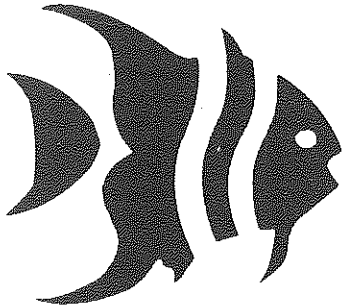


SCHROEDER

DAUPHIN ISLAND SEA LAB



TECHNICAL REPORT

REPORT No. 83-003

ANALYSIS OF AN ENVIRONMENTAL MONITORING PROGRAM
THEODORE SHIP CHANNEL AND BARGE CHANNEL EXTENSION
MOBILE BAY, ALABAMA

VOLUME II

DATA MANAGEMENT AND ANALYSIS

Dauphin Island Sea Lab
Dauphin Island, Alabama 36528

ANALYSIS OF AN ENVIRONMENTAL MONITORING PROGRAM
THEODORE SHIP CHANNEL AND BARGE CHANNEL EXTENSION
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VOLUME II

DATA MANAGEMENT AND ANALYSIS

Prepared for

Mobile District Corps of Engineers
Contract No. DACW01-80-C-0264
(With Ammendments)

Prepared by

Marine Environmental Sciences Consortium
Dauphin Island, Alabama

MARCH 1983

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INTRODUCTION

The key to research is data, and the degree of success associated with that research depends largely upon the quality, quantity and form of the data. It is important, therefore, that the management of the data be performed as an organized, efficient operation requiring a minimum amount of effort. This can be most effectively accomplished by the use of automatic data processing equipment such as digital computers. Once established, a computerized data base allows more flexibility in the query of that data and gives the research more time to adequately interpret the results.

The data management system (DMS) developed for the Marine Environmental Sciences Consortium (MESC) was designed to be simple enough to be utilized by persons with little experience in computer usage but flexible enough to allow complex analyses to be performed. The system is also designed to act as a data archive and reference system so that the data are available to researchers working in the same areas in the future.

This report documents the organization of the DMS, Data Formats used for the various MESC projects and existing application programs developed for MESC. Although it is not designed per se to be a user's manual for the DMS application programs, most documented programs herein will run in a batch mode as they are presented. Some problems may be encountered in implementing these programs on a particular system. Please contact the author for advice with such problems.

RATIONALE AND ORGANIZATION OF THE DATA MANAGEMENT SYSTEM

A. RATIONALE

There are three elements in any data management system. Each is a separate entity; however, all are interrelated and dependent to some extent upon one another. The first of these is data collection, the initial introduction of data into the system. This area is primarily the concern of scientists and technicians who set guidelines about what is measured, what procedures are to be used and what degree of precision is necessary to effect reliability and validity in the data. Overlapping part of this area is the second element, data storage, which is the responsibility of the data manager who works out of the MESC office. Included in this element are such tasks as designing and furnishing forms and formats for the data collection, performing the necessary editing operations, filing, cataloging, making decisions as to storage media, acting as controlling and coordinating center and attending to related tasks. As a result of the first two elements, data display and retrieval exists. The data manager communicates with the "user" of the data and supplies whatever is necessary to get the job done. This may take a variety of forms, a few of which are graphs, maps, charts, tables and data in a form to be used as input to other computer activities.

These three elements serve as an outline of the progressive movement of data from the source to the hands of those people who analyze, manipulate and examine them before drawing conclusions and formulating solutions based on those data.

B. ORGANIZATION

Data collected by MESC are entered into the data base using an IBM 3774-P2 remote batch communication terminal and are stored locally on magnetic diskettes. Individual diskettes are utilized for different data types to insure the fidelity of the data base and to allow for flexible archiving procedures. Data are written onto the diskette in EBCDIC code in the Basic Exchange Diskette format. Editing of the data is accomplished locally using the 3774 terminal. Listings of the raw data can also be obtained locally.

Once the data are entered onto diskettes, they can be transmitted to a central data processor for analysis. Several remote processing centers (hosts) are accessible by the MESC terminal, the University of Alabama in Birmingham (Rust Computer Center), the University of Florida (Northeast Regional Data Center), the University of South Alabama, Wayne State University and the Boeing Computer Service. High speed output can then be routed to the MESC office. All processing centers utilize IBM's operating system OS/MVS JES2 or CP/CMS. In addition to the remote batch facilities, programs and/or data can be entered and retrieved via low speed ASCII terminals in a timeshare mode. These facilities allow for more efficient program editing via CRT displays and retrieval of hardcopy output of graphics display.

A flow diagram of the use of the data management system is presented in Figure 1. Data are transmitted to the host center and stored on an operating system (OS) disk file. Applications programs are then transmitted which read the data from the disk (host) system, perform the necessary analyses and route the output to the MESC/RJE terminal. Alternately, application programs can be submitted via timesharing facilities and retrieved directly or routed for RJE retrieval. Once the analyses are completed, the data are scratched from the host system to achieve maximum economy.

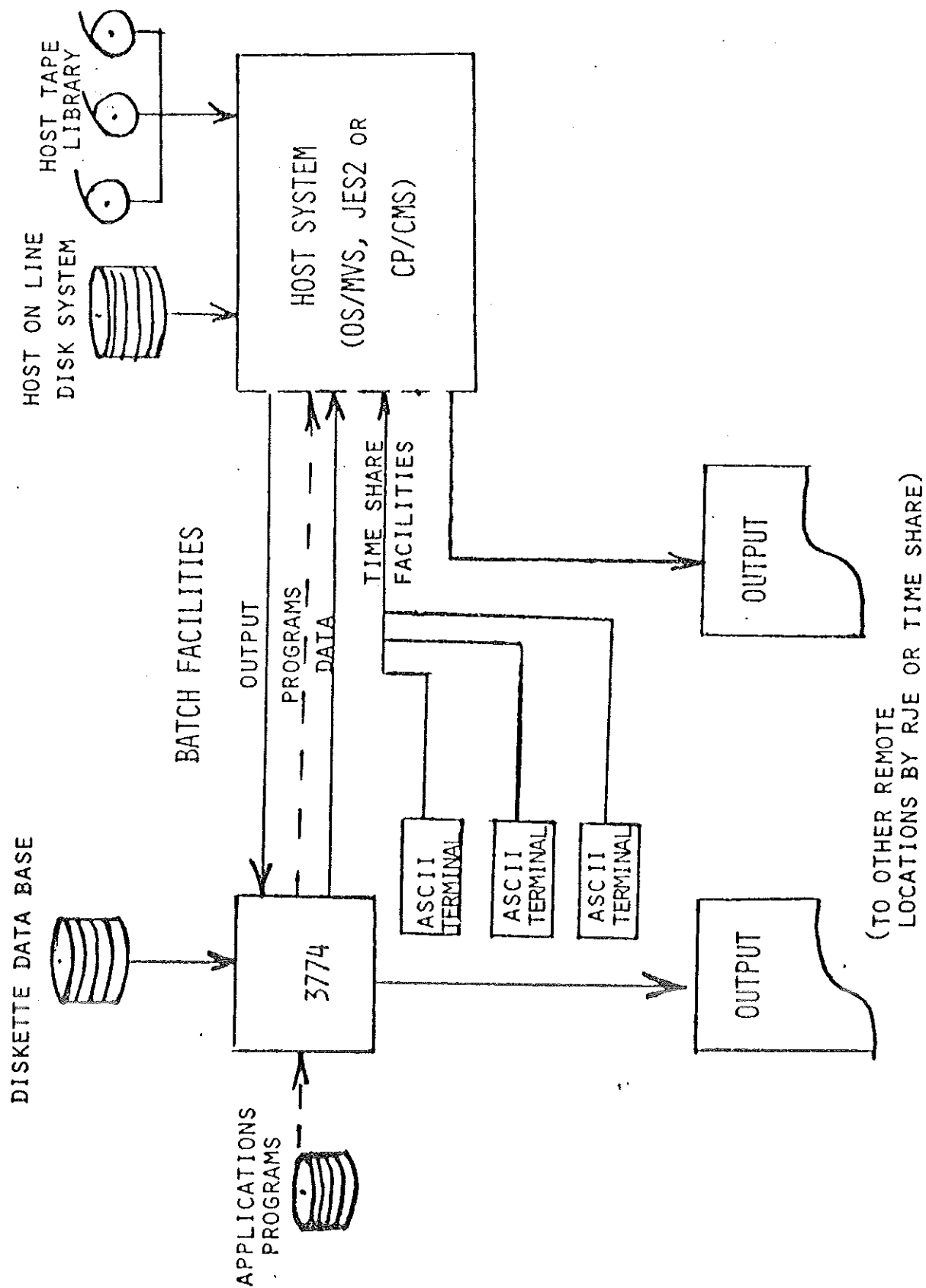


Figure 1. Flow Diagram Illustrating Information Flow Through the Data Management System.

STATUS OF THE DATA MANAGEMENT SYSTEM

A. OVERVIEW

Since both the various elements of the data base and their respective application programs are dynamic entities, changes in both can be expected, even before this report is submitted. However most changes will consist of 1) improved versions of the application programs; 2) correcting errors in the data files; and 3) updating data files with more recently collected data. A final tape of the Theodore project data was prepared under contract DACW01-82-M-9911 and provided to the Mobile District. Table 1 presents the data and formats for these files which are resident at the Mobile District ADP center.

Status of the individual work elements of this phase of the project are presented in the following sections with representative examples of the displays developed. All application programs for the manipulation of physical, benthic and sedimentological data are documented in Appendices B, C and D respectively.

With the exception of a few specialized displays, all programs for data manipulation and handling have been written in the Statistical Analysis System's language (SAS 1979). This has the particular advantages of 1) the language is well documented; 2) the language is simple to use, even for those with little or no previous experience; and 3) it prepares the data in a format which is ready to be analyzed using the powerful library of procedures available in SAS.

TABLE 1. Description of Data Files and formats for the Data Tape containing the Theodore Data.

MARINE ENVIRONMENTAL SCIENCES CONSORTIUM
DATA MANAGEMENT SYSTEM
TAPE PREPARED FOR ARMY CORPS OF ENGINEERS, MOBILE DISTRICT
CONTRACT NO: DACWO1-82-M-9911

DATE: 10.31.82
PREPARED BY: JAR

The characteristics of this tape are as follows:

DENSITY: 1600 BPI
TRACKS: 9 Track Tape
LABEL: Unlabelled
CHARACTER SET: ASCII
RECORD FORMAT: Fixed Block
LOGICAL RECORD LENGTH: 80
BLOCK SIZE: 80

The files on this tape are as follows:

- 1 Introduction to tape (Characteristics, Index, Formats)
- 2 Hydrographic and nutrient Data (Source: Dr. Eleuterius)
- 3 Sediment Data (Sources: Drs. Lytle and Lytle; and GSRI Elutriate Data).
- 4 Theodore Project Hydrographic Data
- 5 Theodore Project Sediment Data
- 6 Theodore Project Biological Taxonomic Catalog.
- 7 Theodore Project Biological Data.
- 8 DISL Wind Data.
- 9 DISL Meteorologic Data.
- 10 Theodore Project Continuous Recording Hydrographic Data - Monitoring Phase.
- 11 Theodore Project Continuous Recording Hydrographic Data - Baseline Phase.
- 12 Mobile River System Flow Data.
- 13 End of Recording Message and updates if any.

THE FORMATS OF THE DATA ON THE FILES ARE AS FOLLOWS:

FILE 1: INTRODUCTION TO TAPE
Free form alphanumeric text.

FILE 2: HYDROGRAPHIC AND NUTRIENT DATA (DR. ELEUTERIUS)
Four consecutive records comprise each data entry on this file.
THE FIRST RECORD OF AN ENTRY is a header card formatted as follows:

1-3	Station Number	F3.0
4-9	Date (Month, Day, Year)	F6.0

14-18	Latitude (Degrees, Tenths of Minutes)	F5.0
20-24	Longitude (Degrees, Tenths of Minutes)	F5.0

THE THREE RECORDS THAT FOLLOW are the three observations at each station, and they are formatted as follows:

14-19	Depth (m.)	F6.1
20-25	Temperature (Deg. Centigrade)	F6.1
26-31	Salinity (ppt.)	F6.1
32-37	pH	F6.1
38-43	Dissolved Oxygen (ppm)	F6.2
44-50	Nitrite (microgm. atms. /l)	F7.3
51-58	Nitrate (microgm. atms. /l)	F8.3
59-65	Orthophosphate (microgm. atms. /l)	F7.3
66-72	Total Phosphorous (microgm. atms. /l)	F7.2

FILE 3: Contains the sediment and elutriate data of Drs. Lytle and GSRI.

There are seven types of data on the file, each with its own format, and characterized by a specific ID value in columns 7 and 8.

ID 64 : GSRI SEDIMENT CHEMISTRY

1-6	Sample Number	A6
7-8	ID (=64)	F2.0
15-20	Moisture (%)	F6.2
21-26	Volatile Solids (%)	F6.2
27-32	COD (mg/kgx1000)	F6.2
33-38	TOC (mg/kgx1000)	F6.2
39-44	Total Phosphate (mg/kg)	F6.2
45-50	T.K.N. (mg/kg N)	F6.1
51-55	Ammonia N2 (mg/kg N)	F5.1
56-60	Oil & Grease (mg/kg)	F5.0
61-66	Eh (mv)	F6.0

ID 65 : GSRI SEDIMENT CHEMISTRY

1-6	Sample Number	A6
7-8	ID (=65)	F2.0
16-19	Moisture (%)	F4.1
23-26	Mercury (mg/kg)	F4.2
29-31	Arsenic (mg/kg)	F3.1
34-37	Copper (mg/kg)	F4.1
39-43	Zinc (mg/kg)	F5.1
47-50	Cadmium (mg/kg)	F4.2
52-55	Lead (mg/kg)	F4.1
58-61	Nickel (mg/kg)	F4.1
63-67	Chromium (mg/kg)	F5.1
70-73	Ferrous Iron (mg/kg)	F4.1

ID 66 : GSRI ELUTRIATE DATA - BEFORE

ID 67 : GSRI ELUTRIATE DATA - AFTER

1-6	Sample Number	A6
7-8	ID	F2.0
9-14	Date (Month, Day, Year)	F6.0
16-20	TOC	F5.2

21-24	Ammonia	F4.2
26-30	TKN	F5.3
31-35	Phosphate	F0.4
36-40	Conductivity	F5.0
41-44	Salinity	F4.2
45-47	pH	F0.2
48-51	Mercury	F4.1

52-55	Arsenic	F4.1
56-59	Copper	F4.1
60-63	Zinc	F4.1
64-66	Cadmium	F3.1
67-70	Lead	F4.1
71-73	Nickel	F3.1
74-76	GIR	F3.1
77-80	Iron	F4.1

ID 68 : GSRI SEDIMENT MICROBIOLOGY

1-4	Sample number	A4
7-8	ID (=68)	F2.0
15-19	Moisture (%)	F5.2
20-25	Total Coliforms (No. orgs/g)	F6.0
26-31	Fecal Coliforms (No. orgs/g)	F6.0

ID 69 : DRS. LYTLE ELUTRIATE DATA - BEFORE

ID 70 : DRS. LYTLE ELUTRIATE DATA - AFTER

1-2	Station	A2
3-4	Sample Number	F2.0
5	Condition code	A1
7-8	ID	F2.0
9-14	Date (Month, Day, Year)	F6.0
15-22	DOC	F8.5
23-30	TOC	F8.4
31-38	NH3	F8.4
39-44	NO3	F6.2
45-50	NO2	F6.3
51-58	TKN	F8.4
59-64	PO4	F6.3
65-71	S. O2	F7.2

FILE 4: THEODORE PROJECT HYDROGRAPHIC DATA

These are the data collected on sampling.

Four types exist - Data from B Stations (ID 12).
 - Data from T Stations (ID 11).
 - Data from 26 hour surveys (ID 14).
 - Data from 5 Day Surveys (ID 15).

The formats are common.

1-2	Project Identifier (=CE)	A2
3-4	Cruise Number	F2.0
5-6	Station Number	F2.0
7-8	ID	F2.0
9-14	Date (Month, Day, Year)	F6.0
15-19	Longitude (Deg. tenths of minutes)	F5.0

20-24	Latitude (Deg. tenths of minutes)	F5.0
25-28	Time (CDT)	F4.0
29-33	Depth (M)	F5.1
34-38	Temperature (deg. C)	F5.2
39-45	Conductivity (mmho/cm)	F7.2
46-50	Field NTU	F5.2
51-55	Dissolved oxygen (mg/l)	F5.2
56-61	Turbidity (NTU)	F6.2
62-67	Total Solids (mg/l)	F6.2
69-70	Percent transmittance	F2.0

FILE 5: THEODORE PROJECT SEDIMENT DATA

Four types exist - TOC and Reducing substance data (ID 85).
 - Sediment Grainsize Type 1 (ID 91).
 - Sediment Phi Percentiles (ID 92).

The formats the same as File 4 in columns 1 to 24.

ID 85 : SEDIMENT GRAINSIZE TYPE 1

25-29	Moisture content (%)	F5.1
30-36	TOC	F7.3
37-57	Reducing substances (gO2/kg) 3 Replics.	3F7.0

ID 91 : SEDIMENT PHI PERCENTILES

25-26	Replicate Number (corrs to biol. rep.)	F2.0
27-31	Gravel (%)	F5.2
32-36	Sand (%)	F5.2
37-41	Silt (%)	F5.2
42-46	Clay (%)	F5.2
47-50	Folks Classification Code	A4
51-55	Shepard's Classification Code	A5
56-60	Trefethens Classification Code	A5
61-65	COE Classification Code	A5
66-72	US Bureau of Soils Classn. Code.	A7

ID 92 : SEDIMENT PERCENTILES (IN PHI)

25-26	Replicate Number	F2.0
27-32	5	F6.3
33-38	16	F6.3
39-44	25	F6.3
45-50	50	F6.3
51-56	75	F6.3
57-62	84	F6.3
63-68	95	F6.3
69-74	99.9	F6.3
75-80	Correlation coefficient of extrapln.	F6.5

ID 93 : SEDIMENT GRAINSIZE - TYPE 2

25-26	Replicate Number	F2.0
27-32	Median Diam (Phi)	F6.3
33-38	Mean Diam (Phi)	F6.3
39-44	Standard Deviation	F6.3
45-47	Sorting Code	A3
48-53	Skewness	F6.3
54-56	Skewness Code	A3

57-62	Kurtosis	F6.3
63-65	Kurtosis Code	A3

FILE 6 : BIOLOGICAL TAXONOMIC CATALOG

1-4	Identifier (= 'TAXA')	A4
6-17	Species Code	F12.0
20-23	Higher Taxon Code	F4.0
25-75	Species Name	A49

FILE 7 : BIOLOGICAL DATA

1-24	Same as File 4	
25-36	Species Code	F12.0
37-64	Nos of individuals in reps 1-7	7F4.0

FILE 8 : DISL WIND DATA

Each entry consists of two lines. AM entries are identified by an 'A', and PM entries by a 'P' in column 80.

1-6	Date (Month, Day, Year)	F6.0
7	ID (=9)	F1.0
8-10	Direction at 1 o'clock (degrees)	F3.0
11-13	Speed at 1 o'clock (knots)	F3.0
14-79	As 8-13 from 2 to 12 o'clock	11F6.0
80	A/P	A1

FILE 9 : METEOROLOGIC DATA AT DISL

1-6	Date (Month, Day Year)	F6.0
7	ID (=5)	F1.0
18-21	Time (CDT)	F4.0
22-24	Sky Cover	A3
25-28	Wave height (Feet)	F4.1
29-31	Visibility (Miles)	F3.0
32-34	Wind Direction (Degrees)	F3.0
35-37	Wind Speed (Knots)	F3.0
38-40	Weather Code	F3.0
41-45	Water Temperature (deg. Frht.)	F5.1
46-50	Air Temperature (deg. Frht.)	F5.1
51-55	Wet Bulb (deg. Frht.)	F5.1
56-60	Barometric Pressure (inches of Hg.)	F5.2
61-63	Relative Humidity (%)	F3.0
64-68	Daily Maximum Temperature (deg. F.)	F5.1
69-73	Daily Minimum Temperature (deg. F.)	F5.1
74-79	Precipitation (inches)	F6.2

FILE 10 : THEODORE PROJECT CONTINUOUS RECORDING INSTRUMENT DATA
MONITORING PHASE

Refer to the reports for station locations.

1-6	Date (Month, Day, Year)	F6.0
7-8	ID	F2.0
9-12	Time (CDT)	F4.0
16-20	Station B1 Salinity (ppt)	F5.1
21-25	Station B1 Temperature (deg. C.)	F5.1

31-35	Station B4 Salinity (ppt.)	F5.1
36-40	Station B4 Temperature (deg. C.)	F5.1
46-50	Station B7 Salinity (ppt.)	F5.1
51-55	Station B7 Temperature (deg. C.)	F5.1
61-65	Station B8 Salinity	F5.1
66-70	Station B8 Temperature	F5.1
75	Surface/Bottom	A1

FILE 11 : THEODORE PROJECT CONTINUOUS RECORDING INSTRUMENT DATA
BASELINE PHASE.

1-4	Station Number	A4
7-8	ID	F2.0
11-16	Date (Month, Day, Year)	F6.0
20-24	Time (CDT)	F4.0
26-30	Salinity (ppt.)	F5.1
31-35	Temperature (deg. C.)	F5.1

FILE 12 : MOBILE RIVER SYSTEM FLOW DATA

1-6	Date (Month, Day, Year)	F6.0
7-8	ID (=48)	F2.0
19-27	Coffeeville flow (DISL)	F9.1
28-33	Coffeeville flow (Published)	F6.0
40-49	Claiborne flow (DISL)	F10.1
50-55	Claiborne flow (Published)	F6.0

NOTE: DISL calculated values are used only until Army Corps of Engineers published values become available. DISL and published values for the same day will usually not be on the same record.

FILE 13 : COMPLETION OF RECORDING MESSAGE AND UPDATES IF ANY
Free form alphanumeric text.

The SAS system has been described by Anderson et al. (1980) as follows:

"SAS has most of the other features needed for data base management. It has a convenient retrieval language and a flexible report writing capacity. A wide range of statistical procedures is available, both within SAS and through an interface within the BMDP statistical package (Dixon and Brown 1979). SAS supports the required data types, including dates, times, and missing value recognition as well as the editing and updating functions. Mnemonic abbreviations can be used instead of code numbers for identification, and SAS contains a PL/I-like programming language which can be used to manipulate the data and check input information. Statements are available for sorting, merging, and updating files. In addition, it is a general purpose statistical and relational data base management system which places few restrictions on the evolution of the data base. The cost is reasonable because data can be stored less expensively on tape than on disks.

SAS can accommodate any arbitrarily complex data structure by supporting a relational data base. It directly handles a hierarchical structure by merging levels, two at a time, and associating information from the higher levels with each record from the lower level. Scientific data base management systems such as the Scientific Information Retrieval (SIR) system (Anderson et al. 1976, 1978) have been developed to manage hierarchical files effectively. Although SIR provides a full range of data base management functions, most of them duplicate functions available in SAS. On the other hand, SAS can avoid these inefficiencies and accomplish a multi-level merge in one pass of the data if additional programming statements are used (Ellis 1978)."

A few graphics programs have been implemented using FORTRAN based graphics routines for a Gould plotter. For the most part, these routines are compatible with other graphics equipment and should be readily convertible.

All Job Control Language (JCL) presented in the Appendices in this report is written for an IBM 370/Amdahl 470 installation operating under OS/VS2 JES2 (IBM 1979). Two of the computer installations currently used by MESC operate under CP/CMS systems.

B. INDIVIDUAL DATA MANAGEMENT WORK ELEMENTS

Data Formats: Data formatting for all of the various elements of ongoing projects including input formats for the continuous recording instrument records, has been completed. The formats for all card-image data sets are presented in Appendix A of this report. Input formats for the continuous hydrographic data are included in program B - in Appendix B. While no further data formats are anticipated, new formats will be prepared if additional data requirements prove to be necessary for a particular application.

Programs for Data Input and Conversions: Programming for the input of the raw data into the Data Management System has been completed for all data elements. When conversion of the field data are necessary, such as Dissolved Oxygen correction and conductivity and salinity conversions,

programs have been written which make all necessary conversions and corrections. These procedures are documented in Appendices B, C and D.

Programs for Raw Data Displays: Programs which produce tabularized output of the data have been developed. These outputs are designed to be incorporated into data appendices for the final report. Figures 2 and 3 present output examples of the physical and macroinvertebrate data displays respectively.

Statistical Programs: Since all input programs have been written in SAS, implementation of the statistical procedures in the SAS procedure library is a relatively simple process. Means, correlations, ANOVA and simple and multiple regression can be readily performed using all of the data elements of the study. Additionally, an interface procedure is available to link a SAS job with the procedures available in the Biomedical Programs package (BMDP). This provides the researchers with a large library of statistical procedures that will make analysis of the large data base being assembled a relatively easy task.

To illustrate the capability of the statistical packages, Tables 2 through 4 and Figure 9 show the output from the SAS procedures PROC GLM and PROC PLOT for the variable temperature. Table 2 is a multi-variate analysis of variance table for the variable temperature for both the baseline and operational data. Showing very highly significant trip, station and depth (IDEP) interactions. Tables 3 and 4 show the corresponding tables from the Duncan's multiple range test (of PROC GLM) needed to determine which trips and stations are significantly different from one another. Finally, Figure 4 is a plot of the mean, the maximum and the mean \pm standard error of temperature (by trip). These types of displays were provided to the scientists involved for their interpretation of the data analysis.

Community Analysis: Three indices for macroinfauna community analyses were calculated for this study: Diversity index of Shannon-Weiner (H'), Evenness (J') and Richness (R). The Shannon-Weiner Diversities were calculated by the machine method of Lloyd, Zar and Karr (1968) based on the log to the base 2 (bits). Richness was calculated by the following formula:

$$\text{Richness} = (\bar{X} \text{ sp}-1)/\text{Log } (\bar{X} \text{ ind})$$

Where: $\bar{X} \text{ sp}$ = mean number of species

$\bar{X} \text{ ind}$ = mean number of individuals

Evenness is calculated on the ratio between the species diversity of the sample (H') divided by a hypothetical maximum species diversity (H') expected for a community with that number of species. An explanation of these indices and their use is presented in Weber (1973).

QUALITY ASSURANCE - QUALITY CONTROL

All data input into the MESC data base undergo intensive Quality Assurance and Quality Control (QAQC) procedures. While it can not be categorically stated that there are no errors in the data because of the

***** ARMY CORPS OF ENGINEERS - THEODORE LARGE CHANNEL PROJECT *****													
***** PHYSICAL DATA *****													
***** TURBIDITY STATIONS *****													
***** 14MAY1981 *****													
STATION	TIME (CST)	DEPTH (M)	TEMPERATURE (DEG C)	CONDUCT (MHOS/CM)	SALINITY (PPT)	THERMOSTERIC ANOMALY	DISSOLVED O2 (MG/L)	PTDOXSAT	TURBIDITY (NTU)	TURBIDITY L	TURBIDITY F	TOTAL SOLIDS (MG/L)	XT
1	1025	0.5	22.90	17.00	10.56	5.586	2180	6.60	81.4	5.9	.	6.4	64
1	1025	1.5	22.90	17.50	10.88	5.827	2156	6.18	76.4	.	.	.	.
1	1025	2.5	22.75	21.50	13.45	7.802	1962	5.15	64.4	7.2	.	7.0	48
2	1055	0.5	22.75	20.00	12.49	7.074	2033	7.44	92.5	3.3	.	3.0	82
2	1055	1.5	22.60	20.00	12.49	7.112	2030	7.14	88.6	.	.	.	.
2	1055	3.0	22.50	25.00	15.72	9.570	1788	5.99	75.5	3.9	.	2.9	42
3	1420	0.5	22.00	18.00	11.20	6.293	2110	7.88	95.9	.	.	.	68
3	1420	3.0	21.75	18.00	11.20	6.354	2104	7.76	94.0	4.0	.	3.3	71
5	1403	0.5	22.25	18.00	11.20	6.231	2116	7.01	85.7	4.1	.	3.3	68
5	1403	3.5	22.50	19.50	11.52	6.411	2099	6.55	80.6	3.7	.	4.3	69
6	1245	0.5	22.25	17.50	10.88	5.990	2140	6.86	83.7	4.4	.	4.4	70
6	1325	3.0	22.25	19.00	11.84	6.715	2069	6.82	83.7	5.3	.	5.8	70
7	1325	0.5	22.75	11.00	6.74	2.746	2462	8.20	98.6	32.0	.	33.4	27
7	1325	2.0	23.00	14.00	8.64	4.118	2326	7.89	96.4	26.0	.	27.3	22
8	1240	0.5	22.50	14.50	8.96	4.482	2289	7.73	93.7	5.0	.	4.7	58
8	1240	2.5	22.75	14.50	8.96	4.421	2296	6.27	76.4	7.4	.	8.2	56
9	1133	0.5	22.50	17.50	10.88	5.928	2146	7.31	89.6	3.8	.	3.4	74
9	1133	1.5	22.50	17.50	10.88	5.928	2146	6.74	82.6	.	.	4.6	35
9	1133	3.0	22.50	22.00	13.78	8.108	1931	5.49	68.5	4.8	.	2.6	80
10	1115	0.5	24.50	19.50	12.16	6.374	2102	7.27	93.2	3.2	.	13.9	76
10	1115	1.5	23.75	19.50	12.16	6.573	2083	7.34	92.9	13.0	.	4.0	68
10	1115	3.0	23.50	21.00	13.13	7.365	2005	7.03	89.1	3.7	.	4.0	68
11	1410	0.5	22.25	17.00	10.56	5.748	2164	8.03	97.8	5.8	.	5.8	60
11	1410	3.0	22.25	17.00	10.56	5.748	2164	8.12	99.7	6.8	.	7.3	58
12	1340	0.5	22.40	18.00	11.20	6.194	2120	8.14	99.7	.	.	.	.
12	1340	2.0	22.25	18.00	11.20	6.231	2116	8.08	98.8	.	.	.	.

Figure 2. Example of the output from the physical data application program.

ARMY CORPS OF ENGINEERS - THEODORE BARGE CHANNEL PROJECT										
MONITORING DATA										
BENTHIC MACROINVERTEBRATES - ALL TAXA										
STATION 1										
20APR1982										

TAXON & SPECIES	REPLICATE NO: 1	2	3	4	5	6	7	STATION TOTAL	% STN ABUND	

RHYNCOCOELE										
NEMERTEA										
* - - - - -	0	0	1	-	-	-	-	1	2.38	
TAXON TOTALS	0	0	1	0	0	0	0	1	2.38	

ANNELIDA : POLYCHAETA										
* - - - - -	5	1	1	1	1	4	-	11	26.19	
MEDIOMASTUS AMBIESETA	-	-	-	-	-	-	-	-	-	
SIGAMERA SP. A	1	1	1	1	1	1	-	4	9.52	
PARANDALIA AMERICANA	-	-	-	-	-	-	-	-	-	
SCOLOPLOS ROBUSTUS	1	1	1	1	1	1	2	4	9.52	
PSEUDEURYTHOE AMBIGUA	-	-	-	-	-	-	-	-	-	
CAPITELLA CAPITATA	1	1	-	-	-	-	-	2	4.76	
TAXON TOTALS	2	2	2	3	1	6	4	27	64.29	

MOLLUSCA : PELECYPODA										
* - - - - -	5	2	2	2	1	1	1	14	33.33	
MACOMA SP. A	-	-	-	-	-	-	-	-	-	
TAXON TOTALS	5	2	2	2	1	1	1	14	33.33	

SUMMARY										
NUMBER OF ORGANISMS	7	11	5	5	2	7	5	TOTAL	MEAN ± % C.L	
NUMBER OF SPECIES	3	5	4	4	2	4	3	42	6.00 ± 2.56	
SHANNON WEAVER INDEX	1.15	2.04	1.92	1.92	1.00	1.66	1.52	8	3.57 ± 0.90	
EVENNESS INDEX J'	-	0.72	0.88	0.96	1.00	0.83	0.96	2.55		

ADVISORY : THIS IS PRELIMINARY DATA FOR A PROGRESS REPORT.										

Figure 3. Example of the output from the macroinvertebrate application program.

Table 2. ANOVA table output from PROC GLM.

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: TEMPC

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE
MODEL	41	24354.17106668	594.00417236	1107.36
ERROR	455	244.06856109	0.53641442	
CORRECTED TOTAL	496	24598.23962777		

PR > F R-SQUARE C.V.
 0.0001 0.990078 3.4083
 STD DEV
 0.73240318 TEMPC MEAN
 21.48853119

SOURCE	DF	TYPE I SS	F VALUE	PR > F
TRIP	19	24260.04495710	2380.33	0.0001
STATION	19	40.06617445	3.93	0.0001
IDEP	3	54.05993512	33.59	0.0001

Table 3.

GENERAL LINEAR MODELS PROCEDURE
DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE TEMPC

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

ALPHA LEVEL=.05

DF=455

MS=0.536414

GROUPING			MEAN	N	STATION
	A		22.731250	16	9
	A				
B	A		22.668750	16	8
B	A				
B	A	C	22.593750	16	7
B		C			
B	D	C	22.214583	24	20
B	D	C			
B	D	C	22.212500	16	6
B	D	C			
B	D	C	22.187500	16	1
	D	C			
	D	C	22.075000	16	4
	D	C			
	D	C	22.031250	16	2
	D				
	D		22.022727	22	17
	D				
	D		22.012500	16	5
	D				
	D		21.898276	29	11
	D				
	D		21.706250	16	3
	E		21.187500	28	16
	E				
F	E		21.176923	26	18
F	E				
F	E		21.169643	28	19
F	E				
F	E	G	21.017308	26	14
F	E	G			
F	E	G	20.974286	35	12
F	E	G			
F	E	G	20.940000	35	13
F	E	G			
F	E	G	20.842308	26	22
F		G			
F		G	20.763158	38	21
		G			
		G	20.629167	36	15

Table 4.

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE TEMPC

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

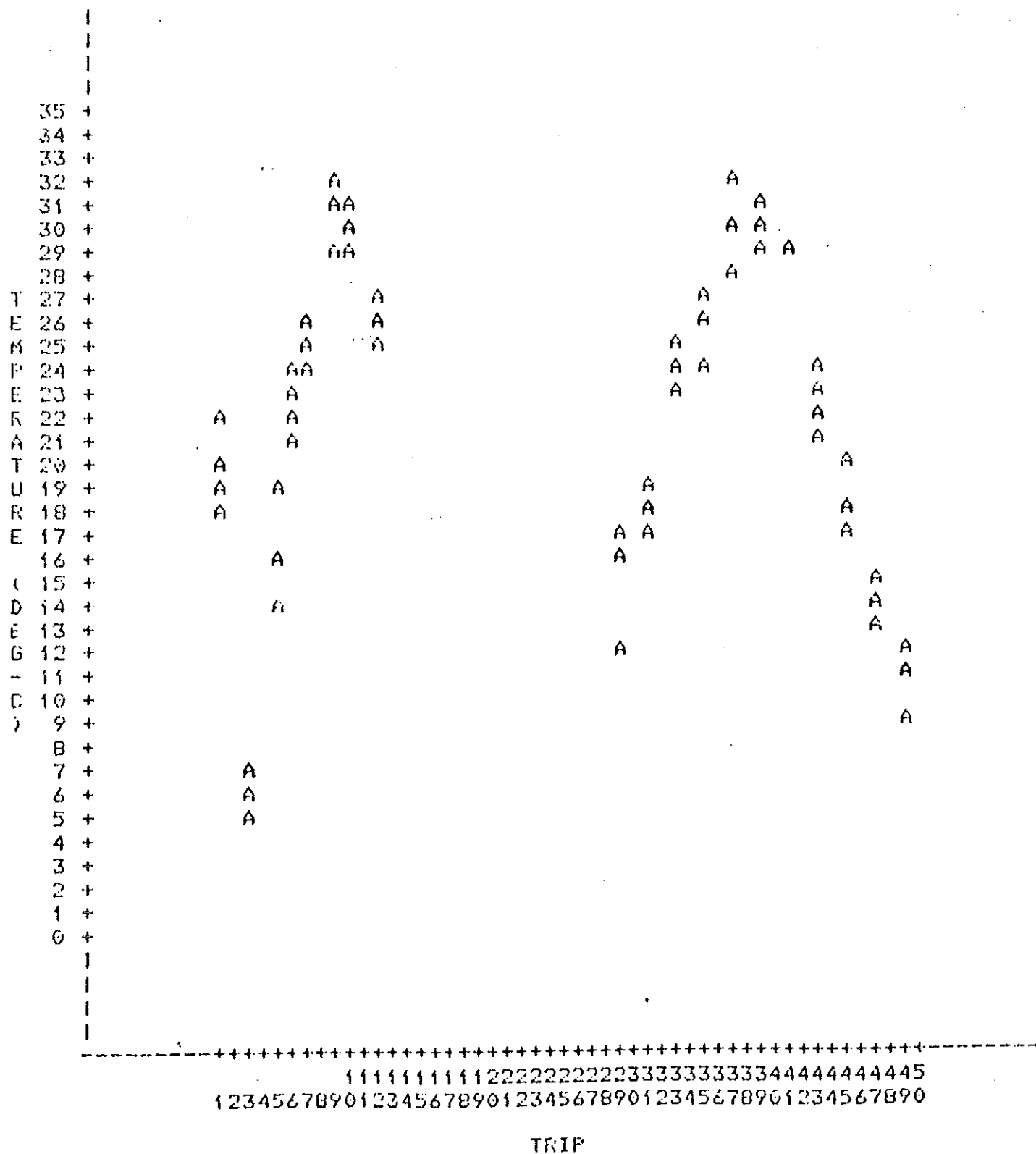
ALPHA LEVEL=.05

DF=455

MS=0.536414

GROUPING	MEAN	N	TRIP
A	31.155556	18	9
B	30.482143	28	39
B			
B	30.233333	30	37
B			
B	30.172222	18	10
C	29.273437	32	41
D	26.100000	18	12
D			
D	26.054688	32	35
D			
D	25.611111	18	7
E	24.276786	28	33
F	22.605556	18	6
F			
F	22.364286	28	43
G	19.694444	18	1
H	18.002941	34	45
H			
H	17.897143	35	31
I	16.100000	18	5
I			
I	16.038095	21	29
J	14.238889	27	47
K	12.708929	28	51
L	10.791667	30	49
M	6.533333	18	3

PLOT OF M3*TRIP... LEGEND: A = 1 OBS, B = 2 OBS, ETC.
PLOT OF T3*TRIP... LEGEND: A = 1 OBS, B = 2 OBS, ETC.
PLOT OF B3*TRIP... LEGEND: A = 1 OBS, B = 2 OBS, ETC.
PLOT OF L3*TRIP... LEGEND: A = 1 OBS, B = 2 OBS, ETC.
PLOT OF U3*TRIP... LEGEND: A = 1 OBS, B = 2 OBS, ETC.



NOTE: 5 OBS HAD MISSING VALUES OR WERE OUT OF RANGE

Figure 9. Output example of the PROC PLOT procedure.

volume of data, future researchers can be reassured that the archived values have been rigorously checked, rechecked and cross-checked.

An outline of the QAQC procedures is depicted in Figure 5. The field data sheets are entered onto the computer coding sheets and verified by visual check. The coding sheets are then keypunched and machine verified by a commercial key punching service. The cards and corresponding listings are then visually checked for errors by comparing the card listing with the computer coding sheets. The computer cards are then read by the IBM 3774 terminal and written onto 8" flexible diskettes at the MESC office. The diskettes are then listed and again cross-checked for accuracy by comparing the listing to the original computer code sheets again. The data are then transmitted to the host system and read onto an online disk data set. Once entered onto the computer, the data are verified by first printing the raw data (Table 5) and comparing the output with the listings from the 3774 diskettes.

Next, plots are prepared (Figure 6), (for physical parameters) and any suspicious points are verified for accuracy with the coded data and compared to the field sheets for final verification. In this way, anomalous or missing data caused by instrument malfunction, operational error (such as the water sampler being lowered into the bottom sediments), or weather conditions can be noted.

Finally, a table of simple statistics is prepared (Table 6) and a plot (Figure 7) of the mean, minimum, maximum, and the mean + standard error is prepared for final verification and quality control check. This procedure ensures that all data entered into the final application programs are correct and complete.

Figure 5. Flow Sheet Illustrating the Data Quality Control Process.

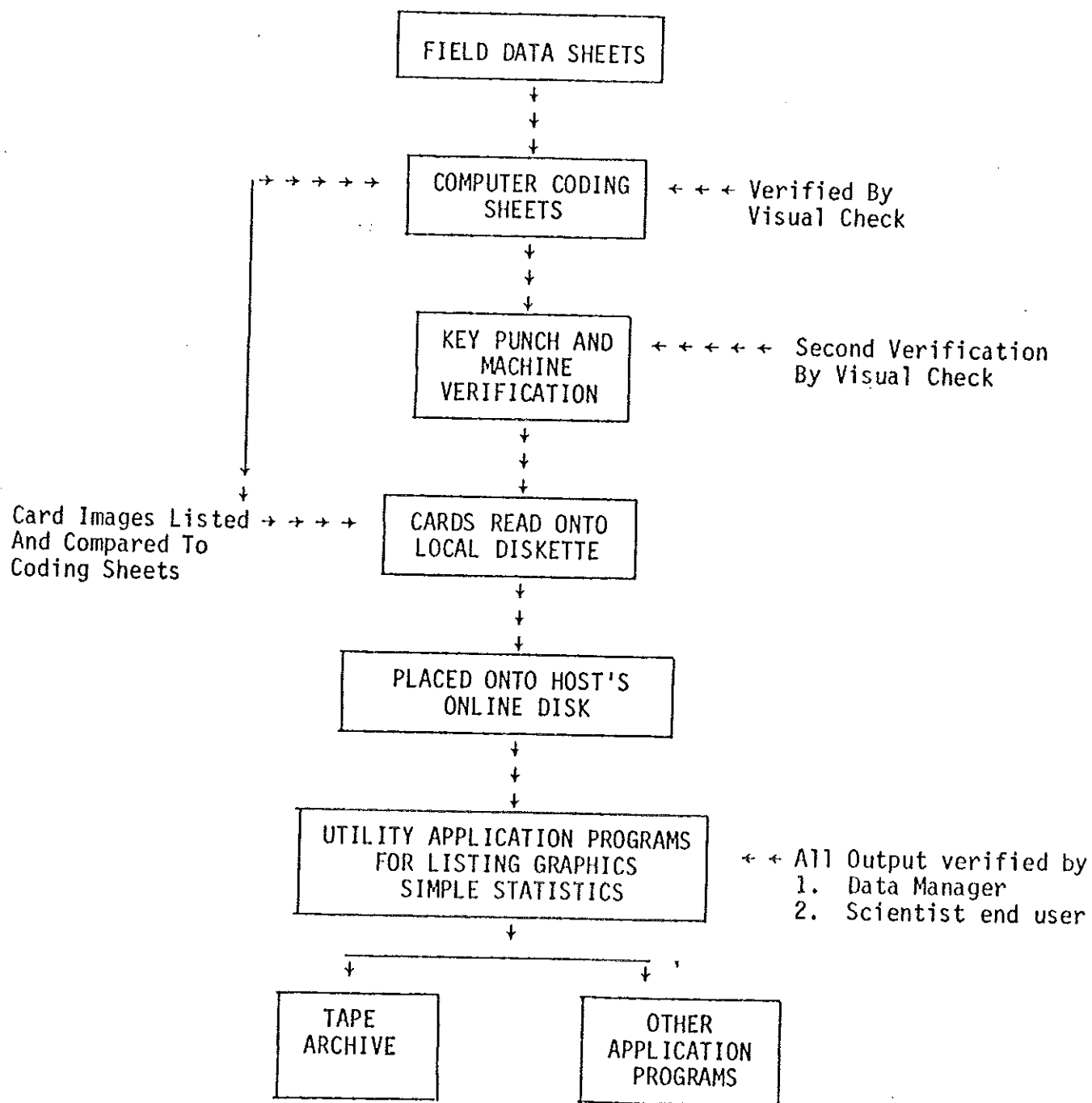


Table 5. Example of an actual QAQC converted data listing for the physical data.

THEODORE SHIP CHANNEL PROJECT - COE
PHYSICAL DATA - CONVERTED VALUES

DATE	LATITUDE	LONGITUDE	STATION	TIME	DEPTH	TEMPERATURE	CONDUCT	SALINITY	DISSOLVED O2	TURBIDITY	TOTAL SOLIDS	XT
MO DA YR	DEG MIN	DEG MIN		(CST)	(M)	(DEG C)	(MHMS/CM)	(PPT)	(MG/L)	(NTU)	(MG/L)	
									FCISAT	L	F	
1 13 81	30 32.0	88 7.1	3	1010	0.5	8.96	26.02	16.38	9.14	86.7	10.20	10.10
1 13 81	30 32.0	88 7.1	3	1010	1.5	8.75	26.02	16.38	9.05	85.5		
1 13 81	30 32.0	88 7.1	3	1010	3.0	8.75	26.02	16.38	8.76	83.3		
1 13 81	30 32.0	88 7.1	3	1010	5.0	9.00	26.02	16.38	8.76	83.3		
1 13 81	30 32.0	88 7.1	3	1010	8.0	9.00	26.53	16.71	8.65	82.4		
1 13 81	30 32.0	88 7.1	3	1010	11.5	10.50	31.15	19.73	8.36	84.0	250.00	677.30
1 13 81	30 31.8	88 6.6	2	1010	0.5	5.60	24.97	15.05	9.33	81.1	4.50	4.30
1 13 81	30 31.8	88 6.6	2	1018	2.5	8.00	25.00	15.72	8.81	81.5		
1 13 81	30 31.8	88 6.6	2	1018	5.0	9.10	25.51	16.05	7.84	74.6		
1 13 81	30 31.8	88 6.6	2	1018	8.0	9.90	26.53	16.71	7.70	74.9		
1 13 81	30 31.8	88 6.6	2	1018	10.0	10.00	27.55	17.38	7.30	71.5		
1 13 81	30 31.8	88 6.6	2	1018	13.5	13.25	36.31	23.11	3.97	33.5	6.60	8.30
1 13 81	30 31.4	88 5.5	1	1030	0.5	8.00	25.00	15.72	9.38	86.7	9.10	10.90
1 13 81	30 31.4	88 5.5	1	1030	1.5	8.00	25.51	16.05	9.26	85.8		
1 13 81	30 31.4	88 5.5	1	1030	3.0	7.90	25.51	16.05	8.98	83.0		
1 13 81	30 31.4	88 5.5	1	1030	6.0	7.75	25.51	16.05	8.52	78.5		
1 13 81	30 31.4	88 5.5	1	1030	10.0	8.25	27.04	17.05	7.16	67.1		
1 13 81	30 31.4	88 5.5	1	1030	12.5	11.75	33.71	21.08	5.74	59.8	170.00	275.60
1 13 81	30 32.0	88 7.1	3	1228	0.5	9.50	26.53	16.71	9.66	93.1	9.60	11.80
1 13 81	30 32.0	88 7.1	3	1228	1.5	9.25	26.02	16.38	9.69	92.7		
1 13 81	30 32.0	88 7.1	3	1228	3.0	9.25	26.53	16.71	9.50	90.9		
1 13 81	30 32.0	88 7.1	3	1228	5.0	9.25	26.53	16.71	9.30	89.1		
1 13 81	30 32.0	88 7.1	3	1228	7.0	9.25	26.53	16.71	9.30	89.1		
1 13 81	30 32.0	88 7.1	3	1228	9.5	10.00	27.55	17.38	9.42	92.3	96.00	149.30
1 13 81	30 31.8	88 6.6	2	1235	9.5	8.25	25.51	16.05	9.91	92.4	5.70	7.50
1 13 81	30 31.8	88 6.6	2	1235	3.0	8.50	26.53	16.71	9.33	87.7		
1 13 81	30 31.8	88 6.6	2	1235	5.0	9.60	26.53	16.71	8.64	83.5		
1 13 81	30 31.8	88 6.6	2	1235	7.0	10.50	27.55	17.38	8.12	80.4		
1 13 81	30 31.8	88 6.6	2	1235	10.0	11.00	28.58	18.05	7.70	77.5		
1 13 81	30 31.8	88 6.6	2	1235	13.0	13.75	37.45	23.79	3.66	40.5	3.70	5.80
1 13 81	30 31.4	88 5.5	1	1247	0.5	0.90	26.53	16.71	10.42	99.0	8.40	9.70
1 13 81	30 31.4	88 5.5	1	1247	3.0	8.50	26.02	16.38	10.08	94.7		
1 13 81	30 31.4	88 5.5	1	1247	5.0	8.75	26.53	16.71	9.31	88.1		
1 13 81	30 31.4	88 5.5	1	1247	7.0	8.50	27.04	17.05	8.64	81.5		
1 13 81	30 31.4	88 5.5	1	1247	10.0	10.00	29.09	18.38	7.44	73.3		
1 13 81	30 31.4	88 5.5	1	1247	13.0	13.50	36.31	23.11	4.91	53.8	56.00	69.20
1 13 81	30 32.0	88 7.1	3	1405	0.5	9.40	25.51	16.05	10.08	96.5	20.00	20.40
1 13 81	30 32.0	88 7.1	3	1405	3.0	9.00	25.51	16.05	9.71	92.2		
1 13 81	30 32.0	88 7.1	3	1405	5.0	9.25	25.51	16.05	9.14	89.1		
1 13 81	30 32.0	88 7.1	3	1405	8.0	9.50	25.51	16.05	8.77	84.2		
1 13 81	30 32.0	88 7.1	3	1405	11.0	10.60	27.55	17.38	8.33	78.8	71.00	64.10
1 13 81	30 31.8	88 6.6	2	1415	0.5	8.25	24.40	15.39	10.33	95.9	3.30	4.50
1 13 81	30 31.8	88 6.6	2	1415	3.0	8.25	24.48	15.39	9.68	87.8		
1 13 81	30 31.8	88 6.6	2	1415	5.0	7.50	26.02	16.38	8.66	83.3		
1 13 81	30 31.8	88 6.6	2	1415	7.0	10.25	27.04	17.05	8.51	83.0		
1 13 81	30 31.8	88 6.6	2	1415	10.0	10.75	28.07	17.72	8.09	80.8		
1 13 81	30 31.8	88 6.6	2	1415	13.5	14.00	36.31	23.11	3.58	39.7	4.20	5.40
1 13 81	30 31.4	88 5.5	1	1428	0.5	8.25	25.00	15.72	10.87	101.1	11.50	10.40

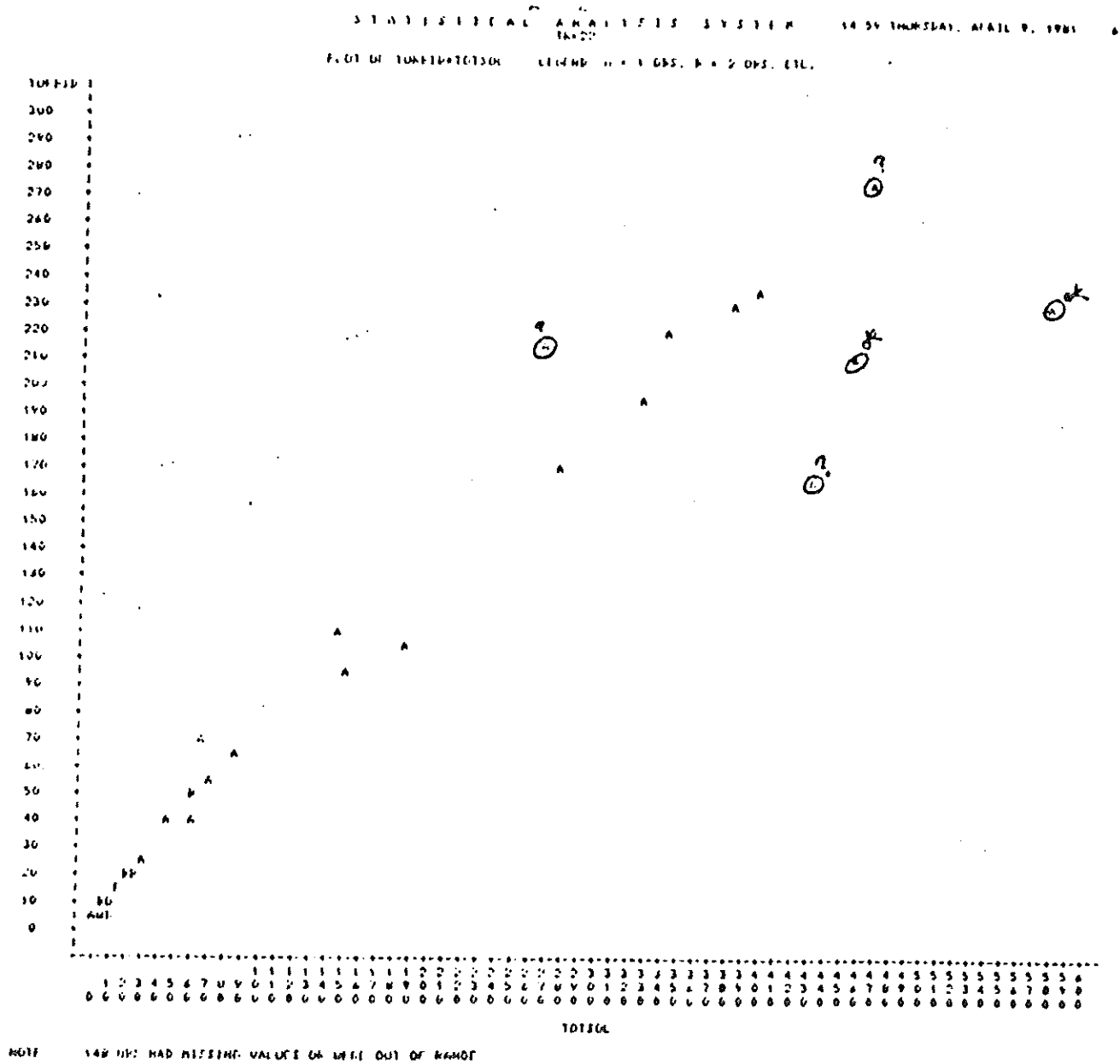


Figure 6. Example of the use of the PROC PLOT procedure for QAQC.

Table 6. Statistical summary table used for the QAQC procedure.

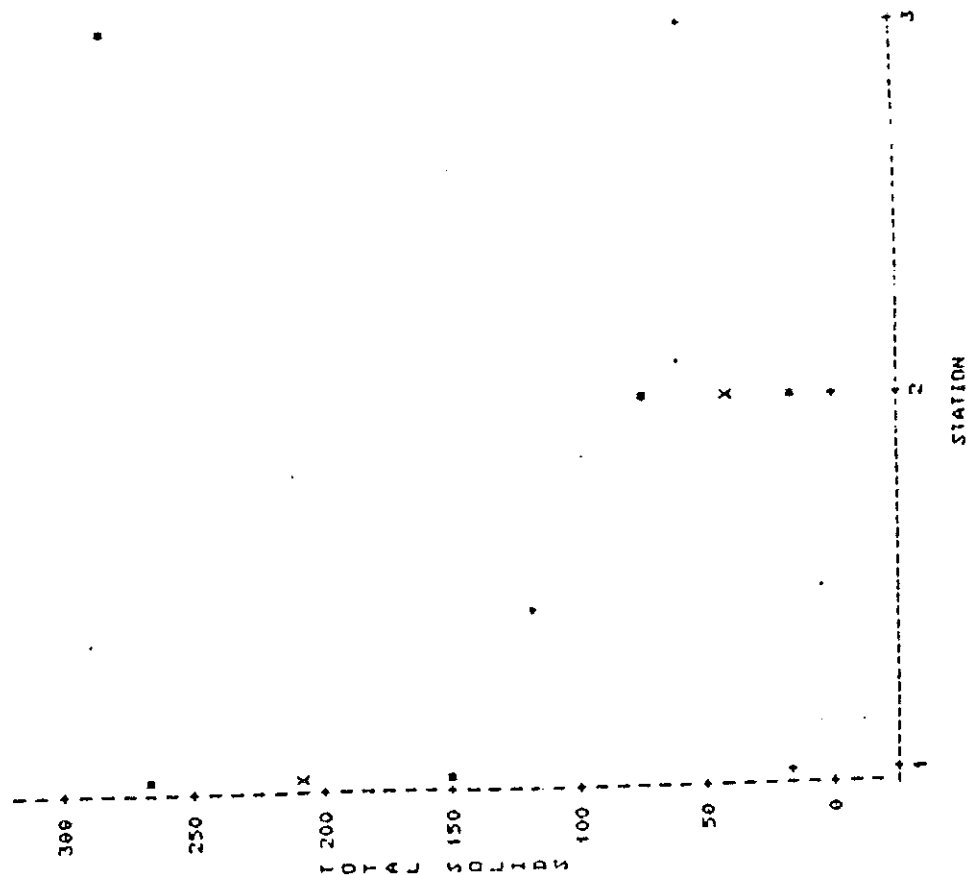
STATION	TEMPERATURE				SALINITY				DISS O2				TURBIDITY				TOTAL SOLIDS				DEPTH
	MEAN	STD E	MIN	MAX	MEAN	STD E	MIN	MAX	MEAN	STD E	MIN	MAX	MEAN	STD E	MIN	MAX	MEAN	STD E	MIN	MAX	
1	8.4	0.1	8.0	8.9	16.1	0.1	15.7	16.7	10.4	0.2	9.4	11.6	7.0	0.7	3.7	11.5	7.0	0.8	2.4	10.9	1
1	8.2	0.2	7.0	9.0	16.6	0.1	16.0	17.0	9.4	0.2	8.5	10.8									2
1	11.4	0.4	9.3	13.5	19.6	0.5	17.4	23.1	6.5	0.5	4.9	10.6	12.4	2.0	16.0	270.0	206.8	55.8	14.2	632.7	3
2	8.1	0.2	5.6	9.3	15.8	0.1	15.1	16.0	9.6	0.2	8.4	10.6	4.8	0.2	3.3	5.9	5.5	0.3	3.8	7.5	1
2	10.1	0.2	9.0	11.3	17.1	0.1	16.4	17.4	8.0	0.1	7.0	8.7									2
2	13.6	0.1	13.3	14.3	22.7	0.5	16.7	23.8	4.1	0.2	3.1	6.2	23.4	12.3	3.7	165.0	45.6	32.2	4.0	428.7	3
3	9.4	0.1	8.9	10.0	16.5	0.1	15.4	17.0	8.5	0.2	7.5	10.3	12.3	1.0	7.3	20.0	12.4	1.0	7.2	20.4	1
3	9.9	0.1	9.0	10.5	16.5	0.1	16.0	17.6	8.3	0.2	7.4	9.3									2
3	10.7	0.1	10.0	11.5	18.1	0.2	16.0	19.7	7.4	0.6	2.5	9.4	197.2	27.7	48.0	340.0	357.3	70.8	58.6	803.7	3

$T_{temp}^{\circ}C$ Sol ppt 20 ppm (constant) CHA Mg⁻¹

Surface 5.6 - 10.0 15.1 - 17.0 7.6 (74) - 11.6 (107) 2.4 - 20.4
 Bottom 9.3 - 14.3 16.0 - 23.8 2.5 (74) - 10.6 (103) 3.8 - 814

STATISTICAL ANALYSIS SYSTEM 26
15:29 THURSDAY, APRIL 9, 1981
TR=22 IDEF=3

PLOT OF E=STATION SYMBOL USED IS X
PLOT OF QF=STATION SYMBOL USED IS *
PLOT OF QM=STATION SYMBOL USED IS +
PLOT OF V=STATION SYMBOL USED IS +
PLOT OF A=STATION SYMBOL USED IS -



NOTE 5 DFC HAD MISSING VALUES IN UNIT ONE OF EPOCH

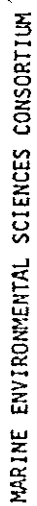
Figure 7. Statistical summary plot used for QAQC check.

REFERENCES

- Anderson, S. H., M. Geissler and D. K. Dawson. 1980. Coastal and Marine Bird Data Base. Fish and Wildlife Service. FWS/OBS-80/39.
- Bloom, S. A., S. L. Santos and S. G. Field. 1977. A package of computer programs for benthic community analysis. Bull. Mar. Sci. 27: 577-580.
- Bosch, D. 1977. Application of numerical classification in ecological investigation of water pollution. Corvallis-Environmental Research Laboratory. ORD.U.S.EPA. Corvallis EPA-600/3-77-033.
- I.B.M. 1979. OS/VS2 MVS JCL Technical newsletter GC28-069-4.
- Lloyd, M., J. H. Zar, and J. R. Karr. 1968. On the calculation of information-theoretical measures of diversity. Am. Mid. Nat. 79(2): 257-272.
- SAS 1979. SAS USER'S GUIDE, 1979 EDITION. SAS Institute, Cary, North Carolina.
- Weber, C. I. 1973. Biological Field and Laboratory Methods for Measuring the Quality of Surface Water and Effluents. EPA - 670/4-73-001. Cincinnati.

APPENDIX A.
DATA FORMATS

A-1

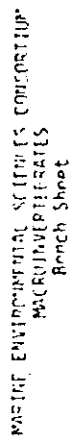


ANALYST

GENERALIZED BIOTA FORM

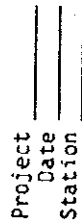
RECORDED

A-2



Project	Date	Location	Taxon	Date Counted	Analyst

[illegible]



MARINE ENVIRONMENTAL SCIENCES CONSORTIUM
PHYTOPLANKTON
Bench Sheet

Date Counted _____
Analyst _____

[illegible]

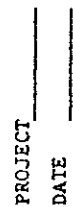
Project _____
 Date _____
 Station _____

MARINE ENVIRONMENTAL SCIENCES CONSORTIUM
 ZOOPLANKTON
 Bench Sheet

Date Counted _____
 Analyst _____

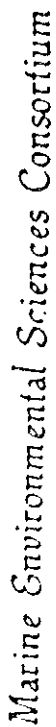
SAMPLE	DATE	COORD.	CODE	F1		S1	F2	S2	REP1	REP2
				1	2	1	2	1	2	1
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3										
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79										
80										
81										
82										
83										
84										
85										
86										
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90										
91										
92										
93										
94										
95										
96										
97										
98										
99										
100										

**Number of forms per field may vary slightly



Marine Environmental Sciences Consortium

Chlorophyll a[illegible]



STATION

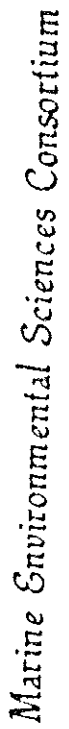
ANALYST

DATE _____

RECORDED

FORAMINIFERA DATA

[illegible]



ANALYST

SEDIMENT CHARACTERISTICS

DATE RECORDED

[illegible]



Marine Environmental Sciences Consortium

DATE

ANALYST

PROJECT

SEDIMENT SCREEN ANALYSIS

DATE RECORDER

COORDINATES

SAMPLE

ID

DATE

Long.

Lat.

TOTAL DOY

WEIGHT

SIZE

WEIGHT

SIZE

WEIGHT

SIZE

WEIGHT

SIZE

WEIGHT

REP. C

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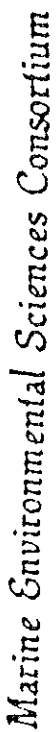
87

87

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87

87



ANALYST

DATE RECORDED

SEDIMENT GRAIN SIZE

[illegible]

Project _____
Date _____

KEY: CL : CLAY

SIC : SILTY CLAY

SGM : SLIGHTLY GRAVELLY MUD

SGS : SLIGHTLY GRAVELLY SANDS

SSC : SANDY: SILTY CLAY

SAC : SANDY CLAY

[illegible]

Project _____
Date _____A-12

Project _____
Date _____

Project _____
Date _____

A-13

APPENDIX B.
PROGRAMS FOR PHYSICAL DATA

```
//MESCJOB JOB (7000,2285,05,05,000),HORTON,CLASS=A
/*PASSWORD
/*ROUTE PRINT REMOTE51
// EXEC SAS
//DATA1 DD DSN=UF.G0002285.CE05.PDATA,DISP=SHR,UNIT=SYSDA
//*ATA2 DD DSN=UF.G0002285.SAS.COESTAT,DISP=(NEW,CATLG),
/* SPACE=(TRK,(50,10)),UNIT=SYSDA
/*
//SYSIN DD *
```

```

*
*
* ***** PHYSICAL DATA INPUT PROGRAM *****
*
* THIS PROGRAM READS IN DATA FROM CARD IMAGE DISK
*
* RECORDS WHICH ARE IN THE 11 OR 12 FORMAT
* AS PER MESC DATA FORMAT CONVENTIONS ;
*
* OPTIONS PAGESIZE=60 NOSOURCE ;
*
DATA ONE ; INFILE DATA1 ;
INPUT TR 3-4 STATION 5-6 I 7-8 DATE 9-14 MONTH 9-10
      DAY 11-12 YEAR 13-14 LONGDG 15-16 ILNGMN 17-19
      COORD 15-24 LATDG 20-21 ILATMN 22-24 TIME 25-28
      DEPTH 29-33
      TEMPC 34-38 RCOND 39-45 FNTUS 46-50 RDO2 51-55
      TURBID 56-61 TOT SOL 62-67 PRCNTT 68-70 IID 71-73
      C1 $74-75 IDEF 76-77 SMPNO 78-80 ;
*
*
***** ;
*
*
* ;
IF I = 11 ;
*F MONTH = 8;
*F TR >=19 ;
IF C1 = 'DL' THEN DELETE ;
LNGMN = ILNGMN /10. ;
LATMN = ILATMN /10. ;
IF STATION = . THEN DELETE ;
IF DATE = . THEN DELETE ;
PROC SORT ; BY DATE STATION DEPTH ;
*
*
*
* ;

```

```
***** RAW DATA DISPLAY *****
***** PHYSICAL DATA ***** ;
```

```
*
```

```
*
```

```
DATA _NULL_ ; SET ONE ;
```

```
BY DATE ;
```

```
FILE PRINT NOTITLES ;
```

```
IF FIRST.DATE THEN DO ;
```

```
PUT _PAGE_ ;
```

```
PUT 132*'*' //
```

```
  @20 'THEODORE SHIP CHANNEL PROJECT - COE' /
```

```
  @25 'PHYSICAL DATA - RAW OUTPUT' //
```

```
  @4 'DATE' @14 'LATITUDE' @24 'LONGITUDE' @35 'STATION'
```

```
  @44 'TIME' @50 'DEPTH' @58 'TEMPERATURE'
```

```
  @72 'CONDUCTIVITY' @87 'DISSOLVED O2' @102 'TURBIDITY'
```

```
  @113 'TOTAL SOLIDS' @128 '%T' ;
```

```
PUT @2 'MO DA YR' @14 'DEG MIN' @24 'DEG MIN'
```

```
  @43 '(CST)' @51 '(M)' @60 '(DEG C)'
```

```
  @73 '(MMHDS/CM)' @90 '(MG/L)' @104 '(NTU)'
```

```
  @117 '(MG/L)' // 132*'*' ;
```

```
END ;
```

```
*
```

```
*
```

```
PUT @2 MONTH 2. @5 DAY 2. @8 YEAR 2. @14 LATDG 2.
```

```
  @17 LATMN 4.1 @25 LONGDG 2. @28 LNGMN 4.1
```

```
  @35 STATION 2. @44 TIME 4. @49 DEPTH 4.1
```

```
  @58 TEMPC 5.2 @74 RCOND 7.2 @91 RDO2 5.2
```

```
  @103 TURBID 6.2 @116 TOTISOL 7.2
```

```
  @128 PRCNTT 2.1 ;
```

```
**
```

```
** ;
```



```

*      ***** CONDUCTIVITY/SALINITY CONVERSION *****
*
*      FOR HYDROLAB SURVYOR
*
*      * ERROR FACTOR *
*      * DERIVED FROM *
*      * DATA OF *
*      *PIJANOWSKI, NOIC*
*      * 11/73 *
*
*      R SQUARE = 0.996
*
* ;
DATA FIX ; SET ONE ;
ERR = 0.16415 * (EXP(0.045065*RCOND)) ;
*
* ;
COND = ERR + RCOND ;
*
*      ***** SALINITY CONVERSION ; *****
*
*      DERIVED FROM DATA GIVEN
*      IN THE HYDROLAB
*      SURVEYOR MODEL 6D
*      MANUAL
*
*      R SQUARE = 0.998 ;
*
* ;
SALIN = 0.566533 * (COND**1.03241) ;
*
*      *KNUDSEN EQN*
*
* ;
CL = (SALIN - 0.030)/1.805 ;
*
*      ***** ABSOLUTE TEMPERATURE CONVERSION *****
*
* ;
T = 273.00 + TEMPC ;
*
*      GREENS SOLUBILITY COEFFICIENT FOR OXYGEN;
*      (GREEN AND CARRITT 1967, J. MAR. RES. 25:140)
*
* ;
OXCDEF3 = EXP((-7.424 + (4417/T) - 2.927 * (LOG(T)) + 0.04238 * T)
- (CL*(-0.1288 + (53.44/T) - 0.04442*(LOG(T)) + 7.145E-4*(T)))) ;
*
*      VAPOR PRESSURE OF SEAWATER
*
*      GOFF - GRATCH FORMULATION
*      AFTER GREEN AND CARRITT 1967
*

```


*SMIL SMG SATM DOSATFW FACTOR DISSO2 PERSAT ;
PROC SORT ; BY DATE STATION DEPTH ;

```

***** CORRECTED DATA DISPLAY *****
*
*      PHYSICAL DATA ;
*
*
DATA _NULL_ ; SET FIX ;
BY DATE ;
FILE PRINT NOTITLES ;
IF FIRST.DATE THEN DO ;
PUT _PAGE_ ;
*
*
PUT 132*'X' //
  @20 'THEODORE SHIP CHANNEL PROJECT - COE' /
  @25 'PHYSICAL DATA - CONVERTED VALUES' //
  @4 'DATE'
  @14 'LATITUDE' @24 'LONGITUDE' @35 'STATION'
  @44 'TIME' @49 'DEPTH' @55 'TEMPERATURE'
  @68 'CONDUCT' @77 'SALINITY' @87 'DISSOLVED O2'
  @102 'TURBIDITY' @113 'TOTAL SOLIDS' @128 'XT' ;
PUT @43 '(CST)' @51 '(M)'
  @57 '(DEG C)' @67 '(MMHOS/CM)' @78 '(FFT)' @91 '(MG/L)'
  @104 '(NTU)' @116 '(MG/L)' ;
PUT @2 'MO DA YR' @14 'DEG MIN' @24 'DEG MIN'
  @87 'OBS PCTSAT' @103 'L' @110 'F' // 132*'X' ;
END ;
*
*
*
PUT @2 MONTH 2. @5 DAY 2. @8 YEAR 2. @14 LATDG 2.
  @17 LATMN 4.1 @25 LONGDG 2. @28 LNGMN 4.1
  @35 STATION 2. @44 TIME 4. @49 DEPTH 4.1
  @58 TEMPC 5.2 @68 COND 7.2 @77 SALIN 5.2 @86 DISSO2 5.2
  @94 PERSAT 5.1 @101 TURBID 6.2 @109 FNTUS
  6.2 @116 TOTISOL 7.2 @128 PRCNTT 3.1 ;
** ;
*
*
*
*
*

```

*

*

FLOTIT SUBPROGRAM

*

*

*

*

*

*

*

DATA FLOTIT ; SET FIX;

PROC SORT ; BY TR;

*

PROC PLOT UNIFORM ; BY TR ;

PLOT TURBID*TOTSOL / VAXIS = 0 TO 100 BY 10

HAXIS = 0 TO 140 BY 10 ;

*

*

PLOT DISSO2*SALIN / VAXIS = 0 TO 15 BY 5

HAXIS = 0 TO 35 BY 5 ;

*

PLOT TURBID*TOTSOL / VAXIS = 0 TO 300 BY 10

HAXIS = 0 TO 600 BY 10 ;

*

*

*

PLOT FNTUS*TURBID / VAXIS = 0 TO 140 BY 10

HAXIS = 0 TO 140 BY 10;

```

*
DATA XBAR; SET FIX;
*
IF IDEP = 4 THEN DELETE ;
IF TIME <= 1200 THEN TM=1;
IF TIME > 1200 THEN TM=2;
*
PROC SORT ; BY TR STATION      IDEP ;
*
PROC MEANS NOPRINT; BY TR STATION      IDEP ;
  VAR TEMP SALIN PRESAT TURBID TOT SOL ;
  OUTPUT OUT = TEMP MEAN = A B C D
           STDERR = M N O P
           MIN = R S T U
           MAX = G H I J ;
*
ID DEPTH DATE MONTH YEAR ;
*
DATA _NULL_ ; SET TEMP ; BY TR ;
FILE PRINT NOTITLES ;
IF FIRST.TR THEN DO ;
  PUT _PAGE_ ;
  PUT @35 'DATE = ' MONTH 2. YEAR 4. / ;
  PUT @1 'STATION' @15 'TEMPERATURE' @35 'SALINITY' @55 'PCTSAT' @78 'TURBIDITY'
    @104 'TOTAL SOLIDS' @126 'DEPTH' / ;
  PUT @10 3* 'MEAN STD E MIN MAX '
  @72 2* 'MEAN STD E MIN MAX ' @127 'CODE' / ;
END ;
*
PUT @2 STATION @10 (A M R G)(5.1) @31 (B N S H)(5.1)
  @52 (C O T I)(5.1) @72 (D P U J)(6.1)
  @98 (E Q V K)(6.1) @129 IDEP 1. ;
*
DATA PLOTA ; SET TEMP ;
  P = A+H ;
  M = A-M ;
  P = E+N ;
  M = E-N ;
  P = C+O ;
  M = C-O ;
  P = D+P ;
  M = D-P ;
  P = E+Q ;
  M = E-Q ;
PTIONS LINESIZE=66;
*
PROC SORT ; BY TR IDEP ;
PROC PLOT ; BY TR IDEP ;
LABEL  A=TEMPERATURE B=SALINITY C=PCTSAT D=TURBIDITY
       E=TOTAL SOLIDS ;
*LOT A*STATION = 'X'
  MP*STATION = '*'
  MM*STATION = '*'
  R*STATION = '+'
  G*STATION = '-' /OVERLAY VAXIS = 10 TO 40 BY 10 ;
*LOT B*STATION = 'X'

  NP*STATION = '*'

  NM*STATION = '*'

```

S*STATION='+'
H*STATION='-' /OVERLAY VAXIS = 0 TO 40 BY 5 ;
PLOT C*STATION='X'
OF*STATION='*'

OM*STATION='*'
T*STATION='+'

I*STATION='-' /OVERLAY VAXIS = 0 TO 150 BY 25;
*LOT D*STATION='X'
PF*STATION='*'

PM*STATION='*'
U*STATION='+'
J*STATION='-' /OVERLAY VAXIS = 0 TO 300 BY 50;
*LOT E*STATION='X'

QP*STATION='*'
QM*STATION='*'

V*STATION='+'
K*STATION='-' / OVERLAY VAXIS = 0 TO 300 BY 50;

*
*
*
*

```

*   CORRELLATIONS   *
*   OF               *
*   PHYSICAL DATA  * ;
*
DATA CORRIT ; SET FIX ;
*
* ;
LOGTRBD = LOG10(TURBID) ;
LOGNTU  = LOG10(FNTUS) ;
LOGTSOL = LOG10(TOTSOL) ;
*
*
*
* ;
KEEP TR DATE STATION DEPTH TURBID FNTUS TOTSOL PRCNTT LOGTRBD
      LOGNTU LOGTSOL ;
*
*
*
* ;
PROC SORT ; BY TR ;
PROC CORR ;
VAR TURBID FNTUS TOTSOL PRCNTT LOGTRBD LOGNTU
      LOGTSOL ;
PROC CORR ; BY TR ;
VAR TURBID FNTUS TOTSOL
      PRCNTT LOGTRBD LOGNTU LOGTSOL ;
*
*
*
*

```



```

*
*
DATA CORALL ; SET FIX ;
*
OPTIONS PAGESIZE = 60 LINESIZE = 100 ;
*
LOGNTU = LOG10(FNTUS) ;
LOGTSOL = LOG10(TOTSOL) ;
*
IF TR = 1 THEN LBL = 'A' ;
IF TR = 3 THEN LBL = 'B' ;
IF TR = 5 THEN LBL = 'C' ;
IF TR = 7 THEN LBL = 'D' ;
IF TR = 9 THEN LBL = 'E' ;
IF TR = 11 THEN LBL = 'F' ;
IF TR = 13 THEN LBL = 'G' ;
IF TR = 15 THEN LBL = 'H' ;
IF TR = 17 THEN LBL = 'I' ;
IF TR = 19 THEN LBL = 'J' ;
IF TR = 21 THEN LBL = 'K' ;
IF TR = 23 THEN LBL = 'L' ;
IF TR = 25 THEN LBL = 'M' ;
IF TR = 27 THEN LBL = 'N' ;
IF TR = 29 THEN LBL = 'O' ;
*
*
PROC PLOT ; PLOT
TURBID * FNTUS=LBL /VAXIS = 0 TO 300 BY 50
HAXIS = 0 TO 300 BY 50 ;

PLOT
FNTUS * TOTSOL=LBL /VAXIS = 0 TO 300 BY 50
HAXIS = 0 TO 600 BY 50 ;

*
PLOT PRCNTT * LOGNTU=LBL /VAXIS = 0 TO 100 BY 10
HAXIS = 0 TO 2 BY 0.25 ;

*
PLOT PRCNTT * LOGTSOL=LBL /VAXIS = 0 TO 100 BY 10
HAXIS = 0 TO 2 BY 0.25 ;

*
PLOT TURBID * TOTSOL=LBL /VAXIS = 0 TO 300 BY 50
HAXIS = 0 TO 600 BY 50 ;
*

```

```
*  
*  
DATA CORALL ; SET FIX ;  
*  
OPTIONS PAGESIZE = 60 LINESIZE = 100 ;  
*
```

```
DATA DATA2.PDATA ; INFILE PLOTA ;  
PROC PRINT DATA = DATA2.PDATA ;
```

// EXEC SYMAP
 //SYSIN DD *
 A-OUTLINE

	X	
57.1	0.0	
57.5	2.7	
57.8	4.6	
59.3	6.1	
59.1	7.5	
59.1	9.2	
59.2	8.0	
61.5	7.9	
61.2	7.4	
61.7	6.7	
63.5	7.4	
63.9	7.9	
0	11.7	
	11.2	
	12.6	
	12.9	
73.3		
62.8		
63.5		
61.6	1.0	
58.1	1.2	
61.6	0.0	
57.1	0.0	

99999
 P-DATA

49.0	18.2
47.8	22.7
46.4	26.6
45.6	31.1
42.6	27.9

01
 02
 03
 04
 05

39.6	24.9
36.0	21.4
39.8	20.6
44.0	19.3
46.0	21.4
44.0	27.6
39.8	23.2

06
 07
 08
 09
 10
 11
 12

99999
 E-VALUES

25.5
 27.9
 29.6
 28.3
 28.3
 22.3
 17.0
 19.7
 24.5
 26.2
 30.7
 19.1

99999
 C-OTOLEGENDS

L	36.0	24.7
	50.0	24.7
L	40.3	18.3
	40.3	24.7

99999
 F-MAP

CORPS OF ENGINEERS THEODORE CHANNEL STUDY
 SALINITY AT BOTTOM
 NOVEMBER 1980

1	5.	10.		
2	36.0	15.	50.0	37.
11	0.0			
15	6.	10.		
8				

99999
 999999
 /*EOF

```

/*SETUP TAPEB,1
// EXEC SAS
//ONE DD DSN=ONE,UNIT=(TAPEB,1,DEFER),DISP=(OLD,KEEP),
//      LABEL=(1,NL),DCB=(DEN=2,LRECL=80,BLKSIZE=1600,RECFM=FB),
//      VOL=SER=MESC
//SYSIN DD *
DATA ONE; INFILE ONE;
INPUT SAL 12-15 TEMP 16-18;
IF SAL = 999 THEN SAL = 0;
Y=SAL/10.;
X=TEMP/10.;
PROC AUTOREG;
MODEL Y = / NLAG=24;
PROC AUTOREG;
MODEL X = /NLAG=24;
/*EOF

```

APPENDIX C.
PROGRAMS FOR BIOLOGICAL DATA

INPUT S 81268 81268 6

```
*****
**
*   THIS MODULE PREPARES THE BIOLOGICAL DATA FOR FURTHER USE.
**   IT MAY BE USED WITH THE FILES: RAWDATA - RAW DATA DISPLAYS
**                                     SUMMARY - SUMMARY STATISTICS
**
**   TO USE LOAD THE INPUT FILE AND THEN FETCH THE REQUIRED FILE.
**
*****
//BIODISP JOB (7000,2285,50,10,0),ANANDA,CLASS=A
/*PASSWORD
/*ROUTE PRINT REMOTE51
// EXEC SAS
//DATA1 DD DSN=UF.G0002285.CE04.BNTHS,DISP=SHR
//DATA2 DD DSN=UF.G0002285.TAXA.FILE1,DISP=SHR
//SYSIN DD *
OPTIONS NOSOURCE NONOTES ERRORS = 0 PAGESIZE = 63 ;
DATA IN ; INFILE DATA1 ;
INPUT TRIP 3-4 STATION 5-6 ID 7-8
      BIRTHDAY MDDYY6. LONG6 15-16 ILNGMN 17-19 LATD6 20-21
      ILATD6 22-24 COORD 15-24 TAXON 25-28 @25 CODE BZ12.
      @37 (REP1-REP7) (4.) ;
FORMAT BIRTHDAY DATE9. ;
PROC SORT , BY CODE ;
DATA TAXA ; INFILE DATA2 ;
INPUT @6 CODE BZ12. @21 NAME $CHAR50. ;
PROC SORT ; BY CODE ;
DATA GO ; MERGE IN TAXA ; BY CODE ;
IF CODE = . THEN DELETE ;
PROC SORT ; BY TRIP BIRTHDAY STATION CODE ;
PROC MEANS NOPRINT ; BY TRIP BIRTHDAY STATION CODE ;
VAR REP1-REP7 ;
OUTPUT OUT = DO SUM=SREP1-SREP7 ;
ID TAXON NAME ;
DATA READY ; SET DO ;
SSUM = SUM (OF SREP1-SREP7) ;
IF SSUM = . THEN DELETE ;
INVERSE = 1/SSUM ;
PROC SORT ; BY TRIP BIRTHDAY STATION TAXON INVERSE ;
DATA FIX ; SET READY ;
PROC SORT ; BY TRIP BIRTHDAY STATION TAXON INVERSE ;
PROC MEANS NOPRINT ; BY TRIP BIRTHDAY STATION ;
VAR SSUM SREP1-SREP7 ; OUTPUT OUT=ONE SUM=TOTAL SUMREP1-SUMREP7 ;
ID TAXON NAME INVERSE ;
DATA TWO ; MERGE ONE READY ; BY TRIP BIRTHDAY STATION ;
SPSTOT = SUM (OF SREP1-SREP7) ;
PROC SORT ; BY TRIP BIRTHDAY STATION TAXON INVERSE ;
DATA THREE ; SET TWO ; BY TRIP BIRTHDAY STATION TAXON INVERSE ;
```

INPUT S 81268 81268 6

```
IF TRIP > 90 ;
ARRAY REP SREP1-SREP4;
ARRAY SUMREP SUMREP1-SUMREP4 ;
ARRAY SHANREP SHANREP1-SHANREP4 ;
ARRAY TAXREP TAXREP1-TAXREP4 ;
ARRAY SPECREP SPECREP1-SPECREP4;
ARRAY EVENREP EVENREP1-EVENREP4 ;
RETAIN SHANREP1-SHANREP4 TAXREP1-TAXREP4 SPECREP1-SPECREP4
EVENREP1-EVENREP4 ;
IF FIRST.STATION THEN DO ;
SHANNON=0 ; SPECTOT=0 ; EVEN=0 ;
DO _I_=1 TO 4;
EVENREP=0;
SHANREP=0 ;
SPECREP=0;
END;
END;
IF FIRST.TAXON THEN DO ;
DO _I_ = 1 TO 4 ; TAXREP = 0 ; END ; TAXTOT=. ; END;
DO OVER REP;
IF REP=0 THEN REP=. ;
IF REP=. THEN GO TO SKIP;
TAXREP = TAXREP + REP;
SPECREP = SPECREP + 1;
SHANREP = SHANREP + (-REP/SUMREP *LOG2(REP/SUMREP));
SKIP: END;
PERCENT = SPSTOT/TOTAL*100.;
SHANNON + (-SPSTOT/TOTAL *LOG2(SPSTOT/TOTAL));
TAXTOT + SPSTOT;
SPECTOT + 1;
IF LAST.TAXON THEN DO ;
PERCENT1 = TAXTOT/TOTAL*100.;
END;
IF LAST.STATION THEN DO ;
MEANNO = MEAN (OF SUMREP1-SUMREP4);
LIMITNO = STDERR (OF SUMREP1-SUMREP4) * 3.182; * 5% CONF. LIM. FOR 3 DF;
MEANSF = MEAN (OF SPECREP1-SPECREP4);
LIMITSF = STDERR(OF SPECREP1-SPECREP4) * 3.182;* 5% CONF. LIM. FOR 3 DF;
EVEN = (SHANNON/LOG2(SPECTOT));
DO OVER EVENREP ; EVENREP = (SHANREP / LOG2 (SPECREP)) ; END ;
END;
DATA FOUR ; SET TWO ; BY TRIP BIRTHDAY STATION TAXON INVERSE ;
IF TRIP < 90 ;
ARRAY REP SREP1-SREP7;
ARRAY SUMREP SUMREP1-SUMREP7 ;
ARRAY SHANREP SHANREP1-SHANREP7 ;
ARRAY TAXREP TAXREP1-TAXREP7 ;
ARRAY SPECREP SPECREP1-SPECREP7;
```


INPUT S 01260 01260 6

```

ARRAY EVENREP EVENREP1-EVENREP7 ;
RETAIN SHANREP1-SHANREP7 TAXREP1-TAXREP7 SPECREP1-SPECREP7
EVENREP1-EVENREP7 ;
IF FIRST.STATION THEN DO ;
SHANNON=0 ; SPECTOT=0 ; EVEN=0 ;
DO _I_=1 TO 7 ;
EVENREP=0 ;
SHANREP=0 ;
SPECREP=0 ;
END ;
END ;
IF FIRST.TAXON THEN DO ;
DO _I_ = 1 TO 7 ; TAXREP = 0 ; END ; TAXTOT=. ; END ;
DO OVER REP ;
IF REP=0 THEN REP=. ;
IF REP=. THEN GO TO SKIP ;
TAXREP = TAXREP + REP ;
SPECREP = SPECREP + 1 ;
SHANREP = SHANREP + (-REP/SUMREP * LOG2(REP/SUMREP)) ;
SKIP: END ;
PERCENT = SPSTOT/TOTAL*100. ;
SHANNON + (-SPSTOT/TOTAL * LOG2(SPSTOT/TOTAL)) ;
TAXTOT + SPSTOT ;
SPECTOT + 1 ;
IF LAST.TAXON THEN DO ;
PERCENTT = TAXTOT/TOTAL*100. ;
END ;
IF LAST.STATION THEN DO ;
MEANNO = MEAN (OF SUMREP1-SUMREP7) ;
LIMITNO = STDERR (OF SUMREP1-SUMREP7) * 2.447 ; * 5% CONF. LIM. FOR 6 DF ;
MEANSP = MEAN (OF SPECREP1-SPECREP7) ;
LIMITSP = STDERR (OF SPECREP1-SPECREP7) * 2.447 ; * 5% CONF. LIM. FOR 6 DF ;
EVEN = (SHANNON/LOG2(SPECTOT)) ;
DO OVER EVENREP ; EVENREP = (SHANREP / LOG2 (SPECREP)) ; END ;
END ;
*****
**
** THIS IS THE END OF THE INPUT MODULE
**
*****
```

```

*****
*
**      THIS MODULE FITS AT THE END OF FILE INPUT.
**      THIS MODULE PREPARES RAW DATA DISPLAYS FOR THE BASELINE
**      AS WELL AS THE MONITORING. TO GET RID OF THE BASELINE PUT IN
**      A STATEMENT IF TRIP IS LESS THAN 90 AT THE HEAD OF DATA SET
**      FIVE WHERE INDICATED.
**      TO RESTRICT THE MODULE TO A QUARTERLY REPORT DELETE THE BASELINE AS
**      ABOVE AND INSERT A COUPLE OF STATEMENTS IF TRIP IS GREATER THAN AND
**      IF TRIP IS LESS THAN IN DATA FIVE WHERE INDICATED.
**
*****
**      HERE WE GO ;
DATA FIVE ; SET THREE FOUR ;
**      INSERT RESTRICTING STATEMENTS HERE. REMEMBER THAT FOR POLYCHAETES
**      ONLY THE FILE PRINT MUST ALSO BE ALTERED FROM ALL TAXA AND THIS LINE
**      COMMENCED FOUR SPACES EARLIER THAN NOW ;
IF NAME = 'CALLIANASSA LATISPINA' THEN NAME = 'CALLIANASSA JAMAICENSE' ;
IF CODE = 812902020100 THEN NAME = 'HEMIPHOLIS ELONGATA' ;
    IF TAXON = 6162 THEN TAXON = 6161 ;
    IF TAXON = 5103 THEN TAXON = 5110 ;
    IF TAXON = 5108 THEN TAXON = 5110 ;
    IF TAXON = 5105 THEN TAXON = 5110 ;
    IF TAXON = 8120 THEN TAXON = 8129 ;
    IF TAXON = 8741 THEN TAXON = 8700 ;
    IF TAXON = 5510 THEN TAXON = 5515 ;
    IF TAXON = 5516 THEN TAXON = 5515 ;
    IF TAXON = 6168 THEN TAXON = 6169 ;
    IF TAXON = 5507 THEN TAXON = 5515 ;
    IF TAXON = 5513 THEN TAXON = 5515 ;
    IF TAXON = 5502 THEN TAXON = 5515 ;
    IF TAXON = 5506 THEN TAXON = 5515 ;
    IF TAXON = 6177 THEN TAXON = 6179 ;
    IF TAXON = 6183 THEN TAXON = 6189 ;
    IF TAXON = 5509 THEN TAXON = 5515 ;
PROC FORMAT ;
VALUE PHYL 3758 = COELENTERATA : ACTINIARIA
    3901 = PLATYHELMINTHES      4300 = RHYNCOCOELA
    5001 = ANNELIDA : POLYCHAETA 5004 = ANNELIDA : OLIGICHAETA
    6134 = CRUSTACEA : CIRREPEDIA 6154 = CRUSTACEA : CUMACEA
    6177-6179 = CRUSTACEA : NATANTIA
    5100-5129 = MOLLUSCA : GASTROPODA
    5131 = MOLLUSCA : GASTROPODA : NUDIBRANCHIATA
    5500-5599 = MOLLUSCA : PELECYPODA
    6200 = ARTHROPODA : INSECTA
    8700-8800 = VERTEBRATA : PISCES
    6161-6162 = CRUSTACEA : ISOPODA
    6168-6169 = CRUSTACEA : AMPHIPODA

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4700            = NEMATODA
8300            = CHAETOGNATHA
8126-8129 = ECHINODERMATA : OPHIUROIDEA
7700 = PHORONIDA    7200 = SIPUNCULIDA
8201 = CEPHALOCHORDATA
6180-6189 = CRUSTACEA : BRACHYURA ;
PROC SORT ; BY TRIP BIRTHDAY STATION TAXON INVERSE ;
DATA SIX ; SET FIVE ; BY TRIP BIRTHDAY STATION TAXON ;
IF TRIP < 90 ;
FILE PRINT NOTITLES PAGESIZE= 63 HEADER = HEAD ;
IF FIRST.STATION THEN DO ; PUT _PAGE_ ; END ;
IF FIRST.TAXON THEN DO ; PUT @10 TAXON PHYL. ; END ;
PUT @15 NAME 30.                            @45 '*' (SREP1-SREP7) (+3 5.)
@106 '*' +1 SPSTOT 7. +6 PERCENT 5.2 ;
IF LAST.TAXON THEN DO ;
PUT / @30 'TAXON TOTALS' @46 (TAXREP1-TAXREP7)
(8.) @106 '*' TAXTOT 8. +6 PERCENT 5.2 OVERPRINT @45 '*' 87*'_ ' / ; END;
IF LAST.STATION THEN DO ;
PUT 132*'_ ' // @56 'SUMMARY' OVERPRINT @56 7*'_ ' / @110 'TOTAL'
@120 'MEAN +' OVERPRINT @125 '_ 5% C.L.' / ;
PUT @25 'NUMBER OF ORGANISMS' @46 (SUMREP1-SUMREP7) (8.) @106 '*'
TOTAL 8. MEANNO 9.2 @125 '+' OVERPRINT @125 '_ LIMITNO 7.2 / ;
PUT @25 'NUMBER OF SPECIES' @46 (SPECREP1-SPECREP7) (8.) @106 '*'
SPECTOT 8. MEANSF 9.2 @125 '+' OVERPRINT @125 '_ LIMITSF 7.2 / ;
PUT @25 'SHANNON WEAVER INDEX' @46 (SHANREP1-SHANREP7) (8.2) @106 '*'
SHANNON 8.2 / ;
PUT @25 'EVENNESS INDEX J''' @46 (EVENREP1-EVENREP7)(8.2) @106 '*'
EVEN 8.2 / ; PUT / 132*'*' / ;
END; RETURN ;
HEAD: PUT 132*'*' //
@38 'ARMY CORPS OF ENGINEERS - THEODORE DARGE CHANNEL PROJECT' //
@58 'MONITORING DATA ' //
@47 'BENTHIC MACROINVERTEBRATES - ALL TAXA' /
@43 'STATION' @51 STATION 1.
@80 BIRTHDAY ; IF FIRST.STATION = 0 THEN DO ; PUT @60
'(CONTINUED)' / ; END ; PUT 132 * '_ ' //
@110 'STATION' @121 '% STN' /
@15 'TAXON & SPECIES' @39 'REPLICATE NO: 1' @69 '3' @61 '2'
@76 '4' @85 '5' @93 '6' @101 '7' @111 'TOTAL' @121
'ABUND'// 132*'_ ' // ;
RETURN;
DATA SEVEN ; SET FIVE ; BY TRIP BIRTHDAY STATION TAXON ;
IF TRIP > 90 ;
FILE PRINT NOTITLES PAGESIZE= 63 HEADER = FOOT ;
IF FIRST.STATION THEN DO ; PUT _PAGE_ ; END ;
IF FIRST.TAXON THEN DO ; PUT @22 TAXON PHYL. ; END ;
PUT @27 NAME 30.                            @57 '*' (SREP1-SREP4) (+3 5.)
@94 '*' +1 SPSTOT 7. +6 PERCENT 5.2 ;

```

```
IF LAST.TAXON THEN DO ;
  PUT / @42 'TAXON TOTALS' @58 (TAXREP1-TAXREP4)
    (8.) @94 '*' TAXTOT 8. +6 PERCENT 5.2 OVERPRINT @57 '*' 63*'_ ' / ;
END;
IF LAST.STATION THEN DO ;
  PUT 132*'_ ' // @56 'SUMMARY' OVERPRINT @56 7*'_ ' / @98 'TOTAL'
  @108 'MEAN +' OVERPRINT @113 '_ 5% C.L.' / ;
  PUT @37 'NUMBER OF ORGANISMS ' @58 (SUMREP1-SUMREP4) (8.) @94 '*'
    TOTAL 8. MEANNO 9.2 @113 '+' OVERPRINT @113 '_ ' LIMITNO 7.2 / ;
  PUT @37 'NUMBER OF SPECIES' @58 (SPECREP1-SPECREP4) (8.) @94 '*'
    SPECTOT 8. MEANSF 9.2 @113 '+' OVERPRINT @113 '_ ' LIMITSF 7.2 / ;
  PUT @37 'SHANNON WEAVER INDEX' @58 (SHANREP1-SHANREP4) (8.2) @94 '*'
    SHANNON 8.2 / ;
  PUT @37 'EVENNESS INDEX J'' ' @58 (EVENREP1-EVENREP4)(8.2) @94 '*'
    EVEN 8.2 / ; PUT / 132*'*' / ;
END; RETURN ;
FOOT: PUT 132*'*' //
@38 'ARMY CORPS OF ENGINEERS - THEODORE BARGE CHANNEL PROJECT' //
@59 'BASELINE DATA' //
@48 'BENTHIC MACROINVERTEBRATES - ALL TAXA' /
@43 'STATION' @51 STATION 1.
@80 BIRTHDAY ; IF FIRST.STATION = 0 THEN DO ; PUT @60
  '(CONTINUED)' / ; END ; PUT 132 * '_ ' //
@98 'STATION' @109 '% STN' /
@27 'TAXON & SPECIES' @51 'REPLICATE NO: 1' @81 '3' @73 '2'
@88 '4' @99 'TOTAL' @109
  'ABUND'// 132*'_ ' // ;
RETURN;
```

```
//BIODISP JOB (7000,2285,15,10,0),ANANDA,CLASS=A
/*PASSWORD
ROUTE PRINT REMOTE51
// EXEC SAS
//DATA1 DD DSN=UF.G0002285.CE04.BNTHS,DISP=SHR
//DATA2 DD DSN=UF.G0002285.TAXA.FILE1,DISP=SHR
//SYSIN DD *
OPTIONS NOSOURCE NONOTES ERRORS=0 ;
DATA IN ; INFILE DATA1 ;
INPUT TRIP 3-4 STATION 5-6 ID 7-8
      BIRTHDAY MMDDYY6. LONDG 15-16 ILNGMN 17-19 LATDG 20-21
      1LATDG 22-24 COORD 15-24 TAXON 25-28 @25 CODE BZ12.
      @37 (REP1-REP7) (4.) ;
FORMAT BIRTHDAY DATE9. ;
PROC SORT ; BY CODE ;
DATA TAXA ; INFILE DATA2 ;
INPUT @6 CODE BZ12. @21 NAME $CHAR50. ;
PROC SORT ; BY CODE ;
DATA GO ; MERGE IN TAXA ; BY CODE ;
IF CODE = . THEN DELETE ;
PROC FORMAT ;
VALUE PHYL 3758 = COELENTERATA : ACTINIARIA
           3901 = PLATYHELMINTHES           4300 = RHYNCOCOELA
           5001 = ANNELIDA : POLYCHAETA     5004 = ANNELIDA : OLIGICHAETA
           6134 = CRUSTACEA : CIRREPEDIA    6154 = CRUSTACEA : CUMACEA
           6162 = CRUSTACEA : ISOPODA       6169 = CRUSTACEA : AMPHIPODA
           6179 = CRUSTACEA : NATANTIA
           5110 = MOLLUSCA : GASTROPODA : CEPHALASPIDEA
           5103 = MOLLUSCA : GASTROPODA : MESOGASTROPODA
           5108 = MOLLUSCA : GASTROPODA : ENTOMOTAENIATA
           5105 = MOLLUSCA : GASTROPODA : NEOGASTROPODA
           5131 = MOLLUSCA : GASTROPODA : NUDIBRANCHIATA
           5500-5599 = MOLLUSCA : PELECYFODA
           6200 = ARTHROPODA : INSECTA
           8120 = ECHINODERMATA : OPHIUROIDEA
           6180-6189 = CRUSTACEA : DECAPODA ;
PROC SORT ; BY TRIP BIRTHDAY STATION CODE ;
PROC MEANS NOPRINT ; BY TRIP BIRTHDAY STATION CODE ;
VAR REP1-REP7 ;
OUTPUT OUT = DO SUM=SREP1-SREP7 ;
ID TAXON NAME ;
DATA READY ; SET DO ;
SSUM = SUM (OF SREP1-SREP7);
IF SSUM = . THEN DELETE;
INVERSE = 1/SSUM ;
PROC SORT ; BY TRIP BIRTHDAY STATION TAXON INVERSE ;
DATA FIX ; SET READY ;
PROC SORT ; BY TRIP BIRTHDAY STATION TAXON INVERSE ;
```

INPUT 81257 81257 6

**

** THIS MODULE PREPARES THE BIOLOGICAL DATA FOR FURTHER USE.
IT MAY BE USED WITH THE FILES: RAWDATA - RAW DATA DISPLAYS
SUMMARY - SUMMARY STATISTICS

**

** TO USE LOAD THE INPUT FILE AND THEN FETCH THE REQUIRED FILE.

**

//RIODISP JOB (7000,2285,15,10,0),ARANDA,CLASS=A

//*PASSWORD

//ROUTE PRINT REMOTE54

// EXEC SAS

//DATA1 DD DSN=UF.G0002285.CE04.BNTHS,DISP=SHR

//DATA2 DD DSN=UF.G0002285.TAXA.FILE1,DISP=SHR

//SYSID DD *

OPTIONS NODSOURCE NONOTES ERRORS = 0 PAGESIZE = 63 ;

DATA IN ; INFILE DATA1 ;

INPUT TRIP 3-4 STATION 5-6 TD 7-8

BIRTHDAY BDDYY6. LORDB 15-16 ILNGMN 17-19 LATDB 20-24

HLATDB 22-24 COORD 15-24 TAXON ID-25 @25 CODE B712.

@37 (REP1-REP7) (4.) ;

FORMAT BIRTHDAY DATE9. ;

PROC SORT ; BY CODE ;

DATA TAXA ; INFILE DATA2 ;

INPUT @6 CODE B712. @21 NAME \$CHAR50. ;

PROC SORT ; BY CODE ;

DATA GO ; MERGE IN TAXA ; BY CODE ;

IF (CPL = 1) THEN DELETE ;

PROC SORT ; BY TRIP BIRTHDAY STATION CODE ;

PROC MEANS NOPRINT ; BY TRIP BIRTHDAY STATION CODE ;

VAR REP1-REP7 ;

OUTPUT OUT = DO SUB=REP1-REP7 ;

IF TAXON NAME ;

DATA READY ; SET DO ;

SSUM = SUM (OF REP1-REP7) ;

IF SSUM = 1 THEN DELETE ;

INVERSE = 1/SSUM ;

PROC SORT ; BY TRIP BIRTHDAY STATION TAXON INVERSE ;

DATA FIX ; SET READY ;

PROC SORT ; BY TRIP BIRTHDAY STATION TAXON INVERSE ;

PROC MEANS NOPRINT ; BY TRIP BIRTHDAY STATION ;

VAR SSUM REP1-REP7 ; OUTPUT OUT=ONE SUM=TOTAL SUMREP1-SUMREP7 ;

ID TAXON NAME INVERSE ;

DATA TWO ; MERGE ONE READY ; BY TRIP BIRTHDAY STATION ;

SSUM1 = SUM (OF REP1-REP7) ;

PROC SORT ; BY TRIP BIRTHDAY STATION TAXON INVERSE ;

DATA THREE ; SET TWO ; BY TRIP BIRTHDAY STATION TAXON INVERSE ;

INPUT 81257 81257 6

```
IF TRIP > 90 ;
ARRAY REP SREP1-SREP4;
ARRAY SUMREP SUMREP1-SUMREP4 ;
ARRAY SHANREP SHANREP1-SHANREP4 ;
ARRAY TAXREP TAXREP1-TAXREP4 ;
ARRAY SPECREP SPECREP1-SPECREP4;
ARRAY EVENREP EVENREP1-EVENREP4 ;
RETAIN SHANREP1-SHANREP4 TAXREP1-TAXREP4 SPECREP1-SPECREP4
EVENREP1-EVENREP4 ;
IF FIRST.STATION THEN DO ;
SHANREP=0 ; SPECTOT=0 ; EVEN=0 ;
DO _J_=1 TO 4;
EVENREP=0;
SHANREP=0 ;
SPECREP=0;
END;
END;
IF FIRST.TAXON THEN DO ;
DO _I_ = 1 TO 4 ; TAXREP = 0 ; END ; TAXTOT= . ; END;
DO OVER REP;
IF REP=0 THEN REP= . ;
IF REP= . THEN GO TO SKIP;
TAXREP = TAXREP + REP;
SPECREP = SPECREP + 1;
SHANREP = SHANREP + (-REP/SUMREP * LOG2(REP/SUMREP));
SKIP: END;
PERCENT = SPSTOT/TOTAL*100.;
SHANREP + (-SPSTOT/TOTAL * LOG2(SPSTOT/TOTAL));
TAXTOT + SPSTOT;
SPECTOT + 1;
IF LAST.TAXON THEN DO ;
PERCENT = TAXTOT/TOTAL*100.;
END;
IF LAST.STATION THEN DO ;
MEANNO = MEAN (OF SUMREP1-SUMREP4);
LIMITNO = STDER (OF SUMREP1-SUMREP4) * 2.447; * 5% CONF. LIM. FOR 3 DF;
MEANSP = MEAN (OF SPECREP1-SPECREP4);
LIMITSP = STDER(OF SPECREP1-SPECREP4) * 2.447; * 5% CONF. LIM. FOR 3 DF;
EVEN = (SHANREP/LOG2(SPECTOT));
DO OVER EVENREP ; EVENREP = (SHANREP / LOG2 (SPECREP)) ; END ;
END;
DATA FOUR ; SET TWO ; BY TRIP BIRTHDAY STATION TAXON INVERSE ;
IF TRIP < 90 ;
ARRAY REP SREP1-SREP7;
ARRAY SUMREP SUMREP1-SUMREP7 ;
ARRAY SHANREP SHANREP1-SHANREP7 ;
ARRAY TAXREP TAXREP1-TAXREP7 ;
ARRAY SPECREP SPECREP1-SPECREP7;
```

INPUT

81257

81257

6

```

ARRAY EVENREP EVENREP1-EVENREP7 ;
REJAIN SHANREP1-SHANREP7 TAXREP1-TAXREP7 SPECREP1-SPECREP7
EVENREP1-EVENREP7 ;
IF FIRST.STATION THEN DO ;
SHANNON=0 ; SPECTOT=0 ; EVEN=0 ;
DO _I_=1 TO 7;
EVENREP=0;
SHANREP=0 ;
SPECREP=0;
END;
END;
IF FIRST.TAXON THEN DO ;
DO _I_ = 1 TO 7 ; TAXREP = 0 ; END ; TAXTOT=. ; END;
DO OVER REP;
IF REP=0 THEN REP=. ;
IF REP=. THEN GO TO SKIP;
TAXREP = TAXREP + REP;
SPECREP = SPECREP + 1;
SHANREP = SHANREP + (-REP/SUMREP * LOG2(REP/SUMREP));
SKIP: END;
PERCENT = SPSTOT/TOTAL*100.;
SHANNON = (-SPSTOT/TOTAL * LOG2(SPSTOT/TOTAL));
TAXTOT + S1TOT;
SPECTOT + 1;
IF LAST.TAXON THEN DO ;
PERCENT = TAXTOT/TOTAL*100.;
END;
IF LAST.STATION THEN DO ;
MEANNO = MEAN (OF SUMREP1-SUMREP7);
LIMITNO = STDER (OF SUMREP1-SUMREP7) * 2.447; * 5% CONF. LIM. FOR 6 DF;
MEANSP = MEAN (OF SPECREP1-SPECREP7);
LIMITSP = STDER(OF SPECREP1-SPECREP7) * 2.447; * 5% CONF. LIM. FOR 6 DF;
EVEN = (SHANNON / LOG2(SPECTOT));
DO OVER EVENREP ; EVENREP = (SHANREP / LOG2 (SPECREP)) ; END ;
END;

```



```

PROC MEANS NOPRINT ; BY TRIP BIRTHDAY STATION ;
  VAR SSUM SREP1 SREP7 ; OUTPUT OUT=ONE SUM=TOTAL SUMREP1-SUMREP7 ;
  ID TAXON NAME INVERSE ;
DATA TWO ; MERGE ONE READY ; BY TRIP BIRTHDAY STATION ;
SPSTOT = SUM (OF SREP1-SREP7) ;
PROC SORT ; BY TRIP BIRTHDAY STATION TAXON INVERSE ;
DATA THREE ; SET TWO , BY TRIP BIRTHDAY STATION TAXON ;
FILE PRINT NOTITLES PAGESIZE=63
ARRAY REP SREP1-SREP7 ;
ARRAY SUMREP SUMREP1-SUMREP7 ;
ARRAY SHANREP SHANREP1-SHANREP7 ;
ARRAY TAXREP TAXREP1-TAXREP7 ;
ARRAY SPECREP SPECREP1-SPECREP7 ;
ARRAY EVENREP EVENREP1-EVENREP7 ;
RETAIN SHANREP1 SHANREP7 TAXREP1 TAXREP7 SPECREP1 SPECREP7
EVENREP1 EVENREP7 ;
IF FIRST.STATION THEN DO ;
  PUT _PAGE_ ;
  PUT 132*' ' //
  @38 'ARMY CORPS OF ENGINEERS - THEODORE BARGE CHANNEL PROJECT //
  @43 'BENTHIC MACROINVERTEBRATES - ALL TAXA' /
  @43 'STATION' @51 'STATION 1.'
  @60 'BIRTHDAY' // 132*' ' //
  @110 'STATION' @120 '% STN' /
  @15 'TAXON & SPECIES' @39 'REPLICATE NO: 1' @69 '3' @61 '2'
  @76 '4' @85 '5' @93 '6' @101 '7' @111 'TOTAL' @120
  'ABUND' // 132*' ' // ;
  SHANNON=0 ; SPECTOT=0 ; EVEN=0 ;
  DO _I_=1 TO 7 ;
    EVENREP=0 ;
    SHANREP=0 ;
    SPECREP=0 ;
  END ;
  IF FIRST.TAXON THEN DO ;
    PUT @10 TAXON PHYL. ; DO _I_ = 1 TO 7 ; TAXREP = 0 ; END ; TAXTOT=. ; END ;
  DO OVER REP ;
    IF REP=0 THEN REP=. ;
    IF REP=. THEN GO TO SKIP ;
    TAXREP = TAXREP + REP ;
    SPECREP = SPECREP + 1 ;
    SHANREP = SHANREP + (-REP/SUMREP * LOG2(REP/SUMREP)) ;
    SKIP: END ;
  PERCENT = SPSTOT/TOTAL*100. ;
  SHANNON + (-SPSTOT/TOTAL * LOG (SPSTOT/TOTAL)) ;
  TAXTOT + SPSTOT ;
  SPECTOT + 1 ;
  PUT @15 NAME 30. @45 '*' (SREP1-SREP7) (+3 5.)

```

```

      @106 '*' +1 SPSTOT 7. +6 PERCENT 5.2
IF LAST.TAXON THEN DO ;
  PERCENT = TAXTOT/TOTAL*100.;
  .JT / @30 'TAXON TOTALS' @46 (TAXREP1-TAXREP7)
    (8.) @106 '*' TAXTOT 8. +6 PERCENT 5.2 OVERPRINT @45 '*' 87*'_ ' / ;
END;
IF LAST.STATION THEN DO ;
  PUT 132*'_ ' // @56 'SUMMARY' OVERPRINT @56 7*'_ ' / @110 'TOTAL'
  @120 'MEAN +' OVERPRINT @125 '_ 5% C.L' / ;

  MEAN = MEAN (OF SUMREP1-SUMREP7);
  LIMIT = STDERR (OF SUMREP1-SUMREP7) * 2.447; * 5% CONF. LIM. FOR 6 DF;
  PUT @25 'NUMBER OF ORGANISMS' @46 (SUMREP1-SUMREP7) (8.) @106 '*'
    TOTAL 8. MEAN 9.2 @125 '+' OVERPRINT @125 '_ ' LIMIT 7.2 / ;

  MEAN = MEAN (OF SPECREP1-SPECREP7);
  LIMIT = STDERR(OF SPECREP1-SPECREP7) * 2.447;* 5% CONF. LIM. FOR 6 DF;
  PUT @25 'NUMBER OF SPECIES' @46 (SPECREP1-SPECREP7) (8.) @106 '*'
    SPECTOT 8. MEAN 9.2 @125 '+' OVERPRINT @125 '_ ' LIMIT 7.2 / ;

  MEAN = MEAN (OF SHANREP1-SHANREP7);
  LIMIT = STDERR(OF SHANREP1-SHANREP7) * 2.447;* 5% CONF. LIM. FOR 6 DF;
  PUT @25 'SHANNON WEAVER INDEX' @46 (SHANREP1-SHANREP7) (8.2) @106 '*'
    SHANNON 8.2 / ;
  EVEN = (SHANNON/LOG2(SPECTOT));
  DO OVER EVENREP ; EVENREP = (SHANREP / LOG2 (SPECREP)) ; END ;
  PUT @25 'EVENESS INDEX J'' ' @46 (EVENREP1-EVENREP7)(8.2) @106 '*'
    EVEN 8.2 / ; PUT / 132*'*' /
  @15 'ADVISORY: THIS IS PRELIMINARY DATA FOR A PROGRESS REPORT.' /
  @26 'FINAL COMPLETE CORRECTED DATA WILL BE PRESENTED IN THE FINAL REPORT.';
END;

```

```

*****
*
*   THIS SUBPROGRAM SETS UP THE INITIAL DATA SET FOR INTERFACE
*   WITH BLOOM'S PACKAGE OR WITH THE GOULD PLOTTER
*   SUBROUTINE. BOTH CANNOT BE USED SIMULTANEOUSLY
*   SINCE ONLY ONE TEMPORARY FILE IS CREATED
*****;
DATA AA ; SET THREE ;
SPEC SUM1 = 0; SPEC SUM2 = 0; SPEC SUM3 = 0; SPEC SUM4=0;
IF STATION = 1 THEN SPEC SUM1 = SSUM ;
IF STATION = 4 THEN SPEC SUM2 = SSUM ;
IF STATION = 7 THEN SPEC SUM3 = SSUM ;
IF STATION = 8 THEN SPEC SUM4 = SSUM ;
KEEP DATE NAME CODE SPEC SUM1-SPEC SUM4 ;
PROC SORT ; BY DATE CODE NAME ; * CHECK SORTS ;
PROC MEANS NOPRINT ; BY DATE CODE NAME ;
VAR SPEC SUM1 - SPEC SUM4 ;
OUTPUT OUT = BB SUM = SAMPLE1 - SAMPLE4 ;
* BE SURE THE NECESSARY SUBPROGRAMS FOLLOW 8 ;

```

```

*****
*      THIS SUBPROGRAM CREATES THE DATA SET NECESSARY      *
*      FOR THE CREATION OF THE TEMPORARY FILE THAT IS      *
*      READ BY THE GOULD SUBROUTINE .                      *
*****
DATA CC ; SET BB ;
  AVERAGE = MEAN (OF SAMPLE1-SAMPLE4) ;
PROC MEANS NOPRINT ; BY DATE ;
  VAR AVERAGE SAMPLE1-SAMPLE4 ;
  OUTPUT OUT= DD SUM = MEANTOT TOTAL1-TOTAL4 ;
DATA EE ; MERGE CC DD ; BY DATE ;
  AVERAGE = (AVERAGE/MEANTOT) * 100. ;
  SAMPLE1 = (SAMPLE1/TOTAL1) * 100. ;
  SAMPLE2 = (SAMPLE2/TOTAL2) * 100. ;
  SAMPLE3 = (SAMPLE3/TOTAL3) * 100. ;
  SAMPLE4 = (SAMPLE4/TOTAL4) * 100. ;
KEEP DATE CODE AVERAGE SAMPLE1-SAMPLE4 NAME ;
PROC SORT ; BY DATE DESCENDING AVERAGE ;
DATA NULL ; SET CC ; BY DATE ;
  FILE PRINT ; IF FIRST.DATE THEN INDEX = 0 ;
  INDEX + 1 ;
  PUT @1 DATE 6. @10 INDEX 2. @ 15 NAME $ 45. @65 AVERAGE 5.2
    @70 (SAMPLE1 -SAMPLE4) (+3 5.2) ;
DATA NULL ; SET EE ; IF DATE = 071080 ;
  FILE TERM ;
  PUT @ 1 AVERAGE 5.2 (SAMPLE1 - SAMPLE4) (5.2) ;

```

```

// EXEC FORTGCG,PLOT=
//FORT.SYSIN DD *
C*****
C
C SPECIES ABUNDANCE GRAPH - FLOOR KOOYMAN, JUNE 1980
C
C THIS PROGRAM TAKES A MATRIX OF SPECIES ABUNDANCES (EXPRESSED AS %
C OF TOTAL DENSITY) OVER A VARIABLE NUMBER OF STATIONS AND PLOTS
C THE VALUES OF THE MATRIX IN A 3-D GRAPH. THE FIRST COLUMN OF THE
C MATRIX CONTAINS THE AVERAGE ABUNDANCES FOR ALL SAMPLING SITES
C COMBINED. ONE MORE COLUMN OF DATA IS EXPECTED FOR EVERY SAMPLING
C SITE.
C THE DATA MATRIX IS PASSED FROM A PREVIOUS JOB STEP AND IS READ IN
C ON UNIT 10
C THE NUMBER OF AXIS PAIRS IS DETERMINED AUTOMATICALLY, AS IS THE
C TOTAL PLOT SIZE AND THE SCALE FACTOR FOR EACH AXIS, I.E. THE
C PROGRAM WILL ACCEPT ANY NUMBER OF COLUMNS (UP TO 16) AND ANY
C NUMBER OF ROWS (UP TO 40) IN THE INPUT MATRIX. A GREATER NUMBER
C OF ROWS (SPECIES) WILL SIMPLY BE IGNORED AND WILL NOT CAUSE AN
C ABEND.
C THREE OPTIONAL INPUT CARDS MAY BE SUPPLIED BY THE USER ON UNIT 5:
C 1. TITLE CARD, UP TO 80 CHARACTERS. WILL APPEAR BELOW THE PLOT.
C IF NO TITLE IS DESIRED, BUT ANY OF THE FOLLOWING TWO OPTIONS
C IS USED, THIS CARD MUST BE INCLUDED AS A BLANK.
C 2. CARD WITH STATION NAMES OR NUMBERS (MUST FOLLOW TITLE OR BLANK
C CARD). STARTING IN COLUMN 1, PUNCH DESIRED NAME OR NUMBER FOR
C EACH SITE, 4 COLUMNS PER SITE, LEFT-JUSTIFIED. IF NO NAMES ARE
C DESIRED AND OPTION 3 IS USED, THIS CARD MUST BE BLANK AND
C SITES WILL AUTOMATICALLY BE NUMBERED CONSECUTIVELY.
C 3. FORMAT CARD, IF A FORMAT OTHER THAN (16F5.2) IS WANTED FOR THE
C DATA MATRIX. IF USED, IT MUST FOLLOW CARD 1 AND 2.
C ALL THREE CARDS MAY OF COURSE BE OMITTED ENTIRELY, OR IF ONLY A
C TITLE IS WANTED, THEN OMIT CARDS 2 AND 3.
C*****
C REAL MATRIX(16,40)/640*0.0/,MAXIM/0.0/
C INTEGER STATIO,SPEC,ROWS/0/,COLUMN/0/
C INTEGER*4 TITLE(20)/20*' '//,SITENM(16)/16*' '//,
C 4 BLANK/' '//,FMT(20)/'(16F',5.2)',18*' '//
C READ OPTION CARDS (IF ANY)
C READ (5,1,END=3)TITLE
C 1 FORMAT(20A4)
C READ (5,1,END=3)SITENM
C READ (5,1,END=3)FORMAT
C 3 DO 5 SPEC=1,40
C READ(10,FMT,END=6)(MATRIX(STATIO,SPEC),STATIO=1,16)
C ROWS=ROWS+1
C 5 CONTINUE
C 6 DO 8 STATIO=1,16
C DO 7 SPEC=1,ROWS
C IF (MATRIX(STATIO,SPEC).NE.0.0)GOTO 8
C 7 CONTINUE
C GOTO 9
C 8 COLUMN=COLUMN+1
C 9 ROWS=ROWS+5-MOD(ROWS,5)
C DO 10 STATIO=1,COLUMN
C DO 10 SPEC=1,ROWS
C 10 IF(MATRIX(STATIO,SPEC).GT.MAXIM)MAXIM=MATRIX(STATIO,SPEC)
C MAX=(MAXIM+5)/10
C SET UP PLOT SIZE AND ORIGIN
C CALL PLOTS(7.0+COLUMN*0.7,4.0+COLUMN*0.6,0,1,1.5,1.5)
C FROM HERE TO STATEMENT 38 : DRAW ONE AXIS PAIR FOR EACH SITE
C PLUS ONE FOR ALL SITES COMBINED
C DO 38 J=1,COLUMN
C XOFF AND YOFF ARE THE OFFSETS FROM THE ORIGIN
C XOFF=(J-1)*0.7
C YOFF=(J-1)*0.6

```

```

C   DRAW X-AXES
CALL PLOT(0.0+XOFF,0.0+YOFF,3)
CALL PLOT(4.0+XOFF,0.0+YOFF,2)
IF (J.GT.1) GOTO 21
C   FROM HERE TO 20 : DRAW TICK MARKS BELOW THE LOWEST X-AXIS
C   AND NUMBER THEM WITH SPECIES CODES
L=ROWS/5
DO 20 I=1,L
XLEFT=(I-1)*4.0/L
CALL PLOT(4.0+XOFF-XLEFT,0.0+YOFF,3)
CALL PLOT(4.0+XOFF-XLEFT,0.0+YOFF-0.2,2)
IF (J.NE.1) GOTO 20
CALL NUMBER(4.0-XLEFT,-0.4,0.14,(ROWS-(I-1)*5),0.0,-1,0.14,1)
20 CONTINUE
C   DRAW Y-AXES
21 CALL PLOT(0.0+XOFF,0.0+YOFF,3)
CALL PLOT(0.0+XOFF,2.5+YOFF,2)
C   FROM HERE TO 30 : DRAW TICK MARKS LEFT OF Y-AXES AND NUMBER
C   THE LEFTMOST ONE WITH ABUNDANCES
SIZE=1.4/(MAX+5)
DO 30 I=1,MAX
YDOWN=(I-1)*2.5/MAX
CALL PLOT(0.0+XOFF,2.5+YOFF-YDOWN,3)
CALL PLOT(0.0+XOFF-0.14+0.06*MOD(I,2),2.5+YOFF-YDOWN,2)
IF (J.NE.1) GOTO 30
CALL NUMBER(-0.3,2.43-YDOWN,SIZE,(MAX*10-(I-1)*10),0.0,-1,
* SIZE,2)
30 CONTINUE
C   DRAW IN THE MATRIX VALUES FOR EACH STATION AND SPECIES, USING
C   A DIFFERENT SYMBOL FOR EACH STATION
SPACE=4.0/ROWS
SPACE2=0.06+0.4*SPACE
SCALE=20.0/(5.0/MAX)
DO 35 SPEC=1,ROWS
IF (MATRIX(J,SPEC).EQ.0) GOTO 35
CALL PLOT(XOFF+SPEC*SPACE,YOFF,3)
CALL SYMBOL(XOFF+SPEC*SPACE,(YOFF+MATRIX(J,SPEC)/SCALE),
* SPACE2,J,0.0,-2)
35 CONTINUE
IF (J.EQ.1) GOTO 38
C   PUT STATION NUMBERS TO RIGHT OF X-AXES
IF (SITENM(J-1).EQ.BLANK) GOTO 37
CALL SYMBOL(4.2+XOFF,-0.08+YOFF,0.16,SITENM(J-1),0.0,4)
GOTO 38
37 CALL NUMBER(4.2+XOFF,-0.08+YOFF,0.16,J-1,0.0,-1,0.16,1)
38 CONTINUE
CALL SYMBOL(1.0,-0.75,0.16,'SPECIES CODE',0.0,12)
CALL SYMBOL(-0.75,0.5,0.16,'% ABUNDANCE',0.0,11)
CALL SYMBOL(4.3,-0.08,0.16,'ALL SITES',0.0,9)
CALL SYMBOL(0.0,-1.3,0.12,TITLE,0.0,80)
C   DRAW DIAGONAL LINES (MEDIUM LINEWEIGHT) CONNECTING AXIS PAIRS
CALL LINEWT(2)
LINES=ROWS/10+1
DO 40 I=1,LINES
XOFF=(I-1)*10*SPACE
CALL PLOT(0.0+XOFF,0.0,3)
CALL PLOT(0.0+XOFF+(COLUMN-1)*0.7,(COLUMN-1)*0.6,2)
40 CONTINUE
C   DIAGONAL LINES AT LOW LINEWEIGHT
LINES=LINES-1+MOD(ROWS,2)
CALL LINEWT(7)
DO 50 I=1,LINES
XOFF=(I-1)*10*SPACE
CALL PLOT(5*SPACE+XOFF,0.0,3)
CALL PLOT(5*SPACE+XOFF+(COLUMN-1)*0.7,(COLUMN-1)*0.6,2)
50 CONTINUE
C   TERMINATE PLOT
CALL PLOT(0.0,0.,999)
STOP
END

```

```

70.SYSIN DD *
THEODORE CHANNEL PROJECT : PERCENT ABUNDANCE OF BENTHIC INVERTEBRATES
1 4 7 8
//GO.FT10F001 DD DSN=11TEMP,DISP=SHR
// EXEC PLOT
/*EOF

```

APPENDIX D.
PROGRAM FOR SEDIMENTOLOGICAL DATA

```

//MAR1665 JOB (XXXX,757770ENV,JES2),BLANCHER,
// CLASS=A,TIME=2,MSGLEVEL=(2,0)
/*JOBPARM L=3
/*ROUTE PRINT RMT11
// EXEC SAS79,OPTIONS=NDSOURCE
//SEDI DD DSN=MAR1665.CEO0.SEDI2,UNIT=SYSDA,DISP=SHR
/* EXTRA DD CARDS
//SYSIN DD *
OPTIONS ERRORS=0 PAGESIZE=60 ;
DATA SET1 ; INFILE SEDI ;
INPUT TRIP 3-4 SAMPLE 5-6 ID 7-8 DATE 9-14
MO 9-10 DAY 11-12 YR 13-14 COORD 15-24
LNGDG 15-16 ILNGMN 17-19 LATDG 20-21 ILATMN 22-24
MOIST 25-29 TOC 30-36 TRS1 37-43 TRS2 44-50 TRS3 51-57
REPNO 79-80 ;
TRSM = MEAN (OF TRS1-TRS3) ;
LNGMN=ILNGMN/10 ;
LATMN=ILATMN/10 ;
IF ID = 85 ;
IF TRIP = 21 ;
IF DATE = . THEN DELETE ;
/*F TRIP = 9 ;
PROC SORT ; BY TRIP SAMPLE REPNO ;
PROC SORT ; BY TRIP ;
DATA _NULL_ ; SET SET1 ; BY TRIP ;
FILE PRINT NOTITLES ;
IF FIRST.TRIP THEN DO ;
PUT _PAGE_ ;

```



```

DATA SET1 ; INFILE SEDI ;
INPUT TRIP 3-4 SAMPLE 5-6 ID 7-8 DATE 9-14
MO 9-10 DAY 11-12 YR 13-14 COORD 15-24
LNGDG 15-16 ILNGMN 17-19 LATDG 20-21 ILATMN 22-24
MOIST 25-29 TOC 30-36 TRS1 37-43 TRS2 44-50 TRS3 51-57
REFNO 79-80 ;
TRSM = MEAN (OF TRS1-TRS3) ;
LNGMN=ILNGMN/10 ;
LATMN=ILATMN/10 ;
IF ID = 85 ;
IF TRIP = 21 ;
IF DATE = . THEN DELETE ;
*F TRIP = 9 ;
PROC SORT ; BY TRIP SAMPLE REFNO ;
PROC SORT ; BY TRIP ;
DATA _NULL_ ; SET SET1 ; BY TRIP ;
FILE PRINT NOTITLES ;
IF FIRST.TRIP . THEN DO ;
PUT _PAGE_ ;
PUT 132*'*' //
@40 'THEODORE SHIP CHANNEL PROJECT - COE' /
@35 'SEDIMENT CHARACTERISTICS - RAW DATA' //
@10 'DATE' @20 'LATITUDE' @30 'LONGITUDE'
@40 'STATION' @49 'REPLICATE' @60 'MOISTURE' @70 'TOTAL ORGANIC'
@87 'TOTAL REDUCING SUBSTANCES' /
@61 'CONTENT' @72 'CARBON' /
@67 'REP1' @94 'REP2' @99 'REP3' @104 'MEAN' /
132*'*' ;
END ;
PUT @8 MO @11 DAY @14 YR @20 LATDG @23 LATMN
@30 LNGDG @35 LNGMN @42 SAMPLE @51 REFNO
@62 MOIST @73 TOC @87 TRS1 4.0 @94 TRS2 4.0
@99 TRS3 4.0 @104 TRSM 5.1 ;

```

```

****    SEDIMENT SCREEN ANALYSIS    FORMAT 87    ****
*
*
* ;
DATA SCREEN ;   INFILE SEDI ;
INPUT TRIP 3-4 STATION 5-6 I 7-8 DATE 9-14 MONTH 9-10
      DAY 11-12 YEAR 13-14 COORD 15-24 LNGDG 15-16
      ILNMN 17-19 LATDG 20-21 ILTMN 22-24 DRYWT 29-34 SIZE1 35-38
      WGT1 39-44 SIZE2 45-48 WGT2 49-54 SIZE3 55-58
      WGT3 59-64 SIZE4 65-68 WGT4 69-74 REP 75-76 C 77 ;
IF I = 87 ;
IF TRIP = 21 ;
LNGMN = ILNMN/10. ;
LATMN = ILTMN/10. ;
DROP DATE ILNMN ILTMN C I COORD;
PROC SORT ; BY TRIP STATION ;
PROC PRINT D PAGE = 1; BY TRIP;
TITLE SEDIMENT SCREEN ANALYSIS - COE 1980;

```

```

***** SEDIMENT GRAIN SIZE PROGRAM   FORMAT 89   ***** ;
*
*
DATA MAIN ; INFILE SEDI;
INPUT  TRIP 3-4 STATION 5-6 I 7-8 DATE 9-14 MONTH 9-10
      DAY 11-12 YEAR 13-14 COORD 15-24 LNGDG 15-16 ILNMN 17-19
      LATDG 20-21 ILTMN 22-24 REP 29-30 GRAVEL 31-35
      SAND 36-40 SILT 41-45
      CLAY 46-50 DIAM 51-55 ;
IF TRIP = 21 ;
IF I = 89 ;
LNGMN = ILNMN/10. ;
LATMN = ILTMN/10. ;
DROP COORD ILNMN ILTMN ;
PROC SORT ; BY TRIP STATION ;
PROC PRINT D PAGE = 1; BY TRIP;
TITLE SEDIMENT GRAIN SIZE - COE 1980;

```

```

*   MERGE SUBPROGRAM * ;
*
*
DATA AAA ; SET SET1 ;
    STATION = SAMPLE ; REP = REFNO ;
PROC SORT ; BY DATE STATION REP ;
PROC MEANS NOPRINT ; BY DATE STATION REP ;
    VAR MOIST TOC TRSM ;
    OUTPUT OUT= TEMP1 MEAN = MOIST TOC TRS ;
DATA BBB ; MERGE AAA TEMP1 ; BY DATE STATION REP ;
DATA CCC ; SET MAIN ;
*   DROP ILNMN ILTMN DATE COORD ;
PROC SORT ; BY DATE STATION REP ;
DATA ALL ; MERGE BBB CCC ; BY DATE STATION REP ;
*
*   CLUSTERING SUBPROGRAM
*
*
DATA CLUSTER ; SET ALL ;
    PROC CLUSTER NCL= 4 ; BY DATE ;
        ID STATION ;
        VAR MOIST TOC TRS SAND SILT CLAY ;
*   REMEMBER TO CHANGE VAR STATEMENT ;
*
*   CORRELATIONS
*
*
* ; OPTIONS PAGESIZE = 60 ;
DATA ATLAST ; SET ALL ;
    PROC CORR ;
    PROC PLOT ; BY DATE ;
        PLOT TRS*TOC ;
        PLOT TRS * MOIST ;
DATA ANOV ; SET SET1 ;
    PROC SORT ; BY TRIP SAMPLE ;
    PROC GLM ;
        CLASSES TRIP SAMPLE ;
        MODEL TOC = TRIP SAMPLE TRIP*SAMPLE ;
        MEANS TRIP SAMPLE /DUNCAN WALLER ;
*   ANOVA OF TOC * ;
*   BY TRIP SAMPLE * ;
DATA DUNC ; SET SET1 ;
    PROC SORT ; BY SAMPLE ;
    PROC DUNCAN DUNCAN WALLER ;
    BY SAMPLE ;
        CLASS TRIP ;
        VAR TOC ;
        DF 2 ; MS 195.5 ; F 7.30 ;
    PROC DUNCAN DUNCAN WALLER ;
        CLASS SAMPLE ;
        VAR TOC ;
        DF 7 ; MS 110.74 ; F 4.13 ;

```

```

// EXEC FORTGCC,PLOT=,SUBLIB3='GRAPHICS.FORTLIB'
//FORT.SYSIN DD *
C*****
C
C SEDIMENT COMPOSITION GRAPH - FLOOR KOOYMAN, SEPT.1980
C
C THIS PROGRAM PLOTS A STANDARD TRIANGULAR GRAPH OF SEDIMENT
C COMPOSITION. INPUT CONSISTS OF ONE CARD PER STATION, WITH
C % SAND, SILT AND CLAY (IN THAT ORDER). FORMAT IS (3F3.0), I.E.
C 3 COLUMNS FOR EACH PERCENTAGE, RIGHT-JUSTIFIED AS INTEGERS.
C EACH SAMPLE IS PLOTTED AS A UNIQUE SYMBOL, FOLLOWING THE
C ORDER OF SYMBOLS 0-14 IN THE NERDC GRAPHICS SUPPLEMENT. MORE
C THAN 15 SAMPLES CAN NOT BE READ IN, SINCE THE CORRESPONDING
C PLOTTING SYMBOLS WOULD NOT BE CENTERED AROUND THE ACTUAL
C DATA POINT.
C
C*****
      CALL PLOTS(8.0,8.0,0.1,1.0,1.0)
      CALL TRIGRD(6.0,'SEDIMENT COMPOSITION','100% SAND','100% SILT',
      $ '100% CLAY',20,9,9,9)
      CALL LINEWT(-1)
      DO 10 I=1,15
      READ(5,5,END=100)SAND,SILT,CLAY
      5 FORMAT(3F3.0)
      CALL TRIPLT(SAND,SILT,CLAY,I-1,0.1,1)
      10 CONTINUE
      100 STOP
      END
//GO.SYSIN DD *
//* INSERT DATA CARDS HERE
// EXEC PLOT
/*EOF

```