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CHEMICAL SURVEY OF WATERS
ADJACENT TO COLONELS ISLAND,
GLYNN COUNTY, GEORGIA

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The Technical Report Series of the Georgia Marine Science Center is issued by the Georgia Sea Grant Program and the Marine Extension Service of the University of Georgia on Skidaway Island (P. O. Box 13687, Savannah, Georgia 31406). It was established to provide dissemination of technical information and progress reports resulting from marine studies and investigations mainly by staff and faculty of the University System of Georgia. In addition, it is intended for the presentation of techniques and methods, reduced data and general information of interest to industry, local, regional, and state governments and the public. Information contained in these reports is in the public domain. If this prepublication copy is cited, it should be cited as an unpublished manuscript.

Abstract: Basic measurements of the water quality of the Brunswick River adjacent to Colonels Island, Georgia were made over a tidal cycle. The reported values for temperature, salinity, oxygen, pH, ammonia, chlorophyll a, nitrate and phosphate while limited to one season are within the range of values which might be expected for such an estuarine-river system. All the parameters measured indicate that the estuarine area is well mixed.

Various aspects of the water quality at four stations near Colonels Island, Georgia, were examined during 7 and 8 August, 1973 by personnel of Skidaway Institute of Oceanography using the 65 foot vessel R/V Kit Jones for sample collection and shipboard data acquisition. The study was accomplished under a research grant from E.I. DuPont de Nemours and Company of Wilmington, Delaware, who at the time of the study, were considering locating a titanium dioxide plant on Colonels Island.

Samples Locations

Samples were taken near Colonels Island, Glynn County, Georgia, upstream from Brunswick Harbor. Four stations were established (see appended Figure). Station 1 was located in the middle of the channel in the South Brunswick River adjacent to the proposed Du Pont plant site. Station 2 was established in the channel of the Turtle River slightly upstream from its confluence with the South Brunswick and Brunswick Rivers. Station 3 was located in the channel of the Brunswick River adjacent to the entrance to Brunswick Harbor. Station 4 was established in Fancy Bluff Creek, a small tidal creek emptying into the South Brunswick about one-quarter mile upstream of station 1. The four stations were sampled at high tide on the afternoon of 7 August 1973 and low tide on the morning of 8 August 1973. Water depth exceeded 20 feet at all stations with the exception of station 4 which was between 5 and 12 feet, depending upon tide stage.

Water Chemistry

Water chemistry determinations included temperature, salinity, chlorinity,

dissolved oxygen, pH, ammonia, nitrate, phosphate and chlorophyll. Each of these parameters was measured at a point one foot below the surface and one foot above the bottom of the water column using a Kemmerer water bottle of 2 liter capacity. Measurements of each parameter were made at high and low tide. The data are presented in the tables appended to this report.

Temperature. Water temperature was determined with a thermistor used in conjunction with an oxygen meter. The temperature ranged from 28 to 29.5 C among the four stations and two sampling days. This range is typical for the season and location. Georgia estuarine waters generally range between 8 and 30 C over the course of a year, with extremes of 3-4 C outside those limits.

Salinity. Salinity was measured to the nearest part per thousand (ppt) with an American Optical Co. refractometer. The refractometer was standardized prior to use with distilled water and Copenhagen standard sea water. Because of the well mixed nature of the water (typical of the Georgia estuarine zone) more critical measurement of salinity was not felt to be warranted. No salt wedge was detected at any of the stations indicating that plant effluent would be expected to mix with the entire water column if the effluent were adequately dispersed upon release. Note that salinity was higher at low tide than at high tide, although the reverse should be expected. This discrepancy was apparently associated with a heavy rainstorm which occurred throughout the study area for a period of several hours prior to sampling on 7 August.

Chlorinity. Chlorinity was calculated using the formula of Sverdrup, Johnson and Fleming (1972) where:

$$\text{Salinity} = 0.03 + 1.805 \times \text{Chlorinity}$$

The values reported in the column headed "Chlorinity Calculated" were derived using this formula. In addition, an Orion Chloride electrode was used to determine chlorinity (the values obtained are presented under the heading "Chlorinity Electrode"). The electrode was standardized using serial dilutions of Copenhagen standard sea water. The precision of such an electrode is in the vicinity of only \pm 20 percent (H.L. Windom, personal communication), thus the values obtained with the electrode are not as reliable as the calculated values. Because of the low reliability of the electrode, and assuming the law of constant proportions holds for estuarine water, the better chlorinity number is that associated with the calculation based on salinity. The reliability of the refractometer is superior to that of the chloride electrode in our experience.

Dissolved oxygen. Values for dissolved oxygen, as determined with a Yellow Springs oxygen meter, ranged from 3.6 to 5.4 mg/l. These values are typical for Georgia estuarine waters during this time of year. Higher values can be expected during periods when the water temperature is cooler. In general, a value of 5.0 mg/l is considered to be adequate for marine life, and values less than 5.0 mg/l are not desirable. However, in the Georgia estuarine area dissolved oxygen routinely falls below 5.0 mg/l during the summer months. There was a tendency toward lower dissolved oxygen at high tide (samples taken during the afternoon) than at low tide (samples taken during the morning), when the opposite might be expected (since respiration at night would be expected to lower dissolved oxygen levels when photosynthetic productivity ceases). The reason for the dissolved oxygen pattern is not clear because of the limited amount of data.

pH. The pH was found to be slightly alkaline at all stations, typical of

estuarine water having the salinities observed. Salt water is an excellent buffer solution and such values are to be expected except in areas receiving large amounts of natural organic acids or acid industrial effluents. Determinations of pH were made with an Orion pH electrode used in conjunction with a Corning pH meter.

Ammonia. Ammonia concentration was determined with an Orion ammonia electrode used in conjunction with an Orion digital readout specific ion electrode meter. Standard curves were constructed using standard ammonia solutions. The equipment used is capable of measuring ammonia in concentrations down to 20 parts per billion (ppb). The values obtained for ammonia were all within the normal range observed by us for Georgia estuarine waters.

Chlorophyll. Water for chlorophyll analyses was analyzed by fluorometry in the laboratory after suitable treatment. Techniques were modified from Lorenzen (1966). Chlorophyll is variable depending upon season of the year and presence or absence of a dense phytoplankton community. The values obtained are within the expected range for Georgia estuarine areas.

Nitrate. Nitrate was analyzed in the laboratory after the cruise. The samples for nitrate and phosphate were frozen in dry ice immediately after collected and run in the laboratory as soon as possible after the cruise. Nitrate was run by modification of the techniques presented by Bendeschneider and Robinson (1952) and Strickland and Parsons (1968).

Phosphate. Phosphate concentration was determined by the method of Murphy and Riley (1962).

In summary, the values obtained for each of the parameters appeared to fall within expected values for Georgia estuarine waters given the time of year during

which the samples were collected. August is one of the months when the environment is naturally under stress due to high temperature, relatively low dissolved oxygen, and high standing crops of various types of organisms. Another period when stresses occur is the winter period, especially February when temperature is at its lowest. However, during the Georgia winter dissolved oxygen is usually high and the animal population is at its lowest for the year.

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WATER CHEMISTRY DATA8 August 1973Low Tide

Station	Depth	Temperature (C)	Salinity (ppt)	Chlorinity Calculated (ppt)	Chlorinity Electrode (ppt)	Dissolved Oxygen (mg/l)	pH	NH ³ (mg/l)
(1) South Brunswick River	Surface	28.5	22	12.2	14	5.4	7.6	0.025
	Bottom	28.5	22	12.2	14	4.7	7.1	0.047
(2) Turtle River	Surface	29	22	12.2	14	5.3	7.1	0.017
	Bottom	29	23	12.7	14	5.0	7.3	0.032
(3) Upstream Brunswick River	Surface	29.5	23	12.7	15	5.3	7.4	0.022
	Bottom	29	25	13.9	15	5.2	7.5	0.029
(4) Fancy Bluff Creek	Surface	29	20	11.1	14	5.0	7.3	0.018
	Bottom	29	22	12.2	14	5.1	7.4	0.035

WATER CHEMISTRY DATA7 August 1973High Tide

Station	Depth	Temperature (C)	Salinity (ppt)	Chlorinity Calculated (ppt)	Chlorinity Electrode (ppt)	Dissolved Oxygen (mg/l)	pH	NH ³ (mg/l)
(1) South Brunswick River	Surface	28	19	10.5	15	4.4	7.5	0.011
	Bottom	28	19	10.5	14	4.4	7.5	0.038
(2) Turtle River	Surface	29	20	11.1	16	3.6	7.0	0.015
	Bottom	29	20	11.1	16	3.9	7.2	0.022
(3) Upstream Brunswick River	Surface	29.5	20	11.1	19	4.2	7.2	0.018
	Bottom	29	22	12.2	19	3.9	7.1	0.026
(4) Fancy Bluff Creek	Surface	28.5	20	11.1	15	3.9	7.5	0.014
	Bottom	29	20	11.1	15	3.8	7.5	0.016

WATER CHEMISTRY DATA

7 August 1973

High Tide

Station	Depth	Chlorophyll <u>a</u> μg/L	Nitrate μg at/L	Phosphate μg at/L
(1) South Brunswick River	Surface	9.1	16.85	2.50
	Bottom	10.3	18.55	2.61
(2) Turtle River	Surface	8.6	12.99	2.50
	Bottom	8.1	15.00	2.07
(3) Upstream Brunswick River	Surface	9.0	7.91	2.20
	Bottom	7.5	16.00	2.22
(4) Fancy Bluff Creek	Surface	5.9	15.00	2.46
	Bottom	6.3	16.00	2.75

WATER CHEMISTRY DATA

8 August 1973

Low Tide

Station	Depth	Chlorophyll a $\mu\text{g/L}$	Nitrate $\mu\text{g at/L}$	Phosphate $\mu\text{g at/L}$
(1) South Brunswick River	Surface	5.7	21.11	2.32
	Bottom	5.5	22.52	2.61
(2) Turtle River	Surface	3.4	16.14	2.17
	Bottom	4.3	17.42	2.82
(3) Upstream Brunswick River	Surface	3.8	14.58	1.89
	Bottom	3.9	16.00	2.45
(4) Fancy Bluff Creek	Surface	5.1	14.30	2.56
	Bottom	7.0	15.00	2.45



