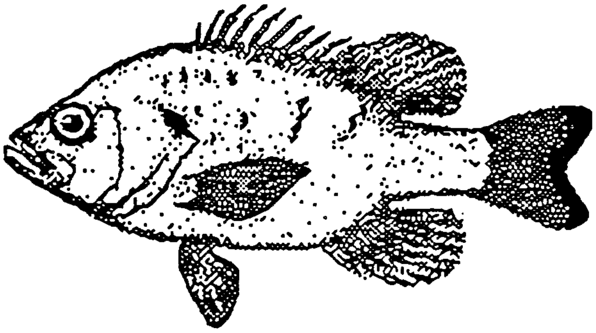
ILLINOIS NATURAL HISTORY SURVEY

Manual for the State Fisheries Analysis System (State FAS): A Package for Fisheries Management and Research

Aquatic Biology Section
Technical Report

Peter B. Bayley and Stephen T. Sobaski



Aquatic Biology Technical Report 87/13

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MANUAL FOR THE STATE FISHERIES ANALYSIS SYSTEM (STATE FAS): A PACKAGE FOR FISHERIES MANAGEMENT AND RESEARCH

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September 1987

SUMMARY OF PROJECT

The major emphasis of this project was in the design and implementation of a fisheries data base, the Fisheries Analysis System (FAS), that would provide information for managers and researchers on a long-term basis. The secondary, but no less important, emphasis was to interpret and analyze FAS data at the District and State levels.

An overview of FAS is presented in Aquatic Biology Technical Report 87/10. A description of the fish population survey data processing in the DISTRICT FAS part of the system is described in the form of a manual in Aquatic Biology Technical Report 87/11 which results from part of the work required under Jobs 101.1 and 101.3. Creel Survey data processing is described in Aquatic Biology Technical Report 87/12 and completes the requirements under Jobs 101.1 and 101.3. The statewide data base, STATE FAS, is described along with uploading and downloading procedures in Aquatic Biology Technical Report 87/13 (Jobs 101.4 and 101.5). Technical Report 87/14 presents an analysis of efficiencies of gears used in generating most of the data in FAS and an analysis of standard parameters for condition factors, resulting from requirements under Jobs 101.2 and 101.6.

This technical report is part of the final report of Project F-46-R, Comparative Analysis of Fish Communities in Impoundments, which was conducted under a memorandum of understanding between the Illinois Department of Conservation and the Board of Trustees of the University of Illinois. The actual work was performed by the Illinois Natural History Survey, a division of the Department of Energy and Natural Resources. The project was supported through Federal Aid in Sport Fish Restoration by the U.S. Fish and Wildlife Service, the Illinois Department of Conservation, and the Illinois Natural History Survey. The form, content, and data interpretation are the responsibility of the University of Illinois and the Illinois Natural History Survey, and not that of the Illinois Department of Conservation.

PREFACE

This manual has been written as a guide to the State Fisheries Analysis System (State FAS). We urge you to read these instructions before and while using the package.

ACKNOWLEDGMENTS

We thank Jana Waite for her excellent redactional work.

Chapter 1

DATA TRANSFER

The uploading of data from DISTRICT FAS (DOC9) to a Prime minicomputer and downloading to R:BASE SYSTEM V is a multistep process of file reformatting and creation through FAS software and transfer via KERMIT file transfer protocol programs.

Initially, data in General Manager's hierarchial structure is converted to an ASCII text format through a DOC9 Applesoft program using General Manager COMPRESS-DATA. COMPRESS-DATA reads a DOC9 data set, compresses the nine screens by eliminating the rewriting of redundant data from previous records, and writes a temporary text file to a designated slot and drive. When transferring several DOC9 data sets in one session, compressed files are stored internally in a RAMFACTOR card (Applied Engineering, Carrolton, TX). This peripheral card expands the Read Accessible Memory of an Apple //e by 1 Mbyte. When addressed by the Applesoft command 'IN #' prior to loading General Manager, an unpartitioned RAMFACTOR card becomes a DOS 3.3 RAM disk, emulating two 400-Kbyte disk drives. Saving files to a RAMFACTOR card increases the efficiency of data transfer by allowing quicker access of the files through storage in auxiliary RAM and increases the volume of data that can be saved to one device.

Compressed text files are then transferred to Illinois Natural History Survey's (INHS) Prime 9955 minicomputer using the file transfer program KERMIT][3.1 for the Apple //e (University of Wisconsin, public domain software).

Once moved to the Prime computer, files can then be interpreted and decompressed through a compiled FORTRAN 77 program, DECOMPRESS. DECOMPRESS reads the compressed structure created by COMPRESS-DATA and creates ASCII text files for each of DOC9's nine screens, restoring all the redundant values of each record. The format of these files is suitable for transfer to the Prime's relational database, INFO9, or down to R:BASE SYSTEM V.

Presently, FAS-STATE uses INFO9 as the main sorting and storage device for all DOC9 data, due to the large storage capacity and high processing speed of the Prime 9955. All nine files created by DECOMPRESS are imported to INFO9 through a single program written in the Prime's programming language CPL. The program, ADDINFO.CPL, calls INFO9, then transfers the files individually. The transfer process entails writing data files to scratch files in INFO and then running a series of checks and comparisons with DOC9 data stored in INFO9 data files. Records with invalid or questionable values are removed from the scratch file and written to an error file for later evaluation. Empty records and records duplicating data, such as lake location, are eliminated. Remaining records are then added to the permanent data file for that screen's data.

Downloading data from INFO9 to R:BASE SYSTEM V is accomplished by first creating an ASCII-delimited file for each of the nine FAS-STATE "Screen" data files

(Appendix A), using the INFO command EXPORT. EXPORT allows for the transfer of all or select records and/or variables from an INFO data file.

Once data is in an ASCII-delimited format, it is easily shipped to the system on which R:BASE V resides using the KERMIT file transfer protocol. Data files saved in MS-DOS format are then read into an R:BASE V database through the R:BASE module FILEGATEWAY. It is a menu driven import/export utility which, in import mode, allows the creation of new databases or data tables or the updating of existing tables.

Chapter 2

DATA BASE ORGANIZATION

FAS-STATE uses the relational data base software R:BASE SYSTEM V to organize and summarize DOC9 (DISTRICT FAS) data sets. R:BASE V is composed of a series of menu- and prompt-driven modules, providing a *user-friendly* environment to create and maintain data bases, as well as providing data input forms, reports, and application programs. Data bases are composed of tables, comparable to DOC9's screens, in which data variables are kept in columns and records in rows. Tables can be further organized into views or *pseudo tables*, where common columns are used to establish links between related data. A single view allows a user to display up to five tables of information without creating additional tables. Data bases in R:BASE V may consist of up to 80 related data tables with up to 800 columns. Any table or view may be composed of up to 80 columns. Single rows in a table can hold up to 4 Kbytes of data; the number of records within a data base are restricted only by a computer's storage capacity or limits imposed by the operating system. To date, FAS-STATE encompasses 9 Mbytes of data from 69 Illinois lakes. Most data are from 1985, although for some lakes data are available from as early as 1981.

At the core of FAS-STATE are the nine data screens, corresponding to those of DOC9 on the Apple //e (Figure 2-1 and Appendix A). The columns in FAS-STATE tables and their order are identical to the structure of DOC9, with several exceptions necessitated by converting a hierarchical database to a relational one. To reduce storage requirements, the *output* fields for impoundment, station, season, and year in DOC9 have been dropped from tables SCREEN5 through SCREEN9 and replaced by a single alphanumeric column, FCODE. FCODE consists of a five digit number, preceded by the character 'D' that is unique for each combination of lake-station-season-year. For example, data collected for Lake Springfield in fall 1985 were given FCODES of D00199, D00200, and D00201 to correspond with the three stations sampled for that impoundment and season. The FCODE of rows in tables SCREEN5 through SCREEN9 provides the link between columns in those tables and data, such as the LAKE, STATION, SEASON, and YEAR columns, found in table SCREEN4. Within the context of a view, FCODE allows data of SCREEN5 through SCREEN9 to be secondarily related to tables SCREEN2 and SCREEN3 through the one-to-one relationship that SCREEN4 has through the common columns LAKE and SPECIES CODE. A column for sampling gear, GEARTYPE, has also been added to DOC9's sample data and length-frequency tables (Screens 6 and 7). GEARTYPE is equal to the first character in the column SEASON; it was added to allow gear to be selected as a criterion for reports.

To provide a link between Screens 1 and 2, the table LAKEDIST was created, which contains the name of each impoundment in FAS-STATE and its associated region and district. In addition to LAKEDIST, other tables relate coded data to text for reports, or to other data items specific to that code. Tables GEAR and SEASON match appropriate text through columns GEARTYPE and SEASON with rows of related tables such as SCREEN7 or SCREEN4. A fourth table, FISHCODE, uses the column SPECIES to link rows in tables SCREEN6 through SCREEN9 with fish species and common names. Future additions and modifications to the structure of FAS-STATE can be readily accomplished through the DEFINITION EXPRESS module of R:BASE V. DEFINITION EXPRESS menus can define new tables or views; add, delete, or reorder table columns; rename tables or columns; create passwords for databases or tables; and create or modify data entry forms and data reports. R:BASE V also allows the creation of new tables from existing tables or views through the relational commands PROJECT, UNION, APPEND, JOIN, INTERSECT, and SUBTRACT.

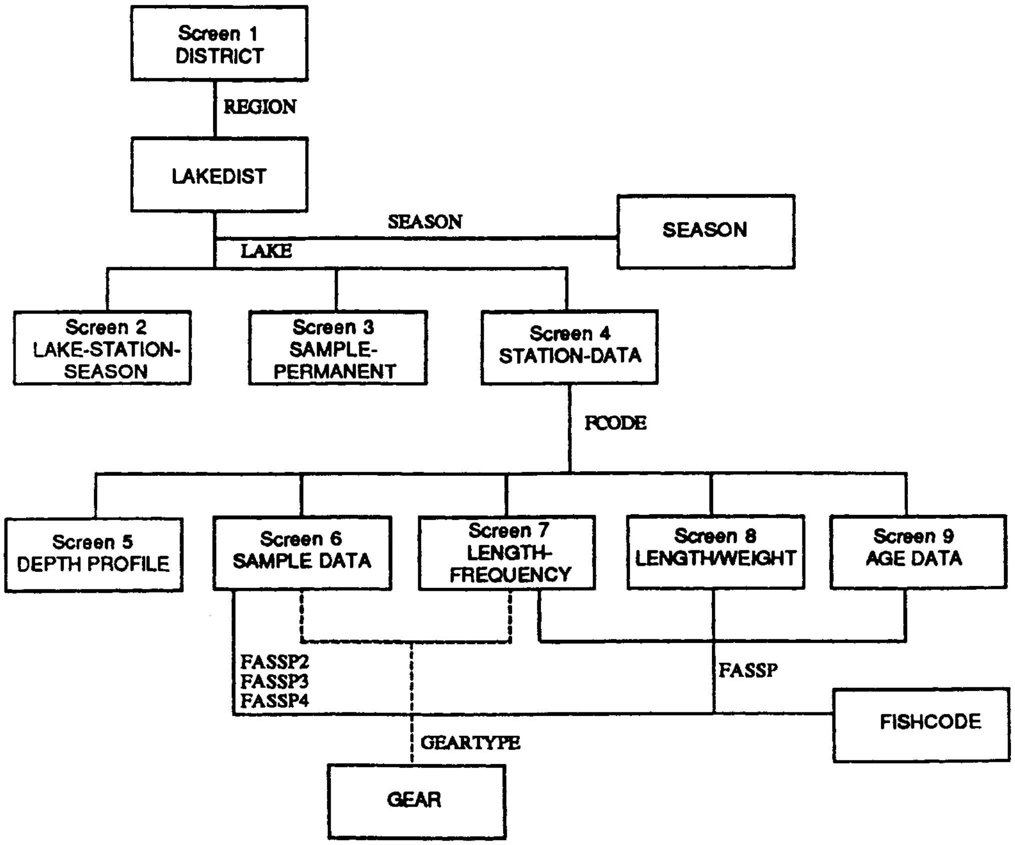


Figure 2-1. The organization of STATE FAS data tables in R:BASE SYSTEM V. The relational paths between tables is flow charted with the primary common column listed between tables.

Chapter 3

DATA REPORTING

This section presents a detailed account of report procedures to serve as a guideline for IDOC personnel in Springfield and Regional offices in the development of new reports. Data output in FAS-STATE is currently handled by the data reporting utilities of R:BASE SYSTEM V. Detailed descriptions of the modules and commands used in report generation are covered in "R:Base System V User's Manual" and "Building Applications-Command Dictionary" (version 1.0, Microrim, Inc., 1986).

The simplest form of displaying data in R:BASE V is through the command SELECT. SELECT lists the data of all or specified columns of a given table or view, either in the default column order or in the order listed in the command. It optionally allows data sets to be sorted on up to ten columns prior to listing. SELECT also allows for the inclusion of a condition list of up to ten criteria that rows must meet in order to be displayed.

Other R:BASE V commands relating to data output include:

COMPUTE--used for the calculation of simple function values such as minimum, maximum, mean, and standard deviation for a selected column;
TALLY--lists each unique value of a column and its number of occurrences; and
CROSSTAB--counts the number of cases, computes the sum, or calculates the average of each unique pair of values from two columns in a table or view.

All three of these commands may be used with a WHERE clause, which defines the condition list for rows in the data set.

To create more formal data output, R:BASE V provides the module REPORTS EXPRESS, which allows users to create reports for a single table or for the data of several related tables through a specific view, using a series of menu-driven prompts and a full-page editor. Within a report, data can be displayed in its originally entered form, summarized through break points, or transformed or totaled through variables defined within the report. The definition of variables within REPORTS EXPRESS also allows for the display of such system variables as #DATE, #TIME, or #PAGE, and of data from additional tables or views through look-up variables. The report editor permits users to define where data is to be displayed on the report page. It also allows the incorporation of text, such as for titles or headings, into the body of the report.

Creating a report in R:BASE V initially involves deciding which data items (columns) to display, whether to display all or a select number of cases (rows), and where those items can be accessed. A list of the tables, views, and columns of a given database can be seen by typing "LIST ALL" while in R:BASE mode. Where columns of interest occur over several related tables, report generation will generally first require the creation of a view to serve as the report's *driving table*. A driving table is the single data table or view for which a report is created. For a report to display data of more than one table or view, either a view must be defined, modified, or look-up variables must be created in the Report's definition menu for the additional columns.

As an example, to produce a summary report of the impoundments, years, and seasons sampled within a selected region of Illinois, the view LAKEYEAR was created for FAS-STATE (Figure 3-1). Views are created and modified within the R:BASE V module DEFINITION EXPRESS. Within its View menu, users are alternately prompted for tables, then columns, for a maximum of five tables from the current data base. Views for reports should include the columns holding data to be displayed, columns used in calculating report variables, columns used in the selection criteria of the view's condition list, *and* columns that serve as links between related tables in the view. Note that tables cannot be included in a view definition until a common column is added from a related table already in the view. Other columns, up to 80 columns per view, may be included so that, for instance, a view may be applicable to other reports. In "LAKEYEAR," the data of four tables are linked, with LAKE being the common column between tables SCREEN2, SCREEN4, and LAKEDIST, and SEASON the link between SCREEN4 and SEASON. Besides these columns, LAKEYEAR includes REGION, LAKE, YEAR, ACREAGE, and SEASTEXT, which are displayed in the summary report LAKEREP. An additional column, DISTRICT, is included as a potential criterion column in the view, a report condition list, or a potential report item.

Once tables and columns are chosen for a view, DEFINITION EXPRESS concludes the view definition process by prompting the user to optionally set a condition list for the view. The list is a string consisting of a maximum of ten criteria on columns, joined by logical operators such as AND or OR. Condition lists limit the rows included in a view and are useful in selecting specific sets of data for a report, such as all fish records for a specific impoundment. Condition lists are also useful in error checking, such as checking for illegal region and district values in LAKEYEAR. Like the view itself, the condition list is created through a series of menu-driven prompts (Figure 3-1).

The definition and inclusion of condition lists in commands often affects the processing efficiency of R:BASE V. Generally, efficiency is increased by setting data conditions on the driving view rather than in the PRINT command executing the report. For example, the creation of a species summary for the Fall 1984 fish census of Lake Shelbyville involves selecting and sorting 1,725 records of 29 species from a view linking tables SCREEN2, SCREEN4, SCREEN7, and FISHCODE. When the condition "WHERE LAKE EQ SHELBYVILLE AND YEAR EQ 84" is included in the view definition, generation of a species list takes 69 minutes to complete. When this condition clause is placed in the PRINT command, the completion of the same report took 145 minutes. The processing of data from a view is additionally expedited by *keying* common columns. A *key* is an index of data locations in a column, formed by R:BASE V as an option in the table creation and modification menu of DEFINITION EXPRESS. R:BASE V can reference only one key per data base operation, therefore it is best to key only the common or criteria column with the greatest number of unique cases. Processing is also expedited when the last rule or criterion in a condition list compares a keyed column using the EQUALS comparison, and when that criterion, in multi-condition clauses, is preceded by the logical operator AND. The processing efficiency of reports can be severely reduced with increased complexity in the driving view's design and or size,

(A) THE DEFINITION PAGE OF "LAKEYEAR"

(VIEW NAME):

LAKEYEAR (Viewname)

(Columns within "LAKEYEAR"):

LAKE	YEAR	SEASON	ACREAGE	SEASTEXT	REGION	DISTRICT
SCREEN4	SCREEN4	SCREEN4	SCREEN2	SEASON	LAKEDIST	LAKEDIST
SCREEN2		SCREEN2				
LAKEDIST		SEASON				

(Tables linked by "LAKEYEAR"):

SCREEN4	SCREEN2	LAKEDIST	SEASON

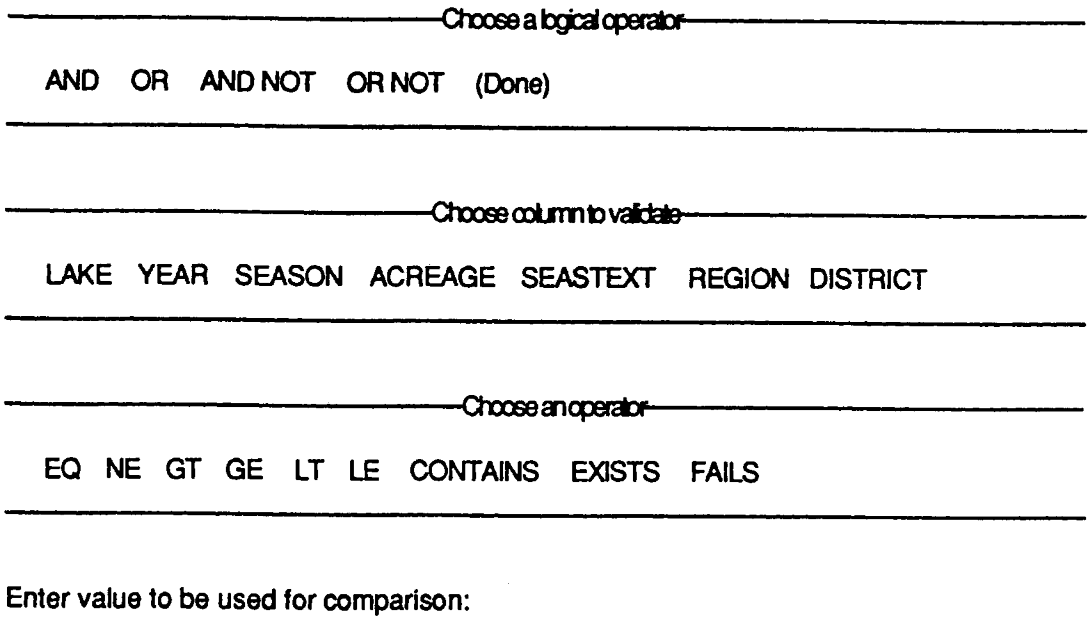
(B) THE CONDITION LIST PAGE OF "LAKEYEAR"

LAKEYEAR

	Column	Operator	Value
	REGION	GT	0
AND	REGION	LT	6
AND	DISTRICT	LT	22

Figure 3-1. The view definition pages of the FAS-STATE view LAKEYEAR, as displayed in the VIEWS menu of R:BASE SYSTEM V moduleDEFINITION EXPRESS.

(C) MENUS AND PROMPTS DISPLAYED IN THE DEFINITION OF CONDITIONS FOR "LAKEYEAR"



Choose a logical operator

AND OR AND NOT OR NOT (Done)

Choose column to validate

LAKE YEAR SEASON ACREAGE SEASTEXT REGION DISTRICT

Choose an operator

EQ NE GT GE LT LE CONTAINS EXISTS FAILS

Enter value to be used for comparison:

Figure 3-1 (concluded).

both in terms of the number of tables related, the total size of each table and the total number of columns comprising the view.

Following the selection of a view or data table, the report creation process continues with the design of the report's format. In R:BASE V, reports are defined and edited using the Report Definition section of the module REPORTS EXPRESS. Reports in R:BASE V are composed of sections, each containing text and/or field positions for column and variable displays.

Prior to entering the Report Definition menu, the user should map out how the report should look. Factors to consider include: which columns to display from the report's driving table or view; whether all rows of data are to be displayed or just summaries of columns; whether variables need to be defined to display the data of other tables, the system variables for date, time, page number, or values of data transformations or calculations; and how the display of data should be organized. Display considerations include: which columns should be displayed in header sections and which columns should be listed as subordinate to header information; whether a column should be displayed in ascending or descending order; whether subtotals and grand totals of columns or variables are required; what text to include in the report (specifically report titles, page titles, and column headings); and the general page and print format of the report.

Report items can be organized into any or all of seven sections in Report Definition. These sections are

1. Report Header--appears once and holds the report's title;

2. Page Header--appears at the top of each page and generally includes such items as page number, date, and column headings;

3. Break Header--appears periodically as a subheading whenever a specified column or variable changes value;

4. Detail--lists all values of a single block of data, usually rows of data from specified columns or variables;

5. Break Footer,--appears at the end of a block of data, whenever a specified column or variable changes value, and generally includes subtotal values of that column or variable;

6. Page Footer--appears at the end of each page and contains such items as page numbers and the sum of column values displayed on that page; and

7. Report Footer--appears at the end of the report and contains such values as column or variable grand totals.

The body of the report may be further subdivided into a maximum of ten blocks by defining breakpoints, with each block consisting of a Break Header section and/or a Detail and Break Footer section.

The size and contents of each section are defined with the EDIT option of the Report's Definition menu. EDIT acts as a full screen editor, allowing quick definition of each report. Specifically EDIT allows the determination of sections to be included in the report, their size, and the location of text and fields with each section. *Fields* are areas of the report page designated for the display of data from specific columns or variables. Fields are located by the definition of starting (S) and ending (E) points through EDIT's cursor, after EDIT prompts for the column or variable to be associated with that field. Text displays, such as titles or column headings, are added by typing the text at the desired page location. Variables used in the report are defined, changed, or deleted through the EXPRESSION option of the Definition menu. Report contents may include a maximum of 40 variables. The third definition option, CONFIGURE, allows page control specifications and report breakpoints to be set.

The order in which execution of the definition options--EDIT, CONFIGURE, and EXPRESSION--are executed is generally not critical. For instance, one can define all report variables in the EXPRESSION menu prior to defining field locations in EDIT, or enter the definitions directly in EDIT. EDIT will prompt for a definition before locating the field of a previously undefined variable. Order is important, however, when defining Break Header or Break Footer sections. Before EDIT will display Break sections as possible report sections, breakpoints must be defined in the

CONFIGURE menu. Breakpoints are flags set by R:BASE V on designated break columns to indicate changes in groups of data. In setting breakpoints, report data are automatically sorted in ascending order on the break columns. Data of break columns are displayed only when the values of those columns change, when their fields are located in Break Header sections. Breakpoints offer a convenient method of creating summary report data, because only unique values of columns or combinations of columns are displayed when the fields of breakpoint columns are located in Break Header sections.

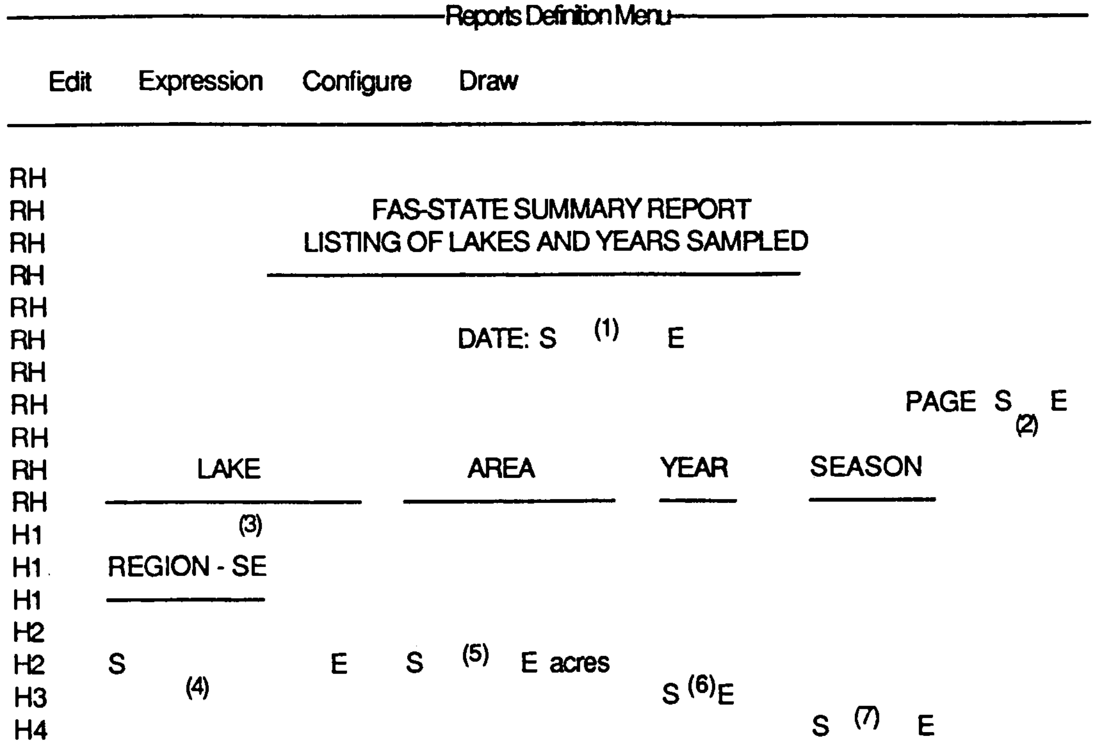
The report LAKEREP (Figure 3-2) is an example of the output possible using REPORTS EXPRESS and DEFINITIONS EXPRESS with FAS-STATE. LAKEREP gives a summary of the impoundments and years sampled within selected IDOC regions from the current FAS-STATE data base. The report displays region identifications, the names of impoundments sampled, their surface area, the years each were sampled, and the seasons in which sampling occurred. Because the columns with these data occur over four related tables, the view LAKEYEAR (Figure 3-1) was created to serve as the driving table for LAKEREP prior to designing the report. Within REPORTS EXPRESS, a report page was designed to display the data of interest in four levels: (1) by region (column REGION); (2) by impoundment (column LAKE); (3) by the years sampled for a given impoundment (column YEAR); and (4) by seasons sampled during a given year (column SEASTEXT, which is the text equivalent of the two digit season code of column SEASON).

Because the view LAKEYEAR is built primarily around the station data table, SCREEN4, it is possible for one combination of Region-Lake-Year-Season to have a number of cases, one for each station sampled in that impoundment. To display a summary of the unique combinations of these four columns, it was necessary to first enter the Configure Page of the Reports Definition Menu and designate each as a break column (Figure 3-2B). The order of break designation is important since it establishes the hierarchy that R:BASE V follows in sorting the rows of data. In the case of LAKEREP, data rows are first sorted on REGION until a row is encountered that has a value for REGION identical to a row already sorted. Those two rows are then sorted on the values of the next break column, LAKE. If both also have the same impoundment name, sorting is then done on the values in break column YEAR. This process continues with all four break columns until all cases of the driving view or table have been sorted.

Once the breakpoints were established, several variables were defined in the Expression Menu of Report Definition. Because data on years are stored only by the last two digits in FAS-STATE, the variable YEARSAMP was defined (Figure 3-2C) to allow display of the true values for years. Variables were also defined for displaying the system variables #DATE, which holds the current date in the computer's operating system clock, and #PAGE, which R:BASE V uses to hold the current page number of a report.

After the definition of all breakpoints and variables, the EDIT option was chosen to select and define sections for the report and the text and field locations of each section. LAKEREP is divided into six sections--a Report Header, a Page Header and four Break Headers, one for each break column. Figure 3-2A shows the format for LAKEREP and the location of each of the variables and columns selected for display. The Report Header consists of seven rows, displaying text for report title and the variable holding the current date, REPDATE. A four-row Page Header

(A) MAIN REPORT DEFINITION MENU WITH THE EDIT PAGE



```
--------------------------Reports Definition Menu--------------------------

   Edit   Expression   Configure   Draw
---------------------------------------------------------------------------
RH
RH                     FAS-STATE SUMMARY REPORT
RH                  LISTING OF LAKES AND YEARS SAMPLED
RH                ______________________________________
RH
RH                         DATE: S   (1)   E
RH
RH                                                          PAGE S   E
RH                                                                (2)
RH         LAKE              AREA          YEAR     SEASON
RH     _____________     ___________      ____     _______
H1             (3)
H1     REGION - SE
H1     ___________
H2
H2     S             E    S  (5)  E acres
H3          (4)                            S (6)E
H4                                                   S  (7)  E
```

RH - report header section
PH - page header section
H1-H4 - break header sections
S - starting point of a column or variable display field
E - endpoint of a display field

(1) - variable REPDATE
(2) - variable REPPAGE
(3) - column REGION
(4) - column LAKE
(5) - column ACREAGE
(6) - variable YEARSAMP
(7) - column SEASTEXT

Figure 3-2. Report definition pages for the FAS-STATE report, LAKEREP, from the R:BASE SYSTEM V module REPORTS EXPRESS.

(B) CONFIGURATION PAGE

```
Lines Per Page ..................: 60
Remove Initial Carriage Return.....: [NO]
Manual Break Reset ..............: [NO]
Page Footer Line Number.........:  0


                  BREAKPOINTS                      FORM FEEDS
             Break        Variable           Header              Footer
             Column       Reset         Before    After     Before    After
             --------     --------      ------    -----     ------    -----
Report                                  [NO]      [NO]      [NO]      [NO]
Page                      [NO]
Break1       REGION       [NO]          [NO]
Break2       LAKE         [NO]          [NO]
Break3       YEAR         [NO]          [NO]
Break4       SEASTEXT     [NO]          [NO]
Break5       [None]       [NO]          [NO]
Break6       [None]       [NO]          [NO]
Break7       [None]       [NO]          [NO]
Break8       [None]       [NO]          [NO]
Break9       [None]       [NO]          [NO]
Break10      [None]       [NO]          [NO]
```

(C) EXPRESSION MENU PAGE

```
---------------------------------Expression Menu---------------------------------

  Define      Delete      Retype      Reorder

-----------------------------------------------------------------------------------

1:   DATE     :   REPDATE    =   .#DATE
2:   INTEGER  :   RPTPAGE    =   .#PAGE
3:   INTEGER  :   YEARSAMP   =   YEAR + 1900
```

Figure 3-2 (concluded).

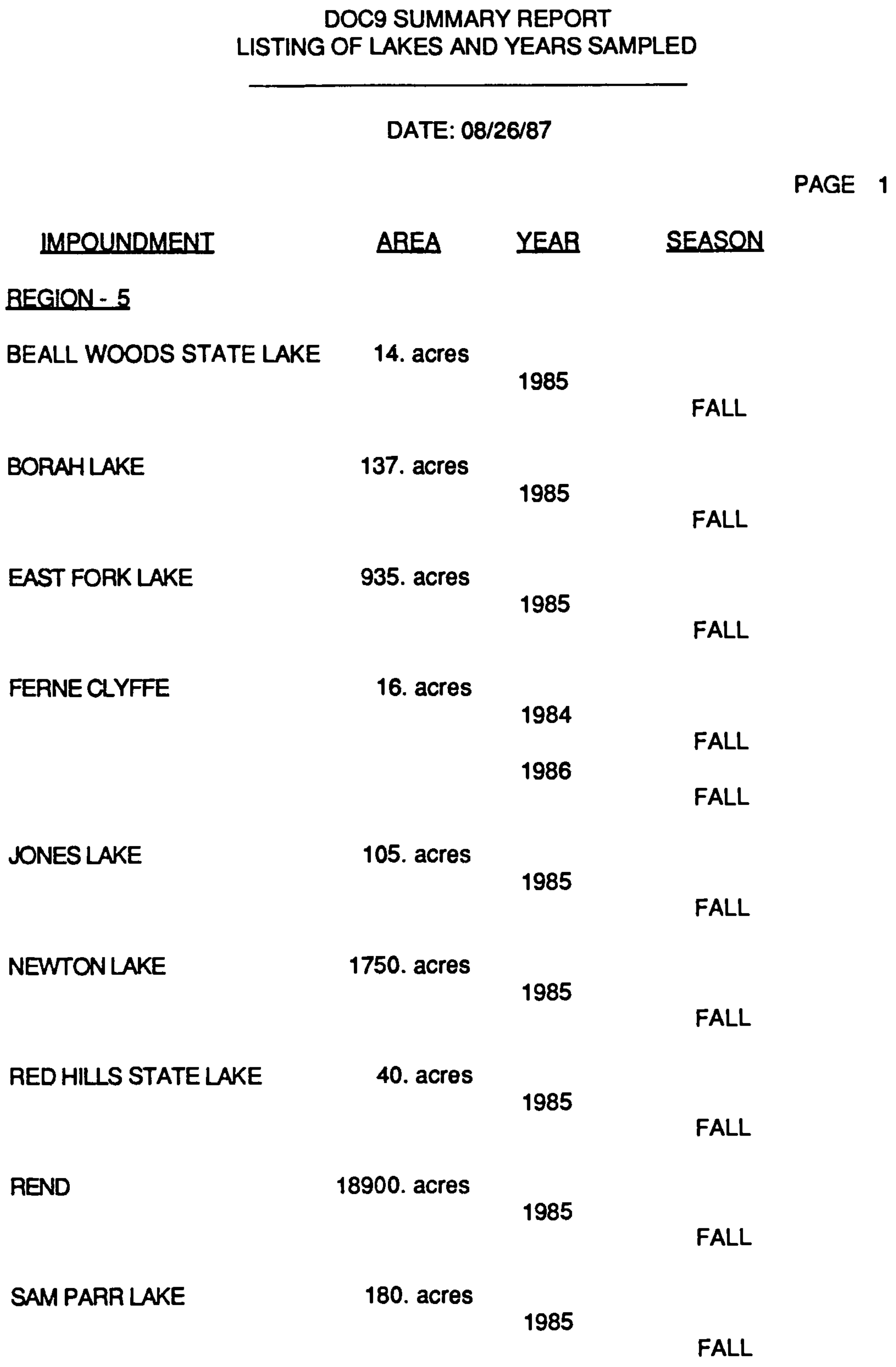
section follows with a field for displaying the page number variable, REPPAGE, and text for the report column titles. The Page Header contents are displayed at the top of each page of the report, with the exception of the initial page. The underlining of column titles is accomplished through the DRAW option of the Report Definition

Menu Data. DRAW provides the option of inserting either single or double lines, vertically or horizontally, anywhere in the report.

The main body of the report displays data from the view LAKEYEAR over four Break Header sections. In the first break section, text is mixed with a field for the column REGION to display the region identification. The second Break Header section includes field locations for LAKE and for the SCREEN2 column with impoundment surface area data, ACREAGE. Because ACREAGE is in the same Break Header section as a break column, a value for ACREAGE will be displayed only when a new value for LAKE is printed. The relationship between LAKE and ACREAGE is one-to-one, *i.e.*, each impoundment has only one surface area value associated with it. Given that, the inclusion of ACREAGE in the same section as LAKE will summarize all of the selected data of these two columns. In the case of a many-to-one relationship, however, only the first value of the column associated with the break column is printed. For instance, if ACREAGE is substituted in the second Break Header by STATION, the column containing FAS-STATE station number data, the report will print only the first station number for each impoundment, regardless of the number of stations actually sampled for that impoundment. To display all values of a many-to-one relationship, a field for the "many" column should be located either in a Data section or in a separate Break Header section, directly under the section with the "one" column. In the case of LAKEREP, each impoundment generally has several years of data stored in FAS-STATE. To display all years sampled for each impoundment, a separate Break Header section was defined following the lake-area section. Because YEARSAMP's field is located in a Break Header section and calculated from the Break column YEAR, a summary list of years is displayed. If YEAR had not been designated a break column, the output of year values would have been unpredictable, since breaks would have been made on unsorted data.

Following the Break Header section for year, Break Header 4 was defined to summarize the seasons sampled for each impoundment per year. Because sampling season is stored only as a two digit code in the core data tables of FAS-STATE, a new table, *Season*, was created to relate the values of the column SEASON with the appropriate season text. The table, Season, (Appendix A) is composed of just two columns, SEASON, which acts as the common column between it and the *Screen* tables and a text column SEASTEXT, which contains such values as FALL. Through the one-to-one relationship established by the column SEASON in LAKEYEAR, SEASTEXT can be defined as a break column in LAKEREP. SEASTEXT is both the last item that report data are sorted by and, by being located in Break Header 4, the last data displayed in the region-lake-year-season data block of LAKEREP.

Once defined, reports are run in R:BASE V's main module, R:BASE, through the PRINT command. To report on just data from IDOC Region 5 for Figure 3-3, an optional WHERE clause was included when entering the PRINT command. The execution command for that example is "PRINT LAKEREP WHERE REGION EQ 5." The WHERE clause is a convenient method for restricting the data covered in a report. For small data sets with just one condition, the turnaround time from entering the command to execution is rapid. For driving views linking large sets of data, or where multiple conditions are placed on a data set, however, it is more efficient, in terms of processing time, to add or change a WHERE clause in the driving view definition rather than in the PRINT command. A second optional clause of the PRINT command, SORTED BY, permits sorting on up to ten columns or report



```
                    DOC9 SUMMARY REPORT
             LISTING OF LAKES AND YEARS SAMPLED

                       DATE: 08/26/87

                                                         PAGE  1

   IMPOUNDMENT                 AREA       YEAR        SEASON

REGION - 5

BEALL WOODS STATE LAKE      14. acres
                                          1985
                                                        FALL

BORAH LAKE                 137. acres
                                          1985
                                                        FALL

EAST FORK LAKE             935. acres
                                          1985
                                                        FALL

FERNE CLYFFE                16. acres
                                          1984
                                                        FALL
                                          1986
                                                        FALL

JONES LAKE                 105. acres
                                          1985
                                                        FALL

NEWTON LAKE               1750. acres
                                          1985
                                                        FALL

RED HILLS STATE LAKE        40. acres
                                          1985
                                                        FALL

REND                     18900. acres
                                          1985
                                                        FALL

SAM PARR LAKE              180. acres
                                          1985
                                                        FALL
```

Figure 3-3. Sample output from the FAS-STATE report LAKEREP.

variables. Inclusion of this clause is required where sorted output is desired from report variables containing breakpoints. In reports with break columns, however, the use of SORTED BY should be avoided. The inclusion of SORTED BY prevents the automatic sorting of data on break columns, thereby potentially ca[illegible]ing unpredictable report output.

Report output in R:BASE V can be directed to any or all of three devices with the OUTPUT command. The default display of reports is to the monitor (OUTPUT SCREEN), but output may be sent to a printer (OUTPUT PRINTER) and/or saved to a DOS file (OUTPUT filename), as well as any combination of the three (*e.g.*, OUTPUT filename WITH BOTH). To change the output device, the OUTPUT command is entered prior to entering a PRINT command.

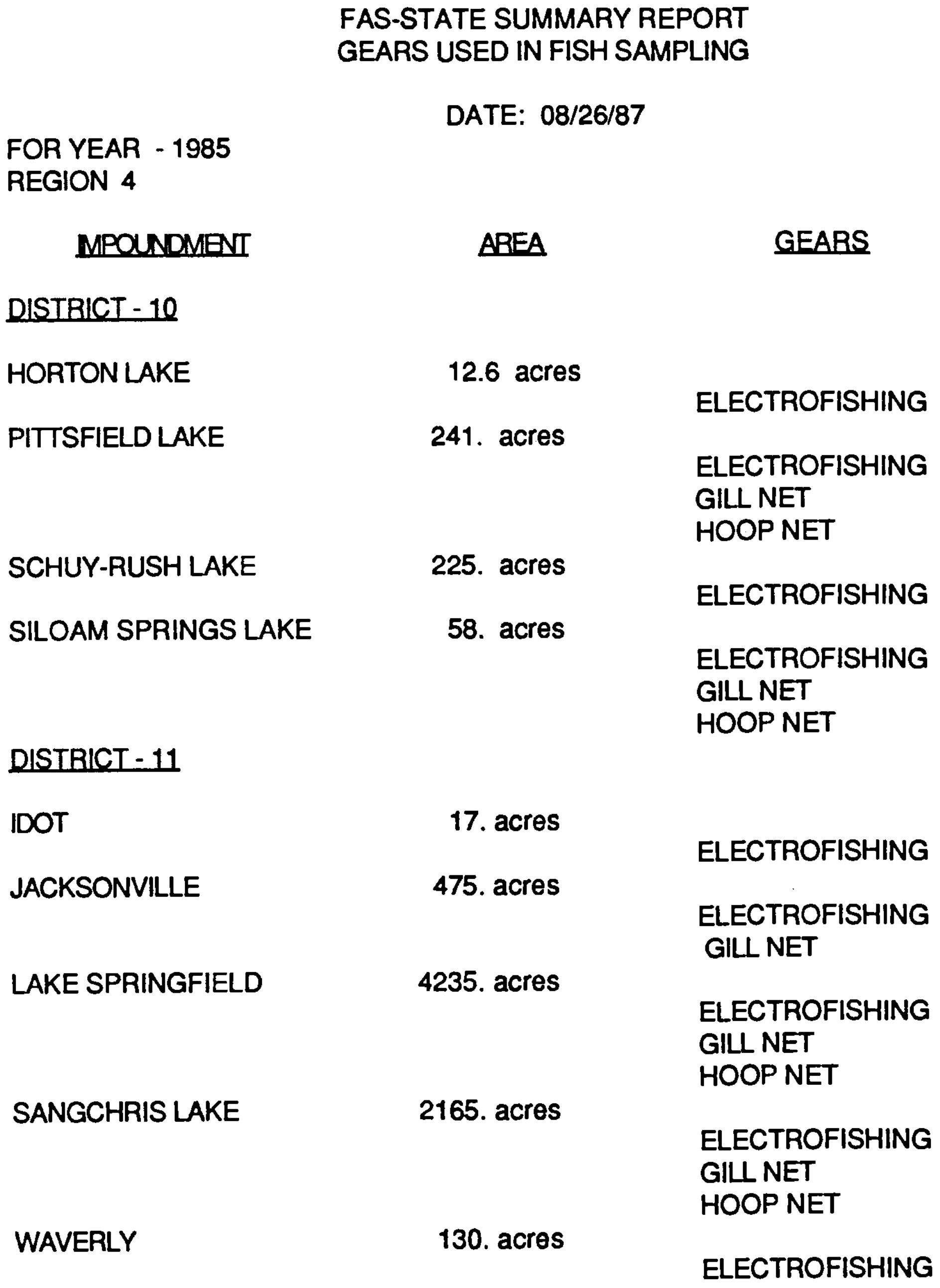
Included in the figures of this report are two further examples of reports created with the FAS-STATE database. Figure 3-4 is a sample output from the report, FISHLIST. FISHLIST summarizes the species of fish collected from a selected impoundment over all years, seasons, stations and sampling methods present in the data base. FISHLIST is driven by the view LAKESPP (Appendix A) and breaks on column FASSP, the three character code for fish species. The condition list specifying the impoundment to be reported on is defined and edited in the view definition of LAKESPP. FISHLIST displays the data of four FAS-STATE columns as well as the system variables for page number and current date. Impoundment name (LAKE), size (ACREAGE), and average depth (AVGDEPTH) are listed in the first break header section of the report. The common names of fish species collected (COMMON) are summarized in a second break header. Because column FASSP has a one-to-one relationship with COMMON, the listing of species will reflect the breakpoints of FASSP, despite the fact that COMMON and not FASSP is displayed.

Figure 3-5 is sample output from the report GEARSUMM. GEARSUMM summarizes the various sampling gears used in a selected region and year, broken down by the IDOC districts and impoundments sampled. To integrate data on impoundment location, impoundment morphometry, and sampling, the view GEARVIEW was created (Appendix A). As with the report FISHLIST, the condition list for region and year is defined in the driving view rather than in the PRINT command. GEARSUMM displays the data of five columns, three of which are designated as break columns. DISTRICT, which holds the district location of the sample, is displayed in the first Break Header section. LAKE is displayed in the second Break Header section with the impoundment area column, ACREAGE. In the third Break Header, the sampling gear used in each impoundment is summarized by displaying the break column GEARTYPE. To round out the report, variables defined to hold the system values for current date and page are displayed in the Report and Page Header sections, respectively. A third report variable holds the value of the year selected, converted from the two-digit format that year data is stored in to its full, four-digit value. The year variable, as well as the number of the region selected, appears in the Page Header section.

R:BASE V'S reporting capability is reasonably flexible, permitting summarization of any set of FAS-STATE data, assuming that those data can be related within the constraints of view and report structures. One major consideration in running reports in R:BASE V, however, is the speed of data processing. Actions requiring frequent disk access, such as relating and sorting in report generation, are constrained by the disk access speed of the user's computer hardware. When

```
                    FAS-STATE SUMMARY REPORT
                     FISH SPECIES COLLECTED

                         DATE: 08/25/87
                                                   PAGE   1

                                          AVERAGE
   IMPOUNDMENT        AREA                 DEPTH

        SPECIES COLLECTED

LAKE SPRINGFIELD      4235. acres          14. feet

        BIGMOUTH BUFFALO
        GREEN SUNFISH X BLUEGILL
        BLACK CRAPPIE
        BLUEGILL
        BROOK SILVERSIDE
        BULLHEAD MINNOW
        CARP
        CHANNEL CATFISH
        FLATHEAD CATFISH
        FRESHWATER DRUM
        GOLDEN SHINER
        GREEN SUNFISH
        GIZZARD SHAD
        LARGEMOUTH BASS
        ORANGESPOTTED SUNFISH
        REDEAR SUNFISH
        RIVER CARPSUCKER
        TIGER MUSKIE
        WALLEYE
        WHITE BASS
        WHITE CRAPPIE
        WHITE SUCKER
        YELLOW BULLHEAD
        YELLOW BASS
```

Figure 3-4. Sample output from the FAS-STATE report FISHLIST.



```
                         FAS-STATE SUMMARY REPORT
                        GEARS USED IN FISH SAMPLING

                              DATE:  08/26/87
FOR YEAR  - 1985
REGION  4

   IMPOUNDMENT               AREA               GEARS

DISTRICT - 10

HORTON LAKE                  12.6  acres
                                            ELECTROFISHING
PITTSFIELD LAKE             241.  acres
                                            ELECTROFISHING
                                            GILL NET
                                            HOOP NET
SCHUY-RUSH LAKE             225.  acres
                                            ELECTROFISHING
SILOAM SPRINGS LAKE          58.  acres
                                            ELECTROFISHING
                                            GILL NET
                                            HOOP NET
DISTRICT - 11

IDOT                         17. acres
                                            ELECTROFISHING
JACKSONVILLE                475. acres
                                            ELECTROFISHING
                                             GILL NET
LAKE SPRINGFIELD           4235. acres
                                            ELECTROFISHING
                                            GILL NET
                                            HOOP NET
SANGCHRIS LAKE             2165. acres
                                            ELECTROFISHING
                                            GILL NET
                                            HOOP NET
WAVERLY                     130. acres
                                            ELECTROFISHING
```

Figure 3-5. Sample output from the FAS-STATE report GEARSUMM.

DISTRICT - 12

BEAVER DAM	56.6 acres	ELECTROFISHING GILL NET
GILLESPIE NEW LAKE	207. acres	ELECTROFISHING
GLEN SHOAL LAKE	1200. acres	ELECTROFISHING
GREENVILLE NEW CITY LAKE	775. acres	ELECTROFISHING
OTTER LAKE	765. acres	ELECTROFISHING GILL NET

Figure 3-5 (concluded).

numerous or complex relates, multiple sorts, or multiple condition checks are required, the execution of such commands as PRINT can potentially take hours with a data base the size of FAS-STATE.

To demonstrate the relative speed of R:BASE V, the report FISHLIST was run on 1984 data of Lake Shelbyville, using an IBM-AT with 30-Mbyte hard disk and 640 Kbytes of RAM. A comparable report was created with the FAS-STATE data base residing in INFO9 on the INHS Prime 9955 minicomputer. Both reports were required to relate the 25,980 records of data table SCREEN7 to the three remaining tables of view LAKEYEAR, eliminate all but the 1,725 records for Lake Shelbyville in 1984, and sort the 29 species present in that data set. The total execution time for the report in INFO9 was 9.6 minutes. In R:BASE V the total run time was 69 minutes when the condition list, specifying impoundment and year, was defined in the driving view. As noted earlier, this run time increased to 145 minutes when the condition list was defined in the PRINT command, rather than in LAKEYEAR's definition. A similar output using the Summary Species Table of DISTRICT FAS (Aquatic Biology Technical Report 87/11) on an Apple //e with the Shelbyville data in RAM memory took 21.5 minutes.

Chapter 4

APPLICATION PROGRAMS

When reports are to be executed on subsets of a driving table or view, an alternative to repeated redefinition of the condition list criteria in DEFINITION EXPRESS is to incorporate the criteria selection process and report execution in an R:BASE application program. An application program consists of a series of R:BASE commands, menus, and/or help screens that normally provide a user with everything needed to enter, update, report, or process data base information. Applications are especially useful in allowing someone with only a working knowledge of R:BASE V to perform a series of operations, such as producing reports on various subsets of a database, without requiring a detailed understanding of the data base itself.

An application in R:BASE V can consist of a single procedure file or a series of files called on by a main program. Each procedure file is organized into one or a series of command blocks, and optionally include menu blocks and help screen blocks. Command blocks are the equivalent of subroutines in other programming languages. These blocks contain sets of R:BASE system commands and functions and are delineated from other blocks of code in a program by the commands $COMMAND and RETURN. Examples of command block operations are commands which set the R:BASE V system environment such as "SET ERROR MESSAGE OFF," IF-THEN-ENDIF segments which route programs to different sets of commands, and execution commands such as RUN or PRINT. Command blocks can also call and run programs written external to R:BASE V using the ZIP command. Command blocks are executed only when requested by name with the RUN command.

Menu blocks consist of individual R:BASE menu definitions. Each block contains a name which is referenced by the menu execution command CHOOSE, followed by the menu type and title, and lastly the list of choices that appear when the menu is displayed. Menus may be defined as either horizontal (ROW) or vertical (COLUMN). The actions ascribed to each option, however, are defined in the command block calling the menu following the CHOOSE command. For vertical menus, a total of nine options are possible, each up to 65 characters in length. The options in vertical menus are numbered, and it is those values that the command block processing the menu tests for when interpreting a user selection. These tests consist of a series of IF-ELSE-ENDIF commands that check the value of the integer variable set to hold the menu choice and then executes the actions defined for that choice. Horizontal menus are processed by command files in a similar fashion; however, they differ from vertical menus in several respects besides the obvious display difference. Menu options in horizontal menus are not numbered; consequently, the values for choice tested for in the calling command file are the option's actual text. Horizontal menus are limited to a total of 1,134 characters, which potentially allows 81 options of eight characters each. Within APPLICATION EXPRESS, horizontal menus are limited to 12 options of up to 10 characters. Menu blocks are delineated in a procedure file by the $MENU command and extend until another block definition or the end of the procedure file is encountered.

The third type of block, the Screen block, is invoked by the DISPLAY command in the procedure file. Screen blocks are made up of single screens of text, and for this reason are primarily used to provide on-line help in an application. Screen blocks are delineated by the command $SCREEN and contain the name unique to that block, followed by the text to be displayed. Screens are commonly called by menus through the F10 key. F10 will return a value of -1 for vertical menus and HELP for horizontal menus. Menu options can then be assigned a DISPLAY command by an IF statement.

Application programs can be created by two methods in R:BASE V. A user-friendly method of creating applications is offered by the module APPLICATION EXPRESS. In this module, a series of menus and prompts are displayed, leading the user through the process of selecting a data base, creating a menu for that data base, then assigning various actions to that menu. Menu actions may include such operations as entering and editing data with a user defined form, displaying the contents of data tables, executing reports, and creating command files. A procedure file is then automatically written and compiled, containing all of the actions selected. Procedure files created in APPLICATION EXPRESS are generally simple, given the constraints of the menu-prompt format. Programs written in APPLICATION EXPRESS, however, may be expanded or edited with the R:BASE V editor, RBEDIT. APPLICATION EXPRESS may, therefore, be useful in creating a rough draft of code that an experienced user can then modify to produce complex applications.

Alternately, an entire procedure file or individual program blocks may be written within RBEDIT. The R:BASE V module CODELOCK is then run to join program blocks together into a compiled procedure file or to convert the ASCII code of a complete command or procedure file into binary form. Procedure files may be composed of as many as 42 blocks of commands, menus and screens.

An example of a possible application for the FAS-STATE database is given in Appendix B. REGMENU.APP is a procedure file, created in RBEDIT for running the impoundment summary report LAKEREP. Because LAKEREP is designed around one condition, the selection of a region, REGMENU.APP is designed to set region specifications interactively through a menu. REGMENU.APP is composed of three blocks--a command block, REGMENU, and two menu blocks, REGION and OUTDEV.

REGMENU is organized into four major segments. The first section opens FAS-STATE, and sets the various system parameters and variables used in the application program. Then the menu REGION is displayed. In this section, the condition list criteria is set for the PRINT command executing LAKEREP, by interpreting the user choices made from REGION. This menu offers the user the option of choosing to report on one, several, or all of the IDOC regions. The menu is continually displayed until either the ESC key is entered or the option EXIT is chosen. Menu choices are stored in the text variable PICK1 and tested with a series of IF-ENDIF statements. A second text variable, RPICK, translates the menu selection into a format which can be added to a condition list. For instance, if "REGION1" is selected from the menu, RPICK is set to "REGION EQ 1." A third text variable, REGPICK, contains the entire condition list statement, including the command WHERE and any connectors required to concatenate multiple menu picks.

The third section of the command block displays the second menu block, OUTDEV, which is a vertical menu that displays all possible output options of R:BASE V. This menu is displayed once and its choice is interpreted through another series of IF-ENDIF statements. Each IF statement executes an OUTPUT command with the appropriate option, except for the last option EXIT, which causes the entire program to terminate.

The command procedure ends by executing the report, resetting variable values and closing the data base, then returning to the program which called the procedure file initially. Because REGMENU contains a portion of an executable statement, in this case the condition list for "PRINT LAKEREP," its prefaced by an ampersand (&) in the PRINT command.

Procedure files performing applications can either be executed from the R:BASE module or called from the command block of a different procedure file. For example, it is possible to create similar application programs for each of the three FAS-STATE reports listed earlier. An initial command file could then be written in RBEDIT or APPLICATION EXPRESS, which, upon entering R:BASE V, would list the reports created for FAS-STATE. Using such a command file anyone could then automatically call and execute any FAS-STATE data base reports.

Appendix A

Data tables and view definitions of FAS-STATE. Within the table definition listings, columns are referred to by their position of order, shown under the heading FLD #, rather than their actual name. Accompanying each number is a brief description of the column, its data type, its length in characters, and whether it is a key column. Column descriptions are listed rather than column names due to the eight character limit placed on names by R:BASE SYSTEM V. View definitions list the names of columns present in the view, parent table(s), and the condition list criteria set on the view.

STATE FAS
SCREEN 1: DISTRICT-1 No lock(s)

FLD#	COLUMN DESCRIPTION	TYPE	LEN	KEY
1	REGION	I	1	
2	DISTRICT	I	2	
3	DIST.BIOLOGIST	T	15	
4	REPLACEMENT NAME	T	8	
5	DATE OF REPLACEMENT	T	8	
6	YEARS OF DATA: FROM 19[ ]	I	2	
7	TO 19[ ]	I	2	
8	DEPTHS/DISTANCES IN (FT) OR (ME)TRIC?	T	2	
9	COMMENTS	T	70	

CURRENT NUMBER OF ROWS: 38

TYPE = (I)nteger, (T)ext
LEN = length of field in characters

STATE FAS
SCREEN 2: LAKE-STATION-SEASON-2

FLD#	COLUMN DESCRIPTION	TYPE	LEN	KEY
1	LAKE	T	30	Y
2	SEASON CODE	I	2	
3	STATION NO.	I	1	
4	COUNTY	T	3	
5	ACREAGE	D	8	
6	CLASS (PU, ST, RE, PR)	T	2	
7	MAX. DEPTH (FT)	I	2	
8	AVE. DEPTH (FT)	D	4	
9	SHORELINE LENGTH (FT)	I	7	
10	COMMENTS	T	70	
11	STATION LOCATION	T	70	
12	STATION SHORELINE LENGTH (FT)	I	6	
13	COMMENTS	T	31	

CURRENT NUMBER OF ROWS: 123

TYPE = (I)nteger, (T)ext, (D)ouble
LEN = length of field in characters

STATE FAS
SCREEN 3: SAMPLE-PERMANENT-3

FLD#	COLUMN DESCRIPTION	TYPE	LEN	KEY
1	LAKE	T	30	Y
2	SEASON CODE	I	2	
3	STATION NO.	I	1	
4	SAMPLE CODE (1ST LET = GEAR, 2ND = #)	T	2	
5	LOCATION	T	70	
6	SHORELINE LENGTH (FT)	I	5	0
7	MEAN DIST. OFFSHORE AT 5-FT DEPTH (FT)	I	2	0
8	MEAN DIST. OFFSHORE AT 10-FT DEPTH (FT)	I	3	0
9	HARD COVER (TRUNKS, BRUSH); RATE 0 TO 3	I	1	
10	% OF SHORE RIP-RAP	I	3	0
11	COMMENTS	T	70	

CURRENT NUMBER OF ROWS: 413

TYPE = (I)nteger, (T)ext
LEN = length of field in characters

STATE FAS
SCREEN 4: STATION DATA-4

FLD#	COLUMN DESCRIPTION	TYPE	LEN	KEY
1	LAKE	T	30	Y
2	SEASON CODE	I	2	
3	STATION NO.	I	1	
4	YEAR	I	2	Y
5	MONTH	I	2	
6	DAY	I	2	
7	RECORD TIME	I	4	
8	AIR TEMP (C)	D	4	
9	TOTAL ALKALINITY		D	4
10	CONDUCTIVITY	D	5	
11	SECCHI (FT)	D	4	
12	WATER LEVEL (FT) PLUS/MINUS NORMAL	D	4	
13	BOATMAN'S NAME	T	12	
14	FRONT DIPPER'S NAME	T	12	
15	COMMENTS	T	31	
16	FCODE	T	6	Y

CURRENT NUMBER OF ROWS: 211

TYPE = (I)nteger, (T)ext, (D)ouble
LEN = length of field in characters

STATE FAS
SCREEN 5: DEPTH PROFILE-5

FLD#	COLUMN DESCRIPTION	TYPE	LEN	KEY
1	MONTH	I	2	
2	DAY	I	2	
3	DEPTH (FT)	D	4	
4	WATER TEMP (C)	D	4	
5	OXYGEN (PPM)	D	4	
6	PH	D	4	
7	FCODE	T	6	Y

CURRENT NUMBER OF ROWS: 269

TYPE = (I)nteger, (T)ext, (D)ouble
LEN = length of field in characters

STATE FAS
SCREEN 6: SAMPLE DATA-6

FLD#	COLUMN DESCRIPTION	TYPE	LEN	KEY
1	SAMPLE CODE	T	2	
2	MONTH	I	2	
3	DAY	I	2	
4	BEGAN AT (24 H)	I	4	
5	ENDED AT (24 H)	I	4	
6	GEAR SET FOR >24 H?	T	1	
7	% SHORELENGTH COVERED	I	3	
8	WEED COVER	I	3	
9	% RUN TIME: SHAD	I	2	
10	MAX. TL SUBSAMPLED	I	2	
11	SPECIES 2 (FASSP2)		T	3
12	% RUN TIME:	I	2	
13	MAX. TL SUBSAMPLED	I	2	
14	SPECIES 3 (FASSP3)		T	3
15	% RUN TIME:	I	2	
16	MAX. TL SUBSAMPLED	I	2	
17	SPECIES 4 (FASSP4)		T	3
18	% RUN TIME:	I	2	
19	MAX. TL SUBSAMPLED	I	2	
20	COMMENTS	T	70	
21	FCODE	T	3	Y
22	GEAR CODE	T	1	Y

CURRENT NUMBER OF ROWS: 688

TYPE = (I)nteger, (T)ext
LEN = length of field in characters

STATE FAS
SCREEN 7: LENGTH-FREQ. DATA-7

FLD#	COLUMN DESCRIPTION	TYPE	LEN	KEY
1	SAMPLE CODE	T	2	
2	FISH SPECIES CODE (FASSP)	T	3	Y
3	TOTAL LENGTH (10 MM DOWN)	I	3	
4	FREQUENCY	I	3	
5	FCODE	T	6	Y
6	GEAR CODE	T	1	Y

CURRENT NUMBER OF ROWS: 25,980

TYPE = (I)nteger, (T)ext
LEN = length of field in characters

STATE FAS
SCREEN 8: LENGTH/WEIGHT DATA-8

FLD#	COLUMN DESCRIPTION	TYPE	LEN	KEY
1	SAMPLE CODE	T	2	
2	FASSP	T	3	
3	TOTAL LENGTH (MM)	I	5	
4	WEIGHT (G)	D	5	
5	FCODE	T	6	Y

CURRENT NUMBER OF ROWS: 42700

TYPE = (I)nteger, (T)ext, (D)ouble
LEN = length of field in characters

STATE FAS
SCREEN 9: AGE DATA-9

FLD#	COLUMN DESCRIPTION	TYPE	LEN	KEY
1	SAMPLE CODE	T	2	
2	FASSP	T	3	
3	TOTAL LENGTH (MM)	D	5	
4	ENVELOPE CODE	I	3	
5	AGE (SCALE)	I	2	
6	AGE (OTOLITH)	I	2	
7	FCODE	T	6	Y

CURRENT NUMBER OF ROWS: 3700

TYPE = (I)nteger, (T)ext, (D)ouble
LEN = length of field in characters

STATE FAS
SCREEN 10: LAKE DIST-10

FLD#	COLUMN DESCRIPTION	TYPE	LEN	KEY
1	LAKE	T	30	Y
2	REGION	I		Y
3	DISTRICT	I		

CURRENT NUMBER OF ROWS: 72

TYPE = (I)nteger, (T)ext
LEN = length of field in characters

STATE FAS
SCREEN 11: FISH CODE-11

FLD#	COLUMN DESCRIPTION	TYPE	LEN	KEY
1	FASSP	T	3	Y
2	MIN. QUALITY SIZE	I		
3	MIN. STOCK LENGTH	I		
4	COMMON NAME	T	35	
5	SPECIES NAME	T	35	

CURRENT NUMBER OF ROWS: 220

TYPE = (I)nteger, (T)ext
LEN = length of field in characters

STATE FAS
SCREEN 12: SEASON-12

FLD#	COLUMN DESCRIPTION	TYPE	LEN	KEY
1	SEASON CODE	I		Y
2	SEASON	T	6	

CURRENT NUMBER OF ROWS: 12

TYPE = (I)nteger, (T)ext
LEN = length of field in characters

STATE FAS
SCREEN 13: GEAR-13

FLD#	COLUMN DESCRIPTION	TYPE	LEN	KEY
1	GEAR CODE	T	1	
2	GEAR	T	16	

CURRENT NUMBER OF ROWS: 13

TYPE = (I)nteger, (T)ext
LEN = length of field in characters

STATE FAS
VIEW: LAKEYEAR

COLUMN		TABLES LINKED		
LAKE	FROM	SCREEN4	SCREEN2	LAKEDIST
YEAR	FROM	SCREEN4		
SEASON	FROM	SCREEN4	SCREEN2	SEASON
ACREAGE	FROM	SCREEN2		
SEASTEXT	FROM	SEASON		
REGION	FROM	LAKEDIST		
DISTRICT	FROM	LAKEDIST		

CONDITION LIST:

WHERE REGION GT 0 AND
REGION LT 6 AND
DISTRICT LT 22

STATE FAS
VIEW: GEARVIEW

COLUMN		TABLES LINKED		
LAKE	FROM	LAKEDIST	SCREEN4	SCREEN2
FCODE	FROM	SCREEN4	SCREEN6	
YEAR	FROM	SCREEN4		
REGION	FROM	LAKEDIST		
DISTRICT	FROM	LAKEDIST		
GEARTYPE	FROM	SCREEN6	GEAR	
GEAR	FROM	GEAR		
SEASON	FROM	SCREEN4	SCREEN2	
ACREAGE	FROM	SCREEN2		

CONDITION LIST:

WHERE YEAR EQ 85 AND
REGION EQ 4

STATE FAS
VIEW: LAKESPP

COLUMN		TABLES LINKED	
LAKE	FROM	SCREEN4	SCREEN2
FCODE	FROM	SCREEN4	SCREEN7
FAS	FROM	SCREEN7	FISHCODE
ACREAGE	FROM	SCREEN2	
AVGDEPTH	FROM	SCREEN2	
COMMON	FROM	FISHCODE	
YEAR	FROM	SCREEN4	

CONDITION LIST:

WHERE LAKE EQ FERNE CLYFFE

Appendix B

Code for the R:Base application program REGMENU.APP. Descriptions of the overall file contents and individual sections and lines are given in the comment statements, which are denoted by asterisks and parentheses.

*(REGMENU.APP is a procedure file that interactively creates criteria for, and then executes, the report LAKEREP. LAKEREP displays a summary of the lakes and years within the FAS-STATE database for selected regions. REGMENU.APP is composed of three blocks: a COMMAND block, REGMENU, and two MENU blocks, REGION and OUTDEV. REGMENU sets the R:BASE system environment, opens FAS-STATE, stores the region selection(s), made in REGION, in variable REGPICK; and uses REGPICK to set the WHERE criteria in PRINTing LAKEREP. The report output is sent to the device(s) selected in menu OUTDEV. Once the report is printed, the program exits to either the procedure file (menu) that called it or to the R:BASE system module. LAKEREP summarizes data from the VIEW 'LAKEYEAR', which relates data from tables SCREEN2, SCREEN4, LAKEDIST, and SEASON.)

```
$COMMAND
REGMENU
OPEN FAS-STATE               *(Opens FAS-STATE database.)
SET MESSAGE OFF              *(Sets R:BASE messages off.)
SET ERROR MESSAGE OFF        *(Sets R:BASE error messages off.)
SET COLOR BACKGRND BLUE      *(Sets screen background color to blue.)
SET COLOR FOREGRND WHITE     *(Sets screen foreground color to white.)
SET BELL OFF                 *(Sets bell off.)
SET VAR PICK1 TEXT           *(Defines a text variable to hold the region menu
                             choice.)
SET VAR RPICK TEXT           *(Defines the variable used for holding  the region
                             criterion set by PICK1's value.)
SET VAR REGPICK TEXT         *(Defines a text variable to hold all region
                             criteria selected  in menu REGION.)
SET VAR COUNTER INT          *(Defines integer variable for flagging if one or more
                             regions have been chosen. When COUNTER is GT
                             1, 'OR' is inserted when  concatenating the variable
                             RPICK to REGPICK .)
SET VAR COUNTER = 1          *(Initializes 'COUNTER' at 1.)
SET VAR DEVOUT INT           *(Defines an integer variable for holding the selection
                             made from the column menu OUTDEV.)
SET VAR FILENAM TEXT         *(Defines a text variable to hold the name of the file
                             entered when the DOS file option of 'OUTDEV' is
                             chosen.)
LABEL STARTAPP               *(Labels a return point for further menu selections.)
NEWPAGE                      *(Clears the display screen.)
```

The following block checks the choices made from the menu REGION. The CHOOSE command stores the value of the menu selection, then passes through a series of IF-ENDIF statements, performing the operation(s) associated with the menu selection. Within the IF-THEN blocks, the text variable RPICK is initialized to hold part of the condition list used with the PRINT command. The variable REGPICK is then defined to hold the entire condition list for the PRINT command by concatenating the value of RPICK onto its present value, inserting the boolean operator "OR" for cases where more than one region is selected for reporting. The menu continues to prompt for selections using the GOTO STARTAPP statement until the option EXIT is chosen.

```
CHOOSE PICK1 FROM REGION IN REGMENU.APX
IF PICK1 EQ "ESC" THEN
 GOTO ENDAPP
ENDIF
IF PICK1 EQ "REGION 1 " THEN
 SET VAR RPICK TO "REGION EQ 1"
IF COUNTER = 1 THEN
 SET VAR REGPICK TO "WHERE" & .RPICK
 ENDIF
IF COUNTER > 1 THEN
 SET VAR REGPICK TO.REGPICK & "OR" .RPICK
ENDIF
 SET VAR COUNTER = 2
 GOTO STARTAPP
ENDIF
IF PICK1 EQ "REGION 2 " THEN
 SET VAR RPICK TO "REGION EQ 2"
 IF COUNTER = 1 THEN
   SET VAR REGPICK TO "WHERE" & .RPICK
 ENDIF
 IF COUNTER > 1 THEN
   SET VAR REGPICK TO .REGPICK & "OR" .RPICK
 ENDIF
   SET VAR COUNTER = 2
 GOTO STARTAPP
ENDIF
IF PICK1 EQ "REGION 3 " THEN
 SET VAR RPICK TO "REGION EQ 3"
 IF COUNTER = 1 THEN
   SET VAR REGPICK TO "WHERE" & .RPICK
 ENDIF
 IF COUNTER > 1 THEN
   SET VAR REGPICK TO .REGPICK & "OR" & .RPICK
 ENDIF
   SET VAR COUNTER = 2
 GOTO STARTAPP
ENDIF
IF PICK1 EQ "REGION 4 " THEN
 SET VAR RPICK TO "REGION EQ 4"
 IF COUNTER = 1 THEN
```

```
   SET VAR REGPICK TO "WHERE" & .RPICK
 ENDIF
 IF COUNTER > 1  THEN
   SET VAR REGPICK TO .REGPICK & "OR" & .RPICK
 ENDIF
   SET VAR COUNTER = 2
 GOTO STARTAPP
ENDIF
IF PICK1 EQ "REGION 5 " THEN
 SET VAR RPICK TO "REGION EQ 5"
 IF COUNTER = 1 THEN
   SET VAR REGPICK TO "WHERE" & .RPICK
 ENDIF
 IF COUNTER > 1  THEN
   SET VAR REGPICK TO .REGPICK & "OR" & .RPICK
 ENDIF
   SET VAR COUNTER = 2
 GOTO STARTAPP
ENDIF
IF PICK1 EQ "ALL     " THEN
   SET VAR REGPICK TO ""
 GOTO STARTAPP
ENDIF
IF PICK1 EQ "EXIT    " THEN
 GOTO ENDAPP
ENDIF


LABEL ENDAPP
```

*(This IF-ENDIF terminates the application by going to LABEL THATSALL, when the ESC option is chosen without making prior menu selections from REGION.)

```
IF COUNTER EQ 1 THEN
 GOTO THATSALL
ENDIF
NEWPAGE
```

*(This block defines the output device to be used in printing the report, through the menu OUTDEV. Since OUTDEV is a column menu, the CHOOSE variable is an integer by default, rather than text, as in the row menu REGION. REGMENU.APX is the compiled version of this application file, created by the R:BASE module CODELOCK. If EXIT is chosen in this menu, the procedure file is terminated without creating a report.)

```
 CHOOSE DEVOUT FROM OUTDEV IN REGMENU.APX
 IF DEVOUT = 1 THEN
  OUTPUT SCREEN
  GOTO OUTEND
 ENDIF
 IF DEVOUT = 2 THEN
  OUTPUT PRINTER
  GOTO OUTEND
 ENDIF
 IF DEVOUT = 3 THEN
  OUTPUT SCREEN WITH PRINTER
  GOTO OUTEND
 ENDIF
 IF DEVOUT = 4 THEN
  WRITE " "
 FILLIN FILENAM USING "PLEASE ENTER A FILENAME TO SAVE YOUR REPORT TO
DISK : "
  WRITE " "
  OUTPUT .FILENAM WITH SCREEN
  GOTO OUTEND
 ENDIF
 IF DEVOUT = 5 THEN
  WRITE " "
 FILLIN FILENAM USING "PLEASE ENTER A FILENAME TO SAVE YOUR REPORT TO
DISK : "
  WRITE " "
  OUTPUT .FILENAM WITH BOTH
  GOTO OUTEND
 ENDIF
 IF DEVOUT = 6 THEN
   GOTO THATSALL
 ENDIF


LABEL OUTEND                  *(Identifies the program section where the report is
                              run.)
NEWPAGE
PRINT LAKEREP & REGPICK       *(Executes the report LAKEREP. '& REGPICK
                              specifies the list of regions prefaced by " WHERE ",
                                 held in the variable REGPICK, thus providing a
                                 condition list for the report.)
OUTPUT SCREEN                 *(Resets the output device to screen only.)
WRITE " "                     *(Displays the message given in quotes. In this case it
                              prints a blank line.)
WRITE " "
WRITE "                       END OF THE LAKES LISITING. HIT <CR> TO
                              CONTINUE"
PAUSE                         *(Suspends execution of the program until the
                                 operator presses a key on the keyboard.)
LABEL THATSALL                *(Label routing execution to the end of the program.)
CLEAR ALL VARIABLES           *(Resets all variables back to null or zero.)
```

```
WRITE " "                       *(Displays message that the program is ending.)
WRITE "                         --- EXITING LAKE SPECIES REPORT ROUTINE -----"
WRITE " "
RETURN                          *(Returns control back to the file calling the program,
                                that being either another menu in a procedure file or
                                to R:BASE.)
```

*(The following is a menu block, REGION, used for selecting regions, and denoted by $MENU. The line following $MENU is the name used by the CHOOSE command to call the menu. The next line denotes the type of menu, either ROW or COLUMN, and the message to be displayed at the head of the menu. This is then followed by the menu selections, each of which is listed on an individual line).

```
$MENU
REGION
ROW PLEASE SELECT A REGION
REGION 1
REGION 2
REGION 3
REGION 4
REGION 5
ALL
EXIT
```

*(The menu block for menu OUTDEV, providing output options.)

```
$MENU
OUTDEV
COLUMN  SELECT AN OUTPUT DEVICE
SCREEN
PRINTER
SCREEN AND PRINTER
DOS FILE
FILE-SCREEN-PRINTER
EXIT
```