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Bugsum: A User-Interactive Computer Program for Summarizing Abundance Data on Benthic Freshwater Life Forms of Newfoundland

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BUGSUM: A USER-INTERACTIVE COMPUTER PROGRAM FOR SUMMARIZING ABUNDANCE DATA ON BENTHIC FRESHWATER LIFE FORMS OF NEWFOUNDLAND

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ABSTRACT

Marshall, G. W., and P. M. Ryan. 1986. BUGSUM: a user-interactive computer program for summarizing abundance data on benthic freshwater life forms of Newfoundland. Can. Tech. Rep. Fish. Aquat. Sci. 1465: iv + 66 p.

An interactive computer program named BUGSUM, which summarizes abundance data on Newfoundland's benthic freshwater life forms, is described and presented with instructions for its use. The program generates summarized catch statistics for each taxon identified and all taxa combined in individual samples or combinations of samples (REPORT1) and generates these statistics for major taxonomic groupings such as Class, Order, and Family (REPORT2). Output includes total catch, mean catch, minimum and maximum catch, sample standard deviation about the mean catch, and a listing of the selection parameters chosen. Programming was done utilizing SAS software running under an OS operating system. Sample printouts of results are included in the report. Information generated by the program will assist in the rapid characterization of freshwater communities and in the recognition of changes in those communities.

RÉSUMÉ

Marshall, G. W., and P. M. Ryan. 1986. BUGSUM: a user-interactive computer program for summarizing abundance data on benthic freshwater life forms of Newfoundland. Can. Tech. Rep. Fish. Aquat. Sci. 1465: iv + 66 p.

Les auteurs décrivent et indiquent comment utiliser un programme informatique interactif, le BUGSUM, qui résume les données sur l'abondance des organismes benthiques d'eau douce de Terre-Neuve. Le programme permet d'obtenir des statistiques individuelles sur les prises pour chaque taxon identifié et tous les taxons réunis d'échantillons individuels ou de groupes d'échantillons (REPORT1). Il permet aussi d'obtenir ces statistiques pour les principaux groupes taxonomiques, notamment la classe, l'ordre et la famille (REPORT2). Les résultats comprennent les prises totales, les prises moyennes, les prises minimum et maximum, l'écart-type des prises par rapport à la moyenne ainsi qu'une liste des paramètres de sélection utilisés. La programmation a été faite avec un logiciel SAS en système opérationnel OS. Des imprimés types sont annexés au rapport. L'information fournie par ce programme facilitera la caractérisation rapide des communautés d'eau douce et la détermination des modifications subies par ces communautés.

INTRODUCTION

This report presents and describes a 'user-friendly' computer program developed to assist in the analyses and interpretation of catches of bottom-dwelling animals from Newfoundland's fresh waters.

The program summarizes data files prepared using the previously described ten-digit computer code for freshwater animals of Newfoundland (Ryan 1983) and the coding specifications used for data from the Experimental Ponds Area, central Newfoundland (Ryan and Wakeham 1984; Ryan et al. 1985). With some slight modification, the program may be applied to data from other areas.

The program was designed to summarize data collected with Surber samplers, drift net samplers, Ekman grab samplers, and artificial substrate samplers. These devices and their use are reviewed in Welch (1948), Edmondson and Winberg (1971), and Stirn (1981).

Having obtained and coded the identity and numerical abundance of each kind of animal in individual samples, users are able to readily generate summary catch statistics for individual samples or combinations of samples. The summary catch statistics generated are the total catch, mean catch per sample, minimum catch per sample, maximum catch per sample, and the sample standard deviation about the mean catch per sample. These statistics are generated for each taxon identified and all taxa combined (REPORT1). If all animals in the samples are not identified to a common taxonomic level (e.g. genus or species), or if the user wishes to conduct subsequent analyses with broader or more inclusive taxonomic groupings, the same summary statistics may be generated for major taxonomic groupings such as Class, Order, and Family (REPORT2).

Information generated with this computer program may be of use in the monitoring of aquatic systems when the rapid recognition of deviations from long-term trends is desired or, in short-term studies, for the generation of information comparable to that obtained elsewhere. Examples of such applications can be found in Hellawell (1978), Harvey et al. (1981), and Stirn (1981).

MATERIALS AND METHODS

HARDWARE AND SOFTWARE

The series of programs as they exist within the Department of Fisheries and Oceans, St. John's, are currently running on an Amdahl 5860 mainframe computer under an MVS-XA operating system.

The front-end programs used to create the necessary files and the major report-generating program are written using the base SAS® version 5 software* under OS (Anon. 1982).

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*SAS® is a registered trademark of SAS Institute Inc., Cary, N.C., USA.

The BUGSUM procedure was written using the SAS Macro Language facility. This facility was used for several reasons:

i) it allows for a line-prompted and full-screen menu system to prompt users for necessary input for running either REPORT1 or REPORT2, and;

ii) it allows the use of the Autocall facility whereby the macro program BUGSUM can reside in a user macro library. The benefits associated with this feature are that other macro calls within the main macro BUGSUM can be conditionally executed (i.e. only macros that are actually invoked would be compiled) and storing user macros in macro libraries requires less overhead than the conventional methods of invoking macros.

INPUT FILES AND PROGRAM CONTROL

As presented here, the program summarizes benthic invertebrate data from the Experimental Ponds Area, Newfoundland. Data from each type of sampling device was considered a discrete 'data type'. The coding specifications used to describe these data types for chosen areas and chosen years are presented in Appendix 1.

The REPORT1 module of BUGSUM is designed to provide the user with a listing of all taxa encountered in a sample or group of samples of benthic invertebrates, together with the summary statistics corresponding to each of the taxa and for all taxa combined. Two files were required to produce a summary in REPORT1 format:

1. The first file is a sequential file, REPORT1.CODES, which contains species names and associated species codes (Fig. 1). This file is converted into a SAS data set (REP1CODE) via a SAS program and stored in a SAS data base called REPORT.DATABASE (Appendix 2; Table 1).

   The species code which identifies each species is a systematic ten-digit computer code designed and used at the Department of Fisheries and Oceans to adequately represent freshwater animals of Newfoundland (Ryan 1983). Successful use of the programs as described in this report requires the implementation of a file with the same specifications.

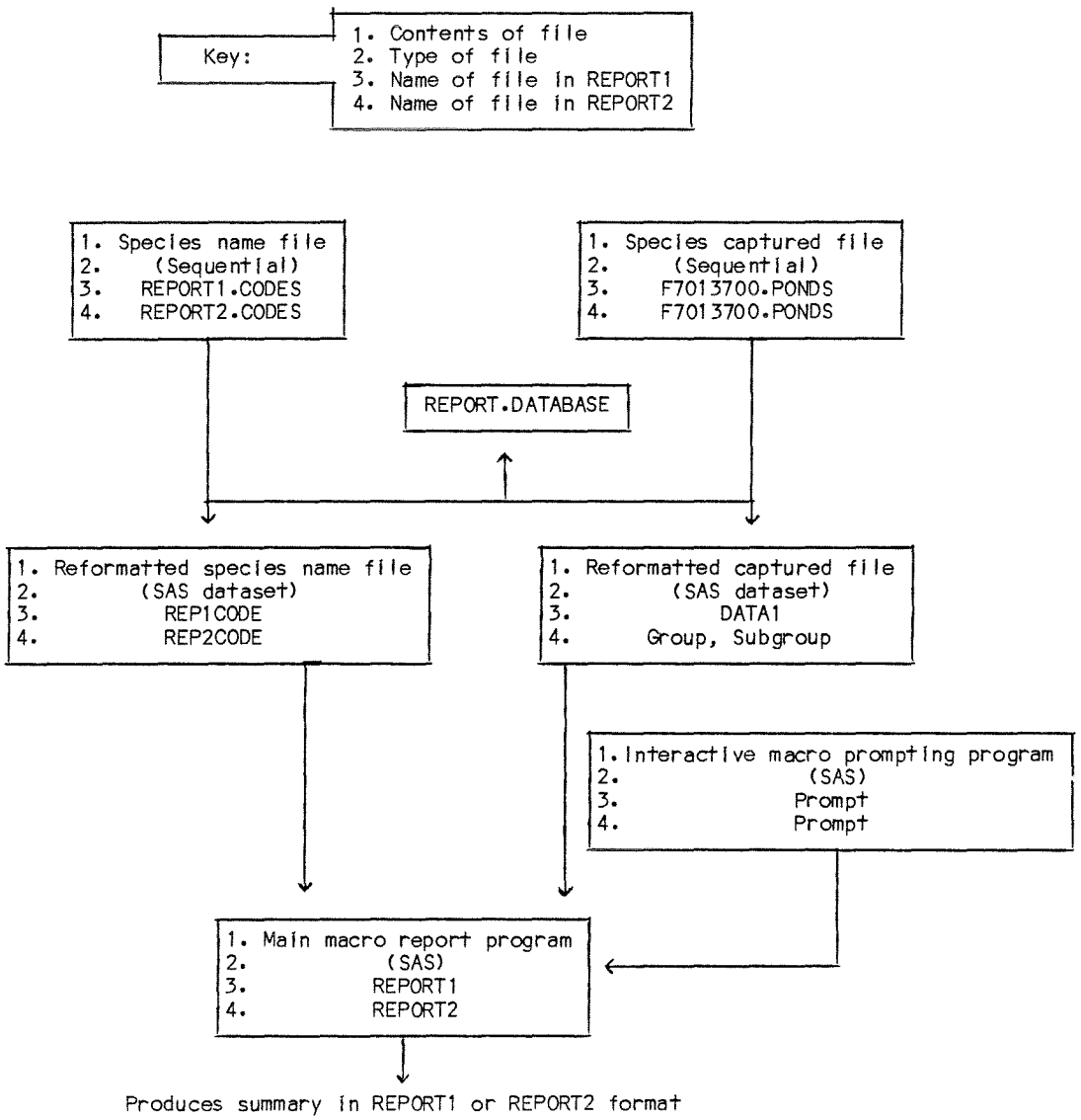
   The program which transforms the file REPORT1.CODES to a SAS data set also creates additional records to accommodate all possible life stages. These additional records are needed for two reasons:

   i) no life stage variable is coded on the sequential file REPORT1.CODES and;

   ii) the second file containing the number of individuals of each species caught for all samples contains a life stage code. This life stage code is necessary for subsequent merging of both files.

2. The second file used to produce a table in REPORT1 format is derived from an external data file stored on tape. The file used as an example in this

Fig. 1. Diagram of file structures and program control.



report is F7013700.PONDS which contains information on collected samples from the Experimental Ponds Area codes as in Appendix 1.

This file is converted to a permanent SAS data set (DATA1) and stored in the SAS data base REPORT.DATABASE on disk created in section 1 above. One of the major advantages of storing data in a permanent SAS file is the elimination of repeated reading of input data values each time REPORT1 is executed. As a result input/output operations and subsequent cpu time charges are reduced.

The SAS program which transforms the external tape file F7013700.PONDS into the permanent SAS data set member DATA1 and some representative records are described in Appendix 2, Table 2. For a full description of permanent SAS data set definitions, naming conventions, and managing and storing information refer to Anon. (1982), p. 361-385.

Once the files described in sections (1) and (2) above have been successfully constructed, the user can then generate a synopsis in REPORT1 format (see RESULTS).

The REPORT2 module of BUGSUM is designed to provide the user with a listing of major taxonomic groupings within a sample or group of samples, together with the summary statistics corresponding to the individuals within each of the groupings and for all groupings combined. The major taxonomic groups used in REPORT2 were chosen for the purposes of separating taxa according to traits such as trophic level and life history (i.e. grouped by family) and providing for rapid comparisons of invertebrate catches to the invertebrates, usually identified to class or order, encountered in fish stomach samples. Two files were required to produce a summary in REPORT2 format:

1. The first file is a sequential data set called REPORT2.CODES (Appendix 3, Table 1a) which contains a list of species codes, associated species names, and life stages (Fig. 1). One difference in this file and the comparable file used in REPORT1 is that it already contains the life stage variable. This file is converted to a SAS data set (REP2CODE) via a SAS program (Appendix 3, Table 1b) and stored in the SAS data base named REPORT.DATABASE. The resulting SAS data set REP2CODE condenses the species code to the first six characters since no animals are separated according to genus and species in REPORT2.CODES.

   REPORT2.CODES is set up in a manner such that the major class, subclass, phylum, order, or suborder names begin in column 1 while family names or, in some cases, order or suborder names are indented to begin in column 3. The reason for this format is to allow for a sorted, code-sequenced report for animals captured. Successful use of programs producing REPORT2 requires that all invertebrate taxa collected be included in the categories specified in Appendix 3, Table 1a.

2. The second file required for REPORT2 contains two permanent SAS data sets (GROUP, SUBGROUP) derived from an external data file on tape

(F7013700.PONDS) containing data formats as per the Life Form Coding Specifications used at the Department of Fisheries and Oceans.

Appendix 3, Table 2 shows the SAS program listing (Table 2a) which creates these data sets along with some representative data records (Table 2b). These two separate SAS data sets are required in order to accumulate statistics in the proper groupings based on the species name file (REP2CODE) outlined in section (1) above. This program listing also shows programming code which selects particular records (lines 7-9, 12) for REPORT2 and creates temporary variables (SC, SC2) used to select records for SAS data sets GROUP and SUBGROUP (lines 18-27, 28-32).

When the files described in sections (1) and (2) above are created, the user is able to produce a REPORT2 type summary (see RESULTS).

The BUGSUM procedure requires users to input, at the terminal, responses to prompts based on the Life Form Coding Specifications (Appendix 1). Varying degrees of breakdown can be achieved contingent on replies to both yes/no questions and prompts for selected codes from the Life Form Coding Specifications. In order for either report to be produced, it is necessary that the Data Type, Area, and Year codes be specified by the user. These are the minimum requirements needed in generating a summary report. Various report breakdowns can be achieved by responses to further prompts based on user requirements.

A complete source listing of the macro program BUGSUM is presented in Appendix 4.

RESULTS AND DISCUSSION

The following are examples of typical jobs run at the Department of Fisheries and Oceans, St. John's. <ur> indicates user response and <cr> indicates carriage return or enter key on keyboard.

SAMPLE JOB RUN (REPORT1)

Once logged on to a terminal a user simply invokes SAS under TSO to initiate the interactive session by typing

```
TSAS OPTIONS('NONOTES NODMS') AUTOS('''G70141A.BUGSUM.CNTL''')    <cr>
```

The TSAS command sets several options in SAS under TSO, creates output and work files, and links the user macro library to the system default macro library. Different installations may use a different TSAS command.

The SAS system then responds with a line number followed by a question mark (i.e. 1?) which is a prompt for user action. The user types

%BUGSUM <cr>

This invokes the main macro program. After a few seconds the system welcomes the user and awaits for a carriage return to continue processing with the next screen.

The following screen prompts the user to enter a single numeric code indicating the type of summary required.

1. SELECT REQUIRED REPORT:

   1 REPORT IN REPORT1 FORMAT

   2 REPORT IN REPORT2 FORMAT

   ENTER NUMBER:

<ur> 1 <cr>

2. ENTER STARTING YEAR FOR WHICH YOU REQUIRE REPORT (E.G. 78).

<ur> 77 <cr>

3. ENTER FINAL YEAR FOR WHICH YOU REQUIRE REPORT (E.G. 82).
   IF SAME AS STARTING YEAR RE-ENTER STARTING YEAR.

<ur> 77 <cr>

These two prompts together allow the user to specify a range of yearly values for which the report is required. In this example only data values from 1977 are selected.

YOU SELECTED YEAR(S) 1977 TO 1977

This message serves as a check to ensure that the intended year or series of years was correctly entered at the terminal by the user.

4. ENTER NUMBER OF DATA TYPES TO BE PROCESSED (TO A MAXIMUM OF 99).

<ur> 2 <cr>

This prompt requires the user to input a number between 1 and 99 to indicate the total number of data types to be processed together as per the Life Form Coding Specifications thus allowing for combinations of data types. In this case the user wishes to combine two data types.

5. ENTER 2 DATA TYPE(S) AS PER LIFE FORM CODING SPECIFICATIONS.
   SEPARATE BY BLANKS IF MORE THAN ONE DATA TYPE SELECTED.

<ur> 6 7 <cr>

YOU SELECTED DATA TYPE(S) 6 7

Based on the number of data types selected in prompt (4), the user continues inputing unique data type codes until all codes have been entered. In this example data types represented by codes 6 and 7 are to be combined.

6. ENTER NUMBER OF AREAS TO BE ANALYZED (TO A MAXIMUM OF 999).

<ur> 1 <cr>

Similar to prompt (4), the user enters a number between 1 and 999.

7. ENTER 1 AREA(S) AS PER LIFE FORM CODING SPECIFICATIONS.
   SEPARATE BY BLANKS IF MORE THAN ONE AREA SELECTED.

<ur> 7 <cr>

YOU SELECTED AREA(S) 7

Based on the number of areas requested in prompt (6),a valid numeric code is entered referring to a particular area specified on the Life Form Coding Specifications. Here only area 7 is required.

8. DO YOU WISH TO SELECT BY SUBAREA? (ENTER Y OR N)

<ur> N <cr>

This prompt allows the user to select individual subareas from within the particular area or areas selected in prompt (7).

9. DO YOU WISH TO SELECT BY SAMPLE SEQUENCE NUMBER, BY MONTH OR BY MONTH AND DAY? ENTER ONE OF THE FOLLOWING CODES:

```
*********************************
*   0 = NEITHER                 *
*   1 = SAMPLE SEQUENCE NUMBER  *
*   2 = MONTH OR MONTH AND DAY  *
*********************************
```

<ur> 1 <cr>

10. HOW MANY SAMPLE SEQUENCE NUMBERS TO BE ANALYZED?

<ur> 4 <cr>

11. ENTER 4 SAMPLE SEQUENCE NUMBER(S) AS PER LIFE FORM CODING SPECIFICATIONS. SEPARATE BY BLANKS IF MORE THAN ONE SAMPLE SEQUENCE NUMBER SELECTED.

<ur> 6 9 10 11 <cr>

YOU SELECTED SAMPLE SEQUENCE NUMBER(S) 6 9 10 11

Based on the number of sample sequence numbers selected in prompt (10), the user inputs the correct number of unique sample sequence numbers based on the Life Form Coding Specifications. In this example sample sequence numbers 6 9 10 11 were selected.

12. ENTER REPORT TITLE (MAXIMUM OF 150 CHARACTERS INCLUDING BLANKS).

<ur> SPRUCE POND OUTLET 15 MINUTE DRIFT SAMPLES 1977
SAMPLE SEQUENCE NUMBERS 6 9 10 11 ONLY <cr>

Prompt (12) provides the user with the option of specifying a title for the report produced. The user should take note that a terminal programming error will possibly result if the title selected is greater than 150 characters in length.

At this point all input parameters required have been specified and the prompting macro lists all chosen parameters.

```
YOU SELECTED YEAR(S) 1977 TO 1977
YOU SELECTED DATA TYPE(S) 6 7
YOU SELECTED AREA(S) 7
YOU SELECTED SUBAREA(S) 0
YOU SELECTED SAMPLE SEQUENCE NUMBER(S) 6 9 10 11
YOU SELECTED MONTH(S) 0
YOU SELECTED DAY(S) 0
YOU SELECTED TITLE SPRUCE POND OUTLET    15 MINUTE DRIFT SAMPLES
      1977          SAMPLE SEQUENCE NUMBERS 6 9 10 11 ONLY
```

A value of zero indicates that no selection was made for that variable.

At this stage the interactive prompting macro is finished and the following message is issued.

PROCESSING BEGINS...

This indicates that that all necessary parameters have been successfully entered by the user. A second macro named REPORT1 is invoked

which creates a temporary data set containing job control language* and the main report producing SAS programming statements. This data set is then submitted to the computer system for execution. When submitted, the macro program responds with

JOB***** jobid SCHEDULED

indicating that that the job identified by ***** has been submitted for batch execution.

IDC0550I ENTRY(A) G70141A.@@@@@@ DELETED

The member @@@@@@ is a temporary data set which contains the report producing SAS programming statements.

YOUR JOB HAS BEEN SUBMITTED TO BATCH AND WILL BE ROUTED TO LOCAL PRINTER.

EXITING BUGSUM...

These are the final messages to the user indicating normal completion of the job. The output resulting from the above sample job is listed in Table 1. At this point the user is again prompted by the SAS system with a line number and question mark. If the user wishes to run the main macro program again he simply types %BUGSUM as before. To exit the SAS interactive session the user may issue an ENDSAS; statement or the symbols /* in columns 1 and 2.

The system of programs as they currently exist does casual checks of the validity of input issued at the terminal by the user. If a user responds to a prompt with a code that is invalid or does not appear as a code on the Life Form Coding Specifications, for example, then erroneous results may occur. It is hoped that the prompts made by the calling program are straightforward enough for any user to interpret what input parameters are necessary.

If at any time during the interactive session the user incorrectly enters a response or wishes to terminate the session for any reason,the user simply presses the attention interrupt key (break,dup) on the terminal to halt execution. The user can then begin the session again by typing

%BUGSUM <cr>

The average batch job run at the Department of Fisheries and Oceans, St. John's, requires 150OK of core storage and uses approximately 7-8 cpu seconds.

---

*The job control language described in this report may be slightly different than that required by other installations with different job control requirements.

Table 1. Sample output, REPORT1.

```
YOU SELECTED YEAR(S) 1977 TO 1977
YOU SELECTED DATA TYPE(S) 6 7
YOU SELECTED AREA(S) 7
YOU SELECTED SUBAREA(S) 0
YOU SELECTED SAMPLE SEQ NUMBER(S) 6 9 10 11
YOU SELECTED MONTH(S) 0
YOU SELECTED DAY(S) 0
YOU SELECTED TITLE SPRUCE POND OUTLET   15 MINUTE DRIFT SAMPLES   1977
   SAMPLE SEQUENCE NUMBERS 6 9 10 11 ONLY

NOTE: A ZERO (0) INDICATES THAT NO SELECTION WAS MADE FOR THE PARTICULAR VARIABLE.


SPRUCE POND OUTLET   15 MINUTE DRIFT SAMPLES   1977   SAMPLE SEQUENCE NUMBERS 6 9 10 11 ONLY

NUMBER OF SAMPLES WAS: 4
```

TAXA	LIFE STAGE	CODE TAXA	CODE LIFE STAGE	NUMBER	MEAN	MIN	MAX	STANDARD DEVIATION
TRICLADIDA PLANARIIDAE		0705010000	.	1	0.2500	0	1	0.5000
HETERODONTA SPHAERIIDAE		3302010000	.	7	1.7500	0	6	2.8723
HIRUDINEA		3500000000	.	1	0.2500	0	1	0.5000
ARACHNOIDEA HYDRACARINA		3902000000	.	4	1.0000	0	2	0.8165
COPEPODA CALANOIDA		4201000000	.	1	0.2500	0	1	0.5000
COPEPODA CYCLOPOIDA		4202000000	.	1	0.2500	0	1	0.5000
BRANCHIOPODA CLADOCERA		4501000000	.	1	0.2500	0	1	0.5000
INSECTA EPHEMEROPTERA	NYMPH	6001000000	3	4	1.0000	0	3	1.4142
SIPHLONURIDAE AMELETUS	NYMPH	6001010100	3	1	0.2500	0	1	0.5000
HEPTAGENIIDAE STENONEMA	NYMPH	6001030400	3	1	0.2500	0	1	0.5000
EPHEMERELLIDAE EPHEMERELLA	NYMPH	6001050200	3	3	0.7500	0	2	0.9574
INSECTA PLECOPTERA	NYMPH	6005000000	3	4	1.0000	0	4	2.0000
TRICHOPTERA POLYCENTROPODIDAE	LARVA	6009040000	4	2	0.5000	0	2	1.0000
HYDROPSYCHIDAE HYDROPSYCHE	LARVA	6009050300	4	4	1.0000	0	4	2.0000
HYDROPSYCHIDAE CHEUMATOPSYCHE	LARVA	6009050400	4	1	0.2500	0	1	0.5000
LIMNEPHILIDAE NEOPHYLAX	LARVA	6009090200	4	1	0.2500	0	1	0.5000
INSECTA DIPTERA	ADULT	6010000000	1	7	1.7500	0	3	1.2583
INSECTA DIPTERA	PUPA	6010000000	5	10	2.5000	0	6	2.5166
DIPTERA CHIRONOMIDAE	LARVA	6010080000	4	3	0.7500	0	1	0.5000
DIPTERA SIMULIIDAE	LARVA	6010090000	4	3	0.7500	0	3	1.5000
ALL	ALL	----------		60	15.0000	13	17	2.3094
ALL	ALL EXCEPT EXUVIA	----------		60	15.0000	13	17	2.3094

SAMPLE JOB RUN (REPORT2)

Once logged on to a terminal a user simply invokes SAS under TSO to initiate the interactive session by typing

TSAS OPTIONS('NONOTES NODMS') AUTOS('''G70141A.BUGSUM.CNTL''') <cr>

The TSAS command sets several options in SAS under TSO, creates output and work files and links the user macro library to the system default macro library. Different installations may use a different TSAS command.

The SAS system then responds with a line number followed by a question mark (i.e. 1?) which is a prompt for user action. The user types

%BUGSUM <cr>

This invokes the main macro program. After a few seconds the system welcomes the user and awaits for a carriage return to continue processing with the next screen.

The following screen prompts the user to enter a single numeric code indicating the type of summary required.

1. SELECT REQUIRED REPORT:

   1 REPORT IN REPORT1 FORMAT

   2 REPORT IN REPORT2 FORMAT

   ENTER NUMBER:

   <ur> 2 <cr>

2. ENTER STARTING YEAR FOR WHICH YOU REQUIRE REPORT (E.G. 78).

   <ur> 77 <cr>

3. ENTER FINAL YEAR FOR WHICH YOU REQUIRE REPORT (E.G. 82).
   IF SAME AS STARTING YEAR, RE-ENTER STARTING YEAR.

   <ur> 78 <cr>

   These two prompts together allow the user to specify a range of yearly values for which the report is required. In this example all data values from 1977 to 1978 inclusive would be selected.

YOU SELECTED YEAR(S) 1977 TO 1978

This message serves as a check to ensure that the intended year or series of years was correctly entered at the terminal by the user.

4. ENTER NUMBER OF DATA TYPES TO BE PROCESSED (TO A MAXIMUM OF 99).

<ur> 1 <cr>

This prompt requires the user to input a number between 1 and 99 to indicate the total number of data types to be processed together as per the Life Form Coding Specifications thus allowing for combinations of data types. In this case the user selected only one data type.

5. ENTER 1 DATA TYPE(S) AS PER LIFE FORM CODING SPECIFICATIONS.
SEPARATE BY BLANKS IF MORE THAN ONE DATA TYPE SELECTED.

<ur> 5 <cr>

YOU SELECTED DATA TYPE(S) 5

Based on the number of data types selected in prompt (4),the user continues inputing unique data type codes until all codes have been entered. In this example data type represented by code 5 is to be combined.

6. ENTER NUMBER OF AREAS TO BE ANALYZED (TO A MAXIMUM OF 999).

<ur> 1 <cr>

Similar to prompt (4), the user enters a number between 1 and 999.

7. ENTER 1 AREA(S) AS PER LIFE FORM CODING SPECIFICATIONS.
SEPARATE BY BLANKS IF MORE THAN ONE AREA SELECTED.

<ur> 5 <cr>

YOU SELECTED AREA(S) 5

Based on the number of areas requested in prompt (6),a valid numeric code is entered referring to a particular area specified on the Life Form Coding Specifications. Here only area 5 is required.

8. DO YOU WISH TO SELECT BY SUBAREA? (ENTER Y OR N)

<ur> y <cr>

This prompt allows the user to select individual subareas from within the particular area or areas selected in prompt (7).

9. ENTER NUMBER OF SUBAREAS TO BE ANALYZED (TO A MAXIMUM OF 999).

<ur> 1 <cr>

Similar to prompt (6), the user inputs a number between 1 and 999.

10. ENTER 1 SUBAREA(S) AS PER LIFE FORM CODING SPECIFICATIONS.
SEPARATE BY BLANKS IF MORE THAN ONE SUBAREA SELECTED.

<ur> 5 <cr>

YOU SELECTED SUBAREA(S) 5

Based on the number of subareas chosen in prompt (9), this prompt requires a valid subarea code chosen as per the Life Form Coding Specifications.

11. DO YOU WISH TO SELECT BY SAMPLE SEQUENCE NUMBER, BY MONTH OR BY MONTH AND DAY? ENTER ONE OF THE FOLLOWING CODES:

```
*********************************
*   0 = NEITHER                 *
*   1 = SAMPLE SEQUENCE NUMBER  *
*   2 = MONTH OR MONTH AND DAY  *
*********************************
```

<ur> 2 <cr>

This prompt demonstrates the lowest level of breakdown achievable with these reports. The user can select samples based on known sample sequence numbers, for selected months or for selected days within months. In this example option 2 is selected.

12. ENTER NUMBER OF MONTHS TO BE ANALYZED (TO A MAXIMUM OF 12).

<ur> 1 <cr>

User enters a single value between 1 and 12 to indicate the number of months required.

13. ENTER 1 MONTH(S) AS PER LIFE FORM CODING SPECIFICATIONS.
SEPARATE BY BLANKS IF MORE THAN ONE MONTH SELECTED.

<ur> 8 <cr>

YOU SELECTED MONTH(S) 8

Based on the number of months selected in prompt (12), the user enters unique codes specified in the Life Form Coding Specifications (i.e. Jan=1, ... Dec=12). Here the month of August is chosen.

14. DO YOU WISH TO SELECT BY DAY? (ENTER Y OR N)

<ur> N <cr>

Individual sampling days for the month or months selected in prompt (13) may be specified. Selection by days was not required in this example.

15. ENTER REPORT TITLE (MAXIMUM OF 150 CHARACTERS INCLUDING BLANKS).

<ur> SURBER SAMPLES SPRUCE POND MAJOR INLET 1977-1978
UNSPECIFIED LOCATION AUGUST <cr>

Prompt (15) provides the user with the option of specifying a title for the report produced. The user should take note that a terminal programming error will possibly result if the title selected is greater than 150 characters in length.

At this point all input parameters required have been specified and the prompting macro lists all chosen parameters.

```
YOU SELECTED YEAR(S) 1977 TO 1978
YOU SELECTED DATA TYPE(S) 5
YOU SELECTED AREA(S) 5
YOU SELECTED SUBAREA(S) 5
YOU SELECTED SAMPLE SEQUENCE NUMBER(S) 0
YOU SELECTED MONTH(S) 8
YOU SELECTED DAY(S) 0
YOU SELECTED TITLE  SURBER SAMPLES    SPRUCE POND MAJOR INLET
1977-1978  UNSPECIFIED LOCATION                        AUGUST
```

A value of zero indicates that no selection was made for that variable.

At this stage the interactive prompting macro is finished and the following message is issued.

PROCESSING BEGINS...

This indicates that that all necessary parameters have been successfully entered by the user. A second macro named REPORT2 is invoked which creates

a temporary data set containing job control language* and the main report producing SAS programming statements. This data set is then submitted to the computer system for execution. When submitted the macro program responds with

JOB***** jobid SCHEDULED

indicating that that the job identified by ***** has been submitted for batch execution.

IDC0550I ENTRY(A) G70141A.@@@@@@ DELETED

The member @@@@@@ is a temporary data set which contains the report producing SAS programming statements.

YOUR JOB HAS BEEN SUBMITTED TO BATCH AND WILL BE ROUTED TO LOCAL PRINTER.

EXITING BUGSUM...

These are the final messages to the user indicating normal completion of the job. The output resulting from the above sample job is listed in Table 2. At this point the user is again prompted by the SAS system with a line number and question mark.If the user wishes to run the main macro program again he simply types %BUGSUM as before. To exit the SAS interactive session the user may issue an ENDSAS; statement or the symbols /* in columns 1 and 2.

The system of programs as they currently exist does casual checks of the validity of input issued at the terminal by the user. If a user responds to a prompt with a code that is invalid or does not appear as a code on the Life Form Coding Specifications, then erroneous results may occur. It is hoped that the prompts made by the calling program are straightforward enough for any user to interpret what input parameters are necessary.

If at any time during the interactive session the user incorrectly enters a response or wishes to terminate the session for any reason, the user simply presses the attention interrupt key (break,dup) on the terminal to halt execution. The user can then begin the session again by typing

%BUGSUM <cr>

ACKNOWLEDGMENTS

G. D. Somerton provided assistance in program development. K. Harding typed the report. R. J. Gibson and G. D. Somerton constructively reviewed the manuscript.

---

*Job control languages may differ among installations.

Table 2. Sample output, REPORT2.

```
YOU SELECTED YEAR(S) 1977 TO 1978
YOU SELECTED DATA TYPE(S) 5
YOU SELECTED AREA(S) 5
YOU SELECTED SUBAREA(S) 5
YOU SELECTED SAMPLE SEQ NUMBER(S) 0
YOU SELECTED MONTH(S) 8
YOU SELECTED DAY(S) 0
YOU SELECTED TITLE SURBER SAMPLES    SPRUCE POND MAJOR INLET    1977-1978
  UNSPECIFIED LOCATION    AUGUST

NOTE:  A ZERO (0) INDICATES THAT NO SELECTION WAS MADE FOR THE PARTICULAR VARIABLE.

SURBER SAMPLES    SPRUCE POND MAJOR INLET    1977-1978    UNSPECIFIED LOCATION    AUGUST

NUMBER OF SAMPLES WAS: 36
```

TAXA	CODE TAXA	CODE LIFE STAGE	NUMBER	MEAN	MIN	MAX	STANDARD DEVIATION
GASTROPODA	3000000000	.	49	1.3611	0	6	1.8997
HYDROBIIDAE	3001040000	.	5	0.1389	0	3	0.5929
VIVIPARIDAE	3001050000	.	30	0.8333	0	6	1.4243
LYMNAEIDAE	3003020000	.	9	0.2500	0	3	0.6492
UNIDENTIFIED GASTROPODA	3000000000	.	5	0.1389	0	5	0.8333
PELECYPODA	3300000000	.	49	1.3611	0	12	2.3562
SPHAERIIDAE	3302010000	.	49	1.3611	0	12	2.3562
HIRUDINEA	3500000000	.	22	0.6111	0	2	0.8711
OLIGOCHAETA	3600000000	.	8	0.2222	0	2	0.5909
ARACHNOIDEA	3900000000	.	9	0.2500	0	2	0.5542
HYDRACARINA	3902000000	.	9	0.2500	0	2	0.5542
AMPHIPODA	5502000000	.	175	4.8611	0	24	6.3568
TALITRIDAE	5502010000	.	175	4.8611	0	24	6.3568
INSECTA	6000000000	.	246	6.8333	0	10	6.0498
EPHEMEROPTERA (NYMPH)	6001000000	3	112	3.1111	0	10	4.5405
BAETIDAE (NYMPH)	6001020000	3	7	0.1944	0	4	0.7491
HEPTAGENIIDAE (NYMPH)	6001030000	3	8	0.2222	0	5	0.8656
LEPTOPHLEBIIDAE (NYMPH)	6001040000	3	45	1.2500	0	10	2.1696
EPHEMERELLIDAE (NYMPH)	6001050000	3	38	1.0556	0	10	2.2161
CAENIDAE (NYMPH)	6001070000	3	1	0.0278	0	1	0.1667
UNIDENTIFIED EPHEMEROPTERA	6001000000	.	13	0.3611	0	9	1.5703
ODONATA (NYMPH)		3	9	0.2500	0	2	0.5542
ZYGOPTERA (NYMPH)	6003000000	3	5	0.1389	0	2	0.4245
COENAGRIIDAE (NYMPH)	6003030000	3	5	0.1389	0	2	0.4245
ANISOPTERA (NYMPH)	6004000000	3	4	0.1111	0	1	0.3187
AESHNIDAE (NYMPH)	6004010000	3	4	0.1111	0	1	0.3187
COLEOPTERA (ADULT)	6008000000	1	7	0.1944	0	1	0.4014
ELMIDAE (ADULT)	6008060000	1	2	0.0556	0	1	0.2323
UNIDENTIFIED COLEOPTERA	6008000000	.	5	0.1389	0	1	0.3507
TRICHOPTERA (LARVA)	6009000000	4	37	1.0278	0	5	1.4038
POLYCENTROPODIDAE (LARVA)	6009040000	4	5	0.1389	0	1	0.3507
HYDROPSYCHIDAE (LARVA)	6009050000	4	4	0.1111	0	2	0.3984
HYDROPTILIDAE (LARVA)	6009060000	4	7	0.1944	0	4	0.7491
PHRYGANEIDAE (LARVA)	6009080000	4	2	0.0556	0	1	0.2323
LIMNEPHILIDAE (LARVA)	6009090000	4	1	0.0278	0	1	0.1667
LEPTOCERIDAE (LARVA)	6009120000	4	16	0.4444	0	5	1.2058
UNIDENTIFIED TRICHOPTERA	6009000000	.	2	0.0556	0	1	0.2323
DIPTERA (LARVA)	6010000000	4	81	2.2500	0	10	2.8322
CERATOPOGONIDAE (LARVA)	6010070000	4	1	0.0278	0	1	0.1667
CHIRONOMIDAE (LARVA)	6010080000	4	74	2.0556	0	10	2.6289
SIMULIIDAE (LARVA)	6010090000	4	4	0.1111	0	1	0.3187
UNIDENTIFIED DIPTERA	6010000000	.	2	0.0556	0	2	0.3333
OTHER INVERTEBRATES		.	1	0.0278	0	1	0.1667
ALL	----------		559	15.5278	2	46	11.0052

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Appendix 1 -- Coding Specifications for Data Processed by BUGSUM

Table 1. Life form coding specifications for benthic invertebrate collections from the Experimental Ponds Area, Newfoundland.

Note that the species code used in these specifications is obtained from:

Ryan, P. M. 1983. Computer code for freshwater life forms of Newfoundland: Part 1 - Animals. Can. MS Rep. Fish. Aquat. Sci. 1729: iv + 159 p.

or, for subsequently issued codes, from the issuing establishment identified on the cover.

Fields	Columns	Digits	Codes
Data type	1-2	2	5. Surber samples 6. 15 minute drift samples 7. 24 hour drift samples 8. Bi-monthly grab samples 9. Grab samples by contour 13. Artificial substrates
Area	3-5	3	1. Spruce Pond 2. Headwater Pond 3. Little Gull Lake 4. Haynes Lake 5. Spruce Pond Major Inlet 6. Spruce Pond Minor Inlet 7. Spruce Pond Outlet 8. Headwater Pond Inlet 9. Headwater Pond Intermittent (southwest) 10. Headwater Pond OUtlet 11. Little Gull Lake Inlet from Spruce Pond 12. Little Gull Lake Outlet 13. Ryan's Pond 14. Ryan's Pond Inlet 15. Ryan's Pond Outlet 16. Cole's Pond 17. Cole's Pond South Inlet 18. Cole's Pond Northwest Inlet 19. Cole's Pond Outlet

Table 1 (cont'd)

Fields	Columns	Digits	Codes
Subarea	6-8	3	1. Station One 2. Station Two 3. Station Three 4. Station Four 5. Unspecified location 6. Headwater Pond by boat mooring 7. Headwater Pond by Station 2 8. Spruce Pond by major inlet 9. Spruce Pond by cabin 301-340. Contour sample Stations 1-40
Sample day	9-10	2	1-31
Sample month	11-12	2	Jan. = 1, Dec. = 12
Sample year	13-14	2	1982 = 82
Sample sequence that year	15-17	3	1. First sampling date 2. Second sampling date 3-999. Etc.
Raw or averaged data	18	1	1. Raw data 2. Averaged data
Number of samples in average if averaged data used	19-21	3	1-999. Number of samples
Sample number	22-25	4	Assigned
Space reserved	26-29	4	Not used
Record type	30	1	Sample record = 1 Species record = 2

Table 1 (cont'd)

Fields	Columns	Digits	Codes
Species code	31-40	10	As per species code listing in five fields (Ryan 1983)
Life stage	41-42	2	1. Adult 2. Juvenile 3. Nymph 4. Larvae (nauplii) 5. Pupa (or resting stage as statoblast) 6. Egg 7. Exuvia (cases, exoskeletons, remains)
Sex	43	1	1. Male 2. Female
Number	44-49	6	Number of individuals

Appendix 2 -- File Creation for REPORT1 Format

Table 1. Conversion of REPORT1.CODES into SAS data set, REP1CODE, for use in REPORT1.

(a) **Partial listing of records contained in data set REPORT1.CODES**

INSECTA	6000000000
INSECTA EPHEMEROPTERA	6001000000
EPHEMEROPTERA SIPHLONURIDAE	6001010000
SIPHLONURIDAE AMELETUS	6001010100
SIPHLONURIDAE SIPHLONURUS	6001010200
SIPHLONURUS ALTERNATUS	6001010201
SIPHLONURUS QUEBECENSIS	6001010202
EPHEMEROPTERA BAETIDAE	6001020000
BAETIDAE BAETIS	6001020100
BAETIS FLAVISTRIGA	6001020101
BAETIS MACDUNNOUGHI	6001020102
BAETIS PYGMAEUS	6001020103
BAETIS TRICAUDATUS	6001020104
BAETIDAE CALLIBAETIS	6001020200
CALLIBAETIS SKOKIANUS	6001020201
BAETIDAE CENTROPTILUM	6001020300
CENTROPTILUM CONVEXUM	6001020301
EPHEMEROPTERA HEPTAGENIIDAE	6001030000
HEPTAGENIIDAE EPEORUS	6001030100
EPEORUS PLEURALIS	6001030101
HEPTAGENIIDAE HEPTAGENIA	6001030200
HEPTAGENIA PULLA	6001030201
HEPTAGENIA HEBE	6001030202
HEPTAGENIIDAE RHITHROGENA	6001030300
RHITHROGENA UNDULATA	6001030301
HEPTAGENIIDAE STENONEMA	6001030400
STENONEMA FEMORATUM	6001030401
STENONEMA VICARIUM	6001030402

(b) **SAS program which transforms REPORT1.CODES to SAS data set REP1CODE**

```
DATA SAVE.REP1CODE(KEEP=NAME CODE LIFESTG);
INFILE IN;
INPUT NAME $ 1-35 CODE $ 41-50;
DO I=0 TO 7;
   LIFESTG=I;
   OUTPUT;
END;

PROC PRINT DATA=SAVE.REP1CODE (OBS=16);
```

Table 1 (cont'd)

(c) **Partial listing of resulting SAS data set for use in REPORT1**

OBS	NAME	CODE	LIFESTG
1	INSECTA	6000000000	0
2	INSECTA	6000000000	1
3	INSECTA	6000000000	2
4	INSECTA	6000000000	3
5	INSECTA	6000000000	4
6	INSECTA	6000000000	5
7	INSECTA	6000000000	6
8	INSECTA	6000000000	7
9	INSECTA EPHEMEROPTERA	6001000000	0
10	INSECTA EPHEMEROPTERA	6001000000	1
11	INSECTA EPHEMEROPTERA	6001000000	2
12	INSECTA EPHEMEROPTERA	6001000000	3
13	INSECTA EPHEMEROPTERA	6001000000	4
14	INSECTA EPHEMEROPTERA	6001000000	5
15	INSECTA EPHEMEROPTERA	6001000000	6
16	INSECTA EPHEMEROPTERA	6001000000	7

Table 2. Conversion of external tape file into SAS data set, DATA1, for use in REPORT1 (a) and representative records (b).

(a)

```
DATA SAVE.DATA1;
INFILE PONDS;
INPUT DT 1-2 AREA 3-5 SUBAREA 6-8 DAY 9-10 MONTH 11-12 YEAR 13-14
    SSN 15-17 SN 22-25 REC_TYPE 30 CODE $ 31-40 LS 41-42
    NUMBER 44-49;
IF ((5<=DT<=9) OR DT=13) AND                /*  SELECTED DATA TYPES  */
  (77<=YEAR<=82) AND                          /* SELECTED YEARS   */
  AREA=1 OR AREA=2 OR (5<=AREA<=8) OR AREA=10;  /*  SELECTED AREAS  */
IF REC_TYPE=1 THEN NUMBER=0;
IF LS=. THEN LS=0;

PROC PRINT DATA=SAVE.DATA1 (OBS=10);
//
```

Table 2 (cont'd)

(b)

OBS	DT	AREA	SUBAREA	DAY	MONTH	YEAR	SSN	SN	REC_TYPE	CODE	LS	NUMBER
1	10	2	1	30	8	78	1	165	1		0	0
2	10	2	1	30	8	78	1	165	2	4201020101	1	24
3	10	2	1	30	8	78	1	165	2	4201020101	1	72
4	10	2	1	30	8	78	1	165	2	4201020101	2	360
5	10	2	1	30	8	78	1	165	2	4202010000	2	504
6	10	2	1	30	8	78	1	165	2	4200000000	4	3813
7	10	2	1	30	8	78	1	165	2	4501020101	2	72
8	10	2	1	30	8	78	1	165	2	4501040201	1	24
9	10	2	1	30	8	78	1	165	2	4501040201	2	120
10	10	2	1	30	8	78	1	165	2	4501050101	1	432

Appendix 3 -- File Creation for REPORT2 Format

Table 1. Conversion of REPORT2.CODES into SAS data set, REP2CODE, for use in REPORT2.

(a) **Data set: REPORT2.CODES**

GASTROPODA		3000000000
HYDROBIIDAE		3001040000
VIVIPARIDAE		3001050000
VALVATIDAE		3001060000
NERTIDAE		3002010000
PHYSIDAE		3003010000
LYMNAEIDAE		3003020000
PLANORBIDAE		3003030000
ANCYLIDAE		3003060000
UNIDENTIFIED GASTROPODA		3000000000
UNIDENTIFIED GASTROPODA		3001000000
UNIDENTIFIED GASTROPODA		3002000000
UNIDENTIFIED GASTROPODA		3003000000
PELECYPODA		3300000000
UNIONIDAE		3301010000
SPHAERIIDAE		3302010000
UNIDENTIFIED PELECYPODA		3300000000
HIRUDINEA		3500000000
OLIGOCHAETA		3600000000
ARACHNOIDEA		3900000000
ARANEAE		3901000000
HYDRACARINA		3902000000
PHALANGIDA		3903000000
UNIDENTIFIED ARACHNOIDEA		3900000000
AMPHIPODA		5502000000
TALITRIDAE		5502010000
GAMMARIDAE		5502020000
UNIDENTIFIED AMPHIPODA		5502000000
CHILOPODA		5600000000
INSECTA		6000000000
EPHEMEROPTERA (NYMPH)	3	6001000000
EPHEMEROPTERA (ADULT)	1	6001000000
SIPHLONURIDAE (NYMPH)	3	6001010000
SIPHLONURIDAE (ADULT)	1	6001010000
BAETIDAE (NYMPH)	3	6001020000
BAETIDAE (ADULT)	1	6001020000
HEPTAGENIIDAE (NYMPH)	3	6001030000
HEPTAGENIIDAE (ADULT)	1	6001030000
LEPTOPHLEBIIDAE (NYMPH)	3	6001040000
LEPTOPHLEBIIDAE (ADULT)	1	6001040000
EPHEMERELLIDAE (NYMPH)	3	6001050000
EPHEMERELLIDAE (ADULT)	1	6001050000
CAENIDAE (NYMPH)	3	6001070000
CAENIDAE (ADULT)	1	6001070000

Table 1 (cont'd)

EPHEMERIDAE (NYMPH)	3	6001080000
EPHEMERIDAE (ADULT)	1	6001080000
UNIDENTIFIED EPHEMEROPTERA		6001000000
ODONATA (NYMPH)	3	6234000000
ODONATA (ADULT)	1	6234000000
ZYGOPTERA (NYMPH)	3	6003000000
ZYGOPTERA (ADULT)	1	6003000000
CALOPTERYGIDAE (NYMPH)	3	6003010000
CALOPTERYGIDAE (ADULT)	1	6003010000
LESTIDAE (NYMPH)	3	6003020000
LESTIDAE (ADULT)	1	6003020000
COENAGRIIDAE (NYMPH)	3	6003030000
COENAGRIIDAE (ADULT)	1	6003030000
UNIDENTIFIED ZYGOPTERA		6003000000
ANISOPTERA (NYMPH)	3	6004000000
ANISOPTERA (ADULT)	1	6004000000
AESHNIDAE (NYMPH)	3	6004010000
AESHNIDAE (ADULT)	1	6004010000
GOMPHIDAE (NYMPH)	3	6004020000
GOMPHIDAE (ADULT)	1	6004020000
CORDULIIDAE (NYMPH)	3	6004030000
CORDULIIDAE (ADULT)	1	6004030000
LIBELLULIDAE (NYMPH)	3	6004040000
LIBELLULIDAE (ADULT)	1	6004040000
UNIDENTIFIED ANISOPTERA		6004000000
UNIDENTIFIED ODONATA		6002000000
PLECOPTERA (NYMPH)	3	6005000000
PLECOPTERA (ADULT)	1	6005000000
LEUCTRIDAE (NYMPH)	3	6005010000
LEUCTRIDAE (ADULT)	1	6005010000
CAPNIIDAE (NYMPH)	3	6005020000
CAPNIIDAE (ADULT)	1	6005020000
NEMOURIDAE (NYMPH)	3	6005030000
NEMOURIDAE (ADULT)	1	6005030000
CHLOROPERLIDAE (NYMPH)	3	6005040000
CHLOROPERLIDAE (ADULT)	1	6005040000
PERLODIDAE (NYMPH)	3	6005060000
PERLODIDAE (ADULT)	1	6005060000
TAENIOPTERYGIDAE (NYMPH)	3	6005070000
TAENIOPTERYGIDAE (ADULT)	1	6005070000
UNIDENTIFIED PLECOPTERA		6005000000
HEMIPTERA (NYMPH)	3	6006000000
HEMIPTERA (ADULT)	1	6006000000
CORIXIDAE (NYMPH)	3	6006010000
CORIXIDAE (ADULT)	1	6006010000
NOTONECTIDAE (NYMPH)	3	6006020000
NOTONECTIDAE (ADULT)	1	6006020000

Table 1 (cont'd)

BELOSTOMATIDAE (NYMPH)	3	6006030000
BELOSTOMATIDAE (ADULT)	1	6006030000
MESOVELIIDAE (NYMPH)	3	6006040000
MESOVELIIDAE (ADULT)	1	6006040000
VELIIDAE (NYMPH)	3	6006050000
VELIIDAE (ADULT)	1	6006050000
GERRIDAE (NYMPH)	3	6006060000
GERRIDAE (ADULT)	1	6006060000
REDUVIIDAE (NYMPH)	3	6006080000
REDUVIIDAE (ADULT)	1	6006080000
MIRIDAE (NYMPH)	3	6006090000
MIRIDAE (ADULT)	1	6006090000
UNIDENTIFIED HEMIPTERA		6006000000
NEUROPTERA (LARVA)	4	6007000000
NEUROPTERA (ADULT)	1	6007000000
SISYRIDAE (LARVA)	4	6007010000
SISYRIDAE (ADULT)	1	6007010000
HEMEROBIIDAE (LARVA)	4	6007020000
HEMEROBIIDAE (ADULT)	1	6007020000
UNIDENTIFIED NEUROPTERA		6007000000
COLEOPTERA (LARVA)	4	6008000000
COLEOPTERA (PUPA)	5	6008000000
COLEOPTERA (ADULT)	1	6008000000
HALIPLIDAE (LARVA)	4	6008010000
HALIPLIDAE (PUPA)	5	6008010000
HALIPLIDAE (ADULT)	1	6008010000
DYTISCIDAE (LARVA)	4	6008020000
DYTISCIDAE (PUPA)	5	6008020000
DYTISCIDAE (ADULT)	1	6008020000
GYRINIDAE (LARVA)	4	6008030000
GYRINIDAE (PUPA)	5	6008030000
GYRINIDAE (ADULT)	1	6008030000
HYDROPHILIDAE (LARVA)	4	6008040000
HYDROPHILIDAE (PUPA)	5	6008040000
HYDROPHILIDAE (ADULT)	1	6008040000
HELODIDAE (LARVA)	4	6008050000
HELODIDAE (PUPA)	5	6008050000
HELODIDAE (ADULT)	1	6008050000
ELMIDAE (LARVA)	4	6008060000
ELMIDAE (PUPA)	5	6008060000
ELMIDAE (ADULT)	1	6008060000
CHRYSOMELIDAE (LARVA)	4	6008070000
CHRYSOMELIDAE (PUPA)	5	6008070000
CHRYSOMELIDAE (ADULT)	1	6008070000
ELATERIDAE (LARVA)	4	6008080000
ELATERIDAE (PUPA)	5	6008080000
ELATERIDAE (ADULT)	1	6008080000

Table 1 (cont'd)

CIRCULIONIDAE (LARVA)	4	6008090000
CIRCULIONIDAE (PUPA)	5	6008090000
CIRCULIONIDAE (ADULT)	1	6008090000
STAPHYLINIDAE (LARVA)	4	6008100000
STAPHYLINIDAE (PUPA)	5	6008100000
STAPHYLINIDAE (ADULT)	1	6008100000
LATHRIDIIDAE (LARVA)	4	6008110000
LATHRIDIIDAE (PUPA)	5	6008110000
LATHRIDIIDAE (ADULT)	1	6008110000
DRYOPODIDAE (LARVA)	4	6008120000
DRYOPODIDAE (PUPA)	5	6008120000
DRYOPODIDAE (ADULT)	1	6008120000
CANTHARIDAE (LARVA)	4	6008130000
CANTHARIDAE (PUPA)	5	6008130000
CANTHARIDAE (ADULT)	1	6008130000
SCOLYTIDAE (LARVA)	4	6008140000
SCOLYTIDAE (PUPA)	5	6008140000
SCOLYTIDAE (ADULT)	1	6008140000
CRYPTOPHAGIDAE (LARVA)	4	6008150000
CRYPTOPHAGIDAE (PUPA)	5	6008150000
CRYPTOPHAGIDAE (ADULT)	1	6008150000
CARABIDAE (LARVA)	4	6008160000
CARABIDAE (PUPA)	5	6008160000
CARABIDAE (ADULT)	1	6008160000
DERMESTIDAE (LARVA)	4	6008170000
DERMESTIDAE (PUPA)	5	6008170000
DERMESTIDAE (ADULT)	1	6008170000
UNIDENTIFIED COLEOPTERA		6008000000
TRICHOPTERA (LARVA)	4	6009000000
TRICHOPTERA (PUPA)	5	6009000000
TRICHOPTERA (ADULT)	1	6009000000
RHYACOPHILIDAE (LARVA)	4	6009010000
RHYACOPHILIDAE (PUPA)	5	6009010000
RHYACOPHILIDAE (ADULT)	1	6009010000
GLOSSOSOMATIDAE (LARVA)	4	6009020000
GLOSSOSOMATIDAE (PUPA)	5	6009020000
GLOSSOSOMATIDAE (ADULT)	1	6009020000
PHILOPOTOMIDAE (LARVA)	4	6009030000
PHILOPOTOMIDAE (PUPA)	5	6009030000
PHILOPOTOMIDAE (ADULT)	1	6009030000
POLYCENTROPODIDAE (LARVA)	4	6009040000
POLYCENTROPODIDAE (PUPA)	5	6009040000
POLYCENTROPODIDAE (ADULT)	1	6009040000
HYDROPSYCHIDAE (LARVA)	4	6009050000
HYDROPSYCHIDAE (PUPA)	5	6009050000
HYDROPSYCHIDAE (ADULT)	1	6009050000
HYDROPTILIDAE (LARVA)	4	6009060000

Table 1 (cont'd)

HYDROPTILIDAE (PUPA)	5	6009060000
HYDROPTILIDAE (ADULT)	1	6009060000
PSYCHOMYIIDAE (LARVA)	4	6009070000
PSYCHOMYIIDAE (PUPA)	5	6009070000
PSYCHOMYIIDAE (ADULT)	1	6009070000
PHRYGANEIDAE (LARVA)	4	6009080000
PHRYGANEIDAE (PUPA)	5	6009080000
PHRYGANEIDAE (ADULT)	1	6009080000
LIMNEPHILIDAE (LARVA)	4	6009090000
LIMNEPHILIDAE (PUPA)	5	6009090000
LIMNEPHILIDAE (ADULT)	1	6009090000
MOLANNIDAE (LARVA)	4	6009110000
MOLANNIDAE (PUPA)	5	6009110000
MOLANNIDAE (ADULT)	1	6009110000
LEPTOCERIDAE (LARVA)	4	6009120000
LEPTOCERIDAE (PUPA)	5	6009120000
LEPTOCERIDAE (ADULT)	1	6009120000
LEPIDOSTOMATIDAE (LARVA)	4	6009130000
LEPIDOSTOMATIDAE (PUPA)	5	6009130000
LEPIDOSTOMATIDAE (ADULT)	1	6009130000
BRACHYCENTRIDAE (LARVA)	4	6009140000
BRACHYCENTRIDAE (PUPA)	5	6009140000
BRACHYCENTRIDAE (ADULT)	1	6009140000
HELICOPSYCHIDAE (LARVA)	4	6009150000
HELICOPSYCHIDAE (PUPA)	5	6009150000
HELICOPSYCHIDAE (ADULT)	1	6009150000
UNIDENTIFIED TRICHOPTERA		6009000000
DIPTERA (LARVA)	4	6010000000
DIPTERA (PUPA)	5	6010000000
DIPTERA (ADULT)	1	6010000000
TIPULIDAE (LARVA)	4	6010010000
TIPULIDAE (PUPA)	5	6010010000
TIPULIDAE (ADULT)	1	6010010000
DIXIDAE (LARVA)	4	6010040000
DIXIDAE (PUPA)	5	6010040000
DIXIDAE (ADULT)	1	6010040000
CHAOBORIDAE (LARVA)	4	6010050000
CHAOBORIDAE (PUPA)	5	6010050000
CHAOBORIDAE (ADULT)	1	6010050000
CULICIDAE (LARVA)	4	6010060000
CULICIDAE (PUPA)	5	6010060000
CULICIDAE (ADULT)	1	6010060000
CERATOPOGONIDAE (LARVA)	4	6010070000
CERATOPOGONIDAE (PUPA)	5	6010070000
CERATOPOGONIDAE (ADULT)	1	6010070000
CHIRONOMIDAE (LARVA)	4	6010080000
CHIRONOMIDAE (PUPA)	5	6010080000

Table 1 (cont'd)

CHIRONOMIDAE (ADULT)	1	6010080000
SIMULIIDAE (LARVA)	4	6010090000
SIMULIIDAE (PUPA)	5	6010090000
SIMULIIDAE (ADULT)	1	6010090000
TABANIDAE (LARVA)	4	6010110000
TABANIDAE (PUPA)	5	6010110000
TABANIDAE (ADULT)	1	6010110000
EMPIDIDAE (LARVA)	4	6010120000
EMPIDIDAE (PUPA)	5	6010120000
EMPIDIDAE (ADULT)	1	6010120000
DOLICHOPODIDAE (LARVA)	4	6010130000
DOLICHOPODIDAE (PUPA)	5	6010130000
DOLICHOPODIDAE (ADULT)	1	6010130000
SYRPHIDAE (LARVA)	4	6010140000
SYRPHIDAE (PUPA)	5	6010140000
SYRPHIDAE (ADULT)	1	6010140000
EPHYDRIDAE (LARVA)	4	6010170000
EPHYDRIDAE (PUPA)	5	6010170000
EPHYDRIDAE (ADULT)	1	6010170000
ANTHOMYIIDAE (LARVA)	4	6010190000
ANTHOMYIIDAE (PUPA)	5	6010190000
ANTHOMYIIDAE (ADULT)	1	6010190000
MUSCIDAE (LARVA)	4	6010200000
MUSCIDAE (PUPA)	5	6010200000
MUSCIDAE (ADULT)	1	6010200000
CECIDOMYIIDAE (LARVA)	4	6010210000
CECIDOMYIIDAE (PUPA)	5	6010210000
CECIDOMYIIDAE (ADULT)	1	6010210000
MYCETOPHILIDAE (LARVA)	4	6010220000
MYCETOPHILIDAE (PUPA)	5	6010220000
MYCETOPHILIDAE (ADULT)	1	6010220000
BIBIONIDAE (LARVA)	4	6010230000
BIBIONIDAE (PUPA)	5	6010230000
BIBIONIDAE (ADULT)	1	6010230000
PHORIDAE (LARVA)	4	6010240000
PHORIDAE (PUPA)	5	6010240000
PHORIDAE (ADULT)	1	6010240000
SCIARIDAE (LARVA)	4	6010250000
SCIARIDAE (PUPA)	5	6010250000
SCIARIDAE (ADULT)	1	6010250000
DROSOPHILIDAE (LARVA)	4	6010270000
DROSOPHILIDAE (PUPA)	5	6010270000
DROSOPHILIDAE (ADULT)	1	6010270000
UNIDENTIFIED DIPTERA		6010000000
COLLEMBOLA		6021000000
HOMOPTERA		6031000000
PSOCOPTERA		6033000000

Table 1 (cont'd)

THYSANOPTERA	6038000000
HYMENOPTERA	6043000000
LEPIDOPTERA	6045000000
UNIDENTIFIED INSECTA	6000000000
OTHER INVERTEBRATES	9999000000
PISCES	6300000000

(b) SAS program which transforms REPORT2.CODES to SAS data set REP2CODE

```
DATA SAVE.REP2CODE(KEEP=NAME CODE LS);
INFILE IN;
INPUT @1 NAME $CHAR30. LS 32 CODE $ 43-48; /* COLS 49-52 ARE ALL ZERO */

PROC PRINT DATA=SAVE.REP2CODE;
```

Table 2. Program listing for the creation of SAS data sets GROUP and SUBGROUP for use in REPORT2 (a), and representative data records (b).

(a)

```
 1    DATA SAVE.GROUP SAVE.SUBGROUP;
 2    INFILE PONDS;
 3    INPUT DT 1-2 AREA 3-5 SUBAREA 6-8 DAY 9-10 MONTH 11-12 YEAR 13-14
 4          SSN 15-17 SN 22-25 REC_TYPE 30 CODE $ 31-40 LS 41-42
 5          NUMBER 44-49;
 6     IF REC_TYPE=1 THEN NUMBER=0;
 7     IF ((5<=DT<=9) OR DT=13) AND
 8        (AREA=1 OR AREA=2 OR (5<=AREA<=8) OR AREA=10) AND
 9        (77<=YEAR<=82);
10     LENGTH SC $ 4;
11     LENGTH TEMP SC2 $ 2;
12     IF LS=6 OR LS=7 THEN DELETE;
13     TEMP=SUBSTR(CODE,1,2);
14     IF TEMP='30' OR TEMP='33' OR TEMP='35' OR TEMP='36' OR TEMP='39'
15     OR TEMP='55' OR TEMP='56' THEN LS=.;
16     SC=SUBSTR(CODE,1,4);
17     SC2=SUBSTR(CODE,1,2);
18     IF SC2='30' OR SC2='33' OR SC2='35' OR SC2='36' OR SC2='39'
19     OR SC2='56' OR SC2='01' OR SC2='02' OR SC2='03' OR SC2='04'
20     OR SC2='05' OR SC2='06' OR SC2='07' OR SC2='08' OR SC2='09'
21     OR SC2='10' OR SC2='11' OR SC2='12' OR SC2='13' OR SC2='14'
22     OR SC2='15' OR SC2='16' OR SC2='17' OR SC2='18' OR SC2='19'
23     OR SC2='20' OR SC2='21' OR SC2='42' OR SC2='43' OR SC2='44'
24     OR SC2='45' OR SC2='63' THEN DO;
25      SC=SC2  '00';
26      OUTPUT SAVE.GROUP;
27     END;
28    IF SC='5502' OR SC='6001' OR SC='6002' OR SC='6003' OR SC='6004'
29    OR SC='6005' OR SC='6006' OR SC='6007' OR SC='6008' OR SC='6009'
30    OR SC='6010' OR SC='6021' OR SC='6031' OR SC='6033' OR SC='6038'
31    OR SC='6043' OR SC='6045' THEN OUTPUT SAVE.GROUP;
32    OUTPUT SAVE.SUBGROUP;

33    PROC PRINT DATA=SAVE.GROUP (OBS=10);
34    PROC PRINT DATA=SAVE.SUBGROUP (OBS=10);
```

Table 2 (cont'd)

(b)

Partial listing of records contained in GROUP data set

OBS	DT	AREA	SUBAREA	DAY	MONTH	YEAR	SSN	SN	REC_TYPE	CODE	LS	NUMBER	SC	TEMP	SC2
1	5	8	5	26	5	80	2	330	2	6001030402	3	2	6001	60	60
2	5	8	5	26	5	80	2	330	2	6001040301	3	1	6001	60	60
3	5	8	5	26	5	80	2	330	2	6005060200	3	1	6005	60	60
4	5	8	5	26	5	80	2	330	2	6009010100	5	1	6009	60	60
5	5	8	5	26	5	80	2	330	2	6009050302	4	2	6009	60	60
6	5	8	5	26	5	80	2	330	2	6009120200	4	1	6009	60	60
7	5	8	5	26	5	80	2	331	2	3500000000	.	1	3500	35	35
8	5	8	5	26	5	80	2	331	2	6001030402	3	4	6001	60	60
9	5	8	5	26	5	80	2	331	2	6001040301	3	1	6001	60	60
10	5	8	5	26	5	80	2	331	2	6008060301	4	1	6008	60	60

Partial listing of records contained in SUBGROUP data set

OBS	DT	AREA	SUBAREA	DAY	MONTH	YEAR	SSN	SN	REC_TYPE	CODE	LS	NUMBER	SC	TEMP	SC2
1	5	8	5	26	5	80	2	330	1		.	0			
2	5	8	5	26	5	80	2	330	2	6001030402	3	2	6001	60	60
3	5	8	5	26	5	80	2	330	2	6001040301	3	1	6001	60	60
4	5	8	5	26	5	80	2	330	2	6005060200	3	1	6005	60	60
5	5	8	5	26	5	80	2	330	2	6009010100	5	1	6009	60	60
6	5	8	5	26	5	80	2	330	2	6009050302	4	2	6009	60	60
7	5	8	5	26	5	80	2	330	2	6009120200	4	1	6009	60	60
8	5	8	5	26	5	80	2	331	1		.	0			
9	5	8	5	26	5	80	2	331	2	3500000000	.	1	3500	35	35
10	5	8	5	26	5	80	2	331	2	6001030402	3	4	6001	60	60

Appendix 4 -- Source Statements of Macro Program BUGSUM

Table 1. Source statements of macro program BUGSUM.

```
%GLOBAL YEAR1 YEAR2 CHARSTR1 CHARSTR2 CHARSTR3 CHARSTR4 CHARSTR5
        CHARSTR6 CHARSTR7 CHARSTR8 DT NUMDT AREA NUMAREA J ERRFLAG
        SUBAREA NUMSUB SSN NUMSSN MON NUMMOM DAY NUMDAY TITLE;
%MACRO BUGSUM;
CLEAR;CLEAR;
%PUT %STR(        *****                                          );
%PUT %STR(          *****              **********                 );
%PUT %STR(  *********       *      *********************         * );
%PUT %STR(***          *******   *************************        *);
%PUT %STR(***         ********   ****************************     **);
%PUT %STR(           ****************************************    ** );
%PUT %STR(          **     ***************************************  );
%PUT %STR(         ***  0  ************************************     );
%PUT %STR(         *****************************************       );
%PUT %STR(        ******************************************       );
%PUT %STR(       *******************************************       );
%PUT %STR(      ****      *********************************        );
%PUT %STR(      **           **   **   ***   ***    *****          );
%PUT %STR(      **          **    **    ***   *      * **          );
%PUT %STR(      **          *     *       *   *      *  **         );
%PUT %STR(       *          *     *       *   *      *   **        );
%PUT %STR(                  *     **      *   *      *     *       );
%PUT %STR(                 ***   ****    *** ***  *****    ***     );
%PUT %STR( );
%PUT %STR(    W  E  L  C  O M  E      T  O     B  U  G  S  U  M      );
%PUT %STR(    W  E  L  C  O M  E      T  O     B  U  G  S  U  M      );
%PUT %STR( );
%PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
DATA D1;
%SCREEN2: CLEAR;
%SPACES(3);
%PUT %STR(   *******************************************************);
%PUT %STR(   *   BUGSUM: A USER-INTERACTIVE COMPUTER PROGRAM FOR     *);
%PUT %STR(   *   SUMMARIZING ABUNDANCE DATA ON BENTHIC FRESHWATER    *);
%PUT %STR(   *   LIFE FORMS OF NEWFOUNDLAND.                         *);
%PUT %STR(   *******************************************************);
%SPACES(4);
%PUT %STR(              SELECT REQUIRED REPORT:                     );
%SPACES(1);
%PUT %STR(                 1   REPORT IN REPORT1 FORMAT             );
%SPACES(1);
%PUT %STR(                 2   REPORT IN REPORT2 FORMAT             );
%SPACES(2);
%PUT %STR(              ENTER NUMBER:                               );
%INPUT REPORT;
%IF &REPORT=1 AND &REPORT=2 %THEN %DO;
```

Table 1 (cont'd)

```
  %PUT MUST ENTER EITHER 1 OR 2 (1=REPORT1  2=REPORT2);
  %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
  %GOTO SCREEN2;
%END;
%SPACES(1);
%PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
%SCREEN3:
  %PUT ENTER STARTING YEAR FOR WHICH YOU REQUIRE REPORT (EG. 78).;
  %INPUT YEAR1
  %LET LENYR1=%LENGTH(&YEAR1);
  %PUT ENTER FINAL YEAR FOR WHICH YOU REQUIRE REPORT (EG. 78);
  %PUT IF SAME AS STARTING YEAR RE-ENTER STARTING YEAR.;
  %INPUT YEAR2;
  %LET LENYR2=%LENGTH(&YEAR2);
  %SPACES(1);
  %PUT YOU SELECTED YEAR(S) 19&YEAR1 TO 19&YEAR2.;
 %IF &LENYR1-=2 OR &LENYR2-=2 %THEN %DO;
  %PUT AT LEAST ONE OF THE TWO YEARS ENTERED IS INCORRECT;
  %PUT MUST ENTER LAST TWO CHARACTERS OF YEAR;
  %PUT THE VALUE OF STARTING YEAR WAS &YEAR1;
  %PUT THE VALUE OF FINAL YEAR WAS &YEAR2;
  %SPACES(5);
  %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
  CLEAR PAUSE;
  %GOTO SCREEN3;
 %END;
 %SPACES(5);
 %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
 %SCREEN4: CLEAR PAUSE;
  %PUT ENTER NUMBER OF DATA TYPES TO BE PROCESSED (TO A MAXIMUM OF 99);
  %INPUT NUMDT;
  %LET NUMDT=%EVAL(&NUMDT+0);
  %IF (&NUMDT>0 AND &NUMDT<=99) %THEN %DO;
  %PUT ENTER &NUMDT DATA TYPE(S) AS PER LIFE FORM CODING SPECIFICATIONS.;
  %PUT SEPARATE BY BLANKS IF MORE THAN ONE DATA TYPE SELECTED.;
  %INPUT;
  %LET DT=&SYSBUFFR;
     %CHECK(&DT,&NUMDT,'DATA TYPE');
     %IF &ERRFLAG=1 %THEN %DO;
       %SPACES(4);
       %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
       %GOTO SCREEN4;
     %END;
     %ELSE %DO;
        %PUT YOU SELECTED DATA TYPE(S) &DT;
         %SPACES(5);
```

Table 1 (cont'd)

```
    %END;
   %END;
  %ELSE %DO;
     %PUT MUST ENTER A SINGLE NUMBER BETWEEN 1 AND 99. RE_ENTER...;
     %GOTO SCREEN4;
  %END;
  %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
 %SCREEN5: CLEAR PAUSE;
  %PUT ENTER NUMBER OF AREAS TO BE ANALYSED (TO A MAXIMUM OF 999);
  %INPUT NUMAREA;
  %LET NUMAREA=%EVAL(&NUMAREA+0);
  %IF (&NUMAREA>0 AND &NUMAREA<=999) %THEN %DO;
  %PUT ENTER &NUMAREA AREA(S) AS PER LIFE FORM CODING SPECIFICATIONS.;
  %PUT SEPARATE BY BLANKS IF MORE THAN ONE AREA SELECTED.;
  %INPUT;
  %LET AREA=&SYSBUFFR;
     %CHECK(&AREA,&NUMAREA,AREA);
     %IF &ERRFLAG=1 %THEN %DO;
       %SPACES(4);
       %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
       %GOTO SCREEN5;
     %END;
     %ELSE %DO;
        %PUT YOU SELECTED AREA(S) &AREA;
         %SPACES(5);
     %END;
   %END;
  %ELSE %DO;
     %PUT MUST ENTER A SINGLE NUMBER BETWEEN 1 AND 999. RE_ENTER...;
     %GOTO SCREEN5;
  %END;
  %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
 %SCREEN6: CLEAR PAUSE;
      %PUT DO YOU WISH TO SELECT BY SUBAREA? (ENTER Y OR N);
      %LET SUBAREA=0;
      %LET NUMSUB=0;
      %INPUT SELSUB;
      %IF %UPCASE(&SELSUB)=Y %THEN %DO;
      %PUT ENTER NUMBER OF SUBAREAS TO BE ANALYSED (TO A MAXIMUM OF 999);
      %INPUT NUMSUB;
  %LET NUMSUB=%EVAL(&NUMSUB+0);
  %IF (&NUMSUB>0 AND &NUMSUB<=999) %THEN %DO;
  %PUT ENTER &NUMSUB SUBAREA(S) AS PER LIFE FORM CODING SPECIFICATIONS.;
  %PUT SEPARATE BY BLANKS IF MORE THAN ONE SUBAREA SELECTED.;
  %INPUT;
  %LET SUBAREA=&SYSBUFFR;
```

Table 1 (cont'd)

```
    %CHECK(&SUBAREA,&NUMSUB,SUBAREA);
    %IF &ERRFLAG=1 %THEN %DO;
      %SPACES(4);
      %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
      %GOTO SCREEN6;
    %END;
    %ELSE %DO;
       %PUT YOU SELECTED SUBAREA(S) &SUBAREA;
        %SPACES(5);
    %END;
  %END;
 %ELSE %DO;
    %PUT MUST ENTER A SINGLE NUMBER BETWEEN 1 AND 999. RE_ENTER...;
    %GOTO SCREEN6;
 %END;
 %END;
 %ELSE %IF %UPCASE(&SELSUB)=N %THEN %DO;
     %GOTO NO;
     %END;
     %ELSE %DO;
     %PUT REQUIRED RESPONSE IS Y OR N;
     %GOTO SCREEN6;
     %END;
%NO: %SPACES(5);
     %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
%SCREEN7: CLEAR PAUSE;
     %PUT DO YOU WISH TO SELECT BY SAMPLE SEQUENCE NUMBER, BY MONTH OR;
     %PUT BY MONTH AND DAY?;
     %LET SSN=0;
     %LET MON=0;
     %LET DAY=0;
     %LET NUMSSN=0;
     %LET NUMMON=0;
     %LET NUMDAY=0;
     %PUT ENTER ONE OF THE FOLLOWING CODES:;
     %SPACES(3);
     %PUT ********************************;
     %PUT *     0=NEITHER                 *;
     %PUT *     1=SAMPLE SEQUENCE NUMBER  *;
     %PUT *     2=MONTH OR MONTH AND DAY  *;
     %PUT ********************************;
     %INPUT RESPO12;
     %SPACES(5);
 %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
         %IF &RESPO12=1 %THEN %DO;
%SCREEN8: CLEAR PAUSE;
         %PUT HOW MANY SAMPLE SEQUENCE NUMBERS TO BE ANALYSED?;
```

Table 1 (cont'd)

```
          %INPUT NUMSSN;
          %LET NUMSSN=%EVAL(&NUMSSN+0);
        %IF (&NUMSSN>0 AND &NUMSSN<=999) %THEN %DO;
          %PUT ENTER &NUMSSN SAMPLE SEQUENCE NUMBER(S) AS PER LIFE FORM;
          %PUT CODING SPECIFICATIONS.;
          %PUT SEPARATE BY BLANKS IF MORE THAN ONE SAMPLE SEQUENCE;
          %PUT NUMBER SELECTED.;
        %INPUT;
        %LET SSN=&SYSBUFFR;
        %CHECK(&SSN,&NUMSSN,'SAMPLE SEQUENCE NUMBER');
        %IF &ERRFLAG=1 %THEN %DO;
          %SPACES(4);
          %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
          %GOTO SCREEN7;
        %END;
       %ELSE %DO;
         %PUT YOU SELECTED SAMPLE SEQUENCE NUMBER(S) &SSN;
         %SPACES(5);
       %END;
     %END;
   %ELSE %DO;
     %PUT MUST ENTER A SINGLE NUMBER BETWEEN 1 AND 999. RE_ENTER...;
     %GOTO SCREEN8;
   %END;
  %END;
      %ELSE %IF &RESPO12=2 %THEN %DO;
%SCREEN9: CLEAR PAUSE;
         %LET NUMMON=0;
         %LET MON=0;
         %PUT ENTER NUMBER OF MONTHS TO BE ANALYZED(TO A MAXIMUM OF 12).;
         %INPUT NUMMON;
         %LET NUMMON=%EVAL(&NUMMON+0);
         %IF (&NUMMON>0 AND &NUMMON<=12) %THEN %DO;
          %PUT ENTER &NUMMON MONTH(S) AS PER LIFE FORM CODING;
          %PUT SPECIFICATIONS.;
          %PUT SEPARATE BY BLANKS IF MORE THAN ONE MONTH SELECTED.;
        %INPUT;
        %LET MON=&SYSBUFFR;
        %CHECK(&MON,&NUMMON,'MONTH');
        %IF &ERRFLAG=1 %THEN %DO;
          %SPACES(4);
          %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
          %GOTO SCREEN9;
        %END;
       %ELSE %DO;
         %PUT YOU SELECTED MONTH(S) &MON;
         %SPACES(5);
```

Table 1 (cont'd)

```
        %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
      %END;
    %END;
  %ELSE %DO;
    %PUT MUST ENTER A SINGLE NUMBER BETWEEN 1 AND 12. RE_ENTER...;
    %GOTO SCREEN9;
  %END;
%SCREEN10: CLEAR PAUSE;
        %LET NUMDAY=0;
        %LET DAY=0;
        %PUT DO YOU WISH TO SELECT BY DAY? (ENTER Y OR N);
        %INPUT DAY12;
        %IF %UPCASE(&DAY12)=Y %THEN %DO;
           %PUT ENTER NUMBER OF DAYS (TO A MAXIMUM OF 31).;
           %INPUT NUMDAY;
           %IF (&NUMDAY>0 AND &NUMDAY<=31) %THEN %DO;
           %PUT ENTER &NUMDAY DAY(S) AS PER LIFE FORM CODING;
           %PUT SPECIFICATIONS.;
           %PUT SEPARATE BY BLANKS IF MORE THAN ONE DAY SELECTED.;
       %INPUT;
       %LET DAY=&SYSBUFFR;
       %CHECK(&DAY,&NUMDAY,'DAY');
       %IF &ERRFLAG=1 %THEN %DO;
         %SPACES(4);
         %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
         %GOTO SCREEN10;
       %END;
      %ELSE %DO;
        %PUT YOU SELECTED DAY(S) &DAY;
        %SPACES(5);
      %END;
     %END;
  %ELSE %DO;
    %PUT MUST ENTER A SINGLE NUMBER BETWEEN 1 AND 31. RE_ENTER...;
    %GOTO SCREEN10;
  %END;
 %END;
        %ELSE %IF %UPCASE(&DAY12)=N %THEN %DO;
             %SPACES(5);
             %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
             %GOTO TITLE;
            %END;
           %ELSE %DO;
             %PUT REQUIRED RESPONSE IS Y OR N.;
             %GOTO SCREEN10;
           %END;
 %END;
```

Table 1 (cont'd)

```
     %ELSE %IF &RESPO12=0 %THEN %DO;
      %GOTO TITLE;
     %END;
       %ELSE %DO;
         %PUT REQUIRED RESPONSE IS 0,1 OR 2.;
         %GOTO NO;
     %END;
 %PUT PRESS ENTER TO CONTINUE OR BREAK KEY TO EXIT.;
%TITLE: CLEAR PAUSE;
        %PUT ENTER REPORT TITLE;
        %PUT (MAXIMUM OF 150 CHARACTERS INCLUDING BLANKS).;
        %INPUT;
         %LET TITLE=&SYSBUFFR;
         %PUT YOU SELECTED YEAR(S) 19&YEAR1 TO 19&YEAR2;
         %PUT YOU SELECTED DATA TYPE(S) &DT;
         %PUT YOU SELECTED AREA(S) &AREA;
         %PUT YOU SELECTED SUBAREA(S) &SUBAREA;
         %PUT YOU SELECTED SAMPLE SEQ NUMBER(S) &SSN;
         %PUT YOU SELECTED MONTH(S) &MON;
         %PUT YOU SELECTED DAY(S) &DAY;
         %PUT YOU SELECTED TITLE &TITLE;
         %PUT %STR( );
         %PUT PROCESSING BEGINS...;
%IF &REPORT=1 %THEN %DO;
   %REPORT1(&YEAR1,&YEAR2,&DT,&AREA,&SUBAREA,&SSN,&MON,&DAY,&TITLE);
  %END;
%IF &REPORT=2 %THEN %DO;
     %REPORT2(&YEAR1,&YEAR2,&DT,&AREA,&SUBAREA,&SSN,&MON,&DAY,&TITLE);
    %END;
    %TSO SCHED @@@@@@ OUT(R3);
    %TSO DELETE @@@@@@;
    %PUT YOUR JOB HAS BEEN SUBMITTED TO BATCH AND WILL BE ROUTED TO;
    %PUT LOCAL PRINTER;
    %TSO FREE ATTR(SASDCB);
    %PUT %STR( );
    %PUT EXITING BUGSUM...;
%MEND BUGSUM;
%MACRO SPACES(LINES);
   %DO I=1 %TO &LINES;
      %PUT %STR( );
   %END;
%MEND SPACES;
 %MACRO REPORT1(YEAR1,YEAR2,DT,AREA,SUBAREA,SSN,MON,DAY,TITLE);
 OPTIONS DQUOTE;
 %TSO ALLOC F(INPUT) DA('G70141A.REPORT.DATABASE') SHR;
```

Table 1 (cont'd)

```
%TSO ATTRIB SASDCB LRECL(80) BLKSIZE(6160) DSORG(PS) RECFM(F B);
%TSO ALLOC F(OUTPUT) DA(@@@@@@) SPACE(1 1) TRACKS NEW USING(SASDCB);

            FILE OUTPUT;
            PUT "//HG70141A JOB (7017,000X,1,1),'BUG SUMMARY',CLASS=X"
               / "/*ROUTE PRINT R3"
               / "//  EXEC SAS"
               / "//INPUT  DD DSN=G70141A.REPORT.DATABASE,DISP=SHR"
               / "//SYSIN DD *";

%PUT %STR( );
PUT "PROC SORT DATA=INPUT.REP1CODE OUT=D1; BY CODE LS;                  "

  / "* D22 CONTAINS THOSE SPECIES AND LIFESTAGES CAPTURED;              "

 /   "DATA D22; SET INPUT.DATA1;                                         "
 /   "IF (&YEAR1<=YEAR<=&YEAR2);                                        ";
    %SELECT(&DT,&NUMDT,DT);
    %PUTTEXT;
    %SELECT(&AREA,&NUMAREA,AREA);
    %PUTTEXT;
    %SELECT(&SUBAREA,&NUMSUB,SUBAREA);
    %PUTTEXT;
    %SELECT(&SSN,&NUMSSN,SSN);
    %PUTTEXT;
    %SELECT(&MON,&NUMMON,MONTH);
    %PUTTEXT;
    %SELECT(&DAY,&NUMDAY,DAY);
    %PUTTEXT;
%PUT %STR( );
PUT "PROC SORT; BY CODE LS;                                             "
/ "                                                                     "
/ "DATA D22; MERGE D1 D22(IN=IN1);                                      "
/ "BY CODE LS;                                                          "
/ "IF IN1=1;                                                            "
/ "                                                                     "
/ "PROC SORT; BY CODE LS;                                               "
/ "                                                                     "
/ "DATA D2;SET D22;                                                     "
/ "IF REC_TYPE=2;                                                       "
/ "IF LS=. THEN LS=0; *ENSURES THAT SPECIES NAME WILL;                  "
/ "KEEP SN CODE LS NUMBER; *NOT BE MISSING IN MERGED DATASET A2;        "
/ "                                                                     "
/ "DATA D22A; SET D22;                                                  "
/ "IF LS=7 THEN DELETE;                                                 "
/ "                                                                     "
/ "* CALCULATE TOTAL NUMBER OF SAMPLES;                                 "
```

Table 1 (cont'd)

```
/ "DATA A1; SET D22 END=EOF;                                                  "
/ " IF REC_TYPE=1 THEN TOTSAMP+1;                                             "
/ " IF EOF THEN OUTPUT A1;                                                    "
/ "KEEP TOTSAMP;                                                              "
/ "                                                                           "
/ "*ASSIGN ZERO TO <NUMBER> FOR ANY SPECIES NOT CAUGHT IN EACH SAMPLE;"
/ "DATA A2; MERGE D1 D2; BY CODE LS;                                          "
/ "IF LS=0 THEN LS=.;                                                         "
/ "IF NUMBER=. OR NUMBER=0 THEN DELETE;                                       "
/ "IF NAME=' ' THEN DELETE;                                                  ";
%PUT %STR( );

PUT "* D3 ASSURES THAT THE TOTAL NUMBER OF SAMPLES IS ON EACH RECORD; "
/ "DATA D3 D33;                                                               "
/ "IF _N_=1 THEN SET A1;                                                      "
/ "SET A2 END=EOF;                                                            "
/ "ALLSUM+NUMBER;                                                             "
/ "ALLMEAN=ALLSUM/TOTSAMP;                                                    "
/ "IF EOF THEN OUTPUT D33;                                                    "
/ "OUTPUT D3;                                                                 "
/ "KEEP TOTSAMP CODE LS NUMBER SN NAME ALLSUM ALLMEAN;                        "
/ "                                                                           "
/ "DATA D3A;                                                                  "
/ "IF _N_=1 THEN SET A1;                                                      "
/ "SET A2;                                                                    "
/ "IF LS=7 OR NUMBER=0 THEN DELETE;                                           "
/ "ALLSUM2+NUMBER;                                                            "
/ "ALLMEAN2=ALLSUM2/TOTSAMP;                                                  "
/ "KEEP TOTSAMP CODE LS NUMBER SN NAME ALLSUM2 ALLMEAN2;                      "
/ "                                                                           "
/ "DATA D33A; SET D3A END=EOF;                                                "
/ " IF EOF THEN OUTPUT D33A;                                                  "
/ "                                                                           "
/ "* CALCULATE UNIVARIATE STATISTICS;                                         "
/ "PROC MEANS DATA=D3 NOPRINT; BY CODE LS;                                    "
/ " VAR NUMBER;                                                               "
/ " OUTPUT OUT=D4    N=N                                                      "
/ "                 SUM=SUMNUM                                                "
/ "                 MIN=MIN                                                   "
/ "                 MAX=MAX;                                                  "
/ "                                                                           "
/ "* ELIMINATES REPLICATES OF CODE AND LIFESTAGE,MINIMUM AND MEAN BASE"
/ "* ON WHETHER SPECIES OCCURS IN ALL SAMPLES,CALCULATE <NUMSQR>;            "
/ "DATA D6;MERGE D3 D4; BY CODE LS;                                           "
/ " IF N = TOTSAMP THEN MIN=0;                                                "
/ " IF NUMBER-=0 THEN MEAN=SUMNUM/TOTSAMP;                                    "
/ " ELSE MEAN=0;                                                              "
```

Table 1 (cont'd)

```
/ " NUMSQR=NUMBER**2;                                                    "
/ "                                                                      "
/ "* D7 CONTAINS: <TERM1>...SUM OF X'S SQUARED;                          "
/ "*            <TERM2>...SUM OF X'S THEN SQUARED;                       "
/ "* FOR USE IN <STD> EQUATION;                                          "
/ "PROC MEANS NOPRINT; BY CODE LS;                                       "
/ " VAR NUMSQR NUMBER;                                                   "
/ " OUTPUT OUT=D7   SUM=TERM1 TERM2;                                     "
/ "                                                                      "
/ "DATA D6;SET D6;BY CODE LS;                                            "
/ " IF FIRST.CODE=0 & FIRST.LS=0 THEN DELETE;                           ";
%PUT %STR( );
PUT "* COLLECT ALL VARIABLES, DELETE REPLICATIONS, CALCULATE <STD>;     "
/ "DATA D8; MERGE D6 D7; BY CODE LS;                                     "
/ " LENGTH LSNAME $ 8;                                                   "
/ " IF FIRST.CODE=0 & FIRST.LS=0 THEN DELETE;                            "
/ " IF LS=1 THEN LSNAME='ADULT';                                         "
/ " IF LS=2 THEN LSNAME='JUVENILE';                                      "
/ " IF LS=3 THEN LSNAME='NYMPH';                                         "
/ " IF LS=4 THEN LSNAME='LARVA';                                         "
/ " IF LS=5 THEN LSNAME='PUPA';                                          "
/ " IF LS=6 THEN LSNAME='EGG';                                           "
/ " IF LS=7 THEN LSNAME='EXUVIA';                                        "
/ " STDEV=SQRT((TOTSAMP*TERM1-TERM2**2)/(TOTSAMP*(TOTSAMP-1)));          "
/ "KEEP CODE LS TOTSAMP NUMBER MIN MAX SUMNUM NAME MEAN LSNAME           "
/ "     STDEV;                                                           "
/ "                                                                      "
/ "PROC SORT DATA=D22; BY SN;                                            "
/ "                                                                      "
/ "PROC MEANS DATA=D22 NOPRINT; BY SN;                                   "
/ " VAR NUMBER;                                                          "
/ " OUTPUT OUT=TEMP  SUM=NOANA;                                          "
/ "                                                                      "
/ "PROC SORT DATA=D22A; BY SN;                                           "
/ "                                                                      "
/ "PROC MEANS DATA=D22A NOPRINT; BY SN;                                  "
/ " VAR NUMBER;                                                          "
/ " OUTPUT OUT=TEMP1  SUM=NOANB;                                         "
/ "                                                                      "
/ "PROC MEANS DATA=TEMP NOPRINT;                                         "
/ " VAR NOANA;                                                           "
/ " OUTPUT OUT=D9  MIN=ALLMIN                                            "
/ "                MAX=ALLMAX;                                           "
/ "                                                                      "
/ "PROC MEANS DATA=TEMP1 NOPRINT;                                        "
/ " VAR NOANB;                                                           "
/ " OUTPUT OUT=D99  MIN=ALLMIN2                                          "
```

Table 1 (cont'd)

```
/ "                MAX=ALLMAX2;                                          "
/ "                                                                      "
/ "DATA D9A; SET TEMP;                                                   "
/ " SQRA=NOANA*NOANA;                                                    "
/ "KEEP SQRA;                                                            "
/ "DATA D99A; SET TEMP1;                                                 "
/ " SQRB=NOANB*NOANB;                                                    "
/ "KEEP SQRB;                                                            "
/ "                                                                      "
/ "PROC MEANS DATA=D9A NOPRINT;                                          "
/ " VAR SQRA;                                                            "
/ " OUTPUT OUT=D9B  SUM=SUMSQRA;                                         "
/ "                                                                      "
/ "PROC MEANS DATA=D99A NOPRINT;                                         "
/ " VAR SQRB;                                                            "
/ " OUTPUT OUT=D99B  SUM=SUMSQRB;                                        "
/ "                                                                      "
/ "DATA D9C;                                                             "
/ " SET D9;                                                              "
/ " SET D9B;                                                             "
/ " SET D99;                                                             "
/ " SET D99B;                                                            "
/ " SET D33;                                                             "
/ " SET D33A;                                                            "
/ "STDEVA=SQRT((TOTSAMP*SUMSQRA-ALLSUM*ALLSUM)/(TOTSAMP*(TOTSAMP-1)));"
/ "STDEVB=SQRT((TOTSAMP*SUMSQRB-ALLSUM2*ALLSUM2)                         "
/ "           /(TOTSAMP*(TOTSAMP-1)));                                   "
/ " KEEP ALLSUM ALLMEAN ALLMIN ALLMAX STDEVA ALLSUM2 ALLMEAN2 ALLMIN2 "
/ " ALLMAX2 STDEVB;                                                      "
/ "                                                                      "
/ "* COLLECT ALL REQUIRED VARIABLES TO PRODUCE TABLE;                    "
/ "DATA D12;                                                             "
/ " IF _N_=1 THEN SET D9C;                                               "
/ " SET D8;                                                              "
/ "IF NUMBER=0 THEN DELETE;                                            " ;
%PUT %STR( );
PUT "PROC SORT;BY CODE;                                                  "
/ "* PRODUCE REQUIRED REPORT;                                            "
/ "DATA _NULL_;                                                          "
/ "FILE PRINT NOTITLES;                                                  "
/ "PUT   '          YOU SELECTED YEAR(S) 19&YEAR1 TO 19&YEAR2';         "
/ "PUT / '          YOU SELECTED DATA TYPE(S) &DT';                      "
/ "PUT / '          YOU SELECTED AREA(S) &AREA';                         "
/ "PUT / '          YOU SELECTED SUBAREA(S) &SUBAREA';                   "
/ "PUT / '          YOU SELECTED SAMPLE SEQ NUMBER(S) &SSN';             "
/ "PUT / '          YOU SELECTED MONTH(S) &MON';                         "
/ "PUT / '          YOU SELECTED DAY(S) &DAY';                           "
```

Table 1 (cont'd)

```
/ "PUT / '          YOU SELECTED TITLE &TITLE' ;                          "
/ "PUT ///// @3 'NOTE: A ZERO (0) INDICATES THAT NO SELECTION WAS '       "
/ "       ' MADE FOR THE PARTICULAR VARIABLE.';                           "
/ "DATA _NULL_;                                                           "
/ "   IF _N_=I THEN I=1;                                                  "
/ "          ELSE I=I+1;                                                  "
/ " FILE PRINT HEADER=H NOTITLES;                                         "
/ " SET D12 POINT=I NOBS=NOBS END=EOF;                                    "
/ "     IF NOBS=0 THEN DO;                                                "
/ "PUT _PAGE_;                                                            "
/ "PUT / @3 'NO RECORDS WERE PROCESSED. CHECK INPUT PARAMETERS'           "
/ "         ' SELECTED IN PROMPTING PROGRAM FOR CORRECT CODES.';          "
/ "END;                                                                   "
/ "  ELSE IF NOBS>=I THEN DO;                                             "
/ " PUT @1 NAME $32. @37 LSNAME $8.                                       "
/ "   @48 CODE $10.  @60 LS 2.                                            "
/ "   @68 SUMNUM 5.  @76 MEAN 7.4                                         "
/ "   @85 MIN 3.     @91 MAX 4.                                           "
/ "   @98 STDEV 8.4;                                                      "
/ " IF NOBS=I THEN PUT // @1 105*'-' /                                    "
/ "                  @16 'ALL'          @38 'ALL'                         "
/ "                  @48 17*'-'         @66 ALLSUM 7.                     "
/ "                  @76 ALLMEAN 7.4    @86 ALLMIN 2.                     "
/ "                  @91 ALLMAX 4.      @98 STDEVA 8.4                    "
/ "                 / @1 105*'-' /                                        "
/ "                  @16 'ALL'          @28 'ALL EXCEPT EXUVIA'           "
/ "                  @48 17*'-'         @66 ALLSUM2 7.                    "
/ "                  @76 ALLMEAN2 7.4   @86 ALLMIN2 2.                    "
/ "                  @91 ALLMAX2 4.     @98 STDEVB 8.4                    "
/ "                / @1 105*'-';                                          "
/ " RETURN;                                                               "
/ " END;                                                                  "
/ " STOP;                                                                 "
/ "H: PUT / @16 '&TITLE';                                                 "
/ "       PUT  /     @15 ' NUMBER OF SAMPLES WAS: ' TOTSAMP //           "
/ "                   @51 '----CODE-----' /                               "
/ "                   @37 'LIFE'    @59 'LIFE'    @100 'STANDARD' /       "
/ "                   @10 'TAXA'    @37 'STAGE'   @51 'TAXA'              "
/ "                   @59 'STAGE'   @67 'NUMBER'  @77 'MEAN'              "
/ "                   @85 'MIN'     @92 'MAX'     @100 'DEVIATION' //;"
/ " RETURN;                                                               ";
RUN;
%MEND REPORT1;

   %MACRO REPORT2(YEAR1,YEAR2,DT,AREA,SUBAREA,SSN,MON,DAY,TITLE);
   OPTIONS DQUOTE;
   %TSO ALLOC F(INPUT) DA('G70141A.REPORT.DATABASE') SHR;
```

Table 1 (cont'd)

```
 %TSO ATTRIB SASDCB LRECL(80) BLKSIZE(6160) DSORG(PS) RECFM(F B);
 %TSO ALLOC F(OUTPUT) DA(@@@@@@) SPACE(1 1) TRACKS NEW USING(SASDCB);

              FILE OUTPUT;
              PUT "//HG70141A JOB (7017,000X,1,1),MARSHALL,CLASS=X"
                 / "/*ROUTE PRINT R3"
                 / "//  EXEC SAS"
                 / "//MSGSORT DD DUMMY,SYSOUT=A"
                 / "//SPECY  DD DSN=G70141A.REPORT2.CODES,DISP=SHR"
                 / "//INPUT  DD DSN=G70141A.REPORT.DATABASE,DISP=SHR"
                 / "//SYSIN DD *";
%PUT %STR( );
PUT "OPTIONS SORTMSG=MSGSORT;"
 / "* DATA GCODES CONTAINS SPECIES CODES (SC) FOR MAJOR GROUPS INDENTIFIED;"
 / "* ON SPECY2.DATA BY 2 CHARACTERS IN FIRST 2 BYTES OF (NAME) FIELD.;"
 / "* SUBGROUP CODES HAVE 2 BLANKS IN FIRST 2 BYTES OF (NAME) FIELD ;";

PUT "DATA GCODES SCODES;                                                  "
 / " LENGTH CODE $ 6;                                                     "
 / " LENGTH SC $ 4;                                                       "
 / " INFILE SPECY;                                                        "
 / " INPUT @1 NAME $CHAR30. LS 32 CODE $ 43-48;                           "
 / "   IF SUBSTR(NAME,1,2)-='  ' THEN DO;                                 "
 / "     SC=SUBSTR(CODE,1,4);                                             "
 / "     OUTPUT GCODES;                                                   "
 / "   END;                                                               "
 / "     ELSE OUTPUT SCODES;                                              "

 / "*  EXTRACT REQUIRED INFO FOR SUMMARY TABLE AND CREATE SPECIES CODE;    "
 / "*   9999 WHICH IS A PSEUDO CODE FOR OTHER INVERTEBRATES ;             "
 / "                                                                      "
 / " DATA GROUP;SET INPUT.GROUP; "
 / " IF (&YEAR1<=YEAR<=&YEAR2);";
     %SELECT(&DT,&NUMDT,DT);
     %PUTTEXT;
     %SELECT(&AREA,&NUMAREA,AREA);
     %PUTTEXT;
     %SELECT(&SUBAREA,&NUMSUB,SUBAREA);
     %PUTTEXT;
     %SELECT(&SSN,&NUMSSN,SSN);
     %PUTTEXT;
     %SELECT(&MON,&NUMMON,MONTH);
     %PUTTEXT;
     %SELECT(&DAY,&NUMDAY,DAY);
     %PUTTEXT;
```

Table 1 (cont'd)

```
%PUT %STR( );

PUT "IF SC='0100' OR SC='0200' OR SC='0300' OR SC='0400' OR SC='0500' OR     "
/ " SC='0600' OR SC='0700' OR SC='0800' OR SC='0900' OR SC='1000' OR         "
/ " SC='1100' OR SC='1200' OR SC='1300' OR SC='1400' OR SC='1500' OR         "
/ " SC='1600' OR SC='1700' OR SC='1800' OR SC='1900' OR SC='2000' OR         "
/ " SC='2100' OR SC='2200' OR SC='2300' OR SC='2400' OR SC='2500' OR         "
/ " SC='2600' OR SC='4200' OR SC='4300' OR SC='4400' OR SC='4500' OR         "
/ " SC='5000' THEN DO;                                                       "
/ "             SC='9999';                                                   "
/ "             LS=.;                                                        "
/ "           END;                                                           "
/ "IF SC='6021' OR SC='6031' OR SC='6033' OR SC='6038' OR SC='6043'          "
/ "OR SC='6045' OR SC='6300' THEN LS=.;                                      "
/ "                                                                          "
/ " * EXTRACT REQUIRED INFO FROM SUBGROUP FILE  ;                            "
/ "                                                                          "
/ " DATA SUBGROUP;SET INPUT.SUBGROUP; "
/   "IF (&YEAR1<=YEAR<=&YEAR2);";
    %SELECT(&DT,&NUMDT,DT);
    %PUTTEXT;
    %SELECT(&AREA,&NUMAREA,AREA);
    %PUTTEXT;
    %SELECT(&SUBAREA,&NUMSUB,SUBAREA);
    %PUTTEXT;
    %SELECT(&SSN,&NUMSSN,SSN);
    %PUTTEXT;
    %SELECT(&MON,&NUMMON,MONTH);
    %PUTTEXT;
    %SELECT(&DAY,&NUMDAY,DAY);
    %PUTTEXT;

%PUT %STR( );

PUT "  * DATA TOTAL CONTAINS THE TOTAL NUMBER OF SAMPLES TAKEN FOR ;        "
/ "    * SELECTED DT,AREA & YEAR  ;                                         "

/ "  PROC SORT;BY SN;                                                        "

/ "DATA TOTAL;SET SUBGROUP;BY SN;                                            "
/ "  IF FIRST.SN THEN COUNT=1;ELSE COUNT=0;                                  "
/ "PROC MEANS NOPRINT DATA=TOTAL;                                            "
/ "  VAR COUNT;                                                              "
/ "  OUTPUT OUT=TOTAL SUM=TOTSAMP;                                           "

/ " * ASSIGN LS TO MISSING FOR SELECTED CODES SINCE SOME LS ARE NOT ;        "
/ " * MISSING ;                                                              "
```

Table 1 (cont'd)

```
/ "                                                                          "
/ "DATA SUBGROUP; SET SUBGROUP;                                              "
/ " IF SUBSTR(CODE,5,2)='00' THEN LS=.;                                      "
/ "                                                                          "
/ " * ADD & ADD2 DATASETS CREATE ADDITIONAL SPECIES CODES TO ACCOUNT ;       "
/ " * FOR INSECTA & ODONATA ;                                                "
/ "                                                                          "
/ "DATA ADD;SET GROUP;                                                       "
/ " IF SC='6001' OR SC='6002'                                                "
/ " OR SC='6003' OR SC='6004' OR SC='6005' OR SC='6006' OR SC='6007'         "
/ " OR SC='6008' OR SC='6009' OR SC='6010' OR SC='6021' OR SC='6031'         "
/ " OR SC='6033' OR SC='6038' OR SC='6043' OR SC='6045'                      "
/ " THEN DO;                                                                 "
/ "   SC='6000';                                                             "
/ "   LS=.;                                                                  "
/ "   OUTPUT ADD;                                                            "
/ " END;                                                                     "
/ "DATA ADD2;SET GROUP;                                                      "
/ " IF SC='6002' OR SC='6003' OR SC='6004'                                   "
/ " THEN DO;                                                                 "
/ " SC='6234'; * PSEUDO-CODE FOR REPLICATE CODE FOR SPECIES ODONATA;         "
/ " OUTPUT ADD2;                                                             "
/ " END;                                                                     "
/ "                                                                          "
/ " * ADD NEWLY CREATED CODES TO GROUP FILE ;                                "
/ "                                                                          "
/ "DATA GROUP;SET GROUP ADD ADD2;                                            "
/ "                                                                          "
/ " * ADD TOTSAMP VARIABLE TO GROUP DATASET ;                                "
/ "                                                                          "
/ "DATA GROUP;                                                               "
/ " IF _N_=1 THEN SET TOTAL;                                                 "
/ " SET GROUP;                                                               "
/ "PROC SORT; BY SC LS;                                                      "
/ "PROC MEANS NOPRINT; BY SC LS;                                             "
/ " VAR NUMBER;                                                              "
/ " OUTPUT OUT=COMBGRP SUM=NUMBER; *SUM NUMBER TO COMPARE TO TOTSAMP;        "
/ " PROC SORT; BY LS;                                                        "
/ " PROC FREQ; BY LS;                                                        "
/ " TABLES SC/NOPRINT OUT=CC;      * CODE COUNTS ;                           "
/ "                                                                          "
/ "PROC SORT DATA=CC; BY SC;                                                 "
/ "                                                                          "
/ "  *GA CONTAINS SPECIES FOUND IN EACH SAMPLE , GB CONTAINS SPECIES;        "
/ "  *FOUND IN AT LEAST ONE BUT NOT ALL SAMPLES  ;                           "
/ "                                                                          "
/ "DATA GA GB;                                                               "
```

Table 1 (cont'd)

```
/ " MERGE CC GROUP; BY SC;                                                  "
/ " IF COUNT=TOTSAMP THEN OUTPUT GA;                                        "
/ "   ELSE OUTPUT GB;                                                       "
/ "                                                                         "
/ "                                                                         "
/ " * CALCULATE MIN & MAX NUMBERS FOR SPECIES FOUND IN ALL SAMPLES ;        "
/ "                                                                       " ;
%PUT %STR( );
PUT "PROC SORT DATA=GA; BY SC LS TOTSAMP;                                   "
/ "PROC MEANS NOPRINT DATA=GA; BY SC LS TOTSAMP;                            "
/ " VAR NUMBER;                                                             "
/ " OUTPUT OUT=GASTAT  MIN=MIN MAX=MAX;                                     "
/ "                                                                         "
/ "                                                                         "
/ "  * GACOMB DATASET CONTAINS SUMS OF NUMBERS FOR EACH SAMPLE ;            "
/ "                                                                         "
/ "PROC MEANS DATA=GA NOPRINT;BY SC LS TOTSAMP;                             "
/ " VAR NUMBER;                                                             "
/ " OUTPUT OUT=GACOMB   SUM=NUMBER;                                         "
/ "                                                                         "
/ "DATA GACOMB;SET GACOMB;                                                  "
/ " NUMSQR=NUMBER**2;                                                       "
/ "                                                                         "
/ "                                                                         "
/ "PROC MEANS NOPRINT DATA=GACOMB; BY SC LS TOTSAMP;                        "
/ " VAR NUMBER NUMSQR;                                                      "
/ " OUTPUT OUT=GASTAT2 SUM=TERM2 TERM1 ;                                    "
/ "   *  TERM2 IS SUM OF NUMBERS FOR EACH CODE AND LS;                      "
/ "PROC SORT DATA=GCODES; BY SC LS;                                         "
/ "                                                                         "
/ "DATA REPORTA;MERGE GCODES GASTAT GASTAT2; BY SC LS;                      "
/ " MEAN=TERM2/TOTSAMP;                                                     "
/ " STDEV=SQRT((TOTSAMP*TERM1-TERM2**2)/(TOTSAMP*(TOTSAMP-1)));             "
/ " IF TOTSAMP=. OR NAME=' ' THEN DELETE;                                   "
/ "PROC SORT DATA=GB; BY SC LS TOTSAMP;                                     "
/ "PROC MEANS NOPRINT DATA=GB; BY SC LS TOTSAMP;                            "
/ " VAR NUMBER;                                                             "
/ " OUTPUT OUT=GBSTAT  MIN=MIN MAX=MAX;                                     "
/ "PROC SORT DATA=GB; BY SC LS SN TOTSAMP;                                  "
/ "                                                                         "
/ "PROC MEANS NOPRINT;BY SC LS SN TOTSAMP;                                  "
/ " VAR NUMBER;                                                             "
/ " OUTPUT OUT=GBCOMB   SUM=NUMBER;                                         "
/ "                                                                         "
/ "DATA GBCOMB;SET GBCOMB;                                                  "
/ " NUMSQR=NUMBER**2;                                                       "
/ "                                                                       ";
```

Table 1 (cont'd)

```
 %PUT %STR( );
PUT "PROC SORT DATA=GBCOMB; BY SC LS TOTSAMP;                                  "
 / "PROC MEANS NOPRINT DATA=GBCOMB; BY SC LS TOTSAMP;                          "
 / " VAR NUMBER NUMSQR;                                                        "
 / " OUTPUT OUT=GBSTAT2  SUM=TERM2 TERM1;                                      "
 / "  *  TERM2 IS SUM OF NUMBERS FOR EACH CODE AND LS;                         "
 / "DATA REPORTB;MERGE GCODES GBSTAT GBSTAT2; BY SC LS;                        "
 / " MEAN=TERM2/TOTSAMP;                                                       "
 / " STDEV=SQRT((TOTSAMP*TERM1-TERM2**2)/(TOTSAMP*(TOTSAMP-1)));               "
 / " IF TOTSAMP=. OR NAME=' ' THEN DELETE;                                     "
 / "DATA REPORTB;SET REPORTB;                                                  "
 / " MIN=0;                                                                    "
 / "DATA REPORT1;SET REPORTA REPORTB; BY SC LS;                                "
 / "DATA SUBGROUP;                                                             "
 / " IF _N_=1 THEN SET TOTAL;                                                  "
 / " SET SUBGROUP;                                                             "
 / " CODE=SUBSTR(CODE,1,6);                                                    "
 / "PROC SORT; BY SN CODE LS;                                                  "
 / "PROC MEANS NOPRINT; BY SN CODE LS;                                         "
 / " VAR NUMBER;                                                               "
 / " OUTPUT OUT=COMBSUBG   SUM=NUMBER;                                         "
 / "PROC SORT; BY LS;                                                          "
 / "PROC FREQ; BY LS;                                                          "
 / " TABLES CODE/NOPRINT OUT=SUBCC;      * CODE COUNTS ;                       "
 / " PROC SORT DATA=SUBCC; BY CODE;                                            "
 / " PROC SORT DATA=SUBGROUP; BY CODE;                                         "
 / "DATA SA;                                                                   "
 / " MERGE SUBCC SUBGROUP; BY CODE;                                            "
 / "                                                                           "
 / "PROC SORT DATA=SA; BY CODE LS TOTSAMP;                                     "
 / "PROC MEANS NOPRINT DATA=SA; BY CODE LS TOTSAMP;                            "
 / " VAR NUMBER;                                                               "
 / " OUTPUT OUT=SASTAT  MIN=MIN MAX=MAX;                                       "
 / "                                                                           "
 / "PROC SORT DATA=SA; BY CODE LS SN TOTSAMP;                                  "
 / "                                                                           "
 / "PROC MEANS NOPRINT;BY CODE LS SN TOTSAMP;                                  "
 / " VAR NUMBER;                                                               "
 / " OUTPUT OUT=SACOMB   SUM=NUMBER;                                           "
 / "                                                                           "
 / "DATA SACOMB;SET SACOMB;                                                    "
 / " NUMSQR=NUMBER**2;                                                         "
 / "                                                                           "
 / "                                                                           "
 / "PROC SORT DATA=SACOMB; BY CODE LS TOTSAMP;                                 "
 / "PROC MEANS NOPRINT DATA=SACOMB; BY CODE LS TOTSAMP;                        "
 / " VAR NUMBER NUMSQR;                                                        "
```

Table 1 (cont'd)

```
/ " OUTPUT OUT=SASTAT2 SUM=TERM2 TERM1 ;                                  "
/ "                                                                       "
/ "                                                                      ";
%PUT %STR( );
PUT "PROC SORT DATA=SCODES; BY CODE LS;                                   "
/ "PROC SORT DATA=SASTAT; BY CODE LS;                                     "
/ "PROC SORT DATA=SASTAT2; BY CODE LS;                                    "
/ "                                                                       "
/ "DATA REPORT2;MERGE SCODES SASTAT SASTAT2; BY CODE LS;                  "
/ " MEAN=TERM2/TOTSAMP;                                                   "
/ " STDEV=SQRT((TOTSAMP*TERM1-TERM2**2)/(TOTSAMP*(TOTSAMP-1)));           "
/ " IF TOTSAMP=. OR NAME=' ' THEN DELETE;                                 "
/ " MIN=0;                                                                "
/ "DATA REPORT;SET REPORT1 REPORT2;                                       "
/ "IF (SUBSTR(NAME,3,12)='UNIDENTIFIED') & SUBSTR(CODE,3,2)='00'          "
/ " THEN TEMPCODE=SUBSTR(CODE,1,2)11'9999'; ELSE                          "
/ "IF SUBSTR(NAME,3,12)='UNIDENTIFIED' THEN                               "
/ "   TEMPCODE=SUBSTR(CODE,1,4)11'99';                                    "
/ " ELSE TEMPCODE=CODE;                                                   "
/ "IF SC='9999' THEN TEMPCODE='999999';                                   "
/ "IF SC='6234' THEN TEMPCODE='600200';                                   "
/ "                                                                       "
/ "                                                                       "
/ "PROC SORT; BY TEMPCODE LS;                                             "
/ "DATA REPORT;SET REPORT;BY TEMPCODE LS;                                 "
/ " IF SC='9999' THEN CODE=' ';                                           "
/ "DATA ALL;                                                              "
/ " SET SUBGROUP;                                                         "
/ "                                                                       "
/ "PROC SORT;BY SN;                                                       "
/ "PROC MEANS NOPRINT;BY SN;                                              "
/ " VAR NUMBER;                                                           "
/ " OUTPUT OUT=ALLCOMB   SUM=SUMNO;                                       "
/ "                                                                       "
/ "DATA ALLCOMB;SET ALLCOMB;                                              "
/ "NUMSQ=SUMNO**2;                                                        "
/ "                                                                       "
/ "PROC MEANS NOPRINT;                                                    "
/ " VAR SUMNO NUMSQ;                                                      "
/ " OUTPUT OUT=ALLSTAT   SUM=ALLSUM ALLSUMSQ MIN=ALLMIN MAX=ALLMAX;       "
/ "                                                                       "
/ "DATA ALLSTAT;                                                          "
/ " IF _N_=1 THEN SET ALLSTAT;BY ALLSUM;                                  "
/ " SET SUBGROUP;                                                         "
/ " ALLMEAN=ALLSUM/TOTSAMP;                                               "
/ " ALLSTD=SQRT((TOTSAMP*ALLSUMSQ-ALLSUM**2)/(TOTSAMP*(TOTSAMP-1)));     "
/ " IF LAST.ALLSUM THEN OUTPUT ALLSTAT;                                   "
```

Table 1 (cont'd)

```
/ " KEEP ALLSUM ALLMIN ALLMAX ALLMEAN ALLSTD;                                  "
/ "                                                                            "
/ "DATA FINAL;                                                                 "
/ " LENGTH NEWCODE $ 10;                                                       "
/ " IF _N_=1 THEN SET ALLSTAT;                                                 "
/ " SET REPORT;                                                                "
/ " IF SC='6234' THEN CODE=' ';                                                "
/ " IF CODE=' ' THEN NEWCODE=' '; ELSE NEWCODE=CODE||'0000';                   "
/ "                                                                            "
/ "                                                                           ";
PUT "* PRODUCE REQUIRED REPORT;                                                "
/ "DATA _NULL_; "
/ "FILE PRINT NOTITLES;"
/ "PUT   '        YOU SELECTED YEAR(S) 19&YEAR1 TO 19&YEAR2'; "
/ "PUT / '        YOU SELECTED DATA TYPE(S) &DT'; "
/ "PUT / '        YOU SELECTED AREA(S) &AREA'; "
/ "PUT / '        YOU SELECTED SUBAREA(S) &SUBAREA'; "
/ "PUT / '        YOU SELECTED SAMPLE SEQ NUMBER(S) &SSN'; "
/ "PUT / '        YOU SELECTED MONTH(S) &MON'; "
/ "PUT / '        YOU SELECTED DAY(S) &DAY'; "
/ "PUT / '        YOU SELECTED TITLE &TITLE' ; "
/ "PUT ////// 'NOTE: A ZERO (0) INDICATES THAT NO SELECTION WAS MADE'"
/ "      ' FOR THE PARTICULAR VARIABLE.';"
/ "DATA _NULL_;"
/ "  IF _N_=1 THEN I=1; "
/ "           ELSE I=I+1; "
/ "  FILE PRINT HEADER=H NOTITLES;"
/ "  SET FINAL POINT=I NOBS=NOBS END=EOF; "
/ "      IF NOBS=0 THEN DO; "
/ " PUT _PAGE_;"
/ " PUT @3 'NO RECORDS WERE PROCESSED. CHECK INPUT PARAMETERS'"
/ "        ' SELECTED IN PROMPTING PROGRAM FOR CORRECT CODES.';"
/ "END;"
/ "  ELSE IF NOBS =I THEN DO;                                                  "
/ " PUT @1 NAME $32.                                                           "
/ "    @48 NEWCODE $10.  @60 LS 2.                                             "
/ "    @68 TERM2 5.      @76 MEAN 7.4                                          "
/ "    @84 MIN 4.        @91 MAX 4.                                            "
/ "    @98 STDEV 7.4;                                                          "
/ " IF NOBS=I THEN PUT // @1 104*'-' /                                         "
/ "                   @16 'ALL'                                                "
/ "                   @48 14*'-'        @66 ALLSUM 7.                          "
/ "                   @76 ALLMEAN 7.4   @84 ALLMIN 4.                          "
/ "                   @91 ALLMAX 4.     @97 ALLSTD 8.4                         "
/ "                 / @1 104*'-' /;                                            "
/ " RETURN;                                                                    "
/ " END; "
```

Table 1 (cont'd)

```
 / "STOP; "
 / "H: PUT / @15 '&TITLE';                                                  "
 / "        PUT  //     @15 'NUMBER OF SAMPLES WAS: ' TOTSAMP //            "
 / "                    @51 '----CODE-----' /                               "
 / "                    @59 'LIFE'    @98 'STANDARD' /                      "
 / "                    @10 'TAXA'    @51 'TAXA'                            "
 / "                    @59 'STAGE'   @67 'NUMBER'  @77 'MEAN'              "
 / "                    @85 'MIN'     @92 'MAX'     @98 'DEVIATION' //;     "
 / " RETURN;";
 RUN;
 %MEND REPORT2;
%MACRO CHECK(SEL,NUMSEL,NAMESEL);
%LET ERRFLAG=0;
%LET LEN=%LENGTH(&SEL);
%LET NOBLKS=0;
%DO I=1 %TO &LEN;
   %LET BLANK=;
   %IF %SUBSTR(&SEL,&I,1)=&BLANK %THEN %DO;
      %LET NOBLKS=%EVAL(&NOBLKS+1);
   %END;
%END;
%LET NOBLKS=%EVAL(&NOBLKS+1);
%IF &NOBLKS>&NUMSEL %THEN %DO;
   %LET ERRFLAG=1;
   %PUT NUMBER OF &NAMESEL(S) IS GREATER THAN NUMBER SELECTED;
   %PUT OR ;
   %PUT IF MORE THAN 1 &NAMESEL SELECTED, ENSURE THAT EXACTLY 1 BLANK;
   %PUT SEPERATES EACH DATA VALUE;
 %END;
 %ELSE %DO;
%LET COUNT=0;
%DO I=1 %TO &NUMSEL;
    %LET BLANK=;
    %LET NUMBER=%SCAN(&SEL,&I,%STR( ));
    %IF &NUMBER-=&BLANK %THEN %DO;
    %LET COUNT=%EVAL(&COUNT+1);
    %END;
%END;
%IF &NUMSEL>&COUNT %THEN %DO;
   %LET ERRFLAG=1;
   %PUT NUMBER OF &NAMESEL(S) ENTERED IS LESS THAN NUMBER SELECTED;
   %PUT OR ;
   %PUT IF MORE THAN 1 &NAMESEL SELECTED, ENSURE THAT EXACTLY 1 BLANK;
   %PUT SEPERATES EACH DATA VALUE;
%END;
%END;
%MEND CHECK;
```

Table 1 (cont'd)

```
    %MACRO SELECT(SEL,NUMSEL,NAMESEL);
        %IF &NUMSEL=0 %THEN %DO;
         %LET J=1;
         %LET CHARSTR&J=$;
        %END;
         %ELSE %DO;
         %LET ORSTR=OR;
        %DO I=1 %TO &NUMSEL;
          %LET TEMP=%SCAN(&SEL,&I);
          %LET ASTR=&NAMESEL=;
          %IF &I=1 %THEN %DO;
            %LET J=1;
            %LET CHARSTR&J=&ASTR &TEMP;
            %LET OLDSTR=&ASTR &TEMP;
          %END;
         %ELSE %DO;
            %LET STRLEN=%LENGTH(&&CHARSTR&J);
              %IF &STRLEN>150 %THEN %DO;
                 %PUT STRING LENGTH IS &STRLEN;
                 %LET A=&J;
                 %LET CHARSTR&A=&ASTR &TEMP &ORSTR &OLDSTR;
                 %PUT CHARSTR&A IS &&CHARSTR&A;
                 %LET J=%EVAL(&J+1);
                 %LET CHARSTR&J=;
                 %LET OLDSTR=;
                 %LET ORSTR=;
           %END;
            %ELSE %DO;
               %IF &I=&NUMSEL %THEN %DO;
                 %LET CHARSTR&J=&ASTR &TEMP &ORSTR &OLDSTR;
               %END;
                 %ELSE %DO;
                     %LET CHARSTR&J=&ASTR &TEMP &ORSTR &OLDSTR;
                     %LET OLDSTR=&ASTR &TEMP &ORSTR &OLDSTR;
                     %LET ORSTR=OR;
                 %END;
            %END;
         %END;
       %END;
     %END;
   %MEND SELECT;
%MACRO PUTTEXT;
       %DO K=1 %TO &J;
        %IF &K=1 %THEN %DO;
         %IF &&CHARSTR&K=$ %THEN %DO;
           PUT   "*;";
          %END;
```

Table 1 (cont'd)

```
            %ELSE %DO;
              PUT   "IF &&CHARSTR&K";
             %IF &K=&J %THEN %DO;
                PUT   ";";
             %END;
           %END;
          %END;
         %ELSE %DO;
          PUT   "OR &&CHARSTR&K";
             %IF &K=&J %THEN %DO;
                PUT   ";";
             %END;
         %END;
      %END;
%MEND PUTTEXT;
```