

**Hydrologic and Biological
Monitoring of Lower Sarasota Bay
1975 - 1978**



**Sarasota High School Advanced Marine Science
Report # 1
JUNE, 1979**

**Edited by: Michael Stuart
Student Editor: Penny Taddio**

POLLUTION
CONTROL

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SARASOTA HIGH SCHOOL ADVANCED
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TABLE OF CONTENTS

	<u>Page</u>
A. Introduction.	A-1
B. Acknowledgements.	B-1
C. Water Monitoring	
Introduction.	C-1
Methods	C-3
Station Descriptions.	C-8
Data.	C-11
Discussion.	C-35
Summary	C-68
D. Zooplankton	
Introduction.	D-1
Methods	D-2
Station Descriptions.	D-3
Data.	D-3
Discussion.	D-14
E. Grass Flat Measured Tows	
Introduction.	E-1
Methods	E-1
Station Descriptions.	E-2
Data.	E-2
Discussion.	E-26
Summary	E-41
F. Bibliography.	F-1

LIST OF TABLES

	<u>Page</u>
C-1	Sarasota County Air & Water Pollution Control Department annual averages for hydrographic data C-2
C-2	Seasonal hydrographic data for Station #1. C-13
C-3	Seasonal hydrographic data for Station #11 C-17
C-4	Seasonal hydrographic data for Station #2. C-18
C-5	Seasonal hydrographic data for Station #3. C-23
C-6	Seasonal hydrographic data for Station #4. C-28
C-7	Seasonal hydrographic data for Station #6. C-33
C-8	Seasonal hydrographic data for Station #7. C-34
C-9	Monthly averages of hydrographic parameters for Station #1 C-36
C-10	Monthly averages of hydrographic parameters for Station #11. C-38
C-11	Monthly averages of hydrographic parameters for Station #2 C-39
C-12	Monthly averages of hydrographic parameters for Station #3 C-41
C-13	Monthly averages of hydrographic parameters for Station #4 C-43
C-14	Monthly averages of hydrographic parameters for Station #6 C-45
C-15	Monthly averages of hydrographic parameters for Station #7 C-45
C-16	Annual (based on 9 months) adjusted averages for hydrographic parameters at Stations 1,2,3 and 4. C-46
C-17	Oxygen solubility vs. salinity and temperature C-59
D-1	Seasonal distribution of zooplankton for Station #1 D-5
D-2	Seasonal distribution of zooplankton for Station #11. D-7
D-3	Seasonal distribution of zooplankton for Station #2 D-8

	<u>Page</u>
D-4 Seasonal distribution of zooplankton for Station #3	D-9
D-5 Seasonal distribution of zooplankton for Station #4	D-11
D-6 Seasonal distribution of zooplankton for Station #6	D-13
D-7 Seasonal distribution of zooplankton for Station #7	D-14
E-1 Monthly size frequency distribution data for catches on the Bayfront grass flat	E-4
E-2 Monthly size frequency distribution data for catches on the Wreck grass flat.	E-6
E-3 Monthly size frequency distribution data for catches on the Bird Key Yacht Club grass flat. . .	E-9
E-4 Monthly size frequency distribution data for catches on the Big Pass grass flat	E-12
E-5 Monthly size frequency distribution data for catches on the South Lido grass flat	E-15
E-6 Monthly size frequency distribution data for catches on the Inner City Island grass flat. . . .	E-18
E-7 Monthly size frequency distribution data for catches on the Outer City Island grass flat. . . .	E-21
E-8 Technical names for organisms caught in the measured tows.	E-24

LIST OF FIGURES

	<u>Page</u>
C-1 Chart of Water Monitoring Station locations.	C-9
C-2 Graphs of hydrographic parameters for Station #1 . . .	C-46
C-3 Graphs of hydrographic parameters for Station #11. . .	C-48
C-4 Graphs of hydrographic parameters for Station #2 . . .	C-49
C-5 Graphs of hydrographic parameters for Station #3 . . .	C-51
C-6 Graphs of hydrographic parameters for Station #4 . . .	C-53
C-7 Graphs of hydrographic parameters for Stations # #6 and 7	C-55
C-8 Graphs of Annual (based on 9 months) adjusted averages for Stations #1, 2, 3 and 4	C-56
E-1 Chart of Measured Tow Station location	E-3
E-2 Graphs of monthly size-frequency distribution for grass shrimp	E-27
E-3 Graphs of monthly size-frequency distribution for bayonet shrimp	E-29
E-4 Graphs of monthly size-frequency distribution for pink shrimp.	E-31
E-5 Graphs of monthly size-frequency distribution for pin fish	E-33
E-6 Graphs of monthly size-frequency distribution for file fish.	E-35

A. INTRODUCTION

Marine science education includes teaching the process of science as well as the content of the field. In teaching the process of marine science, teachers routinely have students learn various techniques such as plankton sampling, biological sampling, oxygen determination, salinity determination, etc. The data collected during this teaching process is usually used only by the students. At Sarasota High School, the data was recorded to demonstrate seasonal variations. Soon it was apparent that with a little effort, the data the students were collecting could be useful to the scientific community.

In the fall of 1975, the students and faculty devised techniques to routinely collect data at a variety of locations. By having students monitor individually, rather than as a group, they were able to cover a whole year with the same total student hours that were spent when the group worked together on the same thing. Examination and interpretation of this data soon became a major focal point for the classes as it could be used to demonstrate the major principles of Marine Ecology. The change in format had other advantages in that the students were learning about their own bay and providing useful baseline data for others at the same time. Their work became very relevant.

Most of the students working on the monitoring program are enrolled in Advanced Marine Ecology. This means that they have already had general biology, regular marine science, advanced

math, and many have had chemistry. Their knowledge of science is therefore quite good. With close supervision they can produce good results.

From 1975 to present, equipment has slowly been accumulated that allows more accuracy. By April of 1978, the program was operating with all approved methods of sampling and a boat to expand the stations covered. The Carefree Learner is a 41 foot flat-bottomed boat with a Coast Guard rated passenger capacity of 32 plus a crew of three. She is 13 feet six inches wide and has a nominal draft of 9 to 18 inches, depending on the tilt of the motor. The boat is powered by an 85 horsepower Evinrude engine that will push her at 7 knots.

She is equipped with spud and danforth type anchors; flowing aquariums; Ray Jefferson 400 and Gemtronics GT-12025 depth finders; Loran A; VHF and CB radios; a hydrophone that plays through a central P.A. system; and a variety of nets, dredges and electronic monitoring equipment described under methods and materials.

The boat's major advantage is that it has allowed all of the students in a class to work together with a teacher. Each student rotates through the various types of data collection and analysis, thereby maximizing their understanding of each component. Even though they only spend a short time on each activity they now work closely with students doing the other tests so they can see the changes over a long period of time.

This study included basic water monitoring; quantitative plankton counts, and a quantitative survey of the organisms on grass flats. A later publication will cover these factors in more depth and report on chlorophylls and B.O.D.s as well.

We consider our data to be an indicator of trends and a stimulator of questions for other more sophisticated facilities to use as a spring board for further research. Though we have tried in all ways to be technically accurate, our facility and learning situation can result in occasional errors that might not occur in another laboratory. One thing we did have going for us was inexpensive willing hands to do the work, and since it provided a great learning situation, we went forward with enthusiasm. We humbly offer this document for your examination in the hope that it will help define the bay system, and stimulate your thinking and interest in doing further work on Sarasota Bay.

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We are also very grateful to the community and its organizations for their help in building our research vessel.

C. WATER MONITORING

Introduction

Very little understanding of the biology of an estuary can be obtained until some knowledge of the physical and chemical factors influencing that system has been obtained. Long term examination of these factors is needed to determine the types and rates of change that might occur in a bay system that is being stressed by urbanization.

Except for the work the Sarasota County Air and Water Pollution Department has done, very little long term water monitoring has been done on Sarasota Bay. A summary of the county's annual averages for stations that are close to those reported in this study are given in Table C-1. As can be seen in the table some factors were only measured once in a year while the maximum number of samples was 10.

In the last year, the county has sampled more often. The county reports conductivity and temperature rather than salinity. Salinities for the table were calculated from conductivity and temperature so that the values could be compared to those found in this study. Some error is, of course, introduced by making this conversion.

As this report was being printed, Rhonda Evans at the Sarasota County Air and Water Pollution Control Department was completing a bibliography on all of the work done on Sarasota

TABLE C-1

Sarasota County Air & Water Pollution Control Department
Annual Hydrographic Data

Sta. #	Year	# of Samp.	Temp. °C	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l	Total Colif /100ml
508***	1973	3-4*	26.0	34.0**		7.56	8.2				67
	1974	1-2	28.0				6.4				100
	1975	2-4	25.4	24.5		8.10	6.9				100
	1976	2	28.8			7.80	6.8				100
529	1973	6-7	23.8	32.9		7.87	8.4				272
	1974	1-2	25.0	31.1		8.15	6.8				100
	1975	1-5	21.3	30.5		8.17	7.5	.0250		.0060	200
	1976	2	18.0	38.4		8.35	10.2				450
531	1973	6-7	24.3	33.8		7.83	8.2				68
	1974	1-2	24.5	31.9		8.00	6.4				100
	1975	1-5	26.0	29.6		8.17	7.2	.0250		.0060	180
	1976	3	20.5	38.0		8.33	9.4				100
549	1972	1-10	24.0	33.8	7.3	7.90	6.3				
	1973	1-7	25.7	26.0	5.0	7.86	5.5				214
	1974	1-4	20.0	25.2	3.0	8.00	5.8				175
	1975	1-3	24.0	22.0	4.4	7.50	4.7				9466
	1976	4	24.6	28.0		8.03	6.4				2362
606	1973	4-5	24.1	34.0		7.72	7.9				65
	1974	1-2	24.0	32.3		8.05	6.4				100
	1975	2-8	25.0	27.0		8.17	6.4	.1128		.2720	203
	1976	3	20.8	36.8		8.37	9.1				133

* Maximum and minimum number of samples for the year.

** Salinity computed from temperature and conductivity.

*** 508-located in Sarasota Bay near Indian Beach Drive.
 529-located in Little Sarasota Bay near Sarasota Pier.
 531-located in Little Sarasota Bay near marker #5
 549-located at entrance of Whitaker Bayou in Sarasota Bay.
 606-located at Big Sarasota Pass, dock S, marker 16.

Bay. Some of these references are listed in the bibliography of this paper. A survey of that literature indicates that no long term monitoring has been done but many short term studies have been completed. These studies have been done by New College, Mote Marine Laboratory, the Environmental Protection Agency, and others. The State Department of Natural Resources and the Department of Environmental Regulation also have limited information collected during environmental surveys of proposed alterations to the bay system.

Methods

From September, 1973 to May, 1975, samples were collected and analyzed by pairs of students doing all of their work in the field. The samples were collected and analyzed between 10:00 hrs. and 12:00 hrs.. After September, 1975, a schedule change in the time for Advanced Marine classes resulted in samples being run between 13:00 and 15:00 hrs. This change in time had an effect on O_2 and pH values as 24-hour sampling curves show as much as a 2.5 ppm difference in DO at some stations from 10:00 to 14:00 hrs.

Although sampling early in the morning might have been more meaningful for O_2 , pH, and CO_2 values, school scheduling did not allow much modification of the time. With the exception of daylight savings and the June, July, and August 1978 samples, the 13:00 - 15:00 hr. time slot has been used. Daylight savings time forced sampling 1 hour earlier from April to October each year. In the summer of 1978, poor communications resulted in sampling at earlier hours so some of this data was not used in the graphs.

(See Tables C-2 through C-8 for sampling times.) From September, 1975 to April, 1978, pairs of students did the monitoring work in the field. Assemblies, athletics, weather and period changes permitting, the stations were monitored on a regular schedule during those years. Station #1 was done on Monday, Station #2 was done on Tuesday, Station #3 was done on Wednesday and Station #4 was done on Thursday. Due to lack of equipment the stations couldn't all be done on the same day. With the launching of the "Carefree Learner" in April of 1978, all stations could be run on the same day between 13:00 and 15:00 hrs. No attempt was made to match tide or weather conditions. From April, 1978, monitoring was done twice a month with an attempt to have the first run in the first two weeks of the month and the second in the second two weeks with about two weeks between the samples. A weather bias has been introduced as the "Carefree Learner" does not go out in winds of over 20 knots or in rain. With these two exceptions samples are always run on a Monday or Tuesday scheduled well in advance to randomize the prevailing environmental conditions during sampling periods.

Wind speed, wind direction, wave conditions, percent cloud cover, and air temperature were recorded for each sample. Wind speeds were recorded in 5-knot intervals as indicated by a hand-held anemometer and direction was taken from the boat's compass. Wave conditions were estimated. Cloud cover was estimated in percent over an area described by a circle 30° from the vertical. This was done to minimize the effects of clouds on the horizon that would have little effect on the incident light in the area.

Air temperature was taken using a mercury thermometer held in the shade.

Tide and rainfall data were obtained from the Sarasota Herald-Tribune. For each sample the prior tide time and height and the next tide time and height were recorded. Rainfall was obtained from the newspaper. Their recording station is located at the City Water Treatment Plant on 12th Street.

Top samples were collected 6" below the surface while bottom samples were taken 1' above the bottom. Station depths varied so the depth of the bottom sample varied.

Water temperature was taken with a mercury thermometer until April, 1978. Samples from the surface and bottom were collected in Van Dorn water sampling bottles. The thermometer was placed in the top to be read. In April, 1978, a YSI Model 33 SCT meter was purchased and so temperature was taken with it at the time salinity was read.

Salinity was determined from 1975 to April, 1978 using an American Optical Goldberg Temperature Compensated Refractometer. Samples for salinity determination were collected with Van Dorn sampling bottles. Direct readings were obtained with a YSI Model 33 SCT meter from April, 1978 to present.

Throughout this sampling period, turbidity was run using the Hach DREL/2 portable turbidimeter. This method had limitations as the scale was hard to read and it was a transmittance method and color interfered heavily on samples at certain times of the year at station #1. In January of 1979, a Hach Model 16-800 portable turbidimeter was purchased. This is a nephelometry method and so alleviates some of the problems with color.

The two methods do correlate quite well on open bay samples even though they differ in Hudson Bayou at times.

pH samples were drawn from the Van Dorn sample bottles and then measured with the Hach Model 17-OH phenol red pH test kit. This is a color comparator disk technique and has worked quite well. From January, 1978 to April, 1978, a Hach Model 17-200 pH meter was used as a back-up. From April, 1978 to present, a Chemtrix Type 40 pH meter with a Model HO-50 submergible probe on a 30 foot lead was used so the pH could be taken directly. pH meters were standardized with pH 7 and 9 buffers that were brought to ambient temperature by setting them in aquariums with circulating water.

Until April, 1978, oxygen was measured with a Hach Model Ox-2P Dissolved Oxygen Test Kit. Optimum accuracy was obtained by running this test with the low range method. Field test accuracy was checked against Standard Method Azide Modification procedure. Dissolved Oxygen tests indicated the Hach kits were within + 1 ppm with better accuracy the rule rather than the exception. Samples were collected with Hach Model 1962, Dissolved Oxygen Samplers. From April 1978, a YSI Model 57 Dissolved Oxygen Meter with a remote probe was used. This eliminated the need for sample collection. The instrument was calibrated with a YSI 5075 calibration Chamber.

Prior to March 1977, Nitrates were run using the Brucine Method from Standard Methods (1). Few students were capable of obtaining good results with this method in the time they were allotted so it was seldom done. From March of 1977 to

December 1978, nitrates were measured with Hach's Model NI-14 Low Range Nitrate Test Kit. The low range method was used. Nitrate values were usually very low and exceeded the lower limits of the test. Without additional testing, this test measures both nitrate and nitrite. From December 1978 to present, nitrates were done with the method for Low Range Nitrates listed in Hach's book, Procedures, Chemical Lists and Glassware for Water and Wastewater Analysis (10). This procedure uses a Bausch and Lomb Spectronic 20 and at 99% transmittance gives a value of 0.008 mg/l. The concentration of nitrate is near this limit most of the time. Even though the values are questionable, constant monitoring of this factor would show any increase in value.

From March 1977 to December 1978, phosphates were run using Hach Model PO-24 Phosphate Test Kits. Only orthophosphate was checked in the low range of the kit. This kit is usually very satisfactory, but in December 1978, the APHA approved method as outlined in Hach's water analysis book was used (10). This method has proven to be very satisfactory for the ranges found in Sarasota Bay. A Bauch and Lomb Spectronic 20 is used in the analysis.

In addition to the parameters mentioned B.O.D.s, chlorophyll a, Chlorophyll b, and phaeophytins have been analyzed. Since this work did not begin until December 1978 the methods and data will not be reported in this paper. In the spring of 1981 a second publication will discuss this data.

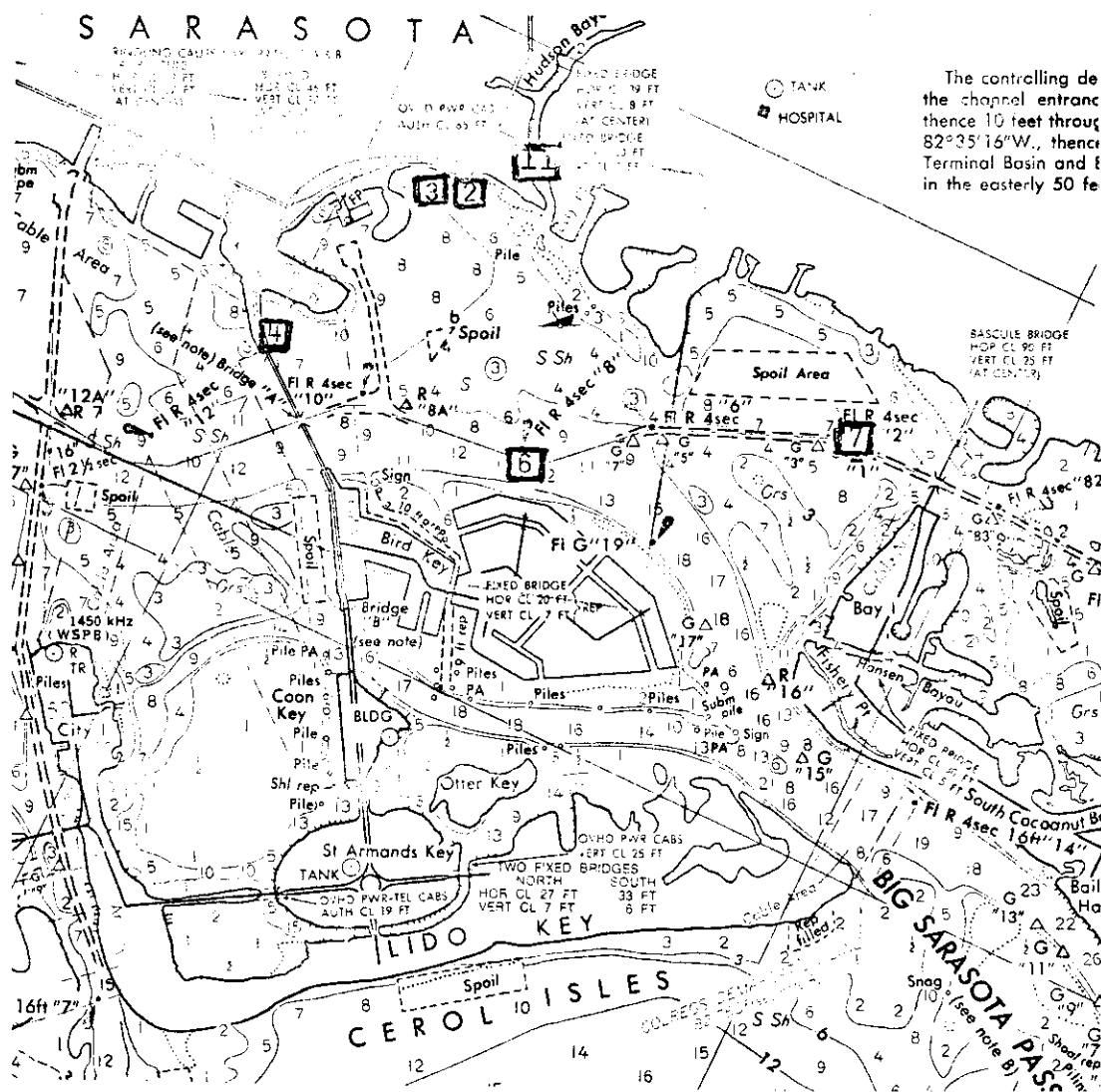
Station Descriptions

Most of the stations in this study were chosen for convenience. Open bay stations were added only after the boat was launched. Until an adequate representation of each of the stations has been obtained, data collection will continue at those stations. Each station should be defined well enough through seasonal and annual variations so that in years to come the data collected will represent an accurate baseline for comparison. In 1980 new stations will be chosen strictly on their merits in terms of maximizing the hydrographic definition of Sarasota Bay.

Station #1 is located on the Sarasota High School Campus in the upper reaches of Hudson Bayou. Hudson Bayou divides on campus with one arm going under Bahia Vista and southward while the other arm has a dam on campus and then wanders east under School Avenue. Both arms are channelized and drain major residential areas. Though the area is generally serviced by central sewer systems, old septic tanks occur frequently throughout the area. Parking lot, street and lawn runoff are probably a major component of the fresh water during rains. No information is available on the flow rates for Hudson Bayou.

Station #1 is located immediately west of the western parking lot bridge. This parking lot is located off Bahia Vista. This Bridge is about 200 yards east of U.S. #41. The Station is tidal and varies in depth due to siltation. At times it has been as shallow as 1 ft. below mean spring low tides and after heavy rains it erodes to a depth of as much as 4 ft. The depth of the rest

FIGURE C-1
Water Monitoring Station Locations



- Station 11: Lower Hudson Bayou
- Station 2: Bayfront Grass Flat
- Station 3: Oleary's Sailboat Rental
- Station 4: Hart's Landing
- Station 6: Marker #8
- Station 7: Marker #2

of the Bayou on campus is usually only inches below mean spring low tides.

In 1973 the students planted Rhizophora mangle, Avecennia germinans, Laguncularia racemosa, Juncus roemerianus, and Spartina alterniflora throughout the campus in Hudson Bayou. The bottom is generally silt laden sand with a lot of recognizable leaf detritus.

Station #11 is located in Hudson Bayou directly west of the Orange Avenue bridge (see Figure C-1). The station is in the middle of the channel in front of the Hudson Manor Apartments. The depth is about 7 feet below mean spring low tide. The maximum depth for the entrance into Hudson Bayou is about 5.5 feet. The bayou in this location is completely sea walled with little vegetation. The bottom is primarily a thick layer of soft silt as deep as 3 feet in some places.

Station #2 is over a grassflat on the bayfront between Hudson Bayou and Island Park. The station is immediately north of the point where U.S. 41 turns to run parallel to the bay. The station is off the end of a 12" pipe that runs out into the bay about 30 feet. The depth is about 1.5 feet below mean spring low tide level. The dominant vegetation is Halodule wrightii but Thalassia testudinum and Syringodium filiforme can also be found in the immediate area.

From 1973 to 1975, the grass was dense and actively growing, but in 1976, it began to thin out until in 1977 there were fewer than 100 clumps of grass per square meter. The area seems to be recovering at this time. Many storm sewer pipes

empty into the bay in this area. The shore is rip-rap and mangroves are beginning to grow in the rocks.

Station #3 is off the end of the sailboat rental dock at Island Park, south of Marina Jacks. The water is about 7 feet below mean spring low tide and is part of a deep water tongue that curves around Island Park and runs toward Hudson Bayou. The dredged shell-sand beach drops rapidly to 8 feet where the bottom is soft silt about 2 feet deep. Island Park is a filled point enclosing a marina which is connected to this station by a culvert. As at the bayfront grass flat, many culverts carry urban run-off into the immediate area.

Station #4 is adjacent to the filled causeway at the east end of the Ringling Causeway Bridge. The samples are taken off the end of Hart's Landing dock. The water in this area is 11 feet deep. The bottom is fairly hard sand. The area is entirely fill material and seawalls.

Station #6 is located between Bird Key and Island Park at Intracoastal Waterway Marker #8. The channel is 11 feet deep over hard sand. A significant tidal current from Big Pass runs by this station.

Station #7 is located at Intracoastal Waterway Marker #3, just north of the Siesta Key Bridge. The bottom is mud under 9 feet of water. Phillippi Creek water runs past this station on an out-going tide. This is a dredged channel through grass flats.

Data

Tables C-2 through C-8 list the data collected at stations

1, 11, 2, 3, 4, 6, and 7. The time column in the tables indicates the initial time the sample was drawn and the time that the last test was completed. The tide column indicates F for incoming tide, H for + or - 1 1/2 hours or less from a high tide, E for outgoing tide and L for + or - 1 1/2 hours from a low tide.

The reader should note that the sampling times changed from 10:00 - 12:00 to 13:00 - 15:00 in September of 1975. The summer of 1978 has some irregular sampling times.

Stations 6 and 7 were added in May of 1978. Station 1 was discontinued in March of 1978 while Station 11 was added in May of 1978.

TABLE C-2
Seasonal hydrographic data for Station # 1.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
1/10/75	10:20	SE	5-10	0	22.1	F	Top	22.0	28.5	20.0		3.8			
	11:15						Bot	23.0	30.0	15.0		4.4			
1/30/75	10:25	NE	5-10	10	26.0	F	Top	24.5	29.0	7.0	7.95	2.6			
	11:15						Bot	24.0	29.5	17.0	7.6	2.8			
2/13/75	10:00	W	0-5	40	24.2	F	Top	22.2	20.0	22.0	7.8	3.4			
	11:15						Bot	23.5	26.0	19.0	7.9	2.8			
2/28/75	10:00	SW	0-5	80	20.5	L	Top	19.0	25.0	19.0	7.7	4.8			
	11:10						Bot	23.0	28.0	17.0	8.2	4.8			
3/13/75	10:25	SE	5-10	10	25.5	F	Top	23.5	29.5	22.0	8.1	3.2			
	11:20						Bot	25.5	30.0	22.0	8.1	4.6			
4/ 3/75	10:20	SW	15-10	20	28.0	F	Top	28.0	26.5	19.0	7.9	2.2			
	11:10						Bot	27.5	28.0	22.0	8.1	3.0			
4/17/75	10:30	E	0-5	10	25.3	F	Top	23.5	25.0	20.0	8.0	5.4			
	11:10						Bot	24.5	26.5	25.5	8.2	5.4			
5/ 1/75	10:15	SW	5-10	50	28.5	F	Top	26.5	30.0	26.0	8.0	3.6			
	11:20						Bot	29.0	30.1	19.0	8.2	5.2			
5/15/75	10:20	S	10-15	10	30.0	F	Top	26.5	30.0	7.0	8.2	6.4			
	11:20						Bot	27.0	30.5	9.0	8.2	6.4			
9/22/75	13:15	SE	5-10	70	31.0	H	Top	31.0	27.5	21.0	8.0	6.0			
	14:30						Bot	32.5	29.5	37.0	8.2	5.0			
9/29/75	13:17			100	25.0	H	Top	25.0	0.0	62.0	7.3	6.5			
	14:41						Bot	24.0	2.1	65.0	7.4	7.0			
10/ 8/75	13:15	SE	5-10	60	29.0	H	Top	30.0	0.0	55.0	8.1	7.5			
	14:40						Bot	28.0	0.5	45.0	8.3	7.5			
10/13/75	13:20	E	0-5	70	30.5		Top	31.0	17.0	25.0	8.2	8.0			
	14:38						Bot	31.0	21.0	20.0	8.2	7.0			
10/20/75	14:00	NW	5-10	0	25.0	H	Top	27.0	13.0	19.0	8.2	6.5			
	14:38						Bot	26.0	21.5	20.0	8.0	6.5			
11/ 3/75	13:20	N	0-5	0	27.0	H	Top	26.5	31.0		8.5	9.5			
	14:20						Bot	28.5	33.0		8.6	7.5			
11/10/75	13:30	SE	0-5	90	30.0	L	Top	28.0	24.5	18.0	8.3	8.0			
	14:20						Bot	27.0	26.0	19.0	8.4	9.5			
11/10/75	13:30	SE	0-5	90	30.0	L	Top	28.0	24.5	18.0	8.3	8.0			
							Bot	27.0	26.0	19.0	8.4	9.5			

TABLE C-2 (continued)
Seasonal hydrographic data for Station # 1.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
11/17/75	13:15	SW	0-5	50	31.0		Top	20.5	28.0	6.0	8.5	14.5			
	14:00						Bot	20.5	28.0	8.0	8.5	10.0			
11/24/75	13:20	E	0-5	50	19.5	F	Top	22.0	19.0	10.0	8.0	5.0			
	14:55						Bot	21.0	19.0	10.0		7.0			
12/ 1/75	13:40	W	0-5	0	26.0	H	Top	25.0	19.0	7.0	8.3	10.0			
	14:09						Bot	25.0	22.0	3.0	8.5	10.5			
12/ 8/75	13:15	E	0-5	30	27.0	F	Top	28.0	21.0	7.0	8.6	11.0			
	14:15						Bot	28.0	25.0	4.0	8.1	7.0			
12/15/75	13:20		0-5	10	25.0		Top	23.5	32.0	10.0		8.0			
	14:15						Bot	23.5	32.0	8.0	7.5	8.5			
1/ 5/76	13:20			50	20.0	H	Top	19.0	20.0	20.0	8.1	6.0			
	14:30						Bot	20.0	19.0	20.0	8.2	5.5			
2/23/76	13:20		10-15	80	19.2	F	Top	22.5	2.0		8.2	9.0			
	14:15						Bot	21.8	2.5		7.9	5.0			
3/ 1/76	13:25	NE	5-10	60	30.0	H	Top	28.0	30.0		8.6	9.0			
	14:21						Bot	27.0	30.0		8.6	8.5			
3/ 8/76	13:25	S	0-5	40	26.2	L	Top	28.8	29.0	19.0	7.7	10.0			
	14:12						Bot	27.0	29.0	17.0	8.3	9.0			
3/15/76	13:25	SW	10-15	0	27.1	F	Top	28.0	30.0	58.0	8.3	7.5			
	14:25						Bot	28.0	28.0	30.0	8.4	10.5			
3/22/76	13:32	SW	0-5	60	27.0	F	Top	28.2	29.0	28.0	8.2	9.0			
	14:20						Bot	28.0	30.0	32.0	8.3	7.5			
4/26/76	13:33	SE	0-5	20	32.0	E	Top	30.0	29.0			9.0			
	14:33						Bot	29.0	30.0		8.5	9.5			
5/ 3/76	13:30	NW		10	32.0	H	Top	29.0	26.0			7.0			
	14:40						Bot	28.5	28.0		8.5	5.0			
9/13/76	13:20	SW	0-5	80	32.0	F	Top	32.0	14.0	25.0	8.2	8.5			
	14:18						Bot	33.5	19.0	28.0	8.4	10.0			
9/21/76	13:25	SW	10-15	50	32.5	L	Top	30.0	22.0	19.0	8.5	6.5			
	14:53						Bot	28.5	30.0	28.0	8.4	6.0			
10/13/76	13:20	NE	10-15	30	27.5	F	Top	28.0	26.0	21.0	8.5	6.0			
	14:55						Bot	27.5	26.0	24.0	8.5	5.0			
10/20/76	13:20	SW	5-10	30	29.0	E	Top	27.3	4.0	40.0	7.8	1.5			
	14:10						Bot	26.5	7.0	38.0	7.9	1.5			

TABLE C-2. (continued)
Seasonal hydrographic data for Station #1.

Date	Time	Wind Dir	Wind Speed Knts.	Cloud Cover %	Air Temp °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
11/15/76	13:22	W	10-15	100	23.0	L	Top	24.5	18.0	19.0	8.3	8.5			
							Bot	24.0	18.0	19.0	8.3	8.5			
11/22/76	13:25	NE	10-15	50	16.5	H	Top	22.5	20.0	24.0	8.0	5.0			
							Bot	22.5	20.0	24.0	8.0	5.0			
12/13/76	13:20	SW	5-10	100	24.0	F	Top	24.5	16.0	15.0	8.5	6.0			
							Bot	24.5	16.0	15.0	8.5	6.0			
11/ 3/77	13:20	NW	10-15	10	21.0	H	Top	20.0	0.0	65.0	8.0	7.0			
							Bot	20.0	0.0	65.0	8.0	7.0			
1/10/77	13:30	NW	15-20	90	17.0	F	Top	19.0	0.0	30.0	7.8	8.0			
							Bot	19.0	0.0	30.0	7.8	8.0			
1/31/77	13:40	NE	10-15	100	17.0	H	Top	13.0	13.0	22.0	7.9	5.0			
							Bot	13.0	13.0	22.0	7.9	5.0			
2/ 7/77	13:15	W	10-15	70	19.5	H	Top	18.0	11.0	20.0	8.0	5.5			
							Bot	18.0	11.0	20.0	8.0	5.5			
2/14/77	13:15	NE	5-10	80	21.3	H	Top	18.5	14.0	20.0	8.2	7.5			
							Bot	18.5	14.0	20.0	8.2	7.5			
3/ 7/77	13:15	W	5-10	100	20.0	L	Top	28.0	22.0	19.0	8.2	7.5	0.0	0.40	
							Bot	22.0	24.0	22.0	8.4	7.5	0.0	0.40	
3/14/77	13:15	W	5-10	80	26.5	L	Top	28.0	22.0	24.0	7.9	8.5	0.0	0.47	
							Bot	28.0	22.0	24.0	7.9	8.5	0.0	0.47	
5/ 9/77	13:30	N	5-10	100	26.0	E	Top	29.5	25.5	42.0	8.5	6.0			0.27
							Bot	29.5	25.5	42.0	8.5	6.0			0.27
5/16/77	13:15	NE	0-5	50	29.5	H	Top	28.5	29.5	25.0	8.2	5.0			0.14
							Bot	28.5	29.5	25.0	8.2	5.0			0.14
5/23/77	13:15	W	10-15	80	29.0	F	Top	26.5	30.5	20.0	8.2	5.0			0.19
							Bot	26.5	30.5	20.0	8.2	5.0			0.19
7/10/77	16:00	W	10-15		32.0		Top	33.0	18.0	45.0	8.6	9.5	0.0	0.30	
							Bot	33.0	18.0	45.0	8.6	9.5	0.0	0.30	
9/12/77	13:34	NW	5-10	90	33.0	H	Top	31.0	29.0	34.0	8.5	2.0	0.0	0.0	
	14:28						Bot	32.0	27.0	38.0	8.5	2.0	0.0	0.0	
1/20/77	13:20	W	0-5	60	30.0	L	Top	30.0	2.0	61.0	7.6	4.0	0.0	0.57	
	13:49						Bot	29.5	2.0	61.0	7.6	4.0	0.0	0.57	
10/10/77	13:15	SW	5-10	20	30.0	H	Top	30.0	15.0	12.0	8.0	6.0	0.0	0.03	
	14:55						Bot	30.0	32.0	10.0	8.2	4.0	0.0	0.18	

TABLE C-2 (continued)
Seasonal hydrographic data for Station # 1.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
10/17/77	13:15	NW	5-10	0	21.0	L	Top	26.0	16.0	22.0	8.2	4.5	0.0	0.08	
							Bot	26.0	28.0	18.0	8.4	8.0	0.0	0.05	
10/24/77	13:15	NE	5-10	40	28.0	H	Top	25.5	21.0	15.0	7.8	7.0	0.0	0.11	
							Bot	24.5	29.0	14.0	8.4	6.0	0.0	0.05	
11/ 2/77	13:15	SE	5-10	40	28.0	F	Top	23.0	28.5	15.0	8.5	6.0	0.0	0.23	
							Bot	23.0	27.0	15.0	8.2	5.5	0.0	0.25	
11/14/77	13:30		5-10	30	22.0	F	Top	23.0	20.0	22.0	8.0	5.0	0.0	0.18	
							Bot	23.0	20.0	22.0	8.0	5.0	0.0	0.18	
1/ 9/78	13:10			20	13.0	H	Top	17.0	0.0	16.0	7.5	7.0	0.05	0.03	
1/30/78	13:33	NE	5-10	0	18.0	H	Top	13.2	0.7	20.0	7.65	7.5	0.0	0.13	
							Bot	13.2	0.7	20.0	7.6	7.5	0.0	0.13	
2/ 6/78	13:25	Ne	15-20	10	13.3	H	Top	17.0	15.7	23.0	7.6	6.0	0.0	0.04	
							Bot	17.0	15.7	23.0	7.6	6.0	0.0	0.04	
2/13/78	13:30	S	10-15	10	23.0		Top	21.5	28.3		7.98	10.9	0.0	0.0	
							Bot	21.5	28.3		7.98	10.9	0.0	0.0	
2/27/78	13:13			10	28.0	H	Top	21.0	6.0	33.0	7.9	5.0	0.0	0.07	
							Bot	20.0	7.5	10.0	7.7	5.0	0.0	0.10	
3/ 6/78	13:30				30.0	E	Top	20.0	0.0	24.0	8.0	2.0	0.0	0.07	
							Bot	20.0	0.0	24.0	7.9	2.0	0.0	0.07	

TABLE C-3
Seasonal hydrographic data for Station # 11.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho ng/l
4/ 5/78	12:05						Top	27.0	31.0		7.80	7.0	0.0		
							Bot	25.0	31.0		7.80	7.1	0.0		
4/ 6/78	14:25				24.0		Top	25.2	33.0		8.20	7.0			
	14:31						Bot	23.6	32.0		8.15	6.2			
5?10/78							Top	30.1	32.9		8.15	6.5	0.0		0.0
							Bot	29.0	32.0		7.60	5.5	0.0		0.0
5/16/78	13:33	SW	0-5	0	29.0	H	Top	27.5	33.5		8.09	5.6	0.0		0.0
	13:46						Bot	26.0	33.5		8.01	5.1	0.0		0.0
6/23/78	12:47	SW	5-10		28.7	F	Top	27.0	25.0			5.4	0.0		0.0
	12:55						Bot		30.0			5.7	0.0		0.0
6/27/78	12:47			90	33.3		Top	31.5	26.8			5.4			
	12:55						Bot	29.5	26.0			4.0			
6/30/78	11:19		5-10		32.0	H	Top	31.5	30.0			4.5	0.0		0.0
	11:25						Bot	30.9	32.5			4.0	0.0		0.0
7/ 5/78	13:25			0	32.0	H	Top	32.0	33.2			5.8	0.0		0.0
	13:30						Bot	32.0	30.5			5.8	0.0		0.0
7/11/78	10:47				32.0	L	Top	31.8	31.1			4.4	0.0		0.0
	10:54						Bot	31.0	32.8			3.6	0.0		0.0
7/21/78	10:18	E	0-5	30	30.5	H	Top	29.0	30.5			5.2	0.0		0.0
	10:27						Bot	28.7	31.3			0.1	0.0		0.0
7/27/78	9:48	S	0-5	90	29.0	E	Top	30.0	31.2			4.0	0.0		0.0
	9:54						Bot	29.5	32.1			4.0	0.0		0.0
8/ 1/78	8:45	S	0-5	0	28.3	H	Top	29.0	27.0			3.3	0.0		0.0
	8:51						Bot	30.0	27.0			3.1	0.0		0.0
9/11/78	14:15	SW	0-5	0	28.0	E	Top	31.2	32.1	12.0	8.30	6.9	0.0		0.09
	14:35						Bot	31.2	31.9	23.0	8.25	4.7	0.0		0.05
9/19/78	13:45	NE	5-10	80	32.5	F	Top	29.9	32.3	10.0	8.39	7.6	0.0		0.09
	13:55						Bot	29.0	32.0	17.0	8.45	7.7	0.0		0.25
10/ 3/78	14:14	NW	0-5	20	32.5	H	Top	29.9	32.1	8.0	8.39	5.7	0.0		0.13
	14:18						Bot	28.8	31.5	5.0	8.20	4.5			0.10
10/17/78	13:58	SE	0-5	0	26.5	H	Top	23.1	31.3	8.0	7.89	5.7	0.0		0.13
	14:10						Bot	22.9	32.7	12.0	7.91	6.4			0.13
10/30/78	14:20	NE	0-5	10	30.0	E	Top	26.6	32.8	5.0	8.55	5.6	0.0		
	14:23						Bot	25.4	31.0	12.0	8.45	5.4			

TABLE C-3 (continued)
 Seasonal hydrographic data for Station # 11.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
11/14/78	14:03			40	29.5	H	Top	23.5	33.1	13.0	8.09	5.3	0.0		
	14:10						Bot	22.5	33.0	37.0	7.55	5.7			
11/27/78	14:09	SE	5-10	20	27.0	E	Top	23.0	33.5	6.0	8.10	5.4	0.0		0.06
	14:14						Bot	22.9	33.2	27.0	8.15	6.3			0.22
12/11/78	14:16	NW	5-10	100	17.0	E	Top	21.0	32.5	9.0	7.85	5.3	0.0		0.09
	14:21						Bot	21.0	33.0	14.0	7.80	4.1			0.07
1/ 4/79	14:25	NE	5-10	50	17.0	H	Top	16.8	30.6	6.0	7.90	7.1	0.001		0.09
							Bot	16.0	30.8	9.0	8.00	7.1	0.00		0.07
1/29/79	14:17	NW	5-10	10	14.2	H	Top	17.2	27.9	6.9	7.40	7.6	0.00		0.15
	14:20						Bot	16.0	29.0	19.0	7.05	8.0	0.00		0.79

TABLE C-4
Seasonal hydrographic data for Station # 2.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
1/ 9/75	10:10	SW	0-5	10	22.8	F	Top	19.0	34.0	12.0		6.0			
	12:05						Bot	21.0	32.0	5.0		10.0			
1/29/75	10:20	SE	0-5	10	24.0	F	Top	22.0	32.5	9.0		9.2	0.29	0.06	
	12:00						Bot	22.0	32.5	9.0		8.2			
2/12/75	10:15	SW	5-10	10	22.3	F	Top	20.5	31.0	10.0	8.4	5.0			
	12:15						Bot	22.0	32.0	11.0	8.5	11.4			
2/27/75	10:15	NE	0-5	90	20.6	L	Top	19.2	32.0	10.0	8.2	8.2			
	11:45						Bot	19.2	31.0	7.0	8.2	8.2			
3/12/75	10:15	E	10-15	70	23.0	F	Top	21.0	32.0	9.0	8.2	5.8	0.18	0.02	
	11:50						Bot	22.5	31.0	9.5	8.5	11.4			
4/ 2/75	10:12	NE	5-10	90	22.0		Top	26.4	30.0	5.0	8.6	6.4			
	12:45						Bot	23.0	33.5	15.0	8.2	9.4			
4/16/75	10:10			0	21.5	L	Top	22.0	31.5	12.0	8.5	7.4			
	10:45						Bot	22.0	31.5	12.0	8.5	7.0			
4/30/75	10:10	NW	5-10	10	27.5	L	Top	26.7	31.9	7.0	8.3	7.0			
	11:45						Bot	22.0	33.0	15.0	8.2	7.0			
5/14/75	10:10	SW	0-5	0	27.4	F	Top	27.2	34.0	12.0	8.3	6.4			
	11:45						Bot	28.5	33.0	9.5	8.7	9.8			
9/30/75	13:20	NE	0-5	20	31.0	E	Top	32.1	31.0	9.0		12.0			
	14:30						Bot	31.0	31.0	16.0		14.0			
10/ 7/75	13:20	SE	0-5	50	31.0	H	Top	31.0	31.5	10.0	8.6	11.0			
	14:25						Bot	31.0	31.5	10.0	8.6	11.0			
10/14/75	13:42	NW		90	33.0	E	Top	29.0	32.0	20.0	8.5	7.5			
	14:19						Bot	29.0	32.0	20.0	8.5	6.5			
10/21/75	13:30		5-10	10	31.5	H	top	28.3	32.0	4.0	8.5	13.5			
	14:30						Bot	27.0	32.0	19.0	8.3	15.0			
10/28/75	13:45		5-10	90	30.5	L	Top	27.4	34.0	3.0					
	14:30						Bot	27.4	32.0	3.0					
11/ 4/75	13:45	SW		40	31.0	F	Top	26.0	34.0		8.4				
							Bot	25.9	31.0		8.5				
11/18/75	13:30	NE	5-10	30	30.0	H	Top	21.0	33.0	5.0	8.7	10.0			
	13:45						Bot	20.5	30.0	19.0		10.5			
11/25/75	13:35		0-5	70	23.0	F	Top	20.5	32.0	5.0	8.5	10.5			
	14:48						Bot	20.0	30.0	8.0	8.6	9.5			

TABLE C-4 (continued)
Seasonal hydrographic data for Station # 2.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
12/ 2/75	13:55	NE	10-15	70	23.0	F	Top	22.2	30.0	15.0	8.1	19.5		
	14:48						Bot	21.0	30.0	27.0	8.0	9.5		
12/ 9/75	13:15		0-5	100	23.0	L	Top	22.0	31.0	5.0	8.5	5.0		
	14:10						Bot	27.0	30.0	9.5	8.4	6.0		
12/16/75	13:40		0-5	0	27.0	H	Top	27.5	30.5	0.5	8.3	9.0		
	14:45						Bot	27.0	32.0	5.0	8.5	8.5		
2/ 3/76	13:10	SW	5-10	0	21.0	E	Top	19.0	31.0		8.2	6.5		
	13:45						Bot	18.0	31.0		8.2	6.5		
3/ 2/76	13:10	W	5-10	10	26.0	H	Top	25.2	33.4		8.5	13.5		
	13:45						Bot	25.2	33.4		8.5	13.5		
3/ 9/76	13:25	SW	20-25	30	25.0	F	Top	27.0	31.0	30.0	8.1	8.0		
	14:15						Bot	26.0	31.0	25.0	8.0	7.5		
3/16/76	13:40		10-15	90	24.5	H	Top	25.5	30.0	15.0	8.5	8.0		
	14:15						Bot	25.5	30.0	15.0	8.5	8.0		
3/23/76	13:45	NE	0-5	90	25.0	L	Top	28.0	30.0		8.8	11.0		
							Bot	26.0	30.0		8.9	11.5		
3/26/76	13:35	SW	25-30	20	28.0	E	Top	27.5	33.0	15.0	8.5	9.5		
	14:40						Bot	27.0	33.0	12.0	8.4	8.5		
4/20/76	13:25	W	5-10	50	25.5	F	Top	28.0	32.0		8.3	11.0		
	14:13						Bot	28.0	32.0		8.5	10.5		
5/ 4/76	13:35	E	0-5	0	32.5	H	Top	28.0	32.0		8.3	11.0		
	14:38						Bot	28.0	32.0		8.5	10.5		
9/ 7/76	13:20	SW	10-15	10	31.0	H	Top	31.5	31.5	7.0	8.4	8.5		
	14:50						Bot	31.5	31.5	7.0	8.4	8.5		
9/14/76	13:30	NE	5-10	50	28.5	E	Top	31.0	31.0	10.0		10.0		
	14:47						Bot	30.5	31.0	18.0	8.4	10.5		
10/12/76	13:30	NW	10-15	20	30.0	F	Top	26.0	33.0	15.0	8.5	8.5		
	14:30						Bot	25.5	33.0	15.0	8.5	10.0		
10/19/76	13:20	NW	15-20	80	31.3	E	Top	26.3	34.0	13.5	8.7	10.5		
	14:21						Bot	26.5	34.5	15.0	8.7	10.0		
5/25/76	13:35	NW	15-20	50	28.0	E	Top	27.0	31.0		8.4	10.0		
	14:45						Bot	26.5	30.5		8.3	10.0		
11/ 9/76	13:30	W	0-5	10	23.0	H	Top	18.0	32.0	8.0	8.3	7.5		
							Bot	20.0	32.0	8.0	8.1	7.0		
11/16/76	13:25	NE	0-5	20	24.0	L	Top	22.5	31.5	10.0	8.3	7.0		
							Bot	23.0	32.0	13.0	8.4	7.5		

TABLE C-4 (continued)
Seasonal hydrographic data for Station # 2.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
12/14/76	13:25	E	5-10	100	25.0	L	Top	22.0	32.0	9.0	8.4	5.0			
							Bot	21.0	32.0	13.0	8.5	6.0			
1/ 4/76	13:25	NW	0-5	50	16.5	H	Top	16.0	29.5	33.0	8.4	7.0			
							Bot	16.5	25.0	2.5	8.5	7.0			
1/11/77	13:30	NE	5-10	10	13.0	F	Top	16.5	30.0	9.0	8.5	7.5			
							Bot	15.0	30.0	10.0	8.7	7.0			
2/ 1/77	13:00	NE	5-10	0	11.0	H	Top	16.0	31.0	7.0	8.5	9.5			
	13:05						Bot	16.0	31.0	8.0	8.4	8.5			
2/15/77	13:00	NE	0-5	90	21.0	H	Top	16.0	32.0	9.0	8.5	9.5			
							Bot	17.0	32.0	9.0	8.6	9.5			
3/22/77	14:00	W	10-15	100		H	Top	25.0	31.0	18.0	8.5	8.5	0.0		0.03
	14:20						Bot	25.0	31.0	24.0	8.4	8.0	0.0		0.13
4/12/77	13:00			80	29.5	L	Top	22.0	33.0	20.0	9.0	5.0	0.001		0.13
	14:40						Bot	22.0	33.0	20.0	9.0	5.5	0.001		0.13
4/19/77	13:00	E	5-10	60	32.5	E	Top	24.0	32.0	10.5	8.9	6.0	0.0		0.003
	14:30						Bot	24.0	34.0	10.5	8.9	6.0	0.0		0.003
4/26/77	13:00			80	31.5		Top	24.5	31.0	10.5	8.4	8.0	0.0		0.10
	14:20						Bot	24.5	31.0	10.5	8.4	8.0	0.0		0.10
5/17/77	13:10	E	15-20	30	33.5	H	Top	25.5	34.0	10.0	8.3	7.5			0.10
	13:30						Bot	25.5	34.0	13.0	8.2	7.0			0.09
5/24/77	13:00	W	5-10	20	31.5	F	Top	29.0	33.0	6.0	8.2	9.0			0.10
	13:30						Bot	29.0	32.0	6.0	8.0	9.0			0.09
5/31/77	13:15	W	5-10	10	34.0	E	Top	29.5	34.0	18.0	7.9	6.0			0.12
	13:30						Bot	29.5	34.0	18.0	7.9	6.0			0.11
7/10/77	14:00	W	10-15		32.0		Top	35.0	33.0	45.0	8.5	77.0	0.0		
							Bot	35.0	33.0	45.0	8.6	6.5	0.0		
9/13/77	13:05	NW	0-5	50	31.0	H	Top	30.0	31.0	10.0	8.5	6.5	0.0		0.11
							Bot	33.0	31.0	15.0	8.4	5.5	0.0		0.10
9/22/77	13:00	SW	5-10	20	30.0	E	Top	30.0	30.0	17.0	8.5	7.5	0.0		0.13
							Bot	30.0	30.0	23.0	8.5	6.0	0.0		0.11
10/18/77	13:45				25.0	L	Top	23.5	34.0	7.0	7.5	2.0	0.0		0.16
							Bot	24.5	34.0	8.0	7.1	3.0	0.0		0.13
10/25/77	13:45	E	15-20	90	31.5	H	Top	26.5	34.0	4.0	7.6	2.0	0.0		0.02
	14:10						Bot	27.0	32.5	2.0	8.5	4.0	0.0		0.02
11/ 8/77	13:50			0	26.0	E	Top	25.0	31.0	5.0	8.5	8.5	0.0		0.10
	15:20						Bot	25.0	31.0	2.0	8.5	8.0	0.0		0.10

TABLE C-4 (continued)
Seasonal hydrographic data for Station # 2.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
11/22/77	13:25	E	0-5	100	31.0	E	Top	23.0	32.0	10.0	8.7	7.0	0.0		0.14
	14:30						Bot	23.0	32.0	4.0	8.3	7.1	0.0		0.14
12/13/77	13:15			100	27.9	H	Top	21.5	31.5	1.0	8.7	1.5	0.0		0.04
	14:40						Bot	20.1	31.9	1.0	8.3	2.0	0.0		0.04
1/ 3/ 78	13:34			100	19.0	L	Top	16.0	25.0	5.0	8.5	1.9	0.05		0.05
	14:00						Bot	12.0	30.0	12.0	8.1		0.07		0.05
1/10/78	13:40				11.0	H	Top	13.0	30.0	5.0	8.7	2.0	0.02		0.07
	14:30						Bot	12.5	35.0	5.0	8.4		0.0		0.07
1/31/78	13:20	W	0-5	30	18.0	L	Top	16.0	31.1	11.0	8.5	4.5	0.0		0.10
							Bot	16.0	31.1	1.0	8.5	4.5	0.0		0.10
2/ 7/78	13:26		5-10	70	16.2	H	Top	14.9	25.3	5.0	8.2	10.0	0.0		0.11
							Bot	14.9	25.3	5.0	8.2	10.0	0.0		0.11
5/16/78	13:50	SW	0-5	0	28.5		Top	28.0	34.1		8.49	7.9	0.0		0.0
							Bot	27.8	34.1		8.50	8.6	0.0		0.0
6/23/78	14:01	SW			28.2	F	Top	30.9	18.4			7.4	0.0		0.0
	14:05						Bot	30.4	30.1			7.1	0.0		0.0
6/30/78	12:48		5-10	50	30.7	E	Top	31.9	32.1			6.5	0.0		0.0
	12:52						Bot	31.9	32.1			6.5	0.0		0.0
7/11/78	7:57			40	26.7	E	Top	30.2	33.2			5.5	0.0		0.0
	8:15						Bot	30.3	33.0			5.0	0.0		0.0
7/27/78	8:23	S	0-5	100	26.0	H	Top	28.5	32.0			2.3	0.0		0.0
	8:38						Bot	28.5	32.0			2.3	0.0		0.0
8/ 1/78	10:03	S	0-5	90	29.8	E	Top	29.5	30.5			5.8	0.0		0.0
	10:07						Bot	29.5	30.5			5.8	0.0		0.0
9/19/78	13:38	NE	0-5	80	32.0	E	Top	29.2	32.9	3.0	8.55	9.2	0.0		0.0
	14:05						Bot	28.9	32.7	3.0	8.35	7.1	0.0		0.0
10/17/78	13:40	NE	5-10	0	26.0	H	Top	22.9	32.2	3.0	8.12	7.5	0.0		0.07
	13:48						Bot	22.3	32.1	3.0	8.19	7.5			0.10
10/30/78	14:00	NE	0-5	10	29.5	E	Top	25.2	33.0	1.0	8.50	6.7	0.0		
	14:10						Bot	25.0	33.0	3.0	8.55	6.5			
11/14/78	13:52			40	30.5	H	Top	23.1	33.9	18.0	7.99	6.5	0.0		0.0
	13:59						Bot	22.9	33.8	18.0	8.00	5.0			0.0
11/27/78	13:59	SE	15-20	20	26.0	E	Top	23.2	33.6	6.0	8.20	7.6	0.0		0.06
	14:03						Bot	23.0	33.8	10.0	8.20	7.5			0.09
12/11/78	14:05	NW	5-10	100	17.0	E	Top	21.0	33.2	9.0	7.95	6.6	0.0		0.08
	14:10						Bot	21.0	33.1	8.0	7.95	6.4			0.07

TABLE C-4 (continued)
 Seasonal hydrographic data for Station # 2.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
1/ 4/79	14:35	NE	5-10	50	17.5	F	Top	15.9	31.2	4.0	7.90	8.6	0.00		0.10
							Bot	15.1	30.8	15.0	8.00	8.3	0.00	0.10	
1/30/79	14:11	W	5-10	0	15.9	H	Top	15.9	30.0	6.8	7.60	8.5	0.003		0.15
							Bot	15.9	29.9	15.8	7.90	10.2	0.00	0.79	

TABLE C-5
Seasonal hydrographic data for Station # 3

Data	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
1/15/75	10:10	NE	0-5	0	16.0	F	Top	16.0	33.0	9.0		9.0			
	Bot						14.0	32.5	10.0	8.3	9.0				
1/27/75	10:20	SE	5-10	0	23.5	F	Top	20.0	32.5	9.0		6.4	0.38	0.00	
	Bot						20.0	32.0	9.0	8.8					
2/10/75	10:10	NE	0-5	100	18.0	F	Top	19.0	32.5	5.0	8.5	8.0			
	Bot						18.0	31.0	5.0	8.5	5.5				
2/24/75	10:15	NW	5-10	100		F	Top		32.5		8.5				
	Bot														
3/10/75	10:15	W	0-5	10	22.0	F	Top	18.8	32.2			8.4			
	Bot						19.0	31.5	9.0	8.4	8.0				
3/31/75	10:30	SW	5-10	80	27.5	F	Top	25.2	31.0	15.0	8.3	5.8	0.178	0.05	
	Bot						26.0	33.0	18.0	8.5	6.4				
4/14/75	10:30	SW	5-10	10	25.6	F	Top	23.1	31.9	8.5	7.3	8.0			
	Bot						24.0	33.5	16.0	8.5	5.5				
4/28/75	10:15	S	10-15	10	27.0	F	Top	27.0	35.1	9.0	7.5	8.2			
	Bot						26.0	36.0	11.0	8.4					
5/12/75	10:15	SE	0-5	20	28.6	H	Top	28.2	32.0	17.0	8.4	6.6			
	Bot														
9/24/75	13:25	E	0-5	80	30.0	F	Top	30.0	25.0	2.0	8.3	9.0			
	Bot							30.0	4.5	8.3	8.0				
10/1/75	13:36			10	31.0	F	Top	29.5	33.0	5.0		9.0			
	Bot						29.5	30.0	3.0		9.0				
10/8/75	13:45	SW	0-5	60	32.0	F	Top	31.0	28.5		8.7	9.0			
	Bot						31.0	29.0		8.7	7.0				
10/15/75	13:25	SE	10-15	0	30.0	F	Top	29.5	31.0	2.0	8.3	7.5			
	Bot						28.5	30.0	3.0	8.4	7.0				
10/22/75	13:50	NE	0-5	20	30.9	L	Top	26.5	33.0	14.0	8.5	6.5			
	Bot						26.5	31.0	18.0	8.6	6.5				
10/29/75	13:40	SE	0-5	70	29.0	L	Top	27.5	31.0	9.0	8.5	8.5			
	Bot						27.0	31.0	19.0	8.6	6.5				
11/5/75	13:45	SE	5-10	30	29.5	H	Top	27.0			8.2	9.5			
	Bot						26.0	35.0		8.5	5.5				
11/12/75	13:35	NE	10-15	90	27.5	L	Top	26.0	31.0	11.0		8.0			
	Bot						26.0	31.0	10.0	8.5	6.0				
11/26/75	13:32	NE	5-10	10	23.0	L	Top	21.3	31.0	8.0	8.1	9.5			
	Bot						20.0	30.0	8.7	8.2	10.0				

TABLE C-5 (continued)
Seasonal hydrographic data for Station # 3

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
12/ 3/75	13:35	NE	5-10	0	25.0	F	Top	23.0	31.0	3.0	7.2	5.5			
	14:25						Bot	22.0	30.0	4.0	8.5	5.0			
12/10/75	13:40	N	10-15	0	18.5	F	Top	20.0	30.0	7.0	8.4	8.0			
	14:35						Bot	21.0	31.0	17.0	8.3	7.0			
12/17/75	13:45		5-10	0	25.0	E	Top	22.0	31.0	15.0		9.0			
	14:32						Bot	21.0	31.0	21.0	8.3	6.5			
2/ 4/76	14:00	NE	0-5	30	25.0	H	Top	19.0	32.0		8.1	6.5			
	14:41						Bot	18.0	31.0		8.2	5.5			
2/11/76	13:20		0-5	0	23.9	E	Top	19.6	32.0		8.5	10.0			
	14:20						Bot	18.1	34.0		8.5	6.5			
2/25/76	13:30	SE	5-10	90	22.5	L	Top	19.0	32.0		8.7	7.5			
	14:20						Bot	19.0	32.0		8.2	7.0			
3/ 3/76	13:30	SW	5-10	60	25.0	H	Top	24.0	32.0	15.0	8.5	9.0			
	14:20						Bot	22.0		18.0	8.5	8.0			
3/10/76	13:30	NW	5-10	100	24.0	F	Top	23.0	32.0	10.0		4.5			
	14:10						Bot	23.0	32.0			4.0			
3/17/76	13:35	NE	0-5	0	23.0	H	Top	23.5	34.0	19.0	8.2	5.0			
	14:30						Bot	24.5	34.0		8.1	7.5			
3/24/76	13:45	SW	20-30	30	27.6	L	Top	23.2	32.0		8.5	9.5			
	14:42						Bot	22.8	31.0		8.4	7.5			
4/ 7/76	13:33	SW	5-10	90	26.6	H	Top	27.5	31.0	25.0	8.4	7.5			
	14:49						Bot	27.0	32.0	15.0	8.1	6.5			
4/28/76	13:45	N	0-5	40	30.0	H	Top	26.0	32.0			3.5			
	14:30						Bot	25.0	32.0		8.3	3.5			
5/19/76	13:25	NW	0-5	70	26.0	F	Top	24.0	32.0		8.6	6.0			
	14:15						Bot	23.0	34.0		8.3	5.5			
9/ 8/76	13:45	NW	5-10	70	34.0	H	Top	32.0	32.0	8.0	8.5	11.0			
	14:15						Bot	31.0	34.0		8.4	8.0			
9/15/76	13:30	NW	5-10	40	29.0	F	Bot	29.5	33.0	12.0	8.3	9.5			
	14:30						Top	28.0	32.0	27.0	8.2	8.0			
9/22/76	13:25	NW	0-5	40	31.0	H	Top	30.0	33.0	8.0	8.3	9.0			
	14:30						Bot	28.0	33.0	16.0	8.4	6.5			
10/11/76	13:20	NE	10-15	90	25.5	F	Top	26.0	34.5	15.0	8.5	7.0			
	14:05						Bot	26.5	33.9	9.0	8.5	5.0			
10/18/76	13:20	NE	10-15	100	26.5	E	Top	25.7	32.0	12.0	8.5	5.0			
	14:15						Bot	25.5	33.0	35.0	8.5	3.0			
11/10/76	13:40	SW	5-10	10	26.0	H	Top	20.5	32.0	10.0	8.3	5.0			
							Bot	19.0	32.0	5.0	8.3	8.5			

TABLE C-5 (continued)
Seasonal hydrographic data for Station # 3

Date	Time	Wind Dir.	Wind Speed	Cloud Cover	Air Temp.	Tide	Depth	Wat. Temp.	Sal.	Turb.	pH	O ₂	NO ₂ -N NO ₃ -N	PO ₄ -P Ortho
11/17/76	13:30	NW	0-5	100	24.0	L	Top	22.0	30.0	8.0	8.2	7.0		
							Bot	22.0	32.0	5.0	8.3	7.0		
12/15/76	13:30	SW	5-10	90	22.5	L	Top	21.0	30.0	8.0	8.5	6.5		
							Bot	21.0	30.0	10.0	8.5	5.5		
1/ 5/77	13:40	SW	5-10	0	17.0	H	Top	16.0	30.0	19.0	8.5	7.5		
							Bot	16.0	32.0	22.0	8.5	7.0		
1/12/77	13:20	NE	10-15	90	17.0	L	Top	15.0	30.0	8.0	8.5	8.5		
							Bot	15.0	32.0	10.0	8.5	8.5		
2/ 2/77	13:30	NE	5-10	100	16.0	E	Top	13.0	31.0	10.0	8.4	8.5		
							Bot	10.0	31.0	5.0	8.5	8.5		
2/ 9/77	13:15	NE	5-10	10		F	Top	15.5		1.0	8.5	9.0		
							Bot	12.0		33.0	8.5	8.5		
3/ 9/77	13:15	E	10-15	60	27.0	H	Top	20.5	30.0	19.0		8.5	0.0	0.10
							Bot	19.0	31.0	24.0	8.2	7.5	0.0	0.26
3/16/77	13:25	W	5-10	0	24.0	E	Top	24.0	31.0	15.0	8.5	9.0	0.0	0.05
							Bot	26.0	31.0	17.0	8.6	8.5	0.0	0.05
5/11/77	13:30	E	10-20	90	28.5	L	Top	27.0	31.0	10.0	8.4	7.5		0.11
							Bot	26.0	31.0	38.0	8.7	6.0		0.13
5/18/77	13:30	E	5-10	20	32.0	H	Top	27.5	31.0	12.0	8.3	7.0		0.05
							Bot	29.0	31.0	38.0	8.5	6.0		0.20
5/25/77	13:30	SW	5-10	20	31.0	L	Top	30.0	31.5	9.0	8.4	6.5		0.07
							Bot	29.5	31.5	18.0	8.5	5.5		0.08
7/10/77	14:00	W	5-10		30.0		Top	32.0	33.0		8.4	4.5	0.0	0.10
							Bot	31.5	33.0		8.5	6.0	0.0	0.26
9/14/77	13:38 14:27	SW	5-10	90	31.0	H	Top	30.0	30.0	13.0	8.5	4.0	0.0	0.01
							Bot	29.5	31.0	19.0	8.5	3.5	0.0	0.01
9/21/77	13:27 14:17	W	0-5	50	34.0	E	Top	31.0	30.0	30.0	8.5	2.0	0.0	0.01
							Bot	31.0	31.0	18.0	8.5	3.0	0.0	0.00
10/12/77	13:30	S	10-15	10	27.0	H	Top	29.0	33.0	40.0	8.5	7.5	0.0	0.03
							Bot	29.0	32.0	50.0	8.4	6.5	0.0	0.20
10/19/77	13:30	N	5-10	0	26.0	L	Top	22.0	33.0	2.0	8.3	8.5	0.0	0.08
							Bot	22.5	32.0	2.0	8.5	8.0	0.0	0.08
11/16/77	13:20	S	5-10	80	25.0	F	Top	20.0	31.5	10.0	8.5	5.5	0.0	0.10
							Bot	20.0	31.0	10.0	8.5	4.0	0.0	0.13
12/ 7/77	13:00			10	15.0	E	Top	20.0	32.0	9.0		4.0	0.0	0.01
							Bot	18.0	32.0	38.0	8.0	5.0	0.0	0.02

TABLE C-5 (continued)
Seasonal hydrographic data for Station # 3.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
12/14/77	13:20	S	5-10	100	23.0	F	Top	20.8	31.0	10.0	8.0	7.0	0.0		0.01
							Bot	21.8	30.0		8.1	4.5	0.0		0.01
1/4/78	13:30	S	5-10	10	21.0	L	Top	19.0	30.0	8.5	8.5	2.0	0.05		0.01
							Bot	17.0	30.0	8.0	8.5	5.5	0.02		0.07
1/10/78	13:40			30	11.0	H	Top	13.0	30.0	5.0	8.7	2.0			0.07
							Bot								
2/1/78	13:45	NW	5-10	0	22.0	F	Top	18.8	28.9	2.0	8.2	7.5	0.0		0.00
							Bot	18.5	27.8	20.0	8.4	9.5	0.0		0.00
2/8/78		NE	5-10	90	20.0	H	Top	16.0	32.2	30.0	7.9	8.5	0.0		0.00
							Bot								
2/28/78	13:30	S	5-10	60	22.0	H	Top	19.0	26.0	18.0	8.5	8.0	0.0		0.02
							Bot	19.0	25.0	18.0	8.3	6.0	0.0		0.01
3/7/78	13:30	NE	5-10	40	23.0	H	Top	20.0	30.0	18.0	8.4	8.0	0.0		0.02
							Bot	22.0	30.0	1.0	8.3	6.0	0.0		0.01
4/6/78	13:55			0	24.0		Top	20.0	30.0	18.0	8.4	8.0	0.05		
	14:10						Bot	22.0	30.0	1.0	8.3	6.0	0.05		
5/16/78	14:05		0	0	27.0		Top	27.0	34.1		8.39	7.2	0.0		0.00
	14:11						Bot	27.0	34.0		8.21	5.8	0.0		0.00
6/23/78	12:25	SW	5-10		28.2	F	Top	27.9	19.1			6.5	0.0		0.00
	12:40						Bot	27.0	32.3			5.2	0.0		0.00
6/30/78	12:54		10	50	31.5	F	Top	32.2	33.0			5.3	0.0		0.00
	13:02						Bot	31.2	32.5			5.3	0.0		0.23
7/11/78	8:24		10	40	29.0	E	Top	29.9	33.7			5.4	0.0		0.00
	8:33						Bot	29.8	29.1			5.1	0.0		0.20
8/1/78	9:45	S	0.5	70	29.8	H	Top	29.2	30.0			5.3	0.0		0.00
	10:00						Bot	29.0	29.0			2.6	0.0		0.00
9/11/78	13:45	SW	0-5	0	31.0	H	Top	30.2	32.5	8.0	8.45	7.3	0.0		0.07
	14:10						Bot	30.1	32.5	13.0	8.50	7.5	0.0		0.03
9/19/78	14:07	E	5-10	70	33.0	L	Top	29.9	32.9		8.51	7.1	0.0		
	14:15						Bot	29.2	32.5		8.60	7.0	0.0		
10/3/78	13:35	SE	0-5	20	32.0	H	Top	28.0	32.9	3.0	8.38	6.5	0.0		0.00
	13:50						Bot	28.8	32.5	8.0	8.45	5.8	0.0		0.00
10/17/78	13:30	NE	5-10	0	25.5	H	Top	22.1	32.9	5.0	8.12	7.4	0.0		0.10
	13:39						Bot	26.8	29.8	4.0	8.18	6.3			
10/30/78	13:48	NE	5-10	10	30.0	E	Top	25.1	33.2	2.0	8.50	6.7	0.0		
	13:58						Bot	25.0	33.2	9.0	8.40	6.3			
11/14/78	13:40			40	29.0	H	Top	24.1	32.3	15.0	8.10	6.5	0.0		0.0
	13:49						Bot	23.6	33.9	18.0	8.00	6.2			0.0

TABLE C-5 (continued)
 Seasonal hydrographic data for Station # 3

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
11/27/78	13:50	SE	10-15	20	25.5	E	Top	22.9	32.1	4.0	8.1	5.2	0.00		0.05
	13:55						Bot	23.0	32.0	1.0	8.0	5.1			0.05
12/11/78	13:55	NW	5-10	100	17.0	E	Top	21.0	33.5	7.0	7.95	6.7	0.00		0.08
	14:02						Bot	20.5	33.0	11.0	7.9	6.3			0.08
1/ 4/79	14:43	NE	5-10	50	17.0	H	Top	15.9	33.6	7.0	7.9	7.6	0.00		0.13
	14:46						Bot	15.9	33.8	22.0	8.0	7.6	0.00		0.09
1/29/79	14:29	NW	5-10	10	15.2	H	Top	15.8	29.1	6.3	7.55	8.4	0.00		0.13
							Bot	15.9	29.0	7.1	7.10	8.6	0.00		0.10

TABLE C-6
Seasonal hydrographic data for Station # 4.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
1/ 8/75	10:18	SE	10-15	0	23.0	F	Top	19.5	33.0	5.0	8.9	11.0			
	Bot														
1/16/75	11:15	SE	5-10	0	24.5	F	Top							0.20	0.07
	Bot						18.5	32.0		8.9					
1/28/75	11:10	SW	5-10	10	24.0	F	Top	20.0	31.5	3.0		12.0	0.90	0.06	
	Bot						23.0	31.0	10.0	8.8	9.4				
2/11/75	10:20	NW	0-5	100	24.2	F	Top	19.8	33.0	10.0	8.5	7.0			
	Bot						20.0	32.0	6.0	8.0	7.6				
2/25/75	10:13	NE	15-20	80	18.1	F	Top	20.5	33.0	18.0	8.9	5.4			
	Bot						21.0	32.0	12.0	8.9	5.6				
3/11/75	10:10	SE	5-10	10	23.5	F	Top	21.0	32.5	7.0		6.0	0.22	0.027	
	Bot						22.0	32.0	13.0	8.9	8.2				
4/ 1 75	11:00	S	5-10	90	30.0	L	Top								
	Bot						26.5	31.5	7.0	8.9	8.6				
4/15/75	10:15	NW	15-20	100	24.1	F	Top	23.5	33.5	10.0	8.5	9.0			
	Bot						24.0	34.0	13.0	8.4	6.0				
4/29/75	10:25	SW	10-15	10	28.0	F	Top	27.0	33.5	10.0	8.5	7.4			
	Bot						25.0	33.5	12.0	7.7	8.0				
5/13/75	10:25	S	0-5	100	28.0	F	Top	27.0	32.8	13.0	8.5	6.2			
	Bot						28.0	33.5	10.5	8.5	6.8				
9/25/75	13:17	NW	10-15	60	23.0	F	Top	27.0	30.0	10.0	8.3	9.0			
	Bot						27.0	30.0	7.0	8.5					
10/ 2/75	13:25	NW	5-10	50	29.5	F	Top	29.0	30.0	10.0	8.5	10.9			
	Bot						29.0	29.5	10.0	8.5	10.5				
10/ 6/75	13:20	NE		50	30.0	H	Top	25.5	32.0	5.0	8.2	8.5			
	Bot						25.5	32.0	5.0	8.3	8.5				
10/ 9/75	13:40				30.0	H	Top	31.0	25.0	6.0	8.3	11.0			
	Bot						30.0	26.0	10.0	8.5	9.0				
10/16/75	13:15	NE		50	30.0	E	Top	26.0	30.0	5.0	8.5	8.5			
	Bot						27.0	30.0	5.0	8.3	7.5				
11/13/75	13:35	NW	30-35	0	20.0	L	Top	25.0	33.0	50.0	7.8	9.0			
	Bot						25.0	32.0	75.0	8.4	8.5				
11/20/75	13:35	S	0-5	10	26.0	H	Top	21.5	28.0	36.0	8.5	5.5			
	Bot						22.0	29.0	32.0	8.4	10.0				
11/30/75	13:30	NW	5-10	80	27.5	L	Top	26.0	31.0	5.0	8.5	7.5			
	Bot						25.0	31.0	8.0	8.5	8.0				

TABLE C-6 (continued)
Seasonal hydrographic data for Station # 4.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
12/ 4/75	13:20		5-10		23.0	H	Top	23.0	32.0	5.0	8.1	12.0			
	14:15						Bot	21.5	31.0	5.0	8.2	9.0			
12/11/75	14:00	NE	0-5	0		L	Top		32.0	19.0	8.5	10.0			
	14:50						Bot		32.0	20.0	8.5	12.0			
2/ 4/76	15:30	S	5-1-	0	26.8	H	Top	24.5	31.0		8.1	5.5			
	15:45						Bot	24.0	31.0		8.2	4.5			
2/ 5/76	14:30		0-5	0	27.0	H	Top	18.0	30.0		8.5	5.5			
							Bot	19.0	30.0			8.0			
2/12/76	13:45	S	0-5	20	24.0	F	Top	17.1	36.0		8.4	9.0			
	14:15						Bot	17.2	30.0		8.5	6.5			
2/19/76	13:20	SW	0-5	20	26.6	H	Top	21.0	31.0			7.0			
	14:00						Bot	20.0	31.0			7.0			
3/11/76	13:15		0-5	0	26.0	L	Top	23.5	32.0	5.0	8.4	7.5			
	14:35						Bot	23.0	31.0	15.0	8.3	7.0			
4/29/76	13:20		0-5	20	31.0	H	Top	26.0	33.0		8.6	8.5			
	14:10						Bot	28.0	35.0		8.2	7.0			
5/20/76	13:30		0-5	80	31.0	L	Top	29.0	32.0		8.7	6.5			
							Bot	28.0	35.0		8.5	7.0			
9/ 9/76	14:05	E	5-10	0	32.5	H	Top	33.0	32.0	5.0	8.7	7.0			
	14:51						Bot	31.0	31.0	9.0	8.5	8.0			
9/16/76	13:40	NE	5-10	10	31.0	L	Top	30.0	31.5	12.0	8.2	9.0			
	14:47						Bot	29.0	31.5	19.0	8.9	8.5			
10/14/76	13:20	NW	5-10	40	28.0	L	Top	24.5	34.0	15.0	8.6	10.0			
	14:30						Bot	25.0	34.0	12.0	8.6	9.5			
10/21/76	13:25	NE	20-25	0	19.5	F	Top	25.0	33.0	18.0	8.6	9.0			
	14:21						Bot	25.0	32.0	16.0	8.8	8.5			
11/11/76	13:20	S	5-10	20	26.0	F	Top	18.0	32.0	28.0	8.3	6.0			
							Bot	19.0	30.0	5.0	8.3	8.0			
11/18/76	13:30	NE	0-5	20	25.5	L	Top	22.0	31.5	9.0	8.4	7.0			
							Bot	21.5	32.0	13.0	8.4	6.5			
1/ 6/77	13:30	SW	0-5	60	29.0	H	Top	17.5	30.0	2.0	8.7	5.0			
							Bot	17.0	30.0	3.0	8.5	4.5			

TABLE C-6 (continued)
Seasonal hydrographic data for Station # 4.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
1/13/77	13:30	E	10-15	30	19.0	F	Top	16.0	30.0	8.0	8.5	7.5		
							Bot	15.5	30.0	5.0	8.3	7.0		
1/27/77	13:30	E	0-5	90	18.5	F	Top	16.0	30.0	6.0	8.7	5.0		
							Bot	15.5	31.0	5.5	8.6	5.0		
2/ 3/77	12:45	S	10-15	80	26.0	H	Top	15.0	31.0	8.0	8.6	6.5		
							Bot	14.5	31.0	8.0	8.6	9.0		
2/10/77	12:30	NE	0-5	20	26.0	F	Top	18.5	29.0	5.0	8.6	10.0		
							Bot	16.0	31.0	5.0	8.6	10.0		
3/17/77	13:35	W	10-15	0		E	Top	25.0	31.0	13.0	8.0	7.5	0.0	0.10
	14:00						Bot	25.0	31.0	16.0	8.5	8.0	0.0	
3/31/77	13:30		5-10	0	30.0		Top	26.0	34.0	25.0	8.5	4.5	0.0	
	13:45						Bot	25.0	33.5	7.0	8.4	4.5	0.0	
4/14/77	13:00		0-5	50	27.5	E	Top	23.5	32.0	6.0	8.7	7.0	0.0	0.12
	15:00						Bot	23.0	32.5	9.0	9.1	7.5	0.001	
5/12/77	13:00	E	20-25	70	26.0	E	Top	24.0	34.0	16.0	8.5	6.0	0.04	0.05
	13:30						Bot	25.0	34.0	13.0	8.5	6.5	0.07	0.03
5/19/77	13:10	W	5-10	50	31.5	H	Top	25.5	35.0	8.0	8.3	7.5		0.07
	13:45						Bot	25.5	35.0	13.0	8.2	7.5		0.08
5/26/77	13:05	SW	5-10	10	34.5	L	Top	28.5	34.0	10.0	8.5	7.5		0.10
	13:30						Bot	28.5	34.0	15.0	8.2	7.5		0.11
7/10/77	14:00				33.0		Top	32.0	34.0	12.0	8.6	5.0		0.13
							Bot	31.5	34.0	13.0	8.6	6.0		0.13
9/ 8/77	12:37	E	0-5	20		E	Top		30.0	5.0	8.5	4.5	0.0	0.11
	13:05						Bot		30.0	10.0	8.5	5.0	0.0	0.12
9/15/77	13:40	NE	5-10	90	31.0	H	Top	30.0	31.0	10.0	8.7	5.5	0.0	0.01
							Bot	29.0	31.0	15.0	8.6	6.0	0.0	0.01
10/13/77	13:45				23.5	H	Top	27.0			8.2		0.0	
	14:10						Bot	27.0			8.5	4.0	0.0	
10/20/77	13:35		15-20	50	28.0	E	Top	24.0	30.5	8.0	8.5	4.0	0.0	0.30
	13:55						Bot	24.0	32.0	25.0	7.9	2.5	0.0	0.18
11/10/77	13:35	NW	15-20	100	23.0	E	Top	22.0	32.0	28.0	8.7	6.0	0.0	0.02
	14:50						Bot	24.0	32.0	12.0	8.6	6.5	0.0	0.02
11/17/77	13:40			10	29.0	L	Top	23.0	32.0	5.0	8.7	8.5	0.0	0.03
	14:50						Bot	23.0	32.0	5.0	8.7	7.5	0.0	0.03
12/ 8/77	13:35			100	28.2	E	Top	17.8	20.0	5.0	7.5	3.0	0.0	0.13
	14:41						Bot	17.2	25.0	9.0	7.2	5.0	0.0	0.13

TABLE C-6 (continued)
Seasonal hydrographic data for Station # 4.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
1/12/78	13:37			50	19.9	E	Top	13.5	30.0	3.0	8.5	3.5	0.05		0.03
	14:30						Bot	16.0	25.0	6.0	8.2	4.0	0.05		0.02
1/26/78	13:20			0	17.2	H	Top	17.0	30.5	5.0	8.3	7.0	0.005		0.07
	14:30						Bot	18.0	30.2	7.0	8.6	9.0	0.005		0.04
2/ 2/78	13:30			90	20.0	F	Top	15.0	30.9	8.5	8.4	6.0	0.0		0.09
	15:00						Bot	16.0	30.9	8.3	8.5	7.0	0.0		0.13
2/ 9/78	13:30			100	14.4	H	Top	13.0	31.7	8.1	8.4	8.0	0.0		0.08
	15:00		Rain				Bot	13.0	31.5	8.5	8.49	7.0	0.02		0.08
2/23/78	13:30	S	0-5	0	26.0	H	Top	13.5	30.0	7.0	7.9	6.0	0.0		0.03
							Bot	13.5	28.8	30.0	8.3	6.0	0.0		0.01
3/ 2/78	13:30	S	5-10	10	23.0	F	Top	19.0	30.0	12.0	8.3	6.0	0.0		0.01
							Bot	19.0	27.0	30.0	8.3	6.0	0.0		0.01
4/ 6/78	14:10				24.0		Top	24.0	33.0		8.25	8.0			0.1
	14:20						Bot	23.3	32.5		8.20	7.6			
5/10/78							Top	29.0	33.5		7.75	6.4			
							Bot	28.2	32.0		7.60	5.8			
6/23/78	13:40	SW	10-15		28.1	F	Top	30.9	27.9			7.6	0.0		0.0
	13:45						Bot	30.5	30.0			6.7	0.0		0.0
6/30/78	8:57		10-15	50	30.7	F	Top	30.5	32.9			5.6	0.0		0.0
	9:08						Bot	30.5	32.5			5.6	0.0		0.0
7/ 5/78	8:28		10-15	50	29.0	F	Top	31.4	33.2			5.1	0.0		0.0
	8:50						Bot	31.4	26.5			5.0	0.0		0.0
7/11/78	12:24			40	32.5	L	Top	31.0	33.1			6.8	0.0		0.0
	12:32						Bot	30.5	33.0			6.0	0.0		0.0
8/ 1/78	8:15	S	0-5		28.6	H	Top	29.5	30.8			5.4	0.0		0.0
	8:30						Bot	29.5	32.1			4.7	0.0		0.0
9/12/78	13:45	NW	5-10	10	33.0	E	Top	30.3	32.5	6.0	8.45	8.1			0.0
	14:05						Bot	30.2	32.3	8.0	8.50	7.9			0.0
9/19/78	14:21	NE	5-10	70	33.5	L	Top	29.8	32.6	8.0	8.25	8.4	0.0		
	14:25						Bot	29.6	32.4	3.0	8.50	8.4	0.0		
10/17/78	14:32	E	5-10	0	25.1	H	Top	22.9	32.1	3.0	8.5	7.0	0.0		0.10
	14:38						Bot	23.0	32.1	3.0	8.3	7.0			0.07
10/30/78	13:41	NE	5-10	10	29.5	E	Top	25.0	33.0	2.0	8.5	6.7	0.0		
	13:46						Bot	24.8	33.0	1.0	8.6	6.1			
11/14/78	14:31			40	28.0	H	Top	26.1	31.5	15.0	8.01	6.5	0.0		0.02
	14:36						Bot	25.9	32.5	13.0	8.01	5.7			
11/27/78	14:23	SE	10-15	20	26.0	E	Top	23.6	33.2	7.0	8.05	6.5	0.0		0.12
	14:26						Bot	22.9	33.2	5.0	8.2	6.4			0.12

TABLE C-6 (continued)
 Seasonal hydrographic data for Station # 4.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
12/11/78	13:15	NW	5-10	100	18.0	H	Top	20.1	32.2	10.0	7.9	6.5	0.00		0.07
	Bot						20.1	32.2	9.0	7.85	6.4	0.00	0.07		
1/ 4/79	13:40	NE	5-10	50	16.5	F	Top	13.5	34.9	4.0	7.8	7.6			0.05
	Bot						13.5	34.9	6.0	8.0	7.5		0.04		
1/29/79	13:39	NW	5-10	0	12.0	H	Top	14.8	25.0	11.5	8.2	8.3	0.00		0.12
	Bot						14.5	25.0	13.8	8.15	8.3	0.00	0.09		

TABLE C-7
Seasonal hydrographic data for Station # 6.

Date	Time	Wind Dir.	Wind Speed Knts	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
5/10/78				60			Top	28.3	33.2		8.50	6.5	0.0		0.0
							Bot	28.8	33.0		8.15	6.1	0.0		0.0
5/16/78	14:15				27.0		Top	27.0	34.0		8.20	7.0			0.0
	14:22						Bot	26.5	33.8		8.21	5.7			0.0
6/23/78	13:20	SW	10-15		28.3	F	Top	27.7	33.8			7.0	0.0		0.0
	13:30						Bot	27.9	33.2			6.7	0.0		0.0
6/30/78	9:20		5-10	50	30.5	F	Top	30.1	33.5			6.2	0.0		0.0
	9:29						Bot	30.0	33.1			6.2	0.0		0.0
7/ 5/78	12:42			0	31.2	H	Top	31.0	32.8			6.5	0.0		0.0
	12:52						Bot	31.0	28.0			6.4	0.0		0.0
7/11/78	12:44			40	30.6	L	Top	32.0	33.2			6.7	0.0		0.0
	12:57						Bot	32.0	33.2			6.4	0.0		0.0
8/ 1/78	9:24	S	0-5	80	28.5	H	Top	29.2	32.8			5.2	0.0		0.0
	9:35						Bot	28.2	33.7			4.9	0.0		0.0
9/12/78	14:15	NW	5-10	10	33.0	E	Top	30.4	32.8	3.0	8.52	7.7	0.0		0.0
	14:35						Bot	30.2	32.7	2.0	8.50	7.5	0.0		0.0
9/19/78	14:31	E	10-15	80	32.0	L	Top	29.1	32.7	12.0	8.42	7.9	0.0		0.0
	14:35						Bot	29.5	32.6	8.0	8.50	7.7	0.0		0.0
10/17/78	14:15	NE	5-10	0	24.5	H	Top	23.1	33.0	2.0	8.40	6.8	0.0		0.10
	14:25						Bot	23.1	32.9	3.0	8.40	6.2			0.13
11/14/78	14:15			40	28.0	H	Top	26.1	33.9	14.0	8.15	6.3	0.0		0.0
	14:24						Bot	26.2	31.8	13.0	8.10	6.2			
12/11/78	14:30	NW	5-10	100	17.0	L	Top	21.0	33.3	8.0	7.95	7.0	0.00		0.05
	14:34						Bot	21.2	33.2	9.0	8.00	5.0	0.00		0.06
1/ 4/79	14:00	NE	10-15	50	16.5	F	Top	13.2	32.5	10.0	7.80	7.5	0.00		0.08
	14:10						Bot	13.0	32.9	9.0	7.90	7.3	0.04		0.07
1/29/79	13:55	NW	10-15	10	11.8	H	Top	15.2	28.9	33.0	7.55	7.7	0.00		0.09
	14:06						Bot	15.0	31.1	35.0	7.75	7.6	0.03		0.09

TABLE C-8
Seasonal hydrographic data for Station # 7.

Date	Time	Wind Dir.	Wind Speed Knts.	Cloud Cover %	Air Temp. °C.	Tide	Depth	Wat. Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N mg/l	NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
5/10/78				70			Top	29.8	33.6		8.20	6.4	0.0		0.0
							Bot	28.9	33.1		8.25	5.9	0.02		0.0
6/23/78	13:10	SW	10-15	0	28.2	F	Top	27.1	32.6			7.3	0.0		0.0
	13:17						Bot	27.1	33.6			6.8	0.0		0.0
6/30/78	10:56		5-10	50	31.0	H	Top	30.5	33.0			6.0	0.0		0.0
	11:03						Bot	32.0	33.1			5.8	0.0		0.0
7/5/78	13:00				31.7	H	Top	32.0	31.8			6.4	0.0		0.0
	13:11						Bot	32.0	31.5			5.9	0.0		0.0
7/11/78	10:16		5-10	40	32.0	L	Top	30.4	32.2			5.4	0.0		0.21
							Bot	30.3	33.0			5.1	0.0		0.0
7/21/78	9:40	E	0-5	70	28.7	H	Top	28.5	30.8			6.2	0.0		0.0
	9:56						Bot	28.9	32.2			4.4	0.0		0.0
8/1/78	9:07	S	0-5	50	28.8	H	Top	29.3	29.5			5.3	0.0		0.0
	9:15						Bot	29.5	32.2			3.8	0.0		0.20
10/3/78	14:32	NW	0-5	20	32.1	H	Top	28.9	32.0	4.0	8.23	6.4	0.0		0.10
	14:37						Bot	28.1	32.1	4.0	8.40	5.9	0.0		0.13
10/30/78	14:30	NE	0-5	50	28.5	E	Top	25.5	33.1	1.0	8.52	6.7	0.0		
	14:40						Bot	25.1	33.2	3.0	8.48	6.7			
12/14/78	13:50	NW	10-15	10	19.0	H	Top	19.9	32.4	6.0	8.10	7.6	0.002		0.03
	13:59						Bot	19.9	32.2	5.0	8.20	7.5	0.00		0.03
1/4/78	14:15	NE	5-10	50	15.1	F	Top	14.2	29.9	6.0	7.80	7.2	0.065		0.03
	14:20						Bot	14.9	30.2	7.0	7.90	7.1	0.022		0.10
1/30/79	13:45	W	5-10	0	15.2	H	Top	16.2	28.8	7.1	7.80	8.2	0.038		0.11
	14:00						Bot	15.5	27.5	20.9	8.00	8.5	0.00		0.06

Discussion

This water monitoring program was intended to define the seasonal variations for a variety of physical and chemical factors and to be used as a baseline for future comparison. Monthly averages were computed to lessen the variation of individual samples. These averages are reported in Tables C-9 through C-15.

Annual averages were computed and are reported for all stations in Table C-16. These annual averages are based on only 9 months since the summer months were seldom sampled. The months of June, July, and August were omitted. Only stations 1, 2, 3, and 4 are reported as the other three stations were not initiated until April of 1978.

Figures C-2 through C-7 show the monthly averages graphically. Nitrates and phosphates were omitted from the monthly graphs.

Figure C-8 graphically represents the annual averages for each station.

TABLE C-9

Monthly averages of hydrographic parameters for Station # 1.

Date	Rain Fall In.	N	Depth	Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
1/75	0.4	(2)	Top	23.3	28.8	13.5	8.0	3.2		
			Bot	23.5	29.8	16.0	7.6	3.6		
2/75	1.7	(2)	Top	20.6	22.5	20.5	7.8	4.1		
			Bot	23.3	27.0	18.0	8.1	3.8		
3/75	1.0	(1)	Top	23.5	29.5	22.0	8.1	3.2		
			Bot	25.5	30.0	22.0	8.1	4.6		
4/75	0.7	(2)	Top	25.8	25.8	19.5	8.0	3.5		
			Bot	26.0	27.3	23.5	8.2	4.2		
5/75	4.7	(2)	Top	26.5	30.0	16.5	8.2	4.2		
			Bot	28.0	30.3	14.0	8.2	5.8		
6/75	4.3	(0)								
7/75	9.8	(0)								
8/75	7.1	(0)								
9/75	6.2	(2)	Top	28.0	13.8	41.5	7.7	6.3		
			Bot	28.0	15.8	51.0	7.8	6.0		
10/75	2.4	(3)	Top	29.3	10.0	22.0	8.2	8.2		
			Bot	28.3	14.3	20.0	8.2	7.0		
11/75	0.5	(4)	Top	24.3	25.6	11.3	8.3	9.3		
			Bot	24.3	26.5	12.3	8.5	8.5		
12/75	2.0	(3)	Top	25.5	24.0	8.0	8.4	9.7		
			Bot	25.5	26.3	5.0	8.0	8.7		
1/76	2.7	(1)	Top	19.0	20.0	20.0	8.1	6.0		
			Bot	20.0	19.0	20.0	8.2	5.5		
2/76	0.3	(1)	Top	22.5	2.0		8.2	9.0		
			Bot	21.8	2.5		7.9	5.0		
3/76	0.3	(4)	Top	28.3	29.5	35.0	8.2	8.9		
			Bot	27.5	29.3	26.3	8.4	8.9		
4/76	1.7	(1)	Top	30.0	29.0			9.0		
			Bot	29.0	30.0		8.5	9.5		
5/76	5.1	(1)	Top	29.0	26.0			7.0		
			Bot	28.5	28.0		8.5	5.0		
6/76	7.3	(0)								
7/76	4.1	(0)								
8/76	5.4	(0)								
9/76	4.2	(2)	Top	31.0	18.0	22.0	8.4	7.5		
			Bot	31.0	24.5	28.0	8.4	8.0		
10/76	1.7	(2)	Top	27.7	15.0	30.5	8.2	3.8		
			Bot	27.0	16.5	31.0	8.2	3.3		
11/76	1.6	(2)	Top	23.5	19.0	21.5	8.2	6.8		
			Bot	23.3	19.0	21.5	8.2	6.8		
12/76	1.4	(1)	Top	24.5	16.0	15.0	8.5	6.0		
			Bot	24.5	16.0	15.0	8.5	6.0		

TABLE (Continued)

Monthly averages of hydrographic parameters for Station # 1.

Date	Rain Fall In.	N	Depth	Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
1/77	2.5	(3)	Top	17.3	4.3	39.0	7.9	6.7		
			Bot	17.3	4.3	39.0	7.9	6.7		
2/77	1.4	(2)	Top	18.3	12.5	20.0	8.1	6.5		
			Bot	18.3	12.5	20.0	8.1	6.5		
3/77	1.1	(2)	Top	28.0	22.0	21.5	8.1	8.0	0.0	0.43
			Bot	25.0	23.0	23.0	8.2	8.0	0.0	0.43
4/77	1.0	(0)								
5/77	1.2	(3)	Top	28.2	28.5	29.0	8.3	5.3		0.20
			Bot	28.2	28.5	29.0	8.3	5.3		0.20
6/77	5.7	(0)								
7/77	6.9	(1)	Top	33.0	18.0	45.0	8.6	9.5	0.0	0.30
			Bot	33.0	18.0	45.0	8.6	9.5	0.0	0.30
8/77	12.5	(0)								
9/77	7.9	(2)	Top	30.5	15.5	47.5	8.1	3.0	0.0	0.30
			Bot	30.8	14.5	49.5	8.1	3.0	0.0	0.30
10/77	0.5	(3)	Top	27.2	17.3	16.3	8.0	5.8	0.0	0.07
			Bot	27.5	29.7	14.0	8.3	6.0	0.0	0.09
11/77	2.0	(2)	Top	23.0	24.3	18.5	8.3	6.0		0.20
			Bot	23.0	23.5	18.5	8.1	5.3		0.23
12/77	6.7	(0)								
1/78	3.4	(2)	Top	15.1	0.7	18.0	7.6	7.3	0.02	0.08
			Bot	15.1	0.7	18.0	7.6	7.3	0.02	0.08
2/78	4.3	(3)	Top	19.8	16.7	28.0	7.9	8.0		0.04
			Bot	19.5	17.2	16.5	7.8	8.0		0.05
3/78	3.3	(1)	Top	20.0		24.0	8.0	2.0		0.07
			Bot	20.0		24.0	7.9	2.0		0.07

TABLE C-10

Monthly averages of hydrographic parameters for Station # 11.

Date	Rain Fall In.	N	Depth	Temp.	Sal.	Turb.	pH	O ₂	NO ₂ -N	NO ₃ -N	PO ₄ -P
				°C.	‰	NTU		mg/l	mg/l	Ortho mg/l	
4/78	0.8	(2)	Top	26.1	32.0		8.0	7.0	0.0		
			Bot	24.3	31.5		8.0	6.7	0.0		
5/78	5.0	(2)	Top	28.8	33.2		8.1	6.1	0.0	0.0	0.0
			Bot	27.5	32.8		7.8	5.3	0.0	0.0	0.0
6/78	6.9	(3)	Top	30.0	27.3			5.1	0.0	0.0	0.0
			Bot	30.2	29.5			4.6	0.0	0.0	0.0
7/78	10.8	(4)	Top	30.7	31.5			4.9	0.0	0.0	0.0
			Bot	30.3	31.6			3.4	0.0	0.0	0.0
8/78	6.6	(1)	Top	29.0	27.0			3.3	0.0	0.0	0.0
			Bot	30.0	27.0			3.1	0.0	0.0	0.0
9/78	3.0	(2)	Top	30.6	32.2	11.0	8.3	7.3	0.0	0.0	0.09
			Bot	30.1	32.0	20.0	8.3	6.2	0.0	0.0	0.15
10/78	2.8	(3)	Top	26.5	32.1	7.0	8.3	5.7	0.0	0.0	0.13
			Bot	25.7	31.7	9.7	8.2	5.4			0.12
11/78	0.5	(2)	Top	23.3	33.3	9.5	8.1	5.4	0.0	0.0	0.06
			Bot	22.7	33.1	32.0	7.9	6.0			0.22
12/78	2.7	(1)	Top	21.0	32.5	9.0	7.9	5.3	0.00	0.00	0.09
			Bot	21.0	33.0	14.0	7.8	4.1	0.00	0.00	0.07

TABLE C-11

Monthly averages of hydrographic parameters for Station # 2.

Date	Rain Fall In.	N	Depth	Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
1/75	0.4	(2)	Top	20.5	33.3	10.5		7.6	0.29	0.06
			Bot	21.5	32.3	7.0		9.1		
2/75	1.7	(2)	Top	19.9	31.5	10.0	8.3	7.4		
			Bot	20.6	31.5	9.0	8.4	9.8		
3/75	1.0	(1)	Top	21.0	32.0	9.0	8.2	5.8	0.18	0.02
			Bot	22.5	31.0	9.5	8.5	11.4		
4/75	0.7	(3)	Top	25.0	31.1	8.0	8.5	6.9		
			Bot	22.3	32.7	14.0	8.3	7.9		
5/75	4.7	(1)	Top	27.2	34.0	12.0	8.3	6.4		
			Bot	28.5	33.0	9.5	8.7	9.8		
6/75	4.3	(0)								
7/75	9.8	(0)								
8/75	7.1	(0)								
9/75	6.2	(1)	Top	32.1	31.0	9.0		12.0		
			Bot	31.0	31.0	16.0		14.0		
10/75	2.5	(4)	Top	28.9	32.4	9.3	8.5	10.7		
			Bot	28.6	31.9	13.0	8.5	10.8		
11/75	0.5	(3)	Top	22.5	33.0	5.0	8.5	10.3		
			Bot	22.1	30.3	13.5	8.6	10.0		
12/75	2.0	(3)	Top	22.2	30.5	6.8	8.3	7.8		
			Bot	21.7	30.7	13.8	8.3	8.0		
1/76	2.7	(0)								
2/76	0.3	(1)	Top	19.0	31.0		8.2	6.5		
			Bot	18.0	31.0		8.2	6.5		
3/76	0.3	(5)	Top	26.6	31.5	20.0	8.5	10.0		
			Bot	25.9	31.5	17.3	8.5	9.8		
4/76	1.7	(1)	Top	28.0	32.0		8.3	11.0		
			Bot	28.0	32.0		8.5	10.5		
5/76	5.1	(2)	Top	27.5	31.5		8.4	10.5		
			Bot	27.3	31.3		8.4	10.3		
6/76	7.3	(0)								
7/76	4.1	(0)								
8/76	5.4	(0)								
9/76	4.2	(2)	Top	31.3	31.3	8.5	8.4	9.3		
			Bot	31.0	31.3	12.5	8.4	9.5		
10/76	1.7	(2)	Top	26.2	33.5	14.3	8.6	9.5		
			Bot	26.0	33.8	15.0	8.6	10.0		
11/76	1.6	(2)	Top	20.3	31.8	9.0	8.3	7.3		
			Bot	21.5	32.0	10.5	8.3	7.3		
12/76	1.4	(1)	Top	22.0	32.0	9.0	8.4	5.0		
			Bot	21.0	32.0	13.0	8.5	6.0		

TABLE (Continued)

Monthly averages of hydrographic parameters for Station # 2.

Date	Rain Fall In.	N	Depth	Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
1/77	2.5	(2)	Top	16.3	29.8	6.0	8.5	7.3		
			Bot	15.8	27.5	6.3	8.6	7.0		
2/77	1.4	(2)	Top	16.0	31.5	8.0	8.5	9.5		
			Bot	16.5	31.5	8.5	8.5	9.0		
3/77	1.1	(1)	Top	25.0	31.0	18.0	8.5	8.5	0.0	0.03
			Bot	25.0	31.0	24.0	8.4	8.0	0.0	0.13
4/77	1.0	(3)	Top	23.5	32.7	13.7	8.8	6.5	0.0	0.08
			Bot	23.5	32.7	13.7	8.8	6.5	0.0	0.08
5/77	1.2	(3)	Top	28.0	33.7	11.3	8.1	7.5		0.11
			Bot	28.0	33.3	12.3	8.0	7.3		0.10
6/77	5.7	(0)								
7/77	6.9	(1)	Top	35.0	33.0	45.0	8.5	7.0	0.0	
			Bot	35.0	33.0	45.0	8.6	6.5	0.0	
8/77	12.5	(0)								
9/77	7.9	(2)	Top	30.0	30.5	13.5	8.5	7.0	0.0	0.12
			Bot	31.5	30.5	19.0	8.5	5.8	0.0	0.10
10/77	0.5	(2)	Top	25.0	34.0	5.5	7.6	2.0	0.0	0.09
			Bot	25.8	33.3	5.0	7.8	3.5	0.0	0.08
11/77	2.0	(2)	Top	24.0	31.5	7.5	8.6	7.8	0.0	0.12
			Bot	24.0	31.5	3.0	8.4	7.6	0.0	0.12
12/77	6.7	(1)	Top	21.5	31.5	1.0	8.7	1.5	0.0	0.04
			Bot	20.1	31.9	1.0	8.3	2.0	0.0	0.04
1/78	3.4	(3)	Top	15.0	28.7	3.7	8.6	2.8	0.02	0.07
			Bot	13.5	32.0	6.0	8.3	4.5	0.02	0.07
2/78	4.3	(1)	Top	14.9	25.3	5.0	8.2	10.0	0.0	0.11
			Bot	14.9	25.3	5.0	8.2	10.0	0.0	0.11
3/78	3.3	(0)								
4/78	0.8	(0)								
5/78	5.0	(1)	Top	28.0	34.1		8.5	7.9	0.0	0.0
			Bot	27.8	34.1		8.5	8.6	0.0	0.0
6/78	6.9	(2)	Top	31.4	25.3			6.9	0.0	0.0
			Bot	31.2	31.1			6.8	0.0	0.0
7/78	10.8	(2)	Top	29.4	32.6			3.9	0.0	0.0
			Bot	29.4	32.5			3.7	0.0	0.0
8/78	6.6	(1)	Top	29.5	30.5			5.8	0.0	0.0
			Bot	29.5	30.5			5.8	0.0	0.0
9/78	3.0	(1)	Top	29.2	32.9	3.0	8.5	9.2	0.0	
			Bot	29.2	32.7	6.0	8.6	8.8	0.0	
10/78	2.8	(3)	Top	25.7	32.7	3.3	8.3	6.8	0.0	0.03
			Bot	25.4	32.6	4.0	8.4	7.0	0.0	0.05
11/78	0.5	(2)	Top	23.2	33.8	12.0	8.1	7.1	0.0	0.03
			Bot	23.0	33.8	14.0	8.1	6.3		0.04
12/78	2.7	(1)	Top	21.0	33.2	9.0	8.0	6.6	0.0	0.08
			Bot	21.0	33.1	8.0	8.0	6.4		0.07

TABLE C-12

Monthly averages of hydrographic parameters for Station # 3.

Date	Rain Fall In.	N	Depth	Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
1/75	0.4	(2)	Top	18.0	32.7	9.0		9.2		
			Bot	18.0	32.3	9.5	8.6	9.0		
2/75	1.7	(2)	Top	19.0	32.5	5.0	8.5	8.0		
			Bot	18.0	31.0	5.0	8.5	5.5		
3/75	1.0	(2)	Top	21.6	31.6	15.0	8.3	7.1		
			Bot	22.5	32.3	13.5	8.5	7.2		
4/75	0.7	(2)	Top	25.1	33.5	8.7	7.4	8.1		
			Bot	25.0	34.8	13.5	8.5	5.5		
5/75	4.7	(1)	Top	28.2	32.0	17.0	8.4	6.0		
			Bot	--	--	--	--	--		
6/75	4.3	(0)								
7/75	9.8	(0)								
8/75	7.1	(0)								
9/75	6.2	(1)	Top	30.0	25.0	2.0	8.3	9.0		
			Bot	--	30.0	4.5	8.3	8.0		
10/75	2.4	(5)	Top	28.8	31.3	7.5	8.5	8.1		
			Bot	28.5	30.2	10.8	8.6	7.2		
11/75	0.5	(3)	Top	24.8	31.0	9.5	8.2	9.0		
			Bot	24.0	32.0	9.3	8.4	7.2		
12/75	2.0	(3)	Top	21.7	30.7	8.3	7.8	7.2		
			Bot	21.3	30.7	14.0	8.4	6.2		
1/76	2.7	(0)								
2/76	0.3	(3)	Top	19.2	31.3		8.4	8.0		
			Bot	18.4	32.3		8.3	6.3		
3/76	0.3	(4)	Top	23.4	32.5	14.6	8.4	8.0		
			Bot	23.1	32.3	18.0	8.3	6.8		
4/76	1.7	(2)	Top	26.8	31.5	35.0	8.4	5.5		
			Bot	26.0	32.0	15.0	8.2	5.0		
5/76	5.1	(1)	Top	24.0	32.0		8.6	6.0		
			Bot	23.0	34.0		8.3	5.5		
6/76	7.3	(0)								
7/76	4.1	(0)								
8/76	5.4	(0)								
9/76	4.2	(3)	Top	30.5	32.7	9.3	8.4	9.8		
			Bot	29.0	33.0	21.5	8.3	7.5		
10/76	1.7	(2)	Top	25.9	33.3	13.5	8.5	6.0		
			Bot	26.0	33.5	22.0	8.5	4.0		
11/76	1.6	(2)	Top	21.3	31.0	9.0	8.3	6.0		
			Bot	20.5	32.0	5.0	8.4	7.8		
12/76	1.4	(1)	Top	21.0	30.0	8.0	8.5	6.5		
			Bot	21.0	30.0	10.0	8.5	5.5		

TABLE (Continued)

Monthly averages of hydrographic parameters for Station # 3.

Date	Rain Fall In.	N	Depth	Temp.	Sal.	Turb.	pH	O ₂	NO ₂ -N	NO ₃ -N	PO ₄ -P
				°C.	‰	NTU		mg/l	mg/l	mg/l	
1/77	2.5	(2)	Top	15.5	30.0	13.5	8.5	8.0			
			Bot	15.5	32.0	16.0	8.5	7.8			
2/77	1.4	(2)	Top	14.3	31.0	5.5	8.5	8.8			
			Bot	11.0	31.0	19.0	8.5	8.5			
3/77	1.1	(2)	Top	22.3	30.5	17.0	8.5	8.8	0.0	0.07	
			Bot	22.5	31.0	20.5	8.4	8.0	0.0	0.16	
4/77	1.0	(0)									
5/77	1.2	(3)	Top	28.2	31.2	10.3	8.4	7.0			0.04
			Bot	28.2	31.2	31.3	8.6	5.8			0.14
6/77	5.7	(0)									
7/77	6.9	(1)	Top	32.0	33.0		8.4	4.5	0.0	0.10	
			Bot	31.5	33.0		8.5	6.0	0.0	0.27	
8/77	12.5	(0)									
9/77	7.9	(2)	Top	30.5	30.0	16.5	8.5	3.0	0.0	0.02	
			Bot	30.3	31.0	18.5	8.5	3.3	0.0	0.01	
10/77	0.5	(2)	Top	25.5	33.0	21.0	8.4	8.0	0.0	0.06	
			Bot	25.7	32.0	26.0	8.5	7.3	0.0	0.14	
11/77	2.0	(1)	Top	20.0	31.5	10.0	8.5	5.5	0.0	0.10	
			Bot	20.0	31.0	10.0	8.5	4.0	0.0	0.13	
12/77	6.7	(2)	Top	20.4	31.5	9.5	8.0	3.0	0.0	0.02	
			Bot	19.9	31.0	21.0	8.1	4.8	0.0	0.03	
1/78	3.4	(2)	Top	16.0	30.0	6.8	8.6	2.0	0.05	0.04	
			Bot	17.0	30.0	8.0	8.7	5.5	0.02	0.07	
2/78	4.3	(3)	Top	17.9	29.0	16.7	8.2	8.0	0.0	0.01	
			Bot	18.8	26.4	19.0	8.4	7.8	0.0	0.01	
3/78	3.3	(1)	Top	20.0	30.0	18.0	8.4	8.0	0.0	0.02	
			Bot	22.0	30.0	1.0	8.3	6.0	0.0	0.01	
4/78	0.8	(1)	Top	25.2	32.5		8.3	7.9	0.05		
			Bot	24.0	32.5		8.2	6.8	0.05		
5/78	5.0	(1)	Top	27.0	34.1		8.4	7.2	0.0	0.0	
			Bot	27.0	34.0		8.2	5.8	0.0	0.0	
6/78	6.9	(2)	Top	30.1	26.1			5.9	0.0	0.0	
			Bot	29.1	32.4			5.3	0.0	0.12	
7/78	10.8	(1)	Top	29.9	33.7			5.4	0.0	0.0	
			Bot	29.8	29.1			5.1	0.0	0.20	
8/78	6.6	(1)	Top	29.2	30.0			5.3	0.0	0.0	
			Bot	29.0	29.0			2.6	0.0	0.0	
9/78	3.0	(2)	Top	30.1	32.7	8.0	8.5	7.2	0.0	0.07	
			Bot	29.7	32.5	13.0	8.6	7.3	0.0	0.03	
10/78	2.8	(3)	Top	25.1	33.0	3.3	8.3	6.9	0.0	0.05	
			Bot	26.9	31.8	7.0	8.3	6.1	0.0	0.0	
11/78	0.5	(2)	Top	23.5	32.2	9.5	8.1	5.9	0.00	0.03	
			Bot	23.3	33.0	9.5	8.0	5.7		0.03	
12/78	2.7	(1)	Top	21.0	33.5	7.0	8.0	6.7	0.00	0.08	
			Bot	20.5	33.0	11.0	7.9	6.3		0.08	

TABLE C-13

Monthly averages of hydrographic parameters for Station # 4.

Date	Rain Fall In.	N	Depth	Temp.	Sal.	Turb.	pH	O ₂	NO ₂ -N	PO ₄ -P
				°C.	‰	NTU		mg/l	NO ₃ -N mg/l	Ortho mg/l
1/75	0.4	(3)	Top	19.8	32.3	4.0	8.9	11.5		
			Bot	20.7	31.5	10.0	8.8	9.4		
2/75	1.7	(2)	Top	20.2	33.0	14.0	8.7	6.2		
			Bot	20.5	32.0	9.0	8.5	6.6		
3/75	1.0	(1)	Top	21.0	32.5	7.0		6.0		
			Bot	22.0	32.0	13.0	8.9	8.2		
4/75	0.7	(3)	Top	25.3	33.5	10.0	8.5	8.2		
			Bot	25.2	33.0	10.7	8.3	7.5		
5/75	4.7	(1)	Top	27.0	32.8	13.0	8.5	6.2		
			Bot	28.0	33.5	10.5	8.5	6.8		
6/75	4.3	(0)	Top							
7/75	9.8	(0)								
8/75	7.1	(0)								
9/75	6.2	(1)	Top	27.0	30.0	10.0	8.3	9.0		
			Bot	27.0	30.0	7.0	8.5			
10/75	2.4	(4)	Top	28.1	29.3	6.5	8.4	9.7		
			Bot	27.9	29.4	7.5	8.4	8.9		
11/75	0.5	(3)	Top	24.2	30.7	30.3	8.3	7.3		
			Bot	24.0	30.7	38.3	8.5	8.8		
12/75	2.0	(2)	Top	23.0	32.0	12.0	8.3	11.0		
			Bot	21.5	31.5	12.5	8.3	10.5		
1/76	2.7	(0)								
2/76	0.3	(4)	Top	20.3	32.0		8.3	6.8		
			Bot	20.0	30.5		8.4	6.5		
3/76	0.3	(1)	Top	23.5	32.0	5.0	8.4	7.5		
			Bot	23.0	31.0	15.0	8.3	7.0		
4/76	1.7	(1)	Top	26.0	33.0		8.6	8.5		
			Bot	28.0	35.0		8.2	7.0		
5/76	5.1	(1)	Top	29.0	32.0		8.7	6.5		
			Bot	28.0	35.0		8.5	7.0		
6/76	7.3	(0)								
7/76	4.1	(0)								
8/76	5.4	(0)								
9/76	4.2	(2)	Top	31.5	31.8	8.5	8.5	8.0		
			Bot	30.0	31.3	14.0	8.7	8.3		
10/76	1.7	(2)	Top	24.8	33.5	16.5	8.6	9.5		
			Bot	25.0	33.0	14.0	8.7	9.0		
11/76	1.6	(2)	Top	20.0	31.8	18.5	8.4	6.5		
			Bot	20.3	31.0	19.0	8.4	7.3		
12/76	1.4	(0)								

TABLE (Continued)

Monthly averages of hydrographic parameters for Station # 4.

Date	Rain Fall In.	N	Depth	Temp. °/C	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
1/77	2.5	(3)	Top	16.5	30.0	5.3	8.6	5.8		
			Bot	16.0	30.3	4.5	8.5	5.5		
2/77	1.4	(2)	Top	16.8	30.0	6.5	8.6	8.3		
			Bot	15.3	31.0	6.5	8.6	9.5		
3/77	1.1	(2)	Top	25.5	32.5	19.0	8.3	6.0	0.0	0.10
			Bot	25.0	32.3	11.5	8.5	7.3	0.0	
4/77	1.0	(1)	Top	23.5	32.0	6.0	8.7	7.0	0.0	0.12
			Bot	23.0	32.5	9.0	9.1	7.5	0.001	
5/77	1.2	(3)	Top	26.0	34.3	11.3	8.4	7.0	0.01	0.07
			Bot	26.3	34.3	13.7	8.3	7.2	0.02	0.07
6/77	5.7	(0)								
7/77	6.9	(1)	Top	32.0	34.0	12.0	8.6	5.0		0.13
			Bot	31.5	34.0	13.0	8.6	6.0		0.13
8/77	12.5	(0)								
9/77	7.9	(2)	Top	30.0	30.5	7.5	8.6	5.0	0.0	0.06
			Bot	29.0	30.5	12.5	8.6	5.5	0.0	0.06
10/77	0.5	(2)	Top	25.5	30.5	8.0	8.4	4.0	0.0	0.30
			Bot	25.5	32.0	25.0	8.2	3.3	0.0	0.18
11/77	2.0	(2)	Top	22.5	32.0	21.5	8.7	7.3	0.0	0.03
			Bot	23.5	32.0	8.5	8.7	7.0	0.0	0.03
12/77	6.7	(1)	Top	17.8	20.0	5.0	7.5	3.0	0.0	0.13
			Bot	17.2	25.0	9.0	7.2	5.0	0.0	0.13
1/78	3.4	(2)	Top	15.3	30.3	4.0	8.4	5.8	0.03	0.05
			Bot	17.0	27.6	6.5	8.4	6.5	0.03	0.03
2/78	4.3	(3)	Top	13.8	30.5	7.9	8.2	6.7	0.0	0.07
			Bot	14.2	30.4	15.6	8.4	6.7	0.007	0.07
3/78	3.3	(1)	Top	19.0	30.0	12.0	8.3	9.0	0.0	0.01
			Bot	19.0	27.0	30.0	8.3	6.0	0.0	0.01
4/78	0.8	(1)	Top	24.0	33.0		8.3	8.0		0.10
			Bot	23.3	32.5		8.2	7.6		
5/78	5.0	(1)	Top	29.4	33.5		7.8	6.4		
			Bot	28.2	32.0		7.6	5.8		
6/78	6.9	(2)	Top	30.7	30.4			6.6	0.0	0.0
			Bot	30.5	31.3			6.2	0.0	0.0
7/78	10.8	(2)	Top	31.2	33.2			6.0	0.0	0.0
			Bot	31.0	30.0			5.5	0.0	0.0
8/78	6.6	(1)	Top	29.5	30.8			5.4	0.0	0.0
			Bot	29.5	32.1			4.7	0.0	0.0
9/78	3.0	(2)	Top	30.1	32.6	7.0	8.35	8.3	0.0	0.0
			Bot	29.9	32.4	5.5	8.50	8.2	0.0	0.0
10/78	2.8	(2)	Top	24.0	32.6	2.5	8.5	6.9	0.0	0.10
			Bot	23.9	32.6	2.0	8.5	6.6		0.07
11/78	0.5	(2)	Top	24.9	32.4	11.0	8.03	6.5	0.0	0.07
			Bot	24.4	32.9	9.0	8.11	6.1		0.12
12/78	2.7	(1)	Top	20.1	32.2	10.0	7.9	6.5	0.00	0.07

TABLE C-14

Monthly averages of hydrographic parameters for Station # 6.

Date	Rain Fall In.	N	Depth	Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
5/78	5.0	(2)	Top	27.7	33.6		8.4	6.8	0.0	0.0
			Bot	27.7	33.4		8.2	5.9	0.0	0.0
6/78	6.9	(2)	Top	28.9	33.7			6.6	0.0	0.0
			Bot	29.0	33.2			6.5	0.0	0.0
7/78	10.8	(2)	Top	31.5	33.0			6.6	0.0	0.0
			Bot	31.5	30.6			6.4	0.0	0.0
8/78	6.6	(1)	Top	29.2	32.8			5.2	0.0	0.0
			Bot	28.2	33.7			4.9	0.0	0.0
9/78	3.0	(2)	Top	29.8	32.8	7.5	8.5	7.8	0.0	0.0
			Bot	29.9	32.7	5.0	8.5	7.6	0.0	0.0
10/78	2.8	(1)	Top	23.1	33.0	2.0	8.4	6.8	0.0	0.10
			Bot	23.1	32.9	3.0	8.4	6.2		0.13
11/78	0.5	(1)	Top	26.1	33.9	14.0	8.2	6.3	0.0	0.0
			Bot	26.2	31.8	13.0	8.1	6.2		
12/78	2.7	(1)	Top	21.0	33.3	8.0	8.0	7.0	0.00	0.05
			Bot	21.2	33.2	9.0	8.0	5.0	0.00	0.06

TABLE C-15

Monthly averages of hydrographic parameters for Station # 7.

Date	Rain Fall In.	N	Depth	Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N NO ₃ -N mg/l	PO ₄ -p Ortho mg/l
5/78	5.0	(1)	Top	29.8	33.6		8.2	6.4	0.0	0.0
			Bot	28.9	33.1		8.2	5.9	0.02	0.0
6/78	6.9	(2)	Top	28.8	32.9			6.7	0.0	0.0
			Bot	28.7	33.4			6.3	0.0	0.0
7/78	10.8	(3)	Top	30.3	31.6			6.0	0.0	0.07
			Bot	30.4	32.2			5.1	0.0	0.0
8/78	6.6	(1)	Top	29.3	29.5			5.3	0.0	0.0
			Bot	29.5	32.2			3.8	0.0	0.60
9/78	3.0	(0)								
10/78	2.8	(2)	Top	27.2	32.6	2.5	8.4	6.6	0.0	0.10
			Bot	26.6	32.7	3.5	8.5	6.3	0.0	0.13
11/78	0.5	(0)								
12/78	2.7	(1)	Top	19.9	32.4	6.0	8.1	7.6	0.002	0.05
			Bot	19.9	32.2	5.0	8.2	7.5	0.00	0.05

TABLE C-16

Annual adjusted averages for hydrographic parameters.
(Based on 9 months)

Date	Rain Fall In.	Depth	Temp. °C.	Sal. ‰	Turb. NTU	pH	O ₂ mg/l	NO ₂ -N NO ₃ -N mg/l	PO ₄ -P Ortho mg/l
Station # 1.									
1975	39.2	Top	25.2	23.3	19.4	8.1	5.7		
		Bot	25.8	25.2	20.2	8.1	5.8		
1976	37.6	Top	26.2	19.3	22.7	8.3	7.1		
		Bot	25.8	20.5	22.9	8.3	6.4		
1977	48.4	Top	24.5	19.1	24.8	8.1	6.1	0.0	0.25
		Bot	24.1	20.4	25.1	8.2	6.0	0.0	0.26
Station # 2.									
1975	39.2	Top	24.4	32.1	8.9	8.4	8.3		
		Bot	24.3	31.6	11.7	8.5	10.1		
1976	37.6	Top	24.2	31.7	10.8	8.4	8.5		
		Bot	23.9	31.7	12.0	8.4	8.6		
1977	48.4	Top	23.3	31.8	9.4	8.4	6.4	0.002	0.08
		Bot	23.4	31.5	10.3	8.4	6.3	0.002	0.09
1978	50.3	Top	23.0	31.6	8.3	8.3	7.4	0.002	0.05
		Bot	22.7	32.0	9.4	8.3	7.7	0.002	0.06
Station # 3.									
1975	39.2	Top	24.1	31.1	9.1	8.2	8.0		
		Bot	23.9	31.7	10.8	8.4	6.9		
1976	37.6	Top	23.2	31.7	13.6	8.4	6.8		
		Bot	22.7	32.2	15.3	8.4	6.2		
1977	48.4	Top	22.4	31.2	13.4	8.4	6.6	0.0	0.04
		Bot	22.0	31.5	19.6	8.4	6.1	0.0	0.13
1978	50.3	Top	22.9	31.9	11.0	8.3	6.6	0.011	0.04
		Bot	23.2	31.5	10.9	8.3	6.4	0.007	0.03
Station # 4.									
1975	39.2	Top	24.0	31.8	11.9	8.5	8.3		
		Bot	24.1	31.5	13.2	8.5	8.3		
1976	37.6	Top	23.9	31.8		8.5	7.5		
		Bot	23.8	32.1		8.3	7.4		
1977	48.4	Top	22.7	30.2	10.0	8.4	5.9	0.001	0.12
		Bot	22.3	31.1	11.1	8.4	6.4	0.003	0.10
1978	50.3	Top	22.2	31.9	7.9	8.2	7.1	0.004	0.06
		Bot	22.2	31.1	11.1	8.2	6.7	0.005	0.05

FIGURE C-2

Graphs of hydrographic parameters for Station # 1.

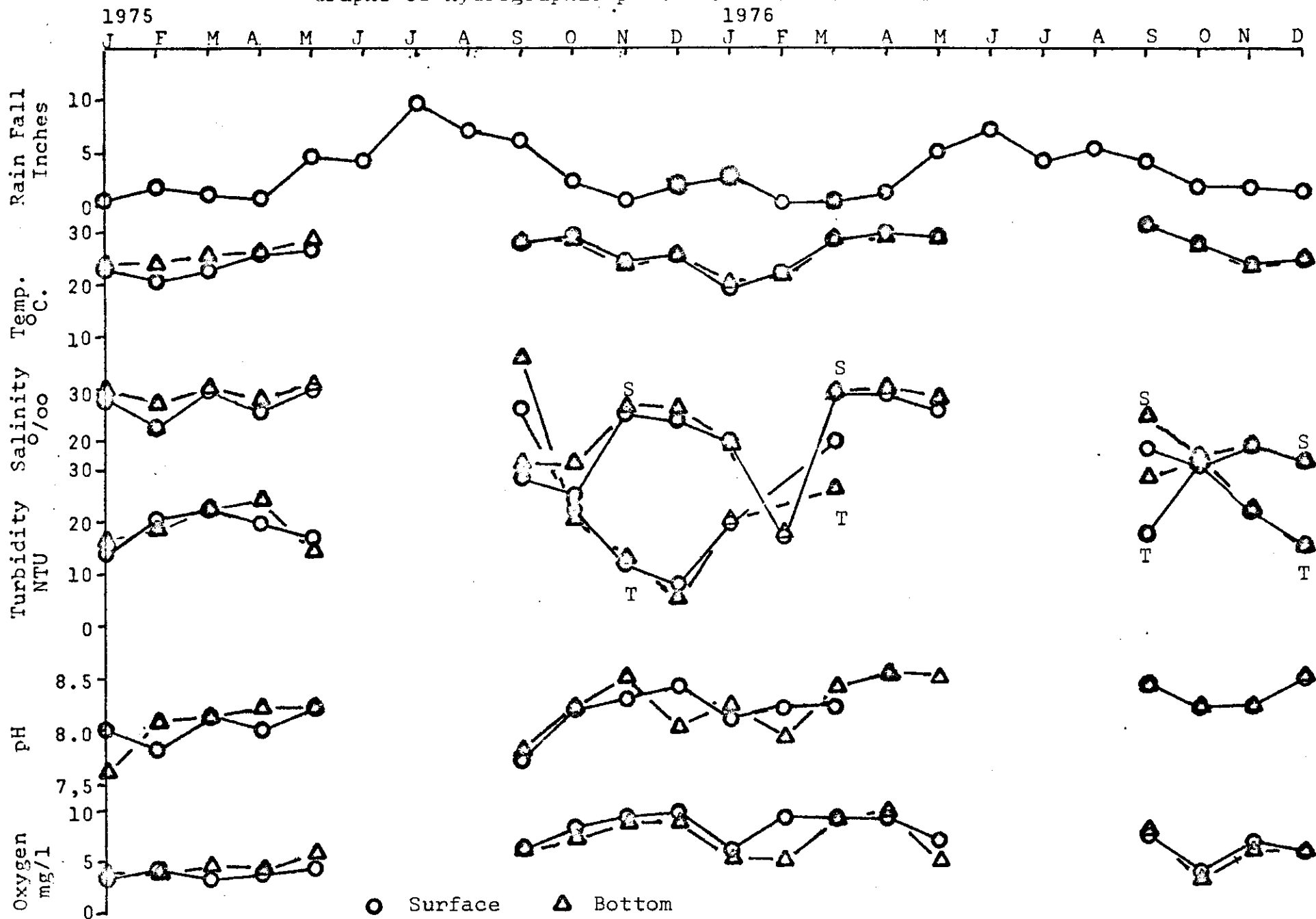


FIGURE C-2 (continued)
 Graphs of hydrographic parameters for Station # 1.

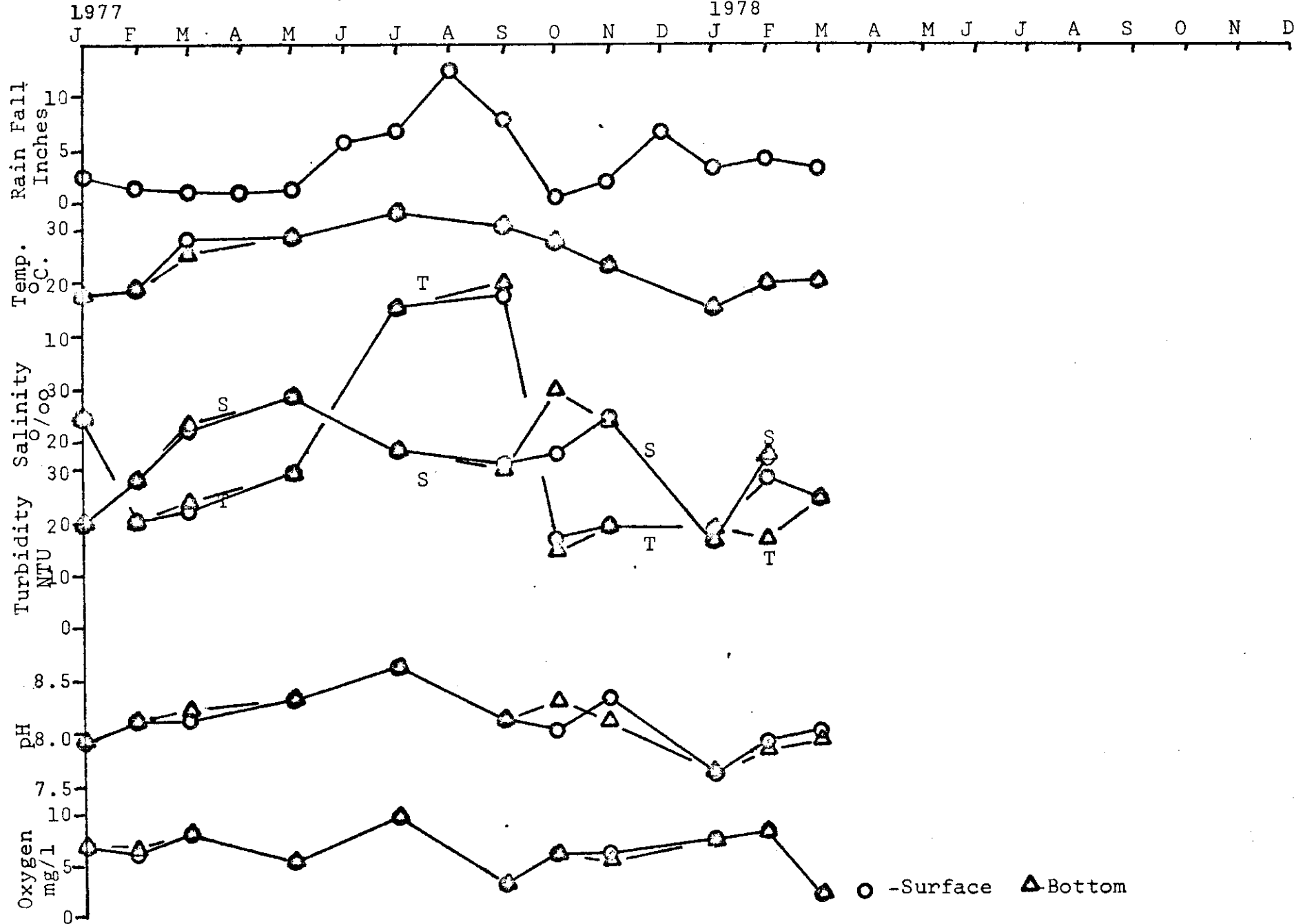


FIGURE C-3
 Graphs of hydrographic parameters for Station # 11.

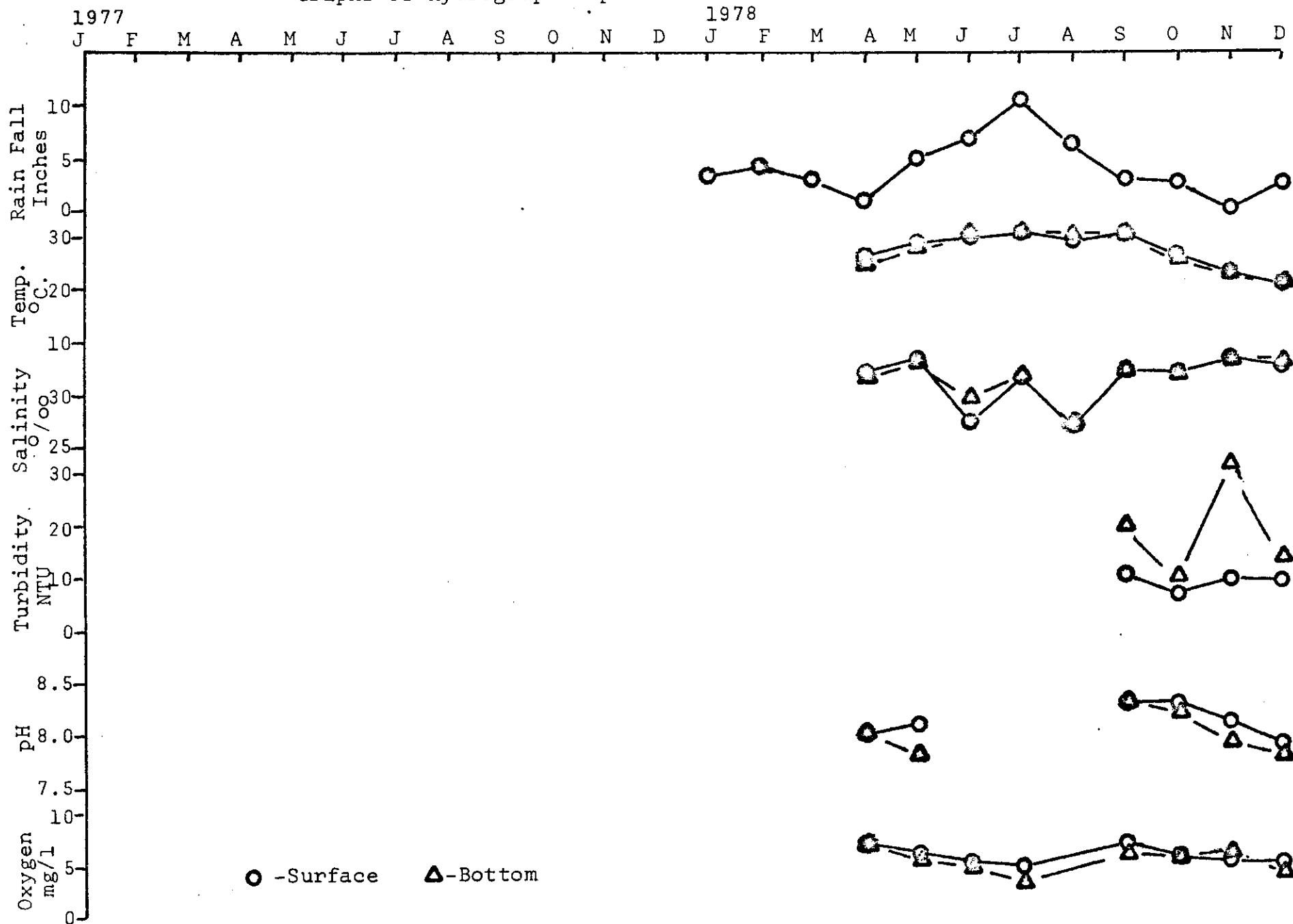


FIGURE C-4
 Graphs of hydrographic parameters for Station # 2.

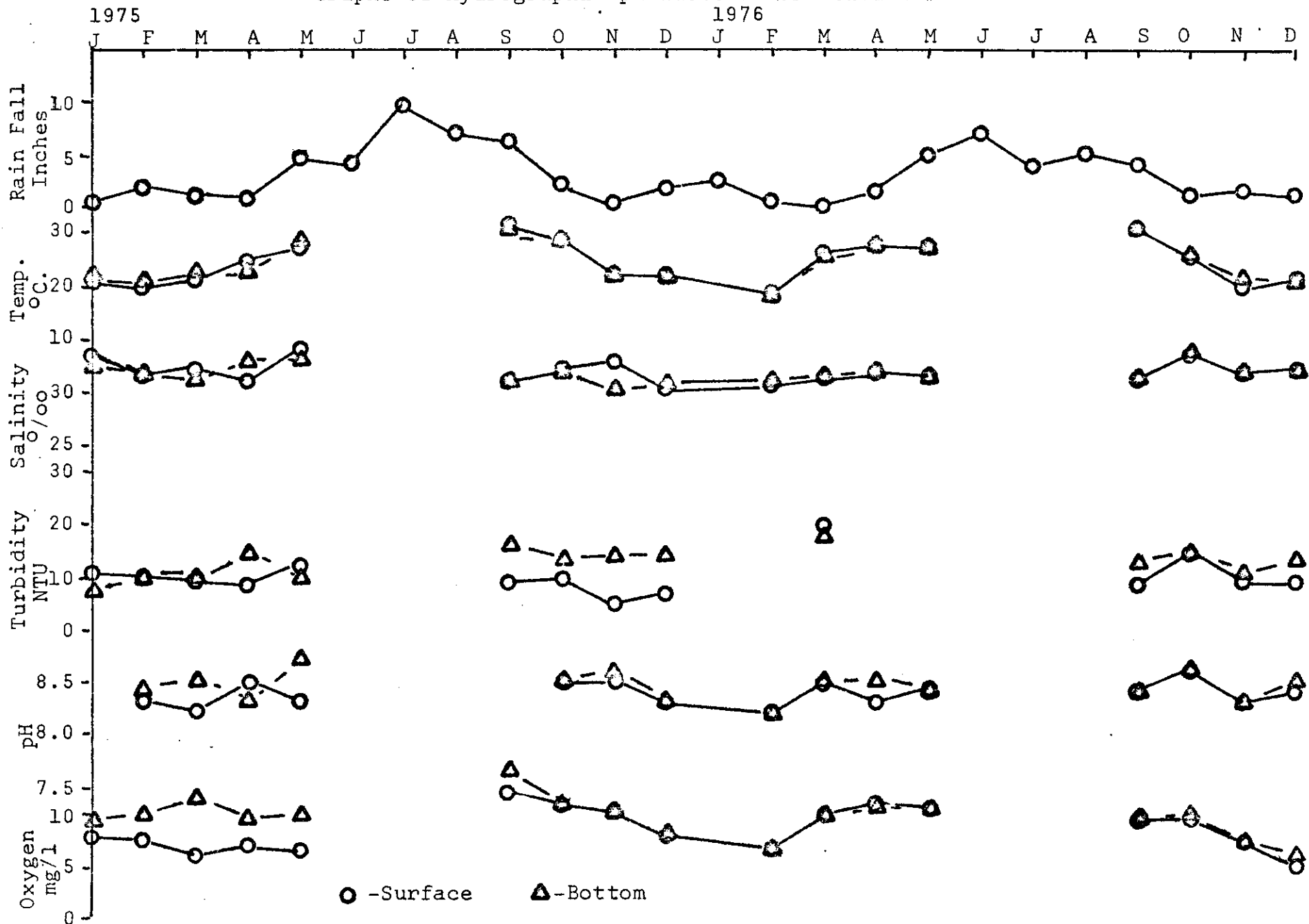


FIGURE (Continued)
 Graphs of hydrographic parameters for Station # 2.

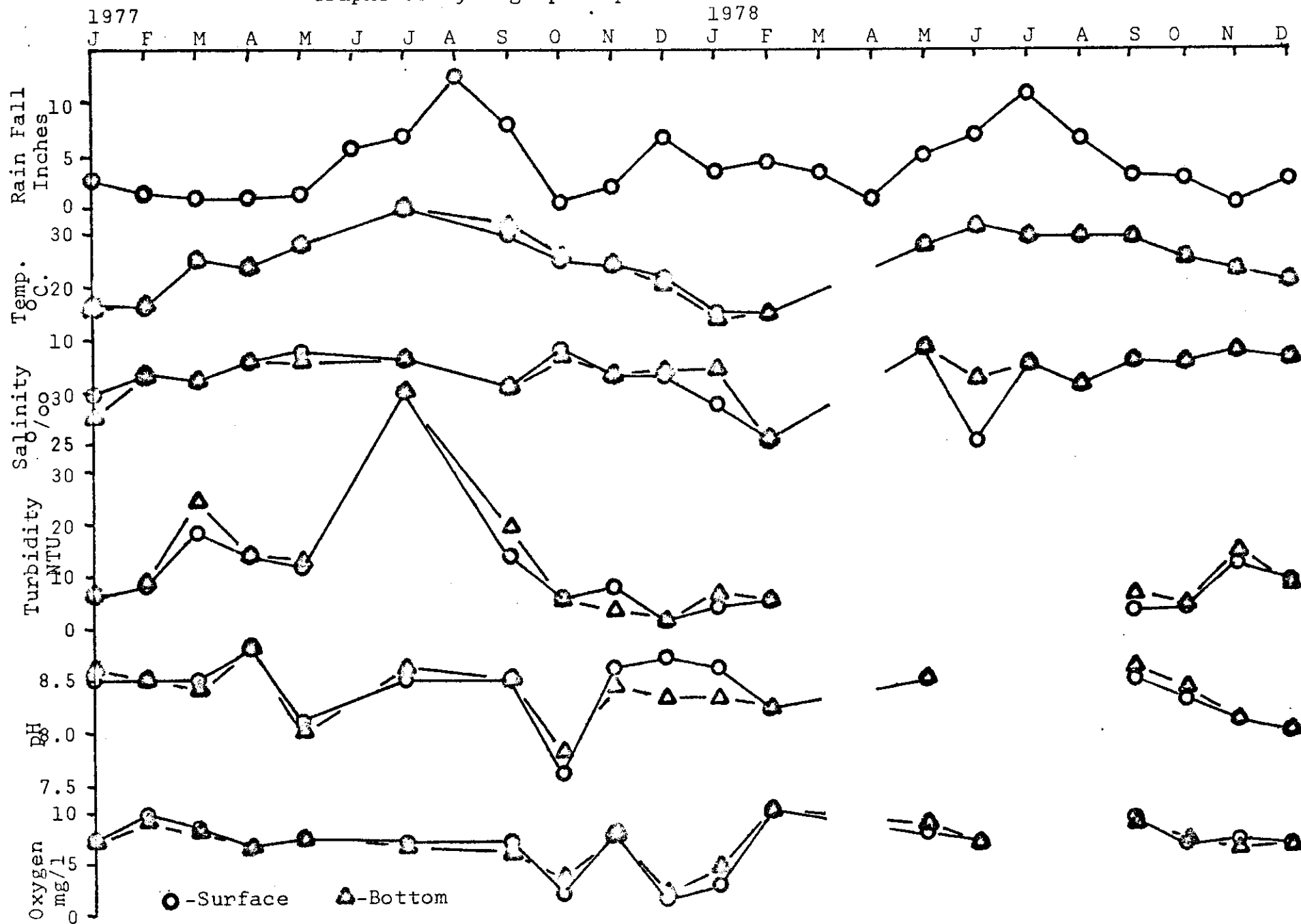


FIGURE C-5
 Graphs of hydrographic parameters for Station # 3.

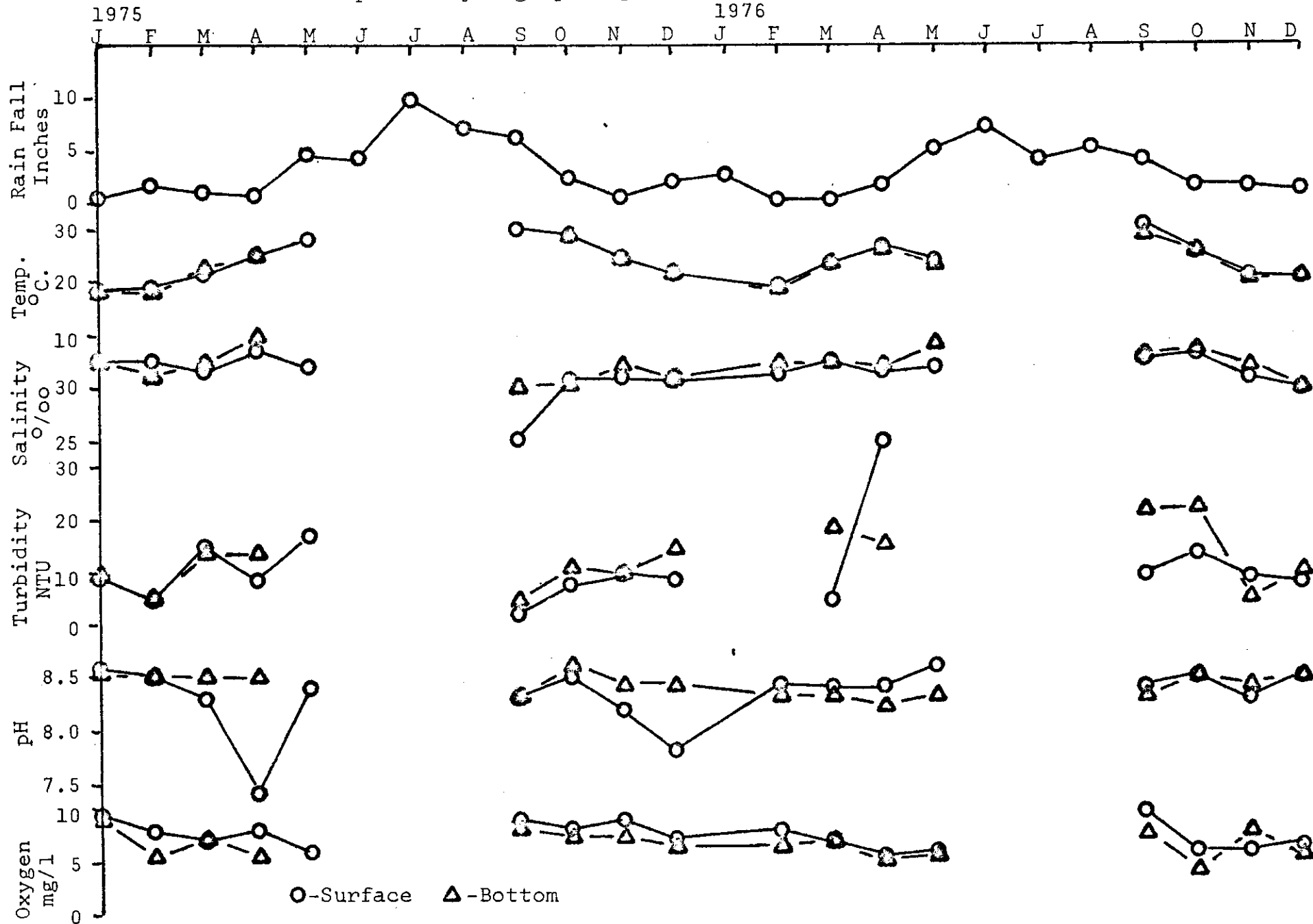


FIGURE (Continued)
 Graphs of hydrographic parameters for Station # 3.

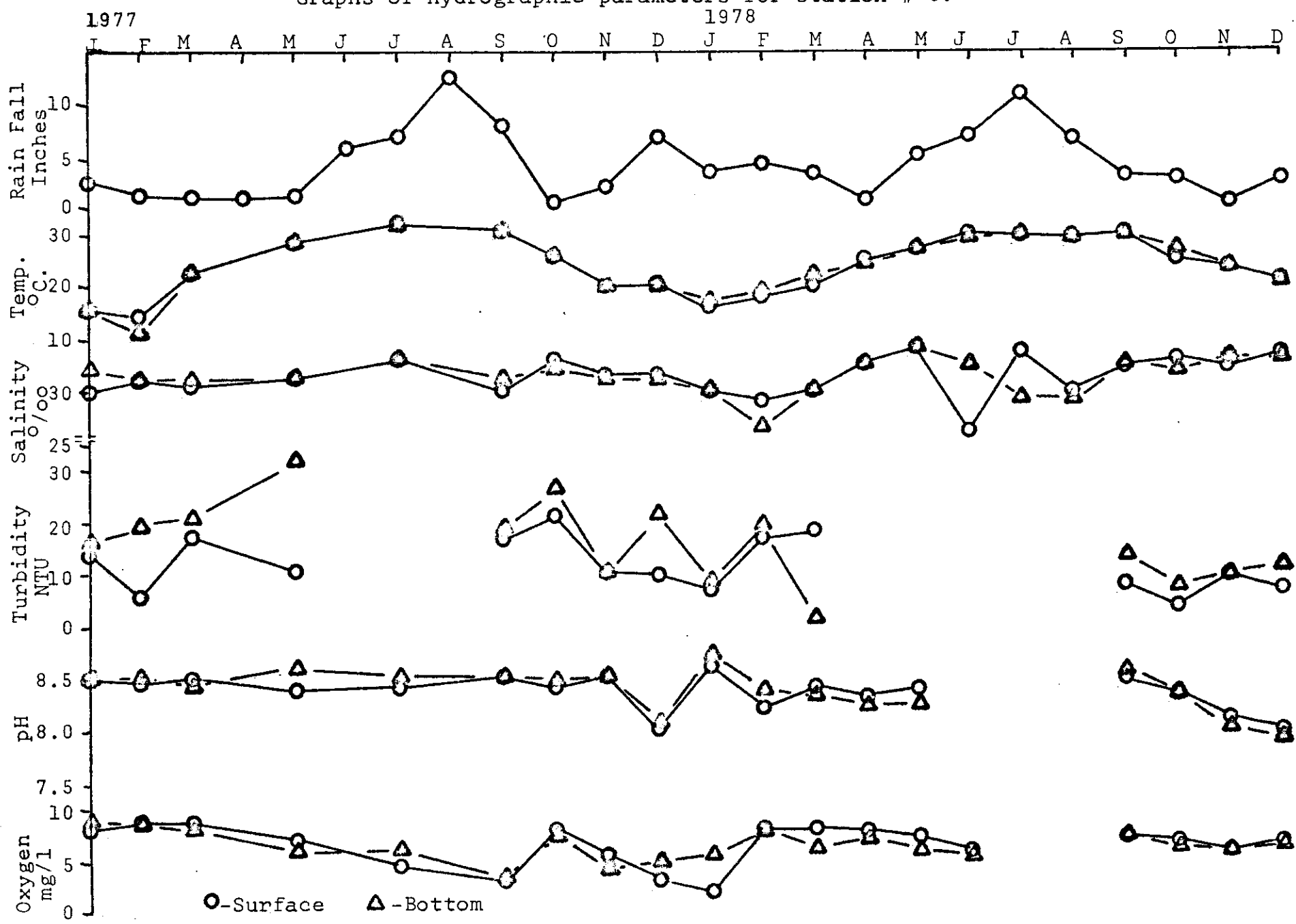


FIGURE C-6
 Graphs of hydrographic parameters for Station # 4.

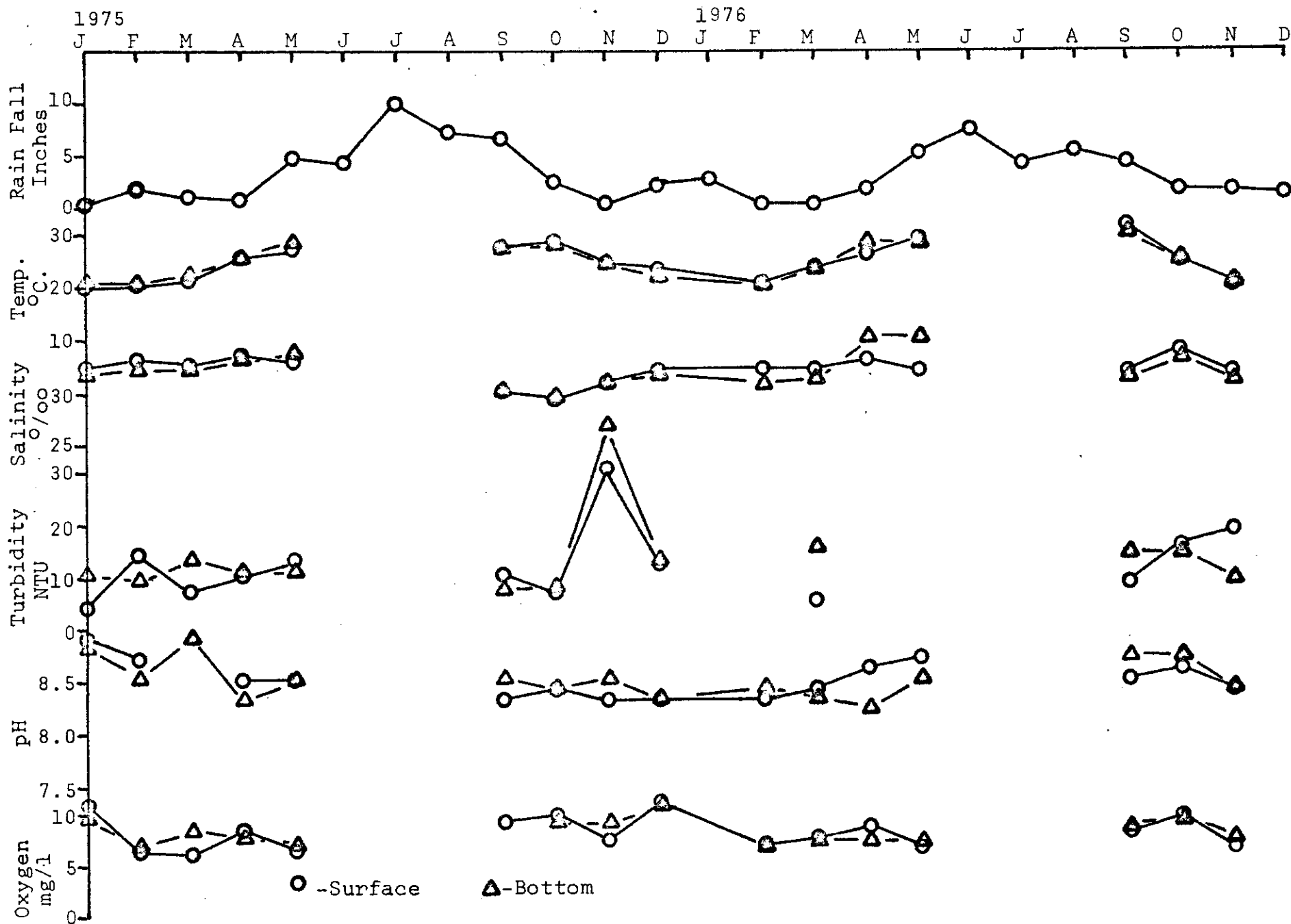


FIGURE (Continued)
 Graphs of hydrographic parameters for Station # 4.

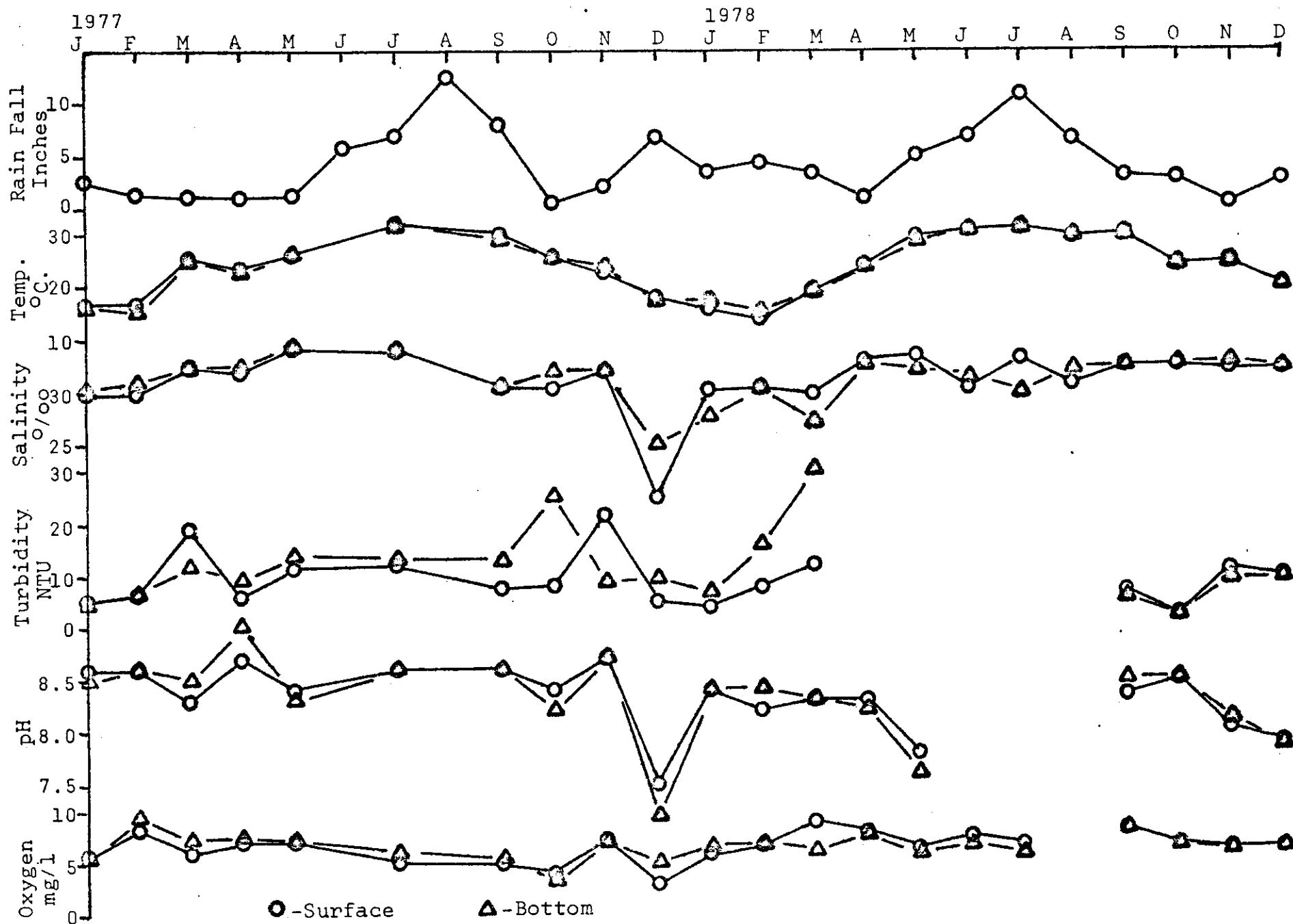


FIGURE C-7
 Graphs of hydrographic parameters for Stations # 6 and # 7.

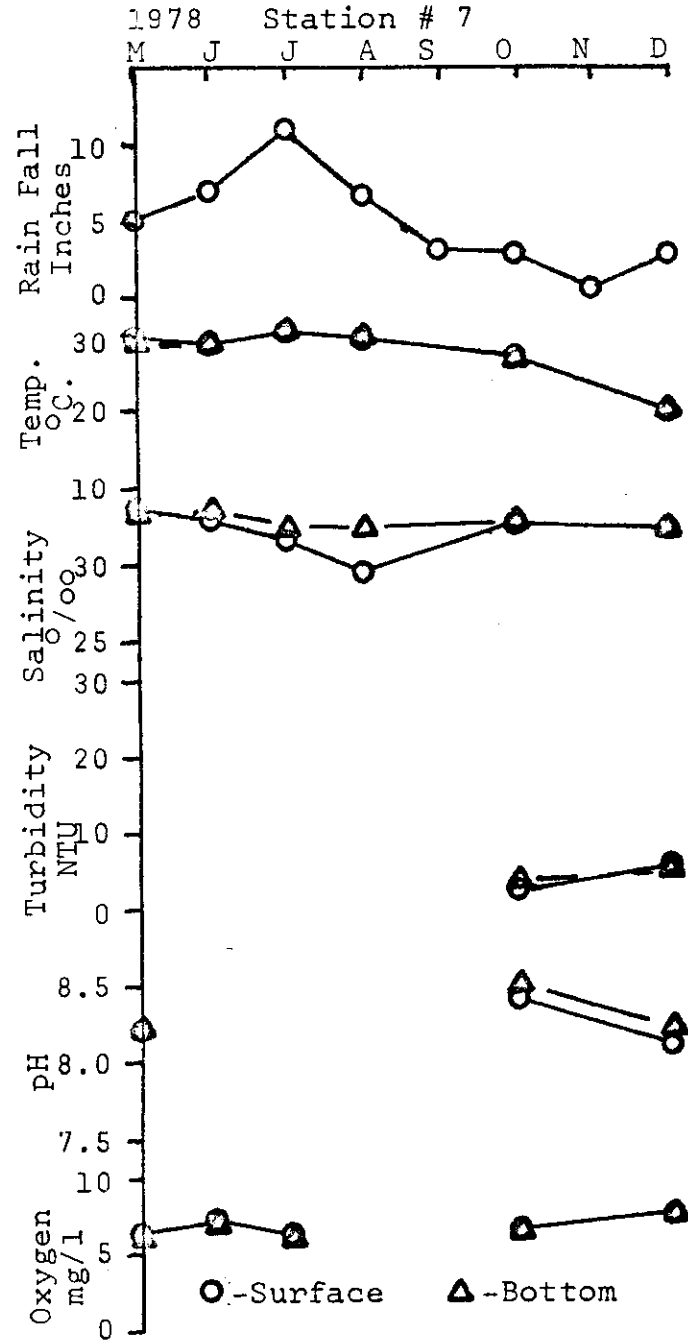
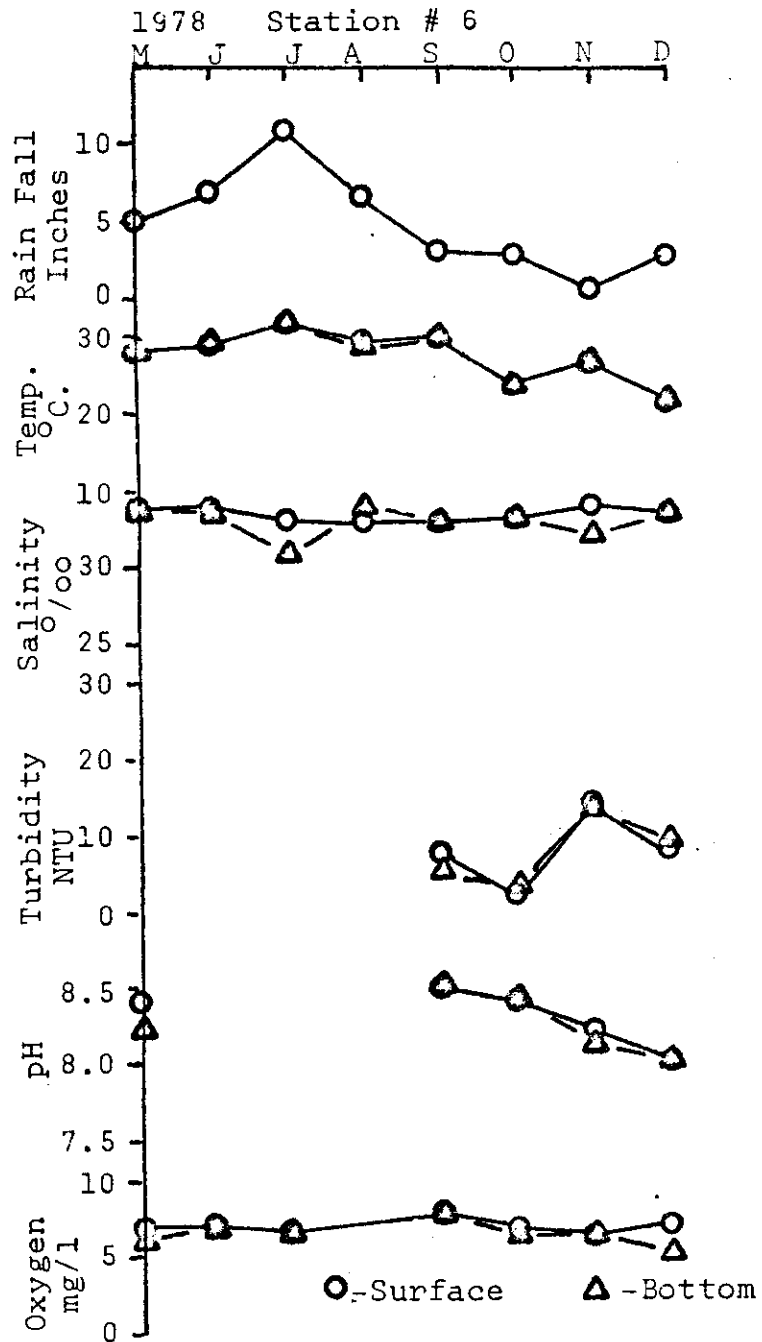
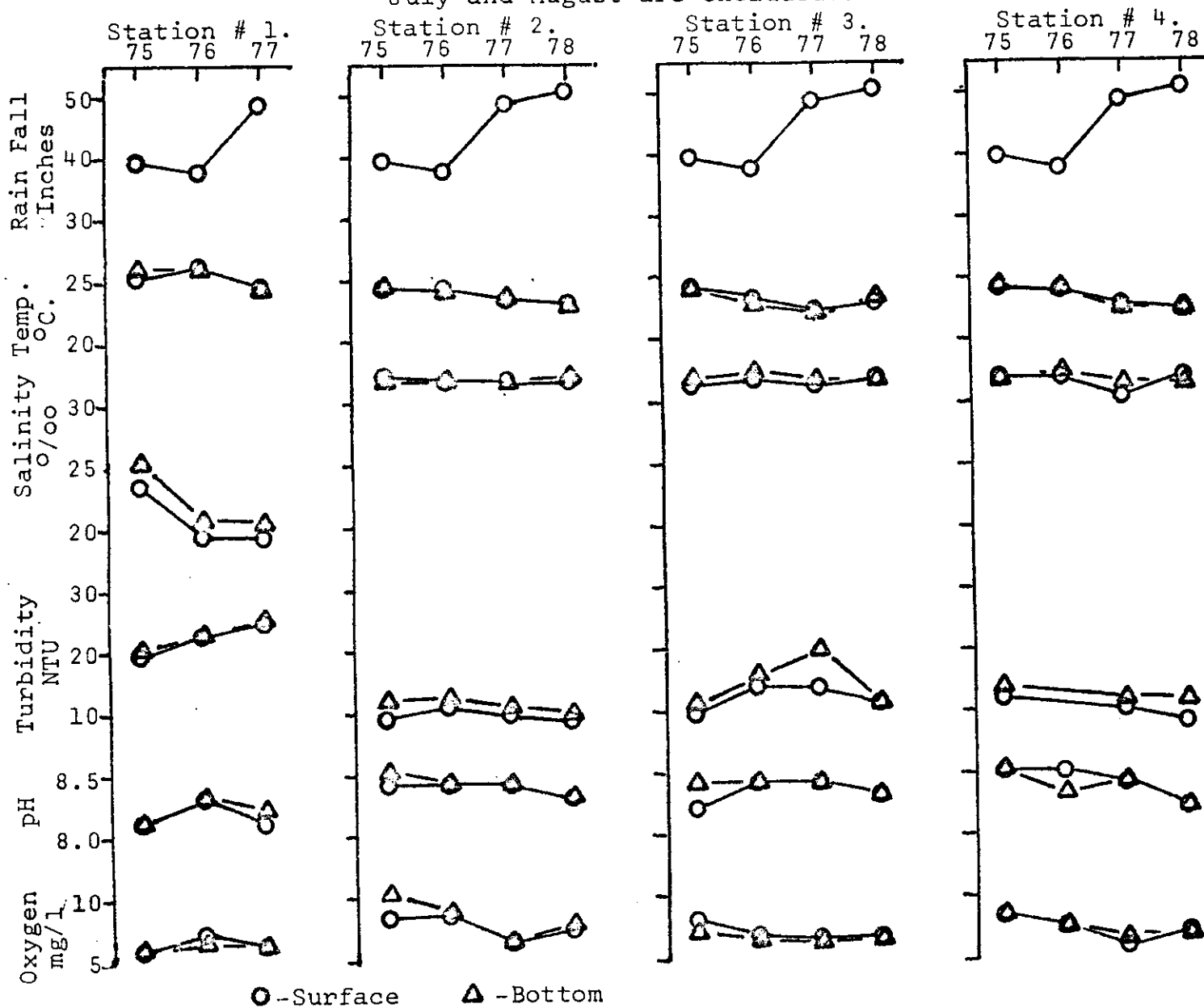


FIGURE C-8

Annual adjusted hydrographic averages.
 (Based on 9 months. June,
 July and August are excluded.)



The recording period started with two years of very low rainfall. Rainfall in 1977 and 1978 went up considerably but still did not reach the expected annual average rainfall of 54 inches per year. This fact should be noted when interpreting the annual averages for other factors.

From 1975 - 1978, the bay temperature declined as can be seen in the annual temperature averages at all stations. The nine month temperature average dropped from 1 to 2 degrees at each station over the four year period. This drop is primarily due to colder winter months and not an all year cooling trend.

Station #1 - Upper Hudson Bayou

Temperatures in Hudson Bayou ranged from a low of 13.0°C. (Jan. 1977) to a high of 33.5°C. (Sept. 1976). Higher summer temperatures might have been noted if summer data had been routinely collected. Hudson Bayou consistently exhibited higher temperatures in the winter. Upper Hudson Bayou temperatures averaged one or more degrees higher than the open bay. This could have been due to the shallow nature of the Bayou and the fact that the samples were taken in the afternoon. The effects of warm ground water input shouldn't be dismissed, however, as even the morning sampling times in 1975 showed higher temperatures than the open bay. Additional evidence of this might be indicated by the migration of fish up the Bayou during severe cold fronts.

As would be expected, Upper Hudson Bayou showed the greatest variation in salinities with a low of 0 ‰ and a high of 33.0 ‰. Average annual nine month salinities for the Bayou were usually more than 10 ‰ lower than the other stations.

Salinities were generally low during the rainy summer and winter months and high during the drier fall and spring. The highest average salinities were during the severe spring drought of 1975. Little regular stratification was found at this station.

Turbidities in Upper Hudson Bayou ranged from 3.0 to 65.0 N.T.U. A storm turbidity in May of 1978 had a record 300 + N.T.U. reading. Turbidities in the Upper Bayou averaged more than 15 N.T.U. higher than the other stations. A definite annual average turbidity increase was noted in the Bayou. Another year of data will be collected in 1981 to see if this trend continues.

The pH at this station is generally about 0.2 units lower than the rest of the bay. The range was from 7.3 to 8.6. Lower pH's were generally associated with lower salinities. This is to be expected as the pH of the fresh water above the dam is usually in the lower 7's. No annual trend was noted.

Oxygen values in Upper Hudson Bayou were slightly lower than at the other stations. Values ranged from 1.5 to 14.5 ppm. Oxygen values were usually lower than saturation levels by about 17% (See Table C-17 for theoretical saturations). Oxygen was most correlated with temperature but many anomalies occurred. Lows were sometimes found in September or October as the water started to cool off. Very high oxygen values were associated with low tides when dense algal mats covered the bottom or in the summer when phytoplankton counts were high. Twenty-four hr. monitoring in the moat showed ranges of from 0 before dawn to 12.3 at 17:00 hrs. in September, 1974. Lesser 24 hr. variations occur in the winter and the variation was from

TABLE C-17

Oxygen Solubility vs. Salinity and Temperature
mg/l

	Temperature °C.				
	30	25	20	15	10
35	6.2	6.7	7.4	8.1	9.0
30	6.4	7.0	7.6	8.4	9.3
25	6.6	7.2	7.8	8.6	9.6
20	6.8	7.4	8.1	8.9	9.9
15	6.9	7.6	8.3	9.2	10.2
10	7.1	7.8	8.6	9.5	10.6
5	7.3	8.0	8.8	9.8	10.9
0	7.5	8.3	9.1	10.1	11.2

1.2 to 10.4 in September of 1978. This system probably becomes anoxic frequently in the late summer. The night/day variation has always been at least 4 ppm when it has been checked. The muds on the bottom are all anaerobic with only one species of polychaete usually found.

Though no attempt was made to collect samples during heavy rains, nitrate values were usually below the limits of the procedures used. Phosphates ranged from 0.00 to 0.47 or the phosphate - P mg/l. A more detailed report of the nutrient question will be made in the next publication.

This station will be interesting to watch through the years as it shows the most degradation. The extensive halophyte planting could have some effects on the Bayou with time. The raw

data show the sudden changes in salinity after a rainfall with a quick rebound back to higher salinities. It is probable that this process occurred slower in the past. Some attempt to return to more gradual changes in salinities would probably help. Perhaps weirs in the upper drainage basin could help.

According to the Sarasota County Air and Water Pollution Control Department, Coliforms are still quite high during the rainy season. Some retainment system might also help this problem.

Station #11 - Lower Hudson Bayou

Though a full year of sampling had not been completed for Station #11 when this publication was completed, some conclusions are already apparent. The station parallels the open bay stations more than it does the Upper Bayou. This probably indicates that this is a very low flow tributary with major fresh water flow only occurring during storm run-off periods. Supporting this is the fact that salinities were generally high with the lowest being 25.0 ‰. Temperature, turbidity and pH all approximated open bay stations.

This station exhibited more stratification than any of the other stations. Though not always, surface to bottom temperature differences were usually around 1°C. Bottom turbidities were usually considerably higher and bottom oxygen values were generally lower than the surface. Though surface DO's were generally below saturation values, the bottom DO's were nearly always well below saturation values. This is obviously a stressed area; time and other tests should help determine the causes of the low oxygen

readings in Lower Hudson Bayou.

Station #2 - Bayfront Grass Flat

Station #2 with its shallow character and the associated grasses proved to be quite interesting. Rapid changes were the rule in the 24 hr. monitoring work and great variations were characteristic of most parameters at this station.

Temperature had the greatest range at this station with lows of 12.0°C. and a record high for this research of 35.0°C. The bottom temperatures were usually slightly cooler. The 9 month average annual temperature was between 22.7 and 24.4°C. As was noted at the other stations, the water has fallen 1.5°C. over the last 4 years.

Salinity has consistently averaged 31 to 32 ‰ for a year even though it has ranged from a low of 18 ‰ to a high of 34.5 ‰. Sudden and short lived drops of salinity occurred regularly after rains. Mixing seldom took more than 24 hours. The highest salinities were usually recorded during October, November, April and May - coinciding with the dry periods. Summer evaporation rates are apparently fairly high when compared to rainfall, as this station frequently had high summer salinities. This would further support the concept that this is a very low fresh water flow estuary.

Turbidity has been fairly stable at station #2 with little variation from an average of 10 N.T.U. over the period of 1975 to 1978. The range was from 1 to 45 N.T.U. High peaks were most often associated with westerly winds or heavy rainfall. During this period this station generally had the lowest turbidities. This could be due to entrapment of silt particles

by the grasses. As of yet, unpublished data for the winter and spring of 1979 has, however, shown a substantial increase in turbidity at this station.

The pH at this station is generally around 8.4 with slightly lower pH's during rainy winter months. The lowest pH recorded was 7.6 while the highest was 9.0. No year to year trend has been noted.

With the exception of 1977 DO values were at or above saturation levels. 1977 was the low year of the die off for the grasses on this flat (see station description). 1978 represented a recovery year and things seem to be back to normal in 1979. The annual oxygen values seem to reflect this decline in the grasses. 1975 and 1976 were above saturation while 1977 was below and 1978 was right at saturation value. Unlike the other stations, the winter DO values, when the grasses die back, are generally lower than the spring, summer and fall values. Values at the time we sample are generally above saturation except in the winter. This grass flat regularly exhibited very low pre-dawn summer DO's. In September of 1974, and September of 1978, there were several days when the pre-dawn values were 0 ppm. It is interesting to note that there were major red tides during these years. Other years the low pre-dawn values were usually between 1 and 2 ppm. This station exhibited the greatest 24 hr. cycle for oxygen values. Station #2 also exhibited the greatest variation in afternoon values with a low of 1.5 ppm and a high of 15 ppm.

Nitrate values were generally very low at this station. The average annual value was 0.002 mg/l NO₂-N/NO₃-N for both 1977 and

1978. Phosphate values were also quite low with the annual averages ranging from between 0.05 to 0.09 mg/l $\text{PO}_4\text{-P}$. It is interesting to note that the nitrate values in 1975 were higher than phosphate values at our stations and all but one county station (see table C-1). During the period of 1977 through 1978 phosphates were always in excess of nitrates at all stations. We have no explanation for this reversal.

Station #3 - O'Leary's

Temperature values at this station closely parallel those at station's 2 and 4, with the nine month average being 23°C ., + or - 1°C . The same general cooling trend was noted at this station during the reporting period. The lowest temperature recorded was 10°C ., and the highest was 32.2°C .

Salinity values were quite stable at station #3 throughout the years with the nine month average ranging from 31.1, to a high of 32.2. The lowest salinity recorded was 25.0 ‰ and the highest was 36.0 ‰. A very slight stratification is noted at this station. Turbidity data further indicate that some stratification exists.

Turbidity values ranged from 1 to 50 N.T.U. with the nine month averages varying from 9.1 to 19.6 N.T.U. This station had the highest turbidities of the open bay stations. Surface turbidities were higher than the other open bay stations and the bottom turbidities were considerably higher. From 1975 to 1977, a steady increase in bottom turbidity was observed. In 1978, the turbidity dropped from the 19.6 value in 1977, to 10.9 in 1978. January through February, 1979 values are again up

with the average around 15 N.T.U., while the surface average is again around 10 N.T.U. Except for high turbidities in the summer, no regular seasonal trends for turbidity have been noted. Rain and wind seem to have the greatest effect on turbidity in this area with the exception of the bottom turbidities as already noted.

Nine month average pH values were 8.4, + or - 0.1. The lowest pH recorded at this station was 7.2, while the high was 8.8. PH values seemed to be lower during rainy winter months as was the case at some of the other stations.

The nine month averages for dissolved oxygen at station 3 were in the 6's. The range was from 2.0 to 11.0. The DO values on the average were near or above saturation levels in 1975. From 1976 to 1978, dissolved oxygen fell below saturation levels with the bottom values being even further below saturation. Though stations 2 and 4 were below saturation in 1977, none of the other bay stations exhibited this sub-saturation trend. Most of this sub-saturation occurred during the summer and fall months - with values in the winter being near saturation. Twenty four hour monitoring showed low levels before dawn throughout the summer and even in April 1977. In April 1977, DO ranged from 0.9 to 7.4 during the 24 hour period. This station seems to be quite stressed with a lot of material coming to the area from somewhere and then decomposing lowering oxygen levels and raising the turbidity. The water at the bottom appeared to be milky in color. B.O.D.'s are now being run monthly to help determine the causes of these anomalies. The problem is probably due to heavy

urban run-off in the area but the marina and three nearby lift stations can't be dismissed yet.

As at other stations, nitrate values were also very low at this station. Phosphates fluctuated more than nitrates, but they too were often very low. The bottom water frequently had summer build-ups of phosphates. At times during the spring and summer months of 1978, both the phosphate and nitrate values were near zero.

Monitoring efforts in 1979 have again shown increases in turbidity and DO depression. A high chlorophyll a and plankton peak was observed at this station in January 1979. The Chlorophyll a value was nearly 18 mg/m^3 while the plankton count (mostly copepod nauplii) soared to $65,000/\text{m}^3$, the normal winter levels of less than $20,000/\text{m}^3$. At station 2, 100 yds. away, none of this was observed. Extensive study of all kinds will continue at this station.

Station #4 - Hart's Landing

Of the 4 original stations, station #4 represents the most stable environment with the least variation in most parameters. Temperature exhibited the same trends as at stations 2 and 3. Nine month averages ranged from 22.2 to 24.1°C . The range was from 13.0 to 33.0°C . The twelve month average for this station and lower Sarasota Bay in general would probably be around 25°C ., + or - 1°C . The 1978 twelve month average was 24.25°C .

Nine month salinity averages were usually between 31 and $32 \text{ }^\circ/\text{oo}$, with a range from 20 to $36 \text{ }^\circ/\text{oo}$. Computation of the twelve month average for salinity gives a value of $31.8 \text{ }^\circ/\text{oo}$, while the nine month average was $31.9 \text{ }^\circ/\text{oo}$ for 1978. While a

few lower salinities were recorded at station #4 they seldom lasted more than a few days. No variations due to tides were ever noted at stations 2,3 or 4 for salinity or for temperature.

Turbidities at this station ranged from 1 to 75 N.T.U. with the nine month averages being between 7.9 and 13.2.

The nine month pH average dropped from 8.5 to 8.2, over the four year period. No explanation can be found for this and it didn't occur at other stations with the possible exception of 1978.

Dissolved oxygen at station #4 was usually at or above saturation in the afternoon. This station also exhibited the depressed DO's in 1977, that were found at station #2. This seems significant especially since station #3 which is between these stations did not show a depression in 1977. Seasonally DO values seemed to parallel temperature with a few irregularities. The range for oxygen was 2.5 to 12 ppm. The maximum 24 hour range was less than 4 ppm.

Nitrate values were very low during 1977 and 1978. All values were below .07 mg/l, and usually were lower than our procedures would measure. In 1975, as at other stations, the nitrate values were quite high, ranging from 0.2 to 0.9 mg/l. Phosphates ranged from below detection levels to 0.3 mg/l in 1977-78. In the winter of 1975 they ranged from 0.027 to 0.07 mg/l. A decline in the annual average for phosphate from 1977 - 1978 is noteworthy. Perhaps the balance between the two nutrients is about to reverse again. The nutrient situation will be interesting to watch during the years to come.

Station #6 - Marker #8

As this station was added in May 1978, no annual averages are yet available. Salinity, however, appears to have less fluctuation and a higher average at station #6 over all other stations. Very little stratification was noted.

Turbidity was lower than the other stations. During the 1979 winter months, an interesting phenomena was noted. During heavy westerly winds the flood tide carried highly turbid (30 + N.T.U.) water into the bay. This turbidity curtain worked its way across the bay and would finally be detected at station #4, but never reached stations 11, 2 or 3. This could be seen visually. Apparently during this situation, there is very little mixing on the east side of the bay.

Oxygen levels were usually quite stable from month to month and they were usually just below saturation levels. The bottom DO values were generally lower than the surface values.

Station #7 - Marker #2

Station #7 is influenced by waters coming from Phillippi Creek. Salinity is fairly stable but fluctuates more than station #6.

Temperature and salinity data indicate some stratification at this station in the summer and fall. Dissolved oxygen values at the bottom were lower than the surface values during this same time period. Surface oxygen values were usually at, or above, saturation levels while the bottom values were often below.

Phosphate values were sometimes high at this station, especially at the bottom. Nitrates were usually low but during

the heavy rain in January 1979, nitrate values climbed to a high of 0.065 mg/l at the surface.

Summary

Lower Sarasota Bay appears to be a low freshwater flow system with fairly stable salinity that averages around 32 ‰ + or - 1 ‰. Summer to winter values don't vary much, with most stations having a range of 26 to 34 ‰. When salinities fall below 30 ‰, it isn't for very long. Vertical mixing seems fairly complete.

Temperatures average around 25°C. + or - 1°C., with a range of about 20°C. A general cooling trend was noted from 1975 to 1978.

With the exception of the bottom at station #3, turbidities averaged around 10 + or - 3 N.T.U.s. The bottom turbidities at station #3 are noteworthy, and demonstrate how sections of the bay can operate as nearly separate systems. Flow patterns seem minimal along the eastern part of the bay.

pH values were 8.3 + or - 0.2. Rain seemed to lower pH at most stations. Station #4 has had a declining pH over the last 4 years.

The greatest stress is exhibited by dissolved oxygen data. Stations 1, 11 and 3 exhibit summer depression below saturation values, even in the mid-afternoon when sampling occurred. Twenty four sampling at these stations indicated very low pre-dawn levels. This problem is probably associated with run-off during the summer months. All stations except #6 exhibited some oxygen values below saturation.

Phosphates and nitrates underwent a remarkable switch from 1975 to 1977, with the system changing from phosphate limited to nitrate limited. Highest phosphate values were found at stations 1 and 7, as would be expected. High nitrate values were recorded at station 7. Phosphate values generally declined at all stations from 1977 to 1978.

Since large 24 hour fluctuations in dissolved oxygen are associated with waters rich in fauna and flora, and since these excessive variations in O_2 levels cause the loss of some less tolerant species, it is felt that nutrient reduction should be a goal. This would reduce phytoplankton and thereby faunal elements of the community and help restabilize the oxygen cycles. Turbidities would also be reduced with less plankton, thereby allowing deeper benthic plant communities which would generally work to give an increase in species desirable to man. Since phosphates and nitrates have similar concentrations and even undergo ranking switches, reduction of both should be sought in sewage and run-off treatment systems.

D. ZOOPLANKTON

Introduction

Knowledge of the dynamics of the plankton system is essential to an understanding of the bay system. Much of the productivity of the system is due to phytoplankton that form the bottom of many bay food chains.

In addition to their vital role in estuarine carbon cycles the plankton community can also have significant effects on turbidity levels, O_2 levels and sedimentation. Since the benthic community depends on adequate light penetration for its productivity, increasing turbidities can reduce the depth of survival for benthic plants. Since Sport fishing in Sarasota Bay is dependent on the grass flats knowledge of turbidity changes and their causes are important.

Excessive plankton loads can cause low oxygen levels at night especially when little wind is mixing the water column. Some evidence of this problem is manifest at a few stations so analysis of the plankton community became a part of this study.

Chlorophyll analysis was started in December 1978 in order to observe seasonal and annual changes in the phytoplankton community. This work will be reported in 1981.

Zooplankton counts were taken from 1976 to present. Beginning in September 1978 the samples were taken every month. Since only 4 or 5 months of regular data are available, no statistical analysis will be made in this report.

New College has done some quantitative zooplankton counts but these records were unavailable. The only other data available were found in the section 208 study done on Phillippe Creek by the Southwest Florida Regional Planning Council (29). Samples were taken on June 23, 1977. Robert's Bay had 24,995 individuals/m³ while the bays south of Phillippe Creek ranged from 18,963 to 51,593 individuals/m³. This study reported that the total community metabolism (TCM) for the reported area was moderate to high for the west coast of Florida.

Methods

Until April 1978, plankton samples were taken in the field by pairs of students without supervision. Since that time the samples have been collected regularly from the decks of the Carefree Learner with supervision.

The "Learner" has a 5 meter interval marked on her rail and a Ward's #12 (125 meshes to the inch), 25cm. diameter plankton net is towed very slowly through that distance about 1 foot below the surface. The net is then lowered 3 times into the water without submerging the ring to backwash the plankton. Each time the lower part of the net is tucked into the vial to remove clinging plankton. The 32ml. sample is added to 3ml. of formaldehyde and the net material around the vial is swirled in the mixture to further insure removal of plankters. The net is back flushed with fresh water so that it is ready for the next sample.

Two students each take 1ml. sample of the plankton and place it in a Sedgewick-Rafter counting cell. Samples are agi-

tated before drawing the sample. The slides are counted at 40x on mechanical stage microscopes. The two student counts are averaged and then multiplied by a correction factor to represent the number/cubic meter. The multiplication factor allows for net area, distance towed, dilution with formaldehyde and the portion of the total sample represented by 1ml. The whole sample is counted for larger plankters with a 20x stereoscope.

Due to training difficulties not all plankters are counted. Each student has a book with photographs taken through their scope of a variety of each of the plankters they are to count. The following is a total list of the organisms searched for: nauplii (all nauplii lumped together), copepods, polychaete larvae, bivalve larvae, gastropod larvae, appendicularians, medusae, nematodes, cladocera, chaetognaths, tintinids, echinoderm larvae, zoea, fish eggs, fish larvae, and dinoflagellates of the genus Noctiluca. Records are also kept on other groups if they represent a significant portion.

Due to losses through net clogging and overflow these counts are, if anything, low. Each sample is checked by Mr. Stuart and constant records indicate that very small plankters are occasionally missed and so this would also cause a low count. The method does, however, provide uniformity with time because all of the variables remain fairly constant.

Station Descriptions

See station descriptions on page C-8.

Data

The counts for stations 1, 11, 2, 3, 4, 6 and 7 are given

in Tables D-1 through D-7.

TABLE D-1

Seasonal distribution of zooplankton in numbers/m³ for Station # 1.

	11/ 2/76	11/15/76	2/ 2/77	10/11/77	10/12/77	11/ 3/77	11/ 9/77	12/ 5/77
Tintinnids					220	7000	3590	1500
Hydromedusae								
Copepods	290	3730	450	4920	5830	3060	4330	9300
Cladocera				150			70	
Chaetognaths								
Appendicularians						150		220
LARVALS								
Pelyceenods					660		70	3900
Gastropods					670	300		70
Polychaetes	140	220	3020	150	150	600		12300
Echinoderms						225		
Nauplii	1230	7750	8100	3530	7770	4780	5900	11700
Decapods								
Fish eggs/ larvae								
Nematodes	1380		550	890				450
Amphipods		450						
Total zooplankton	3040	12370	12340	9640	15300	16115	13960	39440

TABLE D-1 (Continued)

Seasonal distribution of zooplankton in numbers/m³ for Station # 1.

	1/10/78	1/31/78	2/23/78
Tintinnids	300	1650	
Hydromedusae			
Copepods	3450	450	
Cladocera	150		
Chaetognaths			
Appendicularians			
LARVALS			
Pelyceps			70
Gastropods			
Polychaetes	150		
Echinoderms			440
Nauplii	4800	12800	150
Decapods		150	80
Fish eggs/ larvae			
Nematodes	450	375	740
Amphipods			
Total zooplankton	9300	15425	1480

TABLE D-2

Seasonal distribution of zooplankton in numbers/m³ for Station # 11.

	9/19/78	10/ 3/78	11/14/78	12/11/78
Tintinnids		600	225	300
Hydromedusae		3750		
Copepods	17550	6925	3300	3900
Cladocera	150	3375	150	
Chaetognaths				
Appendicularians	7350	1120		
LARVALS				
Pelycepods	10950	2950	1200	2025
Gastropods		2900	300	450
Polychaetes	300	2400	300	225
Echinoderms		370		
Nauplii	20700	15300	3600	4875
Decapods		150		
Fish eggs/ larvae	300	850		
Total zooplankton	57300	40590	9075	11775

TABLE D-3

Seasonal distribution of zooplankton in numbers/m³ for Station # 2.

	11/16/76	11/23/76	9/19/78	10/ 3/78	12/11/78	1/30/78
Tintinnids					600	1800
Hydromedusae			1275	525		150
Copepods	2240	1190	19950	8150	15300	1800
Cladocera			2025	1425		
Chaetognaths						
Appendicularians		300	3975	2925	900	
LARVALS						
Pelycepods	290	300	5725	6600	150	300
Gastropods	290	600	1125	4950	75	
Polychaetes		450	825	975	2700	300
Echinoderms			300			
Nauplii	5210	1790	89550	18300	16215	5250
Decapods						
Fish eggs/ larvae						
Total zooplankton	8030	4630	124750	43850	35940	9600

TABLE D-4

Seasonal distribution of zooplankton in numbers/m³ for Station # 3.

	11/ 2/76	11/15/76	2/ 7/77	5/19/77	9/12/77	10/11/77	11/13/77	12/ 5/77
Tintinnids	2460		1560	2140	1740	600	1875	1200
Hydromedusae		150				670		
Copepods	5640	11950	520	5220	12530	5530	2550	2770
Cladocera				20			75	
Chaetognaths								
Appendicularians		290			300			300
LARVALS								
Pelycepods				60	2900	5140		300
Gastropods		290		420		670	225	
Polychaetes	290	150	820			900	525	600
Echinoderms								
Nauplii	117300	19520	2750	15940	15300	8220	3825	1650
Decapods				100				
Fish eggs/ larvae								
Total zooplankton	125690	32350	5660	23900	32770	21730	9075	6820

TABLE D-4 (Continued)

Seasonal distribution of zooplankton in numbers/m³ for Station # 3.

	9/19/78	10/17/78	11/14/78	12/11/78
Tintinnids		1950	3075	
Hydromedusae	600	1200		
Copepods	32175	10125	7200	7950
Cladocera	750	1650		1050
Chaetognaths				150
Appendicularians	5100	2775		150
LARVALS				
Pelycepods	3600	14625	1125	2850
Gastropods	1425	3375		1200
Polychaetes	525	1380		615
Echinoderms			300	
Nauplii	67725	4915	4050	4950
Decapods		900		150
Fish eggs/ larvae		1050		
Total zooplankton	111900	44245	15450	19065

TABLE D-5

Seasonal distribution of zooplankton in numbers/m³ for Station # 4.

	11/ 6/76	11/16/76	2/ 7/77	10/11/77	11/ 9/77	1/10/78	2/23/78
Tintinnids	1040		740		3140	525	
Hydromedusae		70					
Copepods	23840	10950	820	7170	4030	7125	2475
Cladocera	150						
Chaetognaths							
Appendicularians		1040		1790			
LARVALS							
Pelycepods	9690	1940	70	4840			370
Gastropods		220		150		75	
Polychaetes	2240	3950	300	370	70		970
Echinoderms							
Nauplii	32780	16240	2680	5830	2390	5475	2320
Decapods							
Fish eggs/ larvae							
Total zooplankton	69740	34410	4610	20150	9630	13200	6135

TABLE D-5 (Continued)

Seasonal distribution of zooplankton in numbers/m³ for Station # 4.

	9/19/78	10/17/78	11/14/78	12/11/78
Tintinnids		450	2950	150
Hydromedusae	525		225	
Copepods	12875	11750	10800	6900
Cladocera	575	150		
Chaetognaths		150	75	
Appendicularians	2400		300	1050
LARVALS				
Pelycepods	1350	1275	150	1065
Gastropods	675	225		750
Polychaetes	975	750	450	1215
Echinoderms				
Nauplii	23700	12300	12975	17400
Decapods				
Fish eggs/ larvae				
Total zooplankton	43075	27050	27925	28530

TABLE D-6

Seasonal distribution of zooplankton in numbers/m³ for Station # 6.

	9/12/78	10/17/78	11/14/78	12/11/78
Tintinnids	375	765	300	2250
Hydromedusae	225	300	150	
Copepods	10525	11850	16050	12825
Cladocera	675			
Chaetognaths				
Appendicularians	1800	300	150	1650
LARVALS				
Pelycepods	2175		3375	300
Gastropods	150	150	375	
Polychaetes	525	300	1350	450
Echinoderms			300	
Nauplii	11850	9600	3675	12525
Decapods				150
Fish eggs/ larvae				
Total zooplankton	28300	23265	25725	30150

TABLE D-7

Seasonal distribution of zooplankton in numbers/m³ for Station # 7.

	10/ 3/78	12/14/78	1/30/79
Tintinnids	225	165	2100
Hydromedusae	375		
Copepods	13105	13080	1200
Cladocera	750		
Chaetognaths			
Appendicularians	1425	465	
LARVALS			
Pelycepods	5250	900	300
Gastropods	4650	150	300
Polychaetes		465	150
Echinoderms	600		
Nauplii	8625	14265	3450
Decapods			
Fish eggs/ larvae			
Total zooplankton	35005	29490	7500

Discussion

Since a full year of data has not yet been collected only limited conclusions may be drawn.

Sarasota Bay exhibits a marked seasonal variation in zooplankton with peaks in the warm summer months and extreme lows in January and February. There is a fair amount of variation, in the warm months from station to station. Stations #2 and #3 had the highest peaks in September while station #6 had the lowest. Station #6, of course, has the highest salinity and is most influenced by Gulf waters. Station #6 also had the most constant populations through the fall months.

Data reported here plus data collected through May 1979 would indicate that the average annual count for the bay system is going to be in excess of 60,000 individuals/m³. This is fairly high for a low flow West Coast estuary especially since the counts reported here are probably low. According to the table listed in by Weiss, 1978, that would be a fairly high count for any area on the Atlantic and Gulf Coasts (34). Counts in excess of this have only been reported for Cox Bay, Anclote Estuary, Long Island Sound and Tampa Bay.

As reported for other estuarine areas the holoplankton dominate the system with copepods and nauplii accounting for the most significant part of the counts. Appendicularians also comprise a significant portion during some months.

Meroplankton accounts for a significant portion during the summer months. This is normal with an active benthic community as in Sarasota Bay.

No further attempts at analysis of this data will be made

in this report. The monthly samples will continue and a complete statistical analysis will be made in 1981 when the zooplankton and phytoplankton can be looked at together.

E. GRASS FLAT MEASURED TOWS

Introduction

Grass flats play a vital role in Sarasota Bay's productivity, especially in terms of man's use of the bay. Many researchers have documented the role grass flats play as nursery areas. Many sport fish spend part of their life cycle on the grass flat or prey on organisms that have used the grass flats. The health of the grass flat system is, therefore, important to man's interest in the bay.

Long term quantitative analysis of the organisms on the grass flats can give an indication of the productivity and stability of the flats. For this reason, a measured tow was initiated that would demonstrate seasonal variations to the students and yet provide useful long term information on the fishes and invertebrates that could be caught with a net.

Methods

Collection is done with a net towed from the boat at 1.25 to 1.5 knots for 5 minutes. The net is a roller trawl with a 1 meter wide and 25 cm high opening over a 10 cm roller. A twelve foot 3/4" stretch mesh nylon net is attached to the frame with a quick release opening at the end of the bag. The tow covers an area of approximately 200 square meters.

Each organism is counted and measured in 2 cm. intervals. The count is done on the boat and new or unusual specimens are

returned to the lab for identification (see bibliography for the keys used in identification). Wind speed, direction, cloud cover, water temperature, O_2 , salinity, pH, tide condition and a description of the vegetation in the net are recorded for each tow.

Station Description

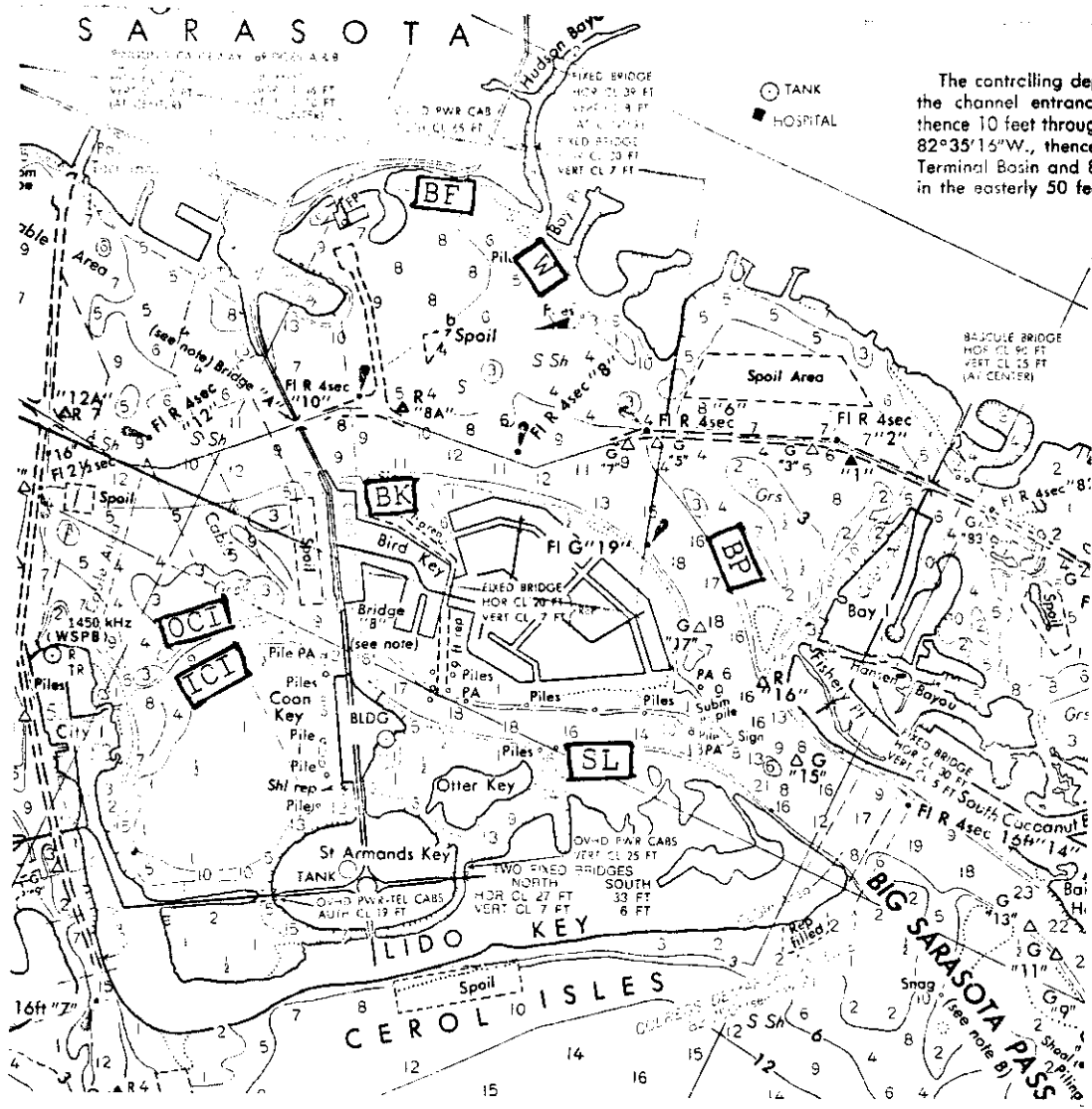
Seven stations are sampled each month. The stations are pictured on the map in Figure E-1. South Lido grass flat and Bird Key Yacht Club grass flat are almost totally turtle grass while the other stations are mixed turtle and shoal grass. The outer City Island grass flat has some manatee grass. Depths in the areas towed are usually around 18" below mean spring low tide with the exception of the outer City Island-grass flat which varies from 18" to 3'.

Big Pass, South Lido, outer City Island and inner City Island grass flats average 1 - 2 ‰ higher salinities than the Bayfront grass flat.

Data

Tables E-1 through E-7 give the results of the catches from April 1978 to February 1979. Table E-8 gives the technical names for the species collected.

FIGURE E-1
Station Locations for Measured Tows



- BF - Bayfront Grass flat
- W - Wreck Grass flat
- BK - Bird Key Yacht Club Grass flat
- BP - Big Pass Grass flat
- SL - South Lido Grass flat
- OCI - Outer City Island Grass flat
- ICI - Inner City Island Grass flat

TABLE E-1

Monthly size frequency distribution data
for catches on the Bayfront grass flat.

	5/78	6/78	8/78	9/78	10/78	11/78	12/78	1/79	2/79	
MOLLUSKS										
Dove Shell	0-2							5		
Oyster Drill	0-2				2					
Tulip Shell	2-4	1								
ARTHROPODS										
Grass Shrimp	0-2		15	1	2	10	18	12	7	1
	2-4	1	8	1	1		38		11	2
	4-6		2							3
Bayonet Shrimp	0-2	1	14					3		
	2-4	5	51		3		3	11	9	1
	4-6		13		3	5	3	3		1
	6-8					2				
Pink Shrimp	2-4			1					1	
	4-6				1		2		2	
	6-8	1					2			1
Spider Crab	0-2		1	2						
Blue Crab	6-8		1							
	8-10				1	1				
	14-16			1	1					
Mud Crab	0-2			2						
Hermit Crab	0-2					3	8	9	21	3
	2-4						2			
ECHINODERMS										
Sea Urchin	4-6		1							
CHORDATES										
Sea Squirt	2-4							1		
	4-6							1		
	6-8							3		
	10-12							1		
Colonial Tunicate	0-2							1		
	2-4							1	1	
Ascidian	2-4									4
	4-6									2
	8-10									1
	10-12									2
	12-14									1
	16-18									1
	20-22									1
	24-26									1

TABLE E-1 (Continued)

Monthly size frequency distribution data
for catches on the Bayfront grass flat.

		5/78	6/78	8/78	9/78	10/78	11/78	12/78	1/79	2/79
CHORDATES (cont.)										
FISH										
Pipe Fish	4-6		2							
	20-22				3					
Sea Horse	2-4						2			
Silversides	2-4				2					
	4-6				5					
Grouper	12-14			1						
Grunt	12-14				1					
Pin Fish	0-2	31								5
	2-4	6	3			1			37	2
	4-6	1	11	2		1			17	
	6-8		5	3	1	1			1	
	8-10			1	2		1			
	10-12				2					
Mojarra	0-2					3			1	
	2-4				6	8			2	1
	4-6		4					1		
Croaker	2-4		2	1						
	4-6		17	1						
	6-8		3	3						
File Fish	0-2	3					9			
	2-4	21	1				13	4		1
	4-6	2						4	1	
	6-8		4							
	8-10		3	1	1					
	10-12				2					
Cow Fish	0-2						1			
Puffers	4-6								2	
Spiny Box Fish	6-8					1	3	8		
	8-10				1			5		
	10-12					1				
Goby	2-4	1								

TABLE E-2

Monthly size frequency distribution data
for catches on the Wreck grass flat.

	5/78	6/78	7/78	9/78	10/78	11/78	12/78	1/79	2/79	
MOLLUSKS										
Horse Conch	2-4							2		
Oyster Drill	0-2					2				
	2-4					1				
ARTHROPODS										
Grass Shrimp	0-2		21	3	8	1	2	77	13	27
	2-4	2	24	3	6	1		3	11	2
	4-6		5		1			2	2	1
	6-8		1							
Bayonet Shrimp	0-2		11	1	1	1		1		1
	2-4	3	24	15	3	8	1	3	11	7
	4-6	2	14	7	2	5	6	7	11	3
	6-8									1
Pink Shrimp	0-2		1							1
	2-4	1	1	1	7				1	3
	4-6	2	15		3	1	5	2	4	
	6-8				1	1	2	3		
	10-12	1								
Spider Crab	4-6			1						
Blue Crab	0-2							1		
	8-10		1							
	10-12			1						
Mud Crab	2-4		1							
	4-6		1							
Hermit Crab	0-2		5		1	2	14	9	60	4
	2-4		3			1	1	1	1	
	4-6		1							
ECHINODERMS										
Sea Urchin	6-8	1								
	8-10			1						
CHORDATES										
Sea Squirt	0-2								6	3
	2-4								1	5
	4-6							1		
	6-8							11		
	8-10							1		
	10-12							1		

TABLE E-2 (Continued)

Monthly size frequency distribution data
for catches on the Wreck grass flat.

		5/78	6/78	7/78	9/78	10/78	11/78	12/78	1/79	2/79
CHORDATES(cont.)										
Colonial	0-2									2
Tunicate	2-4								1	
	6-8							2	1	
	18-20								1	
	Ascidian	0-2							1	
	2-4									1
	4-6								8	1
	6-8								7	2
	8-10								13	
	12-14								6	
	14-16								6	
	16-18								6	
	18-20								14	2
	20-22								1	
	24-26								1	
	26-28								2	
FISH										
Pipe Fish	6-8	1	1							
	8-10		4							
	10-12	1	3							
	12-14		1							
	16-18	1								
Sea Horse	2-4			2	1			1	1	1
	4-6								1	
	8-10	1		1						
Grouper	2-4	2								
	6-8		1							
Snapper	2-4		4							
Grunt	6-8		1							
	8-10		1							
	10-12			1						
Pin Fish	0-2	7	215						25	34
	2-4	38	157	1					28	21
	4-6	5	154	8					3	
	6-8		17	18	7					
	8-10		2	13	14		1			
	10-12	1		1	2					
	12-14							1		
14-16			1							

TABLE E-2 (Continued)

Monthly size frequency distribution data
for catches on the Wreck grass flat.

		5/78	6/78	7/78	9/78	10/78	11/78	12/78	1/79	2/79
CHORDATES(cont.)										
FISH(cont.)										
Mojarra	0-2		3		1			1		
	2-4		5	1	3	1	2		2	
	4-6		3		2		1			
	6-8						2			
Croaker	0-2		1							
	2-4		3							
	4-6			1						
	6-8			9	1					
Trout	4-6		1							
Wrasse	4-6								1	
File Fish	0-2						6			
	2-4	3	1	1			7			
	4-6	5	1					5		
	6-8			1						
	8-10			1				1		
	10-12			1						
Puffers	2-4		1							
Spiny Box Fish	2-4			1	1		1			
	4-6							1		
	6-8			1	1		1	5	1	
	8-10						1		2	
	10-12							1		
	14-16			1						
Toad Fish	0-2		1							
Grassy Scorpion Fish	8-10			1						
Flounder	2-4		1							

TABLE E-3

Monthly size frequency distribution data
for catches on Bird Key Yacht Club grass flat.

		5/78	6/78	7/78	9/78	10/78	11/78	12/78	1/79
MOLLUSKS									
Dove Shell	0-2						5	2	3
	2-4								1
Oyster Drill	0-2						6		
ARTHROPODS									
Grass Shrimp	0-2	1			1		6	29	45
	2-4	1					1	1	4
Bayonet Shrimp	0-2	1	1		1	2	1		2
	2-4	8	8	9	4	6		2	7
	4-6	1		5	4	7	2	9	3
	6-8					2			
Pink Shrimp	0-2					3			
	2-4	1				6		1	2
	4-6	1	4	1		12	2		9
	6-8	1				22	13		
	8-10	2				11	10	1	
	10-12					2	2		
Spider Crab	0-2		1						
Blue Crab	0-2					3			
	2-4					1		1	
	4-6		1						
	6-8		2						
	10-12					1			
Mud Crab	0-2		2						
Hermit Crab	0-2							1	2
ECHINODERMS									
Sea Urchin	0-2					2			
	2-4								1
	6-8			1			2		
CHORDATES									
Sea Squirt	4-6							3	6
	6-8							6	39
	8-10							5	20
	10-12							1	5
	12-14								1
Colonial Tunicate	0-2								9
	2-4								14
	4-6								5
	10-12							1	2
	12-14								1
	18-20								1

TABLE E-3 (Continued)

Monthly size frequency distribution data
for catches on Bird Key Yacht Club grass flat.

	5/78	6/78	7/78	9/78	10/78	11/78	12/78	1/79
CHORDATES Cont.								
Ascidians	0-2							2
	2-4							2
	4-6							2
	6-8							2
	8-10							1
FISH								
Pipefish	2-4	3						
	4-6	1	1					
	6-8	1						
	8-10		1					
	10-12	1		1				
	12-14	1						
	14-16		1					
	18-20	1						
Sea Horse	0-2	1			1			
	2-4	1	5	2	1			
Grouper	8-10			1				
	12-14		2					
Snapper	2-4					2		
Grunt	2-4	1						
	4-6	1						1
	6-8	1		2				
	8-10		2	2				
Pin Fish	0-2	21		1				19
	2-4	125	8	23			1	23
	4-6	37	154	63		1		11
	6-8	5	135	44	4			
	8-10	2	35	7	4	3		
	10-12	1		1	2	1		
	12-14		1	2			2	
Mojarra	0-2			3	4		1	
	2-4			3	16	4		1
	4-6				2		5	3
	6-8				1		1	
Croaker	2-4		1	3				
	4-6		2					
	6-8			1				
Trout	4-6		1					

TABLE E-3 (Continued)

Monthly size frequency distribution data
for catches on Bird Key Yacht Club grass flat.

		5/78	6/78	7/78	9/78	10/78	11/78	12/78	1/79
FISH Cont.									
File Fish	0-2	1					1	1	
	2-4	8						1	
	4-6	2						2	
	6-8	1		3				3	
	8-10			2					
	10-12		1	2	1				
Cow Fish	6-8	1							
	8-10	1		1					
Puffers	4-6								1
	8-10	1							
	10-12		1						
Spiny Box Fish	2-4		1						
	6-8	1							
	8-10			1				1	
	10-12	1	1	1					
	12-14			1	2				
	14-16				1				
Toad Fish	6-8			1					
	8-10		1						
Grassy Scorpion Fish	8-10	1							
Blenny	2-4		1						
Florida Ling	2-4								1
	6-8								1
	8-10								1

TABLE E-4

Monthly size frequency distribution data
for catches on Big Pass grass flat.

		5/78	6/78	10/78	11/78	12/78	1/79	2/79
MOLLUSKS								
Dove Shell	0-2				2	3	2	
	2-4				2			
Horn Shell	0-2							1
	2-4							1
Tulip Shell	2-4		1					
Nudibranch	0-2				1			
ARTHROPODS								
Grass Shrimp	0-2	12	67	4	5	26	81	72
	2-4	1	77				2	6
	4-6		42		1		1	2
Bayonet Shrimp	0-2	3	1	1	2	1	22	2
	2-4	23	18	30	30	21	53	43
	4-6			25	16	9	75	45
	6-8				1			
Pink Shrimp	2-4			1			3	3
	4-6				1			2
	6-8			8	1	1		
	8-10			1	1	2		1
Spider Crab	0-2		2					
	2-4		1					
	12-14		2					
Blue Crab	0-2				1			
	2-4				1			
	4-6		1					
	6-8		1					
Hermit Crab	0-2	4			2	11	26	8
ECHINODERMS								
Star Fish	0-2		48					1
	2-4		22		1	1		
	4-6		6		2			1
Sea Urchin	0-2		1		6			
	2-4					1		
	4-6							3
	6-8							2
	8-10							1
CHORDATES								
Sea Squirt	0-2							3
	2-4					1		1

TABLE E-4 (Continued)

Monthly size frequency distribution data
for catches on Big Pass grass flat.

		5/78	6/78	10/78	11/78	12/78	1/79	2/79
CHORDATES(cont.)								
Colonial	2-4						2	
Tunicate								
Ascidians	0-2							1
	2-4							2
	4-6							2
	8-10							1
FISH								
Anchovy	4-6				1			
Barracuda	4-6						1	
Pipe Fish	6-8	1	1					
	8-10		1					
	10-12		2					
	14-16		1					
	16-18	1						
Sea Horse	2-4		1		1			1
	4-6							1
	16-18	1						
Silversides	4-6							1
Grunt	2-4		1					4
	6-8		1					
	14-16	1						
	20-22		1					
Pin Fish	0-2	12					11	15
	2-4	65	13				24	24
	4-6	6	20		1	1	4	6
	6-8		11					
	8-10		11					
	10-12				2	1		
Sheepshead	2-4		3					
Mojarra	0-2		2		1			
	2-4		10		1	1	1	
	4-6		1			2	1	
Croaker	2-4		5					1
	4-6		16					
	6-8		1					
File Fish	0-2	2			20	4		
	2-4	8			9	51	2	1
	4-6					47		
	6-8	1	2			11		

TABLE E-4 (Continued)

Monthly size frequency distribution data
for catches on Big Pass grass flat.

	5/78	6/78	10/78	11/78	12/78	1/79	2/79
CHORDATES(cont.)							
FISH(cont.)							
Spiny Box Fish 2-4					1		
4-6				1			
6-8			2	2	5		
8-10				2		2	
Toad Fish 10-12		1					
Blenny 0-2		1					
Florida Ling 6-8							1

TABLE E-5

Monthly size frequency distribution data
for catches on South Lido grass flat.

		6/78	7/78	9/78	10/78	11/78	12/78	1/79	2/79
MOLLUSKS									
Dove Shell	0-2					3	2	1	
Horn Shell	0-2					3		1	
Sea Hare	10-12								2
Nudibranch	2-4					8			
ARTHROPODS									
Grass Shrimp	0-2				48	11	261	285	36
	2-4		5		16		29	2	
	4-6						4		
Bayonet Shrimp	0-2				9	1	2	4	28
	2-4	2	9		27	1	14	8	14
	4-6				7	3	24	9	22
Pink Shrimp	2-4		1		2			3	2
	4-6		1	2	19				
	6-8	5			55				
	8-10				29	1			
	10-12				2				
Spider Crab	0-2	1							
	2-4	2							
	4-6	3							
	6-8	2							
	8-10	1							
Blue Crab	0-2							1	2
	2-4			1					
	4-6	2							
	8-10	1							
	12-14	1							
Mud crab	0-2			1					
Hermit Crab	0-2						3		18
ECHINODERMS									
Starfish	0-2	3	2					1	
	2-4		1						
Sea Urchin	0-2	31		5	9				
	2-4			16	6		2	1	
	4-6			1	8	7			
	6-8				2	7			
	8-10				1				

TABLE E-5 (Continued)

Monthly size frequency distribution data
for catches on South Lido grass flat.

		6/78	7/78	9/78	10/78	11/78	12/78	1/79	2/79
ECHINODERMS Cont.									
Worm Sea	10-12							1	
Cucumber	12-14							1	
CHORDATES									
Sea Squirts	2-4						1		
Colonial	0-2							1	
Tunicate	2-4							2	
	4-6							2	
	6-8							1	
Ascidians	0-2							3	
	2-4							1	
	4-6							2	
	6-8							1	
	8-10							1	
FISH									
Anchovy	4-6						1		
Lizard Fish	10-12						1		
	12-14						1		
Pipe Fish	6-8	1							
	8-10	1							
	10-12	4							
	12-14	6							
	14-16	2		1					
Sea Horse	0-2	2							
	2-4	9		2					
	4-6						1		
Grouper	12-14	1							
Snapper	0-2	6							
	2-4	10							
	4-6	2							
Grunt	0-2								
	2-4								4
Pin Fish	0-2							3	8
	2-4		59	25				2	
	4-6	175	50					1	
	6-8	77	55	1					
	8-10	3	11	1					
	10-12			2					

TABLE E-5 (Continued)

Monthly size frequency distribution data
for catches on South Lido grass flat.

		6/78	7/78	9/78	10/78	11/78	12/78	1/79	2/79
CHORDATES(cont,)									
FISH(cont.)									
Mojarra	0-2		9	1	1				
	2-4		5	3					
	4-6		1						
Croaker	0-2	7							2
	2-4	3	2						
	4-6	1	2						
	6-8	1	6						
File Fish	0-2					16	2		2
	2-4	1				5	19		
	4-6	3					22		
	6-8	1					3		
Cow Fish	18-20								1
Puffers	0-2	1							
	2-4	1							
Spiny Box Fish	4-6								2
	8-10				1				
	12-14			1					
Toad Fish	4-6					1			
	10-12	1							
Blenny	6-8	1							
	8-10	1							
Florida Ling	6-8							1	
Flounder	10-12		1						
	18-20	2							
	26-28	1							

TABLE E-6

Monthly size frequency distribution data
for catches on Inner City Island grass flat.

		5/78	6/78	7/78	9/78	10/78	11/78	12/78	2/79
MOLLUSKS									
Dove Shell	0-2						50	30	16
Horn Shell	0-2							5	
Oyster Drill	0-2								2
Horse Conch	0-2							4	
Sea Hare	8-10 10-12						2	2	
Nudibranch	0-2						33	12	
ARTHROPODS									
Grass Shrimp	0-2	15		1	4	2	76	160	95
	2-4	4			7	1	3	3	67
	4-6	8				2			
Bayonet Shrimp	0-2	2				2	5	3	14
	2-4	5		1	1	13	22	7	27
	4-6	3				4	19	13	8
	6-8						1		
Pink Shrimp	2-4		2	4	12	3		7	1
	4-6	1	1		9	20	3	2	2
	6-8				1	21	9	2	
	8-10	1				4	6	8	
	10-12	1				2	3		
Rock Shrimp	0-2							9	
Red Cleaner Shrimp	2-4	1	1						
Spider Crab	0-2		1	1					
	2-4		1	32					
	4-6		19	41					
	6-8		2	21					
Blue Crab	0-2					7			
	2-4	2				3	1		
	4-6			2		1			
	6-8		1						
	8-10	1	2	4					
	10-12		1						
	12-14			1					
Mud Crab	0-2								1
	2-4						2		

TABLE E-6 (Continued)

Monthly size frequency distribution data
for catches on Inner City Island grass flat.

		5/78	6/78	7/78	9/78	10/78	11/78	12/78	2/79
ARTHROPODS(cont.)									
Hermit Crab	0-2	1					2	1	7
ECHINODERMS									
Starfish	0-2		2	1					
	2-4		1	10					
	4-6			8					
Sea Urchin	0-2					6	10	1	
	2-4						5	2	
	4-6			1					
	6-8			1					
CHORDATES									
Colonial Tunicate	0-2								1
Ascidians	0-2								1
	2-4								4
	4-6								6
	8-10								6
	10-12								1
FISH									
Killifish	0-2				1				
	2-4				2				1
	4-6							1	
	6-8							1	
Pipe Fish	2-4	1							
	4-6		1			1			
	6-8			2					
	8-10			1		1		1	
	10-12			7		1		1	
	12-14			3	2				
	14-16			2					
18-20	1								
Sea Horse	0-2		2		1				
	2-4		1		1				
	4-6			1			1		
	10-12	2							
Snapper	2-4						2		
	6-8	1							
Grunt	0-2	1							1
	2-4	3	10						4
	4-6	4	7						2
	6-8	1							

TABLE E-6 (Continued)

Monthly size frequency distribution data
for catches on Inner City Island grass flat.

		5/78	6/78	7/78	9/78	10/78	11/78	12/78	2/79
CHORDATES									
FISH(Cont.)									
Pin Fish	0-2	6	1						28
	2-4	28	77	5	1			2	9
	4-6	18	100	30					
	6-8	13	18	16	1			1	1
	8-10			1	7				
	10-12	2							
Sheepshead	2-4			1					
Mojarra	2-4	2		1	3	4	1		
	4-6			4	1		1	1	
	6-8						1		
Croaker	0-2		12						
	2-4		32						
	4-6		7	1	1				1
	16-18				1				
Jack Knife Fish	4-6		1						
File Fish	0-2						4	2	
	2-4		1	1			7	16	1
	4-6	4		1			1	17	
	6-8			1				4	
	8-10		1						
Puffers	2-4							3	1
	14-16			1					
Spiny Box Fish	0-2		1						
	4-6				2				
	6-8				2				
	8-10	1	1						
	10-12					1			
Toad Fish	6-8					1			
	8-10	1	1						
Goby	2-4	1							
Blenny	2-4			1					
	4-6	1							
Florida Ling	10-12								1
Flounder	8-10			1					

TABLE E-7

Monthly size frequency distribution data
for catches on Outer City Island grass flat.

	5/78	6/78	9/78	10/78	11/78	12/78	1/79	2/79
MOLLUSKS								
Dove Shell	0-2				4			2
	2-4							1
Sea Hare	16-18			1				
	18-20					1		
Nudibranch	0-2				7	24		2
	2-4					1		
ARTHROPODS								
Grass Shrimp	0-2		1	1	6	11	122	22
	2-4	1		1			9	1
	4-6				2		2	
	6-8				1			
Bayonet Shrimp	0-2		2	1		1	25	6
	2-4	3	25	1	7	5	22	7
	4-6		20	14	26	17	17	12
	6-8						1	4
Pink Shrimp	2-4				2			
	4-6				13	1		2
	6-8			1	28	2	9	
	8-10				5	2	30	
	10-12				1		12	
	14-16						1	
Rock Shrimp	0-2						7	
	2-4				1		1	
Spider Crab	4-6		2					
Arrow Crab	2-4							1
Blue Crab	0-2							3
	2-4				2			2
	6-8	1	1				1	
	8-10		1		1			
	16-18						1	
Mud Crab	0-2							1
Hermit Crab	0-2							5
								2
ECHINODERMS								
Sea Urchin	0-2				6	1		
	2-4				1			
	4-6						1	
	8-10						1	

TABLE E-7 (Continued)

Monthly size frequency distribution data
for catches on Outer City Island grass flat.

		5/78	6/78	9/78	10/78	11/78	12/78	1/79	2/79
CHORDATES									
Sea Squirt	0-2								13
	2-4								10
	4-6								1
Colonial Tunicate	0-2							17	2
	2-4							25	5
	4-6							1	1
	6-8							1	
Ascidians	0-2								3
	2-4								2
	4-6								6
	6-8								3
	8-10								1
	10-12								1
FISH									
Pipe Fish	6-8						1		
	8-10			1					
	10-12			6			1		
	12-14	1	5						
	14-16						1		
	16-18						1		
	20-22			1					
	24-26	1							
Sea Horse	0-2			1					
	4-6			1					1
	6-8			1					
	16-18			1					
Grunt	2-4							1	
	4-6			1					1
	16-18	1							
Pin Fish	0-2	1					1	1	12
	2-4	17	1				3	8	3
	4-6	2	11					1	
	6-8		5						
	8-10			1					
	10-12				1				
Sheepshead	0-2			1					
	2-4			1					

TABLE E-7 (Continued)

Monthly size frequency distribution data
for catches on Outer City Island grass flat.

		5/78	6/78	9/78	10/78	11/78	12/78	1/79	2/79
CHORDATES(cont.)									
FISH(cont.)									
Mojarra	0-2			2					
	2-4			4	2			2	
	4-6				2	1			
Croaker	0-2		11						
	2-4		19	2					
	4-6		9						
	16-18	1							
File Fish	0-2					6	2		
	2-4	3	17			5	7	1	
	4-6		5				10		
	6-8		2						
	8-10		3	2					
	10-12		5	1					
Cow Fish	10-12		2						
	16-18		1						
Puffers	0-2						3		
	4-6						1		
	12-14		1						
Spiny Box Fish	6-8					1			
	8-10			1	1				
	12-14		2						
Goby	2-4	1					1		
	4-6								1
Flounder	2-4		1						
	12-14		1						

TABLE E-8

Technical names for roller trawl data.

Common Name	Technical Name
Dove Shell	<u>Columbella rusticoides</u>
Horn Shell	<u>Cerithium muscarum</u>
Oyster Drill	<u>Urosalpinx sp.</u>
Tulip Shell	<u>Fasciolaria hunteria</u>
Horse Conch	<u>Pleuroploca gigantea</u>
Sea Hare	<u>Bursatella leachi</u>
Nudibranch	unidentified
Grass Shrimp	<u>Palaemonetes intermedins</u> , <u>Palaemonetes pugio</u> , <u>Palaemonetes vulgaris</u> , <u>Leander tenuicornis</u> , <u>Trachypeneus constrictus</u> , <u>Hippolyte zostericola</u> , and others as yet unidentified.
Bayonet Shrimp	<u>Tozeuma carolinensis</u>
Pink Shrimp	<u>Penaeus duororum</u>
Red Cleaner Shrimp	<u>Hippolyte wurdemanni</u>
Rock Shrimp	<u>Sicyonia laevigata</u>
Spider Crab	<u>Libinia dubia</u>
Arrow Crab	<u>Stenorhynchus sp.</u>
Blue Crab	<u>Callinectes sapidus</u> (occasionally other portunids)
Mud Crab	A variety of members of the family Xanthidae.
Hermit Crab	Primarily <u>Pagurus annulipes</u> .
Star Fish	<u>Echinaster spinulosus</u>
Sea Urchin	<u>Lytechinus variegatus</u>
Worm Sea Cucumber	<u>Leptosynaptus sp.</u>
Sea Squirt	<u>Molgula sp.</u>
Colonial Tunicate	<u>Clavelina sp.</u>
Ascidian	<u>Didemnum sp.</u> , <u>Botrylus sp.</u> , and others.
Anchovy	<u>Anchoa mitchilli</u>
Lizard Fish	<u>Synodus foetens</u>
Killifish	<u>Lucania parva</u> , rarely a <u>Fundulus</u> .
Pipe Fish	Primarily <u>Syngnathus floridae</u> .
Sea Horse	Primarily <u>Hippocampus zosterae</u> but occasionally <u>Hippocampus erectus</u> .
Silversides	<u>Menidia beryllina</u>
Barracuda	<u>Sphyraena barracuda</u>
Grouper	Unidentified
Snapper	Primarily <u>Lutjanus griseus</u> .
Grunt	Primarily <u>Haemulon striatum</u> .
Pin Fish	<u>Lagodon rhomboides</u>
Sheepshead	<u>Archosargus probatocephalus</u>
Mojarra	Primarily <u>Eucinostomus sp.</u>
Croaker	Primarily <u>Bairdiella chrysura</u> and <u>Leiostomus xanthurus</u> .

TABLE E-8 (Continued)

Technical names for roller trawl data.

Common Name	Technical Name
Trout	<u>Cynoscion nebulosus</u>
Jack Knife Fish	<u>Equetus lanceolatus</u>
Wrasse	<u>Halichoeres bivattatus</u>
File Fish	Primarily <u>Monocanthus hispidus</u> and a few <u>Aluterus schoepfi</u> .
Cow Fish	<u>Acanthostracion quadricornis</u>
Puffer	<u>Sphoeroides nephelus</u>
Spiny Box Fish	<u>Chilomycterus schoepfi</u>
Toad Fish	<u>Opsanus beta</u>
Grassy Scorpion Fish	<u>Scorpaena grandicornis(?)</u>
Goby	Primarily <u>Gobiosoma longipala</u> but a few <u>Gobiosoma robustum</u> .
Blennies	Unidentified.
Florida Ling	<u>Urophycis floridanus</u>
Flounder	Primarily <u>Paralichthys albigutta</u> .

Discussion

Unlike the work of others, little correlation of diversity or numbers with salinity was noted. This was probably due to the small variation in salinity between stations. Exposure to currents seemed to have some effect on diversity. Relative to diversity, the flats ranked in order from highest to lowest as follows: South Lido, inner City Island, Bird Key Yacht Club, Wreck, Big Pass, outer City Island and Bayfront. Tidal currents may not of course be the direct cause, rather it might be lower turbidity, more stable salinity, etc. that would be associated with the Gulf waters.

In interpreting this data one should remember that there were fairly severe red tides in September 1978. The October and November catches were down considerably in both diversity and numbers of fishes while the less effected anthropods were up in both categories.

A second consideration is that this data does not represent a full year of sampling. March and April were omitted from the tables and graphs yet they had some interesting catches that will be reported later. The numbers of organisms caught did not, however, go up until May 1979.

Figures E-2 through E-6 show graphically the monthly size-frequency distribution data for five of the more abundant types of organisms.

FIGURE E-2
 Monthly size-frequency distribution for grass shrimp.

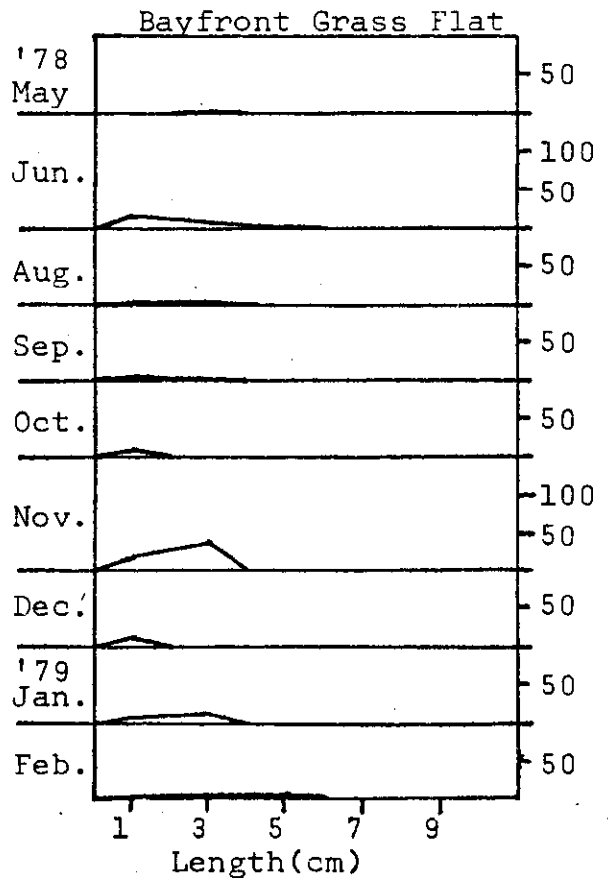
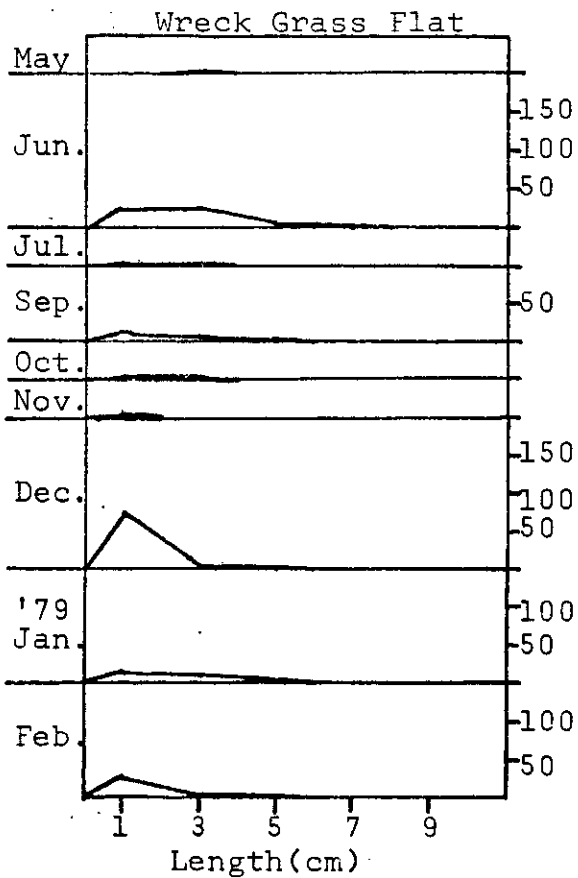
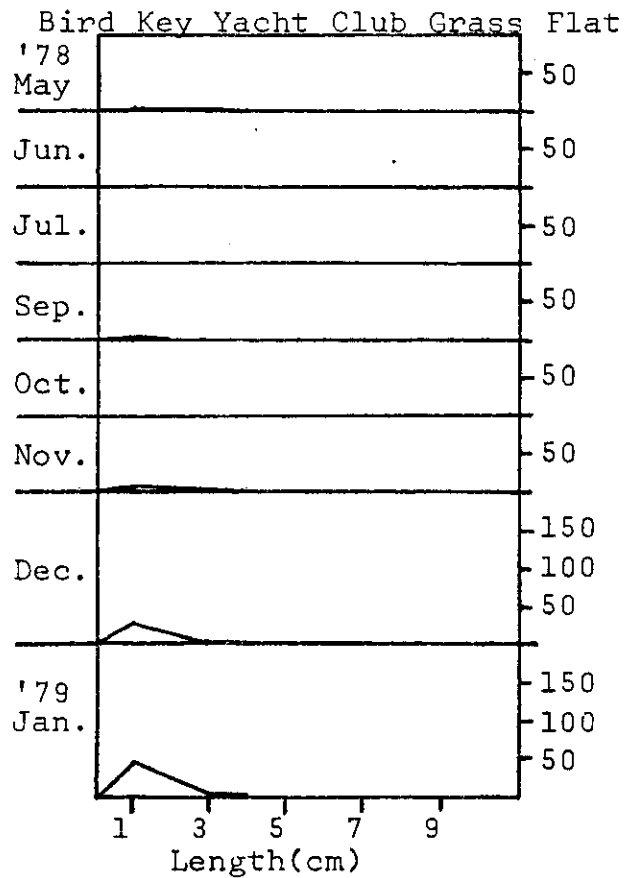
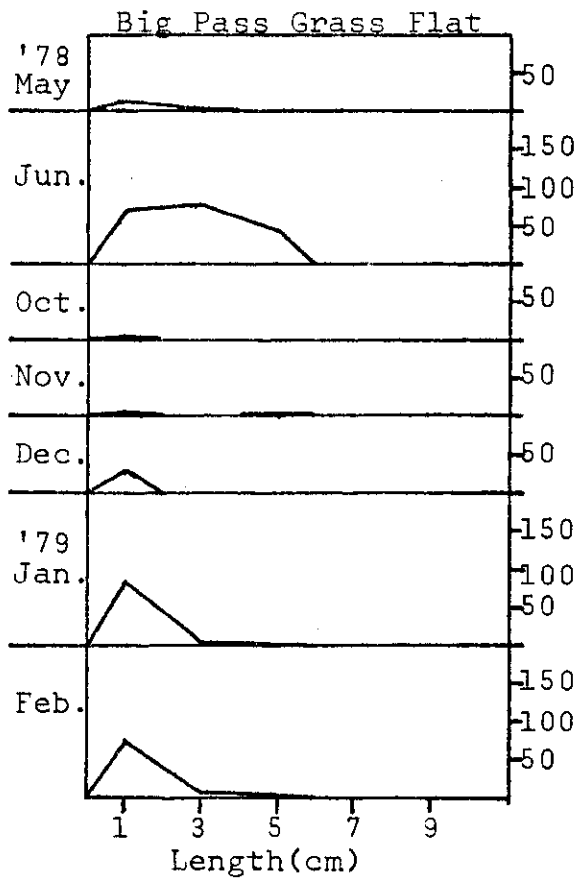


FIGURE E-2 (Continued)
 Monthly size-frequency distribution for grass shrimp.

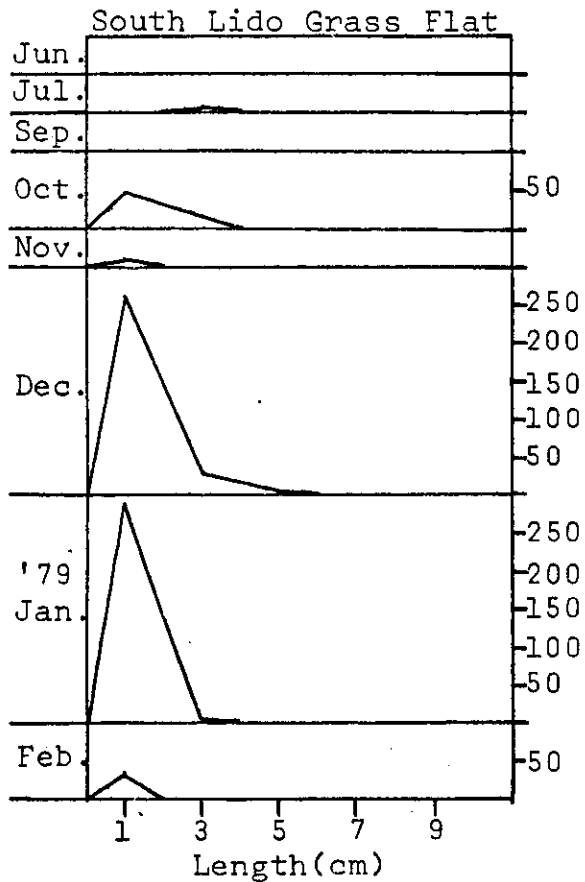
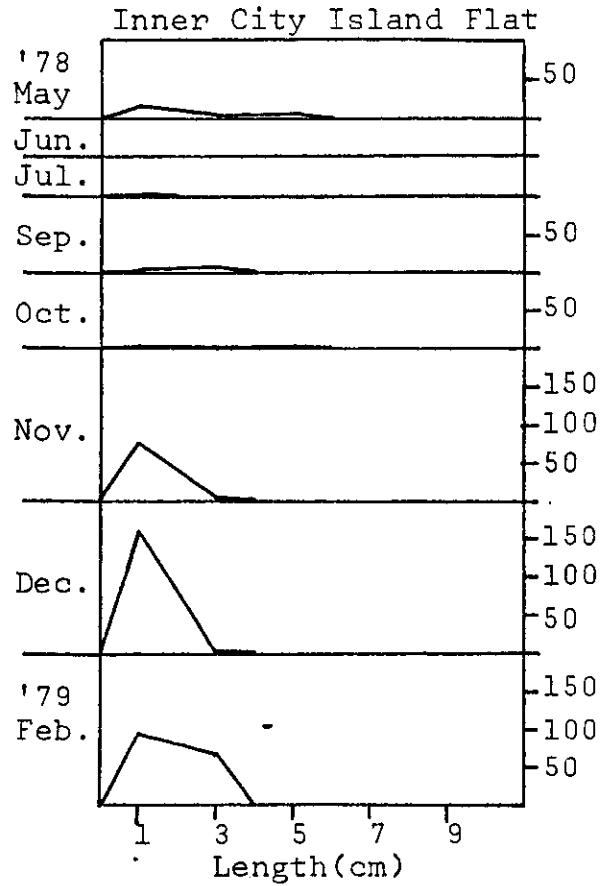
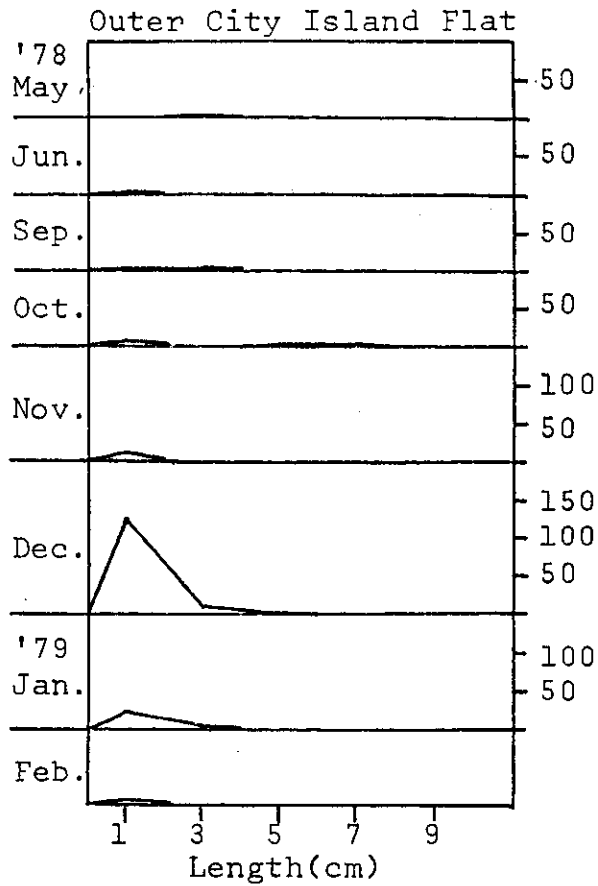


FIGURE E-3
 Monthly size-frequency distribution for bayonet shrimp.
 (*Tozeuma carolinensis*)

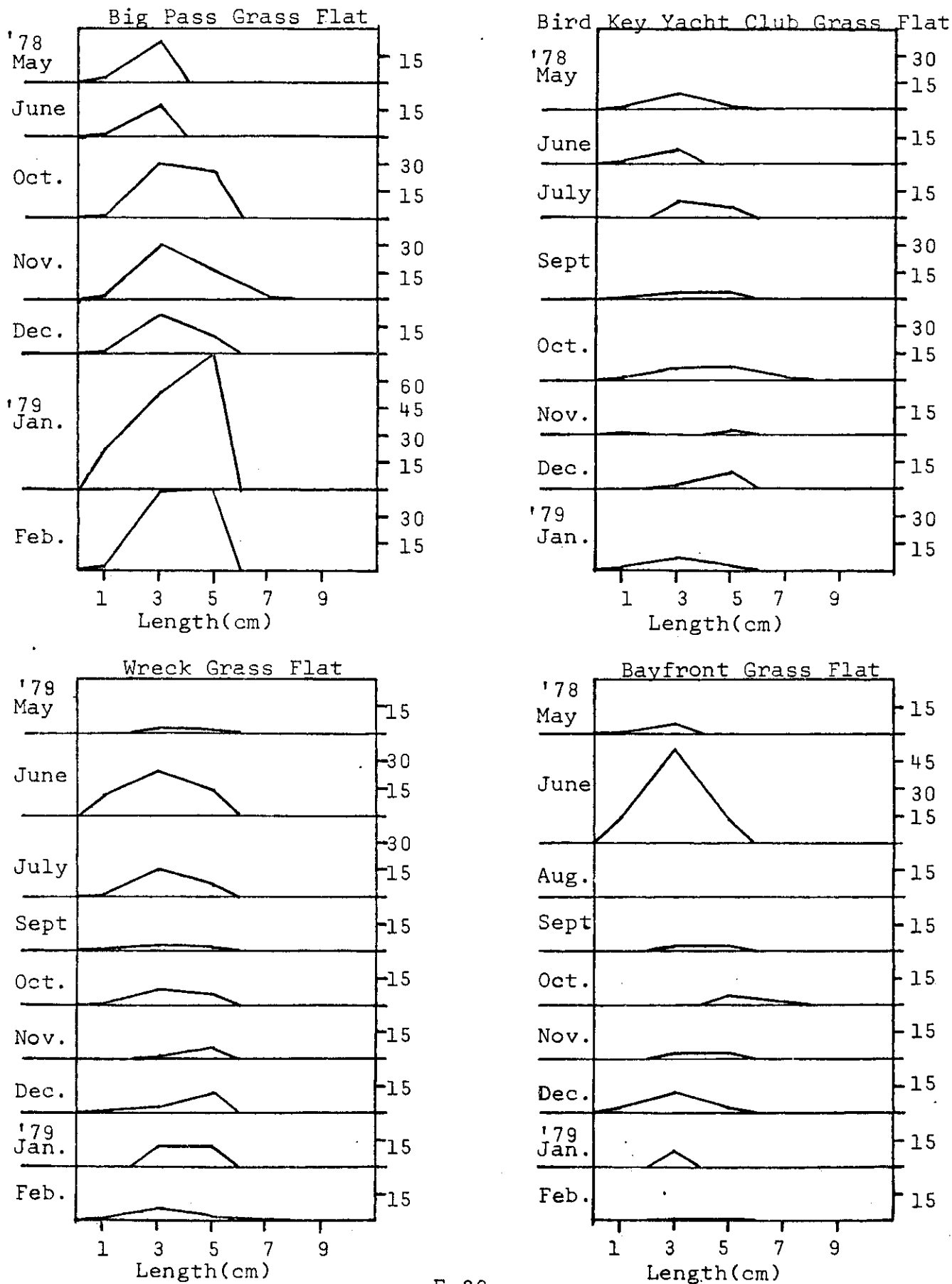


FIGURE E-3 (Continued)
 Monthly size-frequency distribution for bayonet shrimp.
 (*Tozeuma carolinensis*)

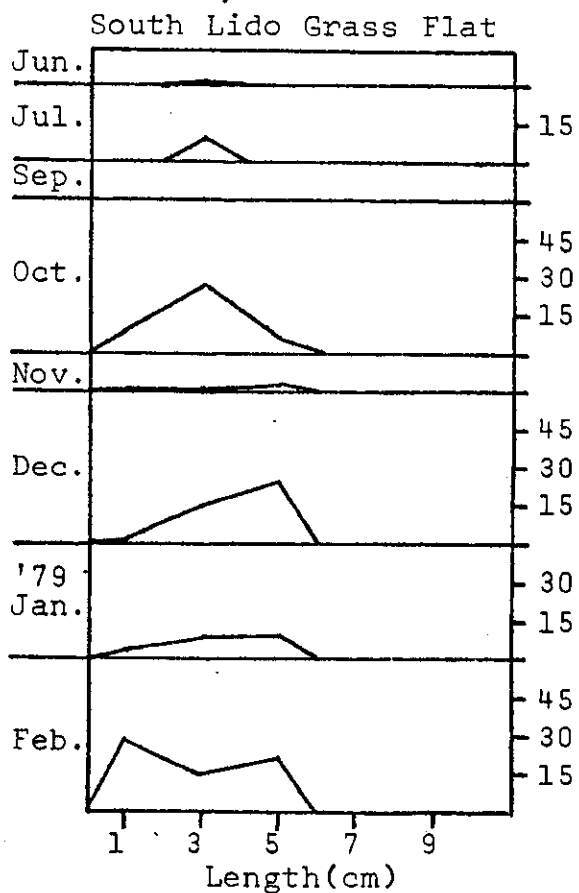
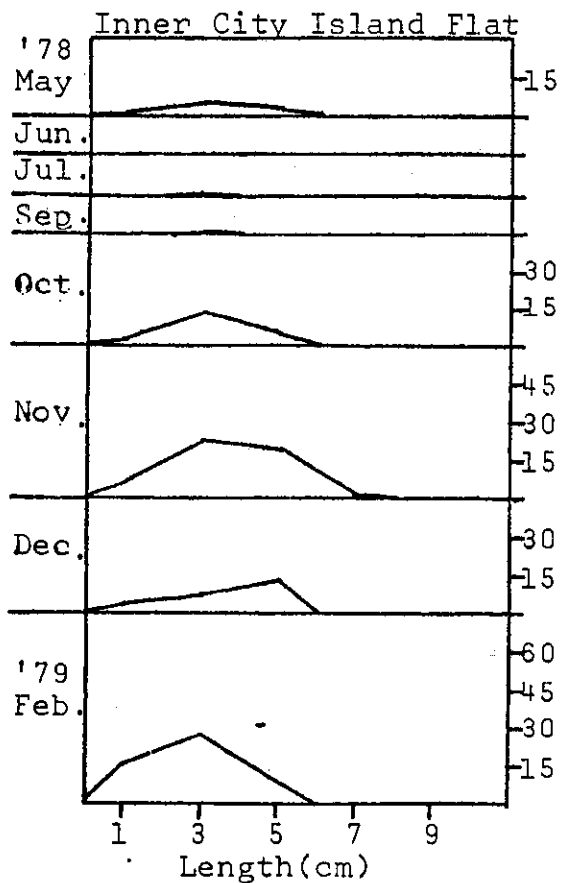
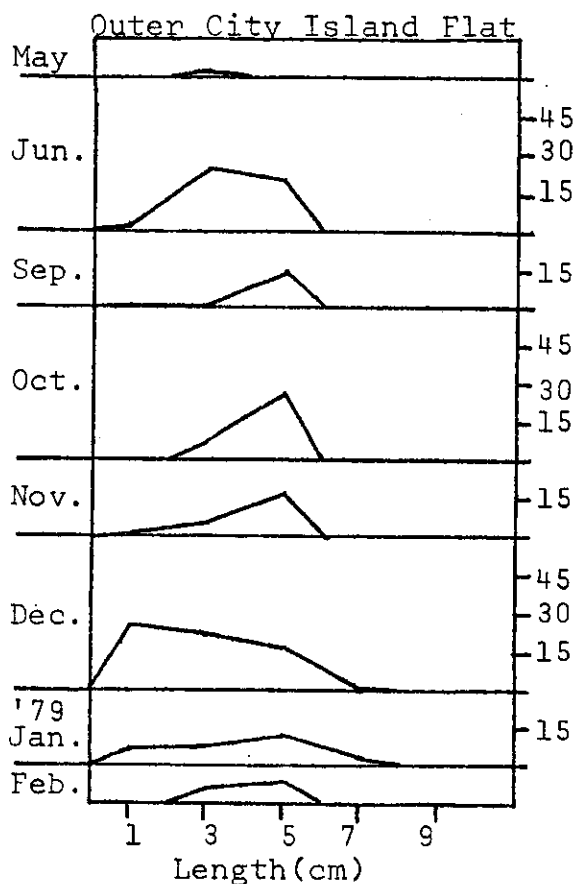


FIGURE E-4
 Monthly size-frequency distribution for pink shrimp.
 (*Penaeus duorarum*)

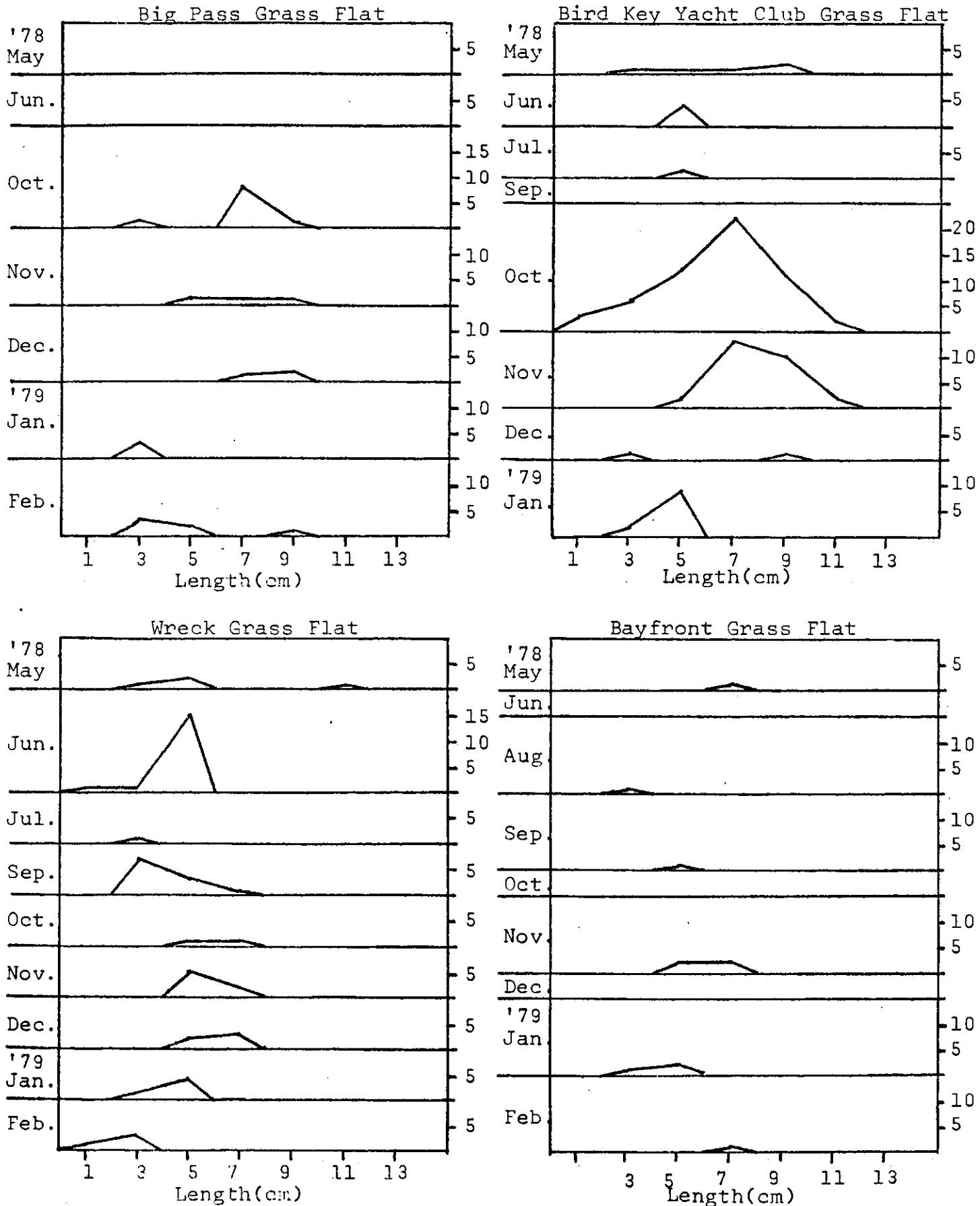


FIGURE E-4 (Continued)
 Monthly size-frequency distribution for pink shrimp.
 (*Penaeus duorarum*)

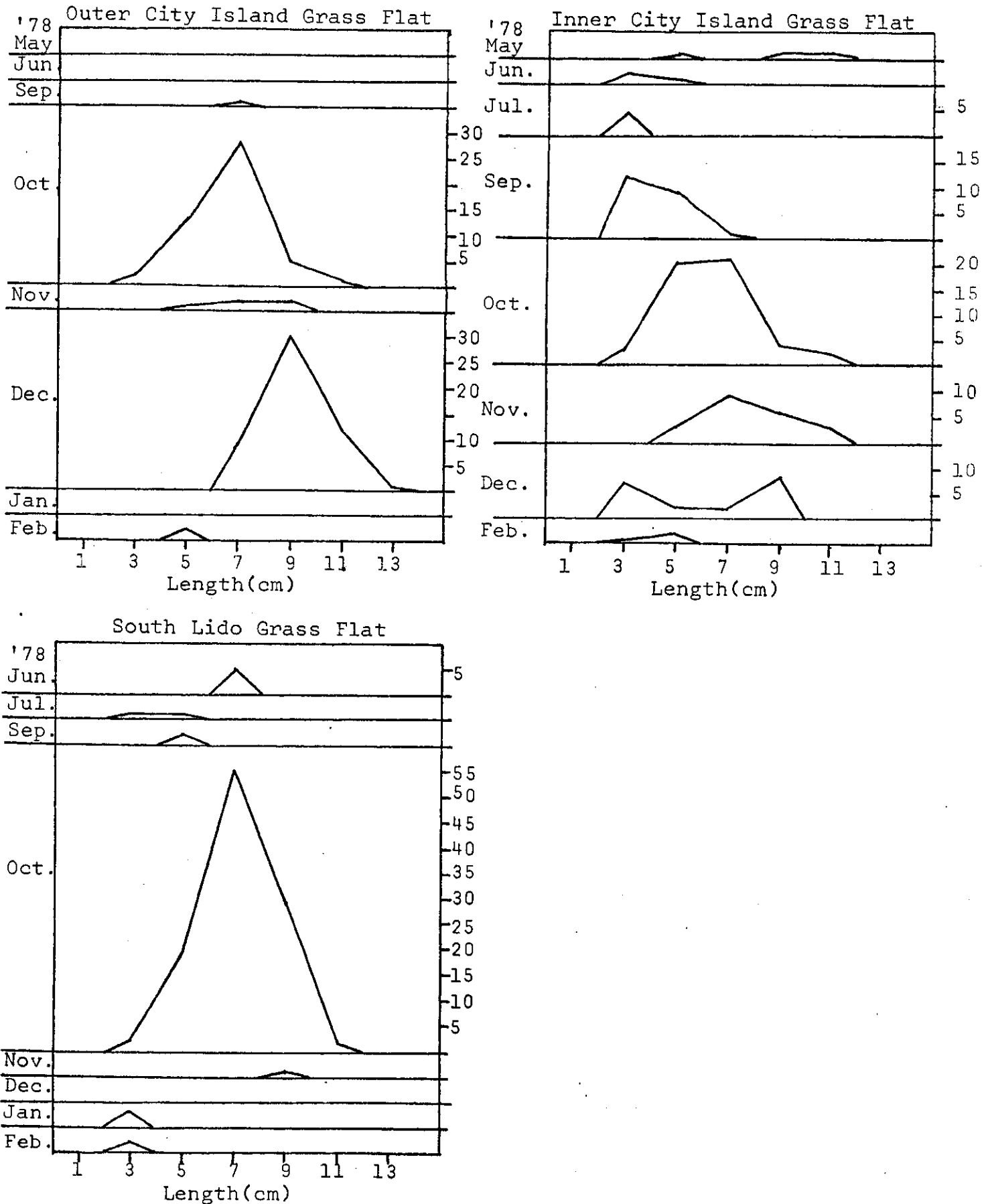


FIGURE E-5
 Monthly size-frequency distribution for pinfish (*Lagodon rhomboides*).

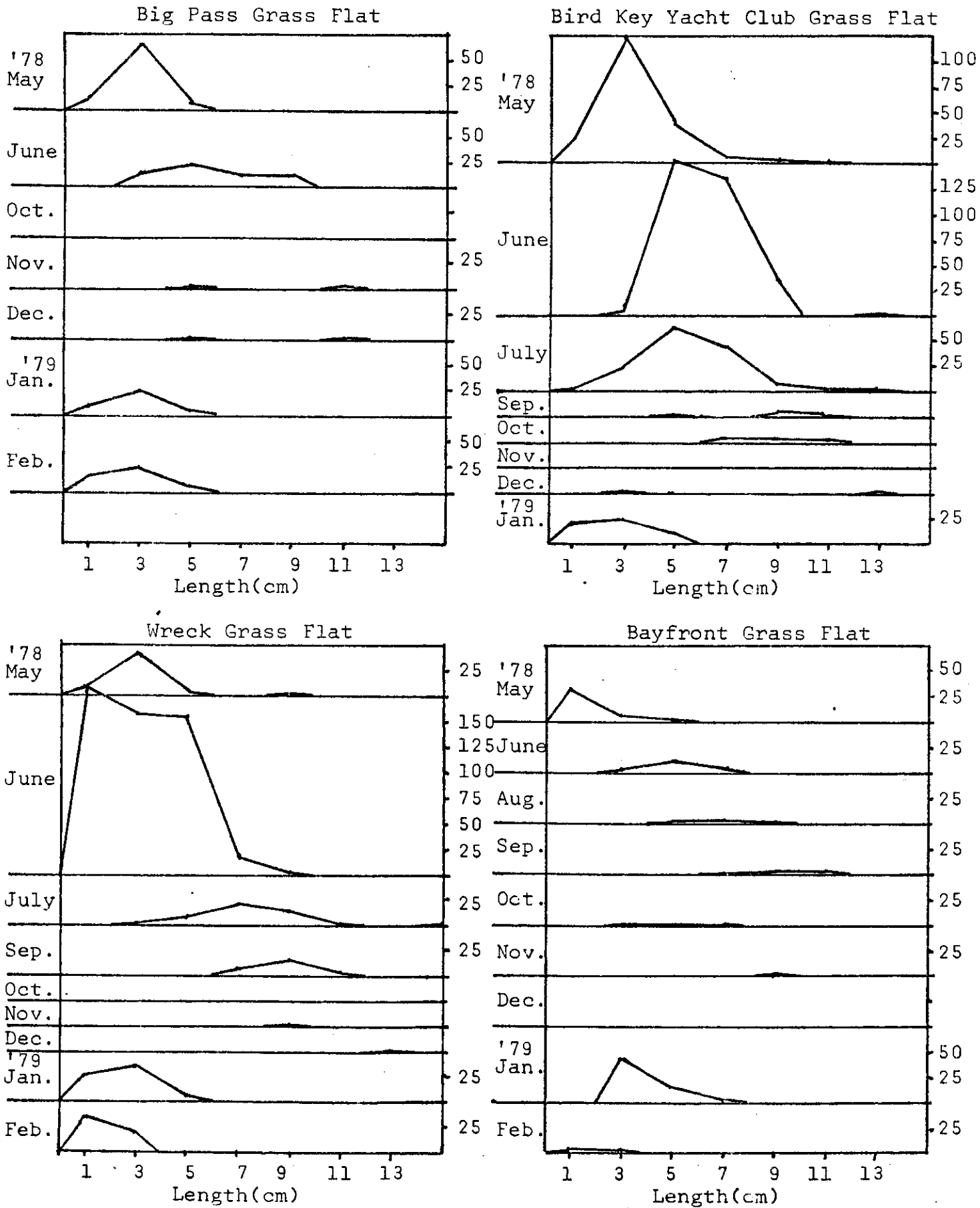


FIGURE E-5 (con't)

Monthly size-frequency distribution for pinfish (Lagodon rhomboides).

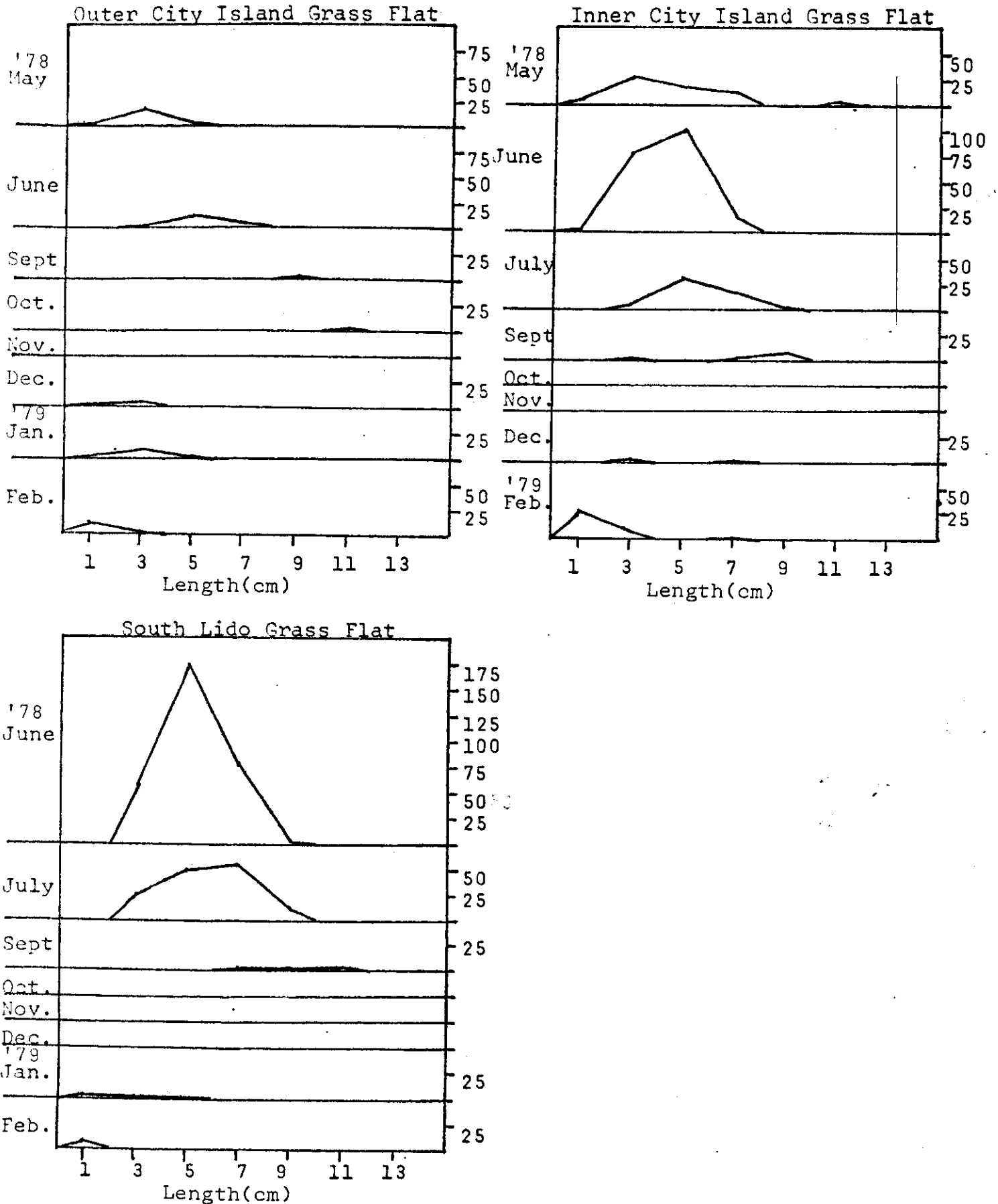


FIGURE E-6
 Monthly size-frequency distribution for file fish.
 (Monacanthus hispidus)

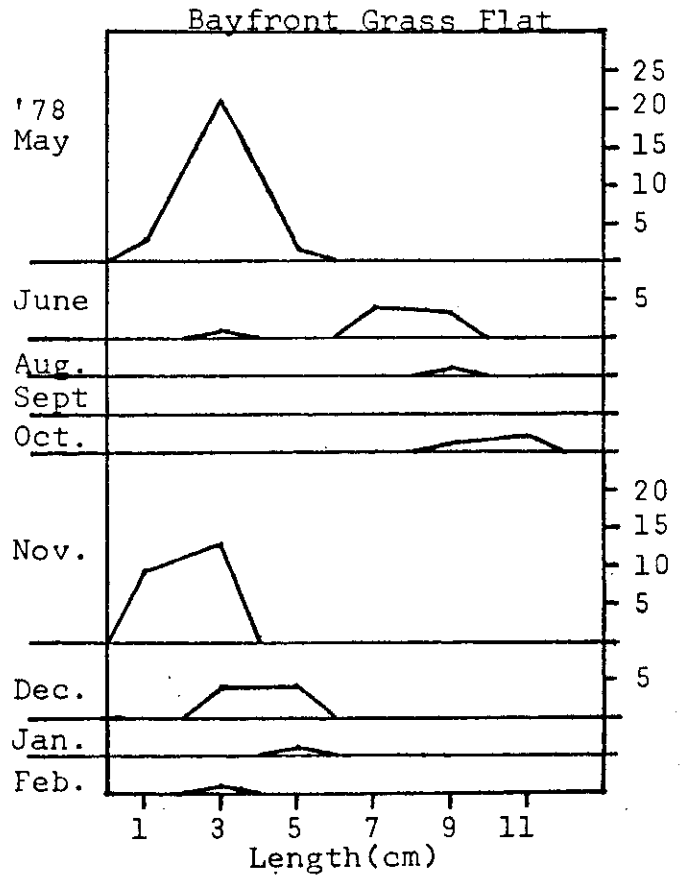
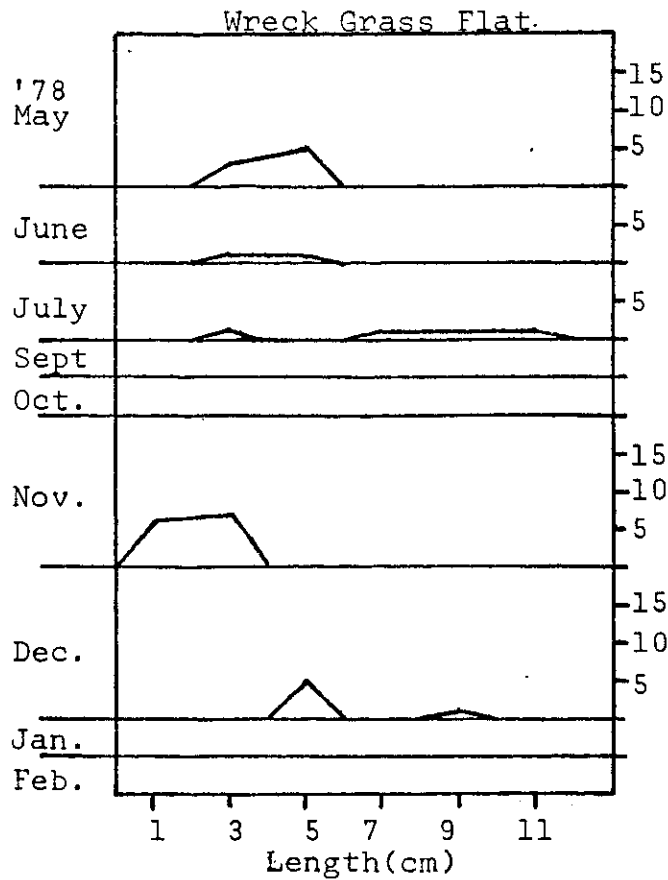
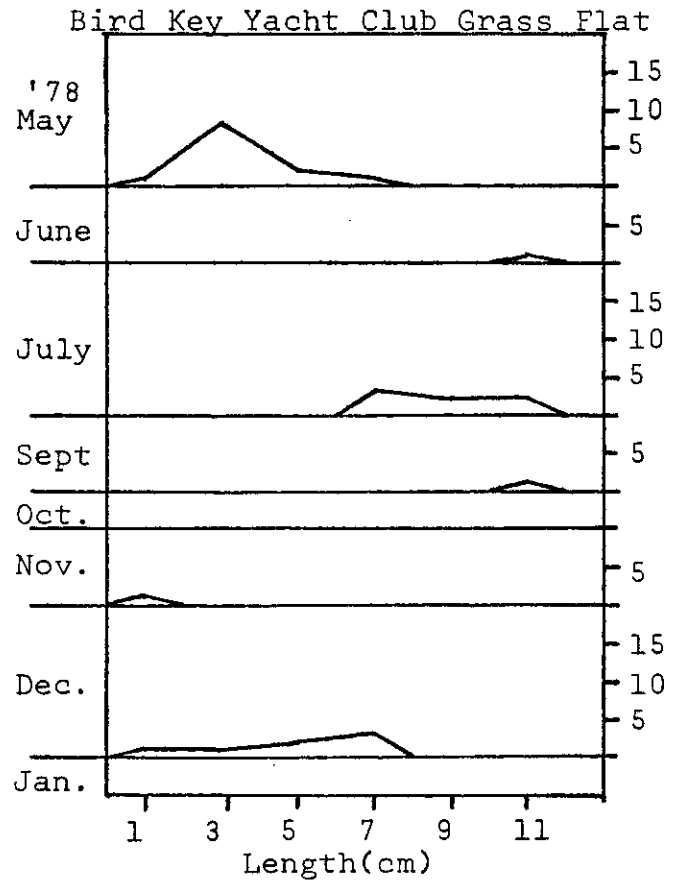
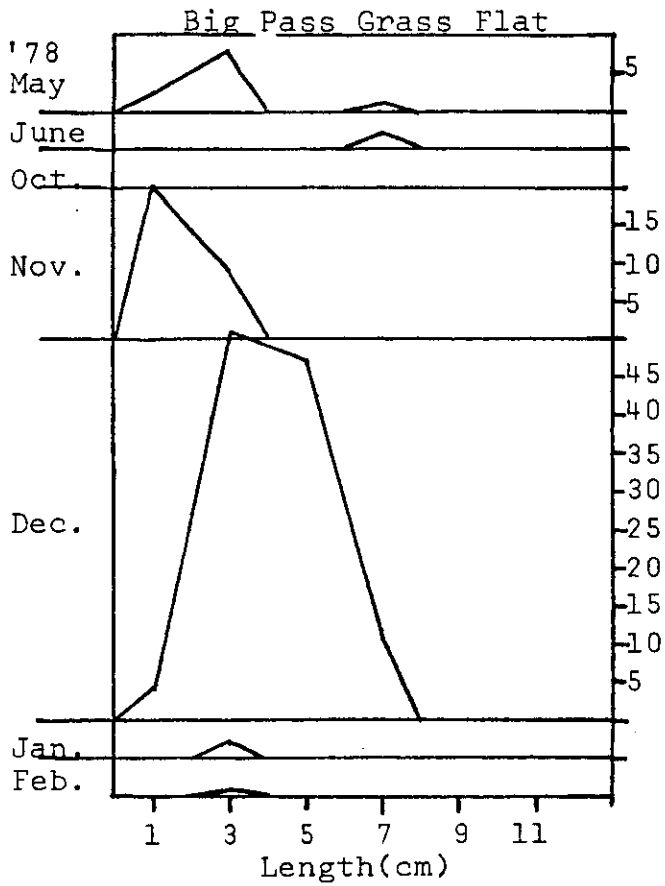
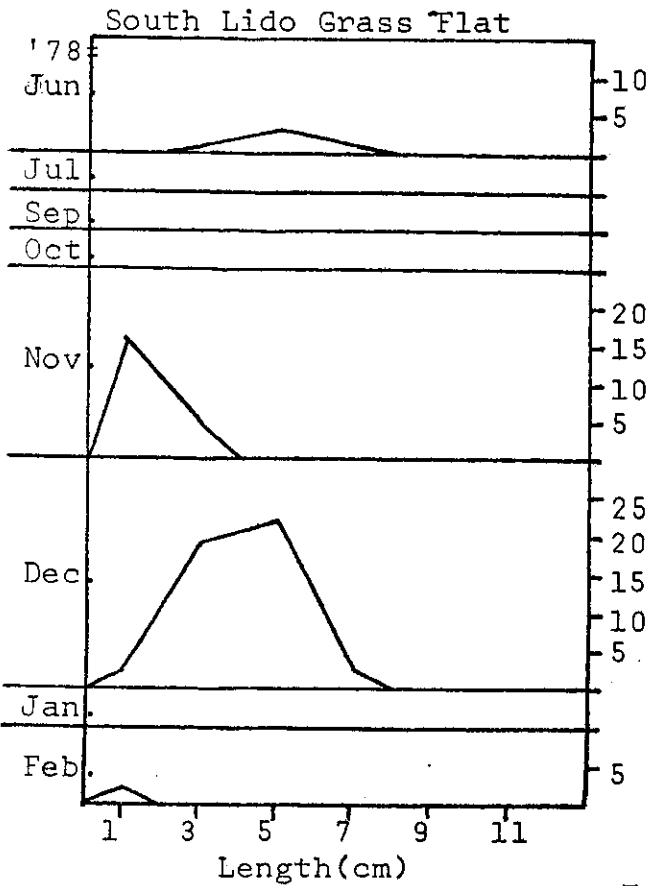
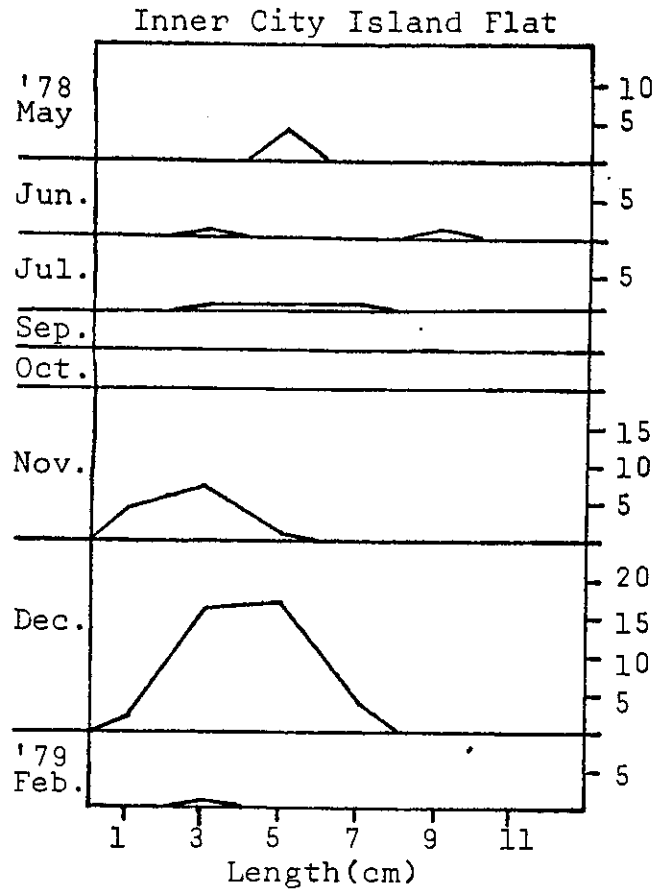
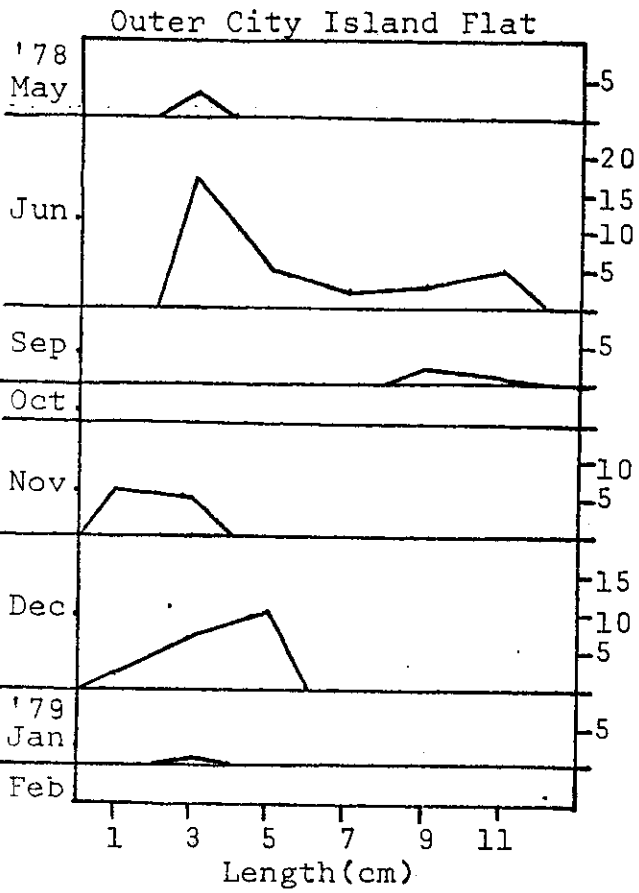


FIGURE E-6 (Continued)
 Monthly size-frequency distribution for file fish.
 (*Monacanthus hispidus*)



As with other species, the apparent seasonal distribution of species may vary as a function of capture techniques as well as population size. More grass shrimp were caught when the net meshes were plugged with algae. This was generally the case for small organisms. Larger organisms could frequently escape the net, thereby biasing the sample. These factors should be kept in mind when examining the data.

Several arthropods were frequently collected, with shrimp being the most numerous. The grass shrimp were several species lumped together in one category (see table E-8). Grass shrimp were by far most often caught in December and January with a second peak in May and June. They were most numerous on the South Lido and City Island grass flats. As with the other shrimp, the red tide seemed to have reduced predators so a record catch was obtained in the fall of 1978.

Bayonet shrimp are also small enough to exhibit some of the catch problems due to mesh size. They were generally caught throughout the recording period with no particular peaks. Some stations show definite seasonality, but when one station is peaking another may be dropping.

Big Pass grass flat definitely had the highest peaks and most constant populations of bayonet shrimp. Generally the flats with current flow produced more bayonet shrimp throughout the recording period. However, in June, both the the Wreck and Bayfront grass flats had large population peaks. No explanation is yet apparent for the seemingly sporadic variations in the bayonet shrimp populations.

Pink shrimp had a record year on the grass flats in the fall. Bait shrimpers from the Cortez area claimed it was the best year they had ever seen. Through October, November and the first part of December many large shrimp were caught at night on the Inner City Islands' flats. It wasn't unusual to get 50 pounds of cleaned shrimp in three hours. The largest shrimp were over 20 cm. long from the tip of the rostrum to the tip of the telson. It seems likely that the high populations were due, in part at least, to predator reduction by the red tide.

Major drops of shrimp were apparent at the inner City Island and the Wreck grass flats by June but not at the other stations until October. A steady size increase was noted at the inner City Island grass flat. The average monthly increase in length of the population from July to November was about 1.5 cm. Bird Key Yacht Club, outer City Island and South Lido grass flats exhibited sudden peaks in October and then a rapid drop into November. The shrimp were again present in large numbers in December at the outer City Island grass flat but no such reoccurrence took place at the other two stations. The Big Pass and the Bayfront grass flats produced few shrimp while the Wreck had a small but steady population.

Echinoderms were also frequently caught. Sea urchins seemed to have small representatives throughout the summer and fall with a peak from October through November, depending on the station. The largest populations occurred at the South Lido grass flat.

Young star fish (Echinaster) were common on the Big Pass and the inner City Island grass flats with highest counts occurring in June and July. The grass flat off the south end of Longboat Key has also been found to have large numbers of this star fish.

Sea squirts, colonial tunicates and ascidians peaked in January and February with the largest numbers on the Wreck, Bayfront, Bird Key Yacht Club and outer City Island grass flats. The tunicates disappeared quickly in later March 1979.

During this recording period, the largest numbers and greatest diversity of fish were caught during the summer months. Winter was the second best season. The red tide probably had a major influence on numbers and diversity of fish throughout the fall months. A steady recovery began at most stations in November. The average number of fish caught at all stations during May, June and July was 160 while the next highest period was during December, January and February with an average of 40.

The most productive flats in terms of the average monthly taken for the reporting period were Bird Key Yacht Club grass flat with 109/month and the Wreck grass flat with 100/month. South Lido had 82/month, inner City Island had 75/month, Big Pass had 67/month, Bayfront had 33/month and outer City Island had an average of 31/month. The ranking for diversity throughout the period was as follows: South Lido (18 species), inner City Island (18), Bird Key Yacht Club (17), Wreck (16), Big Pass (15), outer City Island (13), and Bayfront (13).

The dominant fish in terms of the numbers caught were pin fish and file fish. Pin fish represented 79% of the May catch,

79% of the June catch, 81% of the July catch and 39% of the September catch. Pin fish again made up a dominant part of the catch in the winter. Growth rates were around 1 cm/month for May, June and July populations. The most productive flats for pin fish were the Wreck, Bird Key Yacht Club, South Lido and inner City Island grass flats. The highest count was 545 pin fish in July at the Wreck grass flat. Obviously pin fish play a major role in the grass flat community.

The second most dominant fish in terms of numbers was the file fish. Only 11% of the May catch was file fish but they represented 76% in December. The data would indicate that they grow more than 2 cm. from November to December. All grass flats had high peaks during some month. The December count at the Big Pass grass flat was by far the largest.

Other fairly high population levels were represented by the striped grunts and the croakers. These species also peaked in the summer.

Prior to collecting with the roller trawl a wimilar study was done with 20 ft. seine nets pulled by students. The dominant species in that study were the pin fish and mojarra. Mojarra are fairly infrequent in the present study. This is probably due to the difference in the collection method. Fewer anchovies and sardines have also been noted in the current study. These fish probably avoid the narrow roller trawl and not the seine nets.

Other species exhibiting summer peak seasonality were grouper, snapper, pipe fish, sea horses, trout, grassy scorpion fish, and flounder. The only fish besides the file fish with a

definite winter trend was the Florida Ling. Perhaps some fish would have shown fall peaks had it not been for the red tide.

Summary

All of the grass flats seem productive at some time and probably contribute significantly to the bay food chains. The most stressed flat is probably the Bayfront grass flat. Perhaps the frequent annoxia problems noted at this flat have had an effect on the flat's fauna. A more intensive study will be undertaken to determine why the Wreck and Bayfront grass flats, which are so close together, differ so much.

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