Galveston Bay, Texas
Benthic Community Assessment

Submitted to

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Silver Spring, Maryland 20910

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INTRODUCTION

Galveston Bay, Texas was sampled during the summer of 1996. One aspect of this evaluation was benthic community characterization, which was accomplished via sample collection by National Oceanic and Atmospheric Administration (NOAA) personnel and laboratory and data analysis by Barry A. Vittor & Associates, Inc. (BVA).

METHODS

Sample Collection And Handling

A Young dredge (area = 0.04 m^2) was used to collect replicate bottom samples at each of 22 stations in Galveston Bay, Texas. Macroinfaunal samples were sieved through a 0.5-mm mesh screen and preserved with 10% formalin on ship. Macroinfaunal samples were transported to the BVA laboratory in Mobile, Alabama.

Macroinfaunal Sample Analysis

In the laboratory of BVA, benthic samples were inventoried, rinsed gently through a 0.5-mm mesh sieve to remove preservatives and sediment, stained with Rose Bengal, and stored in 70% isopropanol solution until processing. Sample material (sediment, detritus, organisms) was placed in white enamel trays for sorting under Wild M-5A dissecting microscopes. All macroinvertebrates were carefully removed with forceps and placed in labelled glass vials containing 70% isopropanol. Each vial represented a major taxonomic group (e.g. Polychaeta, Mollusca, Arthropoda). All sorted macroinvertebrates were identified to the lowest practical identification level (LPIL), which in most cases was to species level unless the specimen was a juvenile, damaged, or otherwise unidentifiable. The number of individuals of each taxon, excluding fragments, was recorded. A voucher collection was prepared, composed of representative individuals of each species not previously encountered in samples from the region.

DATA ANALYSIS

All data generated as a result of laboratory analysis of macroinfauna samples were first coded on data sheets. Enumeration data were entered for each species according to station and replicate. These data were reduced to a data summary report for each station, which included a taxonomic species list and benthic community parameters information. Archive data files of species identification and enumeration were prepared.

The QA and QC reports for the Galveston Bay data is given in the Appendix.

The analytical methodologies utilized for this study were similar to those used in similar benthic community characterization reports prepared for other state and federal agency surveys. Macroinfaunal characterization involves an evaluation of several biological community structure parameters (*e.g.*, species abundance, species composition and species diversity indices) during initial data reduction, followed by pattern and classification analysis for delineation of species assemblages. Since species are distributed along environmental gradients, there are generally no distinct boundaries between communities. However, the relationships between habitats and species assemblages often reflect the interactions of physical and biological factors and indicate major ecological trends.

Assemblage Structure

Several numerical indices were chosen for analysis and interpretation of the macroinfaunal data. Selection was based primarily on the ability of the index to provide a meaningful summary of data, as well as the applicability of the index to the characterization of the benthic community. Infaunal abundance is reported as the total number of individuals per station (and site) and the total number of individuals per square meter (= density). Species richness is reported as the total number of taxa represented in a given station (and site) collection.

Taxa diversity, which is often related to the ecological stability and environmental "quality" of the benthos, was estimated by the Pielou's Index (Pielou, 1966), according to the following

formula:

$$H' = -\sum_{i=1}^{s} p_i(\ln p_i)$$

where, S = is the number of taxa in the sample,

i = is the i'th taxa in the sample, and

p_i = is the number of individuals of the i'th taxa divided by the total number of individuals in the sample.

Taxa diversity within a given community is dependent upon the number of taxa present (taxa richness) and the distribution of all individuals among those taxa (equitability or evenness). In order to quantify and compare the equitability in the fauna to the taxa diversity for a given area, Pielou's Index J' (Pielou, 1966) was calculated as J' = H'/lnS, where $\ln S = H'_{max}$, or the maximum possible diversity, when all taxa are represented by the same number of individuals; thus, $J' = H' / H'_{max}$.

Macroinfaunal data were graphically and statistically analyzed to identify any differences in density between stations. Data for total density were variously transformed and tested for normality (Shapiro-Wilk W; SAS Institute, 1995). Data could not be normalized with standard transformations [*e.g.* ln(x+1), √(x+1)], so data were analyzed using non-parametric methods [*e.g.*, Wilcoxon/Kruskal-Wallis Chi-squared test; SAS Institute, 1995].

Faunal Similarities

Numerical classification analysis (Boesch 1977) was performed on the faunal data to examine within- and between- stations differences at the Galveston Bay stations and to compare faunal composition at each station within the site. Both normal and inverse classification analyses were used in this study. Normal analysis (sometimes called Q-analysis) treats samples as individual observations, each being composed of a number of attributes (i.e. the various species from a given sample). Normal analysis is instructive in helping to ascertain community structure and to infer specific ecological conditions between sampling stations from the relative distributions

of species. Inverse classification (termed R-analysis) is based on species as individuals, each of which is characterized by its relative abundance in the various samples. This type of analysis is commonly used to identify species groupings with particular habitats or environmental conditions.

Classification analysis of both station collections (normal analysis) and species (inverse analysis) was performed using the Czekanowski quantitative index of faunal similarity (Field and MacFarlane 1968). This index is computationally equivalent to the Bray-Curtis similarity measure (Bray and Curtis 1957). The value of the similarity index is 1.0 when two samples are identical and 0 when no species are in common. Hierarchical clustering of similarity values is achieved using the group-average sorting strategy (Lance and Williams 1967) and displayed in the form of dendrograms.

Both similarity classification and cluster analysis were performed using the microcomputer package, "Community Analysis System 5.0" (Bloom 1994), as modified for use in BVA's benthic data management program. Taxa used in these analyses were selected according to their percent abundance and percent frequency. Total densities for each of the selected taxa at a given station were log-transformed [x=ln(x+1)] for the analysis.

BENTHIC COMMUNITY CHARACTERIZATION

Faunal Composition, Abundance, And Community Structure

Table 1 provides a complete phylogenetic listing for all stations as well as data on taxa abundance and station occurrence. Four Microsoft ™Excel 5.0 (Macintosh version) spreadsheets are being provided separately to NOAA which include: raw data on taxa abundance and density by replicate, a complete taxonomic listing with station abundance and occurrence, a major taxa table with overall taxa abundance, and an assemblage parameter table including data on mean number of taxa, mean density, taxa diversity and taxa evenness by station and site.

A total of 5,089 organisms, representing 211 taxa, were identified from the 22 stations (Table 2). Polychaetes were the most numerous organisms present representing 71.2% of the total assemblage, followed in abundance by bivalves (8.3%), gastropods (6.6%) and amphipods

Table 1. Abundance and distribution of taxa for the Galveston Bay stations, July/August 1996. Taxa above the shaded line of data were included in the classification analysis.

Taxa	Phylum	Class/ Order	No. Inds.	%	Cumul. %	Station Occur.	% Station Occur.	Site Occur.	% Site Occur.	Comments
Mediomastus (LPIL)	A	Poly	1481	29.10	29.1	22	100.0	57	77	anterior portions only, probably M. ambiseta: pygidium necessary for positive ID
Paraprionospio pinnata	A	Poly	259	5.09	34.2	18	81.8	45	60.8	
Parandalia tricuspis	A	Poly	188	3.69	37.9	14	63.6	30	40.5	
Scoletoma verrilli	A	Poly	146	2.87	40.8	8	36.4	16	21.6	
Maldanidae (LPIL)	A	Poly	139	2.73	43.5	4	18.2	7	9.5	fragmented portion, pygidium necessary for positive identification
Polydora cornuta	A	Poly	122	2.40	45.9	3	13.6	5	6.8	
Magelona sp.H	A	Poly	106	2.08	48.0	7	31.8	12	16.2	
Rhynchocoela (LPIL)	R		104	2.04	50.0	22	100.0	41	55.4	no identifiable characters
Streblospio benedicti	A	Poly	104	2.04	52.1	8	36.4	12	16.2	
Ischadium recurvum	M	Biva	90	1.77	53.8	3	13.6	3	4.1	
Cirrophorus lyra	A	Poly	88	1.73	55.6	2	9.1	7	9.5	
Tubulanus (LPIL)	R		85	1.67	57.2	16	72.7	34	45.9	genus is lowest identification level
Mulinia lateralis	M	Biva	78	1.53	58.8	9	40.9	15	20.3	
Sigambra grubii	A	Poly	80	1.57	60.3	11	50.0	24	32.4	
Acteocina canaliculata	M	Gast	71	1.40	61.7	3	13.6	6	8.1	
Bivalvia (LPIL)	M	Biva	66	1.30	63.0	14	63.6	21	28.4	crushed shell and/or juvenile specimen
Paramphinome sp.B	A	Poly	61	1.20	64.2	6	27.3	8	10.8	
Texadina sphinctostoma	M	Gast	59	1.16	65.4	3	13.6	5	6.8	
Cossura soyeri	A	Poly	50	0.98	66.4	5	22.7	8	10.8	
Balanoglossus (LPIL)	He		49	0.96	67.3	6	27.3	11	14.9	fragmented
Fabricia sp.A	A	Poly	48	0.94	68.3	1	4.5	1	1.4	
Hydrobiidae (LPIL)	M	Gast	45	0.88	69.2	7	31.8	7	9.5	crushed shell and /or juvenile specimen
Batea catharinensis	C	Amph	44	0.86	70.0	2	9.1	2	2.7	
Podarkeopsis levifuscina	A	Poly	44	0.86	70.9	9	40.9	19	25.7	
Clymenella torquata	A	Poly	40	0.79	71.7	1	4.5	2	2.7	
Glycinde solitaria	A	Poly	40	0.79	72.5	12	54.5	22	29.7	
Protohaustorius sp.B	C	Amph	40	0.79	73.2	1	4.5	3	4.1	
Aricidea philbinae	A	Poly	36	0.71	73.9	1	4.5	3	4.1	
Nassarius acutus	M	Gast	36	0.71	74.7	6	27.3	12	16.2	
Rangia cuneata	M	Biva	35	0.69	75.3	2	9.1	4	5.4	
Lineidae (LPIL)	R		33	0.65	76.0	7	31.8	9	12.2	family is lowest identification level
Prionospio (LPIL)	A	Poly	33	0.65	76.6	2	9.1	3	4.1	missing identification characters
Onuphis eremita oculata	A	Poly	32	0.63	77.3	3	13.6	3	4.1	
Owenia fusiformis	A	Poly	31	0.61	77.9	4	18.2	8	10.8	
Sigambra tentaculata	A	Poly	31	0.61	78.5	5	22.7	10	13.5	
Acanthohaustorius sp.C	C	Amph	29	0.57	79.1	2	9.1	4	5.4	
Leitoscoloplos fragilis	A	Poly	29	0.57	79.6	4	18.2	9	12.2	
Spionidae (LPIL)	A	Poly	28	0.55	80.2	6	27.3	8	10.8	missing identification characters and/or immature specimen
Monticellina dorsobranchialis	A	Poly	26	0.51	80.7	2	9.1	3	4.1	
Nereis micromma	A	Poly	26	0.51	81.2	6	27.3	8	10.8	
Ogyrides alphaerostris	C	Deca	25	0.49	81.7	12	54.5	17	23	
Periplomatidae (LPIL)	M	Biva	25	0.49	82.2	2	9.1	3	4.1	juvenile specimen
Branchiostoma (LPIL)	Ce		24	0.47	82.7	4	18.2	7	9.5	genus is lowest identification level
Rictaxis punctostriatus	M	Gast	24	0.47	83.1	1	4.5	2	2.7	
Carazziella hobsonae	A	Poly	23	0.45	83.6	2	9.1	3	4.1	
Oligochaeta (LPIL)	A	Olig	23	0.45	84.0	9	40.9	10	13.5	marine specimens only identified to Class Oligochaeta
Periploma margaritaceum	M	Biva	23	0.45	84.5	4	18.2	6	8.1	
Macoma mitchelli	M	Biva	22	0.43	84.9	9	40.9	14	18.9	
Malmgreniella sp.A	A	Poly	22	0.43	85.3	4	18.2	5	6.8	
Phoronis (LPIL)	Ph		22	0.43	85.8	7	31.8	10	13.5	genus is lowest identification level
Pinnixa (LPIL)	C	Deca	22	0.43	86.2	9	40.9	11	14.9	appendages missing
Spiochaetopterus oculatus	A	Poly	22	0.43	86.6	9	40.9	14	18.9	
Leitoscoloplos (LPIL)	A	Poly	20	0.39	87.0	6	27.3	8	10.8	anterior segments only, abdominal segments necessary for species identification
Crassostrea virginica	M	Biva	19	0.37	87.4	3	13.6	3	4.1	
Ophiuroidea (LPIL)	E	Ophi	19	0.37	87.8	5	22.7	6	8.1	central disk missing characters
Amphiodia atra	E	Ophi	18	0.35	88.1	2	9.1	2	2.7	
Cirratulidae (LPIL)	A	Poly	16	0.31	88.5	3	13.6	5	6.8	
Nereis succinea	A	Poly	16	0.31	88.8	6	27.3	7	9.5	
Anachis obesa	M	Gast	15	0.29	89.1	1	4.5	2	2.7	
Leitoscoloplos robustus	A	Poly	15	0.29	89.4	4	18.2	7	9.5	
Hemipholis elongata	E	Ophi	14	0.28	89.6	2	9.1	3	4.1	
Caecum johnsoni	M	Gast	13	0.26	89.9	2	9.1	2	2.7	
Callianassidae (LPIL)	C	Deca	12	0.24	90.1	4	18.2	7	9.5	
Pagurus (LPIL)	C	Deca	12	0.24	90.4	3	13.6	3	4.1	
Capitellidae (LPIL)	A	Poly	11	0.22	90.6	3	13.6	3	4.1	
Gastropoda (LPIL)	M	Gast	11	0.22	90.8	8	36.4	9	12.2	
Pinnixa pearsei	C	Deca	11	0.22	91.0	4	18.2	5	6.8	
Turbonilla (LPIL)	M	Gast	11	0.22	91.2	1	4.5	2	2.7	
Capitella capitata	A	Poly	10	0.20	91.4	4	18.2	7	9.5	
Listriella barnardi	C	Amph	10	0.20	91.6	4	18.2	5	6.8	
Lyonsia hyalina floridana	M	Biva	10	0.20	91.8	1	4.5	2	2.7	
Odostomia weberi	M	Gast	10	0.20	92.0	2	9.1	4	5.4	
Asychis elongatus	A	Poly	9	0.18	92.2	2	9.1	4	5.4	
Corophium (LPIL)	C	Amph	9	0.18	92.4	2	9.1	2	2.7	
Diopatra cuprea	A	Poly	9	0.18	92.5	7	31.8	7	9.5	
Dipolydora socialis	A	Poly	9	0.18	92.7	3	13.6	6	8.1	
Notomastus (LPIL)	A	Poly	9	0.18	92.9	2	9.1	2	2.7	
Tellinidae (LPIL)	M	Biva	9	0.18	93.1	6	27.3	6	8.1	
Ampelisca abdita	C	Amph	8	0.16	93.2	4	18.2	4	5.4	
Amphiuridae (LPIL)	E	Ophi	8	0.16	93.4	2	9.1	3	4.1	
Nephtys incisa	A	Poly	8	0.16	93.5	4	18.2	5	6.8	
Rhepoxynius epistomus	C	Amph	8	0.16	93.7	1	4.5	2	2.7	
Tectonatica pusilla	M	Gast	8	0.16	93.9	2	9.1	3	4.1	
Aligena texasiana	M	Biva	7	0.14	94.0	1	4.5	1	1.4	
Crepidula plana	M	Gast	7	0.14	94.1	1	4.5	1	1.4	
Glycera americana	A	Poly	7	0.14	94.3	5	22.7	6	8.1	
Magelona sp.I	A	Poly	7	0.14	94.4	3	13.6	4	5.4	
Mysella planulata	M	Biva	7	0.14	94.5	2	9.1	4	5.4	
Ancistrosyllis jonesi	A	Poly	6	0.12	94.7	4	18.2	5	6.8	
Aricidea (LPIL)	A	Poly	6	0.12	94.8	3	13.6	5	6.8	
Heteromastus filiformis	A	Poly	6	0.12	94.9	3	13.6	5	6.8	
Nereis falsa	A	Poly	6	0.12	95.0	2	9.1	2	2.7	
Onuphidae (LPIL)	A	Poly	6	0.12	95.1	2	9.1	4	5.4	
Scoloplos sp.B	A	Poly	6	0.12	95.2	1	4.5	2	2.7	
Terebellidae (LPIL)	A	Poly	6	0.12	95.4	2	9.1	2	2.7	
Abra aequalis	M	Biva	5	0.10	95.5	4	18.2	4	5.4	

Table 1 continued:

Taxa	Phylum	Class/ Order	No. Inds.	%	Cumul. %	Station Occur.	% Station Occur.	Site Occur.	% Site Occur.
Amygdalum papyria	M	Biva	5	0.10	95.6	2	9.1	2	2.7
Apoprionospio pygmaea	A	Poly	5	0.10	95.7	2	9.1	4	5.4
Caecidae (LPIL)	M	Gast	5	0.10	95.8	1	4.5	1	1.4
Cyclaspis pustulata	C	Cuma	5	0.10	95.9	2	9.1	2	2.7
Haustoriidae (LPIL)	C	Amph	5	0.10	96.0	2	9.1	3	4.1
Hesionidae (LPIL)	A	Poly	5	0.10	96.1	4	18.2	4	5.4
Nereidae (LPIL)	A	Poly	5	0.10	96.2	4	18.2	4	5.4
Pyramidellidae (LPIL)	M	Gast	5	0.10	96.3	2	9.1	2	2.7
Serpulidae (LPIL)	A	Poly	5	0.10	96.4	2	9.1	3	4.1
Sigambra bassi	A	Poly	5	0.10	96.4	2	9.1	3	4.1
Syllis maryae	A	Poly	5	0.10	96.5	1	4.5	1	1.4
Actiniaria (LPIL)	Cn	Acti	4	0.08	96.6	3	13.6	3	4.1
Ampelisca (LPIL)	C	Amph	4	0.08	96.7	3	13.6	4	5.4
Deutella incerta	C	Amph	4	0.08	96.8	1	4.5	1	1.4
Hydroides dianthus	A	Poly	4	0.08	96.9	2	9.1	3	4.1
Leptonidae (LPIL)	M	Biva	4	0.08	96.9	1	4.5	1	1.4
Anadara transversa	M	Biva	3	0.06	97.0	2	9.1	2	2.7
Arcidae (LPIL)	M	Biva	3	0.06	97.1	2	9.1	7	9.5
Diastylidae (LPIL)	C	Cuma	3	0.06	97.1	3	13.6	3	4.1
Echinoidea (LPIL)	E	Echi	3	0.06	97.2	2	9.1	2	2.7
Goniadidae (LPIL)	A	Poly	3	0.06	97.2	3	13.6	3	4.1
Grandidierella bonnieroides	C	Amph	3	0.06	97.3	1	4.5	1	1.4
Lumbrineridae (LPIL)	A	Poly	3	0.06	97.4	3	13.6	3	4.1
Marenzellaria viridis	A	Poly	3	0.06	97.4	1	4.5	2	2.7
Nassariidae (LPIL)	M	Gast	3	0.06	97.5	2	9.1	2	2.7
Nereis (LPIL)	A	Poly	3	0.06	97.5	3	13.6	3	4.1
Pinnotheridae (LPIL)	C	Deca	3	0.06	97.6	2	9.1	1	1.4
Scolelepis texana	A	Poly	3	0.06	97.6	3	13.6	3	4.1
Sphenia antillensis	M	Biva	3	0.06	97.7	1	4.5	1	1.4
Tiron tropakis	C	Amph	3	0.06	97.8	2	9.1	2	2.7
Xanthidae (LPIL)	C	Deca	3	0.06	97.8	3	13.6	3	4.1
Aeginellidae (LPIL)	C	Amph	2	0.04	97.9	2	9.1	2	2.7
Ancistrosyllis papillosa	A	Poly	2	0.04	97.9	2	9.1	2	2.7
Armandia agilis	A	Poly	2	0.04	97.9	2	9.1	2	2.7
Bhawania heteroseta	A	Poly	2	0.04	98.0	2	9.1	2	2.7
Dispio uncinata	A	Poly	2	0.04	98.0	1	4.5	1	1.4
Dosinia elegans	M	Biva	2	0.04	98.1	2	9.1	2	2.7
Drilonereis longa	A	Poly	2	0.04	98.1	1	4.5	1	1.4
Edotia triloba	C	Isop	2	0.04	98.1	1	4.5	1	1.4
Elasmopus (LPIL)	C	Amph	2	0.04	98.2	1	4.5	1	1.4
Lepidactylus triarticulatus	C	Amph	2	0.04	98.2	1	4.5	1	1.4
Mediomastus ambiseta	A	Poly	2	0.04	98.3	1	4.5	1	1.4
Melinna maculata	A	Poly	2	0.04	98.3	1	4.5	1	1.4
Mysidae (LPIL)	C	Mysi	2	0.04	98.3	2	9.1	2	2.7
Mytilidae (LPIL)	M	Biva	2	0.04	98.4	1	4.5	1	1.4
Naineris sp.A	A	Poly	2	0.04	98.4	1	4.5	1	1.4
Nephtys picta	A	Poly	2	0.04	98.5	1	4.5	1	1.4
Neverita duplicata	M	Gast	2	0.04	98.5	2	9.1	2	2.7
Odostomia (LPIL)	M	Gast	2	0.04	98.5	2	9.1	2	2.7
Panopeus herbstii	C	Deca	2	0.04	98.6	2	9.1	2	2.7
Parametopella cypris	C	Amph	2	0.04	98.6	1	4.5	1	1.4
Phyllodocidae (LPIL)	A	Poly	2	0.04	98.6	1	4.5	2	2.7
Pilargidae (LPIL)	A	Poly	2	0.04	98.7	2	9.1	2	2.7
Scoloplos (LPIL)	A	Poly	2	0.04	98.7	1	4.5	2	2.7
Sigambra (LPIL)	A	Poly	2	0.04	98.8	2	9.1	2	2.7
Syllidae (LPIL)	A	Poly	2	0.04	98.8	2	9.1	2	2.7
Tagelus divisus	M	Biva	2	0.04	98.8	1	4.5	1	1.4
Viviparidae (LPIL)	M	Gast	2	0.04	98.9	1	4.5	2	2.7
Alpheus estuariensis	C	Deca	1	0.02	98.9	1	4.5	1	1.4
Americamysis bigelowi	C	Mysi	1	0.02	98.9	1	4.5	1	1.4
Ampelisca sp.C	C	Amph	1	0.02	98.9	1	4.5	1	1.4
Amphipoda (LPIL)	C	Amph	1	0.02	99.0	1	4.5	1	1.4
Aricidea sp.E	A	Poly	1	0.02	99.0	1	4.5	1	1.4
Bowmaniella (LPIL)	C	Mysi	1	0.02	99.0	1	4.5	1	1.4
Caecum cooperi	M	Gast	1	0.02	99.0	1	4.5	1	1.4
Callianassa (LPIL)	C	Deca	1	0.02	99.0	1	4.5	1	1.4
Callinectes sapidus	C	Deca	1	0.02	99.1	1	4.5	1	1.4
Calyptraeidae (LPIL)	M	Gast	1	0.02	99.1	1	4.5	1	1.4
Chone (LPIL)	A	Poly	1	0.02	99.1	1	4.5	1	1.4
Crassinella lunulata	M	Biva	1	0.02	99.1	1	4.5	1	1.4
Crepidula (LPIL)	M	Gast	1	0.02	99.1	1	4.5	1	1.4
Cyclaspis (LPIL)	C	Cuma	1	0.02	99.2	1	4.5	1	1.4
Decapoda reptantia (LPIL)	C	Deca	1	0.02	99.2	1	4.5	1	1.4
Dorvilleidae (LPIL)	A	Poly	1	0.02	99.2	1	4.5	1	1.4
Galathowenia oculata	A	Poly	1	0.02	99.2	1	4.5	1	1.4
Hauchiella sp.A	A	Poly	1	0.02	99.2	1	4.5	1	1.4
Listriella (LPIL)	C	Amph	1	0.02	99.3	1	4.5	1	1.4
Mactridae (LPIL)	M	Biva	1	0.02	99.3	1	4.5	1	1.4
Majidae (LPIL)	C	Deca	1	0.02	99.3	1	4.5	1	1.4
Malmgreniella sp.B	A	Poly	1	0.02	99.3	1	4.5	1	1.4
Megalomma pigmentum	A	Poly	1	0.02	99.3	1	4.5	1	1.4
Microphthalmus (LPIL)	A	Poly	1	0.02	99.4	1	4.5	1	1.4
Monoculodes (LPIL)	C	Amph	1	0.02	99.4	1	4.5	1	1.4
Monoculodes sp.D	C	Amph	1	0.02	99.4	1	4.5	1	1.4
Naticidae (LPIL)	M	Gast	1	0.02	99.4	1	4.5	1	1.4
Nephtyidae (LPIL)	A	Poly	1	0.02	99.4	1	4.5	1	1.4
Nephtys simoni	A	Poly	1	0.02	99.5	1	4.5	1	1.4
Nudibranchia (LPIL)	M	Gast	1	0.02	99.5	1	4.5	1	1.4
Odostomia impressa	M	Gast	1	0.02	99.5	1	4.5	1	1.4
Oxyurostylis (LPIL)	C	Cuma	1	0.02	99.5	1	4.5	1	1.4
Oxyurostylis smithi	C	Cuma	1	0.02	99.5	1	4.5	1	1.4
Paracaprella (LPIL)	C	Amph	1	0.02	99.6	1	4.5	1	1.4
Paraonidae (LPIL)	A	Poly	1	0.02	99.6	1	4.5	1	1.4
Pectinaria gouldii	A	Poly	1	0.02	99.6	1	4.5	1	1.4
Pectinariidae (LPIL)	A	Poly	1	0.02	99.6	1	4.5	1	1.4
Phascolion strombi	S		1	0.02	99.6	1	4.5	1	1.4
Phoxocephalidae (LPIL)	C	Amph	1	0.02	99.7	1	4.5	1	1.4
Phyllodoce mucosa	A	Poly	1	0.02	99.7	1	4.5	1	1.4

Table 1 continued:

Taxa	Phylum	Class/ Order	No. Inds.	%	Cumul. %	Station Occur.	% Station Occur.	Site Occur.	% Site Occur.
Pista cristata	A	Poly	1	0.02	99.7	1	4.5	1	1.4
Pista quadrilobata	A	Poly	1	0.02	99.7	1	4.5	1	1.4
Polygordius (LPIL)	A	Poly	1	0.02	99.7	1	4.5	1	1.4
Pomatoceros americanus	A	Poly	1	0.02	99.7	1	4.5	1	1.4
Protohaustorius (LPIL)	C	Amph	1	0.02	99.8	1	4.5	1	1.4
Pyrgocythara plicosa	M	Gast	1	0.02	99.8	1	4.5	1	1.4
Sabellidae (LPIL)	A	Poly	1	0.02	99.8	1	4.5	1	1.4
Scolelepis (LPIL)	A	Poly	1	0.02	99.8	1	4.5	1	1.4
Scoletoma (LPIL)	A	Poly	1	0.02	99.8	1	4.5	1	1.4
Syllis gracilis	A	Poly	1	0.02	99.9	1	4.5	1	1.4
Tellina iris	M	Biva	1	0.02	99.9	1	4.5	1	1.4
Tharyx acutus	A	Poly	1	0.02	99.9	1	4.5	1	1.4
Trachypenaeus (LPIL)	C	Deca	1	0.02	99.9	1	4.5	1	1.4
Trachypenaeus constrictus	C	Deca	1	0.02	99.9	1	4.5	1	1.4
Turbellaria (LPIL)	P	Turb	1	0.02	100.0	1	4.5	1	1.4
Upogebia affinis	C	Deca	1	0.02	100.0	1	4.5	1	1.4
Vitrinellidae (LPIL)	M	Gast	1	0.02	100.0	1	4.5	1	1.4

Taxa Key

A = Annelida
  Olig = Oligochaeta
  Poly = Polychaeta
Ar = Arthropoda
  Inse = Insecta
  Mala = Malacostraca
Cn = Cnidaria
  Anth = Anthozoa
M = Mollusca
  Biva = Bivalvia
  Gast = Gastropoda
Ph = Phoronida
Pl = Platyhelminthes
  Turb = Turbellaria
R = Rhynchocoela
  Anop = Anopla

Table 2. Summary of abundance of major taxonomic groups for the Galveston Bay stations, July/August 1996.

	Number of Individuals	**% Total**	**Number of Taxa**	**% Total**
Annelida				
Polychaeta	3623	71.2	97	46.0
Oligochaeta	23	0.5	1	0.5
Mollusca				
Bivalvia	423	8.3	24	11.4
Gastropoda	337	6.6	26	12.3
Crustacea				
Amphipoda	183	3.6	24	11.4
Decapoda	98	1.9	16	7.6
Other Crustacea	17	0.3	9	4.3
Rhynchocoela	104	2.0	1	0.5
Other Taxa	281	5.5	13	6.2
Total	**5089**		**211**	

(3.6%). Polychaetes represented 46.0% of the total number of taxa followed by gastropods (12.3%), bivalves (11.4%) and amphipods (11.4%) (Table 2). The percentage abundance of the major taxa at the 22 stations is given in Figure 1.

The dominant taxon collected from the samples was the polychaete, Mediomastus (LPIL) representing 29.1% of the total number of individuals identified (note that *Mediomastus* (LPIL) is most probably *Mediomastus ambiseta*; Table 1). The polychaete, *Paraprionospio pinnata* (5.1%) was the only other taxon representing greater that 5% of the total number of organisms identified (Table 1). *Mediomastus* (LPIL) was the most widely distributed taxon being found at 77% of the stations. *Paraprionospio pinnata*, Rhynchocoela (LPIL), *Tubulanus* (LPIL) and *Parandalia tricuspis* were found at 61%, 55%, 46%, and 41% of the stations, respectively (Table 1). The distribution of dominant taxa representing >10% of the total assemblage at each station is given in Table 3.

Station mean density and mean number of taxa data are given in Table 4 and Figures 2 and 3. Mean densities ranged from 342 organisms!m^{-2} at Station 6 to 6145 organisms!m^{-2} at Station 15 (Table 4; Figure 2). There were significant differences in densities between stations (0^2 = 36.59, df = 21, Prob > 0^2 = 0.0188; Table 4; Figure 2). The mean number of taxa per station ranged from 2.5 at Station 8a to 28.0 at Station 15 (Table 4; Figure 3).

Taxa diversity and evenness are given in Table 4 and Figure 4. Taxa diversity (H') ranged from 1.14 at Station 8a to 3.30 at Station 10. Taxa evenness (J) ranged from 0.43 at Station 3 to 0.85 at Station 4.

Numerical Classification Analysis

Normal (stations) and inverse (species) classification analyses were performed on the Galveston Bay data set and displayed as dendrograms (Figures 5 and 6). Selection of the species included in the analyses was based on a minimum representation of 0.37% of the total number of individuals. Count data for the 55 taxa selected were included in a matrix of station and species groups (Table 5). These taxa accounted for 87.8% of the macroinfaunal assemblage collected.

Figure 1. Percent abundance of major taxa for the Galveston Bay, Texas stations, 1996.

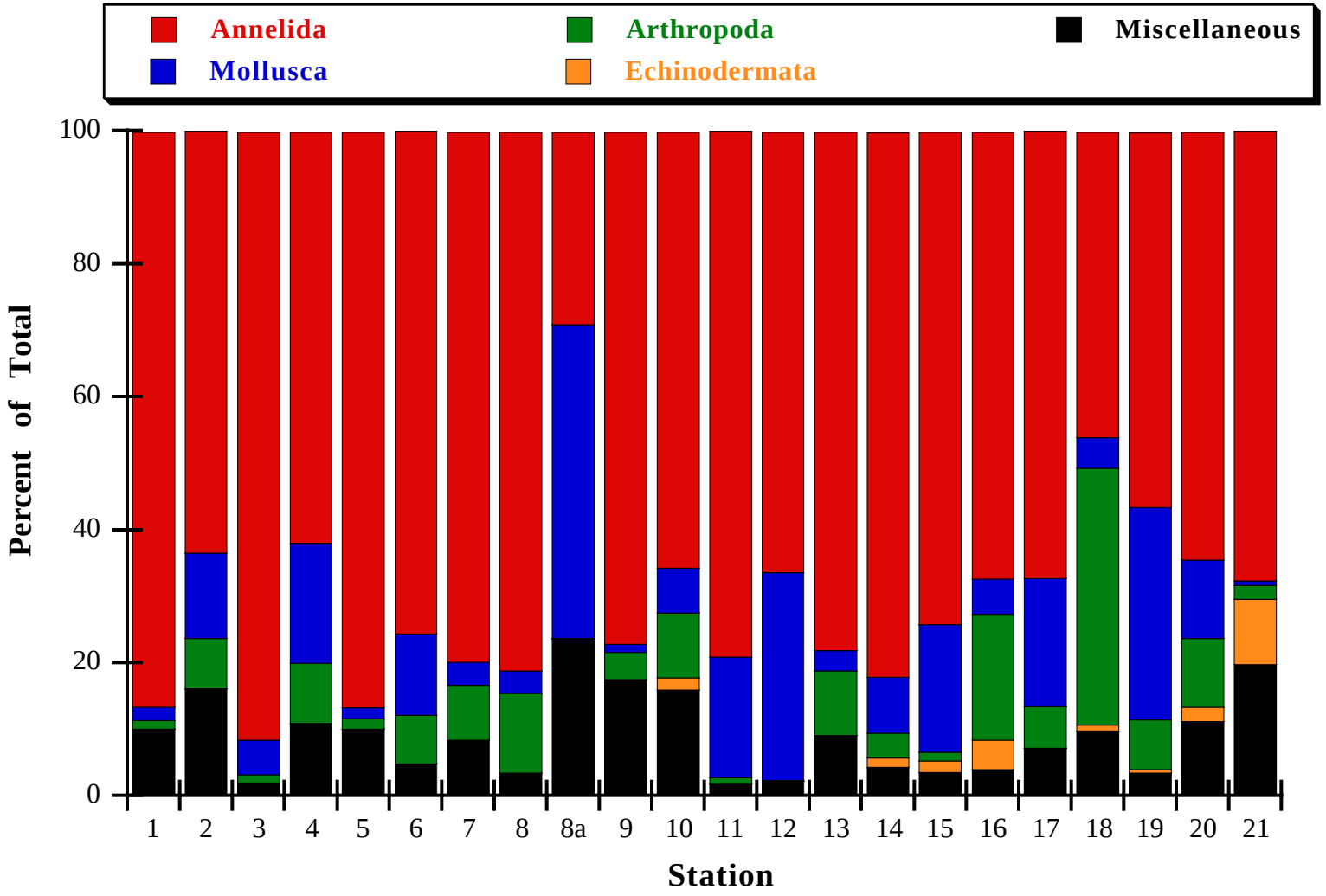


Table 3. Percentage abundance of dominant taxa (> 10% of the total) for the Galveston Bay, Texas stations, 1996.

	STATION																				
Taxa	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**8a**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Rhynchocoela (LPIL)	10.1	15.1			10.0				23.7													
Lineidae (LPIL)																						13.4
Polychaeta																						
Cossura soyeri																						10.6
Fabricia sp. A															14.0							
Magelona sp. H																					11.1	42.3
Mediomastus (LPIL)	69.1	44.1	72.4		48.3	26.8	28.6		26.3		10.4	44.9	49.0	13.4	11.9	34.8		23.5			25.9	
Onuphis eremita oculata																			14.0			
Paramphinome sp. B										10.8	11.0											
Parandala tricuspis	10.7	14.0		29.1		19.5	22.6	30.2						17.1								
Paraprionospio pinnata				10.9		19.5		16.4		31.1				17.1			38.9					
Polydora cornuta												20.7										
Prionospio (LPIL)																		11.8				
Scoletoma verrilli																				18.0		
Sigambra grubii								18.1														
Streblospio benedictii			10.5		21.7																	
Bivalvia																				22.1		
Mulinia lateralis																						
Gastropoda																						
Hydrobiidae (LPIL)		10.8		10.9					47.4													
Amphipoda																						
Acanthohaustorius sp. C																			10.7			
Batea catharinensis																	12.0					
Protohaustorius sp. B																			18.6			

Table 4. Summary of the benthic macroinvertebrate data for the Galveston Bay stations, July/August 1996.

Station	Site	Total Taxa	Mean Taxa per Station	No. Inds.	Density (Mean)	Density (Std. Dev.)	H'	J'
1	Overall	12	6.3	149	1242	1168	1.16	0.47
	3	5		16	400			
	2	7		103	2575			
	1	7		30	750			
2	Overall	12	7.0	93	775	331	1.73	0.70
	4	6		41	1025			
	6	8		36	900			
	5	7		16	400			
3	Overall	16	7.3	152	1267	903	1.20	0.43
	9	5		13	325			
	7	10		54	1350			
	8	7		85	2125			
4	Overall	17	7.7	55	458	356	2.41	0.85
	12	1		2	50			
	10	11		25	625			
	11	11		28	700			
5	Overall	9	5.3	60	500	282	1.55	0.71
	14	5		7	175			
	13	6		27	675			
	15	5		26	650			
6	Overall	14	5.7	41	342	350	2.16	0.82
	18	11		28	700			
	16	6		13	325			
	17	0		0	0			
7	Overall	19	9.3	84	700	229	2.33	0.79
	20	9		26	650			
	21	11		38	950			
	19	8		20	500			
8	Overall	17	8.5	116	725	396	2.16	0.76
	25	6		12	300			
	27	7		33	825			
	28	10		22	550			
	26	11		49	1225			
8A	Overall	4	2.5	38	475	636	1.14	0.82
	22	4		37	925			
	23	1		1	25			
9	Overall	18	7.8	74	463	60	2.38	0.82
	32	11		21	525			
	29	6		20	500			
	30	8		16	400			
	31	6		17	425			
10	Overall	52	18.8	326	1630	511	3.30	0.84
	34	13		68	1700			
	35	12		44	1100			
	36	20		62	1550			
	33	30		98	2450			
	37	19		54	1350			
11	Overall	28	12.3	450	2813	3469	1.93	0.58
	38	14		65	1625			
	41	21		317	7925			
	40	11		60	1500			
	39	3		8	200			
12	Overall	28	16.3	586	4883	1202	2.01	0.60
	42	15		219	5475			
	44	12		140	3500			
	43	22		227	5675			

Table 4 continued:

Station	Site	Total Taxa	Mean Taxa per Station	No. Inds.	Density (Mean)	Density (Std. Dev.)	H'	J'
13	Overall	25	8.6	164	820	251	2.62	0.81
	48	3		28	700			
	45	9		33	825			
	49	7		22	550			
	47	10		32	800			
	46	14		49	1225			
14	Overall	51	25.0	344	2867	1006	3.25	0.83
	50	23		145	3625			
	51	22		69	1725			
	52	30		130	3250			
15	Overall	90	28.0	1229	6145	7546	2.96	0.66
	55	13		30	750			
	56	10		31	775			
	53	60		638	15950			
	54	50		507	12675			
	57	7		23	575			
16	Overall	39	17.0	226	1883	813	2.51	0.69
	58	11		104	2600			
	59	27		82	2050			
	60	13		40	1000			
17	Overall	51	21.3	238	1983	1439	3.04	0.77
	61	17		70	1750			
	63	35		141	3525			
	62	12		27	675			
18	Overall	40	19.7	215	1792	772	2.86	0.78
	66	18		66	1650			
	65	19		44	1100			
	64	22		105	2625			
19	Overall	36	16.3	172	1433	592	2.83	0.79
	67	17		72	1800			
	68	11		30	750			
	69	21		70	1750			
20	Overall	38	15.0	135	1125	1040	2.91	0.80
	71	22		93	2325			
	72	14		20	500			
	70	9		22	550			
21	Overall	22	10.0	142	1183	747	2.08	0.67
	74	16		81	2025			
	75	8		37	925			
	73	6		24	600			

Figure 2. Mean macroinfaunal densities for the Galveston Bay, Texas stations, 1996.

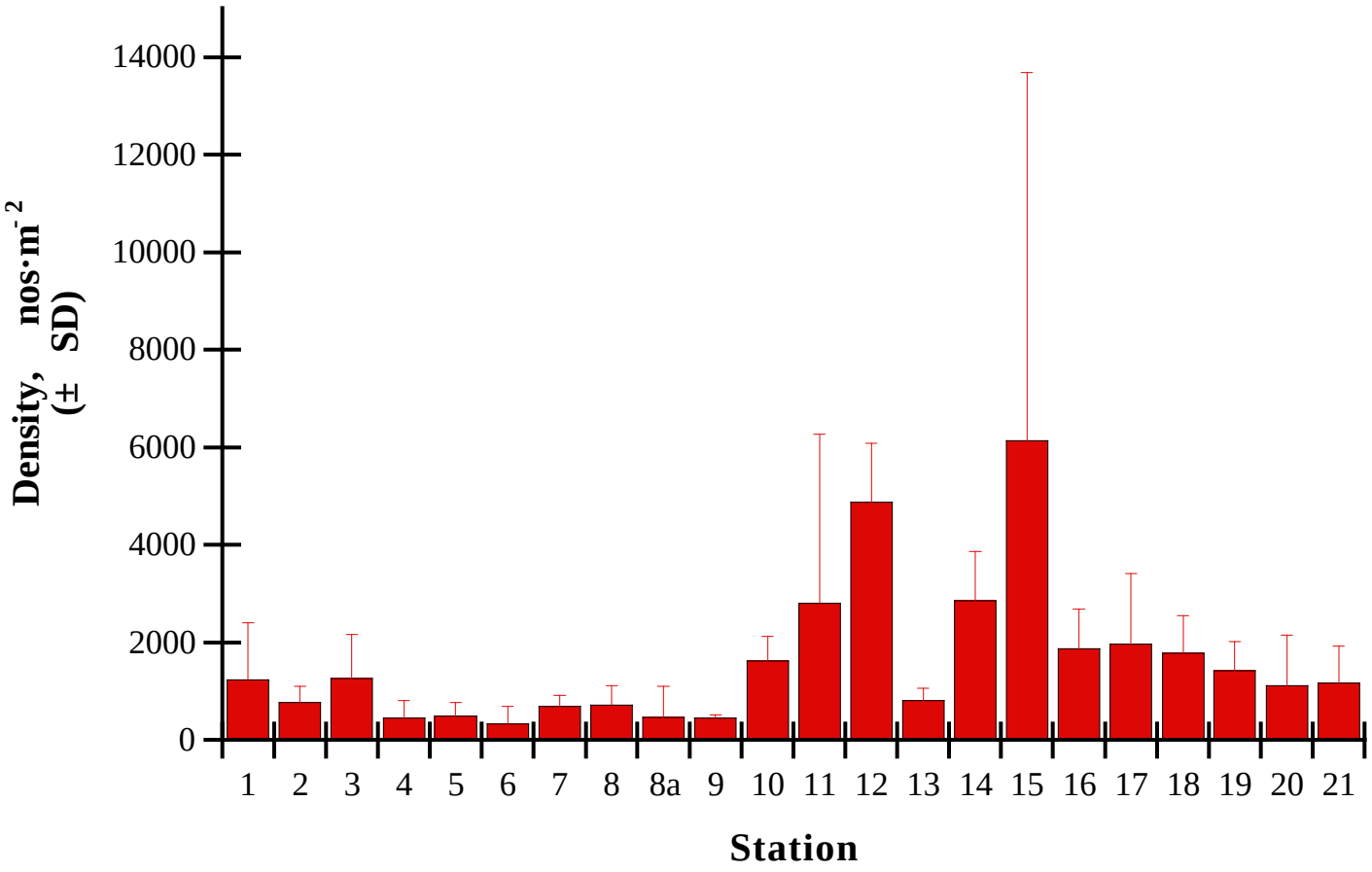


Figure 3. Mean number of macroinvertebrate taxa per relicate for the Galveston Bay stations, 1996.

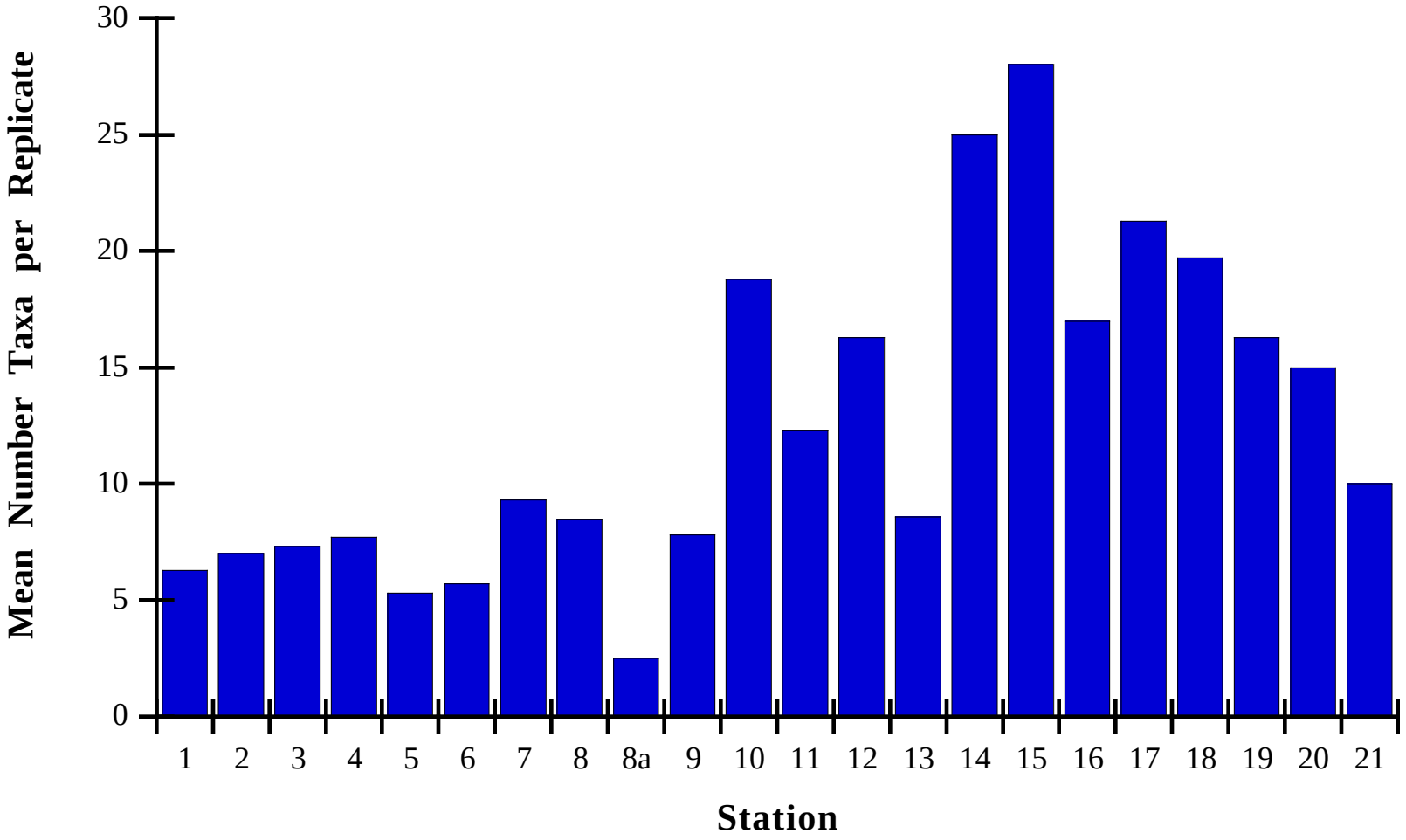
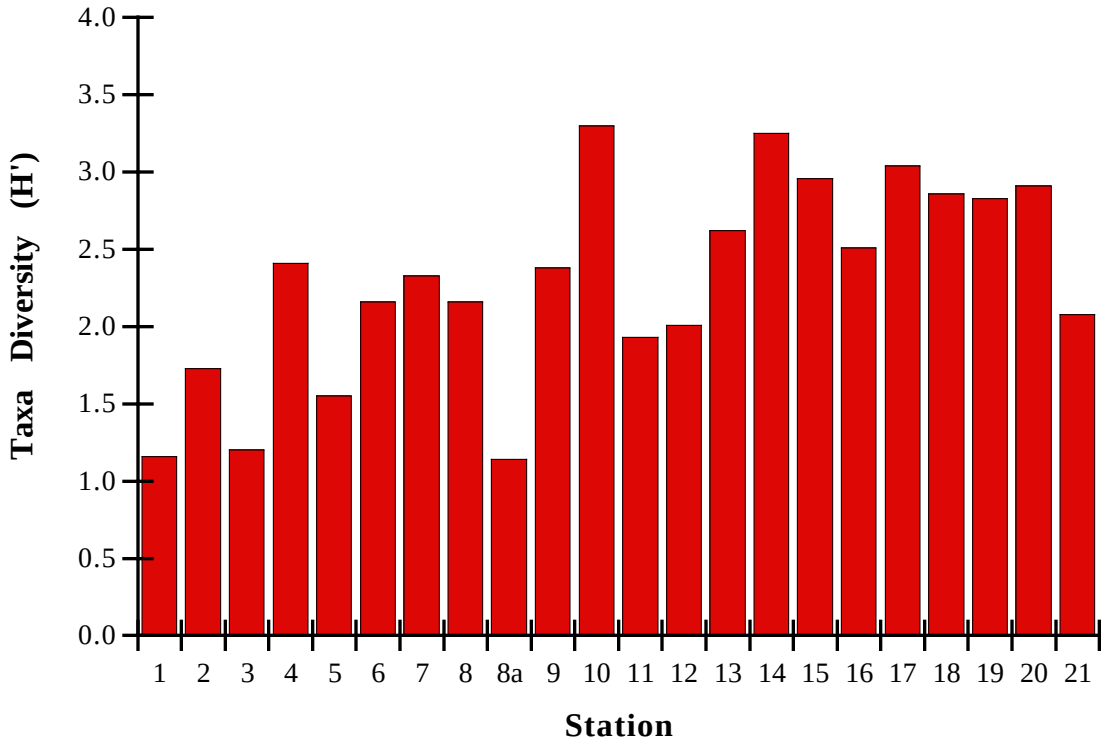
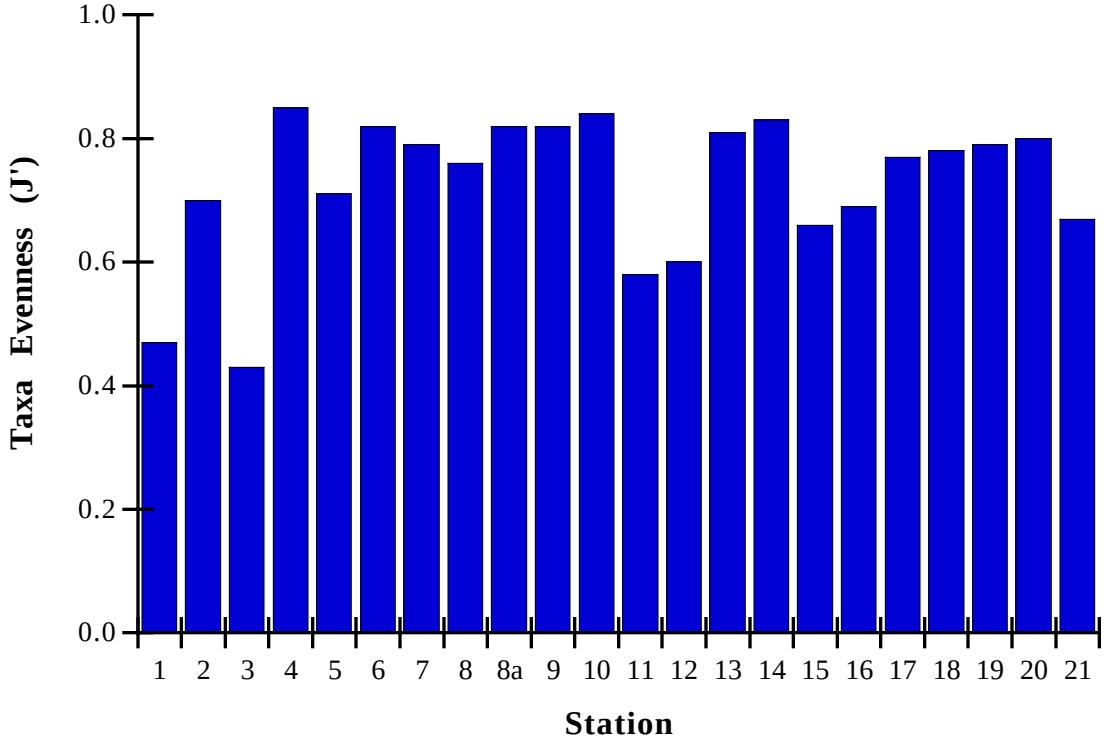


Figure 4. Taxa diversity (H') and evenness (J') for the Galveston Bay stations, 1996.





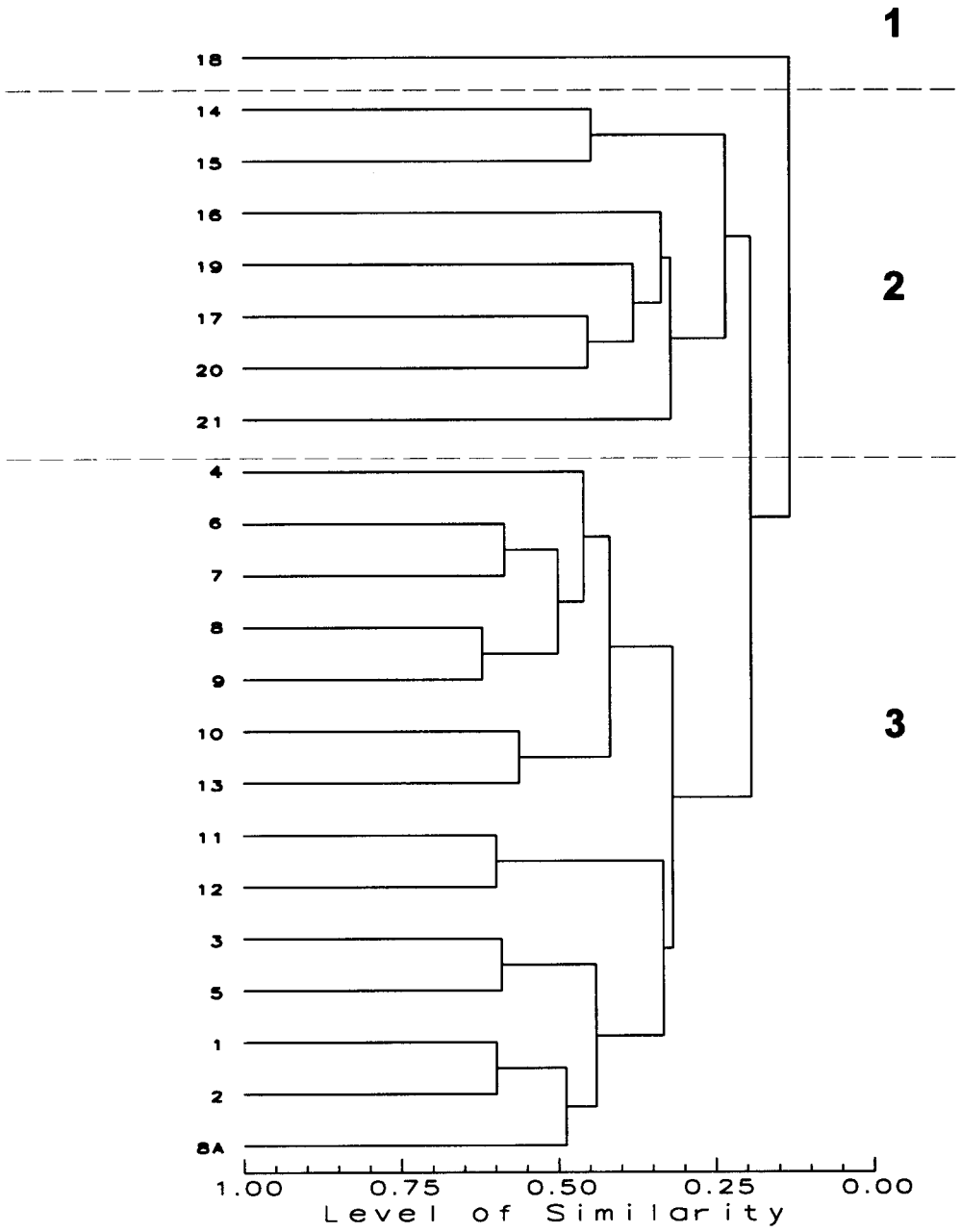


Figure 5. Normal (station) classification analysis for the Galveston Bay stations. Large, bolded numbers (1, 2, 3, 4) denote station groupings.

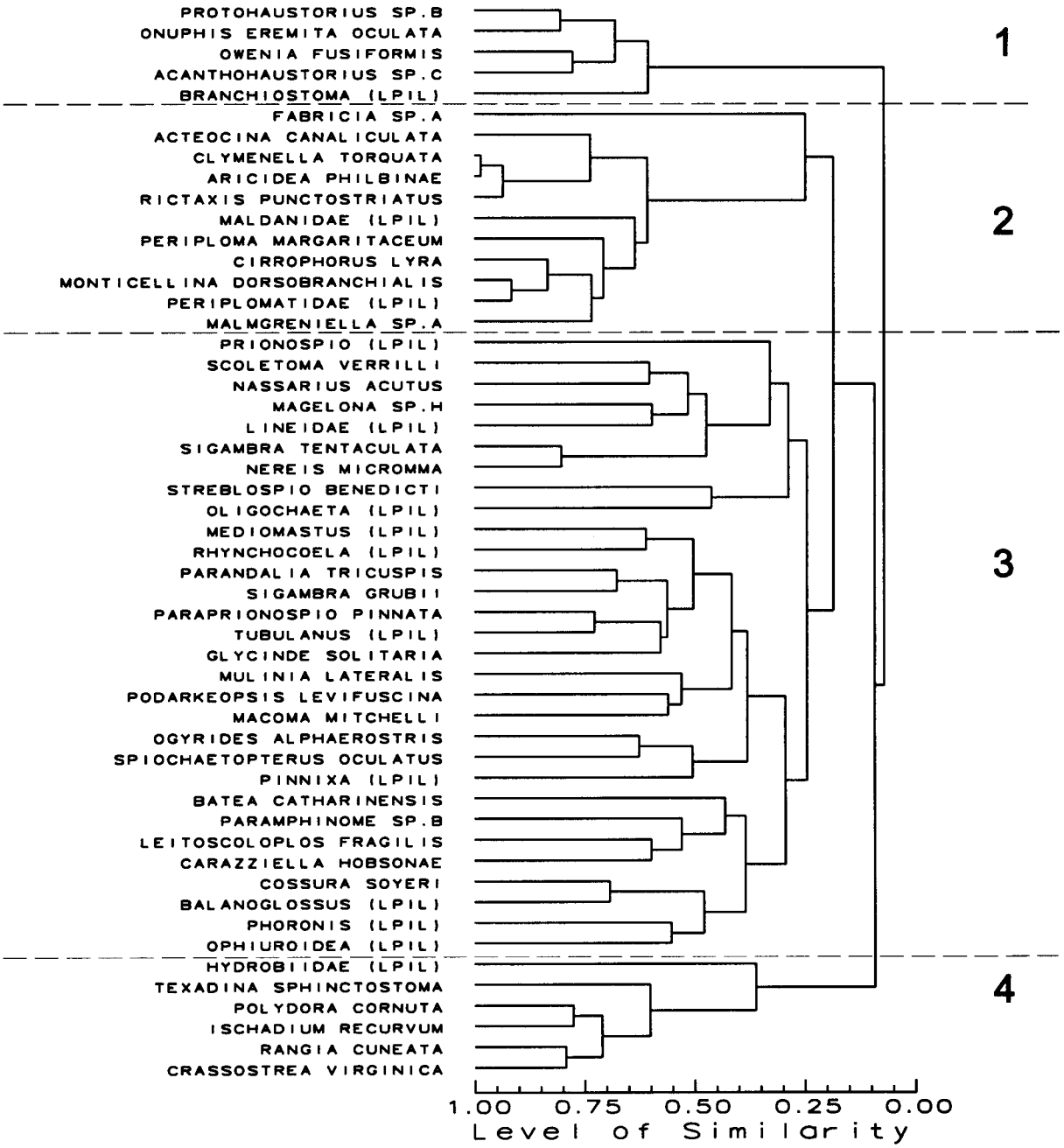


Figure 6. Inverse (taxa) classification analysis for the Galveston Bay stations. Large, bolded numbers (1, 2, 3, 4) denote taxa groupings.

Table 5. Data matrix of the Galveston Bay stations and taxa groups compiled from classification analysis dendrograms.

	STATION																					
TAXA	**18**	**14**	**15**	**16**	**19**	**17**	**20**	**21**	**4**	**6**	**7**	**8**	**9**	**10**	**13**	**11**	**12**	**3**	**5**	**1**	**2**	**8A**
Protohaustorius sp.B	40																					
Onuphis eremita oculata	30				1		1															
Owenia fusiformis	16				12	1	2															
Acanthohaustorius sp.C	23				6																	
Branchiostoma (LPIL)	17			1		2	4															
Fabricia sp.A		48																				
Acteocina canaliculata			68							1				2								
Clymenella torquata			40																			
Aricidea philbinae			36																			
Rictaxis punctostriatus			24																			
Maldanidae (LPIL)		14	116		1									8								
Periploma margaritaceum	1	2	19	1																		
Cirrophorus lyra		18	70																			
Monticellina dorsobranchialis		13	13																			
Periplomatidae (LPIL)		7	18																			
Malmgreniella sp.A		3	17			1	1															
Prionospio (LPIL)						28								5								
Scoletoma verrilli	4	26	64	3	31	5	10							3								
Nassarius acutus			1	1	7	16	8							3								
Magelona sp.H	1			12	13	4	15	60						1								
Lineidae (LPIL)			4	1	3	4		19					1	1								
Sigambra tentaculata		5		15	2	8		1														
Nereis micromma		1		14	1	6	2	2														
Streblospio benedicti		18				18					2						32	16	13	4	1	
Oligochaeta (LPIL)		7	3			6	1							1			1			2	1	1
Mediomastus (LPIL)	19	41	428	6	7	56	35	9	3	11	24	1	3	34	22	202	287	110	29	103	41	10
Rhynchocoela (LPIL)	1	2	15	4	2	1	1	2	2	1	1	1	4	3	3	2	12	3	6	15	14	9
Parandalia tricuspis		1							16	8	19	35	5	21	28	3	21	1	1	16	13	
Sigambra grubii									1	2	2	21	7	14	11	15	4	2		1		
Paraprionospio pinnata		6	8	88	3	5	6	1	6	8	7	19	23	16	28	25	1	5	4			
Tubulanus (LPIL)		5	7	2	1	8	9	2	4		5	3	5	19	7	6	1				1	
Glycinde solitaria			8		1				4	1	4	1	1	3	7	6	1			3		
Mulinia lateralis			13		38					1	1			2	1	5	16	1				
Podarkeopsis levifuscina		10	7									4	2	5	1	3	8		4			
Macoma mitchelli					4								1	3	1	3	7		1	1	1	
Ogyrides alphaerostris					2	1	1			1	1	7	1	4	4	1		1	1			
Spiochaetopterus oculatus			2	2	1	1	1				3	7	2	3								
Pinnixa (LPIL)		6				1	1	1		2		6		2	2					1		
Batea catharinensis				27										17								
Paramphinome sp.B	1				4							1	8	36	11							
Leitoscoloplos fragilis		1	2											12	14							
Carazziella hobsonae														22	1							
Cossura soyeri		20	3			2		15						10								
Balanoglossus (LPIL)		8	7					5					1	23	5							
Phoronis (LPIL)			11	1		2				1	1		1	5								
Ophiuroidea (LPIL)			5	5	1			2						6								
Hydrobiidae (LPIL)									6			1				1	7	2			10	18
Texadina sphinctostoma																1	56	2				
Polydora cornuta									2							93	27					
Ischadium recurvum			2													32	56					
Rangia cuneata																27	8					
Crassostrea virginica																7	11	1				

Numerical classification of the 22 stations can be interpreted at a three-group level (15-24% level of similarity). Group 1 contained only Station 18 with a macroinfaunal assemblage dominated by the amphipods, Protohaustorius sp. B and *Acanthohaustorius* sp. C, the polychaetes, *Onuphis eremita oculata* and *Owenia fusiformis*, and the cephalochordate, *Branchiostoma* (LPIL) (Table 5; Figure 5). Group 2 contained Stations 14, 15, 16, 17, 19, 20 and 21 with a macroinfaunal assemblage dominated by the polychaetes, *Scoletoma verrilli*, *Magelona* sp. H, *Sigambra tentaculata* and *Nereis micromma*, the gastropod, *Nassarius acutus*, and the rhynchocoel family, Lineidae (LPIL) (Table 5; Figure 5). Group 3 contained the remaining stations and a diverse assemblage of polychaetes, mollusks and amphipods (Table 5; Figure 5).

Classification of the 56 taxa at the 22 stations was interpreted at a four-group level (7 - 19% similarity; Table 5 and Figure 6). Group 1 included five taxa found in high densities at Station 18. Group 2 included 11 taxa found in high densities at Stations 14 and 15. Group 3 included a diverse assemblage of taxa found at the remaining 19 stations. Group 4 contained the mollusks, Hydrobiidae (LPIL), *Texadina sphinctostoma*, *Ischadium recurvum*, *Rangia cuneata* and *Crassostrea virginica* and the polychaete, *Polydora cornuta* found in high densities at Stations 11 and 12 (Table 5; Figure 6).

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APPENDIX

QA and QC Reports

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QUALITY ASSURANCE STATEMENT

Client/Project NOAA

Work Assignment Title Galveston Bay 1996

Work Assignment Number GB96 Task Number 1

Description of Data Set or Deliverable: 73 Benthic macroinvertebrate samples collected in July and August of 1996; Young Dredge grabs.

Description of audit and review activities: Judged accuracy rates were well above standard levels for sorting and taxonomy. Laboratory QC reports were completed. Copies of QC results follow (see attachment.) All taxonomic data were entered into computer and printed. This list was checked for accuracy against original taxonomic data sheets.

Description of outstanding issues or deficiencies which may affect data quality: None

Carl M Day 3/13/97

Signature of QA Officer or Reviewer Date

Marianne Whitehurst 3-13-97

Signature of Project Manager Date

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QUALITY CONTROL REWORKS

Client/Project NOAA
Work Assignment Title Galveston Bay 1996
Work Assignment Number GB96MR Task Number 1

Sorting Results:

Sample #	% Accuracy
06-001	100%
11-001	100%
20-003	100%
06-003	100%
8A-003	100%
8A-001	100%
10-004	100%
09-001	100%
10-005	100%
09-003	100%

Taxonomy Results:

Sample #	Taxa	% Accuracy
17-001	Crust./Moll.	95.2%
11-001	Crust./Moll.	100%
02-003	Crust./Moll.	100%
06-001	Crust./Moll.	100%
10-001	Crust./Moll.	100%
18-003	Crust./Moll.	100%
20-001	Crust./Moll.	100%
05-001	Poly./Misc.	100%
8-002	Poly./Misc.	100%
02-001	Poly./Misc.	97%
15-003	Poly./Misc.	97%
10-004	Poly./Misc.	97%
12-002	Poly./Misc.	99%
18-002	Poly./Misc.	96%
18-003	Poly./Misc.	96%

Description of outstanding issues or deficiencies which may affect data quality: None

Carl Mahy 3/13/97

Signature of QA Officer or Reviewer Date