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The Distribution of Macrobenthos in Barataria Basin, Louisiana

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THE DISTRIBUTION OF MACROBENTHOS IN BARATARIA BASIN, LOUISIANA

A Thesis

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TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	ii
LIST OF TABLES	iv
LIST OF FIGURES	v
ABSTRACT	viii
INTRODUCTION	1
MATERIAL AND METHODS	
Area Description	2
Field Work	4
Laboratory Work	10
Numerical Analyses	10
RESULTS	
Salinity	11
Temperature	11
Dissolved Oxygen	18
Sediment Size	18
Detritus	21
Biotic Factors	25
DISCUSSION	
Natural Variability	65
Human Impacts	71
LITERATURE CITED	75
APPENDICES	80
VITA	140

LIST OF TABLES

Table		Page
1.	Ecological characteristics of the water bodies in the Barataria basin.........	3
2.	Environmental characteristics of the sampling stations......................	7
3.	Distribution of detritus in the Barataria basin (November 1978)............	22
4.	Station and month identification to analyze the dendogram presented in Figures 19 and 20.......................	59
5.	Comparison of dominant benthic organisms (%) in estuarine systems of Louisiana.............................	66
6.	Comparison of macrobenthos abundance (organisms/m^2) in Barataria basin, Atchafalaya delta, and Lake Pontchartrain..............................	66
7.	Diversity index comparison in Barataria basin, Atchafalaya delta, and Lake Pontchartrain.....................	69
8.	Cluster analyses comparison between physiochemical and bioecological data of the Barataria basin....................	72

LIST OF FIGURES

Figure		Page
1.	Map of Barataria basin showing location of sampling stations......................	5
2.	Seasonal variation of precipitation and evaporation in southeast Louisiana during the study period..........................	12
3.	Seasonal variation of salinity in Lake Salvador, Little Lake, and St. Denis Bayou......................................	14
4.	Seasonal mean surface and bottom water temperature in the Barataria basin.........	16
5.	Tertiary diagram of sediment gravel-sand-mud proportions......................	19
6.	Seasonal detritus variation in Lake Salvador, Little Lake, and St. Denis Bayou......................................	23
7.	Seasonal distribution of dead shells in Lake Salvador and Little Lake.............	26
8.	Pie diagram illustrating the total percent of composition of major macrobenthos groups.................................	28
9.	Distribution of abundance and biomass over the Barataria basin in November 1978...................................	31

LIST OF FIGURES (CONTINUED)

Figure		Page
10.	Overall percent of composition (vertical height) and spatial distribution of major groups..............	34
11.	Areal distribution of the most important species in the Barataria basin..................................	36
12.	Diversity index distribution in the Barataria basin...........................	44
13.	Dendogram of similarity among stations in November 1978..........................	46
14.	Three dimensional ordination among stations in November 1978.................	49
15.	Seasonal pattern of abundance and salinity in the Barataria basin from November 1977 through November 1978........	51
16.	Seasonal pattern of biomass in the Barataria basin from November 1977 through November 1978.....................	54
17.	Seasonal distribution of diversity index during November 1977 through November 1978 in Lake Salvador, Little Lake and St. Denis Bayou.................	57

LIST OF FIGURES (CONTINUED)

Figure		Page
18.	Dendogram of similarity among stations 16 (Lake Salvador), 23 Little Lake), and 29 (St. Denis Bayou) from November 1977 through November 1978............................	60
19.	Projection of cluster groups of Station 16 (Lake Salvador, 23 (Little Lake), and 29 (St. Denis Bayou) using axis I and V................	63

ABSTRACT

Macrobenthos and environmental variables were measured in the Barataria basin, Louisiana, at 32 stations in November 1978. Three of the stations (Lake Salvador, Little Lake and St. Denis Bayou) were sampled bimonthly from November 1977 through November 1978. Abundance, diversity, and biomass results indicated two different areas: fresh, low-salinity habitats in the upper and middle basin with high biomass, abundance, and diversity, and high-salinity habitats in the lower basin with low biomass, abundance, and diversity. Over the whole basin, crustaceans were the most abundant organisms, while the mollusks dominated the biomass. Insects, nematodes, and oligochaetes were charactersitic of freshwater habitats, while polychaetes occurred in saline waters. Seasonal variation in abundance seemed to be regulated by salinity, while seasonal biomass changes were dependent only on the biomass of *Rangia cuneata*.

Numerical classification was used to analyze spatial and temporal patterns. The natural and modified environments sampled clustered into distinctive groups. The natural stations further clustered into open water and bayou areas. The analyses also indicate a distinctly different seasonality between Middle Lake Salvador, Little Lake, and St. Denis Bayou. Benthic abundance and diversity in freshwater stations are similar to those in the Atchafalaya

delta, while higher salinity stations were similar to those in Lake Pontchartrain.

The results support the idea that benthos are an important food source for nekton and that benthic populations are partially regulated by nekton. Peak benthic biomass coincides with the heaviest use of the area by migrating nekton. Benthic populations are lowest in the lower basin where predation is probably highest.

INTRODUCTION

The benthos are integral parts of any estuarine ecosystem and in past years significant advances have been made in studying their community structure and function. Such knowledge is essential because the bottom organisms interlace with the nekton, the plankton, the microbiota, the nutrient cycles, the detritus, the sediments, and the water column. The importance of benthos is indicated not only by their role as a link among ecosystem components, but also by their natural potential as environmental indicators of detrimental changes in the estuaries. These estuaries are sheltered areas of localized high productivity, and as such they form ideal nursery areas for a wide variety of fish and shellfish, including many species of commercial importance (Mann 1982).

Although the bottom organisms' role in the estuarine systems is a major one, until now there has not been an intense study conducted in the Barataria basin to characterize these organisms and their functions. The present study is a general and initial approach toward an evaluation of the distribution of macrobenthos in the Barataria basin in relation to salinity and water quality. It is part of a project funded by the Louisiana Sea Grant College Program to determine the nursery value of the middle Barataria basin.

MATERIAL AND METHODS

Area Description

The Barataria basin is a large interdistributary estuarine wetland system located between the natural levees of the Mississippi River and Bayou Lafourche. The basin encompasses some 5,240 km^2 of wetlands and water bodies. The water bodies are shallow and there is a gradual slope from the upper basin to the lower basin of approximately one cm/km (Day et al. 1982). This slope, in combination with tides (which have an approximate range of 30 cm at the coast), and rainfall (which is the only major freshwater input) determines the hydrology of the basin (Table 1.).

Basing their classification upon biological characteristics tied to physical and chemical processes, Bahr and Hebrard (1976) described five primary environmental units in Barataria basin. In this work, I sampled the water bodies of four of them: swamp forest and associated water bodies, fresh marsh and associated water bodies, brackish marsh and estuaries, and salt marsh and associated estuaries. I did not sample offshore areas. In another study, Day et al. (1982) reported that on the basis of temporal patterns of productivity, degree of eutrophy and heterotrophy of the water bodies, the basin can be divided into two regions. The waters of the upper basin (Lac des Allemands and Lake Cataouatche) are heteortrophic and

Table 1. Ecological characteristics of water bodies in the Barataria basin. (After Day et al. 1982)

Ecological Zone	Example	Turn overs Per Year	Secchi Depth (cm)	Upland to Wetland & Water Ratio	Net Community Production
Upper Basin	Lac des Allemands	4.6	33	1:2.3	-450
Middle Basin	Lake Cataouatche	1.5	30	1:6.7	-350
	Lake Salvador	1.0	72		-198
Lower Basin	Little Lake	not available	72	1:33.3	-117
	Lower Barataria Bay	14.6	68		0 to + 54

eutrophic with a clear seasonal productivity pattern, while in the lower basin waters (Little Lake and Barataria Bay) production and respiration are more closely balanced, productivity is lower, and there is no seasonal pattern.

Field Work

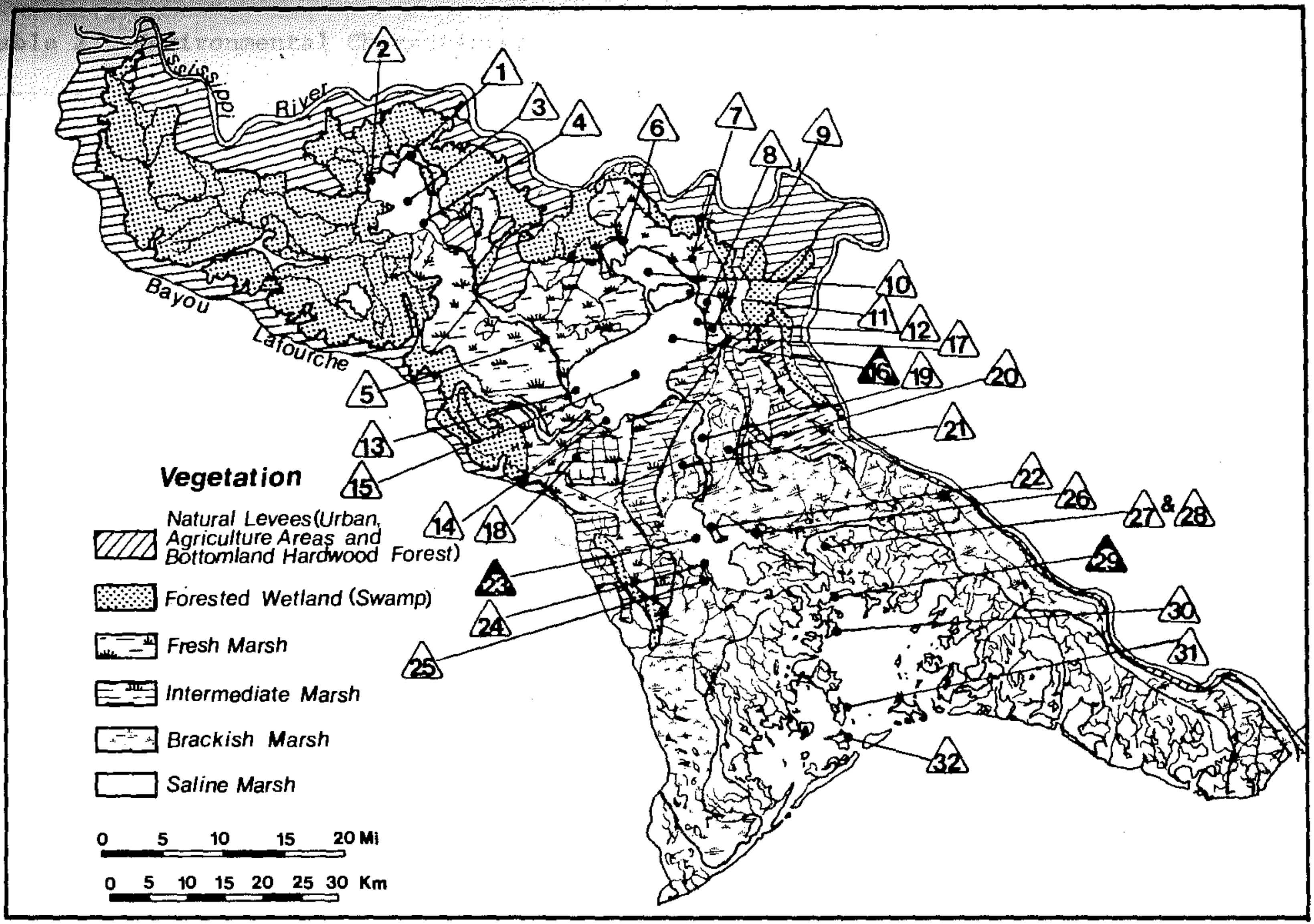
In order to characterize the macrobenthic fauna, I chose 32 stations to represent the range of conditions in the Barataria basin (Figure 1 and Table 2). Three sites were sampled bimonthly from November 1977 to November 1978, while the basin-wide stations were sampled in November 1978.

All samples were collected with an Ekman Bottom grab (22.8 x 22.8 x 22.8 cm. chamber) and sieved through a 500 μm mesh. Each sample was preserved in 10% buffered formaldehyde solution and stained with rose bengal.

Each month surface salinity, temperature, and dissolved oxygen were measured. Measurements of bottom water temperature, dissolved oxygen, and salinity were taken from May through November 1978. At 23 of 32 benthic stations (Stations 1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21, 23, 24, 29, 30, 31, and 32) collection was made from sediment size analysis. Samples were obtained using an acrylic plastic core tube 20 cm long and 7 cm in diameter.

Because in some stations the bottom was completely covered with dead shells, dry weight measurements were registered.

Figure 1. Map of Barataria basin showing location of sampling stations. Dark triangles are stations sampled bimonthly.


Mississippi River
Bayou Lafourche
Vegetation
Natural Levees (Urban, Agriculture Areas and Bottomland Hardwood Forest)
Forested Wetland (Swamp)
Fresh Marsh
Intermediate Marsh
Brackish Marsh
Saline Marsh
0 5 10 15 20 Mi
0 5 10 15 20 25 30 Km
1
2
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4
5
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32

Table 2. Environmental Characteristics of Sampling Stations.

Station Number	Name	Mean Depth(m)	Habitat Type	Salinity Range (‰)	Habitat Characteristic
01	Baie d'eu Haut	1.0	Fresh	0.0	Open Lake
02	Baie a Carlin	1.5	Fresh	0.0	Open Lake
03	Middle Lake des Allemands	2.0	Fresh	0.0	Open Lake
04	South Lake des Allemands	2.0	Fresh	0.0	Open Lake
05	Bayou des Allemands	3.5	Fresh	0.0	Wide Bayou
06	Bayou Verret	1.5	Fresh	0.0	Small Bayou
07	Bayou Segnette	2.8	Fresh	0.0	Small Bayou
08	Bayou Segnette/Waterway North	2.0	Fresh	0.0	Open Bayou
09	Bayou Segnette/Waterway South	2.0	Fresh	0.0	Open Bayou
10	Lake Cataouatche	2.5	Intermediate	0.0-1.0	Open Lake
11	Bayou Bardeaux	3.5	Intermediate	0.0-2.0	Open Bayou
12	Near-Shore Lake Salvador	2.2	Intermediate	0.0-1.0	Lake Edge
13	Temple Bay	2.0	Intermediate	0.0-1.0	Open Lake

Table 2 Continued

Station Number	Name	Mean Depth (m)	Habitat Type	Salinity Range (‰)	Habitat Characteristic
14	Catahoula Bay	2.0	Intermediate	0.0-1.0	Open Lake
15	SW Middle Lake Salvador	3.0	Intermediate	0.0-1.0	Open Lake
*16	Middle Lake Salvador	2.5	Intermediate	0.0-2.0	Open Lake
17	Intracoastal Waterway	4.0	Intermediate	0.0-2.0	Open Canal
18	Delta Farms	3.0	Fresh	0.5	Open Lake
19	Bayou Perrot	2.0	Intermediate	0.0-2.0	Open Bayou
20	Bayou Rigollette	1.5	Brackish	0.0-4.0	Open Bayou
21	Sinuous Bayou	2.0	Brackish	0.0-4.0	Small Bayou
22	Turtle Bay Canal	2.0	Brackish	2.0	Small Canal
*23	Little Lake	2.0	Brackish	0.0-11	Open Lake
24	John the Fool Lake	1.0	Brackish	0.0-9.5	Lake Edge
25	John the Fool Bayou	1.5	Brackish	3.0	Small Bayou
26	Long Bay	1.0	Brackish	1.0-13	Shallow Lake

* = Bimonthly Station

Table 2 Continued

Station Number	Name	Mean Depth(m)	Habitat Type	Salinity Range (‰)	Habitat Characteristic
27	Barataria Waterway	6.0	Saline	19.0	Deep Canal
28	Barataria Waterway	8.0	Saline	19.0	Deep Canal
*29	St. Denis Bayou	2.0	Saline	2.0-20.0	Open Bayou
30	Barataria Bay	2.0	Saline	24.0	Open Bay
31	Pelican Point	2.5	Saline	24.5	Open Bay
32	Near Queen Bess Island	1.8	Saline	27.5	Open Bay/Near Island

* = Bimonthly Station

Salinity measurements were sampled once in stations number 01, 02, 05, 22, 25, 27, 28, 30, 31, 32

Laboratory Work

In the laboratory, entire samples were sorted into detritus, shells, and organisms. The organisms were identified by genus and, as far as possible, species. After identification, specimens were transferred to separate small vials containing formalin. Individuals of each species or type were counted. Ash-free dry weight (AFDW) was determined according to Grodzinski et al. (1975) with no correction made for preservation. Measured biomass (AFDW) for each species or type is presented in Appendix I. The detritus samples were weighed wet, dried to constant weight at 75°C for 48 hours, and then reweighed. Sediment size analyses were conducted according to the method of Folk (1954) but silt and clay fractions were combined.

Numerical Analyses

SAS, the Statistical Analysis System (Barr et al. 1979), was used together with a package of computer programs by Bloom et al. (1976) adapted to the Louisiana State University System Network Computer Center. For the cluster analysis I used the cluster intensity coefficient (beta) of -0.25. The diversity of all collections was calculated using the Shannon-Weiner Index (Clifford and Stephenson 1975) while evenness was measured using $J'=H'/H'_{mx}$ (Pielou 1975).

RESULTS

Salinity

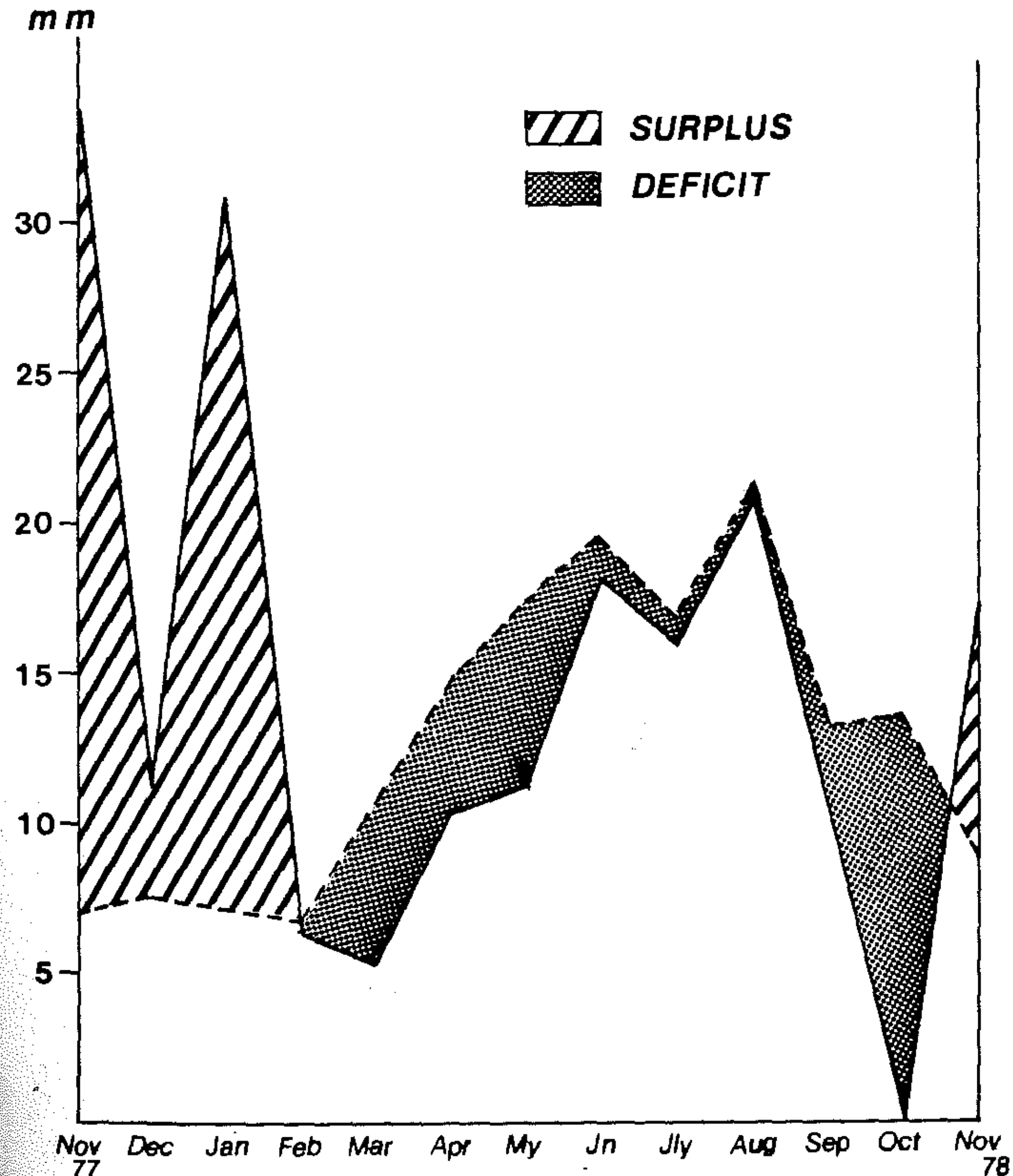
Seasonal salinity patterns at the three bimonthly stations reflected rainfall and evaporation during the study period (Figures 2 and 3). The lowest salinities occurred in high surplus periods of the winter of 1977-78, and the highest salinities occurred during the deficit periods. Annual precipitation in southeast Louisiana in 1977 was 1,751 mm, and in 1978 it was 1,688 mm (NOAA 1977, 1978).

Mean salinities were fresh in the upper basin and increased toward the coast (Table 2). The highest individual salinity measurement was 27.5‰ at Station 32 (north of Grand Terre), while most of the time Stations 1 through 9 contained fresh water (less than 0.5‰). Station 29 (St. Denis Bayou) and Station 26 (Temple Bay) showed the largest salinity variation throughout the study period: 18 ppt and 12 ppt, respectively. There was almost no salinity stratification because of the shallow depth, tides, and winds.

Temperature

Monthly average water temperature at all stations ranged from 4.0°C in January 1978 to 31.0°C in June 1978 (Figure 4, Appendix II). The smallest annual variation

Figure 2. Seasonal variation of precipitation and evaporation in southeast Louisiana during the study period (NOAA 1977, 1978) The solid line represents precipitation and the dashed line represents evaporation.


mm
SURPLUS
DEFICIT
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25
20
15
10
5
Nov 77
Dec
Jan
Feb
Mar
Apr
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Jn
Jly
Aug
Sep
Oct
Nov 78

Figure 3. Seasonal variation of salinity (ppt) in Lake Salvador (solid line), Little Lake (small dashed line), and St. Denis Bayou (large dashed line).


‰
15
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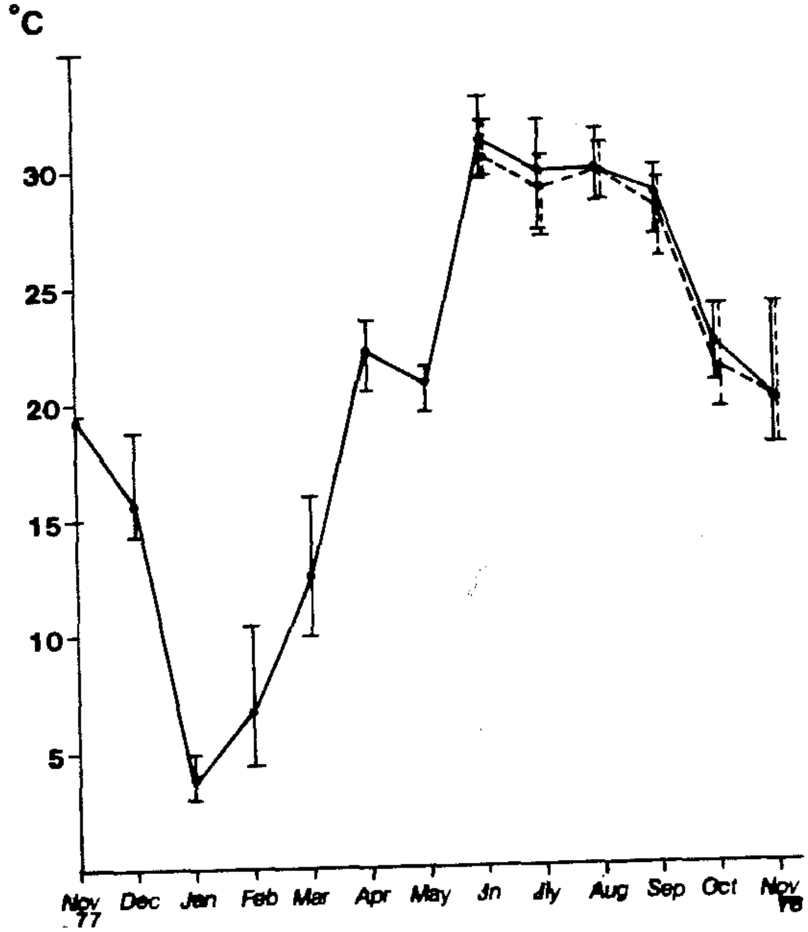
5
Nov
77
Dec
Jan
Feb
Mar
Apr
May
Jn
Jly
Aug
Sep
Oct
Nov
78

Figure 4. Mean surface (solid line) and bottom (dashed line) water temperature in the Barataria basin.


°C
30
25
20
15
10
5
Nov 77
Dec
Jan
Feb
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Apr
May
Jn
Jly
Aug
Sep
Oct
Nov 78

occurred in Station 21 (26.5°C), while the largest was in Station 7 (29.0°C), while the largest was in Station 7 (29.0°C). Water temperatures were generally warmer in the lower basin.

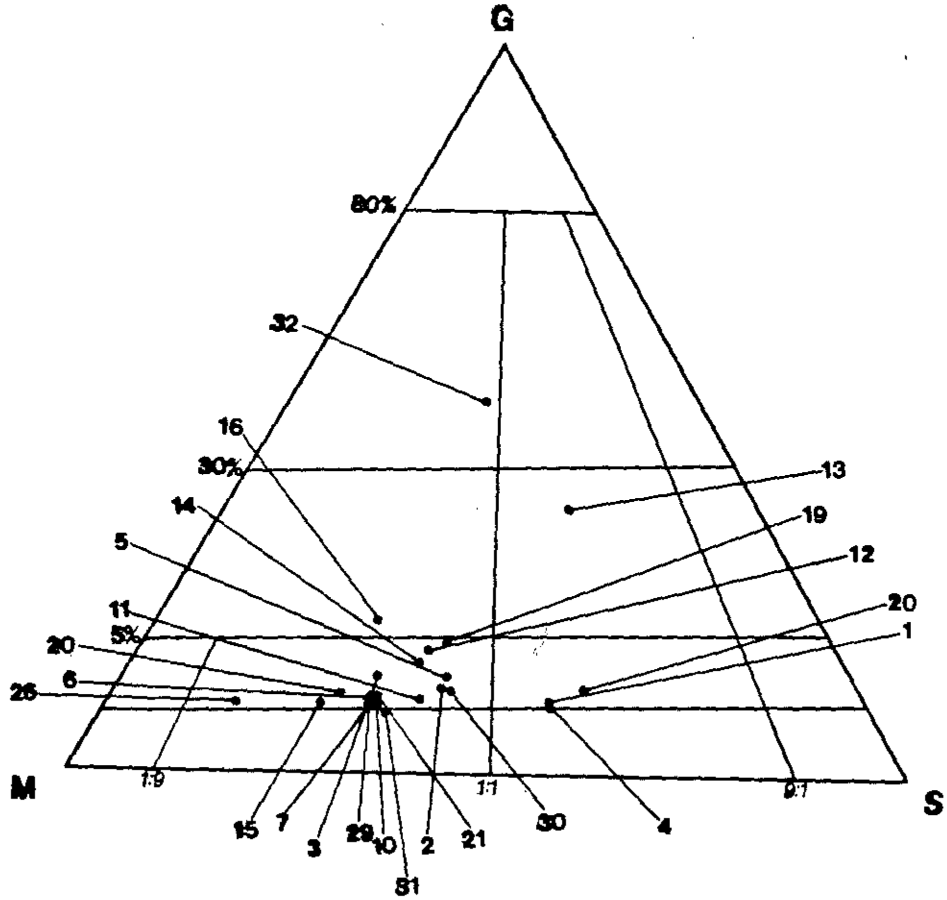
Dissolved Oxygen

Although the dissolved oxygen measurements at the surface and near the bottom were taken only after May 1978 (Appendix III), it is possible to detect an increasing level of dissolved oxygen from the upper to the lower basin. The highest seasonal values of dissolved oxygen (surface and bottom measurements) were registered in October, November, and December 1978, while the lowest value occurred in June and September 1978. There was no correlation between dissolved oxygen and precipitation. Of the samples, 7.5% showed a greater dissolved oxygen level at the bottom and 18% had the same level at the surface and at the bottom. The remainder showed higher oxygen levels at the surface. The highest individual value found was 15.9 ml O_2/l at Bayou Verret in August 1978, and the lowest was 0.3 ml O_2/l at Delta Farms in November 1978.

Sediment Size

The sediment analysis shows that the study area is predominantly characterized by fine sediments (silt and clay) (Figure 5). This fine material ranged from 20% to 85% of the samples and is most noticeable along regions of

Figure 5. Tertiary diagram of sediment gravel-sand-mud proportions.


G
80%
30%
5%
M
S
1:9
1:1
9:1
32
16
13
14
19
5
12
11
20
1
20
6
26
15
7
3
29
10
31
2
21
30
4

quiet water such as Long Bay or in the middle of Lac des Allemands, Lake Salvador, and Lake Cataouatche (Appendix IV). Sand-sized sediments with a mean weighting percentage of 37 are well represented in all stations, while the coarse material appears near sites with strong currents, such as north of Grand Terre, in Lake Salvador (in front of Bayou des Allemands), and in Bayou Perrot, comprising 4% of all stations.

Detritus

Organic detritus is defined in this study as all dead plant and animal matter, including microbiota, collected along with the bottom samples and retained by a 500 μm sieve. The greatest concentration of organic detritus occurred in the brackish habitats (Table 3). The largest overall individual values were found in Bayou Segnette Waterway South (Station 9) and Bayou Bardeaux (Station 11). The lowest values were found in the saline stations near the Gulf.

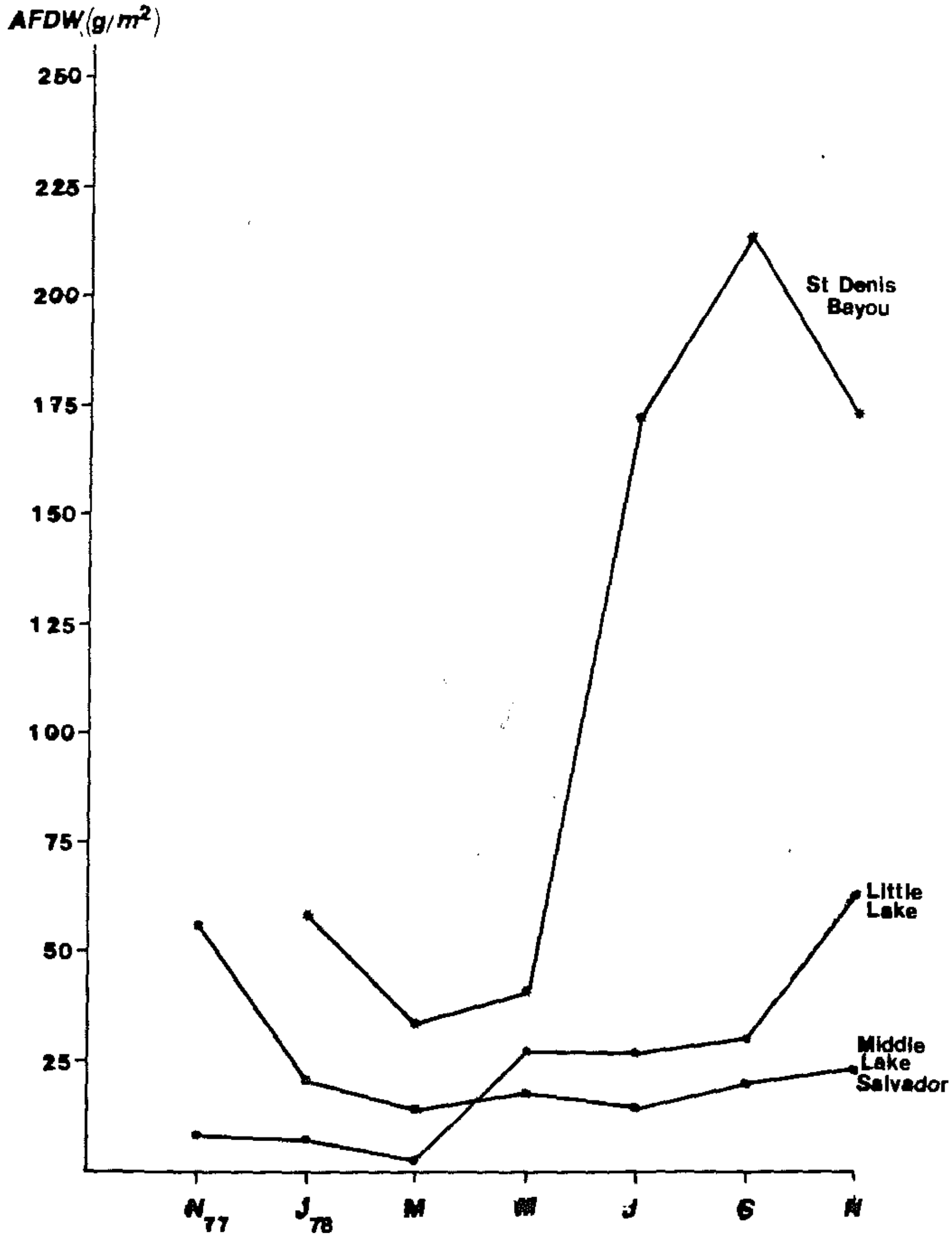
Seasonal changes in organic detritus measured bimonthly in three stations were at a maximum in September 1978 at Station 29, in November 1978 at Station 23, and in November 1977 at Station 16. A minimum occurred in March at all three stations (Figure 6). Seasonal changes are a result of such forcing functions as annual precipitation, coupled with the period in which the plant material, mostly *Spartina alterniflora*, is transformed to a dead standing

Table 3. Distribution of detritus in the Barataria basin (November, 1978)

STATION	*AFDW(g/m^2)	STATION	*AFDW(g/m^2)
01	121.9	17	225.8
02	--	18	254.5
03	--	19	761.1
04	30.2	20	361.5
05	84.7	21	178.1
06	191.4	22	64.2
07	107.4	23	64.7
08	158.0	24	8.9
09	1,154.8	25	51.1
10	19.9	26	62.9
11	859.1	27	20.8
12	170.7	28	698.8
13	150.0	29	174.8
14	135.9	30	15.3
15	--	31	26.0
16	23.6	32	19.8

* AFDW = Ash Free Dry Weight

Figure 6. Seasonal detritus variation in Lake Salvador, Little Lake, and St. Denis Bayou


AFDW(g/m²)
250
225
200
175
150
125
100
75
50
25
N77
J78
M
M
J
S
N
St Denis
Bayou
Little
Lake
Middle
Lake
Salvador

crop. The standing crop of detritus in the estuary at any given time is a complex product of events in different sections of the marsh-estuarine ecosystem (Day et al. 1973).

The appearance of dead-shell bottom is significant both as another variety of substrate for bottom fauna and flora and as a dead crop information parameter for the mollusk. All dead shells were Rangia cuneata, except at Station 32 (north of Grand Terre) where oyster reefs were found. Dead Rangia shells were found in Lake Salvador, Little Lake, and Barataria Bay. Their size varied between 1 cm and 4 cm. The annual variation of dead shells in Lake Salvador and Little Lake is shown in Figure 7.

Biotic Factors

Composition

Ninety-four different species were collected in the Barataria basin, in environments ranging from fresh to marine. A total of 254,813 organisms distributed in 32 stations were sampled in November 1978. Numbers of taxa varied markedly from one station to the next. However, there was a mean of 10 species per station. When summarized at the level of higher taxonomic groups, crustaceans, polychaetes, oligochaetes, nematodes and insects represented 90% of all organisms (Figure 8 and Appendix I).

Abundance

The numerical density of the macrobenthic fauna is low in the lower basin and steadily increases to the upper

Figure 7. Seasonal distribution of dead shells in Lake Salvador (solid line) and Little Lake (dashed line)

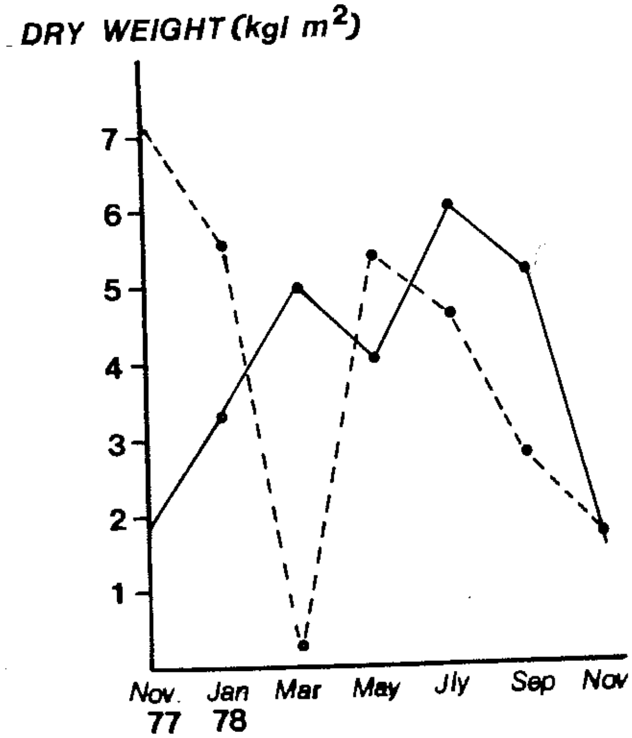
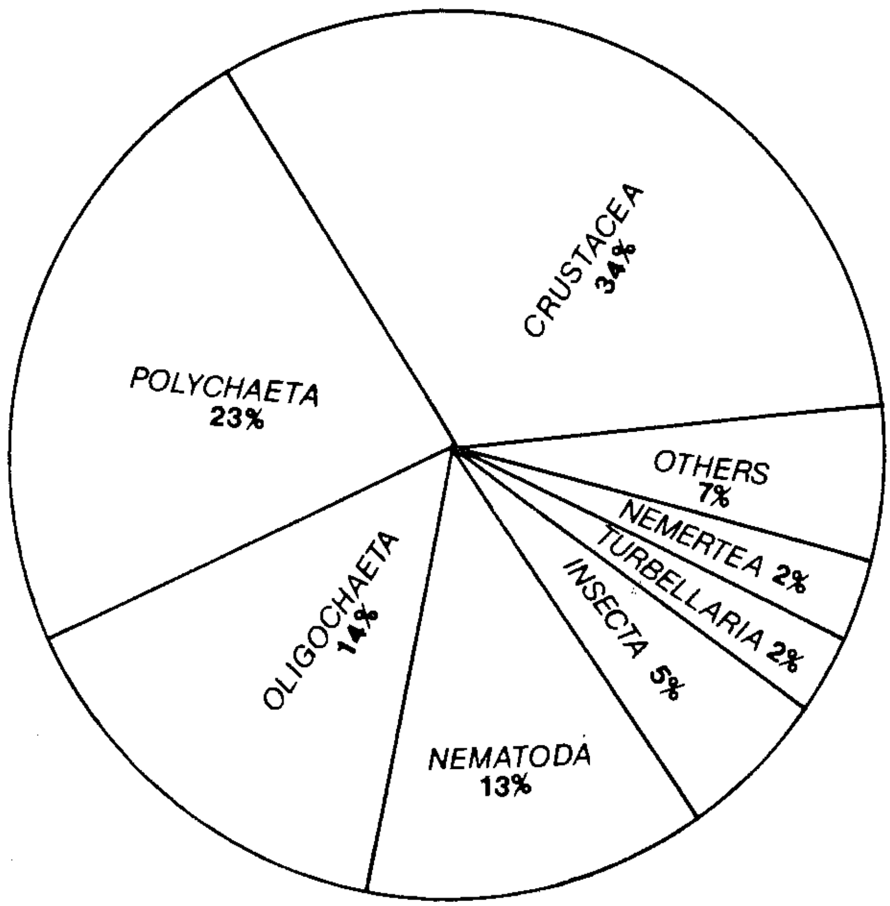

DRY WEIGHT (kg/ m2)
7
6
5
4
3
2
1
Nov. 77
Jan 78
Mar
May
Jly
Sep
Nov

Figure 8. Pie diagram illustrating the total percent composition of major benthic groups.


CRUSTACEA
34%
POLYCHAETA
23%
OTHERS
7%
NEMERTEA 2%
TURBELLARIA 2%
INSECTA 5%
OLIGOCHAETA
14%
NEMATODA
13%

basin. Patterns of high abundance can be identified in stations near the water's edge (Stations 2, 12, and 29) or in natural and shallow bayous (Stations 6, 7, 11, and 19), mostly in the freshwater areas. The largest number per square meter, 40,000 organisms, was found at Station 7 (Bayou Segnette); Gammarus macromucronate and several species of crustaceans contributed the most to these high densities.

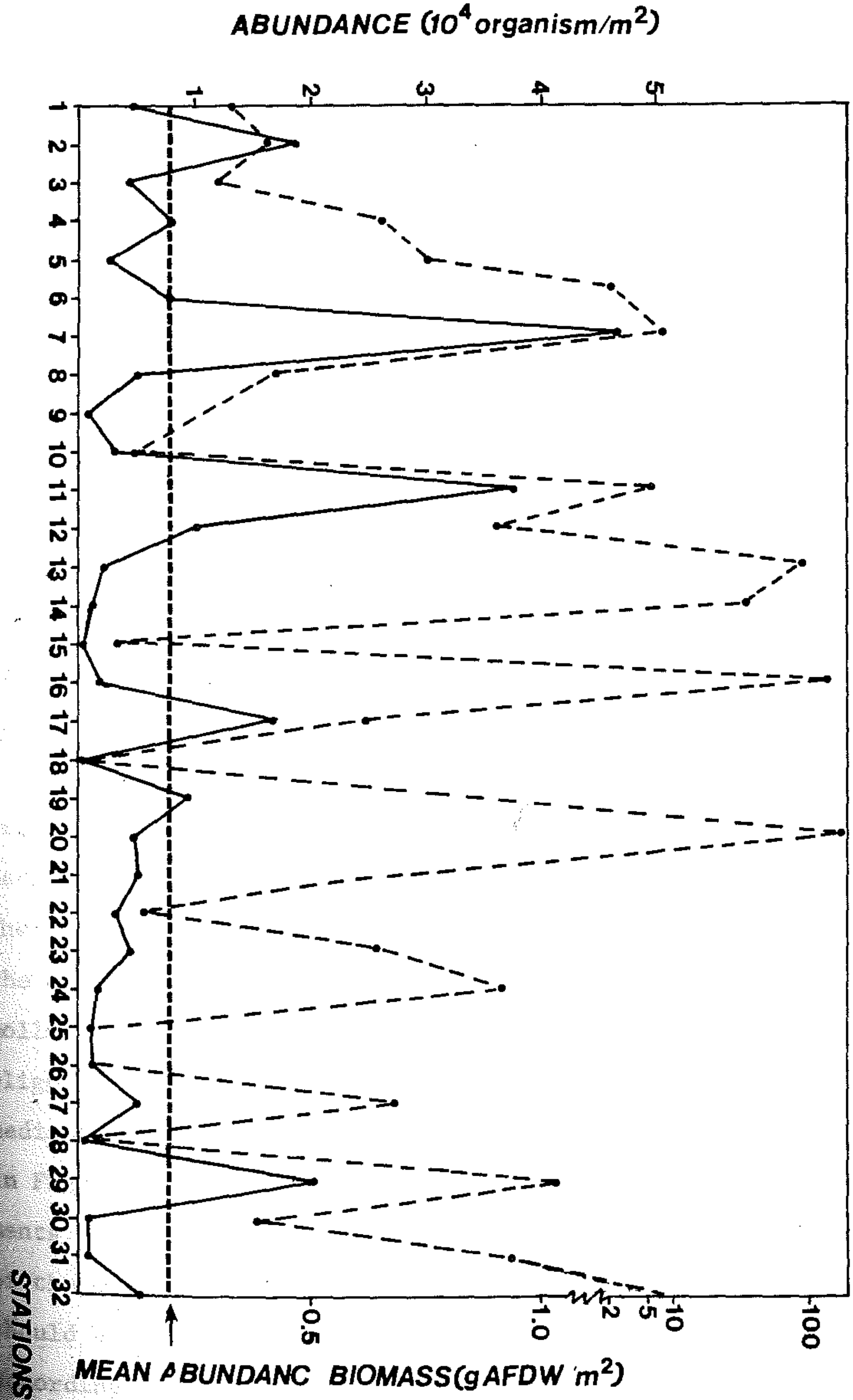
Abundance by weight (biomass in ash free dry weight) yields a different pattern compared with the numerical abundance (Figure 9) caused by the enormous biomass of adult Rangia cuneata, which appeared in Stations 13, 14, 16, and 20. Based upon salinity distribution, the macrobenthos classification was: freshwater, 64% (Stations 1 through 17); oligohaline, 23% (Stations 18 through 22); mesohaline, 0.5% (Stations 23 through 26); and polihaline, 3.5% (Stations 23 through 32).

Crustaceans were the most numerically abundant group, with 44 genera that contributed significantly in 94% of all stations and had 3% of the total biomass. The most important orders were Amphipoda, Cladocera, Ostracoda, and Isopoda.

Polychaeta, represented by 13 genera, appeared in 46% of all stations and had 1.5% of the total biomass. One species alone, Hobsonia florida (=Hypaniola florida), made up almost 40% of the total number of worms.

Mollusca showed 18 genera, which appeared in 78% of

Figure 9. Distribution of abundance and biomass over the Barataria basin in November 1978. The solid line represents abundance and the large dashed line represents biomass.



ABUNDANCE (10^4 organism/m^2)
1
2
3
4
5
STATIONS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
0.5
1.0
2
5
10
100
MEAN ABUNDANC BIOMASS(g AFDW m^2)

all stations and represented 93% of the total biomass (mostly because of Rangia cuneata). Mollusks were numerically dominated by the gastropod, Texadina sphantozoma, which accounted for 55% of the total number.

Oligochaeta were not classified at genera level but were found in 60% of all stations. They represented only 0.5% of the total biomass and 14% of the total number.

With little more than 0.5% of the total biomass and 5% of the total number, insects were characterized mostly by Chironomids, which made up 94% of all insects. Other groups, such as Turbellaria, Nemertea, Hydrozoa, Hirudinea, Stelleroidea, and Nematoda, were not so important in number or in weight (Appendix V).

Spatial Variation

A general comparison among stations revealed that freshwater habitats had a greater numerical abundance, which decreased as the habitat became more marine. Considering the whole basin and the most important groups (Figure 10), the overall spatial distribution of crustaceans and mollusks is evident, while insects, nematodes, and oligochaetes are distributed mostly in the fresh and intermediate habitats. Polychaetes and nemerteans (not shown in Figure 10) were prevalent in brackish and marine environments. Figure 11 shows the spatial patterns of occurrence of the most important species in the Barataria basin. It should be emphasized that patterns of occurrence varied according to seasons (Appendix VI).

Figure 10. Overall percent composition and spatial distribution of major groups.

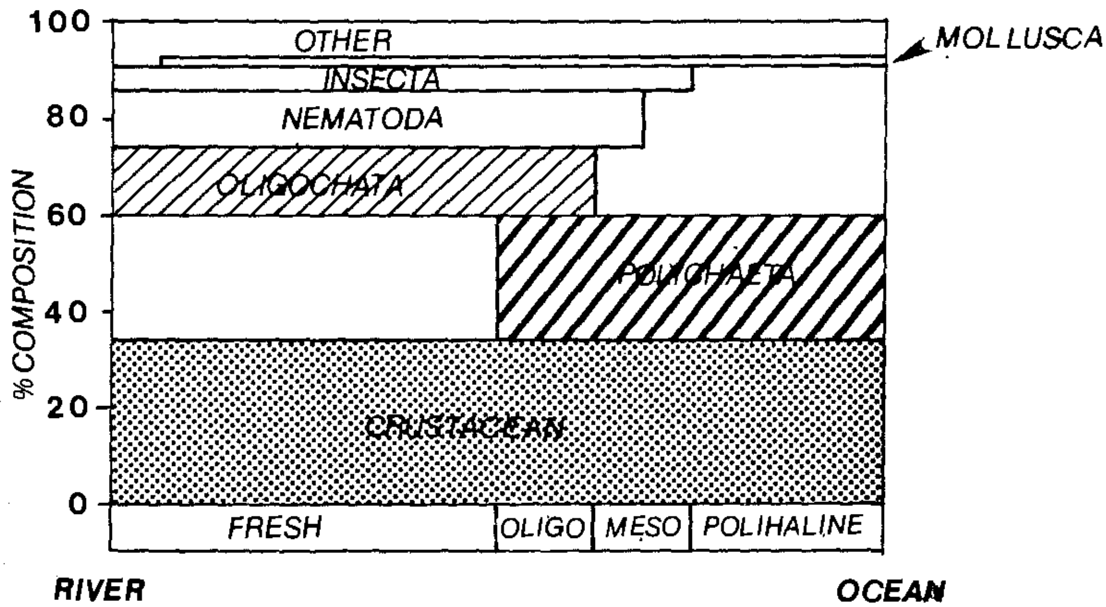

100
80
60
40
20
0
% COMPOSITION
OTHER
MOLLUSCA
INSECTA
NEMATODA
OLIGOCHATA
POLYCHAETA
CRUSTACEAN
FRESH
OLIGO
MESO
POLIHALINE
RIVER
OCEAN

Figure 11. Areal distribution of major groups

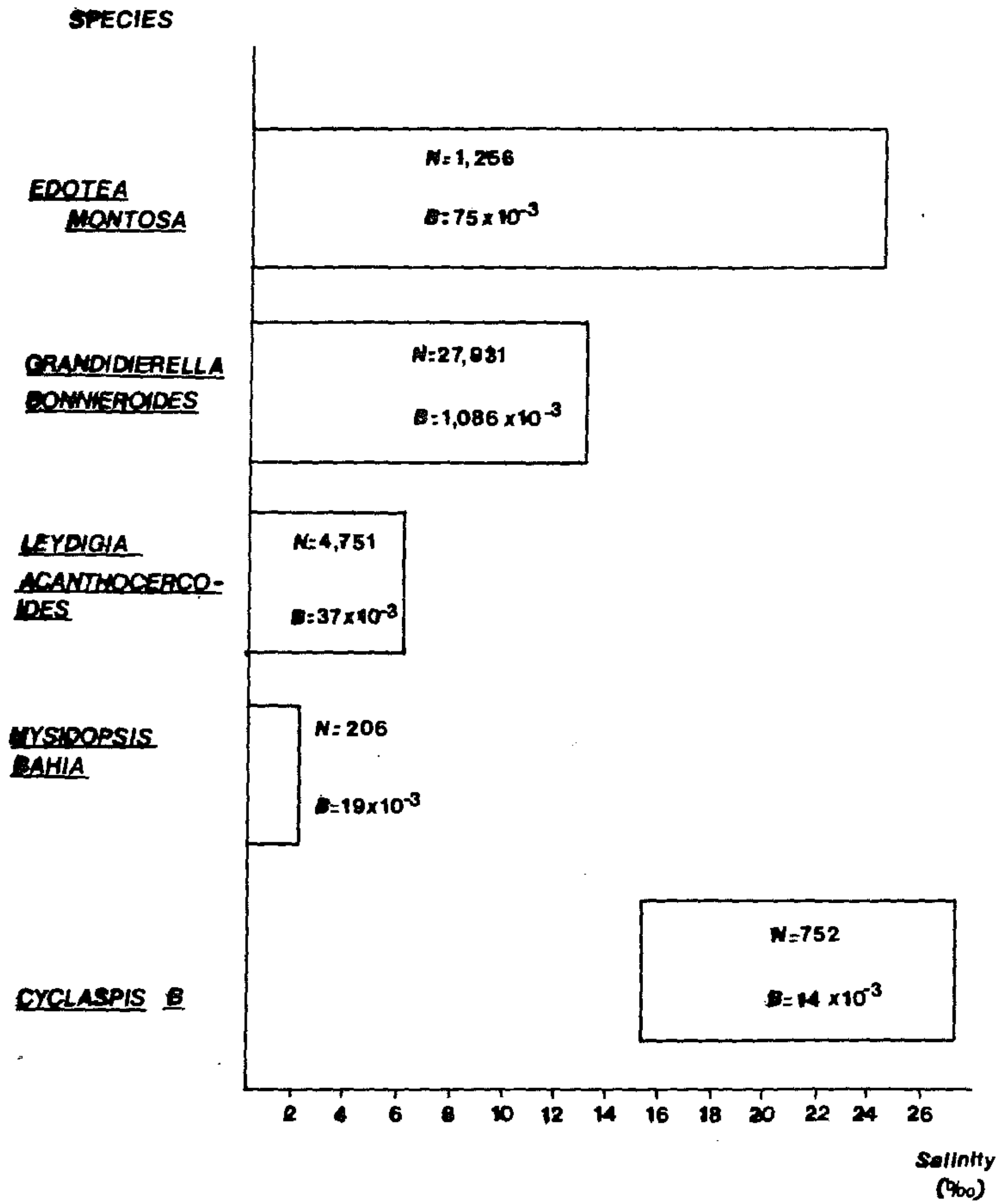
Crustaceans

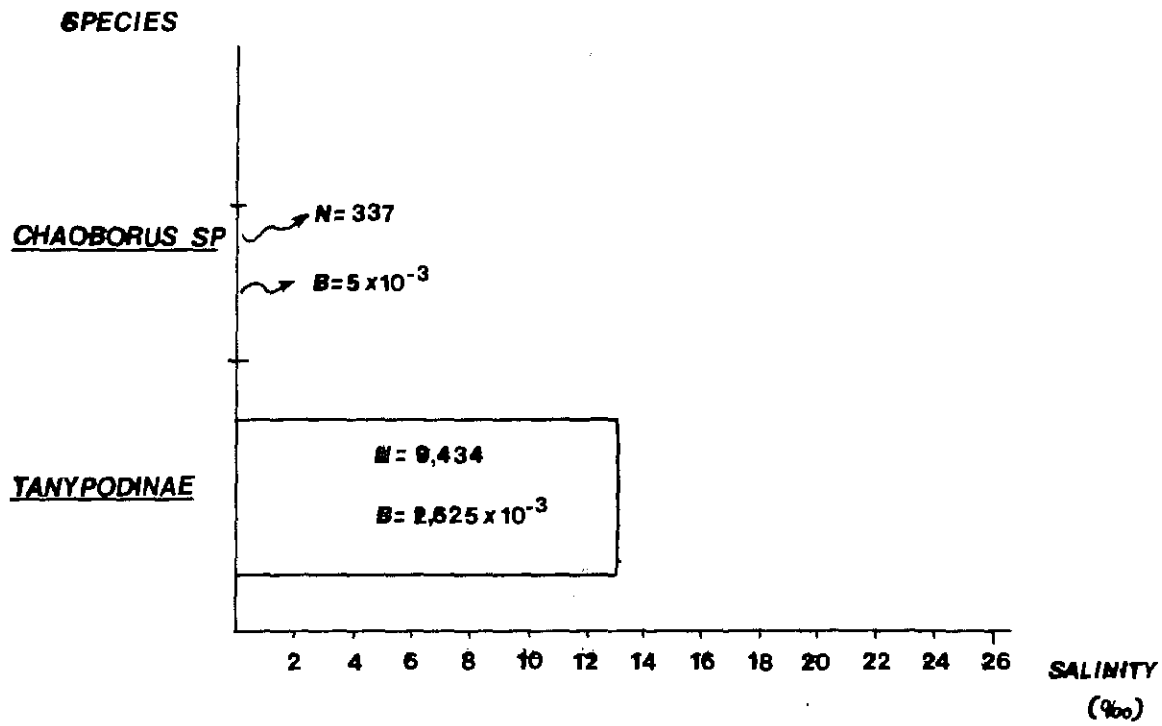
Insects

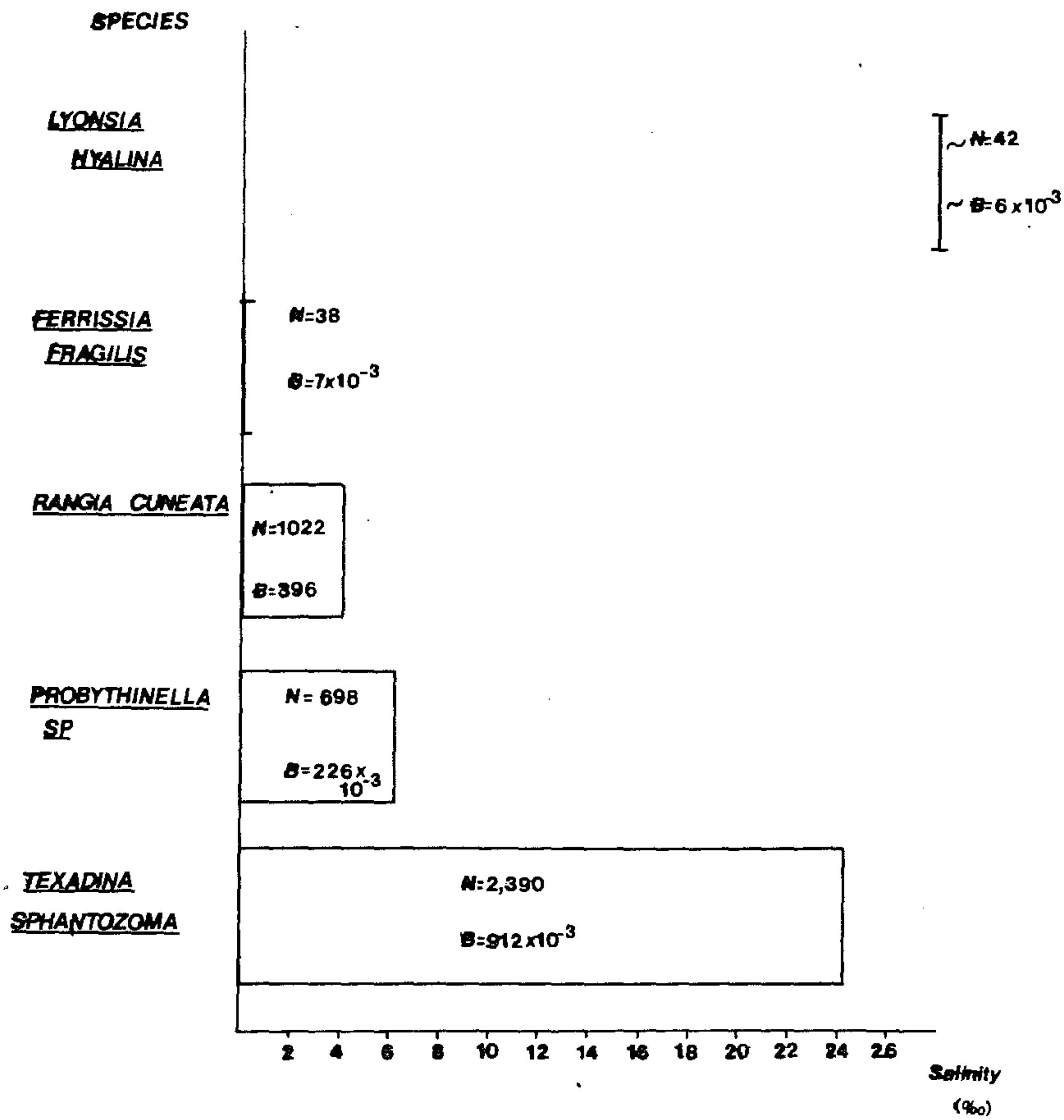
Mollusks

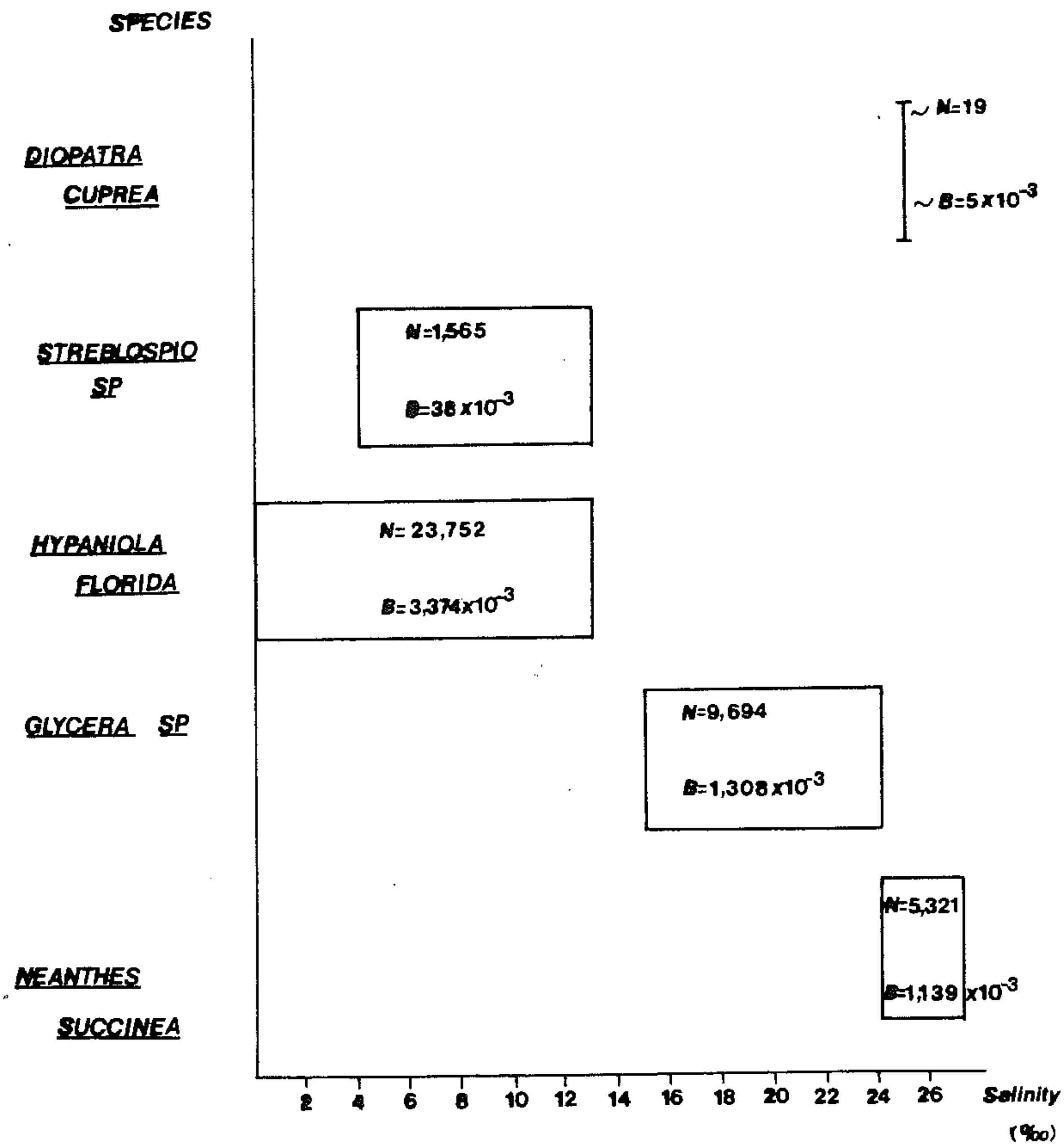
Polychaetes

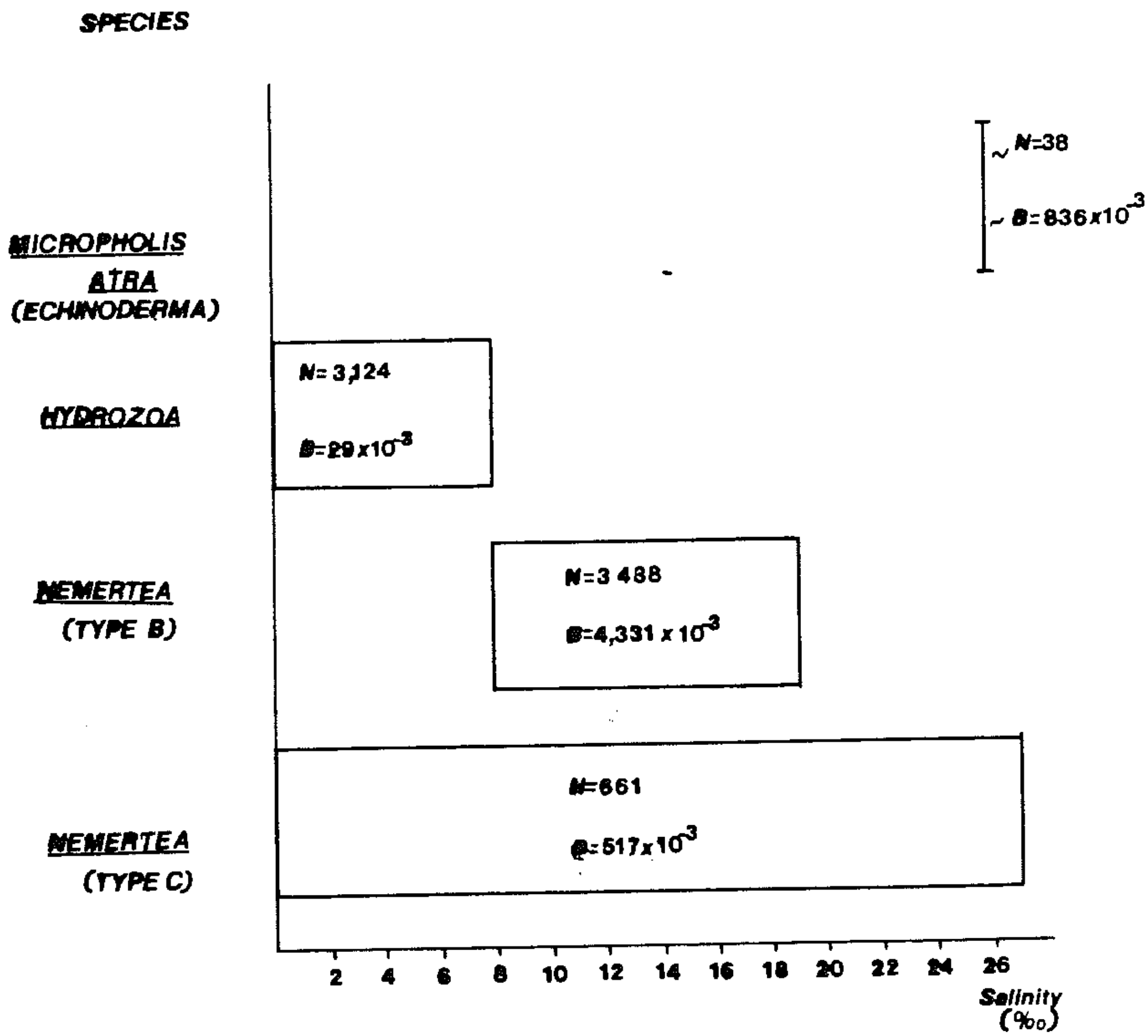
Others


SPECIES
EDOTEA MONTOSA
N: 1,256
B: 75 x 10-3
GRANDIDIERELLA BONNIEROIDES
N:27,931
B: 1,086 x 10-3
LEYDIGIA ACANTHOCERCO-IDES
N: 4,751
B: 37 x 10-3
MYSIDOPSIS BAHIA
N: 206
B: 19x10-3
CYCLASPIS B
N: 752
B: 14 x 10-3
2 4 6 8 10 12 14 16 18 20 22 24 26
Salinity (‰)


SPECIES
CHAOBORUS SP
N= 337
B=5 x10-3
TANYPODINAE
N= 9,434
B= 2,625 x 10-3
2 4 6 8 10 12 14 16 18 20 22 24 26
SALINITY
(‰)


SPECIES
LYONSIA HYALINA
~N=42
~B=6x10^-3
FERRISSIA FRAGILIS
N=38
B=7x10^-3
RANGIA CUNEATA
N=1022
B=396
PROBYTHINELLA SP
N= 698
B=226x10^-3
TEXADINA SPHANTOZOMA
N=2,390
B=912x10^-3
2 4 6 8 10 12 14 16 18 20 22 24 26
Salinity (‰)


SPECIES
DIOPATRA CUPREA
~ N=19
~ B=5x10-3
STREBLOSPIO SP
N=1,565
B=38x10-3
HYPANIOLA FLORIDA
N= 23,752
B= 3,374x10-3
GLYCERA SP
N=9,694
B=1,308x10-3
NEANTHES SUCCINEA
N=5,321
B=1,139 x10-3
2 4 6 8 10 12 14 16 18 20 22 24 26
Salinity (‰)


SPECIES
MICROPHOLIS ATRA (ECHINODERMA)
N=38
B=836x10^-3
HYDROZOA
N=3,124
B=29x10^-3
NEMERTEA (TYPE B)
N=3 488
B=4,331 x 10^-3
NEMERTEA (TYPE C)
N=661
B=517x10^-3
2 4 6 8 10 12 14 16 18 20 22 24 26
Salinity (‰)

The spatial variation was measured and expressed by the diversity index, using the Shannon-Wiener Index. For all 32 stations, the index was 1.417 $\pm$ 0.126. Figure 12 shows the diversity of each station. These indexes showed that diversity decreases toward mesohaline stations and increases again in the polyhaline stations. The lower values found (Stations 8 and 17) were in canals with a high level of modifications. To complete the overall data, an evenness index of 0.64 was calculated, showing how the individuals are apportioned among themselves. Numbers much less than one are indicative of a uniform distribution.

The results of numerical classification, a method for simplifying complex data sets (Boesch 1977), is displayed as a dendogram (Figure 13), where a hierarchical classification of stations based on levels of similarity exhibits eight groups of stations. The parameters used to characterize these groups are diversity, abundance, biomass and habitat characteristics. Cluster A, which includes two stations with high abundance, high diversity, and high biomass is represented by natural bayous (Stations 7 and 11). Cluster B (Station 17) shows one station with high abundance, low diversity, and low biomass, and it is a canal with heavy traffic and significant modifications. Cluster C (Stations 2, 4, 12, 20, 21, and 29) contains stations with low abundance, low diversity, and moderate biomass and is characterized by natural open water bodies. Cluster D (Station 28), with low abundance, low diversity,

Figure 12. Diversity index distribution in the Barataria basin

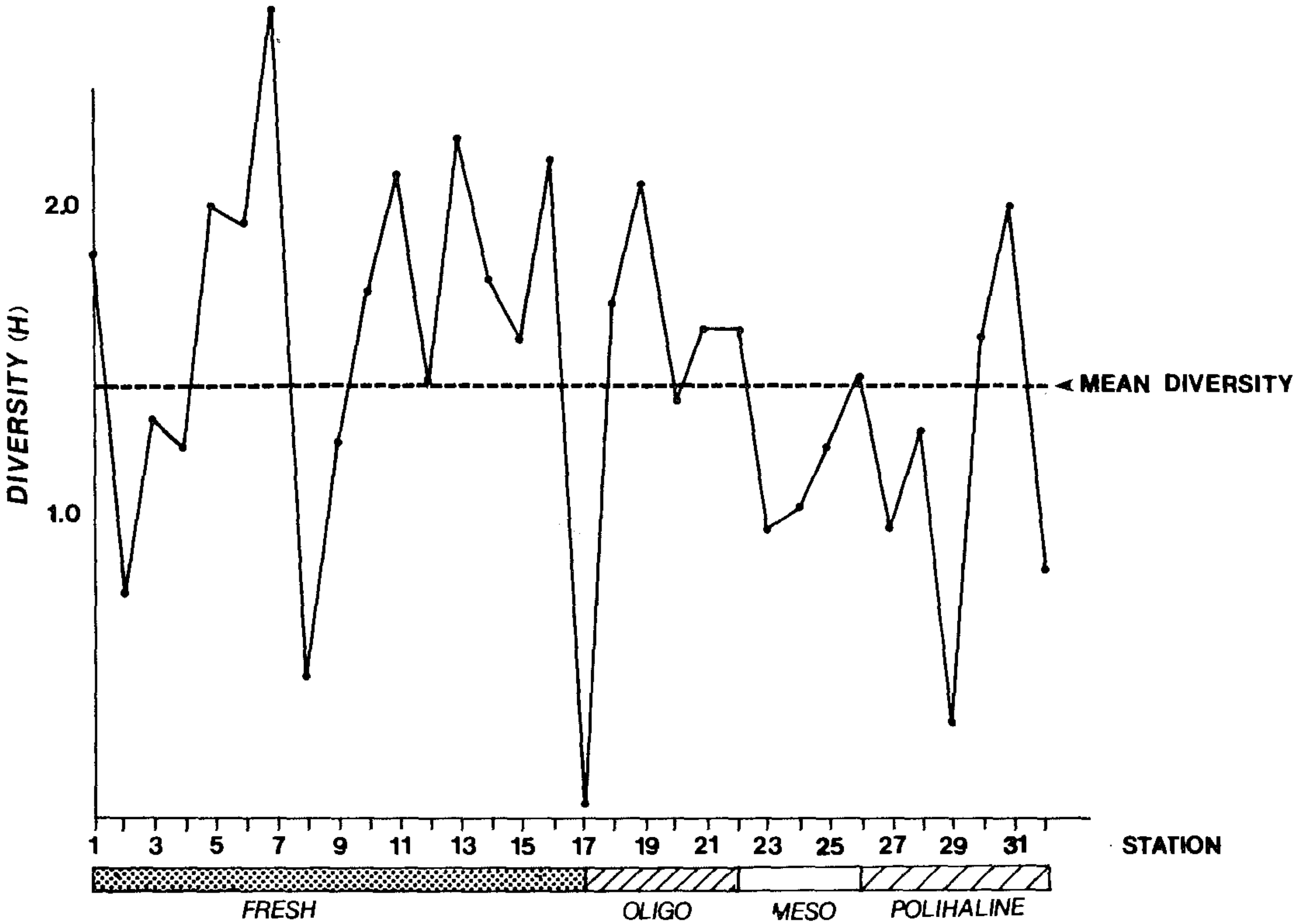
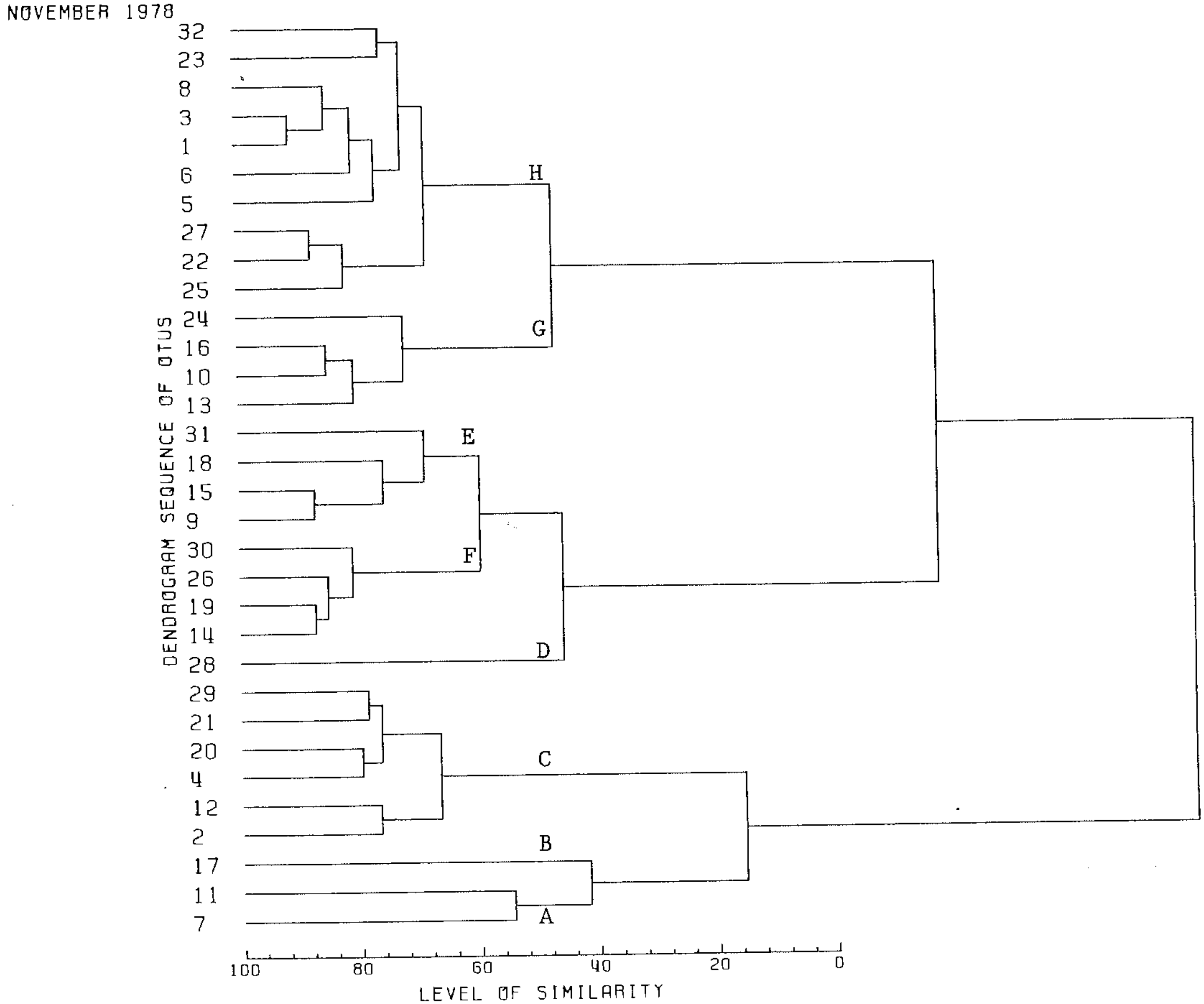

DIVERSITY (H)
2.0
1.0
MEAN DIVERSITY
STATION
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
FRESH
OLIGO
MESO
POLIHALINE

Figure 13. Dendogram of similarity among stations sampled in November 1978.



NOVEMBER 1978
DENDROGRAM SEQUENCE OF OTUS
32
23
8
3
1
6
5
27
22
25
24
16
10
13
31
18
15
9
30
26
19
14
28
29
21
20
4
12
2
17
11
7
H
G
E
F
D
C
B
A
100
80
60
40
20
0
LEVEL OF SIMILARITY

and low biomass, represents a dredged canal. Clusters E (Stations 9, 15, 18, 9, and 31) and F (Stations 14, 19, 26, and 30) show low abundance and high diversity; however, one includes undisturbed stations with high biomass (Cluster F) and the other is modified and has low biomass (Cluster E). Cluster G (Stations 10, 13, 16, and 24) groups stations with low abundance, high diversity, and low biomass. They are all open water bodies. Cluster H (Stations 1, 3, 5, 22, 25, 27 and 32) consists of open water bodies and bayous with low abundance, low diversity, and high biomass. A three-dimensional view of all stations is shown in Figure 14.

Based upon ecological characteristics, these dendograms (Figures 13 and 14) separated in much detail the resulting community structure from different habitats. Groups B, D, and E are stations with large disturbances such as dredging activities and heavy traffic. Groups C, F, and G identify open-water stations primarily in the intermediate habitats. Group H clusters natural stations under environmental stresses such as salinity variation, high nutrient input, and lack of detritus.

Temporal Variation

Three stations were studied to characterize the seasonal patterns of macrobenthos. The seasonal variation in abundance in Lake Salvador and Little Lake showed a direct relationship with salinity, i.e., increasing salinity was accompanied by an increase in abundance, primarily in May and November (Figure 15), while St. Denis Bayou showed an

Figure 14. Three-dimensional ordination among stations sampled in November 1978.

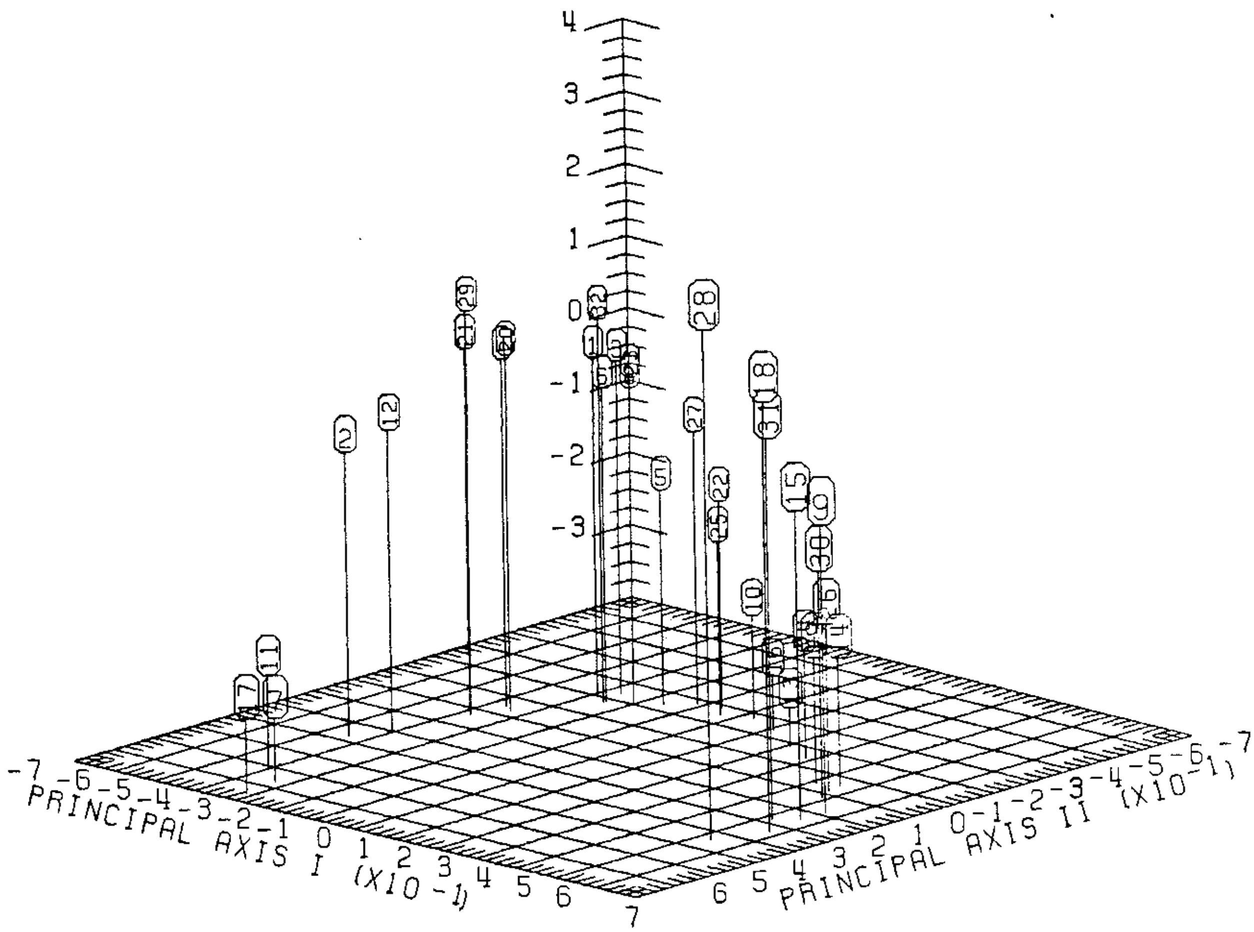
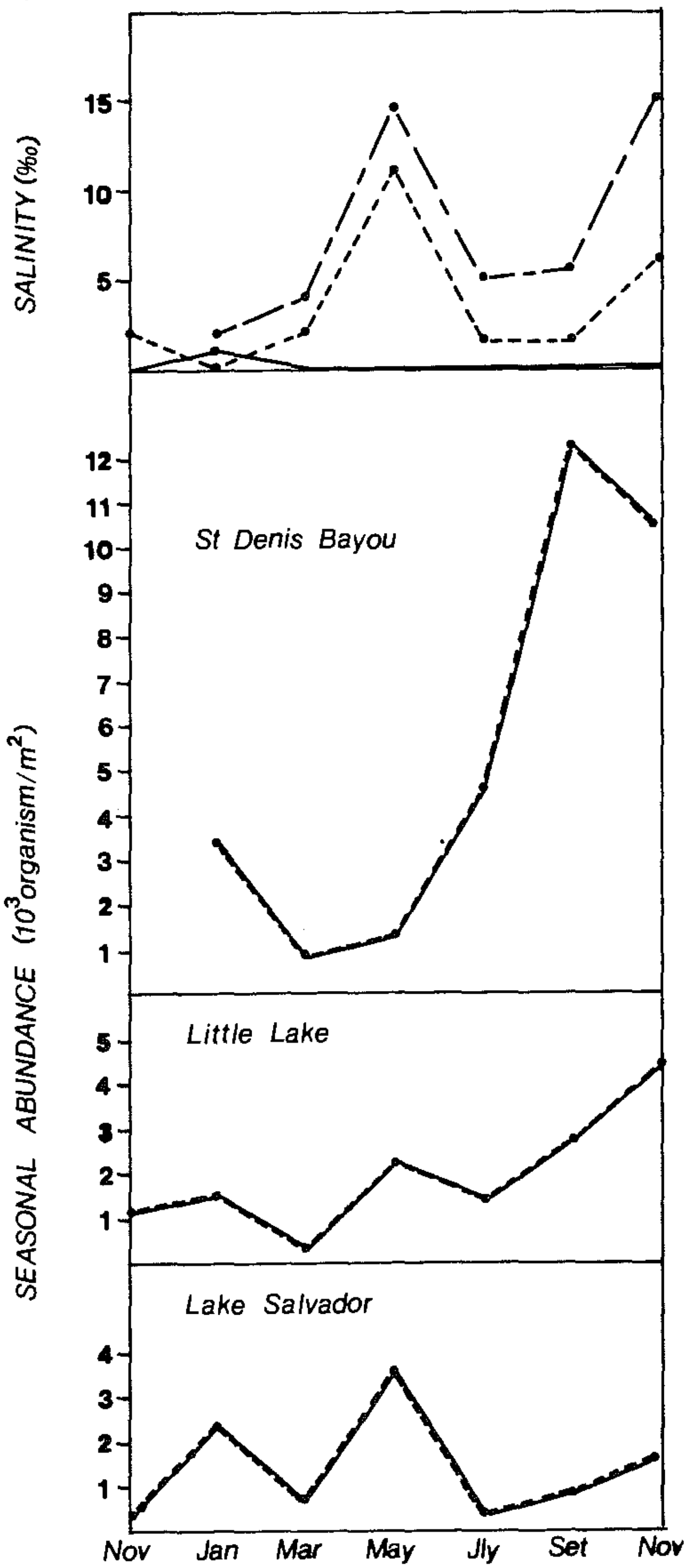

PRINCIPAL AXIS I (X10 -1)
PRINCIPAL AXIS II (X10-1)

Figure 15. Seasonal pattern of abundance and salinity in the Barataria basin from November 1977 through November 1978.


15
10
5
SALINITY (‰)
12
11
10
9
8
7
6
5
4
3
2
1
St Denis Bayou
SEASONAL ABUNDANCE (10^3 organism/m^2)
5
4
3
2
1
Little Lake
4
3
2
1
Lake Salvador
Nov
Jan
Mar
May
Jly
Set
Nov

inverse relationship with salinity.

Some species, such as Texadina sphantozoma, Rangia cuneata (including juveniles--less than 2 mm--from November through May), Hobsonia florida, Nemertea type C, and Capitellidae appeared in some stations the whole year. Nematoda, Parandalia americana, Glycera sp., Turbellaria, Balanus sp., Berosus sp., Ilyocriptus agilis, and Streblospio sp. appeared only one month (Appendix VII).

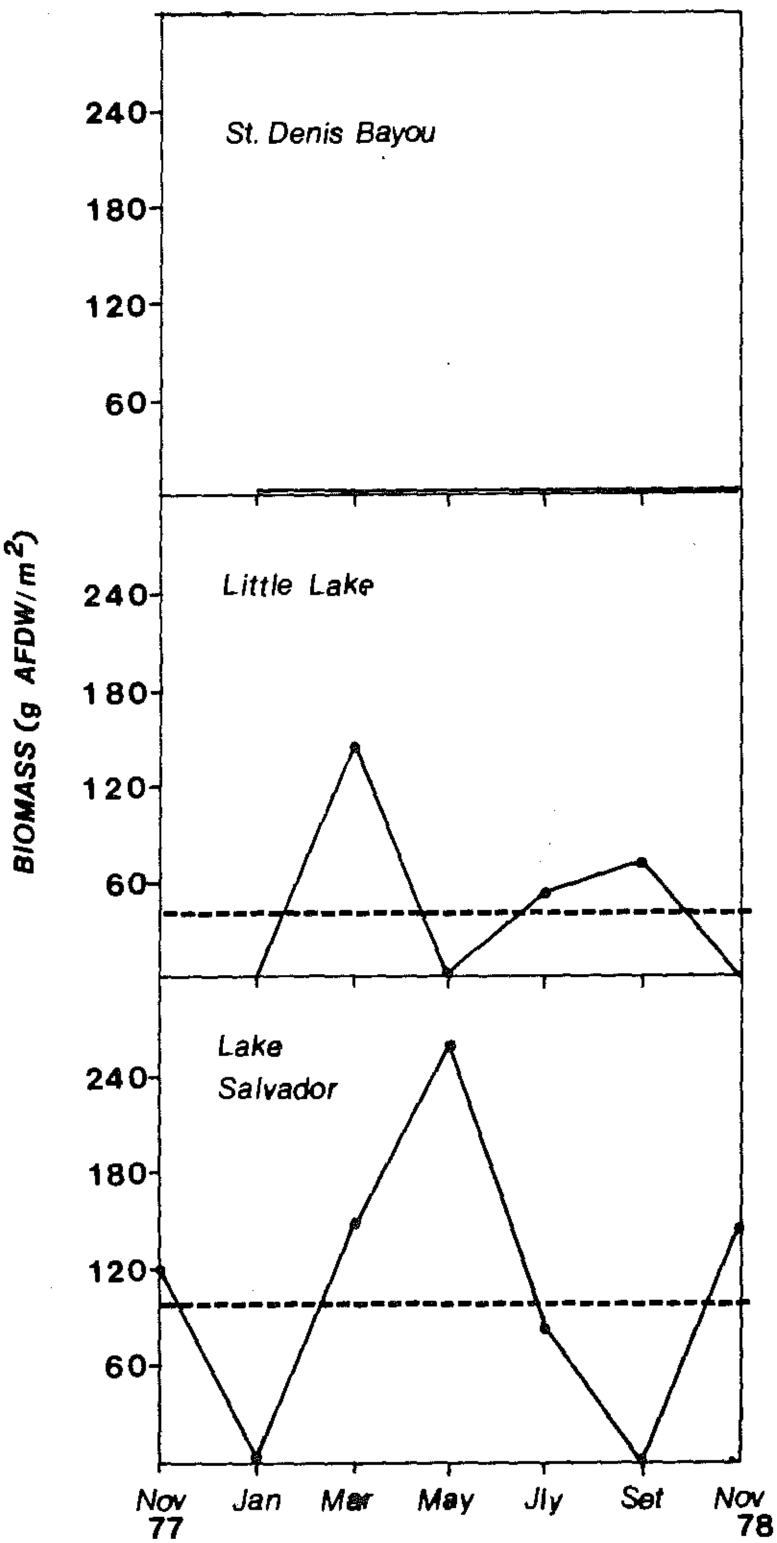
The annual biomass variation (Figure 16) showed a different pattern for each station. In Lake Salvador, with an average biomass of 105 g AFDW/m^2, there were three peaks. May and November 1978 coincided with abundance peaks (and salinity increases), while the month of November 1977 showed a biomass increase caused by large quantities of Rangia (adults) with a mean size of 48mm.

Little Lake had biomass increases in March and September, with an average biomass of 40 g AFDW/m^2. These two peaks are caused by the collection of adult Rangia cuneata. In March, 57 individuals with a mean size of 15 mm were collected, and in September, 480 individuals of 29 mm were collected.

St. Denis Bayou had a very low abundance the whole year, with an average biomass of 3.0 g AFDW/m^2. This biomass is low compared with that of the other stations because of the very small organisms collected and the absence of Rangia.

The diversity index analysis shows a total mean of

Figure 16. Seasonal pattern of biomass in the Barataria basin from November 1977 through November 1978. Dashed lines are mean annual biomass.


St. Denis Bayou
Little Lake
Lake
Salvador
BIOMASS (g AFDW/m2)
240
180
120
60
Nov
77
Jan
Mar
May
Jly
Set
Nov
78

1.33, lower than the whole basin index. The three stations over a one-year period behaved in a similar pattern from November 1977 through March 1978. After that, St. Denis Bayou and Little Lake decreased, while Lake Salvador peaked twice with a maximum (2.147) in November 1978 (Figure 17). The period between November 1977 and March 1978 was characterized by a precipitation surplus and, consequently, low salinities (Figures 2 and 3). The lower diversity value was found in September at Station 29 (St. Denis Bayou). Analyzing the stations one by one can give a different broad view. Lake Salvador showed high diversity when abundance was low, while Little Lake had high diversity and high abundance from November 1977 through March 1978, when the diversity began to decrease with increasing abundance. St. Denis Bayou showed a negative correlation between diversity and abundance throughout the year. The total mean evenness index was 0.639.

Based upon the dendogram (Figure 18) of the three stations studied, the year can be divided into three "seasons." (Table 4 identifies stations and months.) Group A clusters stations with high diversity, low abundance, and, often, low salinity, characterizing primarily the spring season in Lake Salvador and St. Denis Bayou. Group B is formed by stations with high diversity and high abundance, while the biomass is low. It covers the winter, the summer, and the fall. Salinity in this group is also low. Group C exhibits stations with low diversity and high

Figure 17. Seasonal distribution of the diversity index from November 1977 through November 1978 in Lake Salvador, Little Lake, and St. Denis Bayou.

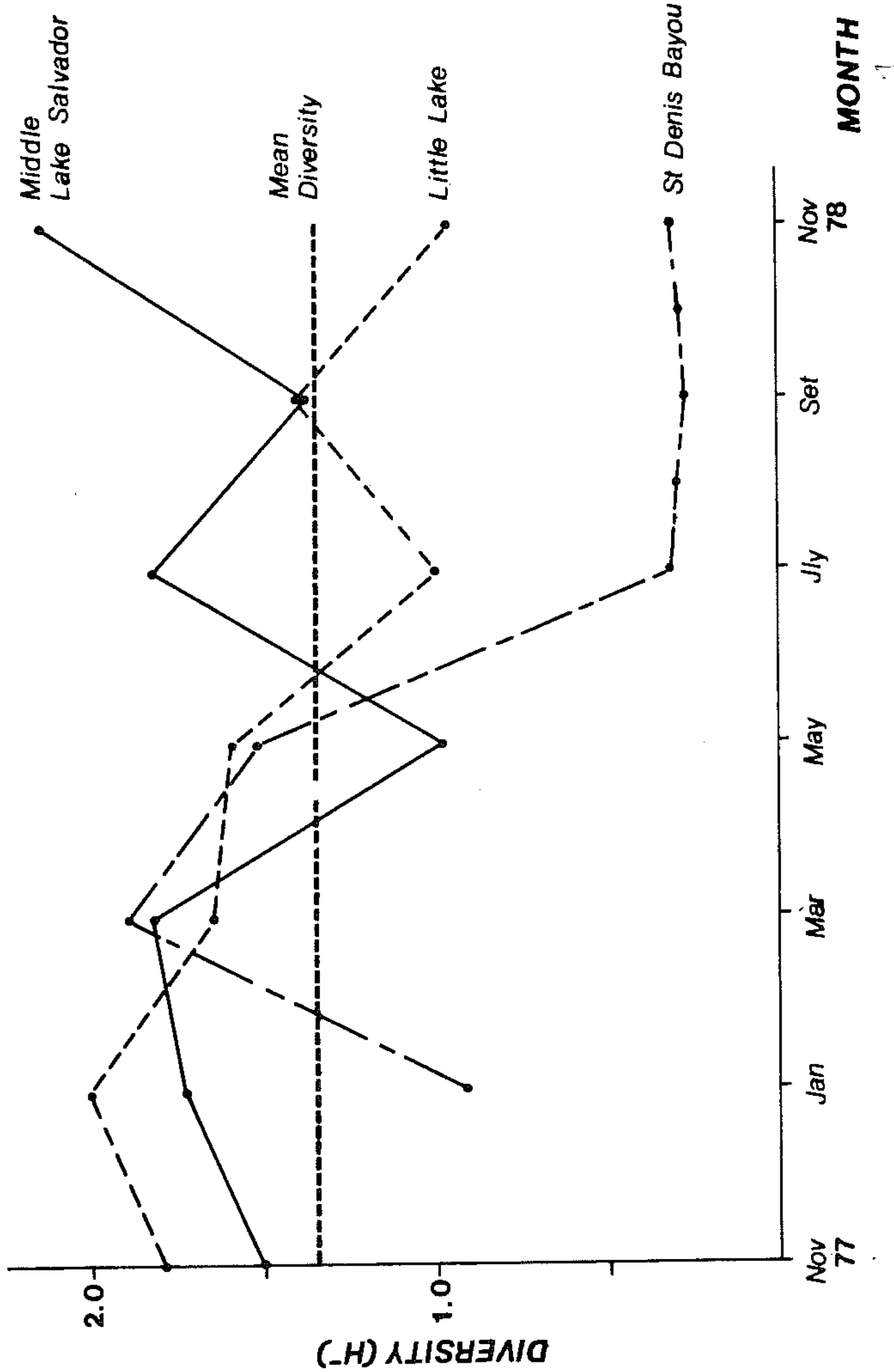

Middle Lake Salvador
Mean Diversity
Little Lake
St Denis Bayou
DIVERSITY (H')
2.0
1.0
Nov 77
Jan
Mar
May
Jly
Set
Nov 78
MONTH

Table 4. Station and month identification to analyze the dendogram presented in Figure 18 and 19.

Station 16 - Lake Salvador

code	month
16	November 1977
01	January 1978
04	March 1978
07	May 1978
10	July 1978
13	September 1978
19	November 1978

Station 23 - Little Lake

code	month
17	November 1977
02	January 1978
05	March 1978
08	May 1978
11	July 1978
14	September 1978
20	November 1978

Station 29 - St. Denis Bayou

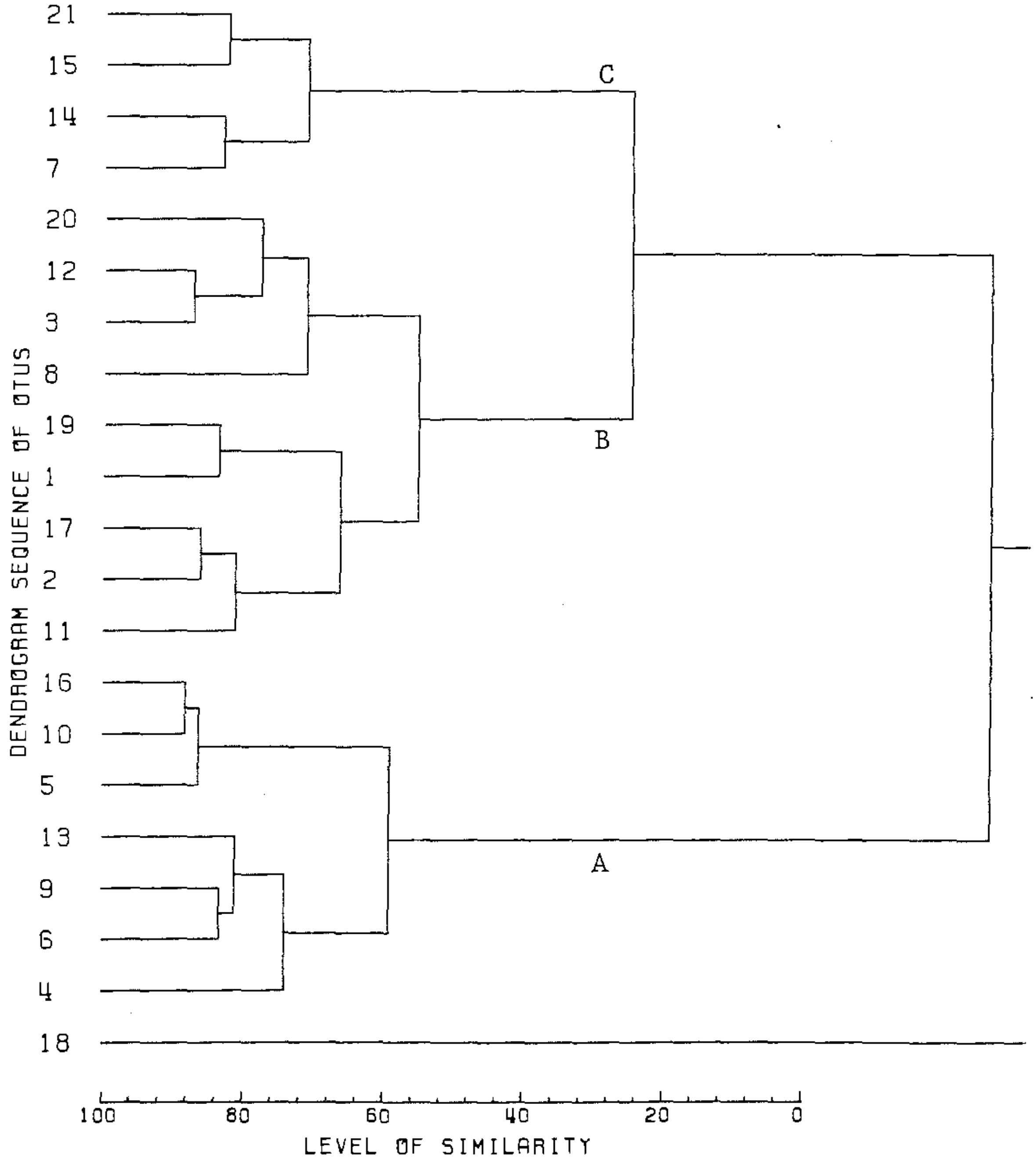
code	month
*18	November 1977
03	January 1978
06	March 1978
09	May 1978
12	July 1978
15	September 1978
21	November 1978

---

* No data available

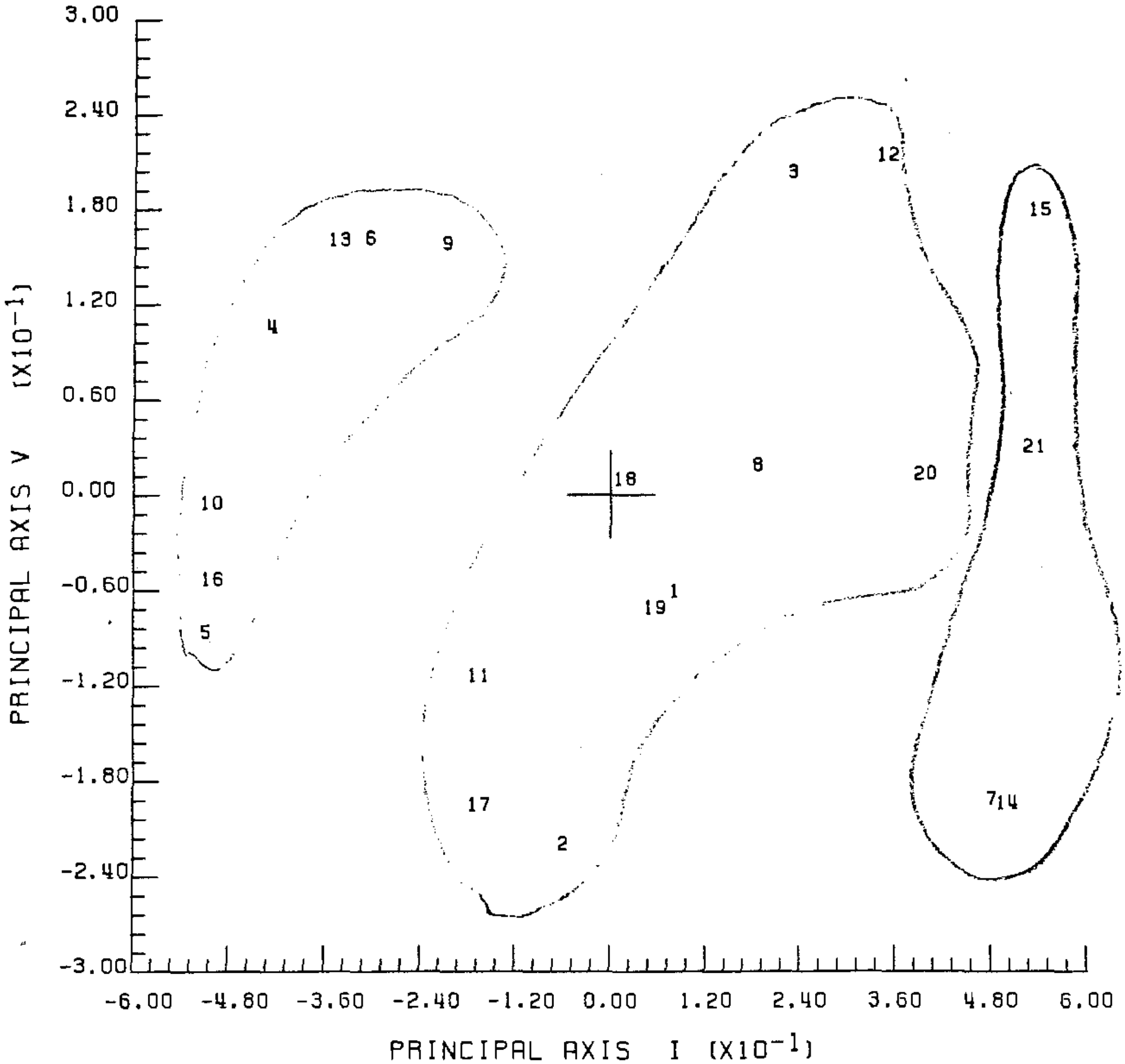
Figure 18. Dendogram of similarity among Lake Salvador, Little Lake, and St. Denis Bayou from November 1977 through November 1978.

STATIONS 16, 23, AND 29



abundance, primarily in the summer. Figure 19 shows cluster groups projected in multidimensional axes (axes I and V).

Figure 19. Projection of cluster groups of Lake Salvador, Little Lake, and St. Denis Bayou using axes I and V.


3.00
2.40
1.80
1.20
0.60
0.00
-0.60
-1.20
-1.80
-2.40
-3.00
PRINCIPAL AXIS V (X10^{-1})
-6.00 -4.80 -3.60 -2.40 -1.20 0.00 1.20 2.40 3.60 4.80 6.00
PRINCIPAL AXIS I (X10^{-1})
13 6
9
4
10
16
5
3
12
15
18
8
20
21
19 1
11
17
2
7 14

DISCUSSION

Natural Variability

Barataria basin, from the freshwater habitats to saline ones, presents an enormous variety of superimposed systems regulated mainly by the hydrologic and salinity regimes (Stone et al. 1978). Although this study encompasses only water bodies and macrobenthos, it helps in understanding the ecological structure and functioning of the basin.

Benthic macroinvertebrate composition (94 species) was numerically dominated by crustacea (mostly the domicolous omnivorous amphipods), which are related to some typical environmental characteristics such as low salinities, detritus, and fine sediments (Hart and Fuller 1979). In Lake Pontchartrain, mollusca (chiefly small hydrobrid gastropods) (Bahr et al. 1982) are dominant, while in the Atchafalaya delta and Calcasieu estuary, the polychaeta show the largest numbers (Table 5) (Sikora and Sikora 1982, Shirley 1982).

A closer analysis in the Barataria basin demonstrates that crustacea dominate the upper and the middle part of the basin while the polychaetes are chiefly in the lower part, the most saline environment. This is similar to the findings in Lake Pontchartrain and the Calcasieu estuary.

Densities varied considerably among stations and reflected individual habitat characteristics (Table 6).

Table 5. Comparison of dominant benthic organisms (%) in estuarine systems of Louisiana

taxa	Barataria Basin	Atchafalaya Delta	Lake Pontchartrain
crustacea	34.0	11.0	--
polychaeta	23.0	34.8	7.5
oligochaeta	14.0	12.3	--
nematoda	13.0	22.0	--
insecta	5.0	7.5	5.5
turbellaria	2.0	--	--
nemertea	2.0	--	0.4
mollusca	--	7.3	82.5
others	7.0	1.4	4.1

Table 6. Comparison of macrofauna abundance (organism/m^2) in Barataria basin, Atchafalaya delta and Lake Pontchartrain

Habitat Type	Barataria Basin	Atchafalaya Delta	Lake Pontchartrain
fresh (stations) 1-17	15,876 $\pm$ 4,352	17,760 $\pm$ 5,631	--
non-fresh (stations) 18-32	3,406 $\pm$ 770	--	3,116 $\pm$ 447

The abundance in the Atchafalaya delta is not significantly different from the abundance in the lowest salinity stations (1 through 17) of the Barataria basin. This characterizes the similarity between the freshwater habitats of both environments. Abundance in the other stations (18 through 32) is significantly lower than in the freshwater stations but is very close to abundance in Lake Pontchartrain, which has salinity levels like those of the lower Barataria basin. This low abundance in the lower Barataria basin could be partly caused by heavy predation in that area.

In the Barataria basin, the crustaceans showed an extraordinary abundance. In the freshwater habitats, Gammarus macromucronate, a significant predator on insect larvae and crustaceans (Anderson and Raasveldt 1974), was predominant and may reflect heavy utilization of resources available.

Despite the numerical abundance of crustaceans in the whole basin, the mollusks represented more than 90% of the total biomass. The filter-feeding Rangia cuneata is responsible for this trend. In most estuaries along the coast of the Gulf of Mexico, the dominant benthic (bottom dwelling) animal in areas where salinity is too low for most marine animals and too high for most freshwater species is the brackish water clam, Rangia cuneata (Hopkins et al. 1973). In this study, Rangia was found in Stations 11, 13, 14, 16, 17, 19, 20, and 23, where the highest salinity measured was 6 ppt (Station 23, November 1978). The area

of distribution includes one in which the adult animals can grow (Stations 13, 14, 16, 17, 20, and 23) and a smaller area in which successful young animals (less than 20 mm) may occur (Stations 11 and 19) (Cain 1972). Since Rangia is a burrowing clam that shows a strong affinity with the substrate, it has been the object of much research in sediment preference (Gooch 1971, Hoese 1972, Parker 1966, Tenore 1970).

In this study I made an attempt to analyze quantitatively the substrate occupied by Rangia cuneata. Most of the time the proportion of sand was between 21% and 73%, and mud (clay and silt) between 20% and 78%. I did not find a good relationship between the brackish water clam and the amount of bottom detritus, although detritus has been often mentioned as a major source of nutrition since Darnell's paper (1958).

Although the diversity index has been questioned (Abele and Walters 1979, Goodman 1975, Green and Vascotto 1978), it can be useful as a comparative empirical value for specific purposes, mainly to reduce biological data. Thus, there are two distinctive areas of diversity in the Barataria basin. These are the freshwater stations, which are not significantly different from the freshwater stations of the Atchafalaya delta, and the salinity gradient stations, having a lower diversity comparable with Lake Pontchartrain (Table 7).

Table 7. Diversity index comparison in Barataria basin, Atchafalaya delta, and Lake Pontchartrain.

Habitat Type	Barataria Basin	Atchafalaya Delta	Lake Pontchartrain
Fresh	1.766($\pm$ 0.133)	1.824($\pm$ 0.077)	--
Non-fresh	1.260($\pm$ 0.118)	--	1.37(+ 0.04)

These data show strong correlation with comparative abundance data (Table 6), where the variation between fresh and non-fresh stations in Barataria basin and corresponding areas in the Atchafalaya delta and Lake Pontchartrain are similar. Considering the whole basin, these patterns shown by the nonfreshwater stations could be partly because of heavy predation by marine and estuarine organisms with tolerance to low salinity but with no capacity to penetrate upstream.

The numerical classification analyzed before coincided with the data cited above, i.e., high diversity and high abundance are characteristics of low salinities and fresh-water stations. The study of the dendograms indicate partitioning of habitats and resources. However, there are temporal changes and station changes from high diversity and low abundance to high diversity and high abundance. Station 16 (Salvador) changed all year from high diversity, low abundance to high diversity, high abundance (except in May).

This strong pattern suggests a pattern of variability caused by predation and high growth. Station 23 (Little Lake) exhibited a similar pattern, but with double high diversity and high abundance characteristics, responding to increases in salinity. In the saline area, Station 29 (St. Denis Bayou) does not have a cyclic pattern, although an increase in diversity with high abundance is noted from September through January.

The information presented in this thesis, as well as in studies by others, suggests that benthic animals serve as an important food source for nekton and that the benthic populations are regulated to a large degree by the nekton. A number of workers have described patterns of use in the Barataria basin by nektonic organisms (Keller 1978, Rogers 1979, Smith 1979, Chambers 1980). All of these workers reported that low salinity and freshwater areas were important habitats and that peak nektonic abundance was in the spring and early summer. This period coincides with peak macrobenthic abundance in Little Lake and Lake Salvador (Figure 16). The fact that both biomass and density of benthic organisms is higher in the middle and upper basin waters (Figures 09, 16, Table 6) may partially explain why nekton seek out these areas. Darnell (1958, 1959, 1961) showed that most estuarine nekton feed heavily on benthic organisms. Conversely, the low biomass and density levels in the lower basin may be related to more intense predation. Thus it appears that the nekton serve to regulate the

benthic population, as suggested by Day et al. (1973).

Human Impacts

Stone et al. (1978) reviewed human activities and their environmental impacts in the Louisiana coastal zone. These activities result in three important and interrelated environmental impacts: hydrologic changes, land loss, and changes in nutrient cycling. Macrobenthic organisms are generally sessile and thus have a limited capacity to avoid environmental impacts. Therefore, they should reflect these impacts more than most other groups of organisms. For example, Lindstedt (1978) studied the abundance of amphipods, total crustaceans, and total macrobenthos found in oil field sites vs. natural sites in the lower Barataria basin. She found that abundance in the oil field was significantly lower (50%).

A number of organisms have been used as biological indicators of detrimental situations in estuarine systems, for example, nematoda, polychaeta (most Capitellidae), ostracoda, isopoda (*Edotea sp*.), and amphipoda (including *Corophium* and *Gammarus*) (Hart and Fuller 1979). The results of this study suggest that *Rangia cuneata* is a good indicator of salinity and water quality problems, especially in its larval and young stages. The key to the use of *Rangia* as an indicator is the fact that a change in salinity is necessary to induce spawning, and that the embryos and early larvae survive only in restricted salinity variations

(Gooch 1971, Cain 1972, Hoese 1972, Hopkins et al. 1973).

A number of studies have shown that increased nutrient loading has led to eutrophic conditions in the middle and upper Barataria basin (Craig and Day 1976, Kemp 1978, Gael and Hopkinson 1979, Hopkinson and Day 1979, 1980, 1980b, Seaton 1979, DeLaune and Patrick 1980). Witzig and Day (1983) used cluster analyses to develop an index of eutrophication based on physiochemical parameters (nitrogen, phosphorus, and chlorophyl (a). Since there are many common stations between this work and their study, it is interesting to determine if there are similarities in the cluster results of the two studies (Table 8).

Table 8. Cluster comparison: Barataria basin

Station Number	physiochemical view	bioecological view
20	cluster 3	cluster C
23	cluster 3	cluster G
25	cluster 3	cluster G
30	cluster 3	cluster G
16	cluster 3	cluster G
17	cluster 1	cluster B
09	cluster 1	cluster E
10	cluster 2	cluster F
05	cluster 2	cluster H
03	cluster 1	cluster H

In comparing the two cluster analyses, three groups can be distinguished in both results, thus indicating agreement between the two indices (physiochemical and bio-ecological). Station 17 (Gulf Intracoastal Waterway) and Station 09 (Bayou Segnette Waterway South) stay in groups B and E in the bioecological index characterizing large modified stations (dredging activities and heavy traffic, while the physiochemical index classified them as group 1-eutrophic (high nutrient concentrations, very turbid water with extensive algal development). The second cluster group involved stations 10, 5, and 3. These are freshwater stations with important human impacts clustered as groups F and H by my work and clustered as groups 1 and 2 (intermediate nutrient concentrations, slightly turbid water with little algal development) by Witzig and Day. Finally, stations 23, 25, 30, and 16 formed groups G and C under my classification (natural open water bodies), while Witzig and Day classified all of them as group 3 (low nutrient concentrations, clear water with little algal development). The sampling time was different, but the stations' locales were the same and there is strong correlation between the two data groups. Analyzing Table 8, it appears that the biological clustering analysis is more sensitive to the water bodies than is the chemical grouping analysis. Throughout this view, we compare all data from the basin, which indicate that the middle region (intermediate or mesohaline habitat) is now under the strongest impact from

agricultural and urban runoff, domestic sewage, salinity modification, and land loss. The large potential export of energy to the marine environment in many forms, such as nutrients, detritus, and biomass, may be placed in further perspective when considered in the light of these problems.

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APPENDIX I

Macrofauna collected from the Barataria basin (from November 1977 through November 1978) and individual mean weight (g ash free dry weight).

Macrofauna collected from the Barataria basin (November 1977 through November 1978) and individual mean weight (g Ash free dry weight)

<u>specie or type</u>	<u>mean weight</u>
Phylum Annelida	
Class Oligochaeta	33.68×10^{-5}
Class Hirudinea	
Order	
Family	
Helobdella lineata (Verril, 1874)	22.21×10^{-5}
Class Polychaeta	
Order Phyllodocida	
Family Pilargiidae	
Parandalia americana (Berkely & Berkely, 1925)	63.37×10^{-5}
Parandalia fauveli (Hartman, 1947)	26.0×10^{-5}
Family Nereidae	
Neanthes (=Nereis) *succinea* (Frey & Leuckart, 1847)	26.3×10^{-5}
Laeonereis culveri (Webster, 1879)	29.5×10^{-5}
Steminonereis martini (Wesenberg-Lund, 1958)	1.2×10^{-5}
Family Glyceridae	
Glycera sp.	13.5×10^{-5}
Family Goniadidae	
Glycinde sp.	43.83×10^{-5}

specie or type	mean weight
Order Terebellida	
Family Ampharetidae	
Hobsonia florida (Hartman, 1951)	173.58×10^{-5}
Order Spionida	
Family Spionidae	
Polydora sp.	4.1×10^{-5}
Streblospio sp.	28.68×10^{-5}
Family Chaetopteridae	
Spiochaetopterus oculatus (Webster, 1879)	1.0×10^{-5}
Order Capitellida	
Family Capitellidae	27.71×10^{-5}
Order Eunicida	
Family Onuphidae	
Diopatra cuprea (Bosc, 1802)	28.0×10^{-5}
Phylum Platyhelminthes	
Class Turbellaria	43.42×10^{-5}
Phylum Rhynchocoela	
Nemertea type A	54.81×10^{-5}
Nemertea type B	40.78×10^{-5}
Nemertea type C	74.22×10^{-5}
Phylum Aschelminthes	
Class Nematoda	2.61×10^{-5}

specie or type	mean weight
Phylum Cnidaria	
Class Hydrozoa	1.24×10^{-5}
Phylum Echinodermata	
Class Stelleroidea	
Order Ophiurida	
Family Amphiuridae	
Micropholis atra (Simpson, 1852)	2.17×10^{-2}
Phylum Arthropoda	
Class Insecta	
Order Diptera	
Family Chaoboridae	
Chaoborus sp.	17.85×10^{-5}
Family Chironomidae	
Sub-Family Tanypodinae	45.25×10^{-5}
Sub-Family Diamesinae	13.97×10^{-5}
Sub-Family Chironominae	5.89×10^{-5}
Order Coleoptera	
Family Hydrophilidae	
Berosus sp.	13.0×10^{-5}
Order Tricoptera	
Family Beraeidae	4.5×10^{-5}
Order Ephemeroptera	
Family Caenidae	
Caenis sp.	1.5×10^{-5}

specie or type	mean weight
Order Odonata	
Family Coenagrionidae	53.0×10^{-5}
Order Hemiptera	
Family Corixidae	7.0×10^{-5}
Class Crustacea	
Order Isopoda	
Family Idoteidae	
Edotea montosa (Stimpson, 1853)	6.2×10^{-5}
Family Anthuridae	
Cyathura polita (Stimpson, 1955)	88.0×10^{-5}
Family Munnidae	
Munna reynoldsi (Frankenberg and Menzies, 1966)	12.01×10^{-5}
Order Amphipoda	
Family Ampeliscidae	
Ampelisca abdita (Mills, 1964)	4.0×10^{-5}
Family Corophiidae	
Corophium louisianum (Shoemaker, 1934)	4.16×10^{-5}
Corophium lacustre (Vanhoffen, 1911)	10.49×10^{-5}
Cerapus sp.	4.0×10^{-5}
Family Aoridae	
Grandidierella bonnieroides (Stephensen, 1948)	10.89×10^{-5}
Family Gammaridae	

specie or type	mean weight
Gammarus tigrinus (Sexton, 1939)	141.20×10^{-5}
Gammarus mucronatus (Say 1818)	10.63×10^{-5}
Gammarus sp. macromucronate form	9.04×10^{-5}
Family Melitidae	
Melita nitida (Smith, 1873)	8.83×10^{-5}
Family Dedicenotidae	
Monoculodes edwardsi (Holmes, 1903)	63.35×10^{-5}
Family Photidae	
Microprotopus ranei (Wigley, 1966)	2.5×10^{-5}
Family Hyalellidae	
Hyalella azteca (Saussure, 1857)	9.84×10^{-5}
Order Cumacea	
Family Bodotriidae	
Cyclaspis sp. type A	7.0×10^{-5}
Cyclaspis sp. type B	22.06×10^{-5}
Family Leuconidae	
Leucon sp.	2.0×10^{-5}
Family Diastylidae	
Oxyunostylis c.f. *smithi* (Calman, 1912)	2.0×10^{-5}
Order Mysidacea	
Family Misidae	
Mysidopsis almyra (Bowman, 1964)	38.27×10^{-5}
Mysidopsis bahia (Molenock, 1969)	91.67×10^{-5}
Order Thoricica	
Family Balanidae	

specie or type	mean weight
Balanus *sp*.	22.0×10^{-5}
Order Cladocera	
Family	
Leydigia *acanthocercoides* (Fisher)	0.74×10^{-5}
Leydigia *leydigi*	0.56×10^{-5}
Chydorus *globosus*	0.51×10^{-5}
Chydorus *sp*.	0.51×10^{-5}
Ilyocryptus *agilis*	6.0×10^{-5}
Ilyocryptus *spinifer* (Herrick)	0.4×10^{-5}
Ilyocryptus *gouldeni*	0.53×10^{-5}
Ilyocryptus *sp*.	0.20×10^{-5}
Family	
Daphnia *sp*.	0.51×10^{-5}
Order Ostracoda	
Family Cypridae	
Candona *caudata* (Kaufmann)	2.26×10^{-5}
Candona *patzcuano* (Tressler)	2.26×10^{-5}
Candona *verretensis* (LeRoy)	2.26×10^{-5}
Cyprideis *salebrosa* (van der Bold)	1.58×10^{-5}
Cypridopsis *vidua* (Müller)	1.58×10^{-5}
Darwinula *stevensoni* (Brady)	1.58×10^{-5}
Physocypria *pustulosa* (Sharpe)	9.10×10^{-5}
Potamocypris *smaragdina* (Vavra)	1.58×10^{-5}
Myodocopida	1.58×10^{-5}

specie or type		mean weight
Phylum Mollusca		
Class Gastropoda		
Order Neogastropoda		
Family Pyramidellidae		
Odostomia weberi (Johnson, 1934)		5.2×10^{-5}
Family Muricidae		
Thais haemastoma (Gray, 1839)		18.27×10^{-2}
Family Littoridinidae		
Texadina sphinctostoma (Abbot & Ladd, 1951)		18.36×10^{-5}
Order Mesogastropoda		
Family Hydrobidae		59.15×10^{-4}
Class Bivalvia		
Order Heterodontia		
Family Mactridae		
Mulinia lateralis		
(Say, 1822)	young	28.12×10^{-5}
	adult	10.72×10^{-3}
Rangia cuneata		
(Gray 1831)	25 mm	12.87×10^{-2}
	29 mm	14.55×10^{-2}
	31 mm	42.63×10^{-2}
	35 mm	53.20×10^{-2}
	37 mm	63.62×10^{-2}
	48 mm	1.13

specie or type	mean weight
Order Prionodontida	
Family Mytilidae	
Ischadium recurvum (Rafinesque, 1871)	16.56×10^{-4}
Family Tellinidae	
Macoma mitchelli (Dall, 1895)	23.38×10^{-4}
Family Lyonsiidae	
Lyonsia hyalina (Connad 1831)	16.00×10^{-5}

APPENDIX II

Water temperature (surface and bottom)

(degrees Celsius)

STATION

	01	02	03	04	05	06	07	08	09
November 77								18.0M	19.0A
December 77					16.1A	17.7N	18.8A		
January 78				5.0A	5.0A	4.5A	4.0N		
February 78				5.0A	4.5A	9.0A	8.0A		
March 78				10.5A	11.0A	14.0A	12.5M		
April 78				22.0A	21.5A	23.5A	22.5M		
May 78				20.5M	21.5A	20.5N	20.0M		
June 78				29.5 29.5 M	31.5 30.5 A	30.0 29.0 M	33.0 31.0 N		
July 78				27.3 27.0 M	28.6 28.0 A	30.5 29.0 A	32.0 30.0 A		
August 78				31.5 30.2 M	31.0 30.1 A	31.0 31.0 A	30.5 29.7 N		
September 78				29.0 28.5 N	30.0 29.0 A	30.0 29.0 A			
October 78				21.0 20.0 M	22.1 20.6 A	21.0 20.4 N	21.0 21.0 M		
November 78	18.0 18.0 M	18.0 18.0 M	17.0 17.0 M	22.5 22.3 M	23.0 22.5 N	20.5 20.7 M	20.7 21.3 M	18.5 18.5 A	

Note: M=morning; A=afternoon; N=noon

STATION Continued

	10	11	12	16	17	18	19	20	21
November 77	19.0M	18.0M		19.0M	20.0A		19.0A	19.0A	
December 77	14.4M	15.5A	14.4M	14.4M			14.4A	16.6A	14.4M
January 78	4.0A	4.0M	4.0M	4.5M			3.0M	3.0M	4.0M
February 78	6.0A	6.0M	5.5M	4.5M			6.5M	6.5M	8.5M
March 78	12.0A	11.0M	11.5M	10.0M			13.0M	12.5A	13.5M
April 78	22.5A	22.0M	21.0M	20.5M			21.0M	22.5A	22.0M
May 78	21.5A	19.5M	19.5M	20.5A			21.5A	21.0A	21.0M
June 78	30.0 30.0 M	32.5 31.0 A	30.5 30.5 M	31.0 30.5 A			31.2 31.2 A	30.2 30.2 M	30.1 30.1 M
July 78	29.5 29.5 A	31.0 29.0 A	29.0 29.0 M	28.5 27.0 M			29.0 29.0 M	29.5 29.5 M	30.5 30.5 N
August 78	30.5 30.7 A	29.5 29.5 M	29.6 29.6 M	29.5 29.3 M			30.8 30.7 A	29.2 29.2 M	29.0 28.8 A
September 78	29.0 27.0 N			27.0 26.0 M			28.0 28.0 M	28.0 28.0 M	28.5 28.0 M
October 78	22.5 20.4 A	20.7 20.8 M	21.0 21.0 M	21.5 19.5 A			21.5 21.5 M	21.5 21.5 M	22.6 22.6 M
November 78	21.0 21.5 A	20.6 20.8 M	21.5 21.5 M	21.0 21.0 M			21.5 21.5 A	24.0 24.0 A	20.0 20.5 M

Note: M=morning; A=afternoon; N=noon

STATION Continued

	22	23	24	26	29	30	31	32
November 77	20.0A	19.0A	21.0A					
December 77		14.6M	14.4M	15.5N	16.5A			
January 78		3.0M		4.0A				
February 78		7.5M		10.5A	9.5A			
March 78		14.0M	16.0A	16.0A	14.0A			
April 78		22.0M	22.5A	23.5A	22.5A			
May 78		21.0M		21.5M	21.5A			
June 78		31.6 30.4 M	31.7 31.0 M	32.4 31.7 A	32.5 32.2 A			
July 78		31.5 28.5 A		30.0 30.0 M	30.5 30.5 N			
August 78				28.6 28.6 A	28.5 28.5 A			
September 78		28.5 28.0 M	28.5 28.5 N	30.0 29.5 A	29.5 29.5 A			
October 78		22.5 22.5 M	22.5 22.0 M	23.5 23.5 A	24.0 24.0 A			
November 78		20.5 20.5 M	19.5 20.0 M	20.0 20.5 N	20.5 20.5 A	18.8 18.8 M	19.0 19.0 M	19.0 19.0 M

Note: M=morning; A=afternoon; N=noon

APPENDIX III

Dissolved oxygen (surface and bottom)

mg O_2/l

	STATION									
	01	02	03	04	05	06	07	08	11	13
June	6.4 5.9			6.4 5.9	6.9 4.4				10.5 7.1	3.1 1.9
July				15.2 5.7	7.5 4.9				12.0 7.2	11.8 7.7
August	8.7			8.7 2.6	5.8 3.0				6.8 6.5	15.9 15.9
September				7.7 5.0	6.9 3.8					5.6 4.1
October				12.0 9.3	9.1 6.8				6.8 6.8	8.0 6.5
November	6.8 6.9	7.7 7.6	7.9 7.6	7.9 7.1	8.0 7.4	8.1 8.0	8.2 8.2	9.2 9.2	7.5 7.0	6.5 6.0
December				8.6 7.9	9.2 8.8				10.4 5.1	8.2 8.0

STATION Continued

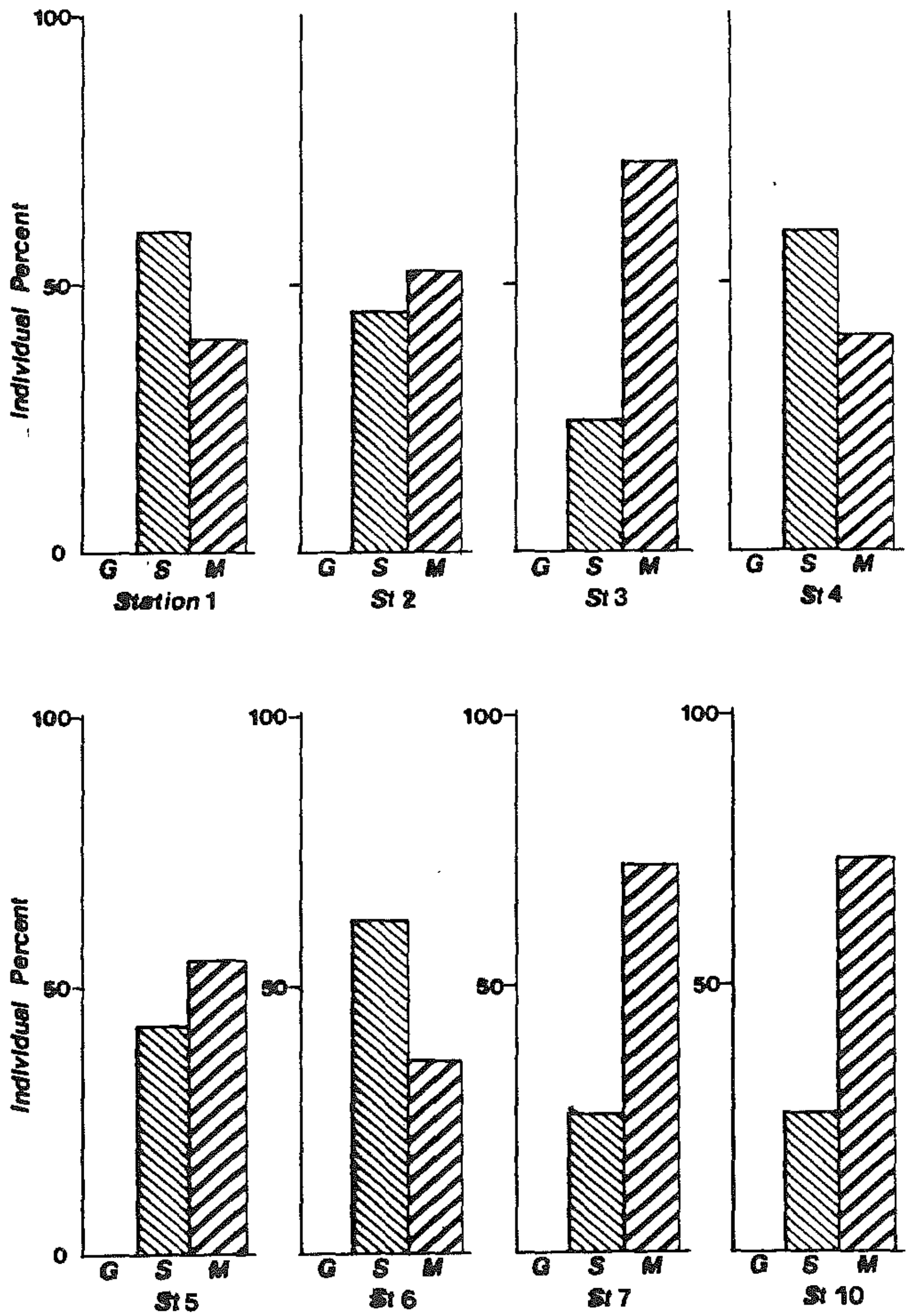
	14	15	16	17	18	19	20	21	23	25
June	6.4	7.7	7.3	7.6		7.7	5.7	4.4	5.9	7.7
	6.2	4.4	7.2	4.7		7.7	5.4	4.2	5.5	6.5
July	11.0	11.0	7.2	7.5		7.0	7.0	4.8	7.6	
	11.0	5.6	6.4	6.2		5.0	5.9	2.7	5.6	
August	15.6	4.0	5.8	6.0		6.9	6.6	6.7		
	15.5	2.7	3.0	5.8		6.8	6.6	6.7		
September	7.9			6.7		6.4	6.3	4.6	5.8	6.7
	6.5			7.2		6.4	6.1	3.7	5.6	6.7
October	10.8	6.7	8.0	9.8		8.0	6.6	6.4	7.3	8.3
	8.4	5.8	7.8	8.4		7.8	6.6	6.4	7.1	7.8
November	9.8	11.3	6.9	7.9	0.5	8.8	8.3	6.2	8.5	9.2
	9.8	7.1	6.7	8.0	0.3	8.6	8.1	6.1	8.4	8.5
December	11.8	6.9	9.6	10.4		9.0	9.6	7.6	9.4	
	12.2	6.8	9.4	10.0		9.0	10.2	7.0	9.4	

STATION Continued

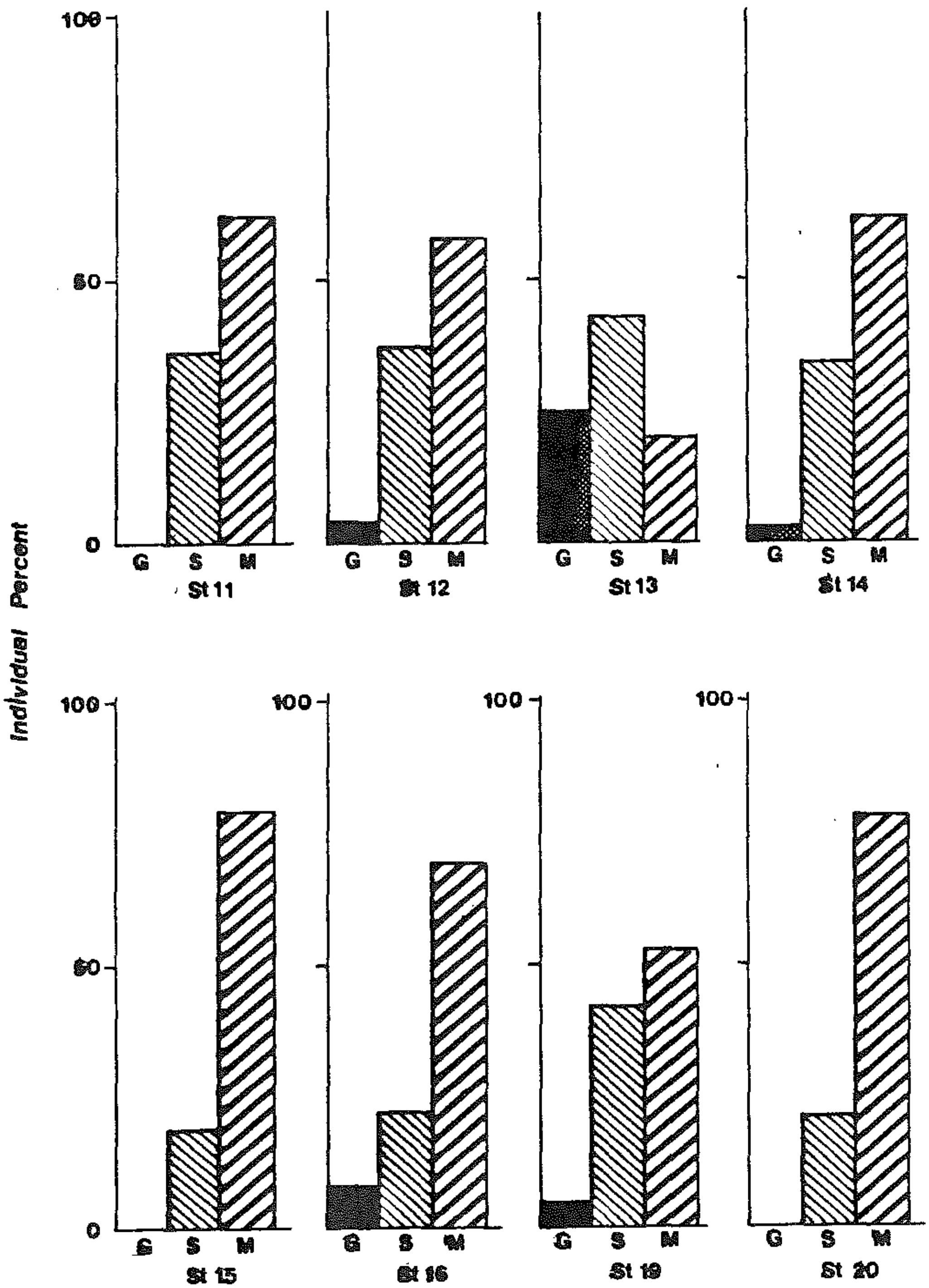
	26	29	30	31	32
June	7.8 6.9	8.8 7.4			
July	7.6 7.6	7.5 7.5			
August	7.5 7.5	6.3 6.1			
September	7.5 7.9	7.8 7.5			
October	9.2 9.1	9.7 9.2			
November	10.2 9.8	9.1 9.8	7.4 7.4	7.3 7.1	7.3 7.2
December	9.0 8.8	9.8 9.6			

APPENDIX IV

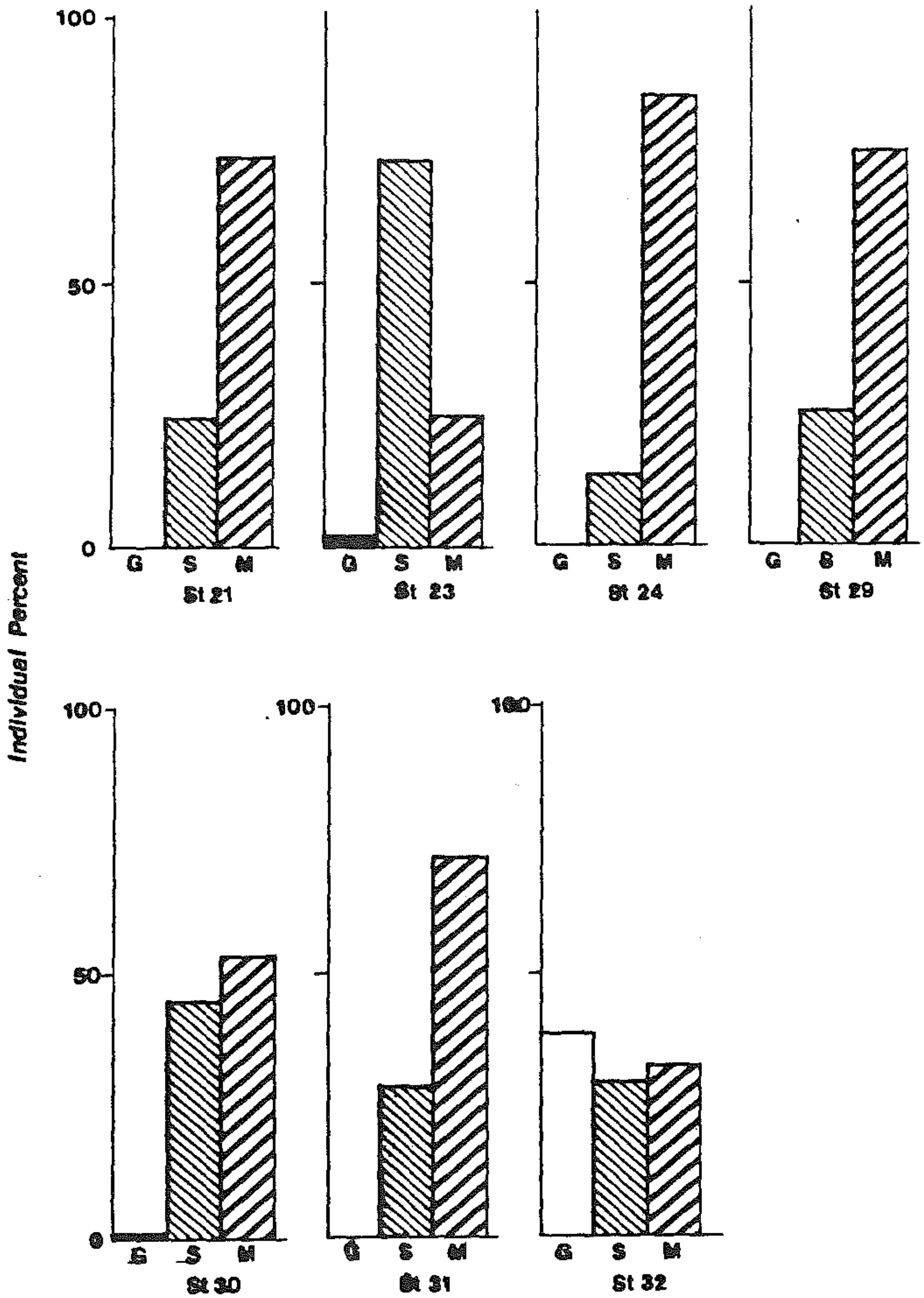
Percentage of distribution of sediment gravel-sand-mud in the Barataria basin.



Individual Percent
100
50
0
G
S
M
Station 1
St 2
St 3
St 4
St 5
St 6
St 7
St 10



Individual Percent
100
50
0
G S M
St 11
St 12
St 13
St 14
St 15
St 16
St 19
St 20


Individual Percent
100
50
0
G S M
St 21
G S M
St 23
G S M
St 24
G S M
St 29
100
50
0
G S M
St 30
100
G S M
St 31
100
G S M
St 32

APPENDIX V

List of the ten most important species by number and biomass

Macrofauna abundance in Barataria basin, Louisiana, in 1978

(in order of abundance by number)

Species name	Rank
Polydora sp.	01
Oligochaeta	02
Capitellidae	03
Nematoda	04
Hypaniola florida	05
Corophium lacustre	06
Glycera sp.	07
Tanypodinae	08
Texadina sphantozoma	09
Rangia cuneata (adults)	10

(in order of abundance by biomass (g AFDW/m^2)

Species name	Rank
Rangia cuneata (adults)	01
Rangia cuneata (juveniles)	02
Micropholis atra	03
Thais haemastoma	04
Congeria leucophaeta	05
Glycera sp.	06
Polidora sp.	07
Hyalella asteca	08
Parandalia americana	09
Ishadium recurvus	10

APPENDIX VI

Composition of benthos samples by station in November 1978 (Number of organisms/m^2)

specie	ST.9	ST.10	ST.11	ST.12	ST.13	ST.14	ST.15
Corophium louisianum	0	0	0	0	0	0	0
Corophium lacustre	0	0	9791	5963	0	0	0
Gammarus tigrinus	0	0	250	0	0	0	0
Gammarus macromucronate	0	0	0	0	0	0	0
Gammarus mucronatus	0	19	3616	0	0	0	0
Melita nitida	0	0	19	0	0	0	0
Hyalella azteca	0	0	0	0	0	0	0
Cerapus sp	0	0	0	0	0	0	0
Grandidierella bonnieroides	0	2690	13196	750	0	0	0
Monoculoides edwardsi	0	0	0	0	126	0	0
Mysidopsis almyra	42	0	0	0	0	0	0
Mysidopsis bahia	0	0	38	0	0	0	0
Edotea montosa	0	0	0	0	0	0	0
Munna reynoldsi	0	0	365	269	42	0	0
Ampelisca abdita	0	0	0	0	0	0	0
Microprotopus ranei	0	0	0	0	0	0	0

specie	ST.16	ST.17	ST.18	ST.19	ST.20	ST.21	ST.22	ST.23
Corophium louisianum	0	0	0	0	0	19	0	0
Corophium lacustre	0	0	0	38	0	38	0	0
Gammarus tigrinus	0		0	0	19	0	0	0
Gammarus macromucronate	0	0	0	0	0	0	0	19
Gammarus mucronatus	0	0	0	0	0	0	0	0
Melita nitida	0	0	0	0	0	0	0	0
Hyalella azteca	0	0	0	0	0	0	0	0
Cerapus sp	0	0	0	0	0	0	0	0
Grandidierella bonnieroides	0	0	0	96	0	211	0	0
Monoculoides edwardsi	0	0	84	0	0	19	0	153
Mysidopsis almyra	0	0	0	307	0	307	0	0
Mysidopsis bahia	0	0	0	0	0	0	84	0
Edotea montosa	0	0	0	153	0	327	84	19
Munna reynoldsi	0	42	0	0	19	0	0	0
Ampelisca abdita	0	0	0	0	0	0	0	0
Microprotopus ranei	0	0	0	0	0	0	0	0

species	ST.24	ST.25	ST.26	ST.27	ST.28	ST.29	ST.30	ST.31
Corophium louisianum	0	42	0	0	0	0	0	0
Corophium lacustre	0	0	0	0	0	0	0	0
Gammarus tigrinus	0	0	0	0	0	0	0	0
Gammarus macromucronate	0	0	0	0	0	0	0	0
Gammarus mucronatus	0	0	0	0	0	0	0	0
Melita nitida	0	0	0	0	0	0	0	0
Hyalella azteca	0	0	0	0	0	0	0	0
Cerapus sp	0	0	0	0	0	0	0	0
Grandidierella bonnieroides	0	379	0	0	0	0	0	0
Monoculoides edwardsi	19	0	153	0	0	19	0	0
Mysidopsis almyra	0	42	211	0	0	0	0	0
Mysidopsis bahia	0	0	0	0	0	0	0	0
Edotea montosa	0	0	0	42	0	0	0	19
Munna reynoldsi	0	0	0	0	0	0	0	0
Ampelisca abdita	0	0	0	0	0	0	0	19

species	ST.32
Corophium louisianum	0
Corophium lacustre	0
Gammarus tigrinus	0
Gammarus macromucronate	0
Gammarus mucronatus	0
Melita nitida	0
Hyalella azteca	0
Cerapus sp	0
Grandidierella bonnieroides	0
Monoculoides edwardsi	0
Mysidopsis almyra	0
Mysidopsis bahia	0
Edotea montosa	0
Munna reynoldsi	0
Ampelisca abdita	0

species	ST.1	ST.2	ST.3	ST.4	ST.5	ST.6	ST.7	ST.8
Leucon sp	0	0	0	0	0	0	0	0
Oxyurostylis smithi	0	0	0	0	0	0	0	0
Cyclaspis spA	0	0	0	0	0	0	0	0
Cyclaspis spB	0	0	0	0	0	0	0	0
Hexapanopeus angustifrons	0	0	0	0	0	0	0	0
Cyathura polita	0	0	0	0	0	0	0	0
Neopanope texana	0	0	0	0	0	0	0	0
Rhithropanopeus hareisii	0	0	0	0	0	0	0	0
Balanus sp	0	0	0	0	0	0	0	0
Leydigia acanthocercoides	84	0	421	57	692	2269	846	0
Leydigia leydigi	1222	0	0	57	115	173	0	0
Chydorus globosus	0	0	0	0	0	0	1442	0
Chydorus sp	0	0	0	0	0	0	230	0
Ilyocriptus agilis	0	0	0	0	19	327	0	0
Ilyocriptus spinifer	0	0	0	0	0	0	0	0

species	ST.9	ST.10	ST.11	ST.12	ST.13	ST.14	ST.15	ST.16
Leucon sp	0	0	0	0	0	0	0	0
Oxyurostylis smithi	0	0	0	0	0	0	0	0
Cyclaspis spA	0	0	0	0	0	0	0	0
Cyclaspis spB	0	0	0	0	0	0	0	0
Hexapanopeus angustifrons	0	0	0	0	0	0	0	0
Cyathura polita	0	0	0	19	0	0	0	0
Neopanope texana	0	0	0	0	0	0	0	0
Rhithropanopeus hareisii	0	0	0	0	0	0	0	0
Balanus sp	0	0	0	0	0	0	0	0
Leydigia acanthocercoides	0	0	0	19	84	0	84	153
Leydigia leydigi	0	0	0	0	0	0	0	0
Chydorus globosus	0	0	0	0	0	0	0	0
Chydorus sp	0	0	0	0	0	0	0	0
Ilyocriptus agilis	0	0	0	19	0	0	0	0
Ilyocriptus spinifer	0	0	0	19	0	0	0	0

species	ST.17	ST.18	ST.19	ST.20	ST.21	ST.22	ST.23	ST.24
Leucon sp	0	0	0	0	0	0	0	0
Oxyurostylis smithi	0	0	0	0	0	0	0	0
Cyclaspis spA	0	0	0	0	0	0	0	0
Cyclaspis spB	0	0	0	0	0	0	0	0
Hexapanopeus angustifrons	0	0	0	0	0	0	0	0
Cyathura polita	0	0	0	0	0	0	0	0
Neopanope texana	0	0	0	0	0	0	0	0
Rhithropanopeus hareisii	0	0	0	0	0	0	0	0
Balanus sp	0	0	0	0	0	0	0	19
Leydigia acanthocercoides	0	0	0	0	0	0	42	0
Leydigia leydigi	0	42	0	0	0	0	0	0
Chydorus globosus	0	42	0	0	0	0	0	0
Chydorus sp	0	0	0	0	0	0	0	0
Ilyocriptus agilis	0	42	0	0	0	0	0	0
Ilyocriptus spinifer	0	0	0	0	0	0	0	0

species	ST.25	ST.26	ST.27	ST.28	ST.29	ST.30	ST.31	ST.32
Leucon sp	0	0	0	0	0	0	19	0
Oxyurostylis smithi	0	0	0	0	19	0	38	0
Cyclaspis spA	0	19	0	0	0	0	0	0
Cyclaspis spB	0	0	0	0	442	30	230	42
Hexapanopeus angustifrons	0	0	0	0	0	115	0	252
Cyathura polita	0	0	0	0	0	0	0	0
Neopanope texana	0	0	0	0	0	0	0	0
Rhithropanopeus hareisii	0	0	0	0	0	0	0	0
Balanus sp	0	0	0	0	0	0	0	0
Leydigia acanthocercoides	0	0	0	0	0	0	0	0
Leydigia leydigi	0	0	0	0	0	0	0	0
Chydorus globosus	0	0	0	0	0	0	0	0
Chydorus sp	0	0	0	0	0	0	0	0
Ilyocriptus agilis	0	0	0	0	0	0	0	0
Ilyocriptus spinifer	0	0	0	0	0	0	0	0

species	ST.1	ST.2	ST.3	ST.4	ST.5	ST.6	ST.7
Ilyocriptus gouldeni	0	0	0	19	38	692	788
Ilyocriptus sp	0	0	0	0	673	0	596
Daphnia sp	0	0	0	0	0	0	19
Candona caudata	1264	0	590	211	557	76	19
Candona verretensis	0	0	0	0	115	19	0
Candona patzcuaro	0	0	0	0	0	0	0
Cyprideis salebrosa	0	0	0	57	38	0	19
Physocypria pustulosa	463	0	0	57	134	190	288
Darwinula stevensoni	0	0	0	0	0	19	0
Potamocypris smaragdina	0	0	0	0	0	0	96
Cypridopsis vidua	0	0	0	0	0	0	615
Modocopida	0	0	0	0	0	0	0
Chaoborus sp	42	295	0	0	0	0	0
Tanypodinae	1391	574	505	865	673	327	730
Diamesinae	42	0	0	0	0	0	577

species	ST.8	ST.9	ST.10	ST.11	ST.12	ST.13	ST.14
Ilyocriptus gouldeni	0	0	38	442	0	0	0
Ilyocriptus sp	0	0	0	19	0	0	0
Daphnia sp	0	0	0	0	0	0	0
Candona caudata	0	0	634	807	0	84	84
Candona verretensis	0	0	519	230	19	295	84
Candona patzcuaro	0	0	0	0	0	0	0
Cyprideis salebrosa	0	0	57	346	0	84	0
Physocypria pustulosa	0	0	19	365	0	0	0
Darwinula stevensoni	0	0	0	190	153	0	0
Potamocypris smaragdina	0	0	0	0	0	0	0
Cypridopsis vidua	0	0	0	0	0	0	0
Myodocopida	0	0	0	0	0	0	0
Chaoborus sp	0	0	0	0	0	0	0
Tanypodinae	84	168	884	134	38	632	252
Diamesinae	126	0	0	403	0	42	0

species	ST.15	ST.16	ST.17	ST.18	ST.19	ST.20	ST.21
Ilyocriptus gouldeni	0	38	0	0	57	0	96
Ilyocriptus sp	0	0	0	0	0	0	0
Daphnia sp	0	0	0	0	0	0	0
Candona caudata	0	190	0	0	0	0	0
Candona verretensis	0	519	0	0	0	0	0
Candona patzcuaro	0	38	0	0	0	0	0
Cyprideis salebrosa	0	0	0	0	0	0	0
Physocypris Pustulosa	0	0	0	0	0	0	0
Darwinula stevensoni	0	0	0	0	0	0	0
Potamocypris smaragdina	0	0	0	0	0	0	0
Cypridopsis vidua	0	0	0	0	0	0	0
Myodocopida	0	0	0	0	0	0	0
Chaoborus sp	0	0	0	0	0	0	0
Tanypodinae	168	307	0	126	173	981	346
Diamesinae	0	0	0	0	0	0	0

species	ST.22	ST.23	ST.24	ST.25	ST.26	ST.27	ST.28
Ilyocriptus gouldeni	0	0	0	0	0	0	0
Ilyocriptus sp	0	0	0	0	0	0	0
Daphnia sp	0	0	0	0	0	0	0
Candona caudata	0	0	0	42	0	0	0
Candona verretensis	0	0	0	0	0	0	0
Candona patzcuaro	0	0	0	0	0	0	0
Cyprideis salebrosa	0	0	0	0	0	0	0
Physocypria pustulosa	0	0	0	0	0	0	0
Darwinula stevensoni	0	0	0	0	0	0	0
Potamocypris smaragdina	0	0	0	0	0	0	0
Cypridopsis vidua	0	0	0	0	0	0	0
Myodocopida	0	0	0	0	0	0	0
Chaoborus sp	0	0	0	0	0	0	0
Tanypodinae	0	57	0	0	19	0	0
Diamesinae	0	5	0	0	153	0	0

species	ST.29	ST.30	ST.31	ST.32
Ilyocriptus gouldeni	0	0	0	0
Ilyocriptus sp	0	0	0	0
Daphnia sp	0	0	0	0
Candona caudata	0	0	0	0
Candona verretensis	0	0	0	0
Candona patzcuaro	0	0	0	0
Cyprideis salebrosa	0	0	0	0
Physocypria pustulosa	0	0	0	0
Darwinula stevensoni	0	0	0	0
Potamocypris smaragdina	0	0	0	0
Cypridopsis vidua	0	0	0	0
Myodocopida	0	0	0	42
Chaoborus sp	0	0	0	0
Tanypodinae	0	0	0	0
Diamesinae	0	0	0	0

species	ST.1	ST.2	ST.3	ST.4	ST.5	ST.6	ST.7
Chironominae	0	0	0	0	0	0	19
Berosus sp	0	0	0	0	0	0	0
Beraeidae	0	0	0	0	0	0	19
Caenis sp	0	0	0	0	0	0	76
Coenagrionidae	0	0	0	0	0	0	250
Corixidae	0	0	0	0	0	0	96
Micropholis atra	0	0	0	0	0	0	0
Helobdella lineata	0	0	126	19	0	0	403
Oligochaeta	843	13661	3457	1365	10195	10233	3789
Turbellaria	0	0	0	0	19	0	5828
Nematoda	801	4123	421	5828	11676	577	19
Nemertea A	0	0	0	0	0	0	0
Nemertea B	0	0	0	0	0	0	0
Nemertea C	0	0	0	0	0	0	0
Neanthes Succinea	0	0	0	0	0	0	0
Laeonereis culveri	0	0	0	0	0	0	0

species	ST.8	ST.9	ST.10	ST.11	ST.12	ST.13	ST.14
Chironominae	84	84	0	0	269	210	84
Berosus sp	0	0	0	0	0	0	0
Beraeidae	0	0	0	0	19	0	0
Caenis sp	0	0	0	0	0	0	0
Coenagrionidae	0	0	0	0	0	0	0
Corixidae	0	0	0	0	0	0	0
Micropholis atra	0	0	0	0	0	0	0
Helobdella lineata	0	0	0	0	0	0	0
Oligochaeta	42	0	730	0	288	126	210
Turbellaria	0	0	0	134	0	0	0
Nematoda	4891	0	0	3905	384	0	0
Nemertea A	0	0	0	0	0	0	0
Nemertea B	0	0	0	0	0	0	0
Nemertea C	0	0	0	0	0	13	0
Neanthes Succinea	0	0	0	0	0	0	0
Laeonereis culveri	0	0	0	0	0	0	0

species	ST.15	ST.16	ST.17	ST.18	ST.19	ST.20	ST.21
Chironominae	84	115	0	42	76	134	0
Berosus sp	0	0	0	0	0	0	0
Beraeidae	0	0	0	0	0	0	0
Caenis sp	0	0	0	0	0	0	0
Coenagrionidae	0	0	0	0	0	0	0
Corixidae	0	0	0	0	0	0	0
Micropholis atra	0	0	0	0	0	0	0
Helobdella lineata	0	0	0	0	0	0	0
Oligochaeta	210	115	0	0	211	57	19
Turbellaria	0	0	0	0	38	0	0
Nematoda	0	0	0	0	19	38	19
Nemertea A	0	0	0	0	0	0	0
Nemertea B	0	0	0	0	0	0	0
Nemertea C	0	76	0	0	0	0	0
Neanthes Succinea	0	0	0	0	0	0	0
Laeonereis culveri	0	0	0	0	0	0	0

species	ST.22	ST.23	ST.24	ST.25	ST.26	ST.27	ST.28
Chironominae	42	0	19	337	19	0	0
Berosus sp	0	0	0	0	0	0	0
Beraeidae	0	0	0	0	0	0	0
Caenis sp	0	0	0	0	0	0	0
Coenagrionidae	0	0	0	0	0	0	0
Corixidae	0	0	0	0	0	0	0
Micropholis atra	0	0	0	0	0	0	0
Helobdella lineata	0	0	0	0	0	0	0
Oligochaeta	2529	0	0	0	0	0	42
Turbellaria	0	0	19	0	0	0	0
Nematoda	0	0	480	0	0	0	0
Nemertea A	0	0	10	0	0	0	0
Nemertea B	0	0	1077	0	0	2319	42
Nemertea C	0	0	38	0	0	84	0
Neanthes Succinea	0	0	0	0	0	0	0
Laeonereis culveri	0	0	0	0	0	0	0

species	ST.29	ST.30	ST.31	ST.32
Chironominae	0	0	0	0
Berosus sp	0	0	0	0
Beraeidae	0	0	0	0
Caenis sp	0	0	0	0
Coenagrionidae	0	0	0	0
Corixidae	0	0	0	0
Micropholis atra	0	0	31	0
Helobdella lineata	0	0	0	0
Oligochaeta	0	0	0	0
Turbellaria	0	0	0	0
Nematoda	0	0	0	0
Nemertea A	0	0	0	0
Nemertea B	0	0	0	0
Nemertea C	0	0	0	379
Neanthes Succinea	0	327	19	4975
Laeonereis culveri	0	0	0	0

species	ST.1	ST.2	ST.3	ST.4	ST.5	ST.6	ST.7
Steninonereis martini	0	0	0	0	0	0	0
Glycera sp	0	0	0	0	0	0	0
Glycinde sp	0	0	0	0	0	0	0
Hobsonia florida	0	0	0	0	0	0	38
Polydora sp	0	0	0	0	0	0	0
Streblospio sp	0	0	0	0	0	0	0
Capitellidae	0	0	0	0	0	0	0
Diopatra cuprea	0	0	0	0	0	0	0
Spiochaetopterus oculatus	0	0	0	0	0	0	0
Parandalia americana	0	0	0	0	0	0	0
Parandalia fauveli	0	0	0	0	0	0	0
Hydrozoa	0	0	0	57	0	0	2808
Texadina sphantozoma	0	0	0	19	211	0	0
Probythinella sp	0	0	0	96	0	0	0
Congeria leucopheata	0	0	0	0	0	0	0
Ischadium recurvus	0	0	0	0	0	0	0

species	ST.8	ST.9	ST.10	ST.11	ST.12	ST.13	ST.14
Steninonereis martini	0	0	0	0	0	0	0
Glycera sp	0	0	0	0	0	0	0
Glycinde sp	0	0	0	0	0	0	0
Hobsonia florida	0	0	0	0	0	0	0
Polydora sp	0	0	0	0	0	0	0
Streblospio sp	0	0	0	0	0	0	0
Capitellidae	0	0	0	0	0	0	0
Diopatra cuprea	0	0	0	0	0	0	0
Spiochaetopterus oculatus	0	0	0	0	0	0	0
Parandalia americana	0	0	0	0	0	0	0
Parandalia fauveli	0	0	0	0	0	0	0
Hydrozoa	0	0	0	0	0	0	0
Texadina sphantozoma	42	421	57	1904	19	84	126
Probythinella sp	0	0	173	211	0	84	19
Congeria leucopheata	0	0	0	0	0	0	0
Ischadium recurvus	0	0	0	0	0	0	0

species	ST.15	ST.16	ST.17	ST.18	ST.19	ST.20	ST.21
Steninonereis martini	0	0	0	0	0	0	0
Glycera sp	0	0	0	0	0	0	0
Glycinde sp	0	0	0	0	0	0	0
Hobsonia florida	0	0	337	0	8137	3154	4078
Polydora sp	0	0	13324	0	0	0	0
Streblospio sp	0	0	0	0	0	250	40
Capitellidae	0	0	0	0	0	0	0
Diopatra cuprea	0	0	0	0	0	0	0
Spiochaetopterus oculatus	0	0	0	0	0	0	0
Parandalia americana	0	0	0	0	42	0	0
Parandalia fauveli	0	0	0	0	0	0	0
Hydrozoa	0	0	0	0	0	57	0
Texadina sphantozoma	0	19	42	0	19	115	0
Probythinella sp	96	96	0	0	0	19	0
Congeria leucopheata	0	0	0	0	0	0	0
Ischadium recurvus	0	0	0	0	0	0	0

species	ST.22	ST.23	ST.24	ST.25	ST.26	ST.27	ST.28
Steninonereis martini	0	0	0	210	0	0	0
Glycera sp	0	0	0	0	0	0	0
Glycinde sp	0	0	0	0	0	0	0
Hobsonia florida	0	788	0	84	0	0	0
Polydora sp	0	0	0	0	0	0	0
Streblospio sp	758	0	0	0	519	0	0
Capitellidae	0	3212	0	0	0	0	0
Diopatra cuprea	0	0	0	0	0	0	0
Spiochaetopterus oculatus	0	0	0	0	0	0	0
Parandalia americana	0	38	0	0	0	0	0
Parandalia fauveli	0	0	0	0	0	0	0
Hydrozoa	126	0	76	0	0	0	0
Texadina sphantozoma	126	115	0	0	0	1602	84
Probythinella sp	0	0	0	0	0	0	0
Congeria leucopheata	0	0	0	0	0	0	0
Ischadium recurvus	0	0	0	0	0	0	0

species	ST. 29	ST. 30	ST. 31	ST. 32
Steninonereis martini	0	0	0	0
Glycera sp	9618	76	0	0
Glycinde sp	0	0	0	0
Hobsonia florida	0	0	0	0
Polydora sp	0	0	0	0
Streblospio sp	0	0	0	0
Capitellidae	0	0	0	0
Diopatra cuprea	0	0	19	0
Spiochaetopterus oculatus	0	0	288	0
Parandalia americana	19	0	38	0
Parandalia fauveli	0	19	0	0
Hydrozoa	0	0	0	0
Texadina sphantozoma	19	0	173	0
Probythinella sp	0	0	0	0
Congeria leucopheata	0	0	0	0
Ischadium recurvus	0	0	0	0

species	ST.1	ST.2	ST.3	ST.4	ST.5	ST.6	ST.7
Mulinia lateralis	0	0	0	0	0	0	0
Odostomia weberi	0	0	0	0	0	0	0
Thais haemastoma	0	0	0	0	0	0	0
Physa sp	0	0	0	0	0	711	0
Pygophoras cornutus	0	0	0	0	0	0	38
Rangia cuneata(young)	0	0	0	0	0	0	0
Rangia cuneata(adult)	0	0	0	0	0	0	0
Amnicola limosa	0	0	0	0	0	0	0
Macoma mitchilli	0	0	0	0	0	0	0
Lyonsia hyalina	0	0	0	0	0	0	0
Membranopora arborescens	0	0	0	0	0	0	0
Laevapex fuscus	0	0	0	0	0	0	19
Menetus sp	0	0	0	0	0	0	596
Ferrissia fragilis	0	0	0	0	0	0	38
Hydrobiidae	0	0	0	0	0	0	0
Gyraulus sp	0	0	0	0	0	0	19

species	ST.8	ST.9	ST.10	ST.11	ST.12	ST.13	ST.14
Mulinia lateralis	0	42	126	0	0	0	0
Odostomia weberi	0	0	0	0	0	0	0
Thais haemastoma	0	0	0	0	0	0	0
Physa sp	0	0	0	0	0	0	0
Pygophoras cornutus	0	0	0	0	0	0	0
Rangia cuneata(young)	0	0	0	0	0	0	0
Rangia cuneata(adult)	0	0	0	0	0	126	126
Amnicola limosa	0	0	0	0	0	0	0
Macoma mitchilli	0	0	0	0	0	0	0
Lyonsia hyalina	0	0	0	0	0	0	0
Membranopora arborescens	0	0	0	0	0	0	0
Laevapex fuscus	0	0	0	0	0	0	0
Menetus sp	0	0	0	0	0	0	0
Ferrissia fragilis	0	0	0	0	0	0	0
Hydrobiidae	0	0	0	0	0	0	0
Gyraulus sp	0	0	0	0	0	0	0

species	ST.15	ST.16	ST.17	ST.18	ST.19	ST.20	ST.21
Mulinia lateralis	0	0	0	0	0	0	0
Odostomia weberi	0	0	0	0	0	0	0
Thais haemastoma	0	0	0	0	0	0	0
Physa sp	0	0	0	0	0	0	0
Pygophoras cornutus	0	0	0	0	0	0	0
Rangia cuneata(young)	0	0	0	0	0	96	0
Rangia cuneata(adult)	0	134	0	0	0	288	0
Amnicola limosa	0	0	0	0	0	0	0
Macoma mitchilli	0	0	0	0	0	0	0
Lyonsia hyalina	0	0	0	0	0	0	0
Membranopora arborescens	0	0	0	0	0	0	0
Laevapex fuscus	0	0	0	0	0	0	0
Menetus sp	0	0	0	0	0	0	0
Ferrissia fragilis	0	0	0	0	0	0	0
Hydrobiidae	0	0	0	0	0	0	0
Gyraulus sp	0	0	0	0	0	0	0

species	ST.22	ST.23	ST.24	ST.25	ST.26	ST.27	ST.28
Mulinia lateralis	0	0	0	0	0	210	42
Odostomia weberi	0	0	0	0	0	0	0
Thais haemastoma	0	0	0	0	0	0	0
Physa sp	0	0	0	0	0	0	0
Pygophoras cornutus	0	0	0	0	0	0	0
Rangia cuneata(young)	0	0	0	0	0	0	0
Rangia cuneata(adult)	0	0	0	0	0	0	0
Amnicola limosa	0	0	0	0	0	0	0
Macoma mitchilli	0	0	0	0	0	0	0
Lyonsia hyalina	0	0	0	0	0	0	0
Membranopora arborescens	0	0	0	0	0	0	0
Laevapex fuscus	0	0	0	0	0	0	0
Menetus sp	0	0	0	0	0	0	0
Ferrissia fragilis	0	0	0	0	0	0	0
Hydrobiidae	0	0	0	0	0	0	0
Gyraulus sp	0	0	0	0	0	0	0

species	ST.29	ST.30	ST.31	ST.32
Mulinia lateralis	0	250	19	42
Odostomia weberi	211	0	0	0
Thais haemastoma	0	0	0	42
Physa sp	0	0	0	0
Pygophoras cornutus	0	0	0	0
Rangia cuneata(young)	0	0	0	0
Rangia cuneata(adult)	0	0	0	0
Amnicola limosa	0	0	0	0
Macoma mitchilli	0	0	19	0
Lyonsia hyalina	0	0	0	42
Membranopora arborescens	0	0	0	42
Laevapex fuscus	0	0	0	0
Menetus sp	0	0	0	0
Ferrissia fragilis	0	0	0	0
Hydrobiidae	0	0	0	0
Gyraulus sp	0	0	0	0

APPENDIX VII

Composition of benthos samples by month
(Number of organisms/m^2)

Station 16 - Lake Salvador

	77 Nov	78 Jan	Mar	May	Jul	Sep	Nov
Corophium lacustre	0	0	19	0	19	0	19
Mysidopsis almyra	42	0	0	38	0	0	0
Candona caudata	0	0	19	0	0	0	190
Candona verretensis	0	0	19	0	0	0	519
Cyprideis salebrosa	0	42	0	0	0	0	0
Candona patzcuaro	0	42	0	0	0	0	38
Laydigia acanthocercoides	0	0	0	0	19	19	153
Ilyocryptus agilis	0	0	0	0	0	134	0
Ilyocryptus gouldeni	0	0	0	0	19	0	38
Probythinella sp.	0	0	0	0	0	0	96
Rangia cuneata	210	168	382	826	134	0	134
Texadina sphantozoma	126	337	0	2558	76	96	19
Tanypodinae	0	168	38	76	134	500	307
Diamesinae	0	0	38	38	0	0	0
Chironominae	42	0	0	0	57	0	115

Station 16 - Lake Salvador Continued

	77 Nov	78 Jan	Mar	May	Jul	Sep	Nov
Oligochaeta	42	0	38	0	0	0	0
Nemertea C	0	168	19	38	0	38	76
Neanhtes succinia	0	0	19	0	0	0	0
Hobsonia florida	0	84	0	38	0	0	0
Streblospio sp.	0	210	0	0	0	0	0
Capitellidae	0	1180	173	0	38	0	0

Station 23 - Little Lake

	77 Nov	78 Jan	Mar	May	Jul	Sep	Nov
Corophium luisianum	84	42	0	0	0	38	0
Gammarus mucronate	0	0	0	19	0	0	0
Gammarus macromucronate	0	0	0	0	0	0	19
Grandidierella bonnieroides	0	42	0	0	0	76	0
Edotea montosa	42	84	0	19	0	0	19
Melita nitida	0	0	0	57	0	0	0
Monoculodes edwardsi	0	0	0	19	0	38	153
Munna reynoldsi	0	0	0	211	0	0	0
Cerapus sp.	0	0	0	19	0	0	0
Berosus sp.	0	0	19	0	0	0	0
Tanypodinae	0	0	0	19	0	57	57
Diamesinae	0	0	0	0	0	0	19
Chironominae	0	0	0	38	0	76	0
Leydigia acanthoceroides	42	0	0	0	0	0	0
Leydigia leidigi	42	0	0	0	0	0	0
Balanus sp.	0	0	0	19	0	0	0

Station 23 - Little Lake Continued

	77 Nov	78 Jan	Mar	May	Jul	Sep	Nov
Neopenone texana	0	0	0	19	0	38	0
Rithropanopeus harrisii	0	42	0	0	0	0	0
Texadina sphantosoma	0	0	0	0	1019	38	115
Rangia cuneata	42	0	57	0	307	480	0
Probythinela sp.	0	0	0	0	0	19	0
Congeria leucophaeta	337	252	0	192	0	19	0
Ischadium recurvus	210	126	0	96	0	0	0
Mulinia sp.	0	0	0	95	76	114	0
Hydrobidae	0	0	38	0	0	0	0
Oligochaeta	0	252	57	0	19	0	0
Nemertea C	0	0	0	0	0	538	0
Neanthes succinia	42	210	0	961	0	0	0
Hobsonia florida	337	295	115	0	38	1231	788
Streblospio sp.	0	0	0	0	0	0	0
Capitelidae	0	337	57	0	19	0	3212
Parandalia americana	0	0	0	1365	19	0	38

Station 29 - St. Denis Bayou

	77 Nov	78 Jan	Mar	May	Jul	Sep	Nov
Gammarus tigrinus	0	0	38	0	0	0	0
Edotea montosa	0	0	38	76	0	19	0
Monoculodes edwardsi	0	42	0	19	0	38	19
Munna reynoldsi	0	0	0	0	0	0	0
Cyathura polita	0	0	38	0	0	0	0
Cyclapsis B	0	0	0	0	0	0	442
Oxyurostylis smithi	0	0	0	0	0	0	19
Cyprideis salebrosa	0	0	0	19	0	0	0
Odostomia weberi	0	0	0	0	0	0	211
Mulinia sp.	0	42	57	152	0	0	0
Texadina sphantosoma	0	0	0	57	0	0	19
Macoma mitchilli	0	0	57	96	57	0	0
Turbellaria	0	0	0	0	0	38	0
Nemertea B	0	758	0	0	211	0	0
Nemertea C	0	210	38	38	38	327	0

Station 29 - St. Denis Bayou Continued

	77 Nov	78 Jan	Mar	May	Jul	Sep	Nov
Glycera sp.	0	0	0	0	0	0	9618
Glycinde sp.	0	0	0	461	0	76	0
Hobsonia florida	0	0	173	0	0	0	0
Polydora sp.	0	0	0	0	0	0	0
Streblospio sp.	0	84	211	0	19	57	0
Capitellidae	0	2276	250	403	4309	11676	0
Laeonereis culveri	0	0	0	0	0	38	0
Parandalia americana	0	0	0	0	0	0	19
Nematoda	0	0	0	38	0	0	0

VITA

Antonio Liborio Philomena was born on October 4, 1951, in Porto Alegre, Rio Grande do Sul, Brasil, to Roberto Manske and Theresinha Liborio Philomena. He attended Colegio Anchieta and Inacio Monanha, graduating in 1970. He enrolled in the Fundacao Universidade do Rio Grande and graduated in the first Brazilian class of B.S. in Oceanology in 1974.

In May 1977, he entered the Graduate School of Louisiana State University and is now a candidate for Master of Science in Marine Sciences after a period of thirty-eight months in Brasil (from May 1979 through January 1983).

On May 22, 1976, he married the former Ana Maria Liesenfeld Guedes of Novo Hamburgo, Rio Grande do Sul, Brasil.

He is at present Head of Departamento de Oceanografia of Fundacao Universidade do Rio Grande.

EXAMINATION AND THESIS REPORT

Candidate: Antonio Liborio Philomena

Major Field: Marine Sciences

Title of Thesis: THE DISTRIBUTION OF MACROBENTHOS IN BARATARIA BASIN, LOUISIANA

Approved:

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

Date of Examination:

February 28, 1983