

Progress Report

No. II

Studies on the Geochemistry and Hydrography
of the Charlotte Harbor Estuary, Florida

Sponsored by: The Department of Oceanography
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Tallahassee, Florida 32306

and

The Mote Marine Laboratory
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INTRODUCTION

The Charlotte Harbor system, one of the largest estuarine environments in Florida, is located on the west coast approximately 60 miles south of Tampa. Physiographically, the Charlotte Harbor system is a complex drowned estuary enclosed by a series of barrier islands. The tidal exchange with the Gulf of Mexico is primarily controlled by two major inlets, Boca Grande Pass on the West and San Carlos Bay to the South. Three rivers drain into the Harbor: the Peace, the Myakka, and the Caloosahatchee.

Previous studies on the area by Schroeder and Bishop (1953), Bandy (1956), Huang and Goodell (1967), Dragovich et al. (1968), Alberts et al. (1969) and Wang (1969) have provided some basic information on the foraminiferal fauna, bottom sediments, hydrological and chemical characteristics, and fish populations, respectively.

Investigators from the Department of Oceanography at Florida State University, with the assistance and support of the Mote Marine Laboratory, initiated an environmental research

program in Charlotte Harbor in August, 1969. The major objective of the first years research has been to investigate the dispersion and assimilation of high dissolved phosphorus concentrations entering the Harbor in the Peace River drainage. A full understanding of the nutrient cycles in Charlotte Harbor and the possible effects of the impending development by man will be necessary for the conservation of this valuable marine resource.

During the present study, the area was sampled extensively (Figure 1) in August, 1969; December, 1969; and March, 1970. The initial period was devoted to an exhaustive sampling program of the entire bay system for salinity, temperature and dissolved phosphorus in surface, bottom water, and interstitial water. The other periods were primarily devoted to concentrated sampling of the Peace River and central portion of the Harbor.

HYDROGRAPHY

Salinity and temperature profiles were taken at all of the stations listed on Figure 1, plus several intermediate stations not illustrated. Water temperature varied for August from 28-32°C, for December from 15-18°C and for March from 18-21°C. The maximum and minimum salinities observed at each station have been compiled into composite diagrams which illustrate the general thermohaline structure in Charlotte Harbor (Figures 2-5). It should be emphasized that these

FIGURE 1.

Charlotte Harbor Station Locations

salinity diagrams represent only observed values and not the systematic synoptic survey data required to establish the detailed circulation patterns in the Harbor.

Figures 2 and 3 illustrate the surface salinity distribution for high and low tide conditions. Figures 4 and 5 present the three dimensional salinity structure for high (flood) and low (ebb) tides. This unique three dimensional representation of the thermohaline structure exhibits the well defined salinity wedge which exists throughout the entire estuary during an ebb tide. On a flood tide the east end of the estuary becomes vertically mixed and there is a gradual transition to a well defined salinity wedge at the mouth of the Peace River. The discharge of the Peace River is well defined by the tongue of low salinity water which follows the east and north sides of the estuary.

The circulation in Charlotte Harbor is extremely interesting and critical to the ecology of the estuary. With the rapid development of adjacent land it is critical that no wastes be discharged into the estuary without a careful consideration of the circulation and flushing characteristics of the disposal area.

GEOCHEMISTRY OF PHOSPHORUS

The distribution of dissolved phosphorus in the surface waters of Charlotte Harbor in August, 1969, December, 1969, and March, 1970, is illustrated in Figures 6-8 and Table 1.

FIGURE 2.

Surface salinity distribution in
Charlotte Harbor at high tide.

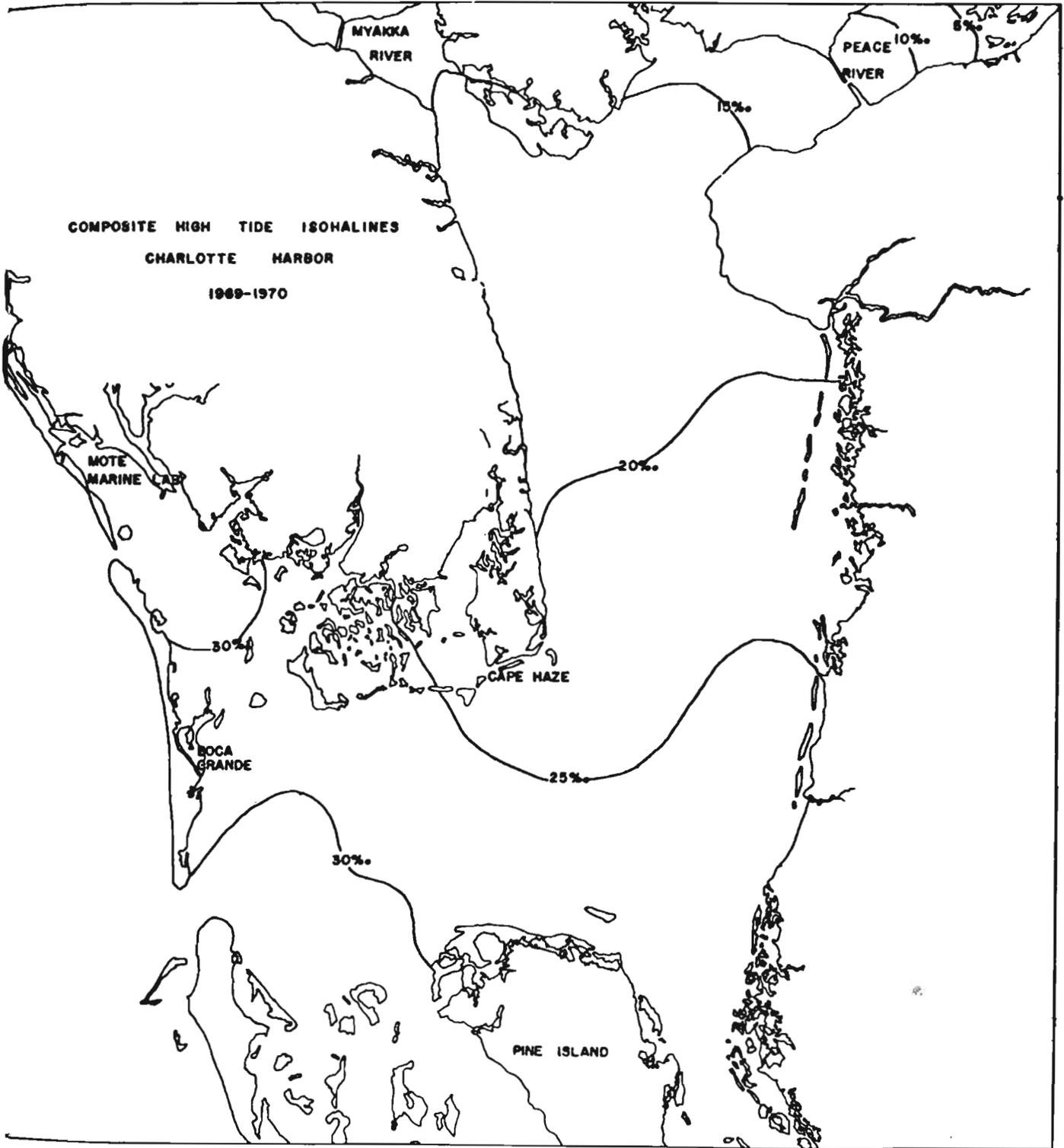


FIGURE 3.

Surface salinity distribution in
Charlotte Harbor at low tide.

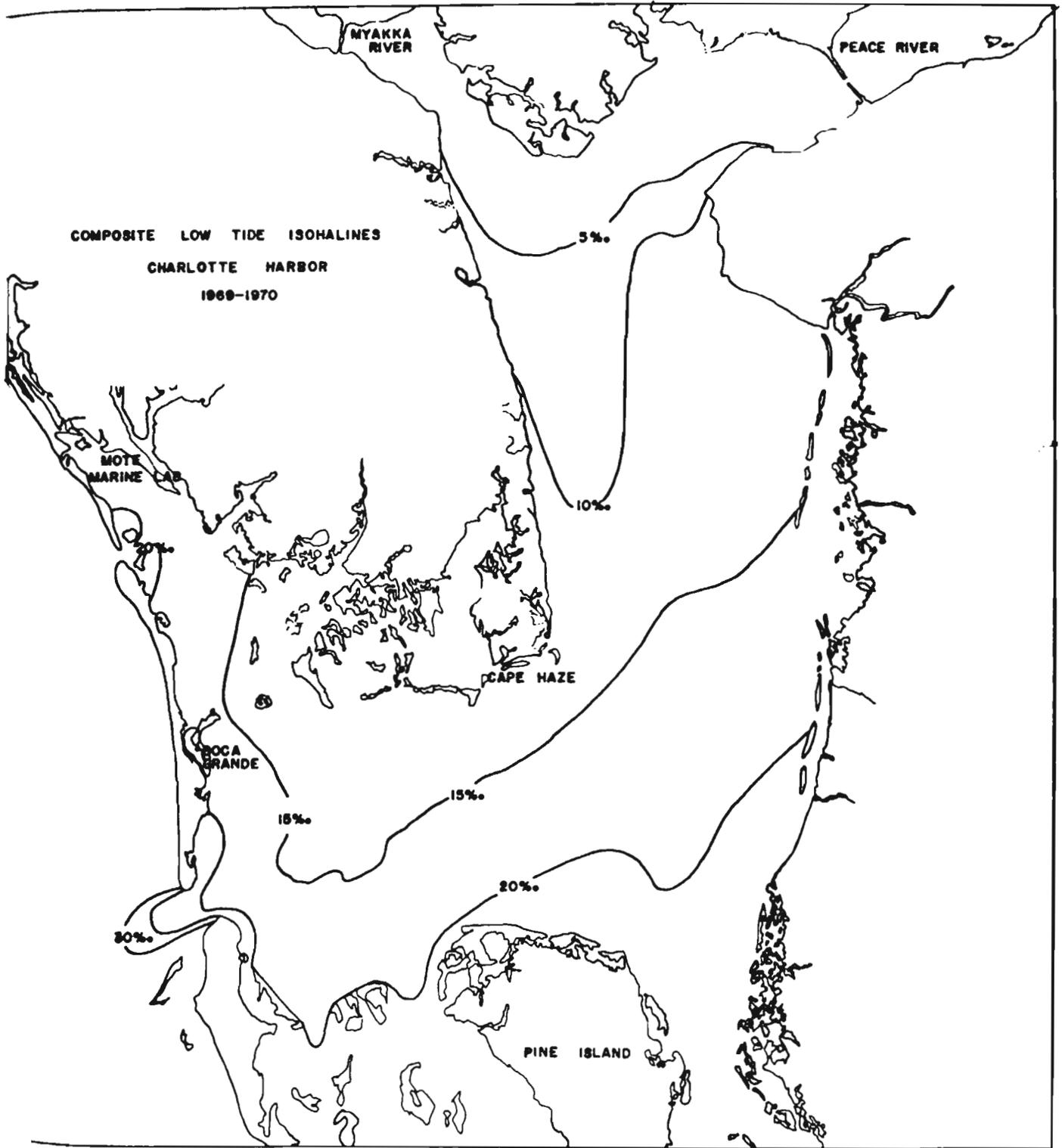


FIGURE 4.

Three-dimensional representation of the salinity structure
in Charlotte Harbor on a flood tide.

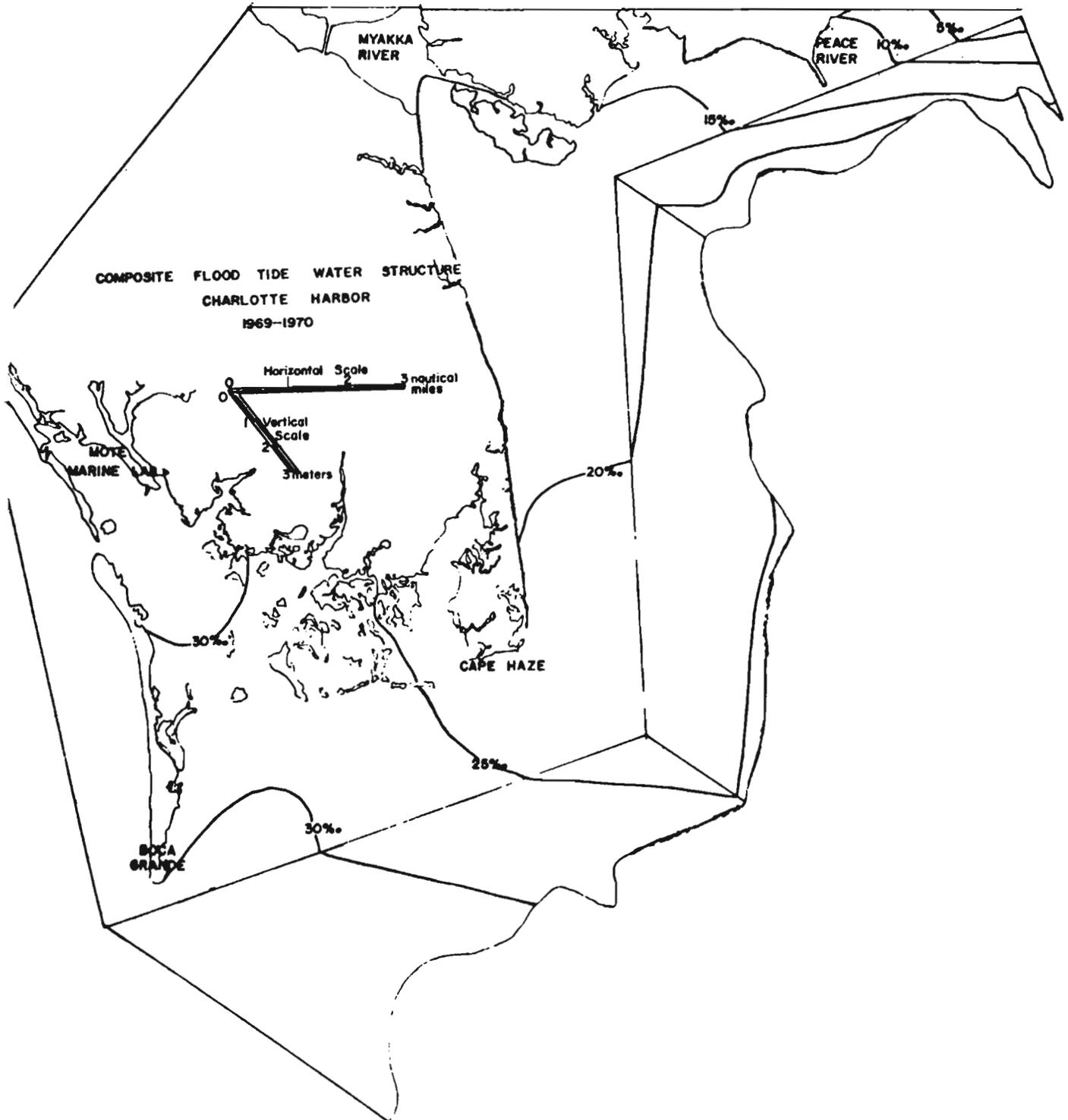
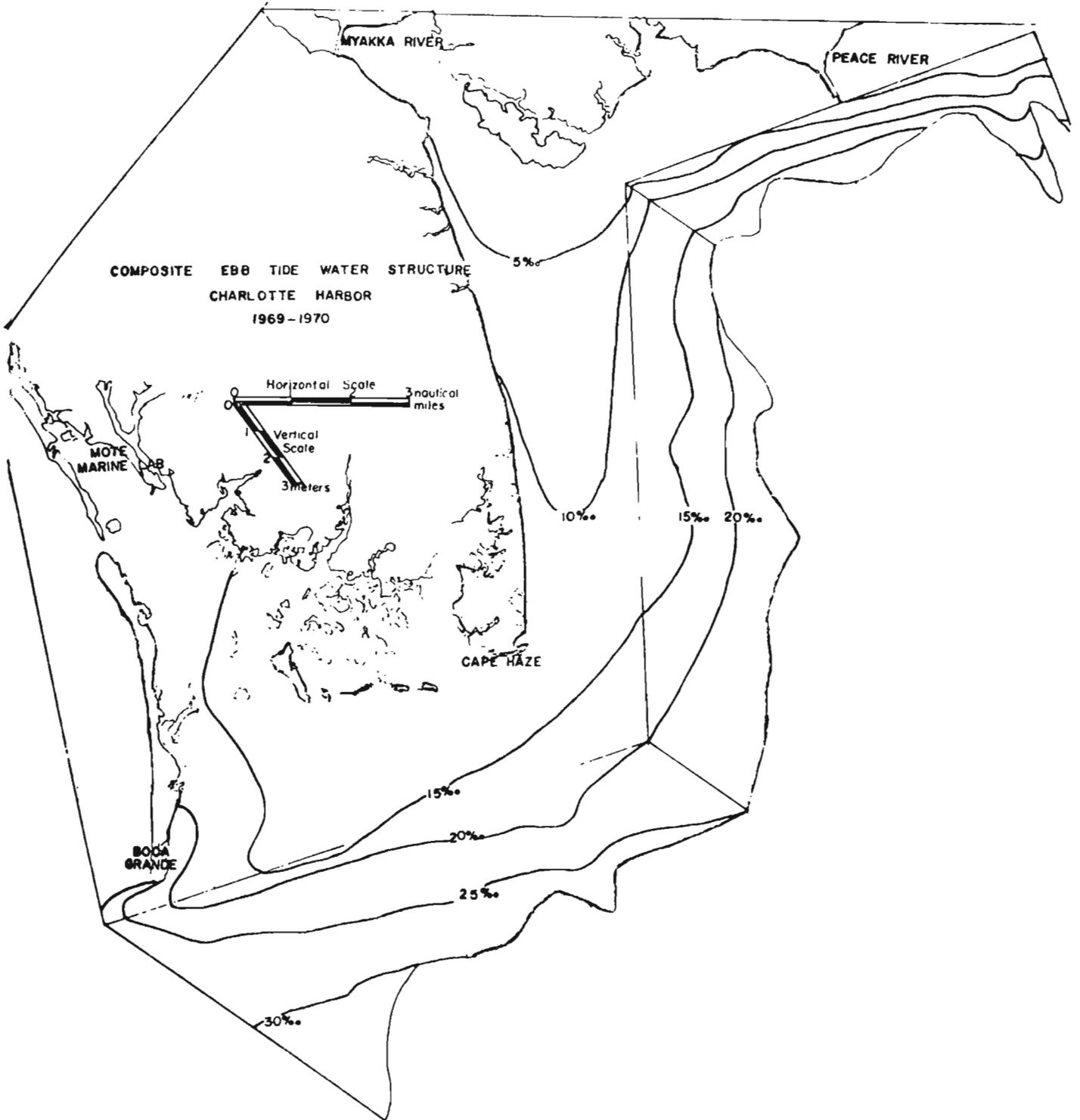


FIGURE 5.

Three-dimensional representation of the salinity structure
in Charlotte Harbor on an ebb tide.



The dissolved phosphorus concentrations of the Peace River are presently about 0.6 ppm P, which is much lower than Donnelly's (1967) values. However, Donnelly did not filter her samples before analysis, and due to the large amount of organic debris and fine-grained particulate apatite in samples of the Peace River (Huang and Goodell, 1967), it is possible that the exceptionally high values are due to reaction of analytical reagents with suspended matter.

The wedge of high phosphorus Peace River water maintains its integrity to Boca Grande Pass (Figure 6). This wedge of water is present at all the sampling periods (Figures 7,8) and appears to effectively divide the bay throughout much of the year. Figure 8 shows Peace River water temporarily diverted into Gasparilla Sound in March as a result of 10-15 knot southeasterly winds.

The fate of the dissolved phosphorus in the estuary was examined as a function of salinity (Table 2) to determine the relative importance of chemical removal mechanisms in controlling the phosphorus content during dilution of river water by seawater. Figure 9 shows the results of this analysis for the periods of December, 1969, and March, 1970.

It can be seen that the linear curves, while exhibiting some scatter, do follow an ideal dilution curve for both periods. It would therefore appear that dilution is the major factor controlling the distribution of phosphorus in the overlying estuarine waters of Charlotte Harbor.

FIGURE 6.

Charlotte Harbor Surface Water Phosphorus

Aug., 1969

FIGURE 7.

Charlotte Harbor Surface Water Phosphorus

Dec., 1969

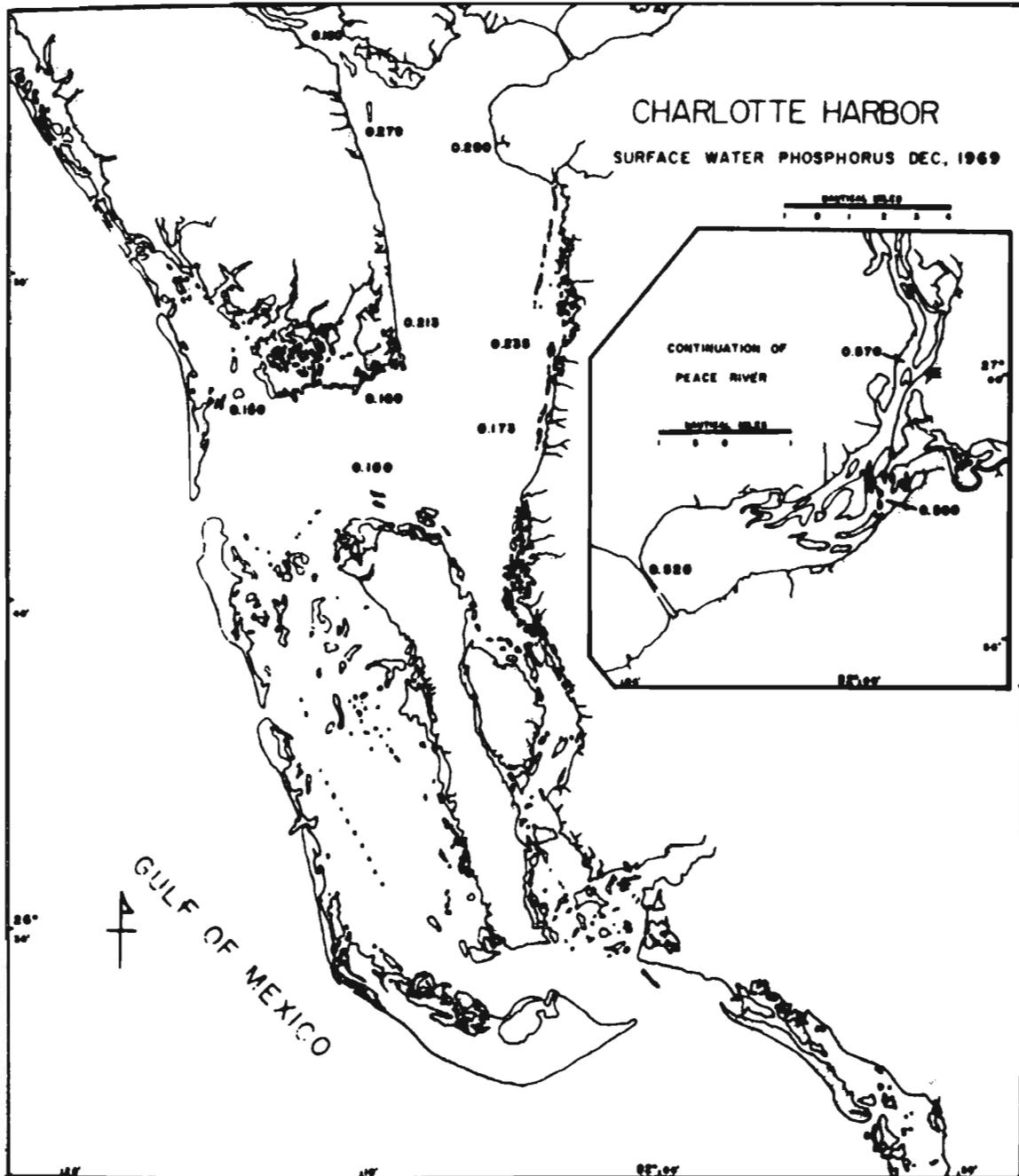


FIGURE 8.

Charlotte Harbor Surface Water Phosphorus
March, 1970

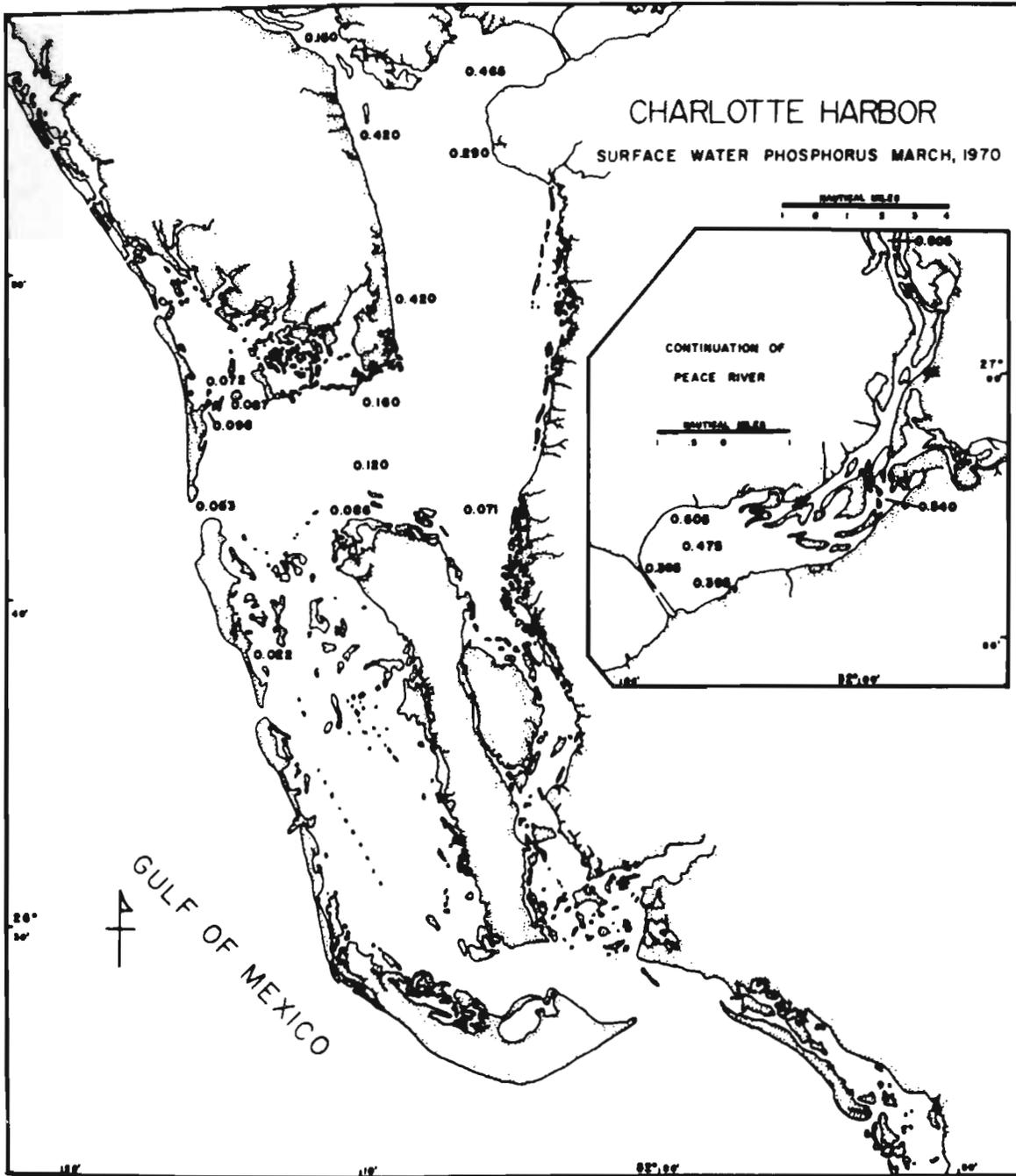
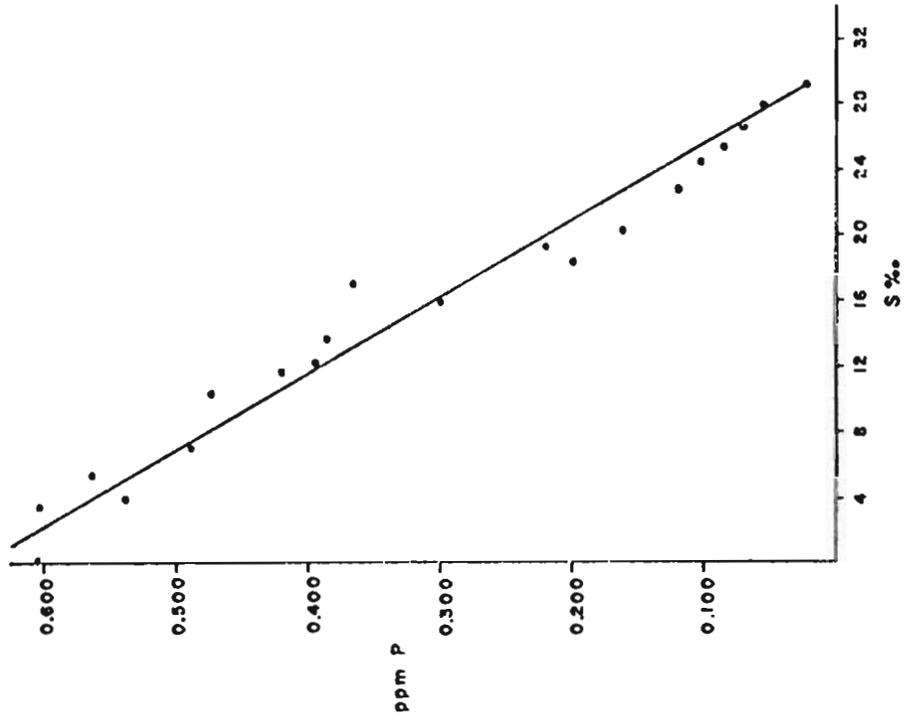


FIGURE 9.

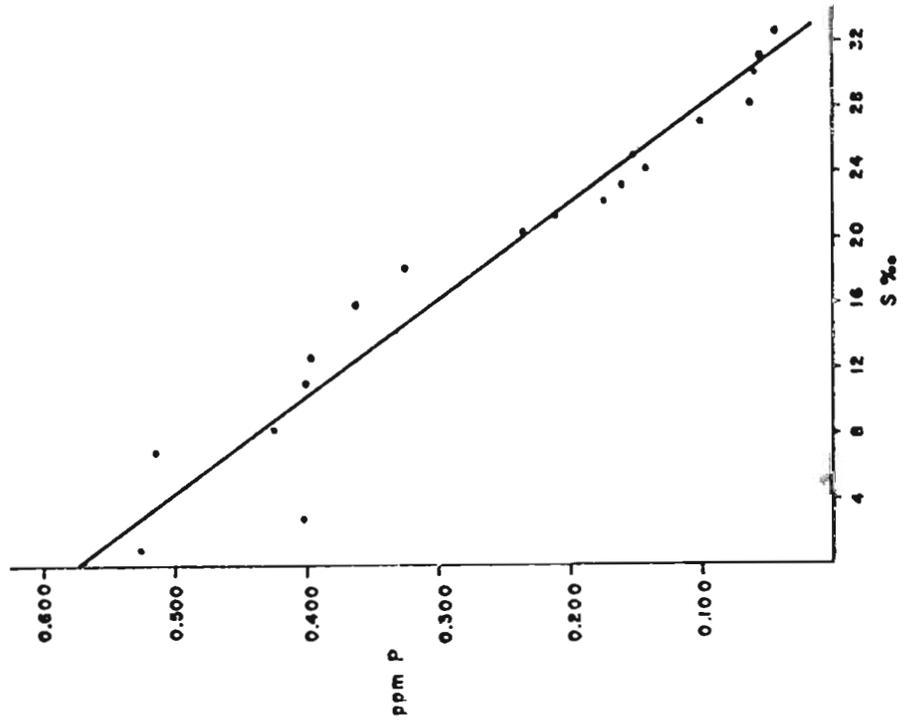
Effect of Dilution on Dissolved Phosphorus

EFFECT OF DILUTION ON DISSOLVED PHOSPHORUS

MARCH, 1970



DEC., 1969



The dissolved phosphorus content of the interstitial waters does not follow ideal dilution (Table 3). In an effort to interpret the interstitial water data, the sedimentary phosphorus phases were fractionated into the aluminum phosphate (Al-P), iron phosphate (Fe-P), reductant-soluble (Red-Sol), calcium phosphate (Ca-P) and total phosphate (Tot-P). The results are shown in Table 4. Figure 10 shows the distribution of the sedimentary phases, dissolved phosphorus in overlying water, and interstitial water phosphorus with respect to the linear distance in the estuary. The index point was chosen as the Punta Gorda bridge, and all distances are in statute miles above or below that point.

The dissolved phosphorus in the overlying waters does not correlate well with changes in the relative abundance of the sedimentary phases. The interstitial water phosphorus concentration exhibits a poor correlation with the dissolved phosphorus content of the overlying water.

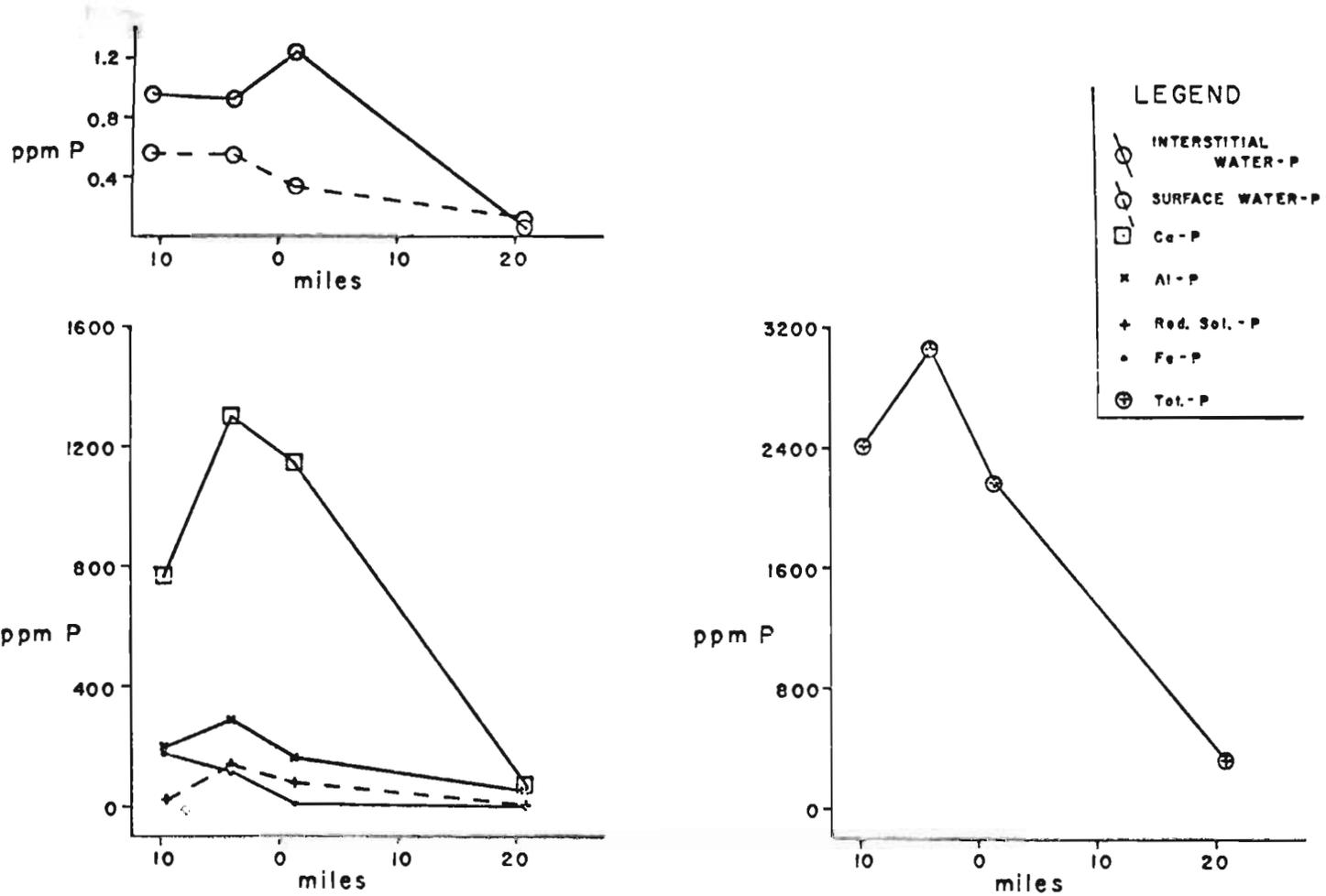
Of particular interest in Figure 10 is the apparent maximum in the curves at station 30. This point represents the area of maximum deposition of phosphorus phases in the estuary. Station 30 has an interstitial water salinity of 11 0/00 which indicates that salt water penetration to this point is not uncommon.

These distribution patterns of sedimentary phosphorus phases do not coincide with the expected patterns for formation

FIGURE 10.

Phosphorus Phase Distribution
in Charlotte Harbor.

PHOSPHORUS PHASE DISTRIBUTION IN CHARLOTTE HARBOR



of sedimentary phases by chemical reaction between dissolved species. This explanation would require an increase in the Ca-P phase below the point of mixing, accompanied by a decrease in the Al-P and Fe-P as more mixing occurred (Nelson, 1967). However, this is not the case. Instead, the results indicate two possible explanations: rapid precipitation of dissolved species and flocculation of suspended matter or detrital phases.

Chemical reaction could be the controlling factor, with mixing occurring so rapidly that most reaction occurs between stations 32 and 30. However, if the phosphorus was removed by this mechanism, the dilution curves would not be linear.

The other possibility for the maxima at a point up-river is that the sedimentary phases consist of detrital, colloidal, or particulate matter carried by the river which flocculates upon contact with seawater. This explanation would account for the decrease in all phosphorus phases in the sediment with linear distance down the river and especially the low Ca-P values observed in areas where seawater in the presence of high dissolved phosphorus concentrations are well mixed. For example, station 9 showed dissolved phosphorus of 0.122 ppm P, salinity of 25.1 ‰, but only 79 ppm P in the Ca-P phase and the lowest total phosphorus of any of the sediments in the harbor, including station 43, which is not from a phosphorus rich river.

Unfortunately, no work has been carried out on the flocculation of various phosphate phases in natural waters. Also, no comprehensive study of the mineralogy of suspended phosphates has yet been conducted. This data would be especially helpful in explaining the possible correlation of the Al-P phase with dissolved phosphorus. Hence, flocculation of phosphate phases over a salinity gradient must remain speculative until further studies may be carried out to either corroborate or disprove the hypothesis.

ADDITIONAL STUDIES

Preliminary studies on the dissolved nitrate and dissolved silicate chemistry in Charlotte Harbor have been conducted. The nitrate values measured in March, 1970, ranged from 0.05-0.1 ppm. It is possible that these low concentrations of dissolved nitrate are an important factor for limiting phytoplankton growth in the presence of high dissolved phosphorus concentrations. The addition of nitrogen to the estuary through sewage disposal or industrial waste disposal could result in serious eutrophication problems.

Dissolved silicate concentrations ranged from 0.31-0.50 ppm in the estuary in June, 1970. These values are below the average values noted for most Florida streams and estuaries. The low dissolved silica might limit diatom growth if the nitrogen limitation were removed.

A study of the primary productivity of Charlotte Harbor and the taxonomy of certain diatom species has been initiated by Miss Lundie Spence of the Department of Biological Sciences at Florida State University.

More detailed studies of the nitrate and silicate chemistry and primary productivity in the Charlotte Harbor estuary will be carried out in July, 1970, and discussed in future reports.

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TABLE 1

CHARLOTTE HARBOR DISSOLVED PHOSPHORUS ANALYSES

Sta. No.	Aug., 1969		Dec., 1967		March, 1970	
	Surface Water ppm P	Interstitial Water S‰	Surface Water ppm P	Interstitial Water S‰	Surface Water ppm P	Interstitial Water S‰
1	0.024	30.7				
2	0.020	31.2				
3	0.016	32.6				
4	0.018	32.4				
5	0.016	29.2				
6	0.020	30.4				31.3
7	0.040	28.5				31.2
8	0.084	26.8			0.072	28.7
9	0.122	25.1	0.052	29.1	0.150	25.0
10	0.132	24.6			0.087	24.9
11	0.152	24.5			0.098	24.2
12	0.079	29.0			0.053	30.0
13	0.024	30.9				28.9
14	0.022	32.8			0.022	29.1
15	0.039	30.0				
16	0.092	30.1				
17	0.026	26.8				
18	0.022	27.0				
19	0.008	30.3				
20	0.040	20.2				
21	0.115	17.6				
22	0.184	20.8			0.071	18.3
23	0.108	22.4			0.086	25.4
24	0.318	16.9			0.120	23.4
25	0.180	20.4			0.100	27.1
26	0.168	20.0			0.173	22.2
27	0.348	13.5			0.235	20.3
					0.280	17.8
					0.290	13.7

TABLE --Continued

Sta. No.	Aug., 1969		Interstitial Water		Dec., 1967		March, 1970	
	Surface Water ppm P	%	ppm P	%	Surface Water ppm P	%	Surface Water ppm P	%
28	0.334	14.7	1.240	23.1			0.465	8.4
29	0.572	00.6			0.526	1.0	0.395	12.1
30	0.552	00.0	0.930	11.3	0.560	00.0	0.540	1.1
31	0.496	00.0						
32	0.564	00.0	0.960	1.2	0.570	00.0	0.605	00.0
34	0.208	5.8	0.082	16.1	0.160	13.1	0.150	
35	0.326	12.4			0.279	18.0	0.420	12.8
36	0.440	11.2			0.213	21.4	0.420	15.8
37	0.242	18.2			0.160	23.3	0.160	18.5
38	0.144	23.5						
39	0.360	00.0					0.395	11.8
40	0.460	10.9					0.475	10.3
41	0.420	8.9					0.605	3.4
42	0.033	25.0						
43	0.071	7.0	0.065	12.8				
44	0.061	32.2						

TABLE 2 SALINITY GRADIENT PHOSPHORUS DATA

Dec., 1969		March, 1970	
S‰	ppm P	S‰	ppm P
00.0	0.570	0.0	0.605
1	0.526	1	
2		2	
2.9	0.405	3.4	0.605
4		3.9	0.540
5		5.3	0.565
6		6	
7.0	0.518	7.0	0.490
8.4	0.425	8	
9		9	
10		10.3	0.475
11.1	0.400	11.5	0.420
12.7	0.397	12.1	0.395
13.1		13.6	0.387
14			
15			
16.0	0.365	15.9	0.300
17			
18.2	0.326	18.3	0.200
19		19.2	0.220
20.3	0.235	20.2	0.162
21.4	0.213		
22.2	0.173		
23.3	0.160	22.7	0.120
24.2	0.142	24.4	0.103
25.0	0.150	25.3	0.086
26		26.5	0.072
27.1	0.100		
28.2	0.065	27.8	0.053
29		29.1	0.022
30.1	0.063		
31.2	0.055		
32.5	0.044		

TABLE 3 SALINITY AND DISSOLVED PHOSPHORUS
OF CHARLOTTE HARBOR INTERSTITIAL WATERS

Sample	Interstitial water ppm P	S‰
CH-32 (0-10)	0.960	1.2
CH-32 (10-20)	0.790	3.4
CH-32 (20-35)	0.790	2.9
CH-30 (0-20)	0.930	11.3
CH-28 (0-10)	1.240	23.1
CH-28 (10-20)	1.040	25.3
CH-28 (20-30)	0.870	25.8
CH-34 (0-10)	0.082	16.1
CH-34 (10-20)	0.250	15.0
CH- 9 (0-10)	0.052	29.1
CH-43 (0-10)	0.065	12.8

TABLE 4 CHARLOTTE HARBOR
 SEDIMENTARY PHOSPHORUS PHASES
 (all values in ppm)

Sample	Al-P	Fe-P	Ca-P	Red. Sol-P	Tot-P
CH-32 (0-10)	195	177	767	23	2408
CH-30 (0-20)	291	122	1300	143	3059
CH-28 (0-10)	169	13	1144	80	2166
CH-28 (10-20)	107	6	273	54	1154
CH-28 (20-30)	92	17	230	83	1060
CH-34 (0-10)	49	0	984	36	1187
CH- 9 (0-10)	62	0	79	0	329
CH-43 (0-10)	89	0	335	0	843
Precision	± 12.5%	± 30.4%	± 10.0%	± 6.5%	± 7.6%

APPENDIX I

EXPERIMENTAL

Unless otherwise stated, a Beckman Model DBG spectrophotometer was used to measure absorbance in colorimetric analyses.

Continuous sample shaking was performed on either a New Brunswick Model G 76 Gyrotory Water Bath Shaker, or a Scientific Industries, Inc. Multi-Purpose Rotator, Model 150V. Centrifugation was carried out on a Sorvall Model SS-3 Automatic Superspeed Centrifuge.

A. Sample Collection and Preparation

1. Estuarine and river water samples were taken using standard Niskin or Nansen water samplers. A saturated solution of mercuric chloride, 0.8 ml./250 ml. sample, was added as a preservative to all samples immediately after collection.

Samples were filtered through 0.45 Nucleopore or Satorius membrane filters. These filters were chosen in preference to Millipore filters because they were shown not to contain leachable phosphorus. Some freshwater samples were subsequently filtered through 0.10 filters under nitrogen pressure. The latter filtration used Millipore filters which had been prewashed with 200 ml. of distilled water to prevent phosphorus contaminations of samples.

Most samples were analysed within 24 hours of collection and were kept refrigerated for that period. When rapid analysis was not possible, samples were stored up to three weeks in dark polyethylene bottles at -20°C .

2. Sediment samples were obtained with a gravity corer equipped with a polycarbonate core liner. Sediment cores were extruded within one hour after collection. The periphery of the cores were cut away, and the core was subdivided. Each subsection was then squeezed in a hand-operated, stainless steel interstitial water press described by Siever (1962). The water collected in this manner was filtered and stored as above. The pressed sediments were placed in polyethylene bags and stored at -20°C . Samples were oven dried for one day at 100°C and finally ground with a mortar and pestle.

B. Salinity Measurements

Salinity measurements of open water samples were taken on a Hyteck Model 6210 conductivity salinometer, while interstitial water salinities were determined using an American Optical Co., T/C refractometer (Behrens, 1965).

C. Water-reactive Phosphorus Analysis

The basic method of Sutherland, et al. (1966) was used with slight modifications.

REAGENTS:

1. Ammonium Molybdate Solution--15 g. ammonium molybdate, F. W. 1236, dissolved in 500 ml. total solution.

2. Antimony Potassium Tartrate--0.34 g. dissolved in 500 ml. total solution.
3. 5N Sulfuric Acid.
4. Ascorbic Acid Solution--5.4 g. dissolved in 100 ml. distilled water. Solution must be kept refrigerated.

PROCEDURE:

1. Fifty ml. of the filtered sample were placed in a 125 ml. Erlenmeyer flask; and 5 ml. of mixed reagent (20 ml. of molybdate solution, 10 ml. potassium antimony tartrate solution, 50 ml. 5N sulfuric acid and 20 ml. ascorbic acid solution, in that order, were combined prior to use), were added to the sample.

2. The samples were timed for 15 minutes from the addition of reagent to the absorbance reading. This time period was critical within one minute, since the blue molybdate-phosphorus complex was unstable and increased in intensity with time. Hence, all readings were made within the allotted time. Absorbance was read at 690 m μ using a 1 cm. cell for concentrations of 1.0-0.08 ppm P and a 4 cm. cell for concentrations below 0.08 ppm P.

D. Fractionation of Sedimentary Phosphorus Phases

The procedure for this analysis was synthesized from the following references in the soils literature: Chang and Jackson (1957), Frink (1969), Williams, Syers and Walker (1967), Petersen and Corey (1966), Dickman and Bray (1940), and Anderson and Black (1965).

REAGENTS:

1. 0.5M Ammonium Chloride--26.8 g. dissolved in water and diluted to 1 liter.

2. Hydrochloric Acid--Molybdate Reagent--15.0 g. ammonium molybdate dissolved in 300 ml. warm water. The solution was cooled, and 350 ml. of 10.0N hydrochloric acid was added slowly with shaking. Again the solution was cooled and then diluted to 1 liter. Reagent is good for two months if stored in a dark bottle.
3. Stock Stannous Chloride Solution--10 g. stannous chloride dihydrate dissolved in 25 ml. hydrochloric acid. The reagent remains good for two months if kept in a dark bottle.
4. Dilute Stannous Chloride Solution--1.0 ml. of stock solution was added to 332 ml. of distilled water and shaken well. The solution remains good for eight hours.
5. 0.5N Ammonium Fluoride, pH 8.2--18.5 g. ammonium fluoride dissolved in 900 ml. distilled water. The pH was adjusted to 8.2 by addition of 4N ammonium hydroxide. The solution was then made to 1 liter by addition of distilled water, which had been adjusted to pH 8.2 in a similar manner.
6. Chloromolybdic Boric Acid Solution--3.5 g. ammonium molybdate dissolved in about 150 ml. warm water. The solution is cooled, and 75 ml. of concentrated hydrochloric acid was added slowly with stirring. The solution was again cooled. To this solution, another solution of 30 g. boric acid in 200 ml. warm water was added. The total mixture was diluted to 1 liter.
7. Bray reductant--2.5 g. 1-amino-2-naphtol-4-sulfonic acid, 5.0 g. Na_2SO_3 and 146 g. $\text{Na}_2\text{S}_2\text{O}_5$ were ground and mixed. Eight g. of the resulting powder were dissolved in 50 ml. of warm water. The mixture was allowed to stand overnight before use. The mixture remains good for three weeks.
8. 0.1N Sodium Hydroxide.
9. 0.3M Sodium Citrate--88.2 g. tribasic sodium citrate was dissolved in 900 ml. water and diluted to 1 liter.
10. Dithionite-- $\text{Na}_2\text{S}_2\text{O}_4$.
11. 0.25M KMnO_4 was diluted to 1 liter.
12. Molybdate-Sulfuric Acid Solution--60 g. ammonium molybdate was dissolved in 800 ml. boiling water.

The solution was cooled, and 84 ml. concentrated sulfuric acid was added. Again the solution was cooled and diluted to 1 liter.

13. Isobutanol.
14. Concentrated Sulfuric Acid.
15. 0.5N Sulfuric Acid.
16. Primary P Standard--0.2195 g. KH_2PO_4 was dissolved in 400 ml. distilled water. Twenty-five ml. of 7N sulfuric acid was added, and the solution was diluted to 1 liter (50 ppm P).
17. Saturated Sodium Chloride Solution.
18. Phosphate Free Charcoal--Activated charcoal was washed in concentrated hydrochloric acid for three hours, then filtered and washed with distilled water. The charcoal was then washed with concentrated ammonium hydroxide for three hours, filtered, and washed with distilled water. The charcoal was reactivated by heating at 200°C overnight.
19. 6N Ammonium Hydroxide.
20. 10% Magnesium Nitrate Solution--5 g. magnesium nitrate in 50 g. water.
21. 1N Hydrochloric Acid.

PROCEDURE:

1. Ammonium Chloride Soluble Phosphorus.

A weighed sediment sample was placed in an Erlenmeyer flask and shaken for 30 minutes with 50 ml. of 0.5M NH_4Cl . The sample was then centrifuged at 2000 rpm for 10 minutes. The solid residue was saved for the ammonium fluoride extraction.

A 10 ml. aliquot of the unknown was placed in an Erlenmeyer flask and diluted to 35 ml. Ten ml. of the hydrochloric acid-molybdate reagent was added, immediately

followed by 5 ml. of dilute stannous chloride solution. The solution was mixed and allowed to stand for 10 minutes before absorbance was read at 660 mu. The color is stable for 4-20 minutes.

2. Ammonium Fluoride Soluble Phosphorus.

Fifty ml. of 0.5N NH_4F , pH 8.2 was added to the sediment residue from the ammonium chloride extraction. The mixture was shaken for 24 hours and then centrifuged for 10 minutes at 5000 rpm. The solid residue was saved for the sodium hydroxide extraction, while the decanted liquid was analysed for phosphorus.

If the solutions were highly colored, they were filtered through approximately 0.5 g. phosphate free, activated charcoal. A 3 ml. aliquot was then treated with 3 ml. of chloromolybdic-boric acid reagent and 3 drops of Bray reductant. Absorbance was measured at 660 mu after 15 minutes. Color is stable for 15-45 minutes.

3. Sodium Hydroxide Soluble Phosphorus.

The sediment residue was washed twice with 25 ml. portions of saturated sodium chloride solution by centrifugation for 5 minutes at 2000 rpm.

Fifty ml. of 0.1 NaOH was added to the residue, and the mixture was shaken for 18 hours. The mixture was separated by centrifugation at 5000 rpm for 10 minutes, and the residue was saved for the reductant soluble phosphorus analysis.

The supernatant is again cleared with activated charcoal, if necessary, and the analytical procedure was identical to that for the ammonium fluoride soluble phosphorus extraction.

4. Reductant Soluble Phosphorus.

Again the sediment was washed twice with 25 ml. portions of saturated NaCl.

The sample was suspended in 25 ml. of 0.3M sodium citrate. One gram of solid sodium ditionite was added and the suspension was shaken for 5 minutes. The sample was then heated in a water bath at 75-80°C, diluted to 50 ml. and shaken for 5 minutes. The phases were separated by centrifugation at 5000 rpm for 10 minutes, and the solid residue was saved for the acid soluble analysis.

A 3 ml. aliquot of the supernatant was diluted to 25 ml. in a water bath. One and one-half ml. of 0.25M KMnO_4 and 3 ml. ammonium molybdate-sulfuric acid reagent were added while the solution was being heated to 75°C. Five ml. of KMnO_4 was then added in 1 ml. increments with good mixing after each addition. All MnO_2 was allowed to disappear before the addition of the next increment. The last 1 ml. was added dropwise until MnO_2 persisted. The heating was continued for a total time of 11.5 hours. The tubes were removed from the water bath and cooled. The solution was acidified with 15 drops of concentrated sulfuric acid. Ten ml. of isobutyl

alcohol was added, and the solution was mixed. Five ml. of the isobutyl alcohol phase was transferred and washed with 3 ml. of water.

Three ml. of this isobutyl alcohol phase was treated with 3 ml. of 1N HCl in ethyl alcohol and 4 drops of stannous chloride reductant. Absorbance was read at 660 mu within 15 minutes.

5. Acid Soluble Phosphorus.

The solid residue was again washed twice with 25 ml. of saturated NaCl.

The sediment was shaken with 50 ml. of 0.5N H₂SO₄ for one hour. The phases were separated by centrifugation at 5000 rpm for 10 minutes.

One ml. of the supernatant was analysed exactly as in the ammonium fluoride soluble fraction.

6. Total Phosphorus.

A weighed sample of sediment, approximately 0.5 g., was placed in a beaker. The sample was treated with 5 ml. of 6N ammonium hydroxide and 1 ml. of 10% magnesium nitrate solution and heated to dryness on a steam bath. The sample was then ignited for 12 hours at 500-520°C. After ignition, the sample was cooled, treated with 20 ml. of 1N HCl and heated for 10 minutes on a steam bath. The solution was diluted to volume and analysed according to the method for ammonium chloride soluble phosphorus.

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