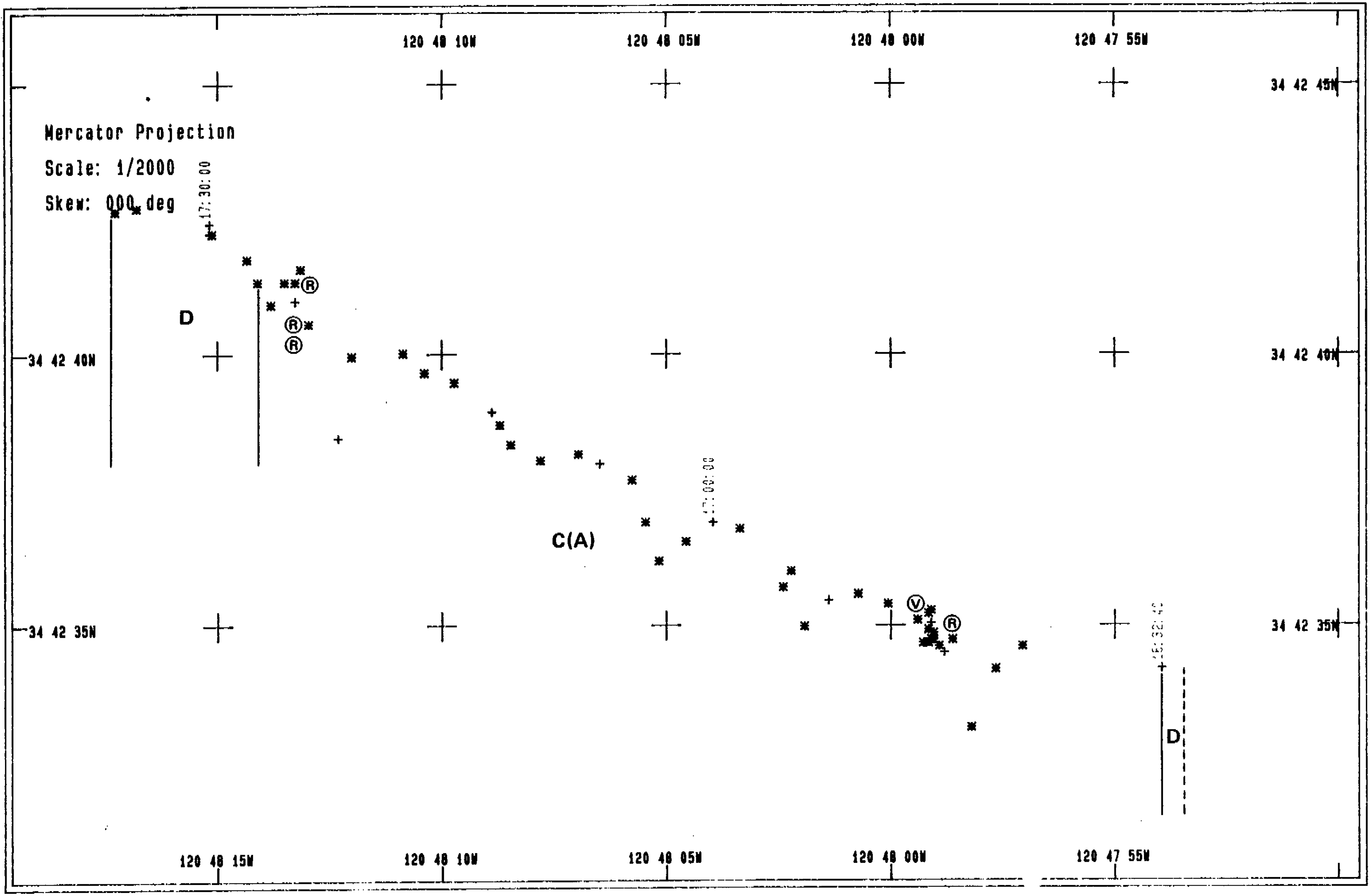
Mercator Projection
Scale: 1/2000
Skew: 000 deg
120 34 35W
120 34 30W
120 34 25W
120 34 20W
34 30 35N
34 30 30N
34 30 25N
C
D
12:30:00

Dive 13A-B



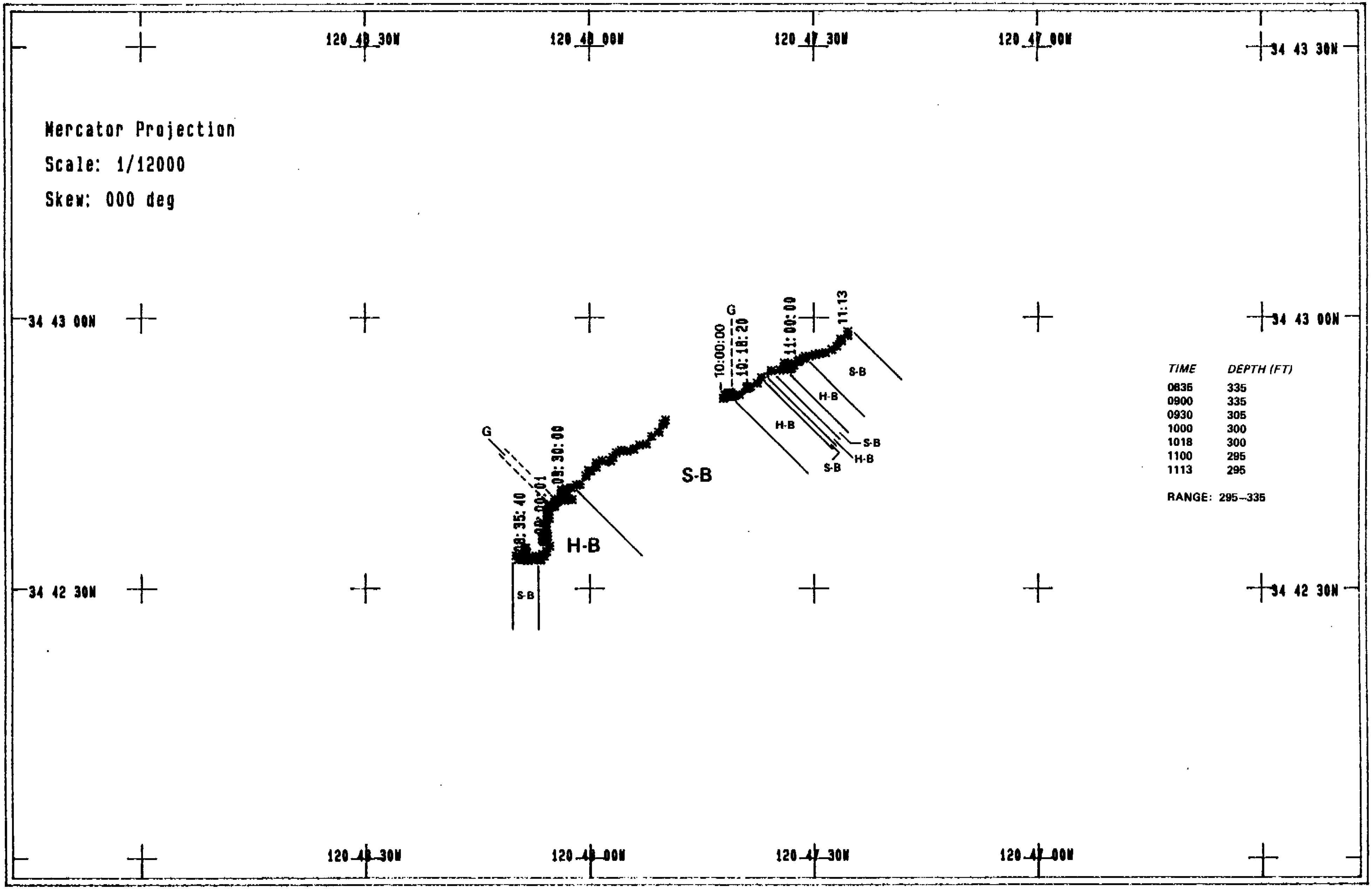
120 48 30W
120 48 00W
120 47 30W
120 47 00W
Mercator Projection
Scale: 1/12000
Skew: 000 deg
34 43 00N
34 42 30N
34 42 00N
120 49 00W
17:30:00
17:00:00
16:32:40
S-B
H-B
TIME DEPTH (FT)
1632 323
1700 312
1730 332
RANGE: 307–332

Dive 13A-B(A)

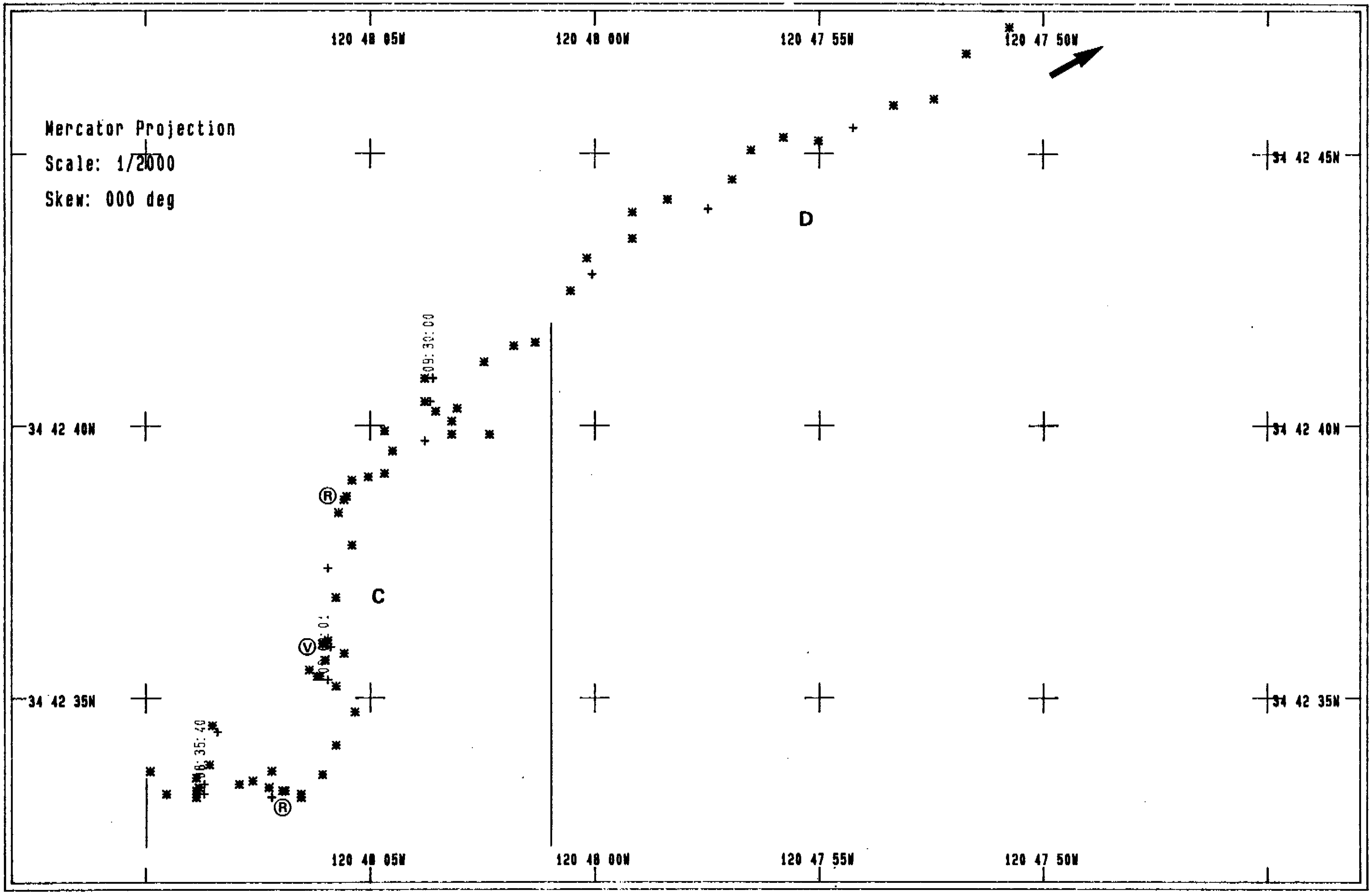


120 48 15W
120 48 10W
120 48 05W
120 48 00W
120 47 55W
34 42 45N
34 42 40N
34 42 35N
Mercator Projection
Scale: 1/2000
Skew: 000 deg
17:30:00
D
C(A)
D

Dive 13C-D

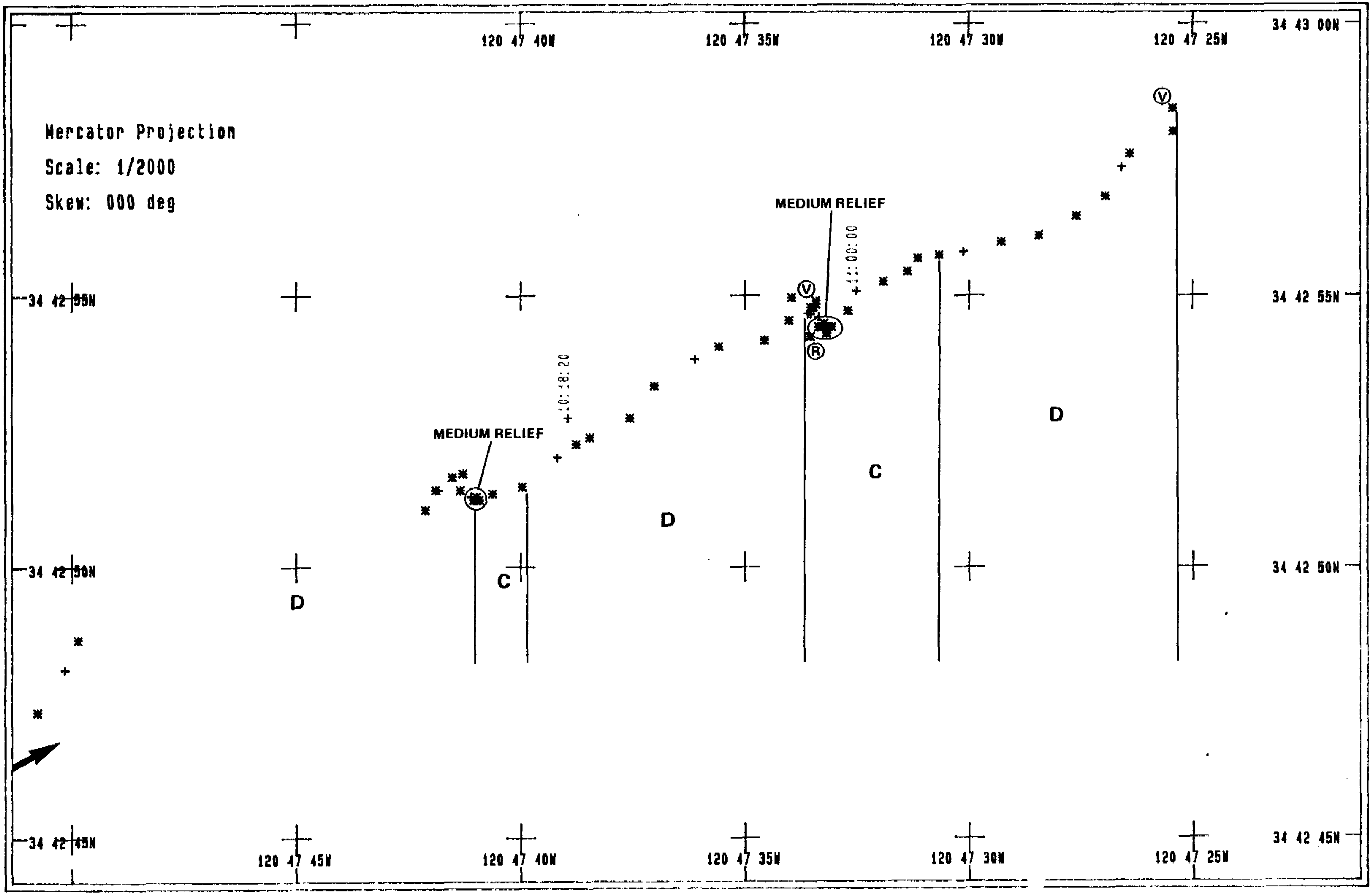

120 48 30W
120 48 00W
120 47 30W
120 47 00W
34 43 30N
34 43 00N
34 42 30N
Mercator Projection
Scale: 1/12000
Skew: 000 deg
G
10:00:00
10:18:20
11:00:00
11:13
08:35:40
09:00:01
09:30:00
S-B
H-B
TIME DEPTH (FT)
0835 335
0900 335
0930 305
1000 300
1018 300
1100 295
1113 295
RANGE: 295–335

Dive 13C-D(A)



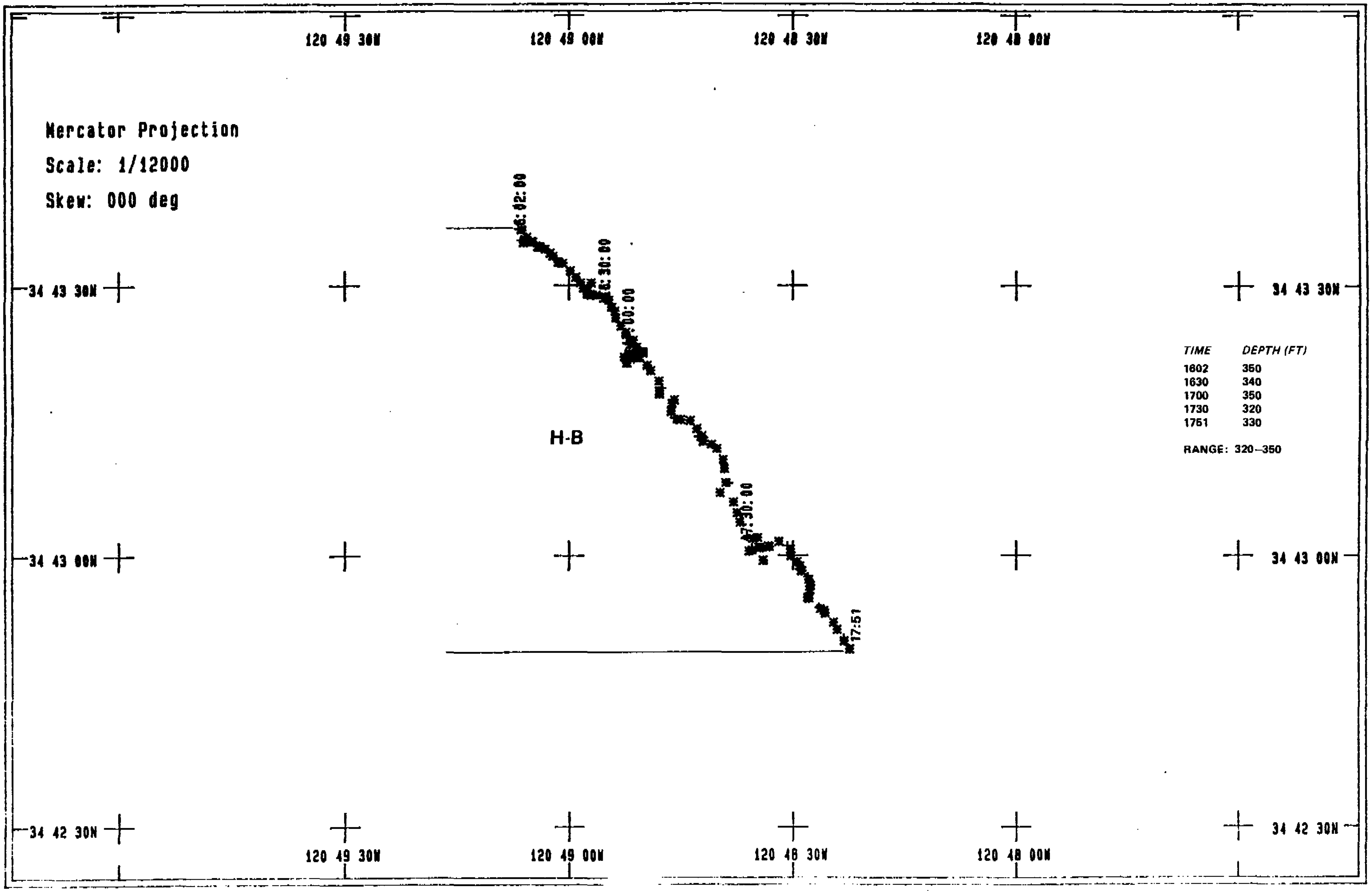
Mercator Projection
Scale: 1/2000
Skew: 000 deg
120 48 05W
120 48 00W
120 47 55W
120 47 50W
34 42 45N
34 42 40N
34 42 35N
09:30:00
06:35:40
D
C

Dive 13C-D(B)



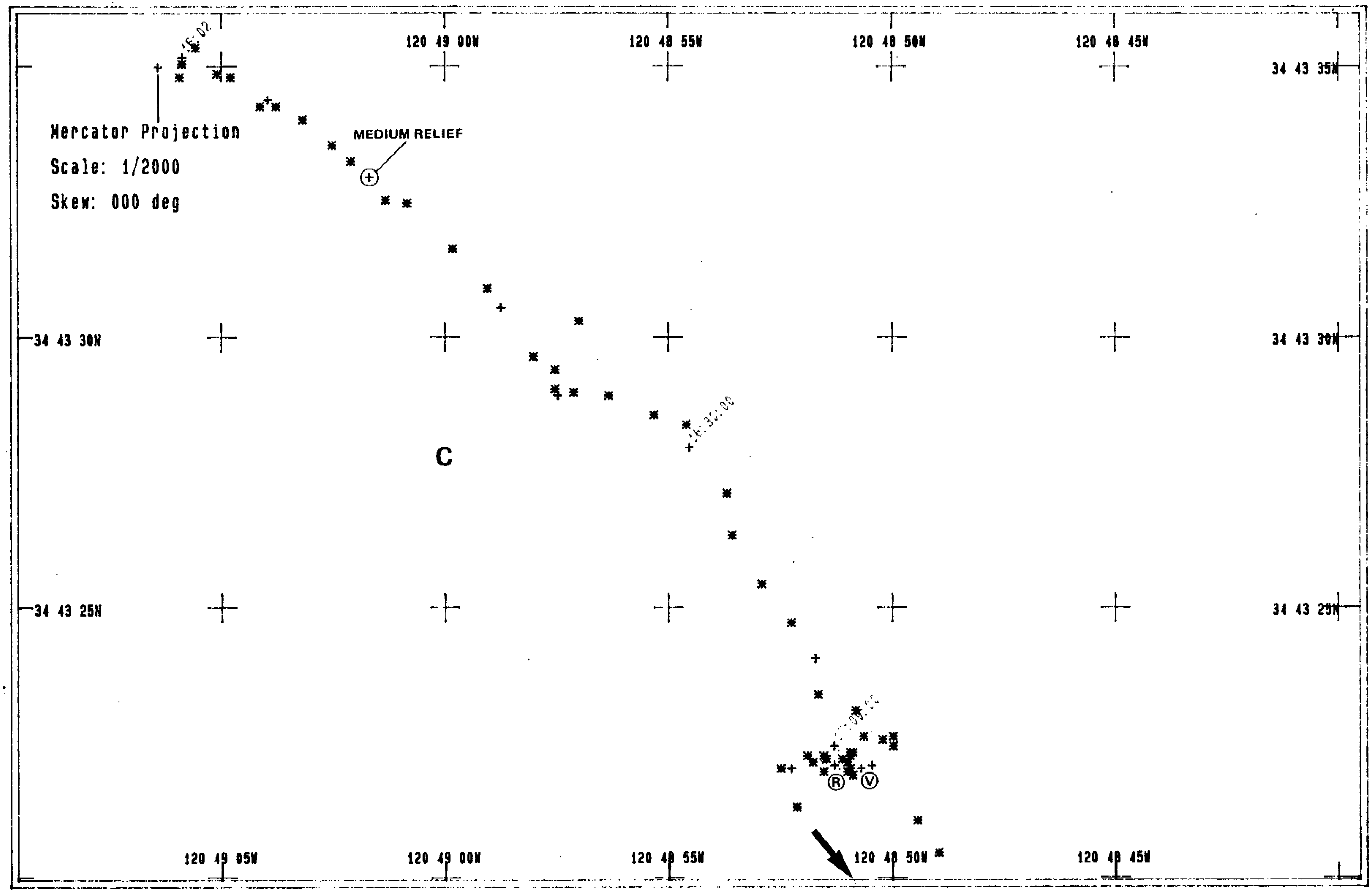
Mercator Projection
Scale: 1/2000
Skew: 000 deg
120 47 40W
120 47 35W
120 47 30W
120 47 25W
34 43 00N
34 42 55N
34 42 50N
34 42 45N
120 47 45W
MEDIUM RELIEF
MEDIUM RELIEF
11:00:00
10:48:20
D
C
D
C
D
D

Dive 14A-B



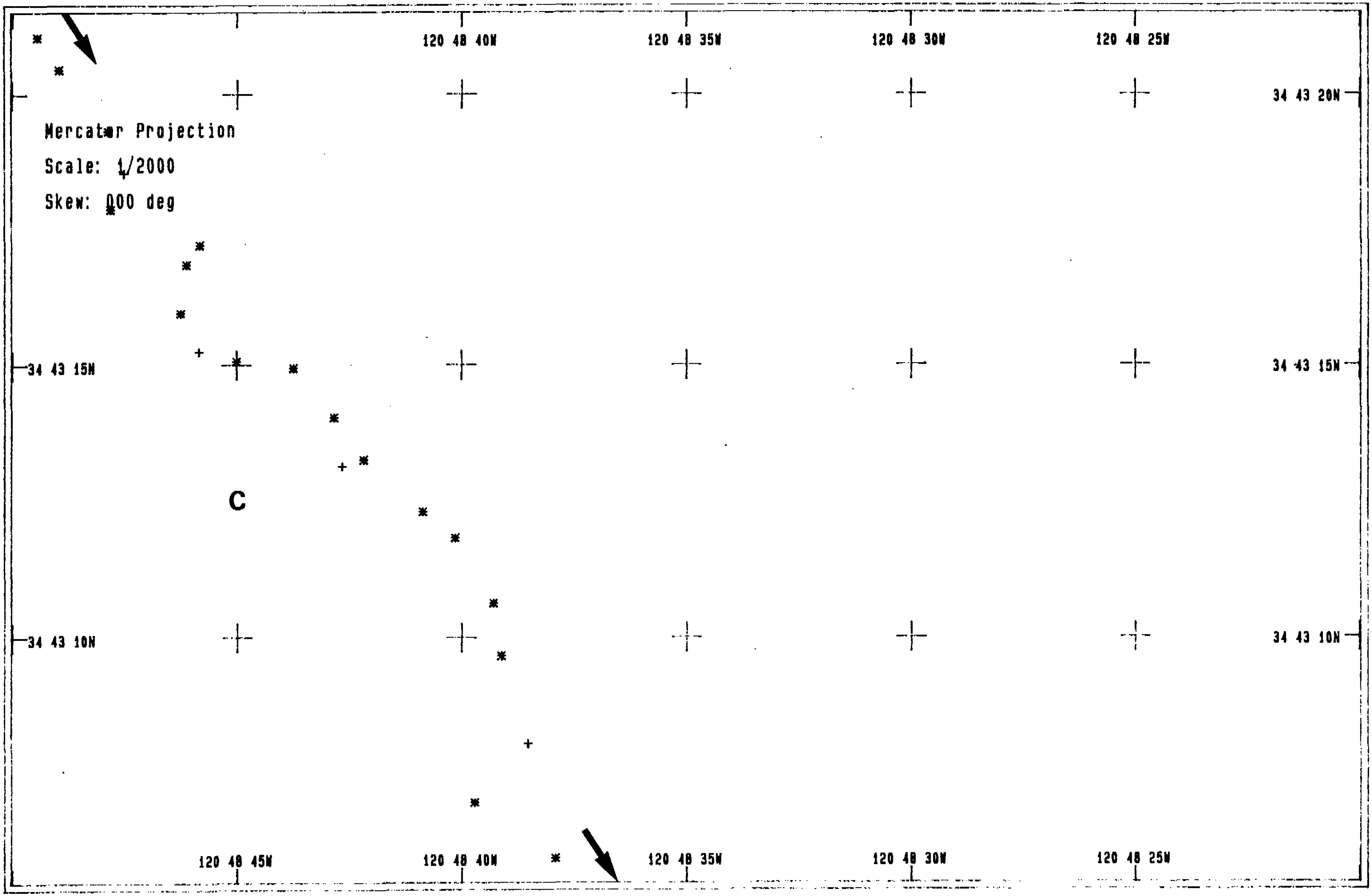
Mercator Projection
Scale: 1/12000
Skew: 000 deg
120 49 30W
120 49 00W
120 48 30W
120 48 00W
34 43 30N
34 43 00N
34 42 30N
H-B
16:02:00
16:30:00
17:00:00
17:30:00
17:51
TIME DEPTH (FT)
1602 350
1630 340
1700 350
1730 320
1751 330
RANGE: 320–350

Dive 14A-B(A)

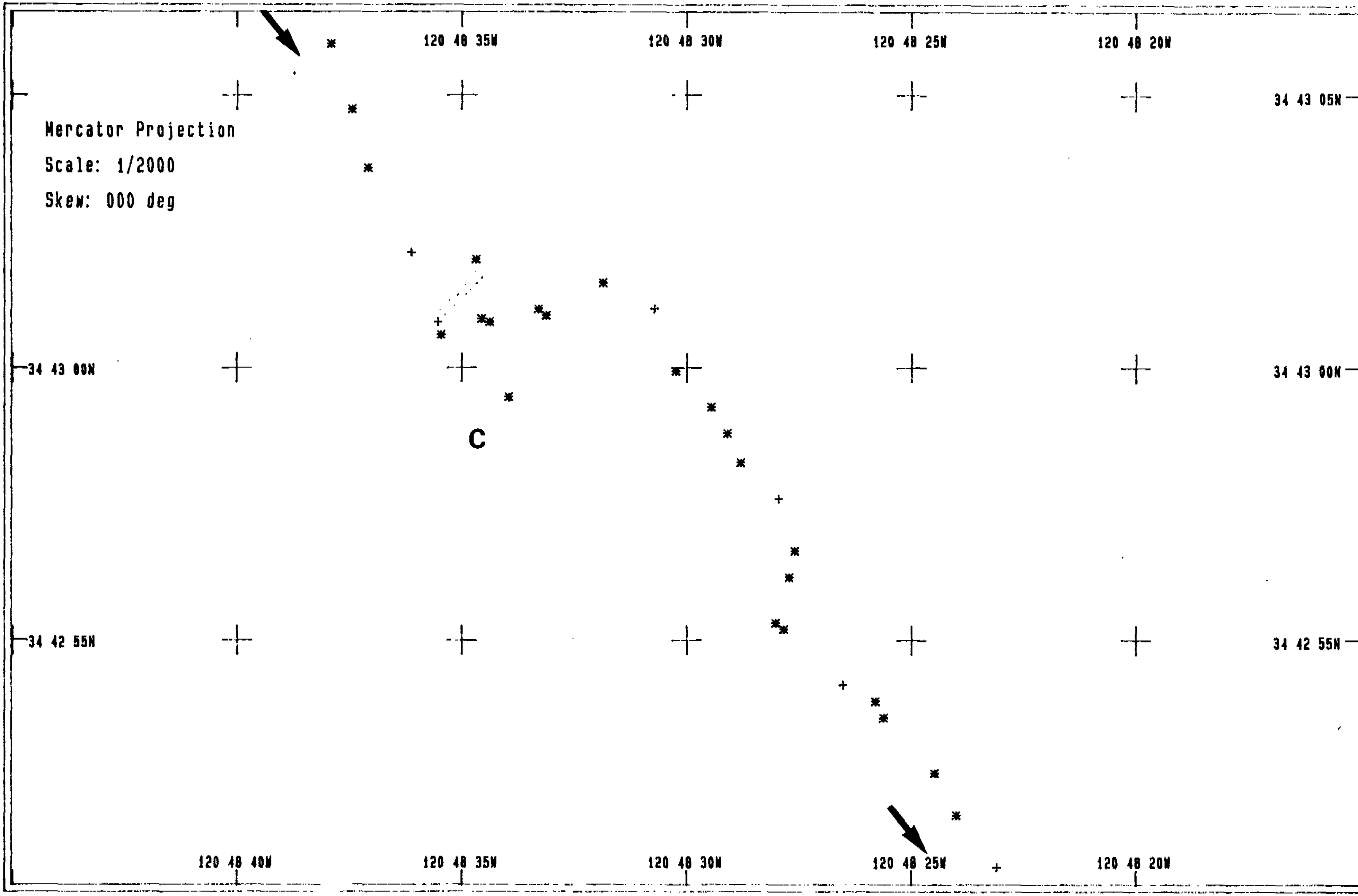


120 49 05W
120 49 00W
120 48 55W
120 48 50W
120 48 45W
34 43 35N
34 43 30N
34 43 25N
Mercator Projection
Scale: 1/2000
Skew: 000 deg
MEDIUM RELIEF
C
R
V

Dive 14A-B(B)

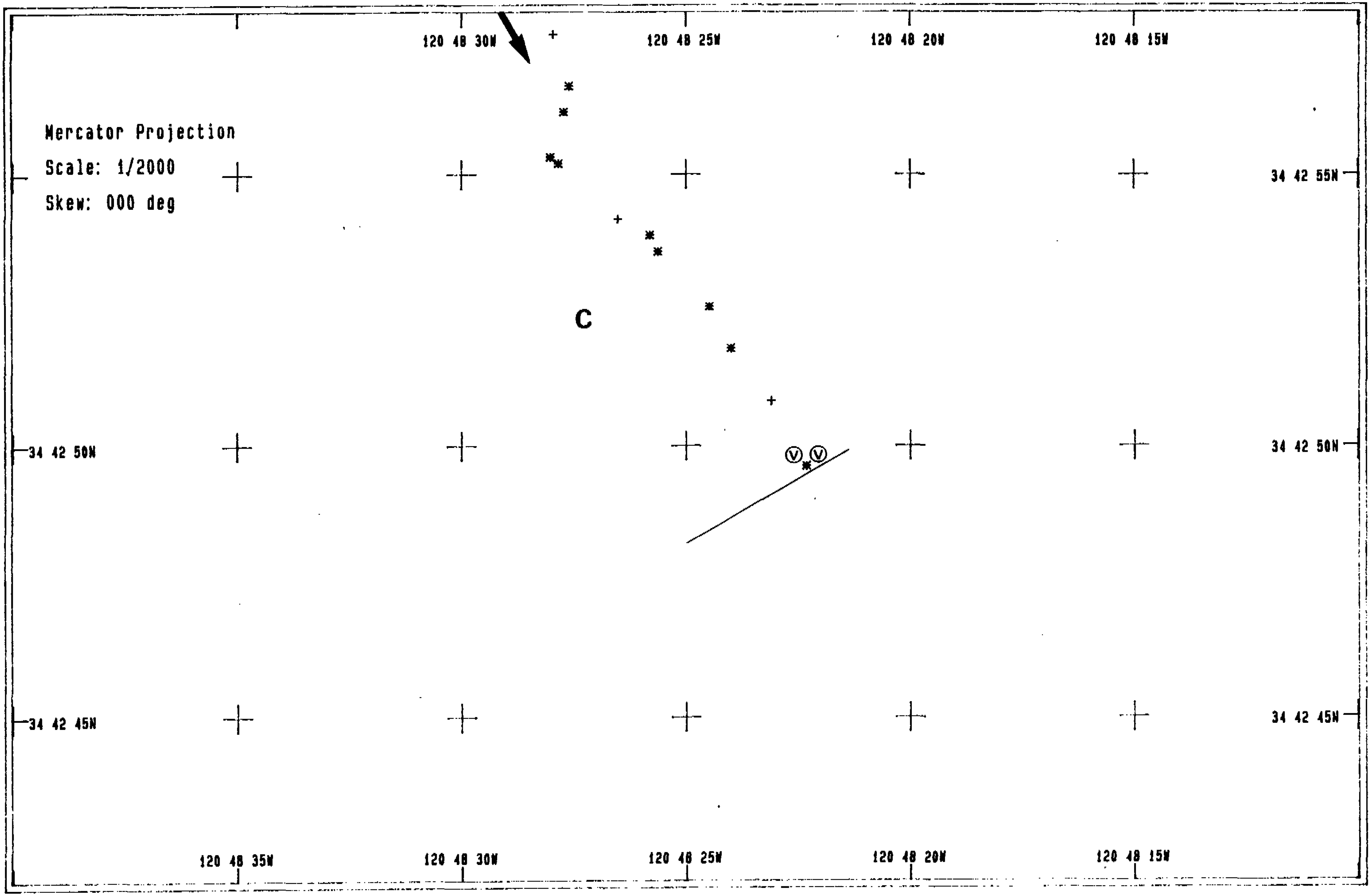

120 48 40W
120 48 35W
120 48 30W
120 48 25W
34 43 20N
Mercator Projection
Scale: 1/2000
Skew: 000 deg
34 43 15N
34 43 15N
C
34 43 10N
34 43 10N
120 48 45W
120 48 40W
120 48 35W
120 48 30W
120 48 25W

Dive 14A-B(C)

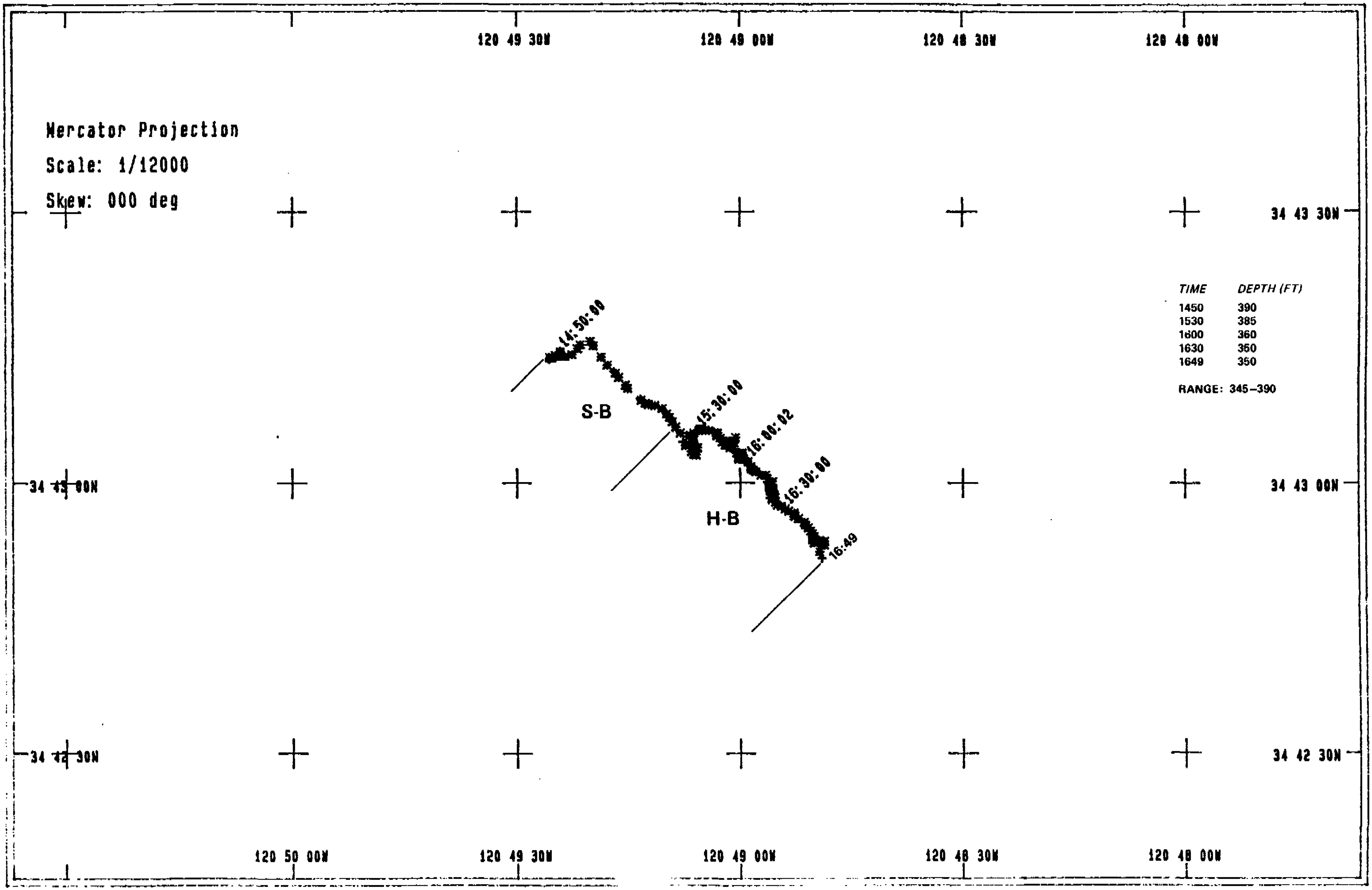


Mercator Projection
Scale: 1/2000
Skew: 000 deg
120 48 35W
120 48 30W
120 48 25W
120 48 20W
120 48 40W
34 43 05N
34 43 00N
34 42 55N
C

Dive 14A-B(D)

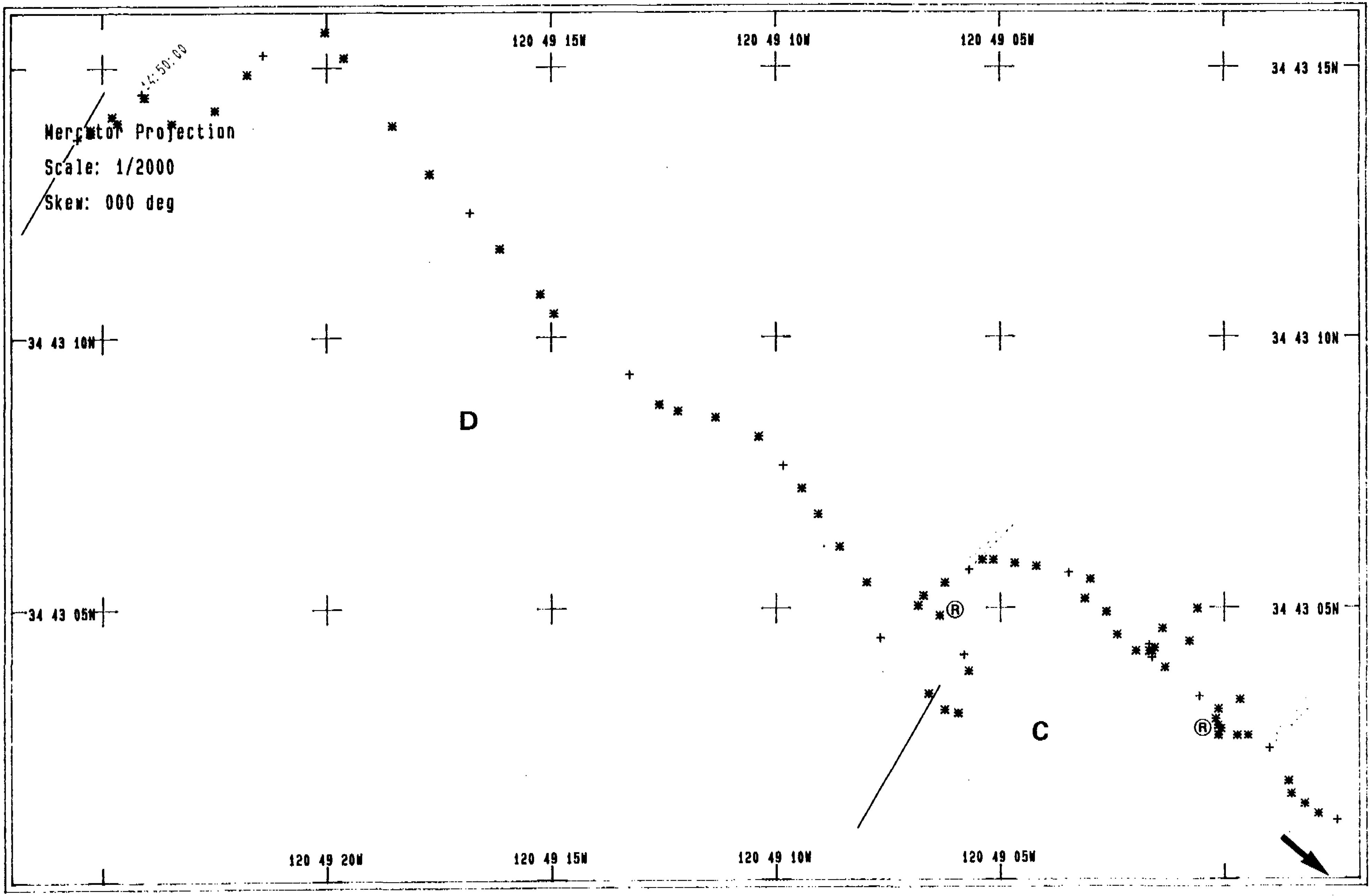

Mercator Projection
Scale: 1/2000
Skew: 000 deg
120 48 30W
120 48 25W
120 48 20W
120 48 15W
34 42 55N
34 42 50N
34 42 45N
C
120 48 35W

Dive 14D-C

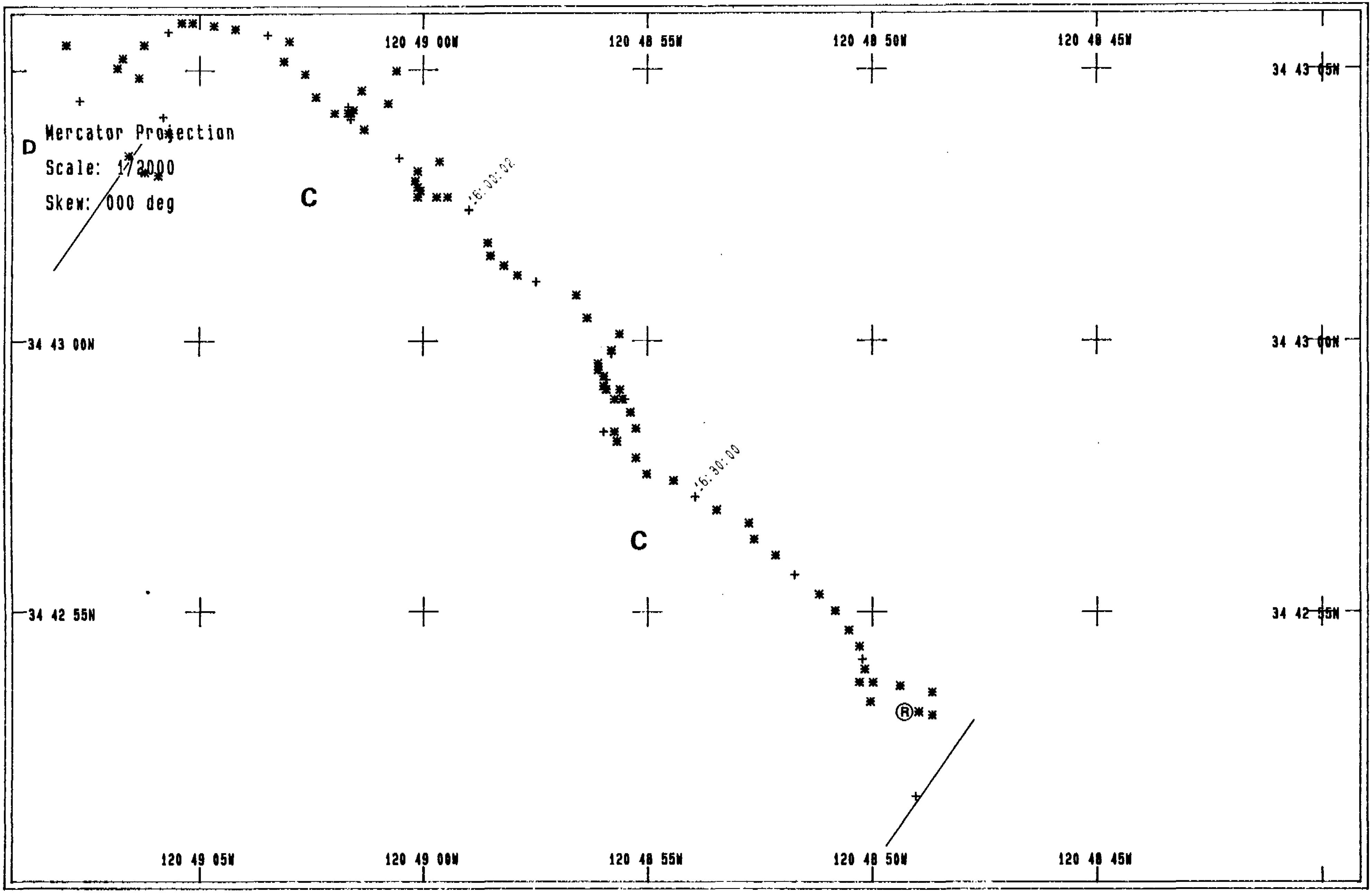


120 49 30W
120 49 00W
120 48 30W
120 48 00W
Mercator Projection
Scale: 1/12000
Skew: 000 deg
34 43 30N
34 43 00N
34 42 30N
14:50:00
15:30:00
16:00:02
16:30:00
16:49
S-B
H-B
TIME DEPTH (FT)
1450 390
1530 385
1600 360
1630 350
1649 350
RANGE: 345–390
120 50 00W

Dive 14D-C(A)

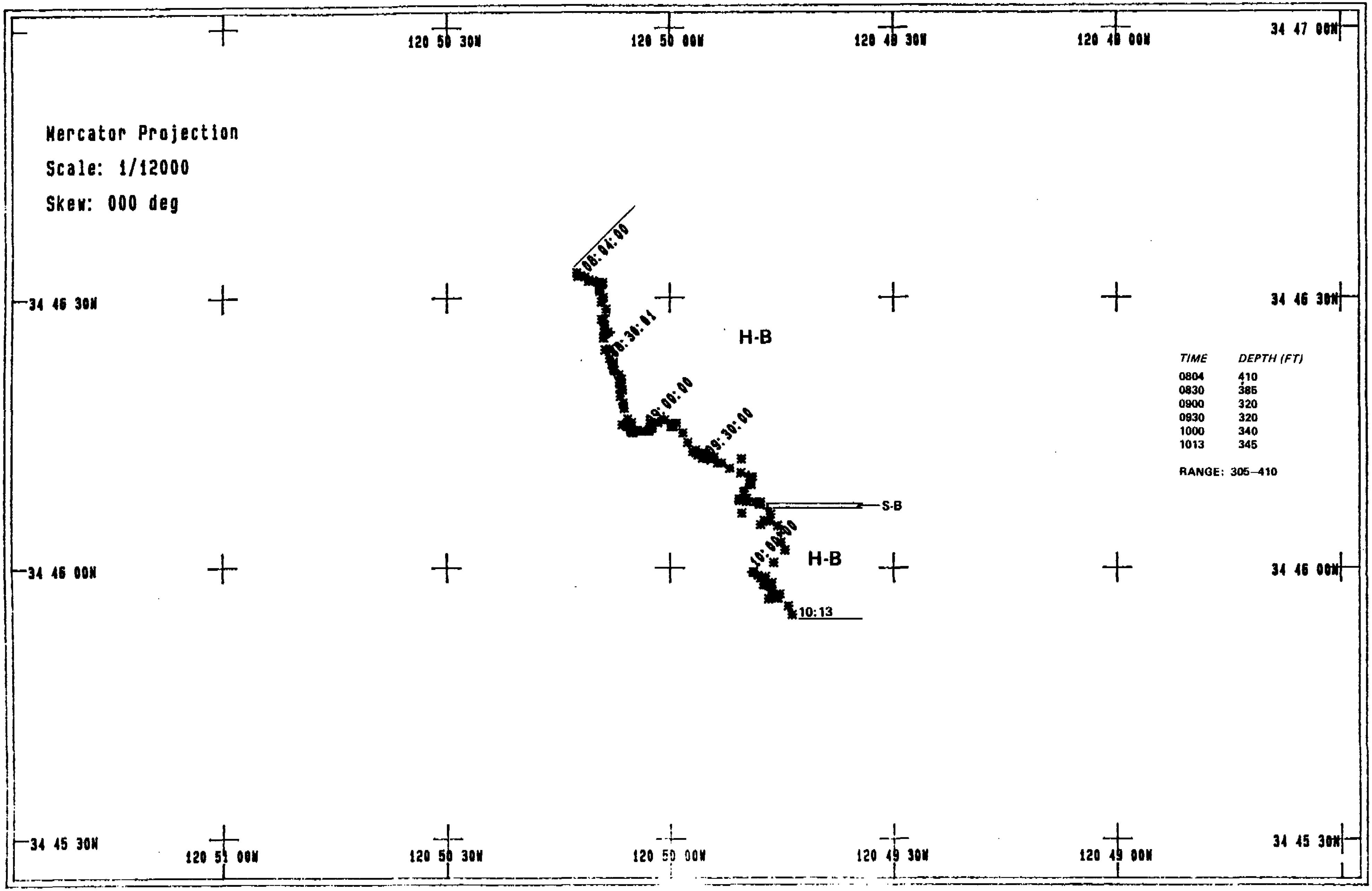

120 49 15W
120 49 10W
120 49 05W
34 43 15N
34 43 10N
34 43 05N
120 49 20W
14:50:00
Mercator Projection
Scale: 1/2000
Skew: 000 deg
D
C

Dive 14D-C(B)



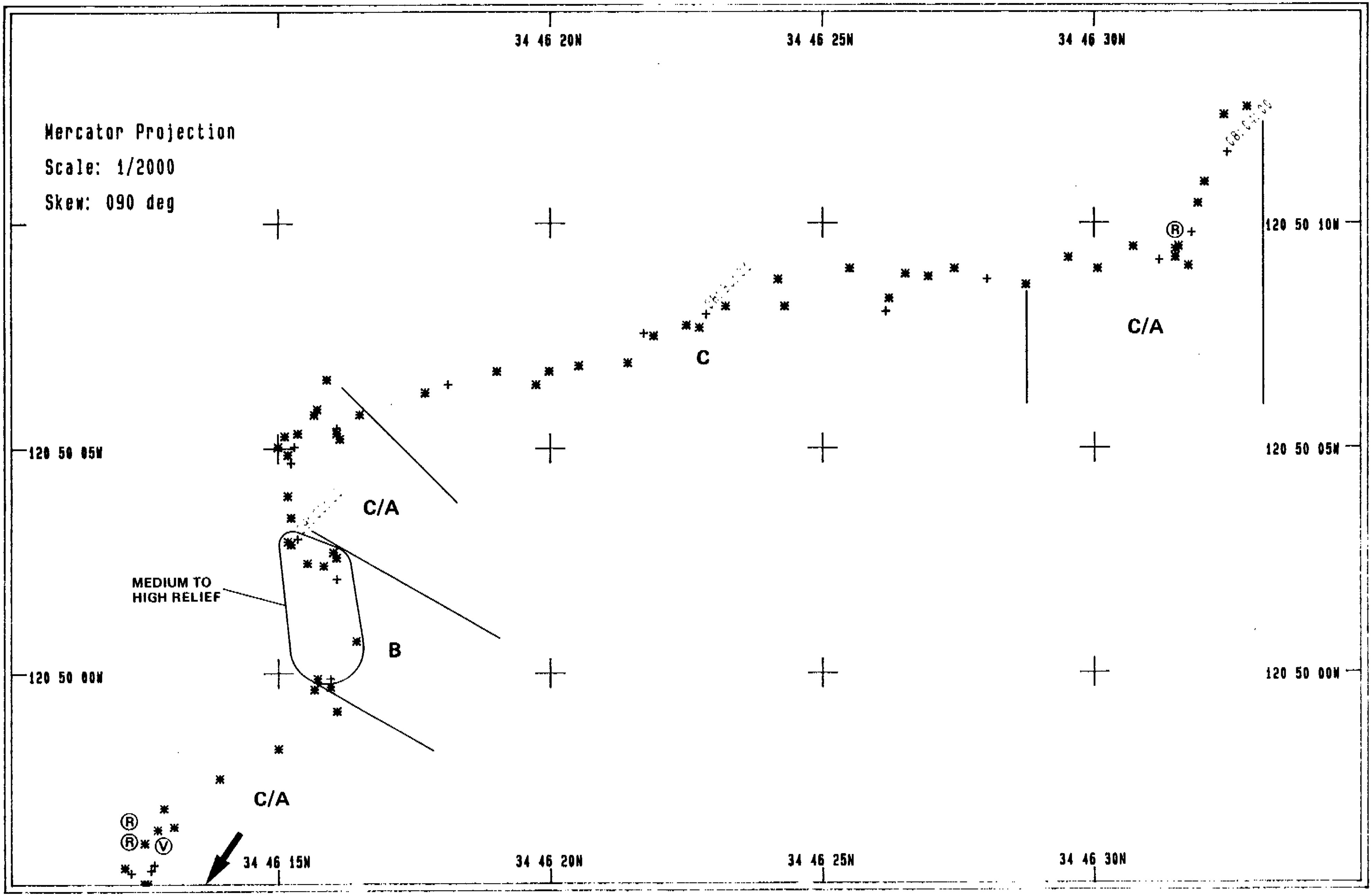
120 49 05W
120 49 00W
120 48 55W
120 48 50W
120 48 45W
34 43 05N
34 43 00N
34 42 55N
Mercator Projection
Scale: 1/2000
Skew: 000 deg
D
C
C
16:00:00
16:30:00

Dive 16A-B



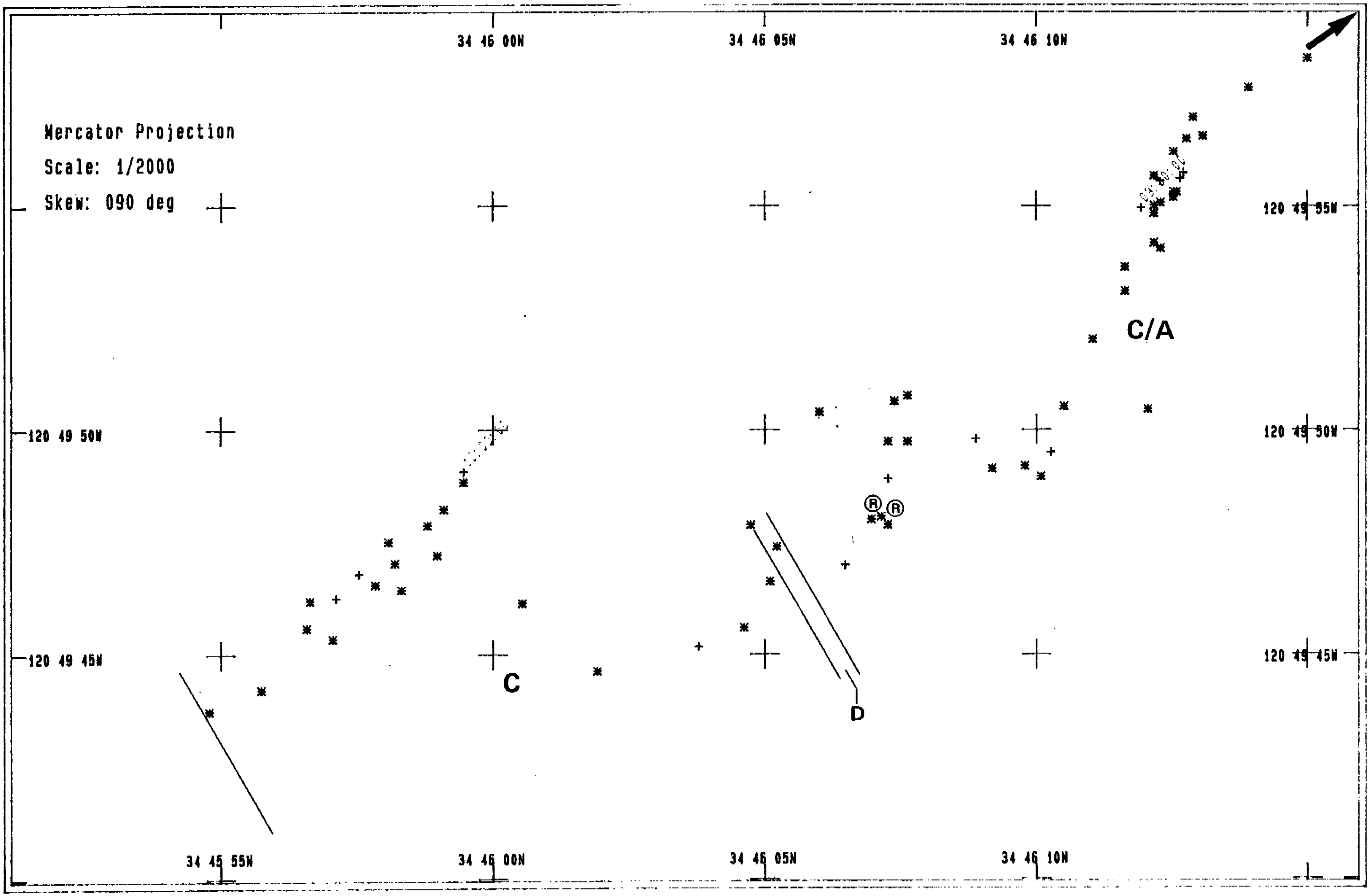
120 50 30W
120 50 00W
120 49 30W
120 49 00W
34 47 00N
Mercator Projection
Scale: 1/12000
Skew: 000 deg
08:04:00
08:30:01
09:00:00
09:30:00
10:00:00
10:13
H-B
S-B
H-B
34 46 30N
34 46 00N
34 45 30N
TIME DEPTH (FT)
0804 410
0830 385
0900 320
0930 320
1000 340
1013 345
RANGE: 305–410
120 51 00W

Dive 16A-B(A)

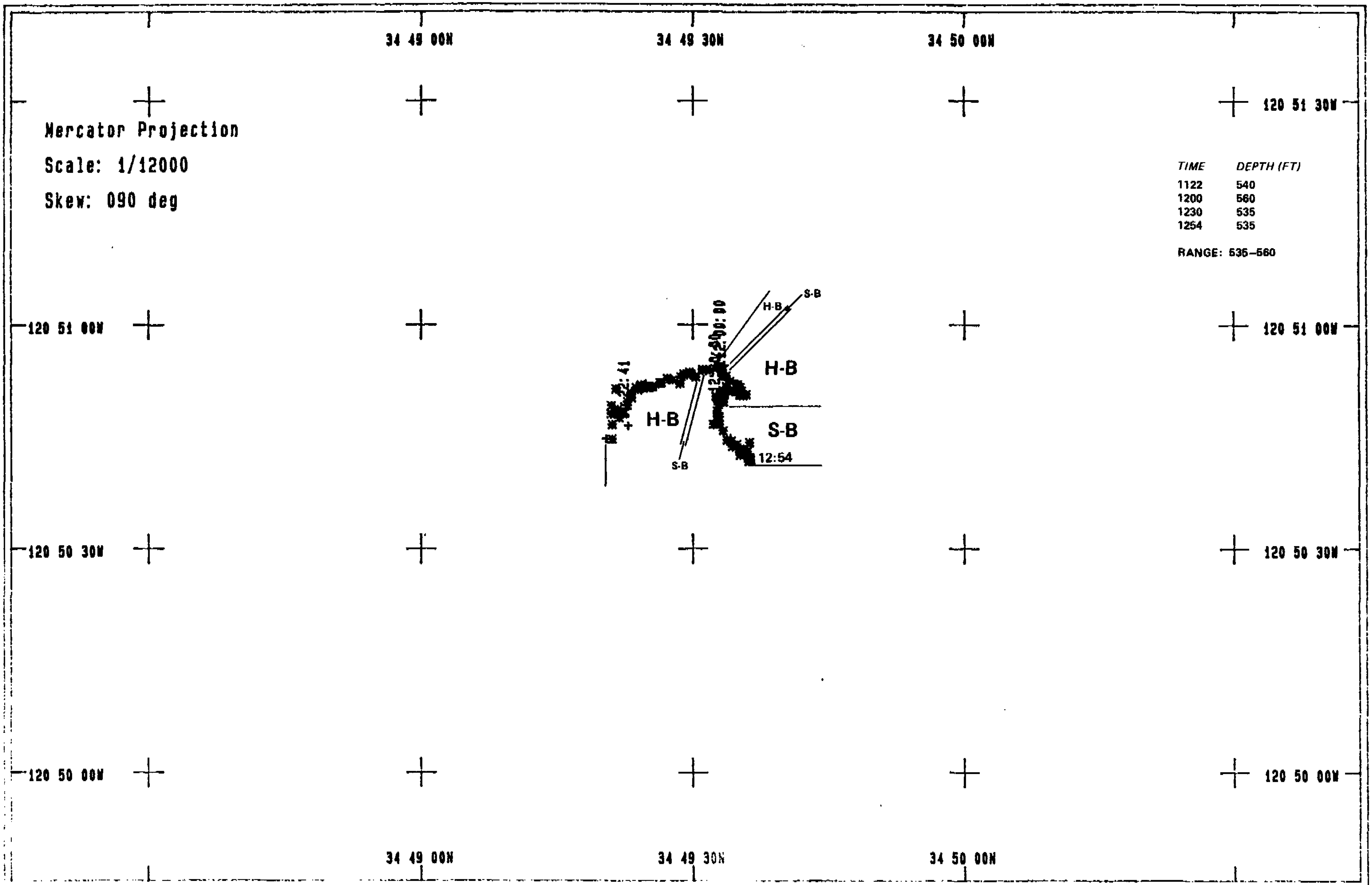


Mercator Projection
Scale: 1/2000
Skew: 090 deg
34 46 15N
34 46 20N
34 46 25N
34 46 30N
120 50 10W
120 50 05W
120 50 00W
C/A
C
B
MEDIUM TO HIGH RELIEF

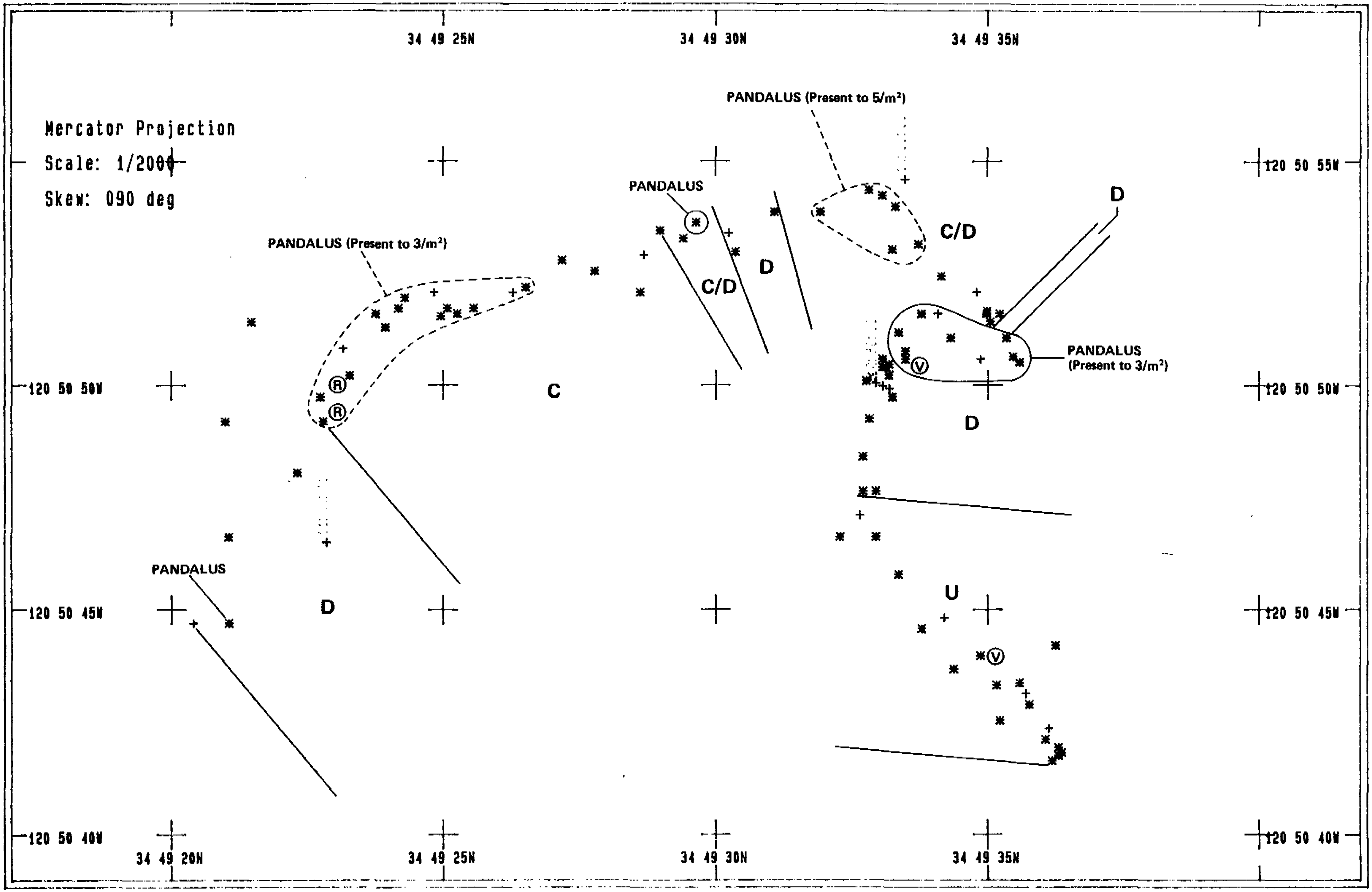
Dive 16A-B(B)


Mercator Projection
Scale: 1/2000
Skew: 090 deg
34 46 00N
34 46 05N
34 46 10N
34 45 55N
120 49 55N
120 49 50N
120 49 45N
C/A
C
D

Dive 17B-A

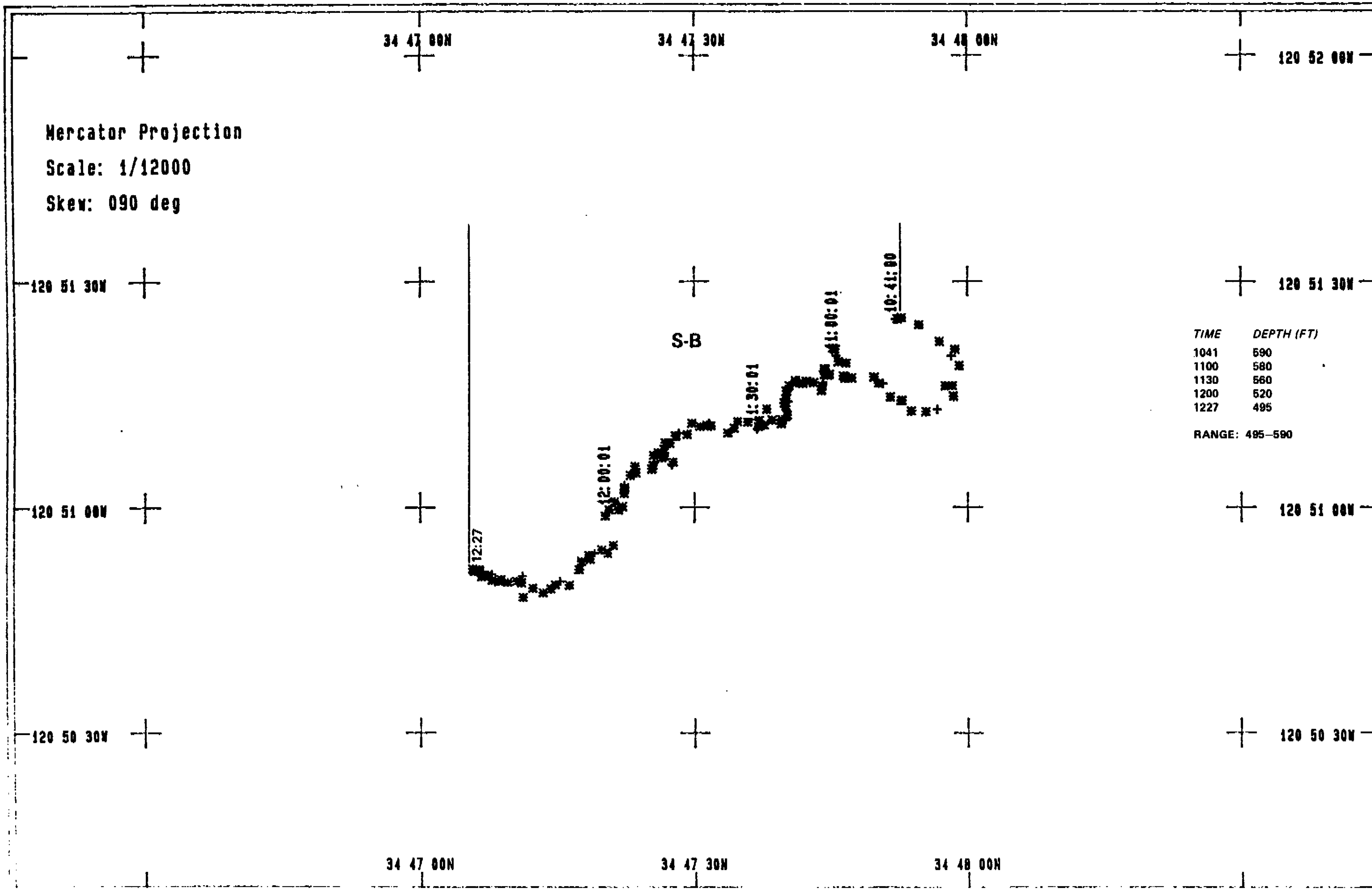

34 49 00N
34 49 30N
34 50 00N
120 51 30W
120 51 00W
120 50 30W
120 50 00W
Mercator Projection
Scale: 1/12000
Skew: 090 deg
TIME DEPTH (FT)
1122 540
1200 560
1230 535
1254 535
RANGE: 535–560
H-B
S-B
12:54

Dive 17B-A(A)



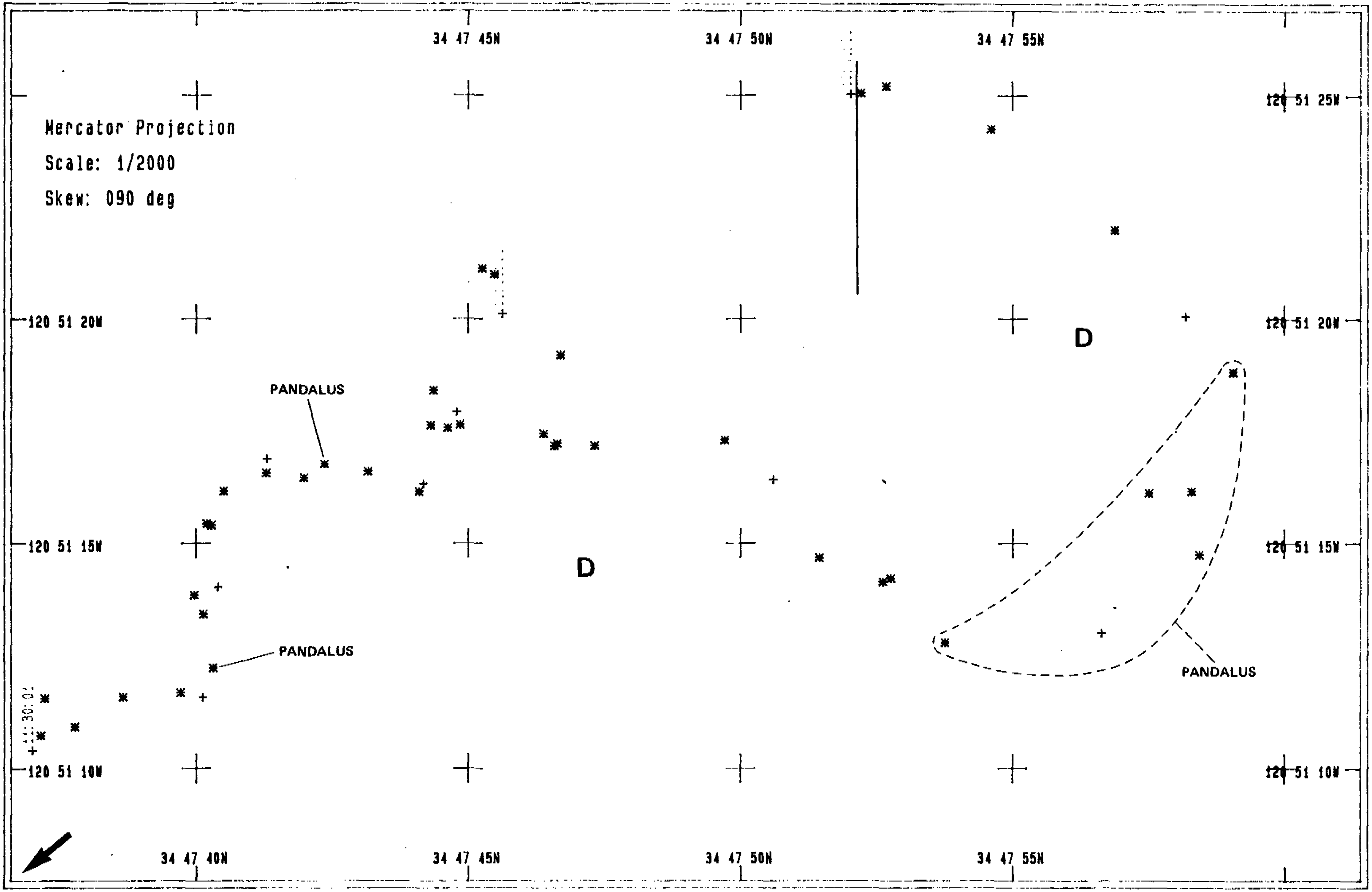
Mercator Projection
Scale: 1/2000
Skew: 090 deg
34 49 20N
34 49 25N
34 49 30N
34 49 35N
120 50 55W
120 50 50W
120 50 45W
120 50 40W
PANDALUS (Present to 3/m²)
PANDALUS
PANDALUS (Present to 5/m²)
PANDALUS (Present to 3/m²)
PANDALUS
C
C/D
D
C/D
D
D
D
U
R
R
V
V

Dive 19A-B



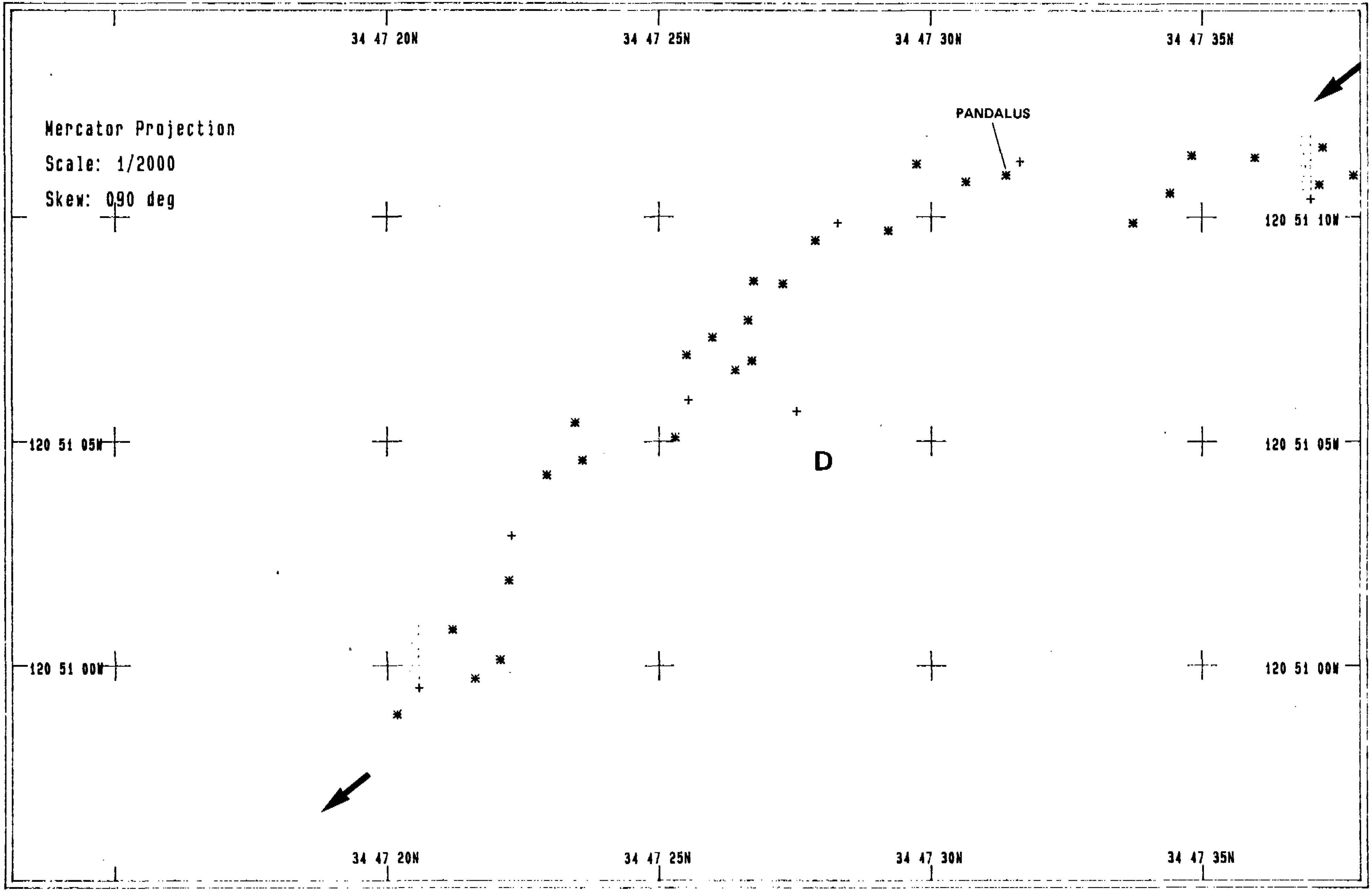
34 47 00N
34 47 30N
34 48 00N
120 52 00W
Mercator Projection
Scale: 1/12000
Skew: 090 deg
120 51 30W
120 51 00W
120 50 30W
S-B
12:27
12:00:01
11:30:01
11:00:01
10:41:00
TIME DEPTH (FT)
1041 590
1100 580
1130 560
1200 520
1227 495
RANGE: 495–590

Dive 19A-B(A)



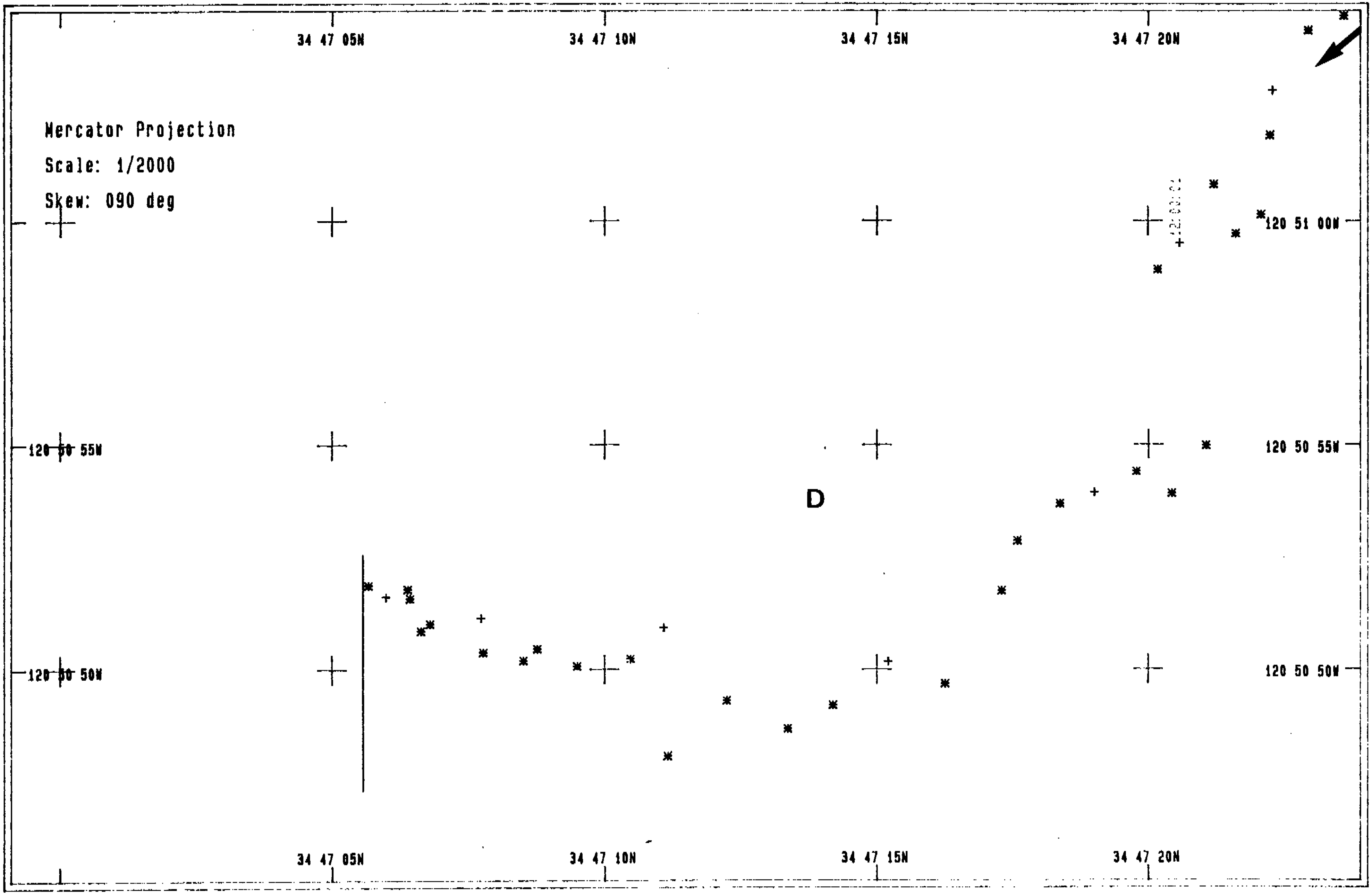
34 47 45N
34 47 50N
34 47 55N
Mercator Projection
Scale: 1/2000
Skew: 090 deg
120 51 25W
120 51 20W
120 51 15W
120 51 10W
D
D
PANDALUS
PANDALUS
PANDALUS
34 47 40N
34 47 45N
34 47 50N
34 47 55N

Dive 19A-B(B)

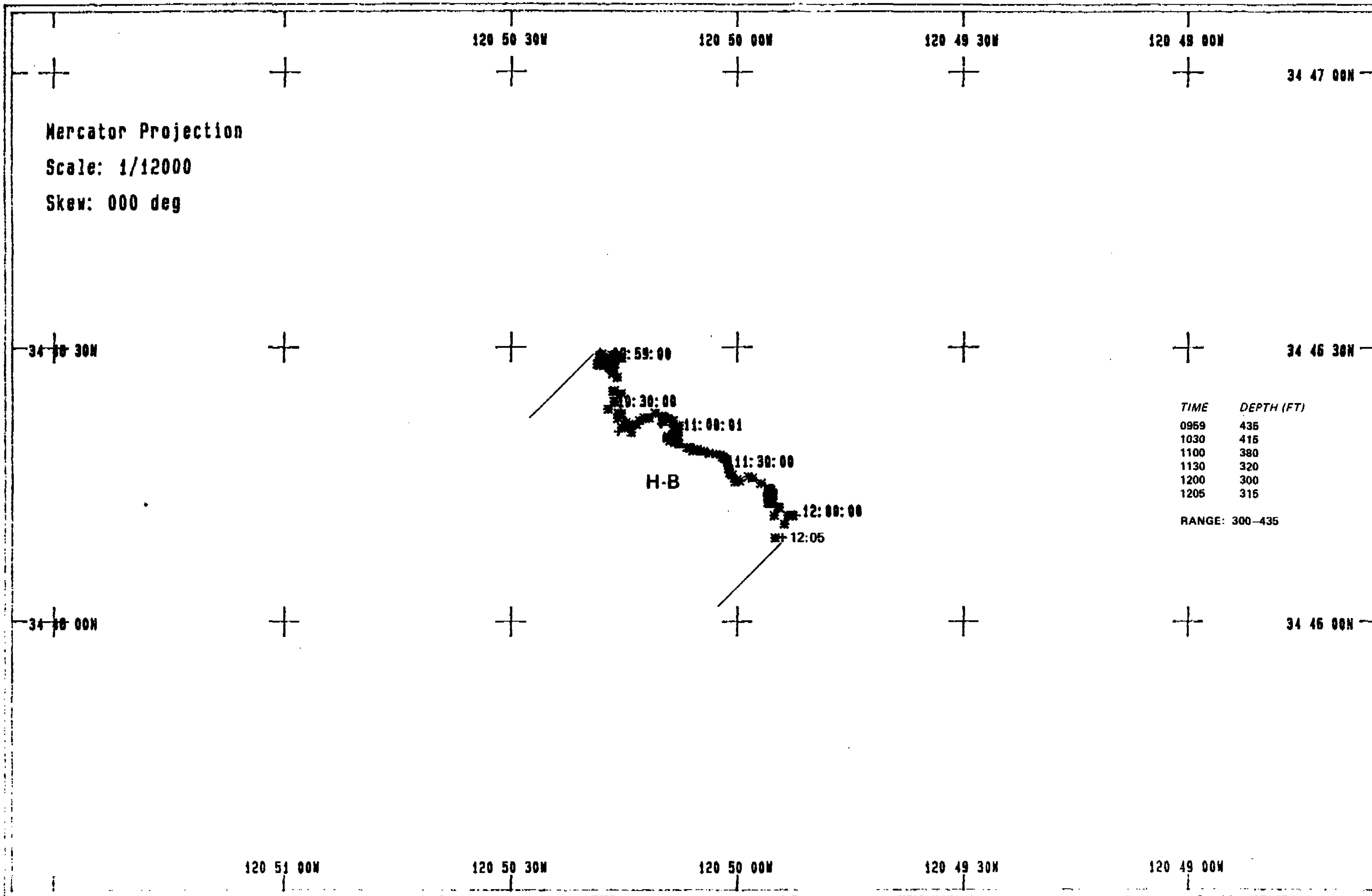


34 47 20N
34 47 25N
34 47 30N
34 47 35N
Mercator Projection
Scale: 1/2000
Skew: 090 deg
PANDALUS
120 51 10W
120 51 05W
120 51 00W
D

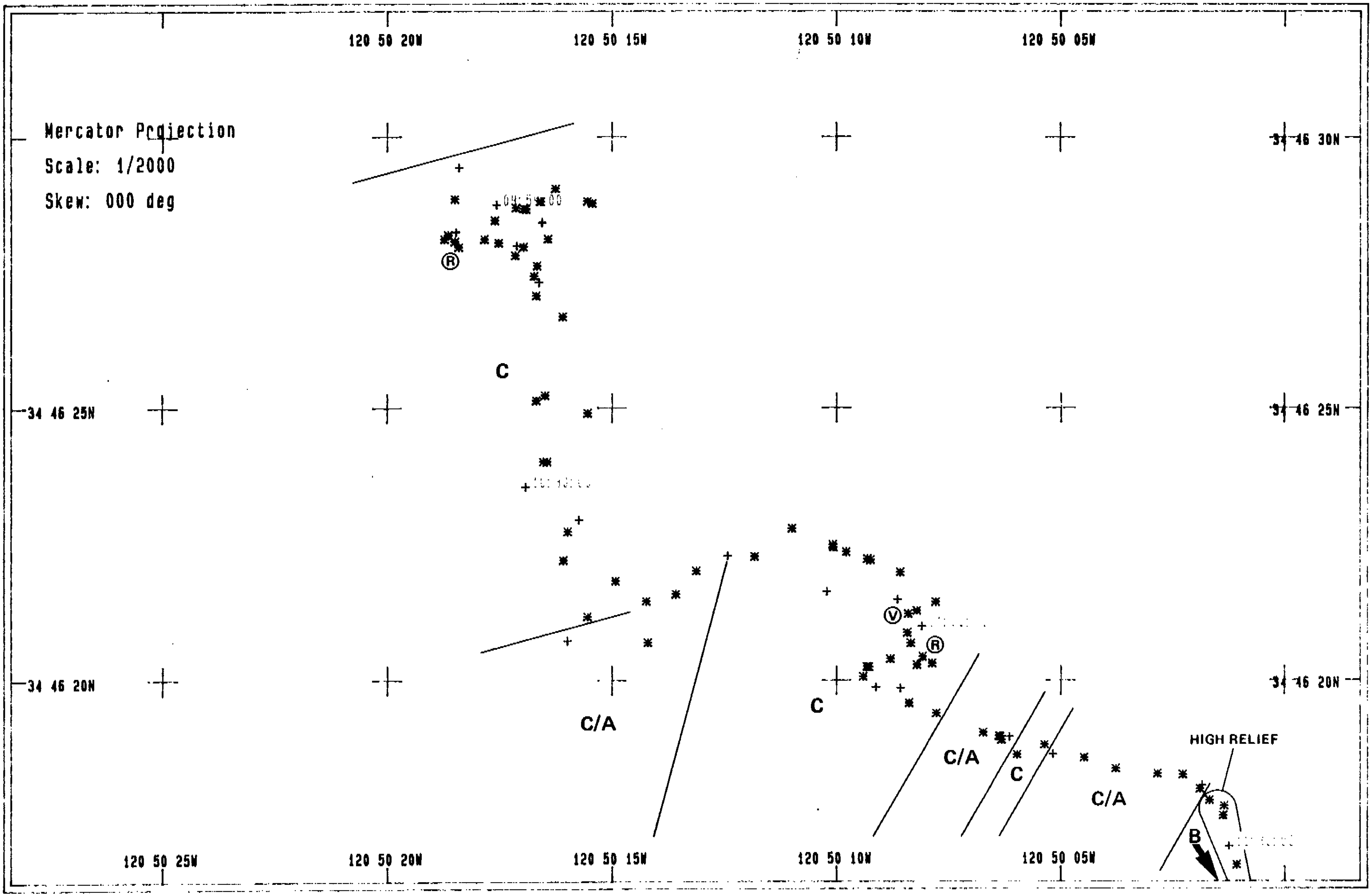
Dive 19A-B(C)


34 47 05N
34 47 10N
34 47 15N
34 47 20N
Mercator Projection
Scale: 1/2000
Skew: 090 deg
120 51 00W
120 50 55W
120 50 50W
D

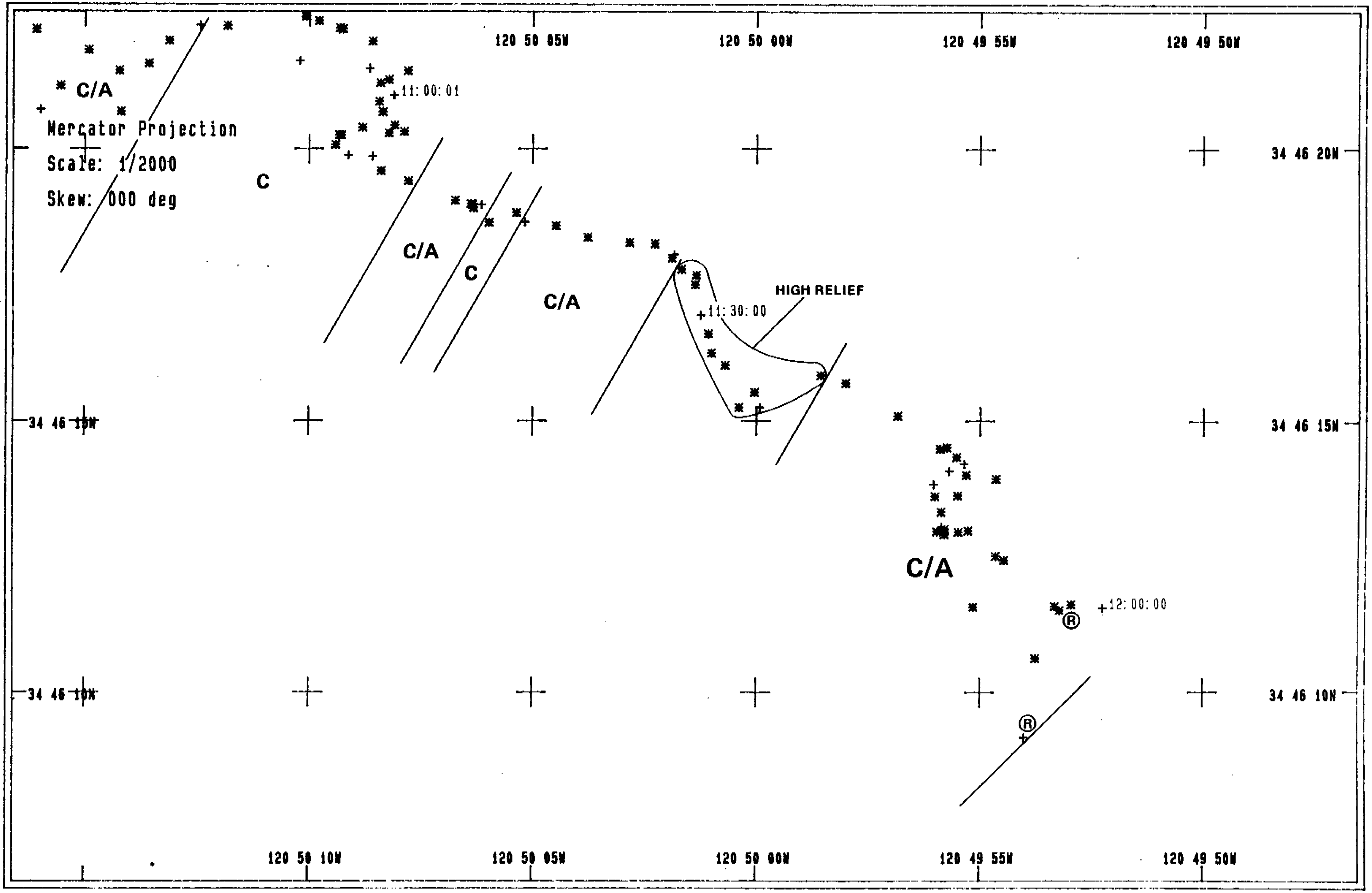
Dive 20A-B


120 50 30W
120 50 00W
120 49 30W
120 49 00W
34 47 00N
Mercator Projection
Scale: 1/12000
Skew: 000 deg
34 46 30N
34 46 00N
:59:00
0:30:00
11:00:01
11:30:00
H-B
12:00:00
12:05
TIME DEPTH (FT)
0959 435
1030 415
1100 380
1130 320
1200 300
1205 315
RANGE: 300–435
120 51 00W
120 50 30W
120 50 00W
120 49 30W
120 49 00W

Dive 20A-B(A)

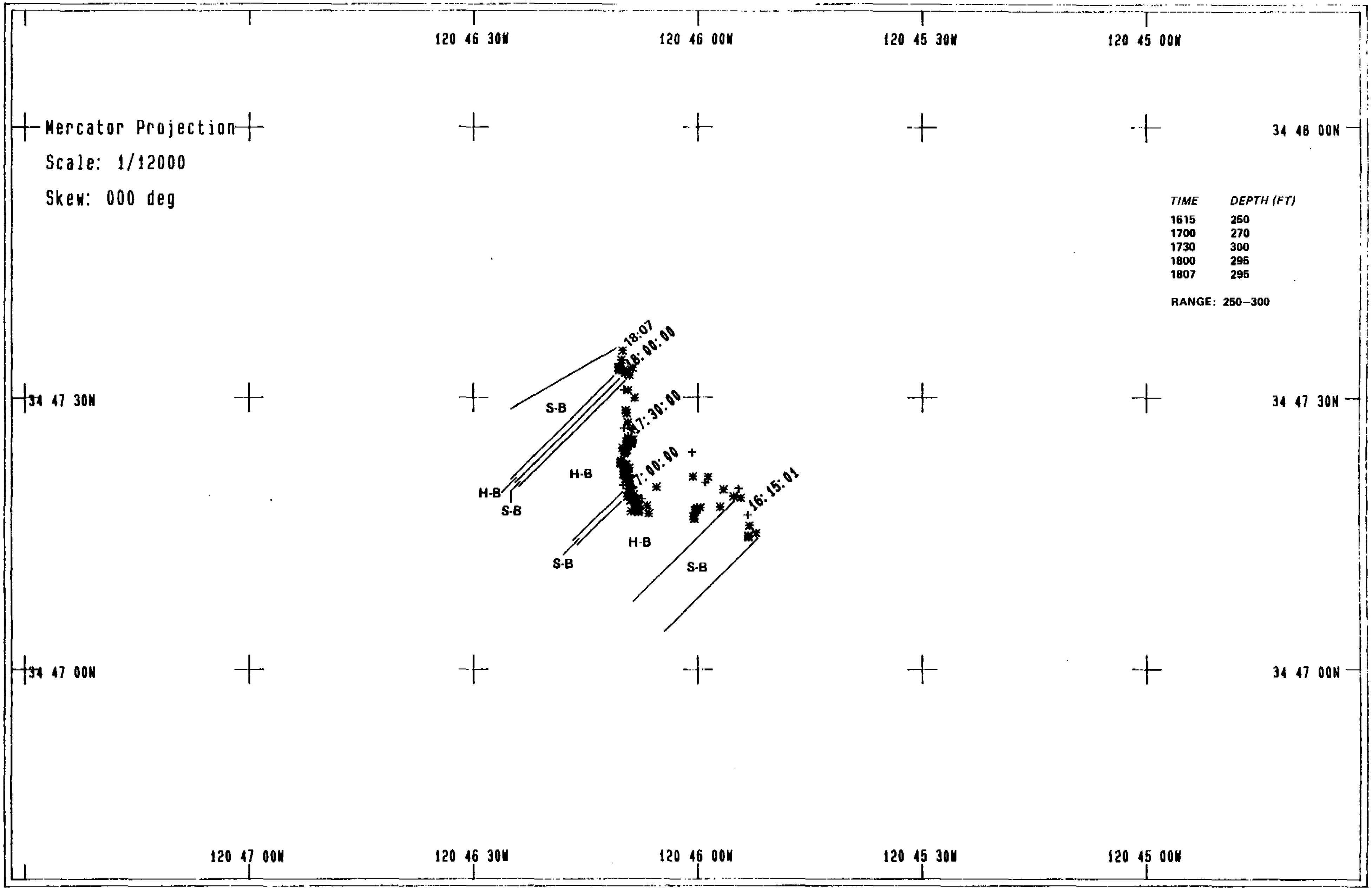

120 50 20W
120 50 15W
120 50 10W
120 50 05W
Mercator Projection
Scale: 1/2000
Skew: 000 deg
34 46 30N
34 46 25N
34 46 20N
C
C/A
C
C/A
C
C/A
HIGH RELIEF
B
120 50 25W
120 50 20W
120 50 15W
120 50 10W
120 50 05W

Dive 20A-B(B)



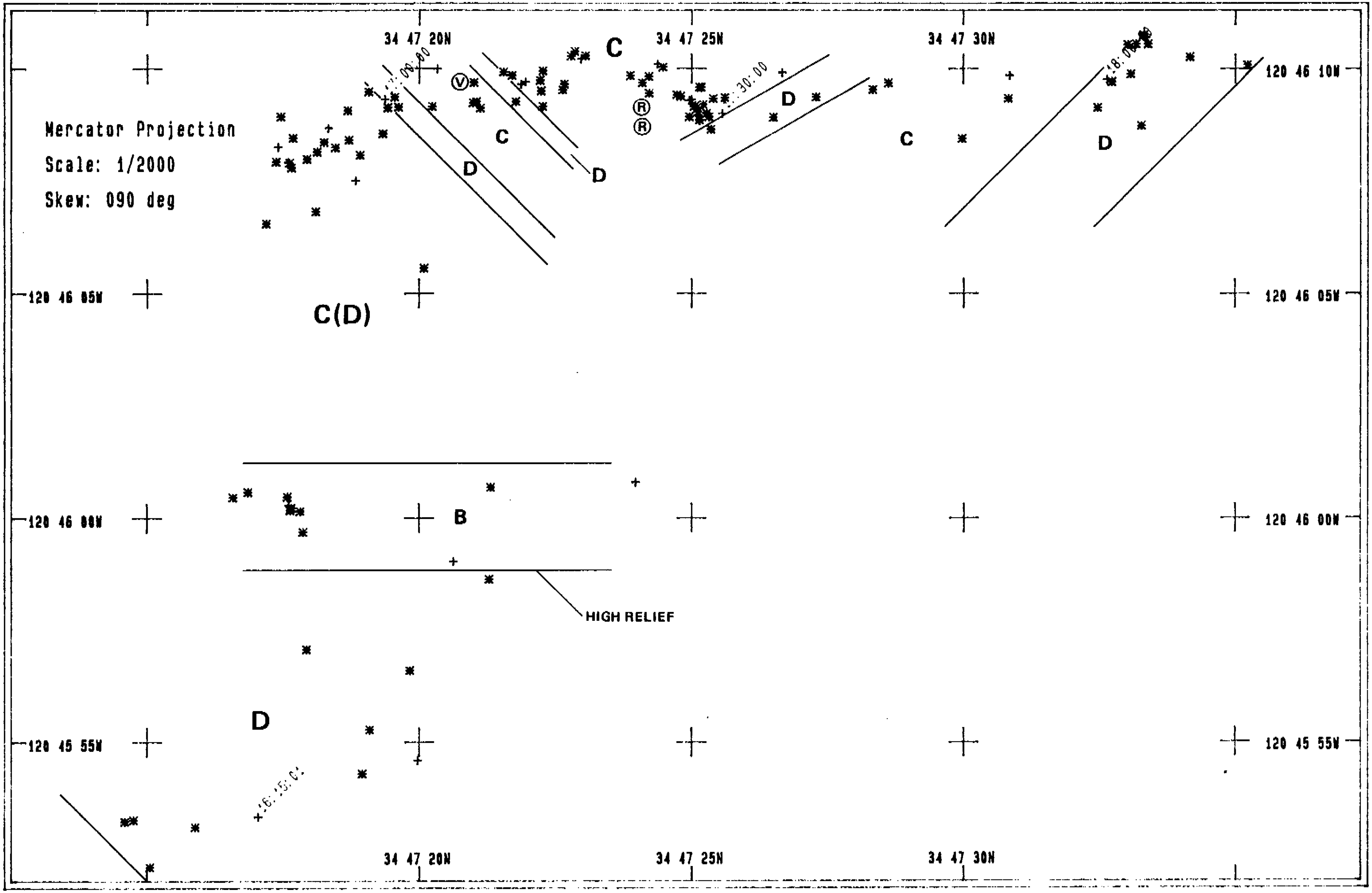
Mercator Projection
Scale: 1/2000
Skew: 000 deg
120 50 10W
120 50 05W
120 50 00W
120 49 55W
120 49 50W
34 46 20N
34 46 15N
34 46 10N
C/A
C
C/A
C
C/A
HIGH RELIEF
C/A
11:00:01
11:30:00
12:00:00

Dive 21A-B

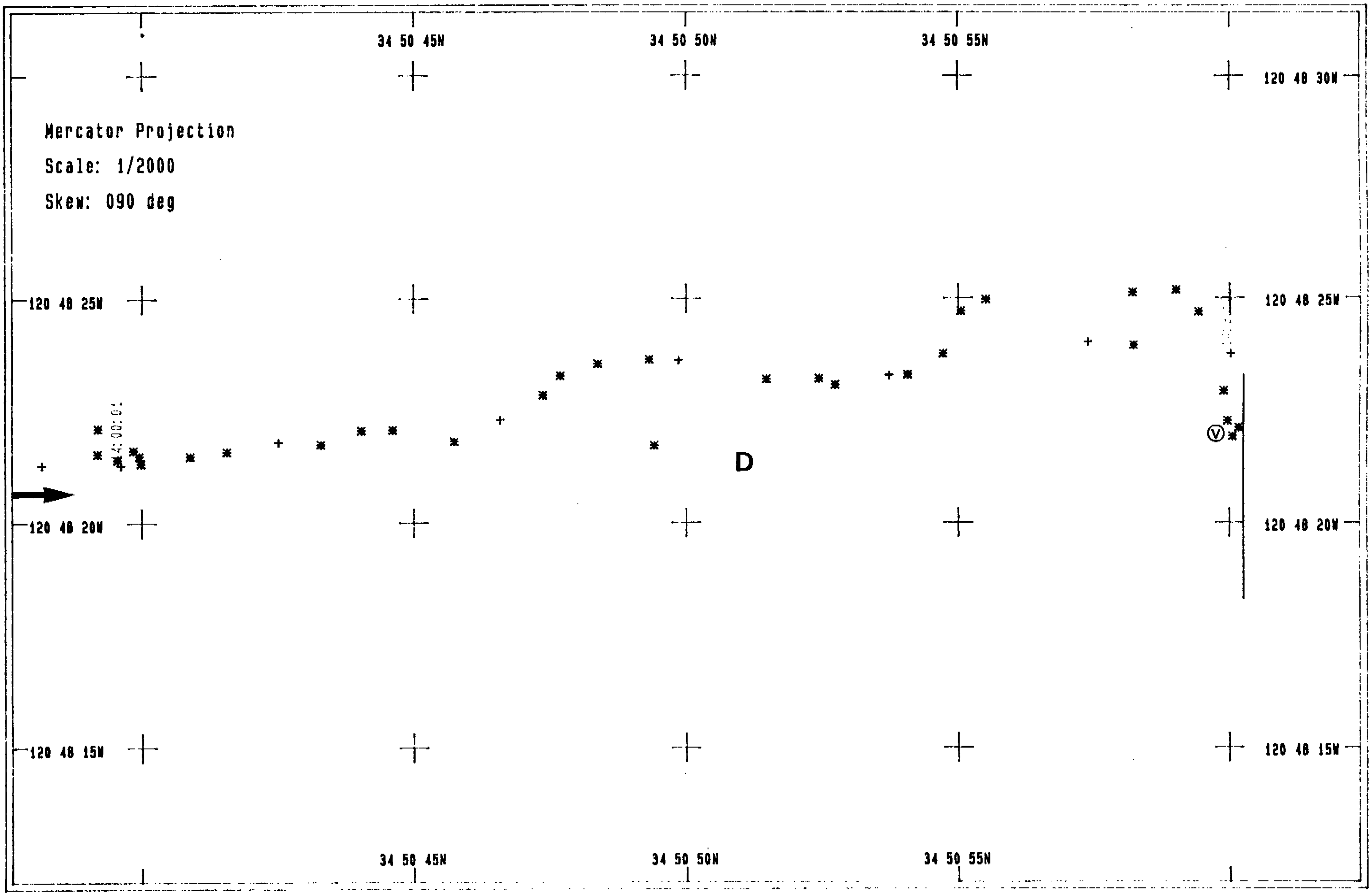


120 46 30W
120 46 00W
120 45 30W
120 45 00W
Mercator Projection
Scale: 1/12000
Skew: 000 deg
34 48 00N
34 47 30N
34 47 00N
120 47 00W
TIME DEPTH (FT)
1615 250
1700 270
1730 300
1800 295
1807 295
RANGE: 250–300
18:07
18:00:00
17:30:00
17:00:00
16:15:01
S-B
H-B
H-B
S-B
S-B
H-B
S-B

Dive 21A-B(A)

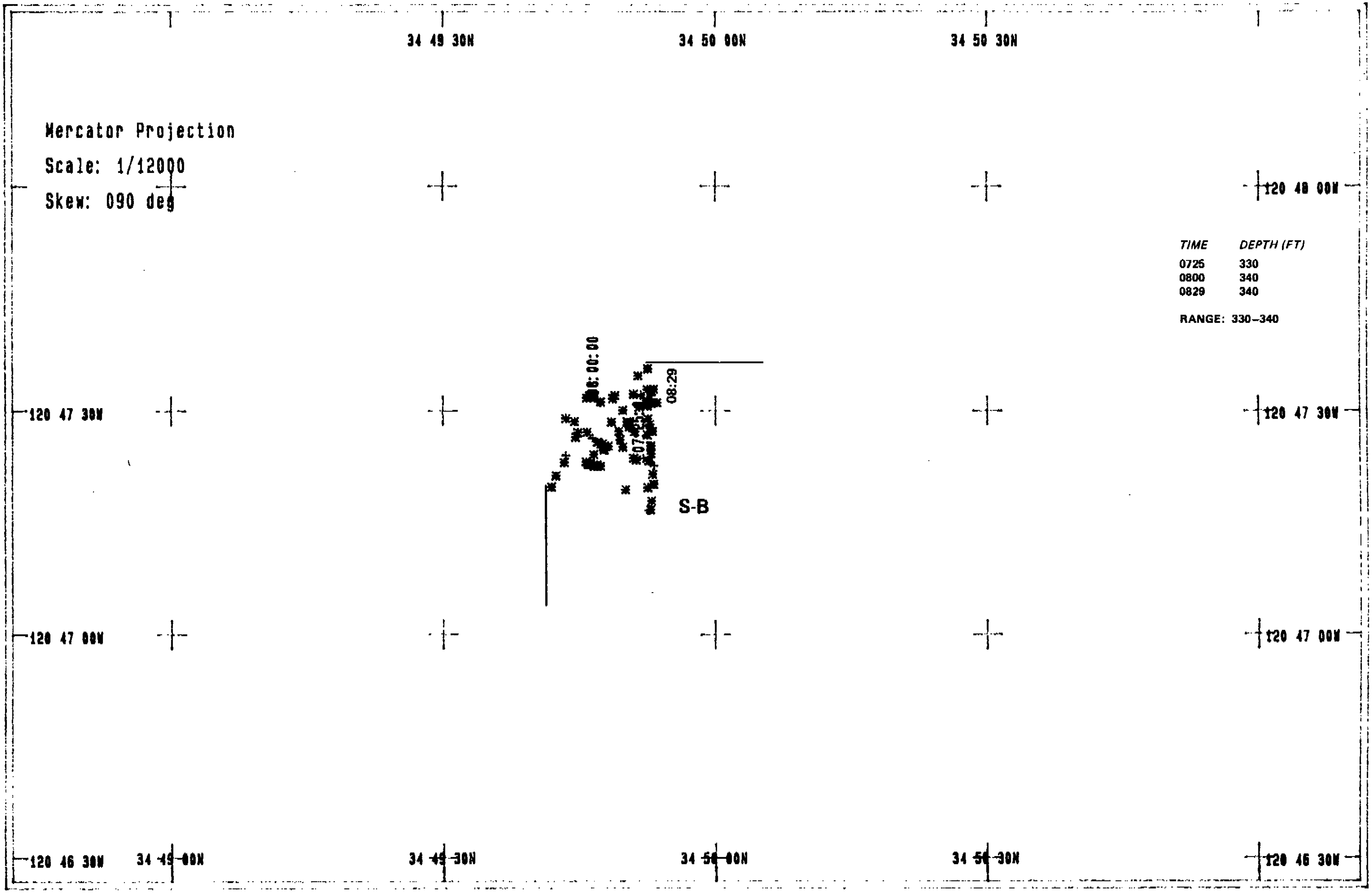

Mercator Projection
Scale: 1/2000
Skew: 090 deg
34 47 20N
34 47 25N
34 47 30N
120 46 10N
120 46 05N
120 46 00N
120 45 55N
C
D
C(D)
B
HIGH RELIEF

Dive 22B-A(B)



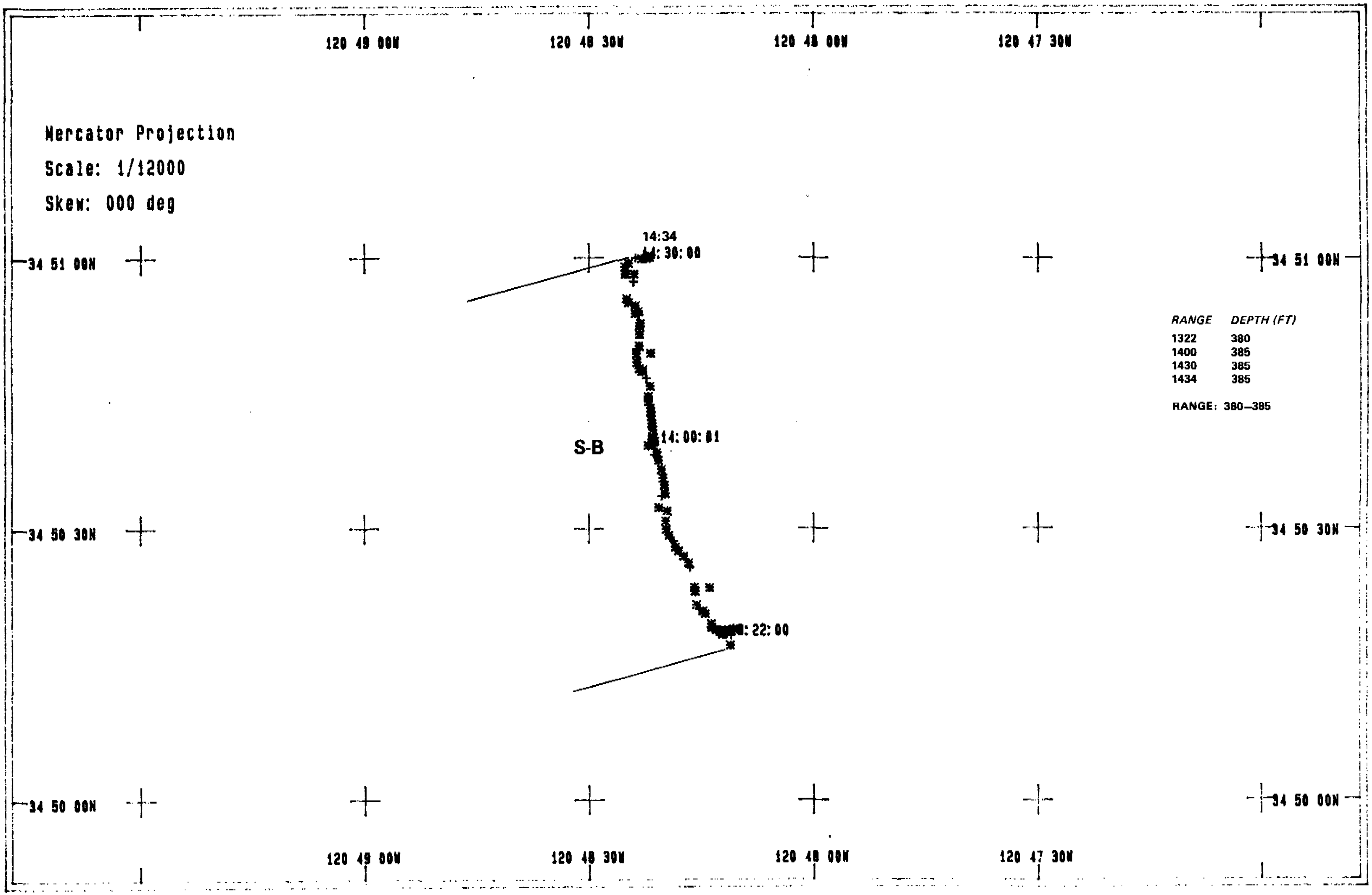
34 50 45N
34 50 50N
34 50 55N
120 48 30W
120 48 25W
120 48 20W
120 48 15W
Mercator Projection
Scale: 1/2000
Skew: 090 deg
D
V
14:00:04

Dive 23B-A



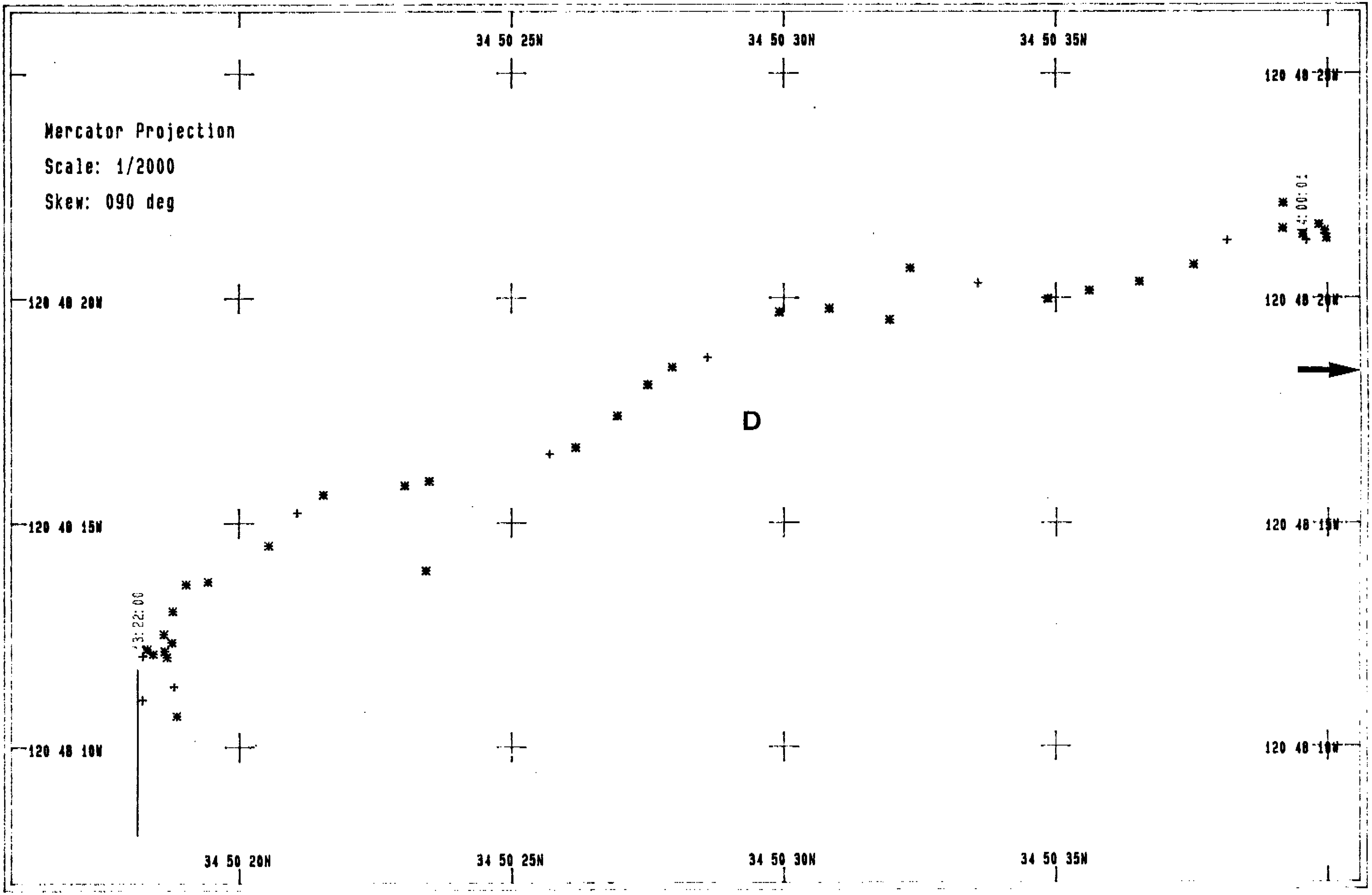
34 49 30N
34 50 00N
34 50 30N
Mercator Projection
Scale: 1/12000
Skew: 090 deg
120 48 00W
120 47 30W
120 47 00W
120 46 30W
34 49 00N
TIME DEPTH (FT)
0725 330
0800 340
0829 340
RANGE: 330–340
08:29
S-B

Dive 22B-A



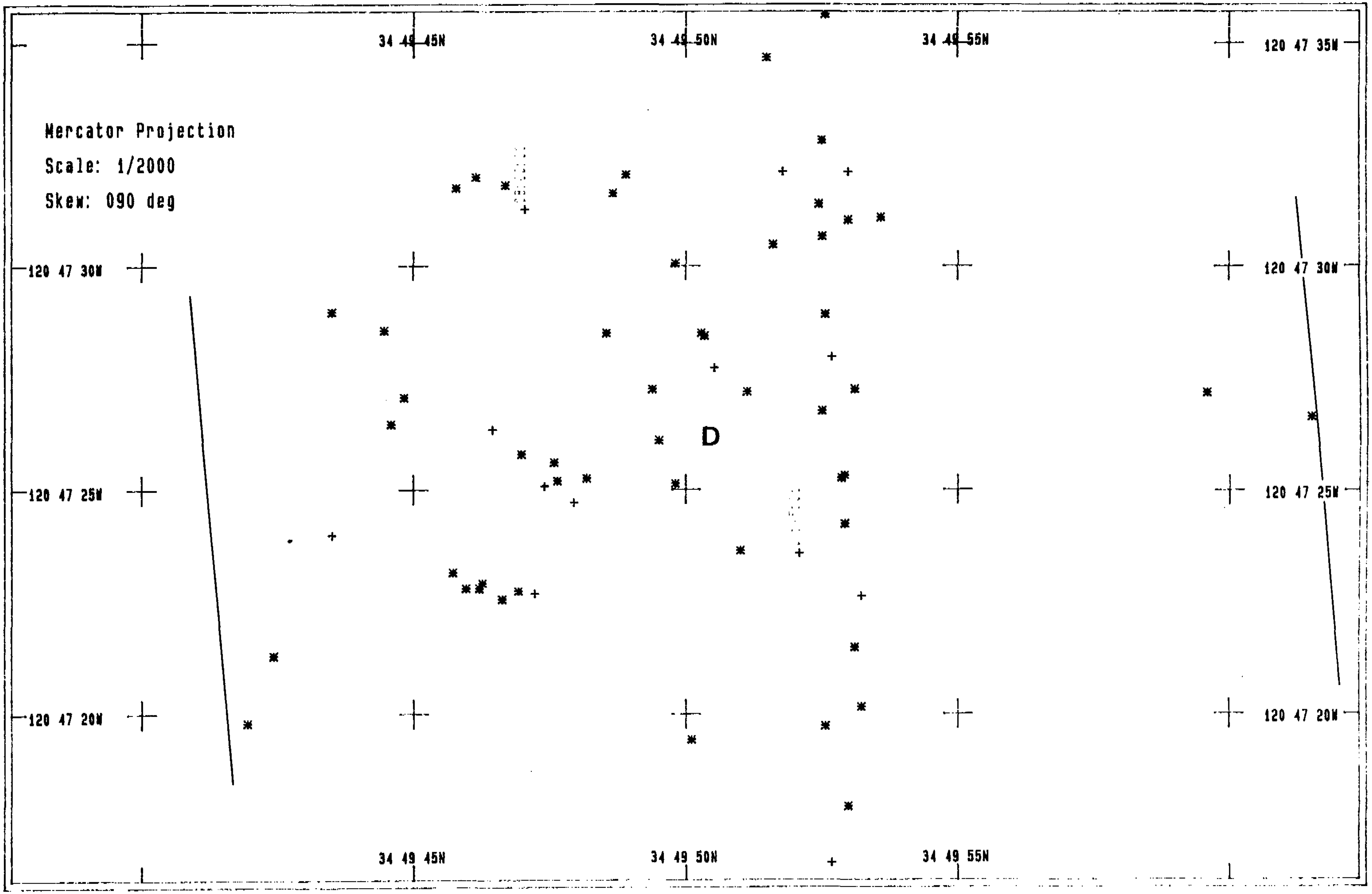
120 49 00W
120 48 30W
120 48 00W
120 47 30W
Mercator Projection
Scale: 1/12000
Skew: 000 deg
34 51 00N
34 50 30N
34 50 00N
14:34
14:30:00
14:00:01
22:00
S-B
RANGE DEPTH (FT)
1322 380
1400 385
1430 385
1434 385
RANGE: 380–385

Dive 22B-A(A)



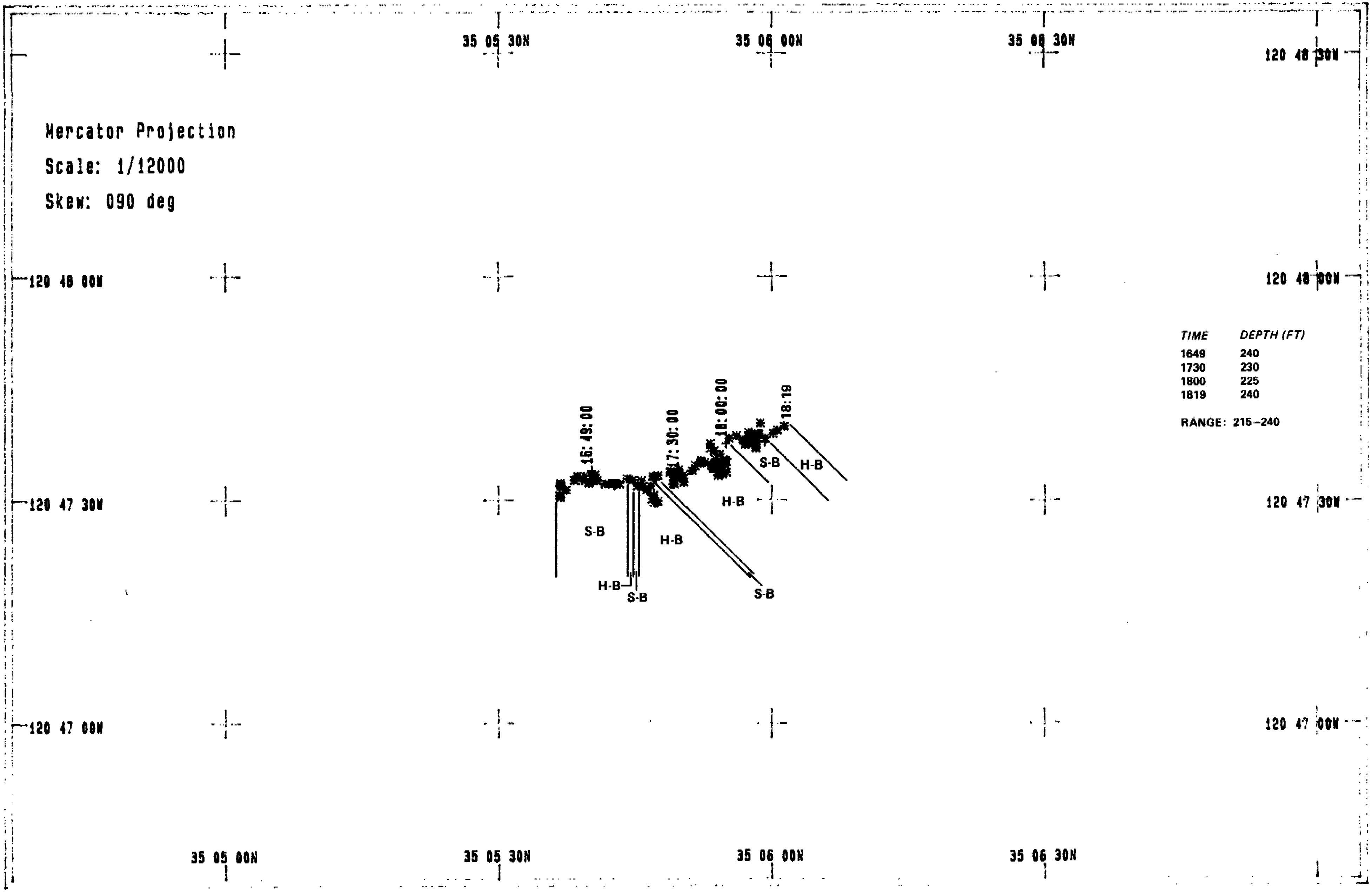
Mercator Projection
Scale: 1/2000
Skew: 090 deg
34 50 20N
34 50 25N
34 50 30N
34 50 35N
120 48 20W
120 48 15W
120 48 10W
D

Dive23B-A(A)



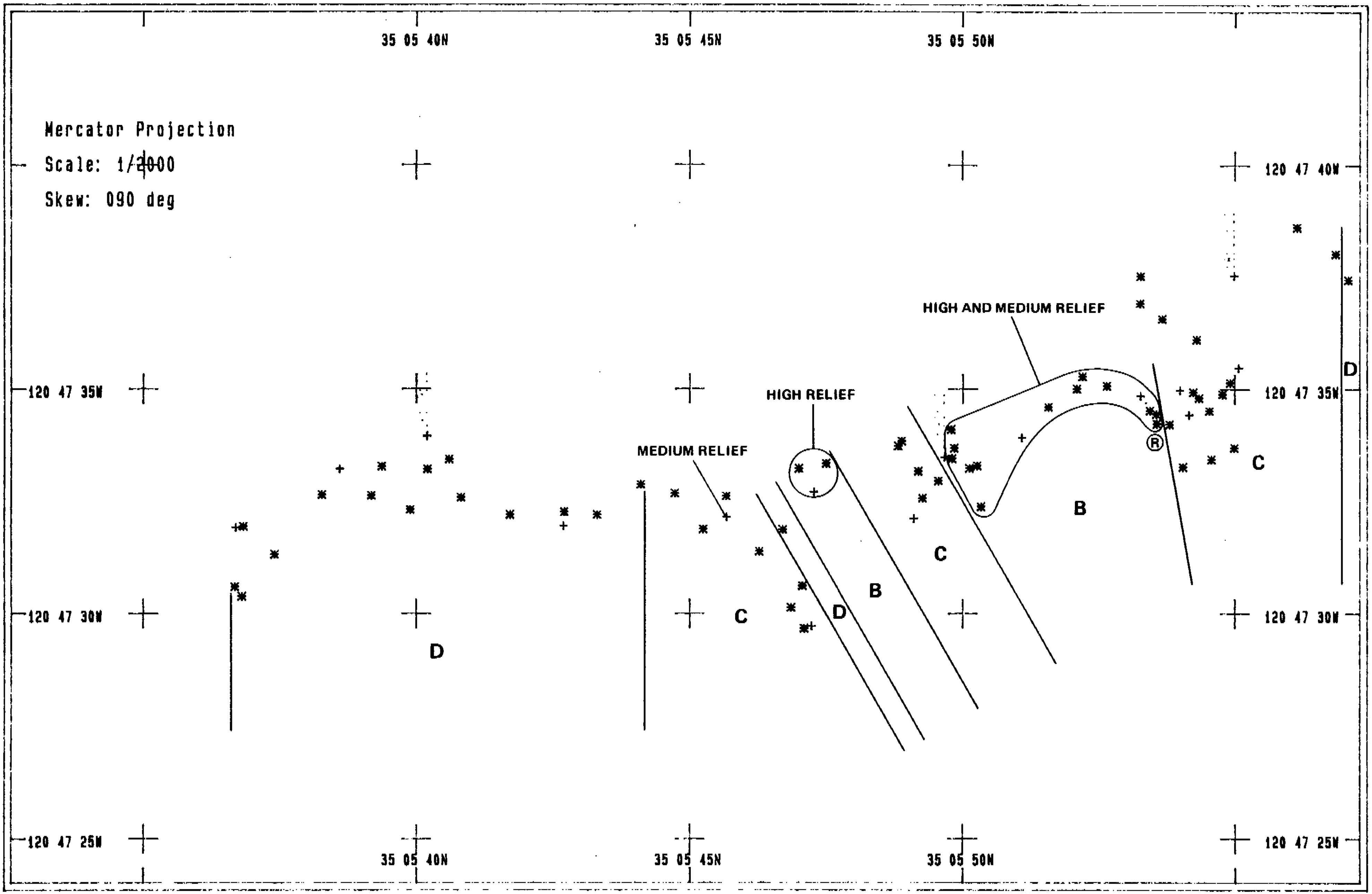
Mercator Projection
Scale: 1/2000
Skew: 090 deg
34 49 45N
34 49 50N
34 49 55N
120 47 35W
120 47 30W
120 47 25W
120 47 20W
D

Dive 25B-A



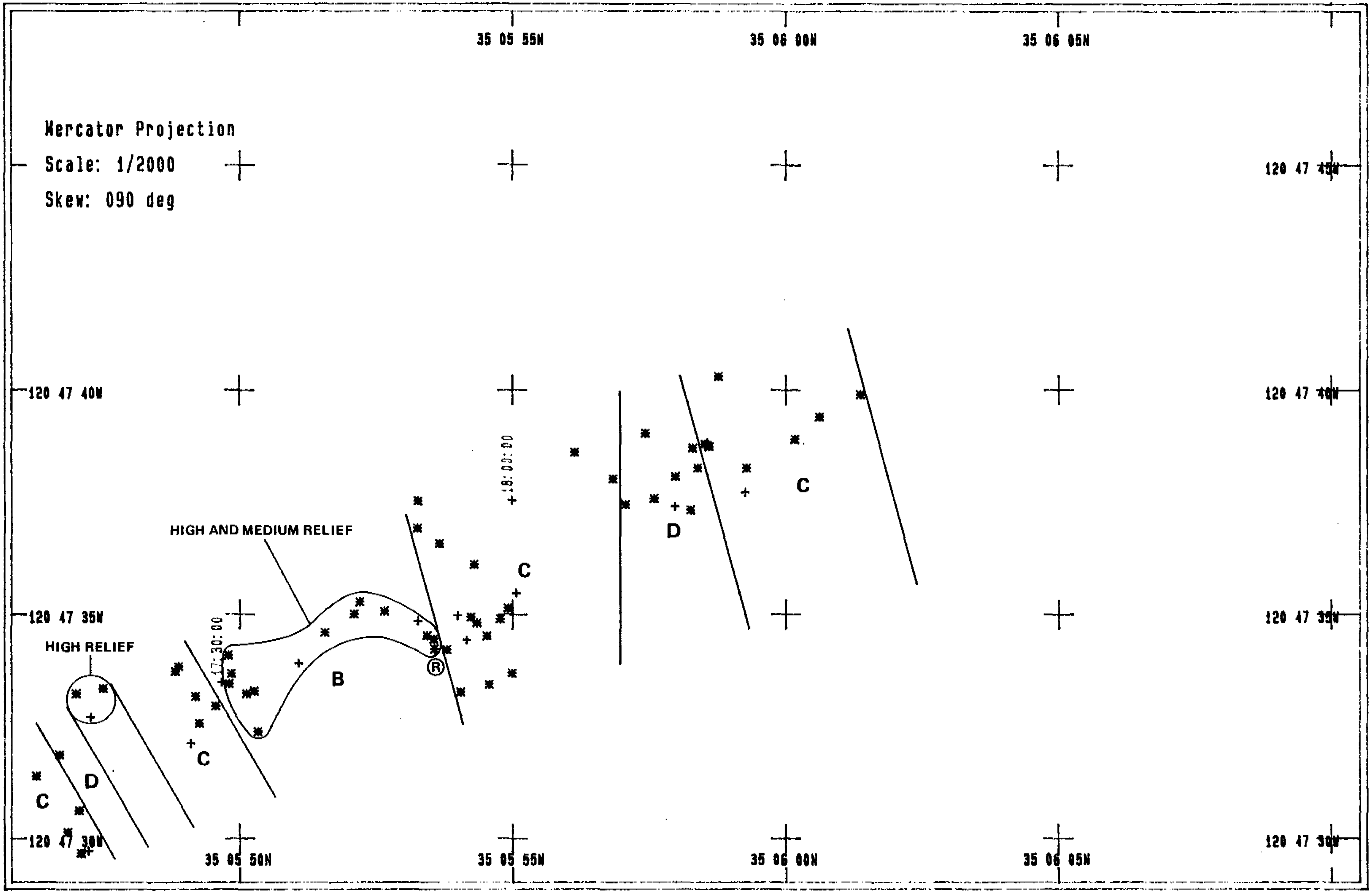
Mercator Projection
Scale: 1/12000
Skew: 090 deg
35 05 00N
35 05 30N
35 06 00N
35 06 30N
120 48 30N
120 48 00N
120 47 30N
120 47 00N
TIME DEPTH (FT)
1649 240
1730 230
1800 225
1819 240
RANGE: 215–240
16:49:00
17:30:00
18:00:00
18:19
S-B
H-B

Dive 25B-A(A)



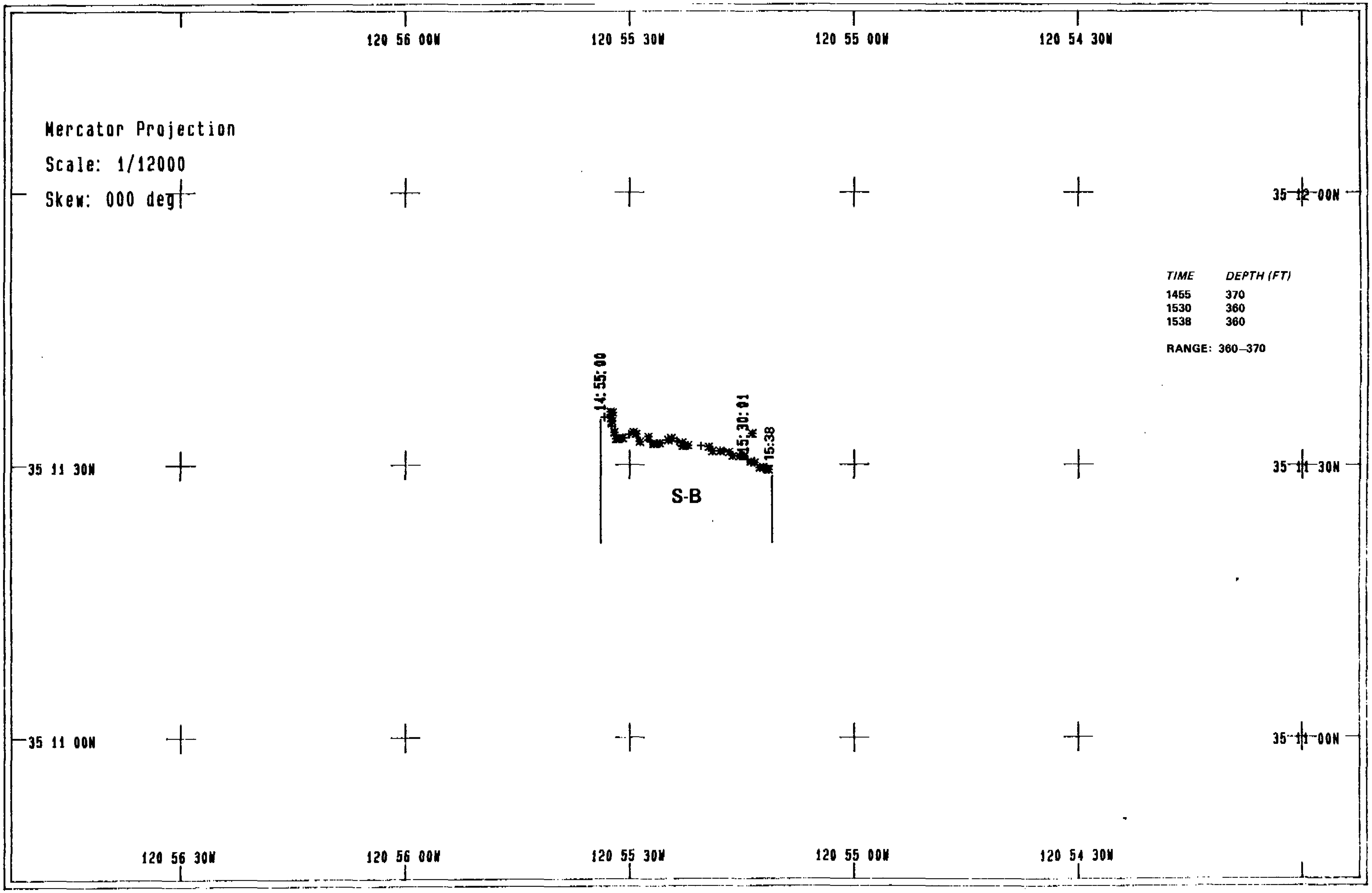
35 05 40N
35 05 45N
35 05 50N
Mercator Projection
Scale: 1/2000
Skew: 090 deg
120 47 40W
120 47 35W
120 47 30W
120 47 25W
HIGH AND MEDIUM RELIEF
HIGH RELIEF
MEDIUM RELIEF
D
C
B
C
B
D
C
D
R

Dive 25B-A(B)



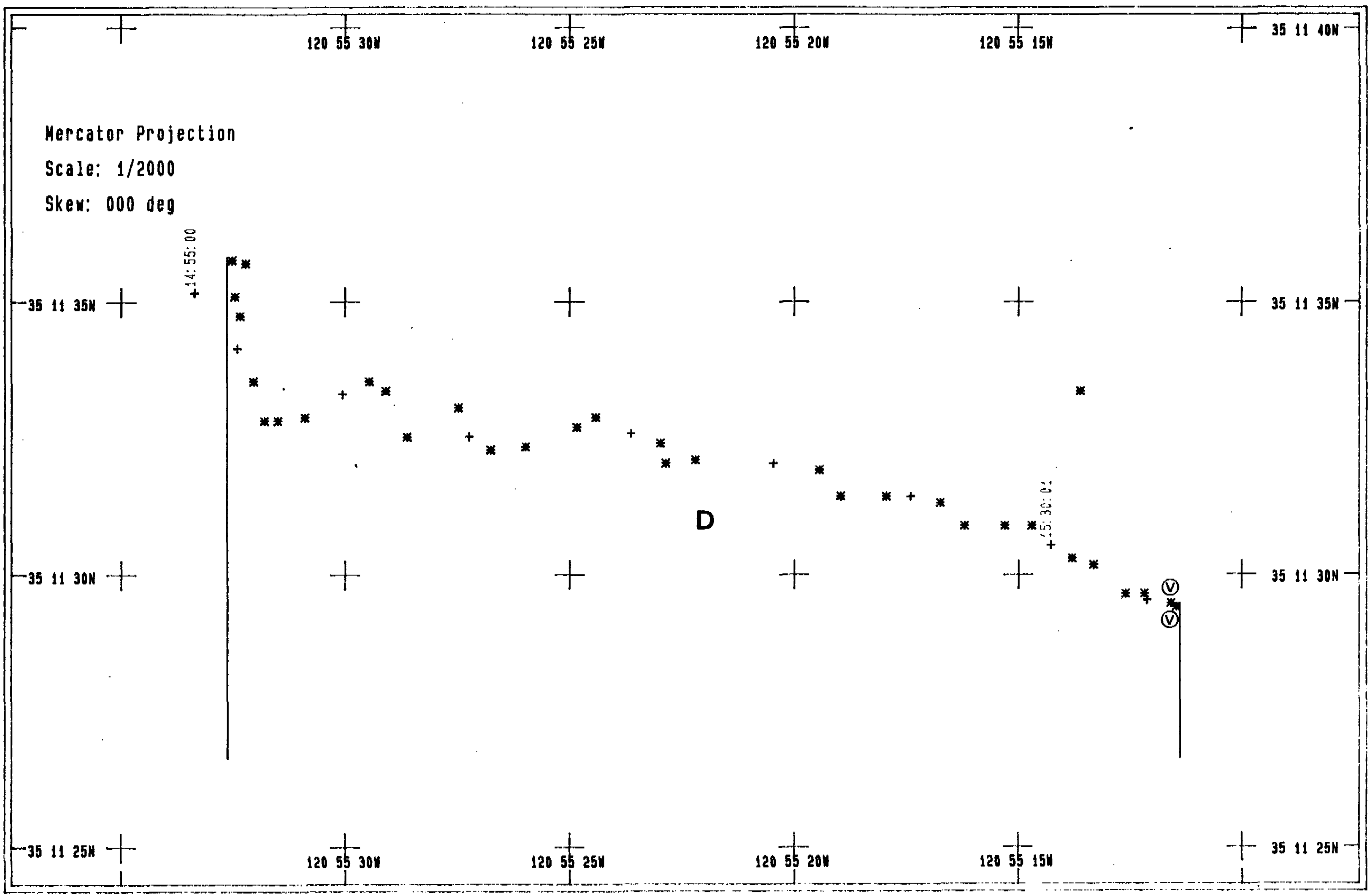
35 05 55N
35 06 00N
35 06 05N
Mercator Projection
Scale: 1/2000
Skew: 090 deg
120 47 45W
120 47 40W
120 47 35W
120 47 30W
35 05 50N
HIGH AND MEDIUM RELIEF
HIGH RELIEF
18:00:00
17:30:00
B
C
D
R

Dive 26D-C

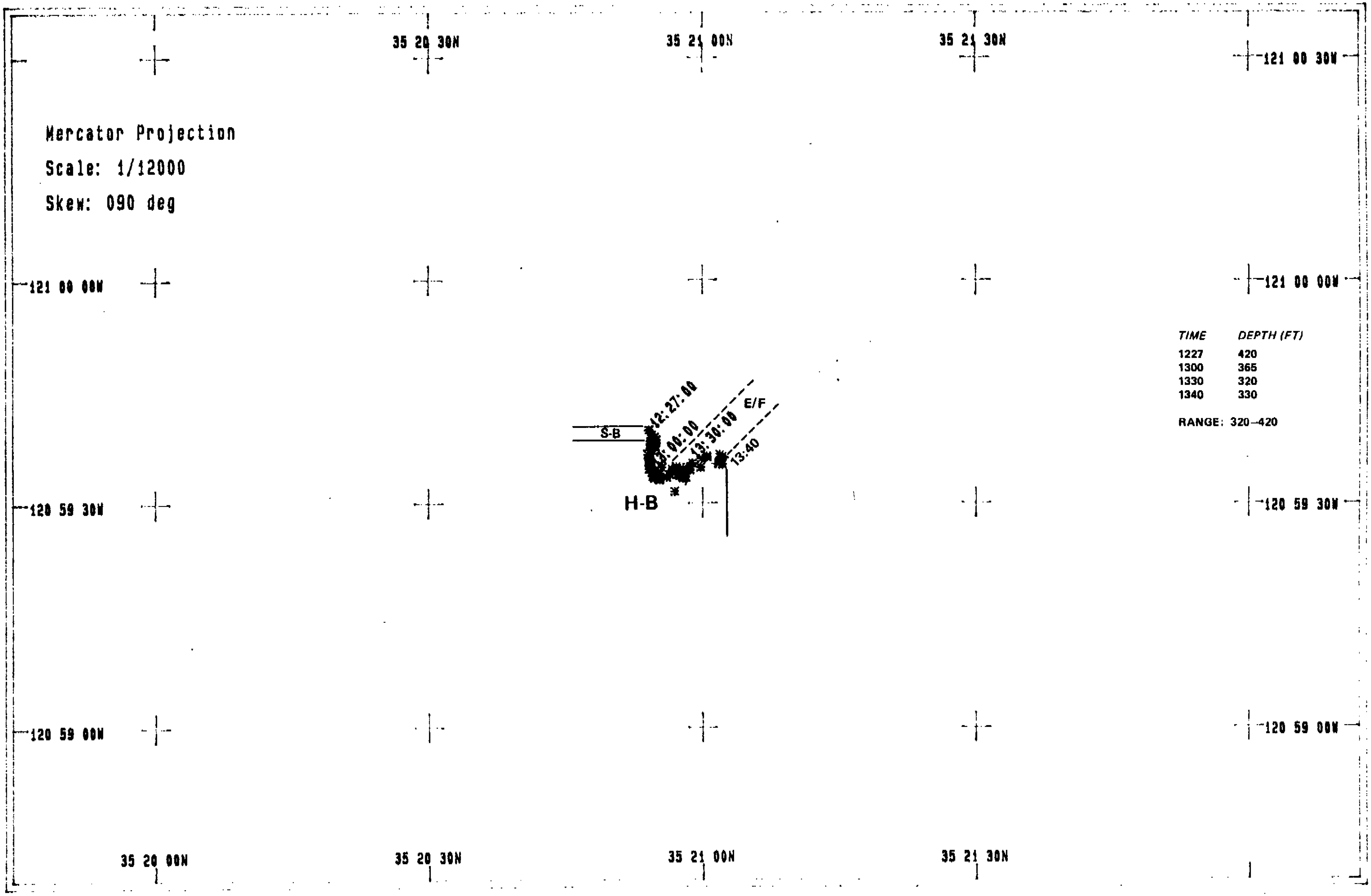


120 56 00W
120 55 30W
120 55 00W
120 54 30W
Mercator Projection
Scale: 1/12000
Skew: 000 deg
35 12 00N
TIME DEPTH (FT)
1455 370
1530 360
1538 360
RANGE: 360–370
14:55:00
15:30:01
15:38
35 11 30N
S-B
35 11 00N
120 56 30W

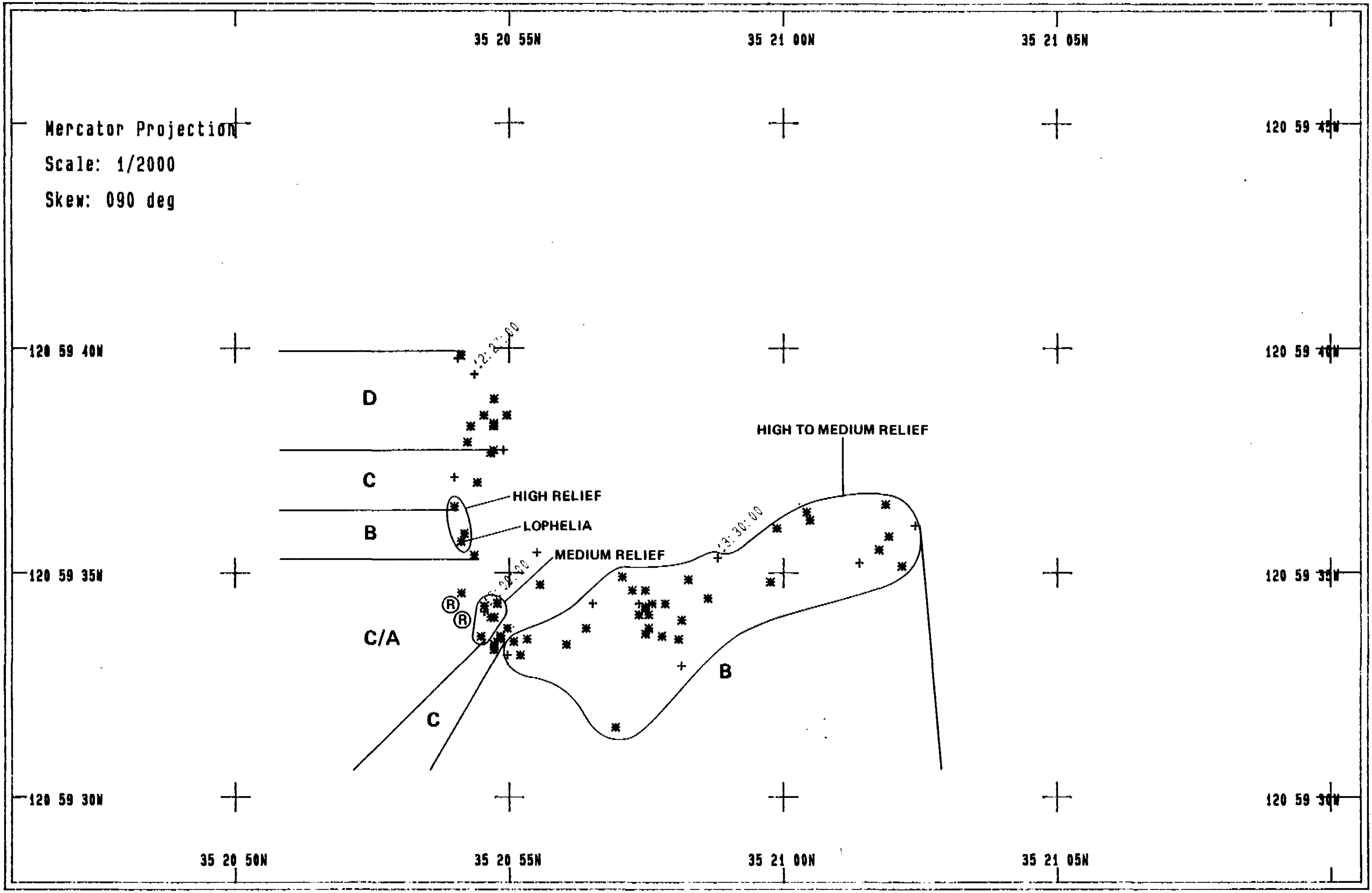
Dive 26D-C(A)


Mercator Projection
Scale: 1/2000
Skew: 000 deg
120 55 30W
120 55 25W
120 55 20W
120 55 15W
35 11 40N
35 11 35N
35 11 30N
35 11 25N
14:55:00
15:30:04
D

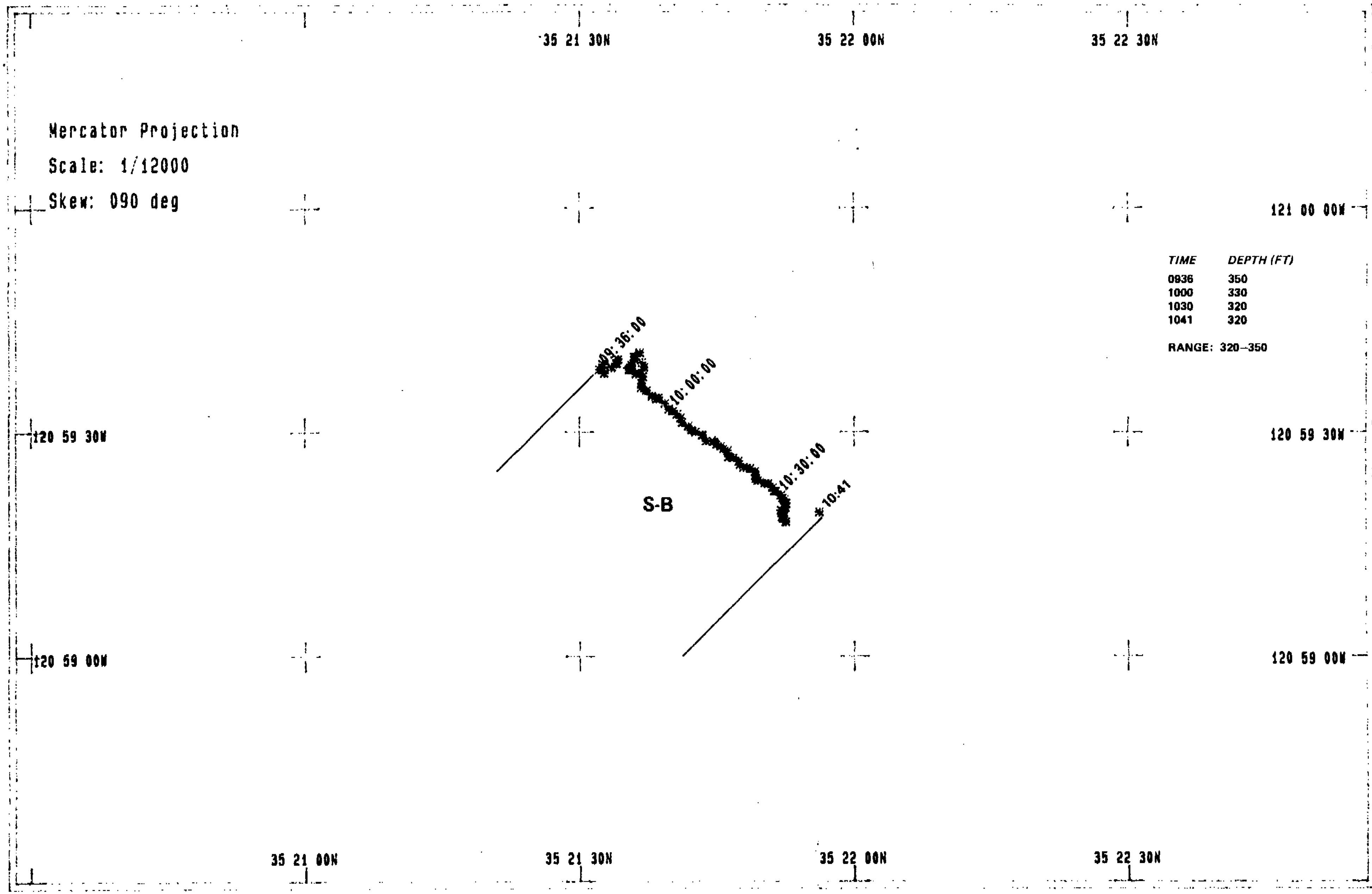
Dive 27A-B


Mercator Projection
Scale: 1/12000
Skew: 090 deg
35 20 00N
35 20 30N
35 21 00N
35 21 30N
121 00 30W
121 00 00W
120 59 30W
120 59 00W
S-B
H-B
E/F
12:27:00
13:00:00
13:30:00
13:40
TIME DEPTH (FT)
1227 420
1300 365
1330 320
1340 330
RANGE: 320–420

Dive27A-B(A)

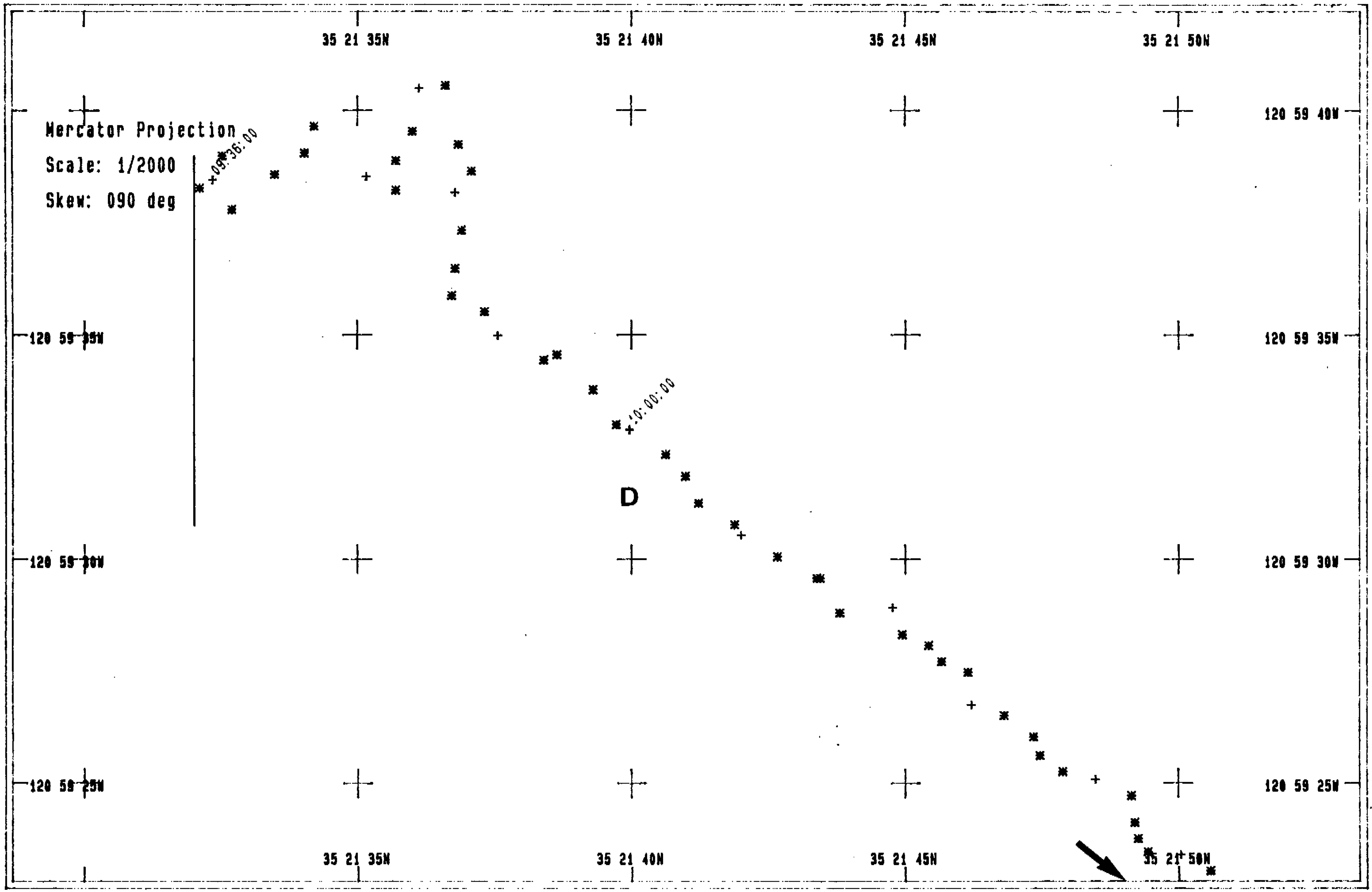

35 20 50N
35 20 55N
35 21 00N
35 21 05N
120 59 45W
120 59 40W
120 59 35W
120 59 30W
Mercator Projection
Scale: 1/2000
Skew: 090 deg
D
C
B
C/A
C
B
HIGH RELIEF
LOPHELIA
MEDIUM RELIEF
HIGH TO MEDIUM RELIEF
13:30:00

Dive 28B-A

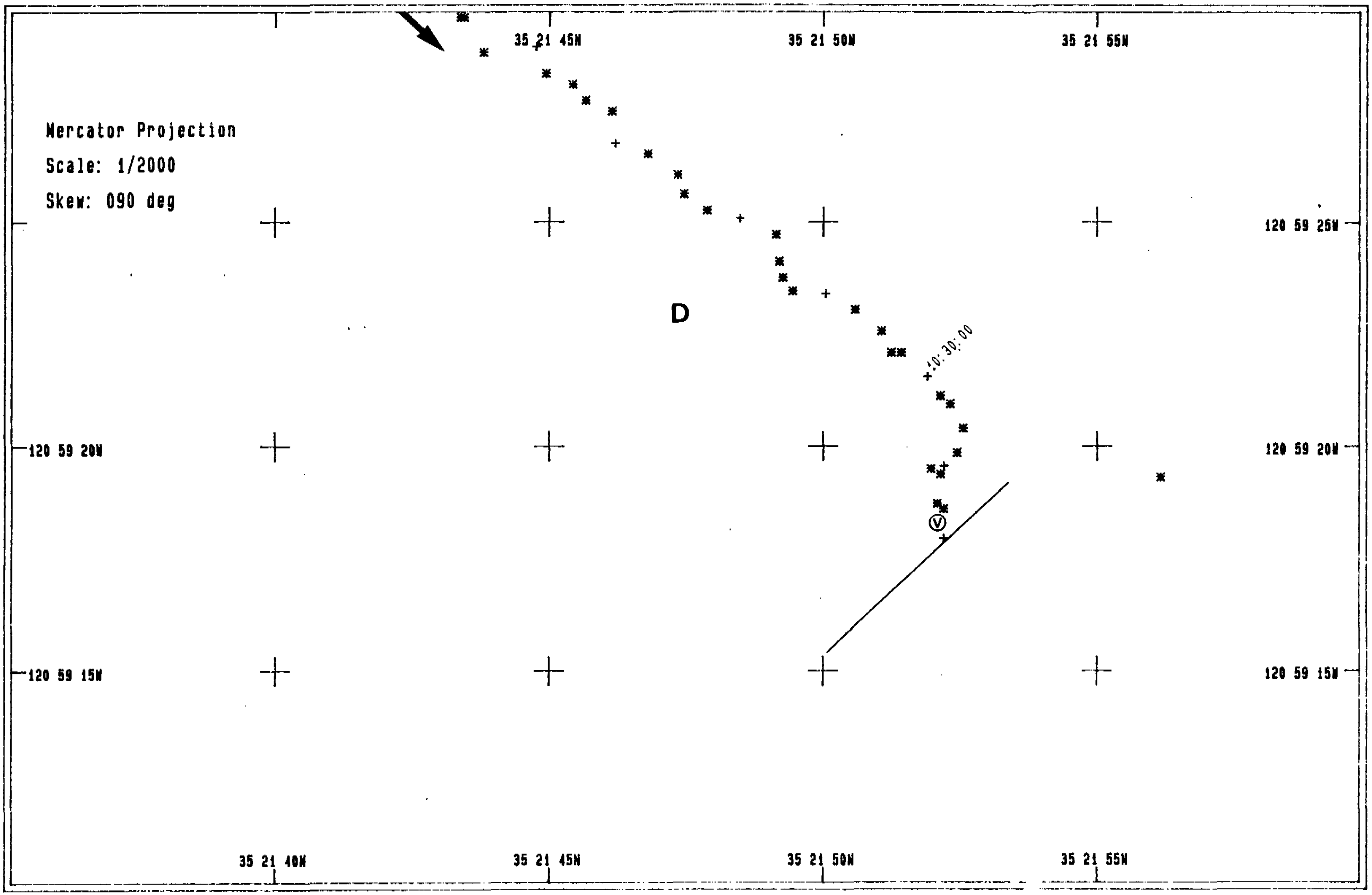


35 21 30N
35 22 00N
35 22 30N
Mercator Projection
Scale: 1/12000
Skew: 090 deg
121 00 00W
TIME DEPTH (FT)
0936 350
1000 330
1030 320
1041 320
RANGE: 320-350
09:36:00
10:00:00
10:30:00
10:41
120 59 30W
S-B
120 59 00W
35 21 00N

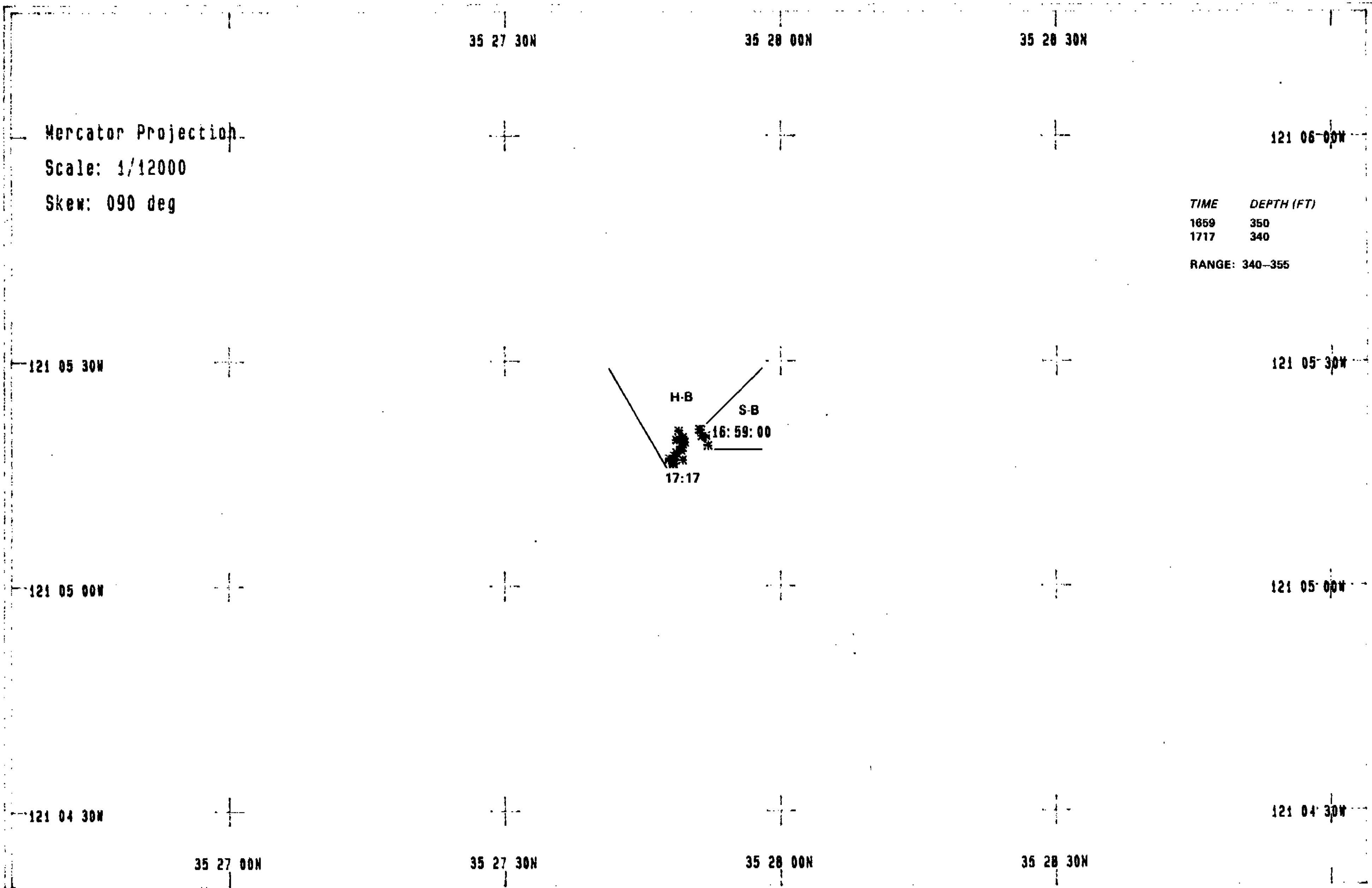
Dive 28B-A(A)


Mercator Projection
Scale: 1/2000
Skew: 090 deg
35 21 35N
35 21 40N
35 21 45N
35 21 50N
120 59 40W
120 59 35W
120 59 30W
120 59 25W
09:36:00
10:00:00
D

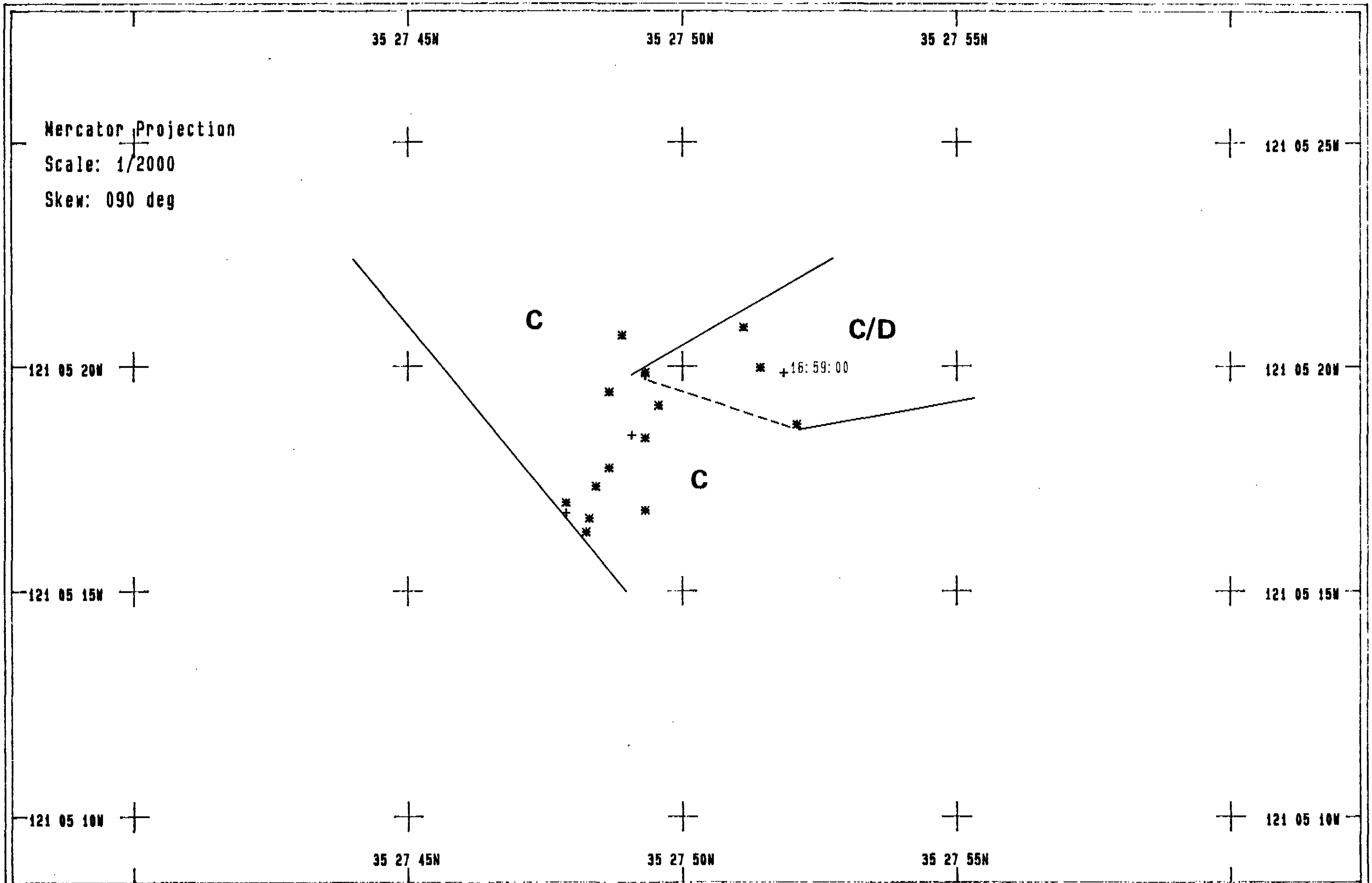
Dive 28B-A(B)


Mercator Projection
Scale: 1/2000
Skew: 090 deg
35 21 45N
35 21 50N
35 21 55N
35 21 40N
120 59 25W
120 59 20W
120 59 15W
10:30:00
D
V

Dive 29B-A


Mercator Projection
Scale: 1/12000
Skew: 090 deg
35 27 30N
35 28 00N
35 28 30N
35 27 00N
121 06 00W
121 05 30W
121 05 00W
121 04 30W
TIME DEPTH (FT)
1659 350
1717 340
RANGE: 340–355
H-B
S-B
16:59:00
17:17

Dive 29B-A(A)



35 27 45N
35 27 50N
35 27 55N
Mercator Projection
Scale: 1/2000
Skew: 090 deg
121 05 25W
121 05 20W
121 05 15W
121 05 10W
C
C/D
16:59:00
C

APPENDIX H

Raw Data from the July/August 1984
Hard-Bottom Survey

APPENDIX H

Hard-Bottom Raw Data Legend

Data Type

0 = Observer record.

P = Photographic record.

X = Poor quality photograph; used only for presence-absence comparisons.

S1, S2 ... SN = Submersible stopped (replicate data); number refers to first, second stop, etc. along a transect.

Time Military time: corresponds to time of navigational positions included as Appendix B.

Depth (ft) Bottom depth in feet.

Species Species code corresponding to Table H-1.

Density (sq. meter) Density estimates based on a range of surface areas from 0.9 to 1.4 m^2 (summarized to $1.0m^2$) for photographic data (see Methods, Sections 2.1.2.4 and 2.2.3), or visual estimates from observer records.

Cover (%) Percent cover based on visual estimates from observer and photographic records.

Relative Abundance Relative abundance data from observer and photographic records; 1 = present, blank = absent, and M = many.

Substrate Coded substrate type and relief:

Column	Description
1	1 = hard-bottom, 2 = soft-bottom.
2	Percentage of column 1; A = 0-25%, B = > 25-50%, C = > 50-75%, and D = > 75-100%.
3	Percentage of sediment cover; A = 0-25%, B = > 25-50%, C = > 50-75%, and D = > 75-100%. Note that for transect plots (Appendix G) the percentage of sediment cover is indicated as E = 0-25%, F = > 25-50%, and G = > 50-75%.
4	Substrate relief; E = low (0-3 ft), F = medium (4-10 ft), and G = high (> 10 ft).
5	Hard-bottom substrate type; H = outcrop, I = boulder, J = cobble, K = pebble, L = rubble.

Table H-1. Hard-Bottom Taxonomic Data Legend

Abbreviation	Taxon	NODC Code
Acan	Acanthoptilum gracile	3754019999
Actin	Actinostola sp. A	3760020401
Agon	Agonidae LPIL	8831080000
Allo	Allocentrotus fragilis	8149030101
Allop	Allopora californica	3709010403
Astro	Astropecten verrilli	8106010599
Bal	Balanophyllia elegans	3769010101
Berth	Berthella californica	5126029999
Berthel	Berthella californica	5126029999
Bris	Brisaster latifrons	8162040101
Cad	Cadlina LPIL	5130020100
Cadfl	Cadlina flavomaculata	5130020101
Cadlut	Cadlina luteomarginata	5130020102
Calli	Calliostoma LPIL	5102100100
Callig	Calliostoma gloriosum	5102100151
Cancer	Cancer LPIL	6188030100
Cancerp	Cancer productus	6188030101
Cephalo	Cephaloscyllium ventriosum	8708010501
Cerian	Cerianthidae LPIL	3743010000
Chilara	Chilara taylori	8792013301
Cithar	Citharichthys LPIL	8857030103
Clinid	Clinidae LPIL	8842090000
Coeno	Coenocyathus bowersi	3768019999
Coryn	Corynactis californica	3757010105
Coryph	Coryphopterus nicholsii	8847010201
Cottid	Cottidae LPIL	8831020000

Abbreviation	Taxon	NODC Code
Cross	Crossaster papposus	8113010103
Cya	Caryophylliidae LPIL (Cyathoceras/Caryophyllia-like)	3768010000
Dama	Damalichthys vaca	8835600601
Dendro	Dendronotus irus	5134060101
Dermas	Dermasterias imbricata	8114030101
Desmo	Desmophyllum crista-galli	3768010801
Diaper	Diaperoecia californica	7810060199
Embio	Embiotocidae LPIL	8835600000
Epta	Eptatretus LPIL	8606010106
Eugor	Eugorgia c.f. rubens	3751059999
Flabell	Flabellinopsis iodinea	5141040107
Floro	Florometra serratissima	8191010201
Fusi	Fusinus LPIL	5105090500
Fusib	Fusinus barbarensis	5105090599
Gib	Gibbonsia LPIL	8842090103
Gorgon	Gorgonocephalus eucnemis	8125030202
Halo	Halocynthia hilgendorfia igaboja	840602040201
Hen	Henricia LPIL	8114040101
Hippas	Hippasteria LPIL	8111040400
Hydro	Hydrolagus collei	8716020101
Laq	Laqueus californianus	8005130101
Leuc	Calcarea LPIL ("Leucetta")	3601000000
Lophe	Lophelia californica	3767030299
Lopho	Lopholithodes foraminatus	6183081002
Loxo	Loxorhynchus crispatus	6187011501
Luid	Luidia foliolata	8105010101

Abbreviation	Taxon	NODC Code
Lycob	Lyconema barbatum	8793011701
Lyt	Lytechinus pictus	8148020102
Med	Mediaster aequalis	8111040501
Megas	Megasurcula LPIL	5106029800
Megasc	Megasurcula carpenteriana	5106029899
Met	Metridium senile	3760060101
Mitra	Mitra idae	5106010399
Muri	Muricea LPIL	3751040199
NO	No Organisms	9800000099
Neosim	Neosimnia LPIL	5103729900
Neptu	Neptunea tabulata	5105050807
Oct	Octopus LPIL (small, common)	5708010200
Octo	Octopus LPIL (small, common)	5708010200
Ophia	Ophiacantha diplasia	8128010199
Ophid	Ophidiidae LPIL	8792010000
Ophiod	Ophiodon elongatus	8827010201
Orth	Orthasterias koehleri	8117031001
Oxy	Oxylebius pictus	8827010301
Pagur	Paguristes LPIL	6183060107
Pan	Pandalus LPIL	6179180100
Panda	Pandalus platyceros	6179180105
Para	Paracyathus stearnsi	3768010299
Parali	Paralithodes LPIL	6183080703
Parast	Parastichopus californicus	8175020101
Parastp	Parastichopus parvimensis	8175020198
Pat	Patiria miniata	8114010101
Perid	Peridontaster crassus	8111019999
Phido	Phidolopora pacifica	7816150301

Abbreviation	Taxon	NODC Code
Pisas	Pisaster brevispinus	8117030501
Pleuro	Pleurobranchea californica	5126020399
Poly	Polymastia pachymastia	3666040199
Poran	Poraniopsis inflata	8114040201
Porich	Porichthys LPIL	8783010101
Protula	Protula superba	5001731199
Psolus	Psolidae LPIL	8172030000
Pter	Pteraster tesselatus	8113040306
Ptilo	Ptilosarcus gurneyi	3754020201
Pycno	Pycnopodia helianthoides	8117031201
Pyura	Pyura haustor	8406020101
Raja	Raja LPIL	8713040100
Rajab	Raja binoculata	8713040103
Rajas	Raja stellulata	8713040111
Rath	Rathbunaster californicus	8117039999
Rathbun	Rathbunella LPIL	8840030300
Sauric	Sebastes auriculatus	8826010103
Scal	Arcoscalpellum californicum	6132010104
Scaur	Sebastes caurinus	8826010108
Schry	Sebastes chrysomelas	8826010168
Scon	Sebastes constellatus	8826010144
Sdiplo	Sebastes diploproa	8826010111
Sebas	Sebastes LPIL	8826010100
Selong	Sebastes elongatus	8826010112
Sfran	Strongylocentrotus franciscanus	8149030202
Sgood	Sebastes goodei	8826010117
Shop	Sebastes hopkinsi	8826010148
Smin	Sebastes miniatus	8826010123

Abbreviation	Taxon	NODC Code
Smys	Sebastes mystinus	8826010124
Sneb	Sebastes nebulosus	8826010125
Soval	Sebastes ovalis	8826010152
Spaus	Sebastes paucispinis	8826010127
Spin	Sebastes pinniger	8826010128
Sros	Sebastes rosaceus	8826010132
Sruber	Sebastes ruberrimus	8826010134
Srubri	Sebastes rubrivinctus	8826010155
Ssemi	Sebastes semicinctus	8826010157
Sserra	Sebastes serranoides/flavidus	8826010115
Stachy	Stachyptilum superbum	3753089999
Stauro	Staurocalyptus LPIL	3632120300
Sty	Stylatula LPIL	3754010100
Stylas	Stylasterias forreri	8117031101
Symp	Symphurus atricauda	8858020116
Szac	Sebates zacentrus	8826010138
Tealia	Tealia LPIL	3760010400
Tere	Terebratulina LPIL	8005070100
Triton	Tritonia LPIL	5134010100
Tritond	Tritonia diomedia	5134010102
Veron	Verongia aurea	3662020299
Zalem	Zalembius rosaceus	8835601101
Zan	Zaniolepis LPIL	8827010400
Zanlat	Zaniolepis latipinnis	8827010401
Zoarcid	Zoarcidae LPIL	8793010000
aeolid	Eolidoidea LPIL	5139000000
anem	Anthozoa LPIL	3740000000
anema	Anthozoa LPIL (anemone sp. A; light pink, Tealia-like)	3740000099

Abbreviation	Taxon	NODC Code
ast	Asteroidea LPIL	8104000000
banoph	c.f. Ophionereis eurybrachyplax (banded ophiuroid)	8129031699
barrel	Porifera LPIL (barrel sponge)	3600000099
brac	Brachiopoda LPIL	8000000000
cc	Caryophylliidae LPIL (cup coral)	3768010099
cco	Caryophylliidae LPIL (cup coral - orange)	3768010098
ccw	Caryophylliidae LPIL (cup coral - white)	3768010097
ccy	Caryophylliidae LPIL (cup coral - yellow)	3768010096
crab	Brachyura LPIL (crab)	6184000000
cuc	Holothuroidea LPIL	8170000000
ebry	Bryozoa LPIL (erect)	7800000099
encrust	encrusting orgranisms (sponges, bryozoans, etc.)	9900000099
eo	erect organisms (hydroids, bryozoans, etc.)	9900000098
esponge	Porifera LPIL (encrusting)	3600000098
etun	Urochordata LPIL (encrusting tunicate)	8400000099
flat	Osteichthyes LPIL (flatfish)	8717000099
gala	Galatheidae LPIL	6183100000
gast	Gastropoda LPIL	5100000000
gorg	Gorgonacea LPIL	3749000000
gorgp	Gorgonacea LPIL (Philogella-like)	3749000099
heart	Spatangoida LPIL	8160000000
hermit	Anomura LPIL	6183000000
hyd	Hydroida LPIL	3701000000
hydaglo	Plumulariidae (Aglaophenia-like)	3704070000
nudi	Nudibranchia LPIL	5127000000
oph	Ophiuroidea LPIL	8120000000
pbump	purple bumps (egg capsules?)	9800000098

Abbreviation	Taxon	NODC Code
polycs	Polychaeta LPIL (sedentary)	5001000000
redsea	Parastichopus c.f. johnsoni (red sea cucumber)	8175020199
rgorg	Lophogorgia LPIL	3751050299
sabell	Sabellidae LPIL	5001700000
seap	Pennatulacea LPIL	3752000000
serp	Serpulidae LPIL	5001730000
shelf	Porifera LIPL (shelf sponge)	3600000097
shrimp	Decapoda LPIL (shrimp)	6175000099
soltun	Urochordata LPIL (solitary tunicate)	8400000098
sponge	Porifera LPIL	3600000000
spongea	Porifera LPIL (Aphrocallistes-like)	3600000096
spongev	Porifera LPIL (Verongia-like)	3600000095
vases	Porifera LPIL (vase sponge)	3600000094
zoan	Zoanthidae LPIL	3756010000

HARD BOTTOM DATA
TRANSECT 6 A/B, 6 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1138	180	Med			1	2DDEH
O/P	1138	180	shelf			1	2DDEH
O	1139	180	Scaur			1	1DDEH
O	1139	180	Coryn			1	1DDEH
O	1141	180	rgorg			1	1DDEH
O	1142	180	anem			1	2DDE0
O	1142	180	rgorg			1	2DDE0
O	1142	180	Luid			1	2DDE0
O	1142	180	Oct			M	2DDE0
O/P	1146	180	rgorg			1	2DDE0
O	1148	180	ebry			1	1DDEI
O	1148	180	Diaper			1	1DDEI
O	1148	180	Para			1	1DDEI
O	1148	180	vases			1	1DDEI
O	1150	180	Cancer			1	1DDEH
O/P	1151	180	ebry		1		1DDEH
O/P	1151	180	zoan			1	1DDEH
O/P	1151	180	Coryn			1	1DDEH
O/P	1151	180	eo		1		1DDEH
O/P	1151	180	cc	70			1DDEH
O/P	1151	180	Eugor			1	1DDEH
O/P	1151	180	rgorg			1	1DDEH
PS3	1154	180	Coryph	1			1DDE0
PS3	1154	180	cc	1			1DDE0
PS3	1155	180	cc	18			1DDE0
PS3	1159	180	Poly			1	1DDE0
PS3	1159	180	sponge		4		1DDE0
PS3	1159	180	cc	95			1DDE0
PS3	1159	180	zoan		1		1DDE0
PXS3	1200	180	Oxy			1	1DDE0
PXS3	1200	180	zoan			1	1DDE0
PXS3	1200	180	eo			1	1DDE0
PXS3	1200	180	cc			M	1DDE0
PXS3	1200	180	gast			1	1DDE0
PS3	1202	180	Oxy	1			1DDE0
PS3	1202	180	Sebas	2			1DDE0
PS3	1202	180	eo		2		1DDE0
PS3	1202	180	cc	40			1DDE0
PS3	1202	180	zoan			1	1DDE0
PS3	1203	180	ebry		5		1DDE0
PS3	1203	180	Poly		1		1DDE0
PS3	1203	180	cc	80			1DDE0
PS3	1203	180	zoan			1	1DDE0
PS3	1203	180	Sebas	1			1DDE0
PS3	1203	180	Coryph	1			1DDE0
PS3	1203	180	Chilara	1			1DDE0
O	1221	180	rgorg			1	1DDE0
O	1221	180	Fusi			1	1DDE0
O	1224	180	Pleuro			1	2D000
P	1226	180	Luid			1	2D000

HARD BOTTOM DATA
TRANSECT 6 A/B, 6 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
P	1226	180	Oct			1	2D000
O	1227	180	Para			1	2DD00
O	1227	180	Coryn			1	2DD00
O	1227	180	Ptilo			1	2DD00

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS1	1631	323	Sty			1	2D000
OS1	1631	323	Acan			1	2D000
OS1	1631	323	Pleuro			1	2D000
OS1	1631	323	Luid			1	2D000
OS1	1631	323	Oct			1	2D000
OS1	1631	323	Megas			1	2D000
OS1	1631	323	Stachy			1	2D000
OS1	1631	323	Med			1	2D000
OS1	1631	323	flat			1	2D000
OS1	1631	323	Zalem			1	2D000
OS1	1631	323	Sebas			1	2D000
O	1634	323	Met			1	1DDEJ
O	1634	323	Stylas			1	1DDEJ
O	1634	323	Hen			1	1DDEJ
O	1634	323	rgorg			1	1DDEJ
O	1634	323	Perid			1	1DDEJ
O	1634	323	Para			M	1DDEJ
O	1634	323	Protula			1	1DDEJ
O	1634	323	Parast			1	1DDEJ
O	1634	323	Berthel			1	1DDEJ
OS2	1638	320	Parast			1	1DDEH
OS2	1638	320	Para			1	1DDEH
OS2	1638	320	Pycno			1	1DDEH
OS2	1638	320	rgorg			1	1DDEH
OS2	1650	312	Pter			1	1DDEH
OS2	1650	312	shelf			1	1DDEH
OS2	1650	312	rgorg			1	1DDEH
OS2	1650	312	Stylas			1	1DDEH
OS2	1650	312	Sebas			1	1DDEH
OS2	1650	312	Parast			1	1DDEH
OS2	1650	312	Hen			1	1DDEH
OS2	1650	312	Met			1	1DDEH
OS2	1650	312	Berthel			1	1DDEH
O	1652	307	Pycno			1	1DDEH
O	1652	307	shelf			1	1DDEH
O	1652	307	Protula			1	1DDEH
O	1652	307	Stylas			1	1DDEH
O	1652	307	Met			1	1DDEH
O	1652	307	Raja			1	1DDEH
O	1654	307	Para			1	1DDEL
O	1654	307	Cya			1	1DDEL
O	1654	307	Parast			M	1DDEL
O	1654	307	Med			M	1DDEL
O	1654	307	Pycno			1	1DDEL
O	1654	307	cc			1	1DDEL
O	1654	307	Gorgon			1	1DDEL
O	1656	310	sponge			1	1DDEL
O	1656	310	Pleuro			1	1DDEL
O	1656	310	Parast			M	1DDEL
O	1656	310	Stylas			M	1DDEL

HARD BOTTOM DATA
TRANSECT 13 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1656	310	cc			1	1DDEL
O	1656	310	Ophia			1	1DDEL
O	1656	310	Hydro			1	1DDEL
O	1656	310	gala			1	1DDEL
O	1656	310	Srubri			1	1DDEL
O	1656	310	Met			1	1DDEL
O	1656	310	Perid			1	1DDEL
O	1656	310	Med			M	1DDEL
O	1656	310	Para			1	1DDEL
O	1656	310	Cya			1	1DDEL
O	1656	310	Rathbun			1	1DDEL
O	1656	310	Orth			1	1DDEL
O	1656	310	shelf			1	1DDEL
O	1656	310	Sebas			1	1DDEL
O	1656	310	Gorgon			1	1DDEL
O	1659	312	Tritond			1	1DDEL
O	1659	312	Parast			M	1DDEL
O	1659	312	Stylas			M	1DDEL
O	1659	312	Med			1	1DDEL
O	1659	312	Para			M	1DDEL
O	1659	312	Cya			M	1DDEL
O	1701	312	Hydro			1	1DDEL
O	1701	312	Hen			1	1DDEL
O	1701	312	flat			1	1DDEL
O	1701	312	Stylas			1	1DDEL
O	1701	312	Para			M	1DDEL
O	1701	312	shelf			1	1DDEL
O	1704	312	Luid			1	2DDEL
O	1704	312	Med			1	2DDEL
O	1704	312	Para			1	2DDEL
O	1704	312	Zan			1	2DDEL
O	1704	312	Cya			1	2DDEL
O	1704	312	Ophia			1	2DDEL
O	1704	312	polycs			1	2DDEL
O	1705	312	Floro			1	1DDEL
O	1705	312	Para			1	1DDEL
O	1705	312	Cya			1	1DDEL
O	1705	312	Stylas			M	1DDEL
O	1705	312	Parast			M	1DDEL
O	1705	312	Gorgon			1	1DDEL
O	1705	312	Ophiod			1	1DDEL
O	1707	320	Orth			1	1DDEL
O	1707	320	Stylas			1	1DDEL
O	1707	320	Allo			1	1DDEL
O	1707	320	Ophiod			1	1DDEL
O	1707	320	sponge			1	1DDEL
O	1707	320	Met			1	1DDEL
O	1709	320	Met			1	1DDEL
O	1709	320	Ophia			1	1DDEL
O	1709	320	shelf			1	1DDEL

HARD BOTTOM DATA
TRANSECT 13 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1709	320	Para			M	1DDEL
O	1709	320	Cya			M	1DDEL
O	1709	320	sponge			1	1DDEL
O	1709	320	Floro			1	1DDEL
O	1709	320	Parast			M	1DDEL
O	1709	320	Med			1	1DDEL
O	1712	325	rgorg			1	1DDEL
O	1712	325	shelf			1	1DDEL
O	1712	325	Ophia			1	1DDEL
O	1712	325	Med			1	1DDEL
O	1712	325	Stylas			1	1DDEL
O	1712	325	Parast			1	1DDEL
O	1712	325	Pycno			1	1DDEL
O	1712	325	Perid			1	1DDEL
O	1712	325	Actin			1	1DDEL
O	1712	325	Allo			1	1DDEL
OS3	1720	330	Para			M	1DDEL
OS3	1720	330	Parast			1	1DDEL
OS3	1720	330	Ophia			1	1DDEL
OS3	1720	330	Met			1	1DDEL
OS3	1720	330	Stylas			1	1DDEL
OS3	1720	330	Med			1	1DDEL
OS3	1720	330	Cya			1	1DDEL
OS3	1720	330	sponge			1	1DDEL
OS3	1720	330	Hen			1	1DDEL
OS3	1720	330	Protula			1	1DDEL
OS3	1720	330	Zan			1	1DDEL
OS3	1720	330	gala			1	1DDEL
OS3	1720	330	Neptu			1	1DDEL
OS3	1720	330	Cadfl			1	1DDEL
O	1726	330	Halo			1	1DDEL
O	1726	330	Sfran			1	1DDEL
O	1726	330	Met			1	1DDEL
O	1726	330	Protula			1	1DDEL
O	1726	330	Stylas			1	1DDEL
O	1726	330	Parast			1	1DDEL
O	1726	330	Gorgon			1	1DDEL
O	1727	332	Gorgon			1	2DDEH
O	1727	332	Med			1	2DDEH
O	1727	332	Oct			1	2DDEH.
O	1727	332	Sty			1	2DDEH

HARD BOTTOM DATA
TRANSECT 13 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS1	835	335	Cithar			1	2D000
OS1	835	335	Oct			1	2D000
OS1	835	335	Sebas			1	2D000
O	837	335	Oct			1	2D000
O	837	335	flat			1	2D000
O	837	335	Scon			1	2D000
O	837	335	Med			1	2D000
O	837	335	Sty			1	2D000
O	837	335	oph			1	2D000
O	837	335	Megas			1	2D000
O	837	335	Selong			1	2D000
OS2	841	335	Met			1	1DDEJ
OS2	841	335	Sebas			1	1DDEJ
OS2	841	335	Parast			1	1DDEJ
OS2	841	335	Hen			1	1DDEJ
OS2	841	335	rgorg			1	1DDEJ
OS2	841	335	Para			M	1DDEJ
OS2	841	335	Zan			1	1DDEJ
OS2	841	335	Megas			1	1DDEJ
OS2	841	335	hyd			1	1DDEJ
OS2	841	335	eo			1	1DDEJ
OS2	844	335	Sebas			1	1DDEJ
OS2	844	335	Zan			1	1DDEJ
OS2	854	335	Coryph			1	1CDEL
OS2	854	335	Stylas			M	1CDEL
OS2	854	335	Ophia			1	1CDEL
OS2	854	335	Med			1	1CDEL
OS2	854	335	Protula			1	1CDEL
OS2	854	335	Megas			M	1CDEL
OS2	854	335	Pleuro			1	1CDEL
OS2	854	335	Perid			1	1CDEL
OS2	854	335	gorg			1	1CDEL
OS2	854	335	gala			1	1CDEL
OS2	854	335	Parast			M	1CDEL
P	855	335	Med	1			10DE0
P	855	335	eo		8		10DE0
P	855	335	cc	33			10DE0
P	855	335	zoan			1	10DE0
O/P	857	335	rgorg	2			1DDEL
O/P	857	335	Parast	1			1DDEL
O/P	857	335	Coryph	1			1DDEL
O/P	857	335	ccw	16			1DDEL
O/P	857	335	Hen			1	1DDEL
O/P	857	335	Ophia			1	1DDEL
O/P	857	335	Stylas			1	1DDEL
O/P	857	335	Med			M	1DDEL
O/P	857	335	ebry			1	1DDEL
O/P	857	335	sponge			1	1DDEL
O/P	857	335	nudi			1	1DDEL
P	858	335	Parast	1			1DDEL

HARD BOTTOM DATA
TRANSECT 13 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
P	858	335	ccw	13			1DDEL
P	858	335	Para	1			1DDEL
P	858	335	cc	90			1DDEL
P	858	335	oph	1			1DDEL
P	858	335	eo		3		1DDEL
OS3	859	335	gorg			1	1DDEL
OS3	859	335	Cadlut			1	1DDEL
OS3	859	335	Bal			1	1DDEL
OS3	859	335	cc			1	1DDEL
OS3	859	335	Parast			1	1DDEL
PS3	900	335	Parast	1			1DDEL
PS3	900	335	sponge			1	1DDEL
PS3	900	335	Ophia	1			1DDEL
PS3	900	335	rgorg	2			1DDEL
PS3	900	335	Halo	1			1DDEL
PS3	900	335	Bal	2			1DDEL
PS3	900	335	ccw	3			1DDEL
PS3	900	335	cc	64			1DDEL
PS3	900	335	Para	1			1DDEL
PS3	900	335	ebry			1	1DDEL
PS3	900	335	eo		1		1DDEL
OS3	902	325	cc			M	1DDEI
OS3	902	325	Perid			1	1DDEI
OS3	902	325	Ophia			1	1DDEI
OS3	902	325	Stylas			1	1DDEI
OS3	902	325	Met			1	1DDEI
OS3	902	325	Leuc			1	1DDEI
OS3	902	325	shelf			1	1DDEI
OS3	902	325	gala			1	1DDEI
OS3	902	325	Oct			1	1DDEI
OS3	902	325	nudi			1	1DDEI
OS3	902	325	Gorgon			1	1DDEI
OS3	902	325	Sebas			1	1DDEI
P	903	325	Ophia	5			1DDE0
P	903	325	oph	1			1DDE0
P	903	325	rgorg	1			1DDE0
P	903	325	Para	2			1DDE0
P	903	325	ccw	6			1DDE0
P	903	325	cc	57			1DDE0
P	903	325	ebry		1		1DDE0
P	903	325	zoan		1		1DDE0
P	903	325	eo		20		1DDE0
P	905	325	Med	1			1DDE0
P	905	325	Ophia	1			1DDE0
P	905	325	ccw	5			1DDE0
P	905	325	Para	2			1DDE0
P	905	325	cc	47			1DDE0
P	905	325	eo		5		1DDE0
P	906	325	rgorg		4		1DDE0
P	906	325	Ophia	3			1DDE0

HARD BOTTOM DATA
TRANSECT 13 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
P	906	325	Stylas	1			1DDE0
P	906	325	ccw	5			1DDE0
P	906	325	cc	27			1DDE0
P	906	325	eo		5		1DDE0
O	907	325	Orth			1	1DDEL
O	907	325	Berthel			1	1DDEL
O	907	325	gorg			1	1DDEL
O	907	325	Stylas			1	1DDEL
O	907	325	Zan			1	1DDEL
O	907	325	Met			1	1DDEL
O	907	325	Hen			1	1DDEL
O	907	325	Leuc			1	1DDEL
O	907	325	Perid			1	1DDEL
O	907	325	Med			1	1DDEL
O	907	325	Sebas			1	1DDEL
O	907	325	Cancer			1	1DDEL
O	907	325	Shop			1	1DDEL
O	907	325	shelf			1	1DDEL
O	907	325	Poran			1	1DDEL
O	907	325	Cross			1	1DDEL
O	907	325	Parast			1	1DDEL
O	907	325	Allo			1	1DDEL
PX	908	325	Zan			1	1DDE0
PX	908	325	Ophia			1	1DDEQ
PX	908	325	rgorg			1	1DDE0
PX	908	325	ast			1	1DDE0
PX	908	325	cc			1	1DDE0
PX	909	325	Parast			1	1DDE0
PX	909	325	Ophia			1	1DDE0
PX	909	325	rgorg			1	1DDE0
PX	909	325	Bal			1	1DDE0
PX	909	325	ccw			1	1DDE0
PX	909	325	cc			1	1DDE0
PX	909	325	eo			1	1DDE0
PX	909	325	Halo			1	1DDE0
O	910	315	Stylas			1	1CDEI
O	910	315	shelf			1	1CDEI
O	910	315	oph			1	1CDEI
O	910	315	Cross			1	1CDEI
O	910	315	gala			1	1CDEI
O	910	315	Allo			1	1CDEI
O	910	315	Med			M	1CDEI
P	911	315	Med	1			1DDE0
P	911	315	rgorg	1			1DDE0
P	911	315	cc	21			1DDE0
P	911	315	eo		5		1DDE0
PX	913	315	Med			1	1DDEI
PX	913	315	rgorg			1	1DDEI
PX	913	315	oph			1	1DDEI
PX	913	315	ccw			1	1DDEI

HARD BOTTOM DATA
TRANSECT 1 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
P	849	245	Lyt	5			2D000
P	851	245	Lyt	5			2D000
PS1	853	245	Lyt	10			1DD00
PS1	853	245	Para	6			1DD00
PS1	853	245	cc	4			1DD00
PS1	853	245	eo		1		1DD00
PS1	854	245	Lyt	1			2D000
PS1	856	245	eo		1		1DD00
PS1	856	245	cc	3			1DD00
PXS1	857	245	Para			1	1DD00
PXS1	857	245	cc			1	1DD00
PS1	859	245	Lyt	1			1DD00
PS1	859	245	cc	2			1DD00
PS1	865	245	Para	1			1DD00
OS1	901	245	Hen			1	1DD0H
OS1	901	245	gorg			1	1DD0H
PS1	902	245	Lyt	1			1DD00
PS1	902	245	Para	6			1DD00
PS1	902	245	cc	3			1DD00
PS1	905	245	Eugor	1			1DD00
PS1	905	245	ebry		1		1DD00
PS1	905	245	Para	7			1DD00
PS1	905	245	cc	30			1DD00
PS1	905	245	eo		1		1DD00
PS	907	245	Parast			1	1DD00
PS	909	245	Parast	1			1DD00
PS	909	245	Lyt	1			1DD00
PS	909	245	cc	30			1DD00
PS	909	245	Para	13			1DD00
PS	909	245	Calli	1			1DD00
PS	909	245	eo		5		1DD00
OS	910	240	sponge			1	1DD00
OS	910	240	Sebas			1	1DD00
PS	912	240	sponge			1	1DD00
PS	912	240	Para			M	1DD00
PS	912	240	cc			M	1DD00
PS	912	240	eo			1	1DD00
OS2	918	240	cc			M	1D0EH
OS2	918	240	Sebas			1	1D0EH
OS2	918	240	gorg			1	1D0EH
O/PXS2	920	240	oph			1	2D0EH
O/PXS2	920	240	cc			1	2D0EH
O/PXS2	920	240	Oct			1	2D0EH
O/PXS2	920	240	Lyt			M	2DOEH
O/PXS2	920	240	Med			1	2DOEH
O/PXS2	920	240	Acan			1	2D0EH
O/PXS2	920	240	Sebas			1	2DOEH
O/PXS2	920	240	Agon			1	2D0EH
O/PXS2	920	240	Coryph			1	2D0EH

HARD BOTTOM DATA
TRANSECT 1 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/PXS2	920	240	sponge			1	2D0EH
PS2	923	240	soltun	1			1DD00
PS2	923	240	eo		10		1DD00
PS2	923	240	Para	4			1DD00
PS2	923	240	cc	10			1DD00
O/P	925	240	Para	3			1DDEH
O/P	925	240	ebry			1	1DDEH
PX	926	240	Parast			1	1DDEH
PX	926	240	cc			1	1DDEH
PX	926	240	ebry			1	1DDEH
PS	926	240	Para			1	1DDEH
PX	926	240	eo			1	1DDEH
PX	926	240	oph			1	1DDEH
O/P	934	240	Oct			1	2DDEH
O/P	934	240	Parast			1	2DDEH
O/P	934	240	Med			1	2DDEH
O/P	934	240	Srubri			1	2DDEH
O/P	934	240	nudi			1	2DDEH
O/P	934	240	Acan			1	2DDEH
O/P	934	240	aeolid			1	2DDEH
O/P	934	240	Para	7			2DDEH
O/P	934	240	Coryph	1			2DDEH
O/P	934	240	cc	15			2DDEH
O/P	934	240	eo		10		2DQEH
PX	936	240	Oct			1	20000
PX	937	240	Acan			1	20000
PX	937	240	Lyt			1	20000
O/P	939	240	Stauro			1	2DDEH
O/P	939	240	Oct			1	2DDEH
O/P	939	240	Parast			1	2DDEH
O/P	939	240	Ptilo			1	2DDEH
O/P	941	240	Acan			1	20000
O/P	941	240	Med			1	20000
O/P	941	240	spongev			1	20000
O/P	941	240	Oct			1	20000
O/P	941	240	Lyt			1	20000
O/P	941	240	oph			1	20000
P	942	240	NO			0	20000
O	943	240	cc			1	10000
O	943	240	ebry			1	10000
O/P	944	230	Oct	1			1D0E0
O/P	944	230	Acan			1	1D0E0
O/P	944	230	esponge			1	1D0E0
O/P	945	230	Oct			1	1000E
O/P	945	230	Zan			1	1000E
O/P	945	230	sponge			1	1000E
O/P	945	230	rgorg			1	1000E
O/P	945	230	Hen			1	1000E
O/P	945	230	Stachy			1	1000E
O/P	945	230	cc			1	1000E

HARD BOTTOM DATA
TRANSECT 1 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	945	230	Pleuro			1	1000E
O/P	945	230	Luid			1	1000E
O/P	945	230	Scaur			1	1000E
O/P	945	230	Coryph			1	1000E
O/P	945	230	Para			1	1000E
PX	947	230	Lyt			1	1DD00
PX	947	230	Para			1	1DD00
PX	947	230	cc			1	1DD00
PX	947	230	eo			1	1DD00
O	948	230	Acan			1	20000
O/P	949	230	Luid			1	10000
O/P	949	230	Oct			1	10000
O/P	949	230	sponge		1		10000
O/P	949	230	Para	10			10000
O/P	949	230	cc	6			10000
O/P	949	230	eo		3		10000
O/P	949	230	Sebas			1	10000
PX	950	230	Lyt			1	20000
O	951	230	Oct			1	10D00
O	951	230	Parast			1	10D00
O	951	230	Zanlat			1	10D00
O	951	230	cc			1	10D00
O	952	240	cc			1	10DEH
O	952	240	sponge			1	10DEH
O	952	240	Pleuro			1	10DEH
O	952	240	Oct			1	10DEH
O	952	240	Parast			1	10DEH
O	952	240	Lyt			1	10DEH
O	952	240	Zan			M	10DEH
PX	953	240	NO			0	20000
OP	955	240	Lyt	1			2DD00
OP	955	240	Para			1	2DDEH
OP	955	240	Cya			1	2DDEH
OP	955	240	Parast			1	2DDEH
OP	955	240	Oct			1	2DDEH
O	956	240	Parast			1	2D0EH
O	956	240	Oct			1	2D0EH
O	956	240	Acan			1	2D0EH
O	956	240	sponge			1	2D0EH
O	956	240	cc			1	2D0EH
O	957	240	Med			1	2D0EH
O/P	957	240	Zanlat			1	2D0EH
O/P	957	240	Sebas			1	2D0EH
O/P	957	240	Acan			1	2D0EH
O/P	957	240	Oct			1	2D0EH
O/P	957	240	Para			1	2D0EH
O/P	957	240	Lyt	3		1	2D0EH
PX	958	240	NO			0	20000
O	959	240	Luid			1	20000
O/P	1000	240	Para			1	2D0E0

HARD BOTTOM DATA
TRANSECT 1 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1000	240	Med			1	2D0E0
O/P	1000	240	Pleuro			1	2D0E0
O/P	1000	240	Astro			1	2D0E0
O/P	1000	240	Lyt			1	2D0E0
P	1001	240	Oct	1			20000
P	1001	240	Lyt	2			20000
O/P	1003	240	ebry			1	10DEH
O/P	1003	240	Hen			1	10DEH
O/P	1003	240	Agon			1	10DEH
O/P	1003	240	cc			M	10DEH
O/P	1003	240	sponge			M	10DEH
O/P	1003	240	hyd			1	10DEH
O/P	1003	240	Parast			1	10DEH
O/P	1003	240	Lyt			1	10DEH
O/P	1003	240	eo			1	10DEH
O	1004	240	Sebas			1	1DDEH
P	1005	240	Para	2			1DD00
P	1005	240	eo		1		1DD00
P	1005	240	Lyt	1			1DD00
P	1005	240	flat	1			1DD00
O/P	1006	240	Lyt			1	20000
O/P	1006	240	Oct			M	20000
O/P	1006	240	Med			1	20000
O/P	1006	240	Parast			1	20000
O	1007	240	Oct			1	20000
O	1007	240	Lyt			1	20000
P	1008	240	Lyt	2			20000
P	1009	240	Lyt	6			20000
O	1010	240	Oct			1	2D0EH
O	1010	240	Lyt			1	2D0EH
O	1010	240	ebry			1	2D0EH
O	1010	240	Para			1	2D0EH
O	1010	240	aeolid			1	2D0EH
P	1011	240	Lyt	3			20000
O	1012	240	Calli			1	2DDEH
O	1012	240	Med			1	2DDEH
O/PS3	1013	235	Oct			1	2D0E0
O/PS3	1013	235	Sebas			1	2D0E0
O/PS3	1013	235	Lyt	1			2D0E0
O/PS3	1013	235	eo		1		2D0E0
O/PS3	1013	235	Agon			1	2D0E0
PS3	1014	235	Lyt			1	20000
OS3	1015	235	Med			1	2D000
OS3	1015	235	Lyt			1	2D000
OS3	1015	235	Luid			1	2D000
OS3	1015	235	Panda			M	2D000
OS3	1015	235	Zan			1	2D000
OS3	1015	235	Oct			1	2D000
OS3	1015	235	Sebas			1	2D000
PS3	1016	235	NO			0	20000

HARD BOTTOM DATA
TRANSECT 1 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PS3	1017	235	NO			0	20000
O	1018	235	Oct			1	20000
O	1018	235	Lyt			1	20000
O	1018	235	Panda			1	20000
P	1019	235	NO			0	20000
O	1020	235	Parast			1	20000
P	1021	235	Lyt	1			20000
O/P	1022	235	Lyt	1			10DE0
O/P	1022	235	Oct			1	10DE0
O/P	1022	235	Lyt			1	10DE0
O/P	1022	235	sponge			1	10DE0
PS4	1024	235	NO			0	20000
OSS4	1025	235	Para			1	10000
OSS4	1025	235	sponge			1	10000
OSS4	1025	235	ebry			1	10000
PS	1027	235	Lyt	2			200E0
O/PS	1029	235	ebry		5		20DE0
O/PS	1029	235	rgorg	1			20DE0
O/PS	1029	235	Lyt	6			20DE0
O/PS	1029	235	Sty	1			20DE0
O/PS	1029	235	Hen			1	20DE0
O/P	1030	235	zoan			1	20DE0
O/P	1030	235	Para	1			20DE0
O/P	1030	235	Lyt	1			20DE0
O/P	1030	235	eo			1	20DE0
O/P	1032	235	cc			1	200E0
O/P	1032	235	sponge			1	200E0
P	1033	235	Lyt	3			20000
OS5	1038	235	Cancer			1	20000
OS5	1039	235	Oct			1	20000
OS5	1039	235	Parast			1	20000
O/PS5	1040	235	Lyt			1	200EH
O/PS5	1040	235	Parast			1	200EH
O/PS5	1040	235	Stachy			1	200EH
O/PS5	1040	235	spongev			1	200EH
O/PS5	1040	235	hyd			1	200EH
O/PS5	1040	235	ebry			1	200EH
O/PS5	1041	235	spongev			1	1DDEH
O/PS5	1041	235	hydaglo			1	1DDEH
O/PS5	1041	235	Para			1	1DDEH
O/PS5	1041	235	Lyt			1	1DDEH
O/PS5	1043	235	Ptilo			1	100EH
OS5	1044	235	Lyt			M	20000
OS5	1044	235	Stachy			1	20000
OS5	1044	235	Parast			1	20000
OS5	1044	235	Oct			1	20000
PS5	1045	235	Lyt			1	20000
PS5	1045	235	seap			1	20000
PS5	1046	235	Lyt	6			20000
PXS5	1051	235	eo		1		20000

HARD BOTTOM DATA
TRANSECT 1 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PXS5	1054	235	Lyt	6			20000
PXS5	1054	235	Oct	1			20000
PXS5	1054	235	flat	1			20000

HARD BOTTOM DATA
TRANSECT 1 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/PS1	1641	250	Lyt			1	2D000
O/PS1	1641	250	Oct			1	2D000
O/PS1	1641	250	Acan			1	2D000
PS1	1643	250	NO			0	2D000
P	1645	250	NO			0	20000
PS	1646	250	NO			0	20000
P	1648	250	Lyt			1	20000
P	1649	250	NO			0	20000
O/P	1651	250	Med	1			1CD00
O/P	1651	250	Calli	1			1CD00
O/P	1651	250	Para	23			1CD00
O/P	1651	250	cc	23			1CD00
O/P	1651	250	ebry		1		1CD00
O/P	1651	250	eo		10		1CD00
O/P	1651	250	Acan			1	1CD00
O/P	1651	250	Sebas			1	1CD00
O/P	1651	250	Astro			1	1CD00
P	1653	250	Para	17			1DAE0
P	1653	250	cc	22			1DAE0
P	1653	250	eo		3		1DAE0
P	1653	250	Oct			1	1DAE0
P	1654	250	eo		2		1DDE0
P	1654	250	cc	1			1DDE0
PX	1656	250	NO			0	10000
PX	1657	250	Eugor			1	1DD00
PX	1657	250	cc			1	1DD00
PX	1657	250	eo			1	1DD00
O/P	1659	245	Sros			1	10000
O/P	1659	245	Parast			1	10000
O/P	1659	245	Scaur			1	10000
O/P	1659	245	Oct			1	10000
O/P	1659	245	Med			1	10000
O/P	1659	245	Lyt			1	10000
O/P	1659	245	Acan			1	10000
O/P	1659	245	Cithar			1	10000
PX	1701	245	NO			0	10D00
O	1703	250	Zanlat			1	10000
O	1703	250	Med			1	10000
O	1703	250	Sebas			1	10000
O	1703	250	Oct			1	10000
O	1703	250	Callig			1	10000
O	1703	250	Eugor			1	10000
PS2	1705	250	Parast	1			10D00
PS2	1705	250	eo		1		10D00
PS2	1705	250	ebry		1		10D00
PS2	1709	250	Para	6			10D00
PS2	1709	250	cc	4			10D00
PS2	1709	250	eo		2		10D00
PS2	1710	250	Para	12			10D00

HARD BOTTOM DATA
TRANSECT 1 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PS2	1710	250	cc	14			10D00
PS2	1710	250	ebry			1	10D00
PS2	1710	250	eo		5		10D00
PS2	1713	250	Para	17			10D00
PS2	1713	250	cc	12			10D00
PS2	1713	250	Calli	1			10D00
PS2	1713	250	eo		20		10D00
PS2	1717	250	sponge		1		10D00
PS2	1717	250	Para	20			10D00
PS2	1717	250	cc	15			10D00
PS2	1717	250	eo		10		10D00
P	1721	250	Eugor	1			10D00
P	1721	250	Parast	1			10D00
P	1721	250	eo		10		10D00
P	1721	250	Para	30			10D00
P	1721	250	cc	20			10D00
O	1722	250	Pat			1	2D000
O	1722	250	Lyt			1	2D000
O	1722	250	cc			1	2D000
O	1722	250	Pleuro			1	2D000
O	1722	250	Oct			1	2D000
O	1722	250	Astro			1	2D000
O	1722	250	sabell			1	2D000
P	1723	250	eo			1	20000
O/P	1725	255	Zanlat			1	2D000
O/P	1725	255	Parast	1			2D000
O/P	1725	255	Lyt	1			2D000
O/P	1725	255	Oct			1	2D000
O/P	1725	255	Veron			1	2D000
O/P	1725	255	Med			1	2D000
O/P	1725	255	Cithar			1	2D000
O/P	1725	255	Met			1	2D000
O/P	1725	255	Acan			1	2D000
P	1726	255	NO			0	20000
P	1728	255	Para	1			20000
PX	1729	255	NO			0	20000
O	1731	250	nudi			1	10000
O	1731	250	hyd			1	10000
O	1731	250	Oct			M	10000
O	1731	250	Phido			1	10000
O	1731	250	Med			1	10000
O	1731	250	ebry			1	10000
O	1731	250	Tere			1	10000
PX	1733	250	Para			1	2DD00
PX	1733	250	cc			1	2DD00
PX	1733	250	gast			1	2DD00
P	1734	250	Para	5			1DD00
P	1734	250	cc	3			1DD00
P	1734	250	eo		10		1DD00
O/P	1736	250	Lyt			1	2DDEI

HARD BOTTOM DATA
TRANSECT 1 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1736	250	Perid			1	2DDEI
P	1737	250	NO			0	20000
O	1738	250	Para			M	10000
O	1738	250	Berth			1	10000
O	1738	250	Tere			1	10000
O	1738	250	Sebas			M	10000
O/P	1739	250	Oct			1	20000
O/P	1739	250	Lyt			1	20000
O/P	1739	250	Pleuro			1	20000
O/P	1739	250	Astro			1	20000
O/P	1739	250	Parast			1	20000
PX	1741	250	NO			0	10D00
P	1742	250	eo			1	20000
OP/S3	1744	250	sponge			1	10000
OP/S3	1744	250	cc			1	10000
OP/S3	1744	250	Oct			1	10000
OP/S3	1744	250	Lyt			1	10000
P	1753	250	NO			0	20000
O	1754	255	Pleuro			1	20000
O	1754	255	Zan			1	20000
O	1754	255	Astro			1	20000
P	1755	255	NO			0	20000
O/P	1757	250	Eugor			1	100E0
O/P	1757	250	Hen			1	100E0
O/P	1757	250	nudi			1	100E0
O/P	1757	250	hyd			1	100E0
O/P	1757	250	Muri			1	100E0
O/P	1757	250	Oct			1	100E0
O/P	1757	250	Pagur			1	100E0
O/P	1757	250	Acan			1	100E0
O/P	1757	250	Sfran			1	100E0
O/P	1757	250	Sebas			M	100E0
O/P	1757	250	Pleuro			1	100E0
O/P	1757	250	cc			1	100E0
P	1758	250	cc	1			10D00
P	1758	250	ebry		1		10D00
O	1759	250	Parast			1	1A0E0
O	1759	250	Med			1	1A0E0
O	1759	250	Oct			1	1A0E0
O	1759	250	sponge			1	1A0E0
O	1759	250	Para			1	1A0E0
P	1803	250	Parast	1			20000
O/P	1805	245	Eugor			1	10D00
O/P	1805	245	Coeno			1	10D00
O/P	1805	245	Para			1	10D00
O/P	1805	245	cc			1	10D00
O/P	1805	245	Leuc			1	10D00
O/P	1805	245	Allo			1	10D00
O/P	1805	245	Perid			1	10D00
O/P	1805	245	cc			M	10D00

HARD BOTTOM DATA
TRANSECT 1 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1805	245	Hen			1	10D00
O/P	1805	245	Sros			1	10D00
P	1806	245	Leuc			1	10D00
P	1806	245	Para	14			10D00
P	1806	245	cc	5			10D00
P	1806	245	eo		5		10D00
PX	1808	245	Coeno			1	10D00
PX	1808	245	Para			1	10D00
PX	1808	245	cc			M	10D00
PX	1808	245	eo			M	10D00
PX	1809	245	Coeno			1	10D00
PX	1809	245	Para			M	10D00
PX	1809	245	cc			M	10D00
PX	1809	245	polycs			1	10D00
PX	1809	245	pbump			1	10D00
O/PS4	1813	245	Coeno		15		10C00
O/PS4	1813	245	Para	54			10C00
O/PS4	1813	245	cc	5			10C00
O/PS4	1813	245	crab	1			10C00
O/PS4	1813	245	Hen			1	10C00
O/PS4	1813	245	Sros			1	10C00
PX	1814	245	Para			1	10B00
PX	1814	245	cc			1	10B00
PX	1814	245	eo			M	10B00
PX	1814	245	Coeno			1	10B00
PX	1816	245	Leuc			1	1DD00
PX	1816	245	Para			M	1DD00
PX	1816	245	cc			1	1DD00
PX	1816	245	Hen			1	1DD00
PS5	1821	245	soltun		1		1DD00
PS5	1821	245	Para	12			1DD00
PS5	1821	245	cc	15			1DD00
PS5	1821	245	eo		15		1DD00
PS5	1821	245	crab	1			1DD00
PS5	1822	245	soltun	1			1DD00
PS5	1822	245	Para	30			1DD00
PS5	1822	245	cc	10			1DD00
PS5	1822	245	eo	15			1DD00
PS5	1822	245	pbump			1	1DD00
PS5	1825	245	Med	1			1DD00
PS5	1825	245	Para	27			1DD00
PS5	1825	245	cc	5			1DD00
PS5	1825	245	Leuc	3			1DD00
PS5	1825	245	eo		15		1DD00
O	1827	250	Med			1	20000
O	1827	250	Coryph			1	20000
O	1827	250	pleuro			1	20000
O/P	1829	250	cc			1	10D00
O/P	1829	250	ebry			1	10D00
O/P	1829	250	Zan			1	10D00

HARD BOTTOM DATA
TRANSECT 1 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1829	250	Para	1			10D00
O/P	1829	250	Parast	1			10D00
O/P	1829	250	Oct			1	10D00
P	1830	250	Lyt	1			2D000
P	1832	250	NO			0	2D000
PX	1833	250	Para			1	2DD00
PX	1833	250	cc			1	2DD00
PX	1833	250	Lyt			1	2DD00
PX	1835	250	Lyt			1	2D000
P	1837	250	Para	4			2CD00
PX	1838	250	Para	4			1DD00
PX	1838	250	eo		1		1DD00
P	1841	250	NO				2D000
P	1843	250	Lyt	2			2CD00
P	1843	250	gast	1			2CD00
P	1843	250	Para	1			2CD00
P	1843	250	cc	1			2CD00
P	1843	250	Parast	1			2CD00
PX	1845	250	NO			0	2D000
O/P.	1846	255	Lyt			M	10D00
O/P	1846	255	Para	1			10D00
O/P	1846	255	Parast			1	10D00
O/P	1846	255	Hen			1	10D00
O/P	1846	255	Pagur			1	10D00
O/P	1846	255	cc			1	10D00
O/P	1846	255	Oct			1	10D00
O/P	1846	255	Zan			1	10D00
O/P	1846	255	Perid			1	10D00
O/P	1846	255	rgorg			1	10D00
O/P	1848	255	Parast			1	10D00
O/P	1848	255	Para			1	10D00
O/P	1848	255	cc			1	10D00
O/P	1849	255	NO			0	10000
O/P	1851	255	Sty			1	2D000
O/P	1851	255	Flabell			1	2D000
O/P	1851	255	Eugor			1	2D000
O/P	1851	255	Hydro			1	2D000
O/P	1851	255	Hen			1	2D000
O/P	1851	255	Coryph			1	2D000
O/P	1851	255	Med			1	2D000
O/P	1851	255	Lyt			1	2D000
PXS6	1853	255	Lyt			1	2DD00
PXS6	1853	255	eo			1	2DD00
PXS6	1854	255	Para			1	1CD00
PXS6	1854	255	cc			1	1CD00
PXS6	1854	255	Lyt			1	1CD00
PXS6	1854	255	eo			1	1CD00
OS6	1855	260	Lyt	25			2D000
OS6	1855	260	Scon			1	2D000
PS6	1856	260	shrimp	1			2D000

HARD BOTTOM DATA
TRANSECT 1 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PS6	1901	260	NO			0	2D000
PS6	1904	265	NO			0	2D000

HARD BOTTOM DATA
TRANSECT 2 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1150	400	Floro			M	1D0EJ
O	1150	400	oph			M	1D0EJ
O	1150	400	Spaus			1	1D0EJ
O	1150	400	brac			1	1D0EJ
O	1150	400	cc			1	1D0EJ
O	1150	400	brac			1	1D0EJ
O	1151	400	brach			1	1D0FI
O	1151	400	oph			M	1D0FI
O	1151	400	shelf			M	1D0FI
O	1151	400	Floro			M	1D0FI
O	1151	400	serp			1	1D0FI
O	1206	340	Coryn			1	1DAGH
O	1206	340	Scon			1	1DAGH
O	1209	340	Lophe			1	1DAGH
O	1209	340	Gorgon			1	1DAGH
O	1209	340	Allop			1	1DAGH
O	1209	340	sponge			M	1DAGH
O	1209	340	Coryn			1	1DAGH
O	1209	340	gala			1	1DAGH
O	1215	340	Lophe			M	1D0GH
O	1215	340	sponge			1	1D0GH
OS1	1223	380	Med			1	1DDEI
OS1	1223	380	Floro			M	1DDEI
OS1	1223	380	Gorgon			1	1DDEI
OS1	1223	380	oph			1	1DDEI
OS2	1235	380	Actin			1	1DD00
OS2	1235	380	Flora			1	1DD00
OS2	1235	380	soltun			1	1DD00
OS2	1235	380	Oct			1	1DD00
OS3	1244	380	vases			1	1DD0J
OS3	1244	380	brac			1	1DD0J
OS3	1244	380	Med			1	1DD0J
OS3	1244	380	gorg			1	1DD0J
OS3	1244	380	Sebas			1	1DD0J
OS3	1244	380	Gorgon			M	1DD0J
OS3	1244	380	Allo			1	1DD0J
OS3	1244	380	shelf			1	1DD0J
OS3	1244	380	rgorg			1	1DD0J
O	1248	380	Actin			1	1DD0I
O	1248	380	shelf			1	1DD0I
O	1248	380	Sebas			1	1DD0I
O	1248	380	oph			M	1DD0I
O	1248	380	Floro			M	1DD0I
O	1251	380	Pyura			1	1DDF0
O	1251	380	vases			1	1DDF0
O	1251	380	shelf			1	1DDF0
O	1251	380	gala			1	1DDF0
O	1251	380	Poran			1	1DDF0
O	1251	380	Actin			1	1DDF0

HARD BOTTOM DATA
TRANSECT 2 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1251	380	Gorgon			1	1DDF0
O	1253	330	shelf			1	1D0FI
O	1253	330	Perid			1	1D0FI
O	1253	330	Coeno			1	1D0FI
O	1253	330	Actin			1	1D0FI
O	1253	330	Lophe			1	1D0FI
O	1253	330	gorg			1	1D0FI
O	1301	330	sponge			1	1D0GH
O	1301	330	Lophe			M	1D0GH
O	1301	330	shelf			1	1D0GH
O	1301	330	Coryn			1	1D0GH
O	1306	330	Lophe			1	1DAGH
O	1306	330	Ophiod			1	1DAGH
O	1306	330	zoan			1	1DAGH
O	1306	330	Srubi			1	1DAGH
OS4	1320	420	Gorgon			1	10DEL
OS4	1320	420	gorg			1	10DEL
OS4	1320	420	Allo			1	10DEL

HARD BOTTOM DATA
TRANSECT 2 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS1	1700	410	Sebas			1	2D000
OS1	1700	410	gast			1	2D000
OS1	1700	410	Med			1	2D000
OS1	1700	410	hermit			1	2D000
OS1	1700	410	Megas			1	2D000
OS1	1700	410	Para			1	2D000
OS1	1700	410	Allo			1	2D000
OS1	1702	410	Srubri			1	2D000
OS1	1702	410	Sebas			1	2D000
OS1	1702	410	Ophia			1	2D000
OS1	1702	410	gorg			1	2D000
OS1	1702	410	oph			1	2D000
OS1	1702	410	Allo			1	2D000
OS1	1702	410	Perid			1	2D000
O	1710	410	gorg			1	2DD00
O	1710	410	Med			1	2DD00
O	1710	410	Allo			1	2DD00
O	1710	410	cc			1	2DD00
O	1712	410	Med			1	2D000
O	1712	410	Allo			1	2D000
O	1712	410	Megas			1	2D000
O	1712	410	flat			1	2D000
O	1712	410	cc			1	2D000
O	1712	410	hermit			1	2D000
O	1715	410	Med			M	2D000
O	1715	410	soltun			1	2D000
O	1715	410	Allo			1	2D000
O	1715	410	Neptu			1	2D000
O	1715	410	Lopho			1	2D000
O	1716	410	Gorgon			1	10000
O	1716	410	Ophia			M	10000
O	1716	410	Floro			1	10000
OS2	1723	410	Ophia			M	1DD00
OS2	1723	410	Floro			M	1DD00
OS2	1723	410	Med			M	1DD00
OS2	1723	410	Allo			1	1DD00
OS2	1723	410	Perid			1	1DD00
OS2	1723	410	ccw			1	1DD00
OS2	1723	410	gorgp			M	1DD00
O	1725	410	Gorgon			1	10000
O	1725	410	seap			1	10000
O	1725	410	Allo			1	10000
O	1725	410	Med			1	10000
O	1725	410	Bal			1	10000
O	1725	410	gast			1	10000
O	1725	410	oph			1	10000
O	1727	410	Med			1	2D000
O	1727	410	Allo			1	2D000
O	1727	410	oph			1	2D000
O	1727	410	brac			1	2D000

HARD BOTTOM DATA
TRANSECT 2 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1727	410	Oct			1	2D000
O	1729	410	Allo			1	20000
O	1729	410	ccw			1	20000
O	1729	410	Oct			M	20000
O	1729	410	Gorgon			1	20000
O	1729	410	sponge			1	20000
O	1729	410	hermit			1	20000
O	1729	410	Para			1	20000
O	1729	410	Cya			1	20000
O	1729	410	seap			1	20000
O	1731	410	Oct			M	2D0EH
O	1731	410	Med			M	2D0EH
O	1731	410	hermit			1	2D0EH
O	1732	410	Oct			1	2D0EH
O	1732	410	Med			1	2D0EH
O	1732	410	hermit			1	2D0EH
O	1732	410	Lopho			1	2D0EH
O	1735	410	Met			1	2D0EH
O	1735	410	flat			1	2D0EH
O	1735	410	Hydro			1	2D0EH
O	1735	410	Gorgon			1	2D0EH
O	1735	410	Oct			1	2D0EH
O	1737	410	Megas			1	2D0EH
O	1737	410	Oct			1	2D0EH
O	1737	410	ccw			1	2D0EH
O	1737	410	cco			1	2D0EH
O	1737	410	ccy			1	2D0EH
O	1737	410	Allo			M	2D0EH
O	1737	410	Med			M	2D0EH
O	1737	410	hermit			1	2D0EH
O	1739	410	gorg			1	2D0EH
O	1739	410	Hippas			1	2D0EH
O	1739	410	Ptilo			1	2D0EH
O	1739	410	sponge			1	2D0EH
O	1739	410	serp			1	2D0EH
O	1739	410	Allo			M	2D0EH
O	1740	410	Gorgon			1	10000
O	1740	410	gorg			1	10000
O	1740	410	Lopho			M	10000
O	1740	410	sponge			1	10000
O	1740	410	brac			1	10000
O	1740	410	Floro			1	10000
O	1740	410	Sebas			1	10000
O	1740	410	Allo			1	10000
O	1740	410	Ophia			M	10000
O	1741	410	gorg			1	2D0EH
O	1741	410	Hydro			1	2D0EH
O	1741	410	ccw			1	2D0EH
O	1741	410	Oct			1	2D0EH
O	1741	410	Allo			M	2D0EH

HARD BOTTOM DATA
TRANSECT 2 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1741	410	Med			1	2D0EH
O	1741	410	hermit			1	2D0EH
O	1741	410	Cottid			1	2D0EH
O	1746	410	Allo			M	200E0
O	1746	410	Gorgon			1	200E0
O	1746	410	Oct			1	200E0
O	1746	410	Cottid			1	200E0
O	1751	410	Lopho			1	200E0
O	1751	410	Allo			1	200E0
O	1751	410	Med			1	200E0
O	1754	410	Allo			1	200E0
O	1754	410	Med			1	200E0
O	1754	410	gast			M	200E0
O	1754	410	Oct			1	200E0
O	1754	410	Stylas			1	200E0
O	1754	410	Gorgon			1	200E0
O	1756	410	Megas			1	200E0
O	1756	410	Oct			1	200E0
O	1756	410	Lopho			1	200E0
O	1756	410	seap			1	200E0
O	1757	410	Oct			1	200E0
O	1757	410	Stylas			1	200E0
O	1757	410	Med			1	200E0
O	1757	410	Allo			1	200E0
O	1757	410	seap			1	200E0
O	1758	410	cc			1	200E0
O	1758	410	Med			1	200E0
O	1758	410	serp			1	200E0
O	1758	410	Lopho			1	200E0
O	1758	410	hermit			1	200E0
O	1758	410	gorgp			1	200E0
O	1759	410	Gorgon			1	200E0
O	1759	410	soltun			1	200E0
O	1759	410	Allo			1	200E0
O	1759	410	ast			1	200E0
O	1759	410	Oct			1	200E0
O	1801	410	Med			1	2D0E0
O	1801	410	Megas			1	2D0E0
O	1814	410	Med			1	2D0E0
O	1814	410	Allo			1	2D0E0
O	1814	410	Oct			1	2D0E0
O	1815	410	Med			1	2D0E0
O	1815	410	gast			1	2D0E0
O	1816	410	Med			1	2D0E0
O	1816	410	Perid			1	2D0E0
O	1816	410	Para			1	2D0E0
O	1816	410	Cya			1	2D0E0
O	1816	410	Ptilo			1	2D0E0
O	1817	410	flat			1	2D0E0
O	1817	410	Allo			M	2D0E0

HARD BOTTOM DATA
TRANSECT 2 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1817	410	Med			1	2D0E0
O	1817	410	Oct			1	2D0E0
O	1817	410	gorgp			1	2D0E0
O	1817	410	Neptu			1	2D0E0
O	1817	410	Megas			1	2D0E0
O	1817	410	cc			1	2D0E0
O	1819	410	sponge			1	2D0E0
O	1819	410	ast			1	2D0E0
O	1819	410	Megas			1	2D0E0
O	1819	410	hermit			1	2D0E0
O	1819	410	Med			M	2D0E0
O	1819	410	Allo			M	2D0E0
O	1820	410	Megas			1	2D0E0
O	1820	410	Mitra			1	2D0E0
O	1820	410	Allo			1	2D0E0
O	1820	410	oph			1	2D0E0
O	1820	410	Cya			1	2D0E0
O	1820	410	Met			1	2D0E0
O	1821	410	Lopho			1	2D0E0
O	1821	410	Hippas			1	2D0E0
O	1823	410	Lopho			1	2D0E0
O	1823	410	Oct			1	2D0E0
O	1823	410	Gorgon			1	2D0E0
O	1823	410	Med			1	2D0E0
O	1823	410	Megas			1	2D0E0
O	1823	410	Allo			1	2D0E0
O	1825	410	gorgp			1	2D0E0
O	1825	410	Oct			1	2D0E0
O	1825	410	Med			1	2D0E0
O	1825	410	Allo			1	2D0E0
O	1826	410	Oct			1	2D0E0
O	1826	410	Megas			1	2D0E0
O	1826	410	Allo			1	2D0E0
O	1826	410	Med			1	2D0E0
O	1826	410	zoan			1	2D0E0
O	1828	400	Med			1	2D0E0
O	1828	400	Allo			1	2D0E0
O	1828	400	oph			1	2D0E0
O	1828	400	seap			1	2D0E0
O	1828	400	Cya			1	2D0E0
O	1828	400	Para			1	2D0E0
O	1828	400	Oct			1	2D0E0

HARD BOTTOM DATA
TRANSECT 4 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS1	1001	790	Allo	.3			2D000
OS1	1001	790	Parali			1	2D000
OS1	1001	790	Bris	.5			2D000
OS1	1001	790	Fusi			1	2D000
OS1	1001	790	flat			1	2D000
OS1	1001	790	hermit			1	2D000
OS1	1001	790	Oct			1	2D000
OS1	1001	790	Szac			1	2D000
O	1005	790	Sdiplo			1	2D000
O	1005	790	hermit			1	2D000
O	1005	790	shrimp			1	2D000
O	1005	790	Met			1	2D000
O	1005	790	Zoarcid			1	2D000
O	1007	770	flat			1	2D000
O	1009	770	Sty			1	2D000
O	1009	770	Lycob			1	2D000
O	1009	770	Pagur			1	2D000
O	1013	770	Bris			M	2D000
O	1013	770	Allo			1	2D000
O	1013	770	hermit			1	2D000
O	1013	770	Sty			1	2D000
O	1013	770	Oct			1	2D000
O	1013	770	Epta			1	2D000
O/P	1017	750	oph			.1	2D000
O/P	1017	750	Hydro			1	10000
O/P	1017	750	Panda			1	10000
O/P	1017	750	Rajas			1	10000
O/P	1017	750	Parast			1	10000
O/P	1017	750	Allo			1	10000
O/P	1017	750	hermit			1	10000
O	1020	750	Sty			1	2D000
O	1020	750	eo			1	2D000
O/P	1022	710	Ophiod			1	2D000
O/P	1022	710	Hydro			1	2D000
O/P	1022	710	oph			1	2D000
O	1023	710	redsea			1	2D000
O	1023	710	anem			1	2D000
O	1023	710	Panda			1	2D000
O/P	1024	710	Panda			1	2D000
O/P	1024	710	Bris			1	2D000
O/P	1024	710	Zoarcid			1	2D000
PX	1025	710	heart			1	2D000
O	1027	710	Med			1	2D000
O	1027	710	Panda			1	2D000
P	1028	710	oph			1	2D000
O	1029	670	Sty			1	2D000
O	1029	670	Ophid			1	2D000
O/P	1030	670	Parast			1	2D000
O/P	1030	670	flat			1	2D000
O/P	1030	670	oph			1	2D000

HARD BOTTOM DATA
TRANSECT 4 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1034	650	anema			1	2D000
O	1034	650	Sty			1	2D000
O	1034	650	flat			1	2D000
P	1035	650	oph			1	2D000
O/P	1036	630	Met			1	2D000
O/P	1036	630	Sty			1	2D000
O/P	1036	630	Parast			1	2D000
O/P	1036	630	redsea			1	2D000
O/P	1036	630	oph			1	2D000
O/P	1036	630	Zoarcid			1	2D000
O/P	1036	630	Agon			1	2D000
P	1038	630	oph			1	2D000
P	1040	630	oph			1	2D000
O/P	1041	630	Met			1	1DDFH
O/P	1041	630	Sebas			1	1DDFH
O/P	1041	630	Actin			1	1DDFH
O/P	1041	630	oph			1	1DDFH
O/P	1041	630	Desmo			1	1DDFH
O/P	1041	630	Ophia	3			1DDFH
O/P	1041	630	redsea	1			1DDFH
O/P	1041	630	Stylas	1			1DDFH
O/P	1041	630	Lophe			1	1DDFH
O/P	1041	630	Tere	4			1DDFH
O/P	1041	630	gast	2			1DDFH
O/P	1041	630	Para	1			1DDFH
O/P	1041	630	Perid	1			1DDFH
O/P	1041	630	cc	3			1DDFH
O/P	1041	630	eo		1		1DDFH
P	1043	630	Met		1		1D0F0
P	1043	630	Actin		1		1D0F0
P	1043	630	eo		1		1D0F0
O	1045	620	Met			M	1D0F0
O	1045	620	Med			1	1D0F0
O	1045	620	Ophia			1	1D0F0
O	1045	620	Desmo			1	1D0F0
O	1045	620	oph			1	1D0F0
O	1045	620	Gorgon			1	1D0F0
O	1045	620	Rath			1	1D0F0
O	1045	620	shelf			1	1D0F0
O	1045	620	Actin			1	1D0F0
P	1046	620	Met	1			1DD00
P	1046	620	Ophia	2			1DD00
P	1046	620	oph	6			1DD00
P	1046	620	eo		1		1DD00
P	1046	620	ccw	1			1DD00
P	1046	620	gast	2			1DD00
P	1048	620	Met			1	1DD00
P	1048	620	Med			1	1DD00
P	1048	620	Ophia			1	1DD00
P	1048	620	gala			1	1DD00

HARD BOTTOM DATA
TRANSECT 4 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
P	1048	620	Oct			1	1DD00
P	1048	620	cc			1	1DD00
P	1048	620	Coryn			1	1DD00
O/P	1049	615	oph			1	2D000
O/P	1049	615	Met			1	2D000
O/P	1049	615	Rath			1	2D000
P	1051	615	oph			1	2D000
P	1051	615	polycs			1	2D000
P	1052	615	oph			1	2D000
OS2	1053	600	Selong			1	2D000
OS2	1053	600	Ophid			1	2D000
OS2	1053	600	Parast			1	2D000
OS2	1053	600	Sty			1	2D000
OS2	1053	600	oph			1	2D000
OS2	1053	600	Med			1	2D000
OS2	1056	600	oph			1	2D000
OS2	1056	600	polycs			1	2D000
OS2	1057	580	Perid			1	2D000
OS2	1057	580	hermit			1	2D000
OS2	1057	580	Hydro			1	2D000
O/PS2	1059	570	Med			1	2D000
O/PS2	1059	570	ast			1	2D000
O/PS2	1059	570	Zanlat			1	2D000
O/PS2	1059	570	Oct			1	2D000
O/PS2	1059	570	oph			1	2D000
P	1100	570	oph			1	2D000
O/P	1102	560	Rath			1	2D000
O/P	1102	560	Epta			1	2D000
O/P	1102	560	oph			1	2D000
P	1104	540	oph			1	2D000
O/P	1105	540	oph			1	2D000
O/P	1105	540	Oct			1	2D000
O/P	1105	540	Zoarcid			1	2D000
O/P	1105	540	anema			1	2D000
PXS3	1107	540	NO			0	2D000
PS3	1108	540	oph			1	2D000
O/PS3	1110	560	Met	4			10DE0
O/PS3	1110	560	Ophia	2			10DE0
O/PS3	1110	560	oph	7			10DE0
O/PS3	1110	560	eo		1		10DE0
O/PS3	1110	560	Perid	1			10DE0
O/PS3	1110	560	anema	1			10DE0
O/PS3	1110	560	ccw	1			10DE0
O/PS3	1110	560	anema	1			10DE0
O/PS3	1110	560	Stylas			1	10DE0
O/PS3	1110	560	ebry			1	10DE0
O/PS3	1110	560	rgorg			1	10DE0
O/PS3	1110	560	Floro			1	10DE0
O/PS3	1110	560	cc			1	10DE0
O/PS3	1110	560	polycs			1	10DE0

HARD BOTTOM DATA
TRANSECT 4 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PXS3	1115	560	redsea			1	10000
PXS3	1115	560	Allo			1	10000
PXS3	1115	560	oph			1	10000
PXS3	1116	560	Met			1	10000
PXS3	1116	560	Floro			1	10000
PXS3	1116	560	Ophia			1	10000
PXS3	1116	560	Halo			1	10000
PXS3	1116	560	rgorg			1	10000
PXS3	1116	560	gast			1	10000
PXS3	1128	560	Sfran			1	10000
PXS3	1128	560	Met			1	10000
O/PS3	1131	560	Met	7			1DDEH
O/PS3	1131	560	Ophia	4			1DDEH
O/PS3	1131	560	oph	6			1DDEH
O/PS3	1131	560	Halo	1			1DDEH
O/PS3	1131	560	Tere	1			1DDEH
O/PS3	1131	560	ccw	4			1DDEH
O/PS3	1131	560	Fusi	1			1DDEH
O/PS3	1131	560	Actin			1	1DDEH
O/PS3	1131	560	Gorgon			1	1DDEH
O/PS3	1131	560	stauro			1	1DDEH
O/PS3	1131	560	cc			1	1DDEH
O/PS3	1131	560	shelf			1	1DDEH
O/PS3	1131	560	Loxo			1	1DDEH
P	1134	560	Met			1	1DD00
P	1134	560	Ophia			1	1DD00
P	1134	560	Tere			1	1DD00
O	1135	570	Sebas			1	1D0FH
O	1135	570	brac			M	1D0FH
O	1135	570	shelf			1	1D0FH
O	1135	570	cc			M	1D0FH
O	1135	570	gala			1	1D0FH
O/PS4	1137	570	rgorg			1	1DDFH
O/PS4	1137	570	vases			1	1DDFH
O/PS4	1137	570	Met			M	1DDFH
O/PS4	1137	570	Tere			M	1DDFH
O/PS4	1137	570	Ophia			M	1DDFH
O/PS4	1137	570	oph			1	1DDFH
O/PS4	1137	570	Actin			1	1DDFH
O/PS4	1137	570	Gorgon			1	1DDFH
O/PS4	1137	570	anem	10			1DDFH
O/PS4	1137	570	gala	3			1DDFH
O/PS4	1137	570	eo		10		1DDFH

HARD BOTTOM DATA
TRANSECT 6 A/B, 6 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	941	200	Met			1	2DDE0
O/P	941	200	Med			1	2DDE0
O/P	941	200	cc			1	2DDE0
O/P	941	200	Luid			1	2DDE0
O/P	941	200	Oct			1	2DDE0
O/P	941	200	Cithar			1	2DDE0
P	944	200	NO			0	2D000
O/P	946	200	Coryn			1	1DDEH
O/P	946	200	Para			1	1DDEH
O/P	946	200	Bal			1	1DDEH
O/P	946	200	cc			M	1DDEH
O/P	946	200	ebry			1	1DDEH
O/P	946	200	Sserra			1	1DDEH
O/P	946	200	Phido			1	1DDEH
O/P	947	200	Scaur			1	1DDEH
O/P	947	200	Sserra			1	1DDEH
O/P	947	200	Parast			1	1DDEH
O/P	947	200	Met			1	1DDEH
O/P	947	200	sponge			1	1DDEH
O/P	947	200	Sros			1	1DDEH
O/P	947	200	Oct			1	1DDEH
O/P	947	200	nudl			1	1DDEH
O/P	947	200	gorg			1	1DDEH
O/P	947	200	Para	8			1DDEH
O/P	947	200	cc	145			1DDEH
O/P	947	200	soltun	1			1DDEH
O/P	947	200	eo		1		1DDEH
O	950	205	Dama			1	1DDE0
O	950	205	Para			1	1DDE0
O	950	205	hydaglo			1	1DDE0
O	950	205	sponge			1	1DDE0
O	950	205	Srubri			1	1DDE0
O	950	205	cc			1	1DDE0
PS1	951	205	Med	1			1DDE0
PS1	951	205	Coryn			1	1DDE0
PS1	951	205	Cad	1			1DDE0
PS1	951	205	eo		2		1DDE0
PS1	951	205	Para	5			1DDE0
PS1	951	205	cc	120			1DDE0
PS1	951	205	ebry			1	1DDE0
PS1	952	205	Psolus	1			1DDE0
PS1	952	205	Coryph	1			1DDE0
PS1	952	205	sponge			1	1DDE0
PS1	952	205	cc	55			1DDE0
PS1	952	205	vases			1	1DDE0
PS1	952	205	Sros			1	1DDE0
PS1	1007	205	sponge			1	1DDE0
PS1	1007	205	cc	85			1DDE0
PS1	1007	205	Scaur			1	1DDE0
PS1	1015	205	Coryph	2			1DDE0

HARD BOTTOM DATA
TRANSECT 6 A/B, 6 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PS1	1015	205	sponge			1	1DDE0
PS1	1015	205	eo		2		1DDE0
PS1	1015	205	cc	36			1DDE0
PS1	1015	205	ebry			1	1DDE0
PS1	1015	205	Parast			1	1DDE0
PS1	1015	205	rgorg			1	1DDE0
OS1	1024	205	Phido			1	1DDE0
OS1	1024	205	Coryn			1	1DDE0
OS1	1024	205	Met			1	1DDE0
OS1	1024	205	hydaglo			1	1DDE0
OS1	1024	205	shelf			1	1DDE0
O	1030	205	Megas			1	1DDEH
O	1030	205	soltun			1	1DDEH
O	1030	205	cc			1	1DDEH
O	1030	205	Sfran			1	1DDEH
O	1030	205	shelf			1	1DDEH
PX	1035	205	Poly			1	1DDEH
PX	1035	205	gast			1	1DDEH
PX	1035	205	eo			1	1DDEH
PX	1035	205	Coryn			1	1DDEH
PX	1035	205	cc			M	1DDEH
O/P	1037	205	nudi			1	1DDEH
O/P	1037	205	Para			1	1DDEH
O/P	1037	205	Hydro			1	1DDEH
O/P	1037	205	Med			1	1DDEH
O/P	1037	205	shelf			1	1DDEH
O/P	1037	205	sponge			1	1DDEH
O/P	1037	205	Coryn			M	1DDEH
P	1039	205	Coryph	1			1DDEH
P	1039	205	hydaglo		3		1DDEH
P	1039	205	zoan			1	1DDEH
P	1039	205	eo		1		1DDEH
P	1039	205	sponge		2		1DDEH
P	1039	205	cc	60			1DDEH
P	1039	205	Poly			1	1DDEH
O	1040	210	Med			1	2DDE0
O	1040	210	Oct			1	2DDE0
O	1040	210	Sty			1	2DDE0
O	1040	210	rgorg			1	2DDE0
O	1040	210	Met			1	2DDE0
O	1040	210	Tealia			1	2DDE0
O	1040	210	Para			1	2DDE0
O/P	1045	210	flat			1	2D000
O/P	1045	210	Sty			1	2D000
O	1049	210	Met			1	1DDEH
O	1050	210	Met			1	1DDEH
O	1050	210	Coryn			1	1DDEH
O	1050	210	Med			1	1DDEH
O	1050	210	rgorg			1	1DDEH
O/P	1051	210	Met			1	1DDEH

HARD BOTTOM DATA
TRANSECT 6 A/B, 6 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1051	210	rgorg	2			1DDEH
O/P	1051	210	cc	85			1DDEH
O/P	1051	210	Bal	1			1DDEH
O/P	1051	210	ebry		1		1DDEH
O/P	1051	210	eo		1		1DDEH
O/P	1051	210	zoan			1	1DDEH
O/P	1051	210	Neosim			1	1DDEH
O	1052	210	Cad			1	1DDEH
O	1052	210	rgorg			1	1DDEH
O/P	1053	210	Med			1	1DDEH
O/P	1053	210	Diaper			1	1DDEH
O	1054	210	Met			1	2DDEH
O	1054	210	shelf			1	2DDEH
O	1054	210	Parast			1	2DDEH
O/P	1055	210	Poly			1	1DDEH
O/P	1055	210	rgorg			1	1DDEH
O/P	1055	210	ebry			1	1DDEH
O/P	1055	210	eo			1	1DDEH
O/P	1055	210	sponge			1	1DDEH
O/P	1055	210	cc			M	1DDEH
O/P	1055	210	gast			1	1DDEH
O/P	1055	210	Megas			1	1DDEH
O/P	1056	210	Med			1	1DDEH
O/P	1056	210	Met			1	1DDEH
O	1057	210	Diaper			1	1DDEH
O	1057	210	rgorg			1	1DDEH
O	1100	210	NO			0	1DDEH
O	1101	210	Coeno			1	1DDFH
O	1102	210	Hydro			1	1DDEH
O	1102	210	Srubri			1	1DDEH
O/P	1103	190	Parast			1	1DDEH
O/P	1103	190	Corph			1	1DDEH
O/P	1103	190	Phido			1	1DDEH
O/P	1103	190	sponge			1	1DDEH
O/P	1103	190	eo			1	1DDEH
O/P	1103	190	cc			M	1DDEH
O	1104	190	NO			0	2D000
O	1105	190	Coryn			1	1DDEH
O	1107	190	Eugor			1	1DDEH
O	1107	190	Hen			1	1DDEH
O	1107	190	nudi			1	1DDEH
O	1107	190	Parast			1	1DDEH
O/P	1109	190	Parast			1	1DDEH
O/P	1109	190	cc			M	1DDEH
O/P	1109	190	ebry			1	1DDEH
O/P	1109	190	Pat			1	1DDEH
O/P	1109	190	Hen			1	1DDEH
O/P	1109	190	Gib			1	1DDEH
O/P	1109	190	Cephalo			1	1DDEH
O/P	1109	190	Cancer			1	1DDEH

HARD BOTTOM DATA
TRANSECT 6 A/B, 6 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1112	180	Pat			1	1DDFH
O/P	1112	180	Sserra			1	1DDFH
O/P	1112	180	Sros			1	1DDFH
O/P	1112	180	Smys			1	1DDFH
O/P	1112	180	Dermas			1	1DDFH
O/P	1112	180	shelf			1	1DDFH
O/P	1112	180	Parast			1	1DDFH
O/P	1112	180	cc			1	1DDFH
PS2	1117	180	Med	1			1DDFH
PS2	1117	180	Parast	2			1DDFH
PS2	1117	180	sponge		2		1DDFH
PS2	1117	180	nudi	1			1DDFH
PS2	1117	180	cc	125			1DDFH
PS2	1117	180	ebry			1	1DDFH
PS2	1120	180	Coryph	2			1DD0H
PS2	1120	180	sponge			1	1DD0H
PS2	1120	180	cc	220			1DD0H
O/PS2	1122	180	nudi			1	1DDEH
O/PS2	1122	180	Corph	2			1DDEH
O/PS2	1122	180	sponge			1	1DDEH
O/PS2	1122	180	eo		5		1DDEH
O/PS2	1122	180	ebry			1	1DDEH
O/PS2	1122	180	zoan			1	1DDEH
O/PS2	1123	180	flat			1	2D000
O/PS2	1123	180	Luid			1	2D000
O/PS2	1123	180	Pat			1	2D000
O/PS2	1123	180	Med			1	2D000
O	1124	180	shelf			1	1DDFH
O	1124	180	rgorg			1	1DDFH
O/P	1125	180	Zan			1	2D000
O/P	1128	180	NO			0	20000
O/P	1133	180	Poly		1		1DDEH
O/P	1133	180	eo		1		1DDEH
O/P	1133	180	cc	10			1DDEH
O/P	1133	180	zoan			1	1DDEH
O/P	1133	180	Oct			1	1DDEH
O/P	1133	180	rgorg			1	1DDEH
O/P	1133	180	Med			1	1DDEH
O/P	1133	180	Corph			1	1DDEH
O/P	1133	180	Para			1	1DDEH
O/P	1133	180	Coryn			1	1DDEH
O/P	1135	180	Coryph	1			1DDEH
O/P	1135	180	Oph	1			1DDEH
O/P	1135	180	Bal	1			1DDEH
O/P	1135	180	Parast	1			1DDEH
O/P	1135	180	soltun	1			1DDEH
O/P	1135	180	cc	17			1DDEH
O/P	1135	180	shelf			1	1DDEH
O/P	1135	180	Sty			1	1DDEH
O/P	1135	180	Luid			1	1DDEH

HARD BOTTOM DATA
TRANSECT 13 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PX	913	315	cc			1	1DDEI
PX	913	315	eo			1	1DDEI
P	914	315	cc	18			1DDEI
P	914	315	rgorg	2			1DDEI
P	914	315	eo		15		1DDEI
O/P	916	315	Perid	2			1DDEI
O/P	916	315	ast	1			1DDEI
O/P	916	315	rgorg	2			1DDEI
O/P	916	315	Ophia	7			1DDEI
O/P	916	315	ccw	9			1DDEI
O/P	916	315	Para	3			1DDEI
O/P	916	315	cc	22			1DDEI
O/P	916	315	eo		2		1DDEI
O/P	916	315	Oct			1	1DDEI
O/P	916	315	Rath			1	1DDEI
O/P	916	315	Stylas			1	1DDEI
O/P	916	315	Poran			1	1DDEI
O/P	916	315	Clinid			1	1DDEI
O/P	916	315	shrimp			1	1DDEI
O/P.	916	315	Sebas			1	1DDEI
PX	917	315	rgorg			1	1DDE0
PX	917	315	ast			1	1DDE0
PX	917	315	Ophia			1	1DDE0
PX	917	315	ccw			1	1DDE0
PX	917	315	cc			1	1DDE0
PX	917	315	Bal			1	1DDE0
PX	917	315	ebry			1	1DDE0
PX	917	315	eo			1	1DDE0
O	918	310	Stylas			1	1DDEI
O	918	310	Sebas			1	1DDEI
O	918	310	gorg			1	1DDEI
O	918	310	Met			1	1DDEI
O	918	310	Perid			1	1DDEI
O	918	310	Parast			M	1DDEI
O	918	310	soltun			1	1DDEI
O	918	310	Coryph			1	1DDEI
O	918	310	Cancer			1	1DDEI
O	918	310	cc			1	1DDEI
O	918	310	shrimp			1	1DDEI
O	918	310	vases			1	1DDEI
P	918	310	rgorg	5			1DDE0
P	918	310	Ophia	1			1DDE0
P	918	310	ccw	3			1DDE0
P	918	310	Para	1			1DDE0
P	918	310	cc	23			1DDE0
P	918	310	ebry		1		1DDE0
P	918	310	eo		3		1DDE0
O/PX	921	305	Met			1	1DDEI
O/PX	921	305	cc			1	1DDEI
O/PX	921	305	hyd			1	1DDEI

HARD BOTTOM DATA
TRANSECT 13 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/PX	921	305	ebry			1	1DDEI
O/PX	921	305	gorg			1	1DDEI
O/PX	921	305	Stylas			1	1DDEI
O/PX	921	305	rgorg			M	1DDEI
O/PX	921	305	Med			1	1DDEI
O/PX	921	305	Perid			1	1DDEI
O/PX	921	305	Para			1	1DDEI
O/PX	921	305	ccw			1	1DDEI
O/PX	921	305	cc			1	1DDEI
O/PX	921	305	eo			1	1DDEI
PXS4	922	305	Met			1	1DDEI
PXS4	922	305	rgorg			1	1DDEI
PXS4	922	305	Stylas			1	1DDEI
PXS4	922	305	eo			1	1DDEI
OSS4	927	305	Met			1	1DDEI
OSS4	927	305	Shop			1	1DDEI
OSS4	927	305	Gorgon			1	1DDEI
OSS4	927	305	Hen			1	1DDEI
OSS4	927	305	vases			1	1DDEI
OSS4	927	305	Triton			1	1DDEI
OSS4	927	305	spongea			1	1DDEI
PX	929	305	Med			1	1DDEI
PX	929	305	Hen			1	1DDEI
PX	929	305	rgorg			1	1DDEI
PX	929	305	ccw			1	1DDEI
PX	929	305	cc			1	1DDEI
PX	929	305	Parast			1	1DDEI
PX	929	305	eo			1	1DDEI
PX	930	305	rgorg			1	1DDEI
PX	930	305	ccw			1	1DDEI
PX	930	305	cc			1	1DDEI
PX	930	305	eo			1	1DDEI
PX	930	305	encrust			1	1DDEI
O	931	300	vases			1	1DDEI
O	931	300	Triton			1	1DDEI
O	931	300	Perid			1	1DDEI
O	931	300	shelf			1	1DDEI
P	932	300	Med	2			1DDEI
P	932	300	Parast	1			1DDEI
P	932	300	rgorg	2			1DDEI
P	932	300	ccw	6			1DDEI
P	932	300	cc	63			1DDEI
P	932	300	eo		5		1DDEI
O	933	315	Gorgon			1	1DDE0
O	933	315	Met			1	1DDE0
O	933	315	Hen			1	1DDE0
O	933	315	Med			1	1DDE0
O	933	315	Sebas			1	1DDE0
O	933	315	Srubri			1	1DDE0
O	933	315	Megas			1	1DDE0

HARD BOTTOM DATA
TRANSECT 13 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	934	320	Sty			1	2D000
O	934	320	Med			1	2D000
O	934	320	Selong			1	2D000
O	934	320	Cithar			1	2D000
O	934	320	Acan			1	2D000
O	934	320	Luid			1	2D000
O	934	320	Oct			1	2D000
O	934	320	anem			1	2D000
O	934	320	Sebas			1	2D000
O/P	937	315	Med	1			2D000
O/P	937	315	Oct	1			2D000
O/P	938	315	Ptilo			1	2D000
O/P	938	315	Luid			1	2D000
O/P	938	315	Oct			1	2D000
O/P	938	315	Acan			1	2D000
O/P	938	315	Med			1	2D000
O/P	938	315	Sty			1	2D000
O/P	938	315	Cithar			1	2D000
O/P	941	305	Sebas			1	2D000
O/P	941	305	flat			1	2D000
O/P	941	305	Oct			M	2D000
O/P	941	305	Acan			1	2D000
O/P	941	305	oph			1	2D000
O	943	310	Med			1	2D000
O	943	310	Sty			1	2D000
O	943	310	Cithar			1	2D000
O	943	310	Luid			1	2D000
O	943	310	Oct			1	2D000
O	943	310	Rath			1	2D000
O	943	310	Zan			1	2D000
O	943	310	oph			1	2D000
O	943	310	Ptilo			1	2D000
P	945	310	oph			1	2D000
P	946	310	flat	1			2D000
P	946	310	Lyt	1			2D000
P	948	310	NO			0	2D000
O	949	305	Lyt			1	2D000
O	949	305	Zan			1	2D000
O	951	305	Sebas			1	2D000
O	951	305	Lyt			1	2D000
O	951	305	Sty			1	2D000
O	951	305	Acan			1	2D000
O	951	305	Ptilo			1	2D000
O	951	305	Oct			M	2D000
O	951	305	Luid			1	2D000
O	954	305	Oct			1	2D000
O	954	305	oph			1	2D000
O	954	305	Sebas			1	2D000
O	954	305	Met			1	2D000
O	954	305	anem			1	2D000

HARD BOTTOM DATA
TRANSECT 13 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
P	956	305	anema	1			2D000
O/P	957	305	oph			1	2D000
O/P	957	305	Selong			1	2D000
O/P	957	305	Luid			1	2D000
O/P	957	305	Sty			1	2D000
O/P	957	305	Acan			1	2D000
O/P	957	305	Zan			1	2D000
O/P	957	305	Oct			1	2D000
O/PS5	959	300	Oct			1	2D000
OS5	1007	300	Lyt			1	2D000
OS5	1007	300	Megas			1	2D000
O	1010	300	Met			M	1DDEH
O	1010	300	Sebas			1	1DDEH
O	1010	300	Stylas			1	1DDEH
O	1010	300	Sserra			1	1DDEH
O	1010	300	Spin			1	1DDEH
O	1010	300	Ophiod			1	1DDEH
O	1010	300	crab			1	1DDEH
O	1010	300	Med			1	1DDEH
O/P	1013	300	Met			M	1DCFH
O/P	1013	300	Med	1			1DCFH
O/P	1013	300	cc	3			1DCFH
O/P	1013	300	eo		2		1DCFH
O/PX	1015	300	Met			1	1D0FH
O/PX	1015	300	Sebas			1	1D0FH
O/PX	1015	300	hermit			1	1D0FH
O/PX	1015	300	Sserra			1	1D0FH
O/PX	1015	300	crab			1	1D0FH
O/PX	1015	300	eo			1	1D0FH
PX	1018	300	Met			1	1DDFH
PX	1018	300	cc			1	1DDFH
PX	1018	300	eo			1	1DDFH
O/P	1020	300	gala			1	1DDFH
O/P	1020	300	Megas			1	1DDFH
O/P	1020	300	cc			1	1DDFH
O/P	1020	300	eo			1	1DDFH
O/P	1020	300	Met			1	1DDFH
O/P	1020	300	Sebas			1	1DDFH
O/P	1020	300	gast			1	1DDFH
O/P	1020	300	Sserra			1	1DDFH
O/P	1020	300	Sruber			1	1DDFH
O/P	1020	300	Sgood			1	1DDFH
O/P	1020	300	Megas			1	1DDFH
O	1025	300	Scaur			1	1DDEI
O	1025	300	Sruber			1	1DDEI
O/PXS6	1025	300	Sebas			1	1DDEI
O/PXS6	1026	300	Parast			1	2D0E0
O/PXS6	1026	300	oph			1	2D0E0
O/PXS6	1026	300	cc			1	2D0E0
O/PXS6	1026	300	Met			1	2D0E0

HARD BOTTOM DATA
TRANSECT 13 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/PXS6	1026	300	Cerian			1	2D0E0
O/PXS6	1026	300	Sebas			1	2D0E0
O/PXS6	1028	300	Met			M	1DDEI
O/PXS6	1028	300	gala			1	1DDEI
O/PXS6	1028	300	Protula			1	1DDEI
O/PXS6	1028	300	Perid			1	1DDEI
O/PXS6	1028	300	rgorg			1	1DDEI
O/PXS6	1028	300	Srubri			1	1DDEI
O/PXS6	1028	300	Sebas			1	1DDEI
O/PXS6	1029	300	cc			1	1DDEI
O/PXS6	1029	300	eo			1	1DDEI
O/PXS6	1029	300	Stylas			1	1DDEI
O/PXS6	1029	300	anem			1	1DDEI
O/PXS6	1029	300	Protula			1	1DDEI
O/PXS6	1029	300	Megas			1	1DDEI
O/PXS6	1029	300	hermit			1	1DDEI
O/PXS6	1029	300	Parast			1	1DDEI
O/PXS6	1029	300	Sebas			M	1DDEI
O/PXS6	1029	300	Met			M	1DDEI
O/PXS6	1029	300	Srubri			1	1DDEI
O/PXS6	1029	300	Hen			1	1DDEI
O/PXS6	1029	300	Perid			1	1DDEI
OS6	1032	300	Coryph			1	2D000
OS6	1032	300	Parast			1	2D000
OS6	1032	300	Med			1	2D000
OS6	1032	300	Sty			1	2D000
OS6	1032	300	Oct			1	2D000
OS6	1032	300	Acan			1	2D000
OS6	1032	300	Luid			1	2D000
O	1036	300	Met			1	2D000
O	1036	300	anem			1	2D000
O	1036	300	Luid			1	2D000
O	1036	300	Ophiod			1	2D000
O	1036	300	Sebas			1	2D000
O	1036	300	flat			1	2D000
O	1036	300	Med			1	2D000
P	1037	300	Sty	1			2D000
O/P	1039	300	Med	1			2D000
O/P	1039	300	Sty	1			2D000
O/P	1039	300	Lyt			1	2D000
O/P	1039	300	Acan			1	2D000
O/P	1039	300	anema			1	2D000
O/P	1039	300	Rath			1	2D000
O/P	1039	300	Ophiod			1	2D000
P	1040	300	Sebas				2D000
O/P	1042	300	Parast	1			1DDEI
O/P	1042	300	rgorg	11			1DDEI
O/P	1042	300	ccw	5			1DDEI
O/P	1042	300	cc	22			1DDEI
O/P	1042	300	eo		1		1DDEI

HARD BOTTOM DATA
TRANSECT 13 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1042	300	Perid			1	1DDEI
O/P	1042	300	Met			1	1DDEI
O/P	1042	300	hyd			1	1DDEI
O/P	1042	300	soltun			1	1DDEI
O/P	1042	300	Pan			1	1DDEI
O/P	1042	300	hermit			1	1DDEI
O/P	1042	300	Hydro			1	1DDEI
O/P	1042	300	Coryph			1	1DDEI
PXS7	1047	300	Met			1	1DDEI
PXS7	1047	300	rgorg			1	1DDEI
PXS7	1047	300	cc			1	1DDEI
PXS7	1047	300	eo			1	1DDEI
PXS7	1047	300	encrust			1	1DDEI
O/PX	1056	303	gast			1	1DDEI
O/PX	1056	303	rgorg			1	1DDEI
O/PX	1056	303	Coryph			1	1DDEI
O/PX	1056	303	cc			1	1DDEI
O/PX	1056	303	eo			1	1DDEI
O/PX	1056	303	Met			1	1DDEI
O/PX	1056	303	Megas			1	1DDEI
O/PX	1056	303	hermit			1	1DDEI
O/PX	1056	303	Sebas			M	1DDEI
O/PX	1056	303	Protula			1	1DDEI
O/PX	1056	303	Scaur			1	1DDEI
O/PX	1056	303	Ophiod			1	1DDEI
O/PX	1056	303	Sserra			M	1DDEI
O/PX	1056	303	Srubri			1	1DDEI
O/PX	1056	303	Sruber			1	1DDEI
PX	1058	303	Med			1	1DDFI
PX	1058	303	rgorg			1	1DDFI
PX	1058	303	cc			1	1DDFI
O/PX	1100	295	Met			1	1DDFI
O/PX	1100	295	Med			1	1DDFI
O/PX	1100	295	Sebas			M	1DDFI
O/PX	1100	295	rgorg			1	1DDFI
O/PX	1100	295	cc			1	1DDFI
O/PX	1100	295	Srubri			1	1DDFI
O/PX	1100	295	Hydro			M	1DDFI
O/PX	1100	295	Ophiod			1	1DDFI
O/PX	1100	295	Sgood			1	1DDFI
O/PX	1100	295	Scaur			1	1DDFI
PX	1101	295	Med			1	1DDFI
PX	1101	295	Met			1	1DDFI
PX	1101	295	Hydro			1	1DDFI
PX	1101	295	Srubri			1	1DDFI
PX	1101	295	Sebas			1	1DDFI
O	1102	295	Ophiod			1	1DDEH
O	1102	295	Sgood			1	1DDEH
O	1102	295	Sebas			1	1DDEH
O	1102	295	Srubri			1	1DDEH

HARD BOTTOM DATA
TRANSECT 13 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1102	295	Met			1	1DDEH
O	1102	295	Med			M	1DDEH
O	1102	295	Sebas			M	1DDEH
O	1102	295	hermit			1	1DDEH
PX	1103	295	Met			1	1DDE0
PX	1103	295	Megas			1	1DDE0
PX	1103	295	rgorg			1	1DDE0
PX	1103	295	Sebas			1	1DDE0
O	1104	295	Med			1	2D000
O	1104	295	Sebas			1	2D000

HARD BOTTOM DATA
TRANSECT 14 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS1	1555	350	cc			M	1DDEH
OS1	1555	350	Rath			1	1DDEH
OS1	1555	350	Acan			1	1DDEH
OS1	1555	350	Med			1	1DDEH
OS1	1555	350	oph			1	1DDEH
OS1	1555	350	Ophia			1	1DDEH
OS1	1557	350	Actin			1	1DDEH
OS1	1557	350	Oct			1	1DDEH
OS1	1557	350	Sebas			1	1DDEH
OS1	1557	350	gorg			1	1DDEH
O	1603	350	Actin			1	1DDEH
O	1603	350	flat			1	1DDEH
O	1603	350	brac			1	1DDEH
O	1603	350	Stylas			1	1DDEH
O	1603	350	Allo			1	1DDEH
O	1603	350	Zanlat			1	1DDEH
O	1603	350	Med			1	1DDEH
O	1603	350	Stachy			1	1DDEH
O	1603	350	sponge			1	1DDEH
O	1607	350	Floro			1	1DDEH
O	1607	350	Sebas			1	1DDEH
O	1607	350	brac			1	1DDEH
O	1607	350	sponge			1	1DDEH
O	1607	350	Ophia			M	1DDEH
O	1607	350	oph			M	1DDEH
O	1607	350	Med			M	1DDEH
O	1607	350	Gorgon			1	1DDEH
O	1607	350	esponge			1	1DDEH
O	1607	350	shelf			1	1DDEH
O	1607	350	Cancerp			1	1DDEH
O	1610	350	shelf			1	1DDEH
O	1610	350	Halo			M	1DDEH
O	1610	350	oph			M	1DDEH
O	1610	350	Actin			1	1DDEH
O	1610	350	Med			1	1DDEH
O	1610	350	Sebas			1	1DDEH
O	1610	350	Allo			1	1DDEH
O	1610	350	rgorg			1	1DDEH
O	1610	350	Tere			1	1DDEH
O	1610	350	cc			M	1DDEH
P	1611	350	Ophia	13			1DDEH
P	1611	350	cc	60			1DDEH
P	1611	350	rgorg	1			1DDEH
O/PX	1613	350	Med			1	1DDEH
O/PX	1613	350	Allo			1	1DDEH
O/PX	1613	350	Ophia			1	1DDEH
O/PX	1613	350	cc			M	1DDEH
O/PX	1613	350	Parast			1	1DDEH
O/PX	1613	350	Zan			1	1DDEH
O/PX	1613	350	Oct			M	1DDEH

HARD BOTTOM DATA
TRANSECT 14 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/PX	1613	350	Sserra			1	1DDEH
O/PX	1613	350	Hen			1	1DDEH
O/PX	1613	350	nudi			1	1DDEH
O/PX	1613	350	Floro			1	1DDEH
O/PX	1613	350	Gorgon			1	1DDEH
O/PX	1613	350	Stylas			1	1DDEH
O/PX	1615	350	Actin			1	1DDFH
O/PX	1615	350	shelf			1	1DDFH
O/PX	1615	350	Sros			1	1DDFH
O/PX	1615	350	Sserra			1	1DDFH
O/PX	1615	350	cc			1	1DDFH
O/PX	1615	350	Para			1	1DDFH
O/PX	1615	350	Gorgon			1	1DDFH
O/PX	1615	350	Sebas			1	1DDFH
O/PX	1615	350	Perid			1	1DDFH
O/PX	1615	350	Sdiplo			1	1DDFH
P	1616	350	Med			1	1DD00
P	1616	350	Ophia			1	1DD00
P	1616	350	cc			M	1DD00
O	1617	340	Orth			1	1DD00
O	1617	340	Agon			1	1DD00
O	1617	340	Selong			1	1DD00
O	1617	340	cc			1	1DD00
O/P	1618	340	Raja			1	1DD00
O/P	1618	340	Zan			1	1DD00
O/P	1618	340	Stylas			1	1DD00
O/P	1618	340	Oct			1	1DD00
O/P	1618	340	Med	1			1DD00
O/P	1618	340	cc	30			1DD00
O/P	1618	340	Allo			1	1DD00
O/P	1618	340	Halo	3			1DD00
O/P	1618	340	oph			M	1DD00
O/P	1618	340	flat			1	1DD00
O/P	1618	340	brac			1	1DD00
O/P	1618	340	para	35			1DD00
O/P	1618	340	Calli	1			1DD00
P	1619	340	Ophia	10			1DD00
P	1619	340	ast	3			1DD00
P	1619	340	cc	11			1DD00
P	1619	340	Para	5			1DD00
P	1619	340	so		2		1DD00
P	1619	340	Halo	2			1DD00
P	1619	340	oph	3			1DD00
PX	1621	340	Floro			1	10000
PX	1621	340	Ophia			1	10000
PX	1621	340	Para			1	10000
PX	1621	340	cc			1	10000
O	1622	340	Sros			1	1DDEJ
O	1622	340	Sebas			1	1DDEJ
O	1622	340	Gorgon			1	1DDEJ

HARD BOTTOM DATA
TRANSECT 14 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1622	340	Floro			1	1DDEJ
O	1622	340	Stylas			1	1DDEJ
O	1622	340	shelf			1	1DDEJ
O	1622	340	oph			M	1DDEJ
O	1622	340	Protula			1	1DDEJ
O	1622	340	gala			1	1DDEJ
O	1622	340	Actin			1	1DDEJ
O	1622	340	Szac			1	1DDEJ
P	1623	340	Ophia	19			1DDEJ
P	1623	340	Parast	1			1DDEJ
P	1623	340	rgorg	3			1DDEJ
P	1623	340	Para	5			1DDEJ
P	1623	340	cc	5			1DDEJ
P	1623	340	Oct	1			1DDEJ
P	1623	340	eo		5		1DDEJ
PX	1624	340	Oct			1	1DDEJ
PX	1624	340	Halo			1	1DDEJ
PX	1624	340	rgorg			1	1DDEJ
PX	1624	340	Tere			1	1DDEJ
PX	1624	340	Ophia			1	1DDEJ
PX	1624	340	cc			1	1DDEJ
PX	1624	340	Para			1	1DDEJ
PX	1626	340	Med			1	1DDEJ
PX	1626	340	Coryph			1	1DDEJ
PX	1626	340	Ophia			1	1DDEJ
PX	1626	340	Halo			1	1DDEJ
PX	1626	340	cc			1	1DDEJ
P	1627	340	Floro	1			1DDEJ
P	1627	340	Ophia	7			1DDEJ
P	1627	340	Med	2			1DDEJ
P	1627	340	cc	10			1DDEJ
P	1627	340	Halo	1			1DDEJ
P	1627	340	soltun	1			1DDEJ
PX	1629	340	Ophia			1	1DDEJ
PX	1629	340	rgorg			1	1DDEJ
PX	1629	340	Halo			1	1DDEJ
PX	1629	340	cc			1	1DDEJ
P	1631	340	Perid	1			1DDEJ
P	1631	340	Ophia	7			1DDEJ
P	1631	340	rgorg	1			1DDEJ
P	1631	340	Para	15			1DDEJ
P	1631	340	cc	40			1DDEJ
P	1631	340	Halo	2			1DDEJ
PX	1632	340	Allo			1	1DDEJ
PX	1632	340	Med			1	1DDEJ
PX	1632	340	Ophia			1	1DDEJ
PX	1632	340	Para			1	1DDEJ
PX	1632	340	cc			1	1DDEJ
PX	1632	340	Halo			1	1DDEJ
PX	1632	340	gast			1	1DDEJ

HARD BOTTOM DATA
TRANSECT 14 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PX	1632	340	ast			1	1DDEJ
PX	1634	340	Ophia			1	1DDEJ
PX	1634	340	cc			1	1DDEJ
PX	1634	340	Med			1	1DDEJ
PX	1635	340	Halo			1	1DDEJ
PX	1635	340	Ophia			1	1DDEJ
PX	1635	340	Para			1	1DDEJ
PX	1635	340	cc			1	1DDEJ
P	1637	340	Med	1			1DDEJ
P	1637	340	Ophia	11			1DDEJ
P	1637	340	cc	20			1DDEJ
P	1637	340	Para	10			1DDEJ
P	1637	340	ast	1			1DDEJ
PS2	1639	340	Ophia	13			1DDEJ
PS2	1639	340	sponge		1		1DDEJ
PS2	1639	340	Para	2			1DDEJ
PS2	1639	340	cc	15			1DDEJ
PS2	1639	340	soltun	1			1DDEJ
PS2	1640	340	Ophia	14			1DDEJ
PS2	1640	340	Para	4			1DDEJ
PS2	1640	340	cc	11			1DDEJ
PS2	1640	340	eo		10		1DDEJ
PS2	1642	340	Med	1			1DDEJ
PS2	1642	340	Ophia	14			1DDEJ
PS2	1642	340	Para	1			1DDEJ
PS2	1642	340	cc	15			1DDEJ
PS2	1642	340	Perid	1			1DDEJ
O/PS2	1650	340	Hen	1			1DDEJ
O/PS2	1650	340	ast	1			1DDEJ
O/PS2	1650	340	rgorg	1			1DDEJ
O/PS2	1650	340	cc	40			1DDEJ
O/PS2	1650	340	Para	10			1DDEJ
O/PS2	1650	340	Ophia			1	1DDEJ
O/PS2	1650	340	oph			1	1DDEJ
O/PS2	1650	340	Med			1	1DDEJ
O/PS2	1650	340	Stylas			1	1DDEJ
O/PS2	1650	340	Oct			1	1DDEJ
O/PS2	1650	340	Rath			1	1DDEJ
O/PS2	1650	340	polycs			1	1DDEJ
O/PXS2	1656	340	Ophia			1	1DDE0
O/PXS2	1656	340	Med			1	1DDE0
O/PXS2	1656	340	Para			1	1DDE0
O/PXS2	1656	340	cc			1	1DDE0
O/PXS2	1656	340	Sebas			M	1DDE0
O/PXS2	1656	340	Selong			1	1DDE0
O/PXS2	1656	340	Allo			1	1DDE0
O/PXS2	1656	340	cc			M	1DDE0
O/PXS2	1656	340	Halo			1	1DDE0
O/PXS2	1656	340	Gorgon			1	1DDE0
O/PXS2	1656	340	shelf			1	1DDE0

HARD BOTTOM DATA
TRANSECT 14 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/PXS2	1656	340	oph			M	1DDE0
O/PXS2	1656	340	sponge			1	1DDE0
PX	1658	340	Ophia			1	1DDE0
PX	1658	340	Med			1	1DDE0
PX	1658	340	Para			1	1DDE0
PX	1658	340	cc			1	1DDE0
PX	1659	340	Med			1	1DDE0
PX	1659	340	Ophia			1	1DDE0
PX	1659	340	cc			1	1DDE0
O	1700	350	Szac			1	1DDEH
O	1700	350	Stylas			1	1DDEH
O	1700	350	Floro			1	1DDEH
O	1700	350	shelf			1	1DDEH
O	1700	350	oph			M	1DDEH
O	1700	350	gala			1	1DDEH
O	1700	350	Parast			1	1DDEH
PX	1701	350	Floro			1	1DDEH
PX	1701	350	Ophia			1	1DDEH
PX	1701	350	cc			1	1DDEH
O	1702	350	Hen			1	1DDEH
O	1702	350	Orth			1	1DDEH
O	1702	350	gala			1	1DDEH
O	1702	350	Lopho			1	1DDEH
O	1702	350	shelf			1	1DDEH
O	1702	350	Zan			1	1DDEH
O	1702	350	barrel			1	1DDEH
O	1702	350	Parast			1	1DDEH
O	1702	350	Poran			1	1DDEH
O	1702	350	Ophiod			1	1DDEH
PX	1703	350	Med			1	1DDEH
PX	1703	350	Halo			1	1DDEH
PX	1703	350	Para			1	1DDEH
PX	1703	350	cc			1	1DDEH
PX	1703	350	Ophia			1	1DDEH
O/P	1704	350	Bal	1			1DDEH
O/P	1704	350	rgorg	1			1DDEH
O/P	1704	350	Floro	1			1DDEH
O/P	1704	350	Ophia	7			1DDEH
O/P	1704	350	Oct	1			1DDEH
O/P	1704	350	cc	25			1DDEH
O/P	1704	350	Para	10			1DDEH
O/P	1704	350	Med			1	1DDEH
O/P	1704	350	Sebas			1	1DDEH
O/P	1704	350	Protula			1	1DDEH
O/P	1704	350	nudi			1	1DDEH
O/P	1704	350	Allo			1	1DDEH
O/P	1704	350	Met			1	1DDEH
O/P	1704	350	shelf			1	1DDEH
O/P	1704	350	Ophiod			1	1DDEH
O/P	1704	350	Actin			1	1DDEH

HARD BOTTOM DATA
TRANSECT 14 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1704	350	Rath			1	1DDEH
O/P	1704	350	oph			1	1DDEH
O/P	1704	350	Selong			1	1DDEH
O/P	1704	350	Gorgon			1	1DDEH
PX	1706	350	Ophia			1	1DDEH
PX	1706	350	Med			1	1DDEH
PX	1706	350	cc			1	1DDEH
PX	1706	350	Halo			1	1DDEH
O/P	1707	350	rgorg	1			1DDEH
O/P	1707	350	Ophia	6			1DDEH
O/P	1707	350	Para	7			1DDEH
O/P	1707	350	cc	10			1DDEH
O/P	1707	350	Halo	1			1DDEH
O/P	1707	350	encrust			1	1DDEH
O/P	1707	350	Floro			1	1DDEH
O/P	1707	350	Oct			1	1DDEH
O/P	1707	350	shelf			1	1DDEH
O/P	1707	350	Stylas			1	1DDEH
O/P	1707	350	Rath			1	1DDEH
O/P	1707	350	Actin			1	1DDEH
O/P	1707	350	Sebas			1	1DDEH
O/P	1707	350	Coryph			1	1DDEH
O/P	1707	350	Hen			1	1DDEH
PX	1709	350	Actin			1	1DDEI
PX	1709	350	soltun			1	1DDEI
PX	1709	350	Hen			1	1DDEI
PX	1709	350	Med			1	1DDEI
PX	1709	350	Ophia			1	1DDEI
PX	1709	350	cc			1	1DDEI
PX	1709	350	Halo			1	1DDEI
O	1710	350	Sebas			1	1DDEH
O	1710	350	cc			M	1DDEH
O	1710	350	Floro			1	1DDEH
PX	1711	350	rgorg			1	1DDEH
PX	1711	350	Ophia			1	1DDEH
PX	1711	350	Floro			1	1DDEH
PX	1711	350	cc			1	1DDEH
PX	1711	350	Para			1	1DDEH
PX	1711	350	Halo			1	1DDEH
PX	1711	350	soltun			1	1DDEH
P	1712	350	rgorg	1			1DDEI
P	1712	350	Floro	2			1DDEI
P	1712	350	Ophia	3			1DDEI
P	1712	350	Para	15			1DDEI
P	1712	350	cc	25			1DDEI
P	1712	350	Halo	2			1DDEI
P	1712	350	soltun	3			1DDEI
P	1712	350	eo	10			1DDEI
O/PX	1714	350	Floro			M	1DDE0
O/PX	1714	350	Med			1	1DDE0

HARD BOTTOM DATA
TRANSECT 14 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/PX	1714	350	Ophia			1	1DDE0
O/PX	1714	350	cc			1	1DDE0
O/PX	1714	350	Para			1	1DDE0
O/PX	1714	350	ast			1	1DDE0
O/PX	1714	350	eo			1	1DDE0
O/PX	1714	350	oph			M	1DDE0
O/PX	1714	350	Tere			1	1DDE0
O/PX	1714	350	Sebas			1	1DDE0
O/PX	1715	350	flat			1	1DDE0
O/PX	1715	350	Ophia			1	1DDE0
O/PX	1715	350	cc			1	1DDE0
O	1716	350	Stylas			1	1DDEH
O	1716	350	Rath			1	1DDEH
O	1716	350	cc			1	1DDEH
O	1716	350	oph			1	1DDEH
O	1716	350	Floro			1	1DDEH
O	1716	350	Actin			1	1DDEH
O	1716	350	Allo			1	1DDEH
O	1716	350	sponge			1	1DDEH
P	1717	350	crab	1			1DDEH
P	1717	350	Ophia	1			1DDEH
P	1717	350	Para	33			1DDEH
P	1717	350	cc	5			1DDEH
P	1717	350	encrust			1	1DDEH
O/PX	1719	330	Floro			1	1DDEH
O/PX	1719	330	Med			1	1DDEH
O/PX	1719	330	Ophia			1	1DDEH
O/PX	1719	330	cc			1	1DDEH
O/PX	1719	330	Gorgon			1	1DDEH
O/PX	1719	330	Szac			1	1DDEH
O/PX	1719	330	sponge			1	1DDEH
O/PX	1719	330	Floro			1	1DDEH
O/PX	1719	330	Protula			1	1DDEH
O/PX	1720	330	Med			1	1DDEH
O/PX	1720	330	Floro			1	1DDEH
O/PX	1720	330	ast			1	1DDEH
O/PX	1720	330	Ophia			1	1DDEH
O/PX	1720	330	oph			1	1DDEH
O/PX	1720	330	Halo			1	1DDEH
O/PX	1720	330	cc			1	1DDEH
O/PX	1720	330	shelf			1	1DDEH
O/PX	1720	330	Stylas			1	1DDEH
O/PX	1720	330	Protula			1	1DDEH
O/PX	1720	330	barrel			1	1DDEH
O/P	1722	330	Actin	1			1DDEH
O/P	1722	330	Para	11			1DDEH
O/P	1722	330	cc	13			1DDEH
O/P	1722	330	ccw	2			1DDEH
O/P	1722	330	Ophia	3			1DDEH
O/P	1722	330	Coryph	1			1DDEH

HARD BOTTOM DATA
TRANSECT 14 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1722	330	eo		1		1DDEH
O/P	1722	330	Halo	1			1DDEH
O/P	1722	330	sponge			1	1DDEH
O/P	1722	330	Met			1	1DDEH
O/P	1722	330	Protula			1	1DDEH
O/PX	1723	330	Oct			1	1DDEH
O/PX	1723	330	Tere			1	1DDEH
O/PX	1723	330	Ophia			1	1DDEH
O/PX	1723	330	Para			1	1DDEH
O/PX	1723	330	ccw			1	1DDEH
O/PX	1723	330	cc			1	1DDEH
O/PX	1723	330	Halo			1	1DDEH
O/PX	1723	330	Phido			1	1DDEH
O/PX	1723	330	Floro			1	1DDEH
O/PX	1723	330	oph			1	1DDEH
O/PX	1723	330	anem			1	1DDEH
O/PX	1723	330	Orth			1	1DDEH
O/PX	1723	330	Sebas			1	1DDEH
O/PX	1723	330	Stylas			1	1DDEH
O/PX	1723	330	Gorgon			1	1DDEH
O/PX	1723	330	Actin			1	1DDEH
O/PX	1723	330	gala			1	1DDEH
O/PX	1723	330	Sgood			1	1DDEH
O/PX	1723	330	aeolid			1	1DDEH
O/P	1725	320	gala	2			1DDEH
O/P	1725	320	rgorg	3			1DDEH
O/P	1725	320	Ophia	2			1DDEH
O/P	1725	320	ccw	4			1DDEH
O/P	1725	320	Para	16			1DDEH
O/P	1725	320	cc	70			1DDEH
O/P	1725	320	eo		10		1DDEH
O/P	1725	320	oph	1			1DDEH
O/P	1725	320	ebry			1	1DDEH
O/P	1725	320	gast			1	1DDEH
O/P	1725	320	Floro			M	1DDEH
O/P	1725	320	Rath			1	1DDEH
O/P	1725	320	Stylas			1	1DDEH
O/P	1725	320	Med			1	1DDEH
PX	1727	320	Allo			1	1DDEI
PX	1727	320	Floro			1	1DDEI
PX	1727	320	Ophia			1	1DDEI
PX	1727	320	cc			1	1DDEI
PX	1727	320	Perid			1	1DDEI
PX	1728	320	Ophia			1	1DDE0
PX	1728	320	cc			1	1DDE0
O/PX	1730	320	ast			1	1DDEH
O/PX	1730	320	Ophia			1	1DDEH
O/PX	1730	320	cc			1	1DDEH
O/PX	1730	320	Pter			1	1DDEH
O/PX	1730	320	Protula			1	1DDEH

HARD BOTTOM DATA
TRANSECT 14 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/PX	1730	320	Selong			1	1DDEH
O/PX	1730	320	Zanlat			1	1DDEH
O/PX	1730	320	Pagur			1	1DDEH
O/PX	1730	320	Floro			1	1DDEH
O/PX	1730	320	Actin			1	1DDEH
O/PX	1730	320	seap			1	1DDEH
O/P	1731	320	Actin	1			1DDEJ
O/P	1731	320	Ophia	10			1DDEJ
O/P	1731	320	eo		3		1DDEJ
O/P	1731	320	Para	45			1DDEJ
O/P	1731	320	ccw	2			1DDEJ
O/P	1731	320	cc	55			1DDEJ
O/P	1731	320	Tere			1	1DDEJ
O/P	1731	320	Parast			1	1DDEJ
O/P	1731	320	Med			1	1DDEJ
O/P	1731	320	sponge			1	1DDEJ
O/P	1731	320	nudi			1	1DDEJ
O/P	1731	320	oph			1	1DDEJ
O/P	1733	320	Parast	1			1DDEJ
O/P	1733	320	Tere	2			1DDEJ
O/P	1733	320	ebry			1	1DDEJ
O/P	1733	320	Ophia	6			1DDEJ
O/P	1733	320	rgorg	4			1DDEJ
O/P	1733	320	shelf			1	1DDEJ
O/P	1733	320	Med	1			1DDEJ
O/P	1733	320	Halo	1			1DDEJ
O/P	1733	320	Para	14			1DDEJ
O/P	1733	320	cc	35			1DDEJ
O/P	1733	320	ccw	2			1DDEJ
O/P	1733	320	Hen			1	1DDEJ
O/P	1733	320	Oct			1	1DDEJ
O/P	1733	320	Neptu			1	1DDEJ
O/P	1733	320	Sebas			1	1DDEJ
O/P	1733	320	Protula			1	1DDEJ
O/PX	1734	320	Floro			M	1DDEJ
O/PX	1734	320	Selong			1	1DDEJ
O/PX	1734	320	Ophia			1	1DDEJ
O/PX	1734	320	cc			M	1DDEJ
O/PX	1734	320	Parast			1	1DDEJ
PX	1736	320	Med			1	1DDEI
PX	1736	320	Stachy			1	1DDEI
PX	1736	320	Ophia			1	1DDEI
PX	1736	320	Para			1	1DDEI
PX	1736	320	cc			1	1DDEI
O	1737	320	seap			1	1DDEI
O	1737	320	Oct			1	1DDEI
O	1737	320	shelf			1	1DDEI
O	1737	320	Halo			1	1DDEI
O/P	1738	320	Orth			1	1DDEH
O/P	1738	320	Med	3			1DDEH

HARD BOTTOM DATA
TRANSECT 14 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1738	320	Ophia	1			1DDEH
O/P	1738	320	rgorg	1			1DDEH
O/P	1738	320	Para	10			1DDEH
O/P	1738	320	cc	10			1DDEH
O/P	1738	320	Floro			M	1DDEH
O/P	1738	320	Selong			1	1DDEH
O/P	1738	320	shelf			1	1DDEH
O/P	1738	320	Met			1	1DDEH
O/P	1738	320	gast			1	1DDEH
O/P	1738	320	Gorgon			1	1DDEH
PX	1739	320	Floro			1	1DDE0
PX	1739	320	Ophia			1	1DDE0
PX	1739	320	cc			1	1DDE0
PX	1739	320	ast			1	1DDE0
PX	1739	320	Halo			1	1DDE0
P	1741	320	Med	2			1DDE0
P	1741	320	Coryph	1			1DDE0
P	1741	320	Para	12			1DDE0
P	1741	320	cc	35			1DDE0
P	1741	320	Ophia	3			1DDE0
P	1741	320	Halo	2			1DDE0
P	1741	320	soltun	1			1DDE0
P	1741	320	eo		5		1DDE0
PX	1742	320	Med			1	1DDE0
PX	1742	320	Ophia			1	1DDE0
PX	1742	320	Halo			1	1DDE0
PX	1742	320	Para			1	1DDE0
PX	1742	320	cc			1	1DDE0
PX	1742	320	eo			1	1DDE0
O	1743	330	Gorgon			1	1DDE0
O	1743	330	Selong			1	1DDE0
O	1743	330	Actin			1	1DDE0
O	1743	330	Stylas			1	1DDE0
O	1743	330	Med			1	1DDE0
O	1743	330	Tere			1	1DDE0
O	1743	330	Protula			1	1DDE0
O	1743	330	nudi			1	1DDE0
O	1743	330	Met			1	1DDE0
O	1743	330	Rath			1	1DDE0
O	1743	330	Sebas			1	1DDE0
O	1743	330	cc			1	1DDE0
PX	1744	330	Para			1	1BDE0
PX	1744	330	cc			1	1BDE0
O/P	1746	330	Med	1			1DDEI
O/P	1746	330	rgorg	2			1DDEI
O/P	1746	330	Actin	1			1DDEI
O/P	1746	330	Ophia	1			1DDEI
O/P	1746	330	gast	1			1DDEI
O/P	1746	330	Para	12			1DDEI
O/P	1746	330	shelf			1	1DDEI

HARD BOTTOM DATA
TRANSECT 14 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1746	330	cc	55			1DDEI
O/P	1746	330	ccw	3			1DDEI
O/P	1746	330	eo		10		1DDEI
O/P	1746	330	Tere	1			1DDEI
O/P	1746	330	Orth			1	1DDEI
O/P	1746	330	Met			1	1DDEI
O/P	1746	330	Sebas			1	1DDEI
O/PX	1747	330	Para			1	1DDE0
O/PX	1747	330	cc			M	1DDE0
O/PX	1747	330	gast			1	1DDE0
O/PX	1747	330	Ophia			1	1DDE0
O/PX	1747	330	Selong			1	1DDE0
O/PX	1747	330	Met			1	1DDE0
O/PX	1747	330	Floro			1	1DDE0
O/PX	1747	330	oph			M	1DDE0
O/PX	1747	330	gala			1	1DDE0
O/PX	1747	330	sponge			1	1DDE0
O/PX	1747	330	Orth			1	1DDE0
O/PX	1747	330	Gorgon			1	1DDE0
O/PX	1747	330	Rath			1	1DDE0
O/PX	1747	330	Parast			1	1DDE0
PX	1749	330	cc			1	1DDE0
PX	1750	330	Med			1	1DDE0
PX	1750	330	rgorg			1	1DDE0
PX	1750	330	Ophia			1	1DDE0
PX	1750	330	Para			1	1DDE0
PX	1750	330	cc			1	1DDE0
PX	1750	330	eo			1	1DDE0
PXS3	1752	330	Met			1	1DDE0
PXS3	1752	330	rgorg			1	1DDE0
PXS3	1752	330	Para			1	1DDE0
PXS3	1752	330	cc			1	1DDE0
PXS3	1752	330	eo			1	1DDE0
PS3	1755	330	Ophia	6			1DDE0
PS3	1755	330	rgorg	3			1DDE0
PS3	1755	330	Zan	1			1DDE0
PS3	1755	330	eo		10		1DDE0
PS3	1755	330	Para	45			1DDE0
PS3	1755	330	ccw	2			1DDE0
PS3	1755	330	cc	20			1DDE0
PS3	1757	330	rgorg	1			1DDE0
PS3	1757	330	sponge			1	1DDE0
PS3	1757	330	Med	2			1DDE0
PS3	1757	330	Ophia	4			1DDE0
PS3	1757	330	Para	6			1DDE0
PS3	1757	330	cc	14			1DDE0
PS3	1757	330	eo		10		1DDE0
PS3	1758	330	shelf		5		1DDE0
PS3	1758	330	Sty	1			1DDE0
PS3	1758	330	rgorg	3			1DDE0

HARD BOTTOM DATA
TRANSECT 14 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PS3	1758	330	Ophla	5			1DDE0
PS3	1758	330	soltun	2			1DDE0
PS3	1758	330	Halo	2			1DDE0
PS3	1758	330	ebry		1		1DDE0
PS3	1758	330	eo		10		1DDE0
PS3	1758	330	Para	11			1DDE0
PS3	1758	330	cc	15			1DDE0
PS3	1758	330	ast	1			1DDE0
PS3	1800	330	Ophla	7			1DDE0
PS3	1800	330	Para	22			1DDE0
PS3	1800	330	cc	17			1DDE0
PS3	1800	330	ccw	2			1DDE0
PS3	1800	330	eo		10		1DDE0
PS3	1800	330	ast	1			1DDE0
PS3	1800	330	soltun	1			1DDE0

HARD BOTTOM DATA
TRANSECT 14 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1454	390	Oct			1	2D000
O	1454	390	Med			1	2D000
O	1454	390	Sty			1	2D000
O	1454	390	oph			1	2D000
O	1454	390	polycs			1	2D000
O	1454	390	Luid			1	2D000
O	1454	390	Zan			1	2D000
O	1457	390	Oct			1	2D000
O	1457	390	Sty			1	2D000
O	1457	390	Acan			1	2D000
O	1457	390	Stachy			1	2D000
O	1457	390	oph			1	2D000
O	1457	390	Med			1	2D000
O	1459	385	Stachy			1	2D000
O	1459	385	Oct			1	2D000
O	1459	385	Zan			1	2D000
O	1459	385	Cithar			1	2D000
PX	1506	385	Zan			1	2D000
PX	1506	385	Oct			1	2D000
PX	1506	385	oph			1	2D000
PX	1508	385	oph			1	2D000
PX	1509	385	NO			0	2D000
P	1511	385	NO			0	2D000
P	1514	385	oph			1	2D000
P	1516	385	NO			0	2D000
P	1517	385	Oct	2			2D000
P	1517	385	oph			1	2D000
P	1519	385	oph			1	2D000
P	1521	385	NO			0	2D000
PX	1522	385	Oct			1	1CD00
PX	1522	385	oph			1	1CD00
PS1	1524	385	rgorg	1			1DD00
PS1	1524	385	oph	6			1DD00
PS1	1524	385	Perid	1			1DD00
PS1	1524	385	ccw	2			1DD00
PS1	1524	385	Para	5			1DD00
PS1	1524	385	cc	15			1DD00
PS1	1524	385	eo		5		1DD00
PS1	1525	385	Ophia	6			1DD0J
PS1	1525	385	Para	4			1DD0J
PS1	1525	385	cc	16			1DD0J
PS1	1525	385	ccw	2			1DD0J
PS1	1525	385	ebry		3		1DD0J
PS1	1525	385	eo		3		1DD0J
OS1	1527	385	Met			1	1DD0J
OS1	1527	385	brac			1	1DD0J
OS1	1527	385	rgorg			1	1DD0J
OS1	1527	385	Sebas			1	1DD0J
OS1	1527	385	Ophia			1	1DD0J

HARD BOTTOM DATA
TRANSECT 14 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS1	1527	385	Floro			1	1DD0J
OS1	1527	385	Protula			1	1DD0J
OS1	1527	385	Rath			1	1DD0J
OS1	1527	385	hyd			1	1DD0J
OS1	1527	385	ebry			1	1DD0J
OS1	1527	385	Actin			1	1DD0J
OS1	1527	385	oph			1	1DD0J
PS1	1529	385	Med	1			1DD0J
PS1	1529	385	Met	1			1DD0J
PS1	1529	385	Ophia	14			1DD0J
PS1	1529	385	Floro	2			1DD0J
PS1	1529	385	Para	3			1DD0J
PS1	1529	385	ccw	2			1DD0J
PS1	1529	385	cc	16			1DD0J
PS1	1529	385	eo		2		1DD0J
O	1531	385	Med			1	1DDEJ
O	1531	385	Sebas			1	1DDEJ
O	1531	385	cco			1	1DDEJ
O	1531	385	ccw			1	1DDEJ
O	1531	385	Actin			1	1DDEJ
O	1531	385	brac			1	1DDEJ
O	1531	385	Met			1	1DDEJ
O	1531	385	ast			1	1DDEJ
O	1531	385	Floro			1	1DDEJ
O	1531	385	Halo			M	1DDEJ
O	1531	385	Zan			1	1DDEJ
O	1531	385	Stachy			1	1DDEJ
O	1531	385	Tere			1	1DDEJ
O	1531	385	Hen			1	1DDEJ
O/P	1532	385	Selong			1	1DDEJ
O/P	1532	385	Ophia	11			1DDEJ
O/P	1532	385	Halo	1			1DDEJ
O/P	1532	385	Para	7			1DDEJ
O/P	1532	385	ccw	1			1DDEJ
O/P	1532	385	cc	23			1DDEJ
O/P	1532	385	Allo			1	1DDEJ
O/P	1532	385	rgorg			1	1DDEJ
O/P	1532	385	Hen			1	1DDEJ
O/P	1532	385	Sebas			1	1DDEJ
O/P	1532	385	Actin			1	1DDEJ
O/P	1532	385	Rath			1	1DDEJ
O/P	1532	385	Floro			1	1DDEJ
O/P	1532	385	gast			1	1DDEJ
O/P	1532	385	Parast			1	1DDEJ
P	1533	385	rgorg	1			1DDEJ
P	1533	385	Halo	2			1DDEJ
P	1533	385	Ophia	1			1DDEJ
P	1533	385	Para	2			1DDEJ
P	1533	385	cc	19			1DDEJ
P	1533	385	eo		5		1DDEJ

HARD BOTTOM DATA
TRANSECT 14 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
P	1533	385	Oct	1			1DDEJ
O	1534	370	Hen			1	1DDEJ
O	1534	370	Selong			1	1DDEJ
O	1534	370	Met			1	1DDEJ
O	1534	370	Actin			1	1DDEJ
O	1534	370	Leuc			1	1DDEJ
O	1534	370	Halo			1	1DDEJ
O	1534	370	Rath			1	1DDEJ
O	1534	370	Tere			M	1DDEJ
O	1534	370	rgorg			1	1DDEJ
O/P	1537	370	shelf			1	1DDEJ
O/P	1537	370	Tere	3			1DDEJ
O/P	1537	370	rgorg	1			1DDEJ
O/P	1537	370	Ophia	1			1DDEJ
O/P	1537	370	Bal	1			1DDEJ
O/P	1537	370	Para	1			1DDEJ
O/P	1537	370	cc	36			1DDEJ
O/P	1537	370	eo		3		1DDEJ
O/P	1537	370	Sebas			1	1DDEJ
O/P	1537	370	Met			1	1DDEJ
O/P	1537	370	shelf			1	1DDEJ
O/P	1537	370	Selong			1	1DDEJ
O/P	1537	370	Halo			M	1DDEJ
O/P	1537	370	brac			M	1DDEJ
PXS2	1540	370	Ophia	3			1DDEJ
PXS2	1540	370	cc	16			1DDEJ
PXS2	1540	370	ccw	3			1DDEJ
PXS2	1540	370	Para	4			1DDEJ
PXS2	1540	370	Bal	1			1DDEJ
PXS2	1540	370	soltun	1			1DDEJ
PXS2	1540	370	ebry		3		1DDEJ
PXS2	1540	370	eo		2		1DDEJ
PXS2	1541	370	Ophia	3			1DDEJ
PXS2	1541	370	ccw	3			1DDEJ
PXS2	1541	370	Para	5			1DDEJ
PXS2	1541	370	cc	14			1DDEJ
PXS2	1541	370	Halo	2			1DDEJ
PXS2	1541	370	eo		5		1DDEJ
PXS2	1545	370	Halo			1	1DDEJ
PXS2	1545	370	rgorg			1	1DDEJ
PXS2	1545	370	sponge			1	1DDEJ
PXS2	1545	370	Ophia			1	1DDEJ
PXS2	1545	370	Para			1	1DDEJ
PXS2	1545	370	cc			1	1DDEJ
PXS2	1545	370	eo			1	1DDEJ
PXS2	1545	370	ebry			1	1DDEJ
PXS2	1545	370	vases			1	1DDEJ
O/P	1548	370	Med	1			1DDEJ
O/P	1548	370	Ophia	13			1DDEJ
O/P	1548	370	Tere	1			1DDEJ

HARD BOTTOM DATA
TRANSECT 14 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1548	370	oph	7			1DDEJ
O/P	1548	370	Para	6			1DDEJ
O/P	1548	370	cc	18			1DDEJ
O/P	1548	370	eo		5		1DDEJ
O/P	1548	370	Perid			1	1DDEJ
O/P	1548	370	Stylas			1	1DDEJ
O/P	1548	370	Sebas			1	1DDEJ
O/P	1548	370	Rath			1	1DDEJ
O/P	1548	370	Selong			1	1DDEJ
O/P	1548	370	shelf			1	1DDEJ
O/P	1548	370	Floro			1	1DDEJ
O/P	1548	370	Allo			1	1DDEJ
O	1550	360	Sty			1	1DDEJ
OS3	1550	360	Zan			1	1DDEJ
OS3	1550	360	oph			1	1DDEJ
O/PS3	1551	360	soltun	3			1DDEJ
O/PS3	1551	360	Para	14			1DDEJ
O/PS3	1551	360	cc	22			1DDEJ
O/PS3	1551	360	ccw	3			1DDEJ
O/PS3	1551	360	Halo	1			1DDEJ
O/PS3	1551	360	eo		5		1DDEJ
O/PS3	1551	360	Floro			1	1DDEJ
O/PS5	1551	360	shelf			1	1DDEJ
O/PS3	1551	360	Perid			1	1DDEJ
O/PS3	1551	360	Parast			1	1DDEJ
PXS3	1553	360	Tere			1	1DDEJ
PXS3	1553	360	Ophia			1	1DDEJ
PXS3	1553	360	Floro			1	1DDEJ
PXS3	1553	360	Para			1	1DDEJ
PXS3	1553	360	cc			1	1DDEJ
PXS3	1553	360	eo			1	1DDEJ
O/PS3	1554	360	Parast	1			1DDEJ
O/PS3	1554	360	Halo	1			1DDEJ
O/PS3	1554	360	Ophia	3			1DDEJ
O/PS3	1554	360	banoph	1			1DDEJ
O/PS3	1554	360	ast	1			1DDEJ
O/PS3	1554	360	Para	14			1DDEJ
O/PS3	1554	360	Bal	1			1DDEJ
O/PS3	1554	360	ccw	2			1DDEJ
O/PS3	1554	360	cc	10			1DDEJ
O/PS3	1554	360	encrust		1		1DDEJ
O/PS3	1554	360	eo		3		1DDEJ
O/PS3	1554	360	Hen			1	1DDEJ
O/PS3	1554	360	Actin			1	1DDEJ
PX	1556	360	Perid			1	1DDEJ
PX	1556	360	Ophia			1	1DDEJ
PX	1556	360	Bal			1	1DDEJ
PX	1556	360	Para			1	1DDEJ
PX	1556	360	cc			1	1DDEJ
PX	1556	360	ebry			1	1DDEJ

HARD BOTTOM DATA
TRANSECT 14 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PX	1556	360	eo			1	1DDEJ
O/P	1557	360	Halo	1			1DDEJ
O/P	1557	360	gorg	1			1DDEJ
O/P	1557	360	Oct	2			1DDEJ
O/P	1557	360	Ophia	1			1DDEJ
O/P	1557	360	Bal	1			1DDEJ
O/P	1557	360	Para	10			1DDEJ
O/P	1557	360	cc	11			1DDEJ
O/P	1557	360	ccw	2			1DDEJ
O/P	1557	360	ast	1			1DDEJ
O/P	1557	360	ebry			1	1DDEJ
O/P	1557	360	eo		2		1DDEJ
O/P	1557	360	Selong			1	1DDEJ
O/P	1557	360	Actin			1	1DDEJ
O/P	1557	360	Med			1	1DDEJ
O/P	1557	360	Hen			1	1DDEJ
PX	1559	360	Med			1	1D000
PX	1559	360	Ophia			1	1D000
PX	1559	360	cc			1	1D000
O/P	1604	360	Tere	4			1BDEJ
O/P	1604	360	Halo	5			1BDEJ
O/P	1604	360	Ophia	3			1BDEJ
O/P	1604	360	oph	2			1BDEJ
O/P	1604	360	ccw	1			1BDEJ
O/P	1604	360	Para	4			1BDEJ
O/P	1604	360	cc	10			1BDEJ
O/P	1604	360	gast	1			1BDEJ
O/P	1604	360	eo		2		1BDEJ
O/P	1604	360	Sebas			1	1BDEJ
O/P	1604	360	Met			1	1BDEJ
O/P	1604	360	Selong			1	1BDEJ
O/P	1604	360	Zan			1	1BDEJ
O/P	1604	360	Hen			1	1BDEJ
O/P	1604	360	vases			1	1BDEJ
O/P	1604	360	Oct			1	1BDEJ
O/P	1604	360	Srubri			1	1BDEJ
O/P	1604	360	Floro			1	1BDEJ
O/P	1604	360	Stylas			1	1BDEJ
PX	1605	360	oph			1	10D00
PX	1605	360	Para			1	10D00
PX	1605	360	cc			1	10D00
O/PXS4	1607	360	Coryph			1	1DDEI
O/PXS4	1607	360	Ophia			1	1DDEI
O/PXS4	1607	360	Tere			1	1DDEI
O/PXS4	1607	360	rgorg			1	1DDEI
O/PXS4	1607	360	Para			1	1DDEI
O/PXS4	1607	360	cc			1	1DDEI
O/PXS4	1607	360	eo			1	1DDEI
O/PXS4	1607	360	Selong			1	1DDEI
O/PXS4	1607	360	Sebas			1	1DDEI

HARD BOTTOM DATA
TRANSECT 14 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/PXS4	1607	360	Med			1	1DDEI
O/PXS4	1607	360	Rath			1	1DDEI
O/PXS4	1607	360	Perid			1	1DDEI
O/PXS4	1607	360	Stylas			1	1DDEI
O/PXS4	1607	360	Oct			1	1DDEI
O/PXS4	1607	360	Floro			1	1DDEI
OS4	1609	360	Allo			1	1DDEI
OS4	1609	360	Floro			1	1DDEI
OS4	1609	360	Ophia			M	1DDEI
OS4	1609	360	Tere			1	1DDEI
OS4	1609	360	Met			1	1DDEI
OS4	1609	360	Actin			1	1DDEI
OS4	1609	360	cc			1	1DDEI
PS4	1610	360	Tere	10			1DDEI
PS4	1610	360	Med	1			1DDEI
PS4	1610	360	Ophia	8			1DDEI
PS4	1610	360	ccw	1			1DDEI
PS4	1610	360	Para	3			1DDEI
PS4	1610	360	Bal	1			1DDEI
PS4	1610	360	cc	9			1DDEI
PS4	1610	360	Floro	1			1DDEI
PS4	1610	360	eo		5		1DDEI
PS4	1612	360	Tere	5			1DDEI
PS4	1612	360	rgorg	1			1DDEI
PS4	1612	360	gast	1			1DDEI
PS4	1612	360	Perid	1			1DDEI
PS4	1612	360	Ophia	12			1DDEI
PS4	1612	360	ebry		1		1DDEI
PS4	1612	360	eo		5		1DDEI
O/PS4	1613	360	Tere	6			1DDEI
O/PS4	1613	360	Ophia	11			1DDEI
O/PS4	1613	360	Para	4			1DDEI
O/PS4	1613	360	cc	9			1DDEI
O/PS4	1613	360	ebry		1		1DDEI
O/PS4	1613	360	eo		1		1DDEI
O/PS4	1613	360	Halo	1			1DDEI
O/PS4	1613	360	nudi	1			1DDEI
O/PS4	1613	360	Met			1	1DDEI
O/PS4	1613	360	Actin			1	1DDEI
O/PS4	1613	360	Gorgon			1	1DDEI
PS4	1620	360	Tere	3			1DDEI
PS4	1620	360	rgorg	1			1DDEI
PS4	1620	360	Perid	1			1DDEI
PS4	1620	360	Ophia	17			1DDEI
PS4	1620	360	Para	1			1DDEI
PS4	1620	360	cc	18			1DDEI
PS4	1620	360	Halo	1			1DDEI
PS4	1620	360	ebry			1	1DDEI
PS4	1620	360	eo		2		1DDEI
P	1621	360	Med	1			1DDEI

HARD BOTTOM DATA
TRANSECT 14 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
P	1621	360	Tere	2			1DDEI
P	1621	360	Ophia	18			1DDEI
P	1621	360	Halo	5			1DDEI
P	1621	360	soltun	1			1DDEI
P	1621	360	vases	1			1DDEI
P	1621	360	cc	12			1DDEI
P	1621	360	ebry		1		1DDEI
P	1621	360	eo		2		1DDEI
O	1622	345	Oct			1	1CDEJ
O	1622	345	Med			1	1CDEJ
O	1622	345	Sebas			1	1CDEJ
O	1622	345	Zan			1	1CDEJ
O	1622	345	rgorg			1	1CDEJ
O	1622	345	Floro			1	1CDEJ
O	1622	345	Ophia			1	1CDEJ
O	1622	345	gorg			1	1CDEJ
O	1622	345	shelf			1	1CDEJ
O	1622	345	Soval			1	1CDEJ
P	1625	345	Perid	1			10DE0
P	1625	345	Tere	2			10DE0
P	1625	345	Ophia	9			10DE0
P	1625	345	vases	1			10DE0
P	1625	345	Halo	1			10DE0
P	1625	345	Oct	1			10DE0
P	1625	345	ccw	3			10DE0
P	1625	345	Para	1			10DE0
P	1625	345	cc	17			10DE0
P	1625	345	eo	17			10DE0
O/PX	1626	345	Floro			1	1DDEI
O/PX	1626	345	Sebas			1	1DDEI
O/PX	1626	345	Tere			M	1DDEI
O/PX	1626	345	Halo			1	1DDEI
O/PX	1626	345	Ophia			1	1DDEI
O/PX	1626	345	rgorg			1	1DDEI
O/PX	1626	345	Para			1	1DDEI
O/PX	1626	345	cc			1	1DDEI
O/PX	1626	345	Gorgon			1	1DDEI
O/PX	1626	345	Actin			1	1DDEI
O/PX	1626	345	gast			1	1DDEI
O/PX	1626	345	Stylas			1	1DDEI
O/PX	1626	345	Med			M	1DDEI
O/PX	1626	345	Allo			1	1DDEI
O/PX	1626	345	shelf			1	1DDEI
O/PX	1626	345	Shop			1	1DDEI
PX	1628	345	Halo			1	1DDEJ
PX	1628	345	Tere			1	1DDEJ
PX	1628	345	Med			1	1DDEJ
PX	1628	345	Floro			1	1DDEJ
PX	1628	345	Mitra			1	1DDEJ
PX	1628	345	gast			1	1DDEJ

HARD BOTTOM DATA
TRANSECT 14 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PX	1628	345	Ophia			1	1DDEJ
PX	1628	345	cc			1	1DDEJ
P	1629	345	Ophia	8			1DDEJ
P	1629	345	Para	1			1DDEJ
P	1629	345	cc	13			1DDEJ
P	1629	345	ebry			1	1DDEJ
O	1630	350	Met			1	1DDEJ
O	1630	350	Actin			1	1DDEJ
O	1630	350	Hen			1	1DDEJ
O	1630	350	oph			1	1DDEJ
O	1630	350	brac			1	1DDEJ
O	1630	350	cc			1	1DDEJ
O	1630	350	Stylas			1	1DDEJ
O	1630	350	Selong			1	1DDEJ
P	1631	350	Sebas	1			1DDEJ
P	1631	350	Halo	3			1DDEJ
P	1631	350	Tere	3			1DDEJ
P	1631	350	Ophia	9			1DDEJ
P	1631	350	Para	4			1DDEJ
P	1631	350	cc	20			1DDEJ
P	1631	350	ebry		1		1DDEJ
P	1631	350	eo		1		1DDEJ
O/PX	1633	350	Tere			1	1DDEJ
O/PX	1633	350	sponge			1	1DDEJ
O/PX	1633	350	Floro			1	1DDEJ
O/PX	1633	350	Ophia			1	1DDEJ
O/PX	1633	350	Halo			1	1DDEJ
O/PX	1633	350	Para			1	1DDEJ
O/PX	1633	350	cc			1	1DDEJ
O/PX	1634	350	Sebas			1	1DDEJ
O/PX	1634	350	rgorg			1	1DDEJ
O/PX	1634	350	Floro			1	1DDEJ
O/PX	1634	350	Med			1	1DDEJ
O/PX	1634	350	ast			1	1DDEJ
O/PX	1634	350	Halo			1	1DDEJ
O/PX	1634	350	Ophia			1	1DDEJ
O/PX	1634	350	Bal			1	1DDEJ
O/PX	1634	350	Para			1	1DDEJ
O/PX	1634	350	cc			1	1DDEJ
O/PX	1634	350	Tere			1	1DDEJ
O/PX	1634	350	ebry			1	1DDEJ
O/PX	1634	350	eo			1	1DDEJ
O/PX	1634	350	Actin			1	1DDEJ
O/PX	1634	350	Hen			1	1DDEJ
O/PX	1634	350	Gorgon			1	1DDEJ
O/PX	1636	350	Tere			1	1DDEJ
O/PX	1636	350	Ophia			1	1DDEJ
O/PX	1636	350	ast			1	1DDEJ
O/PX	1636	350	Para			1	1DDEJ
O/PX	1636	350	cc			1	1DDEJ

HARD BOTTOM DATA
TRANSECT 14 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/PX	1636	350	Halo			1	1DDEJ
O/PX	1636	350	Shop			1	1DDEJ
O/PX	1636	350	Protula			1	1DDEJ
O/PX	1636	350	Gorgon			1	1DDEJ
O/PX	1636	350	Floro			1	1DDEJ
O/PX	1636	350	Actin			1	1DDEJ
O/PX	1636	350	Sebas			1	1DDEJ
O/PX	1636	350	Met			1	1DDEJ
O/PX	1636	350	Allo			1	1DDEJ
O/PX	1636	350	Hen			1	1DDEJ
PX	1637	350	Med			1	1DDE0
PX	1637	350	Actin			1	1DDE0
PX	1637	350	Tere			1	1DDE0
PX	1637	350	Ophia			1	1DDE0
PX	1637	350	Halo			1	1DDE0
PX	1637	350	rgorg			1	1DDE0
PX	1637	350	Calli			1	1DDE0
PX	1637	350	cc			1	1DDE0
PX	1637	350	ebry			1	1DDE0
PX	1639	350	Floro			1	1DDE0
PX	1639	350	Tere			1	1DDE0
PX	1639	350	Ophia			1	1DDE0
PX	1639	350	rgorg			1	1DDE0
PX	1639	350	Halo			1	1DDE0
PX	1639	350	soltun			1	1DDE0
PX	1639	350	Para			1	1DDE0
PX	1639	350	cc			1	1DDE0
PX	1639	350	sponge			1	1DDE0
PX	1639	350	Bal			1	1DDE0
PS5	1641	350	Med	1			1DDE0
PS5	1641	350	rgorg	2			1DDE0
PS5	1641	350	Tere	6			1DDE0
PS5	1641	350	Floro	1			1DDE0
PS5	1641	350	Ophia	11			1DDE0
PS5	1641	350	Para	11			1DDE0
PS5	1641	350	cc	19			1DDE0
PS5	1641	350	eo		5		1DDE0
PXS5	1650	350	Allo			1	1DDE0
PXS5	1650	350	Halo			1	1DDE0
PXS5	1650	350	Floro			1	1DDE0
PXS5	1650	350	Tere			1	1DDE0
PXS5	1650	350	rgorg			1	1DDE0
PXS5	1650	350	Ophia			1	1DDE0
PXS5	1650	350	cc			1	1DDE0
PXS5	1650	350	eo			1	1DDE0
O/PS5	1652	350	Met	1		1	1DDE0
O/PS5	1652	350	Med	1			1DDE0
O/PS5	1652	350	Tere	4			1DDE0
O/PS5	1652	350	Ophia	9			1DDE0
O/PS5	1652	350	ast	1			1DDE0

HARD BOTTOM DATA
TRANSECT 14 C/D

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/PS5	1652	350	Para	5			1DDE0
O/PS5	1652	350	cc	16			1DDE0
O/PS5	1652	350	shelf	1			1DDE0
O/PS5	1652	350	ebry		1		1DDE0
O/PS5	1652	350	eo		1		1DDE0
O/PS5	1652	350	Actin			1	1DDE0
O/PS5	1652	350	Allo			1	1DDE0

HARD BOTTOM DATA
TRANSECT 16 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS1	801	410	Floro			1	1DDEL
OS1	801	410	oph			M	1DDEL
OS1	801	410	Hen			1	1DDEL
OS1	801	410	Med			1	1DDEL
OS1	801	410	Scon			1	1DDEL
OS1	801	410	Tere			1	1DDEL
OS1	803	410	Floro			1	1DDEL
OS1	803	410	rgorg			1	1DDEL
OS1	803	410	Med			1	1DDEL
OS1	803	410	Scon			1	1DDEL
OS1	803	410	Tere			1	1DDEL
OS1	803	410	cc			1	1DDEL
OS1	803	410	Gorgon			1	1DDEL
OS1	803	410	shelf			1	1DDEL
OS1	803	410	Met			1	1DDEL
OS1	803	410	Actin			1	1DDEL
OS1	803	410	Stauro			1	1DDEL
OS1	803	410	Sebas			1	1DDEL
OS1	803	410	Schry			1	1DDEL
OS1	803	410	sponge			1	1DDEL
OS1	807	400	Poran			1	1DDEL
O	807	400	gast			1	1DDEL
O	807	400	rgorg			1	1DDEL
O	807	400	brac			1	1DDEL
O	813	400	Floro			1	1DDEL
O	813	400	rgorg			1	1DDEL
O	813	400	Med			1	1DDEL
O	813	400	Tere			1	1DDEL
O	813	400	Scon			1	1DDEL
O	813	400	Sebas			1	1DDEL
O	813	400	Actin			1	1DDEL
O	813	400	Rath			1	1DDEL
O	815	398	Scon			1	1DDEL
O	815	398	Sebas			1	1DDEL
O	815	398	Perid			1	1DDEL
O	815	398	Ophiod			1	1DDEL
O	815	398	gast			1	1DDEL
O	815	398	Stauro			1	1DDEL
O	815	398	Actin			1	1DDEL
O	815	398	Hen			1	1DDEL
O	815	398	Ophia			1	1DDEL
O	819	400	Med			1	1DDEL
O	819	400	Actin			1	1DDEL
O	819	400	Scon			1	1DDEL
O	819	400	Gorgon			1	1DDEL
O	819	400	Neptu			1	1DDEL
O	819	400	cc			1	1DDEL
O	819	400	soltun			1	1DDEL
O	819	400	rgorg			1	1DDEL

HARD BOTTOM DATA
TRANSECT 16 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	819	400	Tere			1	1DDEL
O	819	400	Epta			1	1DDEL
O	819	400	vases			1	1DDEL
O	819	400	Perid			1	1DDEL
P	820	400	Ophia	45			1DDEL
P	820	400	banoph	5			1DDEL
P	820	400	Med	2			1DDEL
P	820	400	Tere	2			1DDEL
P	820	400	cc	1			1DDEL
P	820	400	eo			1	1DDEL
P	821	400	Ophia	35			1DDEL
P	821	400	cc	2			1DDEL
P	821	400	banoph	8			1DDEL
P	821	400	Epta			1	1DDEL
PX	823	400	Ophia			1	1DDEL
PX	823	400	banoph			1	1DDEL
PX	823	400	Neptu			1	1DDEL
O	824	395	Sneb			1	1DDEL
O	824	395	Ophia			1	1DDEL
O	824	395	banoph			1	1DDEL
O	824	395	soltun			1	1DDEL
O	824	395	Pagur			1	1DDEL
O	824	395	Stauro			1	1DDEL
O	824	395	shelf			1	1DDEL
O	824	395	Sebas			1	1DDEL
O	824	395	Scon			1	1DDEL
O	824	395	Allo			1	1DDEL
O	824	395	Floro			1	1DDEL
O	824	395	Perid			1	1DDEL
O	824	395	Med			1	1DDEL
O	824	395	Actin			1	1DDEL
P	825	395	Ophia	21			1DDEL
P	825	395	banoph	5			1DDEL
P	825	395	Halo	8			1DDEL
P	825	395	Med	1			1DDEL
P	825	395	cc	1			1DDEL
P	825	395	flat	1			1DDEL
O/P	828	385	Poran			1	1DDEL
O/P	828	385	Gorgon			1	1DDEL
O/P	828	395	shelf			1	1DDEL
O/P	828	385	Loxo			1	1DDEL
O/P	828	385	Floro	1			1DDEL
O/P	828	385	Med	1			1DDEL
O/P	828	385	Tere	1			1DDEL
O/P	828	385	Sebas	1			1DDEL
O/P	828	385	Ophia	50			1DDEL
O/P	828	385	banoph	5			1DDEL
O/P	828	385	Calli	1			1DDEL
O/P	828	385	Halo	3			1DDEL
O/P	828	385	Scon			1	1DDEL

HARD BOTTOM DATA
TRANSECT 16 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	828	385	Actin			1	1DDEL
O/P	828	385	Pagur			1	1DDEL
P	829	385	Hippas	1			1DDEL
P	829	385	Med	1			1DDEL
P	829	385	Ophia	45			1DDEL
P	829	385	banoph	6			1DDEL
P	829	385	Halo	10			1DDEL
P	829	385	oph	5			1DDEL
P	831	385	Ophia	40			1DDEL
P	831	385	banoph	10			1DDEL
P	831	385	oph	3			1DDEL
P	831	385	Halo	2			1DDEL
P	831	385	soltun	1			1DDEL
O/PX	833	370	Halo			1	1DDEL
O/PX	833	370	Floro			1	1DDEL
O/PX	833	370	Ophia			1	1DDEL
O/PX	833	370	banoph			1	1DDEL
O/PX	833	370	Oct			1	1DDEL
O/PX	833	370	Tere			1	1DDEL
O/PX	833	370.	Med			1	1DDEL
O/PX	833	370	Perid			1	1DDEL
O/PX	833	370	Poran			1	1DDEL
O/PX	833	370	Pat			1	1DDEL
O/PX	833	370	soltun			1	1DDEL
O/PX	833	370	Sebas			M	1DDEL
PX	834	370	Ophia			1	1DDEL
PX	834	370	banoph			1	1DDEL
PX	834	370	Sebas			1	1DDEL
PX	836	370	Ophia			M	1DDEL
PX	836	370	Med			1	1DDEL
PX	836	370	Sebas			1	1DDEL
PX	836	370	banoph			1	1DDEL
PX	836	370	Tere			1	1DDEL
PX	836	370	Perid			1	1DDEL
PX	836	370	Halo			1	1DDEL
PX	837	370	Sebas			1	1DDEL
PX	837	370	Ophia			M	1DDEL
PX	837	370	Halo			1	1DDEL
PX	837	370	banoph			1	1DDEL
PX	837	370	soltun			1	1DDEL
O	838	360	Actin			1	1DDEL
O	838	360	Perid			1	1DDEL
O	838	360	shelf			1	1DDEL
O	838	360	Floro			1	1DDEL
O	838	360	Scon			M	1DDEL
O	838	360	etun			1	1DDEL
O	838	360	Med			1	1DDEL
O	838	360	Floro			1	1DDEL
O	838	360	Tere			1	1DDEL
O	838	360	Neptu			1	1DDEL

HARD BOTTOM DATA
TRANSECT 16 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	838	360	Halo			1	1DDEL
O	838	360	Hen			1	1DDEL
PX	839	360	Floro			1	1DDEL
PX	839	360	Neptu			1	1DDEL
PX	839	360	Med			1	1DDEL
PX	839	360	Sebas			1	1DDEL
PX	839	360	Halo			1	1DDEL
PX	839	360	Ophia			M	1DDEL
PX	839	360	banoph			1	1DDEL
PX	839	360	soltun			1	1DDEL
O/P	841	350	Floro	3			1DDEL
O/P	841	350	Ophia	41			1DDEL
O/P	841	350	banoph	4			1DDEL
O/P	841	350	Med			2	1DDEL
O/P	841	350	anem	1			1DDEL
O/P	841	350	encrust			1	1DDEL
O/P	841	350	Halo	3			1DDEL
O/P	841	350	Tere			1	1DDEL
O/P	841	350	Pagur			1	1DDEL
O/P	841	350	nudi			1	1DDEL
O/P	841	350	cc			1	1DDEL
P	842	350	Floro	4			1DDEL
P	842	350	Ophia	30			1DDEL
P	842	350	Tere	10			1DDEL
P	842	350	banoph	5			1DDEL
P	842	350	Med	1			1DDEL
P	842	350	soltun	1			1DDEL
P	842	350	cc	2			1DDEL
P	842	350	eo		2		1DDEL
P	842	350	gast	1			1DDEL
O/PS2	844	350	Floro	2			1DDEL
O/PS2	844	350	Ophia	35			1DDEL
O/PS2	844	350	banoph	5			1DDEL
O/PS2	844	350	Halo	3			1DDEL
O/PS2	844	350	cc	4			1DDEL
O/PS2	844	350	soltun	1			1DDEL
O/PS2	844	350	Para	1			1DDEL
O/PS2	844	350	eo		1		1DDEL
O/PS2	844	350	Berth			1	1DDEL
O/PS2	844	350	rgorg			1	1DDEL
O/PS2	844	350	Scon			1	1DDEL
O/PS2	844	350	Med			1	1DDEL
O/PS2	844	350	Oct			1	1DDEL
O/PS2	844	350	Allo			1	1DDEL
O/PS2	844	350	Bal			1	1DDEL
PS2	849	355	Floro	8			1DDEL
PS2	849	355	Ophia	27			1DDEL
PS2	849	355	banoph	5			1DDEL
PS2	849	355	Tere	3			1DDEL
PS2	849	355	Perid	1			1DDEL

HARD BOTTOM DATA
TRANSECT 16 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PS2	849	355	Halo	3			1DDEL
PS2	852	355	Floro	2			1DDEL
PS2	852	355	Ophia	28			1DDEL
PS2	852	355	banoph	6			1DDEL
PS2	852	355	eo		1		1DDEL
PS2	852	355	cc	3			1DDEL
OS2	853	350	Floro			M	1DDEL
OS2	853	350	Ophia			M	1DDEL
OS2	853	350	Sebas			1	1DDEL
OS2	853	350	Agon			1	1DDEL
OS2	853	350	Scon			1	1DDEL
OS2	853	350	gala			1	1DDEL
P	855	350	Floro	8			1DDEL
P	855	350	Ophia	49			1DDEL
P	855	350	banoph	4			1DDEL
P	855	350	Perid	1			1DDEL
P	855	350	cc	5			1DDEL
P	855	350	encrust			1	1DDEL
P	857	320	Floro	5			1DDEL
P	857	320	Ophia	5			1DDEL
P	857	320	Para	2			1DDEL
P	857	320	shelf	1			1DDEL
P	857	320	Sebas	1			1DDEL
P	857	320	eo			1	1DDEL
P	857	320	sponge			1	1DDEL
P	857	320	ccw	2			1DDEL
O/P	858	320	Floro	6			1DDEH
O/P	858	320	Ophia	5			1DDEH
O/P	858	320	banoph	5			1DDEH
O/P	858	320	ccw	8			1DDEH
O/P	858	320	Para	7			1DDEH
O/P	858	320	cc	1			1DDEH
O/P	858	320	Med	2			1DDEH
O/P	858	320	Perid	2			1DDEH
O/P	858	320	sponge		1		1DDEH
O/P	858	320	Halo	1			1DDEH
O/P	858	320	soltun	2			1DDEH
O/P	858	320	Coeno			1	1DDEH
O/P	858	320	rgorg			1	1DDEH
O/P	858	320	Halo			1	1DDEH
O/P	858	320	Actin			1	1DDEH
O/P	858	320	Poran			1	1DDEH
O/P	858	320	Sebas			1	1DDEH
O/P	858	320	Scon			1	1DDEH
O/P	858	320	Sserra			1	1DDEH
O/P	858	320	Berthel			1	1DDEH
O/P	900	320	Floro	12			1DDFH
O/P	900	320	Tere	3			1DDFH
O/P	900	320	ccw	2			1DDFH
O/P	900	320	Para	2			1DDFH

HARD BOTTOM DATA
TRANSECT 16 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	900	320	Med	1			1DDFH
O/P	900	320	Ophia	16			1DDFH
O/P	900	320	banoph	6			1DDFH
O/P	900	320	ebry			1	1DDFH
O/P	900	320	sabell			1	1DDFH
O/P	900	320	Neptu			1	1DDFH
O/P	900	320	Hydro			1	1DDFH
O/P	900	320	Coryn			1	1DDFH
O/P	900	320	Bal			1	1DDFH
PX	901	320	Med			1	1DDGH
PX	901	320	Perid			1	1DDGH
PX	901	320	Ophia			1	1DDGH
PX	901	320	Para			1	1DDGH
PX	901	320	ccw			1	1DDGH
PX	901	320	cc			1	1DDGH
PX	901	320	banoph			1	1DDGH
PX	901	320	nudi			1	1DDGH
PX	901	320	Gorgon			1	1DDGH
PX	901	320	Sebas			1	1DDGH
PX	901	320	Met			1	1DDGH
PX	901	320	Actin			1	1DDGH
O/PX	903	315	Med			1	1DDFI
O/PX	903	315	Perid			1	1DDFI
O/PX	903	315	rgorg			1	1DDFI
O/PX	903	315	Sebas			1	1DDFI
O/PX	903	315	Coryn			1	1DDFI
O/PX	903	315	Bal			1	1DDFI
O/PX	903	315	Scon			1	1DDFI
O/PX	908	305	Floro			1	1DDFI
O/PX	908	305	Ophia			1	1DDFI
O/PX	908	305	Med			1	1DDFI
O/PX	908	305	Perid			1	1DDFI
O/PX	908	305	Gorgon			1	1DDFI
O/PX	908	305	Loxo			1	1DDFI
O/PX	908	305	Scon			1	1DDFI
O/PX	908	305	Berth			1	1DDFI
O/PX	908	305	Rath			1	1DDFI
P	911	305	Halo	1			1DDEI
P	911	305	sponge			1	1DDEI
P	911	305	soltun	4			1DDEI
P	911	305	Ophia	19			1DDEI
P	911	305	banoph	7			1DDEI
O/P	913	320	Floro	2			1DDEI
O/P	913	320	Ophia	14			1DDEI
O/P	913	320	Med	1			1DDEI
O/P	913	320	rgorg	3			1DDEI
O/P	913	320	Sebas	1			1DDEI
O/P	913	320	soltun	3			1DDEI
O/P	913	320	shelf	2			1DDEI
O/P	913	320	cc	3			1DDEI

HARD BOTTOM DATA
TRANSECT 16 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	913	320	banoph	9			1DDEI
O/P	913	320	eo		5		1DDEI
O/P	913	320	Hen			1	1DDEI
O/P	913	320	Tere			1	1DDEI
O/P	913	320	Halo			1	1DDEI
PX	914	320	Floro			1	1DDEI
PX	914	320	Ophia			1	1DDEI
PX	914	320	banoph			1	1DDEI
PX	914	320	Med			1	1DDEI
PX	914	320	ebry			1	1DDEI
PX	914	320	rgorg			1	1DDEI
PX	914	320	cc			1	1DDEI
PS3	916	320	Ophia	8			1DDEI
PS3	916	320	Para	1			1DDEI
PS3	916	320	anem	1			1DDEI
PS3	916	320	Med	1			1DDEI
PS3	916	320	Perid	2			1DDEI
PS3	916	320	soltun	2			1DDEI
PS3	916	320	Halo	1			1DDEI
PS3	916	320	eo		5		1DDEI
PS3	916	320	banoph	1			1DDEI
OS3	921	320	Perid		1		1DDEI
OS3	921	320	Ophia		1		1DDEI
OS3	921	320	banoph		1		1DDEI
OS3	921	320	Floro		1		1DDEI
OS3	921	320	Poran		1		1DDEI
OS3	921	320	Stylas		1		1DDEI
OS3	921	320	vases		1		1DDEI
OS3	921	320	Berthel		1		1DDEI
PXS3	925	320	Ophia		1		1DDEI
PXS3	925	320	Med		1		1DDEI
PXS3	925	320	Perid			1	1DDEI
PXS3	925	320	Tere			1	1DDEI
PXS3	925	320	Halo			1	1DDEI
PXS3	925	320	eo			1	1DDEI
PXS3	925	320	banoph			1	1DDEI
P	928	320	Halo	1			1DDEI
P	928	320	banoph	5			1DDEI
P	928	320	Ophia	14			1DDEI
P	928	320	ccw	4			1DDEI
P	928	320	Para	1			1DDEI
P	928	320	cc	4			1DDEI
P	928	320	Med	1			1DDEI
PX	930	320	Ophia			1	1DDEJ
PX	930	320	banoph			1	1DDEJ
PX	930	320	soltun			1	1DDEJ
PX	930	320	sponge			1	1DDEJ
PX	930	320	Sebas			1	1DDEJ
PX	930	320	Med			1	1DDEJ
PX	930	320	nudi			1	1DDEJ

HARD BOTTOM DATA
TRANSECT 16 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PX	930	320	Para			1	1DDEJ
PX	932	330	Floro			1	1DDEJ
PX	932	330	Ophia			1	1DDEJ
PX	932	330	sponge			1	1DDEJ
PX	932	330	Med			1	1DDEJ
PX	932	330	Perid			1	1DDEJ
PX	933	330	Ophia			M	1DDEJ
PX	933	330	Floro			1	1DDEJ
PX	933	330	banoph			1	1DDEJ
PX	933	330	Halo			1	1DDEJ
PX	933	330	soltun			1	1DDEJ
PX	933	330	Para			1	1DDEJ
PX	933	330	sponge			1	1DDEJ
PX	935	330	Hen			1	1DDEI
PX	935	330	Med			1	1DDEI
PX	935	330	Perid			1	1DDEI
PX	935	330	ast			1	1DDEI
PX	935	330	Floro			1	1DDEI
PX	935	330	Ophia			1	1DDEI
PX	935	330	banoph			1	1DDEI
PX	936	330	Floro			1	1DDEI
PX	936	330	Ophia			1	1DDEI
PX	936	330	banoph			1	1DDEI
PX	936	330	soltun			1	1DDEI
PX	936	330	rgorg			1	1DDEI
O/P	938	330	Floro	1			1DDEJ
O/P	938	330	Ophia	5			1DDEJ
O/P	938	330	oph	17			1DDEJ
O/P	938	330	Med	2			1DDEJ
O/P	938	330	Perid	1			1DDEJ
O/P	938	330	ccw	1			1DDEJ
O/P	938	330	banoph	3			1DDEJ
O/P	938	330	ebry			1	1DDEJ
O/P	938	330	rgorg			1	1DDEJ
O/P	938	330	Berthel			1	1DDEJ
O/P	938	330	Coryph			1	1DDEJ
O/P	938	330	Oct			1	1DDEJ
O/P	938	330	cc			1	1DDEJ
PS4	940	330	banoph	6			1DDEJ
PS4	940	330	oph	1			1DDEJ
PS4	940	330	Med	1			1DDEJ
PS4	940	330	Bal	1			1DDEJ
PS4	940	330	ccw	1			1DDEJ
PS4	940	330	sponge			1	1DDEJ
PS4	940	330	gast	2			1DDEJ
PS4	940	330	rgorg			1	1DDEJ
PS4	940	330	Halo			1	1DDEJ
PS4	944	330	Med	3			1DDEJ
PS4	944	330	nudi	1			1DDEJ
PS4	944	330	Ophia	2			1DDEJ

HARD BOTTOM DATA
TRANSECT 16 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PS4	944	330	banoph	4			1DDEJ
PS4	944	330	rgorg	2			1DDEJ
PS4	944	330	ccw	3			1DDEJ
O/PXS4	949	330	Floro			1	1DDEI
O/PXS4	949	330	Ophia			1	1DDEI
O/PXS4	949	330	banoph			1	1DDEI
O/PXS4	949	330	encrust			1	1DDEI
O/PXS4	949	330	Rathbun			1	1DDEI
O/PXS4	949	330	Scon			1	1DDEI
O/PXS4	949	330	Sebas			1	1DDEI
O/PXS4	949	330	Floro			1	1DDEI
O/PXS4	949	330	oph			1	1DDEI
O/PXS4	949	330	Tere			1	1DDEI
O/PXS4	949	330	Perid			1	1DDEI
O/PXS4	949	330	Halo			1	1DDEI
O/PXS4	949	330	soltun			1	1DDEI
O/PXS4	949	330	Allo			1	1DDEI
O/PXS4	951	330	Allo			1	2DD00
O/PXS4	951	330	Parast			1	2DD00
O/PXS4	951	330	Oct			1	2DD00
O/PXS4	951	330	flat			1	2DD00
O/PXS4	951	330	Scon			1	2DD00
O/PXS4	951	330	Sabell			1	2DD00
O/PXS4	951	330	Med			1	2DD00
O/PXS4	951	330	Pagur			1	2DD00
P	956	330	gast	1			1DDEJ
P	956	330	Ophia	20			1DDEJ
P	956	330	banoph	7			1DDEJ
P	956	330	Halo	1			1DDEJ
P	956	330	ebry			1	1DDEJ
P	956	330	eo		5		1DDEJ
P	956	330	Hen			1	1DDEJ
P	956	330	Pyura			1	1DDEJ
P	956	330	Callig			1	1DDEJ
P	956	330	nudi			1	1DDEJ
P	956	330	Med			1	1DDEJ
P	956	330	Perid			1	1DDEJ
O/P	957	320	barrel	1			1DDE0
O/P	957	320	shelf	1			1DDE0
O/P	957	320	Sebas	1			1DDE0
O/P	957	320	Ophia	20			1DDE0
O/P	957	320	banoph	1			1DDE0
O/P	957	320	Sserra			1	1DDE0
O/P	957	320	Srubri			1	1DDE0
O/P	957	320	Floro			1	1DDE0
O/P	957	320	Scon			1	1DDE0
O/P	957	320	Smin			1	1DDE0
O/P	957	320	Sauric			1	1DDE0
O/P	957	320	Sebas			1	1DDE0
P	959	340	Med	1			1DDEI

HARD BOTTOM DATA
TRANSECT 16 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
P	959	340	Perid	1			1DDEI
P	959	340	Floro	6			1DDEI
P	959	340	rgorg	3			1DDEI
P	959	340	Ophia	20			1DDEI
P	959	340	banoph	6			1DDEI
P	959	340	Halo	2			1DDEI
P	959	340	soltun	2			1DDEI
P	959	340	Bal	2			1DDEI
O/PX	1000	340	Rath			1	1DDEI
O/PX	1000	340	Srubri			1	1DDEI
O/PX	1000	340	Scon			1	1DDEI
O/PX	1000	340	Floro			1	1DDEI
O/PX	1000	340	Ophia			1	1DDEI
O/P	1002	335	Hen	1			1DDEI
O/P	1002	335	Ophia	23			1DDEI
O/P	1002	335	banoph	10			1DDEI
O/P	1002	335	Med	1			1DDEI
O/P	1002	335	rgorg	1			1DDEI
O/P	1002	335	Hydro			1	1DDEI
O/P	1002	335	Actin			1	1DDEI
O/P	1002	335	Sebas			1	1DDEI
O/P	1002	335	shelf			1	1DDEI
O/P	1002	335	Ophiod			1	1DDEI
O/PX	1004	340	Med			1	1DDEI
O/PX	1004	340	Ophia			1	1DDEI
O/PX	1004	340	shelf			1	1DDEI
O/PX	1004	340	banoph			1	1DDEI
O/PX	1004	340	Selong			1	1DDEI
O/PX	1004	340	Para			1	1DDEI
O/PX	1004	340	Rath			1	1DDEI
O/PX	1004	340	sponge			1	1DDEI
P	1005	340	Ophia	25			1DDEI
P	1005	340	banoph	5			1DDEI
P	1005	340	Halo	1			1DDEI
P	1005	340	Med	2			1DDEI
P	1008	340	Ophia	7			1DDEI
P	1008	340	Allo	1			1DDEI
P	1008	340	soltun	8			1DDEI
P	1008	340	banoph	7			1DDEI
P	1008	340	oph	10			1DDEI
P	1008	340	cc	1			1DDEI
O/P	1013	345	Med	1			1DDEI
O/P	1013	345	ast	2			1DDEI
O/P	1013	345	cc	6			1DDEI
O/P	1013	345	banoph	7			1DDEI
O/P	1013	345	Ophia	1			1DDEI
O/P	1013	345	Allo			1	1DDEI
O/P	1013	345	Scon			1	1DDEI
O/P	1013	345	Neptu			1	1DDEI
O/P	1013	345	Gorgon			1	1DDEI

HARD BOTTOM DATA
TRANSECT 16 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1013	345	Srubri			1	1DDEI
PS5	1015	345	Med	2			1DDEI
PS5	1015	345	Ophia	1			1DDEI
PS5	1015	345	banoph	4			1DDEI
PS5	1015	345	ccw	1			1DDEI
PS5	1015	345	cc	5			1DDEI
PS5	1015	345	soltun	1			1DDEI
PS5	1016	345	Med	2			1DDEI
PS5	1016	345	Perid	1			1DDEI
PS5	1016	345	soltun	6			1DDEI
PS5	1016	345	Ophia	3			1DDEI
PS5	1016	345	oph	3			1DDEI
PS5	1016	345	ccw	1			1DDEI
PS5	1016	345	cc	6			1DDEI
PS5	1016	345	gast	1			1DDEI
PS5	1018	345	Ophia	11			1DDEI
PS5	1018	345	banoph	6			1DDEI
PS5	1018	345	cc	8			1DDEI
PS5	1018	345	Bal	1			1DDEI
PS5	1018	345	oph	1			1DDEI
PS5	1021	345	Ophia	5			1DDEI
PS5	1021	345	Gorgon	2			1DDEI

HARD BOTTOM DATA
TRANSECT 17 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS1	1120	540	Met	1			1DDEH
OS1	1120	540	Panda			1	1DDEH
OS1	1120	540	flat			1	1DDEH
OS1	1120	540	rgorg			1	1DDEH
OS1	1120	540	Octo			1	1DDEH
OS1	1120	540	oph			1	1DDEH
O	1131	540	Stachy			1	1DDEL
O	1131	540	Met			1	1DDEL
O	1131	540	Ptilo			1	1DDEL
O	1131	540	Parast			1	1DDEL
O	1131	540	Rajab			1	1DDEL
O	1133	540	anem			1	1DDEL
O	1133	540	Pleuro			1	1DDEL
O	1133	540	Panda			M	1DDEL
O	1133	540	Stachy			1	1DDEL
O	1133	540	Sty			1	1DDEL
O	1133	540	Ophiod			1	1DDEL
O	1133	540	Hippas			1	1DDEL
O	1133	540	Sebas			1	1DDEL
O	1133	540	Ophia			1	1DDEL
O	1135	540	Pleuro			1	1DDEL
O	1135	540	Med			1	1DDEL
O	1135	540	cc			1	1DDEL
O	1135	540	Panda			1	1DDEL
O	1135	540	Allo			1	1DDEL
O	1135	540	Met			1	1DDEL
O	1136	540	Met			1	1DDEL
O	1136	540	Panda			1	1DDEL
O	1136	540	Pleuro			1	1DDEL
O	1136	540	Ophia			1	1DDEL
O	1137	540	Met			1	1DDFL
O	1137	540	Ophia			1	1DDFL
O	1137	540	Panda			1	1DDFL
O	1137	540	Floro			1	1DDFL
O	1138	540	Panda	2			1DDFL
O	1138	540	Met			1	1DDFL
O	1138	540	Ophia			1	1DDFL
O	1140	540	Ophia			M	1DDFL
O	1140	540	Perid			1	1DDFL
O	1140	540	Zan			1	1DDFL
O	1140	540	Parast			1	1DDFL
O	1140	540	redsea			1	1DDFL
O	1140	540	Sebas			1	1DDFL
O	1140	540	Hen			1	1DDFL
O	1141	530	Panda			1	1DDFL
O	1141	530	Floro			1	1DDFL
O	1141	530	Met			1	1DDFL
O	1141	530	Ophia			1	1DDFL
O	1142	535	Met			1	1DDEL
O	1142	535	Ophia			1	1DDEL

HARD BOTTOM DATA
TRANSECT 17 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1142	535	Panda	3			1DDEL
O	1142	535	Parali			1	1DDEL
O	1147	540	Panda			1	1DDEL
O	1147	540	Stachy			1	1DDEL
O	1147	540	rgorg			1	1DDEL
O	1147	540	Luid			1	1DDEL
O	1147	540	Met			1	1DDEL
O	1147	540	Ophia			1	1DDEL
O	1147	540	Perid			1	1DDEL
O	1149	540	Stachy			1	1DDEL
O	1149	540	Luid			1	1DDEL
O	1149	540	Met			1	1DDEL
O	1149	540	rgorg			1	1DDEL
O	1149	540	Allo			1	1DDEL
O	1149	540	Octo			1	1DDEL
O	1151	550	Ophia			1	1DDEL
O	1151	550	Allo			1	1DDEL
O	1151	550	Zan			1	1DDEL
O	1151	550	Met			1	1DDEL
O	1153	555	Met			1	1DDEL
O	1153	555	Panda			1	1DDEL
O	1153	555	Parast			1	1DDEL
O	1153	555	redsea			1	1DDEL
O	1153	555	Ophia			1	1DDEL
O	1153	555	Sty			1	1DDEL
O	1153	555	Stachy			1	1DDEL
O	1153	555	Ptilo			1	1DDEL
O	1153	555	Oct			1	1DDEL
O	1156	560	seap			1	2D0E0
O	1156	560	heart			1	2D0E0
O	1158	560	Ophia			1	1DDEL
O	1158	560	Parali			1	1DDEL
O	1159	560	Panda			1	1DDEL
O	1159	560	Met			1	1DDEL
O	1201	560	rgorg			1	1DDEL
O	1201	560	Parali			1	1DDEL
O	1201	560	Met			M	1DDEL
O	1201	560	Floro			1	1DDEL
O	1203	555	Allo			1	1DDEL
O	1203	555	Gorgon			1	1DDEL
O	1203	555	anem			1	1DDEL
O	1203	555	Panda			1	1DDEL
O	1205	550	Panda	5			1DDEL
O	1205	550	Rath			1	1DDEL
O	1205	550	Met			1	1DDEL
O	1205	550	Ophia			1	1DDEL
O	1206	550	Luid			1	1DDEL
O	1206	550	Oct			1	1DDEL
O	1206	550	seap			1	1DDEL
O	1206	550	Srubri			1	1DDEL

HARD BOTTOM DATA
TRANSECT 17 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1209	550	Hen			1	2D0E0
O	1209	550	seap			1	2D0E0
O	1209	550	Rath			1	2D0E0
O	1209	550	Actin			1	2D0E0
O	1209	550	Agon			1	2D0E0
O	1209	550	Astro			1	2D0E0
O	1209	550	Oct			1	2D0E0
O	1212	550	Panda			1	1DDEL
O	1212	550	Met			1	1DDEL
O	1214	545	Met			1	1DDEL
O	1214	545	Panda			1	1DDEL
O	1214	545	Rath			1	1DDEL
O	1214	545	Ophia			1	1DDEL
O	1214	545	Floro			1	1DDEL
O	1218	540	Rath			1	1DDEH
O	1218	540	Actin			1	1DDEH
O	1218	540	Ophia			1	1DDEH
O	1218	540	oph			1	1DDEH
OS2	1226	535	Panda	3			1DDEH
OS2	1226	535	redsea			1	1DDEH
OS2	1226	535	Ophiod			1	1DDEH
OS2	1226	535	Stylas			1	1DDEH
O	1231	535	Panda			1	1DDEH
O	1231	535	Sty			1	1DDEH
O	1231	535	Stachy			1	1DDEH
O	1231	535	rgorg			1	1DDEH
O	1231	535	Octo			1	1DDEH
O	1231	535	Met			1	1DDEH
O	1231	535	Astro			1	1DDEH
O	1231	535	Cithar			1	1DDEH
O	1238	540	Oct			1	2D0E0
O	1238	540	seap			1	2D0E0
O	1240	540	anema			1	2D0E0
O	1240	540	Med			1	2D0E0
O	1240	540	rgorg			1	2D0E0
O	1240	540	Agon			1	2D0E0
O	1240	540	Actin			1	2D0E0
O	1242	535	Lyt			1	2D000

HARD BOTTOM DATA
TRANSECT 19 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1047	590	Allo	1			2D000
O	1047	590	Oct			1	2D000
O	1047	590	Med			1	2D000
O	1047	590	Panda			1	2D000
O	1047	590	Selong			1	2D000
O	1047	590	Pleuro			1	2D000
O	1047	590	Ptilo			1	2D000
O	1047	590	Hydro			1	2D000
O	1047	590	Stylas			1	2D000
O	1047	590	Zan			1	2D000
O	1052	590	Zan			1	2DD00
O	1052	590	Panda			1	2DD00
O	1052	590	Met			1	2DD00
O	1052	590	Sty			1	2DD00
O	1052	590	Ptilo			1	2DD00
O	1055	585	Allo			1	2DD00
O	1055	585	Zan			1	2DD00
O	1055	585	oph			1	2DD00
O/P	1100	580	oph			1	2D000
O/P	1100	580	Allo			1	2D000
O/P	1100	580	Oct			1	2D000
O/P	1100	580	hermit			1	2D000
O/P	1102	570	Ptilo			1	2D000
O/P	1102	570	Parast			1	2D000
O/P	1102	570	Sty			1	2D000
O/P	1102	570	Zan			1	2D000
O/P	1104	570	Med			1	2D000
O/P	1104	570	Parast			1	2D000
O	1106	570	Allo			1	2D000
O	1108	570	anem			1	2D000
O	1108	570	flat			1	2D000
O	1108	570	Allo			1	2D000
O	1110	590	Cross			1	2D000
O	1110	590	Parast			1	2D000
O	1110	590	Allo			1	2D000
O	1110	590	Zan			1	2D000
O	1110	590	Oct			1	2D000
O	1110	590	flat			1	2D000
O/P	1113	590	oph			1	2D000
O/P	1113	590	Panda			1	2D000
O	1114	585	Oct			1	2D000
O	1114	585	Allo			1	2D000
O	1114	585	ast			1	2D000
O/P	1116	585	anema			1	2D000
O/P	1116	585	anem			1	2D000
P	1118	585	Allo			1	2D000
P	1120	585	Octo			1	2D000
O/P	1121	580	Pleuro			1	2D000
O/P	1121	580	Allo			1	2D000
O	1123	580	Allo			1	2D000

HARD BOTTOM DATA
TRANSECT 19 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1123	580	anem			1	2D000
O	1123	580	Zan			1	2D000
O	1123	580	Octo			1	2D000
O	1123	580	Stylas			1	2D000
O	1123	580	Panda			1	2D000
O	1123	580	Sros			1	2D000
O	1123	580	Pleuro			1	2D000
O	1124	575	flat			1	2D000
O	1124	575	oph			1	2D000
O	1126	570	Pleuro			1	2D000
O/P	1128	570	Allo	1			2D000
O/P	1128	570	gast	2			2D000
O/P	1131	560	oph			1	2D000
O/P	1131	560	anem			1	2D000
O/P	1131	560	Stylas			1	2D000
P	1132	560	oph			1	2D000
O/P	1134	550	oph			1	2D000
O/P	1134	550	Pleuro			1	2D000
O/P	1134	550	Allo			1	2D000
O	1135	550	Allo			1	2D000
O	1135	550	oph			1	2D000
O	1136	545	Panda			1	2D000
O	1136	545	Allo			1	2D000
O	1136	545	Zan			1	2D000
O	1136	545	Octo			1	2D000
O	1136	545	oph			1	2D000
O	1136	545	Raja			1	2D000
P	1139	545	oph			1	2D000
P	1140	545	oph			1	2D000
O	1141	540	Allo			1	2D000
O	1141	540	Oct			1	2D000
O	1141	540	Zan			1	2D000
O	1141	540	oph			1	2D000
O	1141	540	Parast			1	2D000
O	1144	535	Allo			1	2D000
O	1144	535	Lopho			1	2D000
P	1148	535	oph			1	2D000
O	1149	530	Lopho			1	2D000
O	1149	530	Allo			1	2D000
O	1151	530	Lopho			1	2D000
O	1152	530	Allo			1	2D000
O	1152	530	Lopho			1	2D000
O	1152	530	Allo			1	2D000
O	1152	530	Octo			1	2D000
O	1152	530	Zan			1	2D000
P	1153	530	Octo	1			2D000
P	1153	530	gast	1			2D000
P	1153	530	oph			1	2D000
O/PX	1155	525	oph			1	2D000
O/PX	1155	525	Allo			1	2D000

HARD BOTTOM DATA
TRANSECT 19 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/PX	1155	525	Lopho			1	2D000
O/PX	1155	525	Octo			1	2D000
O/PX	1155	525	Zan			1	2D000
O	1200	520	oph			1	2D000
O	1200	520	Octo			1	2D000
O	1200	520	Zan			1	2D000
O	1200	520	Allo			1	2D000
O	1200	520	anem			1	2D000
O	1200	520	Selong			1	2D000
O	1204	520	Allo			1	2D000
O	1204	520	Octo			1	2D000
O	1206	520	Allo			1	2D000
O	1206	520	Octo			1	2D000
O	1206	520	Porich			1	2D000
O	1209	515	flat			1	2D000
O	1209	515	Parast			1	2D000
O	1209	515	oph			M	2D000
O	1209	515	Allo			1	2D000
O	1212	510	Octo			1	2D000
O	1212	510	oph			1	2D000
O	1212	510	Selong			1	2D000
O	1212	510	Agon			1	2D000
O	1212	510	Sebas			1	2D000
O	1212	510	rgorg			1	2D000
O	1214	510	Lopho			1	2D000
O	1214	510	Met			1	2D000
O	1214	510	Allo			1	2D000
O	1215	510	Allo			1	2D000
O	1215	510	Lopho			1	2D000
O	1216	505	oph			1	2D000
O	1216	505	Lopho			1	2D000
O	1216	505	Allo			1	2D000
O	1216	505	Zan			1	2D000
O	1219	505	Agon			1	2D000
O	1219	505	ast			1	2D000
O	1222	495	Bris			1	2D000
O	1222	495	Ptilo			1	2D000
O	1222	495	oph			1	2D000
O	1222	495	Zan			1	2D000
O	1222	495	Octo			1	2D000

HARD BOTTOM DATA
TRANSECT 20 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS1	1013	435	Gorgon			1	1DDEL
OS1	1013	435	brac			1	1DDEL
OS1	1013	435	Med			1	1DDEL
OS1	1013	435	zoan			1	1DDEL
OS1	1013	435	Halo			1	1DDEL
OS1	1013	435	Floro			1	1DDEL
OS1	1013	435	Ophia			1	1DDEL
OS1	1013	435	Zan			1	1DDEL
OS1	1013	435	Para			1	1DDEL
OS1	1013	435	Cya			1	1DDEL
OS1	1013	435	Ptilo			1	1DDEL
OS1	1013	435	hermit			1	1DDEL
OS1	1013	435	Parast			1	1DDEL
OS1	1013	435	cc			1	1DDEL
OS1	1013	435	Sros			1	1DDEL
OS1	1013	435	Eugor			1	1DDEL
O	1016	435	Pleuro			1	1DDEL
O	1016	435	Ophia	15			1DDEL
O	1016	435	banoph			1	1DDEL
O	1016	435	Stylas			1	1DDEL
O	1016	435	Med			1	1DDEL
O	1016	435	brac			1	1DDEL
O	1016	435	zoan			1	1DDEL
O	1016	435	Actin			1	1DDEL
O	1018	435	eo			1	1DDEL
O	1018	435	oph			1	1DDEL
O	1018	435	Floro			1	1DDEL
O	1018	435	Perid			1	1DDEL
O	1018	435	hermit			1	1DDEL
O	1018	435	brac			1	1DDEL
O	1018	435	Halo			1	1DDEL
P	1019	435	Ophia	9			1DDEL
P	1019	435	banoph	8			1DDEL
P	1019	435	Med	1			1DDEL
P	1019	435	Halo	1			1DDEL
P	1019	435	soltun	1			1DDEL
P	1019	435	zoan			1	1DDEL
O/P	1021	435	Ophia	18			1DDEL
O/P	1021	435	banoph	7			1DDEL
O/P	1021	435	soltun	2			1DDEL
O/P	1021	435	Halo	1			1DDEL
O/P	1021	435	gast	1			1DDEL
O/P	1021	435	Pleuro			1	1DDEL
O/P	1021	435	Allo			1	1DDEL
O/P	1021	435	Srubri			1	1DDEL
O/P	1021	435	shelf			1	1DDEL
O/P	1021	435	Floro			1	1DDEL
O/P	1021	435	Actin			1	1DDEL
O	1025	420	Gorgon			1	1DDEL
O	1025	420	Allo			1	1DDEL

HARD BOTTOM DATA
TRANSECT 20 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1027	420	Ophia	7			1DDEL
O/P	1027	420	banoph	9			1DDEL
O/P	1027	420	Halo	2			1DDEL
O/P	1027	420	Med	1			1DDEL
O/P	1027	420	Neptu	2			1DDEL
O/P	1027	420	cc	3			1DDEL
O/P	1027	420	nudi	1			1DDEL
O/P	1027	420	Floro			1	1DDEL
O/P	1027	420	Zan			1	1DDEL
O/P	1027	420	brac			1	1DDEL
O/P	1027	420	Sros			1	1DDEL
O	1028	415	Actin			1	1DDEL
O	1028	415	Eugor			1	1DDEL
O	1028	415	Gorgon			1	1DDEL
O	1028	415	Floro			1	1DDEL
O	1028	415	Ophia			M	1DDEL
O	1028	415	Pleuro			1	1DDEL
O	1028	415	soltun			1	1DDEL
O	1028	415	ast			1	1DDEL
PX	1029	415	Ophia			1	1DDEL
PX	1029	415	banoph			1	1DDEL
PX	1029	415	Perid			1	1DDEL
PX	1029	415	ast			1	1DDEL
PX	1030	415	Ophia			1	1DDEL
PX	1030	415	Med			1	1DDEL
PX	1030	415	gast			1	1DDEL
PX	1030	415	Halo			1	1DDEL
PX	1030	415	cc			1	1DDEL
O	1031	415	hydaglo			1	1DDEL
O	1031	415	Actin			1	1DDEL
O	1031	415	Pleuro			M	1DDEL
O	1031	415	Perid			1	1DDEL
O/PX	1032	415	Ophia			1	1DDEL
O/PX	1032	415	banoph			1	1DDEL
O/PX	1032	415	Bal			1	1DDEL
O/PX	1032	415	Calli			1	1DDEL
O/PX	1032	415	Halo			1	1DDEL
O/PX	1032	415	soltun			1	1DDEL
O/PX	1032	415	cc			1	1DDEL
O/PX	1032	415	Actin			1	1DEL
O/PX	1032	415	Poran			1	1DDEL
O/PX	1033	410	Ophia			M	1DDEL
O/PX	1033	410	banoph			1	1DDEL
O/PX	1033	410	Med			1	1DDEL
O/PX	1033	410	Perid			1	1DDEL
O/PX	1033	410	Halo			1	1DDEL
O/PX	1033	410	soltun			1	1DDEL
O/PX	1033	410	gast			1	1DDEL
O/PX	1033	410	ast			1	1DDEL
O/PX	1033	410	hydaglo			1	1DDEL

HARD BOTTOM DATA
TRANSECT 20 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/PX	1033	410	shelf			1	1DDEL
O	1034	410	Fusib			1	1DDEJ
O	1034	410	Actin			1	1DDEJ
O	1034	410	Ophia			M	1DDEJ
O	1034	410	Allo			1	1DDEJ
O	1034	410	Floro			1	1DDEJ
O	1034	410	banoph			1	1DDEJ
O	1034	410	shelf			1	1DDEJ
PX	1035	410	Floro			1	1DDEJ
PX	1035	410	Ophia			M	1DDEJ
PX	1035	410	banoph			1	1DDEJ
PX	1035	410	Halo			1	1DDEJ
PX	1035	410	gast			1	1DDEJ
O	1039	410	brac			1	1DDEJ
O	1039	410	Floro			1	1DDEJ
O	1039	410	Ophia			M	1DDEJ
O	1039	410	Gorgon			1	1DDEJ
O	1039	410	Halo			1	1DDEJ
O	1039	410	shelf			1	1DDEJ
O	1039	410	Dendro			1	1DDEJ
O	1039	410	soltun			1	1DDEJ
O	1041	410	Floro			M	1DDEL
O	1041	410	Actin			1	1DDEL
O	1041	410	Hippos			1	1DDEL
O	1041	410	shelf			1	1DDEL
O	1041	410	Ophia			M	1DDEL
O	1041	410	soltun			1	1DDEL
O	1044	390	Actin			1	1DDEL
O	1044	390	shelf			1	1DDEL
O	1044	390	vases			1	1DDEL
O	1044	390	Berthel			1	1DDEL
O	1044	390	ast			1	1DDEL
O	1044	390	Halo			1	1DDEL
O	1044	390	Floro			M	1DDEL
O	1044	390	Ophia			M	1DDEL
O	1044	390	Gorgon			1	1DDEL
PX	1045	390	Ophia			1	1DDEL
PX	1045	390	banoph			1	1DDEL
PX	1045	390	Med			1	1DDEL
PX	1045	390	Halo			1	1DDEL
PX	1045	390	ast			1	1DDEL
P	1046	390	shelf		1		1DDEL
P	1046	390	Med	1			1DDEL
P	1046	390	Floro	1			1DDEL
P	1046	390	Ophia	15			1DDEL
P	1046	390	banoph	12			1DDEL
P	1048	390	Floro	3			1DDEL
P	1048	390	Ophia	34			1DDEL
P	1048	390	banoph	15			1DDEL
P	1048	390	Halo	8			1DDEL

HARD BOTTOM DATA
TRANSECT 20 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
P	1048	390	ccw	2			1DDEL
P	1048	390	Sebas			1	1DDEL
P	1048	390	zoan			1	1DDEL
P	1049	380	Ophia	14			1DDEL
P	1049	380	banoph	5			1DDEL
P	1049	380	Pagur	1			1DDEL
P	1049	380	encrust		1		1DDEL
P	1049	380	Med	1			1DDEL
P	1049	380	Hen	1			1DDEL
P	1049	380	Halo	2			1DDEL
P	1049	380	Para	1			1DDEL
P	1049	380	cc	3			1DDEL
PS2	1051	380	Hippas	1			1DDEL
PS2	1051	380	Sebas			1	1DDEL
PS2	1051	380	Ophia	16			1DDEL
PS2	1051	380	banoph	7			1DDEL
PS2	1051	380	ebry		1		1DDEL
PS2	1051	380	eo			1	1DDEL
O/PS2	1054	380	shelf		2		1DDEL
O/PS2	1054	380	Floro	2			1DDEL
O/PS2	1054	380	Ophia	16			1DDEL
O/PS2	1054	380	banoph	8			1DDEL
O/PS2	1054	380	soltun	2			1DDEL
O/PS2	1054	380	Octo			1	1DDEL
O/PS2	1054	380	Halo			M	1DDEL
PS	1101	380	Halo	6			1DDEL
PS	1101	380	Ophia	20			1DDEL
PS	1101	380	banoph	9			1DDEL
PS	1101	380	ebry		1		1DDEL
PS	1101	380	Allo	1			1DDEL
PS	1101	380	Triton	1			1DDEL
PS	1101	380	zoan			1	1DDEL
PS	1101	380	Hen	1			1DDEL
O/PS2	1110	380	Ophia	13			1DDEI
O/PS2	1110	380	banoph	4			1DDEI
O/PS2	1110	380	cc	4			1DDEI
O/PS2	1110	380	ebry		2		1DDEI
O/PS2	1110	380	Berthel			1	1DDEI
O/PS2	1110	380	Floro			1	1DDEI
OS2/PS2	1110	380	Ophia			1	1DDEI
OS2	1111	380	Rath			1	1DDEI
OS2	1111	380	Med			1	1DDEI
OS2	1111	380	Floro			1	1DDEI
OS2	1111	380	Ophia			1	1DDEI
OS2	1111	380	sponge			1	1DDEI
OS2	1111	380	hydaglo			1	1DDEI
OS2	1111	380	brac			1	1DDEI
OS2	1111	380	Sebas			1	1DDEI
OS2	1111	380	Sros			1	1DDEI
OS2	1111	380	oph			M	1DDEI

HARD BOTTOM DATA
TRANSECT 20 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS2	1111	380	Eugor			1	1DDEI
PXS2	1112	380	Halo			1	1DDEI
PXS2	1112	380	soltun			1	1DDEI
PXS2	1112	380	Floro			1	1DDEI
PXS2	1112	380	Med			1	1DDEI
PXS2	1112	380	ast			1	1DDEI
PXS2	1112	380	Ophia			M	1DDEI
PXS2	1112	380	banoph			1	1DDEI
PXS2	1112	380	cc			1	1DDEI
O/PXS2	1113	380	Med			1	1DDEI
O/PXS2	1113	380	Perid			1	1DDEI
O/PXS2	1113	380	Halo			1	1DDEI
O/PXS2	1113	380	Ophia			1	1DDEI
O/PXS2	1113	380	oph			M	1DDEI
O/PXS2	1113	380	banoph			1	1DDEI
O/PXS2	1113	380	Para			1	1DDEI
O/PXS2	1113	380	soltun			1	1DDEI
O/PXS2	1113	380	Gorgon			1	1DDEI
O/PXS2	1113	380	ast			1	1DDEI
O/PXS2	1113	380	Floro			M	1DDEI
O/PXS2	1113	380	Sebas			1	1DDEI
O/PXS2	1113	380	Sros			1	1DDEI
O/PXS2	1113	380	Allo			1	1DDEI
O/PXS2	1113	380	brac			M	1DDEI
O/P	1115	320	Ophia	16			1DDEI
O/P	1115	320	Sebas			1	1DDEI
O/P	1115	320	banoph	11			1DDEI
O/P	1115	320	Halo	2			1DDEI
O/P	1115	320	ast	1			1DDEI
O/P	1115	320	Floro			1	1DDEI
O/P	1115	320	shelf			1	1DDEI
O/P	1115	320	Para			1	1DDEI
O/P	1117	320	Halo	2			1DDEL
O/P	1117	320	soltun	1			1DDEL
O/P	1117	320	Sebas			1	1DDEL
O/P	1117	320	Med	1			1DDEL
O/P	1117	320	Ophia	47			1DDEL
O/P	1117	320	banoph	7			1DDEL
O/P	1117	320	ebry		2		1DDEL
O/P	1117	320	gast	1			1DDEL
O/P	1117	320	Tere	3			1DDEL
O/P	1117	320	Srubri			1	1DDEL
O/P	1117	320	Gorgon			1	1DDEL
O/P	1117	320	ast			1	1DDEL
O/P	1117	320	Floro			M	1DDEL
O/P	1117	320	Hippas			1	1DDEL
PX	1118	320	shelf			1	1DDEL
PX	1118	320	Floro			1	1DDEL
PX	1118	320	Ophia			M	1DDEL
PX	1118	320	banoph			1	1DDEL

HARD BOTTOM DATA
TRANSECT 20 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PX	1118	320	eo			1	1DDEL
PX	1118	320	Med			1	1DDEL
PX	1118	320	Bal			1	1DDEL
PX	1118	320	cc			1	1DDEL
PX	1118	320	Halo			1	1DDEL
O/P	1120	320	Ophia	21			1DDEL
O/P	1120	320	banoph	10			1DDEL
O/P	1120	320	Bal	1			1DDEL
O/P	1120	320	Para	1			1DDEL
O/P	1120	320	ccw	7			1DDEL
O/P	1120	320	cc	5			1DDEL
O/P	1120	320	ebry		5		1DDEL
O/P	1120	320	Halo	1			1DDEL
O/P	1120	320	Floro			M	1DDEL
O/P	1120	320	Rath			1	1DDEL
O/P	1120	320	Hippas			1	1DDEL
O/P	1120	320	Tritond			1	1DDEL
O/P	1120	320	Eugor			1	1DDEL
O/P	1120	320	Actin			1	1DDEL
PX	1121	320	Ophia			1	1DDEL
PX	1121	320	Floro			1	1DDEL
PX	1121	320	banoph			1	1DDEL
PX	1121	320	ccw			1	1DDEL
PX	1121	320	Med			1	1DDEL
PX	1121	320	cc			1	1DDEL
PX	1121	320	Perid			1	1DDEL
PX	1121	320	encrust			1	1DDEL
O	1122	320	Floro			M	1DDEL
O	1122	320	Ophia			M	1DDEL
O	1122	320	Actin			1	1DDEL
O	1122	320	Para			1	1DDEL
O	1122	320	Cya			1	1DDEL
O	1122	320	Eugor			1	1DDEL
O	1122	320	Hippas			1	1DDEL
O	1122	320	esponge			1	1DDEL
O	1122	320	Stylas			1	1DDEL
O	1122	320	Pter			1	1DDEL
PX	1123	320	rgorg			1	1DDEL
PX	1123	320	Floro			M	1DDEL
PX	1123	320	Ophia			M	1DDEL
PX	1123	320	Sserra			1	1DDEL
PX	1123	320	sponge			1	1DDEL
PX	1123	320	soltun			1	1DDEL
PX	1123	320	Halo			1	1DDEL
PX	1123	320	Bal			1	1DDEL
PX	1123	320	cc			1	1DDEL
O/PX	1125	320	Fforo			M	1DDEI
O/PX	1125	320	Med			1	1DDEI
O/PX	1125	320	Ophia			1	1DDEI
O/PX	1125	320	cc			1	1DDEI

HARD BOTTOM DATA
TRANSECT 20 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/PX	1125	320	soltun			1	1DDEI
O/PX	1125	320	Eugor			1	1DDEI
O/PX	1125	320	Sebas			1	1DDEI
O/PX	1125	320	Hippas			1	1DDEI
P	1126	320	Med	2			1DDEI
P	1126	320	rgorg	3			1DDEI
P	1126	320	Floro	1			1DDEI
P	1126	320	Ophia	25			1DDEI
P	1126	320	banoph	4			1DDEI
P	1126	320	ccw	4			1DDEI
P	1126	320	Para	3			1DDEI
P	1126	320	cc	5			1DDEI
P	1126	320	soltun	2			1DDEI
P	1126	320	eo		10		1DDEI
P	1126	320	Perid	1			1DDEI
P	1126	320	oph	30			1DDEI
P	1126	320	soltun	1			1DDEI
O/P	1128	320	Coryn		25		1DDGH
O/P	1128	320	soltun	2			1DDGH
O/P	1128	320	sponge.		2		1DDGH
O/P	1128	320	Para	9			1DDGH
O/P	1128	320	ccw	1			1DDGH
O/P	1128	320	oph	10			1DDGH
O/P	1128	320	Calli			1	1DDGH
O/P	1128	320	Eugor			1	1DDGH
O/PX	1129	320	Med			1	1DDGH
O/PX	1129	320	rgorg			1	1DDGH
O/PX	1129	320	sponge			1	1DDGH
O/PX	1129	320	Coryn			1	1DDGH
O/PX	1129	320	cc			1	1DDGH
O/PX	1129	320	Eugor			1	1DDGH
O/PX	1129	320	Sebas			1	1DDGH
O/PX	1129	320	Para			1	1DDGH
O/PX	1129	320	cc			1	1DDGH
O/PX	1129	320	anem			1	1DDGH
O/PX	1129	320	soltun			1	1DDGH
O/PX	1129	320	eo			1	1DDGH
O	1134	300	Sebas			M	100GL
O	1134	300	Med			M	100GL
O	1134	300	Gorgon			1	100GL
O	1134	300	Pycno			1	100GL
O	1137	300	vases			1	1DDGL
O	1137	300	Floro			1	1DDGL
O	1137	300	Eugor			1	1DDGL
O	1137	300	Para			1	1DDGL
O	1137	300	Perid			1	1DDGL
O	1137	300	Ophia			1	1DDGL
PX	1138	300	Floro			1	1DDEL
PX	1138	300	Ophia			M	1DDEL
PX	1138	300	banoph			1	1DDEL

HARD BOTTOM DATA
TRANSECT 20 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PX	1138	300	Halo			1	1DDEL
PX	1138	300	soltun			1	1DDEL
PX	1138	300	Perid			1	1DDEL
PX	1138	300	gorg			1	1DDEL
O	1140	300	Floro			M	1DDEJ
O	1140	300	Ophia			1	1DDEJ
O	1140	300	Eugor			1	1DDEJ
O	1140	300	ast			1	1DDEJ
O	1140	300	Gorgon			1	1DDEJ
O	1140	300	Loxo			1	1DDEJ
O	1140	300	sponge			1	1DDEJ
PX	1141	300	Sebas			1	1DDE0
PX	1141	300	Floro			1	1DDE0
PX	1141	300	rgorg			1	1DDE0
PX	1141	300	ast			1	1DDE0
PX	1141	300	Med			1	1DDE0
PX	1141	300	Ophia			1	1DDE0
PX	1141	300	soltun			1	1DDE0
PX	1142	300	Floro			1	1DDEI
PX	1142	300	Perid			1	1DDEI
PX	1142	300	cc			1	1DDEI
PX	1142	300	Ophia			M	1DDEI
PX	1142	300	banoph			1	1DDEI
PX	1142	300	soltun			1	1DDEI
PX	1142	300	rgorg			1	1DDEI
PX	1144	300	Floro			1	10000
PX	1144	300	Ophia			1	10000
PX	1144	300	Med			1	10000
PX	1144	300	Perid			1	10000
PX	1144	300	ast			1	10000
PX	1144	300	cc			1	10000
O/PX	1145	305	Allo			1	1DDEH
O/PX	1145	305	Floro			1	1DDEH
O/PX	1145	305	Ophia			1	1DDEH
O/PX	1145	305	Med			1	1DDEH
O/PX	1145	305	Perid			1	1DDEH
O/PX	1145	305	rgorg			1	1DDEH
O/PX	1145	305	encrust			1	1DDEH
O/PX	1145	305	Stylas			1	1DDEH
O/PX	1145	305	Sebas			M	1DDEH
O/PX	1145	305	soltun			1	1DDEH
O/PX	1145	305	Halo			1	1DDEH
O/PX	1145	305	Srubri			1	1DDEH
O/PX	1145	305	Sros			1	1DDEH
O/PX	1145	305	Hydro			1	1DDEH
O/PX	1145	305	Berthel			1	1DDEH
PX	1147	300	Floro			1	1DDEL
PX	1147	300	Med			1	1DDEL
PX	1147	300	ast			1	1DDEL
PX	1147	300	soltun			1	1DDEL

HARD BOTTOM DATA
TRANSECT 20 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PX	1147	300	Ophia			1	1DDEL
O/PX	1149	300	vases	1			1DDEL
O/PX	1149	300	rgorg	8			1DDEL
O/PX	1149	300	Ophia	14			1DDEL
O/PX	1149	300	Perid	2			1DDEL
O/PX	1149	300	banoph	5			1DDEL
O/PX	1149	300	soltun	1			1DDEL
O/Px	1149	300	nudi	1			1DDEL
O/PX	1149	300	cc	3			1DDEL
O/PX	1149	300	sponge		1		1DDEL
O/PX	1149	300	ebry		1		1DDEL
O/PX	1149	300	Berthel		1		1DDEL
O/PX	1149	300	Eugor		1		1DDEL
O/PX	1149	300	Floro		1		1DDEL
O/PS3	1222	315	Para		1		1DDEL
O/PS3	1222	315	Loxo		1		1DDEL
O/PS3	1222	315	shelf		1		1DDEL
O/PS3	1222	315	Eugor		1		1DDEL
O/PS3	1222	315	Floro		1		1DDEL
O/PS3	1222	315	Perid	1			1DDEL
O/PS3	1222	315	rgorg	4			1DDEL
O/PS3	1222	315	Ophia	8			1DDEL
O/PS3	1222	315	banoph	6			1DDEL
O/PS3	1222	315	sponge		2		1DDEL
O/PXS3	1224	315	rgorg			1	1DDEL
O/PXS3	1224	315	Ophia			1	1DDEL
O/PXS3	1224	315	banoph			1	1DDEL
O/PXS3	1224	315	sponge			1	1DDEL
O/PXS3	1224	315	eo			1	1DDEL
O/PXS3	1224	315	Halo			1	1DDEL
O/PXS3	1224	315	soltun			1	1DDEL
O/PXS3	1224	315	Ophiod			1	1DDEL
O/PXS3	1224	315	Actin			1	1DDEL
O/PXS3	1224	315	Eugor			1	1DDEL
O/PXS3	1224	315	Berthel			1	1DDEL
O/PXS3	1224	315	Chilara			1	1DDEL

HARD BOTTOM DATA
TRANSECT 21 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1616	250	Oct			1	2D000
O	1616	250	Sty			1	2D000
O	1619	250	Acan			1	2D000
O	1619	250	Lyt			1	2D000
O	1619	250	Sty			1	2D000
O	1619	250	oph			1	2D000
O	1619	250	Luid			1	2D000
O	1619	250	Oct			M	2D000
O	1619	250	Zan			1	2D000
O	1619	250	Med			1	2D000
O	1622	250	Med			1	2D000
O	1622	250	Stachy			1	2D000
O	1622	250	Oct			1	2D000
O	1624	250	Zan			1	2D000
O	1624	250	Sty			1	2D000
O	1624	250	Parast			1	2D000
O	1624	250	Oct			1	2D000
O	1624	250	Cithar			1	2D000
O	1624	250	Acan			1	2D000
O	1626	250	Met			M	1DDGH
O	1626	250	Para			1	1DDGH
O	1626	250	Med			1	1DDGH
O	1626	250	Bal			1	1DDGH
O	1626	250	rgorg			M	1DDGH
O	1626	250	Sebas			1	1DDGH
O	1626	250	Perid			1	1DDGH
O	1626	250	Stylas			1	1DDGH
O	1626	250	Srubri			1	1DDGH
O	1626	250	Parast			1	1DDGH
O	1626	250	Selong			1	1DDGH
O	1626	250	sponge			1	1DDGH
O	1630	250	Stylas			1	1DDGH
O	1630	250	Parast			1	1DDGH
O	1630	250	Med			1	1DDGH
O	1630	250	Met			M	1DDGH
O	1630	250	rgorg			1	1DDGH
O	1630	250	Coryn			M	1DDGH
O	1630	250	Para			1	1DDGH
O	1630	250	sponge			1	1DDGH
O	1632	250	Met			M	1DDGH
O	1632	250	Sebas			1	1DDGH
O	1632	250	Selong			1	1DDGH
O	1632	250	rgorg			M	1DDGH
O	1632	250	Parast			1	1DDGH
O	1632	250	sponge			1	1DDGH
O	1633	250	Met			M	1DDGH
O	1633	250	Parast			1	1DDGH
O	1633	250	Med			1	1DDGH

HARD BOTTOM DATA
TRANSECT 21 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1633	250	Stylas			1	1DDGH
O	1633	250	Coryn			M	1DDGH
O	1633	250	sponge			1	1DDGH
O	1633	250	Bal			1	1DDGH
O	1633	250	Para			1	1DDGH
O	1633	250	Sebas			1	1DDGH
O	1636	270	Met			M	1DDGH
O	1636	270	Coryn			M	1DDGH
O	1636	270	Bal			1	1DDGH
O	1636	270	Para			1	1DDGH
O	1639	270	Met			1	1DDEH
O	1639	270	Hydro			1	1DDEH
O	1639	270	Rath			1	1DDEH
O	1639	270	Bal			1	1DDEH
O	1639	270	Para			1	1DDEH
O	1639	270	Tealia			1	1DDEH
O	1639	270	Selong			1	1DDEH
O	1639	270	Cya			1	1DDEH
O	1639	270	Pter			1	1DDEH
O	1651	270	Sebas			1	1DDFI
O	1651	270	Stylas			1	1DDFI
O	1651	270	sponge			1	1DDFI
O	1651	270	Ophiod			1	1DDFI
O	1651	270	Acan			1	1DDFI
O	1651	270	Parast			1	1DDFI
O	1651	270	Selong			1	1DDFI
O	1651	270	Met			1	1DDFI
O	1654	270	Parast			1	1DDFI
O	1654	270	Met			M	1DDFI
O	1654	270	ebry			1	1DDFI
O	1657	270	ast			1	1DDFI
O	1657	270	Med			1	1DDFI
O	1659	270	Oct			1	2ODEH
O	1659	270	Parast			1	2ODEH
O	1659	270	Pleuro			1	2ODEH
O	1659	270	Stachy			1	2ODEH
O	1659	270	Selong			1	2ODEH
O	1659	270	gorg			1	2ODEH
O	1701	270	Met			1	1DDEH
O	1701	270	Gorgon			1	1DDEH
O	1701	270	Zan			1	1DDEH
O	1701	270	Med			1	1DDEH
O	1701	270	Parast			1	1DDEH
O	1703	300	Bal			1	1DDFH
O	1703	300	Met			1	1DDFH
O	1703	300	Para			1	1DDFH
O	1703	300	ast			1	1DDFH
O	1703	300	Parast			1	1DDFH
O	1703	300	Zan			1	1DDFH
O	1703	300	Protula			1	1DDFH

HARD BOTTOM DATA
TRANSECT 21 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1703	300	Gorgon			1	1DDFH
O	1703	300	Stylas			1	1DDFH
O	1708	300	Stylas			1	1DDFH
O	1708	300	Bal			1	1DDFH
O	1708	300	Para			1	1DDFH
O	1708	300	gorg			1	1DDFH
O	1708	300	Parast			1	1DDFH
O	1715	300	sponge			1	1DDFH
O	1715	300	Pter			1	1DDFH
O	1715	300	zoan			1	1DDFH
O	1715	300	Cya			1	1DDFH
O	1715	300	Met			M	1DDFH
O	1715	300	Srubri			1	1DDFH
O	1718	300	Oct			1	1DDEH
O	1718	300	Med			1	1DDEH
O	1718	300	seap			1	1DDEH
O	1718	300	Selong			1	1DDEH
O	1718	300	Stachy			1	1DDEH
O	1718	300	Met			1	1DDEH
O	1718	300	Zan			1	1DDEH
O	1718	300	ast			1	1DDEH
O	1720	300	Met			1	1DDFH
O	1720	300	Bal			1	1DDFH
O	1720	300	Para			1	1DDFH
O	1720	300	rgorg			1	1DDFH
O	1720	300	sponge			1	1DDFH
O	1720	300	Pleuro			1	1DDFH
O	1720	300	Gorgon			1	1dDFH
O	1720	300	Hen			1	1DDFH
O	1720	300	anem			1	1DDFH
O	1720	300	Parast			1	1DDFH\
O	1720	300	Zan			1	1DDFH
O	1723	300	Hydro			1	1DDEH
O	1723	300	Parast			1	1DDEH
O	1723	300	gorg			1	1DDEH
O	1723	300	Oct			1	1DDEH
O	1723	300	Sty			1	1DDEH
O	1723	300	Tealia			1	1DDEH
O	1723	300	Luid			1	1DDEH
O	1743	300	sponge			1	1DDFH
O	1743	300	Coeno			1	1DDFH
O	1746	300	Oct			1	1DDEH
O	1746	300	Luid			1	1DDEH
O	1746	300	gorg			1	1DDEH
O	1746	300	Zan			1	1DDEH
O	1746	300	Ptilo			1	1DDEH
O	1746	300	Acan			1	1DDEH
O	1749	300	Met			1	2DDEO
O	1752	295	Megas			1	2DDEO
O	1752	295	Lyt			1	2DDEO

HARD BOTTOM DATA
TRANSECT 21 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1752	295	Zan			1	2DDEO
O	1752	295	Stachy			1	2DDEO
O	1752	295	Ptilo			1	2DDEO
O	1752	295	Pleuro			1	2DDEO
O	1752	295	Ophid			1	2DDEO
O	1756	295	Met			1	1DDGH
O	1759	295	Met			M	1DDGH
O	1759	295	Stylas			1	1DDGH
O	1759	295	gorg			1	1DDGH
O	1759	295	Sebas			1	1DDGH
O	1759	295	Stylas			1	1DDGH
O	1759	295	sponge			1	1DDGH
O	1759	295	Parast			M	1DDGH
O	1759	295	Bal			1	1DDGH
O	1759	295	Para			1	1DDGH
O	1759	295	Hydro			1	1DDGH
O	1805	295	Sty			1	2DOEH
O	1805	295	Stachy			1	2DOEH
O	1805	295	Oct			1	2DOEH
O	1805	295	Mitra			1	2DOEH
O	1805	295	Lyt			1	2DOEH
O	1805	295	oph			1	2DOEH
O	1805	295	flat			1	2DOEH

HARD BOTTOM DATA
TRANSECT 22 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS1	1323	380	Oct			1	2D000
OS1	1323	380	Sty			1	2D000
OS1	1323	380	Clthar			1	2D000
O	1328	380	Oct			1	2D000
O	1328	380	Sty	.5			2D000
O	1328	380	Acan			1	2D000
O	1328	380	Lyt			1	2D000
O	1329	380	Ptilo			1	2D000
O	1329	380	Oct	.5			2D000
O	1329	380	Cerian			1	2D000
O	1330	380	Cerian			1	2D000
O	1330	380	Lyt			1	2D000
O	1330	380	Oct			1	2D000
O	1330	380	oph			1	2D000
O	1330	380	Luid			1	2D000
O	1330	380	Sty	.5			2D000
O	1330	380	Agon			1	2D000
O	1332	380	Luid			M	2D000
O	1332	380	Acan			1	2D000
O	1332	380	Ophid			1	2D000
O	1332	380	flat			1	2D000
O	1332	380	Lyt			1	2D000
O	1332	380	Cerian			1	2D000
O	1334	380	Met			1	2D000
O	1334	380	Ptilo			1	2D000
O	1334	380	Cerian			1	2D000
O	1334	380	Luid			1	2D000
O	1336	380	Lyt			1	2D000
O	1336	380	Sty			1	2D000
O	1336	380	Oct			1	2D000
O	1336	380	Cerian			1	2D000
O	1337	380	Acan			1	2D000
O	1337	380	Sty			1	2D000
O	1337	380	Cerian			1	2D000
O	1337	380	Lyt			1	2D000
O	1337	380	Oct			1	2D000
O	1337	380	oph			1	2D000
O	1339	380	Oct			1	2D000
O	1339	380	Sty			1	2D000
O	1339	380	oph			1	2D000
O	1340	380	Luid			1	2D000
O	1340	380	Sty.			1	2D000
O	1340	380	Cerian			1	2D000
O	1341	380	Oct			1	2D000
O	1341	380	Sty			1	2D000
O	1341	380	Ptilo			1	2D000
O	1341	380	Lyt			1	2D000
O	1342	380	Met			1	2D000
O	1342	380	Oct			1	2D000
O	1342	380	Sty			1	2D000

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1343	380	Acan			1	2D000
O	1343	380	Megas			1	2D000
O	1344	380	Acan			1	2D000
O	1344	380	Sty			1	2D000
O	1344	380	Cerian			1	2D000
O	1345	380	Luid			1	2D000
O	1345	380	Lyt			1	2D000
O	1345	380	Oct			1	2D000
O	1346	380	Cerian			1	2D000
O	1346	380	Acan			1	2D000
O	1347	380	Ptilo			1	2D000
O	1347	380	Oct			1	2D000
O	1347	380	Cerian			1	2D000
O	1347	380	Sty			1	2D000
O	1348	380	Lyt			1	2D000
O	1348	380	Oct			1	2D000
O	1348	380	Cerian			1	2D000
O	1348	380	Clthar			1	2D000
O	1348	380	Sty			1	2D000
O	1348	380	Acan			1	2D000
O	1348	380	Pleuro			1	2D000
O	1349	380	Sty.			1	2D000
O	1349	380	Oct			1	2D000
O	1349	380	Cerian			1	2D000
O	1349	380	Luid			1	2D000
O	1349	380	Met			1	2D000
O	1350	385	gorgp			1	2D000
O	1350	385	Lyt			1	2D000
O	1350	385	Oct			1	2D000
O	1350	385	Sty			1	2D000
O	1350	385	Cerian			1	2D000
O	1350	385	Luid			1	2D000
O	1351	380	Sty			1	2D000
O	1351	380	Ophid			1	2D000
O	1351	380	Luid			1	2D000
O	1351	380	Ptilo			1	2D000
O	1351	380	Lyt			1	2D000
O	1352	380	Ptilo			1	2D000
O	1352	380	Acan			1	2D000
O	1352	380	Cerian			1	2D000
O	1352	380	Pleuro			1	2D000
O	1353	380	Acan			1	2D000
O	1353	380	oph			1	2D000
O	1353	380	Cerian			1	2D000
O	1354	380	Sty			1	2D000
O	1354	380	Oct			1	2D000
O	1354	380	oph			1	2D000
O	1354	380	Lyt			1	2D000
O	1354	380	Pleuro			1	2D000
O	1354	380	Acan			1	2D000

HARD BOTTOM DATA
TRANSECT 22 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1401	385	gorgp			1	2D000
O	1402	385	Sty			1	2D000
O	1402	385	Oct			1	2D000
O	1402	385	Ptilo			1	2D000
O	1402	385	Luid			1	2D000
O	1403	385	Acan			1	2D000
O	1403	385	Cithar			1	2D000
O	1403	385	Oct			1	2D000
O	1403	385	Sty			1	2D000
O	1403	385	gorgp			1	2D000
O	1405	385	Luid			1	2D000
O	1405	385	Cerian			1	2D000
O	1406	385	gorgp			1	2D000
O	1406	385	oph			1	2D000
O	1406	385	Pleuro			1	2D000
O	1406	385	Acan			1	2D000
O	1407	385	oph			1	2D000
O	1407	385	Lyt			1	2D000
O	1407	385	Cerian			1	2D000
O	1409	385	Stachy			1	2D000
O	1409	385	Acan			1	2D000
O	1409	385	oph			1	2D000
O	1411	385	Ptilo			1	2D000
O	1411	385	flat			1	2D000
O	1411	385	Sty			1	2D000
O	1415	385	Ptilo			1	2D000
O	1416	385	Med			1	2D000
O	1416	385	Oct			1	2D000
O	1416	385	Sty			1	2D000
O	1417	385	Pleuro			1	2D000
O	1417	385	gorgp			1	2D000
O	1417	385	Oct			1	2D000
O	1417	385	Acan			1	2D000
O	1417	385	Sty			1	2D000
O	1417	385	oph			1	2D000
O	1418	385	Stachy			1	2D000
O	1418	385	Cerian			1	2D000
O	1418	385	Ptilo			1	2D000
O	1418	385	Parast			1	2D000
O	1418	385	gorgp			1	2D000
O	1418	385	Lyt			1	2D000
O	1418	385	Luid			1	2D000
O	1418	385	oph			1	2D000
O	1422	385	Acan			1	2D000
O	1422	385	gorgp			1	2D000
O	1422	385	Cerian			1	2D000
O	1422	385	Ptilo			1	2D000
O	1422	385	Oct			1	2D000
O	1424	385	Tritond			1	2D000
O	1425	385	Sty			1	2D000

HARD BOTTOM DATA
TRANSECT 22 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
0	1425	385	Oct			1	2D000
0	1425	385	Ptilo			1	2D000
0	1428	385	Dendro			1	2D000
0	1428	385	Oct			1	2D000
0	1429	385	Acan			1	2D000

HARD BOTTOM DATA
TRANSECT 23 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	724	330	Lyt			1	2D000
O	724	330	Oct			M	2D000
O	724	330	Acan			1	2D000
O	724	330	Tealia			1	2D000
O	728	330	Ptilo			1	2D000
O	728	330	Acan			1	2D000
O	728	330	Lyt			1	2D000
O	728	330	Oct			M	2D000
O	728	330	ast			1	2D000
O	728	330	Tealia			1	2D000
O	728	330	oph			1	2D000
O	734	330	Lyt			1	2D000
O	735	330	oph			1	2D000
O	735	330	Lyt			1	2D000
O	738	330	Ptilo			1	2D000
O	738	330	Rathbun			1	2D000
O	738	330	Astro			1	2D000
O	738	330	Tealia			1	2D000
O	738	330	Luid			1	2D000
O/P	739	330	oph			1	2D000
O/P	739	330	Tealia			1	2D000
P	740	330	oph			1	2D000
O	741	330	crab			1	2D000
O	741	330	Oct			1	2D000
O	741	330	Acan			1	2D000
O	741	330	Lyt			1	2D000
O	741	330	oph			1	2D000
O/P	747	335	Sty	2			2D000
O/P	747	335	Tealia			1	2D000
P	748	335	Oct			1	2D000
P	748	335	oph			1	2D000
O/P	750	335	oph			1	2D000
O/P	750	335	Rathbun			1	2D000
O/P	750	335	Oct			M	2D000
O/P	750	335	Tealia			1	2D000
O/P	750	335	Lyt			1	2D000
O/P	750	335	Pleuro			1	2D000
P	752	335	oph			1	2D000
O	753	340	Ptilo			1	2D000
O	757	340	Med			1	2D000
O	757	340	Tealia			1	2D000
O	759	340	ast			1	2D000
O	820	340	Oct			1	2D000
O	820	340	Acan			1	2D000
O	820	340	Lyt			1	2D000
O	820	340	Tealia			1	2D000
O	820	340	oph			1	2D000
O	820	340	ast			1	2D000
O	823	340	Luid			1	2D000
O	823	340	Sebas			1	2D000

HARD BOTTOM DATA
TRANSECT 23 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	823	340	Ptilo			1	2D000
O	823	340	Oct			1	2D000
O	823	340	Tealia			1	2D000
O	823	340	oph			1	2D000
O	823	340	Met			1	2D000
OS1	830	340	Rathbun			1	2D000
OS1	830	340	ast			1	2D000

HARD BOTTOM DATA
TRANSECT 25 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1655	240	Sty			M	2D000
O	1655	240	Met			1	2D000
O	1655	240	Oct			1	2D000
O	1655	240	Med			1	2D000
O	1655	240	flat			1	2D000
O	1655	240	Luid			1	2D000
O	1655	240	Ptilo			1	2D000
O	1658	240	Embio			1	2D000
O	1658	240	flat			1	2D000
O	1658	240	Sty			M	2D000
O	1658	240	Oct			M	2D000
O	1700	240	Sty			1	2D000
O	1700	240	Oct			1	2D000
O	1701	240	Sty			1	2D000
O	1701	240	Oct			1	2D000
O	1701	240	Zan			1	2D000
O	1701	240	flat			1	2D000
O	1702	240	Sty			1	2D000
O	1702	240	Oct			1	2D000
O	1702	240	Cerian			1	2D000
O	1703	240	Sty			1	2D000
O	1703	240	Oct			1	2D000
O	1703	240	Luid			1	2D000
O	1704	240	Luid			1	2D000
O	1704	240	Sty			M	2D000
O	1704	240	Oct			M	2D000
O	1704	240	Zalem			1	2D000
O	1707	240	Zalem			1	2D000
O	1707	240	Med			1	2D000
O	1707	240	Sty			1	2D000
O	1707	240	Oct			1	2D000
O	1707	240	ast			1	2D000
O	1707	240	Pisas			1	2D000
O	1710	240	Met			1	1DDFH
O	1710	240	Para			M	1DDFH
O	1710	240	rgorg			1	1DDFH
O	1710	240	Bal			1	1DDFH
O	1710	240	cc			1	1DDFH
O	1710	240	eo			1	1DDFH
PX	1711	240	Sty			1	2D000
PX	1713	240	Sty			1	2D000
O	1714	240	Met			1	1DDEH
O	1714	240	Sros			1	1DDEH
O	1714	240	Para			1	1DDEH
O	1714	240	Bal			1	1DDEH
O	1714	240	Pycno			1	1DDEH
O	1715	240	Psolus			1	1DDEH
O	1715	240	cc			1	1DDEH
O	1715	240	rgorg			1	1DDEH
O	1715	240	Para			1	1DDEH

HARD BOTTOM DATA
TRANSECT 25 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1715	240	Bal			1	1DDEH
O	1715	240	Met			1	1DDEH
O	1715	240	Parast			1	1DDEH
PX	1716	240	Med			1	1DDEH
PX	1716	240	Bal			1	1DDEH
PX	1716	240	cc			1	1DDEH
PX	1716	240	ebry			1	1DDEH
PX	1716	240	cuc			1	1DDEH
O	1717	240	Sty			1	2D000
O	1717	240	Oct			1	2D000
O	1717	240	Sebas			1	2D000
O/PX	1718	240	Med			1	1DDGH
O/PX	1718	240	Hen			1	1DDGH
O/PX	1718	240	Para			M	1DDGH
O/PX	1718	240	Bal			1	1DDGH
O/PX	1718	240	cc			M	1DDGH
O/PX	1718	240	eo			1	1DDGH
O/PX	1718	240	Ophiod			1	1DDGH
O/PX	1718	240	Met			1	1DDGH
O/PX	1718	240	Sros			1	1DDGH
O/PX	1718	240	Sserra			1	1DDGH
PX	1719	240	Met			M	1DDGH
O/PX	1720	220	Met			M	1DDGH
O/PX	1720	220	eo			1	1DDGH
O/PX	1720	220	cc			1	1DDGH
O/PX	1720	220	Psolus			1	1DDGH
O/PX	1720	220	Hen			1	1DDGH
O/PX	1720	220	Coryn			1	1DDGH
O/PX	1720	220	Parast			1	1DDGH
O/PX	1720	220	Scaur			1	1DDGH
O/PX	1720	220	Coeno			1	1DDGH
O/PX	1720	220	Smys			1	1DDGH
O/PX	1729	235	Bal			1	1DDEH
O/PX	1729	235	cc			1	1DDEH
O/PX	1729	235	Stylas			1	1DDEH
O/PX	1729	235	Phido			1	1DDEH
O/PX	1729	235	Diaper			1	1DDEH
O/PX	1729	235	Para			M	1DDEH
O/PX	1729	235	Perid			1	1DDEH
O/PX	1729	235	Coryph			1	1DDEH
O/PX	1729	235	Med			1	1DDEH
O/PX	1729	235	Met			1	1DDEH
O/P	1730	230	Med	1			1DDFH
O/P	1730	230	Bal	1			1DDFH
O/P	1730	230	cc	17			1DDFH
O/P	1730	230	eo		1		1DDFH
O/P	1730	230	Sserra		1		1DDFH
O/P	1730	230	Smys		1		1DDFH
O/P	1730	230	Stylas		1		1DDFH
O/P	1730	230	Psolus		1		1DDFH

HARD BOTTOM DATA
TRANSECT 25 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1730	230	Perid		1		1DDFH
O/P	1732	230	Sebas		1		1DDFH
O/P	1732	230	Met		1		1DDFH
O/P	1734	230	Bal		15		1DDGH
O/P	1734	230	cc	23	20		1DDGH
O/P	1734	230	eo		20		1DDGH
O/P	1734	230	rgorg	1			1DDGH
O/P	1734	230	Oct	1			1DDGH
O/P	1734	230	encrust		2		1DDGH
O/P	1734	230	Sros			1	1DDGH
O/P	1734	230	Stylas			1	1DDGH
PX	1735	230	Bal			1	1DDGH
PX	1735	230	cc			1	1DDGH
PX	1735	230	Coryn			1	1DDGH
PX	1735	230	eo			1	1DDGH
PS1	1737	230	Stylas	1			1DDGH
PS1	1737	230	Bal	9			1DDGH
PS1	1737	230	cc	53			1DDGH
PS1	1737	230	eo		2		1DDGH
PS1	1737	230	ebry		1		1DDGH
PS1	1738	230	Bal	13			1DDGH
PS1	1738	230	cc	170			1DDGH
PS1	1738	230	encrust			1	1DDGH
PS1	1742	230	Med	1			1DDGH
PS1	1742	230	Bal	5			1DDGH
PS1	1742	230	cc	90			1DDGH
O/PXS1	1743	230	Met			1	1DDGH
O/PXS1	1743	230	Sebas			1	1DDGH
O/PXS1	1743	230	Parast			1	1DDGH
O/PXS1	1743	230	Coryn			M	1DDGH
O/PXS1	1743	230	Bal			1	1DDGH
O/PXS1	1743	230	Perid			1	1DDGH
O/PXS1	1743	230	Smys			1	1DDGH
O/PXS1	1743	230	Sserra			1	1DDGH
O/PXS1	1745	220	Med			1	1DD0H
O/PXS1	1745	220	cc			1	1DD0H
O/PXS1	1745	220	Sros			1	1DD0H
O/PXS1	1745	220	Met			M	1DD0H
O/PXS1	1745	220	Parast			1	1DD0H
O/PXS1	1745	220	rgorg			1	1DD0H
O	1748	215	Met			M	1DD0H
O	1748	215	Sebas			1	1DD0H
O/P	1751	230	eo		5		2DDE0
O/PX	1801	225	cc			1	1DD0H
O	1802	220	Met			M	1DD0H
O	1802	220	Perid			1	1DD0H
O	1802	220	Sros			1	1DD0H
O	1802	220	Smys			1	1DD0H
O	1802	220	Sserra			1	1DD0H
O/P	1804	230	flat			1	2D000

HARD BOTTOM DATA
TRANSECT 25 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O/P	1804	230	Oct			1	2D000
O/P	1804	230	Sty			1	2D000
O/P	1804	230	Zan			1	2D000
O/P	1804	230	Ptilo			1	2D000
O/P	1804	230	Zalem			1	2D000
O/P	1806	230	NO			0	2D000
O	1807	230	NO			0	10DEH
O	1808	230	Sty			1	2D000
O	1808	230	Oct			1	2D000
P	1809	230	Sty	1			2D000
O	1810	230	Met			1	10DEH
O	1810	230	Para			1	10DEH
O	1810	230	Bal			1	10DEH
PS2	1814	240	rgorg	1			1DDEH
PS2	1814	240	ebry		1		1DDEH
PS2	1814	240	cc	4			1DDEH
PS2	1823	230	eo		5		1DDEH
PS2	1828	230	rgorg	2			1DDEH
PS2	1828	230	eo			1	1DDEH

HARD BOTTOM DATA
TRANSECT 26 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS1	1452	370	Oct			1	2D000
O	1456	370	Oct			1	2D000
O	1456	370	Sty			1	2D000
O	1456	370	Stachy			1	2D000
O	1456	370	Ophid			1	2D000
O	1456	370	Cithar			1	2D000
O	1502	370	Acan			1	2D000
O	1502	370	Luid			1	2D000
O	1502	370	Sty			1	20000
O	1502	370	Oct			1	2D000
O	1502	370	Zan			1	2D000
O	1502	370	polycs			1	2D000
O	1502	370	Selong			1	2D000
O	1507	365	Oct			1	2D000
O	1507	365	Sty			1	2D000
O	1507	365	Cithar			1	2D000
O	1507	365	Zan			1	2D000
O	1507	365	Selong			1	2D000
O	1517	360	flat			1	2D000
O	1517	360	Selong			1	2D000
O	1517	360	Met			1	2D000
O	1517	360	Luid			1	2D000
O	1522	360	Luid			1	2D000

HARD BOTTOM DATA
TRANSECT 27 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS1	1226	420	Laq			1	2DDE0
OS1	1226	420	Med			1	2DDE0
OS1	1226	420	Cithar			1	2DDE0
OS1	1226	420	Oct			1	2DDE0
OS1	1226	420	Tealia			1	2DDE0
O	1232	420	Med			1	2DDE0
O	1232	420	Met			1	2DDE0
O	1232	420	Laq			1	2DDE0
O	1235	420	Med			1	2DDE0
O	1235	420	Laq			1	2DDE0
O	1235	420	Scal			1	2DDE0
O	1235	420	Stachy			1	2DDE0
O	1235	420	Met			1	2DDE0
O	1235	420	Selong			1	2DDE0
O	1235	420	Tealia			1	2DDE0
O	1235	420	Zan			1	2DDE0
O	1239	420	Hippas			1	1DDEL
O	1239	420	Met			M	1DDEL
O	1239	420	Srubri			1	1DDEL
PX	1242	420	Laq			1	1DDEL
PX	1242	420	cc			1	1DDEL
PX	1242	420	gast			1	1DDEL
PX	1242	420	ebry			1	1DDEL
PX	1242	420	Ophia			1	1DDEL
O	1243	420	Floro			1	1DDGL
O	1243	420	Met			1	1DDGL
O	1243	420	Med			1	1DDGL
O	1243	420	Laq			1	1DDGL
O	1243	420	Sebas			1	1DDGL
O	1243	420	zoan			1	1DDGL
P	1244	420	Med	1			1DDGL
P	1244	420	Laq	3			1DDGL
P	1244	420	oph	1			1DDGL
P	1244	420	Sebas			1	1DDGL
P	1244	420	eo		1		1DDGL
O/P	1245	390	Laq			1	1DDGL
O/P	1245	390	Floro			M	1DDGL
O/P	1245	390	Met			M	1DDGL
O/P	1245	390	Sebas			1	1DDGL
O/P	1245	390	Lophe			1	1DDGL
O/P	1245	390	Coeno			1	1DDGL
O/P	1245	390	Bal			1	1DDGL
O/P	1245	390	Para			1	1DDGL
O/P	1245	390	Med				1DDGL
O/P	1245	390	ebry		5		1DDGL
O	1246	370	shelf			1	1DDGL
O	1246	370	sponge			1	1DDGL
O	1247	370	Med	2			1DDEL
O	1247	370	ebry		10		1DDEL
O	1247	370	encrust		5		1DDEL

HARD BOTTOM DATA
TRANSECT 27 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1248	365	Floro			1	1DDFL
O	1248	365	Met			1	1DDFL
O	1248	365	Laq			1	1DDFL
O	1248	365	rgorge			1	1DDFL
O	1248	365	zoan			1	1DDFL
PX	1250	365	Laq			1	1DDFL
Px	1250	365	Med			1	1DDFL
PX	1250	365	Floro			1	1DDFL
PX	1250	365	ebry			1	1DDFL
PS2	1252	365	Floro	1			1DDFL
PS2	1252	365	Med			1	1DDFL
PS2	1252	365	ast	1			1DDFL
PS2	1252	365	Laq	6			1DDFL
PS2	1252	365	ebry		5		1DDFL
PS2	1252	365	cc	1			1DDFL
PS2	1253	365	Med	2			1DDFL
PS2	1253	365	Floro	1			1DDFL
PS2	1253	365	Med	1			1DDFL
PS2	1253	365	eo		5		1DDFL
PS2	1253	365	Laq	1			1DDFL
PS2	1253	365	cc	10			1DDFL
PS2	1253	365	ast	1			1DDFL
PS2	1258	365	Med	2			1DDFL
PS2	1258	365	Laq	2			1DDFL
PS2	1258	365	eo		10		1DDFL
PS2	1258	365	cc	5			1DDFL
PS2	1258	365	Oct	1			1DDFL
O/PS2	1301	365	Sebas			1	1DDFL
O/PS2	1301	365	eo		20		1DDFL
O/PS2	1301	365	Laq	4			1DDFL
O/PS2	1301	365	cc	5			1DDFL
O/PS2	1301	365	Oct	1			1DDFL
O/PS2	1301	365	Met		1		1DDFL
O/PS2	1301	365	Med		M		1DDFL
O/PS2	1301	365	Rath		1		1DDFL
O/PS2	1301	365	rgorg		1		1DDFL
O/PS2	1301	365	Bal		1		1DDFL
O/PS2	1301	365	Para		1		1DDFL
O/PS2	1303	365	cc	2			1DDFL
O/PS2	1303	365	Ophid			1	1DDFL
O/PS2	1303	365	zoan			M	1DDFL
O/PS2	1303	365	Laq			1	1DDFL
PS2	1304	365	Med	1			1DDEL
PS2	1304	365	Laq	2			1DDEL
PS2	1304	365	eo		5		1DDEL
PS2	1304	365	cc	5			1DDEL
O	1305	365	Perid			1	1DDEL
O	1305	365	flat			1	1DDEL
O	1305	365	Met			1	1DDEL
O	1305	365	zoan			M	1DDEL

HARD BOTTOM DATA
TRANSECT 27 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1305	365	sponge			1	1DDEL
O	1305	365	Halo			1	1DDEL
P	1306	365	Med			1	1DDEL
P	1306	365	cc	5			1DDEL
P	1306	365	Halo		1		1DDEL
O/P	1308	365	cc	3			1DDFL
O/P	1308	365	Laq	5			1DDFL
O/P	1308	365	Halo		5		1DDFL
O/P	1308	365	Met			1	1DDFL
O/P	1308	365	Coeno			1	1DDFL
O/P	1308	365	Hen			1	1DDFL
O/P	1308	365	Cad			1	1DDFL
O/P	1308	365	Orth			1	1DDFL
O/P	1308	365	Halo			M	1DDFL
O/P	1309	365	Med	5			1DDEL
O/P	1309	365	sponge		1		1DDEL
O/P	1309	365	cc	15			1DDEL
O/P	1309	365	Laq	3			1DDEL
O/P	1309	365	oph	5			1DDEL
O/P	1309	365	eo		5		1DDEL
O/P	1309	365	Halo		1		1DDEL
O/P	1309	365	zoan			1	1DDEL
O/P	1309	365	Sros			1	1DDEL
O/P	1309	365	Hydro			1	1DDEL
O	1310	365	Orth			1	1DBGL
O	1310	365	Halo			1	1DBGL
O	1310	365	Pyura			1	1DBGL
P	1311	365	cc	5			1DCGL
P	1311	365	eo		2		1DCGL
P	1311	365	Halo		1		1DCGL
P	1311	365	Met	1			1DCGL
P	1312	355	Med	1			1DCGL
P	1312	355	cc	10			1DCGL
P	1312	355	Laq	4			1DCGL
P	1312	355	eo		2		1DCGL
P	1312	355	Halo		1		1DCGL
P	1312	355	oph	6			1DCGL
O	1322	350	sponge			M	1DBGL
OS3	1322	350	Bal			1	1DBGL
OS3	1322	350	Met			1	1DBGL
OS3	1322	350	Sros			1	1DBGL
O	1326	340	Met			1	1DBGL
O	1326	340	Coryn			M	1DBGL
O	1326	340	sponge			1	1DBGL
O	1326	340	Parastp			1	1DBGL
O	1326	340	Halo			1	1DBGL
O	1327	320	Coryn			M	1DBGL
O	1327	320	Perid			1	1DBGL
O	1327	320	Sebas			1	1DBGL
O	1327	320	Para			1	1DBGL

HARD BOTTOM DATA
TRANSECT 27 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
O	1327	320	Bal			1	1DBGL
O	1327	320	ast			1	1DBGL
O	1327	320	sponge			M	1DBGL
O	1331	340	Coryn			M	1DBGL
O	1331	340	Perid			1	1DBGL
O	1331	340	Met			1	1DBGL
O	1331	340	sponge			1	1DBGL
PX	1333	340	Med			1	1DBGL
PX	1333	340	Floro			M	1DBGL
PX	1333	340	cc			1	1DBGL
PX	1333	340	Bal			1	1DBGL
PX	1333	340	Sebas			1	1DBGL
O	1334	350	Floro			1	1DBGL
O	1334	350	sponge			1	1DBGL
O	1334	350	Coryn			1	1DBGL
PX	1335	330	Med			1	1DBGL
PX	1335	330	Perid			1	1DBGL
PX	1335	330	Floro			M	1DBGL
PX	1335	330	cc			1	1DBGL
PX	1335	330	Ophia			1	1DBGL
O/P	1336	330	Perid	2			1DCGL
O/P	1336	330	Sebas			1	1DCGL
O/P	1336	330	sponge		3		1DCGL
O/P	1336	330	cc	.15			1DCGL
O/P	1336	330	encrust		1		1DCGL
O/P	1336	330	Floro			M	1DCGL
O/P	1336	330	Met			1	1DCGL
PX	1250	365	cc			1	1DDFL

HARD BOTTOM DATA
TRANSECT 28 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS1	934	350	flat			1	2D000
OS1	934	350	Cithar			1	20000
OS1	934	350	Oct			1	2D000
O	937	350	Med			1	2D000
O	937	350	Ptilo			1	2D000
O	937	350	Sty			1	2D000
O	937	350	Stachy			1	2D000
O	942	345	Oct			1	2D000
O	942	345	Luid			1	2D000
O	942	345	Sty			1	2D000
O	942	345	Stachy			1	2D000
O	942	345	flat			1	2D000
O	942	345	gast			1	2D000
O	946	345	Med			1	2D000
O	946	345	Zalem			1	2D000
O	948	340	Oct			1	2D000
O	948	340	Sty			1	2D000
O	948	340	Stachy			1	2D000
O	948	340	Ptilo			1	2D000
O	950	340	Sty			1	2D000
O	950	340	Zalem			1	2D000
O	950	340	anema			1	2D000
O	950	340	Cithar			1	2D000
O/P	953	340	Selong			1	2D000
O/P	953	340	Agon			1	2D000
O/P	953	340	oph			1	2D000
O/P	953	340	Oct			1	2D000
O/P	955	335	anema			1	2D000
O/P	955	335	Med			1	2D000
O/P	955	335	flat			1	2D000
O/P	955	335	Ptilo			1	2D000
O/P	957	335	Stachy			1	2D000
O/P	957	335	Zan			1	2D000
O/P	957	335	Chilara			1	2D000
O/P	958	335	Zan			1	2D000
O/P	958	335	Luid			1	2D000
O/P	958	335	anema			1	2D000
O/P	958	335	Chilara			1	2D000
O/P	1000	330	seap			1	2D000
O/P	1000	330	Med			1	2D000
O/P	1000	330	Stachy			1	2D000
O/P	1000	330	Chilara			1	2D000
O/P	1000	330	Agon			1	2D000
O/P	1000	330	Rath			1	2D000
O/P	1000	330	Oct			1	2D000
O/P	1003	330	anema			1	2D000
O/P	1003	330	Selong			1	2D000
O/P	1003	330	Chilara			1	2D000
O/P	1003	330	Sebas			1	2D000
P	1005	330	NO			0	2D000

HARD BOTTOM DATA
TRANSECT 28 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
P	1006	330	NO			0	2D000
P	1008	330	NO			0	2D000
O/P	1009	325	Chilara			1	2D000
O/P	1009	325	Zan			1	2D000
O/P	1009	325	ast			1	2D000
O/P	1009	325	seap			1	2D000
O/P	1011	325	Oct			1	2D000
P	1012	325	NO			1	2D000
O/P	1014	325	Oct			1	2D000
P	1016	325	NO			0	2D000
O/P	1017	325	NO			0	2D000
O/P	1019	325	NO			0	2D000
P	1020	320	NO			0	2D000
P	1022	320	NO			0	2D000
O/P	1024	320	Zalem			1	2D000
O/P	1024	320	Chilara			1	2D000
O/P	1024	320	gast			1	2D000
O/P	1027	320	Oct			1	2D000
O/P	1027	320	Sebas			1	2D000
O/P	1027	320	Chilara			1	2D000
O/P	1028	320	anem			1	2D000
O/P	1030	320	Zan			1	2D000
O/P	1030	320	Oct			1	2D000
O/P	1032	320	Met			1	2D000

HARD BOTTOM DATA
TRANSECT 29 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
OS1	1700	350	Pleuro			1	2D000
OS1	1700	350	Met			1	2D000
OS1	1700	350	Oct			1	2D000
OS1	1700	350	anem			1	2D000
OS1	1700	350	Hen			1	2D000
OS1	1704	350	Floro			1	2DDEH
OS1	1704	350	gorg			1	2DDEH
OS1	1704	350	Acan			1	2DDEH
OS1	1704	350	Met			1	2DDEH
OS1	1704	350	Luid			1	2DDEH
OS1	1704	350	brac			1	2DDEH
OS1	1704	350	Oct			1	2DDEH
OS1	1704	350	Sty			1	2DDEH
OS1	1704	350	anem			1	2DDEH
OS1	1704	350	Para			1	2DDEH
OS1	1704	350	Tritond			1	2DDEH
OS1	1706	350	Met			1	10DEH
OS1	1706	350	Para			1	10DEH
OS1	1706	350	zoan			1	10DEH
OS1	1706	350	Med			1	10DEH
OS1	1706	350	Pleuro			1	10DEH
OS1	1708	350	Pleuro			1	10DEH
OS1	1708	350	brac			1	10DEH
OS1	1708	350	Met			1	10DEH
OS1	1708	350	Oct			1	10DEH
OS1	1708	350	shelf			1	10DEH
OS1	1708	350	vases			1	10DEH
OS1	1708	350	Ophia			1	10DEH
OS1	1708	350	Para			1	10DEH
OS1	1710	350	Para			1	10DEH
OS1	1710	350	Met			1	10DEH
OS1	1710	350	Oct			1	10DEH
OS1	1710	350	Med			1	10DEH
OS1	1710	350	brac			1	10DEH
OS1	1710	350	Porich			1	10DEH
OS1	1710	350	Cancer			1	10DEH
OS1	1712	355	Met			1	10DEH
OS1	1712	355	Laq			M	10DEH
OS1	1712	355	zoan			1	10DEH
OS1	1712	355	Pleuro			1	10DEH
OS1	1712	355	Lyt			1	10DEH
OS1	1712	355	Gorgon			1	10DEH
OS1	1712	355	Zalem			1	10DEH
OS1	1712	355	Floro			1	10DEH
OS1	1714	355	Gorgon			1	1DDEH
OS1	1714	355	Met			M	1DDEH
OS1	1714	355	Laq			M	1DDEH
OS1	1714	355	Rath			1	1DDEH
OS1	1714	355	Ophia			1	1DDEH
PS1	1715	355	Bal	1			1DDEH

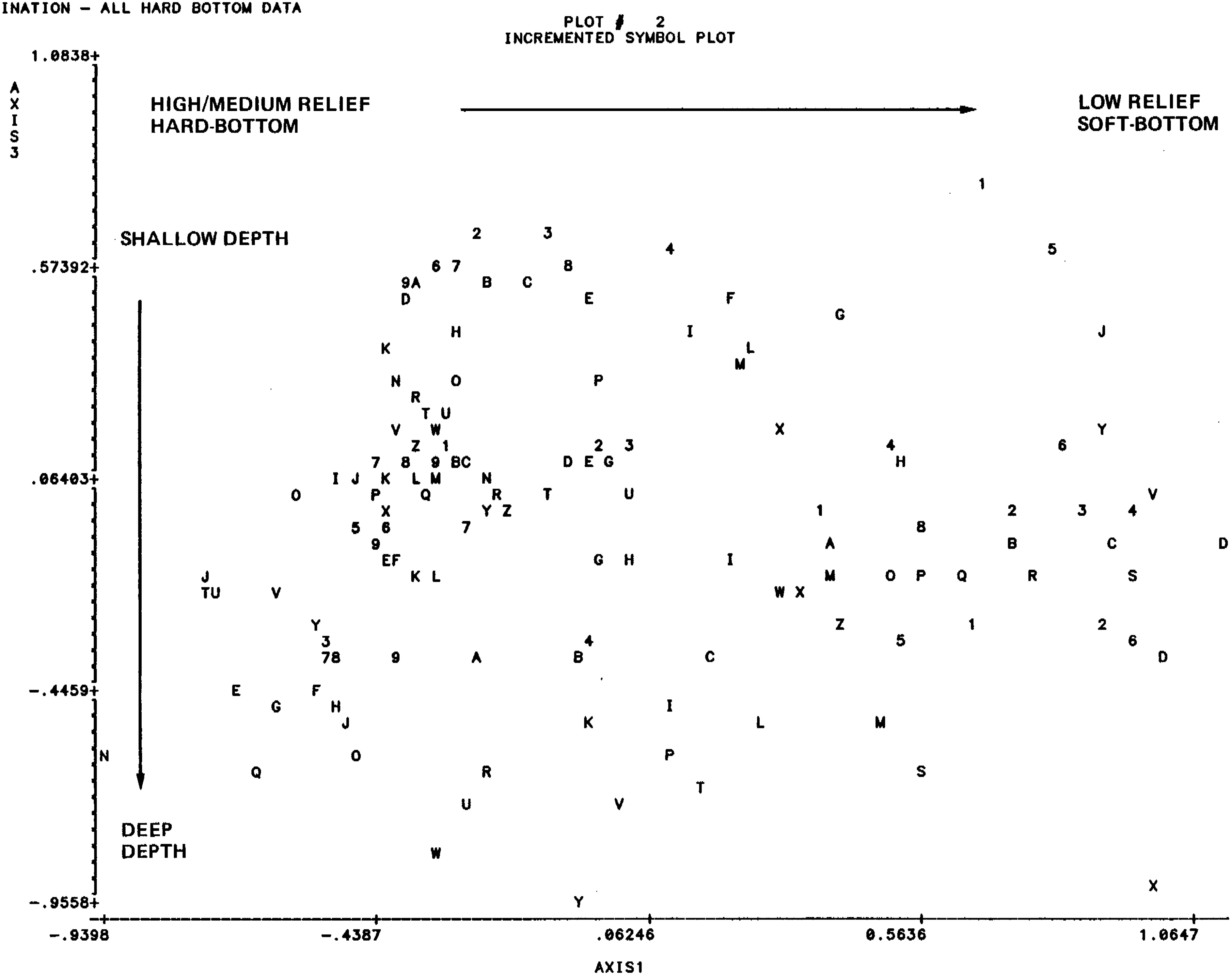
HARD BOTTOM DATA
TRANSECT 29 A/B

DATA TYPE	TIME	DEPTH (FT)	SPECIES	DENSITY (SQ.METER)	COVER (%)	RELAT. ABUND.	SUBSTRATE
PS1	1715	355	oph	5			1DDEH
PS1	1715	355	eo		5		1DDEH
OS1	1716	355	Hen			1	10DEH
OS1	1716	355	Laq			1	10DEH
OS1	1716	355	Floro			1	10DEH
OS1	1716	355	Parast			1	10DEH
OS1	1716	355	flat			1	10DEH
PS1	1717	355	Laq	2			10DEH
O/PS1	1718	355	Met	1			10DEH
O/PS1	1718	355	cc	5			10DEH
O/PS1	1718	355	oph	5			10DEH
O/PS1	1718	355	eo		5		10DEH
O/PS1	1718	355	Pter			1	10DEH
O/PS1	1718	355	Floro			1	10DEH
O/PS1	1718	355	Para			1	10DEH
O/PS1	1718	355	brac			1	10DEH
O/PXS1	1718	355	sponge			1	10DEH
O/PXS1	1720	340	shelf			1	10DFH
O/PXS1	1720	340	Perid			1	10DFH
O/PXS1	1720	340	Laq			1	10DFH
O/PXS1	1720	340	Hen			1	10DEH
O/PXS1	1721	340	shelf			1	1DDEL
O/PXS1	1721	340	ast			1	1DDEL
O/PXS1	1721	340	vases			1	1DDEL
O/PXS1	1721	340	Perid			1	1DDEL
O/PXS1	1721	340	sponge			1	1DDEL

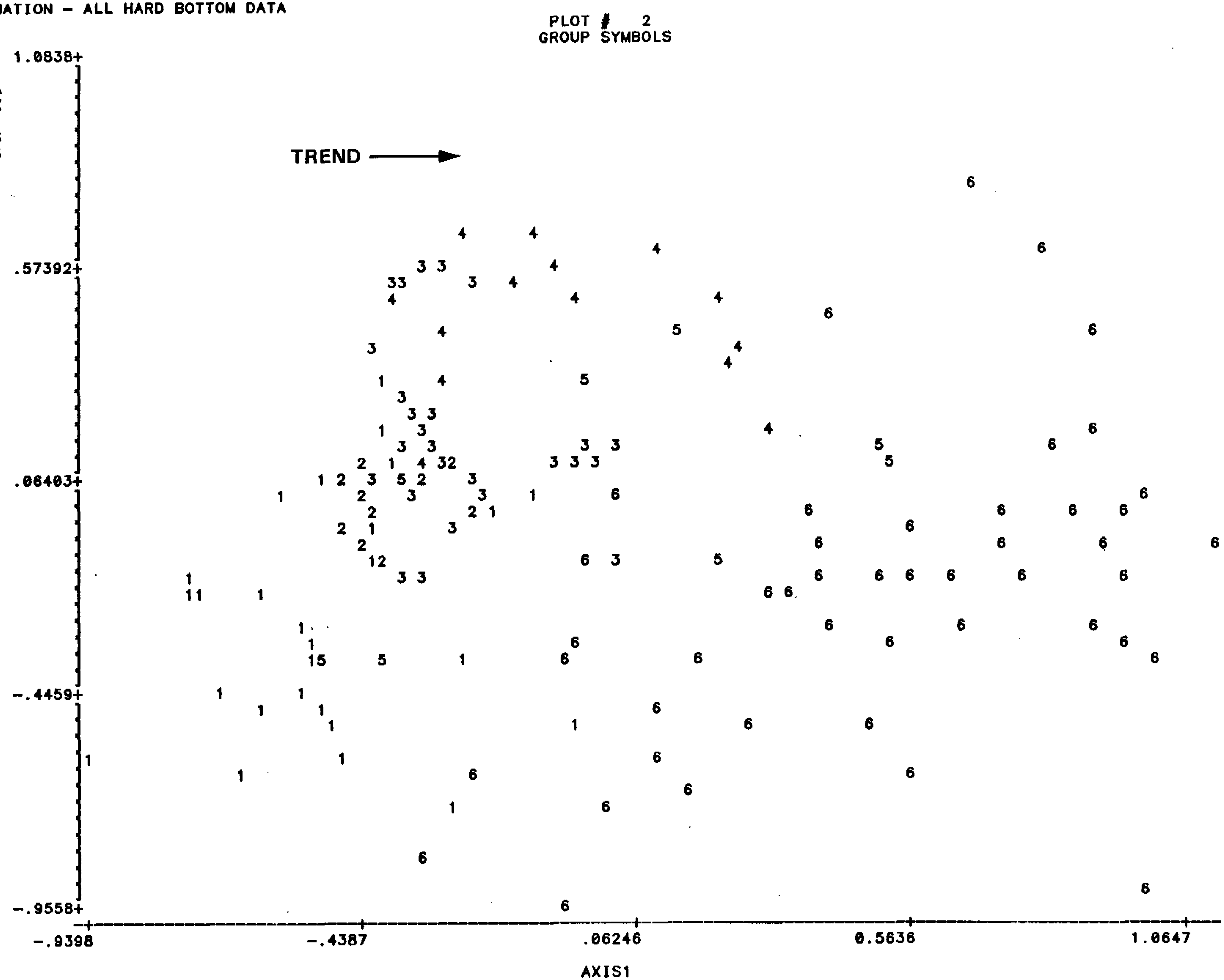
APPENDIX I

Additional Ordination Plots (Axis 1/Axis 3) from Analysis of Hard-Bottom Data

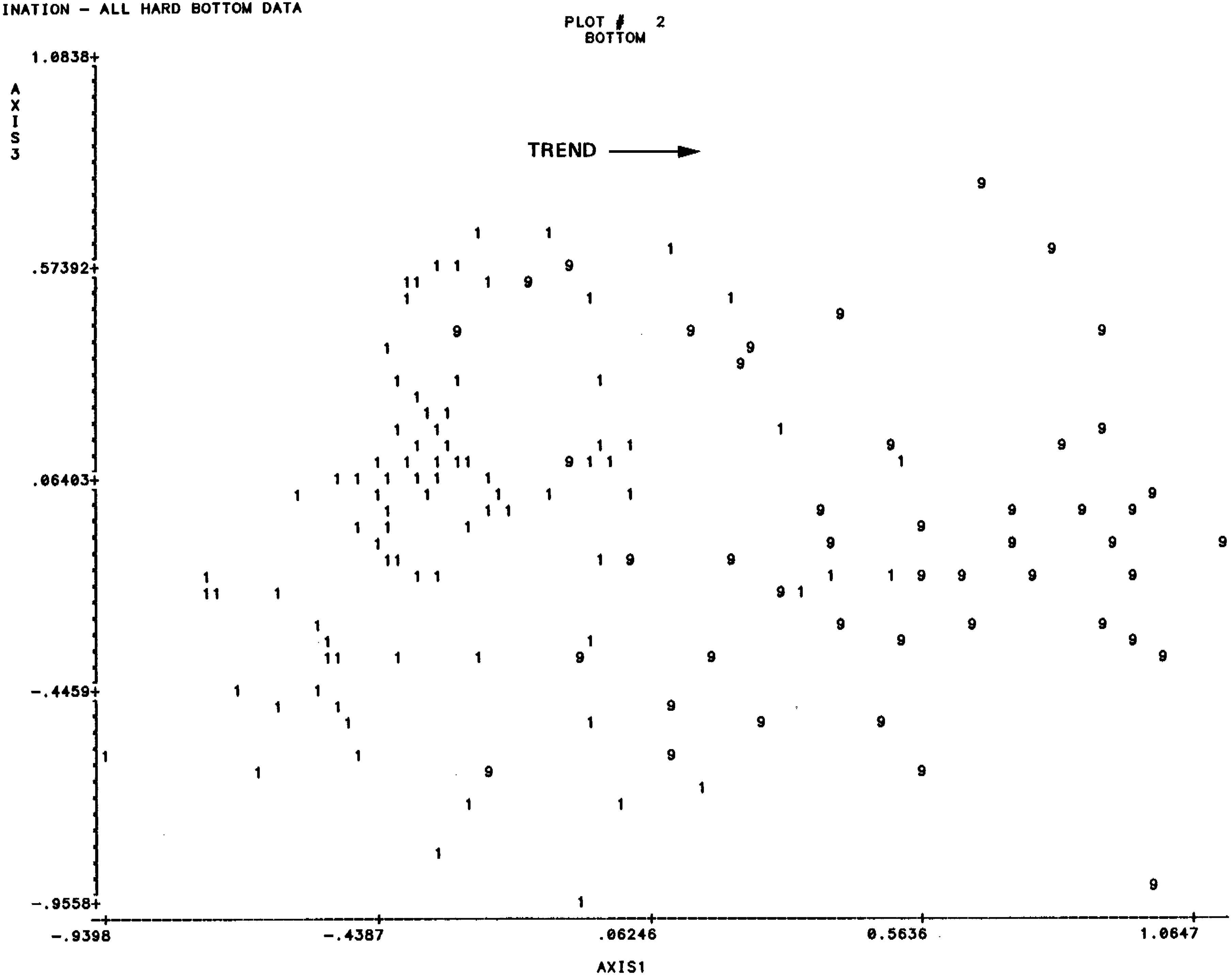
ORDINATION - ALL HARD BOTTOM DATA



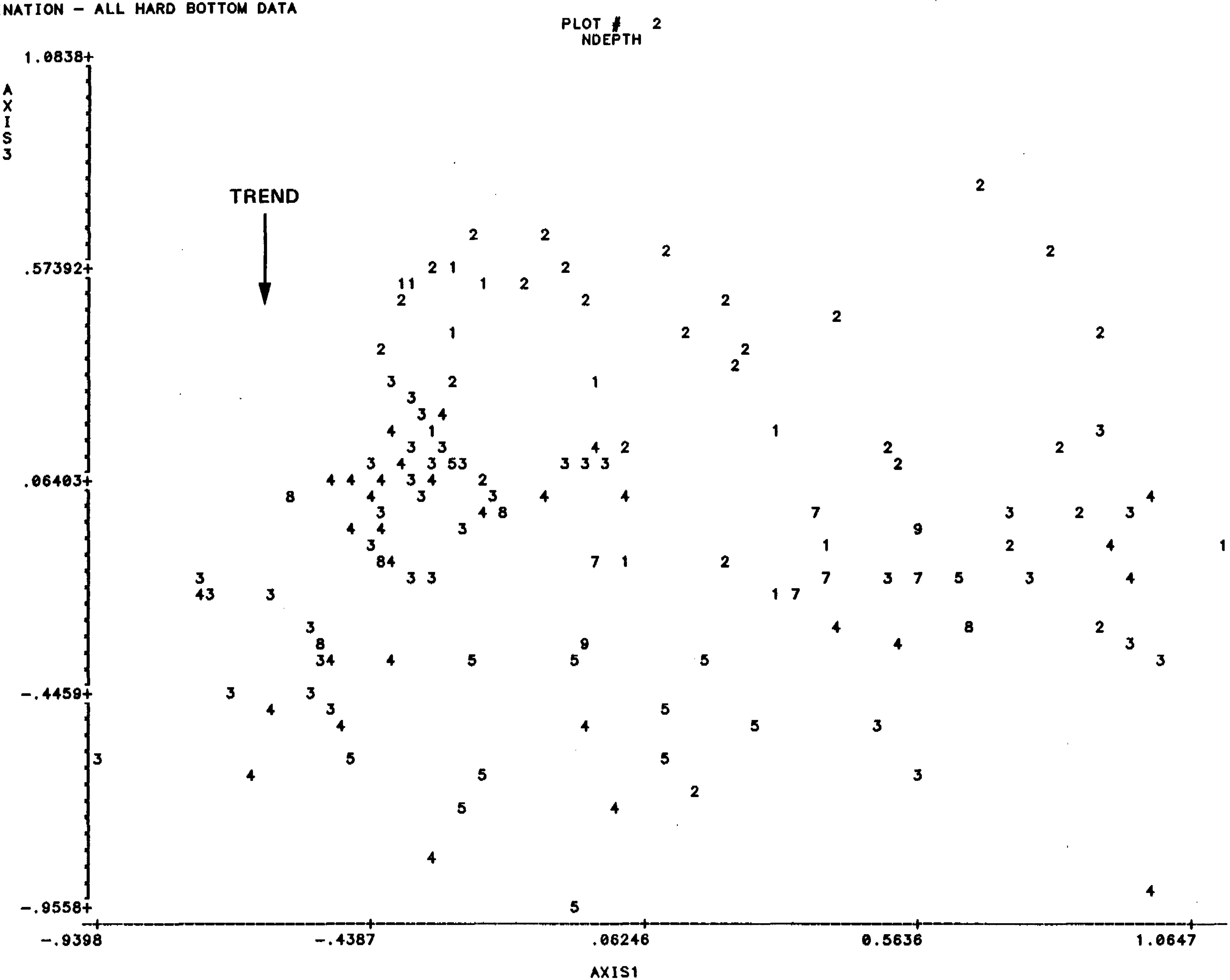
ORDINATION - ALL HARD BOTTOM DATA



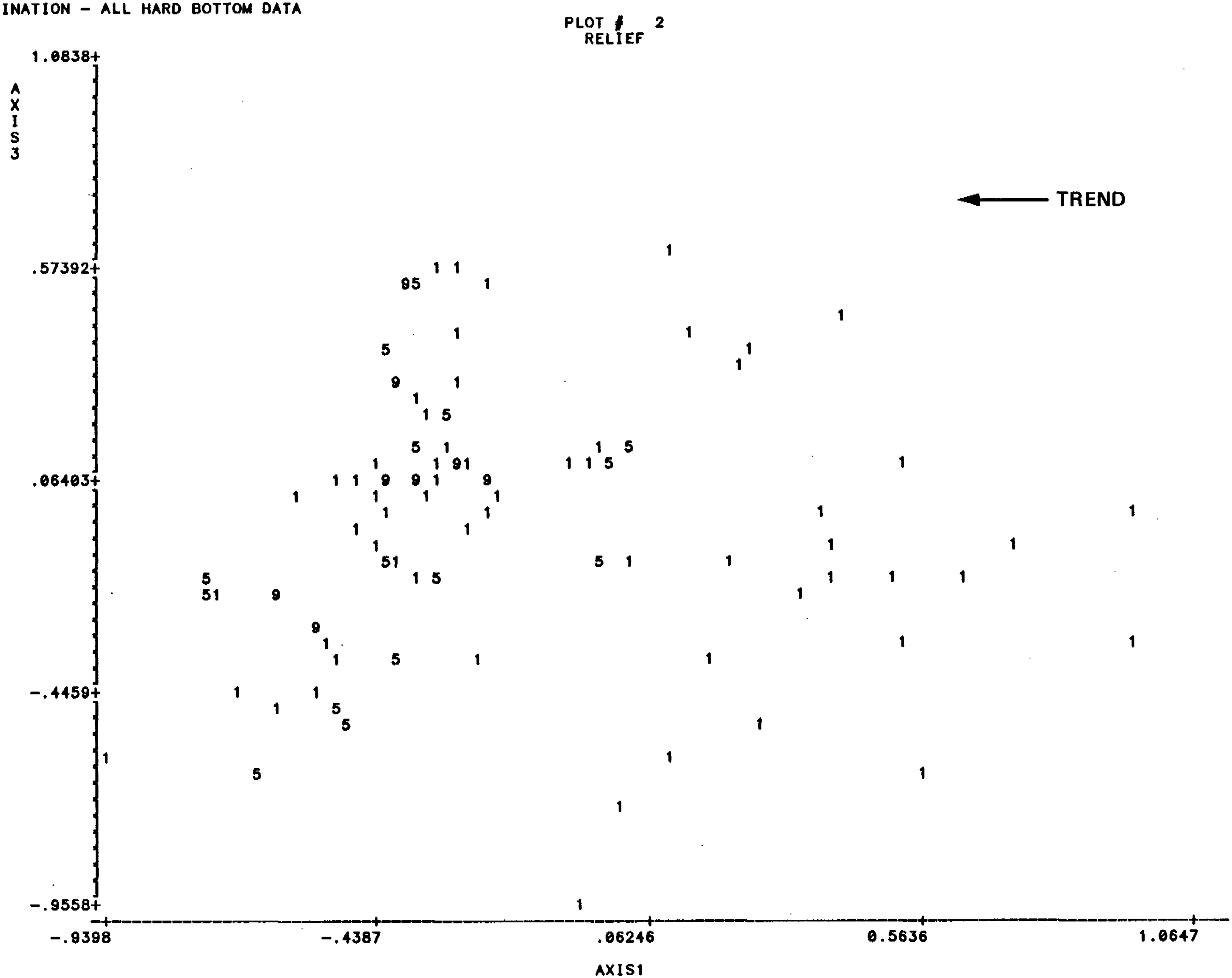
ORDINATION - ALL HARD BOTTOM DATA



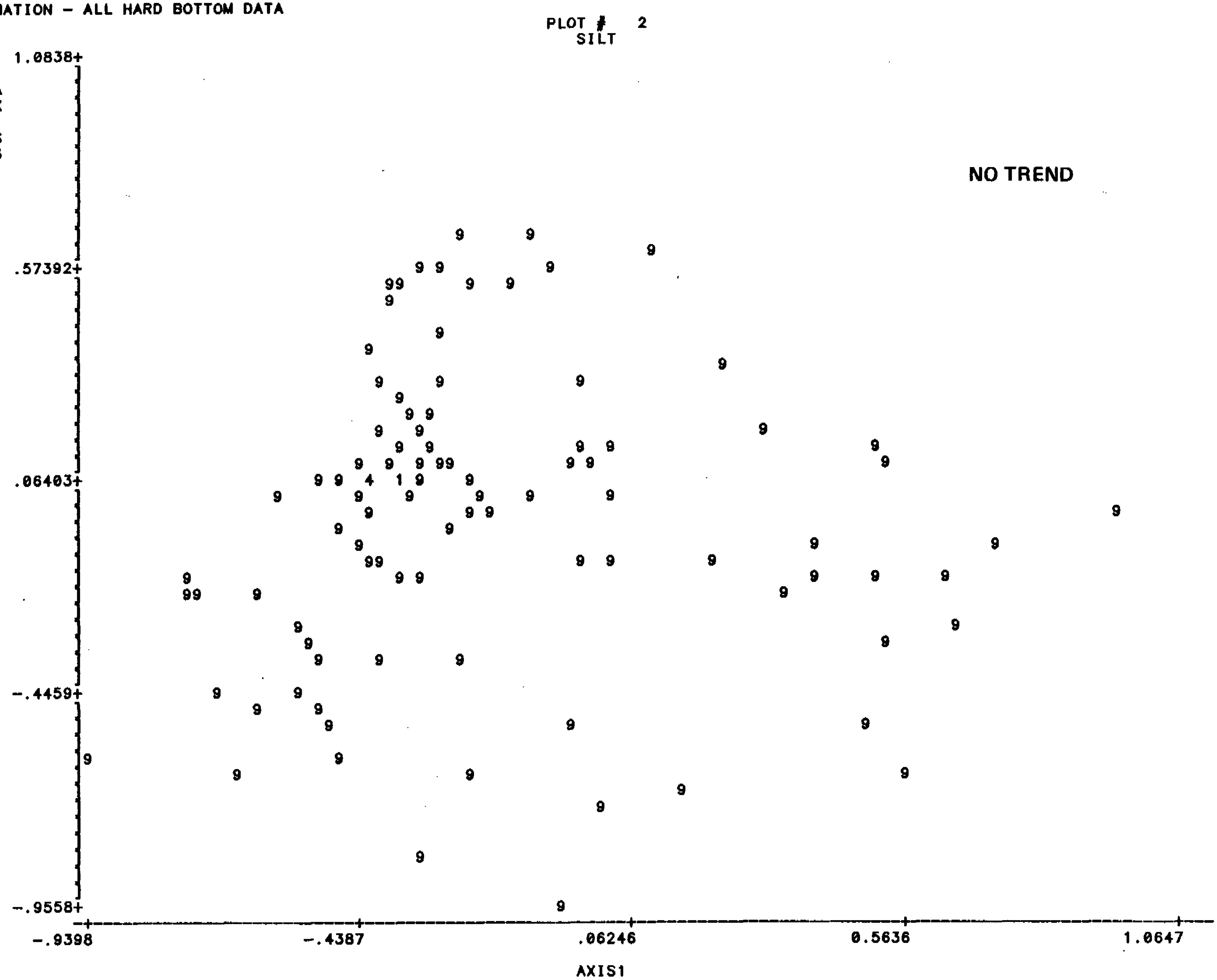
ORDINATION – ALL HARD BOTTOM DATA



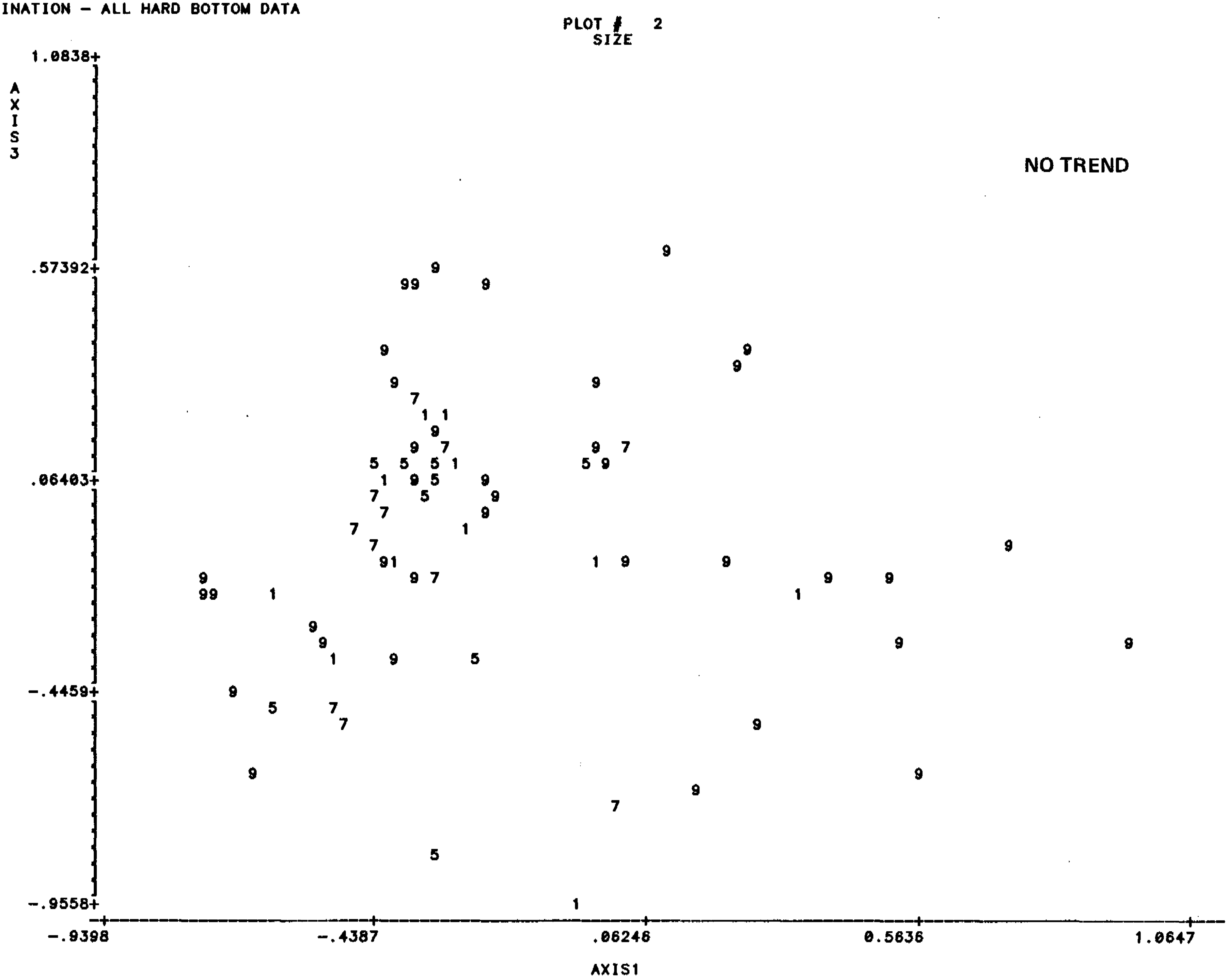
ORDINATION - ALL HARD BOTTOM DATA

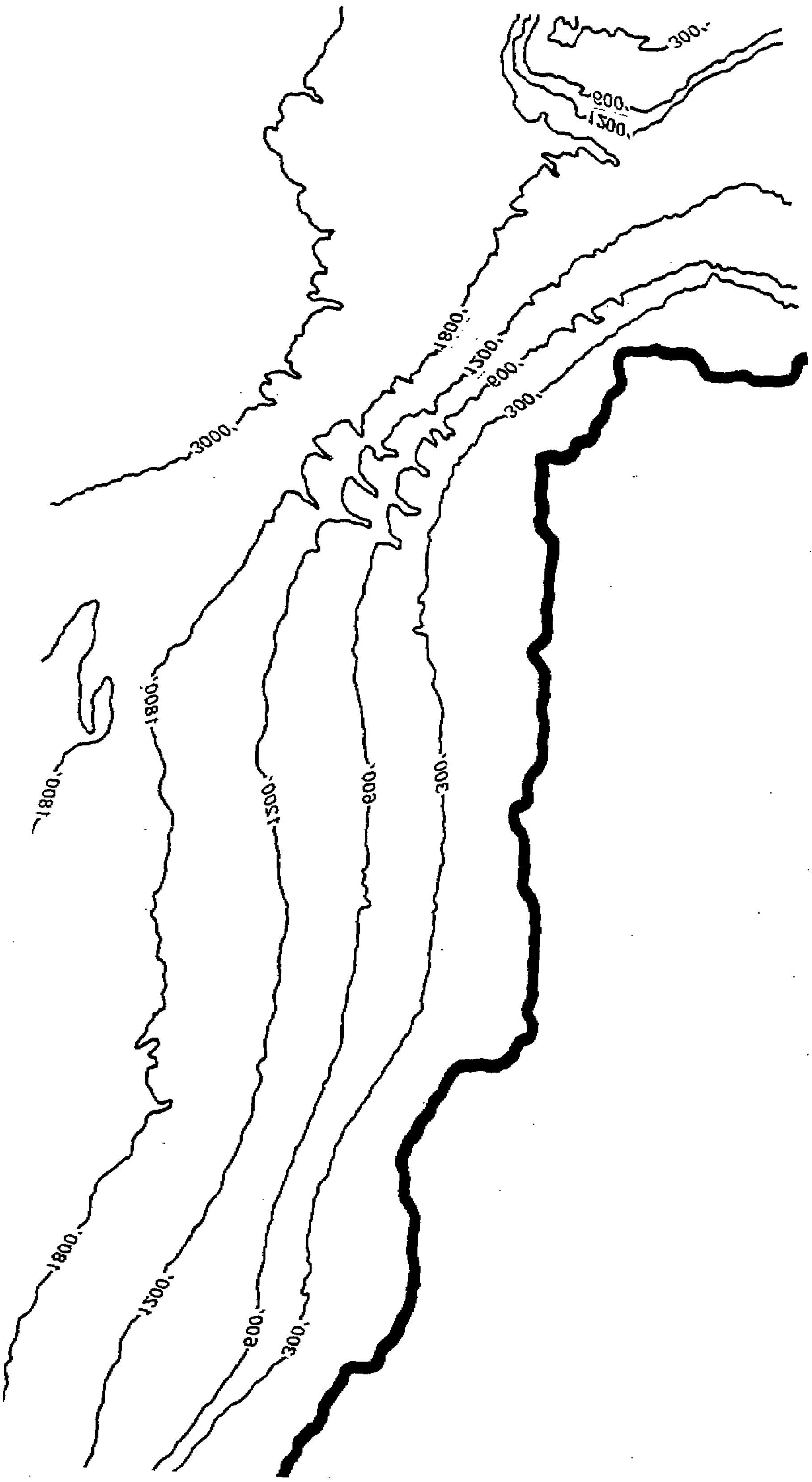


ORDINATION - ALL HARD BOTTOM DATA



ORDINATION – ALL HARD BOTTOM DATA

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