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ILLINOIS NATURAL HISTORY SURVEY

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

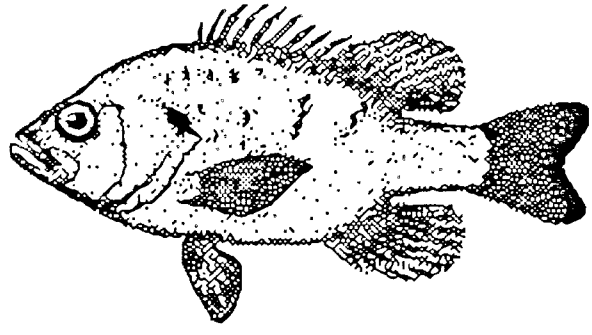
Part 2: Creel Survey Data Base

Aquatic Biology Section

Technical Report

Peter B. Bayley and Douglas J. Austen

Mark Thompson and Alan Citterman, Programmers



Aquatic Biology Technical Report 87/12

Illinois Natural History Survey
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MANUAL FOR THE DISTRICT FISHERIES ANALYSIS SYSTEM (FAS): A PACKAGE FOR FISHERIES MANAGEMENT AND RESEARCH

Part 2: Creel Survey Data Base

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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

The data-base and programs of CREEL have been developed as part of the District Fisheries Analysis System (DISTRICT FAS) to accommodate the typical recreational fishery survey conducted by many state natural resource agencies. CREEL allows survey design, data input, storage, and calculation of a variety of important statistics that managers require. As a part of the FAS system, CREEL runs on an Apple //e microcomputer and uses General Manager™ as the data-base management system. All interface programs are written in Applesoft BASIC™ and have been designed to be easily used and are, for the most part, interactive with the user.

ACKNOWLEDGMENTS

Jana Waite is thanked for her excellent redactional work.

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Chapter 1

STARTING UP AND PERMANENT DATA ENTRY

Basic Information

The data-base design (Figure 1-1) is analogous to a flow chart of the steps to conduct a creel survey and to obtain valid estimates of effort and harvest of the recreational fishery. Each box represents a *screen* in the General Manager™ data base and is composed of related information. The screens can be logically divided into five categories: (1) permanent information in screens 1, 2, 3, and 13 (Figure 1-2); (2) stratum design information in screen 4 (Figure 1-3); (3) sampling dates in screen 5 (Figure 1-3); (4) instantaneous count data in screen 6 (Figure 1-3); and (5) angler interview data in screens 7-12 (Figure 1-4).

The permanent information stored in screens 1, 2, 3, and 13 (Figure 1-2) does not change during the creel year and includes such items as region, district, and length-weight regression parameters to estimate weights of fish caught by anglers. This information is entered once using General Manager's data-entry routine. As with DOC9, all other data entry uses custom-designed programs. The data-entry routine of General Manager should not be used for screens 4-12. However, when correcting errors, BROWSE/UPDATE should be used.

Stratum design information, stored in screen 4 (Figure 1-3), allows the creel manager to designate how the lake will be divided by area and time periods. In most lakes, some stratification is used to efficiently allocate survey effort. Stratification information is used in the calculations and is entered using the program STRATA ENTRY.

Instantaneous count data are stored in screen 6 under the appropriate sampling date in screen 5 (Figure 1-3); it is the basic unit of measurement used to calculate fishing effort. Instantaneous count data are entered in conjunction with interview data using the program DATA ENTRY. Finally, interview data are entered into screens 7-12 (Figure 1-4), one interview at a time, using DATA ENTRY. All interview information is entered at one time, including such supplemental questions as distance traveled by the angler.

Once all information has been entered into CREEL, you may use several *output* programs to summarize the data and obtain estimates of pertinent creel survey parameters. Output programs currently available are (1) an effort table that gives total hours fished, total number of trips, hours per trip, and hours per acre, with associated confidence intervals; (2) a catch table that shows, for up to 10 species and a miscellaneous category, the number of fish caught, number caught per hour, weight caught, and weight caught per hour, with associated confidence intervals; and (3) a generic set of tables that calculates frequencies of response to supplemental questions. The statistical calculations to produce these values are in Appendix A.

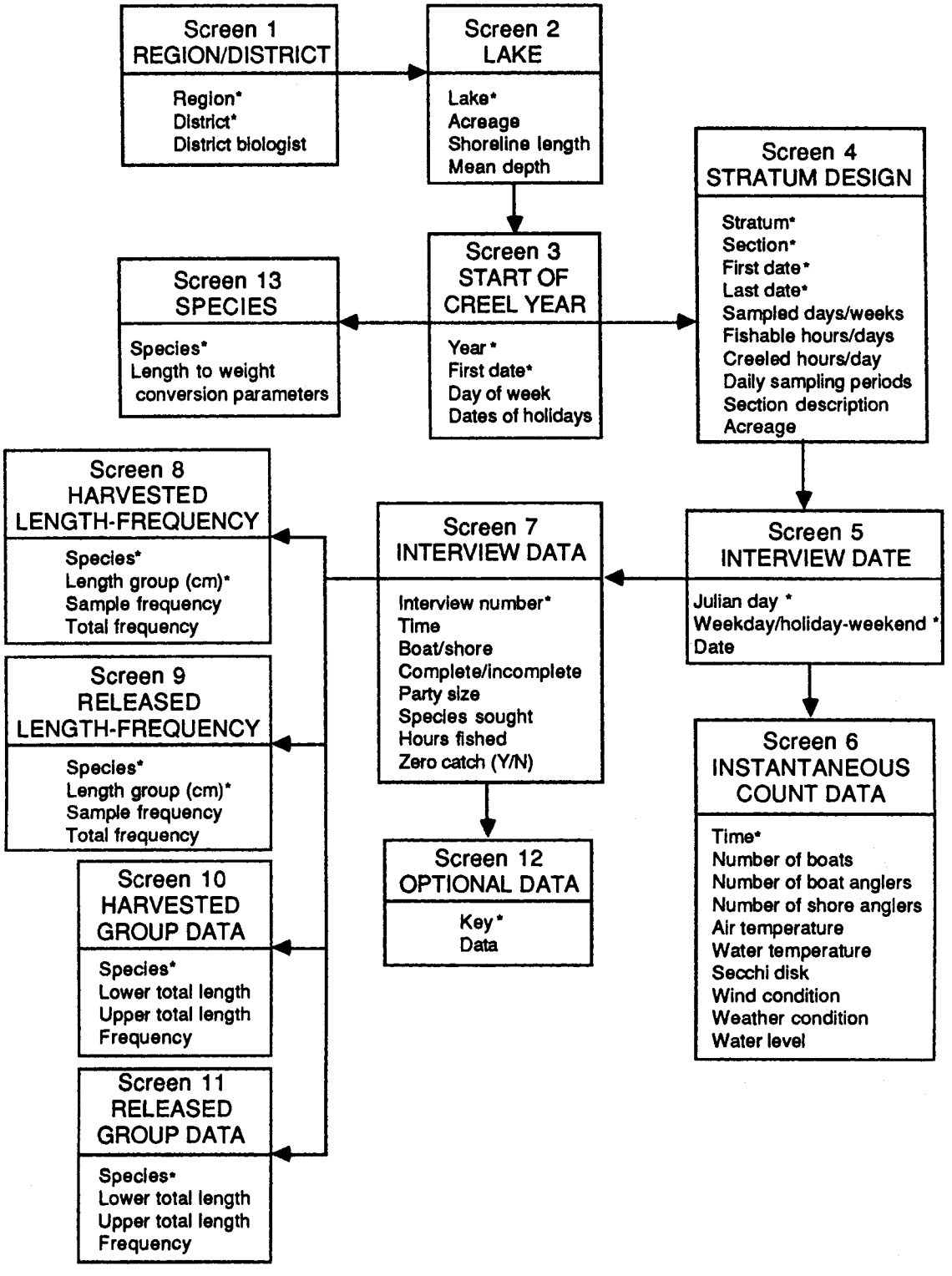

Figure 1-1. Hierarchical structure of CREEL.

CREEL
SCREEN 1: REGION-1

DUPLICATES ARE FIRST
BOOT SCREEN
KEYS ARE: REGION (ASC)
DISTRICT (ASC)
COMBINED KEY LENGTH: 3
1 REGION - 1 RECORD
3 SCREEN FIELDS

FLD#	NAME	TYPE	REFR	LEN
1	REGION	F		1
2	DISTRICT	F		2
3	DIST.BIOLOGIST	V		21

APPROXIMATE RECORD LENGTH IS 24

CREEL
SCREEN 2: LAKE-2

DUPLICATES ARE FIRST
PARENT: REGION-1
KEYS ARE: LAKE (ASC)
COMBINED KEY LENGTH: 21
1 LAKE-2 RECORD FOR EACH REGION-1 RECORD
4 SCREEN FIELDS

FLD#	NAME	TYPE	REFR	LEN	NUM
1	LAKE	V		21	
2	ACREAGE (AC)	V		6	0
3	SHORELINE LENGTH (FT)	V		7	0
4	MEAN DEPTH (FT)	V		5	1

APPROXIMATE RECORD LENGTH IS 39

TYPE = (F)ixed, (V)ariable, or automatic (O)utput
REFR = (S)creen reference.field no.
LEN = length of field
NUM = number of decimal places for numerical variables

Figure 1-2. Screens 1, 2, 3, and 13 of CREEL, which contain permanent data.

CREEL
SCREEN 3: START OF CREEL YEAR-3

DUPLICATES ARE FIRST
PARENT: LAKE--2
KEYS ARE: YEAR (ASC)
FIRST DATE (ASC)
COMBINED KEY LENGTH: 7
1 START OF CREEL YEAR-3 RECORD FOR EACH LAKE--2 RECORD
14 SCREEN FIELDS

FLD#	NAME	TYPE	REFR	LEN	NUM
1	LAKE	O	S2.1	21	
2	YEAR	F		2	
3	FIRST DATE	F		4	
4	DAY OF THE WEEK	F		1	
5	NEW YEAR'S DAY	F		4	
6	M.L. KING'S BIRTHDAY	F		4	
7	PRESIDENT'S DAY	F		4	
8	MEMORIAL DAY	F		4	
9	INDEPENDENCE DAY	F		4	
10	LABOR DAY	F		4	
11	COLUMBUS DAY	F		4	
12	ELECTION DAY	F		4	
13	THANKSGIVING	F		4	
14	CHRISTMAS	F		4	

APPROXIMATE RECORD LENGTH IS 47

TYPE = (F)ixed, (V)ariable, or automatic (O)utput
REFR = (S)creen reference.field no.
LEN = length of field
NUM = number of decimal places for numerical variables

CREEL
SCREEN 13: SPECIES-13

DUPLICATES ARE FIRST
PARENT: START OF CREEL YEAR-3
KEYS ARE: SPECIES (ASC)
COMBINED KEY LENGTH: 3
30 SPECIES-13 RECORDS FOR EACH START OF CREEL YEAR-3 RECORD
3 SCREEN FIELDS

FLD#	NAME	TYPE	REFR	LEN	NUM
1	SPECIES	F		3	
2	'A' WEIGHT PARAMETER	V		11	9
3	'B' WEIGHT PARAMETER	V		7	5

APPROXIMATE RECORD LENGTH IS 21

Figure 1-2 (concluded).

CREEL
SCREEN 4: STRATUM DESIGN-4

DUPLICATES ARE FIRST
PARENT: START OF CREEL YEAR-3
KEYS ARE: STRATUM (ASC)
SECTION (ASC)
FIRST DAY (ASC)
LAST DAY (ASC)
COMBINED KEY LENGTH: 10
10 STRATUM DESIGN-4 RECORDS FOR EACH START OF THE CREEL YEAR-3 RECORD
19 SCREEN FIELDS

FLD#	NAME	TYPE	REFR	LEN	NUM
1	STRATUM	F		2	
2	SECTION	F		2	
3	FIRST DAY	F		3	
4	FIRST DATE	F		4	
5	LAST DAY	F		3	
6	LAST DATE	F		4	
7	SAMPLED DAYS/WEEK	F		1	
8	FISHABLE HOURS/DAY	V		4	1
9	CREELED HOURS/DAY	V		4	1
10	START 1	F		4	
11	INSTANTANEOUS COUNT 1	F		4	
12	START 2	F		4	
13	INSTANTANEOUS COUNT 2	F		4	
14	START 3	F		4	
15	INSTANTANEOUS COUNT 3	F		4	
16	SECTION DESCRIPTION	V		26	
17	ACREAGE (AC)	V		6	0
18	CREEL CLERK	V		26	
19	HOLIDAY/WEEKEND COUNT	V		3	0

APPROXIMATE RECORD LENGTH IS 108

TYPE = (F)ixed, (V)ariable, or automatic (O)utput
REFR = (S)creen reference.field no.
LEN = length of field
NUM = number of decimal places for numerical variables

CREEL
SCREEN 5: INTERVIEW DATE-5

DUPLICATES ARE FIRST
PARENT: STRATUM DESIGN-4
KEYS ARE: DAY (ASC)
WEEKDAY/HOLIDAY-WEEKEND (ASC)
COMBINED KEY LENGTH: 4
12 INTERVIEW DATE-5 RECORDS FOR EACH STRATUM DESIGN-4 RECORD
3 SCREEN FIELDS

FLD#	NAME	TYPE	REFR	LEN	NUM
1	DAY	F		3	
2	WEEKDAY/HOLIDAY-WEEKEND	F		1	
3	DATE	F		4	

APPROXIMATE RECORD LENGTH IS 8

CREEL
SCREEN 6: INSTANTANEOUS COUNT DATA-6

DUPLICATES ARE FIRST
PARENT: INTERVIEW DATE-5
KEYS ARE: TIME (ASC)
COMBINED KEY LENGTH: 5
2 INST. COUNT DATA-6 RECORDS FOR EACH INTERVIEW DATE-5 RECORD
14 SCREEN FIELDS

FLD#	NAME	TYPE	REFR	LEN	NUM
1	LAKE	O	S2.1	21	
2	YEAR	O	S3.2	2	
3	SECTION	O	S4.2	2	
4	DATE	O	S5.3	4	
5	TIME	F		4	
6	NO. BOATS	V		2	0
7	NO. BOAT ANGLERS	V		3	0
8	NO. SHORE ANGLERS	V		3	0
9	AIR TEMPERATURE (C)	V		3	0
10	WATER TEMPERATURE (C)	V		2	0
11	SECCHI DISK (FT)	V		4	1
12	WIND CONDITION	F		1	
13	WEATHER CONDITION	F		1	
14	WATER LEVEL	F		1	

APPROXIMATE RECORD LENGTH IS 24

Figure 1-3. Screens 4, 5, and 6 of CREEL.

CREEL
SCREEN 7: INTERVIEW DATA-7

DUPLICATES ARE FIRST
PARENT: INTERVIEW DATE-5
KEYS ARE: INTERVIEW NO. (ASC)
COMBINED KEY LENGTH: 3
10 INTERVIEW DATA-7 RECORDS FOR EACH INTERVIEW DATE-5 RECORD
12 SCREEN FIELDS

FLD#	NAME	TYPE	REFR	LEN	NUM
1	LAKE	O	S2.1	21	
2	YEAR	O	S3.2	2	
3	SECTION	O	S4.2	2	
4	DATE	O	S5.3	4	
5	INTERVIEW NO.	V		3	0
6	TIME	F		4	
7	BOAT/SHORE	F		1	
8	COMPLETE/INCOMPLETE	F		1	
9	PARTY SIZE	V		2	0
10	SPECIES SOUGHT	F		3	
11	HOURS FISHED	V		4	1
12	ZERO CATCH (Y/N)	F		1	

APPROXIMATE RECORD LENGTH IS 19

TYPE = (F)ixed, (V)ariable, or automatic (O)utput
REFR = (S)creen reference.field no.
LEN = length of field
NUM = number of decimal places for numerical variables

CREEL
SCREEN 8: HARVESTED LENGTH-FREQUENCY-8

DUPLICATES ARE FIRST
PARENT: INTERVIEW DATA-7
KEYS ARE: SPECIES (ASC)
LENGTH GROUP (CM) (ASC)
COMBINED KEY LENGTH: 6
1 HARVESTED L-FREQUENCY-8 RECORDS FOR EACH INTERVIEW DATA-7 RECORD
4 SCREEN FIELDS

FLD#	NAME	TYPE	REFR	LEN	NUM
1	SPECIES	F		3	
2	LENGTH GROUP (CM)	V		3	0
3	SAMPLE FREQUENCY	V		3	0
4	TOTAL FREQUENCY	V		3	0

APPROXIMATE RECORD LENGTH IS 12

CREEL
SCREEN 9: RELEASED LENGTH-FREQUENCY-9

DUPLICATES ARE FIRST
PARENT: INTERVIEW DATA-7
KEYS ARE: SPECIES (ASC)
LENGTH GROUP (CM) (ASC)
COMBINED KEY LENGTH: 6
1 RELEASED L-FREQUENCY-9 RECORD FOR EACH INTERVIEW DATA-7 RECORD
4 SCREEN FIELDS

FLD#	NAME	TYPE	REFR	LEN	NUM
1	SPECIES	F		3	
2	LENGTH GROUP (CM)	V		3	0
3	SAMPLE FREQUENCY	V		3	0
4	TOTAL FREQUENCY	V		3	0

APPROXIMATE RECORD LENGTH IS 12

Figure 1-4. Screens 7-12 of CREEL, which contain interview information.

CREEL
SCREEN 10: HARVESTED GROUP DATA-10

DUPLICATES ARE FIRST
PARENT: INTERVIEW DATA-7
KEYS ARE: SPECIES (ASC)
COMBINED KEY LENGTH: 3
1 HARVESTED GROUP DATA-10 RECORD FOR EACH INTERVIEW DATA-7 RECORD
4 SCREEN FIELDS

FLD#	NAME	TYPE	REFR	LEN	NUM
1	SPECIES	F		3	
2	LOWER TOTAL LENGTH	V		3	0
3	UPPER TOTAL LENGTH	V		3	0
4	FREQUENCY	V		3	0

APPROXIMATE RECORD LENGTH IS 12

TYPE = (F)ixed, (V)ariable, or automatic (O)utput
REFR = (S)creen reference.field no.
LEN = length of field
NUM = number of decimal places for numerical variables

CREEL
SCREEN 11: RELEASED GROUP DATA-11

DUPLICATES ARE FIRST
PARENT: INTERVIEW DATA-7
KEYS ARE: SPECIES (ASC)
COMBINED KEY LENGTH: 3
1 RELEASED GROUP DATA-11 RECORD FOR EACH INTERVIEW DATA-7 RECORD
4 SCREEN FIELDS

FLD#	NAME	TYPE	REFR	LEN	NUM
1	SPECIES	F		3	
2	LOWER TOTAL LENGTH	V		3	0
3	UPPER TOTAL LENGTH	V		3	0
4	FREQUENCY	V		3	0

APPROXIMATE RECORD LENGTH IS 12

CREEL
SCREEN 12: OPTIONAL DATA-12

DUPLICATES ARE FIRST
PARENT: INTERVIEW DATA-7
KEYS ARE: KEY (ASC)
COMBINED KEY LENGTH: 1
1 OPTIONAL DATA-12 RECORD FOR EACH INTERVIEW DATA-7 RECORD
2 SCREEN FIELDS

FLD#	NAME	TYPE	REFR	LEN	NUM
1	KEY	F		1	
2	DATA	V		4	

APPROXIMATE RECORD LENGTH IS 5

Figure 1-4 (concluded).

Materials Required

Apple //e Professional System (128 K)
plus C. Itoh Prowriter (8510 series) printer and
Graphicard (or Grappler+) interface
General Manager™ Master diskette (PC Manager, Inc., 64 E. Ashley Ave., P.O. Box 567, Driggs, ID 83422-0567)
DATA ENTRY: CREEL Diskette
TABULAR OUTPUT: CREEL Diskette
Blank diskettes for data storage
A RAMFACTOR™ (Applied Engineering) card and an accelerator card or chip are recommended.

Start Up

The major steps involved in system booting and simple use of General Manager are given in Part 1: Biological Survey Data (see page 1-1, Special Technical Report 87/11). For specific information on General Manager, please refer to its user's manual. The instructions below assume that General Manager is booted, that you are in the DATA ENTRY option of ACCESS DATA BASE, and that a formatted data disk is in drive 2.

Permanent Data Entry

As shown in Figure 1-1, screens 1, 2, 3, and 13 are the top screens in CREEL. You must enter data for the key fields before proceeding to the other screens.

1. Screen 1: As with DOC9, Region and District codes must be entered. Data for screen 1 should only be entered once for the data base, so be sure that no duplicate screen 1 records are entered. If duplicates exist, delete the erroneous records using <CTRL-D>. Although District Biologist is not a key field it should be entered for a complete data base. Once you have entered the data, press <RETURN> or <🍎> to save the data. Press <Ö> to return to the Data Entry Menu.

2. Screen 2: From the Data Entry Menu, select screen 2 and press <RETURN>. You will then be shown screen 1 with the next to last line indicating that you are to ENTER KEY CRITERIA. You must enter the same data for region and district that you just entered into screen 1 so that General Manager can establish proper parentage. Simply enter the proper region and district (you will notice that an = sign appears as a prefix for each entry) and press <🍎>. You will then be shown screen 2; you are in the data entry mode (again, check the next to last line for an indication of which mode you are in). In screen 2, the only key criteria is Lake, which must be entered to connect subsequent child records with that screen 2 record. However, if data for Acreage, Shoreline Length, and Mean Depth are available, enter those data also. When finished, press <🍎> to save and then quit to the Data Entry Menu.

3. Screen 3: From the Data Entry Menu, select screen 3 and press <RETURN>. As before, you will be shown screen 1 but this time the previously entered

criteria are given (notice the = signs). If correct, press <↵> and proceed to screen 2; enter the criteria for Lake and press <↵> to move to screen 3. The two keys in screen 3 are Year and First Date (the first day of the creel year given in a month/day format). These data are important for later calculations. Consult a calendar to determine the day of week on which the first day of the creel year falls and to find the dates of the listed federal holidays. Once these data are entered, save the data as before and return to the Data Entry Menu.

4. Screen 13: From the Data Entry Menu, select screen 13 (SPECIES-13) and press <RETURN>. You will be asked to enter criteria for screens 1, 2, and 3. Data for screens 1 and 2 should be displayed; press <↵> if these values are correct. For screen 3, enter Lake and First Date and press <↵>. Screen 13 will then be displayed. This screen contains the information to convert weights from lengths taken in the creel surveys. It is important that *a* and *b* parameters from length-weight regressions be entered for each species that will be encountered in the creel survey. Obtain these data from the most recent fishery survey conducted on the lake by the district fisheries biologist. If such data are not available, then values from standard length weight regressions may be used; however, calculated weights may not be as accurate as those obtained using regressions from the specific lake. Once these data are entered for all species, quit from data entry and return to the Master Menu. From this point, all data entry in CREEL should use one of the programs accessed under USER PROGRAMS selected from the Data Base Master Menu.

Supplemental Questions Editing

The supplemental question editor and file refer to a list of questions that may be asked as part of the angler interview. These questions range from distance traveled to the amount of money spent to any question of interest to the fisheries manager. To enter the editor, choose SUPP QUES ED from USER PROGRAMS. This will load and run the program leaving you at the header screen. Press <RETURN> to have the program read the file SUPPLEMENTARY, which contains previously created questions stored on the working programs disk. You are then presented with a screen similar to the one below.

SUPPLEMENTARY QUESTIONS

USE	KEY	PROMPT	#	MIN	MAX
Y	A	DISTANCE TRAVELED IN MILES	Y	0	9999
N	B	QUESTION #2	Y	0	100
N	C	QUESTION #3	Y	0	100
N	D	QUESTION #4	Y	0	100

A maximum of eight questions may be stored in the program. The first column, USE, indicates if the question will be used in the survey, If Y, the question will be asked during data entry after fish length data are entered. If N, the question is suppressed. The next column, KEY, is the data-base designator for the question and is the key field used by General Manager to search for questions to be analyzed in output tables. The PROMPT column is the two-line phrase shown on the screen during data entry. If the question requires a numeric answer (*e.g.*, distance in miles), the # column should have a Y; if the answer is in alpha characters (*e.g.*, yes or no), N should be entered in this column. This designation provides error checking during data entry. Alpha characters cannot be entered if a numeric answer was specified. Similarly, MIN and MAX indicate the lower and upper ranges accepted; values outside of the range will be rejected.

To edit the supplemental questions, press <RETURN> to move to the part that needs to be changed. The arrow keys cannot be used to move backward; move to the bottom using <RETURN> and then answer NO to the question IS THE DATA CORRECT? This will put the cursor at the top of the screen and allow you to further edit the supplemental questions.

Chapter 2

STRATA ENTRY

From Data Base Master Menu, select UTILITIES, and then from the Utilities Menu select RUN USER PROGRAM. You will be asked if you want to use the CREEL data base; answer YES (YES is the default and is selected by pressing <RETURN>). You should now have to the User Programs Menu on the screen. Select STRATA ENTRY and press <RETURN>. A title screen will appear; to continue the program, press <RETURN>.

The STRATA ENTRY program will read the data in screens 1, 2, and 3 and ask you to select a combination of criteria. Once you have selected the Region, District, Lake, and Year, a SECTION DESCRIPTION screen which appear:

REGION 1 DISTRICT
LAKE TEST
YEAR 1987-1988

SECT	ACREAGE (1000)	DESCRIPTION
1	.....	.....
2	.....	.....
3	.....	.....
4	.....	.....
5	.....	.....
6	.....	.....
7	.....	.....
8	.....	.....
9	.....	.....
10	.....	.....

ENTER ZERO ACRES TO DELETE SECTION

You may now designate subdivisions (sections of the lake) for spatial stratification. Up to 10 sections are allowed; the acreage of each should be defined as well as a brief description of the section. The sum of the section acreages must equal the total lake acreage in screen 2, listed here under ACREAGE. These section designations comprise the *spatial* component of the stratum (the *temporal* is discussed below), which is used in creel survey design and in statistical estimates. Later, calculations may be done by individual stratum, any combination of strata, or the lake as a whole.

Once section descriptions are complete, you are shown the screen that permits stratum designation. This rather complex screen is divided into several different columns for each section of the lake. Each column has five components: the first

and last date of the period, the number of days sampled per week, the number of fishable hours per day, and the number of hours creeled in a day. STRATA ENTRY automatically places the first day of the creel year under the first period in section 1. You are then asked to enter the last day of the period and the values for the three additional parameters. The cursor then moves to the next period in that section and the next date that needs to be accounted for in the stratum designation. This process is continued until all periods are completed for the section. **NOTE: Periods, from first to last, must account for a complete year even if creel data were not collected during a time period.** If no activity occurs (*e.g.*, if a section of the lake is closed for duck hunting), enter the appropriate data and zeroes for the sampled days per week, fishable hours per day, and creeled hours per day.

The editing mode in STRATA ENTRY is entered by pressing the <SPACE BAR> several times over the field where dates are entered. The command area at the bottom of the screen indicates the available options. The arrow keys move the cursor and the current stratum available for editing is marked by an asterisk (*). Entering an capital I (<I>) inserts an additional stratum immediately after the current stratum, <D> deletes the current stratum, <C> copies the stratum immediately to the left of the current stratum and writes the copy at the current stratum. If the current stratum is the first in that section, <C> will copy the entire previous section into the current section. Press <RETURN> to return to normal input mode.

To exit from stratum designation, get into edit mode and press <E> for exit. The program will then check the stratum for missing days or improper days (*e.g.*, too many days in a month). If an error is found, you will be sent back to the stratum designation screen. When this screen is validated, you will be asked if you want a printout of the strata, if you want to do more editing, and whether you want to enter daily times for instantaneous counts. Once the stratum table is completed and saved, you are asked if you want to complete times for day-periods and instantaneous counts for screen 4 (at this time, it is informative to complete the daily times for the instantaneous counts although it is not necessary).

The stratum design screen (Figure 1-3) appears as below:

STRATUM
SECTION ACREAGE

Section Description...

PERIOD MM/DD - MM/DD

SAMPLED DAY/WK
FISHABLE HRS/DAY
CREELED HRS/DAY

START #1
COUNT #1
START #2
COUNT #2
START #3
COUNT #3

All information should be complete with the exception of the COUNT field, which represent the starting times of the instantaneous count associated with each period. Up to three periods are allowed but less than three can be used. However, if less than three periods are used, the end time of the last period used must be entered in the start time slot for the first unused period. Normally, one count is made during each period and is started at a designated time. This information must be entered for each stratum and is stored in screen 4. Now all the basic information for the creel survey has been entered. Survey data are now entered using DATA ENTRY.

Chapter 3

DATA ENTRY

The entry of survey data, instantaneous counts, and angler interviews is accomplished by using the program DATA ENTRY. This program is accessed through General Manager and the Main User Program Menu. You will be given a heading screen indicating the name, date, and programmers; press <RETURN> to continue. You are then asked if your measurements are in English or metric units. If English units were used to measure fish, the program runs an algorithm that converts the units, taken to the nearest 0.5-inch, into centimeter groups. When an English measurement could correspond to two or more 1-cm groups, a random number generator allocates that data to a single 1-cm group, taking into account the probability assignments to alternative groups.

As with STRATA ENTRY, you proceed through the sequence of selecting parentage for the data to be entered. The program asks you to select the region, district, lake, year, and section and then to enter the date of the creel survey information. The program checks the date against the appropriate stratum and determines whether it is a weekend/holiday or weekday and brings up the first screen for data entry, the instantaneous count information.

The format of the instantaneous count screen mimics the field data sheet and permits convenient data entry directly from the data sheets. All information is self-explanatory. Wind, sky, and water level descriptors are the first letter of the word chosen as indicative of the conditions (*e.g.*, L for light winds). Once complete and you have answered YES to the question of whether the data are correct, the information is saved as a record in screen 6. Another screen is brought up and you can enter additional counts for the creel day. If you have no further data to enter, press <ESC>.

Angler interview data are entered in four stages. The first stage is data on the angler (*e.g.*, time of interview, party size), the second and third stages accept information on harvested and released fish, respectively, and the fourth on supplemental questions (*e.g.*, distance traveled). In the first stage, interview number and time refer to the sequence of anglers interviewed in the creel day and the actual time that the interview occurred. Boat or shore fishing is designated with a B or S, and complete versus incomplete interviews with a C or I. Party size is the number of anglers in the party, species sought is the standard three-letter code (or ANY if there was no preference), and hours fished is the number of hours fished at time of interview.

Data on all harvested fish are entered, one species at a time, for each line on the screen. Slashes or commas separate individual fish measurements and hyphens separate the lower and upper lengths of a group count. For group counts, the number of fish in the group is requested. For example, if the angler caught four largemouth bass of 36, 37, 39, and 42 cm, 10 bluegill ranging from 15 to 20 cm, and one trophy-size bluegill of 24 cm, the data would be entered as follows:

INTERVIEW NO. 1 (PRESS ESC WHEN DONE)

SPECIES	HARVESTED LENGTHS
LMB	36/37/39/42 .....
BLG	15-20 ..... AMT 10
BLG	24

Group counts must be placed on a separate line from that of individual fish lengths. Fish lengths separated by slashes or commas are assumed to be for single fish. If more than one fish has the same length, enter them separately or use group input. For example, if two LMB have lengths of 35 cm, enter as 35/35 (or 35,35) or as a group with length range of 35-35 and an amount of 2. If there are too many individual fish measurements to fit on one line, use the same species code and continue entry on the next line. Similarly, if you fill the screen, save the current screen by answering YES to the question of whether you have more harvested fish data. This will refresh the screen and allow entry of additional data. To exit from harvest data entry, press <ESC>. Individually measured, harvested fish are stored as screen 8 records while group counts of harvested fish are stored as screen 10 records. Corresponding data for released fish are stored as screen 9 and 11 records, respectively (Figures 1-1 and 1-4).

Data on released fish are entered using the same format as for harvested fish. When completed with data entry, press <ESC> to quit. After all fish data are entered, you are asked to enter data on designated supplemental questions. Once this is done, data entry for the current interview is complete and you are ready for the next angler interview. You may continue to enter data or press <ESC> to quit.

Chapter 4

DATA ANALYSIS - GROUPING

General Information

Because CREEL allows group counts of fish to be entered (with associated minimum and maximum lengths) rather than only individually measured fish, a program was needed to allocate grouped fish into centimeter groups in an equitable manner. The program GROUPING accomplishes this by using a simple algorithm and a random-number generator. GROUPING searches screens 10 and 11 for species for which group counts were entered. For each of these species, the program finds all individually measured fish from records in screens 8 or 9 and formulates a *master* length-frequency distribution. Each master distribution is from either harvested or released data, depending on whether the group count was from screen 10 or 11, respectively. Then the group count data, upper and lower range, and number are read into the program one species at a time. The upper and lower lengths of the range are compared with the master length-frequency distribution for that species. If there are at least three fish for each centimeter group in the master length-frequency within that range, the length frequency is considered good and the fish in the group count are allocated based on direct proportions to the number of fish in that section of the length frequency. For example, if there is a group count of 10 bluegill with a length range of 15-20 cm and the length frequency from individually measured fish is as follows in the middle column, the group count will be allocated as in the right column:

	MASTER	ESTIMATED FREQUENCY
LENGTH	FREQUENCY	IN GROUP COUNT
15	3	1
16	4	1
17	7	2
18	11	3
19	5	2
20	3	1

If there are fewer than three fish in any centimeter group, GROUPING first allocates one fish from the group count to each of the centimeter groups at the upper and lower limit of the range. The remaining fish are then distributed randomly across the length range. Statistical errors involved with these allocation algorithms are negligible compared with sampling errors due to between-angler variation, providing that length ranges of group counts are small.

Grouping

GROUPING is run from the Utilities Menu. The program acts on the entire data set and should be run after data entry has been completed to provide a good set of master length frequencies for each species. A copy of the original data set should be maintained so that the grouping program can be repeated if necessary.

Once loaded, GROUPING asks for the proper parentage (*i.e.*, region, district, etc.) and then shows you a screen that sets up the strata. For example, a lake with three sections and four time periods (spring, summer, winter, and fall) would originally appear as follows:

```
GROUP THE STRATA
LAKE=TEST
YEAR=87
SPECIES: LMB

PER OF          SECTION OF LAKE
YEAR  1  2  3  0  0  0  0  0  0  0

 1    1  1  1
 2    1  1  1
 3    1  1  1
 4    1  1  1
 5
 6
 7
 8
 9
10
11
12

ARROWS TO MOVE, <CR> TO ENTER VALUE,
G TO GO.  ENTER Q TO UNGROUP A STRATUM
```

You may designate the strata from which the program will search for master length frequencies. The default shown would construct length frequency from data in all strata. Alternatively, each of these numbers could be different, indicating that each stratum would be grouped separately. Any other combin ation is possible. GROUPING will search each stratum individually for grouped fish, create a master length frequency for each species in that stratum, and allocate the grouped fish in the stratum based on that length frequency. The program will then move to the next stratum automatically.

In some cases, especially for smaller fish, few individually measured fish are found in single strata. If each stratum was to be treated separately (*i.e.*, had a different number), this would result in too many instances in which the program randomly allocates the grouped fish to centimeter lengths, reducing accuracy rather than basing the allocation on a master length frequency. You must group similar

strata to reduce the incidence of random allocation. To group strata so that several strata are acted on simultaneously by GROUPING, give each stratum in the set the same label (*i.e.*, number) in the table. The ultimate case is the default screen, in which all strata have the same number. Use the arrow keys to move the cursor to the desired stratum, press <RETURN>, and then enter a *group number* that will be used to designate all strata that will be in the group. This unique number can be any that you like and all strata given this number will be acted on simultaneously by GROUPING. Using the same example as above, to group all strata within a season (time period), the table should be changed to:

```
GROUP THE STRATA
LAKE=TEST
YEAR=87
SPECIES: LMB

PER OF          SECTION OF LAKE
YEAR  1  2  3  0  0  0  0  0  0  0

 1    1  1  1
 2    2  2  2
 3    3  3  3
 4    4  4  4
 5
 6
 7
 8
 9
10
11
12

ARROWS TO MOVE, <CR> TO ENTER VALUE,
G TO GO.  ENTER Q TO UNGROUP A STRATUM
```

When you have the grouping table arranged, enter G for 'go.' You are then asked if all species should be grouped in the same manner. If you answer NO to this question, you will be presented with a new grouping table for each species. Generally for most lakes, variation in length frequency will be dependent on time rather than location. Therefore, grouping all sections within time periods would be more appropriate than one section over many time periods, especially for fast-growing species. However, when length ranges of group counts are small, these refinements will make little difference to the final results. The program has an option that automatically processes all group count records, using the default setting shown on page 4-2.

When finished, GROUPING will have completed all chosen stratum and species, allocated all group counts to individual centimeter categories, and erased the old group count records. The data base is now complete and ready for analysis and tabular output.

Chapter 5

DATA OUTPUT

Output options were designed to provide basic summary data for management decisions and breakdowns of strata and substrata for research into methods of improving the survey design. The statistical approach is described in Appendix A.

1. Run the program STATCALC, which calculates the means, variances, and sample sizes for each substratum and group of strata and stores them in text files. These interim text files can be stored on a DOS 3.3 diskette or on the RAMFACTOR card. Groups of strata to be included subsequently in a stratified analysis (Appendix A) are selected by the same process as described in Chapter 4 for length-group allocation. The simplest choice is one group for the entire impoundment and year.

2. You are then asked to select species for analysis. The contents of a file containing the latest species list are read. This list can be edited and is automatically saved in the same file. Up to 10 species are allowed. Two additional categories, all species combined and miscellaneous species (all species except those selected), are automatically included in the calculations for a maximum of 12 taxa.

3. A series of options in STATCALC allows you to coalesce substrata across strata within each group. Suppose that the print-out of summary statistics (see 4) during a previous run indicated that the number of samples during some combinations of day-period and weekday/weekend are very low or nonexistent in a stratum, you can choose to coalesce the data across all strata within each group. This maintains the substrata, which we believe explain much of the variance. Groups consisting of a single stratum will be unchanged. Another alternative allows coalescing across substrata (*e.g.*, pooling data from day periods).

4. The option: DO YOU WANT TO PRINT OUT SUMMARY STATISTICS BY SUBSTRATUM (Y/N) is useful in deciding whether to coalesce strata in a rerun and in improving sampling design. If this option is selected, you are asked to choose between harvest and catch and between numbers or weights and desired taxa. The output is too voluminous for all combinations, but all 12 taxa can be printed. Visual comparisons of sample sizes, means, or variances will reveal any shortcomings with any combination. The print-out contains one line for each substratum and codes for day-period, weekday/weekend, boat/shore/ combined, stratum, section, year-period; data for days sampled, days possible, mean daily effort with variance; and mean CPUE with variance and mean catch (or harvest) with variance data for each taxa.

5. One text file for the statistics for each group of strata is saved by STATCALC. If all taxa and no coalesced data were selected, one group containing one strata would occupy about 20 Kbytes of disk space. More disks can be used if necessary. Speed and capacity are increased using the RAMFACTOR card

option. Normally, one group containing all the strata will be selected for output of statistics from the entire impoundment during 1 year, with or without coalesced strata.

6. Exit to the General Manager menu or proceed directly to the program FINAL, which combines the strata and substrata within each group selected, using the text files output by STATCALC and the calculations in Appendix A. FINAL asks you to select a group, then a confidence level of $\alpha = 0.05$ or 0.10. The following menu is then shown:

    1. PRINT EFFORT TABLE
    2. PRINT CATCH/HARVEST TABLE
    3. CHOOSE NEW GROUP
    4. CHOOSE NEW CONFIDENCE INTERVAL
    5. EXIT

7. Selecting menu option 1 produces a summary broken down into boat/shore/combined fishing and weekday/weekend combinations in terms of angler-hours, angler-hours/acre, hours per trip, and number of trips (Table 5-1). Each page contains data for each day-period, followed by a summary for all day-periods combined. The combined data for all substrata are shown in the last row. Note that the time period is for 12 months, ending on 29 February of the following year, 1988, which in this example is a leap year. The sampling ratio represents the number of dates that were sampled divided by all possible dates in the group. For options 1 or 2, you are asked to choose between a screen preview or the printer.

8. If menu option 2 is selected, you must choose between printing a breakdown of each substratum combination (strata are combined, but unless coalesced are accounted for in the analysis) or the entire group only: DO YOU WANT A SUMMARY OF GROUP ONLY (G) OR OF EACH SUBSTRATUM (INC. THE ENTIRE GROUP(S)? The second option can produce a voluminous output, of which one substratum is shown in Table 5-2. The entire group, which would typically be the entire lake for 12 months, is output from either option; an example is shown in Table 5-3.

CREEL is a complex data set which we believe is necessary to allow for the numerous sources of variance and to maximize the advantages of stratification built into the sampling design. Inevitably there are many ways to output summary data and to design new surveys; therefore we have avoided 'black-boxing' the output at this stage. Further development of the output programs STATCALC and FINAL will continue during F-69-R as we analyze data from a variety of impoundments.

Table 5-1. Example of output effort from FINAL (artificial data).

EFFORT TABLE
REGION :=1 LAKE :=GANDALF
DISTRICT :=01 YEAR :=87
ACREAGE :305 SAMPLING RATIO :=29/365
TIME PERIOD 03/01 TO 02/29 OF LAKE SECTION 1
TIME INTERVAL 2 (1000-1600)

	ANGL HRS	95% CONF INTVL	HRS/ ACRE	95% CONF INTVL	HRS/ TRIP	95% CONF INTVL	# OF TRIPS
BOAT FISHING:							
WEEKDAY:	11532	10899-12165	38	36-40	6.8	6.4-7.2	1698
WEEKEND/H:	3513	3210-3816	12	11-13	9.1	8.9-9.2	386
BOTH:	15045	14223-15744	49	47-52	7.2	6.8-7.6	2084
SHORE FISHING:							
WEEKDAY:	8211	8003-8419	27	26-28	7.1	6.9-7.3	1156
WEEKEND/H:	2928	2725-3131	10	9-10	9.3	9.2-9.4	315
BOTH:	11139	10869-11409	37	36-37	7.6	7.4-7.8	1471
BOAT/SHORE FISHING:							
WEEKDAY:	19743	19114-20372	65	63-67	6.9	6.7-7.1	2861
WEEKEND/H:	6441	6029-6853	21	20-22	9.2	9.1-9.3	700
BOTH:	26184	25302-27066	86	83-89	7.4	7.2-7.6	3561

Table 5-2. Example of one page of output data from FINAL (artificial data) showing a single substratum. MSC = miscellaneous fish.

CATCH, HARVEST, AND CPUE TABLE
REGION :=1 LAKE :=GANDALF
DISTRICT :=01 YEAR :=87
ACREAGE :305 SAMPLING RATIO :=20/365
TIME PERIOD 03/01 TO 02/29 OF LAKE SECTION 1
TIME INTERVAL 2 (1000-1600)

FISHING TYPE: BOAT FISHING
WEEKDAY/END: WEEKDAY
FISH: HARVESTED

SPECIES	#/HR	95% CI	# CAUGHT	95% CI	#/HA	#/ACRE
BLG	3.5	3.3-3.7	6420	6180-6660	52.0	21.0
LMB	1.2	1.1-1.3	2175	2020-2330	17.6	7.1
MSC	0.6	0.4-0.8	925	880-970	7.5	3.0
TOTAL	5.3	4.9-5.7	9520	9130-9910	77.1	31.2

SPECIES	KG/HR	95% CI	KG CAUGHT	95% CI	KG/HA
BLG	0.94	0.91-0.97	1710	1675-1745	13.9
LMB	0.88	0.84-0.92	1592	1570-1614	12.9
MSC	0.13	0.11-0.15	233	226-240	1.9
TOTAL	1.95	1.89-2.01	3435	3392-3478	28.7

SPECIES	LB/HR	95% CI	LB CAUGHT	95% CI	LB/ACRE
BLG	2.07	2.01-2.14	3771	3693-3848	12.4
LMB	1.94	1.85-2.03	3510	3462-3559	11.5
MSC	0.29	0.24-0.33	514	498-529	1.7
TOTAL	4.30	4.17-4.43	7795	7479-7669	25.6

Table 5-3. Example of output data from FINAL (artificial data): summary of one group of strata.

CATCH, HARVEST, AND CPUE TABLE
REGION :=1 LAKE :=GANDALF
DISTRICT :=01 YEAR :=87
ACREAGE :305 SAMPLING RATIO :=49/365
TIME PERIOD 03/01 TO 02/29 OF LAKE SECTION 1
FULL DAY (0600-2200)

FISHING TYPE: BOAT/SHORE COMBINED
WEEKDAY/END: WEEKDAY/WEEKEND COMBINED
FISH: HARVESTED

SPECIES	#/HR	95% CI	# CAUGHT	95% CI	#/HA	#/ACRE
BLG	5.7	5.3-6.1	18211	16909-19513	147.5	59.7
LMB	1.9	1.7-2.1	6125	5320-6930	49.6	20.1
MSC	0.9	0.7-1.1	2988	2870-3106	24.2	9.8
TOTAL	8.5	7.9-9.1	27324	25992-28656	221.4	89.6

SPECIES	KG/HR	95% CI	KG CAUGHT	95% CI	KG/HA
BLG	1.74	1.56-1.92	5231	5112-5320	42.4
LMB	1.56	1.44-1.68	4716	4650-4774	38.2
MSC	0.63	0.52-0.74	1799	1701-1897	14.6
TOTAL	3.93	3.72-4.14	11746	10231-13213	95.2

SPECIES	LB/HR	95% CI	LB CAUGHT	95% CI	LB/ACRE
BLG	3.84	3.44-4.23	11534	11272-11731	37.8
LMB	3.44	3.18-3.70	10399	10253-10527	34.1
MSC	1.39	1.15-1.83	3967	3751-4183	13.0
TOTAL	8.67	8.20-9.18	25900	22559-29135	84.9

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Appendix A

STATISTICAL METHODS FOR CREEL PROGRAMS

The basic statistical unit for creel survey calculations is the time interval within a creel day, which we term day-period. For all IDOC creel surveys since 1987, the day is divided into morning (day-period 1), mid-day (day-period 2), and evening (day-period 3). Typically, day-period 1 ends at 1000 hours and day-period 2 at 1600 hours. If additional periods are used, such as a night period, these can be defined in alternative records of screen 4 in a copy of the data base. Only data corresponding to the time limits of each day-period are selected. The creel survey design and work schedule is then based on randomly chosen day-periods within each stratum (designated as a combination of section of lake and period of year, such as east arm during 1 January-31 March) and the substratum combination of day type (weekday or weekend/holiday) and day-period. Thus, the smallest unit that can be randomly allocated is the day-period, which is the basis for the statistical unit employed (*e.g.*, harvest of bluegill by boat anglers, angling effort of shore anglers, *etc.*). For example, the sample weighting scheme for a lake may require five first day-period samples from a maximum possible 20 first periods available for week-ends in a given stratum. The dates of the five first day-period samples are allocated randomly among the 20 dates available.

Associated with each day-period sample is one instantaneous count and a subsample of those anglers that are interviewed. If more than one instantaneous count is taken in a day-period, the average of the counts is used. The three primary statistical units are calculated as follows. The number of anglers counted multiplied by fishable hours in the time interval is the effort estimate for that unit (eq. 1).

$$E_{ij} = A_{ij} \cdot H_{ij} \qquad (1)$$

where E_{ij} = effort (angler-hours) (the subscript j denotes the sample number for a specific date; i is the substratum denoting a particular combination of day-period, day type, and boat/shore fishing), A_{ij} = instantaneous count of anglers, and H_{ij} = number of hours in the day-period i.

The catch rate estimate is the total number of fish caught divided by the number of hours fished by all anglers interviewed during that time interval (eq. 2).

$$S_{ij} = C_{ij}/h_{ij} \qquad (2)$$

where S_{ij} = catch rates in number or weight of fish species per hour fished, C_{ij} = total number or weight of fish caught by anglers interviewed during the time interval in i, and h_{ij} = total number of hours fished (party size times hours fished at time of each interview summed over all interviews in i, j).

Catch of fish is then estimated by multiplying effort by catch rate (eq. 3).

$$H_{ij} = E_{ij} \cdot S_{ij} \tag{3}$$

where H_{ij} = harvest or catch of fish by number or weight in substratum i. E_{ij} and S_{ij} are as above.

Average hours per trip is calculated from completed trips only and is the sum of all hours fished (party size times hours fished) divided by total number of anglers interviewed who completed their trips.

Thus for each date and day-period sampled, there is a value for effort (angler-hours), catch (number of fish), and catch rate (number of fish per hour). These statistical units are calculated for each species and all species combined within each substratum, which comprise a combination of (a) boat fishing, shore fishing, or both combined; (b) day type; and (c) day-period.

For each substratum and stratum, a mean (eq. 4) and a variance (eq. 5) is calculated for each of the three primary statistical units in (1), (2), and (3) (adapted from Cochran 1963):

$$\bar{X}_i = \frac{\sum_{j=1}^{n} X_{ij}}{n} \tag{4}$$

where X_{ij} = either effort (E_{ij}), catch (H_{ij}), or catch rate (S_{ij}) for substratum i and sample j, and n = number of samples taken. Subscripts for strata are omitted for clarity.

$$VAR(\bar{X}_i) = \frac{\Sigma(X_{ij})^2 - [(\Sigma X_{ij})^2/n]}{n - 1} \tag{5}$$

Depending on the output desired, substrata are combined to give means and variances for the parameters for the new groups, which may be strata, combinations of strata, or the whole lake.

$$\bar{X}_{ST} = \sum_{i=1}^{L} [(N_i/N) \cdot \bar{X}_i] \tag{6}$$

where N_i/N = substratum weight, N_i = maximum number of dates in substratum i that could be sampled, N = total number of dates in all substrata that could be sampled, and L = number of substrata being combined.

$$VAR(\bar{X}_{ST}) = \sum_{i=1}^{L} [(W_i^2 \cdot S_i^2)/n_i] \quad (7)$$

where $W_i = N_i/N$, S_i^2 = sample variance in substratum i, and n_i = sample size in substratum i (*i.e.*, number of dates creeled for a given substratum). The finite population correction is not used because the variance would be zero if all possible dates within a substratum were sampled. This is clearly unrealistic because a census of total catch in each day-period sampled is not being taken.

At this point, we have mean values and variances for each of the three primary statistical units--catch, catch rate (CPUE), and effort--for the strata combination selected for analysis. If the user has decided to group all sections of the lake and all time periods together, we have a mean catch, catch rate, and effort for the whole lake for the year. Mean catch and catch rate (CPUE) are expressed by number or weight and by common species or all species combined.

Mean values per day-period for catch and effort are scaled up to estimate totals by multiplying the mean by the total number of dates among day-periods (N) that could possibly be sampled.

$$X_{TOT} = \bar{X}_{ST} \cdot N \quad (8)$$

Variance for total catch and effort is scaled by N^2:

$$VAR(X_{TOT}) = VAR(\bar{X}_{ST}) \cdot N^2 \quad (9)$$

where $X_{TOT} \equiv$ estimated total for catch or effort. Mean catch rate (CPUE) is given directly by $\bar{X}_{ST}$ from eq. (6) and variance of mean CPUE from eq. (7). For all values that have variances associated with them, a confidence interval is calculated.

$$\bar{X} \pm t_\alpha(SE) \quad (10)$$

where t_α = t value from tables at α significance level and SE = standard error. For catch and effort

$$SE = \sqrt{VAR\,(X_{TOT})}$$

and for CPUE

$$SE = \sqrt{VAR}\ (\bar{X}_{ST})$$

$$\text{Approximate degrees of freedom} = \frac{[\Sigma(N_i^2/n_i) \cdot S_i^2]^2}{\Sigma[((N_i^4/n_i^2) \cdot S_i^4)/n_i - 1]} \qquad (11)$$

The number of trips is estimated by dividing total effort by the average hours per trip. No variance is calculated.

References

Cochran, W. G. 1963. Sampling techniques, 2nd ed. John Wiley and Sons, New York.