TECHNICAL PUBLICATION 85-1

SHORT TERM EFFECTS OF A FRESHWATER DISCHARGE ON THE BIOTA OF ST. LUCIE ESTUARY, FLORIDA

March 1985

By

Daniel E. Haunert
and
J. Robb Startzman

This public document was promulgated at an annual cost of $268.50, or $.53 per copy to inform the public regarding water resource studies of the District.
RPD 385 5C

South Florida Water Management District
Resource Planning Department
Environmental Sciences Division

EXECUTIVE SUMMARY

The productivity of the St. Lucie Estuary is influenced by the salinity regime in the system and is frequently altered by the rapid introduction of fresh water runoff. The most dramatic alterations in salinity occur during regulatory discharges from Lake Okeechobee into the South Fork of the estuary. For the duration of these discharges, salinities are reduced far below normal.

Limited data concerning the environmental effects of regulatory discharges on the St. Lucie Estuary were available before 1977and the District began investigations to document changes in the fish and benthic communities and water quality during controlled discharges. Results from these investigations will ultimately provide the basis for development of methods and procedures that will be sensitive to the ecology of the estuary. Results of a previous study indicated that a controlled three week 1000 cfs discharge had no significant effect on biota; however, this study demonstrated substantial changes in the composition and abundance of benthos and distribution of fish as the result of a three week 2500 cfs discharge.

Salinity and bottom substrate are important environmental factors that affect fish and benthic communities. Before the 2500 cfs discharge began, the inner estuary had a salinity of 5 to 18 ppt and the middle estuary had a salinity of 18 to 30 ppt. Within these two areas, organically rich mud bottoms were inhabited by a high density but low diversity of estuarine benthos. The fish community had little diversity and was dominated by lower trophic level fish, especially bay anchovies. In contrast, sand and shell substrates with seagrasses that occurred in more saline (30 to 36 ppt) waters of the outer estuary, provided habitat for diverse populations of estuarine and marine benthos and fish.

Salinity throughout the estuary was altered by the 2500 cfs discharge. Within the first two weeks of discharge, salinities in the inner and middle estuary were reduced to 0.5 to 5.0 ppt (oligohaline). At the outer limits of this low salinity zone, a salt wedge occurred that remained relatively stable for the duration of the discharge.

The initial reduction in salinities and increase in turbidity in the inner and middle estuary changed the benthic and fish communities. The most apparent changes to benthos occurred where salinity was reduced below 5 ppt during the first two weeks of discharge. The majority of a 44% reduction in the number of benthic organisms resulted from a severe decrease in numbers of the bivalve, *Mulinia lateralis*, which perished from low salinities, and the amphipod, *Ampelisca abdita*, which migrates when stressed by salinity and/or increased turbidity. However, a dramatic increase in abundance of the fresh water midge larvae, *Chironomus crassicaudatus* and a moderate increase in numbers of the polychaete, *Streblospio benedicti* occurred. Six fresh water species were introduced to the inner estuary and four estuarine species were lost or severely reduced in numbers.

The composition and distribution of fish changed with the decline in salinity. Gizzard shad, white catfish, mosquito fish, and black crappie are fresh water species that moved into the inner estuary from upstream. The euryhaline larvae of ladyfish, tarpon, and bonefish, and adult snook moved into the South Fork of the inner estuary from downstream. Several species such as the striped anchovy, pinfish, and pigfish, which are less tolerant of low salinities, avoided the inner estuary. In addition to the above noted fish movements, one other prominent change occurred. The fish occupying the lower trophic level in the inner estuary became more uniformly distributed as the area of low salinity increased during the initial two weeks of discharge. A surge of inorganic nitrogen, which occurred at the onset of the discharge, resulted in an algae bloom that may have provided an additional food supply for planktivorous fish. The dispersion and availability of food organisms, including *A. abdita* and *C. crassicaudatus*, and organic materials may have been responsible for the increased distribution of these fish. The lower trophic level fish returned to their previous distribution in the estuary after the low salinity zone was established and most of the changes in the benthic communities had apparently taken place. In spite of the observed movements of some species, the fish communities (as represented by species presence throughout the estuary), remained stable throughout the five-week experimental discharge.

Under natural conditions the size of the low salinity zone in the St. Lucie Estuary fluctuates in response to seasonal freshwater runoff from the watershed. Many benthic organisms have adapted to transient, low salinity conditions that occur in the inner estuary but cannot tolerate exposure to fresh water for extended periods. The three week, 2500 cfs discharge rapidly increased the size of oligohaline zone to include a large portion of the middle estuary and induced changes in the fish and benthic communities that normally occur in a limited area of the inner estuary. Subsequent modeling studies indicated that if the discharge had continued for another 10 days the inner estuary would have become fresh water and threatened the survival of existing oyster reef communities. Previous regulatory discharges have been large enough and long enough to create fresh water conditions in the middle estuary for extended periods. The loss of oysters in the inner and middle estuary would decrease the carrying capacity of the system since these organisms provide an important food source and habitat for many other organisms.

TABLE OF CONTENTS

PAGE

Executive Summary i
List of Tables ii
List of Figures iii
Acknowledgements iv

Introduction 1
Description of Study Area 1
Sampling Methods 6
Statistical Methods 6
Results 6
Discussion 30
Summary of Results 36
Literature Cited 37

Appendix A Water Temperatures in the St. Lucie Estuary During the 2500 cfs Discharge Study A-1

Appendix B Quantitative Listing of Benthic Fauna Before and After the 2500 cfs Discharge B-1

Appendix C Fish Captured During the 2500 cfs Discharge Study C-1

LIST OF TABLES

TABLE

1 Salinity at Low Tide in the North Fork During the 2500 cfs Discharge Study ....

2 Salinity at Stations 8C and 9C During the 2500 cfs Discharge Study ....

3 Dissolved Oxygen in the North Fork and Outer Estuary During the 2500 cfs Discharge Study ....

4 Turbidity Throughout the St. Lucie Estuary During the 2500 cfs Study ....

5 Depths and Substrate Description at Ekman Stations in the St. Lucie Estuary ....

6 Density and Percent of Population for each Class of Benthos in the Inner and Mid-estuary Before and After theDischarge ....

7 Total Relative Abundance of the Benthic Species Culled at 1% Before and After Discharge ....

8 Density and Percent of Population for each Class of Benthos in the Outer Estuary Before and After the Discharge ....

9 Fish Caught During the 2500 cfs Discharge Study in Decreasing Order of Numerical Abundance, Scientific and Common Name ....

10 Fish Presence Throughout the St. Lucie Estuary During the 2500 cfs Discharge Study ....

11 Fish Response to the 2500 cfs Freshwater Discharge ....

12 Comparison of Percent Presence Lower Trophic Level Fish, with Chi Square ....

13 Number of Fish Species in the Inner and Mid-estuary During the 2500 Discharge Study ....

14 Comparison of the Number of Fish Species Populations with t Statistic ....

LIST OF FIGURES

FIGURE		PAGE
1	St. Lucie Estuary, Florida	2
2	St. Lucie Estuary Drainage Basins	3
3	Bathymetry of the St. Lucie Estuary	4
4	St. Lucie Estuary Sampling Transects	5
5	Rainfall in Tributary Basins of the St. Lucie Estuary, June-July, 1978	8
6	Discharge into the St. Lucie Estuary 6/15/78 thru 7/20/78	9
7	Salinities and Stratification Coefficients in the St. Lucie Estuary, 4 Days Before Discharge and 1 Day of Discharge	10
8	Salinities and Stratification Coefficients in the St. Lucie Estuary, 8 and 18 Days of Discharge	11
9	Salinities and Stratification Coefficients in the St. Lucie Estuary, 2 and 10 Days Post Discharge	12
10	Dissolved Oxygen in the St. Lucie Estuary, 4 Days Before Discharge and 1 Day of Discharge	13
11	Dissolved Oxygen in the St. Lucie Estuary, 8 and 18 Days of Discharge	14
12	Dissolved Oxygen in the St. Lucie Estuary, 2 and 10 Days Post Discharge	16
13	Turbidity in the St. Lucie Estuary During the 2500 cfs Discharge Study	17
14	Nutrients at S-80 During 2500 Discharge Study	18
15	Percent Presence of Benthic Species Before and After the 2500 cfs Discharge. Inner and Middle Estuary Stations 1SCX through 6SCX, Sampled on 6/13/78 and 7/10/78	20
16	Percent Presence of Benthic Species Before and After the 2500 cfs Discharge. Outer Estuary Stations 7SCX through 10SCX, Sampled on 6/13/78 and 7/10/78	22
17	Phenogram Showing the Similarity of Trawl Samples Collected During the 2500 cfs Discharge Study	27
18	Phenogram Showing the Similarity of Seine Samples Collected During the 2500 cfs Discharge Study	27
19	Percent Presence of Fish in the Inner and Middle Estuary During the 2500 cfs Discharge Study	29
20	Salinity Zones in the St. Lucie Estuary, 4 Days Before Discharge and 1 Day of Discharge	31
21	Salinity Zones in the St. Lucie Estuary, 8 and 18 Days of Discharge	32
22	Salinity Zones in the St. Lucie Estuary, 2 and 10 Days Post Discharge	33
23	Salinity Zones in the St. Lucie Estuary Before (6/17/77) and After (7/11/77) the 1000 cfs Discharge Study	35

ACKNOWLEDGEMENTS

The authors wish to commend the South Florida Water Management District for continually striving to maintain and enhance estuarine environments within the District. Ed Terczak, District entomologist, identified the macroinvertebrates and Grant Gilmore of the Harbor Branch Consortium supplied fish taxonomic information and use of their reference collection. Compilation of data were completed with the willing assistance of Al Harkabus. Special thanks to Jim Milleson, Joel VanArman, and other associates for their critical review of the report.

Introduction

The St. Lucie Estuary is an important ecological resource that many aquatic species utilize for part or all of their life history. Almost 65 percent of the commercial fish and most of the sport fish in the South Atlantic Estuarine area are dependent on systems similar to the St. Lucie Estuary for one or more phases of their development (Bollman, 1975).

Salinity is an important factor in estuaries because it influences the presence, distribution, abundance, rate of development, and ultimately the survival of many organisms. For these reasons, the rate and magnitude of change in the salinity gradient throughout the year affects the overall productivity of the estuary. The salinity gradient in the St. Lucie Estuary has been altered in several ways. Canals have been dredged in the basins that drain into the North Fork to provide flood protection and irrigation for agriculture and urban development. These canals discharge stormwater into the estuary much faster than would normally occur; therefore, salinity can be altered rapidly. The St. Lucie Canal, which provides a drainage outlet for Lake Okeechobee, flows into the southern reaches of the South Fork. Regulatory discharges are made periodically from Lake Okeechobee when water levels exceed the flood control schedule developed and implemented by the Army Corps of Engineers and the South Florida Water Management District (SFWMD). These large volume regulatory discharges lower the estuarine salinity gradient far below the normal range for the duration of the discharge. The environmental effects associated with the timing, duration, rate, and quality of water released during these discharges have concerned local citizens, interest groups, and the SFWMD. Major concerns are related to the effects of lowered salinity and increased sediment load on the biota and physical characteristics of the estuary.

The St. Lucie Estuary has received regulatory discharges from Lake Okeechobee since the completion of the St. Lucie Canal (C-44) in 1924. This canal was enlarged in 1949 and freshwater discharges of near 6000 cfs occurred many times. The lake regulation schedule was raised in 1974 and provided more water storage capacity which decreased the amount of water discharged to tide-water. However, in spite of this change, a large regulatory discharge of about 6700 cfs occurred for two weeks in August 1974.

A limited amount of past research was completed which documented some of the effects of discharges on the fish and benthic algae populations of the estuary (Gunter, 1959; Phillips and Ingle, 1960; Springer, 1960; Phillips, 1961; Heald, Iverson, and Berkeley, 1972). These studies, however, were not experimentally designed to document the environmental changes that occurred during a controlled discharge, lasting for a predetermined amount of time. To provide more detailed information, the SFWMD, in cooperation with the Army Corps of Engineers, began investigations which monitored the effects of controlled freshwater releases from Lake Okeechobee on the biota and water quality of the St. Lucie Estuary. A study of the effects of a three week, 1000 cfs discharge in June and July 1977 indicated there were no significant changes in the benthic and fish populations (Haunert and Startzman, 1980); therefore, the estuary had not been subjected to discharges in excess of 1000 cfs since August 1974.

Biological conditions within the estuary were probably representative of the "steady state" conditions before a study of a three-week, 2500 cfs controlled discharge began in June 1978. This study documents that significant changes occurred in the distribution of benthos and fishes in the estuary during this controlled discharge event.

Description of Study Area

The St. Lucie Estuary is located in Martin and St. Lucie Counties on the southeast coast of Florida (Figure 1). Annual rainfall averages about 50 in. with most of this rainfall occurring from May to October. Maximum rainfall events generally occur in September. Citrus and improved pasture are the major land uses in the watershed, but recently urban development has increased. Canals C-23 and C-24 drain numerous smaller canals and have a combined drainage basin area of 333 mi^2. These two canals discharge surface water runoff into the North Fork of the St. Lucie Estuary at structures S-48 and S-49 (Figure 1). Since the completion of the Port Mayaca structure (S-308) on Lake Okeechobee in 1978, runoff from the C-44 basin (189 mi^2) is discharged through the St. Lucie Lock and Dam (S-80) into the South Fork of the estuary when S-308 is closed. The St. Lucie Estuary watershed (Figure 2) also includes the Tidal St. Lucie and North St. Lucie Basins (68 and 189 mi^2) and several smaller basins (4,5, and 6).

The estuary has been divided into four major areas for the purpose of this study: the North and South Forks (collectively termed the inner estuary); the mid-estuary; and the outer estuary. The main body of the North Fork is about four miles long, has a surface area of 4.5 mi^2, and a total volume of 998.5 x 10^6 ft^3 at mean sea level. The center of the North Fork is approximately 10.0 ft deep, and depth increases to 15.0 ft at the confluence with the South Fork (Figure 3). The South Fork has about half the surface area and volume of the North Fork (1.9 mi^2 and 468.7 x 10^6 ft^3). Depths within the South Fork exceed 9.0 ft in the navigation channel but are relatively shallow outside the channel, especially in the vicinity of the Palm City Bridge (Figure 4). The mid-estuary begins at the Roosevelt Bridge, extends east for three miles and "dog-legs" to the southeast for two miles until it is constricted at Hell Gate Point. The surface area and volume of the mid-estuary are similiar to the North Fork (4.7 mi^2 and 972.7 x 10^6 ft^3). At Roosevelt Bridge, depths of 20.0 ft occur with a cross section of only 1000 ft. This sharp relief is contrasted by the gradual depth changes which occur east of the bridge to Hoggs Cove, where maximum depths are similar to the North Fork (10.0 ft) across an average distance of 6000 ft. From Hoggs Cove to Hell Gate Point, the maximum depths increase from 10.0 ft to a small area that has a depth of 26.0 ft. The cross-sectional area at Hell Gate Point (16,750 ft^2) is almost identical to the cross-section at Roosevelt Bridge (16,650 ft^2). From Hell Gate Point, water flows into the outer estuary past the Manatee Pocket to the Crossroads, and meets with the Indian River and Intracoastal Waterway producing complex tidal currents near the St. Lucie Inlet.

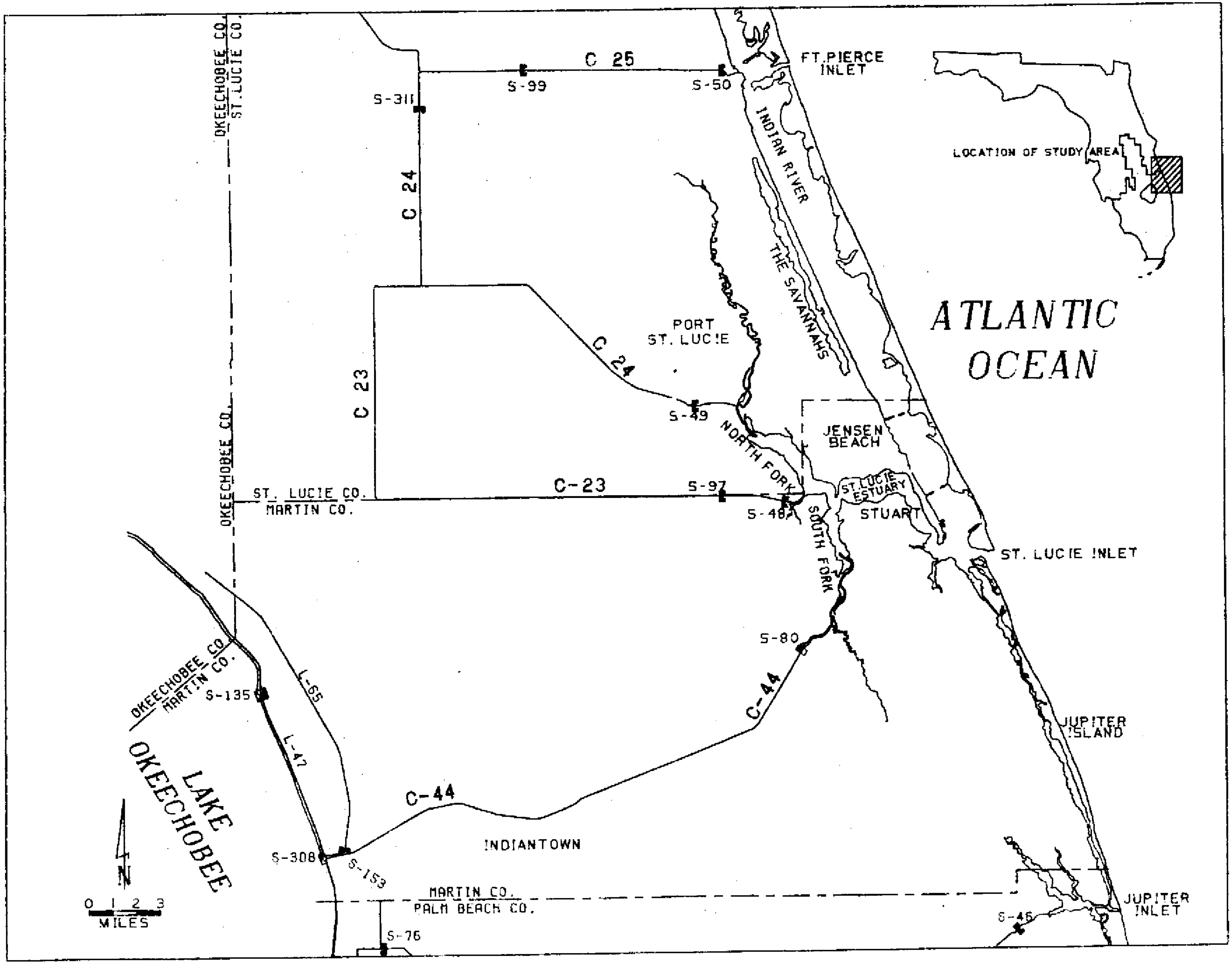

FIGURE 1. ST. LUCIE ESTUARY, FLORIDA

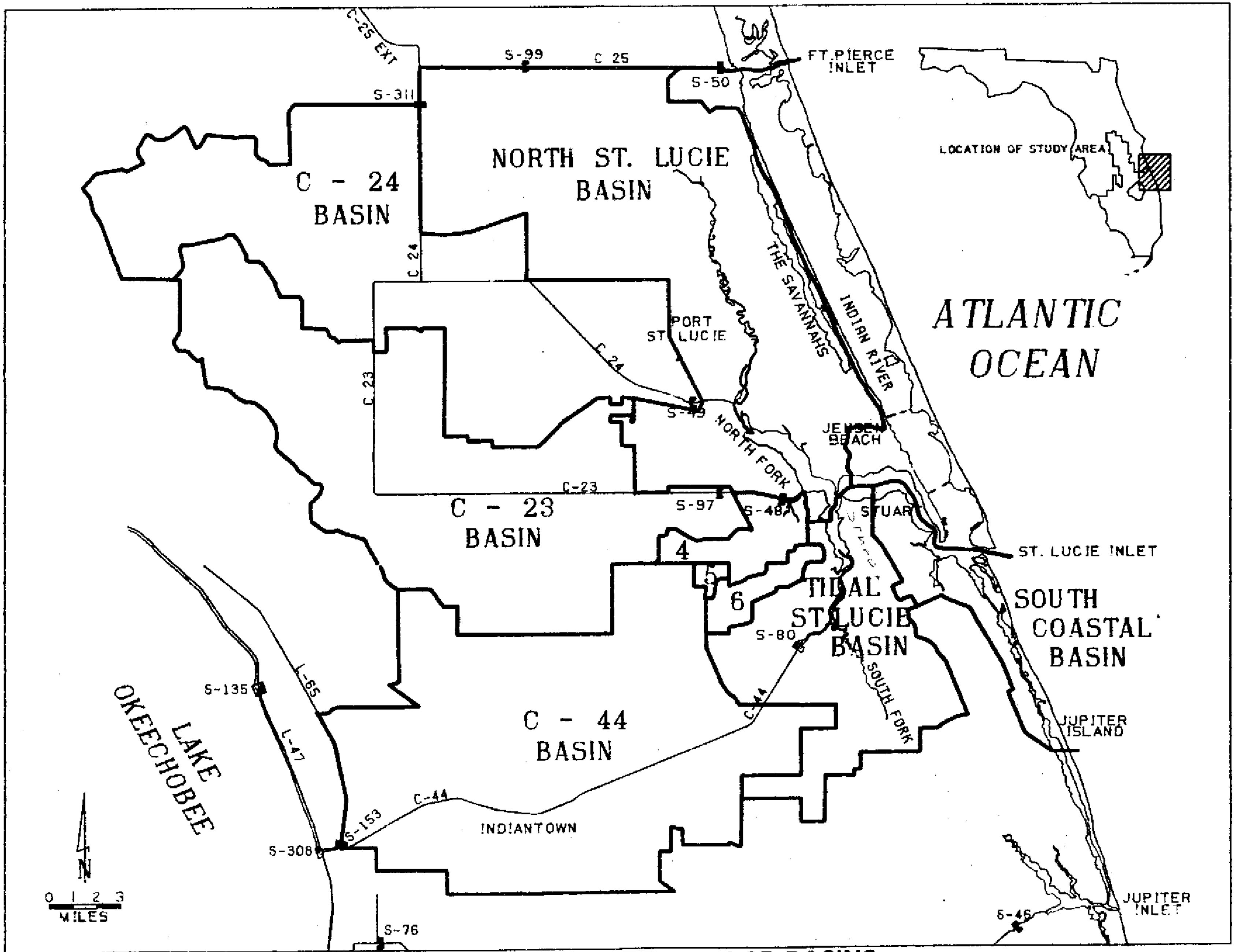

FIGURE 2. ST. LUCIE ESTUARY DRAINAGE BASINS

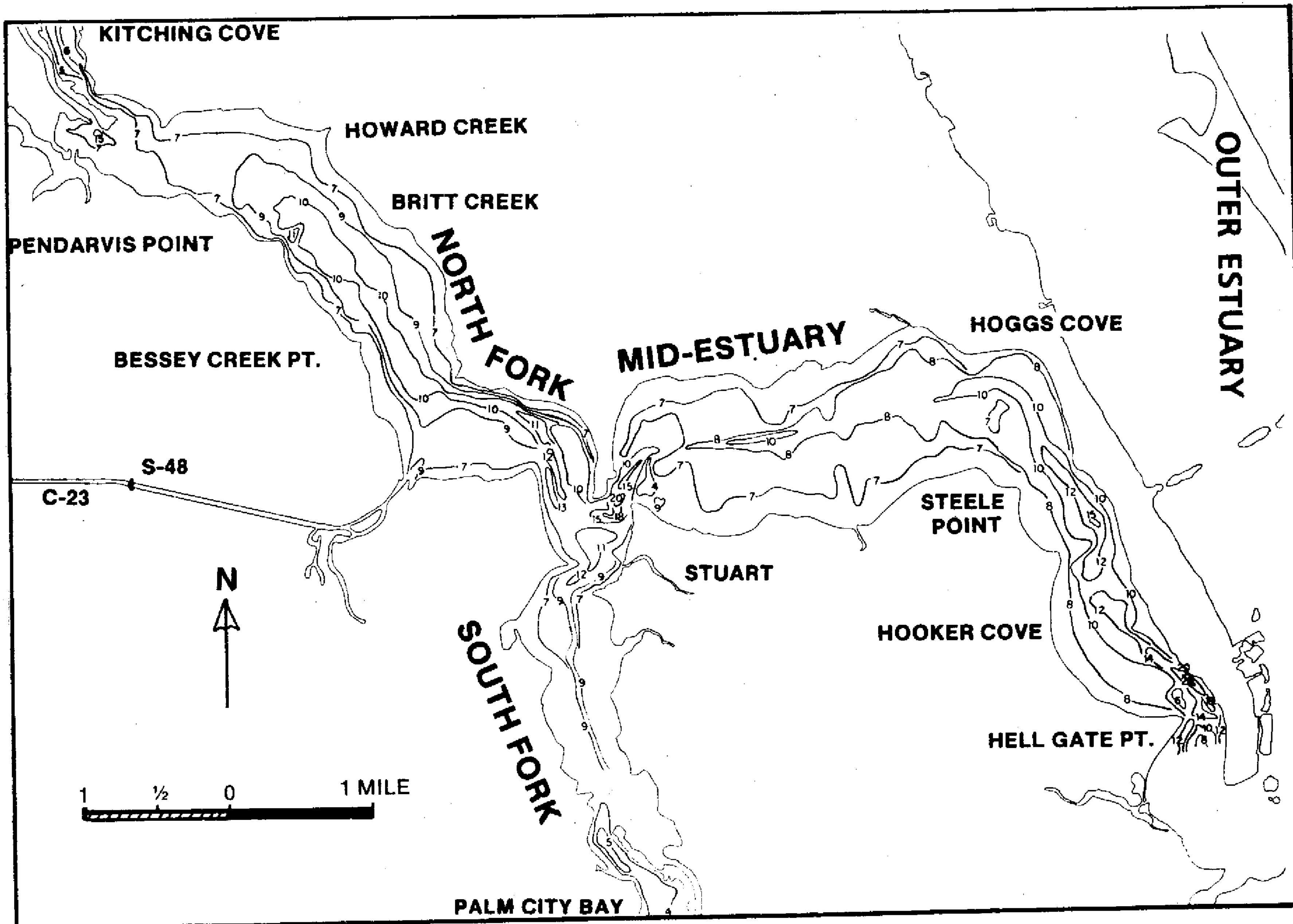

FIGURE 3. BATHYMETRY (in Ft.) OF ST. LUCIE ESTUARY, FLORIDA IN 1981

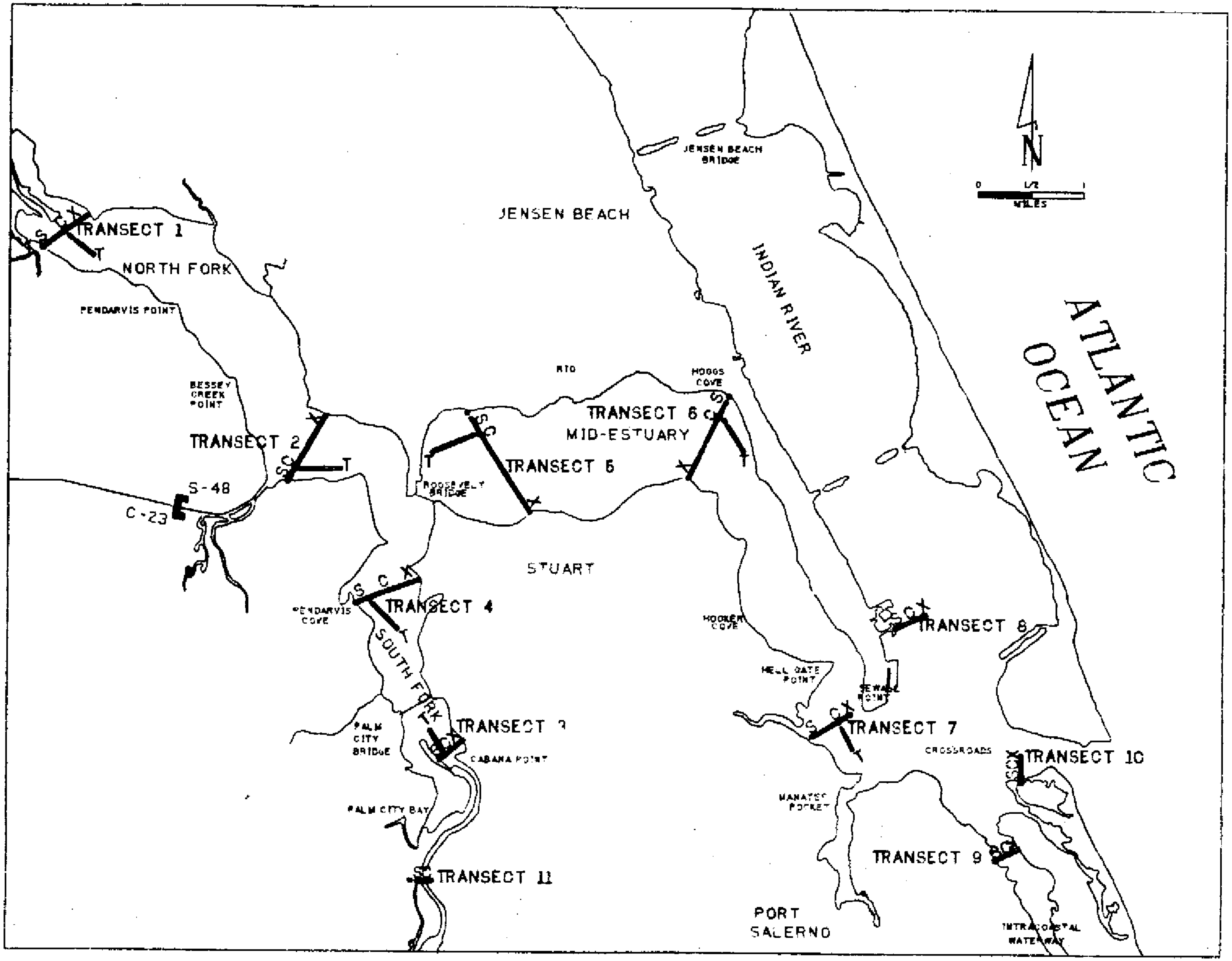

FIGURE 4. ST. LUCIE ESTUARY SAMPLING TRANSECTS

Sampling Methods

A 2500 cfs controlled freshwater discharge from the St. Lucie Lock and Dam (S-80) into the South Fork of the St. Lucie Estuary was made from 19 June to 10 July 1978. Changes in the salinity gradient, water quality, fish, and benthic communities were monitored to ascertain the effects of the discharge. Samples were taken from one week before the discharge began to four days after it ended. Eleven transects were established throughout the estuary with three sample sites (S,C,X) on each transect (Figure 4).

Physical Parameters

Low and high tide measurements of conductivity (which is directly related to salinity), dissolved oxygen, and temperature were taken every week at each "C" (mid-channel) site at 0.5 m depth intervals with a Hydrolab Surveyor Model 6D. Studies lasted for about three hours, began at slack tide in the St. Lucie Inlet (station 10C), and proceeded upstream to the inner estuary. Since there was approximately a three hour time lag for slack tide between the outer and inner estuary, it was possible to obtain near slack tide measurements at most sample locations.

Water Quality

Surface turbidities were monitored twice a week at "C" sites during the latter part of the outgoing tide. Jackson Turbidity Units (JTU) were determined with a Hach Laboratory Turbidimeter Model 1960A. Triplicate water quality samples were taken directly upstream of S-80 twice a week. Samples were collected about 15 cm below the surface to avoid organic surface film. Analyses were completed for nutrients (ammonia N, nitrite N, nitrate N, and orthophosphorus) using methods outlined in APHA Standard Methods, 14th Edition.

Benthic Macroinvertebrates

Benthic macroinvertebrates were sampled at three locations (S, C, and X) along transects 1 to 10. Two benthic grabs with a standard Ekman dredge (232 cm^2) were combined at each station. Samples were taken on 13 June, six days prior to the discharge, and on 10 July, the final day of discharge. The substrate was described before the sample was rinsed with water through a 841 micron pore size, A.S.T.M. standard sieve. Organisms retained in the sieve were rinsed into a glass container and preserved and stained with 10% formalin, 0.025% rose bengal solution. Dissolved oxygen, specific conductance, and temperature were measured near the bottom at the time of sampling.

Fish

Fish species composition in the estuary was sampled weekly for five weeks (before, during, and after the discharge) at eighteen locations during the study. A 7.6 m seine with 3.2 mm mesh was towed along two previously marked 15 m sections of shoreline at each of the eleven "S" locations. In addition, a 4.9 m flat otter trawl with a 12.7 mm bar mesh wing and a 6.4 mm bar mesh tail was towed behind a boat at about three knots for ten minutes along the seven "T" lines depicted in Figure 4. Large fish specimens were identified, measured and released while the remainder of the sample was preserved in a 10% formalin solution. Temperature at the surface was measured at the time of sampling with a hand-held thermometer and read to the nearest 0.1°C. Surface salinity was measured using a temperature compensated refractometer, read to the nearest 0.5 ppt. The refractometer was referenced to standard solutions for calibration.

Field Observations

In addition to sampling water and biota, field observations of unusual events were documented. The response of oysters to the discharge was observed. Several clusters of adult oysters (*Crassostrea virginica*) were collected in the inner estuary and placed in shallow water at station 4S. Each week when seine samples were collected at station 4S the condition of the oysters was noted.

Statistical Methods

Stratification coefficients were calculated for salinity by dividing the mean of the vertical profile by the reading taken at the 0.5 m depth (Van de Kreeke, J. and J.D. Wang, 1976).

Salinity distributions are illustrated by use of a Synagraphic Mapping System (SYMAP), a computer program that constructs concentration gradients to spatially illustrate parameter values (Dougenik and Sheehan, 1975).

Percent presence and total relative abundance of benthic macroinvertebrates were determined using a modification of the methods of Walker and Bambach (1974). Percent presence was calculated as the number of sites at which a species occurred divided by the total number of sites. Total relative abundance is the number of individuals of one species divided by the total number of individuals of all species, and is expressed as a percentage. Chi square analysis at 95% confidence level was used to test the difference between the two sets of benthic samples using the percent presence and the relative abundance.

Similarity and change in benthic species composition were examined by an index of similarity (Odum, 1971) and by a related index of percent difference (Sorenson, 1948). Species diversity was determined with Shannon-Weiner Species Diversity Index $\log_2$ (Shannon, 1963).

The percent presence of the 33 fish that were most often captured before the discharge were compared with the percent presence of these same fish species after the discharge began. Chi square analysis at 95% confidence level was used to find differences among the five sets of samples for fishes at the lower trophic level. The number of fish species captured at each station throughout the study were tested for homogeneity of variance using Bartletts' test and a F max-test at the 95% confidence level. Significant differences among the number of species captured were determined with a t- test at the 95% confidence level (Sokal and Rohlf, 1969).

A cluster analysis was performed on fish presence-absence data for the seine and trawl samples (Pinkham and Pearson, 1976).

Results

Hydrology

Measured sources of freshwater inflow into the inner estuary were rainfall and discharges from three structures. A controlled discharge of 2500 cfs at S-80 in the South Fork began on 19 June 1978 and continued for 22 days until 10 July 1978. Discharges of much lower volumes were periodically made from C-23 and C-24 during the study period. A comparison of the average basin rainfall (Figure 5) with the discharge records (Figure 6) demonstrates the response of the structures to storm runoff. By comparison, discharges from S-80 provided the greatest amount of fresh water and therefore had the greatest impact on the physiochemical character of the estuary.

Salinity

A salinity gradient of 11 to 33 ppt existed in the St. Lucie Estuary from S-80 to the inlet on 15 June, four days before the discharge began. Fresh water tributary flow and insufficient mixing caused a slight stratification of salinity in the South Fork (Figure 7A).

After one day of discharge, salinities in the area from S-80 to the Palm City Bridge were reduced to almost fresh water. Downstream, near the Roosevelt Bridge (station 4), a freshwater lens over brackish water existed. This highly stratified area (stratification coefficient of 4.0) was between the well mixed fresh water in the South Fork and salt water in the outer estuary that had stratification coefficients near 1.0 (Figure 7B). After day one, salinities in the North Fork (Table 1) were only slightly reduced by about 5 ppt at Coconut Point (station 2).

TABLE 1. SALINITY (ppt) AT LOW TIDE IN THE NORTH FORK DURING THE 2500 CFS DISCHARGE STUDY

Station	Date	Mean	Min.	Max.	S.C.*
1C	6/15	10.9	10.2	12.7	1.05
	6/20	11.8	11.1	12.4	1.03
	6/27	3.0	2.0	4.8	1.35
	7/7	1.2	1.2	1.2	1.04
	7/12	0.9	0.8	0.9	96
	7/20	2.0	1.8	3.1	1.14
2C	6/15	16.3	14.3	20.1	1.06
	6/20	11.7	8.3	14.5	1.30
	6/27	6.0	3.1	16.8	1.95
	7/7	1.8	1.5	2.0	1.12
	7/12	1.3	1.3	1.5	1.05
	7/20	4.3	4.2	4.3	1.05

*S.C. = stratification coefficient

After eight days of discharge, salinities in the North Fork were reduced by discharges from S-48 and S-80 (Table 1) and salinities within the mid-estuary had dropped as a result of less dense water (about 6 ppt) moving out of the inner estuary (Figure 8A). Increased stratification and reduced salinities at the St. Lucie Inlet (station 10), station 8 in the Indian River, and station 9 in the Intracoastal Waterway showed that the outer estuary was just beginning to respond to the 2500 cfs discharge after eight days of flow (Figure 8A and Table 2).

Figure 8B represents the gradient after 18 days of discharge (7 July). The inner estuary was almost entirely fresh water and a well-defined salt wedge had formed in the mid-estuary. Salinity measurements at the St. Lucie Inlet were significantly lower than after

TABLE 2. SALINITY (ppt) AT STATIONS 8C AND 9C DURING THE 2500 CFS DISCHARGE STUDY

Sta.	Date	Mean	Min.	Max.	S.C.*	Tide Study
8C	6/15	33.7	32.1	39.1	1.05	Low
	6/16	34.9	34.5	34.8	1.00	High
	6/20	33.4	33.5	33.5	1.00	Low
	6/22	33.2	30.8	34.4	1.05	High
	6/27	37.9	35.3	39.3	1.02	Low
	6/29	26.8	24.1	30.2	1.10	High
	7/6	28.1	15.6	29.5	1.00	High
	7/7	24.9	23.9	25.5	1.03	Low
	7/10	32.2	29.5	32.8	1.00	High
	7/12	24.8	24.5	24.9	1.00	Low
	7/20	29.2	29.2	29.5	1.00	Low
9C	6/15	31.6	31.4	31.8	1.00	Low
	6/16	32.4	32.2	32.4	1.00	High
	6/20	29.8	28.8	30.2	1.00	Low
	6/22	29.5	29.4	29.5	1.00	High
	6/27	34.3	30.5	38.1	1.10	Low
	6/29	20.0	18.6	21.4	1.10	High
	7/6	26.1	19.5	31.4	1.26	High
	7/7	19.8	12.3	25.5	1.16	Low
	7/10	21.6	15.3	29.1	1.34	High
	7/12	18.6	13.3	22.2	1.24	Low

*S.C. = stratification coefficient

eight days, indicating that discharges were no longer being retained within the inner and mid-estuary.

Releases from S-80 ceased on 10 July 1978. Two days after discharges had ceased (Figure 9A), salinities and the amount of stratification were very similar throughout the system to those found on 7 July, three days before the discharge stopped. One additional salinity study was completed on 20 July, 10 days after the discharge stopped (Figure 9B), and showed that the system had returned to an almost linear salinity gradient with moderate stratification in the South Fork. This gradient, however, was lower than the gradient that existed before discharges began.

Dissolved Oxygen (D.O.)

Dissolved oxygen concentrations were highly stratified in the inner and middle estuary prior to the discharge (Figure 10A; Table 3), whereas the oxygen concentrations exhibited a more uniform distribution throughout the water column in the outer estuary. After one day of controlled releases and for the rest of the discharge period, the waters from S-80 to the Palm City Bridge were no longer stratified but were well mixed and highly oxygenated (Figures 10B to 11B). Following 18 days of S-80 releases, an obvious zone of oxygen depletion ("D.O. sag") had developed at station 6 showing comparatively low mean and bottom D.O.'s due to sustained salinity stratification (Figure 11B). However, outer estuary stations 8 and 9 had relatively high D.O.'s and were well mixed. The North Fork primarily had high oxygen concentrations and stratified conditions throughout the study (Table 3). In the South Fork, two days after the discharge stopped, the vertical D.O. concentrations remained high but were less uniform than during the discharge. Ten days after the discharge, however, the D.O. distribution in the water column returned to the

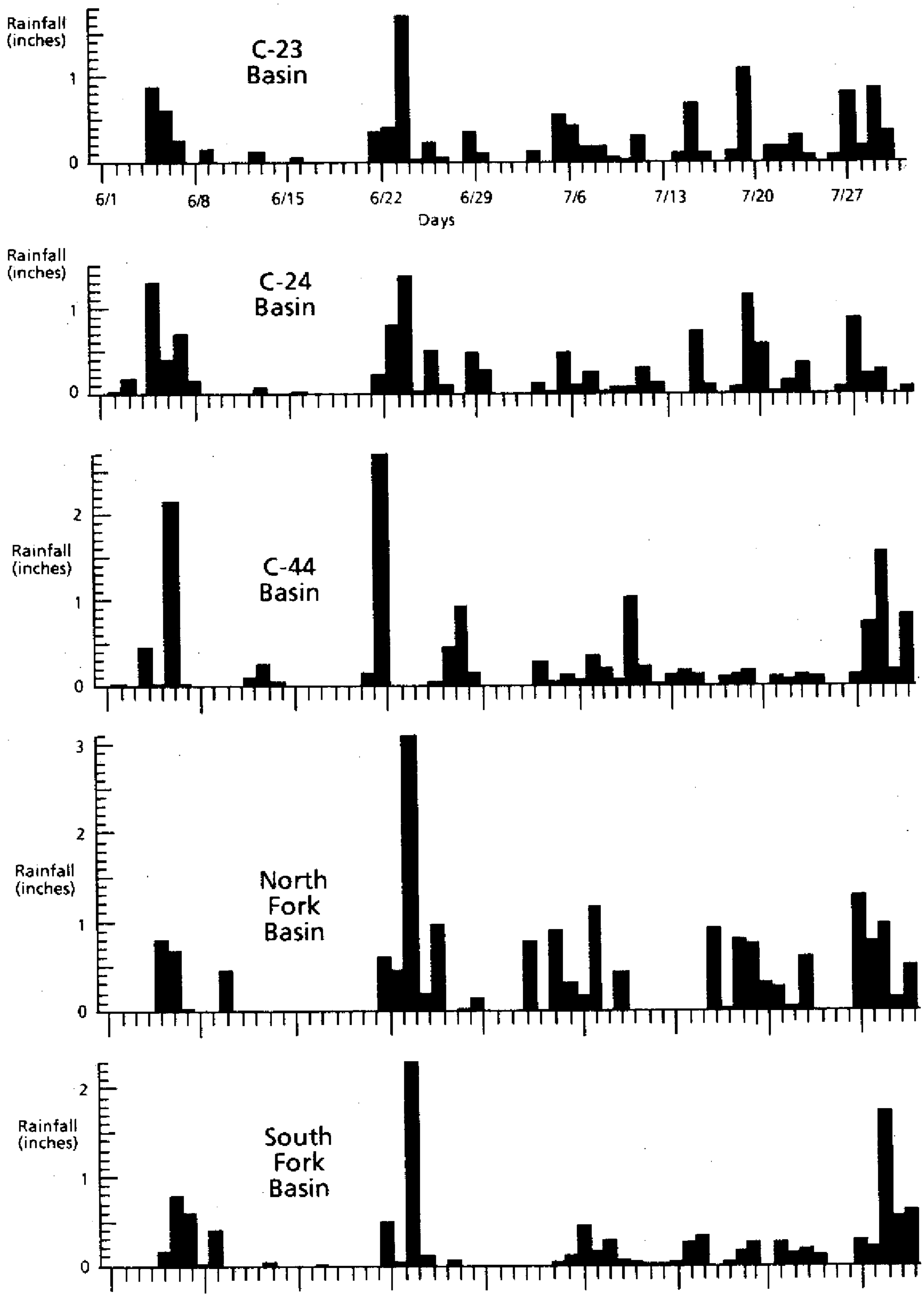

FIGURE 5. RAINFALL IN TRIBUTARY BASINS OF THE ST. LUCIE ESTUARY, JUNE-JULY, 1978

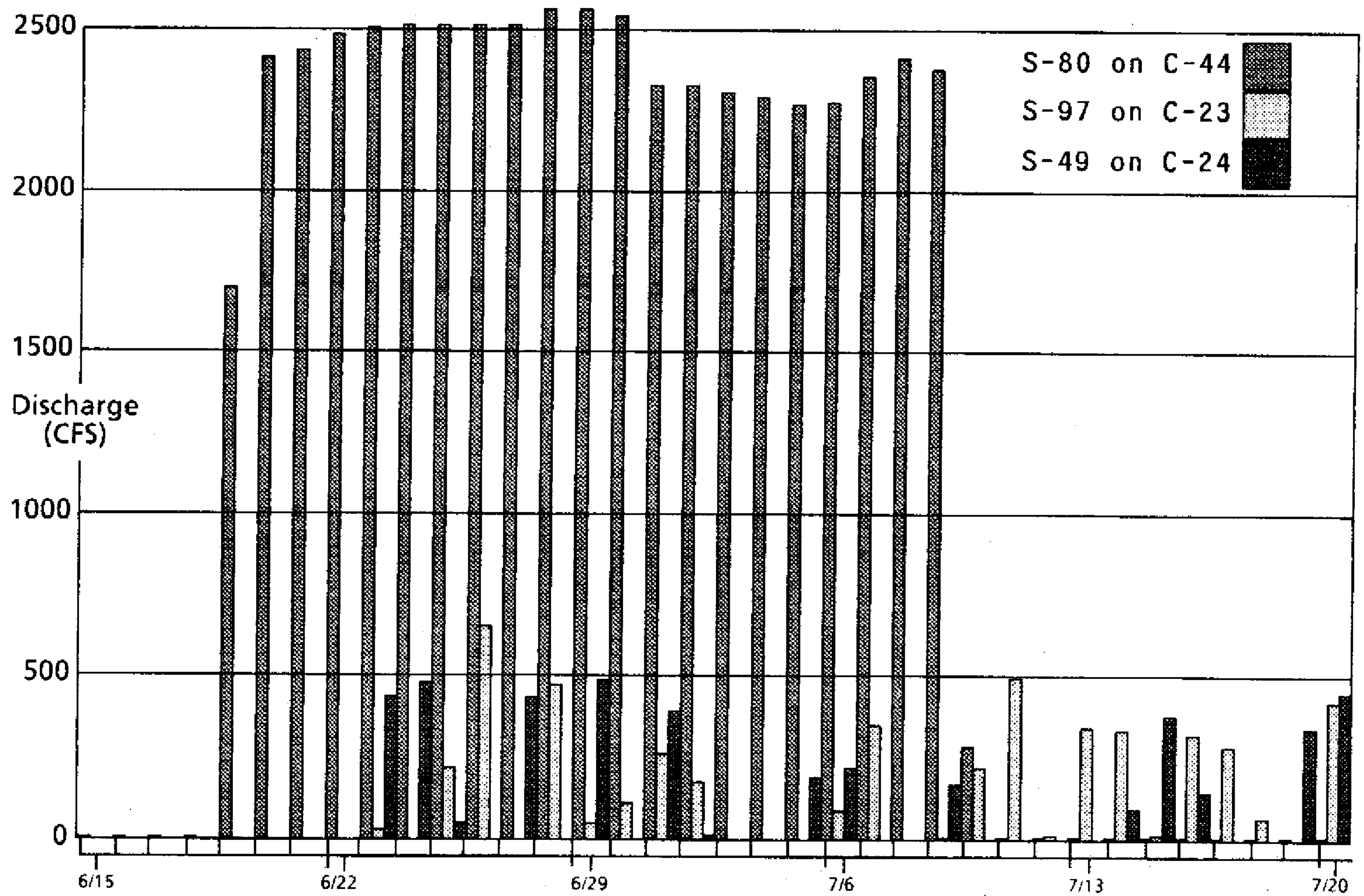

FIGURE 6. DISCHARGES INTO THE ST. LUCIE ESTUARY 6/15/78 THRU 7/20/78

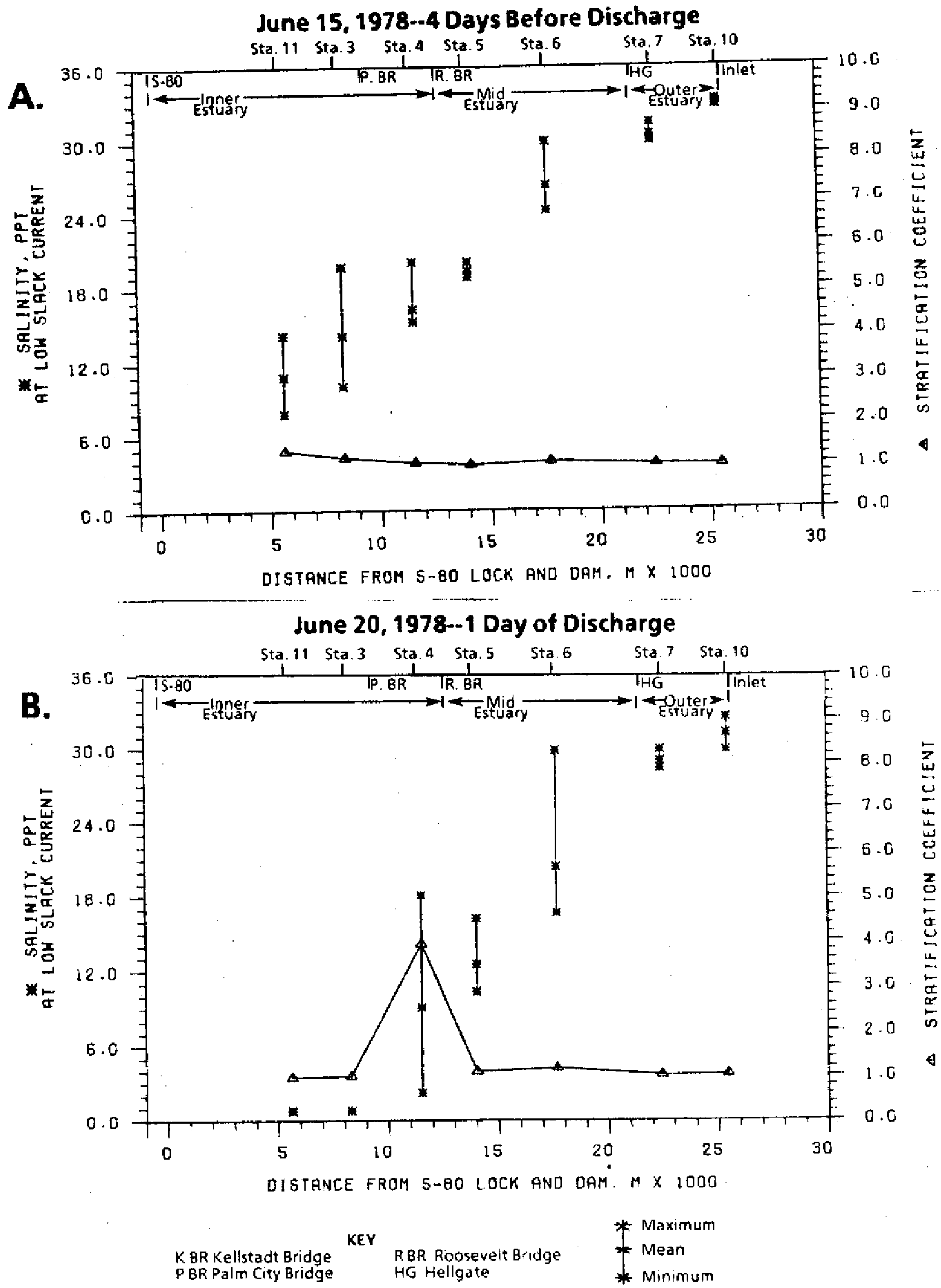

FIGURE 7. SALINITIES AND STRATIFICATION COEFFICIENTS IN THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

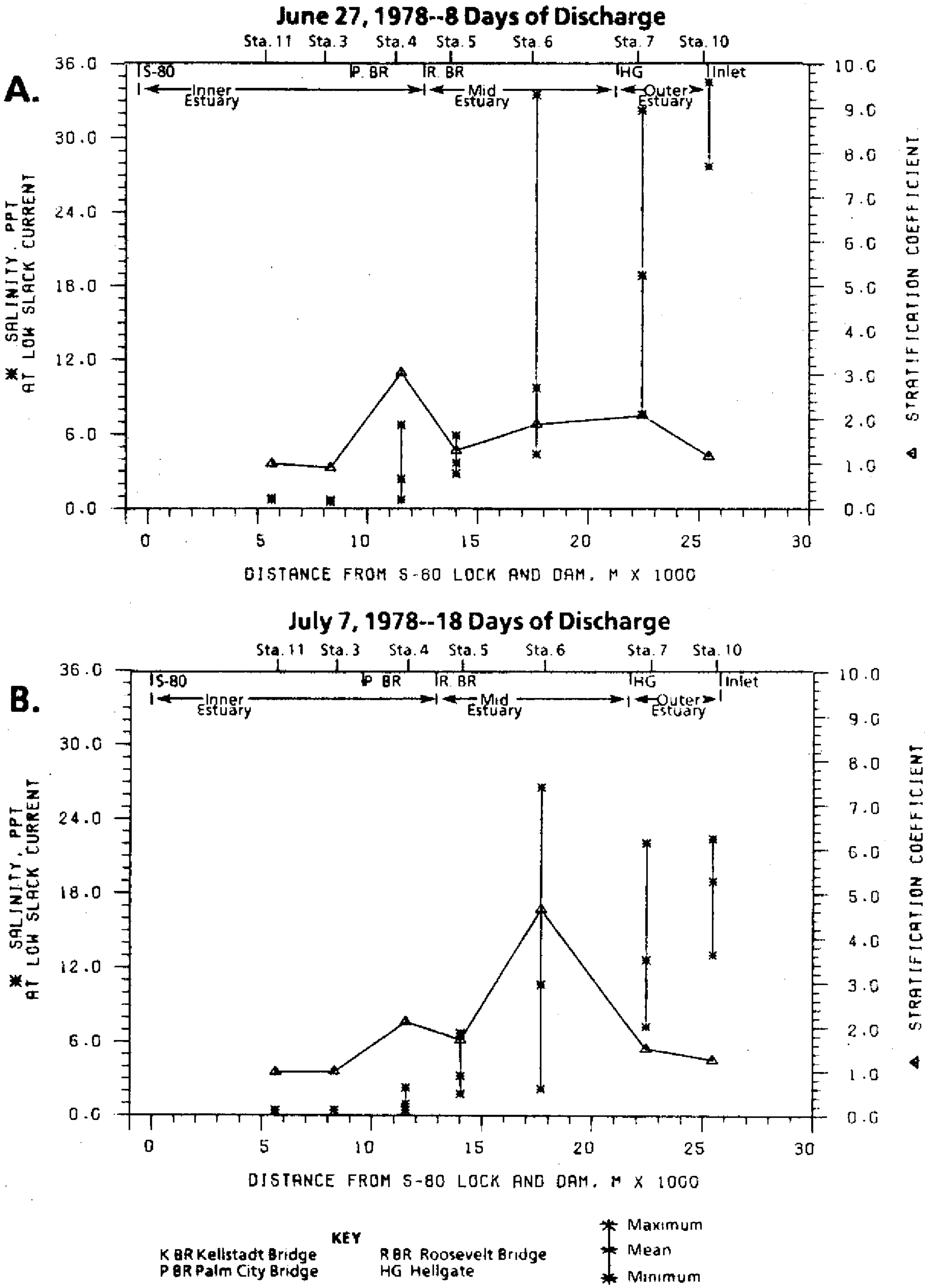

FIGURE 8. SALINITIES AND STRATIFICATION COEFFICIENTS IN THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

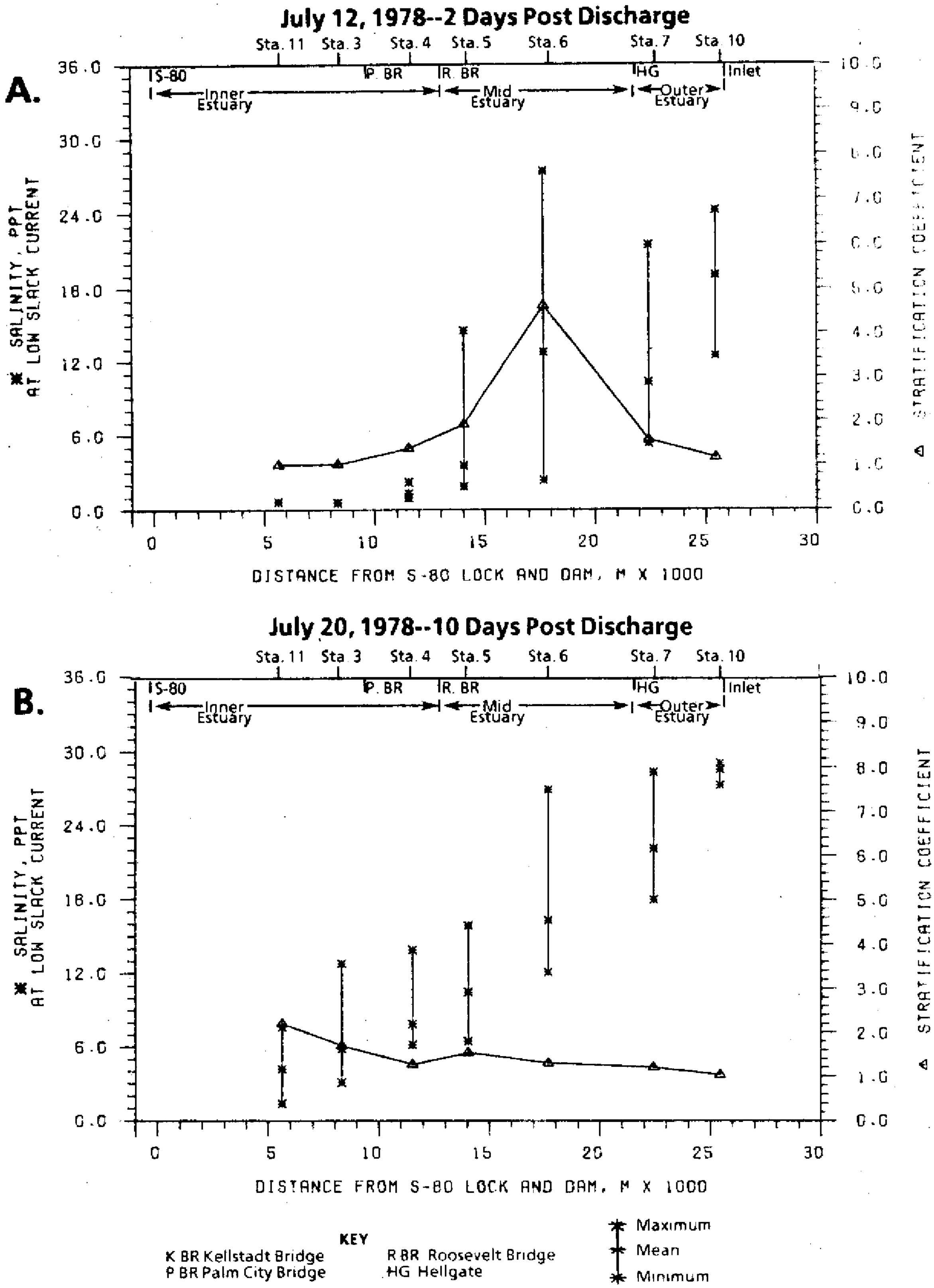

FIGURE 9. SALINITIES AND STRATIFICATION COEFFICIENTS IN THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

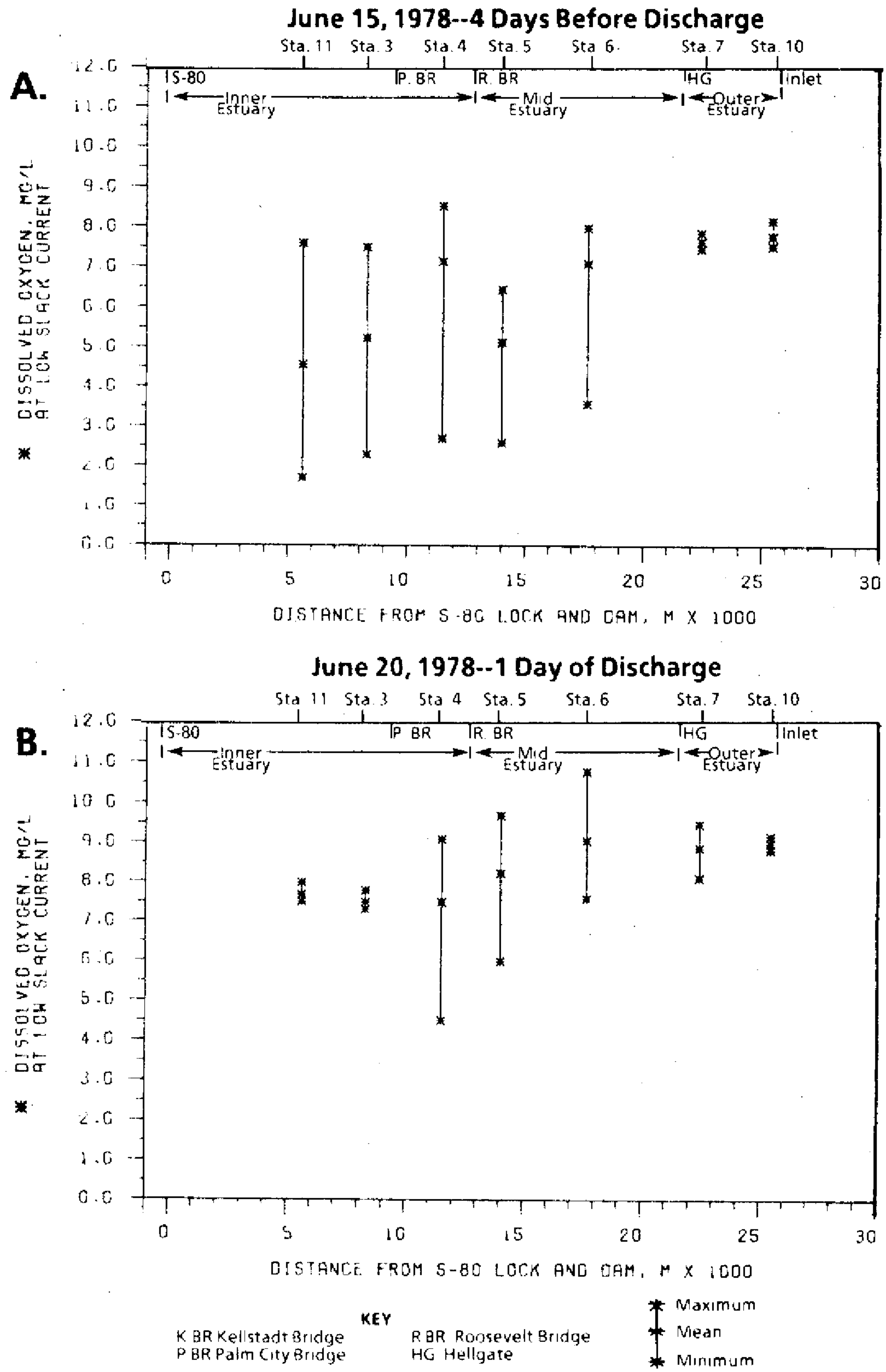

FIGURE 10. DISSOLVED OXYGEN IN THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

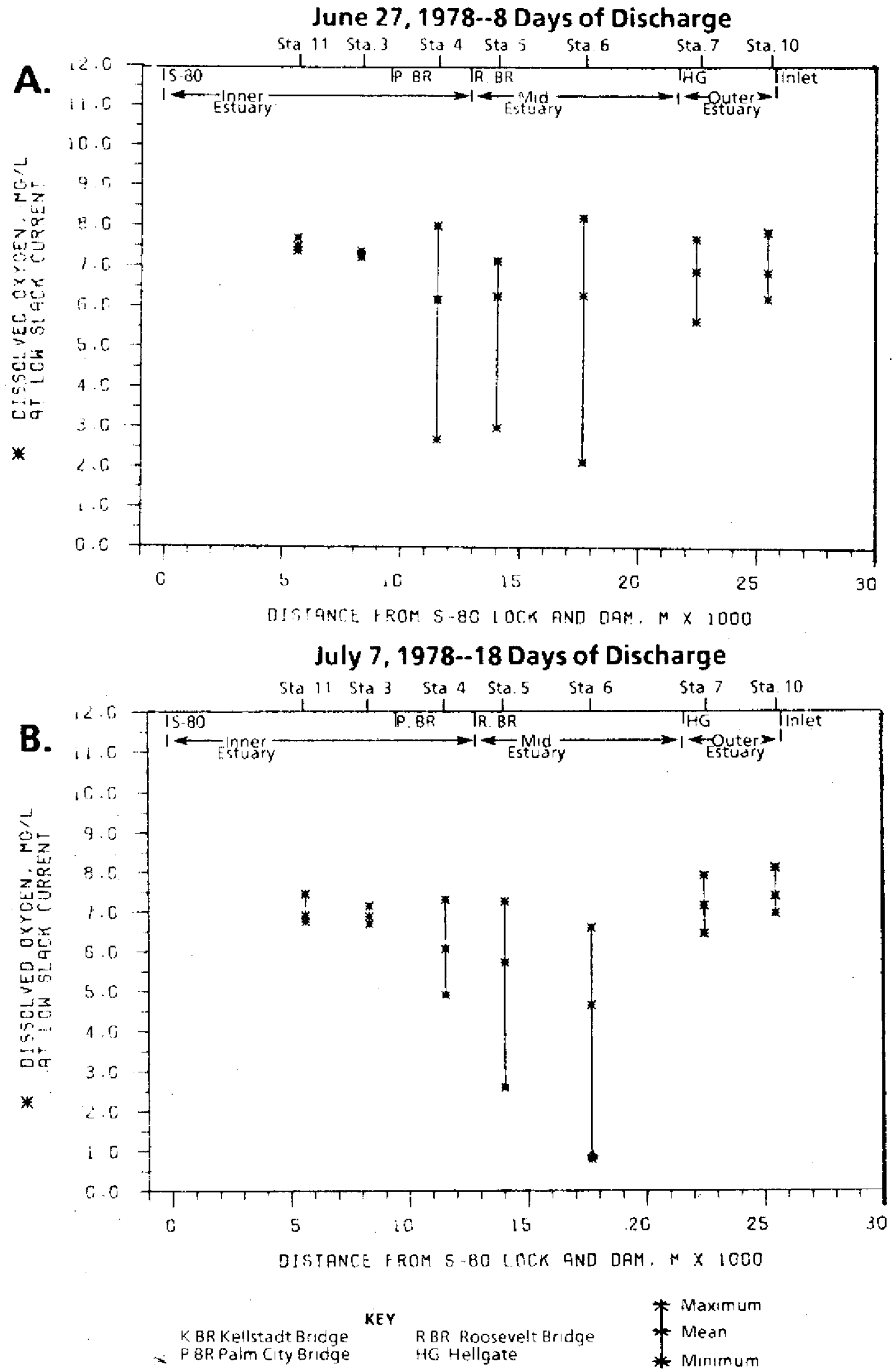

FIGURE 11. DISSOLVED OXYGEN IN THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

highly stratified conditions measured before the discharge began (Figure 12).

Temperature

The average water temperature ranged from 31.5°C in the inner estuary to 27.1°C at the St. Lucie Inlet prior to the discharge. After one day of discharge, the uniform temperatures from the surface to the bottom indicated the water was well mixed from S-80 to the Palm City Bridge. This well mixed water remained for the duration of the discharge. A general trend of higher temperatures in the inner estuary and an overall increase in temperature for the whole estuary occurred as the summer progressed (Appendix A).

Turbidity

Antecedent conditions that are shown in Table 4 reveal turbidity maximums where the estuary widens in the South and North Forks (stations 1 and 3). After the discharge began the most pronounced changes in turbidity occurred in the South Fork to the Roosevelt Bridge area (station 5). Accumulated fine sediments from the St. Lucie Canal (C-44), downstream to about Cabana Point (station 3), were resuspended during the first several days of discharge resulting in rapid increases in turbidity in this area (Figure 13). Further downstream at stations 4 and 5, turbidity slowly increased during the first week of discharge as suspended solids and low salinity water moved out of the system. Stations 6, 7, and 10 in the middle and outer estuary showed only a slight increase in turbidity over background levels. Turbidity measurements in the Indian River (stations 8 and 9) showed no noticeable increase or decrease throughout the study (Table 4).

Nutrients

Nutrient concentrations in the discharge water from S-80 changed rapidly during the first days of releases. Figure 14 shows that ammonia N, nitrite N, and nitrate N dramatically increased on the first day

TABLE 3. DISSOLVED OXYGEN (ppm) IN THE NORTH FORK AND OUTER ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

Date	Mean	Min.	Max.
NORTH FORK STATION 1C			
6/15	8.4	5.0	9.3
6/20	6.8	5.2	8.0
6/27	6.8	5.9	7.5
7/7	6.0	5.0	6.4
7/12	7.3	4.9	8.7
7/20	9.3	7.6	9.6
NORTH FORK STATION 2C			
6/15	6.7	0.9	8.4
6/20	6.5	2.8	10.4
6/27	7.9	0.7	9.8
7/7	7.1	4.6	8.7
7/12	6.8	5.3	7.8
7/20	6.2	1.3	9.6
OUTER ESTUARY STATION 8C			
6/15	7.2	7.0	7.4
6/20	9.2	8.8	9.9
6/27	7.8	7.4	8.4
7/7	6.5	6.3	7.0
7/12	6.3	6.0	6.7
7/20	9.7	9.2	10.6
OUTER ESTUARY STATION 9C			
6/15	7.8	7.7	7.9
6/20	9.2	9.1	9.4
6/27	7.2	6.6	7.6
7/7	7.0	6.8	7.3
7/12	7.3	6.7	8.0
7/20	9.4	9.3	9.8

TABLE 4. TURBIDITY (JTU) THROUGHOUT THE ST. LUCIE ESTUARY DURING THE 2500 CFS STUDY

			Discharge Starts 6-19		Sample Date			Discharge Stops 7-10	
Sta.	Distance (KM) from S-80	6-16	6-20	6-22	6-27	6-30	7-6	7-11	7-14
1		7.0	ND	6.0	7.8	5.5	9.5	7.3	10.0
2		4.8	ND	6.3	9.6	5.0	9.0	9.2	8.2
S-80*	0.0	1.1	ND	4.8	8.5	6.2	ND	ND	2.0
11	5.2	4.0	3.8	15.0	14.0	9.5	12.5	6.0	11.0
3	7.8	8.4	13.6	19.3	16.7	22.5	10.0	13.0	13.0
4	10.8	5.4	7.5	10.6	16.0	10.0	9.9	9.0	10.0
5	12.9	5.8	6.7	8.5	12.1	9.9	11.0	7.8	6.3
6	16.7	2.8	6.9	5.6	7.7	5.4	8.0	7.0	6.3
7	21.9	3.9	5.3	5.9	6.6	5.0	6.9	5.7	4.4
8		5.5	3.5	3.6	8.5	4.1	6.8	5.4	5.2
9		3.8	9.5	5.3	5.8	5.5	7.4	4.0	4.8
10	25.4	3.2	5.2	5.4	5.3	5.5	7.0	4.5	5.4

ND = No Data
*Samples taken upstream

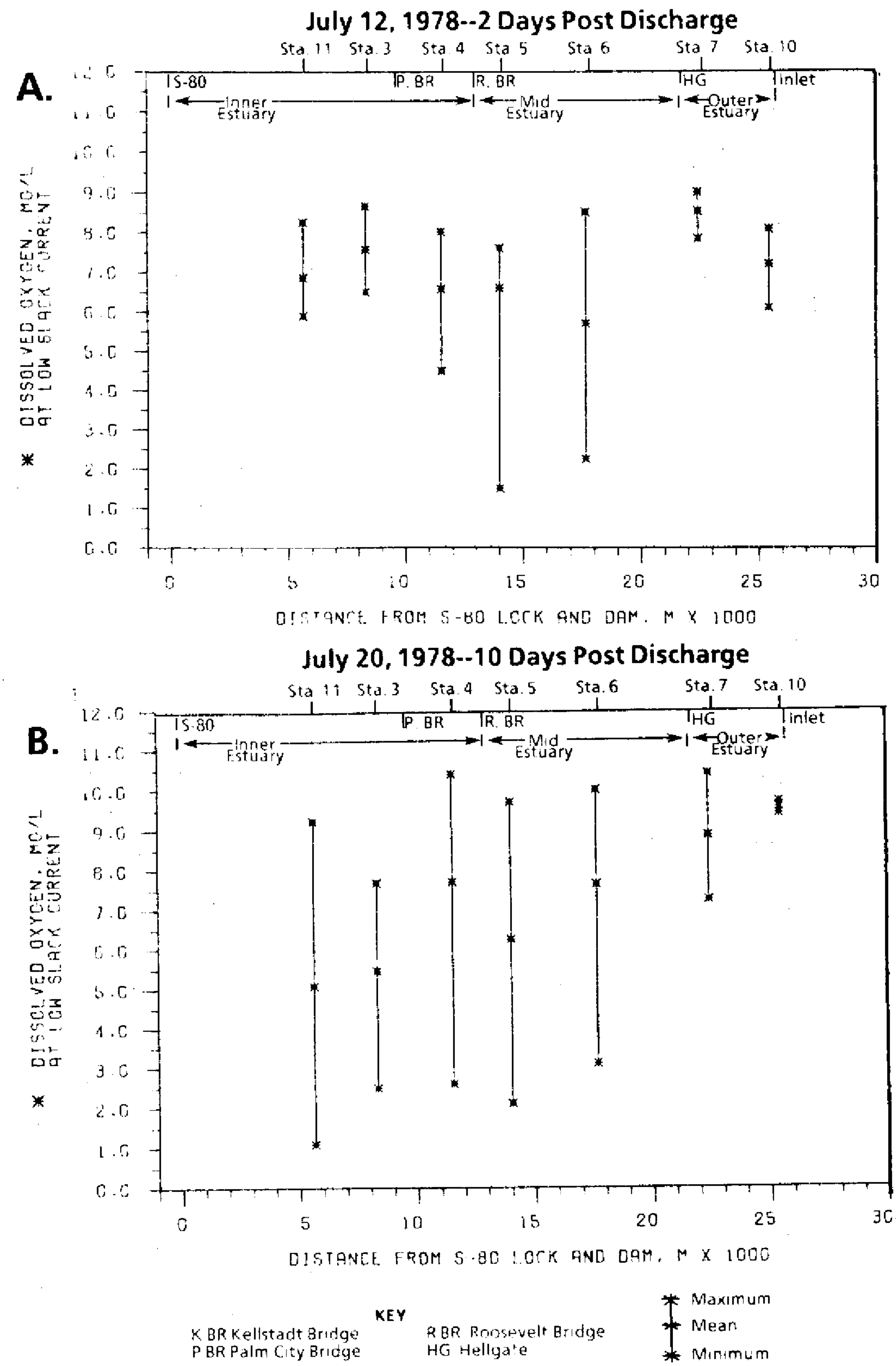

FIGURE 12. DISSOLVED OXYGEN IN THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

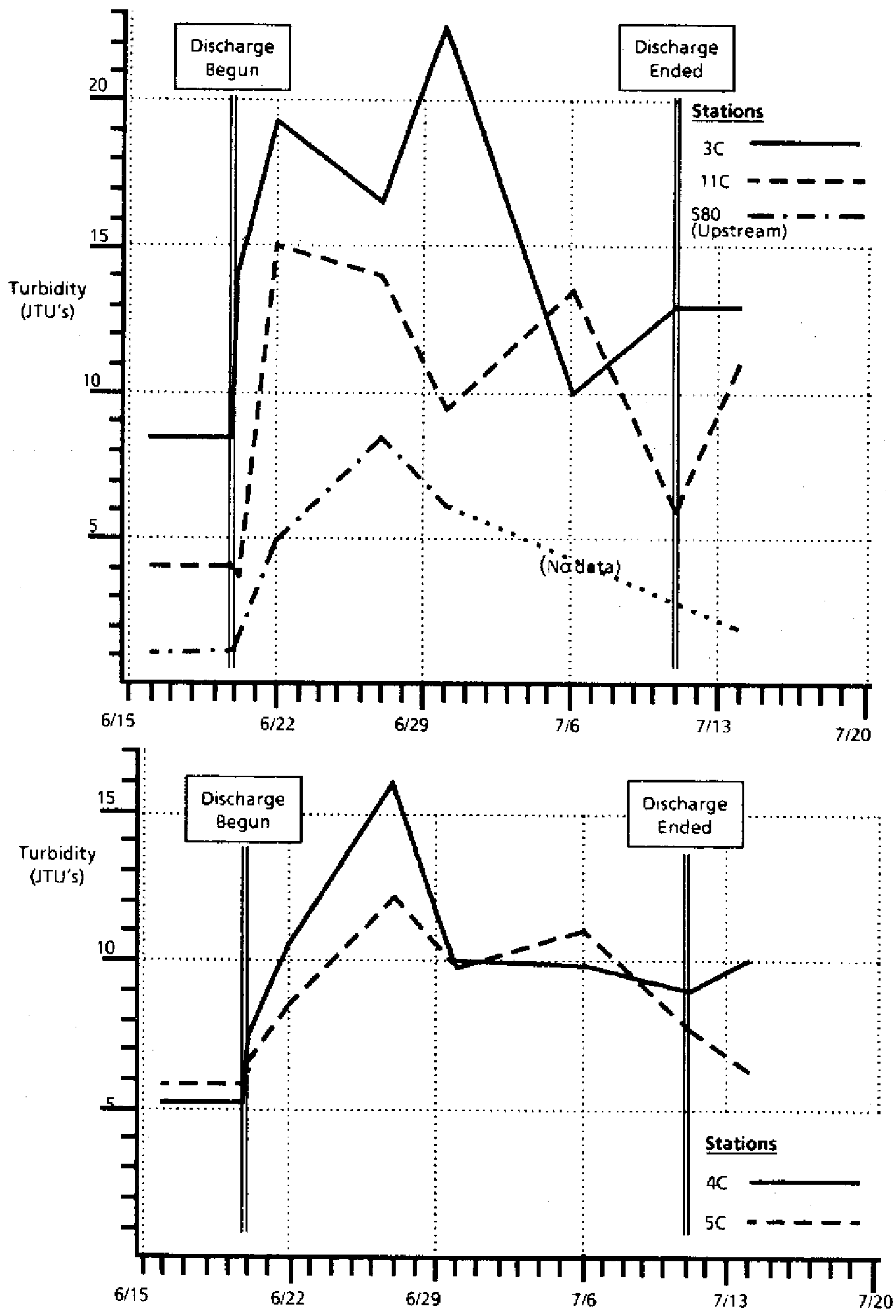

FIGURE 13. TURBIDITY IN THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

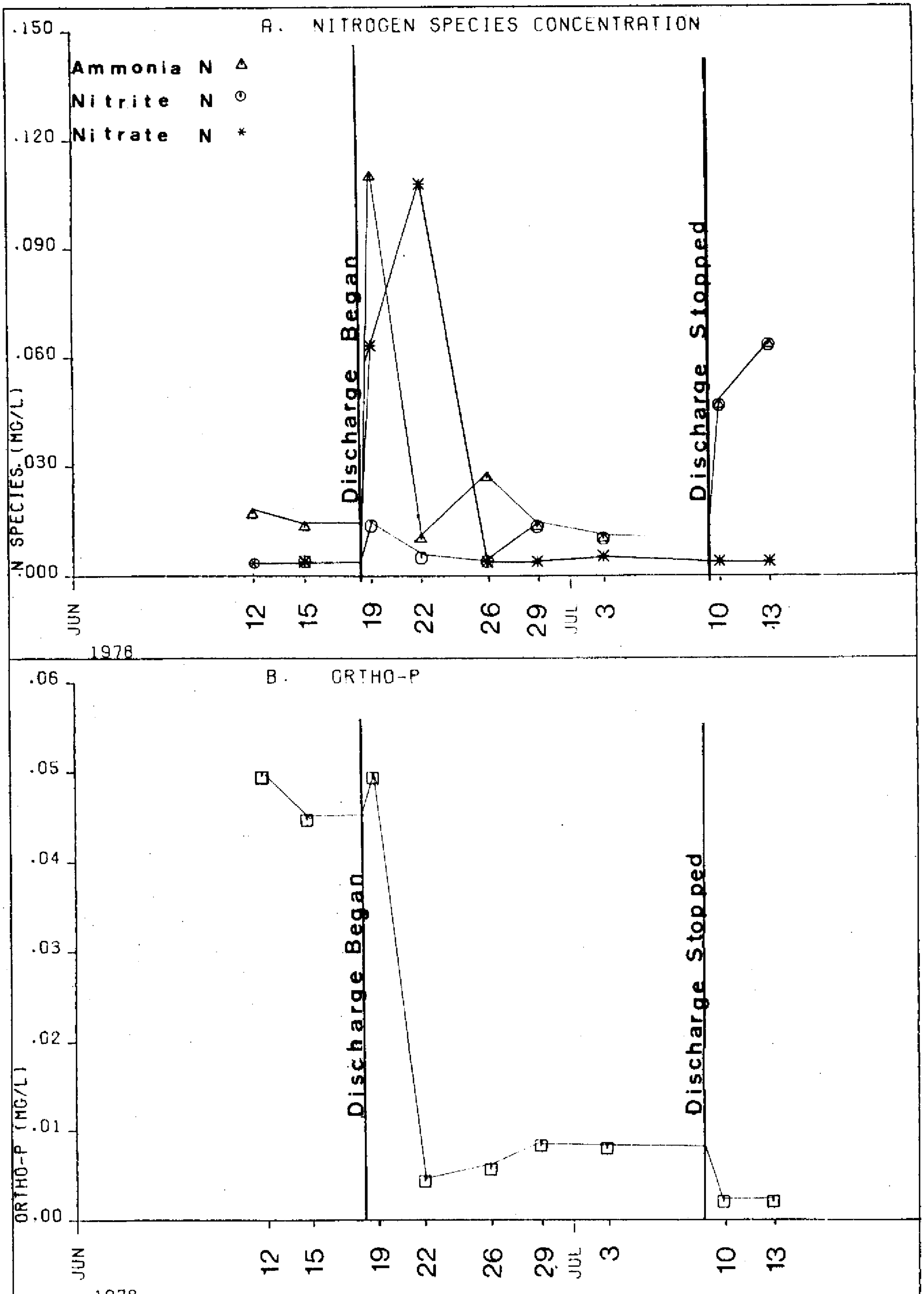

FIGURE 14. NUTRIENTS AT S-80 DURING 2500 CFS DISCHARGE STUDY

of discharge and then returned to pre-discharge levels within a week. Ortho-phosphorus levels upstream of S-80 showed a marked decrease after the third day of discharge. This correlates with the time required to exchange the volume of C-44 during a 2500 cfs release from S-308. Thereafter, ortho-phosphorus levels were similar to concentrations in Lake Okeechobee waters.

Benthic Macroinvertebrates

Substrates sampled for benthic macroinvertebrates in the St. Lucie Estuary were categorized into two groups. The inner and middle estuary (transects 1 to 6) had dark, mud substrates with a considerable amount of organic material. The bottom composition of the outer estuary (transects 7 to 10) was sand and shell (Table 5). Six classes of invertebrates, as represented by 69 species, were collected from these two types of substrates before and after the controlled discharge (Appendix B).

TABLE 5. DEPTHS AND SUBSTRATE DESCRIPTION AT EKMAN STATIONS IN ST. LUCIE ESTUARY

Station	Depth (M)	Substrate Description
	Inner Estuary	
1S	1.7	mud, sand, shell, detritus
1C	2.0	mud, shell, detritus, sapropel
1X	1.0	mud, sand
2S	2.5	mud, shell, detritus
2C	3.0	mud, shell, sapropel
2X	2.5	mud, sapropel, silt
3S	0.7	mud, sand, shell
3C	3.5	mud, sapropel
3X	1.8	mud, silt, sapropel
4S	2.5	mud, sapropel, shell
4C	3.0	mud, shell, sapropel
4X	1.5	mud, shell, sapropel
	Mid-Estuary	
5S	1.5	mud, shell
5C	3.5	mud, shell, sapropel
5X	2.0	mud, sapropel
6S	2.0	mud, shell
6C	3.0	mud, sapropel
6X	1.0	mud, sand
7S	1.0	sand, mud, shell
7C	3.0	sand, mud
7X	2.0	sand, shell, mud
	Outer Estuary	
8S	2.0	sand
8C	3.0	sand, shell
8X	2.0	sand
9S	1.0	sand, mud
9C	3.5	sand, shell, mud
9X	1.5	sand, mud, silt, detritus
10S	1.5	sand, small shell, silt
10C	3.5	sand, small shell
10X	2.5	sand, shell

Sapropel = Bottom deposits rich in decomposing organic matter

Prior to the discharge a considerable difference in species composition and density of organisms was apparent in samples from mud and sand substrates. From the mud habitats, about 80% of the average density (12,500 benthos/m²) consisted of the bivalve, *Mulinia lateralis*, and the amphipods, *Ampelisca abdita*, and *Cerapus* sp. (Tables 6 and 7). Although not represented in large numbers, several other species were present in at least 60% of the samples and included the polychaetes, *Paraprionospio pinnata*, *Nereis* sp., and *Glycinde solitaria* and the isopod, *Leptochelia savignyi* (Figure 15). All of these opportunistic benthic species can tolerate dramatic

TABLE 6. DENSITY (#/m²)x10² AND PERCENT OF POPULATION (PP) FOR EACH CLASS OF BENTHOS IN THE INNER AND MID-ESTUARY BEFORE AND AFTER DISCHARGE

Transect	Class	Before Discharge Density	Before Discharge PP	After Discharge Density	After Discharge PP
1SCX	Bivalvia	110.1	75.9	26.6	42.2
	Crustacea	29.2	20.1	22.6	35.8
	Gastropoda	3.7	2.5	-	-
	Polychaeta	2.1	1.4	1.5	2.4
	Insecta	-	-	12.3	19.6
		145.1		63.0	
2SCX	Crustacea	75.4	59.5	22.9	45.8
	Bivalvia	45.1	35.6	0.9	1.8
	Polychaeta	6.0	4.7	1.3	2.6
	Gastropoda	0.2	0.2	-	-
	Insecta	-	-	25.0	49.9
		126.7		50.1	
	Crustacea	72.8	61.5	23.5	55.6
3SCX	Bivalvia	30.9	26.1	0.4	1.0
	Polychaeta	11.9	10.1	7.5	17.6
	Gastropoda	2.7	2.2	1.7	3.9
	Insecta	0.1	0.1	9.3	21.9
		118.4		42.4	
4SCX	Crustacea	60.6	66.5	6.0	15.3
	Bivalvia	29.2	32.1	0.1	0.4
	Polychaeta	1.3	1.4	20.7	52.5
	Gastropoda	-	-	12.6	32.0
	Insecta	-	-	-	-
		91.1		39.4	
5SCX	Bivalvia	86.6	56.1	88.5	45.3
	Crustacea	63.5	41.1	33.2	17.0
	Polychaeta	4.1	2.7	73.4	37.6
	Gastropoda	0.1	0.1	0.1	0.1
	Insecta	-	-	0.2	0.1
		154.3		195.4	
6SCX	Bivalvia	94.9	82.7	22.8	84.8
	Crustacea	15.0	13.1	0.7	2.7
	Polychaeta	.2	2.8	3.3	12.3
	Gastropoda	1.7	1.4	0.1	0.3
	Insecta	-	-	-	-
		114.8		26.9	
Mean Density =		125.1		69.5	

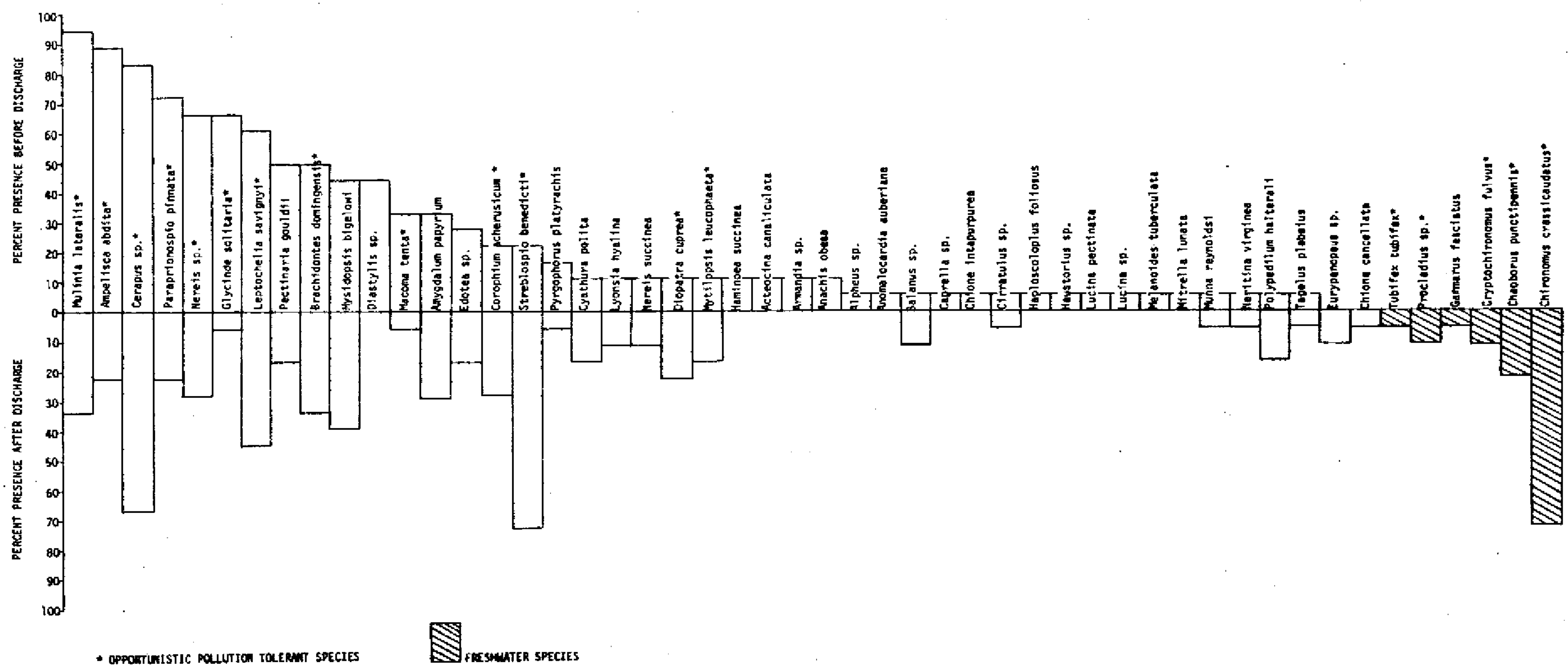

FIGURE 15. PERCENT PRESENCE OF BENTHIC SPECIES BEFORE AND AFTER THE 2500 CFS DISCHARGE. INNER AND MIDDLE ESTUARY STATIONS 1SCX THROUGH 6SCX, SAMPLED ON 6-13-78 AND 7-10-78

changes in the environment and take advantage of a wide variety of habitats.

The average density of organisms in the sand substrate of the outer estuary was appreciably lower (1,120 benthos/m^2) than in the mud substrate (Table 8). Approximately 37% of the number of organisms captured were represented by *M. lateralis*. The amphipod, *Haustorius* sp., and the polychaete, *G. solitaria*, each accounted for about 10% of the number of benthos collected (Table 7). Several other species were less abundant, but were regularly present in at least 50% of the samples (Figure 16). With the inclusion of the bivalve, *Macoma tenta*; the two shrimp, *Mysidopsis bigelowi* and *Diastylis* sp., and the polychaete, *Nereis* sp., these seven species accounted for more than 72% of the benthos captured before the discharge began. The remaining 26 species collected in the outer estuary were not as frequently represented.

TABLE 7. TOTAL RELATIVE ABUNDANCE (TRA%) OF THE BENTHIC SPECIES CULLED AT 1% BEFORE AND AFTER DISCHARGE

Inner and Mid-estuary

TAXA	Transects 1-6 TRA % 6-13-78	TRA % 7-10-78
Mulinia lateralis	44.4	6.4
Ampelisca abdita	25.7	0.8
Cerapus sp.	9.0	16.5
Brachidontes domingensis	6.8	25.8
Leptochelia savignyi	6.3	5.1
Streblospio benedicti	1.6	24.5
Corophium acherusicum	0.4	1.1
Chironomus crassicaudatus	0.01	13.9

Outer Estuary

TAXA	Transects 7-10 TRA % 6-13-78	TRA % 7-10-78
Mulinia lateralis	37.4	51.7
Haustorius sp.	9.6	5.4
Glycinde solitaria	9.5	8.1
Diastylis sp.	6.3	0.4
Macoma tenta	5.6	2.1
Ampelisca abdita	3.1	2.6
Bathyporeia sp	2.7	0.5
Mysidopsis bigelowi	2.4	1.6
Diopatra cuprea	2.3	0.4
Chione cacellata	2.1	0.2
Chione grus	1.9	1.9
Nereis sp.	1.9	0.7
Tellina sp.	1.6	0.0
Mysis stenolepis	1.6	0.2
Cerapus sp.	1.1	0.5
Lyonsia hyalina	1.1	1.1
Chione intapurpurea	1.1	0.4
Acteocina canaliculata	0.5	2.3
Haploscoloplos sp.	0.3	1.1
Armandia sp.	0.8	1.4
Platyischnopeus sp.	0.0	6.3
Sphaeroma destructor	0.0	1.2
Donax variabilis	0.0	3.9

The distribution of benthic species before the discharge was influenced by the type of substrate and level of salinity. The isopods, *L. savignyi* and *Cyathura polita*, and the gastropod *Pyrgophorus platyrachis* exhibited a distinct preference for the inner and middle estuary habitat. The high salinity, sand substrate in the outer estuary provided the only environment for the amphipods, *Bathyporeia* sp., and *Haustorius* sp., and the bivalve, *Chione grus*. Several species, however, were found at higher densities in the mud substrates but were present throughout the estuary. These ubiquitous species included *M. lateralis*, *A. abdita*, *Cerapus* sp., and *G. solitaria*.

After the discharge the similarity index indicated that the benthic invertebrate species composition changed 23% for the entire estuary. This change is attributed to (a) the loss and recruitment of many rare marine and estuarine species which represented less than 1% of the total relative abundance, and (b) to the introduction of seven freshwater species of which six were aquatic insect larvae (Figures 15 and 16). Six of the freshwater invertebrates were present after the discharge in the inner estuary and just downstream of the Roosevelt Bridge (transects 1 to 5). At these same transects the polychaete *G. solitaria* and the cumacean shrimp *Diastylis* sp. were absent after the discharge. The overall species composition change probably occurred during the transition from mesohaline (salinities 5 to 18 ppt) to oligohaline (0.5 to 5 ppt) conditions in the inner estuary. One of the fresh water insect larvae, the mayfly nymph (*Callibaetis floridanus*), was present in the outer estuary at transects 7 and 8 after the discharge where salinities were above 15 ppt.

The highest densities of benthic invertebrates were present in the inner and middle estuary (transects 1 to 6) both before and after the discharge event. However, an overall reduction in densities of 44% occurred in this area and only a slight decrease in densities (1%) occurred in the outer estuary. The reduction in densities at transects 1 to 6 appeared in almost every class of benthic invertebrate. Exceptions included the dramatic increase in density of insects throughout the inner estuary and the increase in polychaetes at transects 4 and 5 (Tables 6 and 8). The introduction of the freshwater midge larvae, (*Chironomus crassicaudatus*) was mainly responsible for the increase in insects. Increased densities of polychaetes resulted primarily from the increase in populations of *Streblospio benedicti*.

The total relative abundance (TRA) of the major species inhabiting the outer estuary did not change substantially after the discharge (Table 7). However, four species in the inner and mid-estuary (*Cerapus* sp., *Streblospio benedicti*, *Brachidontes domingensis*, and *Chironomus crassicaudatus*) showed substantial increases in TRA while *Mulinia lateralis* and *Ampelisca abdita* declined dramatically.

An overall decrease in the species diversity of benthic invertebrates occurred in the inner and mid-estuary. The introduction of numerous freshwater midge larvae and severe reductions of the predominant species, *M. lateralis* and *A. abdita*, in the inner estuary contributed to the overall decrease in species diversity index from 1.7 to 1.4. Contrary to this, the species diversity index in the outer estuary remained 2.2 although the salinity at transects 8 and 9 decreased from about 30 ppt to 20 and 26 ppt respectively, at low tide.

In summary, during the 2500 cfs discharge study there were no significant changes in the macroinvertebrate communities in the outer estuary. Changes in benthos did occur in the inner and middle estuary:

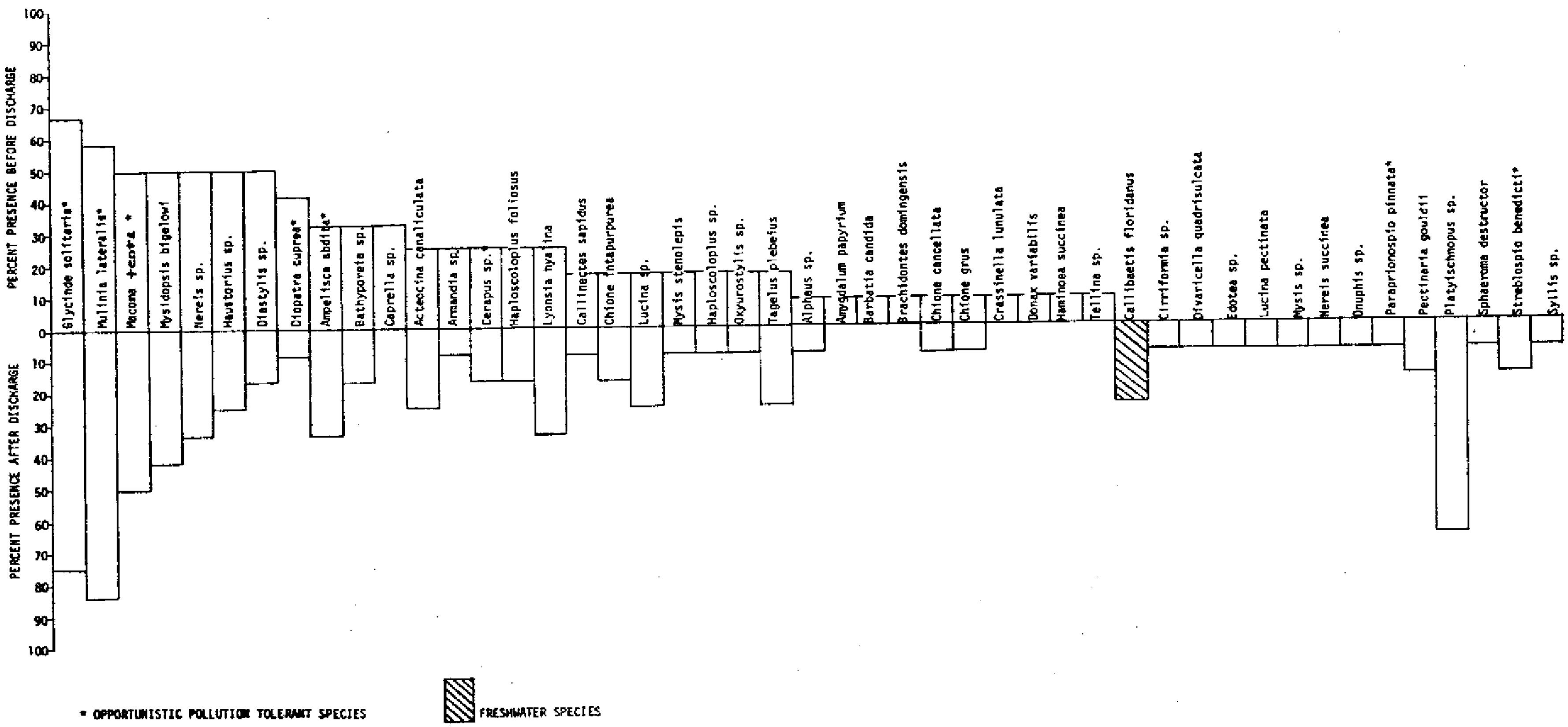

FIGURE 16. PERCENT PRESENCE OF BENTHIC SPECIES BEFORE AND AFTER THE 2500 CFS DISCHARGE. OUTER ESTUARY STATIONS 7SCX THROUGH 10SCX, SAMPLED ON 6-13-78 AND 7-10-78

1. Six freshwater species were introduced and at least four estuarine species were reduced in numbers within the newly created oligohaline zone.
2. A population explosion of the freshwater midge larvae, *Chironomus crassicaudatus*, and an increased density of the polychaete, *Streblospio benedicti* occurred.
3. The overall density of benthos decreased by 44%.

TABLE 8. DENSITY (#/m²)xl02 AND PERCENT OF POPULATION (PP) FOR EACH CLASS OF BENTHOS IN THE OUTER ESTUARY BEFORE AND AFTER DISCHARGE

Transect	Class	Before Discharge Density	Before Discharge PP	After Discharge Density	After Discharge PP
7SCX	Bivalvia	9.8	55.7	4.8	43.5
	Crustacea	3.9	22.5	2.9	26.6
	Polychaeta	3.4	19.7	2.4	22.1
	Gastropoda	0.4	2.1	0.7	6.5
	Insecta	-	-	0.1	1.3
		17.5		10.9	
8SCX	Crustacea	4.4	50.8	1.5	35.6
	Bivalvia	2.8	32.5	1.3	30.5
	Polychaeta	1.3	15.0	1.4	32.2
	Gastropoda	0.1	1.7	-	-
	Insecta	-	-	0.1	1.7
		8.6		4.3	
9SCX	Bivalvia	10.7	66.5	17.2	81.1
	Crustacea	3.6	22.3	2.3	10.8
	Polychaeta	1.5	9.4	1.7	8.1
	Gastropoda	0.2	1.3	-	-
	Insecta	-	-	-	-
		16.-		21.2	
10SCX	Bivalvia	1.0	40.0	2.5	56.4
	Crustacea	0.8	31.4	1.4	30.7
	Polychaeta	0.7	29.6	0.4	8.1
	Gastropoda	-	-	0.2	4.8
	Insecta	-	-	-	-
		2.5		4.5	
Mean Density =		11.2		10.2	

Fish

The trawl and beach seines employed in this study were designed to collect small fish and therefore samples do not adequately represent the larger size classes of important sport and commercial fish. Only five species of fish captured during the study were consistently greater than 100 mm (Appendix C). These species included *Arius felis* (sea catfish), *Bagre marinus* (gafftopsail catfish), *Centropomus undecimalis* (snook), *C. pectinatus* (tarpon snook, known locally as cuban snook), and *Archosargus probatocephalus* (sheepshead).

During this study, a total of 42,178 fish, representing 84 species, were captured. Most of this catch (96%) consisted of 10 species. *Anchoa mitchilli* (bay anchovy), *Menidia beryllina* (tidewater silverside), *Eucinostomus* sp. (mojarras) and Clupeid juveniles (herrings) comprised 92% of the catch (Table 9).

Species presence data were pooled (Table 10) for the South Fork (stations 11, 3, 4), North Fork (stations 1, 2), middle estuary (stations 5,6), and outer estuary (stations 7, 8, 9, 10). These data showed the following general trends:

1. Within the four estuarine areas, those fish that were dominant prior to the discharge remained throughout the entire 2500 cfs monitoring effort.
2. Throughout the study, shallow grassbed communities located in the outer estuary had the greatest diversity of fish.

In Table 11, individual species response to the 2500 cfs discharge was divided into five categories. Four freshwater species were introduced from upstream during the discharge: *Dorosoma cepedianum* (gizzard shad), *Gambusia affinis* (mosquito fish), *Ictalurus catus* (white catfish), and *Pomoxis nigromaculatus* (black crappie). These freshwater species were primarily caught in the South Fork, but *I. catus* was present on the last sample date (12 July) in the North Fork and at Hoggs Cove (station 6T) where the salinity was 4.0 ppt.

Fish that entered the South Fork during the discharge included the larval stages (leptocephalus) of the three primitive marine fishes: *Albula vulpes* (bonefish), *Elops saurus* (ladyfish), and *Megalops atlantica* (tarpon). In addition, *Centropomus undecimalis* (snook) also entered the inner estuary.

Three species left the inner and middle estuary. These species were *Anchoa hepsetus* (striped anchovy), *Lagodon rhomboides* (pinfish), and *Orthpristis chrysoptera* (pigfish).

The last 34 species listed in Table 11 (categories IV and V) either remained within the inner estuary or were present throughout the system during the monitoring efforts.

The reactions of fish communities to the changes in salinity were evaluated with a cluster analysis using pooled presence-absence data in Table 10 for seine and trawl samples. The phenogram (Figure 17) represents a clustering of the four major estuarine trawl sampling areas for five sample dates based on the biotic similarity of the fish communities sampled. The clustering of data suggest that species composition remained similar within the sampling areas throughout the five-week study in spite of dramatic changes in salinity. The middle estuary was unique in this cluster primarily due to the presence of *Anchoa lyolepis*, *Lagodon rhomboides*, *Synodus foeteus*, *Chloroscombus chrysura*, and *Menticirrhus americanus* which were seldom collected in the other areas. Table 10 indicates that *Centropomus pectinatus* was captured only in the North Fork (station 1T) while *Bagre marinus* was unique to the South Fork where *Cynoscion* spp. and *Citharichthys spilopterus* were most often found. Furthermore, the addition of freshwater species to the South Fork after the discharge began accounted for most of the differences in species composition between these two areas.

The similarity in species composition of seine samples during the study was less than for the trawl samples (Figure 18). Before the discharge began the species composition in the North Fork and South Fork were similar (S1 and N1). However, after the discharge began, freshwater species and three species of leptocephalus were added to the South Fork so that the North and South Fork communities became

TABLE 9. FISH CAUGHT DURING THE 2500 CFS DISCHARGE STUDY IN DECREASING ORDER OF NUMERICAL ABUNDANCE, SCIENTIFIC, AND COMMON NAME

	TAXON	COMMON NAME	NUMBER CAUGHT	% OF CATCH
1	Anchoa mitchilli	Bay anchovy	25292	60.0
2	Menidia beryllina	Tidewater silverside	4699	11.1
3	Clupeidae, juveniles*	Herring, juvenile	4496	10.7
4	Eucinostomus, juveniles*	Mojarra, juvenile	2395	5.7
5	Eucinostomus gula	Silver jenny	1031	2.4
6	Eucinostomus argenteus	Spotfin mojarra	981	2.3
7	Dorosoma pentenense	Threadfin shad	570	1.4
8	Diapterus olisthostomus	Irish pompano	295	0.7
9	Arius felis	Sea catfish	276	0.7
10	Micropogon undulatus	Atlantic croaker	222	0.5
11	Bairdiella chrysura	Silver perch	218	0.5
12	Anchoa lyolepis	Dusky anchovy	162	0.5
13	Anchoa hepsetus	Striped anchovy	147	
14	Harengula pensacolae	Scaled sardine	127	
15	Lagodon rhomboides	Pinfish	120	
16	Syngnathus scovelli	Gulf pipefish	120	
17	Orthpristis chrysoptera	Pigfish	108	
18	Diapterus plumeri	Striped mojarra	64	
19	Syngnathus louisianae	Chain pipefish	61	
20	Lutjanus griseus	Gray snapper	54	
21	Cynoscion nothus	Silver seatrout	48	
22	Diplodus holbrooki	Spotted pinfish	44	
23	Trachinotus falcatus	Permit	40	
24	Sphyraena barracuda	Great barracuda	39	
25	Haemulon parrai	Sailors choice	37	
26	Ictalurus catus	White catfish	33	
27	Archosargus probatocephalus	Sheepshead	32	
28	Oligoplites saurus	Leatherjacket	32	
29	Cynoscion regalis	Weakfish	28	
30	Centropomus undecimalis	Snook	26	
31	Bagre marinus	Gafftopsail catfish	24	
32	Citharichthys spilopterus	Bay whiff	23	
33	Bathygobius saporator	Frillfin goby	24	
34	Brevoortia smithi	Yellowfin menhaden	21	
35	Caranx hippos	Crevalle jack	20	
36	Lutjanus synagris	Lane snapper	20	
37	Cynoscion nebulosus	Spotted seatrout	19	
38	Strongylura marina	Atlantic needlefish	16	
39	Sphoeroides testudineus	Checkered puffer	15	
40	Trinectes maculatus	Hogchoker	15	
41	Sparasoma sp.	Parrotfish	15	
42	Achirus lineatus	Lined sole	15	
43	Microgobius gulosus	Clown goby	11	
44	Gobiosoma bosci	Naked goby	10	
45	Centropomus pectinatus	Tarpon snook	10	
46	Gobionellus boleosoma	Darter goby	8	
47	Monacanthus hispidus	Planehead filefish	8	
48	Pomoxis nigromaculatus	Black crappie	7	
49	Mugil curema	White mullet	7	
50	Lactophrys triqueter	Smooth trunkfish	7	
51	Synodus foetens	Inshore lizardfish	7	
52	Dasyatis sabina	Atlantic stingray	6	
53	Megalops atlantica, leptocephalus	Tarpon, larval stage	6	
54	Dorosoma cepedianum	Gizzard shad	6	
55	Mugil cephalus	Striped mullet	6	
56	Fundulus grandis	Gulf killifish	5	
57	Chilomycterus schoepfi	Striped burrfish	5	
58	Chloroscombrus chrysurus	Atlantic bumper	4	
59	Elops saurus, leptocephalus	Lady fish, larval stage	3	
60	Albula vulpes, leptocephalus	Bonefish, larval stage	3	

TABLE 9 (con't). FISH CAUGHT DURING THE 2500 CFS DISCHARGE STUDY IN DECREASING ORDER OF NUMERICAL ABUNDANCE, SCIENTIFIC, AND COMMON NAME

61	Chaetodipterus faber	Spadefish	3
62	Histrio histrio	Sargassumfish	3
63	Gambusia affinis	Mosquito fish	3
64	Opisthonema oglinum	Atlantic thread herring	3
65	Leiostomus xanthurus	Spot	2
66	Lucania parva	Rainwater killfish	2
67	Sphoeroides nephelus	Southern puffer	2
68	Scianenops ocellata	Red drum	2
70	Caranx latus	Horse-eye jack	2
71	Lutjanus mahogoni	Mahogany snapper	2
69	Labrisomus nuchipinnis	Hairy blenny	2
72	Chilomycterus antillarum	Web burrfish	1
73	Menticirrhus americanus	Southern kingfish	1
74	Serranidae	Seabass	1
75	Selen vomer	Lookdown	1
76	Strongylura sp.	Needlefish	1
77	Syngnathus sp.	Pipefish	1
78	Scorpaena grandicornis	Plumed scorpinfish	1
79	Etropus crossotus	Fringed flounder	1
80	Monacnathus sp.	Filefish	1
81	Gobionellus smaragdus	Emerald goby	1
82	Pogonias cromis	Black drum	1
83	Pseudupeneus maculatus	Spotted goatfish	1
84	Dactyloscopus crossotus	Bigeye stargazer	1
85	Gobiidae	Goby	1
		Total	42,178

*Less than 30 mm, difficult to identify to specie

TABLE 10. FISH PRESENCE THROUGHOUT THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

Species* Number	SOUTH FORK 1	2	3	4	5+	NORTH FORK 1	2	3	4	5	MIDDLE ESTUARY 1	2	3	4	5	OUTER ESTUARY 1	2	3	4	5	Species Number
1	B	B	B	B	B	T	B	B	T	B	B	T	B	B	T	B	S	S	B	B	1
2	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	2
3			S	S													S		S	S	3
4	B	B	B	B	T	B	B	T	B	B	B	B	B	T	S	B	B	S	B	S	4
5	S	B	B	S	B	S	B	B	B	S	B	B	B	B	B	B	B	B	B	B	5
6	B	B	B	S	S	B	B	B	B	B	B	B	B	B	S	B	B	B	B	B	6
7	T	B	B	B		S	T	T			T	T	T	T	T						7
8	B	B	S	B	T	B	B	B	B	T			S	T	T			S	S		8
9	T	T	T			T	T	T	T		T	T	T	B	T	T		T			9
10	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T						10
11	T	T	T	T	T			T	T	T				T		S	S	S	S	S	11
12									T		T	T	B			S	S	S	S		12
13		B	S				S				S		S	T		S	B	S	S	S	13
14				S							S							S	S		14
15			S										T	T		S	S	S	S	S	15
16						S	S	S			S	S		S	S	S	S	S	S	S	16
17						T						S				S	S	S	S	S	17
18		T	T	B	T	T	T	T	B	T											18
19												S			S	S	S	S	S	S	19
20	B		T		S	B	T		T					S			S	S	S	S	20
21	T	T		T	T		T				T		T								21
22																S	S	S			22
23						S	S				S	S		S	S		S	S			23
24	S					S			T		S		S	S		S	S	S	S	S	24
25											S		S	S		S	S	S	S	S	25
26		T	B	T						T				T							26
27	T	T	T			T	T	T	T	T						S	T	T			27
28	S	S		S	S	S	S			S		S	S		S	S	S				28
29	T	T	T	T		T						T									29

TABLE 10. (Continued) FISH PRESENCE THROUGHOUT THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

Species*	SOUTH FORK					NORTH FORK					MIDDLE ESTUARY					OUTER ESTUARY					Species
Number	1	2	3	4	5+	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	Number
30		B	S	B	B		T	T	T				S								30
31	T	T	T		T						T	T	T		T						31
32	T	T	T		T			T				T	T	B			S		S		32
33														S	S	S		S	S	S	33
34			B	B	T								B	T							34
35			S	S	S		B	B	T			B	S	T			S				35
36																		S	S	S	36
37			B	T							S			S		S		S	S	S	37
38				S	S				S		S				S	S		S	S	S	38
39	S							T				S		S		S	S	S		S	39
40	T	T	T		T			T	T	T											40
41																S	S	S	S	S	41
42					T			T		T	S			B							42
43				S	S	S															43
44	S	T		S	S		S				S										44
45								T	T	T											45
46					S											S	S	S		S	46
47												S					S		S		47
48		T	T		T																48
49						S				S		S							S	S	49
50																		S	S	S	50
51											T		T					S	S		51
52					T					T	T			T			S				52
53			3										S								53
54		T	S																		54
55		S					S														55
56																	S			S	56
57								T								S				S	57
58												T	T								58
59		S		S																	59
60			S		S																60
61																	S		S		61
62																S					62
63				S	S																63
64				S														T			64
65	T			T																	65
66																	S				66
67																			S	S	67
68				S	S																68
69																S	S				69
70																	T	S			70
71																	S		S		71
72																	S				72
73												T									73
74																			S		74
75																				T	75
76																		S			76
77															S						77
78																	S				78
79																	T				79
80																				S	80
81																S					81
82							T														82
83																			S		83
84																	B				84
85																				S	85
#SP.Seine	11	13	18	20	15	13	13	7	6	7	15	13	15	15	11	26	34	31	32	30	
#Sp.Trawl	16	23	19	14	15	11	14	19	17	13	12	14	14	17	7	5	8	4	5	4	
Total#Sp.	22	27	29	28	27	20	22	21	19	17	23	23	24	26	16	27	37	33	33	31	

*Refer to Table 9. S = Seine, T = Trawl, B = Both Seine and Trawl
+ Sample Dates 1 = 6/14, 2 = 6/20, 3 = 6/28, 4 = 7/5, 5 = 7/12

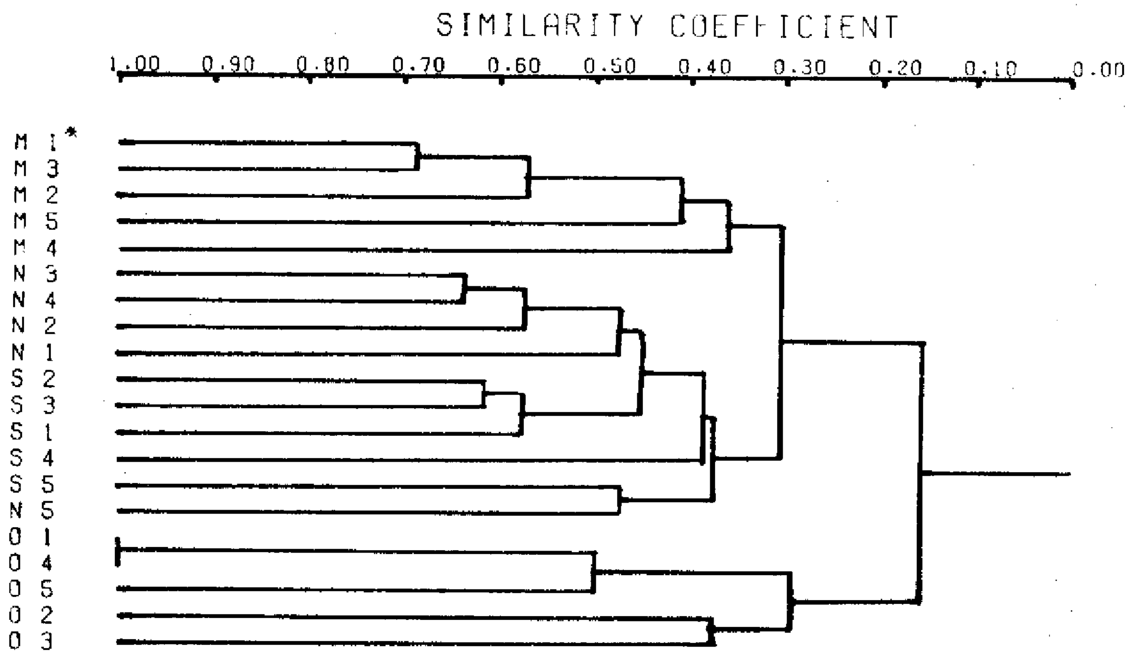

FIGURE 17. PHENOGRAM SHOWING THE SIMILARITY OF TRAWL SAMPLES COLLECTED DURING THE 2500 CFS DISCHARGE STUDY

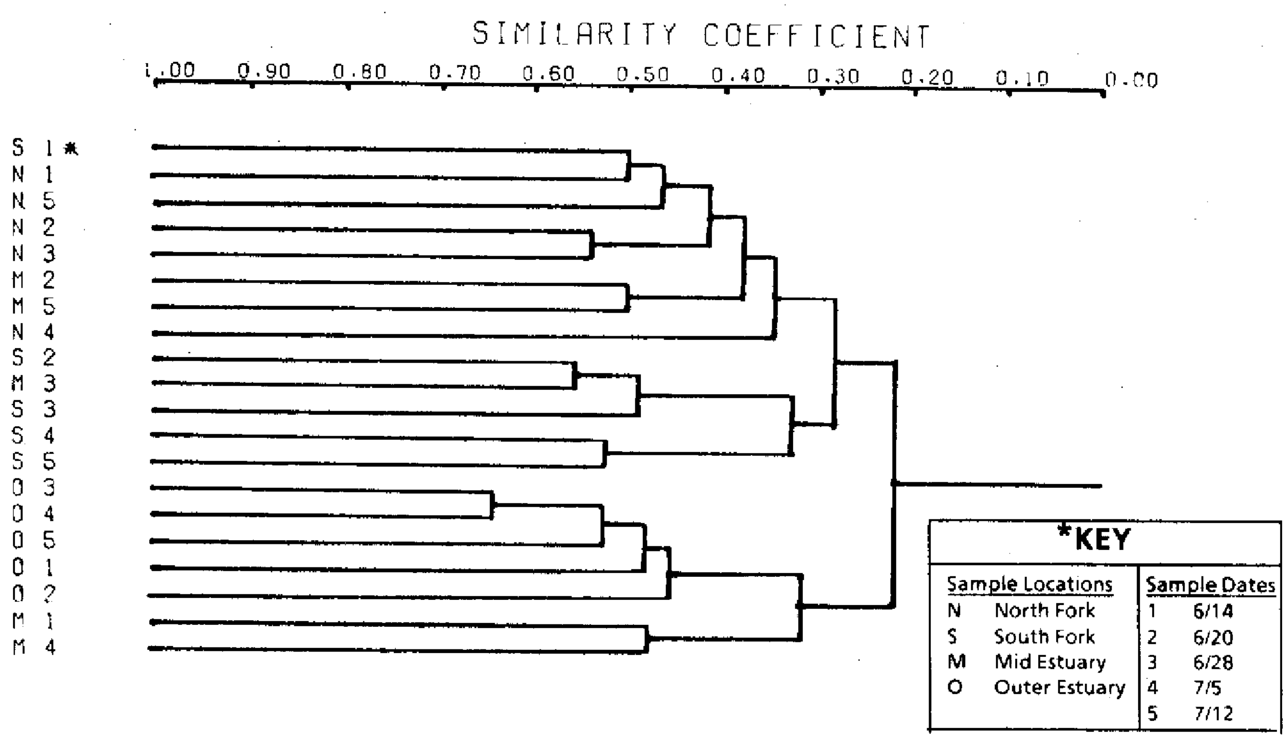

FIGURE 18. PHENOGRAM SHOWING THE SIMILARITY OF SEINE SAMPLES COLLECTED DURING THE 2500 CFS DISCHARGE STUDY

TABLE 11. FISH RESPONSE TO THE 2500 CFS FRESH WATER DISCHARGE

	Salinity* Range (ppt)	G
1. Introduced from Upstream		
Dorosoma cepedianum	0.2-2.2	<0.5%
Gambusia affinis	2.5-4.2	
Ictalurus catus	0.2-4.0	<0.5%
Pomoxis nigromaculatus	0.2-2.0	
2. Came into Inner Estuary		
Albula vulpes, leptocephalus	2.2	
Centropomus undecimalis	0.2-8.2	<0.5%
Elops saurus, leptocephalus	0.2-1.5	
Megalops atlantica, lepto cephalus	1.8-2.2	
3. Moved out of Inner and Mid-estuary		
Anchoa hepsetus	0.2-35.0	
Lagodon rhomboides	2.2-36.0	
Orthpristis chrysoptera	7.6-36.0	
4. Remained in Inner and Mid-estuary		
Achirus lineatus	0.2-15.0	<0.5%
Arius felis	0.2-31.8	0.7%
Bagre marinus	0.2-24.5	<0.5%
Brevoortia smithi	0.2-4.2	<0.5%
Caranx hippos	0.2-36.0	<0.5%
Citharichthys spilopterus	0.2-35.0	<0.5%
Cynoscion nothus	0.2-12.0	
Cynoscion regalis	0.2-12.0	<0.5%
Diapterus plumeri	0.2-8.2	
Diapterus olisthostomus	0.2-25.0	<0.5%
Dorosoma pentenense	0.2-24.5	1.4%
Gobiosoma bosci	1.5-15.0	
Leiostomus xanthurus	1.5-12.0	<0.5%
Microgobius gulosus	2.5-8.0	
Micropogon undulatus	0.2-24.5	<0.5%
Mugil curema	2.2-22.2	
Trachinotus falcatus	2.8-34.0	<0.5%
Trinectes maculatus	0.2-12.0	<0.5%
5. Remained throughout Estuary		
Anchoa mitchilli	0.2-35.0	60.0%
Archosargus probato cephalus	2.0-33.0	
Bairdiella chrysura	0.2-35.0	<0.5%
Clupeid juveniles	1.5-36.0	10.7%
Dasyatis sabina	0.2-35.0	<0.5%
Eucinostomus argenteus	0.2-36.0	2.3%
Eucinostomus gula	0.2-36.0	2.4%
Eucinostomus sp.	0.2-36.0	5.7%
Lutjanus griseus	2.0-35.0	<0.5%
Menidia beryllina	0.2-36.0	11.1%
Mugil cephalus	0.2-36.0	<0.5%
Oligoplites saurus	0.2-35.0	
Sphaeroides testudineus	4.2-36.0	<0.5%
Sphyraena barracuda	0.2-34.0	
Strongylura marina	1.5-32.8	<0.5%
Syngnathus scovelli	2.5-36.0	<0.5%
Total		>95.4%

* = Range of salinities in which these species were collected during the discharge study.
G = Fish that Gunter (1959) found in the inner and mid-estuary after the region was fresh water for 3 months. The percentage shown reveals the portion of catch for the 2500 cfs discharge investigation.
Note: Fish collected during the study but not listed above include those species that remained in the outer estuary or were rare species not captured frequently enough to detect their movement.

distinctively different. Overall, the cluster analyses (Figures 17 and 18) indicate that the communities, represented by species presence, remained very similar throughout the entire controlled discharge experiment.

The percent presence and numbers of species captured at each station for the 33 most abundant species found throughout the estuary were analyzed. Results of the percent presence analysis for the inner and middle estuary indicate that fish feeding on the lower torphic level became more widely distributed throughout this area during the first two weeks of discharge and then returned to the distributions that existed before the discharge (Table 12). Examination

TABLE 12. COMPARISON OF PERCENT PRESENCE LOWER TROPHIC LEVEL FISH, WITH CHI SQUARE

Date		Population 1	2	3	4	5
1	6-14		37.1	37.2	31.9	20.8
2	6-20			10.2*	51.4	40.5
3	6-28				33.3	40.0
4	7-5					30.8
5	7-12					

*No significant difference (95% Confidence Level)

of Figure 19 also reveals that the dispersion occurred mostly among the lower trophic level fish such as *Anchoa mitchilli, A. lyolepis, A. hepsetus, Dorosoma pentenense*, and Clupeid juveniles. Maximum dispersion occurred by 28 June, nine days after the discharge began. The numbers of species captured at individual stations throughout the inner and middle estuary for each sample date were compared (Table 13). The results of this analysis reinforced the fact

TABLE 13. NUMBER OF FISH SPECIES IN THE INNER AND MID ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

Population / Sta.	Date	1 6-14	2 6-20	3 6-28	4 7-5	5 7-12
1S		8	10	4	7	3
1T		9	8	14	10	9
2S		6	8	7	3	6
2T		4	9	10	9	5
3S		5	7	11	8	8
3T		10	15	7	5	11
4S		2	6	8	9	8
4T		9	15	17	11	10
5S		7	7	9	12	7
5T		6	9	12	13	6
6S		7	5	10	9	4
6T		9	10	9	10	5
11S		6	8	13	11	6
MEAN		6.8	9.0	10.1	9.0	6.8
C.V. (%)		33.7	33.6	33.8	30.8	34.7

that the distribution of fish had changed (Tables 13 and 14). The increase in number of species found can be attributed to the introduction of four freshwater species and three species of Elopiformes to the South Fork plus increased distribution of species that were present before the discharge began. The decrease in

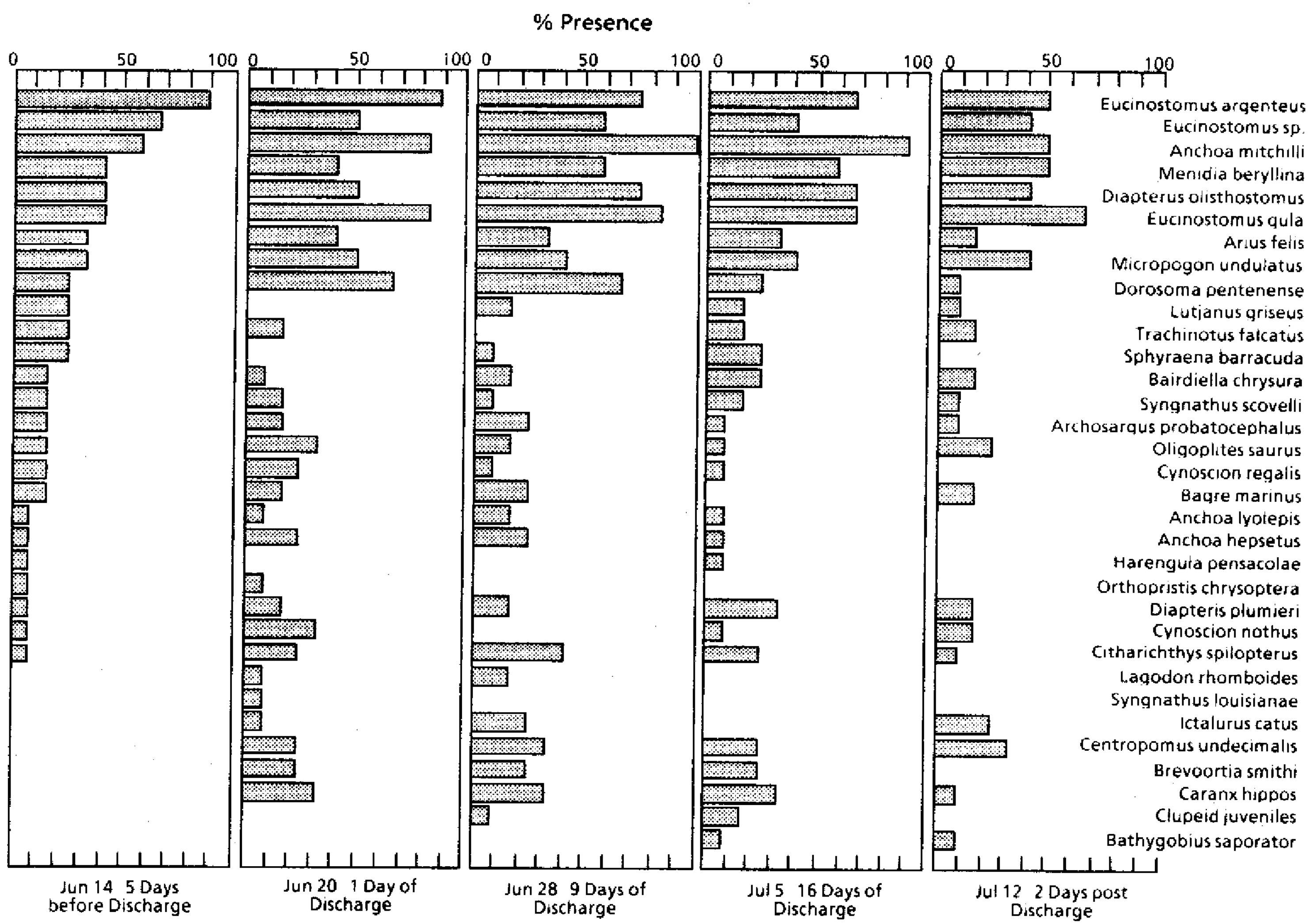

FIGURE 19. PERCENT PRESENCE OF FISH IN THE INNER AND MIDDLE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

the number of species captured at various stations can primarily be attributed to the return of the lower trophic level fish to a distribution similar to that found before the discharge occurred.

TABLE 14. COMPARISON OF THE NUMBER OF FISH SPECIES POPULATIONS WITH t STATISTIC

Population (t value) Sample Sets	1	2	3	4	5
1		2.160*	2.912*	2.243*	I.M.
2			0.853	I.M.	-2.180*
3				-0.885	-2.883*
4					-2.215*
5					

I.M. = Identical Means
* Significant Difference (95% Confidence Level)

Field Observations

Within the first week of 2500 cfs discharge, blooms of blue-green algae (primarily *Anabaena* and *Schizothrix*) occurred in the surface waters of the inner and mid-estuary. The greatest concentrations of these blue-green algae appeared where opposing currents met near Roosevelt Bridge and in windrows in the east-west section of the middle estuary. Surface water algae blooms were no longer apparent during the last week of discharge.

Weekly observations at station 4S of several adult clusters of oysters revealed that individual oysters remained alive throughout the study. By the end of the discharge event, salinity at station 4S was down to 2 ppt, and the oysters were no longer actively feeding.

Discussion

Benthic Macroinvertebrates

The composition of benthic communities in an estuary is influenced by salinity. Estuarine salinities are grouped into four zones that range from nearly fresh water to sea water.

Salinity Zone	Salinity (ppt)
Oligohaline	0.5 to 5.0
Mesohaline	5.0 to 18.0
Polyhaline	18.0 to 30.0
Euhaline	30.0 to 40.0

Prior to the 2500 cfs discharge, the St. Lucie Estuary was characterized by mesohaline conditions in the inner estuary, polyhaline in the middle estuary, and euhaline in the outer estuary (Figure 20A). Although the upper reaches of the North and South Forks were not monitored, oligohaline waters probably existed in these areas where groundwater seepage and freshwater runoff maintain low salinities.

Since many freshwater invertebrates can tolerate oligohaline conditions (Boesh, 1971), the St. Lucie Estuary supported benthic communities that could inhabit the entire range of salinities prior to the experimental discharge.

The benthic community in the mesohaline and polyhaline waters consisted of many species that can tolerate stressful environmental conditions and take advantage of habitat that is not favorable to other benthic organisms. The high organic content in the mud substrates and frequent physical disturbances in the inner and middle estuary are two stressful conditions these species endure. Important adaptive characteristics that allow these species to survive in these areas include: (1) small size; (2) high proportion of resources devoted to reproduction; (3) nearly continuous, prolific reproduction throughout the year; (4) high dispersal ability; (5) primary density-independent mortality; and (6) lack of an equilibrium population size (Rhoads and Young, 1970; McNulty, 1970; Grassle and Grassle, 1974; Tiffany, 1974; Webb, 1976; Diaz and Boesch, 1977; Young and Young, 1977; Deis, 1978; Pearson and Rosenberg, 1978; Hart and Fuller, 1979). Wohsehlag and Copeland (1970) demonstrated a gradual reduction in species diversity in benthic communities that are exposed to stress for long periods of time. Only the most adaptable benthic species will survive the stress; the loss of less adaptable species reduces the community diversity. The low species diversity and large number of opportunistic species collected from the mud substrates in the St. Lucie Estuary suggest that this is a stressed system.

Reduction in salinities during the discharge changed the species composition of the benthic communities. As the fresh water penetrated the inner estuary, mesohaline and polyhaline waters were changed to oligohaline. After the first 10 to 14 days of discharge, a salinity equilibrium was established and the oligohaline zone was maintained until 12 July, two days after the discharge stopped (Figures 20B to 22B). The most apparent changes in benthic species composition occurred within the area that became oligohaline (transect 1 to 5). Opportunistic freshwater midge larvae, mostly *Chironomus crasscaudatus*, invaded all of the oligohaline habitat and reached densities as high as 6000/m^2. Other midge larvae (*Cryptochironomus fulvus*, *Polypedilum halterale*, and *Procladius* sp.) were found in far fewer numbers only in the South Fork where freshwater conditions were present for the longest period. The estuarine polychaete, *Streblospio benedicti*, dramatically increased in density, and the previously dominant clam, *Mulinia lateralis*, and the amphipod, *Ampelisca abdita*, were virtually absent from the newly created oligohaline zone. This new zone, however, was formed during the first few weeks of discharge and it is during this time that most of the benthic community changes probably occurred. *M. lateralis* (coot clam) probably perished from low salinity. The dominant amphipod *A. abdita* has been shown to migrate to more suitable environments when subjected to stress from increased turbidity and/or reduced salinities (Farrow, 1984).

Fish

The fish community in the inner and middle estuary was characterized by a small number of species prior to the discharge. Of these species, the fish that feed at the lower trophic levels were dominant. This type of community structure is often encountered in the South Atlantic Estuarine Region (Livingston, 1976). *Anchoa mitchilli* (bay anchovy) was the most abundant species in this study and is generally the most common fish found within the South Atlantic Region when seines and trawls are used for sampling (Swingle, 1971). The bay anchovy is well adapted to conditions within the St. Lucie Estuary because it can tolerate wide salinity and temperature variations and periods of low food availability. It also has a long spawning season so

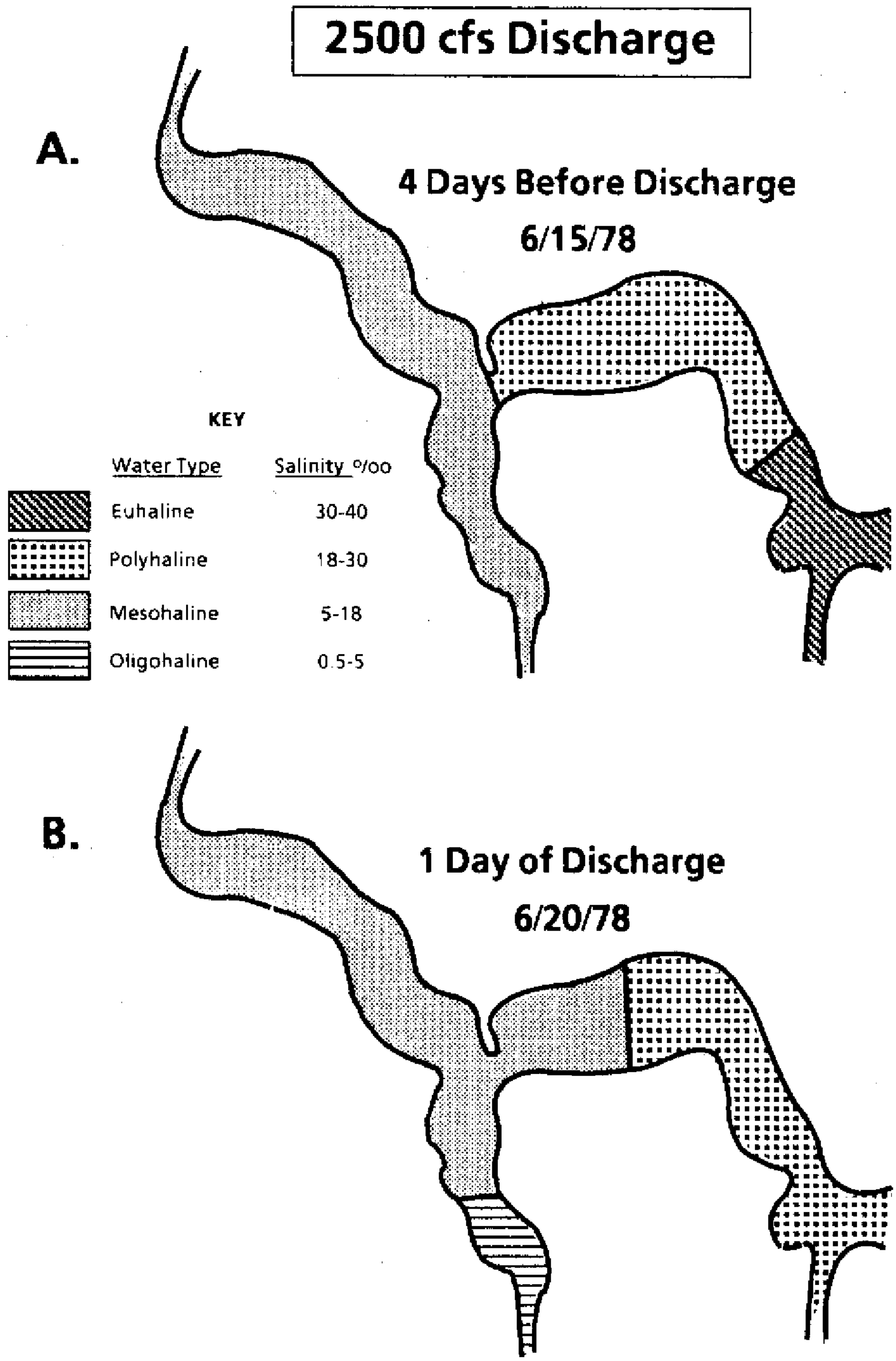

FIGURE 20. SALINITY ZONES IN THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

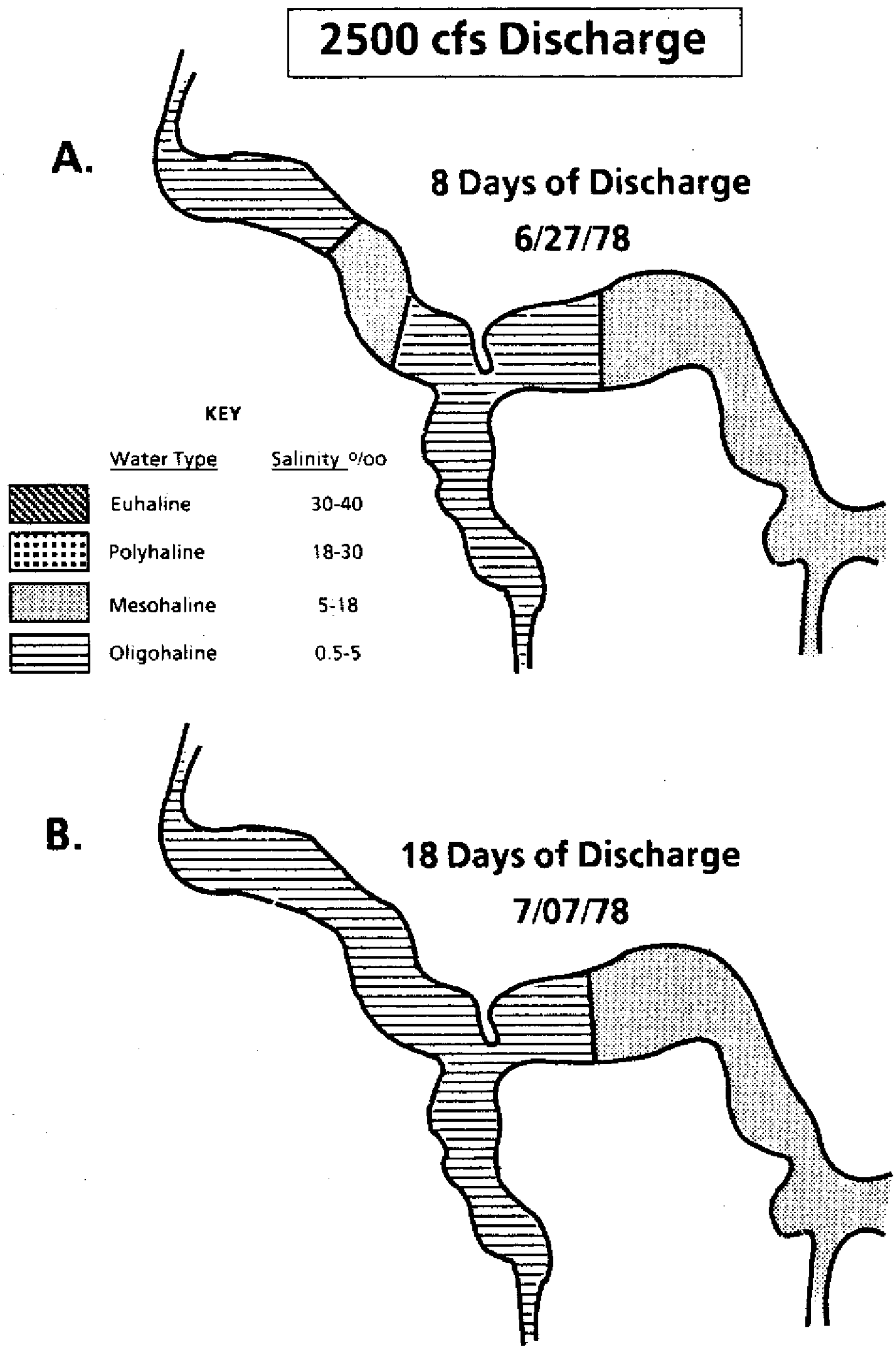

FIGURE 21. SALINITY ZONES IN THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

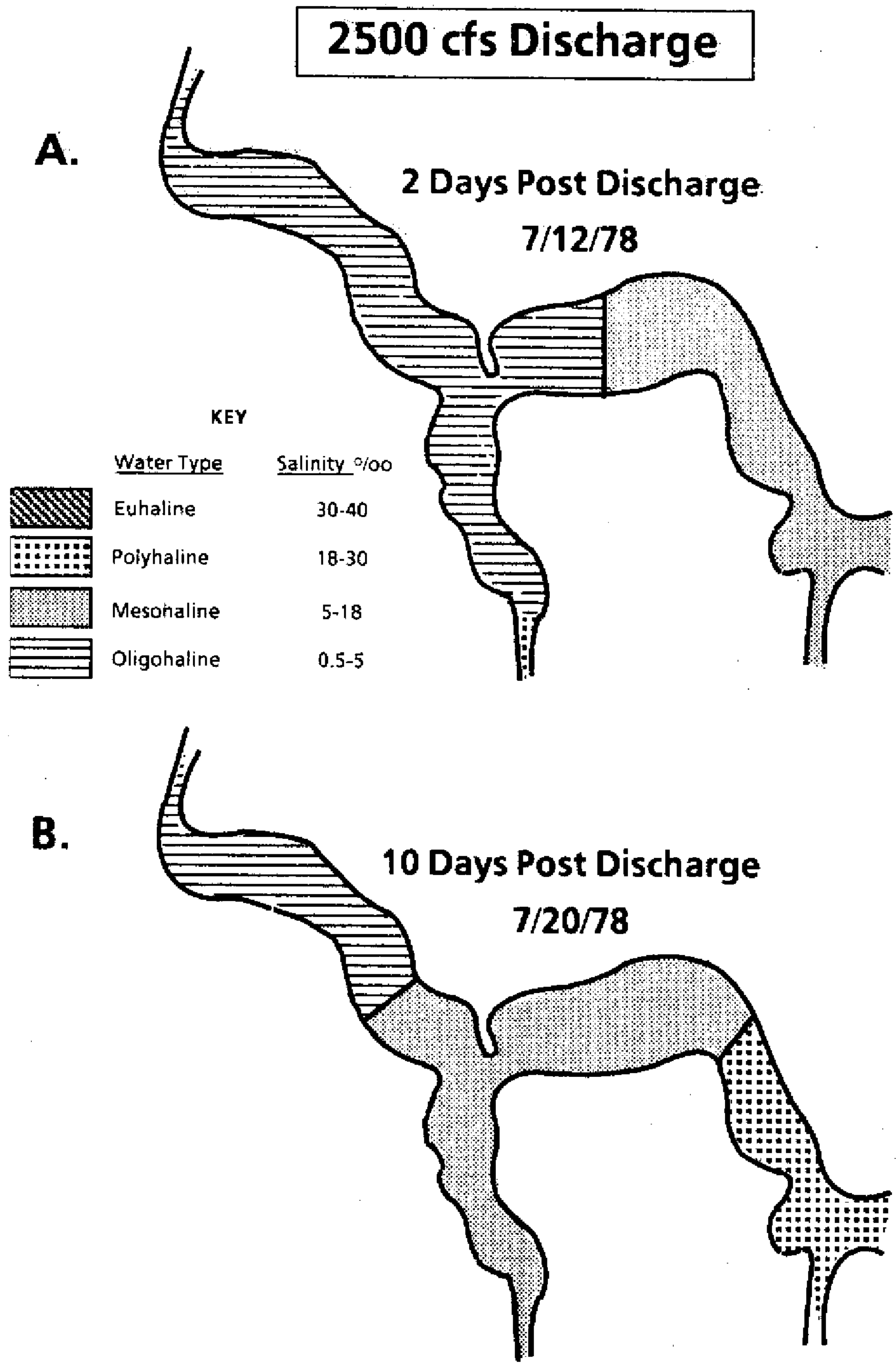

FIGURE 22. SALINITY ZONES IN THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

that juvenile recruitment occurs throughout the year (Bechtel and Copeland, 1970). Fishes that feed at the lower trophic levels such as *Anchoa* spp., *Dorosoma pentenense* (threadfin shad), *Harengula pentenense* (scaled sardine), and *Brevoortia smithi* (yellowfin menhaden) in the St. Lucie Estuary, generally make up the greater portion of the fish biomass of most estuarine areas. These fish utilize a diverse food supply and can be classified as herbivores, detritivores, omnivores or primary carnivores (mostly zooplankton feeders like *Anchoa* spp.). Day, et. al., (1973a) showed that this group of fishes accounted for more than 75% of the total biomass in Baratoria Bay, Louisiana.

Mid-trophic level carnivores encompass a relatively large number of fishes that feed mainly on macrobenthic and microbenthic organisms and small fishes. The most abundant, mid-trophic species were *Menidia beryllina* (tidewater silverside), *Eucinostomus* spp. (mojarras), *Micropogon undulatus* (croaker), *Arius felis* (sea catfish), and *Diapterus olisthostomus* (irish pompano).

The higher trophic level of fishes, which feed mainly on lower trophic level fishes and macrobenthic organisms like crabs and shrimp (Day, et. al., 1973a), were represented primarily by *Cynoscion* spp. (trout), *Lutjanus griseus* (gray snapper), *Sphyraena barracuda* (barracuda), and *Centropomus undecimalis* (snook).

During the discharge, four species of freshwater fish were introduced from upstream. Further, the fresh water coming into the South Fork appeared to attract the larvae of tarpon, bonefish, and ladyfish. Otherwise the fish species that were found throughout the estuary before the discharge were very similar to the species that were collected during and after the releases. Springer (1960) found no significant differences in species composition in the inner estuary during periods of zero, 4000 cfs, and 7000 cfs discharges from S-80. Murdock (1954), however, concluded from interviews with local, commercial, and recreational fishermen that adult predatory fish such as sea trout, bluefish, pompano and mackerel "...avoid the fresh water outflow from the canal and during periods of water release commercial fishing is driven temporarily out of the estuary."

Results of the 2500 cfs discharge study showed that the lower trophic level fish were more widely distributed in the inner and middle estuary during the first two weeks of discharge and then returned to about the distribution that existed before the discharge. This change in distribution may be related to the changes that occurred in the benthic communities and in water quality.

During the first two weeks of discharge the oligohaline zone increased in area. The amphipod, *A. abdita* entered the water column in large numbers seeking a more suitable environment. In addition, a "population explosion" of midge larvae occurred. These invertebrates were widely distributed in the inner and middle estuary and became highly susceptible to fish predation. The resuspended sediments, resulting from increased water velocities in the narrows of the South Fork, undoubtedly contained other benthic species and organic material which were distributed throughout the inner estuary. From the results presented in Figure 14, it appears that the initial increase in nitrogen was due to the liberation of interstitial water from the physical action of the discharge. This nitrogen increase was associated with a bloom of blue-green algae (primarily *Anabaena and Schizo-thrix*) in the inner and middle estuary. These factors provided the lower trophic level fish with a rapid increase in food supply that was well distributed throughout the oligohaline zone. A recent study of the bay anchovy documented the opportunistic feeding behavior of this fish in the St. Lucie Estuary (unpublished study by the South Florida Water Management District). Before a large regulatory discharge began, the diet of the bay anchovy consisted primarily of ostracods and copepods. All of these specimens were collected from a mesohaline habitat. After about a month of discharge, gut analyses revealed that freshwater midge larvae and unidentifiable organic material were the primary food for the bay anchovy within oligohaline waters.

The increased distribution of opportunistic feeding fish during the formation of an oligohaline environment was probably a response to the dispersion and availability of food organisms and organic materials. The return of these fish to the previous distribution occurred after the oligohaline character of the estuary had been established and most of the changes in the benthic community had probably taken place.

Importance of Antecedent Conditions

The reduction in salinities to an oligohaline habitat causes changes in the distribution and composition of benthic and fish communities. Therefore, from a salinity perspective, the effects of discharges from S-80 cannot be adequately assessed unless the antecedent conditions are known. For example, antecedent salinity conditions were documented prior to a 1000 cfs discharge from S-80 that began on 20 June 1977 (Figure 23A). The inner estuary and about half of the middle estuary were polyhaline (18 to 30 ppt). After 21 days of discharge, only a small portion of the South Fork was oligohaline (Figure 23B). The most significant biological changes in that study occurred only within the South Fork benthic communities (Haunert and Startzman, 1980). If the inner estuary had been mesohaline before the 1000 cfs study, as it was when the 2500 cfs study began, 21 days of 1000 cfs discharge may have transformed the whole inner estuary into an oligohaline environment and the benthos and fish would have responded accordingly.

Seasonal Variation in Freshwater Flow

Two of the most important factors in determining productivity of an estuary are the presence of a long growing season together with distinct seasonal pulses of freshwater input (Day et. al., 1973a). Under natural conditions, the St. Lucie Estuary meets these conditions by having relatively warm waters for most of the year, and seasonal rainfall events that cause transient variations of water and nutrient flow into the system. As with the 1000 cfs and 2500 cfs experimental discharges from S-80, these natural pulses of fresh water initially provide nutrients for primary production and reduce salinities to create oligohaline environments. Conversely, prolonged regulatory releases from S-80 can create an extended area of fresh water and oligohaline habitat for the duration of the discharge, which is detrimental to the estuary. The natural pulses provide transient fresh water and oligohaline conditions in a limited area of the inner estuary. Many sessile species of benthic invertebrates are able to tolerate transient fresh water

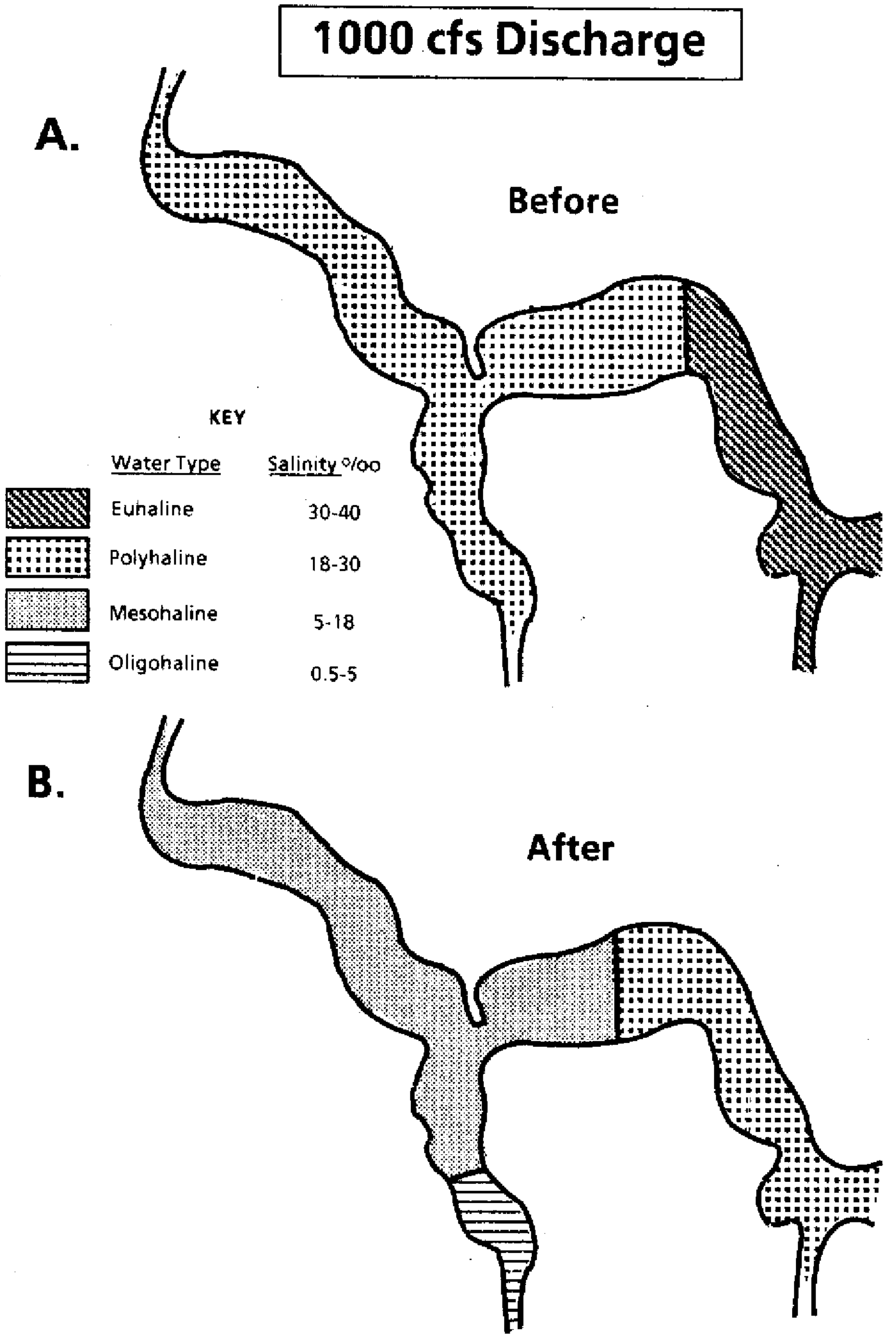

FIGURE 23. SALINITY ZONES IN THE ST. LUCIE ESTUARY BEFORE (6/17/77) AND AFTER (7/11/77) THE 1000 CFS DISCHARGE STUDY

conditions but will not survive sustained fresh water exposure. The oyster, for example, usually thrives in low salinity conditions (5 to 15 ppt), where disease and predators are normally absent. However, if oysters are subjected to more than several days of fresh water they can no longer osmoregulate and will perish. Oysters were not collected as part of the benthic samples in this study but field observations of several small clusters in the South Fork (near station 4S) revealed that these oysters were alive after the 2500 cfs discharge. The salinity in this area did not become low enough to be considered fresh water (less than 0.5 ppt), even though it was oligohaline. However, if the discharge had continued for about 10 more days, this area would have become fresh water according to a simulation produced by the hydrodynamic-salinity model (DYNTRAN version II) which was verified by the District. Previous regulatory discharges have been large enough and have lasted long enough to make the inner, and part of the middle estuary, fresh water. The loss of oyster reefs induces major biological changes since these reefs provide food for fish (such as the once abundant black drum) in the St. Lucie Estuary and vital habitat for numerous organisms (Huner, 1978; Day et. al., 1973b). Oyster populations in the estuary have been severely reduced due to the continual exposure to fresh water and the lack of suitable substrate (clean, hard objects) for settling of oyster larvae when reef regeneration is possible.

SUMMARY OF RESULTS

Turbidity
Before the discharge began maximum turbidity occurred where the estuary widens in the North Fork and South Fork. After the discharge began turbidity increased substantially in the South Fork and just downstream of the Roosevelt Bridge. Turbidity in the Indian River was not affected by the discharge.

Salinity
A linear salinity gradient existed from the inner estuary to the St. Lucie Inlet prior to the controlled freshwater releases. Salinities began to decline in the outer estuary by the eighth day of discharge. After about 10 days of discharge, a well-defined salt wedge was formed in the middle estuary which showed little movement for the remainder of the study. Salinities inland of the salt wedge were below 5 ppt.

Temperature
Before the discharge an average temperature gradient of about 4.0°C existed from the inner estuary eastward to the St. Lucie Inlet. As the discharge proceeded, temperatures became more uniform throughout the estuary while steadily increasing as summer progressed.

Dissolved Oxygen
Dissolved oxygen was highly stratified in the inner and middle estuary before the discharge. This stratification was lost in the South Fork at the onset of the discharge and these waters became highly oxygenated during the discharge. However, D.O. near the bottom was substantially reduced where the salt wedge persisted in the middle estuary.

Nutrients
A dramatic increase in nitrogen levels occurred at S-80 at the beginning of the discharge. Nitrogen concentrations decreased to levels found before the discharge within one week. Ortho-phosphorus levels showed a marked decrease to levels that were the same as those in Lake Okeechobee after the third day of discharge.

Benthic Macroinvertebrates
The highest densities of benthic invertebrates were present in the inner and middle estuary both before and after the discharge. However, an overall reduction in densities of 44% occurred during the discharge. The greatest change in benthic species composition occurred in the newly-created oligohaline zone (0.5 to 5 ppt) of the estuary within the first few weeks of discharge. Freshwater midge larvae, *Chironomus crassicaudatus*, increased dramatically and the estuarine polychaete, *Streblospio benedicti* also increased in number. Additionally, six freshwater species were introduced and at least four estuarine species were lost from the oligohaline zone.

Fishes
The fish community in the inner and middle estuary was represented by a few species, dominated by fishes that feed at the lower trophic level. Shallow, grassbed communities in the outer estuary had the greatest diversity of fish. During the discharge, four species of freshwater fish were introduced from upstream into the oligohaline waters. The larval stages of three primitive species (bonefish, ladyfish, tarpon) were captured in the inner estuary after the discharge began. Three species of fish including striped anchovy, pigfish, and pinfish avoided the lower salinity water. In spite of the apparent movements, fish communities throughout the estuary remained very similar during the entire controlled discharge experiment.

LITERATURE CITED

Bechtel, T.J. and Copeland, B.J. 1970. Fish species diversity indices as indicators of pollution in Galveston Bay, Texas. Cont. Mar. Sci. 15:103- 132.

Boesch, D.F. 1971. Distribution and structure of benthic communities in a gradient estuary. Ph.D. Diss. The College of William and Mary, p. 120.

Bollman, F.H. 1975. The value of estuarine fisheries habitats: some basic considerations in their preservation, p. 95-120. Environmental Protection Agency, Estuarine Pollution Control and Assessment: Proceedings of a conference. Office of Water Planning and Standards; Washington, D.C.

Day, J.W. Jr., Smith, W.G., Hopkinson, C.S., Jr. 1973a. Some trophic relationships of marsh and estuarine areas. Chabreck, R.H., ed. Proceedings of the coastal marsh and estuary management symposium; 1972 July 17-18; Louisiana State University, Baton Rouge, Louisiana, p. 115-135.

Day, J.W. Jr., Smith, W.G., Wagner, P.R., and Stowe, W.C. 1973b. Community structure and carbon budget of a salt marsh and shallow bay estuarine system in Louisiana. Louisiana State University, Center for Wetland Resources, Baton Rouge, La., Sea Grant Publ. No. 72-04, 40 p.

Deis, D.R. 1978. The effects of a wastewater outfall on benthic macroinvertebrates in Lake Worth (Palm Beach County), Florida. M.S. Thesis, Florida Atlantic University, p. 70.

Diaz, R.J. and Boesch, D.F. 1977. Impact of fluid mud dredged material on benthic communities of the tidal James River. Tech. Rept. D-77-45. U.S. Army Corps of Eng., Vicksburg, Miss., p. 38.

Dougenik, J.A. and Sheehan, D.E. 1975. Symap User's Reference Manual. Laboratory for Computer Graphics and Spatial Analysis. Harvard University. Cambridge, Mass.

Farrow, D. 1984. Personal Communications. Dept. of Environmental Regulation, Tampa, Florida.

Gosner, K.L. 1971. Guide to Identification of Marine and Estuarine Invertebrates. Wiley-Interscience, New York, p. 620.

Grassle, J.F. and Grassle, J.P. 1974. Opportunistic life histories and genetic systems in marine benthic polychaetes. J. of Marine Research 32:253-284.

Gunter, G. 1959. Biological investigations of the St. Lucie Estuary in Connection with Lake Okeechobee Discharges through St. Lucie Canal. U.S. Corps of Engineers Report. Part IV, supp. 10. 73 p.

Hart, C.W. Jr. and Fuller, S.L.H. 1974. Pollution ecology of freshwater invertebrates. Academic Press. New York, New York, p. 314-371.

Hart, C.W. Jr. and Fuller, S.L.H. 1979. Pollution ecology of estuarine invertebrates. Academic Press, New York, New York, p. 390.

Haunert, D.E., Startzman, J.R. 1980. Some seasonal fisheries trends and effects of a 1000 cfs freshwater discharge on the fishes and macroinvertebrates in the St. Lucie Estuary, Florida. South Florida Water Management District Technical Publication #80-3, p. 62.

Heald, E.J., Iverson, E.S., and Berkeley, S.A. 1972. A survey of aquatic and shoreline communities in the vicinity of the southwestern portion of Hutchinson Island, Martin County, Florida. Memo Report appended to Developmental Regional Impact Statement Report for Sailfish Point, Hutchinson Island, Martin County, Florida, p. 16.

Hoese, H.D. 1960. Biotic changes in a bay associated with the end of a drought. Limnology and Oceanography 5:326-336.

Huner, J.V. 1978. Aquaculture in Louisiana's coastal zone. Day, J.W. Jr., Culley, D.D. Jr., Turner, E.R., Mumphrey, A.J. Jr., eds. Proceedings of the coastal marsh and estuary management symposium; 1978 March 6-7; Louisiana State University, Baton Rouge, Louisiana, p. 347-362.

Livingston, R.J., Kobylinski, G.J., Lewis, F.G., and Sheridan, P.F. 1976. Long-term fluctuations of epibenthic fish and invertebrate populations in Aplalachicola Bay, Florida. Fishery Bulletin, Vol. 74, No. 2.

Murdock, J.F. 1954. Survey of the effect of releases of water from Lake Okeechobee through the St. Lucie Canal. U.S. Army Corps of Engineers, Interim Report 54-4. Contract No. DA-08-123-ENG-1376.

Odum, E.P. 1971. Fundamentals of Ecology. 3rd Edition. W.B. Saunders Co., Philadelphia. Pg. 144.

Pearson, T.H. and Rosenberg, R. 1978. Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. Oceanogr. Mar. Biol. Ann. Rev. Aberdeen University Press Vol. 16:229-311.

Phillips, R.C. and Ingle, R.M. 1960. Report on the marine plants, bottom types and hydrography of the St. Lucie Estuary and adjacent Indian River, Florida. Florida State Board of Conservation. Marine Laboratory, Spec. Sci. Report No. 60-4, 77 p.

Phillips, R.C. 1961. Seasonal aspects of the marine algal flora of St. Lucie Inlet and adjacent Indian River, Florida. Quart. J. Fla. Acad. Sci. 24(2):135-147.

Pinkham, C.F.A., and Pearson, J.G. 1976. Applications of a new coefficient of similarity to pollution surveys. Jour., WPCF, Vol. 48, No. 4, April 1976. Pg. 717-723.

Rhoads, D.C. and Young, D.K. 1970. The influence of deposit-feeding organisms on sediment stability and community trophic structure. Journal of Marine Research 28:150-178.

Shannon, C.E. and Weaver, W. 1963. The mathematical theory of communication. Univ. Illinois Press, Urbana. 125 p.

Sokal, R.R. and Rohlf, J. 1969. BIOMETRY: The principles and practice of statistics in biological research. W.H. Freeman and Co. San Francisco. Chapter 7.

Sorensen, T. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species content and its application to analyses of the vegetation on Danish commons. Biol. Ski., 5(4):1-34.

Springer, V.G. 1960. Ichthyologial surveys of the lower St. Lucie and Indian Rivers, Florida East Coast. Fla. State Board of Conservation Marine Laboratory, Report No. 60-19, 20 p.

Swingle, H.A. 1971. Biology of Alabama estuarine areas - cooperative Gulf of Mexico estuarine inventory. Ala. Mar. Res. Bull. 5, 123 p.

Tiffany, W.J. 1974. Checklist of benthic invertebrate communities in Sarasota Bay with special reference to water quality indicator species. Marine Biomedical Institute, Univ. Texas, p. 123.

Van de Kreeke, J. and Wang, J.D. 1976. Tidal hydraulics and salt balance of Lake Worth; Rosenstiel School of Marine and Atmospheric Sciences, University of Miami; Technical Report Sept. 1976. Office of Water Research and Technology, Dept. of Int. Grant No. 14-31-0001-9038.

Walker, K.R. and Bambach, R.K. 1974. Principles of benthic community analysis. University of Miami, Division of Marine Geology and Geophysics, Rosenstiel School of Marine and Atmospheric Sciences. P. 2.1-2.20, 3.1-3.11, 5.5-5.11.

Webb, A.D. 1976. The benthic ecology of the intracoastal waterway and adjacent canal systems at Boca Raton, FL. M.S. Thesis, Florida Atlantic University, p. 110.

Wohlschlag, D.E. and Copeland, B.J. 1970. Fragile estuarine systems - ecological considerations. Water Resources Bulletin, Vol. 6:94-105.

Young, D.K. and Young, M.W. 1977. Community structure of the macrobenthos associated with seagrass of the Indian River Estuary, Florida (In Ecology of Marine Benthos, Coull, B.C., ed.). Univ. of S. Carolina, p. 359-382.

APPENDIX A

TEMPERATURES IN THE ST. LUCIE ESTUARY DURING THE 2500 CFS EXPERIMENTAL DISCHARGE

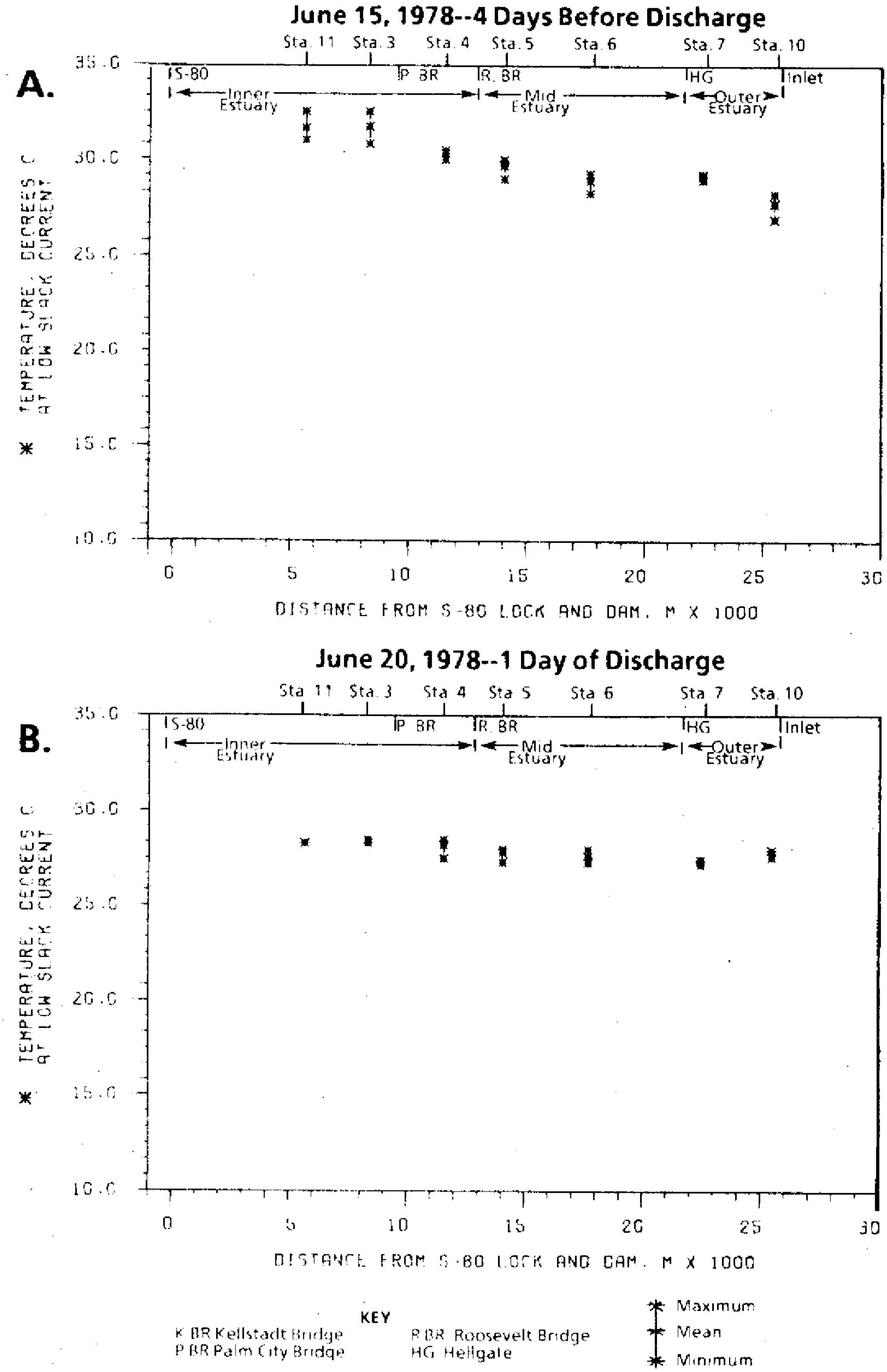

FIGURE A-1. TEMPERATURES IN THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

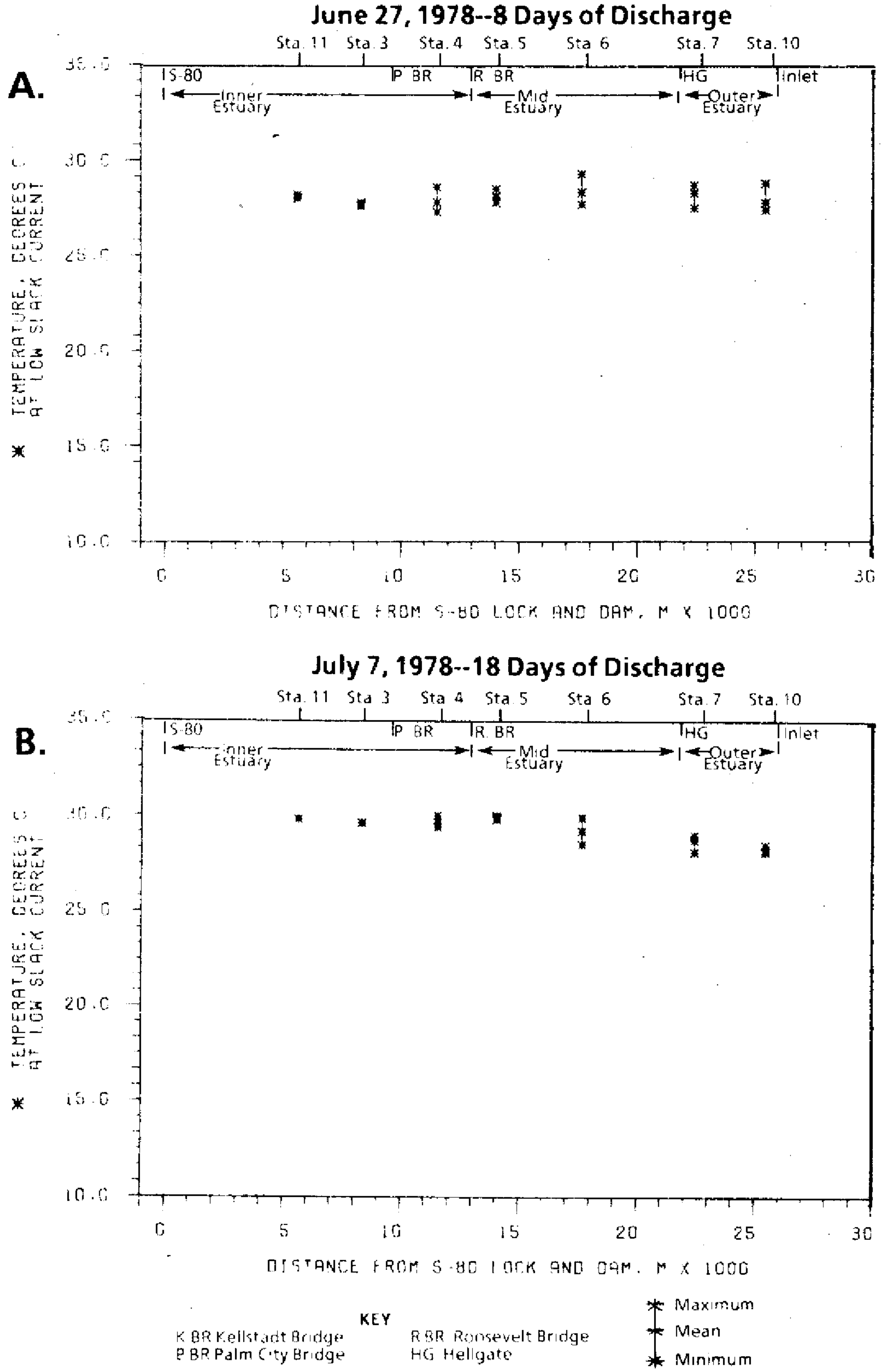

FIGURE A-2. TEMPERATURES IN THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

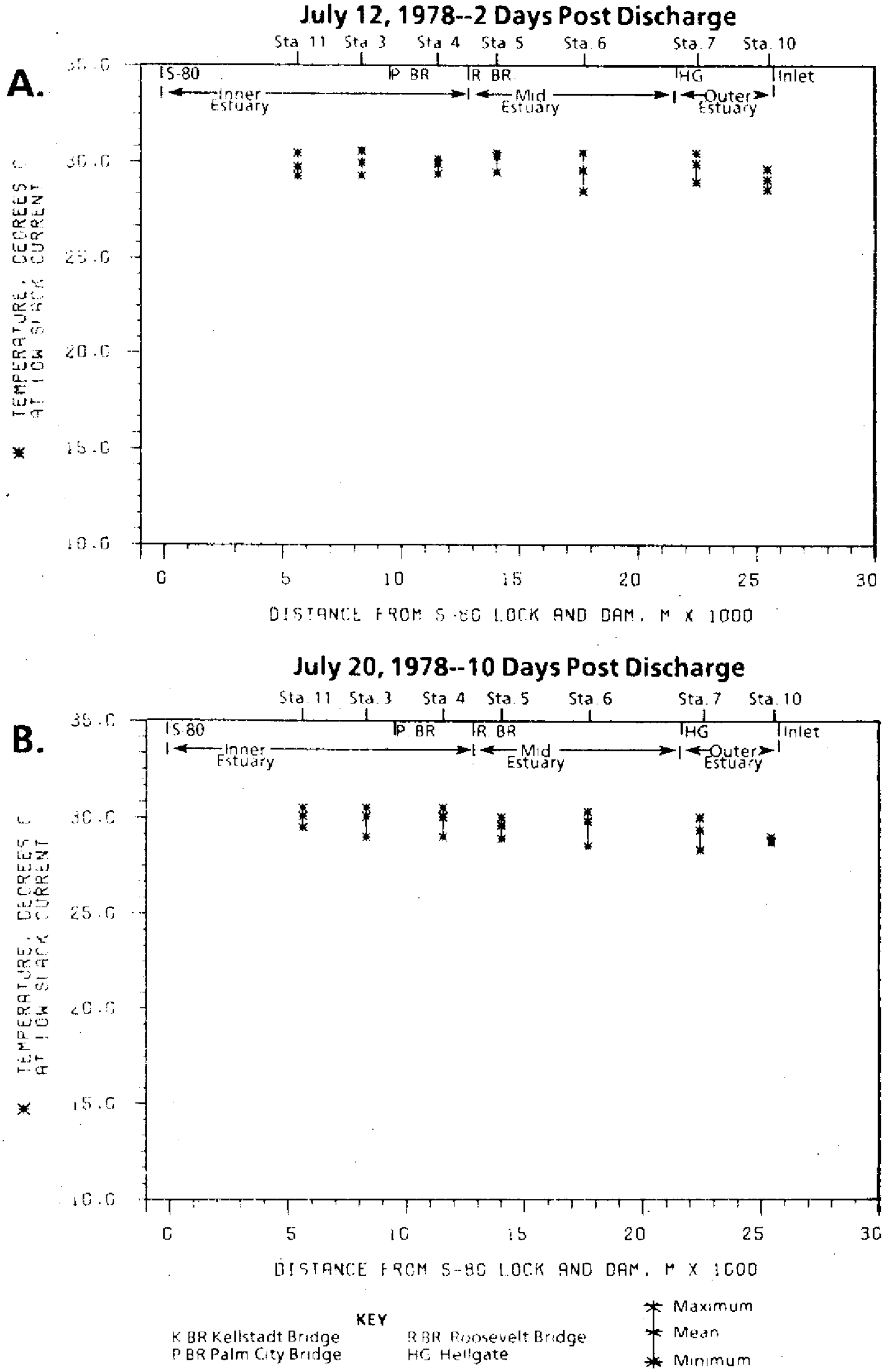

FIGURE A-3. TEMPERATURES IN THE ST. LUCIE ESTUARY DURING THE 2500 CFS DISCHARGE STUDY

TEMPERATURE IN THE NORTH FORK AND AT STATIONS 8C AND 9C DURING THE 2500 cfs DISCHARGE STUDY.

Station	Date	Mean	Min.	Max.
NORTH FORK				
1C	6/15	28.5	28.3	29.0
	6/20	28.1	27.5	28.5
	6/27	28.7	28.0	29.0
	7/7	29.5	28.7	30.1
	7/12	30.1	29.4	30.5
	7/20	30.1	30.0	30.1
2C	6/15	28.8	28.3	29.6
	6/20	28.0	27.6	28.5
	6/27	28.8	27.6	29.5
	7/7	30.1	29.6	30.5
	7/12	30.0	29.5	30.4
	7/20	29.9	29.5	30.0
OUTER ESTUARY				
8C	6/15	27.1	27.0	27.3
	6/20	27.0	26.8	27.3
	6/27	27.9	27.6	28.4
	7/7	28.6	28.6	28.6
	7/12	29.7	29.6	29.8
	7/20	29.2	29.0	29.5
9C	6/15	27.9	27.8	28.0
	6/20	27.7	27.6	27.7
	6/27	27.7	27.5	28.0
	7/7	28.4	28.0	28.5
	7/12	29.3	29.0	29.7
	7/20	29.2	28.9	29.5

APPENDIX B

QUANTITATIVE LISTING OF BENTHIC FAUNA BEFORE AND AFTER 2500 CFS DISCHARGE

	1 S	1 C	1 X	2 S	2 C	2 X	3 S	3 C	3 X	4 S	4 C	4 X	5 S	5 C	5 X	6 S	6 C	6 X	7 S	7 C	7 X	8 S	8 C	8 X	9 S	9 C	9 X	10 S	10 C	10 X
Class Polychaeta																														
Cirratulus sp.													1				1													
Cirriformia sp.																													1	
Glycinde solitaria	3			7	3		1		4		1		4	13	1	9	3/4	2	14/6	16/12	2/3	10/7	1/3		7/4	2	2/8	7/1		
Nereis sp.	5	3		1	5	1/1	3/4	3			4	2	15	2	1/10		1	7	3	1	1			1	2/1	1	3/2		1	
Nereis succinea	5/9												2/9																1	
Diopatra cuprea												3	1/1		1	1		1	7	1						1	4		2	
Onuphis sp.																								1						
Armandia sp.																4	1			1/8		2		2						
Haploscoloplus sp.																						1/6				1				
Haploscoloplus foliosus														1					1	2						1		1		2
Pectinaria gouldii	1	6		1		2/1			1			3	8	1	1/1	11			1								2			
Paraprionospio pinnata	1	1/1		57	3	3				2	3	2	1	3	3	4/7	10/6	4									1			
Streblospio benedicti	9	6		2	13	1	2	152/85	5/9	3/207	61	21		982	18			15	3				2							
Syllis sp.																											3			
Tubifex tubifex							2																							
Class Gastropoda																														
Acteocina canaliculata														1		6			5/8	2					2		1		3	
Haminoea succinea						1	2															2								
Anachis obesa													1					7												
Mitrella lunata																		10												
Pyrgophorus platyrachis			51			1	32/23																							
Neritina virginea						1							1																	
Melanoides tuberculata							3																							

6-13-78 X / X 7-10-78

Taxon	1 S	1 C	1 X	2 S	2 C	2 X	3 S	3 C	3 X	4 S	4 C	4 X	5 S	5 C	5 X	6 S	6 C	6 X	7 S	7 C	7 X	8 S	8 C	8 X	9 S	9 C	9 X	10 S	10 C	10 X
Class Pelecypoda																														
Barbatia candida																											2			
Crassinella lunulata																			4											
Donax variabilis																														22
Divaricella quadrisolcata																						3								
Lucina pectinata											1																4			
Lucina sp.																	1		5	1		2 / 2					1			
Lyonsia hyalina	1													10	2		3		9 / 5	6							1	1	4	1
Mulinia lateralis	403	803	28	135	307	169 / 2	143	106	181 / 6	156	58	184	953		265 / 56	206 / 141	101 / 67	947 / 99	86 / 37	3 / 14	1	6 / 10	3	3	6 / 161	14 / 64	115 / 2	2	1	
Amygdalum papyrium	12 / 9	8				12						1	3	9	4		9	56 / 1									1			
Brachidontes domingensis	197 / 327	35 / 6	5		3	3 / 2		1			5 / 2	1	466 / 613	549													1			
Mytilopsis leucophaeta	28		37		2	1									8															
Tagelus plebeius	1 / 1																		2			1				1	1	1		
Macoma tenta	3	1			1	5						1	1				2		11 / 2	5 / 2	1	3			1 / 4	2 / 2	2	1	2	13
Tellina sp.																						10								
Chione cancellata																	1		13					1						
Chione grus																			5	4		12	1		1					
Chione intapurpurea																			1						5	2		1		
Anomalocardia auberiana													1																	
Class Crustacea																														
Mysis stenolepis																			2		8					1				
Mysis sp.																													1	
Mysidopsis bigelowi			1		2 / 2		2 / 1	3	3	1		6		1 / 1		1	1	1 / 1	2	7 / 2		1	1		3 / 1	2		1	3	3
Diastylis sp.					1		1	3					4		1	5	2	5	5	8	1		1		3	21		1		1
Oxyurostylis sp.																			1						1	2				
Cyathura polita	1					6			1				1 / 2																	
Edotea sp.	3 / 6						2		3				2	4	3			1										1		

6-13-78 [X upper left]
7-10-78 [X lower right]

Stations 1–5

	1 S	1 C	1 X	2 S	2 C	2 X	3 S	3 C	3 X	4 S	4 C	4 X	5 S	5 C	5 X
Munna reynoldsi	4		5												
Sphaeroma destructor															
Ampelisca abdita	190	7		57	386	496		104 / 1	4	147	41	260	6	4 / 31	799 / 9
Caprella sp.														1	
Cerapus sp.	159 / 149	2 / 18		28 / 32	33 / 47	19 / 24	17	211 / 103	354 / 141	32	2 / 2	33 / 48	4	3 / 375	11
Corophium acherusicum	32 / 54		2				1	1 / 1	2 / 1					5	
Gammarus fasciatus								1							
Bathyporeia sp.															
Haustorius sp.														1	
Platyischnopus sp.															
Leptocheilia savignyi			6	2	3	32 / 206	6	6	309 / 57	237 / 3	3 / 3	38 / 22	1 / 2	3	12
Alpheus sp.														1	
Callinectes sapidus															
Eurypanopeus sp.	17												1		
Balanus sp.	66												32 / 26		
Class Insecta															
Callibaetis floridanus															
Chaoborus punctipennis		1													
Chironomus crassicaudatus	4	6	161	29	309	11	23	9	85	2	154	17	2		
Cryptochironomus fulvus									2					1	
Polypedilum halterale									1	1	5	2			
Procladius sp.								1			2				
Class Osteichthyes															
Gobionellus sp.															
Number of sp/station	16 / 13	9 / 6	7 / 2	7 / 5	11 / 9	12 / 11	10 / 9	8 / 9	10 / 9	8 / 6	9 / 5	11 / 6	17 / 11	14 / 10	11 / 8
Total no. of ind./station	1021 / 679	866 / 38	134 / 162	280 / 68	747 / 369	740 / 260	195 / 74	584 / 207	866 / 303	579 / 220	118 / 222	578 / 116	1500 / 660	46 / 1960	1105 / 101

Stations 6–10

	6 S	6 C	6 X	7 S	7 C	7 X	8 S	8 C	8 X	9 S	9 C	9 X	10 S	10 C	10 X
Munna reynoldsi															
Sphaeroma destructor															7
Ampelisca abdita	130	16 / 8	43	1	5						1		12 / 10	1 / 1	3
Caprella sp.				2								1		1	1
Cerapus sp.	1		3 / 1	3 / 2									3 / 1		1
Corophium acherusicum															
Gammarus fasciatus															
Bathyporeia sp.				3		8		3 / 1			2				3
Haustorius sp.					2 / 7	22	49	6 / 1	1	1	2				
Platyischnopus sp.					4		11	3	4	1	12		1		1
Leptocheilia savignyi															
Alpheus sp.				1								2			
Callinectes sapidus										1				1	1
Eurypanopeus sp.															
Balanus sp.															
Class Insecta															
Callibaetis floridanus					1	1			1						
Chaoborus punctipennis															
Chironomus crassicaudatus															
Cryptochironomus fulvus															
Polypedilum halterale															
Procladius sp.															
Class Osteichthyes															
Gobionellus sp.										1					
Number of sp/station	10 / 4	9 / 7	13 / 6	9 / 12	11 / 11	5 / 5	11 / 7	6 / 6	3 / 5	11 / 7	10 / 8	10 / 12	7 / 11	3 / [illegible]	6 / 7
Total no. of ind./station	367 / 160	136 / 99	1088 / 118	177 / 73	56 / 58	20 / 28	100 / 38	15 / 11	4 / 10	32 / 170	27 / 86	151 / 29	26 / 23	3 / [illegible]	21 / 38

Key: 6-13-78 = X (upper left of cell); 7-10-78 = X (lower right of cell)

APPENDIX C

FISH CAPTURED DURING THE 2500 CFS DISCHARGE STUDY

PAGE 1 PHYLOGENETIC SORT OF 2500CES FISH DATA BY TAXON, STATION, AND DATE. 04/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASS I	NO.IND CLASS I	SIZE CLASS II	NO.IND CLASS II	SIZE CLASS III	NO.IND CLASS III	STATION NUMBER	DATE MO.DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITIAL AND SPECIES NAME
508005050104	1	165 0	1	0 0	0	0 0	0	1T	07/12/8	30.5	02.0		9	D.SABINA
508005050104	1	145 0	1	0 0	0	0 0	0	3T	07/12/8	31.2	00.5		11	D.SABINA
508005050104	1	407 0	1	0 0	0	0 0	0	5T	06/14/8	32.5	15.0		5	D.SABINA
508005050104	1	135 0	1	0 0	0	0 0	0	5T	07/05/8	32.2	00.0		13	D.SABINA
508005050104	1	545 0	1	0 0	0	0 0	0	6T	06/14/8	31.5	24.5		8	D.SABINA
508005050104	1	100 0	1	0 0	0	0 0	0	9S	06/20/8	30.0	35.0		20	D.SABINA
508104010102	1	28 0	1	0 0	0	0 0	0	3S	06/21/8	29.0	00.2		6	E.SAURUS LEP
508104010102	2	25 0	2	0 0	0	0 0	0	3S	07/05/8	33.2	01.5		10	E.SAURUS LEP
508104010202	2	22 23	2	0 0	0	0 0	0	3S	06/28/8	30.8	01.8		10	M.ATLANTICA LEP
508104010202	1	18 0	1	0 0	0	0 0	0	5S	06/28/8	32.0	02.0		9	M.ATLANTICA LEP
508104010202	3	22 0	3	0 0	0	0 0	0	11S	06/28/8	30.5	02.2		11	M.ATLANTICA LEP
508104020102	1	22 0	1	0 0	0	0 0	0	4S	07/13/8	31.5	02.2		8	A.VULPES LEP
508104020102	2	25 26	2	0 0	0	0 0	0	11S	06/28/8	30.5	02.2		11	A.VULPES LEP
508107010000	2	20 21	2	0 0	0	0 0	0	3S	07/05/8	33.2	01.5		10	CLUPEIDAE JUVS.
508107010000	9	19 24	9	0 0	0	0 0	0	9S	06/20/8	30.0	35.0		20	CLUPEIDAE JUVS.
508107010000	1	20 0	1	0 0	0	0 0	0	9S	07/06/8	33.0	16.0		17	CLUPEIDAE JUVS.
508107010000	4	18 0	3	25 0	1	0 0	0	9S	07/12/8	31.0	15.5		19	CLUPEIDAE JUVS.
508107010000	9	15 19	9	0 0	0	0 0	0	10S	06/20/8	31.2	36.0		14	CLUPEIDAE JUVS.
508107010000	4440	19 26	4440	0 0	0	0 0	0	10S	07/06/8	27.0	35.8		8	CLUPEIDAE JUVS.
508107010000	2	10 13	2	0 0	0	0 0	0	10S	07/14/8	31.8	26.0		14	CLUPEIDAE JUVS.
508107010000	15	16 22	15	0 0	0	0 0	0	11S	06/28/8	30.5	02.2		11	CLUPEIDAE JUVS.
508107010000	14	17 20	14	0 0	0	0 0	0	11S	07/05/8	33.8	04.2		10	CLUPEIDAE JUVS.
508107010203	2	34 46	2	0 0	0	0 0	0	3T	06/21/8	29.0	00.2		16	H.SMITHI
508107010203	1	29 0	1	0 0	0	0 0	0	4T	06/21/8	29.5	02.2		14	H.SMITHI
508107010203	3	29 34	2	35 0	1	0 0	0	4T	06/28/8	30.8	02.0		16	H.SMITHI
508107010203	7	28 34	3	51 54	3	73 0	1	4T	07/05/8	32.0	03.2		11	H.SMITHI
508107010203	3	30 0	1	44 47	2	0 0	0	5T	07/05/8	32.2	00.0		13	H.SMITHI
508107010203	1	55 0	1	0 0	0	0 0	0	6S	06/28/8	31.0	04.2		10	H.SMITHI
508107010203	2	29 30	2	0 0	0	0 0	0	11S	06/21/8	29.0	00.2		8	H.SMITHI
508107010203	2	35 37	2	0 0	0	0 0	0	11S	06/28/8	30.5	02.2		11	H.SMITHI
508107010401	2	20 29	2	0 0	0	0 0	0	3S	06/28/8	30.8	01.8		10	D.CEPEDIANUM
508107010401	2	34 37	2	0 0	0	0 0	0	3T	06/21/8	29.0	00.2		16	D.CEPEDIANUM
508107010401	2	35 37	2	0 0	0	0 0	0	11S	06/28/8	30.5	02.2		11	D.CEPEDIANUM
508107010402	3	51 0	1	60 61	2	0 0	0	1T	06/21/8	30.5	08.2		9	D.PENTENENSE
508107010402	13	36 46	13	0 0	0	0 0	0	1T	06/28/8	31.0	03.2		14	D.PENTENENSE
508107010402	1	51 0	1	0 0	0	0 0	0	2S	06/14/8	31.0	08.0		6	D.PENTENENSE
508107010402	67	35 57	67	0 0	0	0 0	0	2T	06/21/8	29.5	11.2		8	D.PENTENENSE
508107010402	1	52 0	1	0 0	0	0 0	0	2T	06/28/8	31.2	05.5		10	D.PENTENENSE
508107010402	27	23 39	27	0 0	0	0 0	0	3S	06/21/8	29.0	00.2		6	D.PENTENENSE
508107010402	25	18 22	6	26 39	19	0 0	0	3S	06/28/8	30.8	01.8		10	D.PENTENENSE
508107010402	2	50 52	2	0 0	0	0 0	0	3T	06/14/8	32.5	12.0		11	D.PENTENENSE
508107010402	132	30 62	132	0 0	0	0 0	0	3T	06/21/8	29.0	00.2		16	D.PENTENENSE
508107010402	3	32 41	3	0 0	0	0 0	0	3T	06/28/8	30.5	02.0		7	D.PENTENENSE
508107010402	19	34 55	19	0 0	0	0 0	0	4T	06/21/8	29.5	02.2		14	D.PENTENENSE
508107010402	27	26 34	21	40 47	4	62 82	2	4T	06/28/8	30.8	02.0		16	D.PENTENENSE
508107010402	87	27 42	50	43 73	36	75 0	1	4T	07/05/8	32.0	03.2		11	D.PENTENENSE
508107010402	1	50 0	1	0 0	0	0 0	0	5T	06/21/8	30.0	08.0		9	D.PENTENENSE
508107010402	30	38 50	30	0 0	0	0 0	0	5T	06/28/8	31.0	05.5		11	D.PENTENENSE
508107010402	27	32 39	16	45 61	11	0 0	0	5T	07/05/8	32.2	00.0		13	D.PENTENENSE
508107010402	2	50 57	2	0 0	0	0 0	0	5T	07/13/8	31.2	05.0		6	D.PENTENENSE
508107010402	2	37 50	2	0 0	0	0 0	0	6T	06/14/8	31.5	24.5		8	D.PENTENENSE
508107010402	1	65 0	1	0 0	0	0 0	0	6T	06/21/8	00.0	00.0		11	D.PENTENENSE
508107010402	2	35 44	2	0 0	0	0 0	0	6T	06/28/8	31.5	04.5		8	D.PENTENENSE
508107010402	2	29 35	2	0 0	0	0 0	0	11S	06/21/8	29.0	00.2		8	D.PENTENENSE

PAGE 2 PHYLOGENETIC SORT OF 2500CFS FISH DATA BY TAXON, STATION, AND DATE. 04/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASS I	NO.IND CLASS I	SIZE CLASS II	NO.IND CLASS II	SIZE CLASS III	NO.IND CLASS III	STATION NUMBER	DATE MO.DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITIAL AND SPECIES NAME
508107010602	75	27 40	75	0 0	0	0 0	0	115	06/28/8	30.5	02.2		11	O.PENTENENSE
508107010602	21	25 32	21	0 0	0	0 0	0	115	07/05/8	33.8	04.2		10	O.PENTENENSE
508107010603	1	54 0	1	0 0	0	0 0	0	65	06/14/8	32.5	25.0		6	H.PENSACOLAE
508107010603	37	26 36	37	0 0	0	0 0	0	95	06/29/8	32.5	14.5		13	H.PENSACOLAE
508107010603	11	24 34	11	0 0	0	0 0	0	95	07/06/8	33.0	16.0		17	H.PENSACOLAE
508107010603	77	27 35	77	0 0	0	0 0	0	105	06/27/8	32.5	14.5		20	H.PENSACOLAE
508107010603	1	32 0	1	0 0	0	0 0	0	115	07/05/8	33.8	04.2		10	H.PENSACOLAE
508107010602	1	56 0	1	0 0	0	0 0	0	7T	06/28/8	30.8	16.2		5	O.OGLINUM
508107010802	2	32 0	2	0 0	0	0 0	0	115	07/05/8	33.8	04.2		10	O.OGLINUM
508107020106	1	37 0	1	0 0	0	0 0	0	25	06/21/8	29.9	11.2		8	A.HEPSETUS
508107020106	1	43 0	1	0 0	0	0 0	0	45	06/21/8	29.5	02.2		6	A.HEPSETUS
508107020106	1	44 0	1	0 0	0	0 0	0	45	06/28/8	30.2	02.2		7	A.HEPSETUS
508107020106	1	37 0	1	0 0	0	0 0	0	4T	06/21/8	29.5	02.2		14	A.HEPSETUS
508107020106	2	38 41	2	0 0	0	0 0	0	55	06/28/8	32.0	02.0		9	A.HEPSETUS
508107020106	1	52 0	1	0 0	0	0 0	0	5T	07/05/8	32.2	00.0		13	A.HEPSETUS
508107020106	6	38 50	6	0 0	0	0 0	0	65	06/14/8	32.5	25.0		6	A.HEPSETUS
508107020106	1	28 0	1	0 0	0	0 0	0	65	06/28/8	31.0	04.2		10	A.HEPSETUS
508107020106	4	32 51	4	0 0	0	0 0	0	75	06/15/8	30.0	33.2		11	A.HEPSETUS
508107020106	1	36 0	1	0 0	0	0 0	0	75	07/14/8	30.5	22.2		18	A.HEPSETUS
508107020106	2	55 65	2	0 0	0	0 0	0	7T	06/28/8	30.8	16.2		5	A.HEPSETUS
508107020106	19	28 35	19	0 0	0	0 0	0	95	06/20/8	30.0	35.0		20	A.HEPSETUS
508107020106	104	31 53	104	0 0	0	0 0	0	95	07/06/8	33.0	16.0		17	A.HEPSETUS
508107020106	3	31 36	2	53 0	1	0 0	0	105	06/27/8	32.5	14.5		20	A.HEPSETUS
508107020108	2	60 0	2	0 0	0	0 0	0	2T	07/05/8	32.0	02.2		8	A.LYOLEPIS
508107020109	1	51 0	1	0 0	0	0 0	0	5T	06/14/8	32.5	15.0		5	A.LYOLEPIS
508107020108	1	50 0	1	0 0	0	0 0	0	5T	06/28/8	31.0	05.5		11	A.LYOLEPIS
508107020108	2	35 43	2	0 0	0	0 0	0	65	06/28/8	31.0	04.2		10	A.LYOLEPIS
508107020108	2	41 52	2	0 0	0	0 0	0	6T	06/21/8	00.0	00.0		11	A.LYOLEPIS
508107020108	4	45 48	4	0 0	0	0 0	0	75	06/15/8	30.0	33.2		11	A.LYOLEPIS
508107020108	1	46 0	1	0 0	0	0 0	0	75	06/29/8	32.5	12.0		15	A.LYOLEPIS
508107020108	17	30 41	17	0 0	0	0 0	0	95	06/20/8	30.0	35.0		20	A.LYOLEPIS
508107020108	128	34 46	128	0 0	0	0 0	0	95	07/06/8	33.0	16.0		17	A.LYOLEPIS
508107020108	4	45 52	4	0 0	0	0 0	0	105	06/27/8	30.0	14.2		20	A.LYOLEPIS
508107020109	1	35 0	1	0 0	0	0 0	0	15	06/21/8	29.8	10.0		9	A.MITCHILLI
508107020109	1	25 0	1	0 0	0	0 0	0	15	07/11/8	31.5	03.5		3	A.MITCHILLI
508107020109	18	19 35	18	0 0	0	0 0	0	1T	06/14/8	31.2	06.0		8	A.MITCHILLI
508107020109	2	20 27	2	0 0	0	0 0	0	1T	06/21/8	30.5	04.2		9	A.MITCHILLI
508107020109	5	30 37	5	0 0	0	0 0	0	1T	06/28/8	31.0	03.2		14	A.MITCHILLI
508107020109	16	21 42	16	0 0	0	0 0	0	1T	07/05/8	31.2	04.5		10	A.MITCHILLI
508107020109	185	32 42	185	0 0	0	0 0	0	25	06/28/8	34.0	02.5		7	A.MITCHILLI
508107020109	12	25 53	12	0 0	0	0 0	0	2T	06/21/8	29.5	11.2		8	A.MITCHILLI
508107020109	1	30 0	1	0 0	0	0 0	0	2T	06/28/8	31.2	05.5		10	A.MITCHILLI
508107020109	43	22 42	43	0 0	0	0 0	0	2T	07/05/8	32.0	02.2		8	A.MITCHILLI
508107020109	17	22 43	17	0 0	0	0 0	0	2T	07/12/8	31.5	02.0		4	A.MITCHILLI
508107020109	1707	17 38	1707	0 0	0	0 0	0	35	06/21/8	29.0	00.2		6	A.MITCHILLI
508107020109	958	21 41	958	0 0	0	0 0	0	35	06/28/8	30.8	01.8		10	A.MITCHILLI
508107020109	78	23 42	78	0 0	0	0 0	0	35	07/05/8	33.2	01.5		10	A.MITCHILLI
508107020109	46	17 50	46	0 0	0	0 0	0	3T	06/14/8	32.5	12.0		11	A.MITCHILLI
508107020109	21	20 25	11	34 40	6	46 58	4	3T	06/21/8	29.0	00.2		16	A.MITCHILLI
508107020109	6	23 42	6	0 0	0	0 0	0	3T	06/28/8	30.5	02.0		7	A.MITCHILLI
508107020109	6	25 39	6	0 0	0	0 0	0	3T	07/05/8	33.8	01.5		5	A.MITCHILLI
508107020109	108	30 43	108	0 0	0	0 0	0	3T	07/12/8	31.2	00.5		11	A.MITCHILLI
508107020109	1	20 0	1	0 0	0	0 0	0	45	06/21/8	29.5	02.2		6	A.MITCHILLI
508107020109	41	14 18	28	29 40	13	0 0	0	45	06/28/8	30.2	02.2		7	A.MITCHILLI

PAGE 3 PHYLOGENETIC SORT OF 2500CFS FISH DATA BY TAXON, STATION, AND DATE. 04/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASSI	NO.IND CLASSI	SIZE CLASSII	NO.IND CLASSII	SIZE CLASSIII	NO.IND CLASSIII	STATION NUMBER	DATE MO.DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITIAL AND SPECIES NAME
508107020109	1	35 0	1	0 0	0	0 0	0	4S	07/05/8	32.0	03.0		9	A.MITCHILLI
508107020109	1	37 0	1	0 0	0	0 0	0	4S	07/13/8	31.5	02.2		8	A.MITCHILLI
508107020109	20	25 35	20	0 0	0	0 0	0	4T	06/14/8	32.0	14.0		8	A.MITCHILLI
508107020109	64	22 44	64	0 0	0	0 0	0	4T	06/21/8	29.5	02.2		14	A.MITCHILLI
508107020109	70	21 61	70	0 0	0	0 0	0	4T	06/28/8	30.8	02.0		16	A.MITCHILLI
508107020109	315	22 53	315	0 0	0	0 0	0	4T	07/05/8	32.0	03.2		11	A.MITCHILLI
508107020109	197	21 47	197	0 0	0	0 0	0	4T	07/12/8	31.2	00.5		9	A.MITCHILLI
508107020109	34	30 40	34	0 0	0	0 0	0	5S	06/28/8	32.0	02.0		9	A.MITCHILLI
508107020109	29	32 39	29	0 0	0	0 0	0	5S	07/05/8	32.8	02.8		12	A.MITCHILLI
508107020109	5	31 37	5	0 0	0	0 0	0	5T	06/14/8	32.5	15.0		5	A.MITCHILLI
508107020109	141	24 53	141	0 0	0	0 0	0	5T	06/21/8	30.0	08.0		9	A.MITCHILLI
508107020109	68	25 51	68	0 0	0	0 0	0	5T	06/28/8	31.0	05.5		11	A.MITCHILLI
508107020109	1184	22 70	1184	0 0	0	0 0	0	5T	07/05/8	32.2	00.0		13	A.MITCHILLI
508107020109	672	21 52	672	0 0	0	0 0	0	5T	07/13/8	31.2	05.0		6	A.MITCHILLI
508107020109	28	39 54	28	0 0	0	0 0	0	6S	06/14/8	32.5	25.0		6	A.MITCHILLI
508107020109	286	27 47	286	0 0	0	0 0	0	6S	06/29/8	31.0	04.2		10	A.MITCHILLI
508107020109	4	31 34	4	0 0	0	0 0	0	6S	07/05/8	32.5	04.2		9	A.MITCHILLI
508107020109	23	30 55	23	0 0	0	0 0	0	6T	06/14/8	31.5	24.5		8	A.MITCHILLI
508107020109	98	28 47	98	0 0	0	0 0	0	6T	06/21/8	00.0	00.0		11	A.MITCHILLI
508107020109	146	26 59	146	0 0	0	0 0	0	6T	06/28/8	31.5	04.5		8	A.MITCHILLI
508107020109	7	39 47	7	0 0	0	0 0	0	6T	07/05/8	31.0	05.5		7	A.MITCHILLI
508107020109	4588	26 50	4588	0 0	0	0 0	0	7S	06/15/8	30.0	32.2		11	A.MITCHILLI
508107020109	11	30 42	11	0 0	0	0 0	0	7S	07/06/8	32.0	11.0		11	A.MITCHILLI
508107020109	1	35 0	1	0 0	0	0 0	0	7S	07/14/8	30.5	22.2		18	A.MITCHILLI
508107020109	2	40 45	2	0 0	0	0 0	0	7T	06/21/8	29.6	12.2		6	A.MITCHILLI
508107020109	2	44 48	2	0 0	0	0 0	0	7T	07/05/8	30.2	08.0		4	A.MITCHILLI
508107020109	1	32 0	1	0 0	0	0 0	0	7T	07/13/9	30.8	16.2		4	A.MITCHILLI
508107020109	1	32 0	1	0 0	0	0 0	0	8S	06/15/8	32.5	33.8		10	A.MITCHILLI
508107020109	7	33 42	7	0 0	0	0 0	0	9S	06/20/8	30.0	35.0		20	A.MITCHILLI
508107020109	39	32 46	39	0 0	0	0 0	0	9S	06/29/8	32.5	14.5		13	A.MITCHILLI
508107020109	344	26 46	344	0 0	0	0 0	0	9S	07/06/8	33.0	16.0		17	A.MITCHILLI
508107020109	12	19 36	12	0 0	0	0 0	0	9S	07/12/8	31.0	15.5		18	A.MITCHILLI
508107020109	14	14 23	14	0 0	0	0 0	0	10S	06/20/8	31.2	36.0		14	ANCHOA JUVS.
508107020109	64	30 52	64	0 0	0	0 0	0	10S	06/27/8	32.5	14.5		20	A.MITCHILLI
508107020109	4480	21 31	4480	0 0	0	0 0	0	10S	07/06/8	27.0	35.8		8	ANCHOA SP.
508107020109	1	33 0	1	0 0	0	0 0	0	11S	06/15/8	32.5	08.0		6	A.MITCHILLI
508107020109	8520	20 53	8520	0 0	0	0 0	0	11S	06/21/8	29.0	00.2		9	A.MITCHILLI
508107020109	219	18 44	218	0 0	0	0 0	0	11S	06/28/8	30.5	02.2		11	A.MITCHILLI
508107020109	121	21 36	121	0 0	0	0 0	0	11S	07/05/8	33.8	04.2		10	A.MITCHILLI
508110020201	1	34 0	1	0 0	0	0 0	0	5T	06/28/8	31.0	05.5		11	S.FOETENS
508110020201	1	130 0	1	0 0	0	0 0	0	6T	06/14/8	31.5	24.5		8	S.FOETENS
508110020201	2	39 39	2	0 0	0	0 0	0	7S	06/29/8	32.5	12.0		15	S.FOETENS
508110020201	1	70 0	1	0 0	0	0 0	0	8S	06/29/8	34.5	25.5		15	S.FOETENS
508110020201	1	38 0	1	0 0	0	0 0	0	10S	06/27/8	30.0	16.2		20	S.FOETENS
508110020201	1	36 0	1	0 0	0	0 0	0	10S	07/06/8	27.0	35.8		8	S.FOETENS
508112010102	1	49 0	1	0 0	0	0 0	0	1T	07/12/8	30.5	02.0		9	I.CATUS
508112010102	2	29 40	2	0 0	0	0 0	0	3S	06/28/8	30.8	01.8		10	I.CATUS
508112010102	16	32 37	4	42 44	8	54 57	4	3T	06/21/8	29.0	00.2		16	I.CATUS
508112010102	9	24 38	6	53 60	3	0 0	0	3T	06/28/8	30.5	02.0		7	I.CATUS
508112010102	3	34 0	2	58 0	1	0 0	0	3T	07/12/8	31.2	00.5		11	I.CATUS
508112010102	1	45 0	1	0 0	0	0 0	0	4T	06/28/8	30.8	02.0		16	I.CATUS
508112010102	1	185 0	1	0 0	0	0 0	0	6T	07/13/8	31.0	04.0		4	I.CATUS
508112030101	9	178180	5	190 0	2	200205	2	1T	06/14/8	31.2	06.0		8	A.FELIS
508112030101	36	28 41	31	230240	4	290 0	1	1T	06/21/8	30.5	08.2		9	A.FELIS+FMB JUVS

PAGE 1 PHYLOGENETIC SORT OF 2500CES FISH DATA BY TAXON, STATION, AND DATE. 04/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASS I	NO.IND CLASS I	SIZE CLASS II	NO.IND CLASS II	SIZE CLASS III	NO.IND CLASS III	STATION NUMBER	DATE MO/DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITIAL AND SPECIES NAME
508112030101	9	170190	5	230240	3	290 0	1	1T	06/29/8	31.0	03.2		14	A.FELIS + EGGS
508112030101	14	12 16	12	200280	2	0 0	0	1T	07/05/8	31.2	04.5		10	A.FELIS + EGGS
508112030101	3	245 0	1	260 0	2	0 0	0	2T	06/21/8	29.5	11.2		8	A.FELIS
508112030101	2	240250	2	0 0	0	0 0	0	2T	06/28/8	31.2	05.5		10	A.FELIS
508112030101	3	180190	2	250 0	1	0 0	0	3T	06/14/8	32.5	12.0		11	A.FELIS
508112030101	1	180 0	1	0 0	0	0 0	0	3T	06/21/8	29.0	00.2		14	A.FELIS
508112030101	2	170180	2	0 0	0	0 0	0	4T	06/14/8	32.0	14.0		8	A.FELIS
508112030101	1	260 0	1	0 0	0	0 0	0	4T	06/21/8	29.5	02.2		14	A.FELIS
508112030101	4	140 0	1	180190	2	200 0	1	4T	06/28/8	30.8	02.0		16	A.FELIS
508112030101	1	59 0	1	0 0	0	0 0	0	5S	07/05/8	32.8	02.8		12	A.FELIS
508112030101	5	145160	2	170 0	1	173175	2	5T	06/14/8	32.5	15.0		5	A.FELIS
508112030101	3	120 0	2	235 0	1	0 0	0	5T	06/21/8	30.0	08.0		9	A.FELIS
508112030101	5	58 0	1	190200	2	220230	2	5T	07/05/8	32.2	00.0		13	A.FELIS
508112030101	4	36 0	1	210220	2	250 0	1	5T	07/13/8	31.2	05.0		6	A.FELIS
508112030101	1	190 0	1	0 0	0	0 0	0	6T	06/28/8	31.5	04.5		8	A.FELIS
508112030101	17	3 10	16	250 0	1	0 0	0	6T	07/05/8	31.0	05.5		7	A.FELIS + EGGS
508112030101	150	14 39	143	145 0	1	240270	6	6T	07/13/8	31.0	04.0		4	A.FELIS + EGGS
508112030101	3	165175	2	260 0	1	0 0	0	7T	06/14/8	30.2	31.8		3	A.FELIS
508112030101	3	170 0	1	180185	2	0 0	0	7T	07/05/8	30.2	08.0		4	A.FELIS
508112030201	1	195 0	1	0 0	0	0 0	0	3T	06/14/8	32.5	12.0		11	B.MARINUS
508112030201	3	72 79	3	0 0	0	0 0	0	3T	06/21/8	29.0	00.2		16	B.MARINUS
508112030201	1	95 0	1	0 0	0	0 0	0	3T	07/12/8	31.2	00.5		11	B.MARINUS
508112030201	1	82 0	1	0 0	0	0 0	0	4T	06/28/8	30.8	02.0		16	B.MARINUS
508112030201	4	72 82	3	220 0	1	0 0	0	5T	06/28/8	31.0	05.5		11	B.MARINUS
508112030201	3	170 0	2	0 0	0	230 0	1	5T	07/13/8	31.2	05.0		6	B.MARINUS
508112030201	1	155 0	1	0 0	0	0 0	0	6T	06/14/8	31.5	24.5		8	B.MARINUS
508112030201	1	195 0	1	0 0	0	0 0	0	6T	06/21/8	00.0	00.0		11	B.MARINUS
508112030201	9	140150	7	170180	2	0 0	0	6T	06/28/8	31.5	04.5		8	B.MARINUS
508116020201	3	16 18	3	0 0	0	0 0	0	7S	06/15/8	30.0	32.2		11	H.HISTRIO
508118020300	1	53 0	1	0 0	0	0 0	0	9S	06/29/8	32.5	14.5		13	STRONGYLURA SP.
508118020302	1	68 0	1	0 0	0	0 0	0	1S	07/05/8	32.0	05.2		6	S.MARINA
508118020302	1	47 0	1	0 0	0	0 0	0	3S	07/05/8	33.2	01.5		10	S.MARINA
508118020302	1	67 0	1	0 0	0	0 0	0	4S	07/05/8	32.0	03.0		9	S.MARINA
508118020302	1	110 0	1	0 0	0	0 0	0	4S	07/13/8	31.5	02.2		8	S.MARINA
508118020302	2	90 92	2	0 0	0	0 0	0	6S	06/14/8	32.5	25.0		6	S.MARINA
508118020302	1	90 0	1	0 0	0	0 0	0	6S	07/13/8	32.8	07.8		5	S.MARINA
508118020302	1	75 0	1	0 0	0	0 0	0	8S	06/29/8	34.5	25.5		15	S.MARINA
508118020302	1	85 0	1	0 0	0	0 0	0	8S	07/06/8	32.5	25.0		11	S.MARINA
508118020302	3	35 37	2	75 0	1	0 0	0	9S	07/12/8	31.0	15.5		18	S.MARINA
508118020302	1	103 0	1	0 0	0	0 0	0	10S	06/15/8	31.2	32.8		3	S.MARINA
508118020302	2	43 0	1	93 0	1	0 0	0	10S	07/14/8	31.8	26.0		14	S.MARINA
508118020302	1	40 0	1	0 0	0	0 0	0	11S	07/05/8	33.8	04.2		10	S.MARINA
508118040607	4	40 42	2	49 50	2	0 0	0	9S	07/12/8	31.0	15.5		18	F.GRANDIS
508118040607	1	29 0	1	0 0	0	0 0	0	10S	06/27/8	32.5	14.5		20	F.GRANDIS
508118040902	1	18 0	1	0 0	0	0 0	0	8S	06/15/8	32.5	33.8		10	L.PARVA
508118040902	1	10 0	1	0 0	0	0 0	0	10S	06/20/8	31.2	36.0		14	L.PARVA
508118050201	2	13 0	2	0 0	0	0 0	0	3S	07/13/8	32.8	02.5		8	G.AFFINIS
508118050201	1	26 0	1	0 0	0	0 0	0	11S	07/05/8	33.8	04.2		10	G.AFFINIS
508118060802	432	21 57	432	0 0	0	0 0	0	1S	06/14/8	31.2	07.8		7	M.BERYLLINA
508118060802	69	24 48	69	0 0	0	0 0	0	1S	06/21/8	29.8	10.0		9	M.BERYLLINA
508118060802	287	20 47	287	0 0	0	0 0	0	1S	06/28/8	33.5	02.2		4	M.BERYLLINA
508118060802	140	21 46	140	0 0	0	0 0	0	1S	07/05/8	32.0	05.2		6	M.BERYLLINA
508118060802	160	15 44	160	0 0	0	0 0	0	1S	07/13/8	31.5	03.5		3	M.BERYLLINA
508118060802	171	21 48	171	0 0	0	0 0	0	2S	06/14/8	31.0	08.0		6	M.BERYLLINA

PAGE 5 PHYLOGENETIC SORT OF 2500CES FISH DATA BY TAXON, STATION, AND DATE. 04/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASSI	NO.IND CLASSI	SIZE CLASSII	NO.IND CLASSII	SIZE CLASSIII	NO.IND CLASSIII	STATION NUMBER	DATE MO.DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITIAL AND SPECIES NAME
508118060802	24	27 39	24	0 0	0	0 0	0	25	06/21/78	29.9	11.2		8	M.BERYLLINA
508118060802	15	12 0	1	21 38	14	0 0	0	25	06/28/78	34.0	02.5		7	M.BERYLLINA
508118060802	2	28 39	2	0 0	0	0 0	0	25	07/05/78	32.0	05.5		3	M.BERYLLINA
508118060802	76	9 0	1	14 40	75	0 0	0	25	07/13/78	32.5	02.2		5	M.BERYLLINA
508118060802	49	25 45	49	0 0	0	0 0	0	35	06/14/78	32.0	10.5		5	M.BERYLLINA
508118060802	5	23 0	1	31 42	4	0 0	0	35	06/21/78	29.0	00.2		6	M.BERYLLINA
508118060802	197	11 35	197	0 0	0	0 0	0	35	06/28/78	30.8	01.8		10	M.BERYLLINA
508118060802	138	12 52	138	0 0	0	0 0	0	35	07/05/78	33.2	01.5		10	M.BERYLLINA
508118060802	97	14 39	97	0 0	0	0 0	0	35	07/13/78	32.8	02.5		8	M.BERYLLINA
508118060802	221	14 50	221	0 0	0	0 0	0	45	06/28/78	30.2	02.2		7	M.BERYLLINA
508118060802	78	12 37	78	0 0	0	0 0	0	45	07/05/78	32.0	03.0		9	M.BERYLLINA
508118060802	49	20 43	49	0 0	0	0 0	0	45	07/13/78	31.5	02.2		8	M.BERYLLINA
508118060802	10	34 41	10	0 0	0	0 0	0	55	06/14/78	32.5	15.0		10	M.BERYLLINA
508118060802	1	35 0	1	0 0	0	0 0	0	55	06/21/78	30.2	11.0		10	M.BERYLLINA
508118060802	72	14 29	72	0 0	0	0 0	0	55	06/28/78	32.0	02.0		9	M.BERYLLINA
508118060802	33	25 39	33	0 0	0	0 0	0	55	07/05/78	32.8	02.8		12	M.BERYLLINA
508118060802	5	21 40	5	0 0	0	0 0	0	55	07/13/78	33.5	03.8		6	M.BERYLLINA
508118060802	29	21 28	29	0 0	0	0 0	0	65	06/28/78	31.0	04.2		10	M.BERYLLINA
508118060802	12	20 27	12	0 0	0	0 0	0	65	07/05/78	32.5	04.2		9	M.BERYLLINA
508118060802	2	25 27	2	0 0	0	0 0	0	75	06/29/78	32.5	12.0		15	M.BERYLLINA
508118060802	1	33 0	1	0 0	0	0 0	0	85	06/20/78	32.2	36.0		9	M.BERYLLINA
508118060802	295	24 44	295	0 0	0	0 0	0	85	06/29/78	34.5	25.5		15	M.BERYLLINA
508118060802	51	34 46	51	0 0	0	0 0	0	85	07/06/78	32.5	25.0		11	M.BERYLLINA
508118060802	85	20 50	85	0 0	0	0 0	0	85	07/14/78	31.8	28.2		14	M.BERYLLINA
508118060802	652	18 37	652	0 0	0	0 0	0	115	06/15/78	32.5	08.0		6	M.BERYLLINA
508118060802	13	24 40	13	0 0	0	0 0	0	115	06/21/78	29.0	00.2		8	M.BERYLLINA
508118060802	252	11 43	252	0 0	0	0 0	0	115	06/28/78	30.5	02.2		11	M.BERYLLINA
508118060802	650	12 41	650	0 0	0	0 0	0	115	07/05/78	33.8	04.2		10	M.BERYLLINA
508118060802	416	15 43	416	0 0	0	0 0	0	115	07/13/78	32.8	02.2		6	M.BERYLLINA
508122050600	1	55 0	1	0 0	0	0 0	0	55	07/13/78	33.5	03.8		6	SYNGNATHUS SP.
508122050610	1	75 0	1	0 0	0	0 0	0	55	06/21/78	30.2	11.0		10	S.LOUISIANAE
508122050610	1	69 0	1	0 0	0	0 0	0	75	06/15/78	30.0	33.2		11	S.LOUISIANAE
508122050610	2	112160	2	0 0	0	0 0	0	75	07/14/78	30.5	22.2		18	S.LOUISIANAE
508122050610	4	80 0	1	106 0	1	112116	2	85	06/29/78	34.5	25.5		15	S.LOUISIANAE
508122050610	3	93 0	1	96 97	2	0 0	0	85	07/06/78	32.5	25.0		11	S.LOUISIANAE
508122050610	23	57 70	14	75 79	7	111117	2	85	07/14/78	31.8	28.2		14	S.LOUISIANAE
508122050610	2	77 0	1	99 0	1	0 0	0	95	06/16/78	30.8	33.0		18	S.LOUISIANAE
508122050610	3	78 0	1	86 88	2	0 0	0	95	06/20/78	30.0	35.0		20	S.LOUISIANAE
508122050610	1	79 0	1	0 0	0	0 0	0	95	06/29/78	32.5	14.5		13	S.LOUISIANAE
508122050610	1	104 0	1	121 0	1	0 0	0	95	07/06/78	33.0	16.0		17	S.LOUISIANAE
508122050610	6	97 98	2	107122	2	149184	2	95	07/12/78	31.0	15.5		18	S.LOUISIANAE
508122050610	6	82111	6	0 0	0	0 0	0	105	06/27/78	30.0	16.2		12	S.LOUISIANAE
508122050610	8	70 80	4	86 90	2	119124	2	105	07/14/78	31.8	26.0		14	S.LOUISIANAE
508122050612	1	50 0	1	0 0	0	0 0	0	25	06/14/78	31.0	08.0		6	S.SCOVELLI
508122050612	1	56 0	1	0 0	0	0 0	0	25	06/21/78	29.9	11.2		8	S.SCOVELLI
508122050612	1	52 0	1	0 0	0	0 0	0	25	06/28/78	34.0	02.5		7	S.SCOVELLI
508122050612	1	47 0	1	0 0	0	0 0	0	55	06/14/78	32.5	15.0		10	S.SCOVELLI
508122050612	3	48 0	1	53 0	1	64 0	1	55	06/21/78	30.2	11.0		10	S.SCOVELLI
508122050612	5	46 60	5	0 0	0	0 0	0	55	07/05/78	32.8	02.8		12	S.SCOVELLI
508122050612	4	50 52	2	60 61	2	0 0	0	55	07/13/78	33.5	03.8		6	S.SCOVELLI
508122050612	1	49 0	1	0 0	0	0 0	0	65	07/05/78	32.5	04.2		9	S.SCOVELLI
508122050612	4	30 43	2	48 51	2	0 0	0	75	07/06/78	32.0	11.0		11	S.SCOVELLI
508122050612	5	34 43	3	54 0	1	64 0	1	75	07/14/78	30.5	22.2		18	S.SCOVELLI
508122050612	4	35 39	2	67 71	2	0 0	0	85	06/15/78	32.5	33.8		10	S.SCOVELLI

PAGE 6 PHYLOGENETIC SORT OF 2500CES FISH DATA BY TAXON, STATION, AND DATE. 06/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASSI	NO.IND CLASSI	SIZE CLASSII	NO.IND CLASSII	SIZE CLASSIII	NO.IND CLASSIII	STATION NUMBER	DATE MO,DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITAL AND SPECIES NAME
508122050612	1	45 0	1	0 0	0	0 0	0	8S	06/20/8	32.2	36.0		9	S.SCOVELLI
508122050612	4	41 50	2	64 0	3	74 84	3	8S	06/29/8	34.5	25.5		15	S.SCOVELLI
508122050612	19	45 62	10	67 77	7	85 97	2	8S	07/06/8	32.5	25.0		11	S.SCOVELLI
508122050612	11	37 47	4	58 70	6	75 83	1	8S	07/14/8	31.8	28.2		14	S.SCOVELLI
508122050612	4	58 60	2	70 72	2	0 0	0	9S	06/16/8	30.8	33.0		18	S.SCOVELLI
508122050612	2	51 78	2	0 0	0	0 0	0	9S	06/20/8	30.0	35.0		20	S.SCOVELLI
508122050612	3	51 0	1	59 61	2	0 0	0	9S	07/06/8	33.0	16.0		17	S.SCOVELLI
508122050612	5	42 0	1	58 0	1	65 71	3	9S	07/12/8	31.0	15.5		18	S.SCOVELLI
508122050612	4	66 0	2	69 0	1	75 0	1	10S	06/20/8	31.2	36.0		14	S.SCOVELLI
508122050612	10	43 57	6	60 50	4	0 0	0	10S	06/27/8	30.0	16.2		20	S.SCOVELLI
508122050612	11	34 42	3	51 67	8	0 0	0	10S	07/06/8	27.0	35.8		8	S.SCOVELLI
508122050612	10	36 48	2	58 65	3	72 80	5	10S	07/14/8	31.8	26.0		14	S.SCOVELLI
508123010103	5	270290	2	300 0	2	350 0	1	1T	06/28/8	31.0	03.2		14	C.PECTINATUS
508123010103	2	280285	2	0 0	0	0 0	0	1T	07/05/8	31.2	04.5		10	C.PECTINATUS
508123010103	3	300310	3	0 0	0	0 0	0	1T	07/12/8	30.5	02.0		9	C.PECTINATUS
508123010104	5	245260	2	340390	2	450 0	1	1T	06/21/8	30.5	08.2		9	C.UNDECIMALIS
508123010104	2	240 0	1	360 0	1	0 0	0	1T	06/28/8	31.0	03.2		14	C.UNDECIMALIS
508123010104	3	360 0	1	590 0	1	660 0	1	1T	07/05/8	31.2	04.5		10	C.UNDECIMALIS
508123010104	2	99114	2	0 0	0	0 0	0	3S	06/28/8	30.8	01.8		10	C.UNDECIMALIS
508123010104	1	117 0	1	0 0	0	0 0	0	3S	07/13/8	32.8	02.5		8	C.UNDECIMALIS
508123010104	3	210 0	1	260 0	1	500 0	1	3T	06/21/8	29.0	00.2		16	C.UNDECIMALIS
508123010104	1	260 0	1	0 0	0	0 0	0	3T	07/12/8	31.2	00.5		11	C.UNDECIMALIS
508123010104	1	290 0	1	0 0	0	0 0	0	4T	07/05/8	32.0	03.2		11	C.UNDECIMALIS
508123010104	1	270 0	1	0 0	0	0 0	0	4T	07/12/8	31.2	00.5		9	C.UNDECIMALIS
508123010104	1	340 0	1	0 0	0	0 0	0	6S	06/28/8	31.0	04.2		10	C.UNDECIMALIS
508123010104	2	110115	2	0 0	0	0 0	0	11S	06/21/8	29.0	00.2		8	C.UNDECIMALIS
508123010104	1	145 0	1	0 0	0	0 0	0	11S	06/28/8	30.5	02.2		11	C.UNDECIMALIS
508123010104	1	130 0	1	0 0	0	0 0	0	11S	07/05/8	33.8	04.2		10	C.UNDECIMALIS
508123010104	2	135149	2	0 0	0	0 0	0	11S	07/13/8	32.8	02.2		6	C.UNDECIMALIS
508123030000	1	24 0	1	0 0	0	0 0	0	9S	07/06/8	33.0	16.0		17	UNKNOWN SERRANI
508123050902	5	40 0	2	45 52	3	0 0	0	3T	06/21/8	29.0	00.2		16	P.NIGROMACULATU
508123050902	1	41 0	1	0 0	0	0 0	0	4T	06/28/8	30.8	02.0		16	P.NIGROMACULATU
508123050902	1	41 0	1	0 0	0	0 0	0	4T	07/12/8	31.2	00.5		9	P.NIGROMACULATU
508123130204	1	25 0	1	0 0	0	0 0	0	1S	06/21/8	29.8	10.0		9	C.HIPPOS
508123130204	1	32 0	1	0 0	0	0 0	0	2S	06/28/8	34.0	02.5		7	C.HIPPOS
508123130204	2	20 22	2	0 0	0	0 0	0	2T	06/21/8	29.5	11.2		8	C.HIPPOS
508123130204	2	34 38	2	0 0	0	0 0	0	2T	06/28/8	31.2	05.5		10	C.HIPPOS
508123130204	1	47 0	1	0 0	0	0 0	0	2T	07/05/8	32.0	07.2		8	C.HIPPOS
508123130204	2	32 64	2	0 0	0	0 0	0	4S	06/28/8	30.2	02.2		7	C.HIPPOS
508123130204	1	48 0	1	0 0	0	0 0	0	4S	07/05/8	32.0	03.0		9	C.HIPPOS
508123130204	1	36 0	1	0 0	0	0 0	0	5S	06/28/8	32.0	02.0		9	C.HIPPOS
508123130204	1	21 0	1	0 0	0	0 0	0	5T	06/21/8	30.0	08.0		9	C.HIPPOS
508123130204	1	37 0	1	0 0	0	0 0	0	5T	07/05/8	32.2	00.0		13	C.HIPPOS
508123130204	1	58 0	1	0 0	0	0 0	0	6S	06/21/8	29.5	13.2		4	C.HIPPOS
508123130204	4	23 26	4	0 0	0	0 0	0	10S	06/20/8	31.2	36.0		14	C.HIPPOS
508123130204	1	78 0	1	0 0	0	0 0	0	11S	07/05/8	33.8	04.2		10	C.HIPPOS
508123130204	1	52 0	1	0 0	0	0 0	0	11S	07/13/8	32.8	02.2		6	C.HIPPOS
508123130205	1	23 0	1	0 0	0	0 0	0	7T	06/21/8	29.6	12.2		6	C.LATUS
508123130205	1	24 0	1	0 0	0	0 0	0	10S	06/27/8	30.0	16.2		20	C.LATUS
508123130301	2	52 55	2	0 0	0	0 0	0	6T	06/21/8	00.0	00.0		11	C.CHRYSURUS
508123130301	2	18 48	2	0 0	0	0 0	0	6T	06/29/8	31.5	04.5		8	C.CHRYSURUS
508123130901	2	29 46	2	0 0	0	0 0	0	1S	06/14/8	31.2	07.8		7	O.SAURUS
508123130901	6	43 46	2	51 53	2	59 60	2	1S	06/21/8	29.8	10.0		9	O.SAURUS
508123130901	5	20 29	3	48 0	1	68 0	1	2S	06/21/8	29.9	11.2		8	O.SAURUS

PAGE 7 PHYLOGENETIC SORT OF 2500CES FISH DATA BY TAXON, STATION, AND DATE. 04/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASSI	NO.IND CLASSI	SIZE CLASSII	NO.IND CLASSII	SIZE CLASSIII	NO.IND CLASSIII	STATION NUMBER	DATE MO.DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITIAL AND SPECIES NAME
508123130901	1	95 0	1	0 0	0	0 0	0	2S	07/13/8	32.5	02.2		5	O.SAURUS
508123130901	1	19 0	1	0 0	0	0 0	0	4S	06/14/8	32.5	13.0		2	O.SAURUS
508123130901	3	61 0	1	70 0	1	85 0	1	4S	06/21/8	29.5	02.2		6	O.SAURUS
508123130901	3	41 0	1	61 63	2	0 0	0	4S	07/05/8	32.0	03.0		9	O.SAURUS
508123130901	2	54 0	1	71 0	1	0 0	0	5S	06/21/8	30.2	11.0		10	O.SAURUS
508123130901	1	22 0	1	0 0	0	0 0	0	5S	06/28/8	32.0	02.0		9	O.SAURUS
508123130901	1	12 0	1	0 0	0	0 0	0	6S	06/28/8	31.0	04.2		10	O.SAURUS
508123130901	1	27 0	1	0 0	0	0 0	0	6S	07/13/8	32.8	07.8		5	O.SAURUS
508123130901	1	29 0	1	0 0	0	0 0	0	9S	06/16/8	30.8	33.0		18	O.SAURUS
508123130901	3	22 0	1	29 30	2	0 0	0	9S	06/20/8	30.0	35.0		20	O.SAURUS
508123130901	2	70 0	2	0 0	0	0 0	0	11S	07/13/8	32.8	02.2		6	O.SAURUS
508123131101	1	175 0	1	0 0	0	0 0	0	7T	07/13/8	30.8	16.2		4	S.VOMER
508123131302	1	15 0	1	0 0	0	0 0	0	1S	06/14/8	31.2	07.8		7	T.FALCATUS
508123131302	1	32 0	1	0 0	0	0 0	0	1S	06/21/8	29.8	10.0		9	T.FALCATUS
508123131302	1	21 0	1	0 0	0	0 0	0	5S	06/14/8	32.5	15.0		10	T.FALCATUS
508123131302	1	25 0	1	0 0	0	0 0	0	5S	07/05/8	32.8	02.8		12	T.FALCATUS
508123131302	1	35 0	1	0 0	0	0 0	0	5S	07/13/8	33.5	03.8		6	T.FALCATUS
508123131302	14	23 0	1	30 37	13	0 0	0	6S	06/14/8	32.5	25.0		6	T.FALCATUS
508123131302	2	53 0	1	60 0	1	0 0	0	6S	06/21/8	29.5	13.2		4	T.FALCATUS
508123131302	10	30 32	6	35 38	2	41 44	2	6S	07/05/8	32.5	04.2		9	T.FALCATUS
508123131302	2	32 45	2	0 0	0	0 0	0	6S	07/13/8	32.8	07.8		5	T.FALCATUS
508123131302	3	40 0	1	49 0	1	52 0	1	7S	06/20/8	30.5	34.0		11	T.FALCATUS
508123131302	2	36 37	2	0 0	0	0 0	0	7S	06/29/8	32.5	12.0		15	T.FALCATUS
508123131302	2	21 22	2	0 0	0	0 0	0	8S	06/29/8	34.5	25.5		15	T.FALCATUS
508123170306	2	185210	2	0 0	0	0 0	0	2T	06/14/8	30.8	07.6		4	L.GRISEUS
508123170306	1	170 0	1	0 0	0	0 0	0	2T	06/28/8	31.2	05.5		10	L.GRISEUS
508123170306	1	160 0	1	0 0	0	0 0	0	2T	07/05/8	32.0	02.2		8	L.GRISEUS
508123170306	1	86 0	1	0 0	0	0 0	0	3S	07/13/8	32.8	02.5		8	L.GRISEUS
508123170306	3	19 0	1	215220	2	0 0	0	4T	06/14/8	32.0	14.0		8	L.GRISEUS
508123170306	1	70 0	1	0 0	0	0 0	0	4T	06/28/8	30.8	02.0		16	L.GRISEUS
508123170306	1	110 0	1	0 0	0	0 0	0	6S	07/05/8	32.5	04.2		9	L.GRISEUS
508123170306	8	11 18	6	25 32	2	0 0	0	7S	06/29/8	32.5	12.0		15	L.GRISEUS
508123170306	6	16 17	2	20 22	2	26 36	2	7S	07/06/8	32.0	11.0		11	L.GRISEUS
508123170306	26	11 17	3	21 32	22	45 0	1	7S	07/14/8	30.5	22.2		18	L.GRISEUS
508123170306	1	12 0	1	0 0	0	0 0	0	8S	06/29/8	34.5	25.5		15	L.GRISEUS
508123170306	1	21 0	1	0 0	0	0 0	0	9S	06/20/8	30.0	35.0		20	L.GRISEUS
508123170306	1	15 0	1	0 0	0	0 0	0	9S	06/29/8	32.5	14.5		13	L.GRISEUS
508123170306	1	95 0	1	0 0	0	0 0	0	11S	06/15/8	32.5	08.0		6	L.GRISEUS
508123170308	1	35 0	1	0 0	0	0 0	0	7S	06/20/8	30.5	34.0		11	L.MAHOGONI
508123170308	1	28 0	1	0 0	0	0 0	0	9S	07/06/8	33.0	16.0		17	L.MAHOGONI
508123170309	4	15 20	4	0 0	0	0 0	0	7S	06/29/8	32.5	12.0		15	L.SYNAGRIS
508123170309	4	20 0	1	25 26	2	40 0	1	7S	07/06/8	32.0	11.0		11	L.SYNAGRIS
508123170309	6	14 19	4	25 26	2	0 0	0	7S	07/14/8	30.5	22.2		18	L.SYNAGRIS
508123170309	1	34 0	1	0 0	0	0 0	0	9S	07/12/8	31.0	15.5		18	L.SYNAGRIS
508123170309	1	20 0	1	0 0	0	0 0	0	10S	06/27/8	30.0	16.2		20	L.SYNAGRIS
508123170309	4	13 0	3	16 17	1	0 0	0	10S	07/14/8	31.8	26.0		14	L.SYNAGRIS
508123190101	12	22 37	12	0 0	0	0 0	0	1S	06/14/8	31.2	07.8		7	O.OLISTHOSTOMUS
508123190101	1	29 0	1	0 0	0	0 0	0	1S	06/21/8	29.8	10.0		9	O.OLISTHOSTOMUS
508123190101	14	34 47	14	0 0	0	0 0	0	1S	06/28/8	33.5	02.2		4	O.OLISTHOSTOMUS
508123190101	7	38 44	7	0 0	0	0 0	0	1S	07/05/8	32.0	05.2		6	O.OLISTHOSTOMUS
508123190101	3	31 34	3	0 0	0	0 0	0	1T	06/14/8	31.2	06.0		8	O.OLISTHOSTOMUS
508123190101	1	30 0	1	0 0	0	0 0	0	1T	06/21/8	30.5	08.2		9	O.OLISTHOSTOMUS
508123190101	9	25 40	9	0 0	0	0 0	0	1T	06/28/8	31.0	03.2		14	O.OLISTHOSTOMUS
508123190101	5	36 42	5	0 0	0	0 0	0	1T	07/05/8	31.2	04.5		10	O.OLISTHOSTOMUS

 PHYLOGENETIC SORT OF 2500CFS FISH DATA BY TAXON, STATION, AND DATE. 04/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASS I	NO.IND CLASS I	SIZE CLASS II	NO.IND CLASS II	SIZE CLASS III	NO.IND CLASS III	STATION NUMBER	DATE MO.DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITIAL AND SPECIES NAME
508123190101	2	35 0	2	0 0	0	0 0	0	2S	06/21/78	29.9	11.2		8	D.OLISTHOSTOMUS
508123190101	1	32 0	1	0 0	0	0 0	0	2S	06/28/78	34.0	02.5		7	D.OLISTHOSTOMUS
508123190101	28	18 22	4	25 33	24	0 0	0	2T	06/14/78	30.8	07.6		4	D.OLISTHOSTOMUS
508123190101	10	25 36	10	0 0	0	0 0	0	2T	06/28/78	31.2	05.5		10	D.OLISTHOSTOMUS
508123190101	3	17 21	3	0 0	0	0 0	0	2T	07/05/78	32.0	02.2		8	D.OLISTHOSTOMUS
508123190101	9	25 31	7	42 52	2	0 0	0	2T	07/12/78	31.5	02.0		4	D.OLISTHOSTOMUS
508123190101	2	48 50	2	0 0	0	0 0	0	3S	06/28/78	30.8	01.8		10	D.OLISTHOSTOMUS
508123190101	1	39 0	1	0 0	0	0 0	0	3S	07/13/78	32.8	02.5		8	D.OLISTHOSTOMUS
508123190101	2	45 0	1	95 0	1	0 0	0	3T	07/05/78	33.8	01.5		5	D.OLISTHOSTOMUS
508123190101	12	21 24	6	34 35	2	40 54	4	3T	07/12/78	31.2	00.5		11	D.OLISTHOSTOMUS
508123190101	1	37 0	1	0 0	0	0 0	0	4S	06/21/78	29.5	02.2		6	D.OLISTHOSTOMUS
508123190101	6	24 36	6	0 0	0	0 0	0	4S	06/28/78	30.2	02.2		7	D.OLISTHOSTOMUS
508123190101	3	38 39	2	43 0	1	0 0	0	4S	07/05/78	32.0	03.0		9	D.OLISTHOSTOMUS
508123190101	1	100 0	1	0 0	0	0 0	0	4T	06/14/78	32.0	14.0		8	D.OLISTHOSTOMUS
508123190101	1	26 0	1	0 0	0	0 0	0	4T	06/21/78	29.5	02.2		14	D.OLISTHOSTOMUS
508123190101	13	15 19	4	34 36	2	40 45	7	4T	07/05/78	32.0	03.2		11	D.OLISTHOSTOMUS
508123190101	51	21 27	34	37 47	16	88 0	1	4T	07/12/78	31.2	00.5		9	D.OLISTHOSTOMUS
508123190101	3	27 31	2	38 0	1	0 0	0	5T	06/28/78	31.0	05.5		11	D.OLISTHOSTOMUS
508123190101	2	18 21	2	0 0	0	0 0	0	5T	07/05/78	32.2	00.0		13	D.OLISTHOSTOMUS
508123190101	3	24 0	1	27 0	2	0 0	0	5T	07/13/78	31.2	05.0		6	D.OLISTHOSTOMUS
508123190101	4	25 37	4	0 0	0	0 0	0	6S	06/28/78	31.0	04.2		10	D.OLISTHOSTOMUS
508123190101	1	16 0	1	0 0	0	0 0	0	6T	07/05/78	31.0	05.5		7	D.OLISTHOSTOMUS
508123190101	1	18 0	1	0 0	0	0 0	0	8S	07/06/78	32.5	25.0		11	D.OLISTHOSTOMUS
508123190101	3	32 34	3	0 0	0	0 0	0	9S	07/06/78	33.0	16.0		17	D.OLISTHOSTOMUS
508123190101	1	25 0	1	0 0	0	0 0	0	10S	06/27/78	32.5	14.5		20	D.OLISTHOSTOMUS
508123190101	56	15 34	56	0 0	0	0 0	0	11S	06/15/78	32.5	08.0		6	D.OLISTHOSTOMUS
508123190101	1	30 0	1	0 0	0	0 0	0	11S	06/21/78	29.0	00.2		8	D.OLISTHOSTOMUS
508123190101	2	26 34	2	0 0	0	0 0	0	11S	06/28/78	30.5	02.2		11	D.OLISTHOSTOMUS
508123190102	5	39 51	5	0 0	0	0 0	0	1S	07/05/78	32.0	05.2		6	D.PLUMIERI
508123190102	1	235 0	1	0 0	0	0 0	0	1T	06/14/78	31.2	06.0		8	D.PLUMIERI
508123190102	2	265 0	1	284 0	1	0 0	0	1T	06/21/78	30.5	08.2		9	D.PLUMIERI
508123190102	12	130 0	1	240280	9	310 0	2	1T	06/28/78	31.0	03.2		14	D.PLUMIERI
508123190102	2	210250	2	0 0	0	0 0	0	1T	07/05/78	31.2	04.5		10	D.PLUMIERI
508123190102	3	220250	2	270 0	1	0 0	0	1T	07/12/78	30.5	02.0		9	D.PLUMIERI
508123190102	1	51 0	1	0 0	0	0 0	0	3S	07/05/78	33.2	01.5		10	D.PLUMIERI
508123190102	4	105 0	1	120140	2	180 0	1	3T	06/21/78	29.0	00.2		16	D.PLUMIERI
508123190102	1	260 0	1	0 0	0	0 0	0	3T	06/28/78	30.5	02.0		7	D.PLUMIERI
508123190102	3	49 0	1	121123	2	0 0	0	4T	07/05/78	33.8	01.5		5	D.PLUMIERI
508123190102	30	34 45	11	49 56	18	150 0	1	4T	07/12/78	31.2	00.5		9	D.PLUMIERI
508123190200	145	19 44	145	0 0	0	0 0	0	1S	06/14/78	31.2	07.8		7	EUCINOSTOMUS SP
508123190200	14	27 30	14	0 0	0	0 0	0	1S	06/21/78	29.8	10.0		9	EUCINOSTOMUS SP
508123190200	53	25 33	53	0 0	0	0 0	0	1S	07/05/78	32.0	05.2		6	EUCINOSTOMUS SP
508123190200	1	30 0	1	0 0	0	0 0	0	1T	06/14/78	31.2	06.0		8	EUCINOSTOMUS SP
508123190200	1	28 0	1	0 0	0	0 0	0	2S	07/13/78	32.5	02.2		5	EUCINOSTOMUS SP
508123190200	298	24 48	298	0 0	0	0 0	0	2T	06/14/78	30.8	07.6		4	EUCINOSTOMUS SP
508123190200	12	25 30	12	0 0	0	0 0	0	2T	06/21/78	29.5	11.2		8	EUCINOSTOMUS SP
508123190200	5	19 29	5	0 0	0	0 0	0	2T	06/28/78	31.2	05.5		10	EUCINOSTOMUS SP
508123190200	3	23 30	3	0 0	0	0 0	0	2T	07/05/78	32.0	02.2		8	EUCINOSTOMUS SP
508123190200	4	26 28	4	0 0	0	0 0	0	2T	07/12/78	31.5	02.0		4	EUCINOSTOMUS SP
508123190200	4	11 12	4	0 0	0	0 0	0	3S	06/21/78	29.0	00.2		6	EUCINOSTOMUS SP
508123190200	3	14 19	3	0 0	0	0 0	0	3S	06/28/78	30.8	01.8		10	EUCINOSTOMUS SP
508123190200	7	29 30	7	0 0	0	0 0	0	3S	07/05/78	33.2	01.5		10	EUCINOSTOMUS SP
508123190200	1	31 0	1	0 0	0	0 0	0	3T	07/12/78	31.2	00.5		11	EUCINOSTOMUS SP
508123190200	2	23 26	2	0 0	0	0 0	0	4S	06/28/78	30.2	02.2		7	EUCINOSTOMUS SP

PAGE 9 PHYLOGENETIC SORT OF 2500CES FISH DATA BY TAXON, STATION, AND DATE. 04/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASS I	NO. IND CLASS I	SIZE CLASS II	NO. IND CLASS II	SIZE CLASS III	NO. IND CLASS III	STATION NUMBER	DATE MO.DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITIAL AND SPECIES NAME
508123190200	13	28 32	13	0 0	0	0 0	0	4T	06/14/8	32.0	14.0		8	EUCINOSTOMUS SP
508123190200	3	15 24	3	0 0	0	0 0	0	4T	06/21/8	29.5	02.2		14	EUCINOSTOMUS SP
508123190200	17	14 26	17	0 0	0	0 0	0	4T	06/28/8	30.8	02.0		16	EUCINOSTOMUS SP
508123190200	2	22 26	2	0 0	0	0 0	0	4T	07/05/8	32.0	03.2		11	EUCINOSTOMUS SP
508123190200	12	24 30	12	0 0	0	0 0	0	4T	07/12/8	31.2	00.5		9	EUCINOSTOMUS SP
508123190200	4	21 30	4	0 0	0	0 0	0	5S	07/13/8	33.5	03.8		6	EUCINOSTOMUS SP
508123190200	35	27 30	35	0 0	0	0 0	0	5T	06/14/8	32.5	15.0		5	EUCINOSTOMUS SP
508123190200	70	25 30	70	0 0	0	0 0	0	5T	06/21/8	30.0	08.0		9	EUCINOSTOMUS SP
508123190200	12	14 28	12	0 0	0	0 0	0	5T	06/28/8	31.0	05.5		11	EUCINOSTOMUS SP
508123190200	23	26 35	23	0 0	0	0 0	0	6S	06/14/8	32.5	25.0		6	EUCINOSTOMUS SP
508123190200	223	10 29	223	0 0	0	0 0	0	6S	06/28/8	31.0	04.2		10	EUCINOSTOMUS SP
508123190200	6	30 32	6	0 0	0	0 0	0	6T	06/14/8	31.5	24.5		8	EUCINOSTOMUS SP
508123190200	30	12 30	30	0 0	0	0 0	0	7S	06/20/8	30.5	34.0		11	EUCINOSTOMUS SP
508123190200	18	10 27	18	0 0	0	0 0	0	7S	06/29/8	32.5	12.0		15	EUCINOSTOMUS SP
508123190200	7	13 20	7	0 0	0	0 0	0	7S	07/06/8	32.0	11.0		11	EUCINOSTOMUS SP
508123190200	30	8 30	30	0 0	0	0 0	0	7S	07/14/8	30.5	22.2		18	EUCINOSTOMUS SP
508123190200	362	18 30	362	0 0	0	0 0	0	7T	06/21/8	29.6	12.2		6	EUCINOSTOMUS SP
508123190200	202	19 31	202	0 0	0	0 0	0	7T	06/28/8	30.8	16.2		5	EUCINOSTOMUS SP
508123190200	14	24 31	14	0 0	0	0 0	0	7T	07/05/8	30.2	08.0		4	EUCINOSTOMUS SP
508123190200	10	23 30	10	0 0	0	0 0	0	8S	06/15/8	32.5	33.8		10	EUCINOSTOMUS SP
508123190200	47	17 30	47	0 0	0	0 0	0	8S	06/20/8	32.2	36.0		9	EUCINOSTOMUS SP
508123190200	37	22 30	37	0 0	0	0 0	0	8S	06/29/8	34.5	25.5		15	EUCINOSTOMUS SP
508123190200	1	10 0	1	0 0	0	0 0	0	8S	07/04/8	32.5	25.0		11	EUCINOSTOMUS SP
508123190200	37	10 0	1	24 33	36	0 0	0	9S	06/14/8	30.8	33.0		18	EUCINOSTOMUS SP
508123190200	32	9 24	32	0 0	0	0 0	0	9S	06/20/8	30.0	35.0		20	EUCINOSTOMUS SP
508123190200	2	7 0	2	0 0	0	0 0	0	9S	06/29/8	32.5	14.5		13	EUCINOSTOMUS SP
508123190200	17	7 13	3	19 28	14	0 0	0	9S	07/06/8	33.0	16.0		17	EUCINOSTOMUS SP
508123190200	2	9 11	2	0 0	0	0 0	0	9S	07/12/8	31.0	15.5		18	EUCINOSTOMUS SP
508123190200	31	9 30	31	0 0	0	0 0	0	10S	06/15/8	31.2	32.8		3	EUCINOSTOMUS SP
508123190200	291	7 15	291	0 0	0	0 0	0	10S	06/20/8	31.2	36.0		14	EUCINOSTOMUS SP
508123190200	4	9 10	2	13 26	2	0 0	0	10S	06/27/8	30.0	16.2		20	EUCINOSTOMUS SP
508123190200	209	11 28	209	0 0	0	0 0	0	10S	07/06/8	27.0	35.8		8	EUCINOSTOMUS SP
508123190200	33	15 33	33	0 0	0	0 0	0	11S	06/15/8	32.5	08.0		6	EUCINOSTOMUS SP
508123190200	1	14 0	1	0 0	0	0 0	0	11S	06/21/8	29.0	00.2		9	EUCINOSTOMUS SP
508123190200	4	10 16	4	0 0	0	0 0	0	11S	06/28/8	30.5	02.2		11	EUCINOSTOMUS SP
508123190200	1	12 0	1	0 0	0	0 0	0	11S	07/05/8	33.8	04.2		10	EUCINOSTOMUS SP
508123190201	47	31 48	47	0 0	0	0 0	0	1S	06/21/8	29.8	10.0		9	E.ARGENTEUS
508123190201	8	28 49	8	0 0	0	0 0	0	1S	06/28/8	33.5	02.2		4	E.ARGENTEUS
508123190201	39	36 66	39	0 0	0	0 0	0	1S	07/05/8	32.0	05.2		6	E.ARGENTEUS
508123190201	2	75 78	2	0 0	0	0 0	0	1T	06/14/8	31.2	06.0		8	E.ARGENTEUS
508123190201	4	45 55	2	130 0	1	210 0	1	1T	06/28/8	31.0	03.2		14	E.ARGENTEUS
508123190201	21	28 40	12	46 50	2	66 76	7	2S	06/14/8	31.0	08.0		6	E.ARGENTEUS
508123190201	15	31 44	13	55 57	2	0 0	0	2S	06/21/8	29.9	11.2		8	E.ARGENTEUS
508123190201	21	37 55	21	0 0	0	0 0	0	2S	06/28/8	34.0	02.5		7	E.ARGENTEUS
508123190201	14	49 62	14	0 0	0	0 0	0	2S	07/05/8	32.0	05.5		3	E.ARGENTEUS
508123190201	14	51 63	14	0 0	0	0 0	0	2S	07/13/8	32.5	02.2		5	E.ARGENTEUS
508123190201	6	32 45	6	0 0	0	0 0	0	2T	06/21/8	29.5	11.2		8	E.ARGENTEUS
508123190201	2	43 50	2	0 0	0	0 0	0	2T	07/05/8	32.0	02.2		8	E.ARGENTEUS
508123190201	8	32 40	4	45 55	4	0 0	0	2T	07/12/8	31.5	02.0		4	E.ARGENTEUS
508123190201	2	32 35	2	0 0	0	0 0	0	3S	06/14/8	32.0	10.5		5	E.ARGENTEUS
508123190201	7	31 52	7	0 0	0	0 0	0	3S	06/21/8	29.0	00.2		6	E.ARGENTEUS
508123190201	2	20 35	2	0 0	0	0 0	0	3S	06/28/8	30.8	01.8		10	E.ARGENTEUS
508123190201	1	31 0	1	0 0	0	0 0	0	3T	06/14/8	32.5	12.0		11	E.ARGENTEUS
508123190201	8	34 51	8	0 0	0	0 0	0	4S	06/14/8	32.5	13.0		2	E.ARGENTEUS

PAGE 10 PHYLOGENETIC SORT OF 2500CES FISH DATA BY TAXON, STATION, AND DATE. 04/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASSI	NO.IND CLASSI	SIZE CLASSII	NO.IND CLASSII	SIZE CLASSIII	NO.IND CLASSIII	STATION NUMBER	DATE MO.DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITIAL AND SPECIES NAME
508123190201	9	48 50	2	50 60	6	67 0	1	4S	06/21/8	29.5	02.2		6	F.ARGENTEUS
508123190201	2	47 54	2	0 0	0	0 0	0	4S	06/28/8	30.2	02.2		7	F.ARGENTEUS
508123190201	17	36 48	17	0 0	0	0 0	0	4S	07/05/8	32.0	03.0		9	F.ARGENTEUS
508123190201	4	28 29	2	34 36	2	0 0	0	4S	07/13/8	31.5	02.2		8	F.ARGENTEUS
508123190201	1	78 0	1	0 0	0	0 0	0	4T	06/14/8	32.0	14.0		8	F.ARGENTEUS
508123190201	6	30 39	6	0 0	0	0 0	0	4T	06/21/8	29.5	02.2		14	F.ARGENTEUS
508123190201	1	38 0	1	0 0	0	0 0	0	4T	06/28/8	30.8	02.0		16	F.ARGENTEUS
508123190201	12	34 42	9	64 0	1	90 95	2	5S	06/14/8	32.5	15.0		10	F.ARGENTEUS
508123190201	10	31 45	10	0 0	0	0 0	0	5S	06/21/8	30.2	11.0		10	F.ARGENTEUS
508123190201	22	32 52	22	0 0	0	0 0	0	5S	06/28/8	32.0	02.0		9	F.ARGENTEUS
508123190201	2	49 50	2	0 0	0	0 0	0	5S	07/05/8	32.8	02.8		12	F.ARGENTEUS
508123190201	1	50 0	1	0 0	0	0 0	0	5S	07/13/8	31.5	03.8		6	F.ARGENTEUS
508123190201	19	33 49	19	0 0	0	0 0	0	5T	06/14/8	32.5	15.0		5	F.ARGENTEUS
508123190201	4	35 38	2	45 0	1	87 0	1	5T	06/21/8	30.0	08.0		9	F.ARGENTEUS
508123190201	79	32 45	78	65 0	1	0 0	0	5T	06/28/8	31.0	05.5		11	F.ARGENTEUS
508123190201	4	38 0	2	44 0	1	52 0	1	5T	07/05/9	32.2	00.0		13	F.ARGENTEUS
508123190201	5	55 78	5	0 0	0	0 0	0	6S	06/14/8	32.5	25.0		6	F.ARGENTEUS
508123190201	3	37 39	2	60 0	1	0 0	0	6S	06/21/8	29.5	13.2		4	F.ARGENTEUS
508123190201	41	31 47	41	0 0	0	0 0	0	6S	06/28/8	31.0	04.2		10	F.ARGENTEUS
508123190201	3	38 43	2	65 0	1	0 0	0	6S	07/05/9	32.5	04.2		9	F.ARGENTEUS
508123190201	1	87 0	1	0 0	0	0 0	0	6S	07/13/8	32.8	07.8		5	F.ARGENTEUS
508123190201	8	49 55	2	70 0	1	88100	5	6T	06/14/8	31.5	24.5		8	F.ARGENTEUS
508123190201	19	33 39	9	55 75	10	0 0	0	6T	06/21/8	00.0	00.0		11	F.ARGENTEUS
508123190201	2	44 43	2	0 0	0	0 0	0	6T	07/05/8	31.0	05.5		7	F.ARGENTEUS
508123190201	12	28 35	12	0 0	0	0 0	0	7S	06/15/8	30.0	32.2		11	F.ARGENTEUS
508123190201	1	44 0	1	0 0	0	0 0	0	7S	06/20/8	30.5	34.0		11	F.ARGENTEUS
508123190201	26	30 40	26	0 0	0	0 0	0	7S	06/29/8	32.5	12.0		15	F.ARGENTEUS
508123190201	8	24 27	4	34 36	3	45 0	1	7S	07/06/8	32.0	11.0		11	F.ARGENTEUS
508123190201	16	31 40	16	0 0	0	0 0	0	7S	07/14/9	30.5	22.2		18	F.ARGENTEUS
508123190201	1	41 0	1	0 0	0	0 0	0	7T	06/14/8	30.2	31.8		3	F.ARGENTEUS
508123190201	174	31 60	174	0 0	0	0 0	0	7T	06/21/8	29.6	12.2		6	F.ARGENTEUS
508123190201	17	38 0	1	41 47	5	55 70	11	7T	06/28/8	30.8	16.2		5	F.ARGENTEUS
508123190201	9	35 38	5	52 53	2	85 91	2	7T	07/05/8	30.2	08.0		4	F.ARGENTEUS
508123190201	1	68 0	1	0 0	0	0 0	0	7T	07/13/8	30.8	16.2		4	F.ARGENTEUS
508123190201	40	33 75	40	0 0	0	0 0	0	8S	06/20/8	32.2	36.0		9	F.ARGENTEUS
508123190201	28	31 38	28	0 0	0	0 0	0	8S	06/29/8	34.5	25.5		15	F.ARGENTEUS
508123190201	14	21 41	14	0 0	0	0 0	0	8S	07/06/9	32.5	25.0		11	F.ARGENTEUS
508123190201	5	30 40	5	0 0	0	0 0	0	8S	07/14/8	31.8	28.2		14	F.ARGENTEUS
508123190201	14	30 59	14	0 0	0	0 0	0	9S	06/20/8	30.0	35.0		20	F.ARGENTEUS
508123190201	12	28 36	12	0 0	0	0 0	0	9S	06/29/8	32.5	14.5		13	F.ARGENTEUS
508123190201	20	31 47	19	68 0	1	0 0	0	9S	07/06/8	33.0	16.0		17	F.ARGENTEUS
508123190201	12	37 44	10	52 65	2	0 0	0	9S	07/12/8	31.0	15.5		18	F.ARGENTEUS
508123190201	12	35103	12	0 0	0	0 0	0	10S	06/15/8	31.2	32.8		3	F.ARGENTEUS
508123190201	1	36 0	1	0 0	0	0 0	0	10S	06/20/8	31.2	36.0		14	F.ARGENTEUS
508123190201	26	28 35	17	40 46	9	0 0	0	10S	06/27/8	30.0	16.2		20	F.ARGENTEUS
508123190201	11	30 32	2	35 53	9	0 0	0	10S	07/06/8	27.0	35.8		8	F.ARGENTEUS
508123190201	22	35 39	7	41 47	10	53 97	5	10S	07/14/8	31.8	26.0		14	F.ARGENTEUS
508123190201	3	36 52	3	0 0	0	0 0	0	11S	07/13/8	32.8	02.2		6	F.ARGENTEUS
508123190203	1	72 0	1	0 0	0	0 0	0	1S	06/14/8	31.2	07.8		7	F.GULA
508123190203	33	31 49	19	0 0	0	0 0	0	1S	06/21/9	29.8	10.0		9	F.GULA
508123190203	25	34 54	25	0 0	0	0 0	0	1S	06/28/8	33.5	02.2		4	F.GULA
508123190203	7	37 58	7	0 0	0	0 0	0	1S	07/05/8	32.0	05.2		6	F.GULA
508123190203	5	34 43	5	0 0	0	0 0	0	1S	07/13/8	31.5	03.5		3	F.GULA
508123190203	1	37 0	1	0 0	0	0 0	0	2S	06/14/8	31.0	08.0		6	F.GULA

PAGE 11   PHYLOGENETIC SORT OF 25ADCES FISH DATA BY TAXON, STATION, AND DATE.   06/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASSI	NO.IND CLASSI	SIZE CLASSII	NO.IND CLASSII	SIZE CLASSIII	NO.IND CLASSIII	STATION NUMBER	DATE MO.DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS SPECIES INITIAL AND NAME
508123190203	50	30 40	43	43 58	7	0 0	0	25	06/21/8	29.9	11.2		8	F.GULA
508123190203	23	40 51	23	0 0	0	0 0	0	25	06/28/8	34.0	02.5		7	F.GULA
508123190203	13	47 60	13	0 0	0	0 0	0	25	07/05/8	32.0	05.5		3	F.GULA
508123190203	10	36 0	1	48 58	9	0 0	0	25	07/13/8	32.5	02.2		5	F.GULA
508123190203	8	32 44	8	0 0	0	0 0	0	2T	06/21/8	29.5	11.2		8	F.GULA
508123190203	11	31 34	3	37 50	8	0 0	0	2T	06/28/8	31.2	05.5		10	F.GULA
508123190203	6	35 37	1	40 45	2	53 0	1	2T	07/05/8	32.0	02.2		8	F.GULA
508123190203	1	32 0	1	0 0	0	0 0	0	35	06/14/8	32.0	10.5		5	F.GULA
508123190203	1	44 0	1	0 0	0	0 0	0	35	06/21/8	29.0	00.2		6	F.GULA
508123190203	4	38 39	3	45 0	1	54 55	4	35	07/13/8	32.8	02.5		8	F.GULA
508123190203	9	40 46	7	55 62	2	0 0	0	45	06/21/8	29.5	02.2		6	F.GULA
508123190203	7	30 50	7	0 0	0	0 0	0	45	06/28/8	30.2	02.2		7	F.GULA
508123190203	10	33 51	10	0 0	0	0 0	0	45	07/05/8	32.0	03.0		9	F.GULA
508123190203	7	32 36	3	42 49	4	0 0	0	45	07/13/8	31.5	02.2		8	F.GULA
508123190203	12	30 38	12	0 0	0	0 0	0	4T	06/21/8	29.5	02.2		14	F.GULA
508123190203	1	35 0	1	0 0	0	0 0	0	4T	06/28/8	30.8	02.0		16	F.GULA
508123190203	1	38 0	1	0 0	0	0 0	0	4T	07/12/8	31.2	00.5		9	F.GULA
508123190203	7	30 0	1	37 55	5	43 0	1	55	06/14/8	32.5	15.0		10	F.GULA
508123190203	11	35 45	11	0 0	0	0 0	0	55	06/21/8	30.2	11.0		10	F.GULA
508123190203	29	34 50	28	0 0	0	0 0	0	55	06/28/8	32.0	02.0		9	F.GULA
508123190203	4	39 54	4	0 0	0	0 0	0	55	07/05/8	32.8	02.8		12	F.GULA
508123190203	19	38 55	19	0 0	0	0 0	0	55	07/13/8	33.5	03.8		6	F.GULA
508123190203	2	39 43	2	0 0	0	0 0	0	5T	06/21/8	30.0	08.0		9	F.GULA
508123190203	81	32 48	81	0 0	0	0 0	0	5T	06/28/8	31.0	05.5		11	F.GULA
508123190203	3	49 0	1	50 0	1	51 0	1	5T	07/05/8	32.2	00.0		13	F.GULA
508123190203	5	41 49	2	59 60	2	68 0	1	65	06/21/8	29.5	13.2		4	F.GULA
508123190203	47	31 47	47	0 0	0	0 0	0	65	06/28/8	31.0	04.2		10	F.GULA
508123190203	10	42 60	3	70 80	3	85 92	4	6T	06/14/8	31.5	24.5		8	F.GULA
508123190203	41	33 67	41	0 0	0	0 0	0	6T	06/21/8	00.0	00.0		11	F.GULA
508123190203	47	30 36	8	40 43	29	45 63	10	6T	06/28/8	31.5	04.5		8	F.GULA
508123190203	2	50 53	2	0 0	0	0 0	0	6T	07/05/8	31.0	05.5		7	F.GULA
508123190203	8	43 70	8	0 0	0	0 0	0	6T	07/13/8	31.0	04.0		4	F.GULA
508123190203	6	27 29	6	0 0	0	0 0	0	75	06/15/8	30.0	32.2		11	F.GULA
508123190203	2	44 0	2	0 0	0	0 0	0	75	06/20/8	30.5	34.0		11	F.GULA
508123190203	20	30 40	20	0 0	0	0 0	0	75	06/29/8	32.5	12.0		15	F.GULA
508123190203	25	24 26	5	35 42	20	0 0	0	75	07/06/8	32.0	11.0		11	F.GULA
508123190203	8	33 42	8	0 0	0	0 0	0	75	07/14/8	30.5	22.2		18	F.GULA
508123190203	1	53 0	1	0 0	0	0 0	0	7T	06/14/8	30.2	31.8		3	F.GULA
508123190203	147	31 60	147	0 0	0	0 0	0	7T	06/21/8	29.6	12.2		6	F.GULA
508123190203	11	40 49	11	0 0	0	0 0	0	7T	06/28/8	30.8	16.2		5	F.GULA
508123190203	19	35 41	6	46 56	8	49 80	5	7T	07/05/8	30.2	08.0		4	F.GULA
508123190203	7	40 65	5	58 62	2	0 0	0	7T	07/13/8	30.8	16.2		4	F.GULA
508123190203	16	35 72	16	0 0	0	0 0	0	85	06/20/8	32.2	34.0		9	F.GULA
508123190203	52	31 45	49	55 58	3	0 0	0	85	06/29/8	34.5	25.5		15	F.GULA
508123190203	18	22 50	18	0 0	0	0 0	0	85	07/06/8	32.5	25.0		11	F.GULA
508123190203	13	14 0	1	27 42	12	0 0	0	85	07/14/8	31.8	28.2		14	F.GULA
508123190203	1	55 0	1	0 0	0	0 0	0	95	06/16/8	30.8	33.0		18	F.GULA
508123190203	5	30 62	5	0 0	0	0 0	0	95	06/20/8	30.0	35.0		20	F.GULA
508123190203	13	29 32	5	36 42	6	56 0	2	95	06/29/8	32.5	14.5		13	F.GULA
508123190203	19	34 55	19	0 0	0	0 0	0	95	07/06/8	33.0	16.0		17	F.GULA
508123190203	15	34 36	3	40 41	9	46 50	1	95	07/12/8	31.0	15.5		18	F.GULA
508123190203	11	34 70	11	0 0	0	0 0	0	105	06/15/8	31.2	32.8		7	F.GULA
508123190203	1	31 0	1	0 0	0	0 0	0	105	06/20/8	31.2	36.0		14	F.GULA
508123190203	17	31 88	16	45 0	1	0 0	0	105	06/27/8	30.0	16.2		20	F.GULA

PAGE 12 PHYLOGENETIC SORT OF 2500CES FISH DATA BY TAXON, STATION, AND DATE. 04/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASS I	NO.IND CLASS I	SIZE CLASS II	NO.IND CLASS II	SIZE CLASS III	NO.IND CLASS III	STATION NUMBER	DATE MO.DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITIAL AND SPECIES NAME
508123190203	7	30 32	2	35 51	5	0 0	0	10S	07/06/8	27.0	35.8		8	F.GULA
508123190203	9	36 42	5	49 0	3	72 0	1	10S	07/14/8	31.8	26.0		14	F.GULA
508123190203	4	34 50	4	0 0	0	0 0	0	11S	06/28/8	30.5	02.2		11	F.GULA
508123190203	8	30 36	4	43 45	3	54 0	1	11S	07/05/8	31.8	04.2		10	F.GULA
508123190203	5	39 58	5	0 0	0	0 0	0	11S	07/13/8	32.8	02.2		6	F.GULA
508123200210	1	31 0	1	0 0	0	0 0	0	7S	06/20/8	30.5	34.0		11	H.PARRAI
508123200210	2	21 34	2	0 0	0	0 0	0	7S	06/29/8	32.5	12.0		15	H.PARRAI
508123200210	1	15 0	1	0 0	0	0 0	0	7S	07/14/8	30.5	22.2		18	H.PARRAI
508123200210	1	13 0	1	0 0	0	0 0	0	8S	06/15/8	32.5	33.8		10	H.PARRAI
508123200210	3	12 0	1	16 17	2	0 0	0	8S	06/20/8	32.2	36.0		9	H.PARRAI
508123200210	9	14 20	4	25 27	4	34 0	1	8S	07/06/8	32.5	25.0		11	H.PARRAI
508123200210	12	3 21	11	34 0	1	0 0	0	8S	07/14/8	31.8	28.2		14	H.PARRAI
508123200210	1	32 0	1	0 0	0	0 0	0	9S	06/16/8	30.8	33.0		18	H.PARRAI
508123200210	1	35 0	1	0 0	0	0 0	0	9S	06/20/8	30.0	35.0		20	H.PARRAI
508123200210	2	36 37	2	0 0	0	0 0	0	9S	06/29/8	32.5	14.5		13	H.PARRAI
508123200210	3	14 24	2	32 0	1	0 0	0	10S	06/27/8	30.0	16.2		20	H.PARRAI
508123200210	1	20 0	1	0 0	0	0 0	0	10S	07/14/8	31.8	26.0		14	H.PARRAI
508123200301	7	34 36	3	41 0	2	45 0	2	2T	06/14/8	30.8	07.6		4	O.CHRYSOPTERA
508123200301	2	45 0	1	55 0	1	0 0	0	5S	06/21/8	30.2	11.0		10	O.CHRYSOPTERA
508123200301	10	30 33	5	36 50	5	0 0	0	7S	06/15/8	30.0	32.2		11	O.CHRYSOPTERA
508123200301	1	35 0	1	0 0	0	0 0	0	7S	06/20/8	30.5	34.0		11	O.CHRYSOPTERA
508123200301	7	42 55	7	0 0	0	0 0	0	7S	06/29/8	32.5	12.0		15	O.CHRYSOPTERA
508123200301	12	41 0	1	48 0	2	55 55	9	7S	07/06/8	32.0	21.0		11	O.CHRYSOPTERA
508123200301	15	44 68	15	0 0	0	0 0	0	7S	07/14/8	30.5	22.2		18	O.CHRYSOPTERA
508123200301	3	36 42	3	0 0	0	0 0	0	8S	06/15/8	32.5	33.8		10	O.CHRYSOPTERA
508123200301	2	42 43	2	0 0	0	0 0	0	8S	06/20/8	32.2	36.0		9	O.CHRYSOPTERA
508123200301	4	44 47	2	54 58	2	0 0	0	8S	06/29/8	34.5	25.5		15	O.CHRYSOPTERA
508123200301	1	59 0	1	0 0	0	0 0	0	8S	07/14/8	31.8	28.2		14	O.CHRYSOPTERA
508123200301	11	31 35	4	38 42	5	48 50	2	9S	06/16/8	30.8	33.0		18	O.CHRYSOPTERA
508123200301	20	27 36	10	41 54	10	0 0	0	9S	06/20/8	30.0	35.0		20	O.CHRYSOPTERA
508123200301	1	40 0	1	0 0	0	0 0	0	9S	06/29/8	32.5	14.5		13	O.CHRYSOPTERA
508123200301	1	59 0	1	0 0	0	0 0	0	9S	07/06/8	33.0	16.0		17	O.CHRYSOPTERA
508123200301	1	50 0	1	0 0	0	0 0	0	9S	07/12/8	31.0	15.5		18	O.CHRYSOPTERA
508123200301	7	36 45	7	0 0	0	0 0	0	10S	06/20/8	31.2	36.0		14	O.CHRYSOPTERA
508123200301	2	46 58	2	0 0	0	0 0	0	10S	06/27/8	30.0	16.2		20	O.CHRYSOPTERA
508123200301	1	59 0	1	0 0	0	0 0	0	10S	07/14/8	31.8	26.0		14	O.CHRYSOPTERA
508123210101	2	265330	2	0 0	0	0 0	0	1T	06/14/8	31.2	04.0		8	A.PROBATOCEPHALUS
508123210101	16	10 12	15	200 0	1	0 0	0	1T	06/28/8	31.0	03.2		14	A.PROBATOCEPHALUS
508123210101	1	230 0	1	0 0	0	0 0	0	1T	07/05/8	31.2	04.5		10	A.PROBATOCEPHALUS
508123210101	1	195 0	1	0 0	0	0 0	0	2T	06/21/8	29.5	11.2		8	A.PROBATOCEPHALUS
508123210101	1	250 0	1	0 0	0	0 0	0	2T	06/28/8	31.2	05.5		10	A.PROBATOCEPHALUS
508123210101	1	230 0	1	0 0	0	0 0	0	2T	07/12/8	31.5	02.0		4	A.PROBATOCEPHALUS
508123210101	2	275300	2	0 0	0	0 0	0	4T	06/14/8	32.0	14.0		8	A.PROBATOCEPHALUS
508123210101	1	265 0	1	0 0	0	0 0	0	4T	06/21/8	29.5	02.2		14	A.PROBATOCEPHALUS
508123210101	1	240 0	1	0 0	0	0 0	0	4T	06/28/8	30.8	02.0		16	A.PROBATOCEPHALUS
508123210101	2	280 0	1	405 0	1	0 0	0	7T	06/21/8	29.6	12.2		6	A.PROBATOCEPHALUS
508123210101	3	230 0	1	330350	2	0 0	0	7T	06/28/8	30.8	16.2		5	A.PROBATOCEPHALUS
508123210101	1	25 0	1	0 0	0	0 0	0	9S	06/16/8	30.8	33.0		18	A.PROBATOCEPHALUS
508123210302	5	27 30	5	0 0	0	0 0	0	8S	06/15/8	32.5	33.8		10	D.HOLBROOKI
508123210302	21	28 38	21	0 0	0	0 0	0	10S	06/20/8	31.2	36.0		14	D.HOLBROOKI
508123210302	18	33 42	18	0 0	0	0 0	0	10S	06/27/8	30.0	16.2		20	D.HOLBROOKI
508123210401	1	120 0	1	0 0	0	0 0	0	5T	06/21/8	30.0	08.0		9	L.RHOMBOIDES
508123210401	1	75 0	1	0 0	0	0 0	0	5T	06/28/8	31.0	05.5		11	L.RHOMBOIDES
508123210401	1	60 0	1	0 0	0	0 0	0	7S	06/15/8	30.0	32.2		11	L.RHOMBOIDES

PAGE 13 PHYLOGENETIC SORT OF 2500CES FISH DATA BY TAXON, STATION, AND DATE. 04/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASSI	NO.IND CLASSI	SIZE CLASSII	NO.IND CLASSII	SIZE CLASSIII	NO.IND CLASSIII	STATION NUMBER	DATE MO.DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITIAL AND SPECIES NAME
508123210401	3	49 0	1	56 0	1	95 0	1	7S	06/20/78	30.5	34.0		11	L.RHOMBOIDES
508123210401	2	35 0	1	79 0	1	0 0	0	7S	06/29/78	32.5	12.0		15	L.RHOMBOIDES
508123210401	2	77 78	2	0 0	0	0 0	0	7S	07/06/78	32.0	11.0		11	L.RHOMBOIDES
508123210401	6	36 0	1	50 55	3	71 90	2	7S	07/14/78	30.5	22.2		18	L.RHOMBOIDES
508123210401	17	36 61	17	0 0	0	0 0	0	8S	06/15/78	32.5	33.8		10	L.RHOMBOIDES
508123210401	7	42 64	7	0 0	0	0 0	0	8S	06/20/78	32.2	36.0		9	L.RHOMBOIDES
508123210401	8	42 45	5	50 0	1	58 62	2	8S	06/29/78	34.5	25.5		15	L.RHOMBOIDES
508123210401	4	44 45	2	49 50	2	0 0	0	8S	07/06/78	32.5	25.0		11	L.RHOMBOIDES
508123210401	6	47 50	4	60 0	1	65 0	1	8S	07/14/78	31.8	28.2		14	L.RHOMBOIDES
508123210401	24	37 43	6	46 60	15	66 80	1	9S	06/16/78	30.8	33.0		18	L.RHOMBOIDES
508123210401	16	46 73	16	0 0	0	0 0	0	9S	06/20/78	30.0	35.0		20	L.RHOMBOIDES
508123210401	2	55 0	1	70 0	1	0 0	0	9S	06/29/78	32.5	14.5		13	L.RHOMBOIDES
508123210401	11	55 58	8	67 70	2	75 0	1	9S	07/06/78	33.0	16.0		17	L.RHOMBOIDES
508123210401	1	57 0	1	0 0	0	0 0	0	9S	07/12/78	31.0	15.5		18	L.RHOMBOIDES
508123210401	1	55 0	1	0 0	0	0 0	0	10S	06/20/78	31.2	36.0		14	L.RHOMBOIDES
508123210401	6	48 0	1	53 56	2	70 0	3	10S	06/27/78	32.5	14.5		20	L.RHOMBOIDES
508123210401	1	55 0	1	0 0	0	0 0	0	11S	06/28/78	30.5	02.2		11	L.RHOMBOIDES
508123220202	18	23 30	5	38 60	12	65 0	1	1T	06/28/78	31.0	03.2		14	B.CHRYSURA
508123220202	15	30 37	8	44 45	2	59 80	5	1T	07/05/78	31.2	04.5		10	B.CHRYSURA
508123220202	11	40 45	5	67 70	3	80 85	3	1T	07/12/78	30.5	02.0		9	B.CHRYSURA
508123220202	6	33 0	2	47 52	2	60 67	2	3T	06/14/78	32.5	12.0		11	B.CHRYSURA
508123220202	28	36 46	13	49 54	7	59 72	8	3T	06/21/78	29.0	00.2		16	B.CHRYSURA
508123220202	1	23 0	1	58 0	1	75 0	1	4T	06/28/78	30.8	02.0		16	B.CHRYSURA
508123220202	56	33 46	14	50 93	41	155 0	1	4T	07/05/78	32.0	03.2		11	B.CHRYSURA
508123220202	57	38 48	24	50 67	19	70 88	14	4T	07/12/78	31.2	00.5		9	B.CHRYSURA
508123220202	1	16 0	1	0 0	0	0 0	0	5S	06/14/78	32.5	15.0		10	B.CHRYSURA
508123220202	1	33 0	1	0 0	0	0 0	0	6T	07/05/78	31.0	05.5		7	B.CHRYSURA
508123220202	1	40 0	1	0 0	0	0 0	0	7S	06/20/78	30.5	34.0		11	B.CHRYSURA
508123220202	1	56 0	1	0 0	0	0 0	0	7S	07/06/78	32.0	11.0		11	B.CHRYSURA
508123220202	2	13 0	1	51 0	1	0 0	0	7S	07/14/78	30.5	22.2		18	B.CHRYSURA
508123220202	4	22 0	1	33 36	2	42 0	1	9S	06/16/78	30.8	33.0		18	B.CHRYSURA
508123220202	6	37 38	3	40 41	2	64 0	1	9S	06/20/78	30.0	35.0		20	B.CHRYSURA
508123220202	1	20 0	1	0 0	0	0 0	0	9S	06/29/78	32.5	14.5		13	B.CHRYSURA
508123220202	4	11 14	2	23 0	1	45 0	1	9S	07/06/78	33.0	16.0		17	B.CHRYSURA
508123220202	3	20 43	2	70 0	1	0 0	0	9S	07/12/78	31.0	15.5		18	B.CHRYSURA
508123220402	1	36 0	1	0 0	0	0 0	0	3S	06/28/78	30.8	01.8		10	C.NEBULOSUS
508123220402	5	22 0	1	30 40	3	67 0	1	4T	06/28/78	30.8	02.0		16	C.NEBULOSUS
508123220402	1	60 0	1	0 0	0	0 0	0	4T	07/05/78	32.0	03.2		11	C.NEBULOSUS
508123220402	3	18 20	2	24 0	1	0 0	0	5S	06/14/78	32.5	15.0		10	C.NEBULOSUS
508123220402	1	43 0	1	0 0	0	0 0	0	5S	07/05/78	32.8	02.8		12	C.NEBULOSUS
508123220402	2	21 33	2	0 0	0	0 0	0	7S	06/29/78	32.5	12.0		15	C.NEBULOSUS
508123220402	2	21 28	2	0 0	0	0 0	0	7S	07/14/78	30.5	22.2		18	C.NEBULOSUS
508123220402	1	19 0	1	0 0	0	0 0	0	8S	07/14/78	31.8	28.2		14	C.NEBULOSUS
508123220402	1	16 0	1	0 0	0	0 0	0	9S	06/16/78	30.8	33.0		18	C.NEBULOSUS
508123220402	2	17 27	2	0 0	0	0 0	0	9S	07/12/78	31.0	15.5		18	C.NEBULOSUS
508123220404	6	47 0	1	61 81	4	275 0	1	1T	06/21/78	30.5	08.2		9	C.NOTHUS
508123220404	1	63 0	1	0 0	0	0 0	0	1T	07/12/78	30.5	02.0		9	C.NOTHUS
508123220404	9	67 73	2	75 83	5	104 0	2	3T	06/14/78	32.5	12.0		11	C.NOTHUS
508123220404	3	43 0	1	55 56	2	0 0	0	3T	06/21/78	29.0	00.2		16	C.NOTHUS
508123220404	0	190 0	1	0 0	0	0 0	0	4T	06/21/78	29.5	02.2		14	C.NOTHUS
508123220404	15	33 41	3	43 48	8	58 68	4	4T	07/05/78	32.0	03.2		11	C.NOTHUS
508123220404	11	47 54	10	65 0	1	0 0	0	4T	07/12/78	31.2	00.5		9	C.NOTHUS
508123220404	3	180 190	2	195 0	1	0 0	0	6T	06/21/78	00.0	00.0		11	C.NOTHUS
508123220406	1	57 0	1	0 0	0	0 0	0	1T	06/14/78	31.2	06.0		8	C.REGALIS

PAGE 14 PHYLOGENETIC SORT OF 2500CFS FISH DATA BY TAXON, STATION, AND DATE. 04/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASS I	NO.IND CLASS I	SIZE CLASS II	NO.IND CLASS II	SIZE CLASS III	NO.IND CLASS III	STATION NUMBER	DATE MO,DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITIAL AND SPECIES NAME
508123220406	4	50 0	1	70 75	2	83 0	1	3T	06/14/8	32.5	12.0		11	C.REGALIS
508123220406	1	63 0	1	0 0	0	0 0	0	3T	06/21/8	29.0	00.2		16	C.REGALIS
508123220406	1	79 0	1	0 0	0	0 0	0	4T	06/21/8	29.5	02.2		14	C.REGALIS
508123220406	19	33 47	14	50 0	1	82101	4	4T	06/28/8	30.8	02.0		16	C.REGALIS
508123220406	1	115 0	1	0 0	0	0 0	0	4T	07/05/8	32.0	03.2		11	C.REGALIS
508123220406	1	235 0	1	0 0	0	0 0	0	5T	06/21/8	30.0	08.0		9	C.REGALS
508123220801	1	133 0	1	0 0	0	0 0	0	3T	06/14/8	32.5	12.0		11	L.XANTHURUS
508123220801	1	105 0	1	0 0	0	0 0	0	3T	07/05/8	33.8	01.5		5	L.XANTHURUS
508123220901	1	205 0	1	0 0	0	0 0	0	6T	06/21/8	00.0	00.0		11	M.AMERICANUS
508123221001	13	32 45	3	53115	6	176230	4	1T	06/14/8	31.2	06.0		8	M.UNDULATUS
508123221001	5	38 41	2	51 0	1	210380	2	1T	06/21/8	30.5	08.2		9	M.UNDULATUS
508123221001	1	75 0	1	0 0	0	0 0	0	1T	06/28/8	31.0	03.2		14	M.UNDULATUS
508123221001	1	310 0	1	0 0	0	0 0	0	1T	07/05/8	31.2	04.5		10	M.UNDULATUS
508123221001	5	65 0	1	105110	2	260265	2	1T	07/12/8	30.5	02.0		9	M.UNDULATUS
508123221001	2	245275	2	0 0	0	0 0	0	2T	06/21/8	29.5	11.2		8	M.UNDULATUS
508123221001	26	30 75	19	105150	5	170200	2	3T	06/14/8	32.5	12.0		11	M.UNDULATUS
508123221001	6	58 62	3	125 0	1	195210	2	3T	06/21/8	29.0	00.2		16	M.UNDULATUS
508123221001	19	58 83	12	140155	4	180210	3	3T	06/28/8	30.5	02.0		7	M.UNDULATUS
508123221001	3	77 78	2	135 0	1	0 0	0	3T	07/05/8	33.8	01.5		5	M.UNDULATUS
508123221001	14	41 0	1	70110	11	145210	2	3T	07/12/8	31.2	00.5		11	M.UNDULATUS
508123221001	1	193 0	1	0 0	0	0 0	0	4T	06/14/8	32.0	14.0		8	M.UNDULATUS
508123221001	2	52 0	1	220 0	1	0 0	0	4T	06/21/8	29.5	02.2		14	M.UNDULATUS
508123221001	28	50 95	22	130180	5	260 0	1	4T	06/28/8	30.8	02.0		16	M.UNDULATUS
508123221001	14	60 0	1	70 88	8	180230	5	4T	07/05/8	32.0	03.2		11	M.UNDULATUS
508123221001	15	41 70	7	76 98	6	175185	2	4T	07/12/8	31.2	00.5		9	M.UNDULATUS
508123221001	7	130 0	3	140150	2	160250	2	5T	06/21/8	30.0	08.0		9	M.UNDULATUS
508123221001	1	120 0	1	0 0	0	0 0	0	5T	06/28/8	31.0	05.5		11	M.UNDULATUS
508123221001	2	56 0	2	0 0	0	0 0	0	5T	07/05/8	32.2	00.0		13	M.UNDULATUS
508123221001	1	180 0	1	0 0	0	0 0	0	5T	07/13/8	31.2	05.0		6	M.UNDULATUS
508123221001	7	40 90	2	135150	3	170240	2	6T	06/14/8	31.5	24.5		8	M.UNDULATUS
508123221001	14	145150	6	159165	3	145205	5	6T	06/21/8	00.0	00.0		11	M.UNDULATUS
508123221001	25	27 64	15	73 99	8	180200	2	6T	06/28/8	31.5	04.5		8	M.UNDULATUS
508123221001	9	31 34	2	70 97	4	145150	3	6T	07/05/8	31.0	05.5		7	M.UNDULATUS
508123221001	1	158 0	1	0 0	0	0 0	0	6T	07/13/8	31.0	04.0		4	M.UNDULATUS
508123221201	1	280 0	1	0 0	0	0 0	0	1T	06/21/8	30.5	08.2		9	P.CROMIS
508123221401	1	119 0	1	0 0	0	0 0	0	3S	07/05/8	33.2	01.5		10	S.OCELLATA
508123221401	1	119 0	1	0 0	0	0 0	0	3S	07/13/8	32.8	02.5		8	S.OCELLATA
508123230302	1	42 0	1	0 0	0	0 0	0	10S	07/14/8	31.8	26.0		14	P.MACULATUS
508123260101	1	17 0	1	0 0	0	0 0	0	8S	07/06/8	32.5	25.0		11	C.FABER
508123260101	2	9 15	2	0 0	0	0 0	0	10S	06/20/8	31.2	36.0		14	C.FABER
508123340400	1	31 0	1	0 0	0	0 0	0	8S	06/20/8	32.2	36.0		9	SPARISOMA SP.
508123340400	1	26 0	1	0 0	0	0 0	0	8S	06/29/8	34.5	25.5		15	SPARISOMA SP.
508123340400	2	4 10	2	0 0	0	0 0	0	8S	07/14/8	31.8	28.2		14	SPARISOMA SP.
508123340400	2	35 40	2	0 0	0	0 0	0	9S	06/16/8	30.8	33.0		18	SPARISOMA SP.
508123340400	3	21 25	2	60 0	1	0 0	0	9S	06/20/8	30.0	35.0		20	SPARISOMA SP.
508123340400	2	20 0	1	39 0	1	0 0	0	9S	07/06/8	33.0	16.0		17	SPARASOMA SP.
508123340400	4	10 39	2	39 40	2	0 0	0	9S	07/12/8	31.0	15.5		18	SPARISOMA SP.
508123350201	3	17 18	3	0 0	0	0 0	0	1S	06/21/8	29.8	10.0		9	M.CEPHALUS
508123350201	1	13 0	1	0 0	0	0 0	0	9S	07/12/8	31.0	15.5		18	M.CEPHALUS
508123350201	1	17 0	1	0 0	0	0 0	0	10S	06/20/8	31.2	36.0		14	M.CEPHALUS
508123350201	1	62 0	1	0 0	0	0 0	0	11S	06/21/8	29.0	00.2		8	M.CEPHALUS
508123350202	1	22 0	1	0 0	0	0 0	0	1S	06/14/8	31.2	07.8		7	M.CUREMA
508123350202	1	19 0	1	0 0	0	0 0	0	2S	07/13/8	32.5	02.2		5	M.CUREMA
508123350202	1	18 0	1	0 0	0	0 0	0	5S	06/21/8	30.2	11.0		10	M.CUREMA

 PHYLOGENETIC SORT OF 2500CES FISH DATA BY TAXON, STATION, AND DATE. 04/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASSI	NO.IND CLASSI	SIZE CLASSII	NO.IND CLASSII	SIZE CLASSIII	NO.IND CLASSIII	STATION NUMBER	DATE MO.DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITIAL AND SPECIES NAME
508123350202	2	18 26	2	0 0	0	0 0	0	75	07/06/8	32.0	11.0		11	M.CUREMA
508123350202	2	15 16	2	0 0	0	0 0	0	75	07/14/8	30.5	22.2		18	M.CUREMA
508123360102	1	49 0	1	0 0	0	0 0	0	15	06/14/8	31.2	07.8		7	S.BARRACUDA
508123360102	1	109 0	1	0 0	0	0 0	0	2T	07/05/8	32.0	02.2		8	S.BARRACUDA
508123360102	3	21 0	1	45 48	2	0 0	0	55	06/14/8	32.5	15.0		10	S.BARRACUDA
508123360102	1	105 0	1	0 0	0	0 0	0	55	06/28/8	32.0	02.0		9	S.BARRACUDA
508123360102	1	43 0	1	0 0	0	0 0	0	55	07/05/8	32.8	02.8		12	S.BARRACUDA
508123360102	1	80 0	1	0 0	0	0 0	0	65	07/05/8	32.5	04.2		9	S.BARRACUDA
508123360102	1	46 0	1	0 0	0	0 0	0	75	06/15/8	30.0	32.2		11	S.BARRACUDA
508123360102	1	108 0	1	0 0	0	0 0	0	75	06/20/8	30.5	34.0		11	S.BARRACUDA
508123360102	5	24 0	2	27 28	2	67 0	1	75	06/29/8	32.5	12.0		15	S.BARRACUDA
508123360102	2	20 24	2	0 0	0	0 0	0	75	07/06/8	32.0	11.0		11	S.BARRACUDA
508123360102	7	19 25	4	34 0	1	46 49	2	75	07/14/8	30.5	22.2		18	S.BARRACUDA
508123360102	1	26 0	1	0 0	0	0 0	0	85	06/15/8	32.5	33.8		10	S.BARRACUDA
508123360102	4	18 0	2	21 32	2	0 0	0	85	07/14/8	31.8	28.2		14	S.BARRACUDA
508123360102	2	16 0	2	0 0	0	0 0	0	95	06/16/8	30.8	33.0		18	S.BARRACUDA
508123360102	1	34 0	1	0 0	0	0 0	0	95	07/06/8	33.0	16.0		17	S.BARRACUDA
508123360102	3	19 25	3	0 0	0	0 0	0	105	06/27/8	30.0	16.2		20	S.BARRACUDA
508123360102	3	16 0	1	18 19	2	0 0	0	105	07/14/8	31.8	26.0		14	S.BARRACUDA
508123360102	1	41 0	1	0 0	0	0 0	0	115	06/15/8	32.5	08.0		6	S.BARRACUDA
508123420101	1	29 0	1	0 0	0	0 0	0	105	07/06/8	27.0	35.8		8	B.CROSSOTUS
508123441007	1	57 0	1	0 0	0	0 0	0	85	06/20/8	32.2	36.0		9	L.NUCHIPINNIS
508123441007	1	50 0	1	0 0	0	0 0	0	95	06/16/8	30.8	33.0		18	L.NUCHIPINNIS
508123560400	1	20 0	1	0 0	0	0 0	0	85	07/14/8	31.8	28.2		14	GOBY UNKNOWN
508123560403	1	69 0	1	0 0	0	0 0	0	55	07/05/8	32.8	02.8		12	B.SOPORATOR
508123560403	1	13 0	1	0 0	0	0 0	0	65	07/13/8	32.8	07.8		5	B.SOPORATOR
508123560403	1	22 0	1	0 0	0	0 0	0	75	06/15/8	30.0	33.2		11	B.SOPORATOR
508123560403	1	10 0	1	0 0	0	0 0	0	85	06/29/8	34.5	25.5		15	B.SOPORATOR
508123560403	5	12 0	1	19 0	2	23 24	2	85	07/14/8	31.8	28.2		14	B.SOPORATOR
508123560403	2	40 55	2	0 0	0	0 0	0	95	06/16/8	30.8	33.0		18	B.SOPORATOR
508123560403	5	45 48	3	51 58	2	0 0	0	95	06/29/8	32.5	14.5		13	B.SOPORATOR
508123560403	7	10 0	1	13 24	3	45 55	3	95	07/12/8	31.0	15.5		18	B.SOPORATOR
508123560403	1	41 0	1	0 0	0	0 0	0	105	06/27/8	32.5	14.5		20	B.SOPORATOR
508123561401	1	19 0	1	0 0	0	0 0	0	45	07/13/8	31.5	02.2		8	G.BOLEOSOMA
508123561401	1	33 0	1	0 0	0	0 0	0	85	06/15/8	32.5	33.8		10	G.BOLEOSOMA
508123561401	1	16 0	1	0 0	0	0 0	0	85	06/29/8	34.5	25.5		15	G.BOLEOSOMA
508123561401	1	35 0	1	0 0	0	0 0	0	95	06/16/8	30.8	33.0		18	G.BOLEOSOMA
508123561401	2	22 31	2	0 0	0	0 0	0	95	06/20/8	30.0	35.0		20	G.BOLEOSOMA
508123561401	1	36 0	1	0 0	0	0 0	0	95	06/29/8	32.5	14.5		13	G.BOLEOSOMA
508123561401	1	31 0	1	0 0	0	0 0	0	95	07/12/8	31.0	15.5		18	G.BOLEOSOMA
508123561408	1	55 0	1	0 0	0	0 0	0	95	06/16/8	30.8	33.0		18	G.SMARAGDUS
508123561501	1	14 0	1	0 0	0	0 0	0	25	06/21/8	29.9	11.2		8	G.BOSCI
508123561501	1	11 0	1	0 0	0	0 0	0	35	06/14/8	32.0	10.5		5	G.BOSCI
508123561501	2	12 16	2	0 0	0	0 0	0	35	07/05/8	33.2	01.5		10	G.BOSCI
508123561501	1	23 0	1	0 0	0	0 0	0	45	07/05/8	32.0	03.0		9	G.BOSCI
508123561501	1	14 0	1	0 0	0	0 0	0	45	07/13/8	31.5	02.2		8	G.BOSCI
508123561501	1	24 0	1	0 0	0	0 0	0	4T	06/21/8	29.5	02.2		14	G.BOSCI
508123561501	3	10 11	2	16 0	1	0 0	0	55	06/14/8	32.5	15.0		10	G.BOSCI
508123562302	2	25 28	2	0 0	0	0 0	0	25	06/14/8	31.0	08.0		6	M.GULOSUS
508123562302	7	10 11	4	14 19	2	35 0	1	35	07/05/8	33.2	01.5		10	M.GULOSUS
508123562302	1	29 0	1	0 0	0	0 0	0	35	07/13/8	32.8	02.5		8	M.GULOSUS
508123670409	1	62 0	1	0 0	0	0 0	0	105	06/20/8	31.2	36.0		14	S.GRANDICORNIS
508124010406	2	68 0	1	101 0	1	0 0	0	1T	06/28/8	31.0	03.2		14	C.SPILOPTERUS
508124010406	3	66 0	1	72 73	2	0 0	0	3T	06/21/8	29.0	00.2		16	C.SPILOPTERUS

PAGE 16 PHYLOGENETIC SORT OF 2500CFS FISH DATA BY TAXON, STATION, AND DATE. 04/14/80

GENUS-SPECIE TAXON NUMBER	TOTAL IND	SIZE CLASS I	NO. IND CLASS I	SIZE CLASS II	NO. IND CLASS II	SIZE CLASS III	NO. IND CLASS III	STATION NUMBER	DATE MO. DAY YR	TEMP TOP C	SAL TOP	SAL BOTTOM	NO. OF SPECIES	GENUS INITIAL AND SPECIES NAME
508124010406	2	44 0	1	45 0	1	0 0	0	3T	06/28/8	30.5	02.0		7	C.SPILOPTERUS
508124010406	1	52 0	1	0 0	0	0 0	0	3T	07/12/8	31.2	00.5		11	C.SPILOPTERUS
508124010406	1	42 0	1	0 0	0	0 0	0	4T	06/14/8	32.0	14.0		8	C.SPILOPTERUS
508124010406	3	33 0	1	42 0	1	95 0	1	4T	06/21/8	29.5	02.2		14	C.SPILOPTERUS
508124010406	1	55 0	1	0 0	0	0 0	0	4T	06/29/8	30.8	02.0		16	C.SPILOPTERUS
508124010406	3	54 0	1	64 0	1	76 0	1	5S	07/05/8	32.8	02.8		12	C.SPILOPTERUS
508124010406	2	34 48	2	0 0	0	0 0	0	5T	06/28/8	31.0	05.5		11	C.SPILOPTERUS
508124010406	1	92 0	1	0 0	0	0 0	0	5T	07/05/8	32.2	00.0		13	C.SPILOPTERUS
508124010406	1	43 0	1	0 0	0	0 0	0	6S	07/05/8	32.5	04.2		9	C.SPILOPTERUS
508124010406	1	63 0	1	0 0	0	0 0	0	6T	06/21/8	00.0	00.0		11	C.SPILOPTERUS
508124010406	1	55 0	1	0 0	0	0 0	0	6T	06/28/8	31.5	04.5		8	C.SPILOPTERUS
508124010406	1	55 0	1	0 0	0	0 0	0	9S	06/20/8	30.0	35.0		20	C.SPILOPTERUS
508124010406	1	34 0	1	0 0	0	0 0	0	10S	07/14/8	31.8	24.0		14	C.SPILOPTERUS
508124010701	1	53 0	1	0 0	0	0 0	0	7T	06/21/8	29.6	12.2		6	F.CROSSOTUS
508124030101	3	27 0	1	32 36	2	0 0	0	1T	06/28/8	31.0	03.2		14	A.LINEATUS
508124030101	3	21 0	1	30 0	2	0 0	0	1T	07/12/8	30.5	02.0		9	A.LINEATUS
508124030101	1	22 0	1	0 0	0	0 0	0	3T	07/12/8	31.2	00.5		11	A.LINEATUS
508124030101	1	14 0	1	0 0	0	0 0	0	5S	06/14/8	32.5	15.0		10	A.LINEATUS
508124030101	1	20 0	1	0 0	0	0 0	0	5S	07/05/8	32.8	02.8		12	A.LINEATUS
508124030101	2	22 27	2	0 0	0	0 0	0	5T	07/05/8	32.2	00.0		13	A.LINEATUS
508124030302	3	40 0	1	65 82	2	0 0	0	1T	06/28/8	31.0	03.2		14	T.MACULATUS
508124030302	1	41 0	1	0 0	0	0 0	0	1T	07/05/8	31.2	04.5		10	T.MACULATUS
508124030302	7	39 41	4	45 50	3	0 0	0	1T	07/12/8	30.5	02.0		9	T.MACULATUS
508124030302	1	76 0	1	0 0	0	0 0	0	3T	06/14/8	32.5	12.0		11	T.MACULATUS
508124030302	1	80 0	1	0 0	0	0 0	0	3T	06/21/8	29.0	00.2		16	T.MACULATUS
508124030302	1	75 0	1	0 0	0	0 0	0	3T	06/28/8	30.5	02.0		7	T.MACULATUS
508124030302	1	118 0	1	0 0	0	0 0	0	3T	07/12/8	31.2	00.5		11	T.MACULATUS
508125120500	1	7 0	1	0 0	0	0 0	0	7S	07/14/8	30.5	22.2		18	MONACANTHUS SP.
508125020502	3	13 17	2	24 0	1	0 0	0	5S	06/21/8	30.2	11.0		10	M.HISPIDUS
508125020502	3	9 11	2	21 0	1	0 0	0	7S	06/20/8	30.5	34.0		11	M.HISPIDUS
508125020502	1	8 0	1	0 0	0	0 0	0	9S	07/06/8	32.5	25.0		11	M.HISPIDUS
508125020502	1	15 0	1	0 0	0	0 0	0	9S	06/20/8	30.0	35.0		20	M.HISPIDUS
508125030105	1	19 0	1	0 0	0	0 0	0	8S	06/29/8	34.5	25.5		15	L.TRIQUETER
508125030105	1	15 0	1	0 0	0	0 0	0	8S	07/14/8	31.8	28.2		14	L.TRIQUETER
508125030105	1	19 0	1	0 0	0	0 0	0	9S	07/12/8	31.0	15.5		18	L.TRIQUETER
508125030105	1	9 0	1	0 0	0	0 0	0	10S	06/20/8	31.2	36.0		14	L.TRIQUETER
508125030105	1	9 0	1	0 0	0	0 0	0	10S	07/06/8	27.0	35.8		8	L.TRIQUETER
508125030105	2	20 0	1	29 0	1	0 0	0	10S	07/14/8	31.8	26.0		14	L.TRIQUETER
508125040304	1	7 0	1	0 0	0	0 0	0	7S	06/29/8	32.5	12.0		15	S.NEPHELUS
508125040304	1	38 0	1	0 0	0	0 0	0	9S	07/06/8	33.0	16.0		17	S.NEPHELUS
508125040308	2	150 0	2	0 0	0	0 0	0	2T	06/28/8	31.2	05.5		10	S.TESTUDINEUS
508125040308	1	80 0	1	0 0	0	0 0	0	3S	06/14/8	32.0	10.5		5	S.TESTUDINEUS
508125040308	2	74 0	1	88 0	1	0 0	0	5S	06/21/8	30.2	11.0		10	S.TESTUDINEUS
508125040308	1	80 0	1	0 0	0	0 0	0	6S	07/05/8	32.5	04.2		9	S.TESTUDINEUS
508125040308	1	135 0	1	0 0	0	0 0	0	7S	06/29/8	32.5	12.0		15	S.TESTUDINEUS
508125040308	1	65 0	1	0 0	0	0 0	0	7S	07/14/8	30.5	22.2		18	S.TESTUDINEUS
508125040308	2	180 190	2	0 0	0	0 0	0	9S	06/16/8	30.8	33.0		18	S.TESTUDINEUS
508125040308	2	140 160	2	0 0	0	0 0	0	9S	06/20/8	30.0	35.0		20	S.TESTUDINEUS
508125040308	1	180 0	1	0 0	0	0 0	0	10S	06/20/8	31.2	36.0		14	S.TESTUDINEUS
508125040308	2	135 140	2	0 0	0	0 0	0	10S	06/27/8	32.5	14.5		20	S.TESTUDINEUS
508125050103	1	39 0	1	0 0	0	0 0	0	7S	06/20/8	30.5	34.0		11	C.ANTILLARUM
508125050105	1	43 0	1	0 0	0	0 0	0	2T	06/28/8	31.2	05.5		10	C.SCHOEPFI
508125050105	2	45 0	1	85 0	1	0 0	0	7S	07/14/8	30.5	22.2		18	C.SCHOEPFI
508125050105	1	60 0	1	0 0	0	0 0	0	9S	06/16/8	30.8	33.0		18	C.SCHOEPFI