PREDICTING LONG-TERM EFFECTS OF FRESHWATER INFLOW ON MACROBENTHOS IN THE LAVACA-COLORADO AND GUADALUPE ESTUARIES. YEAR 2.

Paul A. Montagna, Principal Investigator

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FINAL REPORT

PREDICTING LONG-TERM EFFECTS OF FRESHWATER INFLOW

ON MACROBENTHOS IN THE LAVACA-COLORADO AND GUADALUPE

ESTUARIES YEAR 2

by

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Montagna, P.A. The role of turbidity, salinity and water movement on benthic oxygen consumption and production. December 1988, Ocean Science Meeting, San Francisco, California.

Montagna, P.A. and Kalke, R.D. A comparison of freshwater inflow effects on benthic communities in three texas estuaries. 10^{th} Biennial International Estuarine Research Federation Conference, October 8-12, 1989, Baltimore, Maryland.

Montagna, P.A. The role of current flow, resuspension and macrofauna in metabolism and nutrient recycling in estuarine sediments. Benthic Ecology Meeting, March 29-April 1, 1990, Mobile, Alabama.

*Montagna, P.A. Texas estuaries. Oceans Week, Port Aransas Independent School District. April 2, 1990.

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PREDICTING LONG-TERM EFFECTS OF FRESHWATER INFLOW ON MACROBENTHOS IN THE LAVACA-COLORADO AND GUADALUPE ESTUARIES YEAR 2

ABSTRACT

Two estuaries have been studied to determine the effect of year-to-year variation of freshwater inflow on macrobenthic infauna. The estuaries have similar inflow characteristics, but the Lavaca-Colorado has direct exchange of coastal marine water with the Gulf of Mexico and the Guadalupe does not. Studies in the Lavaca-Colorado began in 1984, and studies in the Guadalupe began in 1987. There are changes in community structure and function from year-to-year, which can be linked to the long-term cycle of wet and dry years along the Texas coast. There appears to be a long-term cycle of high-inflow stimulated recruitment, followed by nutrient depletion and recruitment of marine species during low-inflow periods, followed by declines in productivity until the next wet year. These cycles appear to have a period of 2-3 years, but it will take at least 3 more years of data to test this hypothesis.

INTRODUCTION

Prudent management of freshwater resources is required to meet residential, industrial, and agricultural needs while still protecting the natural resources in our environment. One aspect of environmental conservation (as evidenced by good management practices) is to ensure that there is adequate freshwater inflow to our estuaries. Data is needed to describe the effects of freshwater inflow on estuaries, so that an assessment of freshwater needs can be made.

The climate of Texas is characterized by a long-term cycle of floods and droughts. Yet, we have very little information about the scales of natural variability over the long-term. This makes it very difficult to create long-range plans for the management of water resources. Data is needed to describe the long-term variability of biological indicators of freshwater inflow effects.

Previous studies have shown that benthos are good indicators of freshwater inflow effects (Montagna, 1989; Kalke and Montagna, 1991; Montagna and Yoon, 1991; Montagna and Kalke, submitted ms.). However, all of these studies were carried out over a narrow time scale, from seven to 21 months. The studies spanning more than one year hint that there is a long-term effect associated with wet and dry years. The purpose of this study is to determine if freshwater inflow affects on benthos is greater for year-to-year variability than for seasonal variability. This would allow us to build better models of quantitative relationships between freshwater inflow and benthos in Texas estuaries.

METHODS

Why Study Benthos?

Benthos are the most economical and reliable indicators of the effects of freshwater inflow in Texas estuaries. This contradicts the conventional wisdom. Rivers transport nutrients to estuaries, which should stimulate phytoplankton production (Nixon et al., 1986). The benthos would benefit by this production if filter feeders, e.g., oysters consume phytoplankton in the water column or if the primary production is deposited to the bottom via gravity. Previous studies have shown that phytoplankton parameters are very variable. Primary production can vary as much over one or two days as it can over a week. Therefore, we have not been successful in correlating primary production with river inflow. We also don't know what taxonomic groups, let alone species, are responding to the inflow. It would be very labor intensive and expensive to generate enough data to fully describe the natural variability in primary production and phytoplankton species distributions to determine if man's activities in managing freshwater inflow would increase that variability. Benthos, on the other hand, are relatively fixed in space and easy to sample accurately, long-lived and integrate effects over a long time period, and many community characteristics can be measured inexpensively.

Study Design and Area

There are seven major estuarine systems along the Texas coast (Figure 1). Each system receives drainage from one to three major rivers. The northeastern most estuaries receive more freshwater inflow than the southwestern estuaries (Figure 2). Two estuarine systems were studied in detail (Figure 3). Both systems have similar freshwater inflow characteristics, but the Lavaca-Colorado has direct exchange of marine water with the Gulf of Mexico via Pass Cavallo, whereas the Guadalupe does not. To assess ecosystem-wide variability stations in the freshwater influenced and marine influenced zones were chosen. Two stations, which replicate each of the two treatment effects (freshwater and marine) influence, were sampled. Generally these stations were along

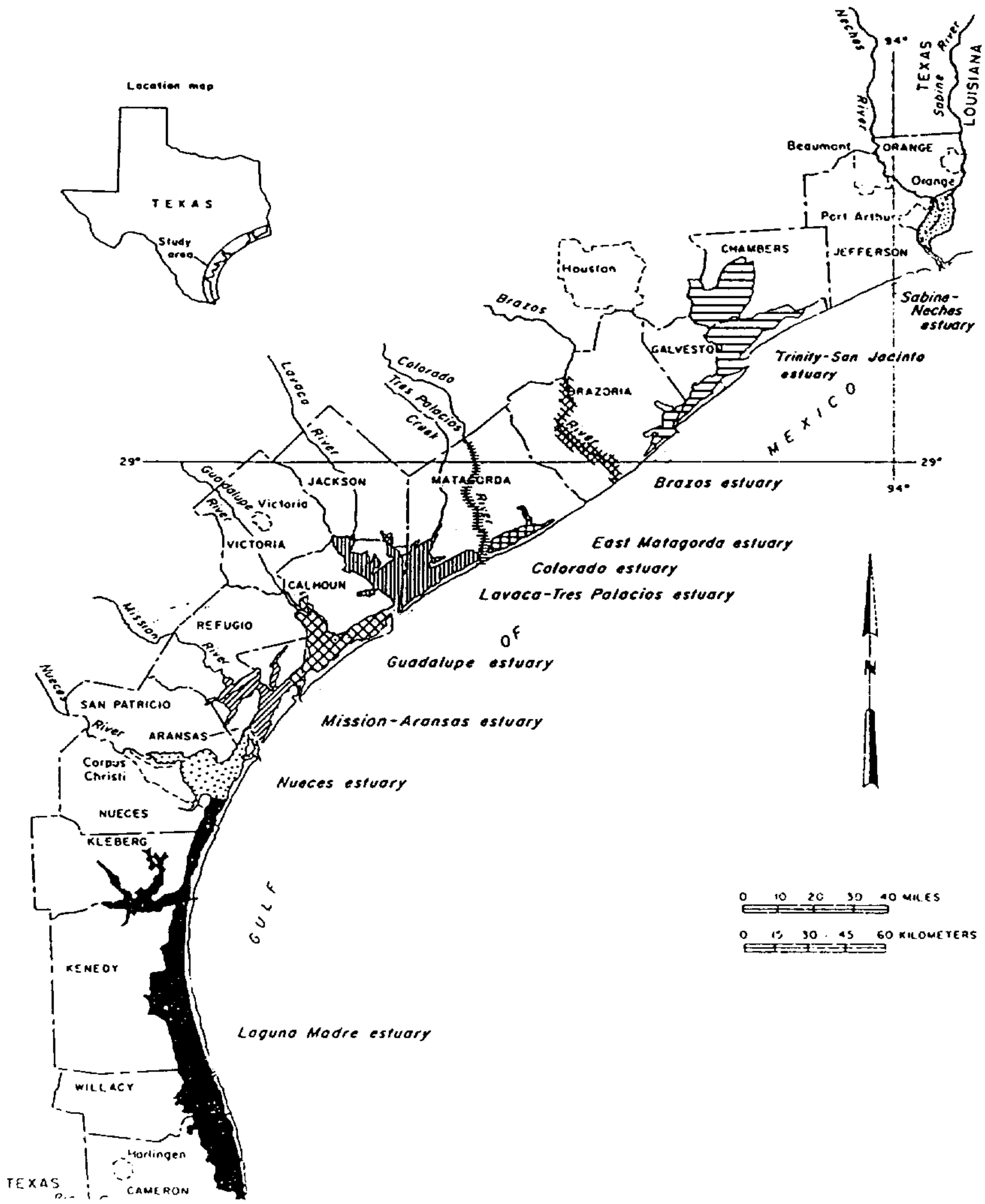

Figure 1. Location of Texas Estuaries.

47 – year (1941 – 1987) Average Freshwater Inflow Balance (10^9 acre – ft · y)

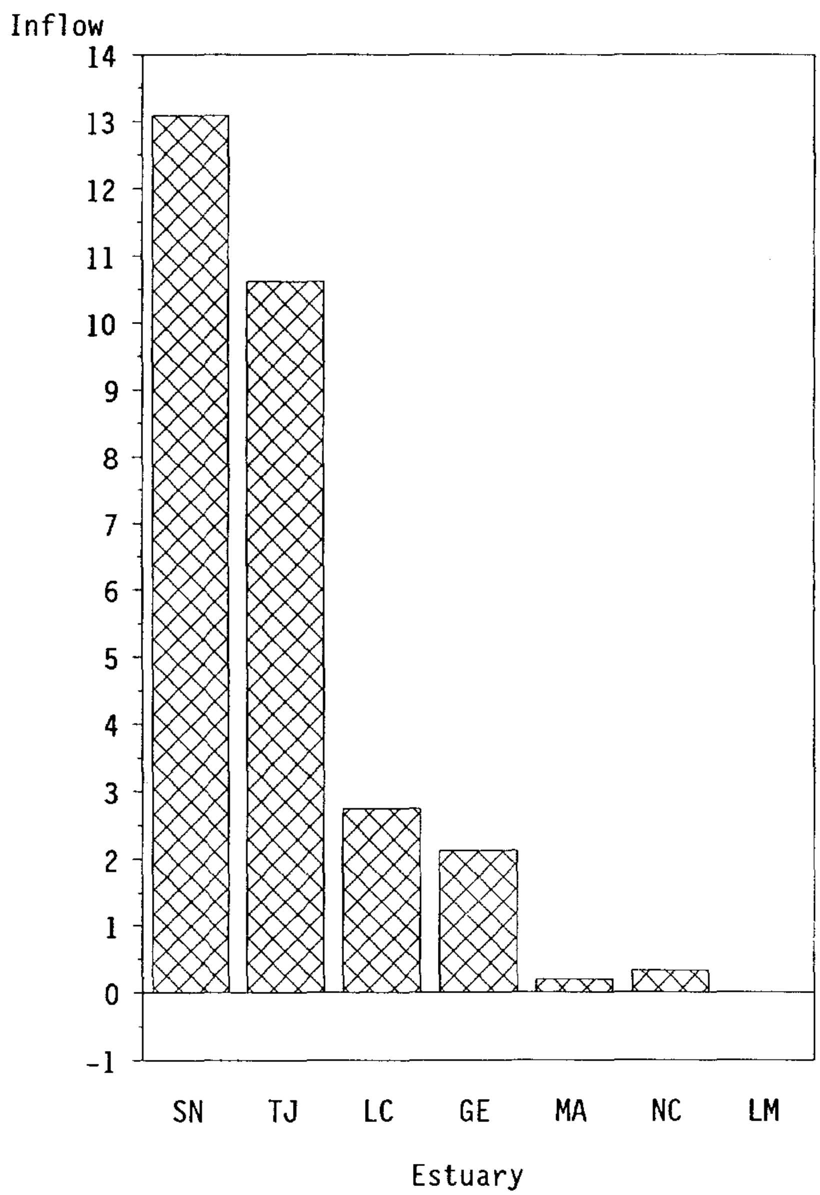

Figure 2. Annual average inflow in Texas Estuaries. SN = Sabine-Neches, TJ = Trinity-San Jacinto, LC = Lavaca-Colorado, GE = Guadalupe, MA = Mission-Aransas, NC = Nueces, LM = Laguna Madre (doesn't show at this scale).

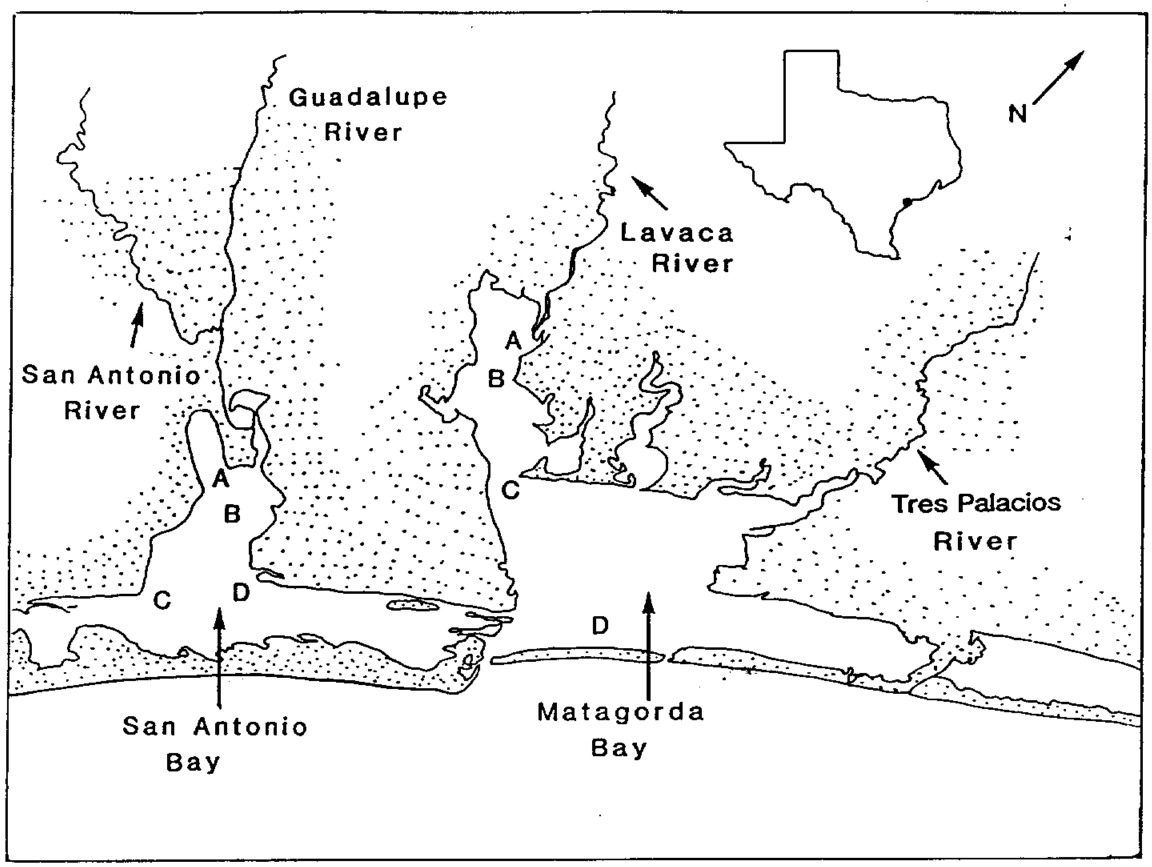

Figure 3. Sampling locations within the Guadalupe and Lavaca-Colorado Estuaries.

the major axis of the estuarine system leading from river mouth to the foot of the estuary near the barrier island. This design avoids pseudoreplication, where only one station has the characteristic of the main effect, and it is not possible to distinguish between station differences and treatment differences.

The Lavaca River empties into Lavaca Bay, which is connected to Matagorda Bay. Matagorda Bay also has freshwater input from the Colorado and Tres Palacios River. Over a 47-year period (1941-1987) the Lavaca-Colorado Estuary received an average of 3.800×10^9 m^3 y^{-1} with a standard deviation of 2.080 m^3 y^{-1} ($3.080 \pm 1.686 \times10^6$ ac-ft y^{-1}) of freshwater input, and the freshwater balance (input-output) was 3.392×10^9 m^3 y^{-1} with a standard deviation of 2.345×10^9 m^3 y^{-1} ($2.750 \pm 1.901 \times10^6$ ac-ft y^{-1}) (TDWR, 1980a; TWDB unpublished data). Four Stations were occupied along the axis of the system. Two stations were in Lavaca Bay (A and B), and two stations were in Matagorda Bay (C and D) (Figure 3). Depths of stations A, B, C, and D were 1.3 m, 2.0 m, 3.1 m, and 4.2 m, respectively. Five field trips were performed. Station A in Lavaca Bay was the same station 85 sampled in 1984-1986 (Jones et al., 1986).

The San Antonio River joins the Guadalupe River that flows into San Antonio Bay. Over a 46-year period the Guadalupe Estuary received an average of 2.896×10^9 m^3 y^{-1} with a standard deviation of 1.597 m^3 y^{-1} ($2.347 \pm 1.295 \times10^6$ ac-ft y^{-1}) of freshwater input, and the freshwater balance (input-output) was 2.624×10^9 m^3 y^{-1} with a standard deviation of 1.722×10^9 m^3 y^{-1} ($2.127 \pm 1.396 \times10^6$ ac-ft y^{-1}) (TDWR, 1980b; TWDB unpublished data). This system was studied from January through July 1987. Four stations were occupied: freshwater influenced stations at the head of the bay (station A) and at mid-bay (station B), and two marine influenced stations near the Intracoastal Waterway, one at the southwestern foot of the bay (station C) and one at the southeastern foot of the bay (station D) (Fig. 1). Stations were sampled five times in the first year. All stations were in shallow water. Depths of stations A, B, C, and D were 1.3 m, 1.9 m, 2.0 m, and 1.6 m, respectively.

Hydrographic Measurements

Salinity, conductivity, temperature, pH, dissolved oxygen, and redox potential were measured at the surface and bottom at each station during each sampling trip. Measurements were made by lowering a probe made by Hydrolab Instruments. Salinities levels are automatically corrected to 25°C. The manufacturer states that the accuracy of salinity measurements are 0.1 ppt. When the Hydrolab instrument was not working, water samples were collected from just beneath the surface and from the bottom in jars, and refractometer readings were made at the surface.

Geological Measurements

Sediment grain size analysis was also performed. Sediment core samples were taken by diver and sectioned at depth intervals 0-3 cm and 3-10 cm. Analysis followed standard geologic procedures (Folk, 1964; E. W. Behrens, personal communication). Percent contribution by weight was measured for four components: rubble (e.g. shell hash), sand, silt, and clay. A 20 cm^3 sediment sample was mixed with 50 ml of hydrogen peroxide and 75 ml of deionized water to digest organic material in the sample. The sample was wet sieved through a 62 μm mesh stainless steel screen using a vacuum pump and a Millipore Hydrosol SST filter holder to separate rubble and sand from silt and clay. After drying, the rubble and sand were separated on a 125 μm screen. The silt and clay fractions were measured using pipette analysis.

Biological Measurements

Sediment was sampled with core tubes held by divers. The macrofauna were sampled with a tube 6.7 cm in diameter, and sectioned at depth intervals of 0-3 cm and 3-10 cm. Three replicates were taken within a 2 m radius. Samples were preserved with 5% buffered formalin, sieved on 0.5 mm mesh screens, sorted, identified, and counted.

Each macrofauna sample was also used to measure biomass. Individuals were combined into higher taxa categories, i.e., Crustacea, Mollusca, Polychaeta, Ophiuroidea, and all other taxa were placed together in one remaining sample. Samples were dried for 24 h at 55 °C, and weighed. Before drying, mollusks were placed in 1 N HCl for 1 min to 8 h to dissolve the carbonate shells, and washed with fresh water.

Statistical Analyses

Statistical analyses to reveal differences among cruises, stations and sediment depths were performed using general linear model procedures (SAS, 1985). Two-way analysis of variance (ANOVA) models were used where sampling dates and stations were the two main effects. Tukey multiple comparison procedures were used to find *a posteriori* differences among sample means (Kirk, 1982). Multivariate ANOVA was used to test for treatment effects on species data. Factor analysis with rotated and unrotated factors was used to determine if communities were similar on different sampling dates. Linear correlation coefficients were calculated to determine if salinity was correlated to macrofauna abundance, biomass or diversity.

Diversity is calculated using Hill's diversity number one (N1) (Hill, 1973). It is a measure of the effective number of species in a sample, and indicates the number of abundant species. It is calculated as the exponentiated form of the Shannon diversity index:

$$N1 = eH' \tag{1}$$

As diversity decreases N1 will tend toward 1. The Shannon index is the average uncertainty per species in an infinite community made up of species with known proportional abundances (Shannon and Weaver, 1949). The Shannon index is calculated by:

$$H' = -\sum_{i=1}^{S}\left[\left(\frac{n_i}{n}\right)\ln\left(\frac{n_i}{n}\right)\right] \tag{2}$$

Where n_i is the number of individuals belonging to the *i*th of *S* species in the sample and *n* is the total number of individuals in the sample.

Richness is an index of the number of species present. The obvious richness index is simply the total number of all species found in a sample regardless of their abundances. Hill (1973) named this index N0. Another well known index of species richness is the Margalef (1958) index (R1). R1 is based on the relationship between the number of species (*S*) and the total number of individuals (*n*) observed:

$$R1 = \frac{S-1}{\ln(n)} \tag{3}$$

Although common, this relationship presupposes that there is a functional relationship between *S* and *n*. This assumption may not be justified in all cases.

Evenness is an index that expresses that all species in a sample are equally abundant. Evenness is a component of diversity. Two evenness indices, E1 and E5, have been calculated. E1 is probably the most common, it is the familiar *J'* of Pielou (1975). It expresses *H'* relative to the maximum value of *H'*:

$$E1 = \frac{H'}{\ln(S)} = \frac{\ln(N1)}{\ln(N0)} \tag{4}$$

E1 is sensitive to species richness. E5 is an index that is not sensitive to species richness. E5 is a modified Hill's ratio (Alatalo, 1981):

$$E5 = \frac{(1/\lambda)-1}{N1-1}$$
$$\text{where, } \lambda = \sum_{i=1}^{S} \frac{n_i(n_i-1)}{n(n-1)} \qquad (5)$$

λ is the Simpson (1949) diversity index. E5 approaches zero as a single species becomes more and more dominant.

RESULTS

There is a linear decrease in average annual freshwater inflow from north to south along the Texas coast (one-way ANOVA, $P = 0.0001$, Figure 2). The Lavaca-Colorado and Guadalupe Estuaries have the same average inflow (linear contrast, $P = 0.3333$, Figure 2). Lavaca-Colorado and Guadalupe Estuaries are very different in certain respects. The Lavaca-Colorado is much larger, receives drainage from three rivers, has a typical primary and secondary bay configuration, and has excellent exchange with the Gulf of Mexico (Figure 3). The Guadalupe has restricted Gulf exchange and is composed of a single bay. The impact of human activities is very different also. The Guadalupe receives drainage from the San Antonio River, which passes through a major metropolitan area, yet San Antonio Bay is very rural. The Lavaca-Colorado watershed is mostly rural, but Lavaca Bay is heavily impacted by channels, ship traffic, and the chemical industry. I must use salinity as an indicator of freshwater inflow. Assessments of freshwater inflow into the Guadalupe and Lavaca-Colorado do not extend beyond 1988 (Figure 4).

Guadalupe Estuary

Since 1987 when this sampling effort began, the Guadalupe has gone through three different phases (Figure 5, Table 1). There was a great flood in the spring of 1987. In the summer of 1987, even the stations located in the zone of greatest marine influence had salinities of near zero. A two year drought followed that period. During the drought salinities rose to 20-30 ppt throughout the estuary. The period between 1990 and 1991 has been one of fluctuations. Salinities in the estuary dropped during spring floods in both years. In the upper part of estuary salinity was near zero, but the salinities at the lower end of the estuary, only dropped to the 6-12 range. The period during 1992 looks a lot like the period during the flood of 1987. In both periods, there is flooding during the winter and low salinities from winter of the preceding year to summer of the current year. Both periods are periods of El Nino. These warm water events in the western Pacific ocean induce increased rainfall events in the Gulf of Mexico.

A trend is beginning to show itself. There appears to be three kinds of climatic influences on the estuary. Flood years, perhaps during El Nino years, when there is rain and lower salinities during the winter and continuing until early summer. Drought years, when rainfall is low during winter and spring resulting in high year-round salinities. "Seasonal" temperate patterns, when there is a spring rain or runoff period resulting in seasonal fluctuation of salinities. So far, we are seeing the beginning of one full cycle.

The sediments of the upper part of the estuary are characterized by high silt and clay contents (Figure 6, Table 2). Only station D sediments were dominated by sand. Rubble was common in deep sediments from A, and shallow sediments in C. The composition of the sediments at all stations has not changed much since the beginning of this study in 1987 (Table 2).

Macrofauna abundance (Figure 7) and biomass (Figure 8) are generally higher in stations A and B in the upper end of the estuary than in stations C and D in the lower end of the estuary (linear contrast, $P=0.0001$ for both). The average density (in units of individuals $\cdot$ m^{-2}) over the entire study period was 40,687 at A, 35,879 at B, 16,143 at D, and 15,250 at C (Table 4). The average biomass (in units of g $\cdot$ m^{-2}) during the entire study period was 8.33 at A, 6.33 at B, 4.90 at D and 2.69 at C. An exception to the generality is biomass in station D when rare, but large, ophiuroids are present (Figure 9). There were large year-to-year fluctuations in both parameters during the course of the study, but in general, the station pairs changed in similar ways.

Average estuarine-wide salinity was plotted with average estuarine-wide abundance (Figure 9), average estuarine-wide biomass (Figure 10), and average estuarine-wide diversity (Figure 11) to determine the relationship between freshwater inflow and biological response. Over time, biomass was significantly correlated with changes in salinity ($r=0.66$, $P=0.0019$), but abundance was not correlated with salinity ($r=0.39$, $P=0.0973$). However, a simple correlation with salinity does not reveal the whole picture. It is obvious that there are two patterns, a long-term pattern and a seasonal pattern. Over the long term peaks of abundance and biomass occurred after periods of high inflow in April 1988, January 1991, and July 1991. This leads me to predict that we will see a recovery of abundance and biomass in the winter and spring of 1993. There is also evidence of seasonality. April usually has the lowest salinity (in 1988, 1989, 1991 and 1992) followed by high biomass (in 1988, 1989 and 1991). This would lead us to believe that biomass will be high in July 1992.

The dominant species over the course of the entire study is *Streblospio benedicti*, averaging 7,925 individuals$\cdot$m^{-2} at all stations (Table 4). This suspension feeding species was five times more abundant at stations A and B, than at stations C and D. The dominant organisms at stations C and D are the deposit feeding polychaetes from the genus *Mediomastus*.

Hill's diversity index was correlated with salinity over time (r=0.71, P=0.0004; Figure 11, Table 5). Diversity seemed to be most affected by annual and seasonal changes through time (Table 6). There appears to be a succession of species groups through time on annual and seasonal scales. The first two factors in a factor analysis of sampling dates accounts for 78% of the variability in the species dataset (Figure 12). The first factor (explaining 54.6% of the variability separates the data into suites of species during the periods between 1987-88 and 1989-92 (Figure 12). This roughly corresponds to the transition from a wet to dry period. There is not enough data in the second wet cycle, beginning in the winter 1991 to separate out that data. The second factor (explaining 23.8% of the variability) is related to seasonal components, separating spring and summer data from fall and winter data. The third factor (13.6% of the variability) increased the variance explained to 92%. The third factor separates years within cycles (Figure 13).

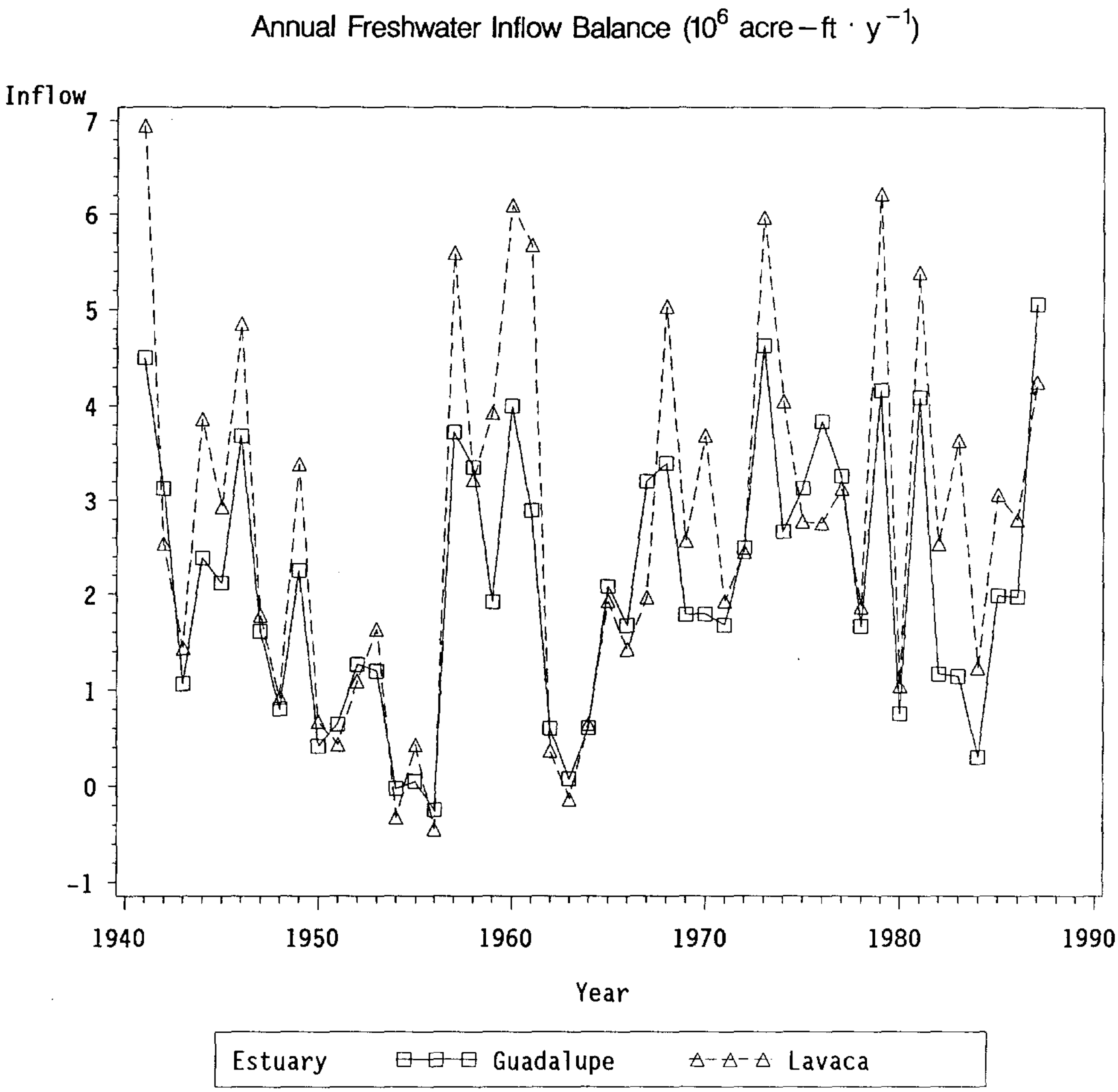

Figure 4. Annual freshwater inflow balance in the Guadalupe and Lavaca Estuary.

Guadalupe Estuary
Salinity (ppt)

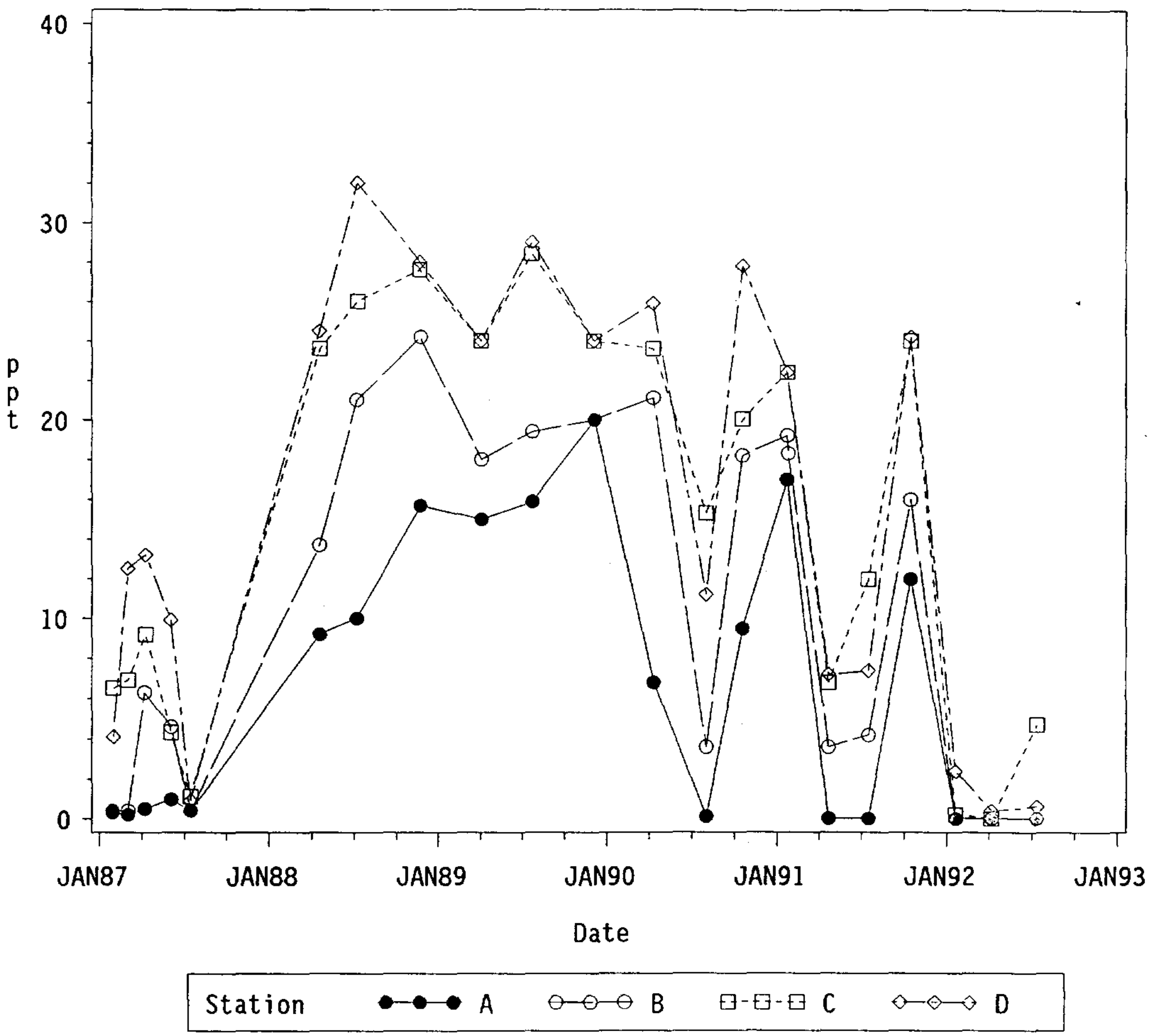

Figure 5. Bottom water salinity at four stations in the Guadalupe Estuary.

Guadalupe Estuary Sediment Composition (% dry weight)

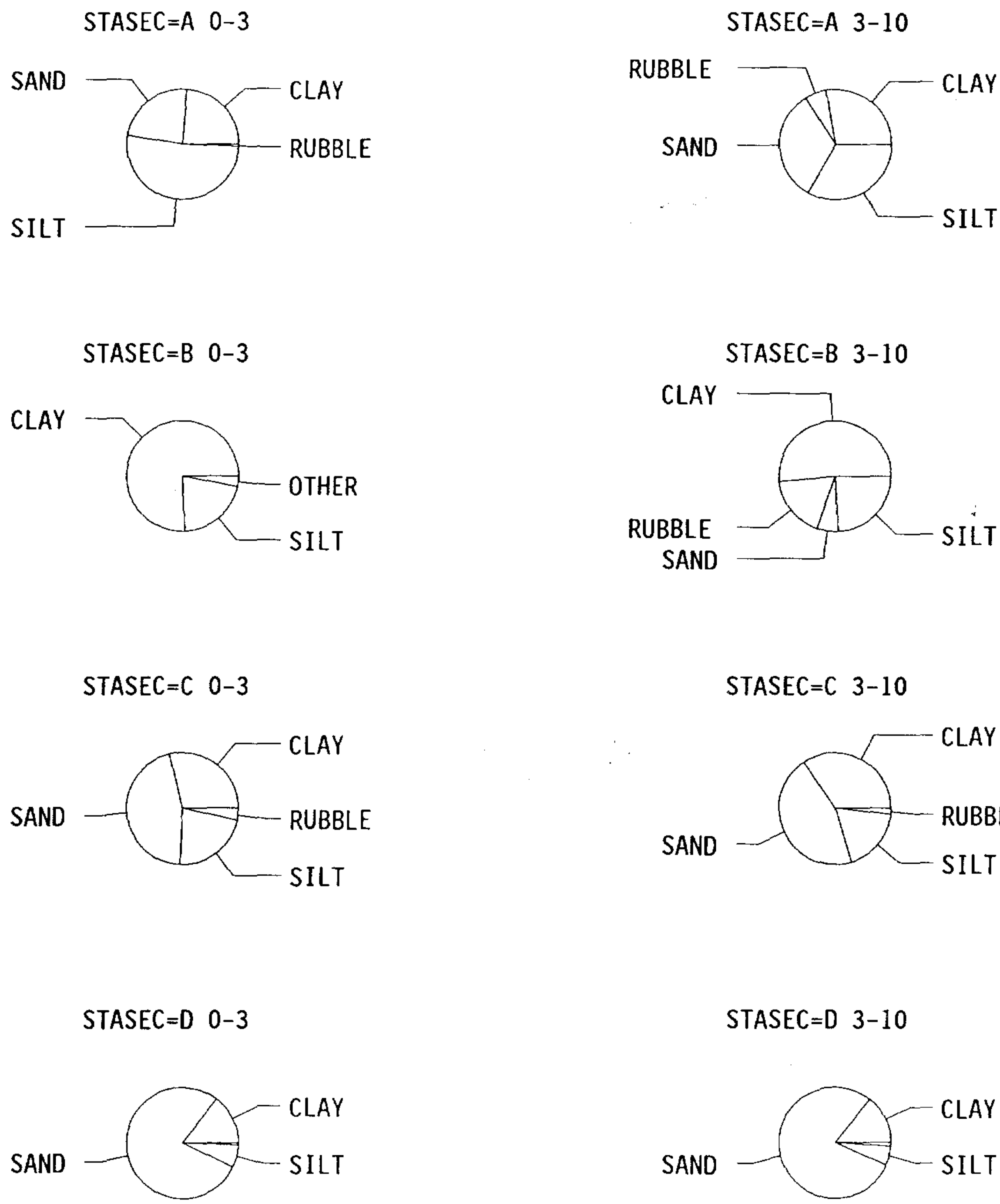

Figure 6. Sediment grain size in the Guadalupe Estuary. Samples taken in October 1991. STASEC=Station, vertical section combination. Section in cm.

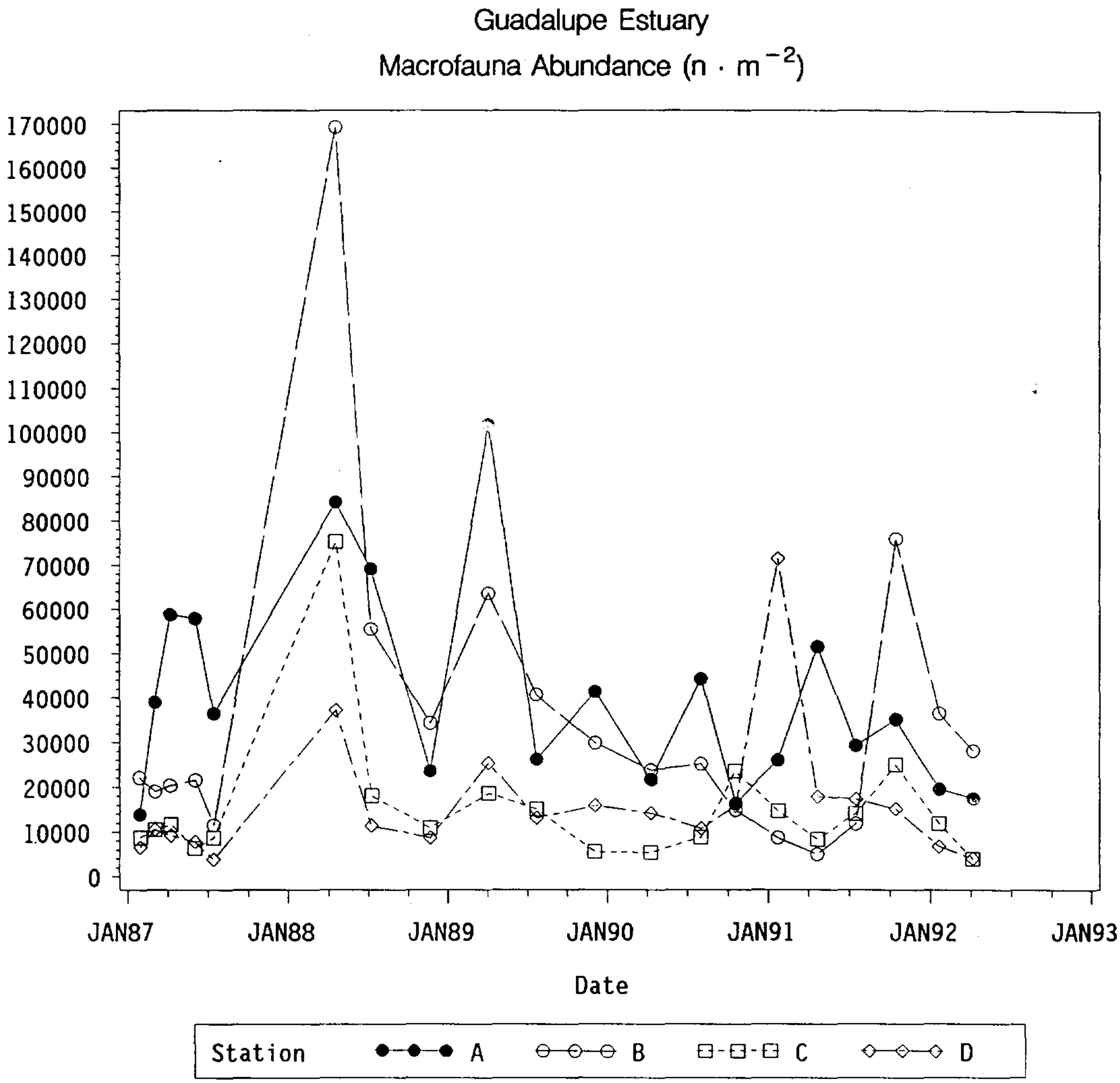

Figure 7. Macrofauna abundance at four stations in the Guadalupe Estuary. Samples taken to a depth of 10 cm, average of $n=3$.

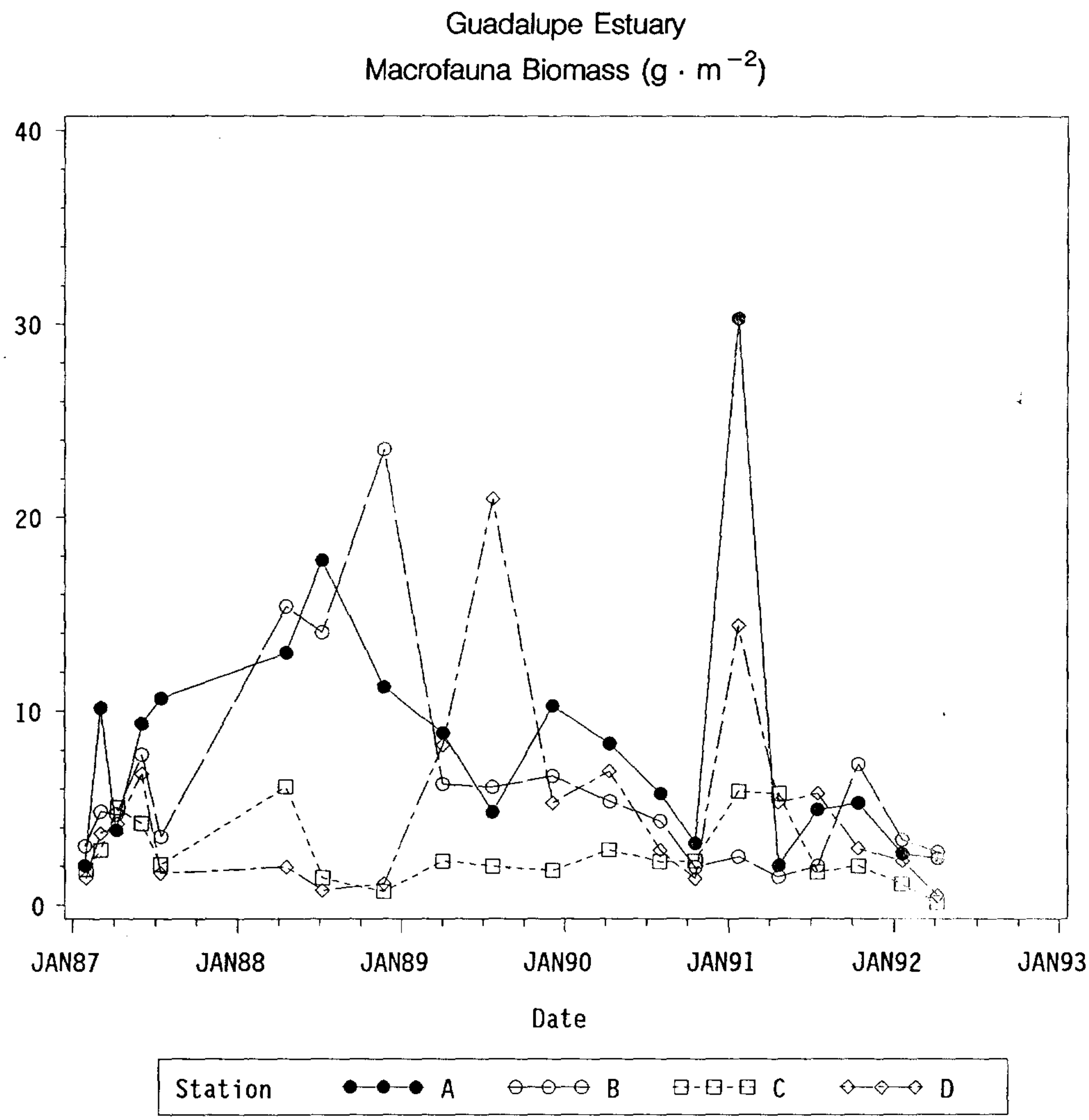

Figure 8. Macrofauna biomass at four stations in the Guadalupe Estuary. Samples taken to a depth of 10 cm, average of n=3.

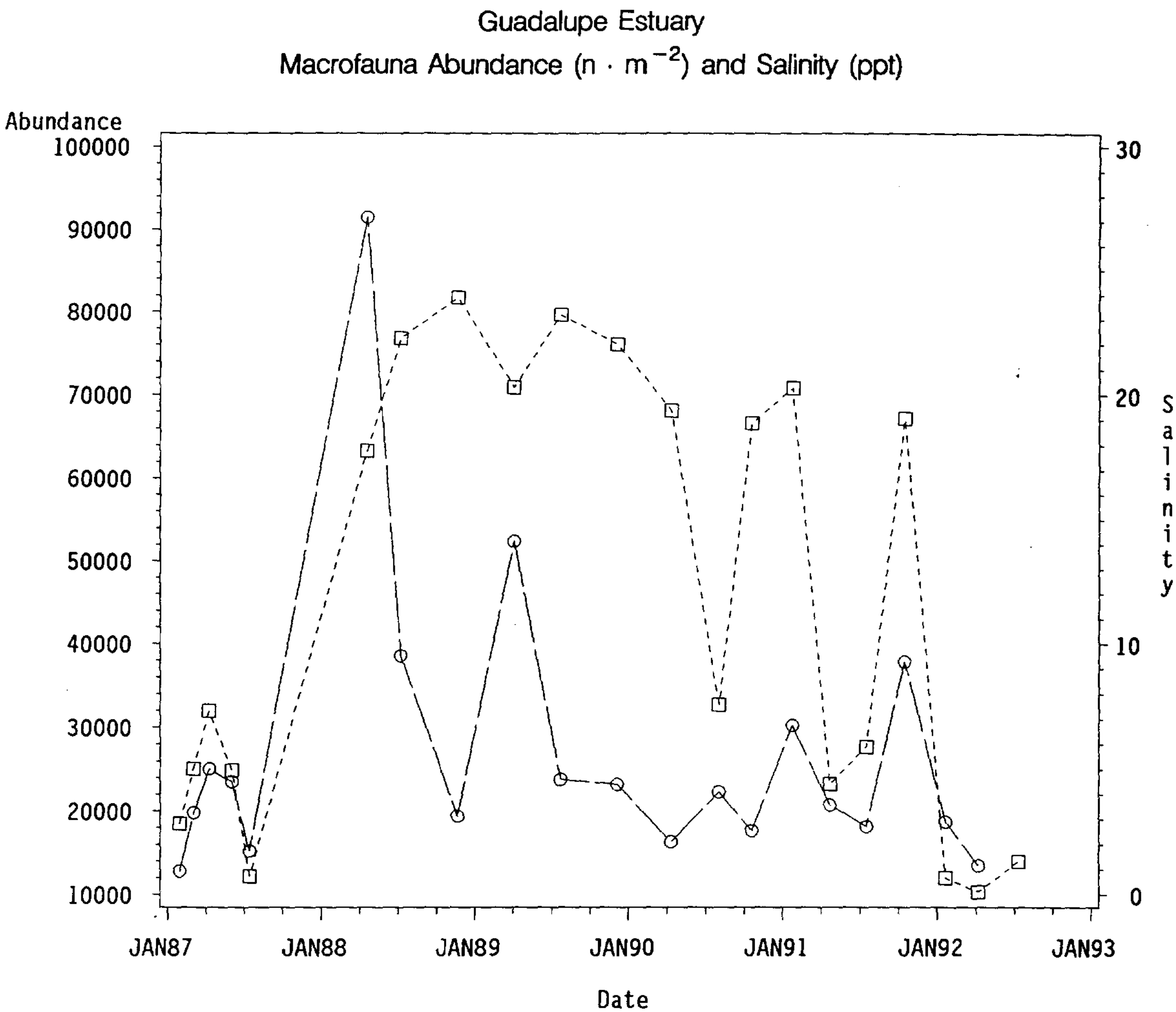

Figure 9. Relationships between macrofauna abundance and salinity in the Guadalupe Estuary. Average abundance (○) and salinity (□) at all stations.

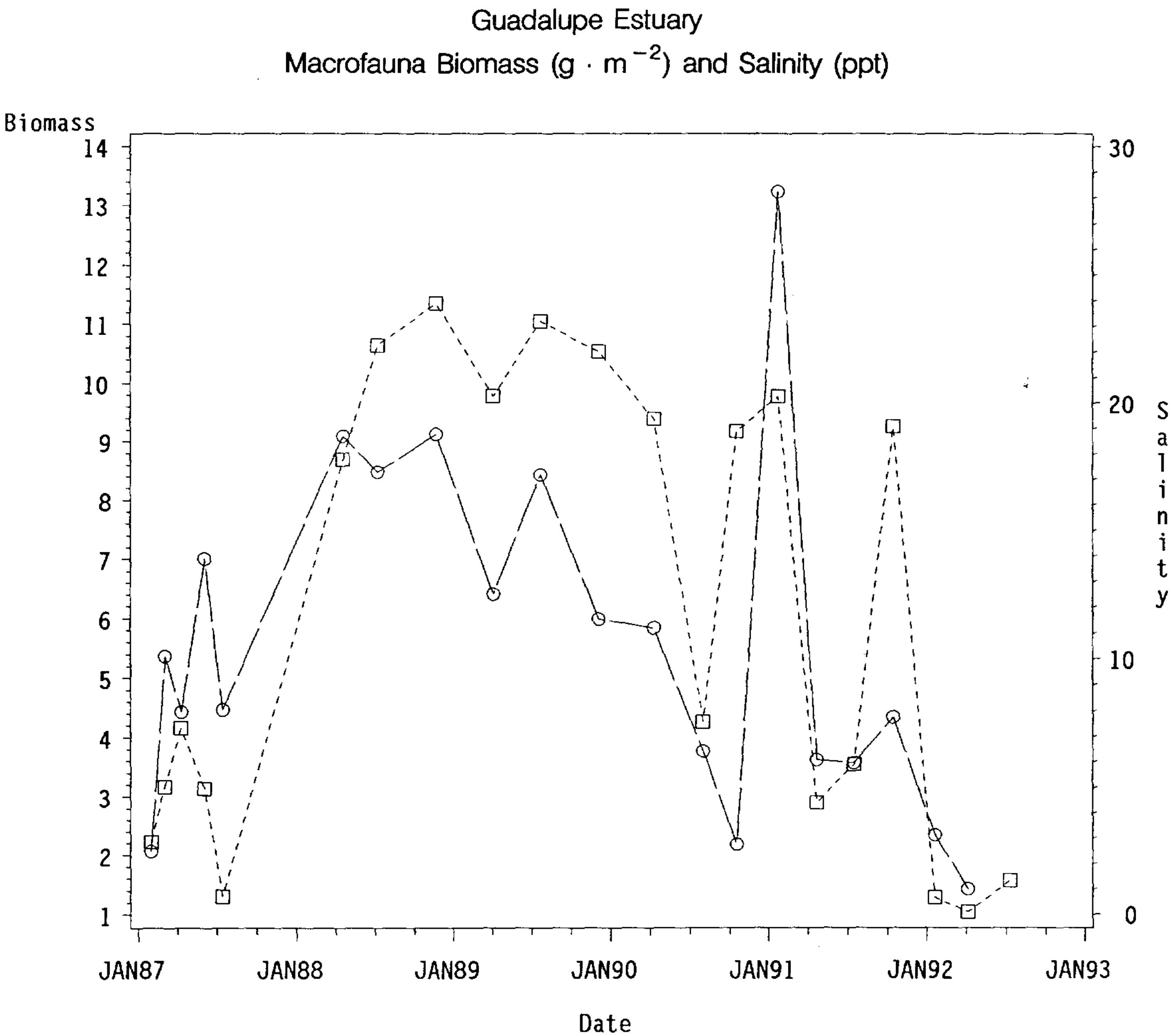

Figure 10. Relationships between macrofauna biomass and salinity in the Guadalupe Estuary. Average biomass (○) and salinity (□) at all stations.

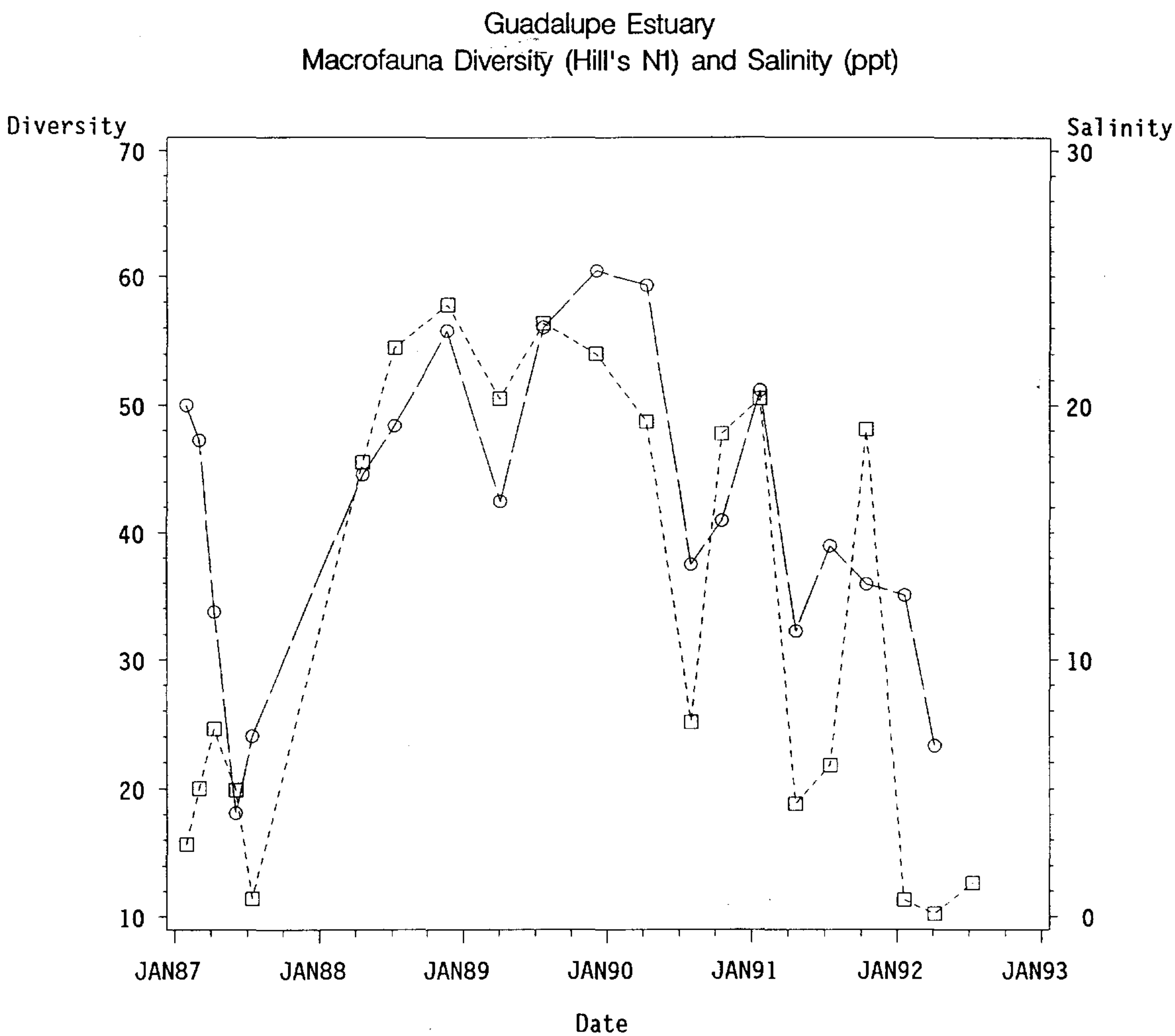

Figure 11. Relationships between macrofauna diversity and salinity in the Guadalupe Estuary. Average diversity (○) and salinity (□) at all stations.

Guadalupe Estuary
Principal Factor Analysis

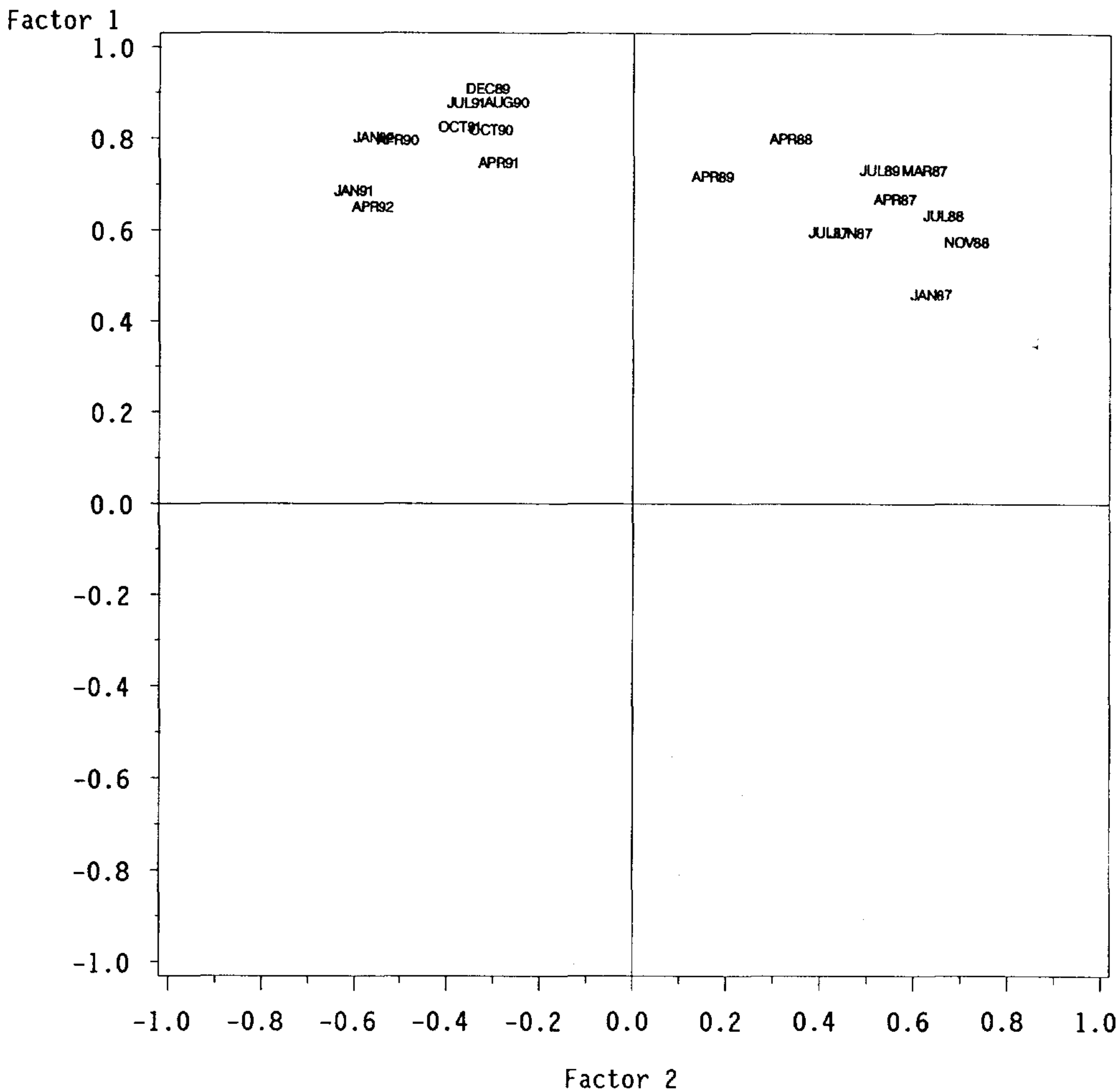

Figure 12. First two factors for macrofauna species at all sampling dates in the Guadalupe Estuary. Species occurring at all stations for a given date.

Guadalupe Estuary
Principal Factor Analysis

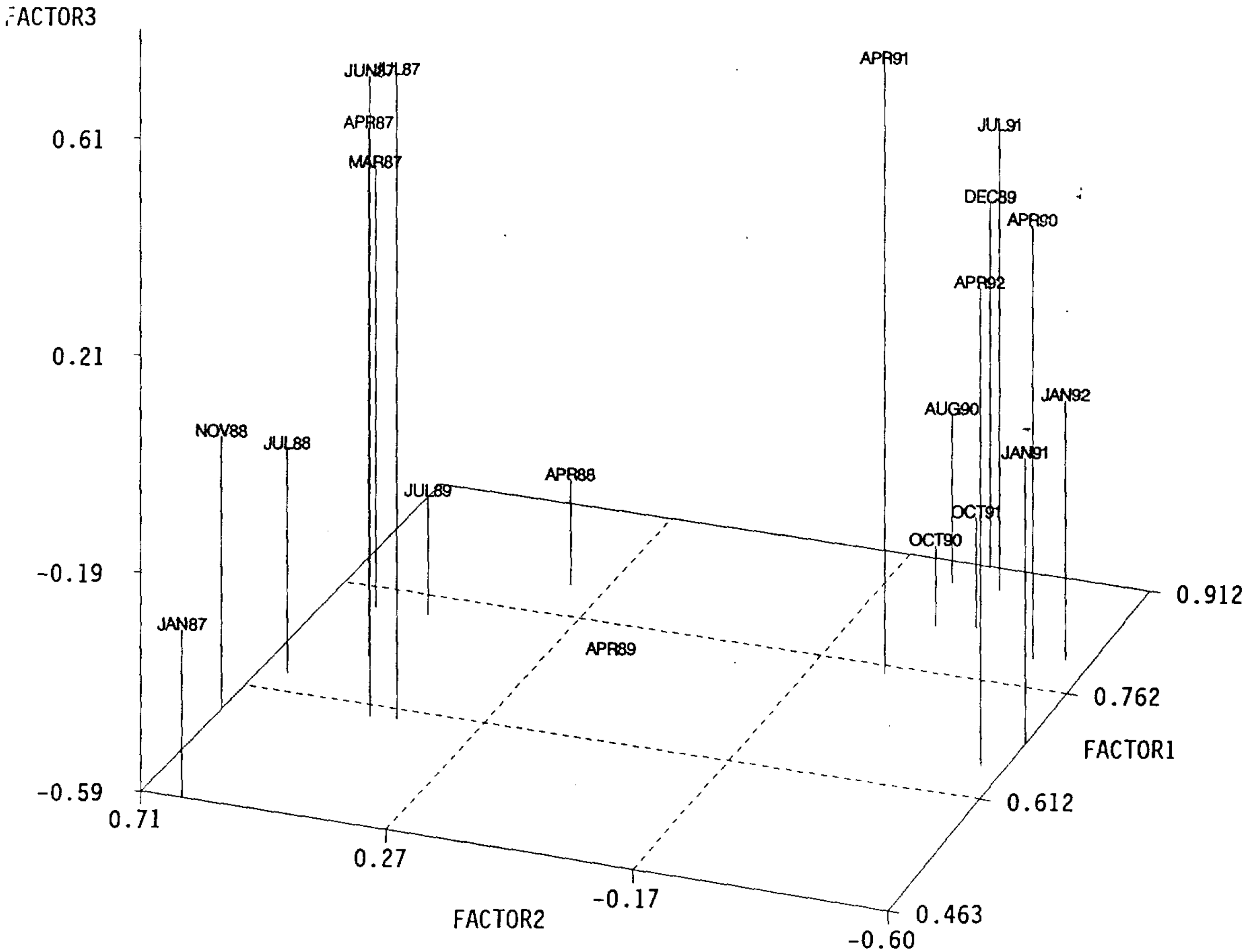

Figure 13. First three factors for macrofauna species at all sampling dates in the Guadalupe Estuary. Species occurring at all stations for a given date.

Station A was also studied during 1984-1986, and called station 85 in previous studies (Kalke and Montagna, 1991). Unfortunately, my record is incomplete during 1987, so we can not look at the effect of the spring flood in the Lavaca-Colorado Estuary (Table 7). However, the period between 1984 and 1985 was a very wet period indicated by low salinities in station A (Figure 14). 1986 to early 1987 was dry, and similar to the recent period from April 1990 to the present. 1988 through 1989 was the highest salinity period recorded. Surprisingly, the flood events of 1991-1992 did not produce lowered salinities in Matagorda Bay (stations C and D) (Table 7).

The sediments of the upper part of the estuary are characterized by high silt and clay contents (Figure 15, Table 8). Rubble and sand were rare at station A. Sand, silt was present in stations C and D. Rubble was most common in sediments from C.

Macrofauna abundance (Figure 16) and biomass (Figure 17) are generally higher in stations C and D in the lower end of the estuary than in stations A and B in the upper end of the estuary (linear contrast, $P=0.0001$ for both). The average density (in units of individuals $\cdot$ m^{-2}) over the entire study period was 9,221 at A, 9,127 at B, 18,045 at C, and 25,910 at D (Table 9). The average biomass (in units of g $\cdot$ m^{-2}) during the entire study period was 2.74 at A, 2.00 at B, 10.52 at C, and 15.89 at D. There were large year-to-year fluctuations in both parameters during the course of the study, but in general, the station pairs were changed in similar ways. There were more polychaete and crustacean species in the lower part of the estuary (stations C and D) than in the upper part of the estuary (stations A and B) (Table 10).

Average estuarine-wide salinity was plotted with average estuarine-wide abundance (Figure 18), average estuarine-wide biomass (Figure 19), and average estuarine-wide diversity (Figure 20) to determine the relationship between freshwater inflow and biological response. Although, both abundance and biomass seem to respond to salinity patterns over time, neither abundance ($r=0.35$, $P=0.2021$), nor biomass ($r=0.22$, $P=0.4357$) was significantly correlated with changes in salinity. The lack of correlation is due to fluctuations during two periods. Between April and July 1988, abundance and biomass decreased when salinity increased. A similar anomaly occurred between April and July 1991. In other periods, downward trends in salinity correlate to downward trend in abundance and biomass. Hill's diversity index was also not correlated with salinity ($r=-0.40$, $P=0.1442$). Diversity seemed to be most affected by seasonal swings (Figure 20).

There appears to be a succession of species groups through time. The first two factors in a factor analysis of sampling dates accounts for 90% of the variability in the species dataset. The first factor (63% of the variability) appears to be related to suites of species during the period between April 1988 July 1989 (Figure 21). This period was the most consistently dry period during this sampling as evidenced by the higher salinities during that period (e.g., Figure 21). The second factor (27% of the variability) is related to the spring and summer communities present from during the first part of that period. The third factor (4% of the variability) separates the seasons within years (Figure 22).

Lavaca-Colorado Estuary Station A

Since station A was studied from 1984, we can look at the data from that station alone to try and discern long-term trends. Unfortunately, there was a 20-month break in records from August 1986 through April 1988. Biomass was measured differently during the 1984-1986 study, so we can only compare abundance and diversity with the current dataset. Both abundance (r=0.39, P=0.0378), and diversity (r=0.35, P=0.0642) have weak significant correlations to salinity changes over time. The trends are more clear in the long-term data set. Abundance and salinity were low from 1984 to 1986, they both increased from 1986 to 1987, were uniformly high from 1988 to 1990, both declined in 1991 during a wet period, and both increased slightly during late 1991 (Figure 23). Diversity exhibited the same trends (Figure 24). Within these general trends, small fluctuations are also obvious. During the height of the 1988 drought, both abundance and diversity dropped. This analysis confirms two ideas in the present study, that trends are only obvious over long periods of time, and that floods and droughts are both perturbations.

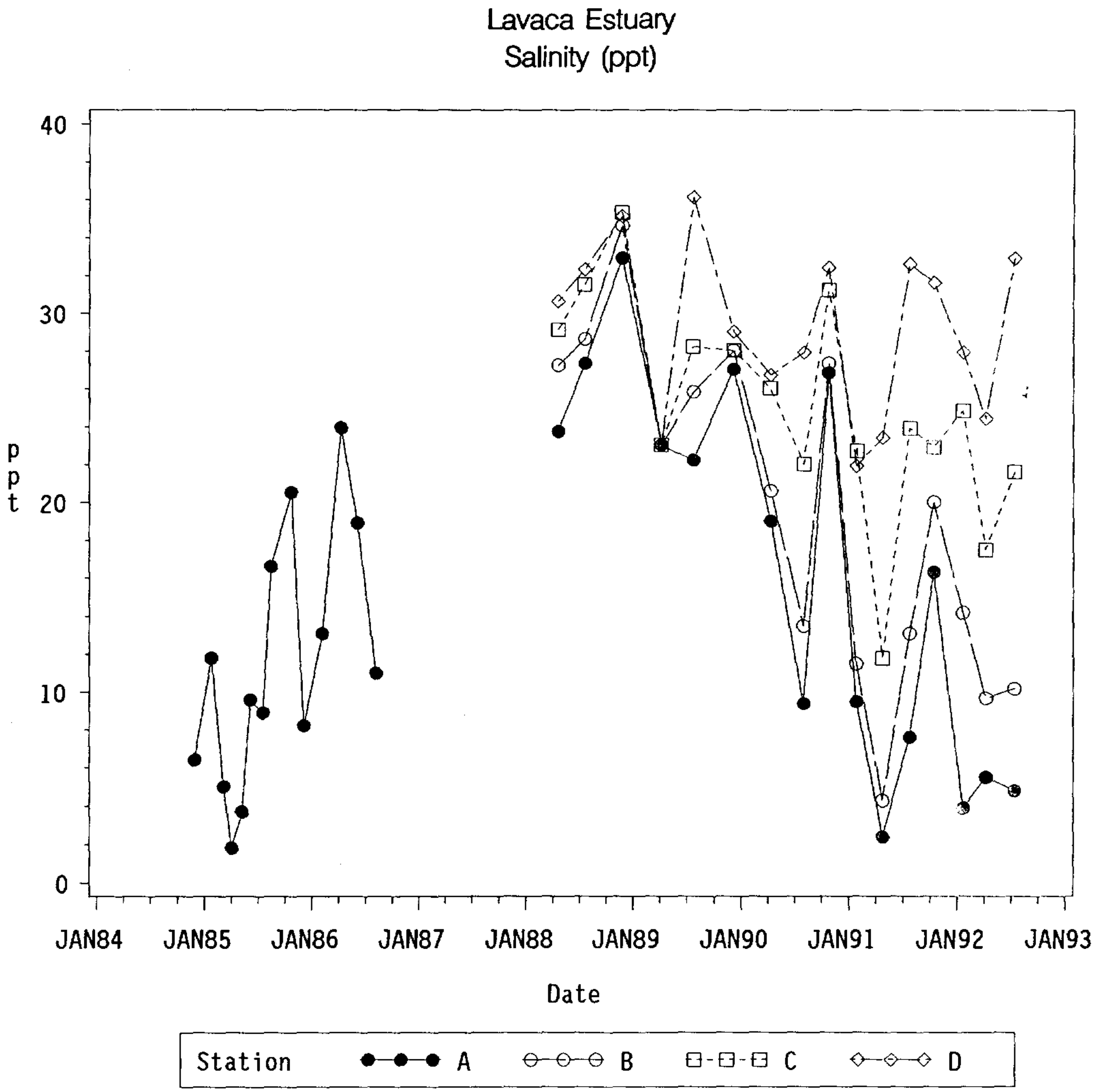

Figure 14. Bottom water salinity at four stations in the Lavaca-Colorado Estuary.

Lavaca – Colorado Estuary Sediment Composition (% dry weight)

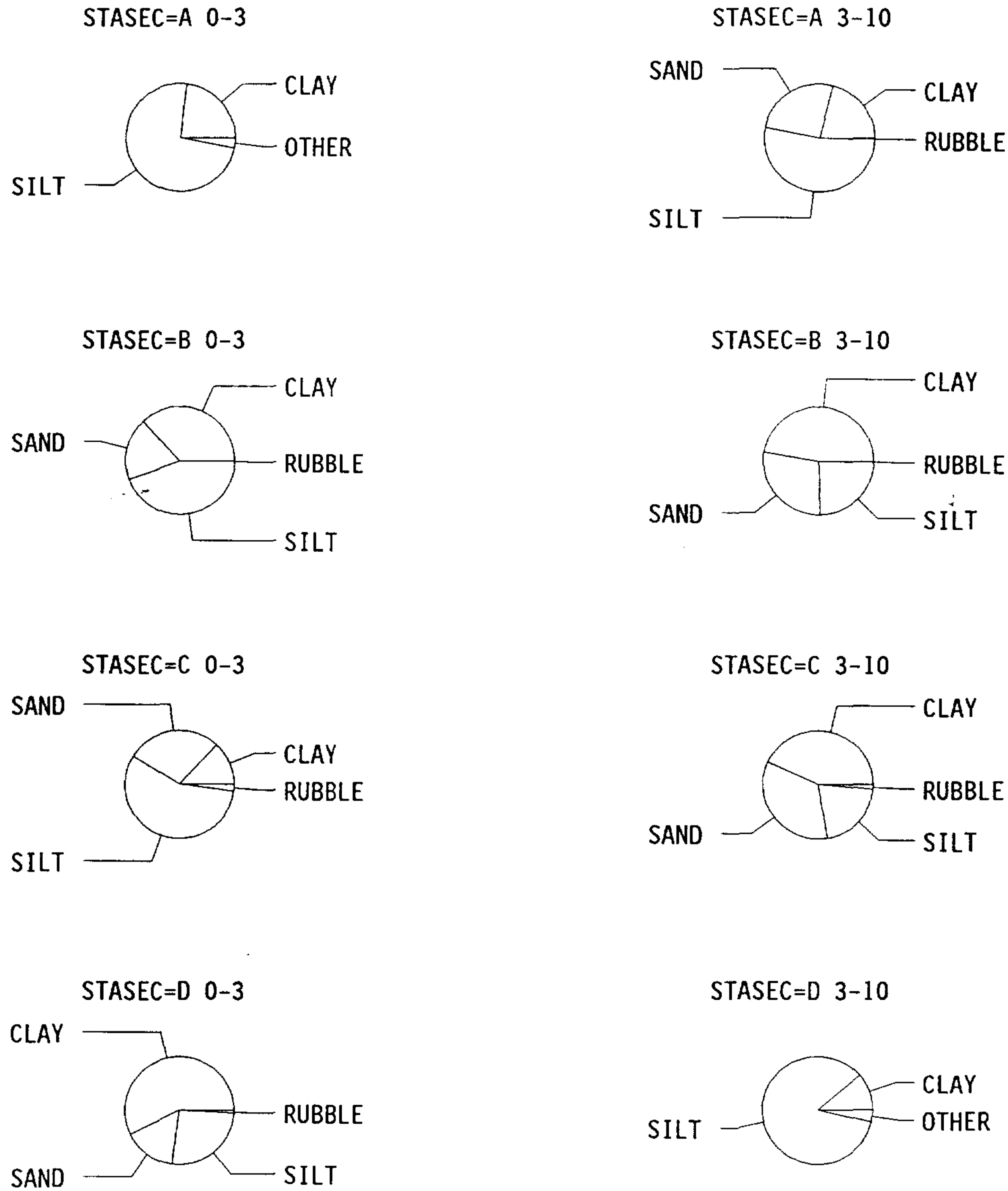

Figure 15. Sediment grain size in the Lavaca-Colorado Estuary. Samples taken in October 1991. STASEC = Station, vertical section combination. Section in cm.

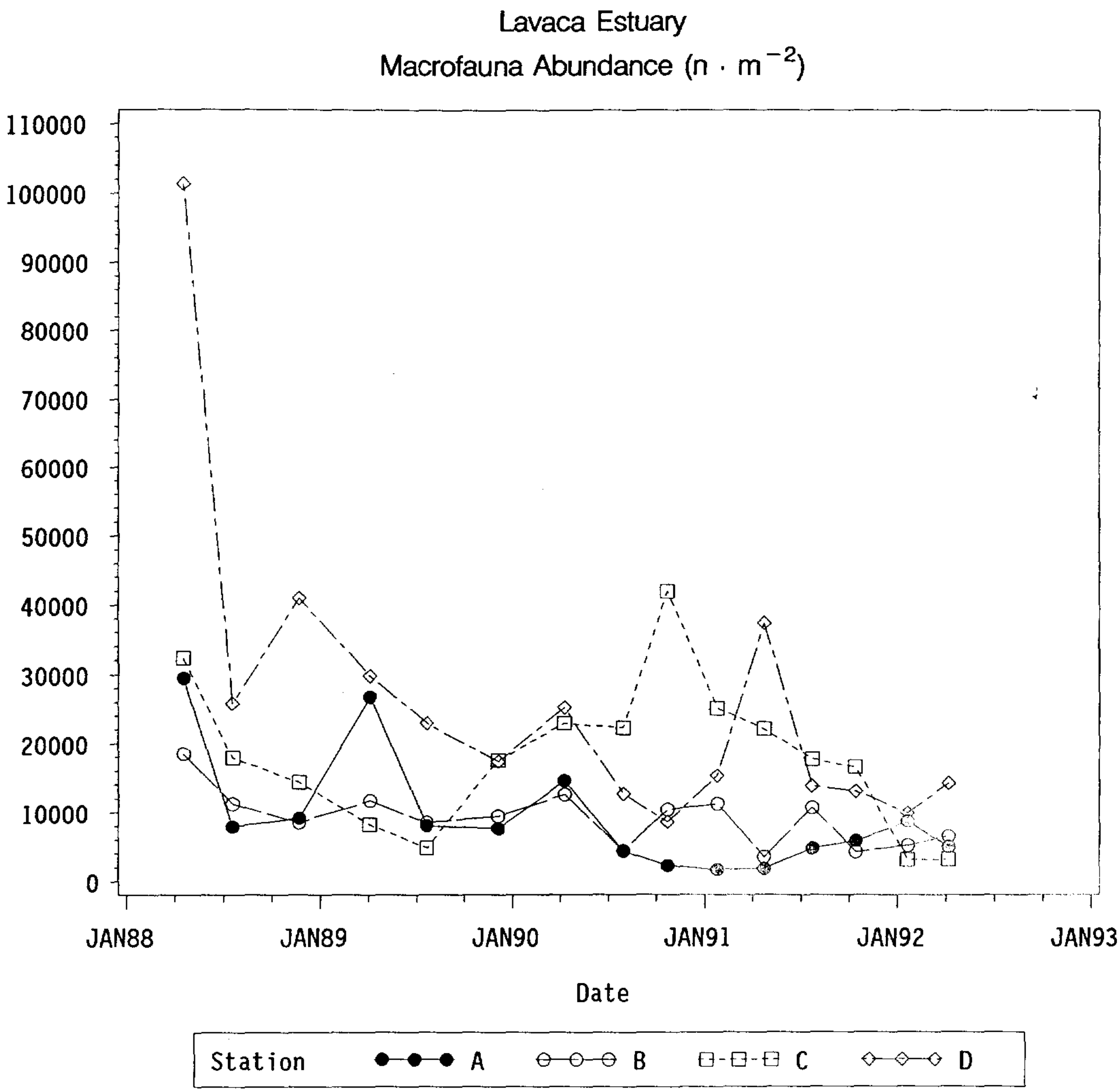

Figure 16. Macrofauna abundance at four stations in the Lavaca-Colorado Estuary. Samples taken to a depth of 10 cm, average of $n=3$.

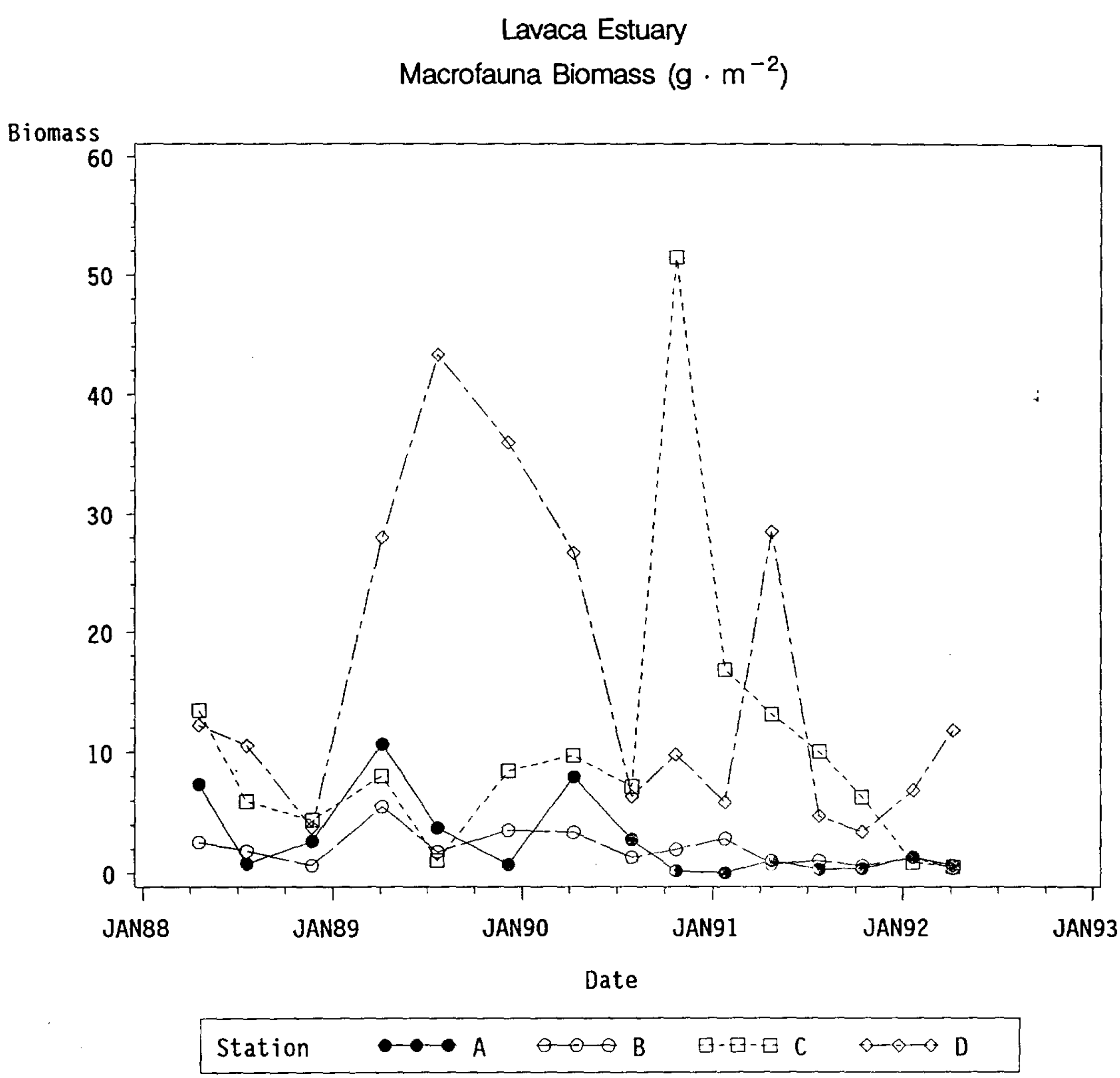

Figure 17. Macrofauna biomass at four stations in the Lavaca-Colorado Estuary. Samples taken to a depth of 10 cm, average of $n=3$.

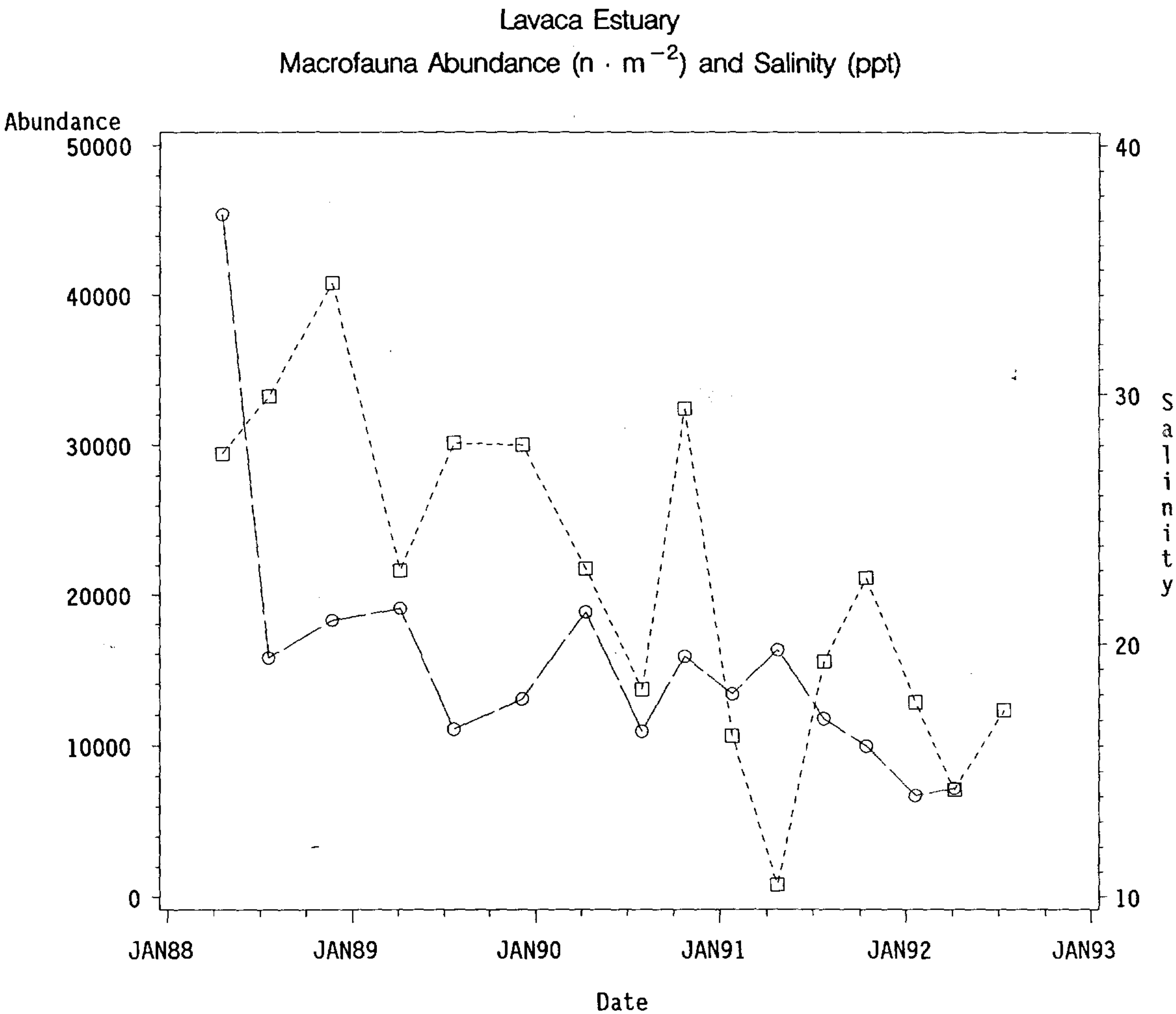

Figure 18. Relationships between macrofauna abundance and salinity in the Lavaca-Colorado Estuary. Average abundance (○) and salinity (□) at all stations.

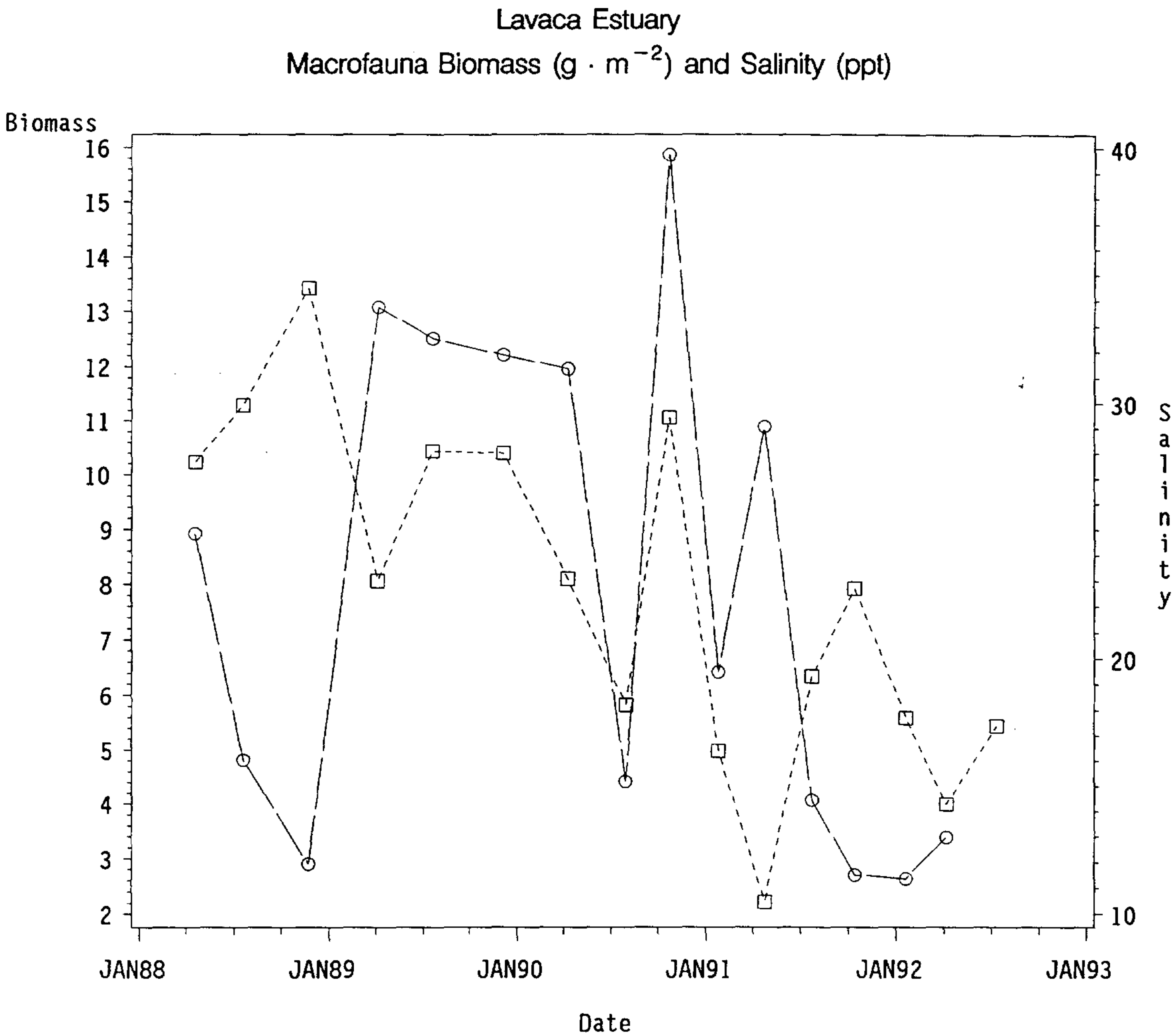

Figure 19. Relationships between macrofauna biomass and salinity in the Lavaca-Colorado Estuary. Average biomass (o) and salinity (□) at all stations.

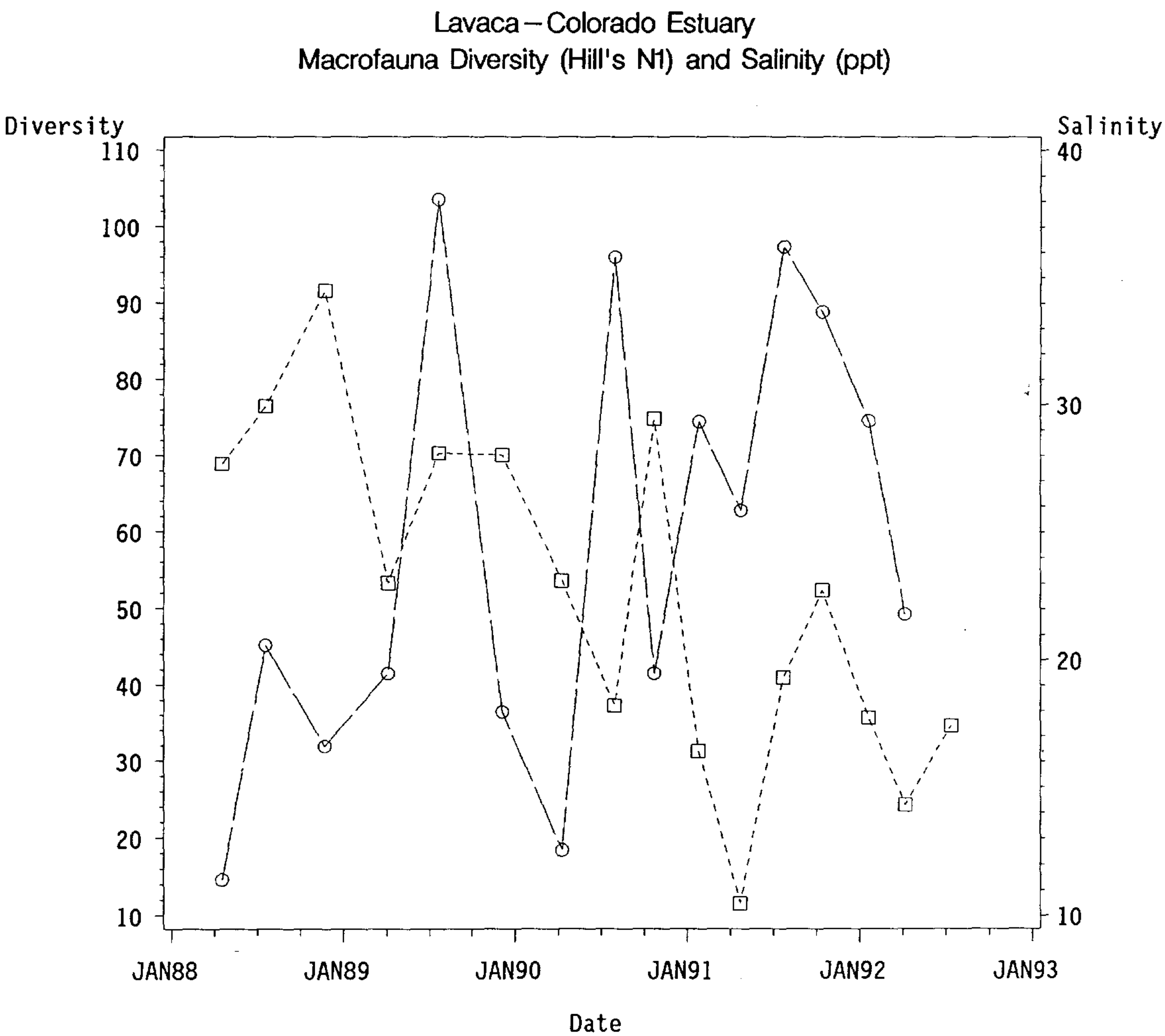

Figure 20. Relationships between macrofauna diversity and salinity in the Lavaca-Colorado Estuary. Average diversity (○) and salinity (□) at all stations.

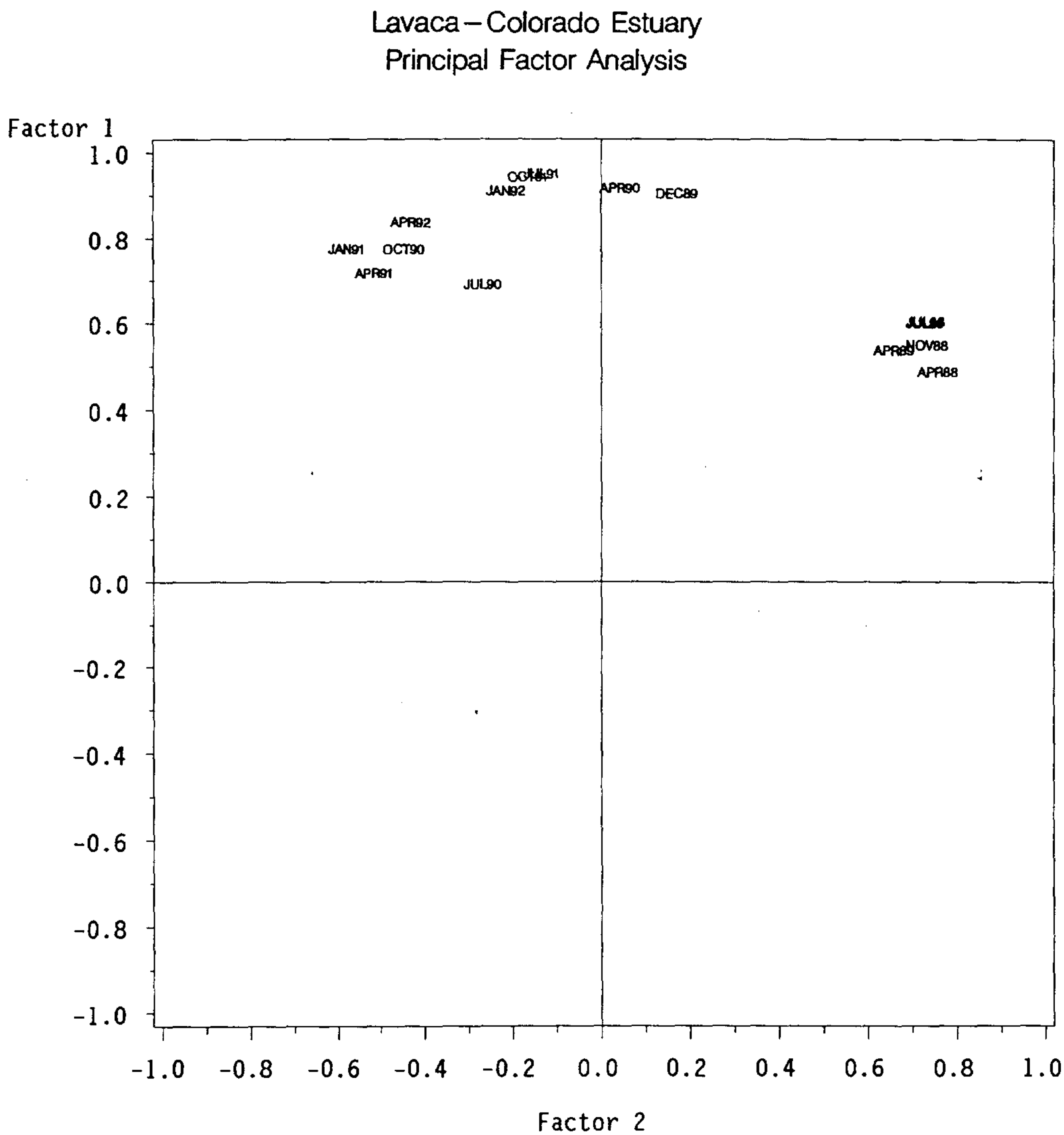

Figure 21. First two factors for macrofauna species at all sampling dates in the Lavaca-Colorado Estuary. Species occurring at all stations for a given date.

Lavaca–Colorado Estuary
Principal Factor Analysis

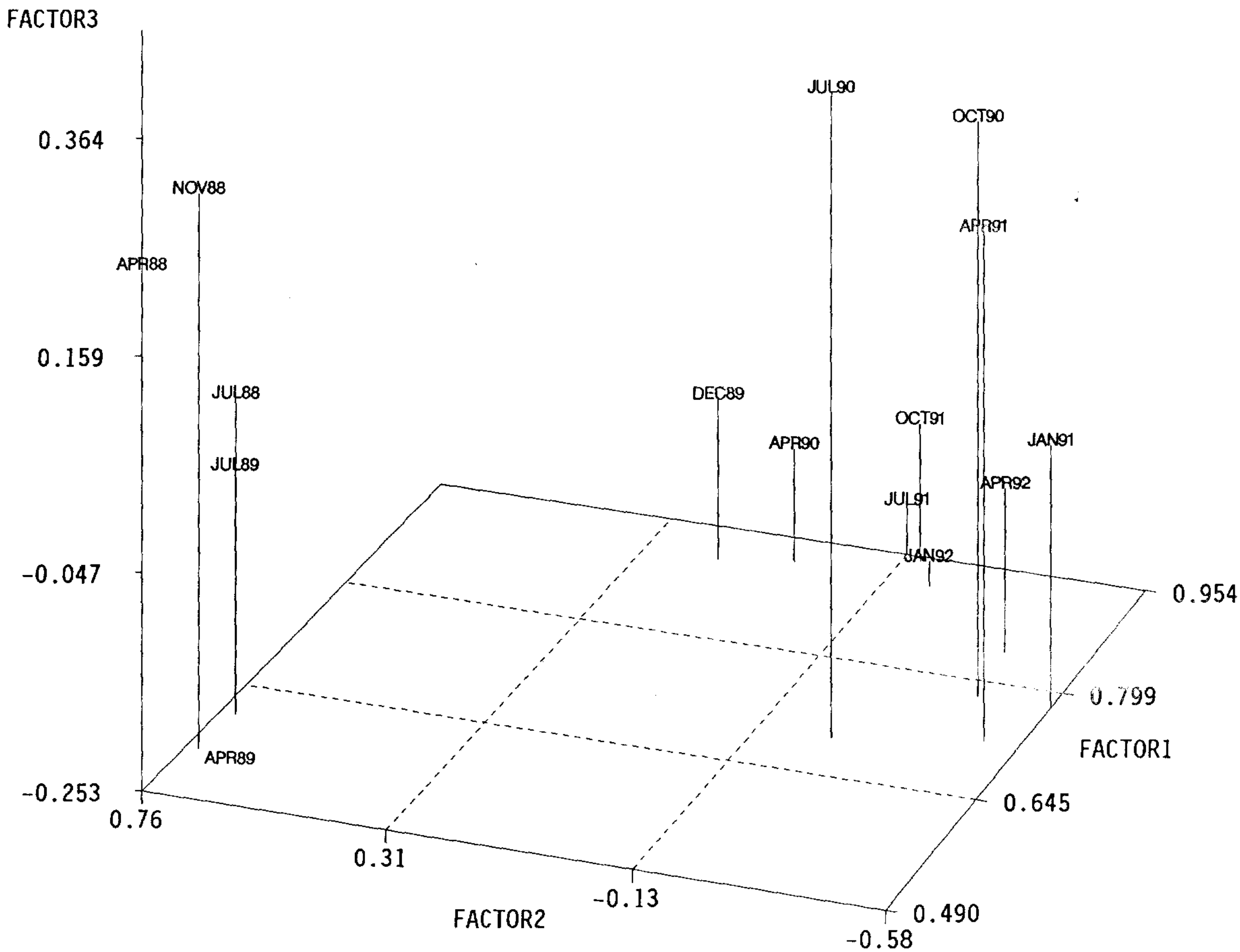

Figure 22. First three factors for macrofauna species at all sampling dates in the Lavaca-Colorado Estuary. Species occurring at all stations for a given date.

Lavaca Bay (Station A)

Macrofauna Abundance (n · m^{-2}) and Salinity (ppt)

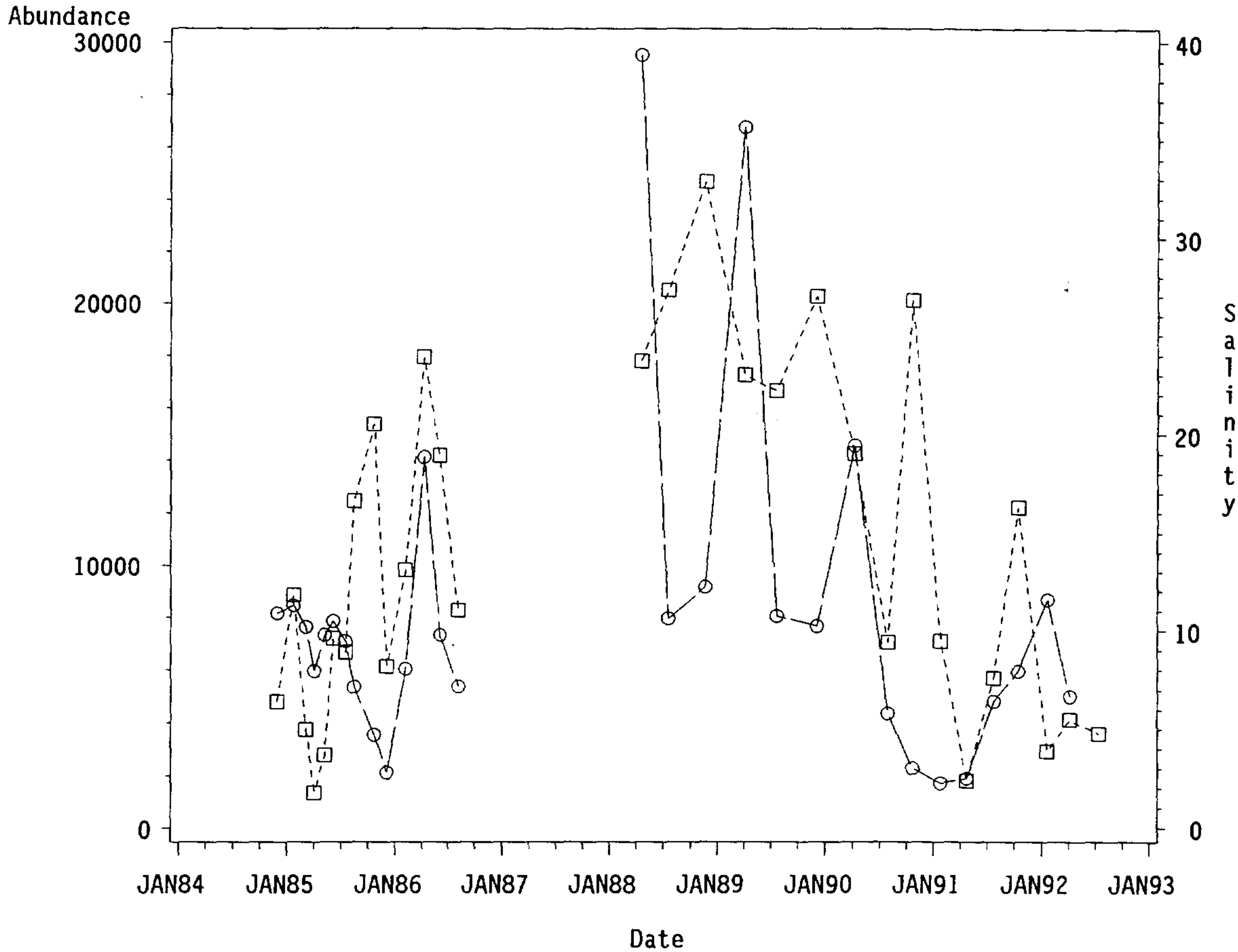

Figure 23. Relationships between macrofauna abundance and salinity in the Lavaca-Colorado Estuary, Station A. Average abundance (○) and salinity (□), $n=3$.

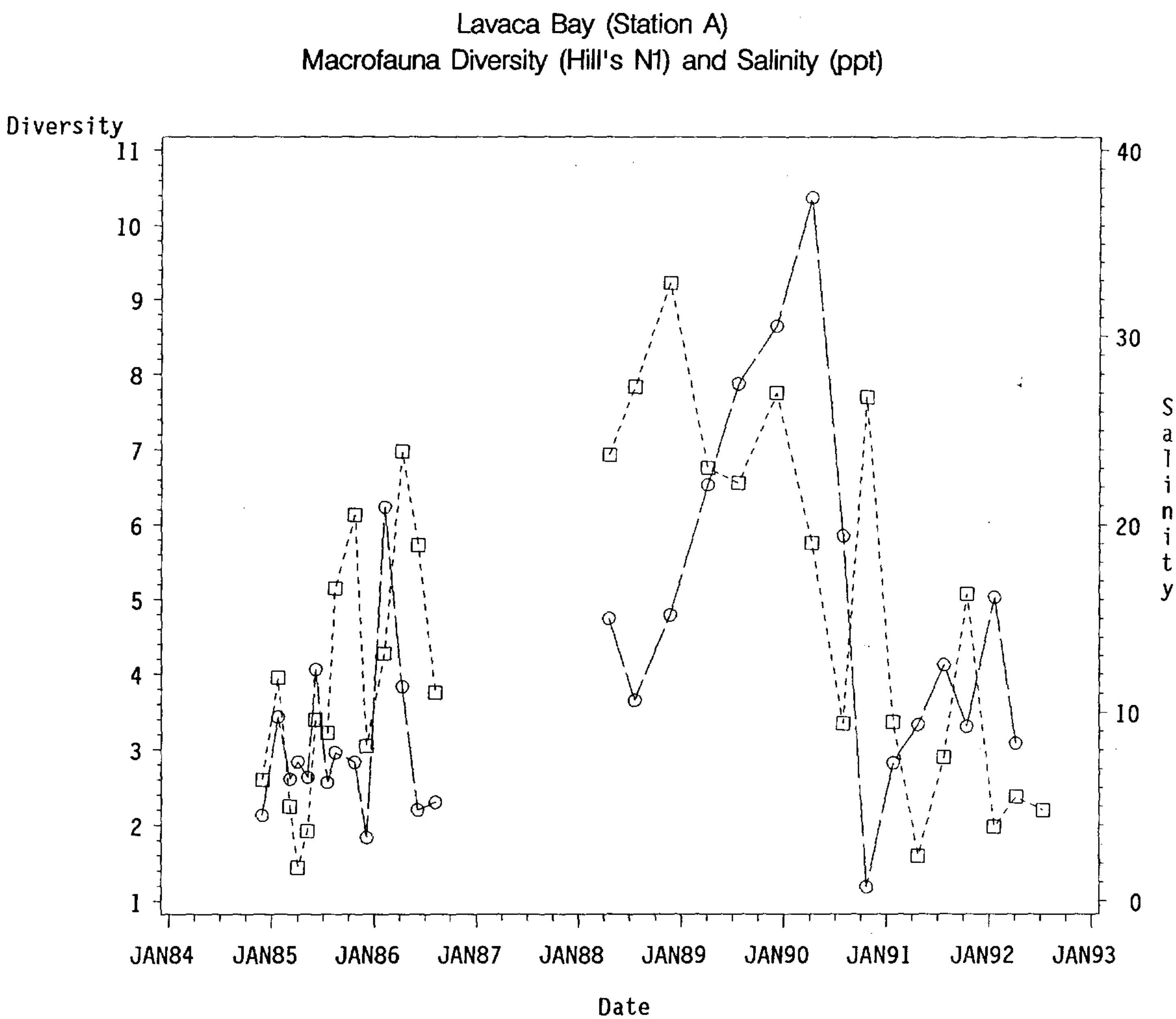

Figure 24. Relationships between macrofauna diversity and salinity in the Lavaca-Colorado Estuary, Station A. Average diversity (○) and salinity (□), $n=3$.

DISCUSSION

The Lavaca-Colorado and Guadalupe Estuaries are similar in the amount of freshwater inflow (Figure 2), but different in two key attributes. The Lavaca-Colorado Estuary (910 km^2 at mean tide) is almost twice as large as the Guadalupe Estuary (579 km^2 at mean tide). The Lavaca-Colorado also has direct exchange of marine water with the Gulf of Mexico via Pass Cavallo and the Matagorda Ship Channel (Figure 3). Because it is smaller and has restricted exchange, the Guadalupe generally has lower salinities (average 12 ppt from 1987-1992) than the Lavaca-Colorado (average 23 ppt from 1988-1992). This indicates that freshwater inflow has a greater effect on the upper part of San Antonio Bay than on Lavaca Bay. This conclusion is supported by several pieces of data. The salinity time series show that at any given time the salinities are lower in the Guadalupe, both estuarine-wide, and particularly at stations A and B in both estuaries (Figures 4 and 14). The amount of total carbon in sediments is much greater in the Guadalupe than in the Lavaca-Colorado (Montagna, 1991). Carbon content of Lavaca-Colorado sediments and Guadalupe-station D sediments are about 1%, but carbon content in the Guadalupe at station C is 3%, and at stations A and B around 4%. The carbon data indicate that organic matter is being trapped or not exported from the Guadalupe Estuary. Profiles of nitrogen content exhibit the same trends found in carbon, but there is less difference in total nitrogen content between the estuaries, both being about 0.05% (Montagna, 1991). Sediment texture is similar in both estuaries (Figures 5 and 15). Both are characterized by silt-clay sediments, with increasing grain sizes from the upper to the lower parts of the estuaries. Differences in physiography between the two estuaries mitigate the similarities of inflow.

Macrofauna abundance is generally larger in the Guadalupe Estuary than in the Lavaca-Colorado Estuary (Figures 7 and 16), but macrofauna biomass is generally larger in the Lavaca-Colorado Estuary (Figures 8 and 17). The average abundance in the Lavaca-Colorado among all times and stations was 15,576 individuals$\cdot m^{-2}$, and the average biomass was 7.79 $g \cdot m^{-2}$. The average abundance in the Guadalupe among all times and stations was 26,990 individuals$\cdot m^{-2}$, and the average biomass was 5.56 $g \cdot m^{-2}$. The differences between the estuaries is due to a greater abundance of ophiuroids, which are rare and large, in the marine stations of the Lavaca-Colorado Estuary (Tables 5 and 8). Diversity is generally greater in the Lavaca-Colorado Estuary (average N1=58 species) than in the Guadalupe Estuary (average N1=42 species) (Figures 11 and 20). These results indicate that since the effect of freshwater inflow is less diluted by marine water in the Guadalupe Estuary, we find higher benthic productivity. The greater Gulf exchange in the Lavaca-Colorado leads to more oceanic species present in the that estuary, so we find higher diversity.

The time series data show that there are large year-to-year fluctuations in both estuaries for both freshwater inflow (as indicated by salinity changes in Figures 4 and 14) and benthic community response (Figures 9, 10, 11, 18, 19, and 20). The key to understanding the biological response to freshwater inflow is to not try and relate biological changes to inflow changes with simples linear models, e.g., regression or correlation. The proper model is a time series model.

Sine waves that are lag-synchronized could more likely be the true response of estuarine organisms to the inter-annual changes in inflow. We have a continuous cycle of drought and flood conditions. The flood cycles are coincident with El Nino events in the western Pacific Ocean. So, climatic cycles in Texas are apparently caused by global changes. These cycles regulate freshwater inflow, and thus, directly affect the biological communities. The variability in the freshwater inflow cycle results in predictable changes in the estuary, which are diagrammed in a conceptual model of the temporal sequence of the hydrological cycle (Figure 25).

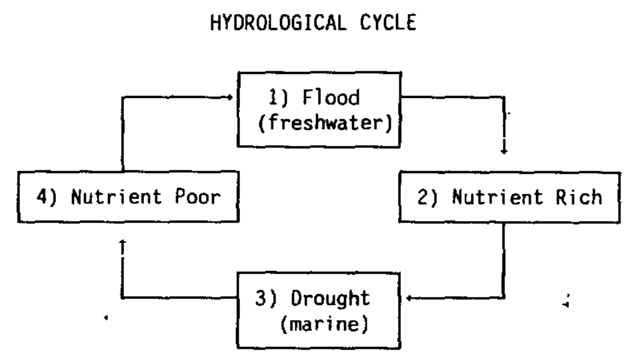

Figure 25. Conceptual model of the long-term effect of freshwater inflow on benthos.

Our study of the Guadalupe Estuary demonstrates the biological effects of this cycle. Flood conditions introduce nutrient rich waters into the estuary which result in lower salinity. This happened in the spring of 1987. During these periods the spatial extent of the freshwater fauna is increased, and the estuarine fauna replaced the marine fauna in the lower end of the estuary. The high level of nutrients stimulated a burst of benthic productivity (of predominantly freshwater and estuarine organisms) in the spring and summer of 1988 (Figures 9 and 10). This was followed by a transition to a drought period with low inflow resulting in higher salinities, lower nutrients, marine fauna, decreased productivity and abundances. At first, the marine fauna responded with a burst of productivity as the remaining nutrients are utilized, but eventually nutrients are depleted resulting in lower densities from 1989 to 1990. There was a rain event in the spring of 1991, with flooding and high freshwater inflows. However, the flood was not nearly as great as the one in 1987. Yet, the biological response in terms of biomass in the summer of 1991 was even larger. The response of abundance was small and hardly noticeable. However, continuous heavy rainfall from winter through spring and into early summer did not reoccur until 1991. This cycle, similar to the 1987 cycle, repeated in the winter 1991 to the spring of 1992, with flooding and high freshwater inflows. Coincidently, El Nino's occurred in both of these periods. We have currently gone through one complete cycle, a wet period in 1987 to a wet period in 1992. Optimally, we would follow this succession for at least one more cycle, probably four more years, to be sure that the response was not by chance alone.

Macrofauna responded to annual variation in freshwater inflow in a similar fashion in the Lavaca-Colorado Estuary. Abundances and biomass were high in the spring of 1988, one year after the flood of 1987 (Figures 16 and 17). Both declined with increasing salinities in the last half of 1988. Abundances have remained relatively constant since 1989. Biomass rose again with lower salinities in the Spring of 1989, and decreased steadily through the drought of 1989-1990. Spring runoff in both 1990 and 1991 resulted in increased biomass. Salinities during 1987 are unknown, so the spring of 1991 is the lowest recorded salinity in this record.

A longer record is available for station A in Lavaca Bay of the Lavaca-Colorado Estuary (Figures 23 and 24). These data illustrate that the long-term trend is more obvious, and that records of eight years duration are much more revealing than records of only three years. There was a wet period in spring of 1985 that was of the same magnitude as the spring of 1991. We do not have two cycles of prolonged wet periods such as the spring of 1992. Prior to 1986-87, there was an El Nino in 1982-83. We might have caught the tail end of that event in the spring of 1984. Abundances were low during both wet periods, and increased in 1986 following the first wet period. The period in early 1988, following the flood of 1987, had the highest abundances. 1989 through 1990 was generally dry with high salinities. Ignoring seasonal changes, abundances generally decreased during this drought period to the lowest recorded. As predicted in last years report (Montagna, 1991; p. 41) there were increased densities in the spring of 1992. The large flood of 1992 should result in densities increasing to the $20{,}000 \cdot m^{-2}$ range during 1993. Time series analysis requires at least three cycles to have occurred. When we have enough data, we can fit the data to time series models.

CONCLUSION

The main difference between these two estuaries relate to both size and Gulf exchange. Freshwater inflow has a larger impact on the smaller-restricted Guadalupe Estuary than in the Lavaca-Colorado. Both the smaller size and restricted inflow have synergistic effects, thus the Guadalupe is generally fresher and has higher carbon content than the Lavaca-Colorado. These conditions lead to higher benthic productivity in the Guadalupe Estuary. On the other hand, higher salinities and invasion of marine species is responsible for a more diverse community in Lavaca-Colorado Estuary. There is long-term, year-to-year variability in inflow that drives benthic community succession, and results in different levels of productivity from year-to-year. It is now apparent that the long-term changes may be related to global climate cycles, e.g., El Nino events in the western Pacific Ocean. By October 1993, we will have sample one complete cycle from beginning to end to beginning.

ACKNOWLEDGEMENTS

This study builds on a data base which originated in other Texas Water Development Board funded studies. Specifically, TWDB contract nos. 8-483-607, 9-483-705, and 9-483-706. The purpose of the studies was to determine the effects of freshwater inflow on benthic biological responses. I especially thank Mr. Richard D. Kalke for all his help and technical support during all phases of this work.

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Table 1. Guadalupe Estuary hydrographic measurements. Abbreviations: STA=Station, Z=Depth, SAL(R)=Salinity by refractometer, SAL(M)=Salinty by meter, COND=Conductivity, TEMP=Temperature, DO=dissolved oxygen, and ORP=oxidation redox potential. Missing values show with a period.

Date	STA	Z (m)	SAL(R) (ppt)	SAL(M) (ppt)	COND (uS/cm)	TEMP (°C)	pH	DO (mg•l⁻¹)	ORP (mV)
28JAN87	A	1.25	.	0.3	.	14.40	.	.	.
28JAN87	B	1.80	.	0.4	.	14.80	.	.	.
30JAN87	C	2.00	.	6.5	.	15.50	.	.	.
30JAN87	D	1.50	.	4.1	.	15.80	.	.	.
03MAR87	A	1.25	.	0.2	.	15.00	.	.	.
03MAR87	B	1.80	.	0.4	.	16.00	.	.	.
03MAR87	C	2.00	.	6.9	.	16.00	.	.	.
03MAR87	D	1.50	.	12.5	.	17.50	.	.	.
08APR87	A	1.25	.	0.5	.	14.50	.	.	.
08APR87	B	1.80	.	6.3	.	15.20	.	.	.
10APR87	C	2.00	.	9.2	.	14.50	.	.	.
10APR87	D	1.50	.	13.2	.	14.90	.	.	.
03JUN87	A	0.00	.	0.5	1.50	26.70	.	9.40	.
03JUN87	A	1.25	.	1.0	1.50	26.20	.	9.40	.
03JUN87	B	0.00	.	4.3	7.70	26.00	7.90	.	.
03JUN87	B	1.80	.	4.6	.	26.70	.	.	.
03JUN87	C	0.00	.	3.4	6.30	26.50	.	.	.
03JUN87	C	2.00	.	4.3	6.60	26.20	.	.	.
03JUN87	D	0.00	.	7.6	13.00	25.90	.	9.40	.
03JUN87	D	1.50	.	9.9	13.00	26.40	.	9.20	.
15JUL87	A	1.25	.	0.4	.	30.50	.	.	.
15JUL87	B	1.80	.	0.4	.	30.00	.	.	.
15JUL87	C	2.00	.	1.1	.	30.50	.	.	.
15JUL87	D	1.50	.	0.9	.	30.50	.	.	.
18APR88	A	0.00	9	9.6	15.60	22.30	.	7.70	.
18APR88	A	1.25	.	9.2	16.20	21.90	.	.	.
18APR88	B	0.00	14	20.5	22.60	22.20	.	7.50	.
18APR88	B	1.75	.	13.7	32.70	22.00	.	.	.
18APR88	C	0.00	25	23.6	37.10	22.00	7.90	7.30	.
18APR88	C	2.00	.	23.6	37.10	22.10	.	22.10	.
18APR88	D	0.00	24	26.7	38.40	22.70	.	7.50	.
18APR88	D	1.60	.	24.5	41.50	22.10	.	7.10	.
07JUL88	A	0.00	10	10.0	.	28.40	.	.	.
07JUL88	A	1.25	10	10.0	.	28.40	.	.	.
07JUL88	B	0.00	21	21.0	.	29.30	.	.	.
07JUL88	B	1.80	21	21.0	.	29.30	.	.	.
08JUL88	C	0.00	26	26.0	.	28.90	.	.	.

08JUL88	C	2.00	26	26.0	.	28.90	.	.	.
08JUL88	D	0.00	32	32.0	.	28.90	.	.	.
08JUL88	D	1.50	32	32.0	.	28.90	.	.	.
06OCT88	A	0.00	15	15.0	.	24.00	.	.	.
06OCT88	B	0.00	22	22.0	.	24.00	.	.	.
06OCT88	C	0.00	29	29.0	.	24.00	.	.	.
22NOV88	A	0.00	.	18.5	25.60	16.10	.	10.30	.
22NOV88	A	1.25	.	15.7	29.70	15.50	.	10.10	.
22NOV88	B	0.00	.	24.9	38.00	16.50	.	9.60	.
22NOV88	B	1.75	.	24.2	39.00	15.40	.	8.20	.
22NOV88	C	0.00	.	30.2	42.80	17.00	.	9.80	.
22NOV88	C	1.78	.	27.6	46.40	16.00	.	9.20	.
22NOV88	D	0.00	.	30.7	43.30	15.70	.	9.90	.
22NOV88	D	1.50	.	28.0	47.00	15.90	.	12.30	.
04APR89	A	1.25	.	15.0	.	24.00	.	.	.
04APR89	B	1.80	.	18.0	.	23.70	.	.	.
04APR89	C	2.00	.	24.0	.	22.00	.	.	.
04APR89	D	1.50	.	24.0	.	23.90	.	.	.
23JUL89	A	1.25	.	15.9	.	31.50	.	.	.
23JUL89	B	1.80	.	19.4	.	31.50	.	.	.
23JUL89	C	2.00	.	28.4	.	31.30	.	.	.
23JUL89	D	1.50	.	29.0	.	31.50	.	.	.
05DEC89	A	0.00	20	.	.	12.00	7.90	13.20	.
05DEC89	A	1.25	.	20.0	.	11.40	8.00	14.50	.
05DEC89	B	0.00	20	.	.	11.40	7.90	12.20	.
05DEC89	B	1.75	.	20.0	.	11.30	8.00	14.80	.
05DEC89	C	0.00	24	.	.	11.70	7.80	10.70	.
05DEC89	C	2.00	.	24.0	.	11.00	7.90	11.80	.
05DEC89	D	0.00	24	.	.	11.80	7.90	12.00	.
05DEC89	D	1.60	.	24.0	.	11.50	7.90	12.60	.
10APR90	C	0.00	24	24.6	37.30	21.18	8.20	8.28	.
10APR90	C	2.20	.	23.6	38.80	20.56	8.16	7.36	.
10APR90	D	0.00	26	25.9	40.50	21.16	8.23	7.65	.
10APR90	D	1.70	.	25.9	40.50	20.91	8.22	7.38	.
11APR90	A	0.00	7	6.9	12.47	19.14	8.02	8.80	.
11APR90	A	1.50	.	6.8	12.51	19.12	8.20	8.60	.
11APR90	B	0.00	20	21.1	33.80	19.50	8.12	8.00	.
11APR90	B	2.10	.	21.1	33.80	19.53	8.10	7.80	.
02AUG90	A	0.00	.	0.1	1.27	29.34	8.73	7.04	0.105
02AUG90	A	1.30	.	0.1	1.27	29.34	8.72	6.70	0.106
02AUG90	B	.	.	5.4	7.12	29.70	.	6.68	1.700
02AUG90	B	1.80	.	3.6	8.75	29.65	.	5.57	1.635
02AUG90	C	0.00	.	15.2	25.30	29.00	.	6.31	0.810
02AUG90	C	1.80	.	15.3	25.40	29.81	8.35	5.94	0.666
02AUG90	D	0.00	.	11.2	19.20	29.46	8.25	6.05	0.143
02AUG90	D	1.20	.	11.2	19.30	29.48	8.25	5.74	0.141
19OCT90	A	0.00	10	9.4	16.40	22.35	9.07	12.93	0.106

19OCT90	A	1.70	.	9.5	16.50	22.26	9.05	12.10	0.107
19OCT90	B	0.00	18	18.0	29.40	22.19	8.67	5.09	0.113
19OCT90	B	2.20	.	18.2	29.70	21.71	8.60	3.40	0.115
19OCT90	C	0.00	20	20.0	32.20	22.25	8.41	4.98	0.121
19OCT90	C	2.30	.	20.0	32.20	21.60	8.41	3.69	0.121
19OCT90	D	0.00	27	27.8	43.20	21.57	8.54	4.25	0.105
19OCT90	D	2.00	.	27.8	43.20	21.50	8.53	4.09	0.106
23JAN91	A	0.00	3	5.1	9.75	10.41	8.17	9.04	0.155
23JAN91	A	1.20	3	17.0	28.00	10.67	8.39	5.86	0.162
23JAN91	B	0.00	18	19.0	30.80	9.98	8.69	11.96	0.157
23JAN91	B	2.00	18	19.2	31.40	10.29	8.58	8.24	0.160
23JAN91	C	0.00	21	22.4	35.60	10.01	8.47	10.40	0.173
23JAN91	C	1.90	21	22.4	35.70	10.01	8.47	10.25	0.173
23JAN91	D	0.00	24	22.3	35.40	10.34	8.37	9.45	0.208
23JAN91	D	1.50	24	22.4	35.60	10.31	8.37	9.40	0.207
25JAN91	B	0.00	9	8.9	16.00	12.38	8.87	15.29	0.138
25JAN91	B	1.80	9	18.3	30.10	11.12	8.52	9.40	0.152
22APR91	A	0.00	0	0.0	0.50	25.26	8.13	7.65	0.137
22APR91	A	1.20	0	0.0	0.51	25.17	8.08	7.35	0.141
22APR91	B	0.00	2	0.6	2.10	24.74	8.18	8.27	0.140
22APR91	B	1.70	2	3.6	7.29	24.19	8.04	6.49	0.150
22APR91	C	0.00	6	6.7	12.30	24.38	8.23	8.90	0.150
22APR91	C	1.80	6	6.8	12.79	24.28	8.18	7.34	0.151
22APR91	D	0.00	7	7.1	12.89	24.51	8.19	8.50	0.148
22APR91	D	1.50	7	7.2	13.31	24.74	8.19	7.90	0.148
17JUL91	A	0.00	0	0.0	0.73	29.98	8.39	7.41	0.131
17JUL91	A	1.20	0	0.0	0.74	29.98	8.44	7.25	0.131
17JUL91	B	0.00	4	4.2	8.20	30.04	8.23	5.75	0.140
17JUL91	B	1.70	4	4.2	8.24	30.07	8.22	5.44	0.142
17JUL91	C	0.00	10	9.3	16.20	30.92	8.49	7.55	0.126
17JUL91	C	1.90	10	12.0	20.70	30.92	8.53	5.96	0.128
17JUL91	D	0.00	7	7.1	12.92	30.65	8.44	6.70	0.120
17JUL91	D	1.50	7	7.4	13.47	30.46	8.46	5.91	0.121
15OCT91	A	0.00	8	7.1	12.31	24.98	8.76	11.30	0.100
15OCT91	A	1.40	.	12.0	20.00	25.21	8.51	6.30	0.111
15OCT91	B	0.00	16	16.0	26.00	24.82	8.32	8.10	0.057
15OCT91	B	1.90	.	16.0	26.00	24.78	8.26	7.30	0.060
15OCT91	C	0.00	24	24.0	37.70	24.83	8.17	7.40	0.118
15OCT91	C	2.00	.	24.0	37.70	24.82	8.17	7.30	0.116
15OCT91	D	0.00	23	23.0	36.30	24.52	8.16	6.80	0.136
15OCT91	D	1.80	.	24.2	37.70	24.75	8.14	6.30	0.138
20JAN92	A	0.00	0	0.0	0.75	10.86	8.49	9.76	0.135
20JAN92	A	1.30	0	0.0	0.75	10.59	8.52	9.56	0.135
20JAN92	B	0.00	0	0.0	0.82	9.25	8.75	10.24	0.121
20JAN92	B	1.70	0	0.0	0.84	8.40	9.07	10.05	0.117
20JAN92	C	0.00	0	0.2	1.33	9.26	8.74	10.16	0.127
20JAN92	C	1.90	0	0.2	1.31	8.55	9.02	9.86	0.122

20JAN92	D	0.00	0	0.7	2.34	10.05	8.64	10.43	0.134
20JAN92	D	1.50	0	2.4	5.21	8.70	8.59	9.81	0.142
06APR92	A	0.00	0	0.0	0.67	21.20	8.50	7.61	0.114
06APR92	A	1.20	0	0.0	0.68	21.19	8.44	7.55	0.115
06APR92	B	0.00	0	0.0	0.72	19.67	9.62	9.75	0.068
06APR92	B	1.70	0	0.0	0.74	19.29	9.49	8.82	0.067
06APR92	C	0.00	1	0.0	1.07	19.44	9.39	9.88	0.062
06APR92	C	1.90	1	0.0	1.08	19.33	9.87	9.66	0.051
06APR92	D	0.00	1	0.4	1.69	21.00	9.28	10.45	0.069
06APR92	D	1.60	1	0.4	1.67	18.08	10.0	8.88	0.056
12JUL92	A	0.00	1	0.0	0.93	30.12	8.56	8.14	0.215
12JUL92	A	0.90	1	0.0	0.93	30.09	8.62	8.01	0.219
12JUL92	B	0.00	2	0.0	1.11	29.32	8.74	8.21	0.205
12JUL92	B	1.50	2	0.0	1.11	29.75	8.79	7.76	0.209
12JUL92	C	0.00	6	4.5	8.76	30.03	8.46	7.96	0.217
12JUL92	C	1.60	6	4.7	9.48	29.65	8.50	7.07	0.223
12JUL92	D	0.00	2	0.6	2.15	29.67	8.79	8.42	0.203
12JUL92	D	1.30	2	0.6	2.15	29.60	8.83	8.11	0.208

Table 2. Sediment grain size in the Guadalupe Estuary. Mean of *n* replicates.

Date	Station	Depth (cm)	*n*	Rubble (%)	Sand (%)	Silt (%)	Clay (%)
03JUN87	A	1	1	4.6	13.2	42.6	39.5
03JUN87	A	2	1	13.9	40.8	27.9	17.4
03JUN87	A	3	1	10.4	36.6	27.7	25.4
03JUN87	A	10	1	16.7	24.6	30.7	28.1
03JUN87	B	1	1	13.0	7.1	31.6	48.3
03JUN87	B	2	1	19.0	8.9	28.0	44.1
03JUN87	B	3	1	8.8	4.2	31.5	55.5
03JUN87	B	10	1	4.8	2.3	30.5	62.4
03JUN87	C	1	1	1.5	12.8	30.6	55.2
03JUN87	C	2	1	4.9	33.9	31.7	29.4
03JUN87	C	3	1	3.7	36.4	29.5	30.4
03JUN87	C	10	1	2.3	19.0	30.0	48.8
03JUN87	D	1	1	3.3	52.5	26.2	18.0
03JUN87	D	2	1	6.8	65.5	12.9	14.7
03JUN87	D	3	1	6.4	77.7	7.6	8.3
03JUN87	D	10	1	4.4	78.0	8.6	9.0
15JUL87	A	1	1	7.2	25.6	43.6	23.6
15JUL87	A	2	1	5.6	20.6	43.2	30.6
15JUL87	A	3	1	7.2	31.5	32.4	29.0
15JUL87	A	10	1	13.0	26.6	27.8	32.6
15JUL87	B	1	1	3.3	1.0	34.0	61.7
15JUL87	B	2	1	3.6	2.7	33.7	60.1
15JUL87	B	3	1	12.7	5.5	33.1	48.7
15JUL87	B	10	1	5.4	4.1	34.0	56.5
15JUL87	C	1	1	0.7	6.7	41.1	51.6
15JUL87	C	2	1	1.8	9.6	39.5	49.0
15JUL87	C	3	1	3.1	27.9	40.1	29.0
15JUL87	C	10	1	3.2	23.8	38.2	34.8
17JUL87	D	1	1	0.5	22.3	41.7	35.5
17JUL87	D	2	1	0.3	8.9	38.8	51.9
17JUL87	D	3	1	0.3	12.8	33.5	53.5
17JUL87	D	10	1	0.4	18.4	32.9	48.3
18APR88	A	3	3	4.8	20.7	41.9	32.6
18APR88	A	10	3	10.5	30.4	29.3	29.8
18APR88	B	3	3	5.0	4.8	36.3	53.9
18APR88	B	10	3	2.9	2.1	37.6	57.4
18APR88	C	3	3	5.7	39.2	28.9	26.2
18APR88	C	10	3	3.1	16.1	32.4	48.4
18APR88	D	3	3	1.0	46.8	26.2	26.0
18APR88	D	10	3	0.8	38.4	23.5	37.3
07JUL88	A	3	3	6.5	8.8	56.3	28.4

07JUL88	A	10	3	5.9	10.0	40.9	43.2
07JUL88	B	3	3	24.2	6.0	40.8	29.0
07JUL88	B	10	3	12.5	4.2	55.9	27.4
08JUL88	C	3	3	7.2	41.2	30.5	21.1
08JUL88	C	10	3	16.3	30.2	36.2	17.4
08JUL88	D	3	3	9.6	52.7	23.7	14.0
08JUL88	D	10	3	10.1	11.8	33.2	45.0
19OCT90	A	3	1	2.6	34.1	34.3	29.0
19OCT90	A	10	1	14.8	33.1	24.5	27.6
19OCT90	B	3	1	11.3	5.3	29.0	54.4
19OCT90	B	10	1	6.0	6.3	34.0	53.7
19OCT90	C	3	1	12.0	37.3	27.2	23.4
19OCT90	C	10	1	3.1	27.5	26.8	42.7
19OCT90	D	3	1	1.0	87.2	6.4	5.4
19OCT90	D	10	1	3.8	81.4	5.8	9.0
15OCT91	A	3	1	0.7	23.6	51.8	23.9
15OCT91	A	10	1	6.2	32.8	33.1	27.8
15OCT91	B	3	1	1.2	1.9	21.3	75.6
15OCT91	B	10	1	17.9	6.3	24.1	51.7
15OCT91	C	3	1	3.4	45.7	22.2	28.7
15OCT91	C	10	1	1.7	45.4	18.4	34.5
15OCT91	D	3	1	0.6	78.5	6.4	14.5
15OCT91	D	10	1	1.1	79.2	5.4	14.3

Table 3. Guadalupe Estuary macrofauna abundance and biomass. Average abundance ($n \cdot m^{-2}$) and biomass ($g \cdot m^{-2}$) for three replicates to a depth of 10 cm.

Date	Station	Abundance	STD	Biomass	STD
28JAN87	A	13898	5580	2.024	0.703
04MAR87	A	38953	5604	10.154	9.162
08APR87	A	58805	43356	3.855	2.498
03JUN87	A	57949	27889	9.339	4.262
15JUL87	A	36495	6249	10.656	1.761
18APR88	A	84241	14393	12.985	2.692
07JUL88	A	69198	6806	17.751	1.373
22NOV88	A	23542	4403	11.243	2.398
04APR89	A	101827	7023	8.880	1.004
23JUL89	A	26186	5240	4.781	1.148
05DEC89	A	41317	7618	10.283	1.541
11APR90	A	21651	3226	8.333	2.516
02AUG90	A	44248	2948	5.738	2.177
19OCT90	A	16357	3124	3.174	0.594
23JAN91	A	26000	4523	30.276	47.281
22APR91	A	51528	4800	2.032	0.143
17JUL91	A	29309	12781	4.906	2.635
15OCT91	A	35171	5199	5.246	0.807
20JAN92	A	19571	2521	2.642	1.581
06APR92	A	17491	12384	2.390	0.732
28JAN87	B	22124	5587	3.035	1.357
04MAR87	B	19004	6487	4.806	1.432
08APR87	B	20325	433	4.667	1.947
03JUN87	B	21554	8583	7.756	0.870
15JUL87	B	11535	6654	3.528	0.704
18APR88	B	169144	20768	15.364	4.243
07JUL88	B	55491	10673	14.040	2.556
22NOV88	B	34320	6542	23.485	1.591
04APR89	B	63630	5369	6.242	1.606
23JUL89	B	40649	3311	6.068	1.729
05DEC89	B	29877	1931	6.661	4.988
11APR90	B	23731	2129	5.328	0.796
02AUG90	B	25149	2681	4.331	0.490
19OCT90	B	14844	1662	1.937	0.959
23JAN91	B	8698	1562	2.470	1.715
22APR91	B	5011	714	1.440	1.613
17JUL91	B	11818	1889	1.999	0.559
15OCT91	B	76016	7159	7.268	0.701
20JAN92	B	36495	11778	3.371	1.264
06APR92	B	28175	5084	2.718	0.648
30JAN87	C	8603	327	1.826	1.917

04MAR87	C	10589	590	2.835	0.772
10APR87	C	11629	1986	5.021	3.047
03JUN87	C	6428	3287	4.185	3.255
15JUL87	C	8698	2979	2.073	1.513
18APR88	C	75259	12918	6.082	0.611
08JUL88	C	18056	2855	1.386	0.513
22NOV88	C	10873	1662	0.688	0.152
04APR89	C	18531	3188	2.260	1.415
23JUL89	C	15031	2878	1.976	0.976
05DEC89	C	5578	1428	1.767	0.870
10APR90	C	5389	2141	2.825	2.553
02AUG90	C	8793	5434	2.218	0.943
19OCT90	C	23542	3439	2.263	0.442
23JAN91	C	14655	4541	5.826	0.959
22APR91	C	8415	2798	5.727	1.320
17JUL91	C	14087	3324	1.692	1.061
15OCT91	C	24960	0	2.007	1.066
20JAN92	C	11913	2600	1.086	0.944
06APR92	C	3971	1985	0.105	0.055
30JAN87	D	6428	590	1.386	0.874
04MAR87	D	10495	2215	3.685	0.751
10APR87	D	9264	3523	4.190	1.527
03JUN87	D	7846	433	6.767	4.867
15JUL87	D	3876	912	1.626	1.321
18APR88	D	37155	3070	1.933	0.313
08JUL88	D	11344	2599	0.751	0.350
22NOV88	D	8698	434	1.088	0.148
04APR89	D	25337	9652	8.259	4.467
23JUL89	D	13046	1965	20.909	13.294
05DEC89	D	15884	9952	5.249	1.672
10APR90	D	14182	1985	6.897	1.199
02AUG90	D	10778	2521	2.811	2.228
19OCT90	D	15789	6019	1.350	0.433
23JAN91	D	71572	21347	14.373	4.777
22APR91	D	17869	3271	5.284	1.520
17JUL91	D	17302	7520	5.731	5.110
15OCT91	D	15127	4620	2.909	2.138
20JAN92	D	6807	1236	2.279	2.512
06APR92	D	4066	1074	0.494	0.641

Table 4. Guadalupe Estuary species list. Average density ($n \cdot m^{-2}$) over entire study period.

Taxa	A	B	C	D
Cnidaria				
Anthozoa				
Anthozoa (unidentified)	5	0	24	5
Platyhelminthes				
Turbellaria				
Turbellaria (unidentified)	14	5	128	24
Rynchocoela				
Rhynchocoel (unidentified)	383	463	383	227
Phoronida				
Phoronis architecta	0	0	203	66
Mollusca				
Gastropoda				
Gastropoda (unidentified)	624	0	0	14
Vitrinellidae				
Vitrinellidae (unidentified)	0	0	0	14
Caecidae				
Caecum pulchellum	0	5	0	5
Caecum johnsoni	0	0	5	5
Nassariidae				
Nassarius acutus	0	0	9	0
Pyramidellidae				
Odostomia sp.	0	0	5	0
Turbonilla sp.	0	0	9	33
Pyramidella crenulata	9	5	14	14
Pyramidella sp.	28	5	0	19
Retusidae				
Acteocina canaliculata	9	38	19	71
Crepidulidae				
Crepidula fornicata	0	0	5	0
Hydrobiidae				
Littoridina sphinctostoma	14742	4311	1002	213
Pelecypoda				
Pelecypoda (unidentified)	0	0	9	33
Nuculanidae				
Nuculana acuta	0	0	0	9
Nuculana concentrica	0	0	0	5
Mytilidae				
Brachidontes exustus	0	33	0	0
Cultellidae				
Ensis minor	0	5	5	47

Leptonidae				
Mysella planulata	0	0	0	161
Tellinidae				
Macoma tenta	0	0	0	5
Tellina sp	0	5	0	5
Macoma mitchelli	194	312	137	255
Veneridae				
Mercenaria campechiensis	0	0	5	5
Lyonsiidae				
Lyonsia hyalina floridana	0	0	5	0
Pandoridae				
Pandora trilineata	0	0	0	5
Sportellidae				
Aligena texasiana	0	0	5	61
Mactridae				
Mulinia lateralis	2628	3370	1101	614
Periploma cf. *orbiculare*	0	0	0	47
Rangia cuneata	33	14	0	0
Periplomatidae				
Periploma margaritaceum	0	0	5	0
Solecurtidae				
Tagelus plebeius	0	0	19	19
Annelida				
Polychaeta				
Sigalionidae				
Sigalionidae (unidentified)	0	0	0	5
Palmyridae (=Chrysopetalidae)				
Paleanotus heteroseta	0	0	0	9
Phyllodocidae				
Eteone heteropoda	0	52	5	9
Anaitides erythrophyllus	0	0	9	0
Pilargiidae				
Parandalia ocularis	52	0	9	24
Hesionidae				
Gyptis vittata	9	5	43	43
Podarke obscura	0	0	5	0
Hesionidae (unidentified)	0	0	0	5
Syllidae				
Sphaerosyllis cf. *sublaevis*	0	0	0	5
Exogone sp.	0	0	0	9
Nereidae				
Nereis succinea	0	0	9	61
Nereidae (unidentified)	0	0	14	19
Glyceridae				
Glycera americana	0	0	0	38
Glycera capitata	0	0	0	5
Goniadidae				

Glycinde solitaria	5	28	199	217
Onuphidae				
Diopatra cuprea	0	5	33	52
Arabellidae				
Drilonereis magna	0	0	5	0
Dorvilleidae				
Schistomeringos rudolphi	0	0	0	5
Spionidae				
Polydora ligni	0	0	0	24
Minuspio cirrifera	0	0	0	5
Paraprionospio pinnata	0	14	104	80
Scolelepis texana	0	5	38	33
Polydora websteri	24	0	0	24
Polydora socialis	0	5	47	14
Streblospio benedicti	11774	15494	2174	2458
Polydora caulleryi	0	0	9	1158
Polydora sp.	33	0	0	5
Scolelepis squamata	5	0	38	14
Spionidae (unidentified)	0	5	0	0
Chaetopteridae				
Spiochaetopterus costarum	0	0	151	1702
Cirratulidae				
Tharyx setigera	0	0	0	5
Cossuridae				
Cossura delta	0	0	99	104
Orbiniidae				
Haploscoloplos foliosus	109	326	265	123
Haploscoloplos fragilis	0	0	0	9
Capitellidae				
Capitella capitata	402	128	33	43
Mediomastus californiensis	3507	5006	4717	3739
Notomastus latericeus	0	0	0	5
Heteromastus filiformis	24	0	0	0
Mediomastus ambiseta	4694	5507	3252	3068
Capitellidae (unidentified)	0	0	0	14
Maldanidae				
Clymenella torquata	0	0	9	76
Asychis sp.	0	0	9	57
Clymenella mucosa	0	0	19	66
Maldanidae (unidentified)	0	0	28	52
Pectinariidae				
Pectinaria gouldii	0	5	5	5
Ampharetidae				
Isolda pulchella	0	0	0	5
Melinna maculata	0	5	19	24
Hobsonia florida	652	71	0	0
Terebellidae				

Pista palmata	0	5	95	9
Terebellidae (unidentified)	0	0	0	5
Sabellidae				
Megalomma bioculatum	0	19	14	19
Sabellidae (unidentified)	0	9	0	0
Serpulidae				
Eupomatus dianthus	0	0	0	5
Serpulidae (unidentified)	0	0	0	14
Polychaete juv. (unidentified)	0	5	5	0
Oligochaeta				
Oligochaeta (unidentified)	199	255	19	0
Crustacea				
Copepoda				
Calanoida				
Diaptomidae				
Pseudodiaptomus coronatus	5	5	24	5
Cyclopoida				
Cyclopidae				
Hemicyclops sp.	0	0	0	14
Cirripedia				
Balanus eburneus	14	9	0	0
Malacostraca				
Reptantia				
Callianassidae				
Callianassa sp.	0	0	5	5
Pinnotheridae				
Pinnixa sp.	0	0	0	5
Pinnixa chacei	0	0	0	5
Pinnotheridae (unidentified)	0	0	0	5
Brachyuran Larvae				
Megalops	5	5	0	0
Mysidacea				
Mysidopsis bahia	5	0	5	24
Bowmaniella sp.	5	0	0	0
Mysidopsis sp.	24	5	0	9
Mysidopsis almyra	19	19	5	0
Cumacea				
Cyclaspis varians	24	52	142	260
Oxyurostylis sp.	0	0	9	5
Leucon sp.	0	0	38	0
Oxyurostylis salinoi	0	14	14	14
Oxyurostylis smithi	9	24	161	142
Amphipoda				
Ampeliscidae				
Ampelisca abdita	24	9	9	24
Gammaridae				

Gammarus mucronatus	5	0	14	0
Oedicerotidae				
Monoculodes sp.	227	151	132	38
Synchelidium americanum	0	0	0	24
Corophiidae				
Erichthonias brasiliensis	0	0	0	38
Corophium ascherusicum	0	9	0	5
Corophium louisianum	0	5	14	0
Microprotopus spp.	5	5	5	5
Bateidae				
Batea catharinensis	0	0	5	5
Liljeborgiidae				
Listriella barnardi	0	0	5	24
Stenothoidae				
Parametopella sp.	0	0	0	5
Caprellidae				
Caprellid	9	0	43	9
Melitidae				
Elasmopus sp.	0	0	5	0
Melita sp.	0	0	14	5
Isopoda				
Anthuridae				
Xenanthura brevitelson	0	0	0	5
Idoteidae				
Edotea montosa	14	9	9	0
Sphaeromatidae				
Cassidinidea lunifrons	0	5	0	0
Echinodermata				
Ophiuroidea				
Ophiuroidea(unidentified)	0	0	5	19
Insecta				
Insect larvae (unidentified)	5	0	0	0
Pterygota				
Diptera				
Chironomidae				
Chironomid larvae	128	28	9	5

Table 5. Diversity measures of the Guadalupe Estuary macrobenthos at each sampling date. Diveristy for entire estuary, including all samples taken at all stations.

Date	Richness		Diversity		Eveness	
	NO	R1	H'	N1	E1	E5
JAN87	101	15.9	3.91	50.0	0.848	0.672
MAR87	110	16.2	3.86	47.2	0.820	0.495
APR87	119	16.9	3.52	33.7	0.736	0.301
JUN87	81	11.6	2.90	18.1	0.659	0.404
JUL87	76	11.6	3.18	24.1	0.735	0.477
APR88	169	20.3	3.80	44.6	0.740	0.556
JUL88	106	14.2	3.88	48.4	0.832	0.795
NOV88	110	16.2	4.02	55.8	0.855	0.749
APR89	169	21.8	3.75	42.4	0.731	0.498
JUL89	151	21.7	4.03	56.0	0.802	0.571
DEC89	150	21.6	4.10	60.4	0.819	0.609
APR90	131	19.9	4.08	59.3	0.837	0.680
AUG90	107	15.5	3.62	37.5	0.775	0.615
OCT90	72	10.7	3.71	40.9	0.868	0.781
JAN91	135	18.7	3.94	51.2	0.802	0.628
APR91	108	15.8	3.47	32.2	0.742	0.507
JUL91	89	13.2	3.66	38.9	0.816	0.524
OCT91	102	13.7	3.58	35.9	0.774	0.686
JAN92	77	11.4	3.56	35.1	0.819	0.698
APR92	57	8.8	3.15	23.3	0.779	0.674

Table 6. Species abundance at each station×date combination in the Guadalupe Estuary. Average number of individuals • m^{-2} for three replicates to a depth of 10 cm.

Date	Species	Station A	B	C	D
JAN87	*Mediomastus californiensis*	7846	13802	4065	3498
JAN87	*Streblospio benedicti*	3214	3214	378	95
JAN87	*Macoma mitchelli*	2080	1702	473	1702
JAN87	*Capitella capitata*	284	284	0	0
JAN87	*Littoridina sphinctostoma*	95	1323	0	0
JAN87	*Monoculodes* sp.	95	756	189	0
JAN87	Oligochaetes (unidentified)	95	95	0	0
JAN87	*Hobsonia florida*	95	0	0	0
JAN87	*Parandalia ocularis*	95	0	0	0
JAN87	Rhynchocoel (unidentified)	0	473	95	0
JAN87	*Mulinia lateralis*	0	284	95	0
JAN87	*Polydora socialis*	0	95	0	0
JAN87	*Edotea montosa*	0	95	0	0
JAN87	*Haploscoloplos foliosus*	0	0	1796	95
JAN87	*Paraprionospio pinnata*	0	0	378	189
JAN87	*Cossura delta*	0	0	378	0
JAN87	*Cyclaspis varians*	0	0	189	378
JAN87	*Glycinde solitaria*	0	0	189	0
JAN87	*Polydora caulleryi*	0	0	95	95
JAN87	*Gyptis vittata*	0	0	95	0
JAN87	*Clymenella mucosa*	0	0	95	0
JAN87	*Ampelisca abdita*	0	0	95	0
JAN87	*Pyramidella* sp.	0	0	0	189
JAN87	*Nereis succinea*	0	0	0	95
JAN87	*Xenanthura brevitelson*	0	0	0	95
	TOTAL	13896	22121	8603	6428
MAR87	*Littoridina sphinctostoma*	24579	2080	0	0
MAR87	*Streblospio benedicti*	4821	3687	284	1229
MAR87	*Mulinia lateralis*	4821	1323	1891	2458
MAR87	*Mediomastus californiensis*	2931	9642	4254	4065
MAR87	Oligochaetes (unidentified)	662	0	0	0
MAR87	*Hobsonia florida*	473	0	0	0
MAR87	*Macoma mitchelli*	189	1891	284	1702
MAR87	Rhynchocoel (unidentified)	95	189	0	0
MAR87	*Capitella capitata*	95	95	0	95
MAR87	*Rangia cuneata*	95	0	0	0
MAR87	Turbellaria (unidentified)	95	0	0	0

MAR87	*Parandalia ocularis*	95	0	0	0
MAR87	*Monoculodes* sp.	0	95	567	0
MAR87	*Haploscoloplos foliosus*	0	0	1702	95
MAR87	*Glycinde solitaria*	0	0	473	0
MAR87	*Cossura delta*	0	0	284	378
MAR87	*Gammarus mucronatus*	0	0	284	0
MAR87	*Clymenella mucosa*	0	0	189	0
MAR87	*Diopatra cuprea*	0	0	95	0
MAR87	*Pectinaria gouldii*	0	0	95	0
MAR87	*Ampelisca abdita*	0	0	95	0
MAR87	*Leucon* sp.	0	0	95	0
MAR87	*Paraprionospio pinnata*	0	0	0	378
MAR87	*Pyramidella* sp.	0	0	0	95
	TOTAL	38948	19001	10588	10493
APR87	*Littoridina sphinctostoma*	36301	3025	0	95
APR87	*Hobsonia florida*	10115	1229	0	0
APR87	*Mulinia lateralis*	3781	3970	189	851
APR87	*Mediomastus californiensis*	3025	9075	5767	3687
APR87	*Streblospio benedicti*	2931	1607	1323	2363
APR87	Oligochaetes (unidentified)	1513	95	0	0
APR87	*Macoma mitchelli*	662	95	567	378
APR87	Turbellaria (unidentified)	189	0	1513	378
APR87	Rhynchocoel (unidentified)	95	95	0	0
APR87	Chironomid larvae	95	0	0	0
APR87	*Parandalia ocularis*	95	0	0	0
APR87	*Brachidontes exustus*	0	662	0	0
APR87	*Monoculodes* sp.	0	95	662	378
APR87	*Edotea montosa*	0	95	95	0
APR87	*Corophium louisianum*	0	95	95	0
APR87	*Capitella capitata*	0	95	0	0
APR87	*Cassidinidea lunifrons*	0	95	0	0
APR87	*Polydora socialis*	0	0	945	0
APR87	*Tagelus plebeius*	0	0	284	189
APR87	*Cossura delta*	0	0	189	189
APR87	*Phoronis architecta*	0	0	0	284
APR87	Capitellidae (unidentified)	0	0	0	284
APR87	*Eteone heteropoda*	0	0	0	95
APR87	*Paraprionospio pinnata*	0	0	0	95
	TOTAL	58800	20325	11628	9264
JUN87	*Littoridina sphinctostoma*	50953	11533	0	189
JUN87	*Mulinia lateralis*	3403	1323	0	284
JUN87	*Mediomastus californiensis*	2174	6428	4727	5388
JUN87	Oligochaetes (unidentified)	473	0	0	0
JUN87	Chironomid larvae	473	0	0	0
JUN87	*Streblospio benedicti*	284	1607	756	473

JUN87	*Parandalia ocularis*	95	0	0	95
JUN87	*Hobsonia florida*	95	0	0	0
JUN87	*Macoma mitchelli*	0	662	189	284
JUN87	*Cossura delta*	0	0	378	0
JUN87	*Nereis succinea*	0	0	189	0
JUN87	Rhynchocoel (unidentified)	0	0	95	284
JUN87	*Tagelus plebeius*	0	0	95	189
JUN87	*Glycinde solitaria*	0	0	0	189
JUN87	*Monoculodes* sp.	0	0	0	189
JUN87	*Capitella capitata*	0	0	0	95
JUN87	*Pectinaria gouldii*	0	0	0	95
JUN87	*Callianassa* sp.	0	0	0	95
	TOTAL	57949	21554	6428	7846
JUL87	*Littoridina sphinctostoma*	27982	7185	3120	95
JUL87	*Mulinia lateralis*	5483	1323	567	567
JUL87	Chironomid larvae	1229	284	189	95
JUL87	*Mediomastus californiensis*	1134	2174	2363	1323
JUL87	Oligochaetes (unidentified)	378	0	0	0
JUL87	*Parandalia ocularis*	284	0	0	95
JUL87	*Streblospio benedicti*	0	473	1418	1323
JUL87	*Macoma mitchelli*	0	95	95	95
JUL87	Turbellaria (unidentified)	0	0	756	0
JUL87	Rhynchocoel (unidentified)	0	0	95	0
JUL87	*Callianassa* sp.	0	0	95	0
JUL87	*Capitella capitata*	0	0	0	284
	TOTAL	36490	11533	8697	3876
APR88	*Streblospio benedicti*	52182	100773	4538	1702
APR88	*Littoridina sphinctostoma*	16638	18907	16449	3876
APR88	*Mulinia lateralis*	8224	26847	17205	5956
APR88	*Hobsonia florida*	1985	95	0	0
APR88	*Capitella capitata*	1796	1513	567	0
APR88	*Mediomastus californiensis*	1323	15409	31480	22121
APR88	*Monoculodes* sp.	756	1796	189	0
APR88	Chironomid larvae	473	284	0	0
APR88	*Polydora websteri*	473	0	0	0
APR88	Rhynchocoel (unidentified)	189	851	473	95
APR88	Megalops	95	95	0	0
APR88	*Gammarus mucronatus*	95	0	0	0
APR88	*Eteone heteropoda*	0	1040	0	0
APR88	*Mysidopsis almyra*	0	378	0	0
APR88	*Glycinde solitaria*	0	284	1891	2552
APR88	*Oxyurostylis smithi*	0	189	851	189
APR88	Oligochaetes (unidentified)	0	189	0	0
APR88	*Rangia cuneata*	0	189	0	0
APR88	*Pectinaria gouldii*	0	95	0	0

APR88	*Macoma mitchelli*	0	95	0	0
APR88	*Pyramidella* sp.	0	95	0	0
APR88	*Scolelepis squamata*	0	0	662	0
APR88	Turbellaria (unidentified)	0	0	284	95
APR88	*Cyclaspis varians*	0	0	284	0
APR88	Nereidae (unidentified)	0	0	189	0
APR88	*Diopatra cuprea*	0	0	95	0
APR88	*Parandalia ocularis*	0	0	95	0
APR88	*Haploscoloplos fragilis*	0	0	0	189
APR88	*Melita* sp.	0	0	0	95
APR88	*Acteocina canaliculata*	0	0	0	95
APR88	Hesionidae (unidentified)	0	0	0	95
APR88	*Mysidopsis bahia*	0	0	0	95
	TOTAL	84229	169120	75249	37152
JUL88	*Mediomastus californiensis*	21837	17016	14085	8603
JUL88	*Streblospio benedicti*	17867	7090	1796	567
JUL88	*Mulinia lateralis*	15314	19947	945	0
JUL88	*Littoridina sphinctostoma*	9264	10115	378	0
JUL88	*Capitella capitata*	3120	95	0	0
JUL88	*Monoculodes* sp.	851	0	0	0
JUL88	Rhynchocoel (unidentified)	378	0	189	95
JUL88	Oligochaetes (unidentified)	284	378	0	0
JUL88	*Polydora* sp.	95	0	0	0
JUL88	*Mysidopsis* sp.	95	0	0	0
JUL88	*Hobsonia florida*	95	0	0	0
JUL88	*Glycinde solitaria*	0	189	378	473
JUL88	*Paraprionospio pinnata*	0	95	95	95
JUL88	*Cyclaspis varians*	0	95	0	189
JUL88	*Macoma mitchelli*	0	95	0	95
JUL88	*Tellina* sp.	0	95	0	0
JUL88	Spionidae (unidentified)	0	95	0	0
JUL88	*Rangia cuneata*	0	95	0	0
JUL88	*Oxyurostylis smithi*	0	95	0	0
JUL88	*Edotea montosa*	0	0	95	0
JUL88	*Scolelepis squamata*	0	0	95	0
JUL88	*Diopatra cuprea*	0	0	0	284
JUL88	*Haploscoloplos foliosus*	0	0	0	189
JUL88	*Acteocina canaliculata*	0	0	0	189
JUL88	Serpulidae (unidentified)	0	0	0	189
JUL88	*Polydora websteri*	0	0	0	95
JUL88	*Macoma tenta*	0	0	0	95
JUL88	*Oxyurostylis salinoi*	0	0	0	95
JUL88	*Pyramidella* sp.	0	0	0	95
	TOTAL	69198	55491	18056	11344
NOV88	*Mediomastus californiensis*	11344	8792	8697	5672

NOV88	*Streblospio benedicti*	3687	2647	1229	851
NOV88	*Mulinia lateralis*	2741	10966	189	95
NOV88	*Littoridina sphinctostoma*	2647	8224	0	0
NOV88	*Capitella capitata*	851	0	0	0
NOV88	*Polydora* sp.	567	0	0	0
NOV88	*Balanus eburneus*	284	189	0	0
NOV88	*Cyclaspis varians*	284	95	0	0
NOV88	Rhynchocoel (unidentified)	189	0	378	378
NOV88	*Oxyurostylis smithi*	189	0	0	95
NOV88	Caprellid	189	0	0	0
NOV88	Oligochaetes (unidentified)	95	3120	0	0
NOV88	Anthozoa (unidentified)	95	0	0	0
NOV88	*Monoculodes* sp.	95	0	0	0
NOV88	*Macoma mitchelli*	95	0	0	0
NOV88	*Scolelepis squamata*	95	0	0	0
NOV88	*Parandalia ocularis*	95	0	0	0
NOV88	*Acteocina canaliculata*	0	189	0	0
NOV88	*Haploscoloplos foliosus*	0	95	95	378
NOV88	*Gyptis vittata*	0	0	284	378
NOV88	*Glycinde solitaria*	0	0	0	378
NOV88	*Polydora websteri*	0	0	0	95
NOV88	*Polydora caulleryi*	0	0	0	95
NOV88	*Paraprionospio pinnata*	0	0	0	95
NOV88	*Nuculana acuta*	0	0	0	95
NOV88	*Mysidopsis* sp.	0	0	0	95
	TOTAL	23539	34316	10871	8697
APR89	*Streblospio benedicti*	70049	46038	1418	95
APR89	Gastropoda (unidentified)	12478	0	0	0
APR89	*Mediomastus californiensis*	6806	6995	11060	11249
APR89	*Littoridina sphinctostoma*	5105	8413	0	0
APR89	*Mulinia lateralis*	3120	284	189	284
APR89	*Capitella capitata*	1134	189	0	95
APR89	*Monoculodes* sp.	1134	0	945	189
APR89	Rhynchocoel (unidentified)	851	95	95	189
APR89	*Pyramidella* sp.	567	0	0	0
APR89	*Macoma mitchelli*	95	473	95	0
APR89	*Acteocina canaliculata*	95	284	284	189
APR89	Oligochaetes (unidentified)	95	95	0	0
APR89	*Gyptis vittata*	95	0	95	95
APR89	*Parandalia ocularis*	95	0	0	189
APR89	*Mysidopsis bahia*	95	0	0	0
APR89	*Haploscoloplos foliosus*	0	473	95	662
APR89	*Oxyurostylis smithi*	0	95	2363	2552
APR89	*Cyclaspis varians*	0	95	1418	2269
APR89	*Glycinde solitaria*	0	95	95	189
APR89	*Ensis minor*	0	0	95	851

APR89	*Microprotopus* spp.	0	0	95	95
APR89	*Paraprionospio pinnata*	0	0	95	0
APR89	*Leucon* sp.	0	0	95	0
APR89	*Polydora caulleryi*	0	0	0	1985
APR89	*Erichthonias brasiliensis*	0	0	0	756
APR89	*Mysella planulata*	0	0	0	567
APR89	*Nereis succinea*	0	0	0	378
APR89	*Megalomma bioculatum*	0	0	0	378
APR89	*Clymenella torquata*	0	0	0	284
APR89	*Ampelisca abdita*	0	0	0	284
APR89	*Diopatra cuprea*	0	0	0	189
APR89	*Polydora websteri*	0	0	0	189
APR89	*Aligena texasiana*	0	0	0	189
APR89	Caprellid	0	0	0	189
APR89	*Glycera americana*	0	0	0	95
APR89	*Melinna maculata*	0	0	0	95
APR89	*Isolda pulchella*	0	0	0	95
APR89	*Tellina* sp.	0	0	0	95
APR89	*Pseudodiaptomus coronatus*	0	0	0	95
APR89	*Batea catharinensis*	0	0	0	95
APR89	*Pandora trilineata*	0	0	0	95
APR89	Terebellidae (unidentified)	0	0	0	95
	TOTAL	101812	63621	18529	25335
JUL89	*Mediomastus californiensis*	11722	10777	7752	4821
JUL89	*Littoridina sphinctostoma*	6428	5010	95	0
JUL89	*Streblospio benedicti*	5105	23350	662	284
JUL89	*Mulinia lateralis*	662	189	0	473
JUL89	*Monoculodes* sp.	378	0	0	0
JUL89	Rhynchocoel (unidentified)	284	284	378	0
JUL89	*Mysidopsis* sp.	284	0	0	0
JUL89	*Mysidopsis almyra*	284	0	0	0
JUL89	*Cyclaspis varians*	189	662	567	1134
JUL89	Oligochaetes (unidentified)	189	0	95	0
JUL89	*Glycinde solitaria*	95	0	95	0
JUL89	*Acteocina canaliculata*	95	0	0	95
JUL89	*Heteromastus filiformis*	95	0	0	0
JUL89	*Pseudodiaptomus coronatus*	95	0	0	0
JUL89	*Bowmaniella* sp.	95	0	0	0
JUL89	*Microprotopus* spp.	95	0	0	0
JUL89	*Pyramidella crenulata*	95	0	0	0
JUL89	*Oxyurostylis salinoi*	0	284	284	189
JUL89	*Paraprionospio pinnata*	0	95	95	0
JUL89	*Pista palmata*	0	0	1891	95
JUL89	Caprellid	0	0	756	0
JUL89	*Melita* sp.	0	0	284	0
JUL89	Pelecypoda (unidentified)	0	0	189	662

JUL89	*Diopatra cuprea*	0	0	189	189
JUL89	*Anaitides erythrophyllus*	0	0	189	0
JUL89	*Turbonilla* sp.	0	0	189	0
JUL89	*Polydora caulleryi*	0	0	95	1418
JUL89	*Podarke obscura*	0	0	95	0
JUL89	*Spiochaetopterus costarum*	0	0	95	0
JUL89	*Megalomma bioculatum*	0	0	95	0
JUL89	*Crepidula fornicata*	0	0	95	0
JUL89	*Odostomia* sp.	0	0	95	0
JUL89	*Periploma margaritaceum*	0	0	95	0
JUL89	*Lyonsia hyalina floridana*	0	0	95	0
JUL89	*Batea catharinensis*	0	0	95	0
JUL89	Nereidae (unidentified)	0	0	95	0
JUL89	*Macoma mitchelli*	0	0	95	0
JUL89	Polychaete juv. (unidentified)	0	0	95	0
JUL89	*Caecum johnsoni*	0	0	95	0
JUL89	*Oxyurostylis* sp.	0	0	95	0
JUL89	*Synchelidium americanum*	0	0	0	473
JUL89	*Aligena texasiana*	0	0	0	378
JUL89	Ophiuroidea (unidentified)	0	0	0	378
JUL89	*Mysidopsis bahia*	0	0	0	378
JUL89	*Nereis succinea*	0	0	0	284
JUL89	*Haploscoloplos foliosus*	0	0	0	284
JUL89	*Listriella barnardi*	0	0	0	284
JUL89	*Scolelepis squamata*	0	0	0	284
JUL89	*Periploma* cf. *orbiculare*	0	0	0	189
JUL89	*Cossura delta*	0	0	0	95
JUL89	*Clymenella mucosa*	0	0	0	95
JUL89	*Clymenella torquata*	0	0	0	95
JUL89	*Melinna maculata*	0	0	0	95
JUL89	*Nuculana acuta*	0	0	0	95
JUL89	Sigalionidae (unidentified)	0	0	0	95
JUL89	Pinnotheridae (unidentified)	0	0	0	95
JUL89	*Parandalia ocularis*	0	0	0	95
	TOTAL	26186	40649	15031	13046
DEC89	*Streblospio benedicti*	15031	4443	1229	284
DEC89	*Littoridina sphinctostoma*	13235	5956	0	0
DEC89	*Mediomastus ambiseta*	9548	11911	2363	1891
DEC89	*Haploscoloplos foliosus*	1513	4443	95	95
DEC89	*Monoculodes* sp.	1040	0	0	0
DEC89	*Capitella capitata*	284	0	0	0
DEC89	*Ampelisca abdita*	284	0	0	0
DEC89	*Macoma mitchelli*	189	95	95	0
DEC89	Rhynchocoel (unidentified)	95	189	95	756
DEC89	*Gyptis vittata*	95	0	0	95
DEC89	Oligochaetes (unidentified)	0	1134	95	0

DEC89	*Megalomma bioculatum*	0	378	95	0
DEC89	*Mulinia lateralis*	0	189	0	0
DEC89	*Acteocina canaliculata*	0	189	0	0
DEC89	Sabellidae (unidentified)	0	189	0	0
DEC89	*Pseudodiaptomus coronatus*	0	95	284	0
DEC89	*Pyramidella crenulata*	0	95	95	0
DEC89	*Caecum pulchellum*	0	95	0	95
DEC89	*Diopatra cuprea*	0	95	0	0
DEC89	*Pista palmata*	0	95	0	0
DEC89	*Microprotopus* spp.	0	95	0	0
DEC89	Turbellaria (unidentified)	0	95	0	0
DEC89	*Oxyurostylis smithi*	0	95	0	0
DEC89	*Glycinde solitaria*	0	0	189	189
DEC89	*Paraprionospio pinnata*	0	0	189	95
DEC89	*Leucon* sp.	0	0	189	0
DEC89	*Mediomastus californiensis*	0	0	95	1702
DEC89	*Listriella barnardi*	0	0	95	95
DEC89	*Drilonereis magna*	0	0	95	0
DEC89	*Scolelepis texana*	0	0	95	0
DEC89	*Melinna maculata*	0	0	95	0
DEC89	*Mysidopsis bahia*	0	0	95	0
DEC89	*Polydora caulleryi*	0	0	0	7846
DEC89	Maldanidae (unidentified)	0	0	0	945
DEC89	*Cossura delta*	0	0	0	378
DEC89	Nereidae (unidentified)	0	0	0	284
DEC89	*Periploma* cf. *orbiculare*	0	0	0	189
DEC89	Anthozoa (unidentified)	0	0	0	95
DEC89	*Spiochaetopterus costarum*	0	0	0	95
DEC89	*Clymenella torquata*	0	0	0	95
DEC89	*Mysella planulata*	0	0	0	95
DEC89	*Aligena texasiana*	0	0	0	95
DEC89	*Cyclaspis varians*	0	0	0	95
DEC89	*Turbonilla* sp.	0	0	0	95
DEC89	*Glycera capitata*	0	0	0	95
DEC89	*Mysidopsis* sp.	0	0	0	95
DEC89	*Exogone* sp.	0	0	0	95
	TOTAL	41311	29873	5577	15882
APR90	*Mediomastus ambiseta*	9359	11060	2741	6617
APR90	*Littoridina sphinctostoma*	7941	4065	0	0
APR90	*Streblospio benedicti*	2269	6617	378	567
APR90	*Haploscoloplos foliosus*	662	1229	851	0
APR90	*Capitella capitata*	284	0	0	0
APR90	*Heteromastus filiformis*	284	0	0	0
APR90	*Ampelisca abdita*	189	189	0	0
APR90	*Mulinia lateralis*	189	0	95	378
APR90	Rhynchocoel (unidentified)	95	95	95	189

APR90	*Macoma mitchelli*	95	0	0	189
APR90	*Pyramidella crenulata*	95	0	0	95
APR90	*Monoculodes* sp.	95	0	0	0
APR90	*Mysidopsis* sp.	95	0	0	0
APR90	*Corophium ascherusicum*	0	189	0	0
APR90	*Melinna maculata*	0	95	95	95
APR90	*Gyptis vittata*	0	95	0	0
APR90	*Ensis minor*	0	95	0	0
APR90	*Phoronis architecta*	0	0	284	0
APR90	Maldanidae (unidentified)	0	0	189	95
APR90	Anthozoa (unidentified)	0	0	95	0
APR90	Oligochaetes (unidentified)	0	0	95	0
APR90	*Glycinde solitaria*	0	0	95	0
APR90	*Diopatra cuprea*	0	0	95	0
APR90	*Megalomma bioculatum*	0	0	95	0
APR90	*Pseudodiaptomus coronatus*	0	0	95	0
APR90	Ophiuroidea (unidentified)	0	0	95	0
APR90	*Clymenella mucosa*	0	0	0	945
APR90	*Asychis* sp.	0	0	0	945
APR90	*Acteocina canaliculata*	0	0	0	567
APR90	*Periploma* cf. *orbiculare*	0	0	0	567
APR90	*Mysella planulata*	0	0	0	473
APR90	*Glycera americana*	0	0	0	378
APR90	*Nereis succinea*	0	0	0	284
APR90	*Polydora socialis*	0	0	0	284
APR90	*Cossura delta*	0	0	0	189
APR90	*Mediomastus californiensis*	0	0	0	189
APR90	*Aligena texasiana*	0	0	0	189
APR90	*Polydora* sp.	0	0	0	95
APR90	*Scolelepis texana*	0	0	0	95
APR90	*Notomastus latericeus*	0	0	0	95
APR90	*Clymenella torquata*	0	0	0	95
APR90	*Pista palmata*	0	0	0	95
APR90	*Nuculana concentrica*	0	0	0	95
APR90	*Parametopella* sp.	0	0	0	95
APR90	*Hemicyclops* sp.	0	0	0	95
APR90	*Exogone* sp.	0	0	0	95
APR90	*Oxyurostylis* sp.	0	0	0	95
	TOTAL	21648	23728	5388	14180
AUG90	*Streblospio benedicti*	20419	16921	756	2552
AUG90	*Littoridina sphinctostoma*	13424	189	0	0
AUG90	*Mediomastus ambiseta*	10304	7468	3592	378
AUG90	*Heteromastus filiformis*	95	0	0	0
AUG90	*Haploscoloplos foliosus*	0	284	0	284
AUG90	*Cyclaspis varians*	0	95	189	0
AUG90	*Acteocina canaliculata*	0	95	95	0

AUG90	*Capitella capitata*	0	95	0	0
AUG90	*Phoronis architecta*	0	0	2741	189
AUG90	*Clymenella torquata*	0	0	189	567
AUG90	*Asychis* sp.	0	0	189	189
AUG90	*Corophium louisianum*	0	0	189	0
AUG90	*Aligena texasiana*	0	0	95	378
AUG90	*Gyptis vittata*	0	0	95	95
AUG90	*Melinna maculata*	0	0	95	95
AUG90	Rhynchocoel (unidentified)	0	0	95	0
AUG90	Oligochaetes (unidentified)	0	0	95	0
AUG90	Caprellid	0	0	95	0
AUG90	*Nassarius acutus*	0	0	95	0
AUG90	*Elasmopus* sp.	0	0	95	0
AUG90	*Oxyurostylis* sp.	0	0	95	0
AUG90	*Mysella planulata*	0	0	0	1985
AUG90	*Polydora caulleryi*	0	0	0	1702
AUG90	*Polydora ligni*	0	0	0	473
AUG90	*Mediomastus californiensis*	0	0	0	378
AUG90	*Glycera americana*	0	0	0	189
AUG90	*Scolelepis texana*	0	0	0	189
AUG90	*Turbonilla* sp.	0	0	0	189
AUG90	*Paleanotus heteroseta*	0	0	0	95
AUG90	*Schistomeringos rudolphi*	0	0	0	95
AUG90	*Clymenella mucosa*	0	0	0	95
AUG90	*Mulinia lateralis*	0	0	0	95
AUG90	*Listriella barnardi*	0	0	0	95
AUG90	Serpulidae (unidentified)	0	0	0	95
AUG90	Vitrinellidae (unidentified)	0	0	0	95
AUG90	*Hemicyclops* sp.	0	0	0	95
AUG90	*Caecum johnsoni*	0	0	0	95
AUG90	*Eupomatus dianthus*	0	0	0	95
	TOTAL	44242	25146	8792	10777
OCT90	*Mediomastus ambiseta*	7563	5294	6334	1134
OCT90	*Streblospio benedicti*	4727	9075	16449	10021
OCT90	*Littoridina sphinctostoma*	3876	189	0	0
OCT90	Rhynchocoel (unidentified)	189	284	95	189
OCT90	*Gyptis vittata*	0	0	189	95
OCT90	*Paraprionospio pinnata*	0	0	189	95
OCT90	*Cossura delta*	0	0	95	189
OCT90	*Clymenella mucosa*	0	0	95	0
OCT90	*Nassarius acutus*	0	0	95	0
OCT90	*Polydora caulleryi*	0	0	0	1985
OCT90	*Mediomastus californiensis*	0	0	0	1702
OCT90	*Mulinia lateralis*	0	0	0	189
OCT90	*Spiochaetopterus costarum*	0	0	0	95
OCT90	*Clymenella torquata*	0	0	0	95

	TOTAL	16354	14842	23539	15787
JAN91	*Mediomastus ambiseta*	14936	3592	6334	25146
JAN91	*Streblospio benedicti*	5672	189	1134	16260
JAN91	Rhynchocoel (unidentified)	3025	3687	2931	284
JAN91	*Littoridina sphinctostoma*	1796	0	0	0
JAN91	*Mulinia lateralis*	284	378	95	378
JAN91	*Capitella capitata*	95	0	0	0
JAN91	*Monoculodes* sp.	95	0	0	0
JAN91	*Rangia cuneata*	95	0	0	0
JAN91	*Macoma mitchelli*	0	567	0	0
JAN91	*Paraprionospio pinnata*	0	95	189	378
JAN91	*Scolelepis texana*	0	95	189	378
JAN91	Polychaete juv. (unidentified)	0	95	0	0
JAN91	*Spiochaetopterus costarum*	0	0	2174	17583
JAN91	*Haploscoloplos foliosus*	0	0	473	284
JAN91	Maldanidae (unidentified)	0	0	378	0
JAN91	*Glycinde solitaria*	0	0	189	0
JAN91	*Phoronis architecta*	0	0	95	662
JAN91	*Diopatra cuprea*	0	0	95	284
JAN91	*Eteone heteropoda*	0	0	95	95
JAN91	*Melinna maculata*	0	0	95	95
JAN91	*Mercenaria campechiensis*	0	0	95	95
JAN91	Anthozoa (unidentified)	0	0	95	0
JAN91	*Polydora caulleryi*	0	0	0	7846
JAN91	*Mediomastus californiensis*	0	0	0	284
JAN91	*Clymenella torquata*	0	0	0	284
JAN91	*Turbonilla* sp.	0	0	0	284
JAN91	Gastropoda (unidentified)	0	0	0	284
JAN91	*Ampelisca abdita*	0	0	0	189
JAN91	*Paleanotus heteroseta*	0	0	0	95
JAN91	*Minuspio cirrifera*	0	0	0	95
JAN91	*Tharyx setigera*	0	0	0	95
JAN91	*Sphaerosyllis* cf. *sublaevis*	0	0	0	95
JAN91	*Corophium ascherusicum*	0	0	0	95
JAN91	*Pinnixa chacei*	0	0	0	95
	TOTAL	25997	8697	14653	71656
APR91	*Littoridina sphinctostoma*	29211	0	0	0
APR91	*Mediomastus ambiseta*	19474	2552	3687	3498
APR91	*Streblospio benedicti*	1418	851	284	1985
APR91	Rhynchocoel (unidentified)	1134	1229	1418	851
APR91	*Rangia cuneata*	284	0	0	0
APR91	*Mulinia lateralis*	0	189	473	95
APR91	*Macoma mitchelli*	0	95	95	0
APR91	*Monoculodes* sp.	0	95	0	0
APR91	*Spiochaetopterus costarum*	0	0	567	10115

APR91	*Paraprionospio pinnata*	0	0	473	189
APR91	*Phoronis architecta*	0	0	378	0
APR91	*Leucon* sp.	0	0	378	0
APR91	*Haploscoloplos foliosus*	0	0	189	0
APR91	*Glycinde solitaria*	0	0	95	189
APR91	*Cossura delta*	0	0	95	95
APR91	Anthozoa (unidentified)	0	0	95	0
APR91	*Gyptis vittata*	0	0	95	0
APR91	*Scolelepis texana*	0	0	95	0
APR91	*Acteocina canaliculata*	0	0	0	284
APR91	*Cyclaspis varians*	0	0	0	189
APR91	*Pyramidella crenulata*	0	0	0	189
APR91	*Clymenella mucosa*	0	0	0	95
APR91	*Turbonilla* sp.	0	0	0	95
	TOTAL	51521	5010	8413	17867
JUL91	*Littoridina sphinctostoma*	21175	0	0	0
JUL91	*Mediomastus ambiseta*	5388	6334	9264	6428
JUL91	*Streblospio benedicti*	2174	5010	3403	3876
JUL91	*Edotea montosa*	189	0	0	0
JUL91	*Mulinia lateralis*	95	189	0	95
JUL91	*Parandalia ocularis*	95	0	95	0
JUL91	Oligochaetes (unidentified)	95	0	0	0
JUL91	*Rangia cuneata*	95	0	0	0
JUL91	Rhynchocoel (unidentified)	0	95	378	473
JUL91	*Capitella capitata*	0	95	0	284
JUL91	*Mysidopsis* sp.	0	95	0	0
JUL91	*Cossura delta*	0	0	378	378
JUL91	*Cyclaspis varians*	0	0	189	756
JUL91	*Phoronis architecta*	0	0	189	95
JUL91	*Pyramidella crenulata*	0	0	95	0
JUL91	*Mysidopsis almyra*	0	0	95	0
JUL91	*Spiochaetopterus costarum*	0	0	0	4159
JUL91	*Glycera americana*	0	0	0	95
JUL91	*Glycinde solitaria*	0	0	0	95
JUL91	*Polydora websteri*	0	0	0	95
JUL91	*Mediomastus californiensis*	0	0	0	95
JUL91	*Clymenella mucosa*	0	0	0	95
JUL91	*Mysella planulata*	0	0	0	95
JUL91	*Ensis minor*	0	0	0	95
JUL91	Nereidae (unidentified)	0	0	0	95
	TOTAL	29305	11817	14085	17300
OCT91	*Streblospio benedicti*	20703	54829	5199	1891
OCT91	*Littoridina sphinctostoma*	9926	0	0	0
OCT91	*Mediomastus ambiseta*	3970	19379	17205	10115
OCT91	Rhynchocoel (unidentified)	95	1702	567	567

OCT91	*Mulinia lateralis*	95	0	0	95
OCT91	*Edotea montosa*	95	0	0	0
OCT91	Chironomid larvae	95	0	0	0
OCT91	*Hobsonia florida*	95	0	0	0
OCT91	*Mysidopsis almyra*	95	0	0	0
OCT91	*Monoculodes* sp.	0	95	95	0
OCT91	*Paraprionospio pinnata*	0	0	378	0
OCT91	*Scolelepis texana*	0	0	378	0
OCT91	*Glycinde solitaria*	0	0	284	95
OCT91	*Spiochaetopterus costarum*	0	0	189	1323
OCT91	*Cossura delta*	0	0	189	95
OCT91	*Diopatra cuprea*	0	0	95	95
OCT91	Anthozoa (unidentified)	0	0	95	0
OCT91	*Capitella capitata*	0	0	95	0
OCT91	*Pseudodiaptomus coronatus*	0	0	95	0
OCT91	*Macoma mitchelli*	0	0	95	0
OCT91	*Polydora caulleryi*	0	0	0	189
OCT91	*Cyclaspis varians*	0	0	0	189
OCT91	*Gyptis vittata*	0	0	0	95
OCT91	*Nereis succinea*	0	0	0	95
OCT91	*Haploscoloplos foliosus*	0	0	0	95
OCT91	*Phoronis architecta*	0	0	0	95
OCT91	*Pinnixa* sp.	0	0	0	95
	TOTAL	35166	76005	24957	15125
JAN92	*Mediomastus ambiseta*	9548	16921	9926	3025
JAN92	*Littoridina sphinctostoma*	5861	0	0	0
JAN92	*Streblospio benedicti*	2836	19096	567	2458
JAN92	Rhynchocoel (unidentified)	662	0	189	95
JAN92	*Macoma mitchelli*	378	284	662	378
JAN92	*Capitella capitata*	95	95	0	0
JAN92	*Hobsonia florida*	95	0	0	0
JAN92	*Parandalia ocularis*	95	0	0	0
JAN92	*Monoculodes* sp.	0	95	0	0
JAN92	*Phoronis architecta*	0	0	378	0
JAN92	Anthozoa (unidentified)	0	0	95	0
JAN92	*Pyramidella crenulata*	0	0	95	0
JAN92	*Spiochaetopterus costarum*	0	0	0	662
JAN92	*Nereis succinea*	0	0	0	95
JAN92	*Hemicyclops* sp.	0	0	0	95
	TOTAL	19568	36490	11911	6806
APR92	*Littoridina sphinctostoma*	8413	0	0	0
APR92	*Mulinia lateralis*	4349	0	95	0
APR92	*Mediomastus ambiseta*	3781	25619	3592	3120
APR92	Rhynchocoel (unidentified)	284	0	0	95
APR92	Chironomid larvae	189	0	0	0

APR92	*Streblospio benedicti*	95	2363	284	284
APR92	*Macoma mitchelli*	95	95	0	284
APR92	Oligochaetes (unidentified)	95	0	0	0
APR92	*Rangia cuneata*	95	0	0	0
APR92	Insect larvae (unidentified)	95	0	0	0
APR92	*Hobsonia florida*	0	95	0	0
APR92	Vitrinellidae (unidentified)	0	0	0	189
APR92	*Cossura delta*	0	0	0	95
	TOTAL	17489	28171	3970	4065
		813648	717508	304965	322926

Table 7. Lavaca-Colorado Estuary hydrographic measurements. Abbreviations: STA=Station, Z=Depth, SAL(R)=Salinity by refractometer, SAL(M)=Salinty by meter, COND=Conductivity, TEMP=Temperature, DO=dissolved oxygen, and ORP=oxidation redox potential. Missing values show with a period.

Date	STA	Z (m)	SAL(R) (ppt)	SAL(M) (ppt)	COND (uS/cm)	TEMP (°C)	pH	DO (mg·l⁻¹)	ORP (mV)
28NOV84	A	.	.	6.4	.	14.90	.	.	.
23JAN85	A	.	.	11.8	.	6.30	.	.	.
06MAR85	A	.	.	5.0	.	16.30	.	.	.
03APR85	A	.	.	1.8	.	20.30	.	.	.
08MAY85	A	.	.	3.7	.	25.00	.	.	.
05JUN85	A	.	.	9.6	.	28.00	.	.	.
17JUL85	A	.	.	8.9	.	28.80	.	.	.
14AUG85	A	.	.	16.6	.	29.80	.	.	.
22OCT85	A	.	.	20.5	.	25.20	.	.	.
04DEC85	A	.	.	8.2	.	10.60	.	.	.
05FEB86	A	.	.	13.1	.	20.00	.	.	.
09APR86	A	.	.	23.9	.	24.50	.	.	.
04JUN86	A	.	.	18.9	.	27.40	.	.	.
06AUG86	A	.	.	11.0	.	28.20	.	.	.
07AUG87	A	.	.	.	.	.	.	.	.
18APR88	A	0.00	25	23.7	37.30	24.10	.	8.50	.
18APR88	A	1.10	.	23.7	37.30	.	.	.	.
18APR88	B	0.00	29	27.3	42.20	23.30	.	8.80	.
18APR88	B	2.15	.	27.2	42.30	23.20	.	8.00	.
18APR88	C	0.00	34	31.0	44.80	22.90	.	.	.
18APR88	C	3.10	.	29.1	47.40	21.60	.	.	.
18APR88	D	0.00	34	31.2	46.90	22.40	.	8.30	.
18APR88	D	4.40	.	30.6	47.70	21.50	.	.	.
19JUL88	A	0.00	28	27.3	42.40	29.90	.	.	.
19JUL88	A	2.00	.	27.3	42.40	29.90	.	.	.
19JUL88	B	0.00	30	28.6	44.10	30.50	.	.	.
19JUL88	B	2.00	.	28.6	44.10	30.50	.	.	.
19JUL88	C	0.00	33	31.5	48.20	29.40	.	6.30	.
19JUL88	C	2.50	.	31.5	48.20	29.60	.	.	.
19JUL88	D	0.00	32	32.3	492.0	29.80	.	.	.
19JUL88	D	4.00	.	32.3	49.20	29.80	.	.	.
22NOV88	A	0.00	32	32.7	49.80	13.80	.	8.90	.
22NOV88	A	1.00	.	32.9	50.00	13.90	.	8.80	.
22NOV88	B	0.00	33	34.5	52.20	14.50	.	8.80	.
22NOV88	B	1.75	.	34.6	52.40	14.60	.	8.60	.
22NOV88	C	0.00	35	35.2	53.20	15.40	.	8.80	.
22NOV88	C	2.50	.	35.3	53.30	15.50	.	8.50	.

22NOV88	D	0.00	35	34.4	52.10	16.70	.	8.50	.
22NOV88	D	4.00	.	35.1	53.00	16.70	.	8.30	.
05APR89	A	1.10	.	23.0	.	21.80	.	.	.
05APR89	B	2.10	.	23.0	.	20.30	.	.	.
05APR89	C	3.10	.	23.0	.	21.40	.	.	.
05APR89	D	4.40	.	23.0	.	21.00	.	.	.
22JUL89	A	1.10	.	22.2	.	29.50	.	.	.
22JUL89	B	2.10	.	25.8	.	29.00	.	.	.
22JUL89	C	3.10	.	28.2	.	31.00	.	.	.
22JUL89	D	4.40	.	36.1	.	31.00	.	.	.
05DEC89	A	0.00	27	.	.	10.40	8.00	11.80	.
05DEC89	A	1.50	27	.	.	10.20	7.90	11.90	.
05DEC89	B	0.00	28	.	.	10.30	7.80	12.20	.
05DEC89	B	2.00	28	.	.	10.30	7.80	12.10	.
05DEC89	C	0.00	28	.	.	11.30	7.80	11.80	.
05DEC89	C	3.60	28	.	.	11.00	7.80	11.20	.
05DEC89	D	0.00	29	.	.	12.40	8.00	10.80	.
05DEC89	D	4.00	29	.	.	12.10	7.80	10.40	.
10APR90	A	0.00	20	19.4	31.00	19.77	8.23	8.20	.
10APR90	A	1.50	.	19.0	31.50	19.77	8.23	8.08	.
10APR90	B	0.00	20	21.6	33.10	19.96	8.26	8.67	.
10APR90	B	2.20	.	20.6	34.60	19.85	8.27	8.15	.
10APR90	C	0.00	26	26.1	40.50	19.90	8.25	8.15	.
10APR90	C	3.20	.	26.0	40.60	19.79	8.25	7.94	.
10APR90	D	0.00	27	27.6	41.70	20.41	8.34	8.63	.
10APR90	D	4.60	.	26.7	42.90	19.95	8.30	7.68	.
31JUL90	A	0.00	.	11.9	16.50	31.52	8.66	8.36	1.080
31JUL90	A	1.10	.	9.4	20.30	31.10	8.49	7.02	1.190
31JUL90	B	0.00	.	16.5	22.60	30.67	8.43	6.61	0.115
31JUL90	B	1.50	.	13.5	27.20	30.10	8.31	5.91	0.122
31JUL90	C	0.00	.	22.3	35.10	31.32	8.29	6.39	0.119
31JUL90	C	2.30	.	22.0	35.50	30.51	8.27	6.00	0.119
31JUL90	D	0.00	.	28.4	43.30	29.65	8.25	5.88	0.120
31JUL90	D	3.90	.	27.9	44.00	29.60	8.27	5.73	0.118
23OCT90	A	0.00	22	23.5	37.30	19.09	8.17	8.90	0.159
23OCT90	A	1.40	.	26.8	42.00	18.87	8.15	8.07	0.161
23OCT90	B	0.00	22	24.7	38.80	18.67	8.18	9.06	0.156
23OCT90	B	2.20	.	27.3	42.90	17.75	8.09	6.64	0.160
23OCT90	C	0.00	28	30.9	47.60	19.10	8.24	6.98	0.148
23OCT90	C	3.30	.	31.2	47.90	18.98	8.24	6.79	0.149
23OCT90	D	0.00	30	32.3	49.40	18.95	8.29	6.47	0.142
23OCT90	D	4.70	.	32.4	49.50	18.97	8.29	6.35	0.142
25JAN91	A	0.00	6	7.9	14.06	12.43	8.45	12.12	0.145
25JAN91	A	1.10	6	9.5	16.50	10.68	8.43	12.98	0.148
25JAN91	B	0.00	8	8.6	15.20	13.60	8.41	11.71	0.143
25JAN91	B	1.70	8	11.5	19.60	10.72	8.44	11.81	0.147
25JAN91	C	0.00	16	17.2	36.60	10.70	8.19	8.60	0.141

25JAN91	C	2.70	16	22.7	36.60	11.52	8.19	8.60	0.141
25JAN91	D	0.00	20	21.1	33.80	11.96	8.23	9.98	0.147
25JAN91	D	4.20	20	21.9	35.00	11.39	8.16	8.94	0.150
24APR91	A	0.00	3	2.4	5.21	24.98	7.95	8.48	0.143
24APR91	A	1.20	3	2.4	5.23	24.95	7.95	8.26	0.143
24APR91	B	0.00	4	4.3	8.35	24.31	7.92	8.24	0.147
24APR91	B	2.00	4	4.3	8.40	24.30	7.92	8.16	0.148
24APR91	C	0.00	10	10.4	18.10	23.64	7.88	8.03	0.145
24APR91	C	3.10	10	11.8	20.30	23.65	7.84	6.50	0.148
24APR91	D	0.00	20	20.9	33.50	23.79	7.87	7.34	0.152
24APR91	D	4.30	20	23.4	36.90	23.64	7.81	5.74	0.154
24JUL91	A	0.00	8	7.4	13.65	29.66	8.40	7.34	0.135
24JUL91	A	1.40	8	7.6	13.72	29.60	8.39	7.10	0.135
24JUL91	B	0.00	12	12.5	20.20	29.98	8.11	6.82	0.149
24JUL91	B	2.10	12	13.1	22.00	29.53	8.12	6.38	0.136
24JUL91	C	0.00	21	20.6	33.10	29.64	7.68	6.12	0.211
24JUL91	C	3.10	21	23.9	37.70	30.02	7.50	2.89	0.215
24JUL91	D	0.00	32	31.4	48.30	29.70	7.85	5.19	0.170
24JUL91	D	4.50	32	32.6	49.50	29.73	7.67	3.18	0.175
14OCT91	A	0.00	16	16.2	26.30	26.20	8.52	7.35	0.099
14OCT91	A	1.20	.	16.3	26.50	24.98	8.50	8.30	0.100
14OCT91	B	0.00	17	16.8	27.20	25.30	8.32	7.90	0.098
14OCT91	B	2.00	.	20.0	32.00	24.55	8.41	7.76	0.099
14OCT91	C	0.00	25	22.5	35.60	23.90	8.31	7.50	0.129
14OCT91	C	3.20	.	22.9	36.10	23.60	8.26	6.36	0.129
14OCT91	D	0.00	28	26.5	41.40	24.30	8.16	7.75	0.122
14OCT91	D	4.40	.	31.6	48.50	24.99	8.04	5.88	0.130
20JAN92	A	0.00	0	0.1	1.23	9.23	8.15	10.68	0.203
20JAN92	A	1.10	0	3.9	8.41	9.62	7.99	9.68	0.220
20JAN92	B	0.00	0	3.0	6.23	8.80	8.12	10.71	0.182
20JAN92	B	1.90	0	14.2	24.00	9.71	8.16	9.28	0.193
20JAN92	C	0.00	10	13.0	21.90	8.44	8.35	10.83	0.164
20JAN92	C	2.60	10	24.8	38.90	11.39	8.18	8.14	0.170
20JAN92	D	0.00	14	16.0	25.90	9.94	8.28	9.49	0.162
20JAN92	D	4.10	14	27.9	43.40	12.30	8.13	7.57	0.167
06APR92	A	0.00	1	0.6	1.98	18.26	8.79	8.21	0.099
06APR92	A	1.30	1	5.5	10.08	17.75	8.65	7.84	0.107
06APR92	B	0.00	7	6.6	12.08	18.16	8.91	9.38	0.095
06APR92	B	2.10	7	9.7	17.00	18.00	8.83	7.71	0.100
06APR92	C	0.00	14	13.1	22.30	18.45	8.97	9.22	0.091
06APR92	C	3.10	14	17.5	31.60	18.10	8.91	6.36	0.096
06APR92	D	0.00	16	16.6	26.80	19.73	8.74	8.41	0.108
06APR92	D	4.50	16	24.4	38.40	18.77	8.91	7.36	0.103
12JUL92	A	0.00	6	4.8	9.19	28.56	8.05	6.91	0.238
12JUL92	A	1.20	6	4.8	9.31	28.57	8.06	6.78	0.245
12JUL92	B	0.00	11	10.2	16.90	28.84	8.03	6.81	0.253
12JUL92	B	1.80	11	10.2	17.40	28.84	8.02	6.62	0.256

12JUL92	C	0.00	21	21.5	33.20	29.20	7.91	6.30	0.253
12JUL92	C	2.70	21	21.6	34.30	29.10	7.93	6.16	0.255
12JUL92	D	0.00	32	31.9	48.90	28.54	7.89	6.28	0.243
12JUL92	D	4.10	32	32.9	50.10	28.12	7.92	4.25	0.248

Table 8. Sediment grain size in the Lavaca Estuary. Mean for *n* replicates.

Date	Station	Depth (cm)	*n*	Rubble (%)	Sand (%)	Silt (%)	Clay (%)
29NOV84	45	3	1	5.9	81.9	5.1	7.1
29NOV84	45	10	1	2.7	93.4	2.2	1.7
29NOV84	45	20	1	1.1	89.2	4.9	4.8
29NOV84	603	3	1	5.7	25.3	10.0	59.1
29NOV84	603	10	1	1.2	6.7	12.4	79.7
29NOV84	603	20	1	1.3	1.8	10.5	86.5
29NOV84	613	3	1	2.4	46.7	23.5	27.3
29NOV84	613	10	1	0.7	43.9	19.5	35.9
29NOV84	613	20	1	1.0	59.9	13.8	25.3
29NOV84	65	3	1	39.9	47.1	6.2	6.7
29NOV84	65	10	1	8.2	16.3	25.5	50.0
29NOV84	65	20	1	3.4	24.0	26.9	45.7
14AUG85	45	3	1	59.6	38.3	0.5	1.6
14AUG85	45	10	1	57.0	41.1	0.2	1.6
14AUG85	45	20	1	67.7	31.1	0.2	1.1
14AUG85	603	3	1	3.0	57.1	10.1	29.8
14AUG85	603	10	1	3.5	52.7	10.6	33.3
14AUG85	603	20	1	3.5	47.0	10.7	38.8
14AUG85	613	3	1	0.9	29.6	17.9	51.7
14AUG85	613	10	1	7.6	47.3	13.1	32.0
14AUG85	613	20	1	0.6	57.6	14.0	27.8
14AUG85	623	3	1	0.5	76.7	11.3	11.5
14AUG85	623	10	1	2.6	63.3	18.2	16.0
14AUG85	623	20	1	0.8	51.4	21.4	26.4
14AUG85	633	3	1	0.5	90.0	5.0	4.5
14AUG85	633	10	1	0.7	84.3	8.1	6.9
14AUG85	633	20	1	0.6	80.2	10.3	8.9
14AUG85	65	3	1	9.2	80.1	4.5	6.2
14AUG85	65	10	1	11.9	51.9	11.6	24.6
14AUG85	65	20	1	0.9	13.2	24.3	61.5
14AUG85	85	.	1	0.8	61.2	17.6	20.4
14AUG85	85	10	1	0.7	49.1	29.5	20.7
14AUG85	85	20	1	1.2	18.8	31.3	48.6
28NOV85	623	3	1	0.3	69.7	12.3	17.7
28NOV85	623	10	1	0.3	61.0	19.0	19.6
28NOV85	623	20	1	1.5	59.6	27.7	11.2
28NOV85	85	3	1	1.2	66.1	15.8	16.9
28NOV85	85	10	1	1.0	61.9	17.3	19.8
28NOV85	85	20	1	0.6	51.6	19.0	28.9
06AUG86	45	3	1	3.6	86.6	4.3	5.5

06AUG86	45	10	1	2.9	78.0	9.9	9.2
06AUG86	45	20	1	18.9	50.2	13.9	17.0
06AUG86	603	3	1	1.4	46.7	23.3	28.7
06AUG86	603	10	1	3.1	57.1	10.5	29.3
06AUG86	603	20	1	2.4	52.9	12.1	32.5
06AUG86	613	3	1	0.6	42.1	17.9	39.3
06AUG86	613	10	1	1.0	52.5	14.6	32.0
06AUG86	613	20	1	1.1	46.0	17.2	35.7
06AUG86	623	3	1	0.7	56.4	26.4	16.4
06AUG86	623	10	1	0.3	64.1	18.3	17.4
06AUG86	623	20	1	0.4	47.3	23.0	29.3
06AUG86	633	3	1	0.2	55.2	23.5	21.0
06AUG86	633	10	1	60.4	0.1	21.1	18.4
06AUG86	633	20	1	0.9	62.8	22.4	13.9
06AUG86	65	3	1	4.7	74.4	9.7	11.3
06AUG86	65	10	1	4.3	73.1	11.3	11.4
06AUG86	65	20	1	3.8	34.8	17.0	44.5
06AUG86	85	3	1	10.2	68.1	6.1	15.6
06AUG86	85	10	1	1.8	67.2	13.2	17.8
06AUG86	85	20	1	0.9	46.0	26.0	27.1
18APR88	A	3	3	2.5	77.4	9.9	10.3
18APR88	A	10	3	0.9	39.1	25.6	34.3
18APR88	B	3	3	0.5	8.0	34.1	57.4
18APR88	B	10	3	0.5	5.2	31.9	62.3
18APR88	C	3	3	5.3	26.1	29.1	39.5
18APR88	C	10	3	1.8	27.2	25.8	45.1
18APR88	D	3	3	0.9	12.1	23.3	63.6
18APR88	D	10	3	1.1	14.5	24.0	60.4
19JUL88	A	3	3	4.7	54.9	14.9	25.5
19JUL88	A	10	3	0.8	39.3	22.1	37.9
19JUL88	B	3	3	1.0	34.2	21.4	43.5
19JUL88	B	10	3	1.2	10.0	27.9	60.8
19JUL88	C	3	3	4.0	33.3	19.6	43.2
19JUL88	C	10	3	1.2	27.2	21.5	50.1
19JUL88	D	3	3	0.6	14.2	24.0	61.2
19JUL88	D	10	3	1.7	14.8	23.2	60.3
23OCT90	A	3	1	0.1	0.7	29.5	69.8
23OCT90	A	10	1	0.5	5.9	26.2	67.4
23OCT90	B	3	1	5.0	41.0	18.9	35.2
23OCT90	B	10	1	1.3	25.9	22.5	50.3
23OCT90	C	3	1	33.8	39.7	8.5	18.1
23OCT90	C	10	1	21.2	34.0	12.7	32.1
23OCT90	D	3	1	1.7	22.7	28.4	47.3
23OCT90	D	10	1	1.8	28.8	22.7	46.6
14OCT91	A	3	1	1.2	1.9	73.8	23.1
14OCT91	A	10	1	0.3	25.9	52.8	21.1
14OCT91	B	3	1	0.1	18.8	44.2	36.9

14OCT91	B	10	1	0.3	28.0	24.4	47.3
14OCT91	C	3	1	2.0	28.1	56.8	13.2
14OCT91	C	10	1	1.3	34.5	21.0	43.2
14OCT91	D	3	1	0.8	15.7	26.2	57.3
14OCT91	D	10	1	0.4	3.1	85.2	11.2

Table 9. Lavaca-Colorado Estuary macrofauna abundance and biomass. Average abundance ($n \cdot m^{-2}$) and biomass ($g \cdot m^{-2}$) for three replicates to a depth of 10 cm.

Date	Station	Abundance	STD	Biomass	STD
28NOV84	A	8149	2521	.	.
23JAN85	A	8451	4803	.	.
06MAR85	A	7621	3524	.	.
03APR85	A	5961	1925	.	.
08MAY85	A	7319	1699	.	.
05JUN85	A	7847	3073	.	.
17JUL85	A	7092	2483	.	.
14AUG85	A	5357	915	.	.
22OCT85	A	3546	692	.	.
04DEC85	A	2113	653	.	.
05FEB86	A	6036	1898	.	.
09APR86	A	14109	2911	.	.
04JUN86	A	7319	2267	.	.
06AUG86	A	5357	795	.	.
18APR88	A	29499	1771	7.381	2.875
19JUL88	A	7941	1725	0.824	0.633
22NOV88	A	9170	1181	2.687	1.577
05APR89	A	26757	6344	10.678	7.117
22JUL89	A	8035	2412	3.790	1.532
05DEC89	A	7658	2269	0.760	0.455
10APR90	A	14560	867	7.956	2.892
31JUL90	A	4349	1845	2.808	4.143
23OCT90	A	2269	750	0.208	0.046
25JAN91	A	1702	851	0.039	0.026
24APR91	A	1891	912	1.082	1.787
24JUL91	A	4822	1501	0.368	0.090
14OCT91	A	5956	3930	0.397	0.207
20JAN92	A	8698	3974	1.373	1.020
06APR92	A	5011	1146	0.689	0.281
18APR88	B	18531	2412	2.605	0.494
19JUL88	B	11249	3124	1.886	1.578
22NOV88	B	8508	1860	0.667	0.450
05APR89	B	11629	2948	5.549	2.101
22JUL89	B	8508	2947	1.812	1.083
05DEC89	B	9455	1456	3.604	2.949
10APR90	B	12575	3592	3.418	1.567
31JUL90	B	4444	590	1.330	0.963
23OCT90	B	10400	3324	2.004	1.326
25JAN91	B	11251	1279	2.896	1.116
24APR91	B	3593	655	0.797	0.332

24JUL91	B	10684	912	1.075	0.467
14OCT91	B	4349	655	0.633	0.553
20JAN92	B	5200	1310	1.358	1.272
06APR92	B	6524	851	0.427	0.168
18APR88	C	32334	12286	13.456	12.015
19JUL88	C	17961	7553	5.989	3.402
22NOV88	C	14369	2147	4.429	1.452
05APR89	C	8226	4292	8.055	9.434
22JUL89	C	4821	2423	1.089	1.340
05DEC89	C	17586	7057	8.484	3.390
10APR90	C	22975	4687	9.729	5.110
31JUL90	C	22313	8069	7.154	1.831
23OCT90	C	42073	4932	51.454	34.782
25JAN91	C	25149	5746	16.861	7.671
24APR91	C	22218	4766	13.160	4.084
24JUL91	C	17775	912	10.048	3.667
14OCT91	C	16546	2379	6.326	3.199
20JAN92	C	3120	284	0.928	0.344
06APR92	C	3215	3360	0.589	0.398
18APR88	D	101340	47872	12.249	4.113
19JUL88	D	25808	3196	10.579	5.802
22NOV88	D	41027	7851	3.817	1.118
05APR89	D	29782	2947	28.041	25.082
22JUL89	D	22972	3001	43.350	23.086
05DEC89	D	17397	4248	35.999	17.594
10APR90	D	25244	4643	26.730	13.264
31JUL90	D	12669	3934	6.370	5.801
23OCT90	D	8604	1889	9.814	3.021
25JAN91	D	15317	1300	5.895	2.275
24APR91	D	37440	10506	28.549	18.105
24JUL91	D	13804	6255	4.787	5.401
14OCT91	D	13142	2412	3.452	2.024
20JAN92	D	9927	2836	6.879	4.752
06APR92	D	14182	8428	11.842	9.012

Table 10. Lavaca-Colorado Estuary species list. Average density ($n \cdot m^{-2}$) over entire study period to a depth of 10 cm.

Taxa	A	B	C	D
Cnidaria				
Anthozoa				
Anthozoa (unidentified)	0	13	13	113
Platyhelminthes				
Turbellaria				
Turbellaria (unidentified)	13	6	69	44
Rynchocoela				
Rhynchocoel (unidentified)	63	101	479	775
Phoronida				
Phoronis architecta	0	50	19	44
Mollusca				
Gastropoda				
Gastropoda (unidentified)	6	6	6	0
Caecidae				
Caecum johnsoni	0	0	19	25
Columbellidae				
Mitrella lunata	0	0	6	0
Nassariidae				
Nassarius acutus	25	32	32	25
Nassarius vibex	0	0	0	13
Pyramidellidae				
Odostomia sp.	19	13	0	0
Turbonilla sp.	0	19	101	6
Pyramidella crenulata	19	82	13	0
Pyramidella sp.	19	25	6	0
Retusidae				
Acteocina canaliculata	107	88	13	13
Crepidulidae				
Crepidula fornicata	0	0	0	19
Hydrobiidae				
Littoridina sphinctostoma	19	0	0	0
Scaphopoda				
Dentaliidae				
Dentalium texasianum	0	0	0	13
Pelecypoda				
Pelecypoda (unidentified)	32	19	32	498
Nuculanidae				
Nuculana acuta	0	0	6	44
Nuculana concentrica	19	38	32	38
Arcidae				

Anadara ovalis	0	0	0	6
Cultellidae				
Ensis minor	88	0	0	0
Leptonidae				
Mysella planulata	25	19	6	19
Tellinidae				
Macoma tenta	0	0	0	13
Tellina sp.	50	38	0	6
Tellina texana	0	0	0	6
Macoma mitchelli	189	101	6	19
Semelidae				
Abra aequalis	0	0	0	76
Veneridae				
Mercenaria campechiensis	0	0	0	6
Corbulidae				
Corbula contracta	0	0	0	788
Pandoridae				
Pandora trilineata	0	13	0	6
Sportellidae				
Aligena texasiana	0	0	13	0
Mactridae				
Mulinia lateralis	693	353	44	19
Periplomatidae				
Periploma margaritaceum	0	0	113	76
Periploma cf. *orbiculare*	0	0	101	1260
Solecurtidae				
Tagelus plebeius	50	0	0	0
Ostreidae				
Crassostrea virginica	0	6	0	0
Hiatellidae				
Hiatella arctica	0	0	0	101
Myidae				
Paramya subovata	0	0	0	132
Annelida				
Polychaeta				
Polynoidae				
Eunoe cf. *nodulosa*	0	0	0	32
Polynoidae (unidentified)	0	0	0	6
Sigalionidae				
Sigalionidae (unidentified)	0	0	38	50
Palmyridae (=Chrysopetalidae)				
Paleanotus heteroseta	0	0	107	366
Phyllodocidae				
Eteone heteropoda	6	0	0	6
Anaitides erythrophyllus	6	0	6	0
Phyllodocidae (unidentified)	6	0	0	0

Pilargiidae				
Sigambra bassi	0	0	0	6
Sigambra tentaculata	0	0	13	126
Ancistrosyllis groenlandica	0	0	19	38
Ancistrosyllis papillosa	0	0	6	13
Parandalia ocularis	76	13	13	0
Ancistrosyllis cf. *falcata*	0	0	0	6
Sigambra cf. *wassi*	0	0	0	6
Pilargiidae (unidentified)	0	0	6	13
Hesionidae				
Gyptis vittata	13	19	435	221
Podarke obscura	0	0	6	13
Syllidae				
Sphaerosyllis cf. *sublaevis*	0	0	0	6
Sphaerosyllis erinaceus	0	0	6	6
Brania clavata	0	0	334	6
Sphaerosyllis sp. A	19	13	32	120
Syllidae (unidentified)	0	0	44	6
Nereidae				
Nereis succinea	0	0	6	0
Ceratonereis irritabilis	0	0	6	0
Laeonereis culveri	6	6	0	0
Nereidae (unidentified)	25	0	13	76
Nephtyidae				
Aglaophamus verrilli	0	0	0	13
Glyceridae				
Glycera americana	0	6	38	19
Glycera capitata	0	0	0	6
Glyceridae (unidentified)	32	6	0	0
Goniadidae				
Glycinde solitaria	290	145	246	107
Onuphidae				
Diopatra cuprea	25	25	38	57
Arabellidae				
Drilonereis magna	0	6	996	107
Dorvilleidae				
Schistomeringosrudolphi	0	0	6	19
Schistomeringossp.A	0	0	19	0
Spionidae				
Polydoraligni	44	0	6	0
Minuspiocirrifera	0	0	359	1216
Paraprionospiopinnata	57	221	170	158
Apoprionospiopygmaea	0	0	13	0
Scolelepistexana	0	6	0	0
Polydorasocialis	0	0	107	6
Streblospiobenedicti	1122	1802	233	95
Polydoracaulleryi	0	0	1796	1046

Polydora sp.	0	0	0	19
Scolelepis squamata	13	0	0	0
Spionidae (unidentified)	0	0	38	397
Magelonidae				
Magelona pettiboneae	0	0	19	0
Magelona phyllisae	0	0	19	6
Chaetopteridae				
Spiochaetopterus costarum	32	25	151	13
Cirratulidae				
Tharyx setigera	0	0	1185	13
Cirriformia filigera	0	0	6	0
Cossuridae				
Cossura delta	202	542	410	674
Orbiniidae				
Haploscoloplos foliosus	57	82	25	76
Naineris laevigata	0	0	25	410
Paraonidae				
Paraonidae Grp. A	0	0	271	25
Paraonidae Grp. B	0	0	1109	498
Opheliidae				
Armandia maculata	0	0	6	50
Capitellidae				
Capitella capitata	32	38	0	0
Mediomastus californiensis	2527	2105	3599	3687
Notomastus latericeus	0	0	6	25
Notomastus cf. *latericeus*	0	0	19	38
Heteromastus filiformis	82	25	0	0
Mediomastus ambiseta	1531	2426	2779	2042
Capitellidae (unidentified)	0	0	13	6
Maldanidae				
Branchioasychis americana	6	13	170	25
Clymenella torquata	13	0	76	19
Asychis sp.	6	0	189	0
Clymenella mucosa	38	50	246	13
Maldanidae (unidentified)	0	50	139	76
Oweniidae				
Owenia fusiformis	0	0	13	0
Flabelligeridae				
Brada cf. *villosacapensis*	0	0	0	6
Pectinariidae				
Pectinaria gouldii	0	0	0	6
Ampharetidae				
Melinna maculata	13	25	57	13
Terebellidae				
Amaenana trilobata	0	0	38	25
Pista palmata	0	0	19	0
Terebellidae (unidentified)	0	0	6	32

Sabellidae				
Sabella microphthalma	0	0	13	0
Megalomma bioculatum	0	6	13	0
Sabellidae (unidentified)	0	0	6	0
Polychaete juv. (unidentified)	0	13	6	50
Oligochaeta				
Oligochaetes (unidentified)	0	0	76	693
Sipuncula				
Phascolion strombi	0	0	6	113
Sipuncula (unidentified)	0	0	0	6
Crustacea				
Ostracoda				
Myodocopa				
Sarsiella texana	13	0	13	0
Sarsiella spinosa	0	0	13	6
Copepoda				
Calanoida				
Diaptomidae				
Pseudodiaptomus coronatus	6	25	32	32
Cyclopoida				
Cyclopidae				
Hemicyclops sp.	6	0	0	19
Lichomolgidae				
Cyclopoid copepod (commensal)	69	19	0	0
Malacostraca				
Natantia				
Ogyrididae				
Ogyrides limicola	0	6	6	0
Penaeidae				
Trachypenaeus constrictus	0	0	6	6
Reptantia				
Paguridae				
Pagurus annulipes	0	0	0	19
Pagurid juv.	0	0	13	0
Portunidae				
Callinectes similis	0	0	6	0
Xanthidae				
Xanthidae (unidentified)	0	0	6	0
Pinnotheridae				
Pinnixa sp.	0	0	0	32
Pinnixa cristata	0	0	13	0
Pinnixa chacei	0	0	25	101
Pinnixa retinens	0	0	13	0
Pinnotheridae (unidentified)	0	0	0	6
Brachyuran Larvae				
Megalops	0	6	0	6
Mysidacea				

Mysidopsis bigelowi	0	0	44	0
Mysidopsis bahia	13	6	19	13
Mysidopsis sp.	6	19	13	13
Cumacea				
Cyclaspis varians	69	76	6	0
Oxyurostylis sp.	0	6	19	6
Leucon sp.	57	88	13	0
Oxyurostylis salinoi	0	0	101	0
Oxyurostylis smithi	63	13	32	6
Eudorella sp.	0	32	13	0
Amphipoda				
Amphipoda (unidentified)	0	0	6	13
Ampeliscidae				
Ampelisca sp.B	0	0	6	32
Ampelisca abdita	1097	101	38	6
Ampelisca verrilli	0	0	13	0
Gammaridae				
Gammarus mucronatus	6	0	0	0
Oedicerotidae				
Monoculodes sp.	19	13	19	0
Corophiidae				
Erichthonias brasiliensis	0	0	0	25
Corophium ascherusicum	0	0	0	6
Photis sp.	0	0	13	0
Microprotopus sp.	19	13	6	0
Liljeborgiidae				
Listriella barnardi	6	6	38	44
Listriella clymenellae	0	0	13	0
Caprellidae				
Caprellid	6	0	13	6
Amphilochidae				
Amphilochus sp.	0	0	6	0
Isopoda				
Idoteidae				
Edotea montosa	44	0	0	0
Tanaidacea				
Apseudidae				
Apseudes sp.A	0	0	6	7304
Insecta				
Pterygota				
Diptera				
Chironomidae				
Chironomid larvae	6	0	0	0
Echinodermata				
Ophiuroidea				
Ophiuroidea (unidentified)	0	0	208	529

Chordata				
Hemichordata				
Schizocardium sp.	0	6	258	447

Table 11. Diversity measures of the Lavaca Estuary macrobenthos at each sampling date. Diveristy for entire estuary, including all samples taken at all stations.

Date	Richness		Diversity		Eveness	
	NO	R1	H'	N1	E1	E5
APR88	235	30.9	2.68	14.7	0.492	10.36
JUL88	188	28.8	3.81	45.2	0.728	1.356
NOV88	191	28.6	3.46	31.9	0.659	4.901
APR89	235	35.0	3.73	41.5	0.682	1.454
JUL89	166	26.8	4.64	104	0.908	0.770
DEC89	221	34.9	3.60	36.4	0.666	5.511
APR90	294	43.9	2.91	18.4	0.513	18.15
JUL90	166	26.9	4.56	96.0	0.893	0.665
OCT90	178	27.2	3.73	41.5	0.719	1.443
JAN91	179	28.1	4.31	74.4	0.831	1.073
APR91	174	26.5	4.14	62.7	0.802	0.904
JUL91	161	25.8	4.58	97.3	0.901	0.755
OCT91	146	24.0	4.49	88.8	0.900	0.808
JAN92	116	20.3	4.31	74.5	0.907	0.742
APR92	87	15.0	3.90	49.3	0.873	0.751

Table 12. Species abundance at each station×date combination in the Lavaca Estuary. Average number of individuals • m^{-2} for three replicates to a depth of 10 cm.

		Station			
Date	Species	A	B	C	D
NOV84	*Mediomastus californiensis*	7468	.	.	.
NOV84	*Streblospio benedicti*	2080	.	.	.
NOV84	*Macoma mitchelli*	567	.	.	.
NOV84	*Capitella capitata*	95	.	.	.
	TOTAL	10210	.	.	.
JAN85	*Mediomastus californiensis*	5105	.	.	.
JAN85	*Streblospio benedicti*	3498	.	.	.
JAN85	*Macoma mitchelli*	1229	.	.	.
JAN85	*Polydora socialis*	284	.	.	.
JAN85	*Mulinia lateralis*	284	.	.	.
JAN85	*Edotea montosa*	189	.	.	.
	TOTAL	10588	.	.	.
MAR85	*Mediomastus californiensis*	6901	.	.	.
MAR85	*Streblospio benedicti*	1418	.	.	.
MAR85	*Macoma mitchelli*	567	.	.	.
MAR85	*Polydora socialis*	284	.	.	.
MAR85	*Mulinia lateralis*	189	.	.	.
MAR85	*Rhynchocoel (unidentified)*	95	.	.	.
MAR85	*Sigambra tentaculata*	95	.	.	.
	TOTAL	9548	.	.	.
APR85	*Mediomastus californiensis*	5105	.	.	.
APR85	*Streblospio benedicti*	1134	.	.	.
APR85	*Mulinia lateralis*	473	.	.	.
APR85	*Macoma mitchelli*	473	.	.	.
APR85	*Chironomid larvae*	189	.	.	.
APR85	*Hobsonia florida*	95	.	.	.
	TOTAL	7468	.	.	.
MAY85	*Mediomastus californiensis*	6428	.	.	.
MAY85	*Streblospio benedicti*	1702	.	.	.
MAY85	*Hobsonia florida*	473	.	.	.
MAY85	*Corophium louisianum*	189	.	.	.
MAY85	*Chironomid larvae*	189	.	.	.
MAY85	*Ancistrosyllis jonesi*	95	.	.	.

MAY85	*Mulinia lateralis*	95	.	.	.
	TOTAL	9170	.	.	.
JUN85	*Mediomastus californiensis*	4727	.	.	.
JUN85	*Streblospio benedicti*	3309	.	.	.
JUN85	*Mulinia lateralis*	378	.	.	.
JUN85	*Hobsonia florida*	378	.	.	.
JUN85	*Capitella capitata*	284	.	.	.
JUN85	Oligochaetes (unidentified)	189	.	.	.
JUN85	*Monoculodes* sp.	189	.	.	.
JUN85	*Ancistrosyllis jonesi*	95	.	.	.
JUN85	*Sigambra tentaculata*	95	.	.	.
JUN85	*Corophium louisianum*	95	.	.	.
JUN85	*Macoma mitchelli*	95	.	.	.
	TOTAL	9831	.	.	.
JUL85	*Mediomastus californiensis*	4727	.	.	.
JUL85	*Streblospio benedicti*	3592	.	.	.
JUL85	Oligochaetes (unidentified)	284	.	.	.
JUL85	*Macoma mitchelli*	189	.	.	.
JUL85	*Mysidopsis* sp.	95	.	.	.
	TOTAL	8886	.	.	.
AUG85	*Mediomastus californiensis*	4254	.	.	.
AUG85	*Streblospio benedicti*	1513	.	.	.
AUG85	Rhynchocoel (unidentified)	284	.	.	.
AUG85	*Capitella capitata*	284	.	.	.
AUG85	*Macoma mitchelli*	284	.	.	.
AUG85	*Laeonereis culveri*	95	.	.	.
	TOTAL	6712	.	.	.
OCT85	*Mediomastus californiensis*	2836	.	.	.
OCT85	*Streblospio benedicti*	945	.	.	.
OCT85	*Glycinde solitaria*	378	.	.	.
OCT85	*Cyclaspis varians*	189	.	.	.
OCT85	Oligochaetes (unidentified)	95	.	.	.
	TOTAL	4443	.	.	.
DEC85	*Mediomastus californiensis*	2269	.	.	.
DEC85	Rhynchocoel (unidentified)	95	.	.	.
DEC85	*Streblospio benedicti*	95	.	.	.
DEC85	*Mulinia lateralis*	95	.	.	.
DEC85	*Macoma mitchelli*	95	.	.	.
	TOTAL	2647	.	.	.
FEB86	*Macoma mitchelli*	2836	.	.	.
FEB86	*Mulinia lateralis*	1607	.	.	.

FEB86	*Streblospio benedicti*	945	.	.	.
FEB86	*Mediomastus californiensis*	945	.	.	.
FEB86	Oligochaetes (unidentified)	284	.	.	.
FEB86	*Ampelisca abdita*	284	.	.	.
FEB86	*Polydora socialis*	189	.	.	.
FEB86	*Eteone heteropoda*	95	.	.	.
FEB86	*Edotea montosa*	95	.	.	.
FEB86	*Corophium louisianum*	95	.	.	.
FEB86	*Monoculodes* sp.	95	.	.	.
FEB86	*Laeonereis culveri*	95	.	.	.
	TOTAL	7563	.	.	.
APR86	*Mediomastus californiensis*	11628	.	.	.
APR86	*Streblospio benedicti*	2458	.	.	.
APR86	*Macoma mitchelli*	945	.	.	.
APR86	*Tagelus plebeius*	662	.	.	.
APR86	*Ampelisca abdita*	473	.	.	.
APR86	*Capitella capitata*	189	.	.	.
APR86	*Mulinia lateralis*	189	.	.	.
APR86	*Edotea montosa*	189	.	.	.
APR86	*Odostomia* cf. *gibbosa*	189	.	.	.
APR86	Rhynchocoel (unidentified)	95	.	.	.
APR86	*Eteone heteropoda*	95	.	.	.
APR86	*Sigambra tentaculata*	95	.	.	.
APR86	*Glycinde solitaria*	95	.	.	.
APR86	*Scolelepis texana*	95	.	.	.
APR86	*Haploscoloplos foliosus*	95	.	.	.
APR86	*Ensis minor*	95	.	.	.
APR86	*Cyclaspis varians*	95	.	.	.
	TOTAL	17678	.	.	.
JUN86	*Mediomastus californiensis*	7185	.	.	.
JUN86	*Glycinde solitaria*	851	.	.	.
JUN86	*Streblospio benedicti*	662	.	.	.
JUN86	Rhynchocoel (unidentified)	284	.	.	.
JUN86	*Macoma mitchelli*	189	.	.	.
	TOTAL	9170	.	.	.
AUG86	*Mediomastus californiensis*	5010	.	.	.
AUG86	*Streblospio benedicti*	1134	.	.	.
AUG86	Oligochaetes (unidentified)	284	.	.	.
AUG86	Rhynchocoel (unidentified)	95	.	.	.
AUG86	*Polydora socialis*	95	.	.	.
AUG86	*Callianassa* sp.	95	.	.	.
	TOTAL	6712	.	.	.

APR88	*Mediomastus californiensis*	18150	10588	10304	15693
APR88	*Mulinia lateralis*	3309	1891	0	0
APR88	*Glycinde solitaria*	2269	662	1134	756
APR88	*Streblospio benedicti*	1229	662	189	0
APR88	*Cyclaspis varians*	662	189	0	0
APR88	*Tagelus plebeius*	662	0	0	0
APR88	*Oxyurostylis smithi*	567	189	378	95
APR88	*Ensis minor*	473	0	0	0
APR88	*Ampelisca abdita*	378	95	0	0
APR88	Nereidae (unidentified)	284	0	0	0
APR88	*Parandalia ocularis*	284	0	0	0
APR88	*Capitella capitata*	189	0	0	0
APR88	*Littoridina sphinctostoma*	189	0	0	0
APR88	*Scolelepis squamata*	189	0	0	0
APR88	*Cossura delta*	95	3309	189	1229
APR88	Rhynchocoel (unidentified)	95	95	1323	662
APR88	*Eteone heteropoda*	95	0	0	0
APR88	*Edotea montosa*	95	0	0	0
APR88	*Gammarus mucronatus*	95	0	0	0
APR88	*Monoculodes* sp.	95	0	0	0
APR88	Phyllodocidae (unidentified)	95	0	0	0
APR88	*Haploscoloplos foliosus*	0	189	378	189
APR88	Cyclopoid copepod (commensal)	0	189	0	0
APR88	*Branchioasychis americana*	0	95	189	0
APR88	Polychaete juv. (unidentified)	0	95	0	284
APR88	*Melinna maculata*	0	95	0	0
APR88	*Microprotopus* spp.	0	95	0	0
APR88	*Pyramidella* sp.	0	95	0	0
APR88	*Polydora caulleryi*	0	0	8035	945
APR88	*Brania clavata*	0	0	5010	95
APR88	*Gyptis vittata*	0	0	1040	756
APR88	*Drilonereis magna*	0	0	756	95
APR88	*Schizocardium* sp.	0	0	662	0
APR88	Spionidae (unidentified)	0	0	567	3498
APR88	Oligochaetes (unidentified)	0	0	473	1702
APR88	Pelecypoda (unidentified)	0	0	189	3214
APR88	*Clymenella mucosa*	0	0	189	95
APR88	*Paleanotus heteroseta*	0	0	95	95
APR88	*Paraprionospio pinnata*	0	0	95	95
APR88	*Phoronis architecta*	0	0	95	95
APR88	*Notomastus* cf. *latericeus*	0	0	95	95
APR88	*Caecum johnsoni*	0	0	95	95
APR88	*Tharyx setigera*	0	0	95	0
APR88	*Clymenella torquata*	0	0	95	0
APR88	*Nuculana acuta*	0	0	95	0
APR88	*Acteocina canaliculata*	0	0	95	0
APR88	*Nassarius acutus*	0	0	95	0

APR88	*Nuculana concentrica*	0	0	95	0
APR88	*Paraonidae* Grp.A	0	0	95	0
APR88	*Sarsiella texana*	0	0	95	0
APR88	Turbellaria (unidentified)	0	0	95	0
APR88	Apseudes sp.A	0	0	0	67308
APR88	*Corbula contracta*	0	0	0	1040
APR88	*Periploma* cf. *orbiculare*	0	0	0	945
APR88	Ophiuroidea (unidentified)	0	0	0	662
APR88	Paraonidae Grp.B	0	0	0	378
APR88	Anthozoa (unidentified)	0	0	0	284
APR88	*Glycera americana*	0	0	0	284
APR88	*Diopatra cuprea*	0	0	0	189
APR88	*Eunoe* cf. *nodulosa*	0	0	0	95
APR88	Polydora sp.	0	0	0	95
APR88	*Notomastus latericeus*	0	0	0	95
APR88	Terebellidae (unidentified)	0	0	0	95
APR88	*Armandiam aculata*	0	0	0	95
	TOTAL	29494	18529	32330	101340
JUL88	*Mediomastus californiensis*	5294	8035	6239	3876
JUL88	*Streblospio benedicti*	1040	95	0	0
JUL88	*Cossura delta*	378	284	284	473
JUL88	*Ampelisca abdita*	284	284	0	0
JUL88	Pyramidella sp.	189	189	0	0
JUL88	*Mysidopsis bahia*	189	0	0	0
JUL88	*Glycinde solitaria*	95	473	189	95
JUL88	*Mulinia lateralis*	95	378	0	0
JUL88	*Paraprionospio pinnata*	95	284	189	0
JUL88	*Macoma mitchelli*	95	95	0	0
JUL88	*Diopatra cuprea*	95	0	0	0
JUL88	*Acteocina canaliculata*	95	0	0	0
JUL88	Rhynchocoel (unidentified)	0	189	567	1796
JUL88	*Clymenella mucosa*	0	189	189	0
JUL88	Pelecypoda (unidentified)	0	189	95	284
JUL88	Odostomia sp.	0	189	0	0
JUL88	Leucon sp.	0	189	0	0
JUL88	*Gyptis vittata*	0	95	284	378
JUL88	*Cyclaspis varians*	0	95	0	0
JUL88	*Polydora caulleryi*	0	0	5956	1229
JUL88	Schizocardium sp.	0	0	756	95
JUL88	Syllidae (unidentified)	0	0	662	95
JUL88	*Tharyx setigera*	0	0	473	0
JUL88	*Branchioasychis americana*	0	0	473	0
JUL88	Oligochaetes (unidentified)	0	0	284	2458
JUL88	Paraonidae Grp.B	0	0	284	473
JUL88	*Minuspio cirrifera*	0	0	284	0
JUL88	*Drilonereis magna*	0	0	189	0

JUL88	*Periploma* cf. *orbiculare*	0	0	95	756
JUL88	Ophiuroidea (unidentified)	0	0	95	473
JUL88	Turbonilla sp.	0	0	95	95
JUL88	Turbellaria (unidentified)	0	0	95	95
JUL88	*Spiochaetopterus costarum*	0	0	95	0
JUL88	Monoculodes sp.	0	0	95	0
JUL88	Apseudes sp.A	0	0	0	8981
JUL88	Spionidae (unidentified)	0	0	0	1323
JUL88	*Paleanotus heteroseta*	0	0	0	567
JUL88	*Pinnixa chacei*	0	0	0	378
JUL88	*Eunoe* cf. *nodulosa*	0	0	0	284
JUL88	*Sigambra tentaculata*	0	0	0	189
JUL88	*Notomastus latericeus*	0	0	0	189
JUL88	Paraonidae Grp.A	0	0	0	189
JUL88	*Armandia maculata*	0	0	0	189
JUL88	Anthozoa (unidentified)	0	0	0	95
JUL88	*Dentalium texasianum*	0	0	0	95
JUL88	*Abra aequalis*	0	0	0	95
JUL88	Ampelisca sp.B	0	0	0	95
JUL88	*Phascolion strombi*	0	0	0	95
JUL88	*Listriella barnardi*	0	0	0	95
JUL88	*Nuculana concentrica*	0	0	0	95
JUL88	Megalops	0	0	0	95
JUL88	*Caecum johnsoni*	0	0	0	95
	TOTAL	7941	11249	17961	25808
NOV88	*Mediomastus californiensis*	5672	1323	6239	4821
NOV88	*Cossura delta*	851	473	378	284
NOV88	*Haploscoloplos foliosus*	567	0	0	851
NOV88	*Streblospio benedicti*	473	5767	0	0
NOV88	*Glycinde solitaria*	284	0	284	95
NOV88	*Ampelisca abdita*	189	189	0	0
NOV88	Rhynchocoel (unidentified)	189	95	189	567
NOV88	*Heteromastus filiformis*	189	0	0	0
NOV88	*Paraprionospio pinnata*	95	378	189	378
NOV88	Gastropoda (unidentified)	95	95	0	0
NOV88	*Gyptis vittata*	95	0	851	378
NOV88	Pelecypoda (unidentified)	95	0	95	1513
NOV88	*Spiochaetopterus costarum*	95	0	95	0
NOV88	*Parandalia ocularis*	95	0	95	0
NOV88	*Edotea montosa*	95	0	0	0
NOV88	Hemicyclops sp.	95	0	0	0
NOV88	Maldanidae (unidentified)	0	95	1040	378
NOV88	Leucon sp.	0	95	0	0
NOV88	Paraonidae Grp.B	0	0	1323	378
NOV88	*Tharyx setigera*	0	0	851	95
NOV88	*Polydora caulleryi*	0	0	567	378

NOV88	*Branchioasychis americana*	0	0	567	0
NOV88	*Drilonereis magna*	0	0	378	189
NOV88	*Listriella barnardi*	0	0	284	189
NOV88	Schizocardium sp.	0	0	284	0
NOV88	*Minuspio cirrifera*	0	0	95	3120
NOV88	*Polydora ligni*	0	0	95	0
NOV88	*Clymenella torquata*	0	0	95	0
NOV88	Monoculodes sp.	0	0	95	0
NOV88	Turbonilla sp.	0	0	95	0
NOV88	Paraonidae Grp.A	0	0	95	0
NOV88	Capitellidae (unidentified)	0	0	95	0
NOV88	Apseudes sp.A	0	0	0	19852
NOV88	*Corbula contracta*	0	0	0	1702
NOV88	Ophiuroidea (unidentified)	0	0	0	1040
NOV88	*Periploma* cf. *orbiculare*	0	0	0	1040
NOV88	Oligochaetes (unidentified)	0	0	0	567
NOV88	*Nuculana acuta*	0	0	0	567
NOV88	Sphaerosyllis sp.A	0	0	0	473
NOV88	Polychaete juv. (unidentified)	0	0	0	378
NOV88	*Diopatra cuprea*	0	0	0	284
NOV88	*Armandia maculata*	0	0	0	284
NOV88	*Pinnixa chacei*	0	0	0	284
NOV88	Nereidae (unidentified)	0	0	0	189
NOV88	Terebellidae (unidentified)	0	0	0	189
NOV88	*Macoma tenta*	0	0	0	95
NOV88	Tellina sp.	0	0	0	95
NOV88	*Phoronis architecta*	0	0	0	95
NOV88	*Mercenaria campechiensis*	0	0	0	95
NOV88	Turbellaria (unidentified)	0	0	0	95
NOV88	*Ancistrosyllis* cf. *falcata*	0	0	0	95
	TOTAL	9170	8508	14369	41027
APR89	*Ampelisca abdita*	12384	95	0	0
APR89	*Mulinia lateralis*	4538	945	95	95
APR89	*Mediomastus californiensis*	4065	6712	4065	9359
APR89	Cyclopoid copepod (commensal)	1040	95	0	0
APR89	*Ensis minor*	756	0	0	0
APR89	Glyceridae (unidentified)	473	95	0	0
APR89	*Streblospio benedicti*	378	189	189	0
APR89	*Mysella planulata*	378	95	0	95
APR89	*Oxyurostylis smithi*	378	0	95	0
APR89	*Cyclaspis varians*	378	0	0	0
APR89	*Cossura delta*	284	378	0	284
APR89	*Haploscoloplos foliosus*	189	662	0	95
APR89	*Acteocina canaliculata*	189	378	0	189
APR89	Monoculodes sp.	189	0	0	0
APR89	*Paraprionospio pinnata*	95	378	284	95

APR89	*Diopatra cuprea*	95	189	0	0
APR89	*Gyptis vittata*	95	95	189	189
APR89	Turbellaria (unidentified)	95	95	0	0
APR89	Pyramidella sp.	95	0	95	0
APR89	*Anaitides erythrophyllus*	95	0	0	0
APR89	*Spiochaetopterus costarum*	95	0	0	0
APR89	*Clymenella torquata*	95	0	0	0
APR89	*Edotea montosa*	95	0	0	0
APR89	Caprellid	95	0	0	0
APR89	*Tagelus plebeius*	95	0	0	0
APR89	*Parandalia ocularis*	95	0	0	0
APR89	*Macoma mitchelli*	0	378	95	0
APR89	*Nuculana concentrica*	0	189	0	284
APR89	*Clymenella mucosa*	0	95	662	0
APR89	*Glycinde solitaria*	0	95	284	95
APR89	Maldanidae (unidentified)	0	95	0	0
APR89	*Ogyrides limicola*	0	95	0	0
APR89	Schizocardium sp.	0	95	0	0
APR89	*Pandora trilineata*	0	95	0	0
APR89	Leucon sp.	0	95	0	0
APR89	Rhynchocoel (unidentified)	0	0	378	1134
APR89	*Drilonereis magna*	0	0	378	473
APR89	*Tharyx setigera*	0	0	378	0
APR89	Paraonidae Grp.A	0	0	189	0
APR89	*Minuspio cirrifera*	0	0	95	1702
APR89	Oligochaetes (unidentified)	0	0	95	95
APR89	*Branchioasychis americana*	0	0	95	95
APR89	Polychaete juv. (unidentified)	0	0	95	95
APR89	*Sphaerosyllis erinaceus*	0	0	95	95
APR89	*Ceratonereis irritabilis*	0	0	95	0
APR89	Turbonilla sp.	0	0	95	0
APR89	*Callinectes similis*	0	0	95	0
APR89	*Pinnixa chacei*	0	0	95	0
APR89	Apseudes sp.A	0	0	0	3970
APR89	*Corbula contracta*	0	0	0	2931
APR89	*Periploma* cf. *orbiculare*	0	0	0	2552
APR89	*Paleanotus heteroseta*	0	0	0	756
APR89	*Polydora caulleryi*	0	0	0	662
APR89	Ophiuroidea (unidentified)	0	0	0	662
APR89	Sphaerosyllis sp.A	0	0	0	567
APR89	*Phascolion strombi*	0	0	0	473
APR89	Ampelisca sp.B	0	0	0	378
APR89	Paraonidae Grp.B	0	0	0	378
APR89	*Sigambra tentaculata*	0	0	0	189
APR89	*Nassarius vibex*	0	0	0	189
APR89	*Abra aequalis*	0	0	0	189
APR89	*Pseudodiaptomus coronatus*	0	0	0	189

APR89	*Notomastus* cf. *latericeus*	0	0	0	189
APR89	Anthozoa (unidentified)	0	0	0	95
APR89	*Melinna maculata*	0	0	0	95
APR89	*Macoma tenta*	0	0	0	95
APR89	*Tellina texana*	0	0	0	95
APR89	*Listriella barnardi*	0	0	0	95
APR89	*Anadara ovalis*	0	0	0	95
APR89	*Sphaerosyllis* cf. *sublaevis*	0	0	0	95
APR89	Nereidae (unidentified)	0	0	0	95
APR89	Terebellidae (unidentified)	0	0	0	95
APR89	Pelecypoda (unidentified)	0	0	0	95
APR89	Amphipoda (unidentified)	0	0	0	95
	TOTAL	26753	11628	8224	29778
JUL89	*Mediomastus californiensis*	3403	2552	2552	3781
JUL89	*Streblospio benedicti*	1229	2080	0	0
JUL89	*Mulinia lateralis*	662	95	0	0
JUL89	*Acteocina canaliculata*	473	0	95	0
JUL89	*Glycinde solitaria*	378	95	378	0
JUL89	*Cossura delta*	284	567	189	378
JUL89	Microprotopus spp.	284	95	0	0
JUL89	Odostomia sp.	284	0	0	0
JUL89	*Paraprionospio pinnata*	189	284	95	284
JUL89	Pelecypoda (unidentified)	189	95	0	95
JUL89	*Nassarius acutus*	95	284	95	284
JUL89	*Ampelisca abdita*	95	189	0	0
JUL89	*Diopatra cuprea*	95	0	0	0
JUL89	*Clymenella mucosa*	95	0	0	0
JUL89	*Melinnama culata*	95	0	0	0
JUL89	*Macoma mitchelli*	95	0	0	0
JUL89	*Parandalia ocularis*	95	0	0	0
JUL89	*Cyclaspis varians*	0	851	0	0
JUL89	Leucon sp.	0	284	0	0
JUL89	Rhynchocoel (unidentified)	0	189	189	945
JUL89	*Pseudodiaptomus coronatus*	0	189	95	0
JUL89	Monoculodes sp.	0	189	0	0
JUL89	*Mysidopsis bahia*	0	95	189	0
JUL89	*Spiochaetopterus costarum*	0	95	0	0
JUL89	*Pandora trilineata*	0	95	0	0
JUL89	Pyramidella sp.	0	95	0	0
JUL89	Oxyurostylis sp.	0	95	0	0
JUL89	*Listriella barnardi*	0	0	189	0
JUL89	Ophiuroidea (unidentified)	0	0	95	756
JUL89	Paraonidae Grp.B	0	0	95	284
JUL89	*Branchioasychis americana*	0	0	95	95
JUL89	*Gyptis vittata*	0	0	95	0
JUL89	*Tharyx setigera*	0	0	95	0

JUL89	*Megalomma bioculatum*	0	0	95	0
JUL89	*Ogyrides limicola*	0	0	95	0
JUL89	Mysidopsis sp.	0	0	95	0
JUL89	Apseudes sp.A	0	0	0	5294
JUL89	*Periploma* cf. *orbiculare*	0	0	0	4538
JUL89	*Corbula contracta*	0	0	0	2174
JUL89	Spionidae (unidentified)	0	0	0	1134
JUL89	*Paleanotus heteroseta*	0	0	0	662
JUL89	Sigalionidae (unidentified)	0	0	0	284
JUL89	*Notomastus* cf. *latericeus*	0	0	0	284
JUL89	Sphaerosyllis sp.A	0	0	0	189
JUL89	*Sigambra tentaculata*	0	0	0	95
JUL89	*Aglaophamus verrilli*	0	0	0	95
JUL89	*Drilonereis magna*	0	0	0	95
JUL89	*Polydora caulleryi*	0	0	0	95
JUL89	*Clymenella torquata*	0	0	0	95
JUL89	Maldanidae (unidentified)	0	0	0	95
JUL89	*Dentalium texasianum*	0	0	0	95
JUL89	*Nuculana acuta*	0	0	0	95
JUL89	Paraonidae Grp.A	0	0	0	95
JUL89	Capitellidae (unidentified)	0	0	0	95
JUL89	Terebellidae (unidentified)	0	0	0	95
JUL89	Sipuncula (unidentified)	0	0	0	95
JUL89	Turbellaria (unidentified)	0	0	0	95
JUL89	*Caecum johnsoni*	0	0	0	95
JUL89	*Pinnixa chacei*	0	0	0	95
JUL89	*Brada* cf. *villosa capensis*	0	0	0	95
	TOTAL	8035	8508	4821	22972
DEC89	*Mediomastus ambiseta*	3120	3120	662	0
DEC89	*Streblospio benedicti*	1323	1796	0	0
DEC89	Tellina sp.	567	189	0	0
DEC89	*Acteocina canaliculata*	378	0	0	0
DEC89	*Cossura delta*	284	378	473	0
DEC89	*Mulinia lateralis*	284	95	0	0
DEC89	Leucon sp.	284	95	0	0
DEC89	*Pyramidella crenulata*	189	284	0	0
DEC89	*Clymenella mucosa*	189	0	0	0
DEC89	*Mediomastus californiensis*	95	1702	5010	2647
DEC89	*Paraprionospio pinnata*	95	284	0	95
DEC89	*Spiochaetopterus costarum*	95	0	851	0
DEC89	Asychis sp.	95	0	378	0
DEC89	*Listriella barnardi*	95	0	95	95
DEC89	*Ampelisca abdita*	95	0	95	0
DEC89	Nereidae (unidentified)	95	0	0	95
DEC89	*Haploscoloplos foliosus*	95	0	0	0
DEC89	*Nuculana concentrica*	95	0	0	0

DEC89	*Sarsiella texana*	95	0	0	0
DEC89	*Parandalia ocularis*	95	0	0	0
DEC89	Maldanidae (unidentified)	0	567	756	95
DEC89	*Phoronis architecta*	0	473	0	0
DEC89	Anthozoa (unidentified)	0	189	95	95
DEC89	*Gyptis vittata*	0	95	662	284
DEC89	Rhynchocoel (unidentified)	0	95	284	378
DEC89	*Nassarius acutus*	0	95	0	95
DEC89	*Tharyx setigera*	0	0	2458	0
DEC89	*Drilonereis magna*	0	0	945	95
DEC89	*Periploma* cf. *orbiculare*	0	0	756	2269
DEC89	Ophiuroidea (unidentified)	0	0	567	756
DEC89	Paraonidae Grp.A	0	0	567	0
DEC89	*Polydora caulleryi*	0	0	378	189
DEC89	*Minuspio cirrifera*	0	0	284	2363
DEC89	Paraonidae Grp.B	0	0	284	189
DEC89	Sigalionidae (unidentified)	0	0	189	95
DEC89	*Magelona pettiboneae*	0	0	189	0
DEC89	*Branchioasychis americana*	0	0	189	0
DEC89	Photis sp.	0	0	189	0
DEC89	Oxyurostylis sp.	0	0	189	0
DEC89	Apseudes sp.A	0	0	95	473
DEC89	*Pinnixa chacei*	0	0	95	473
DEC89	Oligochaetes (unidentified)	0	0	95	284
DEC89	Pilargiidae (unidentified)	0	0	95	95
DEC89	Caprellid	0	0	95	0
DEC89	Ampelisca sp.B	0	0	95	0
DEC89	*Phascolion strombi*	0	0	95	0
DEC89	Turbonilla sp.	0	0	95	0
DEC89	Sphaerosyllis sp.A	0	0	95	0
DEC89	*Mysidopsis bahia*	0	0	95	0
DEC89	Eudorella sp.	0	0	95	0
DEC89	*Hiatella arctica*	0	0	0	1418
DEC89	*Naineris laevigata*	0	0	0	1323
DEC89	*Corbula contracta*	0	0	0	851
DEC89	*Paleanotus heteroseta*	0	0	0	662
DEC89	Schizocardium sp.	0	0	0	662
DEC89	Pelecypoda (unidentified)	0	0	0	284
DEC89	*Podarke obscura*	0	0	0	189
DEC89	Polydora sp.	0	0	0	189
DEC89	*Ancistrosyllis papillosa*	0	0	0	95
DEC89	*Sigambra tentaculata*	0	0	0	95
DEC89	*Magelona phyllisae*	0	0	0	95
DEC89	*Notomastus latericeus*	0	0	0	95
DEC89	*Mysella planulata*	0	0	0	95
DEC89	Turbellaria (unidentified)	0	0	0	95
DEC89	*Amaenana trilobata*	0	0	0	95

	TOTAL	7657	9453	17583	17394
APR90	*Mediomastus ambiseta*	5010	4916	0	1229
APR90	*Ampelisca abdita*	2647	473	378	0
APR90	*Streblospio benedicti*	1229	756	0	0
APR90	*Heteromastus filiformis*	945	378	0	0
APR90	*Glycinde solitaria*	851	473	0	0
APR90	*Polydora ligni*	567	0	0	0
APR90	*Acteocina canaliculata*	473	945	0	0
APR90	Sphaerosyllis sp.A	284	189	0	473
APR90	*Macoma mitchelli*	284	95	0	0
APR90	*Nassarius acutus*	284	0	0	0
APR90	*Cossura delta*	189	473	851	284
APR90	*Clymenella mucosa*	189	473	662	95
APR90	*Nuculana concentrica*	189	378	378	95
APR90	*Paraprionospio pinnata*	189	189	0	189
APR90	Pelecypoda (unidentified)	189	0	0	473
APR90	Leucon sp.	95	567	95	0
APR90	*Melinna maculata*	95	284	189	0
APR90	*Diopatra cuprea*	95	189	0	95
APR90	*Spiochaetopterus costarum*	95	95	1134	189
APR90	*Mulinia lateralis*	95	95	0	95
APR90	*Branchioasychis americana*	95	0	473	95
APR90	*Pseudodiaptomus coronatus*	95	0	189	95
APR90	*Sarsiella texana*	95	0	95	0
APR90	*Clymenella torquata*	95	0	0	0
APR90	*Ensis minor*	95	0	0	0
APR90	*Parandalia ocularis*	95	0	0	0
APR90	*Haploscoloplos foliosus*	0	378	0	0
APR90	Eudorella sp.	0	284	95	0
APR90	*Phoronis architecta*	0	284	0	0
APR90	Mysidopsis sp.	0	189	0	95
APR90	*Mysella planulata*	0	189	0	0
APR90	*Glycera americana*	0	95	284	0
APR90	*Scolelepis texana*	0	95	0	0
APR90	*Megalomma bioculatum*	0	95	0	0
APR90	*Mediomastus californiensis*	0	0	5767	3403
APR90	*Drilonereis magna*	0	0	3970	95
APR90	*Oxyurostylis salinoi*	0	0	1513	0
APR90	Paraonidae Grp.B	0	0	945	662
APR90	*Tharyx setigera*	0	0	756	0
APR90	Rhynchocoel (unidentified)	0	0	662	851
APR90	*Mysidopsis bigelowi*	0	0	662	0
APR90	*Periploma* cf. *orbiculare*	0	0	567	2931
APR90	*Gyptis vittata*	0	0	567	95
APR90	Paraonidae Grp.A	0	0	473	0
APR90	*Polydora socialis*	0	0	378	95

APR90	Asychis sp.	0	0	378	0
APR90	*Polydora caulleryi*	0	0	284	95
APR90	*Minuspio cirrifera*	0	0	189	2269
APR90	Turbonilla sp.	0	0	189	0
APR90	Schizocardium sp.	0	0	95	1134
APR90	*Naineris laevigata*	0	0	95	756
APR90	Ophiuroidea (unidentified)	0	0	95	473
APR90	*Amaenana trilobata*	0	0	95	284
APR90	*Magelona pettiboneae*	0	0	95	0
APR90	*Pista palmata*	0	0	95	0
APR90	*Aligena texasiana*	0	0	95	0
APR90	*Ampelisca verrilli*	0	0	95	0
APR90	Monoculodes sp.	0	0	95	0
APR90	Apseudes sp.A	0	0	0	2269
APR90	*Corbula contracta*	0	0	0	1985
APR90	*Paleanotus heteroseta*	0	0	0	756
APR90	*Abraa equalis*	0	0	0	567
APR90	Oligochaetes (unidentified)	0	0	0	473
APR90	*Erichthonias brasiliensis*	0	0	0	378
APR90	Nereidae (unidentified)	0	0	0	378
APR90	Anthozoa (unidentified)	0	0	0	284
APR90	*Crepidula fornicata*	0	0	0	284
APR90	*Pagurus annulipes*	0	0	0	284
APR90	*Schistomeringos rudolphi*	0	0	0	189
APR90	*Eteone heteropoda*	0	0	0	95
APR90	*Ancistrosyllis papillosa*	0	0	0	95
APR90	Polynoidae (unidentified)	0	0	0	95
APR90	Sigalionidae (unidentified)	0	0	0	95
APR90	Pinnotheridae (unidentified)	0	0	0	95
APR90	Pinnixa sp.	0	0	0	95
APR90	*Sarsiella spinosa*	0	0	0	95
APR90	Oxyurostylis sp.	0	0	0	95
	TOTAL	14558	12573	22972	25240
JUL90	*Streblospio benedicti*	2363	1607	189	95
JUL90	*Mediomastus ambiseta*	378	189	2647	2552
JUL90	Leucon sp.	378	0	0	0
JUL90	*Cossura delta*	284	567	95	567
JUL90	Rhynchocoel (unidentified)	95	189	756	662
JUL90	*Paraprionospio pinnata*	95	189	0	284
JUL90	*Mulinia lateralis*	95	95	0	0
JUL90	*Laeonereis culveri*	95	95	0	0
JUL90	*Clymenella mucosa*	95	0	567	0
JUL90	*Pyramidella crenulata*	95	0	189	0
JUL90	Turbellaria (unidentified)	95	0	189	0
JUL90	*Glycinde solitaria*	95	0	95	95
JUL90	*Spiochaetopterus costarum*	95	0	0	0

JUL90	*Edotea montosa*	95	0	0	0
JUL90	*Mediomastus californiensis*	0	662	756	284
JUL90	*Ampelisca abdita*	0	189	95	0
JUL90	Turbonilla sp.	0	189	95	0
JUL90	Eudorella sp.	0	189	0	0
JUL90	*Branchioasychis americana*	0	95	0	0
JUL90	*Listriella barnardi*	0	95	0	0
JUL90	*Nassarius acutus*	0	95	0	0
JUL90	*Tharyx setigera*	0	0	6334	0
JUL90	*Polydora caulleryi*	0	0	2836	0
JUL90	*Drilonereis magna*	0	0	2363	189
JUL90	Paraonidae Grp.B	0	0	1229	1418
JUL90	*Minuspio cirrifera*	0	0	756	1418
JUL90	Asychis sp.	0	0	473	0
JUL90	*Melinna maculata*	0	0	473	0
JUL90	Ophiuroidea (unidentified)	0	0	284	284
JUL90	*Clymenella torquata*	0	0	284	0
JUL90	*Sabella microphthalma*	0	0	189	0
JUL90	*Gyptis vittata*	0	0	95	189
JUL90	*Ancistrosyllis groenlandica*	0	0	95	95
JUL90	Nereidae (unidentified)	0	0	95	95
JUL90	*Caecum johnsoni*	0	0	95	95
JUL90	*Glycera americana*	0	0	95	0
JUL90	*Polydora socialis*	0	0	95	0
JUL90	*Notomastus latericeus*	0	0	95	0
JUL90	*Owenia fusiformis*	0	0	95	0
JUL90	*Listriella clymenellae*	0	0	95	0
JUL90	*Phoronis architecta*	0	0	95	0
JUL90	Schizocardium sp.	0	0	95	0
JUL90	Amphilochus sp.	0	0	95	0
JUL90	Sabellidae (unidentified)	0	0	95	0
JUL90	Sphaerosyllis sp.A	0	0	95	0
JUL90	*Cirriformia filigera*	0	0	95	0
JUL90	Oligochaetes (unidentified)	0	0	0	2174
JUL90	*Periploma* cf. *orbiculare*	0	0	0	1229
JUL90	*Paleanotus heteroseta*	0	0	0	189
JUL90	*Corbula contracta*	0	0	0	189
JUL90	*Abra aequalis*	0	0	0	95
JUL90	Paraonidae Grp.A	0	0	0	95
JUL90	*Hiatella arctica*	0	0	0	95
JUL90	Apseudes sp.A	0	0	0	95
JUL90	*Pinnixa chacei*	0	0	0	95
JUL90	*Naineris laevigata*	0	0	0	95
	TOTAL	4349	4443	22310	12667
OCT90	*Streblospio benedicti*	2174	7563	2080	0
OCT90	Leucon sp.	95	0	0	0

OCT90	*Mediomastus ambiseta*	0	1702	15220	0
OCT90	*Paraprionospio pinnata*	0	284	567	95
OCT90	*Cossura delta*	0	189	662	189
OCT90	*Spiochaetopterus costarum*	0	189	0	0
OCT90	*Pseudodiaptomus coronatus*	0	189	0	0
OCT90	*Drilonereis magna*	0	95	1418	0
OCT90	Rhynchocoel (unidentified)	0	95	473	756
OCT90	Mysidopsis sp.	0	95	0	0
OCT90	*Polydora caulleryi*	0	0	6617	0
OCT90	*Tharyx setigera*	0	0	3309	0
OCT90	Paraonidae Grp.B	0	0	1702	473
OCT90	Ophiuroidea (unidentified)	0	0	1134	662
OCT90	Asychis sp.	0	0	1040	0
OCT90	*Gyptis vittata*	0	0	945	284
OCT90	*Polydora socialis*	0	0	851	0
OCT90	*Clymenella mucosa*	0	0	851	0
OCT90	*Paleanotus heteroseta*	0	0	567	0
OCT90	*Diopatra cuprea*	0	0	473	0
OCT90	Sigalionidae (unidentified)	0	0	378	95
OCT90	Paraonidae Grp.A	0	0	378	0
OCT90	Schistomeringos sp.A	0	0	284	0
OCT90	*Amaenana trilobata*	0	0	284	0
OCT90	*Minuspio cirrifera*	0	0	189	1229
OCT90	*Apoprionospio pygmaea*	0	0	189	0
OCT90	*Clymenella torquata*	0	0	189	0
OCT90	Pagurid juv.	0	0	189	0
OCT90	*Pinnixa cristata*	0	0	189	0
OCT90	*Pinnixa retinens*	0	0	189	0
OCT90	Turbonilla sp.	0	0	189	0
OCT90	Pelecypoda (unidentified)	0	0	95	378
OCT90	Anthozoa (unidentified)	0	0	95	0
OCT90	*Ancistrosyllis papillosa*	0	0	95	0
OCT90	*Glycinde solitaria*	0	0	95	0
OCT90	*Schistomeringos rudolphi*	0	0	95	0
OCT90	*Melinna maculata*	0	0	95	0
OCT90	*Pista palmata*	0	0	95	0
OCT90	*Mitrella lunata*	0	0	95	0
OCT90	*Listriella clymenellae*	0	0	95	0
OCT90	Xanthidae (unidentified)	0	0	95	0
OCT90	Capitellidae (unidentified)	0	0	95	0
OCT90	*Notomastus* cf. *latericeus*	0	0	95	0
OCT90	Terebellidae (unidentified)	0	0	95	0
OCT90	Gastropoda (unidentified)	0	0	95	0
OCT90	Amphipoda (unidentified)	0	0	95	0
OCT90	*Sarsiella spinosa*	0	0	95	0
OCT90	*Mediomastus californiensis*	0	0	0	1702
OCT90	*Periploma* cf. *orbiculare*	0	0	0	756

OCT90	*Corbula contracta*	0	0	0	378
OCT90	*Phascolion strombi*	0	0	0	378
OCT90	*Naineris laevigata*	0	0	0	284
OCT90	Maldanidae (unidentified)	0	0	0	189
OCT90	*Armandia maculata*	0	0	0	189
OCT90	*Sigambra tentaculata*	0	0	0	95
OCT90	*Branchioasychis americana*	0	0	0	95
OCT90	*Pectinaria gouldii*	0	0	0	95
OCT90	Caprellid	0	0	0	95
OCT90	Schizocardium sp.	0	0	0	95
OCT90	*Sigambra* cf. *wassi*	0	0	0	95
	TOTAL	2269	10339	42067	8603
JAN91	*Streblospio benedicti*	1040	2174	473	0
JAN91	*Mulinia lateralis*	378	1418	284	95
JAN91	Tellina sp.	189	378	0	0
JAN91	*Glycinde solitaria*	95	0	0	0
JAN91	*Mediomastus ambiseta*	0	4916	10682	5861
JAN91	*Cossura delta*	0	756	756	567
JAN91	*Paraprionospio pinnata*	0	756	567	0
JAN91	*Pyramidella crenulata*	0	567	0	0
JAN91	Rhynchocoel (unidentified)	0	189	567	1040
JAN91	Polychaete juv. (unidentified)	0	95	0	0
JAN91	*Drilonereis magna*	0	0	2174	95
JAN91	Paraonidae Grp.B	0	0	1229	378
JAN91	*Polydora caulleryi*	0	0	1134	0
JAN91	*Minuspio cirrifera*	0	0	851	473
JAN91	*Tharyx setigera*	0	0	851	95
JAN91	Schizocardium sp.	0	0	567	1985
JAN91	Paraonidae Grp.A	0	0	567	0
JAN91	*Paleanotus heteroseta*	0	0	473	567
JAN91	Asychis sp.	0	0	473	0
JAN91	*Clymenella torquata*	0	0	378	95
JAN91	*Gyptis vittata*	0	0	378	0
JAN91	Ophiuroidea (unidentified)	0	0	284	284
JAN91	*Branchioasychis americana*	0	0	284	0
JAN91	*Clymenella mucosa*	0	0	284	0
JAN91	*Periploma margaritaceum*	0	0	284	0
JAN91	*Polydora socialis*	0	0	189	0
JAN91	*Nassarius acutus*	0	0	189	0
JAN91	*Amaenana trilobata*	0	0	189	0
JAN91	*Podarke obscura*	0	0	95	0
JAN91	*Glycera americana*	0	0	95	0
JAN91	*Magelona phyllisae*	0	0	95	0
JAN91	*Spiochaetopterus costarum*	0	0	95	0
JAN91	*Megalomma bioculatum*	0	0	95	0
JAN91	*Aligena texasiana*	0	0	95	0

JAN91	*Ampelisca verrilli*	0	0	95	0
JAN91	Caprellid	0	0	95	0
JAN91	Turbonilla sp.	0	0	95	0
JAN91	Nereidae (unidentified)	0	0	95	0
JAN91	Sphaerosyllis sp.A	0	0	95	0
JAN91	*Periploma cf. orbiculare*	0	0	0	1323
JAN91	*Naineris laevigata*	0	0	0	756
JAN91	*Phascolion strombi*	0	0	0	567
JAN91	*Corbula contracta*	0	0	0	284
JAN91	*Sigambra tentaculata*	0	0	0	189
JAN91	*Schistomeringos rudolphi*	0	0	0	95
JAN91	Maldanidae (unidentified)	0	0	0	95
JAN91	*Abra aequalis*	0	0	0	95
JAN91	*Ampelisca abdita*	0	0	0	95
JAN91	*Phoronis architecta*	0	0	0	95
JAN91	Pilargiidae (unidentified)	0	0	0	95
JAN91	Amphipoda (unidentified)	0	0	0	95
	TOTAL	1702	11249	25146	15314
APR91	*Streblospio benedicti*	1040	1891	284	189
APR91	*Mediomastus ambiseta*	473	1229	7846	11249
APR91	*Macoma mitchelli*	189	0	0	0
APR91	*Capitella capitata*	95	95	0	0
APR91	*Heteromastus filiformis*	95	0	0	0
APR91	*Paraprionospio pinnata*	0	189	284	95
APR91	*Cossura delta*	0	95	945	1985
APR91	Turbonilla sp.	0	95	189	0
APR91	Paraonidae Grp.B	0	0	3498	756
APR91	*Minuspio cirrifera*	0	0	1607	1985
APR91	*Drilonereis magna*	0	0	1134	95
APR91	*Polydora caulleryi*	0	0	945	12100
APR91	Rhynchocoel (unidentified)	0	0	851	1134
APR91	Schizocardium sp.	0	0	662	2741
APR91	*Gyptis vittata*	0	0	662	0
APR91	Paraonidae Grp.A	0	0	662	0
APR91	*Glycinde solitaria*	0	0	567	378
APR91	Turbellaria (unidentified)	0	0	284	284
APR91	*Paleanotus heteroseta*	0	0	189	378
APR91	Ophiuroidea (unidentified)	0	0	189	284
APR91	*Tharyx setigera*	0	0	189	0
APR91	*Naineris laevigata*	0	0	95	662
APR91	*Clymenella torquata*	0	0	95	95
APR91	*Polydora socialis*	0	0	95	0
APR91	*Mediomastus californiensis*	0	0	95	0
APR91	*Branchioasychis americana*	0	0	95	0
APR91	*Clymenella mucosa*	0	0	95	0
APR91	Asychis sp.	0	0	95	0

APR91	*Owenia fusiformis*	0	0	95	0
APR91	*Melinna maculata*	0	0	95	0
APR91	*Periploma margaritaceum*	0	0	95	0
APR91	*Notomastus* cf. *latericeus*	0	0	95	0
APR91	*Parandalia ocularis*	0	0	95	0
APR91	Oxyurostylis sp.	0	0	95	0
APR91	Oligochaetes (unidentified)	0	0	0	567
APR91	Pinnixa sp.	0	0	0	378
APR91	*Phoronis architecta*	0	0	0	284
APR91	*Periploma* cf. *orbiculare*	0	0	0	284
APR91	Anthozoa (unidentified)	0	0	0	189
APR91	*Pseudodiaptomus coronatus*	0	0	0	189
APR91	*Listriella barnardi*	0	0	0	189
APR91	Sigalionidae (unidentified)	0	0	0	189
APR91	*Mysidopsis bahia*	0	0	0	189
APR91	*Sigambra tentaculata*	0	0	0	95
APR91	*Corbula contracta*	0	0	0	95
APR91	*Ancistrosyllis groenlandica*	0	0	0	95
APR91	Nereidae (unidentified)	0	0	0	95
APR91	*Glycera capitata*	0	0	0	95
APR91	Sphaerosyllis sp.A	0	0	0	95
	TOTAL	1891	3592	22215	37435
JUL91	*Mediomastus ambiseta*	3025	7374	2363	1985
JUL91	*Streblospio benedicti*	567	1796	0	0
JUL91	Rhynchocoel (unidentified)	284	284	378	662
JUL91	*Edotea montosa*	284	0	0	0
JUL91	*Capitella capitata*	95	473	0	0
JUL91	*Macoma mitchelli*	95	189	0	0
JUL91	*Parandalia ocularis*	95	95	0	0
JUL91	*Mulinia lateralis*	95	0	0	0
JUL91	Mysidopsis sp.	95	0	0	0
JUL91	Chironomid larvae	95	0	0	0
JUL91	*Littoridina sphinctostoma*	95	0	0	0
JUL91	*Glycinde solitaria*	0	189	473	0
JUL91	*Cossura delta*	0	95	473	945
JUL91	*Pyramidella crenulata*	0	95	0	0
JUL91	*Crassostrea virginica*	0	95	0	0
JUL91	*Mediomastus californiensis*	0	0	6145	3781
JUL91	Paraonidae Grp.B	0	0	2269	756
JUL91	*Drilonereis magna*	0	0	662	0
JUL91	*Minuspio cirrifera*	0	0	473	1229
JUL91	Paraonidae Grp.A	0	0	473	0
JUL91	Schizocardium sp.	0	0	378	0
JUL91	*Gyptis vittata*	0	0	284	473
JUL91	*Paleanotus heteroseta*	0	0	284	378
JUL91	*Tharyx setigera*	0	0	284	0

JUL91	Turbonilla sp.	0	0	284	0
JUL91	*Periploma margaritaceum*	0	0	189	1134
JUL91	*Naineris laevigata*	0	0	189	284
JUL91	*Ancistrosyllis groenlandica*	0	0	189	95
JUL91	*Clymenella mucosa*	0	0	189	0
JUL91	*Pseudodiaptomus coronatus*	0	0	189	0
JUL91	Turbellaria (unidentified)	0	0	189	0
JUL91	Oligochaetes (unidentified)	0	0	95	378
JUL91	*Paraprionospio pinnata*	0	0	95	284
JUL91	Ophiuroidea (unidentified)	0	0	95	189
JUL91	*Trachypenaeus constrictus*	0	0	95	95
JUL91	*Phoronis architecta*	0	0	95	95
JUL91	*Anaitides erythrophyllus*	0	0	95	0
JUL91	*Nereis succinea*	0	0	95	0
JUL91	*Glycera americana*	0	0	95	0
JUL91	*Diopatra cuprea*	0	0	95	0
JUL91	*Magelona phyllisae*	0	0	95	0
JUL91	*Branchioasychis americana*	0	0	95	0
JUL91	*Pista palmata*	0	0	95	0
JUL91	Microprotopus spp.	0	0	95	0
JUL91	Sphaerosyllis sp.A	0	0	95	0
JUL91	Leucon sp.	0	0	95	0
JUL91	*Periploma* cf. *orbiculare*	0	0	0	284
JUL91	*Paramya subovata*	0	0	0	284
JUL91	*Sigambra tentaculata*	0	0	0	189
JUL91	*Phascolion strombi*	0	0	0	189
JUL91	*Pinnixa chacei*	0	0	0	95
	TOTAL	4821	10682	17772	13802
OCT91	*Mediomastus ambiseta*	3781	3403	2174	1891
OCT91	*Streblospio benedicti*	1040	378	0	756
OCT91	*Ampelisca abdita*	378	0	0	0
OCT91	*Glycinde solitaria*	284	95	95	0
OCT91	*Mulinia lateralis*	189	95	189	0
OCT91	*Parandalia ocularis*	189	0	0	0
OCT91	*Mediomastus californiensis*	95	0	3214	3687
OCT91	*Cossura delta*	0	189	662	851
OCT91	Rhynchocoel (unidentified)	0	95	567	95
OCT91	Megalops	0	95	0	0
OCT91	Paraonidae Grp.B	0	0	3309	378
OCT91	*Tharyx setigera*	0	0	1702	0
OCT91	*Periploma margaritaceum*	0	0	1134	0
OCT91	*Gyptis vittata*	0	0	473	284
OCT91	*Drilonereis magna*	0	0	473	95
OCT91	Schizocardium sp.	0	0	378	0
OCT91	*Minuspio cirrifera*	0	0	284	851
OCT91	Ophiuroidea (unidentified)	0	0	284	378

OCT91	*Paraprionospio pinnata*	0	0	189	378
OCT91	Maldanidae (unidentified)	0	0	189	95
OCT91	*Pinnixa chacei*	0	0	189	95
OCT91	*Polydora caulleryi*	0	0	189	0
OCT91	Turbellaria (unidentified)	0	0	189	0
OCT91	Mysidopsis sp.	0	0	95	95
OCT91	*Mysella planulata*	0	0	95	0
OCT91	*Cyclaspis varians*	0	0	95	0
OCT91	Turbonilla sp.	0	0	95	0
OCT91	Paraonidae Grp.A	0	0	95	0
OCT91	*Periploma* cf. *orbiculare*	0	0	95	0
OCT91	*Caecum johnsoni*	0	0	95	0
OCT91	Oligochaetes (unidentified)	0	0	0	1323
OCT91	Pelecypoda (unidentified)	0	0	0	1134
OCT91	*Sigambra tentaculata*	0	0	0	378
OCT91	*Corbula contracta*	0	0	0	189
OCT91	*Paleanotus heteroseta*	0	0	0	95
OCT91	Nereidae (unidentified)	0	0	0	95
	TOTAL	5956	4349	16543	13140
JAN92	*Mediomastus ambiseta*	3876	3592	95	1607
JAN92	*Macoma mitchelli*	1513	567	0	0
JAN92	*Mediomastus californiensis*	1134	0	1418	2269
JAN92	*Streblospio benedicti*	1134	0	95	0
JAN92	*Cossura delta*	378	378	0	756
JAN92	*Mulinia lateralis*	378	189	95	0
JAN92	Rhynchocoel (unidentified)	95	0	0	473
JAN92	*Capitella capitata*	95	0	0	0
JAN92	*Parandalia ocularis*	95	0	0	0
JAN92	*Pyramidella crenulata*	0	284	0	0
JAN92	*Glycinde solitaria*	0	95	95	95
JAN92	*Paraprionospio pinnata*	0	95	0	0
JAN92	Paraonidae Grp.A	0	0	378	0
JAN92	Paraonidae Grp.B	0	0	284	189
JAN92	*Sigambra tentaculata*	0	0	95	378
JAN92	*Drilonereis magna*	0	0	95	95
JAN92	*Magelona phyllisae*	0	0	95	0
JAN92	*Nassarius acutus*	0	0	95	0
JAN92	*Armandia maculata*	0	0	95	0
JAN92	Sphaerosyllis sp.A	0	0	95	0
JAN92	*Sarsiella spinosa*	0	0	95	0
JAN92	*Paramya subovata*	0	0	0	756
JAN92	Anthozoa (unidentified)	0	0	0	567
JAN92	Ophiuroidea (unidentified)	0	0	0	567
JAN92	*Minuspio cirrifera*	0	0	0	473
JAN92	*Naineris laevigata*	0	0	0	378
JAN92	*Ancistrosyllis groenlandica*	0	0	0	284

JAN92	Oligochaetes (unidentified)	0	0	0	189
JAN92	*Paleanotus heteroseta*	0	0	0	189
JAN92	*Diopatra cuprea*	0	0	0	189
JAN92	*Eunoe* cf. *nodulosa*	0	0	0	95
JAN92	*Aglaophamus verrilli*	0	0	0	95
JAN92	*Abraa equalis*	0	0	0	95
JAN92	*Pandora trilineata*	0	0	0	95
JAN92	*Corophium ascherusicum*	0	0	0	95
	TOTAL	8697	5199	3120	9926
APR92	*Mediomastus ambiseta*	3309	5956	0	4254
APR92	*Streblospio benedicti*	567	284	0	378
APR92	*Macoma mitchelli*	567	189	0	284
APR92	*Mulinia lateralis*	284	0	0	0
APR92	Rhynchocoel (unidentified)	189	0	0	473
APR92	*Polydora ligni*	95	0	0	0
APR92	*Parandalia ocularis*	0	95	0	0
APR92	*Mediomastus californiensis*	0	0	2174	0
APR92	*Minuspio cirrifera*	0	0	284	1134
APR92	*Cossura delta*	0	0	189	1323
APR92	Paraonidae Grp.B	0	0	189	378
APR92	Oligochaetes (unidentified)	0	0	95	189
APR92	Maldanidae (unidentified)	0	0	95	189
APR92	*Sigambra tentaculata*	0	0	95	0
APR92	Paraonidae Grp.A	0	0	95	0
APR92	*Naineris laevigata*	0	0	0	1607
APR92	Apseudes sp.A	0	0	0	1323
APR92	*Paramya subovata*	0	0	0	945
APR92	Ophiuroidea (unidentified)	0	0	0	473
APR92	Hemicyclops sp.	0	0	0	284
APR92	*Paleanotus heteroseta*	0	0	0	189
APR92	Anthozoa (unidentified)	0	0	0	95
APR92	*Sigambra bassi*	0	0	0	95
APR92	*Diopatra cuprea*	0	0	0	95
APR92	*Paraprionospio pinnata*	0	0	0	95
APR92	*Melinna maculata*	0	0	0	95
APR92	*Mysella planulata*	0	0	0	95
APR92	*Nuculana concentrica*	0	0	0	95
APR92	Nereidae (unidentified)	0	0	0	95
	TOTAL	5010	6523	3214	14180
		258927	136884	270649	388627