AN ANALYSIS OF THE OKLAHOMA STATE LAKE CREEL SURVEY TO IMPROVE CREEL SURVEY DESIGN

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PREFACE

The objective of the present study of the data collected in the 1964-65 creel survey of Oklahoma state owned lakes was to provide the background necessary for improving the design of creel surveys on these and similar small lakes.

Dr. R.J. Miller served as major advisor. Drs. D.E. Bee, R.W. Jones and D.W. Toetz served on the advisory committee and reviewed the manuscript. R. Jarman, C. Bennett and C. Collins of the Oklahoma Department of Wildlife Conservation, who supervised the interviewing, provided advice and counsel. L.E. Roberts, Assistant Chief for research of the Oklahoma Department of Wildlife Conservation made available the data and financial assistance to the author. Mrs. Earl Jones was of invaluable assistance in computer programming and processing of these data. Dr. M.D. Grosslein advised the author on creel survey procedures.

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CHAPTER I

INTRODUCTION

Watt (1968) defines resource management as a field which combines basic ecological knowledge with what mathematicians define as a problem of extremum. The problem of extremum or optimumization is that of maximizing or minimizing certain variables. Basic to achieving this is a need to measure the quantity to be maximized. In much of fishery management the desired goal is maximization of yield to the fisherman. This may be considered in terms of total harvest, harvest of particular species, catch per unit effort, or the most difficult to define goal of a fisherman satisfaction. In fisheries such measurement can only be obtained by some type of survey of the fishermen. The tools for doing this should combine the knowledge of characteristics of fisheries with modern sampling techniques.

In order to design creel surveys with maximum effectiveness to obtain estimates of such statistics as total harvest, total effort, species composition of the catch, and catch-rate, characteristics of the fishermen and the fishery need to be critically examined. When knowledge of the fishery can be combined with statistical sampling methodology, survey design will be enhanced. This paper presents an evaluation of the information collected in a year-long (December 1964 to December 1965) creel survey of lakes owned by the Oklahoma Department of Wildlife Conservation in order to provice a basis for improved

survey design for small lakes such as these.

Lambou (1966) has defined creel survey as "a survey of sport fishery where sport fishermen are checked by a creel checker while they are in the actual process of fishing or at the completion of their fishing trip". The author concurs with this definition particularly as it pertains to the use of the term creel survey instead of the previously commonly used term of creel census (Lagler, 1956, Overton, 1954, Rounsefell and Everhart, 1953). The term census should be restricted to those surveys in which sampling procedure is not used and a complete enumeration is obtained (Cochran, 1963).

Creel surveys are of two basic types. In the roving type the interviewer moves among the fishermen interviewing them while they are in the process of fishing. This procedure is necessitated on lakes with numerous areas by which fishermen can reach the water. It is also used when the maximum amount of fishermen contacts are desired within a limited time. In the completed-trip type fishermen are contacted as they pass a check point when leaving. It is the latter type which was used in the survey of the Oklahoma state-owned lakes.

Although creel surveys have had wide spread use since 1920 (Grosslein, 1961) very few studies have dealt with the problems involved in sample creel survey designs that affect the accuracy and precision of the estimates. The most comprehensive of these (DiCostanzo, 1956, Grosslein, 1961, Lambou, 1961, and Tait, 1953) have analyzed data collecting in roving creel surveys designed on lakes with numerous access areas.

CHAPTER II

PURPOSE AND DESIGN OF THE SURVEY

In 1964 the Oklahoma Department of Wildlife Conservation decided to survey the fishermen on their State owned lakes. They wanted to estimate the following: (1) man-hours of fishing, (2) party size, (3) numbers and pounds of fish caught, (4) species composition of the catch, (5) average size of fish caught by species, (6) catch per hour in terms of numbers and pounds, (7) monthly distribution of fishing effort and catch by species, (8) sex of fishermen, (9) the number of Oklahoma resident and non-resident fishermen, (10) the number of fishermen using various methods of fishing (boat, bank, floater, and heated dock), (11) the number of fishermen using various types of fishing (live bait, dead bait, and artificial lures), and (12) the amount of effort directed by the fishermen towards specific classes of fish. A form suitable for keypunching in standard use in Oklahoma was used to record these data. A copy of this form is presented in Figure 1. Detailed instructions as to its use can be obtained from the Oklahoma Fishery Research Laboratory, Norman, Oklahoma.

Satisfactory information was obtained on all of these items from the parties interviewed, with the exception of the amount of effort directed by fishermen towards various species. To obtain this, the creel checker was instructed to ask the fishermen for what species they had been fishing. A discussion of the failure of this procedure

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OKLA. FISHERY RESEARCH LAB. - CREEL SURVEY FORM

SER. NO.	LOCATION	AREA	DATE	DAY	TIME
					A.M. P.M.

NO. IN PARTY	RES.	NON-RES	SEX M	SEX F	BOAT	BANK	FLOATER	HTD. DOCK	OTHER
					1	2	3	4	

ANY FISH CAUGHT	YES	NO	PARTY TOTAL	HRS. FISHING	MAN HRS.	NO. CAUGHT	LBS.	FINISHED YES	FINISHED NO
	1	2						1	2

LURE				LIVE BAIT				DEAD BAIT				OTHER
CAST	SPIN	FLY CAST	TROLL	FISH	WORM	GR. HOP.	CRICKET	CUT FISH	GUTS	SHRIMP	DOUGH	
1	2	3	4	5	6	7	8	9	10	11	12	

CODE	HOURS FISHED	MAN HRS. FISHED	NO. CAUGHT	LBS.		INDIVIDUAL SPECIES	CODE	NO. CAUGHT	LBS.
						LARGEMOUTH BASS	22		
						SMALLMOUTH BASS	20		
10					BASS	SPOTTED BASS	21		
						WHITE CRAPPIE	23		
1					CRAPPIE	BLACK CRAPPIE	24		
						CHANNEL CAT	87		
						BLUE CAT	83		
						FLATHEAD CAT	88		
2					CATFISH	BULLHEADS	96		
3					WHITE BASS	WHITE BASS	2		
						BLUEGILL	14		
						REDEAR	17		
						GREEN SUNFISH	12		
						LONGEAR	16		
						ORANGESPOT	13		
						WARMOUTH	10		
						ROCK BASS	8		
						UNID. SUNFISH	25		
4					SUNFISH				
					WALLEYE /	WALLEYE	69		
5					SAUGER	SAUGER	68		
6					DRUM	DRUM	81		
7					CARP	CARP	123		
8					GAR	GAR	107		
9					TROUT	RAINBOW	114		

CHECKED BY:

REMARKS:

Figure 1. Interview Form

is presented in Chapter X. The estimates of items 1 through 9 have been published by Jarman et al. (in press) and are briefly discussed in Chapter III. The estimates of items 11 and 12 are given in Chapter VII.

The lakes in this survey had two features which permitted the design to be based on interviews of completed fishermen trips and to be considered a census of the fishermen on the days sampled. These were the small size of the lakes (26 to 180 acres) and the fact that access to the lakes was limited. Each lake had from one to three routes by which fishermen could reach the lake. Typically these consisted of dirt roads leading to the lake through which all vehicles had to pass. The lakes could be reached with a difficult cross-country hike but the assumption was made that few fishermen would attempt this feat. From any access area the creel checker could usually watch all fishermen on the lake. When the checker was on duty he could obtain a census of all fishermen leaving the lake by that access area.

In designing a survey the following items must be decided upon: the designation of the sampling unit, whether or not sampling should be with or without replacement and the number of strata to be used (if any).

The use of time of day, access area, day, period of the year, and weekday-holiday-weekend designations in designing creel surveys is frequently reported in the literature (Gasaway, 1967; Johnson and Wroblewski, 1962; Lambou and Stern, 1959; Moyle and Franklin, 1957; Stevenson and Richards, 1959; Tait, 1953; and Taylor and Carroll, 1967). These criteria also were used to design the present survey. Implicit in their use is the assumption that characteristics of the fishery vary with the above items. Yet, Carlander et al. (1958) have pointed out, that the actual effect of these variables has rarely been investigated.

The sampling unit selected was a half-day period spent by the survey clerk at one access point. The sampling unit is the unit actually sampled and in the random sampling scheme used in the present study each sampling unit was given a numerical designation. These numbers were selected from a random number table to determine the units actually surveyed. For example, a half day on Monday spent on access area one on a lake would be one sampling unit, a half day spent on Tuesday on access area one another, a half day on Monday on access area three another, etc. The designation of the sampling units for weekday and weekend strata for lakes with one, two, and three access areas are presented in Tables I, II, and III. The same designations are used for the a.m. and p.m. periods in selecting the sample.

The question of whether or not to sample without replacement revolves around the opinion as to whether or not all sampling units should enter the sample equally. If it is assumed that differences between sampling units would not be random, then sampling without replacement is appropriate. This assumption was made in the present survey. The question of its validity is discussed later in regards to differences between a.m. and p.m. periods and among days of the week.

Time of the year was considered to be a characteristic upon which to design strata. This was originally done because it was believed that fishing would vary over the year and some form of stratification on time of year would improve precision. It was later decided that the estimates for the fishery be determined for different seasonal periods. This is another reason for this type of stratification.

Weeks were divided into four strata: weekday mornings, weekday afternoons, weekend and holiday mornings, and weekday and holiday

afternoons. The morning period ended at 12:00 noon and began early enough in the morning so that all fishermen leaving the lake could be contacted. The afternoon period began at noon and lasted until all fishermen had departed from the lake. Equal weight was given to morning and afternoon periods and to weekday and weekend strata. This meant that one morning and one afternoon sample was taken each weekday and likewise on each weekend. Thus the weekend fishermen were sampled heavier than their weekday counterparts. The apportioning of these samples to strata was not done on a statistical basis but rather for convenience and because of an assumption of heavier weekend fishing pressure.

The fact that the sampling was done without replacement restricted the possible time periods that could be used as strata to multiples of the number of sampling units in each of four strata present within each time period, i.e. weekday a.m. and p.m. and weekend a.m. and p.m. For lakes with one access area these values were five and two weeks respectively, for lakes with two access areas - ten and four weeks, and for lakes with three access areas - 15 and six weeks. In the present survey, multiples of one were used and each of these time periods designated as a cycle. Therefore, estimates were made utilizing a weekday-weekend stratum, a time of day (a.m. - p.m.) stratum and a cycle stratum. A hypothetical sampling schedule is given in Table IV for a lake with two access areas showing the cycles present. The schedules for each lake are listed in the files of the Oklahoma Department of Wildlife Conservation.

On three of these lakes, Kingfisher, Schultz and Vincent, the supervisory biologists found it necessary to alter the original design

to adjust to field conditions. They either encountered more access areas than originally expected and/or had difficulty in hiring creel checkers. In redesigning the survey schedules on these lakes the same sampling units were used as in the basic plans. However, the samples were drawn for each week without replacement so that no cycles were present in the strata configuration and each sampling unit was represented unequally in the sample. On weekends, on Lake Schooler one complete day was sampled rather than two half days because of labor requirements. The survey also was used to gather information on the recreationists other than fishermen but these data are not discussed in this paper, although they are reported by Jarman et al. (in press).

The survey began in the second week of December 1964 and ended in the first week of December 1965. Problems in obtaining creel checkers limited the coverage of Lake Schultz to the eight-month period from April to December 1965 and the survey of Lake Kingfisher to the six-month period from June to December 1965.

The sampling design for the survey was developed by Victor Lambou, at that time Director of the research unit of the Oklahoma Department of Wildlife Conservation, the Oklahoma Fishery Research Laboratory. The survey was supervised by the Regional Fishery Biologists of the Department of Wildlife Conservation. Part-time employees were hired to contact the fishermen. The author directed the estimation of the desired statistics from the survey. The information gathered from the fishermen in this survey provided the data for the analyses in the present study. Throughout this discussion the term significant difference refers to a difference judged to be significant at the 0.05 probability level using the particular type of statistical testing

procedure mentioned in connection with that analysis. Unreferenced statistical methods follow Steel and Torrie (1960) and Cochran (1963).

CHAPTER III

LAKE DESCRIPTIONS

The Oklahoma Department of Wildlife Conservation began construction of the first state owned lake in 1953. Since that time a total of seventeen lakes have been built. Federal Aid to Fish Restoration (D-J) provided funds for the construction of most of these lakes. Sites were selected to provide fishable waters in areas of the state where none existed. They were designed and constructed solely for sport fishing and recreational use. Swimming, skiing and trotlining are outlawed on all lakes to provide a more suitable environment for the sport fishermen. Waterfowl hunting is encouraged on fourteen of the lakes. No fees are charged to users on any of the lakes.

Department ownership provides the Fisheries Division a twofold opportunity. First, to provide quality fishing in areas of distinct shortage through proper management and secondly, to experiment with new techniques for developing better management tools for use in Oklahoma waters. Manpower and funds, to date, have not been available to initiate a planned program of management on any of the lakes.

This creel survey was conducted on ten of the lakes which ranged in size from 26 to 180 acres and totaling 727 acres. Five state lakes were either still under construction or were unsuitable for a creel survey at the time of the project. The ten lakes sampled are located in virtually every physiographic region in the state and vary greatly

in water chemistry, productivity, and surrounding terrain. The lakes in the western portion of the state are located in short and mixed grass prairie biomes and the eastern lakes are surrounded by pine, postoak-blackjack oak forest. Figure 2 shows the location of each lake and the human population density in Oklahoma. Pertinent statistics concerning each lake are presented in Table V.

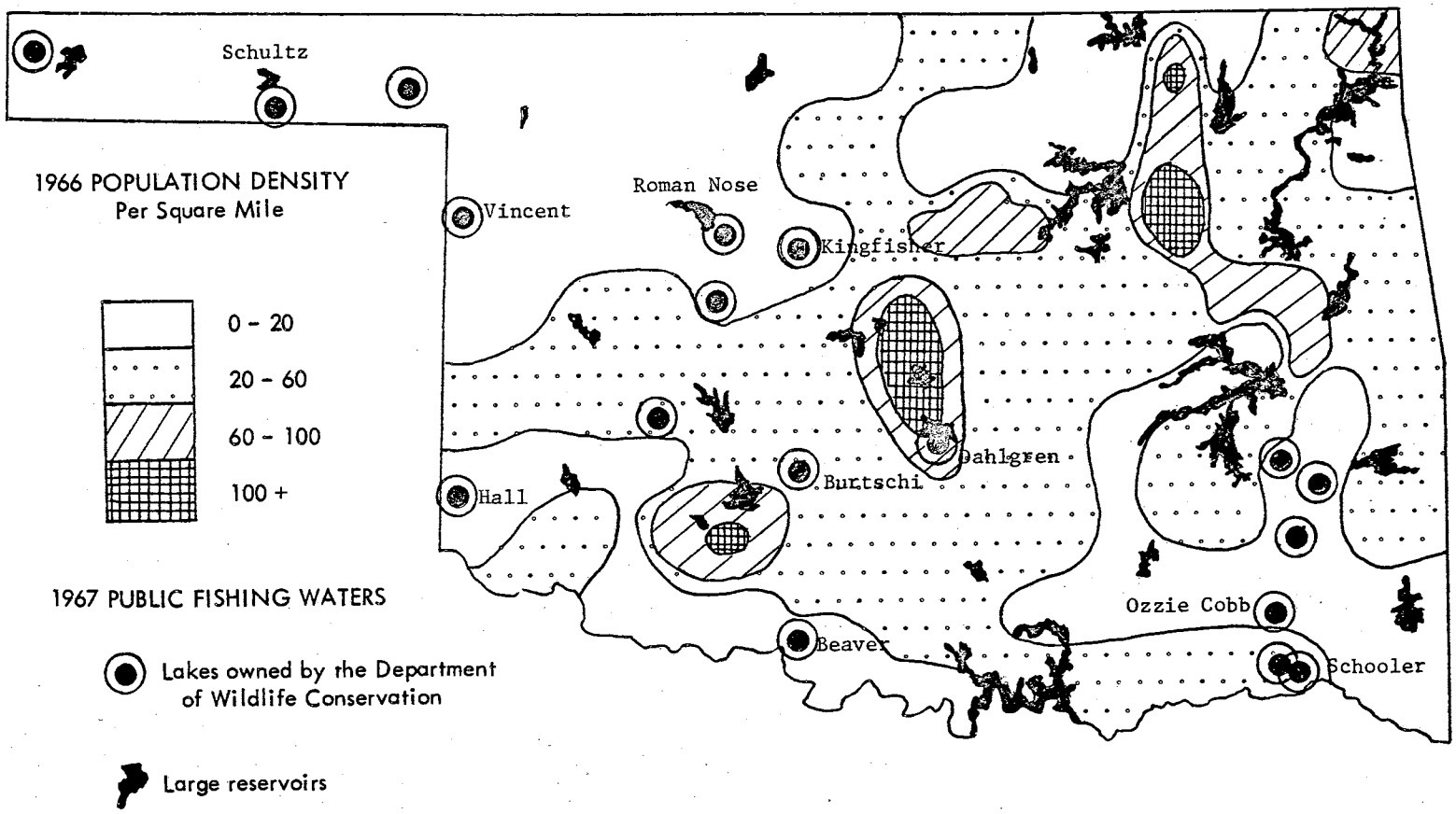

Figure 2. Oklahoma Public Fishing Waters and Associated Population Density

CHAPTER IV

ESTIMATES OF SURVEY STATISTICS

Estimates of the total annual number and pounds of fish caught, hours fished, species composition of the catch and average size of fish caught, number of fishing parties and party size, number of fishermen and average hours spent fishing, the percent sex and resident composition of the anglers, and the seasonal distribution of the catch for these Oklahoma State owned lakes have been reported by Jarman et al. (in press). Catch-per-hour values obtained by dividing the total estimated fish caught by the total estimated number of hours fished were also reported. The present author conducted the analyses of the data to make these estimates. A brief summary of these estimates is presented here.

Creel Survey Statistics

Average harvest and fishermen use are presented in Table VI. Total pounds of fish of all species harvested ranged from 22 to 107 per acre, with most lakes having 40 to 60 pounds per acre. The number of fish per acre varied from 68 to 242. There was no linear relationship between fishing pressure and catch rate (Figure 3). Also population density around the lakes did not influence fishing pressure, e.g. Lake Vincent is located in a remote area and still received heavy fishing pressure.

Table VII presents composition of catch data from the ten lakes.

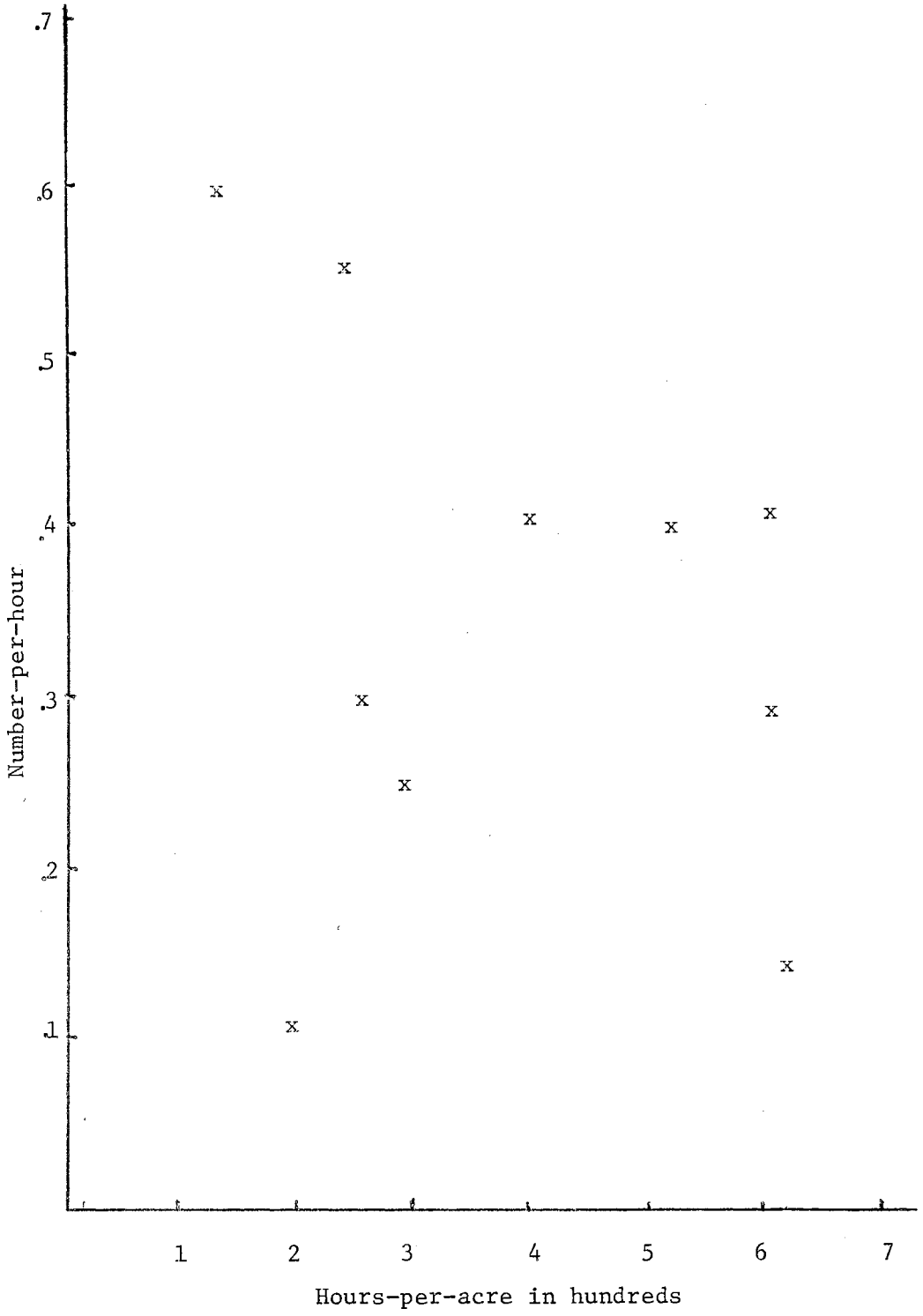

Figure 3. Fishing Success Versus Fishing Effort for Oklahoma State Owned Lakes

Bass and catfish comprised the largest portion of the catch in most lakes. The average weight of bass ranged from 0.65 to 2.10 pounds and catfish average 0.57 to 1.90 pounds. The remainder of the catch was crappie and sunfish with crappie being the least important. Average weight of sunfish ranged from 0.17 to 0.50 pounds. Crappie were somewhat larger but averaged less than 0.5 pounds.

Virtually all bass weighed were largemouth bass (Micropterus salmoides) with both black bullheads (Ictalurus melas) and channel catfish (Ictalurus punctatus) being represented in the catfish class. In all lakes channel catfish were more numerous than bullheads. The sunfish harvested were bluegill (Lepomis macrochirus), redear (Lepomis microlophus) and green (Lepomis cyanellus). Both white crappie (Pomoxis annularis) and black crappie (Pomoxis nigromaculatus) were represented in the harvest.

Oklahoma fishermen, when fishing state owned lakes, usually went fishing in parties of two or three and fished approximately three hours (Table VIII). In all but two lakes, fishermen were predominately residents of Oklahoma and two-thirds were males. On Lakes Vincent and Hall, located near the Texas border, approximately one-half of the fishermen were non-residents.

Figure 4 taken from Jarman et al. (in press) shows the seasonal distribution of total harvest and fishing pressure by class of fish. The majority of both occurred from April through October. Crappie harvest was highest in May and poor through the summer. Bass harvest was large throughout the summer months and small from December through March. Most catfish were harvested through the summer and early fall while sunfish harvest was heavy in the spring and early summer.

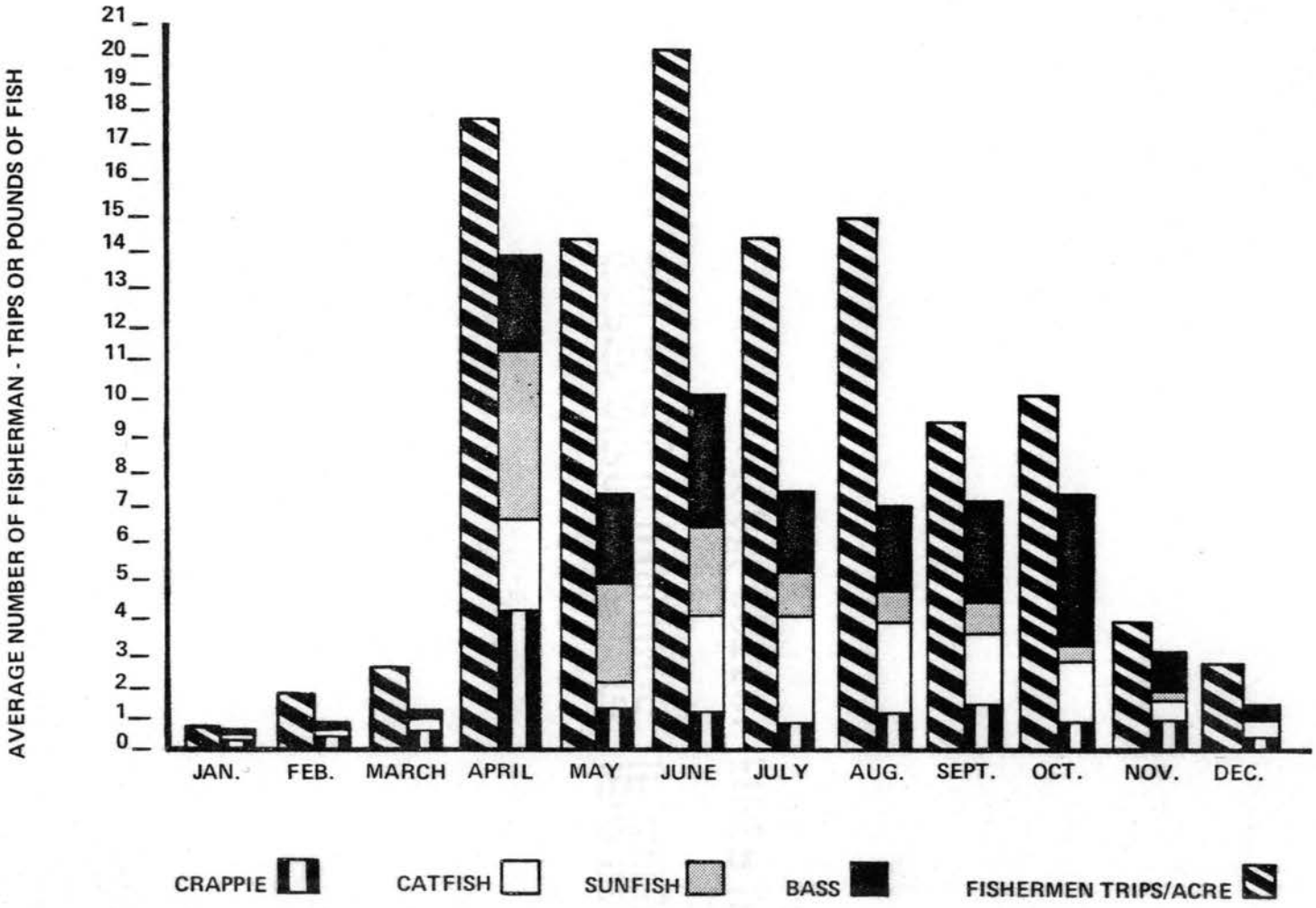

Figure 4. Average Seasonal Catch and Number of Fisherman-trips Per Acre in Oklahoma State Lakes

Major uses of the lakes other than fishing were sightseeing, camping, and picnicking. Boaters were well represented on most lakes even though outboard motors are limited to ten horsepower or less. Swimming is prohibited on all lakes but represented one-third of the recreational use on Schooler Lake and was represented in the data on four other lakes.

Variation in surrounding facilities and lake location accounted for differences in the percent of use among different lakes. Lake Burtschi has good picnicking facilities so this use was high. Lake Roman Nose has good camping facilities; therefore, camping hours were high. A large portion of the campers also fished while at the lake and this made estimates of fishing time more difficult, particularly on Ozzie Cobb and Schooler. Two lakes (Vincent and Kingfisher) had high percentages of sightseers. Both of these lakes are located near western Oklahoma towns with virtually no other public water or natural attractions located in the area.

Estimation Methodology

Ideally in a creel survey of completed trips, the estimate of a desired total within strata and the corresponding variance is quite simple. The following example is given for the estimation of manhours fished. However, the same procedure would hold for other statistics such as pounds or numbers caught.

The total manhours fished within a stratum would be estimated by the formula:

$$X_h = \frac{N_h}{n_h} \bar{x}_h$$

where X_h = the total estimated number of manhours fished in stratum h

n_h = number of sampling units sampled in stratum h

N_h = total possible number of sampling units in stratum h

$$\bar{x}_h = \sum_{i=1}^{n_h} x_{ih}$$

where x_{ih} = the number of manhours fished in sample unit i

The variance would be estimated by the following formula:

$$V_h = \frac{N_h^2 S^2}{n_h} \left(\frac{N_h - n_h}{N_h} \right)$$

where S^2 = standard deviation of the observation within stratum h

However in the present case the value for most desired statistics was not obtained for each sampling unit because not all of the fishing parties were successfully interviewed. The reasons for this will be discussed in later chapters. Since the number of such parties was known, the number of parties was estimated by the above procedure. The other statistics however were estimated by the following formula:

$$Y_h = P_h \bar{y}_h$$

where Y_h = desired total in stratum h such as number of manhours fished

P_h = number of parties in stratum h estimated by the preceding procedure

$\bar{y}_h$ = mean number of manhours fished per fishing party in stratum h

The variance of the $\bar{y}_h$ term can be estimated by:

$$V(\bar{y}_h) = \frac{(\bar{y}_h - y_{ih})^2}{n_h (n_h - 1)} \left(\frac{N_h - n_h}{N_h} \right)$$

where y_{ih} = the number of manhours fished by the i the party in the h stratum

Goodman (1960) has developed an exact formula for the variance of a product of two independent variables. In our above example these variables are party number and average manhours fished per party, both within stratum h.

$$V(P_h \bar{y}_h) = P_h^2 V(\bar{y}_h) + \bar{y}_h^2 V(P_h) + V(\bar{y}_h) V(P_h)$$

The increase in the components of the variance in this procedure over the simpler form appropriate when all parties had useable interviews within a sampling unit indicates the need to make every effort possible to obtain successful interviews on every party.

Estimates of annual total and then variances were obtained by summing estimates for each stratum over all strata.

Both stratum and annual catch-per-unit effort values were estimated by dividing the appropriate estimated catch by the estimated manhours. Approximate confidence limits for catch-per-unit effort values were obtained by dividing the corresponding upper and lower 95 percent confidence limits estimated for the catch and effort values.

CHAPTER V

EVALUATION OF MISSING DATA

This survey attempted to be a complete census of all fishermen leaving the lake at a particular access area during the time that the survey taker was scheduled to be on duty. As would be expected, such perfection was not achieved. Occasionally, a sample period was skipped entirely as a result of such factors as illness of the creel checker or changeovers in personnel. Thus the estimates for those strata were based on fewer samples, decreasing their precision and probably their accuracy. In addition to the data missing for this reason, there were cases where individual parties were not interviewed during the sampling period. Also, there were some interview forms that had to be rejected because the data appearing on them was judged to be invalid by the regional biologists or the author. This chapter discusses these problems.

Missing Interviews

Missing interviews fell into two categories. The first were those of fishermen that left when the checker was temporarily not at his duty post. Because of the small size of the lakes the checker was able to determine the number of parties that had left during his absence. The assumption made in this study that such individuals did not on the average differ from the interviewed fishermen, was probably valid.

The second were those of fishermen who refused to stop for the checker. The only statistic obtained for these two groups of fishermen was party size.

The number of missed parties and the average number of fishermen in such parties are presented in Table IX. Very few parties were missed except on Lakes Burtschi and Roman Nose. The number on the former did not seem exceptional in view of the lake's larger size and heavier fishing pressure. The very large number on Lake Roman Nose raised considerable questions as to the validity of the estimates. It is possible that the particular creel checker was not aggressive enough in contacting fishermen.

In the two comparable cases, the average party size for interviewed and uninterviewed fishermen respectively was 3.6 and 3.7 for Burtschi and 2.8 and 2.9 for Roman Nose. The closeness of these values gives some confidence to the assumption that interviewed and non-interviewed fishermen were similar in their catch and effort statistics also as was assumed in the method of estimating yearly values.

Unusable Interview Forms

Creel checkers were instructed in the intricacies of interviewing fishermen and completing the survey form. However, as would be expected in a situation where local persons were hired on a part-time basis, there were often errors on the code sheets that resulted in those interviews being of limited usefulness. The pressure of other duties limited the time the supervisory biologists could devote to the survey, thus also contributing to recurring errors on the interview sheets. Some errors are inevitable in any survey and a discussion of

complications involved in dealing with these may be informative.

Information collected on the forms are of two types. The first are items that are crucial to estimating harvest, effort, and catch per unit effort. These are the party size, hours fished, and the number and pounds of fish caught. When these items were either omitted from the forms or were obviously inaccurate, then the interviews were classified as unusable and used only in the estimates of party numbers.

In the second type the forms did not have suitable information concerning resident, non-resident and male, female proportions; type of fishing, i.e. boat, bank, floater or heated dock; method of fishing, i.e. lure, live bait, dead bait, and other; and species sought. These forms were utilized in the estimate of total effort, catch, and catch rate, but were not utilized for the other statistics. Forms in this second category are not considered as rejected interviews for the analyses in this section.

All of the rejected interview forms were scrutinized and classified for each lake according to the reason for their classification as unusable. In Table X are presented the number of interview forms which were rejected because of missing data in the following categories: parties, hours, weight, and those unusable for other reasons. The other category included forms rejected for such reasons as too many hours, fish of impossible sizes etc. Whether or not any fish had been caught was recorded on each code sheet so it was possible to determine the difference between those for which no fish were caught and those for which fish were caught but not recorded. Since some interview forms contained more than one type of missing data, the total number

of rejects was less than the sum of the numbers in Table X.

On Lake Beaver, 3.2 percent of the interviews were rejected. The missing values were fairly evenly distributed between parties, pounds, numbers, and hours. Most of the rejects on Lake Burtschi (88.5 percent) were a result of lack of data on pounds caught. A total of 8.4 percent of the interviews were rejected. The creel checkers on Lakes Dahlgren, Kingfisher, Schooler, and Schultz turned in very few forms which had to be rejected. On Lakes Ozzie Cobb, Roman Nose, and Vincent, rejected interviews ranged from two to six percent with most of the forms rejected either for miscellaneous reasons or lack of weight data. Lake Hall had 62.4 percent of the forms rejected. Of these forms, 72.9 percent had hours missing, 41.9 percent numbers missing, 40.5 percent pounds missing, 10.9 percent other, and one percent no information on party size. The large number of forms with pounds missing was partially a result of the checked fish being dressed. This error could have been partially reduced by the taking of length measurements on fish that had been cleaned and using length-weight relationships to estimate pounds landed. The seasonal distribution of rejected interviews was reviewed to determine whether or not the number of rejected interviews decreased with time and the increasing experience of the creel checker. No such decrease was evident. This fact demonstrates the danger of the lack of continuing review of the interview forms in a creel study during the survey in order to eliminate repeated errors. The average values were then calculated for average party size, number of hours fished, number of fish caught, and pounds of fish caught for those rejected interviews which contained usable information on one or more of these categories.

That is, an interview was used in computing the average party size if that value was usable, even though other items such as number of hours were not. These average values were then compared (using t-tests) to the corresponding annual values estimated for the survey. The results are given in Table XI.

Average party size of rejected forms was very close to the overall estimate in all cases but Lakes Hall and Burtschi. The unusable forms gave an underestimate in the first case and an overestimate in the second. The former difference was not significant but the latter was. Only on these two lakes would the overall estimated number of fishermen probably have been changed if the rejected interviews had been usable. Although the magnitude of the difference in party size was greater for Lake Burtschi the lesser proportion of unusable data on that lake relative to Lake Hall would mean that the effect on the total estimate would be less. Hours fished by parties whose interviews were rejected differed significantly from the overall estimate only for Lakes Burtschi and Ozzie Cobb. This lack of significant difference was due to the large variation in the number of hours fished, as the absolute magnitude of the differences in mean fishing time ranged from 0.3 to 4.2 hours. In five of the six cases the difference was in the direction of more hours fished being recorded on the unusable forms.

On Lakes Beaver and Hall the fishermen whose interview forms were rejected caught significantly fewer fish than the overall estimate. The only other significant difference was in Lake Vincent where the value for the number caught for the unusable forms was the highest.

In terms of pounds caught the rejected interview forms had lower

values in all cases but Lake Vincent. Significant differences occurred on Lakes Beaver, Burtschi, and Ozzie Cobb.

On an overall basis there appears to be no strong evidence to reject the procedure of treating the usable interview forms as representative of the fishermen in general. Some of the differences observed between their values and those of the overall averages may be due to seasonal or even daily variations. However, it was not possible to test this possibility because of the small sample size. Certainly the use of this procedure is probably preferable to that of ignoring them entirely. However, as some differences did exist, especially in the hours fished, the necessity of keeping the number of such unusable forms to a minimum should be stressed.

CHAPTER VI

COMPARISON BETWEEN WEEKDAY AND WEEKEND VALUES

It is almost invariable in creel studies designed to estimate yield that the weekdays be considered as one stratum and weekends and holidays another. This has been done because of the heavier daily fishing pressure and harvest in the latter stratum. Many studies have demonstrated this fact (e.g. Churchill and Snow, 1964; Grosslein, 1961; Schmulback, 1958; and Steward, 1964). These differences hold true in this study also (Table XII), for only on Lake Kingfisher did the effort on weekends approach the 28 percent figure that strata would have if the effort were distributed evenly. However, as Carlander et al. (1958) have pointed out, creel survey designs have been mainly based on the distribution of effort and although this is proper for estimating effort it may not be so for estimating other statistics. Due to manpower limitations creel studies estimates of total effort and harvest are always not within the range of possibilities even on small lakes. In these cases the species composition and the catch rates are the items estimated. As the greater number of fishermen are found on the weekends it would be more efficient to concentrate survey efforts on those times. However, if those characteristics differed between weekdays and weekends estimates based on weekend samples only would be misleading. Such difference could likely exist if the greater ease of getting to the

lakes on weekends means that a less expert class of fishermen dominate the weekend period.

The weekday-weekend catch compositions are compared (Table XIII). None of the species were significantly different in percentage compositions in the catch when tested using the Wilcoxin signed rank procedure (Wilcoxin and Wilcox, 1964). Although there were differences between these two periods there was no explainable pattern. However, the fact that these differences did exist would indicate that any catch composition based only on one period should be made with the realization that there might be a change if both periods were considered.

Characteristics of fishing parties are presented in Table XIV. There was no significant difference in the percentage of male and females and residents versus non-residents in the weekday-weekend comparison. In seven of the ten values the average party size was larger on weekends. They were equal in regard to the other three. This difference was significant in a Wilcoxin signed rank test. However, the average number of hours fished by parties did not differ significantly. Catch rates in number and pounds were significantly lower on weekends as was the percentage of successful fishermen.

Weekday-weekend distribution of type of fishing, i.e. lure, live bait, etc. and of methods of fishing, i.e. boat, bank, etc. are presented in Table XV. No major differences were evident.

CHAPTER VII

COMPARISON OF SURVEY STATISTICS FOR PARTIES USING DIFFERENT TYPES AND METHODS OF FISHING

Fishing parties were classified by the creel checker as to the type of fishing being done in most instances. That is, whether or not the party used artificial lures, live bait, dead bait, or various combinations. As would be expected, many parties could not be classified as to a particular type of fishing. Either one fisherman used more than one type of gear or different members of the same party used different types of gear (Table XV). Parties were also classified as to the method of fishing. That is, whether or not the party fished from a boat, on the bank, in floaters, from a heated dock, or used a combination of these methods (Table XVI). Floaters refer to various types of inflated innertube devices which allow the fisherman to paddle himself around the lake shoreline. Heated docks refer to covered docks which are heated and have a more or less central opening through which people can fish. In some areas of Oklahoma heated docks are heavily utilized in fishing for crappie in the colder months. Such structures were not present on most of the state owned lakes. Fishing parties which could be classified as to method and type were compared using analyses of variance to test for differences in the creel statistics, of party size, number caught, number per hour, pounds per hour, hours fished, and man hours fished. Separate analyses of variance were

computed for each lake for weekday and weekend strata (Tables XVIII to XXXI). Wilcoxin signed rank tests (Wilcoxin and Wilcox, 1964) were used to compare the average values over lakes in an attempt to determine overall trends. When reference is made in the following discussion to presence or lack of a difference between overall creel statistics without reference to a particular test the use of the .05 significance level determined by using a Wilcoxin signed rank test is assumed. The overall averages referred to (Tables XXXII and XXXIII) are unweighted averages over all the individual estimates over lake and weekday-weekend strata. When a comparison is with reference to a particular lake, analysis of variance is assumed. Duncan's multiple range tests as described by Steel and Torrie (1960) were used to separate individual lake-strata analyses of variance.

When party size is viewed over all lakes live bait fishermen had a larger party size than users of artificial lures in 14 of 18 comparisons. This difference was significant. The mean of the average party size over all lakes was 3.1 for lure, and 3.5 for live bait users. Dead bait users were compared to live bait fishermen in ten cases. Of these, dead bait parties had the larger size in only two cases. This difference was significant, as was the difference between dead bait and lure users. In the latter comparison dead bait fishermen had the smaller party size in one case, were tied in one, and larger in the remaining six. The overall average size for dead bait users was 3.2 fishermen. Seven of the 20 analyses of variance were significant.

Parties using live bait unquestionably caught the most fish. They did so in 16 of 18 comparisons with users of artificial lures, and

9 of 10 comparisons with dead bait users. These comparisons were significant. The comparison of dead bait and lure fishermen gave no such difference. The average number of fish caught was 4.4, 2.8, and 2.7 for users of live bait, lures, and dead bait respectively. Seven of the analyses of variance were significant.

On a weight caught basis, the lure fishermen caught more than live bait fishermen in 8 of 18 comparisons. Live bait users caught more pounds of fish in comparison with dead bait users. Apparently the greater number of fish caught by live bait fishermen consisted of smaller fish. The average weight caught was 2.5 pounds for lure fishermen, 2.2 for live bait anglers, and 3.1 for dead bait users. The dead bait fishermen caught mainly catfish whose average size was quite large (Table VI). Eight of the 20 analyses of variances were significant.

In comparing number caught per hour, live bait fishermen were more successful than users of lures in 12 instances, they were equal in two and behind in four. This difference was not significant. However, the comparison between dead and live bait was significant with the former being the least successful in nine cases and the other pair of values being equal. Dead bait fishermen did not differ from lure users. The overall averages were 1.8 for lure, 1.6 for live bait, and 1.2 for dead bait anglers. Seven of the analyses of variance were significant.

Parties using artificial lures were more successful on a weight-per-hour basis than those parties using live bait in ten cases and less in eight. The comparisons between lure and dead bait fishermen and between live bait and dead bait fishermen were also fairly evenly

split. None of these differences were significant. The overall rates were, lure fishermen - 1.4 pounds per hour, live bait - 1.2, and dead bait - 1.4. Six of the 20 individual analyses of variance were significant.

On an hours fished basis, seven of the analyses of variance were significant. Lure fishermen fished longer than live bait users in only five of the 18 comparisons. This difference was significant. Lure fishermen had significantly less hours fished than dead bait fishermen. Dead bait anglers had more hours in six of eight cases. When compared with live bait users dead bait fishermen fished the longest in seven out of ten cases. This difference was not significant. The average hours fished were 4.1 for lure fishermen, 4.5 for live bait users, and 5.7 for dead bait anglers.

Live bait parties had more man-hours than lure users in all but one of the 18 comparisons. This was significant. Dead bait fishermen exceeded lure users in every case and the live bait parties in seven of ten cases. The former was significant but the latter was not. As with the hours fished, seven of the ten analyses of variance of individual comparisons were significant.

Eight of the 19 analyses of variance for party size between different methods of fishing were significant. Parties of boat fishermen exceeded bank users in the average number per party in six of 18 comparisons. A signed rank test showed no significant difference. Floater fishermen were present in large enough numbers for comparison in 12 cases. They had the smallest party size in every case but one. The overall average of party size was 3.3 for boat, 3.4 for bank, and 2.1 for floater fishermen.

Parties using boats caught more fish than bank fishermen in 11 cases and the reverse was true in eight. This difference was not significant nor were the differences between floater and bank fishermen and between floater and boat fishermen. Seven of the analyses of variance were significant. Boat fishermen caught 4.7 fish, bank - 3.2, and floater users 4.1.

Eleven of the analyses of variance for weight caught were significant, and in 15 out of 18 cases the boat fishermen caught more pounds than the anglers using the bank. The overall average for boat fishermen was 3.1 and for bank users 1.9. This difference was significant. Floater fishermen caught more pounds than bank fishermen in nine of ten cases and they caught more than boat fishermen in 11 of 12 cases. These differences were significant. Apparently, since the numbers captured did not differ significantly the floater fishermen caught the largest fish followed by bank and then boat fishermen. Floater fishermen averaged a catch of 4.5 pounds.

Neither the boat-bank, boat-floater, nor bank-floater comparisons were significant for the number caught per hour statistic. Seven of the 19 analyses of variance were significant. Boat fishermen exceeded bank fishermen in 12 cases and were tied in two. In the 10 comparisons between boat and floater fishermen the former were first in six instances and tied in one. Floater fishermen were more successful than bank users in five instances, tied in two and less in four. Bank fishermen caught 1.8 fish per hour, boat 1.5, and floater 1.7 over all lakes.

Ten of the 19 analyses of variance for differences in pounds caught per hour fished were significant. Boat fishermen were more

successful than bank fishermen in 13 cases and were equal in two. The contrast was not as favorable for boat fishermen as was the comparison of total weight caught. However, the difference was still significant. Floater fishermen were more successful than boat fishermen in ten cases and more than bank fishermen in 11 cases. These differences were significant. The overall averages were 1.4 for boat, 1.2 for bank and 2.0 for floater fishermen.

Boat fishermen fished more hours than bank anglers in 12 cases and tied in one. This difference was not significant. Boat and floater fishermen were about evenly divided in terms of hours fished. The former led in five cases and the latter in six. Floater fishermen fished longer than bank anglers in eight of 12 comparisons, and in another case the two were tied. This difference was not significant. Boat anglers averaged 4.6 hours, bank users - 4.4, and floater fishermen - 5.2. Only three of the 19 analyses of variance were significant.

When man-hours were considered only two of the analyses of variance were significant. Boat anglers had the greater man-hours in seven cases, and the reverse was true in the other 11. In comparison between boat and floater fishermen, the former had more man-hours in six cases and the latter in five. When compared with bank anglers floater fishermen logged more man-hours in five instances and less in seven. The overall averages were boat - 9.6, bank - 9.9 and floater - 5.6.

On Lake Beaver 18 percent of the fishermen used lures, 21 percent live bait and 17 percent dead bait. Only the catch in numbers per hour differed significantly on weekdays. On weekends, catch in

numbers and weight, and hours fished differed significantly. Live bait fishermen were the most successful and also fished the longest.

Most of the fishermen on Lake Burtschi used lures (36 percent) followed by live bait (15 percent), and dead bait (2 percent). The pattern of significant differences appeared confusing. On weekdays those parties fishing with lures had the smallest party size and the least hours of fishing time. Live bait anglers caught the most fish while dead bait users caught the most weight. On weekends those with artificial lures caught the least number of fish and dead bait users fished the longest.

One percent of the fishermen on Lake Dahlgren used dead bait, five percent live bait, and 21 percent artificial lures. On weekdays only lure and live bait fishermen were present. Those using lures had a smaller catch per hour in numbers. On weekends the live bait fishermen caught the most fish in numbers and weight, had the best catch rate in numbers, and spent the most man-hours fishing.

Lure and live bait parties were about evenly divided on Lake Hall (26 and 29 percent respectively). Only two percent used dead bait, and none of these were on weekdays. On weekdays those using artificial lures had the smaller party size and caught the most pounds per hour. On weekends the anglers using lures had the best catch in pounds and the most pounds per hour.

On Lake Kingfisher only bait fishermen, both live (33 percent) and dead (6 percent) bait users were present in any numbers. Those fishing with artificial lures exclusively constituted only one percent. On both weekdays and weekends there were no significant differences between the two types of fishermen.

On Lake Ozzie Cobb the bulk of the fishermen used either artificial lures (20 percent of the parties) or live bait (46 percent), only one percent used dead bait. On weekdays the most successful fishermen in terms of fish numbers used live bait. They also spent the most hours and man-hours fishing. On weekends also, live bait fishermen had the best numerical success.

Comparisons were made for Lake Roman Nose between users of artificial lures (22 percent), live bait (24 percent), and dead bait (7 percent). On weekdays those parties fishing with live bait formed the larger parties and had the most man-hours. On weekends likewise, the party size was larger for live bait users, while parties using lures caught the most pounds and pounds per hour.

On Lake Schooler 22 percent of the parties used lures, 63 percent live bait, and 2 percent dead bait. None of the differences tested were significant.

Live bait fishermen (43 percent) were the most common on Lake Schultz followed by those parties using lures (26 percent) and dead bait (8 percent). On weekdays only lure and live bait fishermen were compared. Those fishing with artificial lures caught more pounds of fish and had the best catch rates in terms of both numbers and pounds. However, live bait fishermen had the most hours and man-hours. On weekends there were enough parties of dead bait fishermen to be included in the comparisons. Those using lures had the smallest party size but caught the most pounds and had the best catch rates. The man-hours were fairly evenly spread apart with the greatest amount being for live bait users followed by dead bait fishermen and lastly by those using lures.

On Lake Vincent fishermen using lures were the most common (22 percent) followed by the twelve percent who used dead bait and the ten percent who used live bait. On both weekdays and weekends the fishermen using artificial lures had the smallest party size. On weekends live bait anglers caught the most fish in numbers followed by dead bait and then artificial lure users. The comparisons for pounds caught were significant on both weekdays and weekends. The order was dead bait, live bait, and lures on the former, and dead bait, lures, and live bait on the latter. In terms of catch per hour in number live bait fishermen were the most successful. Dead bait fishermen fished the longest on both weekdays and weekends. The same result held true for man-hours.

On Lake Beaver 19 percent of the fishermen were boat fishermen and 78 percent fished from the bank. The daily catch in numbers, weight, numbers per hour and weight per hour were significantly higher for boat fishermen on weekdays. There were no significant differences in the weekend data.

On Lake Burtschi boat users made up 12 percent of the total. The corresponding figure for bank fishermen was 67 percent, for floater fishermen - 16 percent, and for heated dock users - 4 percent. On weekdays floater fishermen had the smallest party size. Boat fishermen caught the least number but bank fishermen did the worst weightwise. On a catch rate basis bank and floater fishermen did poorest numberwise. In terms of pounds per hour the bank fishermen were the least successful. Parties using boats fished the greatest amount of man-hours. On weekends party size was split into two groups with the largest size for boat and bank parties. The same relation held true

for numbers, weight caught, number per hour, and pounds per hour. Parties fishing from heated docks spent the least hours and man-hours. The results present a confusing picture.

On Lake Dahlgren, fishermen using boats were 76 percent of the total, those using the bank - 10 percent and floater fishermen - 7 percent. On weekdays floater anglers had the smallest party size, caught the most pounds of fish, and had the best catch rate in weight. On weekends also, floater fishermen had the smallest party size. All other comparisons were not significant.

On Lake Hall the anglers were fairly evenly divided between bank (29 percent), boat (43 percent), and floater (28 percent) fishermen. Boat fishermen had larger parties on weekdays than bank or floater anglers. On weekends boat fishermen caught the most fish while on a weight basis bank fishermen caught significantly less than the other anglers. The catch rates were about evenly spread apart with the order from best to poorest being boat, floater, bank, for numbers per hour and floater, boat, bank for pounds per hour.

On Lake Kingfisher almost all (94 percent) of the anglers fished from the bank and only two percent used boats. None of the analyses of variance were significant.

Comparisons between bank (3 percent) and boat (62 percent) fishermen were made for Lake Ozzie Cobb. Boat fishermen caught the most fish on weekdays and on weekends. On weekends they also caught the most pounds and had the best success rates. Parties of boat anglers logged the most hours on weekends.

On Lake Roman Nose bank fishermen were in a majority (84 percent) followed by floater anglers (11 percent) with the smallest proportion

(4 percent) using boats. On weekdays floater users had the best catch rate in terms of weight. On weekends floater fishermen had the smallest party size.

Parties on Lake Schooler were about evenly divided between bank (50 percent) and boat (42 percent) users. On weekdays boat fishermen caught the greatest weight. Boat fishermen had a smaller party size on weekends.

The percentage distribution of parties for Lake Schultz was: 79 percent - bank, 6 percent - boat, and 11 percent - floater. On weekdays only bank and floater parties were compared. The floater users had the smallest party size and were the most successful in terms of numbers, pounds, and catch-per-hour. On weekends boat users were included in the comparisons. The pattern of significant differences however, was the same as on the weekdays. In addition, in terms of number and pounds caught boat fishermen were more successful than bank users.

On Lake Vincent 29.3 percent of the parties used boats, 34.3 percent fished from the bank, and 4.5 percent used floaters. On weekdays none of the differences were significant. On weekends floater fishermen had the smallest party size, caught the most poundage, and the most pounds per hour. Bank fishermen fished the fewest hours.

CHAPTER VIII

RELATIONSHIPS BETWEEN CREEL STATISTICS

In order to utilize the data gathered in the present survey to plan future surveys, it is important to study the relationships among the creel statistics. To keep continuing checks on the fishing quality of these state owned lakes, surveys designed primarily to obtain indices of fishing success would be valuable. In this case, it is important to know the correlations between catch rate and the other creel survey statistics, such as hours fished and catch. The relationship to hours fished is particularly important in any creel survey design of the roving type in which a checker traverses the fishing area at appointed intervals interviewing fishermen in the act of fishing (Robson, 1961; Johnson and Wroblewski, 1962). Such interviews of incompleted trips have a greater probability of contacting those fishermen who fish the longest. Any measure that correlates highly with the number of hours fished will be estimated with a bias in the roving type design. The reverse bias could hold true in short segment sampling of completed fishermen in which parties fishing the shorter number of hours would be sampled more frequently. This was true in the morning samples taken in the present survey, where only those parties leaving before noon were interviewed while those who started early in the morning but fished a long enough period to carry them into the afternoon were missed. For these reasons

the relationship between party size and hours fished and number caught and hours fished were studied. For each comparison correlation coefficients were computed. First and second degree equations were calculated and analyses of variance used to determine whether or not the reductions in variation due to the linear and then the curvilinear term were significant. Since in certain surveys it may be valuable to utilize statistics from successful fishermen only, to obtain a measure of fishing success that might be more sensitive to actual changes in the fish population, all of the above procedures were applied to that group as well as to the total. Analyses were performed for each lake's data separately for both weekdays and weekends.

Catch Rate Versus Hours Fished

The relationship between catch rate and hours fished was examined in three ways. A correlation coefficient was calculated separately for weekends and weekdays between both catch-per-hour in pounds and in numbers and hours fished for parties (Table XXXIV and XXXV). Only Kingfisher weekdays, Kingfisher weekends, and Schultz weekends had correlation coefficients that were significant, and for Kingfisher days the correlation coefficient was not significant for pounds-per-hour. In the latter case, most of the catch consisted of channel catfish in which for some unknown reason, the larger size fish comprised the smaller numerical catches.

A series of analyses of variance were performed to test whether or not the relationship between catch rate and hours fished could be described by a straight line with a slope significantly different from zero and also whether or not this variation was reduced by a

curvilinear regression. Slope values were significantly different from zero only for those cases where the correlation coefficients were significant and in no case did a curvilinear equation have a significant fit.

The r^2 values in every case indicated that only very small proportions of the variation was accounted for by the covariable. The highest r^2 value was 0.07. To view the effect of this relationship from a practical standpoint, one can examine the effect of increasing fishing time on catch-per-hour. To increase the catch-per-hour by one fish, the trip length would have to be increased by 16 hours on weekdays and 20 hours on weekends for Kingfisher and by 13 hours on weekends for Schultz.

When fishermen who were unsuccessful are omitted a different picture results. The successful, and thus probably the better fisherman in every case showed a negative correlation (Table XXXVI and XXXVII) indicating that increasing length of the fishing trips would result in a lower catch-per-hour. Of the forty possible correlation coefficients, eleven were significant: Roman Nose, weekday - number, weekend - pounds; Hall, weekday - pounds, weekend - numbers and pounds; Burtschi, weekday - numbers and pounds, weekend - numbers and pounds; and Ozzie Cobb, weekday - numbers, weekend - pounds.

Analyses of variance revealed significant slope values for the linear regression of the above cases but in no case did a curvilinear regression give a significant fit.

Unlike the case where the unsuccessful fishermen were included two of these correlation coefficients indicated fairly large

relationships for the highest r^2 values (0.20 for Roman Nose weekday - pounds and 0.17 for Hall, weekday - pounds). All of the other r^2 values however, were less than 0.10.

Thus in designing surveys to obtain a catch-per-unit effort for all fishermen calculated by dividing total catch by total effort a survey designed so that the parties fishing the longest time were sampled either more or less frequently than their proportion in the population would not be biased. However if this index was based solely on the results of successful fishermen, a negative bias would result from over sampling the longer trips and the reverse would occur if they were under sampled.

Catch Rate Versus Catch

The relationships between catch rate and catch were significant in all cases when all fishermen were considered both for correlation coefficients and linear regressions (Table XXXVIII). This would be expected because the difference between successful and unsuccessful fishermen might cause a significant relationship between catch rate and catch. The F values for the reduction of variation as a result of using a second degree equation approached significant levels in several cases and a curvilinear regression had a significant fit for Kingfisher weekends, where the curve indicated an initial increase followed by a leveling off. The curve was slight as the regression equation was:

$$Y = -0.0259 + 0.1910\ x\ + 0.0040\ X^2$$

where Y = catch rate

X = catch.

Strong correlations were still evident when only the successful fishermen were considered (Table XXXIX). Apparently one of the reasons the most successful fishermen caught more fish was because of a higher catch rate rather than longer fishing time. The correlation coefficients were quite large. Except for Roman Nose weekdays, where there was no significant relationship, the covariates accounted for from 14 to 62 percent of the variation observed. These correlations indicate that any bias on the part of a creel checker to sample the larger catches would bias upward the catch-per-unit effort statistics.

Catch Rate Versus Party Size

Correlation coefficients were calculated for catch rate in numbers-per-hour and party size both for the situation when all the parties were considered and when only successful parties were used (Tables XL and XLI). In every case, the correlation coefficient was negative. Even though very few of these were significant, the fact that all were negative gives credence to the conclusion that larger size parties did have a tendency to catch fewer fish. Watt (1959) found a negative correlation in a smallmouth bass fishery in Lake Huron. He considered this due to gear competition but it could also be a result of poorer anglers fishing in larger parties. Correlation coefficients were significant only for Dahlgren weekends, Burtschi - weekends, and Schultz - weekdays and weekends when all trips were considered and for Burtschi - weekends, Dahlgren - weekends, Ozzie Cobb - weekends, Schultz - weekends, and Vincent - weekends when successful trips only were considered. The largest significant r^2

value was only 0.09, which indicated that the relationship was of little effect.

When the correlation coefficients were compared for each category for the total fishermen versus the successful only fishermen there was a definite increase in correlation evident (Table XLII). Of 20 possible comparisons there were only three cases where the absolute value of the correlation coefficient was smaller when the total number of fishermen were used and in those cases the differences were very slight while many of the negative differences were quite large. A Wilcoxin signed rank test was applied to these data and the difference was significant. This indicated that in most cases zero catches were distributed among parties of all sizes but that with the removal of these cases there was more evidence for a slight decrease in catch rate with increasing party size.

Linear and curvilinear regressions were computed. The linear regression slope values were significant for those lakes with significant r values but in no case did the second degree equations reduce the variation significantly. For most of the significant linear regressions, the slope values were low. However, for Burtschi weekends for successful fishermen the B value was -0.303 which would result in a decrease in catch rate by approximately one fish with an increase in party size of only three. The only other cases where the effect would be major were Schultz and Ozzie Cobb weekends where an increase in party size by about five would decrease the catch per hour by one fish. Even though the changes appear slight, it would be advisable to caution any creel checkers who would be taking only a sample of the fishermen present on these lakes about the necessity of not sampling the parties

with any bias as regards to party size.

Party Size Versus Hours Fished

The correlation coefficients between party size and hours fished when all fishermen were considered were significant only for Roman Nose weekdays, Schooler weekdays and weekends, Schultz weekends, and Burtschi weekdays and weekends (Table XLIII). The correlations were negative for Schultz, Roman Nose and Burtschi weekdays. In those cases the reduction in variation due to the covariate were very slight as the r^2 values were only 0.05 for Roman Nose, 0.02 for Schultz and 0.01 for Burtschi weekdays. Only in the case of Schooler were the reductions in variation of any magnitude with r^2 values of 0.25 and 0.44.

When just successful parties were considered, only the relationship for Schooler remained significant (Table XLIV). Kingfisher weekends were also significant. In all three cases the relationship was positive and of a reasonable amount of magnitude, the r^2 values being 0.48, 0.56 and 0.52.

The analyses of variances both for all fishermen and for successful fishermen only indicated significant linear regressions where the correlations were significant, but in no case gave a significant curvilinear regression. The actual magnitude of the increase in party size as a result of increase in hours fished was minimal for Burtschi in all cases, but was quite high for Schooler in all cases and for Schultz weekends when all fishermen were considered. The latter slope values indicated an increase of one fisherman per party for a four to five hour increase in hours fished. For Roman Nose weekdays all fishermen, the decrease in party size would occur with a change in

hours fished of the same order of magnitude.

A creel survey procedure that was biased towards sampling parties fishing different lengths of time in different proportions than they were represented in the population could provide biased information on the number of persons fishing. Since the catch rate decreased with increasing party size, the estimate of catch-rate would be biased where party size was related to number of hours fished and the sample was not representative in this regard.

CHAPTER IX

EVALUATION OF STRATA WITHIN WEEKDAY-WEEKEND PERIODS

As discussed under the section on the design of the survey, access areas, cycles, days, and time of day (a.m. and p.m.) were used as strata in selecting the sampling schedule. An evaluation of the effectiveness of such strata for the creel statistics of party size, number caught, pounds caught, number caught per hour, and pounds caught per hour, hours fished, and man-hours fished was conducted by the use of analyses of variance computed separately for each lake for both weekdays and weekends. The basic analyses tested the following terms: area, cycle, day, time, day X cycle, and time X cycle. When terms did not apply in a particular case they were eliminated from that analysis. Cycles were not part of the design on Lakes Kingfisher, Schultz, and Vincent. On Lake Schooler on weekends no morning versus afternoon comparison was possible as a whole day sample was taken rather than two half days. In addition to the above mentioned comparisons analyses of variance were computed for the ratio of resident/ non-resident fishermen and of female/male fishermen to determine whether or not these items might be important considerations in designing strata.

Area Comparisons

Differences between statistics gathered at the various access

areas were tested for significance for Lakes Beaver, Burtschi, Hall, and Schooler (Table XLV). These differences were not significant on Beaver or Schooler in any case. For Burtschi two of the eight possible comparisons were significant. These were the weekday values for parties and the weekend values for hours fished. For Lake Hall, the differences were significant for number of parties on weekdays and weekends, for hours fished on weekends, pounds harvested on both weekdays and weekends, and pounds-per-hour on weekdays only. Apparently only for Lake Hall was there a consistant difference between the data collected at the different access areas. In Table XLVI it can be seen that these differences were all in the direction of larger values in area one.

Cycle Comparisons

As might be expected, cycle differences were usually significant. In Table XLVII are listed the cases where such differences occurred. Parties, hours and pounds caught followed a general curve with peak effort and catch in the April, May, June period. No other peaks were evident. However, the late fall cycles received heavier fishing than the mid-winter period of December through March. The distribution of number of parties by cycle is presented in Table XLVIII. These figures are the average value per half day; the trend is meaningful although the actual values are not particularly so, as they are averages of both morning and afternoons and it will be demonstrated that the afternoon values were higher. The distribution of pounds caught per hour of fishing time (Table XLIX) was much more erratic than the other categories. However, there is still a definite peak in the

April through June cycles.

There were some instances where the interaction terms for day X cycle or time X cycle were significant. Of the 46 analyses of variance with day X cycle terms four were significant. Time X cycle terms were significant in 14 of 42 cases. A review of the actual values revealed no discernable trend that would alter the interpretation given above.

Day Comparisons

The analyses of variance presented overwhelming evidence that the differences between the days of the week for weekdays and between Saturday and Sunday for weekends were not important, as far as number of parties, hours fished, catch in pounds, and pounds-per-hour were concerned. In Table L are presented the values for the categories in which significant differences existed. No pattern was evident in these values. Perusal of the values of the categories for which differences were not significant also indicated the lack of any discernable pattern.

The interaction term between days and cycles was significant for Lakes Roman Nose for parties, on both weekdays and weekends, and on weekdays only for pounds-per-hour. Pounds harvested were significant for Beaver weekends and pounds-per-hour for Dahlgren weekdays. These differences were apparently a result of zero values for certain day-cycle combinations. These could be caused by such factors as inclement weather. An example of the effect of such zero values can be seen in the hours fished weekend values for Lake Roman Nose where in cycle six no one fished on Saturday and 26.0 hours were recorded on Sunday, while in cycle eight 24.0 hours were logged on Saturday

and none on Sunday. None of the patterns of day-time cycle values invalidated the general conclusion of a lack of meaningful day of week variation.

Morning and Afternoon Comparisons

In 17 of 19 possible comparisons there was a significant difference between the number of parties fishing in the morning and in the afternoon (Table LI). In only two of the 19 pairs did the greater number of fishermen complete their trips in the morning. On Lake Roman Nose weekends the values were 3.2 and 3.1, and on Lake Hall the values were 1.4 and 1.0 for a.m. and p.m. respectively. The difference was significant in the latter but not in the former.

As would be expected the differences in hours fished paralleled those for parties. The magnitudes of the differences were greater in favor of the afternoon period (Table LII). In no case did the number of hours fished by anglers completing their trips in the morning exceed those who fished in the afternoon.

Fewer of the comparisons of pounds caught were significant (8 of 17) when contrasted with the previously mentioned statistics (Table LIII). However, in every case but one (Hall - weekends) the afternoon surveys showed greater poundage than in the morning. Only for Dahlgren weekdays were the values (2.20 and 2.26) similar.

The catch in pounds per hour (Table LIV) showed no trend in the morning-afternoon differences. Only six of the 19 comparisons had significant differences. Of these six, the catch-per-hour value was highest in the morning in only one case, but in the 14 non-significant comparisons the morning values were higher in six while

in one case the values were identical.

In several instances the time X cycle interaction terms were significant in the analyses of variance. Whenever interaction occurs a closer scrutiny is required, in this case, to determine whether or not the differences from cycle to cycle invalidate the overall conclusions. On Lake Hall these interactions were significant for parties, hours, pounds, and pounds-per-hour for the weekdays. This was a result of practically no fishermen being successfully interviewed in the morning hours. Pounds caught and number of parties had significant interactions on Lake Roman Nose - weekdays. There was no reasonable pattern to explain these differences. For Lake Burtschi hours fished and number of parties showed significant interactions. This appeared due to a very small difference in favor of the morning in cycle one, in which there was very little fishing, combined with large differences in favor of the afternoon in the last two cycles when fishing pressure was heavy. Lake Schooler on weekdays had a greater number of hours fished in the first three cycles but the reverse was true in the last cycle in the fall. Lake Beaver - weekends, Lake Dahlgren - weekdays, weekends, and Lake Hall - weekdays, weekends had significant time-cycle interactions for party size. In nine of the 12 cycles in Beaver, seven of ten in Dahlgren, and two of 13 in Hall the afternoon values were higher. The latter case was the only one where the morning number of parties surveyed were higher than the afternoon number. In the former two cases the magnitude of the differences as well as the frequency favored the afternoon period.

Ratio of Resident to Non-Resident Fishermen Comparisons

On only three lakes was the proportion of non-resident fishermen relatively high, i.e. above 20 percent (Table VII). These were Lakes Hall, Schultz, and Vincent. On Lake Schooler no non-resident fishermen were recorded. A review of the analyses of variance of the non-resident ratio revealed very few cases where the factors tested were significantly different (Table LV). There was no interpretable pattern to these differences.

Sex Ratio Comparisons

Analyses of variance were used to compare sex ratios (number of females/number of males). The categories where significant F values were found are presented in Table LVI. There was no pattern in the area, cycle, day, and time X cycle differences. In the latter case the presence of zero values were probably responsible for the significance. In six cases the F values of morning versus afternoon data were significant. In each of these cases the afternoon ratio was higher. In Table LVII are presented the morning and afternoon ratios for all comparisons. In 18 of these comparisons the ratio was higher in the afternoon. This difference was significant in a Wilcoxin signed rank test.

CHAPTER X

COMPARISON OF DIFFERENT MEASURES OF SPECIES CATCH PER UNIT OF EFFORT

In evaluating lakes in a sport fishery the prime consideration is fisherman satisfaction. This is usually measured as a rate of catch. This rate is commonly expressed in terms of numbers and/or pounds-per-unit of effort. This effort may be expressed as days fished, fishermen trips, or man-hours. In this study the catch-per-hour fished was used and this was calculated by dividing the total catch for a particular category by the appropriate hours as recommended by Lambou (1966). This is in contrast to the averaging of the catch-per-hour of the various parties as done by Tait (1951). The latter value gives an equal weight to all parties regardless of differences in the amount of hours fished.

In reality, fisherman satisfaction is not only an interrelated function of both numbers and pounds but also of species desirability and prestige. Obviously, if the size of a particular species in a given fishery is too small no amount of success in capturing numbers will be satisfactory. Yet a fisherman might not be satisfied unless he caught several sunfish in a day's fishing but would be happy with only one bass, although the total weight of the latter might exceed that of the former. However, if the species were a prestigious one, such as the muskellunge, a very low catch rate in terms of both numbers and pounds might be considered satisfactory. Both numbers and

pounds-per-hour were calculated in this study. Since the results paralleled each other only the numbers-per-hours statistics will be used in this discussion. Apparently the average size did not vary enough between lakes to confuse this issue.

In determining the catch rates, the question arises as to what is the best measure of effort to use to compute this value for each species or species group. Lambou (1966) has argued for the use of the effort directed towards a particular species. Theoretically, this is the best possible procedure in terms of sensitivity to changes in fishing success. This method has been followed successfully by Davis and Hughes (1965 and 1967) and Lambou and Stern (1959). However, in the situation encountered in the lakes included in this study attempts to determine effort by species sought proved unsuccessful. Apparently the fishermen on these lakes too often fished for, and caught any and all species. Moyle and Franklin (1957) found a similar situation in Minnesota. Mraz and Threinen (1957) in attempting to use this procedure on Brown's Lake, Wisconsin, had difficulty in determining which boats were bass fishermen. Of course, devotees specializing in certain species were present but even if these were isolated there would still be a reservoir of the catch that went to fishermen who fished for anything, or several different species on the same trip. It would be very difficult to separate effort as to the different species when an angler fished for more than one species during his trip. It is my opinion that the effort directed towards a particular species could in many cases be elicited by a skilled interviewer who understood the fishery but such interviewers are rare. In any case, determinations would often be subjective.

One standard way to express catch-per-unit effort for species is to divide the number caught of a particular species by the total effort (Carter, 1957; Hanson, 1965; Johnson, 1957; Neuhold and Lu, 1957). This has the disadvantage of obscuring comparisons between lakes and times for a particular species because of differing amounts of efforts directed at other species. Rupp (1961) suggested that the catch-per-unit effort be calculated using the catch and effort of those fishermen who accounted for 50 percent of the catch. This particular procedure tends to eliminate the casual or novice fishermen from consideration. When this procedure is carried out on a species basis in a mixed species fishery, such as was present on the lakes in this study, one can be fairly sure that these most successful fishermen were directing their effort to the species in question. The disadvantage of this method is that expert fishermen may be quite successful even when the number of fish available has decreased and thus the decline in the catch-per-unit effort would lag behind the decline in the fishery. A fourth possible procedure is to calculate catch-per-unit effort on the basis of the catch and effort for only successful fishermen capturing a particular species. Although this eliminates large amounts of effort which does not produce a catch of the species concerned it may be too sensitive to fluctuations in the number of anglers who by pure chance catch or fail to catch a fish. Stevens (1958 and 1959) used this latter procedure in Santee Cooper Reservoir in South Carolina. A fifth procedure was proposed by Harrison (1962) who used the catch rate of fishermen capturing 1, 2, or 3 more fish. This latter method is not particularly useful in comparisons among bodies of water if conditions vary.

In Tables LVIII to LXI the number caught-per-hour for bass, crappie, catfish, and sunfish are presented for each lake - weekday-weekend combination. These statistics were calculated using just the fishermen who caught 50 percent of each species, the successful fishermen for each species, and the effort of all fishermen. The most obvious contrast between these measures is their order of magnitude with the first two being considerably larger than the last. However, the size of the relative differences between lakes was much greater when all effort was considered. The weekend values were consistently less than the weekday values in all three methods (Tables LVIII to LXI).

Correlation coefficients were calculated between the weekday and the weekend values for all possible pairs (Table LXII). The only correlations of any size were those between the values calculated between successful fishermen capturing 50 percent of the catch and all successful fishermen. This clearly indicates the undesirability of the catch-per-unit effort values calculated on the basis of the catch of a species divided by the total effort expended. There were also seemingly erratic differences between the two groups of successful fishermen in the relative standings of the catch-per-hour values. This indicates the need for a definitive breakdown of the catch-per-unit effort for species groups of fishermen in detailed studies of fishing success. This requires concentrated effort to identify such fishermen during the survey. The percentage of the parties who caught 50 percent of the catch of each species group is given in Table LXIII. There was no pattern of differences in these values. One aim of fishery management is to spread the available fishing to the greatest

possible number of fishermen at acceptable levels of success. The aforementioned statistic may be an appropriate measure of this desired goal. However, these values can fluctuate widely particularly if the number of fishermen interviewed capturing a particular species is small.

CHAPTER XI

HOURLY DISTRIBUTION OF FISHERMEN DEPARTURES

Pfeiffer (1967) proposed that a non-uniform probability creel survey would be valuable in improving efficiency. He demonstrated this for a lake in Kentucky. In his proposal the effort of the creel checker was proportioned on the basis of bi-hourly fishing pressure.

In Tables LXIV and LXV are presented the hourly percentage distribution of fishermen interviews for the Oklahoma state owned lakes. These values are for the times that the parties departed from the lake for those lakes for which this data is available. The pattern of distribution of fishermen departure times did not differ between weekdays and weekends. The only trend appeared to be a concentration of departures around noontime and generally again in the late afternoon although there were lake-to-lake differences. Specifically, Lakes Hall and Roman Nose did not show the increase in late afternoon.

Other studies have listed fishing pressure by hour based on counts of the fishermen present on the body of water in question. Churchill and Snow (1964) found a peak in fishing pressure at 3:00 p.m. with a fairly steep decline to 8:00 p.m. If the time of departure had been plotted, undoubtedly there would have been a peak in the late afternoon. Grosslein (1961) found few hourly differences in the pattern of the distribution of fishing pressure in Oneida Lake, New York. However, there was an upswing in the 8:00 to 9:00 p.m. period.

Alexander and Shetter (1967) studying fishing on the Au Sable River in Michigan also found a peak in the twilight hours (specifically 7:30 to 8:30 p.m.). However, both of these studies were carried out in areas with Daylight Savings Time while at the time of this present study, Oklahoma was still under Standard Time. Schmulback (1959) found the greatest fishing pressure in the summer took place between 2:00 to 4:00 and 6:00 to 8:00 p.m. and in the fall between 1:00 to 3:00 and 3:00 to 5:00 p.m. in the Des Moines River, Iowa.

In using the data collected in this present study to plan future surveys the time change to Daylight Saving Time should be considered. However, behavior habits of fishermen may be slow to adjust to the new conditions. In any case, concentrating sampling effort on the periods when departures are most frequent would increase the efficiency of sampling numbers of fishermen.

CHAPTER XII

IMPLICATIONS FOR CREEL SURVEY DESIGN

When creel surveys are being designed, it is important to have the desired goals definitely outlined. Only if these are clearly in mind can an appropriate design and sampling size be determined. Possible desired estimates in creel surveys are:

Total catch in numbers

Total catch in pounds

Total fishermen effort

Catch rate in numbers

Catch rate in pounds

Methods of fishing

Species composition of the catch

Catch rates by species

Methods of fishing for various species

Seasonal distribution of the above

The above estimates are the basic ones needed for a biologically oriented study of a fishery. However, there are other statistics that evaluate economic and sociological aspects of a fishery. Included among these are estimates of:

Distance traveled to fish

Non-resident - resident breakdown

Sex breakdown

Age breakdown

Money spent for fishing trips

A design optimized to obtain data for one of these pieces of information may not be optimum for some other piece. In fact it would be virtually impossible to construct one sampling design that would be optimum for more than a few pieces of information. As Cochran (1963) has pointed out, when several pieces of information are desired from a survey a compromise between designs optimized for different pieces of information is necessary. Therefore, it is especially crucial that the designer of a survey establish his priorities before selecting his design. This chapter will discuss some of the factors that should be considered in making decisions on creel survey designs and present a proposed design for monitoring the fishing success on these Oklahoma state owned lakes.

Creel Survey Design Based on the Distribution of Fishing Effort

Previous studies reported in the literature have apportioned sampling intensity based on the distribution of effort if they have apportioned it at all. This is the assumption behind the greater sampling ratio of weekends and holidays used in many studies such as Cole and Finkelstein (1959), Frisbee and Ritchie (1965), Gasaway (1967), Lambou and Stern (1959), Robson (1960) and Trenary (1961). There have been others who have sampled according to differential distribution of effort. Taylor and Carroll (1967) on Norris Reservoir, Tennessee, used probability related to effort to select times for making airplane flights to make fishermen counts and they included Wednesday in the weekend strata because local businesses

closed that afternoon. Elser (1960) determined that the time period 11:00 a.m. to 2:00 p.m. had the least variation and the peak fishing pressure in the Northeast River in Maryland so he made his counts at that time. Green (1968) in Dryden Lake, New York, weighted morning and afternoon strata by the proportion of effort expended in the previous year.

Abramson and Tolliday (1959) reported a survey where sampling was based on the optimum allocation technique outlined by Cochran (1963). In this method samples are allotted to the various strata proportional to the variance of that stratum. Using previous years' data for fishing pressure at Moss Landing Pier in Monterey County, California, they determined the number of days necessary to sample in order to obtain a 95 percent confidence interval with a one-half width of 15 percent of the total effort for a simple random sample, a sample allocated proportional to the effort, and the optimum allocation. Sundays and holidays were one stratum, Mondays and Fridays following holidays plus Saturdays were another, and the remaining weekdays the third. The equivalent sample sizes were 100.9, 54.0, and 39.1 days respectively and thus the optimum allocation was definitely superior. Tait (1953) in his studies of Michigan lakes also found that optimum allocation based on effort was the most efficient. Obviously, if a survey is primarily designed to estimate effort then a sampling intensity should be related to the distribution of effort. If, however, other items form the objectives of the survey then a design based on the distribution of effort will be satisfactory only insofar as those items are correlated within the distribution of effort.

Monthly percentage distribution of the variance of the hours

fished are given in Table LXVI. These values are given separately for weekdays and weekends and were computed for the half day totals.

If overall totals are to be estimated in future surveys, then stratification based on fairly wide seasonal periods would be useful. I would suggest the following stratification: November-March, April-June, July-August, and September-October. If monthly values were desired, the schedule would have to be adjusted accordingly. The seasonal distribution of fishing effort is peculiar to the fishery in question depending on the location of the lake and the major species present. For example, in this study, the heavier mid-summer fishing on Lake Roman Nose was undoubtedly due to its attraction as a scenic state park to summer picnickers who also fished.

Within these periods, the question arises as to what further stratification is necessary. The average of the weekday-weekend percentage distribution of effort was 53.5 on weekdays and 46.5 on weekends for parties, 50.7 to 49.3 for fishermen, and 49.2 to 50.8 for hours. There were, however, lake-to-lake variations (Table XI). The overall ratios support the decision in this survey to sample the two strata equally. The expected heavier daily fishing pressure on weekend days was the basis for the decision to sample these days at a higher rate. If the days in the two strata had been given equal weight then the weekend days would have received only 28 percent rather than the 50 percent actually used.

Although this relatively equal distribution of sampling effort was reasonable in this study based on the effort expended, other studies have shown that such equal proportioning of fishing effort does not

always occur. In a resort area lake in Wisconsin, Churchill and Snow (1964) found that only 32 percent of the fishing was done on weekends in the summer while in the winter the reverse was true with the weekends accounting for 64 percent of the fishing effort. Boland (1960) in Parvin Lake, Colorado, found that approximately two-thirds rather than half of the effort and catch occurred on the weekends. Obviously the distribution of fishing effort for the particular lake in question should be evaluated before apportioning sampling effort to weekday and weekend strata and, in fact, before even deciding to use these strata.

Within the weekday and weekend strata the question arises as to whether any further stratification is necessary. The analyses of variance computed for the data collected in this survey demonstrates clearly that there would be no advantage in further consideration of the days of the week within these strata. The greater amount of effort recorded for fishermen who finished their trips in the afternoon indicated that the procedure of giving equal weight to morning and afternoon periods was not the most efficient sampling scheme. The overall percentage distribution of afternoon to morning hours fished was 71.2 to 28.2. The distribution of sampling effort should probably follow this ratio. The heavier afternoon effort agrees with Green's (1968) finding in a warm water lake in New York State and Tait's (1951) work in Michigan but not with Mraz (1964) who found equal effort in a Wisconsin lake. Green (1968) altered his sampling effort for morning and afternoon periods based on the distribution of fishing effort.

In roving surveys it is worthwhile to consider whether or not the party size, the hours fished, or the man-hours fished differed

according to the type or method of fishing. Live bait fishermen had larger party sizes than lure users who in turn had a larger party size than dead bait parties. Parties using live and dead bait fished longer and had more man-hours than those parties using articifial lures. Comparison of parties using boats, floaters, or fishing from the bank did not produce as many overall significant differences, although floater fishermen did fish in the smallest parties. In addition to the above there were significant differences that were present in the analyses of variance conducted on individual lakes. Lopinot (1964 and 1965) studied state owned lakes in Illinois and reported that boat fishermen spent a longer time fishing than bank anglers in 14 of 15 cases. In the other case, the boat fishermen averaged 3.4 hours fished while bank parties spend 3.9 hours fishing. Moyle and Franklin (1955) found that boat anglers had longer fishing trips than their shore counterparts in a study of 14 Minnesota lakes. All of this information emphasizes the necessity for the sampling schedule to have no biases in sampling fishermen who used different types and methods of fishing.

Creel Survey Design Based on the Distribution of the Catch

Carlander et al. (1958) pointed out that little attention has been given to criteria other than fishing effort in designing creel surveys. A review of current literature demonstrates that this conclusion is still valid. If the main object is to estimate the total catch then the sampling scheme should be designed to optimize that value by sampling the periods with the greatest variation in the catch with the highest sampling ratio.

There were strong seasonal differences in the catch. The percent distribution of the variances of the estimated catches for each lake are presented in Table LXVI. The sampling effort should be proportioned throughout the year on this basis. If the actual distribution of the catch can not be estimated from previous years data then the best judgment available should be utilized. If the sampling is to be optimized for the yearly totals then the periods should be as large as possible and the samples taken randomly within that period. However, if specific seasonal totals are desired then the strata must of necessity be the periods (such as months) for which the seasonal estimates are wanted. On the basis of the total catch in this study I would suggest the following periods: November through March, April, and May through October.

As can be seen in Figure 2, distribution of the catch does not always follow exactly the distribution of fishing effort. A higher catch in April relative to effort was evident in these data. Other surveys have also pointed out a contrast between the seasonal distribution of effort and that of catch. Kathrein (1953) found peak harvest in Clearwater Lake, Missouri, to occur in the March through May period, while effort was highest from June through August. Jackson (1958 and 1966) found catch to be highest in March and April on Lakes Spavinaw and Eucha in Oklahoma, while the number of hours fished were highest in July through September in the former and June and July in the latter. Byrd (1959) however, reported that the amount of effort and the amount of catch paralleled each other in the state owned lakes in Alabama which were managed for bass and bluegill.

Within these periods the question is how best to further stratify

the sample. The proportioning of the catch into weekday and weekend periods varied from lake to lake (Table XI). The mean of the proportions for the various lakes was 58.0 for weekdays and 42.0 for weekends for numbers and 55.6 and 44.4 for pounds. These values support the frequently used procedure (and the one used in this study) of sampling one weekday and one weekend day per week mentioned previously. Yet the proportion of the catch on weekdays was greater than the corresponding proportion of effort. The analyses of variance of the data from these Oklahoma lakes indicated that no further consideration of the exact day within each period needs to be made.

The heavier catch recorded in the afternoon as compared to the morning points to the inefficiency of chosing one morning and one afternoon half day to sample for each weekday and weekend period as was done in this survey. The overall percentage of the pounds reported in the afternoon was 67.9 and in the mornings 32.1. Mraz (1964) found numbers caught to be equally distributed between a.m. and p.m. periods but for the greater weight to be caught in the afternoon and evening in Brown's Lake, Wisconsin. I would suggest that a sampling schedule be weighted on the basis of the fish caught. Further evidence of the need to do this was the significant correlation between catch and hours fished, which means that a sampling scheme which overweighted the morning period would sample those fishermen who fished for shorter periods with greater frequency and thus underestimate the catch.

In a roving creel survey designed to estimate total catch, fishermen using different types and methods of fishing may be encountered. There were numerous significant differences in the analyses of

variances for the numbers and pounds by parties using either dead bait, live bait or artificial lures, and also for the tests among anglers using boats, floaters, or fishing from the bank. Therefore any creel survey design should not be biased in favor of one or more of these categories. Possibilities for such a bias are particularly present in roving surveys where a moving creel checker may not be able to contact all types of fishermen in proportion to their abundance in the population. The pattern of the differences between the various types and methods of fishing found in the present study were not consistent enough to recommend concentration of the sampling effort on one or more of these groups according to their contribution to the catch rather than their abundance in the population of anglers on the particular lake in question. Numerous surveys have pointed out the differences in the catch rate of anglers utilizing ways of fishing and this will be discussed in the next section. However it is logical to assume that the combination of such catch rate differences combined with the previously discussed differences in the length of fishing trips would make an impact in the catch.

Creel Survey Design Based on the Distribution of Catch-per-Unit Effort

Possibly the most frequently sought statistic in creel surveys is some measure of fishing quality. This is almost invariably included in surveys where the total catch and effort are estimated and is also sometimes desired by itself. This is especially true in situations where the resources for intense surveys are not available. In sport fisheries the primary goal is fisherman satisfaction concurrent with effective use of the resource. Therefore some measure of the fishing

quality is desired. Some expression of catch-per-unit effort is possibly a better indicator of this than the total harvest or effort expended. The most common measure of quality is the catch (in terms of both numbers and pounds) per man-hour (Lambou, 1966). This has been the value used in this study although the simpler expression catch-per-hour has been used. I concur with Lambou's (1966) recommendation that this is a preferred statistic to the only other commonly used measure - catch-per-trip - which does not take into account the variation between trip lengths.

The question then is how best to sample to obtain such a measure. There have been two types of average catch-per-unit effort calculations. The first is obtained by dividing the total estimated catch by the total estimated effort, and the second is the average of the individual catch-per-unit effort calculated for each fisherman or party. The former, as mentioned previously, was the method used in this study. Grosslein (1961) has pointed out that the latter would not be equivalent to the former in a survey where probability of contact with a fisherman was correlated with that fisherman's trip length if there was a relationship between time fished and catch-per-hour. He found no such correlation in data from Oneida Lake, New York. Di Costanzo (1956) also found no such correlation in his study on Clear Lake, Iowa. In the present study no significant relationships were found between numbers-per-hour or pounds-per-hour both for all fishermen and for successful fishermen only with trip length. These findings indicate that either measure could be used successfully on these lakes.

The seasonal distribution of the variances of the catch-per-hour were examined on all lakes (Table LXVI). In general there were no

monthly trends of the magnitude present in the catch and effort statistics. However, the midwinter catch rates were high while the pressure during those periods was low. This summer-winter contrast has been reported in other studies such as Churchill (1957) in Wisconsin and Cole (1968) in Arkansas. Where the winter fishery is distinct this should be considered either as a completely separate survey or as a separate stratum. The analyses of variance of cycles of data collected from the Oklahoma State owned lakes did produce an indication of an April through June peak although it was not very pronounced. Midwinter samples were often omitted from this analysis because of incompleteness of the data.

It is tempting to design creel surveys aimed at obtaining a catch-per-unit effort on the basis of fishing pressure by concentrating sampling on those periods with the greatest effort more heavily than the distribution of effort would warrant. Thus the greatest number of fishermen would be contacted with the least expenditure of effort. There are two ways this could be accomplished. The first is by concentrating on contacting those parties that had the largest number of fishermen and the second is to concentrate survey effort on those periods (such as weekends) when the fishing pressure was heaviest. These are reasonable procedures only if fishing success was not correlated with these factors. For both total and successful fishermen only categories investigated in this study a small decrease in number caught-per-hour with increasing party size was indicated. On weekends when the number of fishermen was greatest, the average party size was larger, the percentage of successful fishermen less, and the catch-per-hour lower than on weekdays. Samples designed to estimate

catch-per-unit effort should have given an underestimate if they had been directed mainly toward sampling larger size parties on weekends. This contrasts with Grosslein's (1961) conclusion of no weekday-weekend differences of practical significance and with Hanson (1966) who found no close relationships between effort and success on Glendale Lake, Illinois. Within weekday and weekend strata there was no evidence for daily differences in catch-per-unit effort. Morning and afternoon comparisons of pounds caught-per-hour indicated no overall significant differences. Therefore it would seem reasonable to concentrate efforts in the afternoon periods when the effort and catch were greatest. Given the same variation in both periods the standard error of the estimated values would be smaller for the afternoon data as the number of interviews would be larger. Grosslein (1961) also found no significant changes in catch rate in Oneida Lake, New York, in the period from daylight to dark.

Catch-per-hour in terms of pounds and numbers did not appear strongly related to whether or not the parties used lures, live bait, or dead bait. However, floater fishermen in general caught larger fish than boat fishermen who in turn caught more pounds of fish than their counterparts fishing from the bank. These contrasts in terms of weight were significant even though the comparisons in terms of numbers-per-hour were not. Barkley (1960) found that boat fishermen generally had a higher catch-per-unit effort than bank fishermen in all but a very few cases in his study of fishing on Mississippi reservoirs. Lopinot (1964) however, found that catch rate was about the same for boat and bank fishermen on Illinois state lakes. Schulmbach (1959) found that boat fishermen had a higher catch rate

than shore users and that wading fishermen caught the least in terms of numbers-per-hour in three of four comparisons for data from the Des Moines River, Iowa. In Schulmbach's fourth comparison, wading anglers did the best followed by boat and then shore fishermen. Stewart (1964) in his study of South Dakota trout waters found lure fishermen caught more fish-per-hour than live bait users. In surveys of Clear Lake, Iowa, boat and dock fishermen were found to do better than shore anglers while those wading caught the most fish-per-hour (Di Costanzo, 1956; and Di Costanzo and Ridenhour, 1957).

In view of this information surveys designed to estimate rate of success should be careful not to bias the sample toward one method or another. Davis and Hughes (1967) reported using separate creel checkers to survey the bank and boat anglers, although they did not mention how they incorporated this information into their analysis. The treating of these two groups as separate strata should improve the accuracy and precision of the estimate. On the basis of this study, surveys designed to estimate the catch-per-unit effort should be stratified on the basis of weekday - weekend effort and be designed to include all fishing on an unbiased basis. Within these strata, however, it would seem valid to concentrate sampling effort at the peak times that fishermen complete their trips. These times could be sampled proportionately if a total were to be estimated and over-proportionately if only an index of fishing success was desired.

Proposed State Lake Monitoring Creek Survey

The present importance of Oklahoma's state owned lakes does not warrant allocation of the resources of the scope of the 1964-65

survey for continuing studies at this time. However, it would be possible to maintain a monitoring survey of the fishing in these state lakes. Such a survey could even be conducted by Ranger personnel who would visit a lake at a given time and stay for a long enough period to interview every party fishing on the lake. Information on hours fished prior to the interview and catch by species would be obtained and would provide basic data necessary for computing an index of fishing quality. Weight and length measurements of the fish should also be taken. Sex, residence, method, and type of fishing for each party, the number of parties on the lake at the time of the check, and the number of fishermen per party should be recorded. These data should be sufficient to maintain a satisfactory evaluation of these fisheries for planning and management purposes.

This creel survey could be conducted in the April through June period of peak catch and effort so that the greatest number of fishermen would be contacted. One weekday and one weekend sample would be appropriate and based on the data of the present survey should be given equal weight in estimating the overall average values. The days of the week and weekend to be sampled should be drawn randomly without replacement. The time that the lake should be visited would be in the periods from 10:00 a.m. to 1:00 p.m. and from 3:00 p.m. to 5:00 p.m. The exact point sampled within these times would depend on logistics. The period to be sampled each day should be done chosen randomly for each weekday and weekend sample respectively. The procedure for doing this follows:

(1) Assign sampling units to each weekday-time period combination.

Day of Week	Time Period	Unit Designation
Mon.	10:00 a.m. - 1:00 p.m.	1
Mon.	3:00 p.m. - 5:00 p.m.	2
Tues.	10:00 a.m. - 1:00 p.m.	3
Tues.	3:00 p.m. - 5:00 p.m.	4
Wed.	10:00 a.m. - 1:00 p.m.	5
Wed.	3:00 p.m. - 5:00 p.m.	6
Thurs.	10:00 a.m. - 1:00 p.m.	7
Thurs.	3:00 p.m. - 5:00 p.m.	8
Fri.	10:00 a.m. - 1:00 p.m.	9
Fri.	3:00 p.m. - 5:00 p.m.	10

(2) Draw one sampling unit at random for each week to be covered.

(3) Assign sampling units to each weekend-time period combination.

Day of Week	Time Period	Unit Designation
Sat.	10:00 a.m. - 1:00 p.m.	1
Sat.	3:00 p.m. - 5:00 p.m.	2
Sun.	10:00 a.m. - 1:00 p.m.	3
Sun.	3:00 p.m. - 5:00 p.m.	4

(4) Draw one sampling unit at random for each weekend to be covered.

A sampling intensity of this level or even one with half of this effort, e.g., one sample each weekday and weekend every two weeks, during the peak spring fishing season maintained on a yearly basis would provide data necessary for successful management of these lakes.

CHAPTER XIII

SUMMARY

A detailed analysis was made of creel survey data collected in a study of ten Oklahoma state owned lakes conducted from December 1964 to December 1965 in order to provide a basis for future creel surveys. These lakes ranged in size from 26 to 180 acres. Estimates were made of the effort, catch and catch rates, and characteristics of the fishermen such as method and type of fishing. The factors to be considered in creel survey design were evaluated.

The basic design of the creel survey was a stratified sample based on weekdays and weekends and access areas. Cycles were established and days of the week chosen randomly without replacement within the cycle. One morning and one afternoon sample were taken for each access area for each day within each cycle. Cycles were separately established for weekday and weekend strata.

Total estimated pounds of fish harvested ranged from 22 to 107 pounds-per-acre. Effort ranged from 138 to 622 hours per acre. The major species captured were white crappie, channel catfish, largemouth bass and assorted species of sunfish.

Missing data were a major problem in this survey. Such data were of three types. The first was caused by failure to survey a particular sampling unit. The second was caused by failure to collect complete information on certain parties because of the lack of cooperation on

the part of the fishermen. The third category consisted of interview forms that had to be rejected because of the failure of the interviewer to fill out the form completely or accurately. The first type caused the estimate for the cycle involved to be based on a smaller sample size. As much information as was available was obtained on the other types and these values were compared with the estimated values from the complete interviews. The comparisons were not too far out of line so the number of parties was estimated using data from these parties while the estimates on number caught per party etc. were based on the complete interviews and then expanded on the basis of the estimated number of parties. There were, however, enough discrepancies between the missing interviews and the overall estimated values to stress the importance of keeping such missing data to a minimum.

In the evaluation of strata it was found that as far as effort and harvest was concerned, weekdays and weekends should be treated separately. The latter period contained almost half of the fishing effort and catch. However, the catch rates were lower on weekends than on weekdays.

Creel survey statistics were compared for parties using different bait types, i.e., artificial lures, live bait, and dead bait, and fishing methods, i.e., boat, bank, heated dock, and floater. The largest group of anglers used live bait and fished from the shore. There were, however, lake-to-lake variations in the proportion of fishermen using each method and type. Anglers using lures, and floater fishermen tended to be the most successful. Floater fishermen caught larger fish. Boat fishermen in general caught more fish and had higher catch rates than their counterparts on the bank.

The various statistics collected in the creel survey were studied for possible interrelationships. Linear and curvilinear regressions were computed along with correlation coefficients for catch rate versus hours fished, catch rate versus catch, catch rate versus party size, numbers caught versus hours fished and for party size versus hours fished. These calculations were performed both for all fishermen and for successful fishermen only. Catch rate (expressed in terms of pounds) was not found to be related to hours fished. Catch rate was significantly correlated with catch but the small magnitude of the correlation coefficients indicated the importance of fishing skill. There was a tendency for larger parties to catch fewer fish. A little over half of the correlation coefficients between number caught and hours fished were significant when all fishermen were considered, yet only three of 20 were significant when only successful fishermen were used. In general, there was no correlation between party size and hours fished.

Factors possibly useful in designing strata were evaluated within the weekday - weekend periods. In the four lakes with different access areas only one showed consistent significant differences between creel statistics collected at the various access points. Seasonal differences were evident mainly in a peak of fishing effort and harvest in the April through June period. There was some indication of higher catch rates in the spring. In addition, catch rates were higher in the winter when the other values were low. There was no overall significant difference between days within the weekday - weekend periods. The afternoon periods were the ones in which the greatest amount of effort and catch were recorded. There was no significant

difference in the pounds-per-hour between the morning and afternoon samples.

Although the computation of catch rates based on effort directed at a particular species in question is undoubtedly the most accurate measure of abundance, such a procedure proved infeasible in this study. Catch rates by species were computed for the data in this study using all effort, effort of fishermen successful in capturing that species, and the effort of those fishermen accounting for 50 percent of the catch. The latter value appears the most reasonable and probably the most similar to one utilizing the effort devoted to a particular species.

The hourly distribution of trip completions was examined. Peak times of departure were around noon and in the late afternoon.

Creel surveys are usually directed towards gaining information on fishing effort, catch and catch rate. The priorities should be established before beginning the survey. Seasonal strata should be used. All three of these statistics were generally correlated for the lakes in this study, although there were some minor seasonal differences in their exact patterns. Since weekends accounted for about half the effort and almost half the catch, the sampling effort should be so apportioned. However, catch-per-unit effort was lowest on weekends and this should be considered in designing surveys primarily to obtain an index of abundance. Afternoons should be samples more heavily than mornings as the effort and catch recorded then was highest. No such difference was apparent for catch-per-hour; thus, a survey designed specifically for that piece of information should concentrate sampling effort on the noontime and late afternoon

periods when most departures occur. Since there were significant differences between creel statistics for fishermen using various methods and types of angling on the Oklahoma state owned lakes, survey designers should consider very carefully whether or not there is any bias in their sampling of fishermen using different ways of fishing.

A roving creel survey during the spring season sampling the peak hours of fishing pressure is proposed for monitoring the fishing on Oklahoma state owned lakes.

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APPENDIX

TABLE I

COMPOSITION OF SAMPLING UNITS USED TO COMPOSE CREEL SURVEY SAMPLING SCHEDULES FOR LAKES WITH ONE ACCESS AREA

Period	Sampling Unit Designation	Day, Access Point
Weekday	1	1, 1
	2	2, 1
	3	3, 1
	4	4, 1
	5	5, 1
Weekend	1	6, 1
	2	7, 1

TABLE II

COMPOSITION OF SAMPLING UNITS USED TO COMPOSE CREEL SURVEY SAMPLING SCHEDULES FOR LAKES WITH TWO ACCESS POINTS

Period	Sampling Unit Designation	Day, Access Point
Weekday	1	1, 1
	2	1, 2
	3	2, 1
	4	2, 2
	5	3, 1
	6	3, 2
	7	4, 1
	8	4, 2
	9	5, 1
	10	5, 2
Weekend	1	6, 1
	2	6, 2
	3	7, 1
	4	7, 2

TABLE III

COMPOSITION OF SAMPLING UNITS USED TO COMPOSE CREEL SURVEY SAMPLING SCHEDULES FOR LAKES WITH THREE ACCESS POINTS

Period	Sampling Unit Designation	Day, Access Point
Weekday	1	1, 1
	2	1, 2
	3	1, 3
	4	2, 1
	5	2, 2
	6	2, 3
	7	3, 1
	8	3, 2
	9	3, 3
	10	4, 1
	11	4, 2
	12	4, 3
	13	5, 1
	14	5, 2
	15	5, 3
Weekend	1	6, 1
	2	6, 2
	3	6, 3
	4	7, 1
	5	7, 2
	6	7, 3

TABLE IV

HYPOTHETICAL SURVEY SCHEDULE FOR A LAKE WITH TWO ACCESS AREAS

	Weekday Sampling Unit		
Week	A.M.	P.M.	Cycle Number
1	7*	6	1
2	5	2	
3	9	5	
4	2	1	
5	1	4	
6	6	10	
7	10	9	
8	8	8	
9	3	7	
10	4	3	
11	1	4	2
12	2	8	
13	3	2	
14	6	1	
15	10	10	
16	9	3	
17	7	6	
18	5	5	
19	4	9	
20	8	7	
21	10	3	3
22	4	4	
23	8	5	
24	7	8	
25	5	7	
26	3	10	
27	5	2	
28	2	6	
29	9	9	
30	1	1	
31	4	6	4
32	2	7	
33	9	2	
34	7	9	
35	10	10	
36	3	1	
37	6	8	
38	8	4	
39	1	5	

TABLE IV (CONTINUED)

Week	A.M.	P.M.	Cycle Number
40	5	3	
41	1	1	5
42	2	4	
43	5	5	
44	9	8	
45	6	6	
46	7	2	
47	10	3	
48	8	10	
49	4	7	
50	3	9	
51	10	1	6
52	9	8	
	Weekend Sampling Unit		
1	1	1	1
2	4	3	
3	3	4	
4	1	2	
5	1	2	2
6	2	4	
7	3	1	
8	4	3	
9	2	1	3
10	3	2	
11	4	3	
12	1	4	
13	1	2	4
14	4	3	
15	3	4	
16	2	1	
17	1	4	5
18	3	3	
19	2	2	
20	4	1	
21	1	3	6
22	4	2	
23	3	1	
24	3	4	

TABLE IV (CONTINUED)

Week	A.M.	P.M.	Cycle Number
25	3	1	7
26	2	3	
27	4	2	
28	1	4	
29	4	4	8
30	2	1	
31	3	3	
32	1	2	
33	3	2	9
34	1	4	
35	4	3	
36	2	1	
37	4	4	10
38	1	2	
39	3	3	
40	2	1	
41	2	4	11
42	4	3	
43	3	2	
44	1	1	
45	3	4	12
46	1	1	
47	4	3	
48	2	2	
49	3	2	13
50	4	1	
51	2	3	
52	1	4	

*For designation of sampling units see Table II.

**The last cycle is incomplete and thus cannot be treated equally with the others.

TABLE V

OKLAHOMA DEPARTMENT OF WILDLIFE CONSERVATION LAKES

Lake	County	Acreage	Maximum depth in feet	Access areas
Beaver	Jefferson	42.9	28	2
Burtschi	Grady	180.0	28	3
Dahlgren	Cleveland	26.4	20	2
Hall	Harmon	36.2	28	1
Kingfisher	Kingfisher	58.0	20	3
Ozzie Cobb	Pushmataha	69.4	20	1
Roman Nose	Blaine	60.0	24	1
Schooler	Choctaw	28.5	24	2
Schultz	Texas	56.8	14	2
Vincent	Ellis	169.0	41	2

TABLE VI

ANNUAL HARVEST AND FISHERMAN USE AT TEN OKLAHOMA PUBLIC LAKES FROM DECEMBER 1964 TO DECEMBER 1965 WITH APPROXIMATE 95% CONFIDENCE INTERVALS

Lake	Acres	Numbers	Pounds	Number Per Acre	Pounds Per Acre	Hours	Hours Per Acre	Number Per Hour	Pounds Per Hour
Beaver	42.9	3,301 ± 1,746	2,047 ± 1,380	79 ± 39	49 ± 31	11,284 ± 2,170	263 ± 50	.29	.37
Burtschi	180.0	43,499 ±13,485	19,268 ± 6,046	242 ± 82	107 ± 34	112,044 ± 22,568	622 ±125	.40	.20
Dahlgren	26.4	2,430 ± 816	1,157 ± 410	92 ± 24	43 ± 12	16,302 ± 2,540	617 ± 96	.15	.07
Hall	36.2	8,628 ± 5,286	810 ± 320	238 ±146	22 ± 9	20,351 ± 5,779	562 ±159	.40	.04
Ozzie Cobb	69.4	10,726 ± 2,848	3,927 ± 868	154 ± 42	57 ± 13	19,954 ± 2,808	287 ± 40	.54	.20
Roman Nose	60.0	4,093 ± 1,659	1,862 ± 725	68 ± 28	31 ± 12	26,165 ± 16,071	434 ±102	.39	.27
Schooler	28.5	2,441 ± 2,238	674 ± 543	86 ± 78	24 ± 19	3,924 ± 1,435	138 ± 50	.60	.20
Vincent	169.0	17,424 ± 6,134	8,472 ± 2,951	174 ± 62	85 ± 30	62,227 ± 12,024	622 ±120	.28	.14
Kingfisher*	58.0	1,321 ± 1,286	475 ± 1,111	23 ± 22	23 ± 19	10,635 ± 2,872	183 ± 49	.10	.10
Schultz**	56.8	4,641 ± 1,807	3,751 ± 1,382	81 ± 32	66 ± 24	17,194 ± 5,530	302 ± 98	.27	.22

*Six month survey

**Eight month survey

TABLE VII

ANNUAL SPORT FISHING HARVEST BY CLASS OF FISH ON TEN OKLAHOMA FISHING LAKES

Lake	Bass			Crappie			Catfish			Sunfish		
	No.	Lbs.	Avg. Wt.	No.	Lbs.	Avg. Wt.	No.	Lbs.	Avg. Wt.	No.	Lbs.	Avg. Wt.
Beaver	318	278	.90	1374	636	.46	558	731	1.31	580	163	.28
Burtschi	3574	3627	1.00	6346	3229	.51	1238	2302	1.90	25052	5016	.20
Dahlgren	220	392	1.78	560	159	.28	860	492	.57	794	104	.13
Hall	801	1718	2.10	436	436	.30	448	654	1.50	1092	319	.30
Ozzie Cobb	798	717	.90	3950	1036	.26	1856	1394	.75	3452	644	.19
Roman Nose	416	291	.70	66	26	.40	180	347	1.90	1400	214	.15
Schooler	50	104	2.10	83	33	.40	--	--	--	2130	480	.20
Vincent	2233	1691	.75	452	367	.80	4122	3882	.94	10978	1824	.17
Kingfisher*	111	13	1.20	--	--	--	1146	1194	1.00	146	67	.50
Schultz**	2132	2163	1.00	--	--	--	2024	1592	.90	--	--	--

*Six month survey

**Eight month survey

TABLE VIII

ANNUAL FISHING PARTY CHARACTERISTICS ON TEN OKLAHOMA LAKES

Lake	Number of Parties	Average Party Size	Number of Fishermen	Average Time Spent Fishing	Resident %	Non-resident %	Male %	Female %
Beaver	1,722	2.4	4,070 ± 540	2.8	91.5	8.3	76.0	24.0
Burtschi	14,273	3.6	30,805 ± 2,585	2.2	95.9	4.1	74.2	25.8
Dahlgren	1,680	2.7	4,540 ± 302	3.6	97.4	2.6	69.3	30.7
Hall	2,745	2.1	5,734 ± 906	3.6	58.1	41.9	73.5	26.5
Ozzie Cobb	2,040	2.9	5,914 ± 766	3.4	87.7	10.3	65.3	34.7
Roman Nose	2,581	2.8	7,123 ± 515	3.7	95.4	4.6	64.9	35.1
Schooler	794	2.1	1,684 ± 472	2.3	100.0	0.0	68.8	30.2
Vincent	4,199	2.72	11,425 ± 1,121	5.4	40.0	60.0	65.0	35.0
Kingfisher	2,268	1.7	3,925 ± 265	2.7	98.9	1.1	68.9	31.1
Schultz	1,726	2.2	3,867 ± 486	4.5	78.6	21.4	74.5	25.5

TABLE IX

FISHERMEN NOT CHECKED

Lake	Parties refused	Av. No. of fishermen per party	Parties missed	Av. No. of fishermen per party
Beaver	1	3.0	-	-
Burtschi	50	3.7	10	4.8
Dahlgren	3	4.0	-	-
Hall	-	-	-	-
Kingfisher	2	2.0	-	-
Ozzie Cobb	2	2.0	1	2.0
Roman Nose	190	2.9	14	2.9
Schooler	11	3.0	1	2.0
Schultz	-	-	-	-
Vincent	-	-	-	-

TABLE X

DISTRIBUTION OF REJECTED INTERVIEW FORMS BY REASON FOR REJECTION

Lake	Missing Item				Other	Rejects	
	Parties	Pounds	Numbers	Hours		Number	Percent
Beaver	13	17	10	12	1	35	13.2
Burtschi	4	123	28	12	11	139	8.4
Dahlgren	-	-	-	-	2	2	.3
Hall	3	115	119	207	31	284	62.4
Kingfisher	-	-	-	1	1	2	1.1
Ozzie Cobb	-	2	-	-	11	13	2.8
Roman Nose	1	-	-	-	26	27	5.3
Schooler	-	-	-	-	-	0	0
Schultz	-	-	-	-	-	0	0
Vincent	-	16	3	-	7	23	5.7

TABLE XI

COMPARISON OF AVERAGES OF CREEL STATISTICS FOR REJECTED INTERVIEWS WITH ESTIMATED ANNUAL VALUES

Lake	Rejected Forms	Annual Estimate	Significant	Rejected Forms	Annual Estimate	Significant
	Party Size of			Hours of		
Beaver	2.5	2.4	No	3.1	2.8	No
Burtschi	2.2	3.6	Yes	5.1	2.2	Yes
Hall	2.4	2.1	No	4.1	3.6	No
Ozzie Cobb	3.4	2.9	No	7.6	3.4	Yes
Roman Nose	2.6	2.8	No	3.1	3.7	No
Vincent	2.8	2.7	No	6.7	5.4	No
	Numbers of			Pounds of		
Beaver	0.9	1.9	Yes	0.14	0.12	Yes
Burtschi	5.0	3.0	No	0.51	1.34	Yes
Hall	0.2	3.1	Yes	0.17	0.30	No
Ozzie Cobb	10.7	5.3	No	0.40	1.92	Yes
Roman Nose	3.7	1.6	No	1.71	0.72	No
Vincent	9.2	4.1	Yes	2.33	2.02	No

TABLE XII

PERCENT ANNUAL DISTRIBUTION OF EFFORT AND HARVEST BY PERIODS

Lake	Period	Number of parties%	Number of Fishermen%	Hours Fished%	Number Caught%	Pounds Caught%
Beaver	Weekday	64	67	69	68	57
	Weekend	36	33	31	32	43
Burtschi	Weekday	53	47	37	57	55
	Weekend	47	53	63	43	45
Dahlgren	Weekday	60	53	55	66	76
	Weekend	40	47	45	34	24
Hall	Weekday	57	57	52	62	49
	Weekend	43	43	48	38	51
Kingfisher	Weekday	71	71	71	71	72
	Weekend	29	29	29	29	28
Ozzie Cobb	Weekday	43	37	41	49	48
	Weekend	57	63	59	51	52
Roman Nose	Weekday	40	40	30	59	51
	Weekend	60	60	70	41	49
Schooler	Weekday	43	39	40	38	43
	Weekend	57	61	60	62	57
Schultz	Weekday	53	47	45	51	53
	Weekend	47	53	55	49	47
Vincent	Weekday	51	49	52	59	52
	Weekend	49	51	48	41	48

TABLE XIII

PERCENT ANNUAL COMPOSITION OF THE CATCH BY SPECIES GROUP

Lake	Period	Percent Number of				Percent Weight of			
		Bass	Crappie	Catfish	Sunfish	Bass	Crappie	Catfish	Sunfish
Beaver	Weekday	12.0	50.8	17.3	20.9	9.2	36.6	36.6	9.2
	Weekend	11.7	43.9	24.6	20.0	8.7	32.6	32.6	8.7
Burtschi	Weekday	13.4	18.0	4.1	64.5	22.1	23.1	19.2	35.8
	Weekend	8.3	16.0	7.6	68.2	29.5	17.7	16.2	36.4
Dahlgren	Weekday	11.8	16.5	38.3	33.3	40.3	9.3	42.4	8.0
	Weekend	3.6	35.8	29.5	31.2	14.5	28.6	44.5	12.4
Hall	Weekday	16.1	16.0	8.4	59.5	51.5	9.7	16.0	22.8
	Weekend	41.4	15.4	23.4	19.7	64.9	4.6	26.6	3.8
Kingfisher	Weekday	6.8	-	81.8	11.4	9.3	-	85.2	5.5
	Weekend	11.8	-	81.3	6.8	10.5	-	89.1	2.4
Ozzie Cobb	Weekday	6.0	32.0	21.0	41.0	11.3	22.2	43.0	23.1
	Weekend	9.9	50.6	13.2	26.2	23.1	26.3	41.0	10.0
Roman Nose	Weekday	6.7	13.4	9.4	70.8	21.8	3.0	47.0	26.5
	Weekend	32.1	2.1	7.2	58.2	58.2	2.7	21.3	14.3
Schooler	Weekday	1.1	7.1	-	91.8	4.2	7.7	-	88.1
	Weekend	3.2	1.3	-	95.5	27.9	3.4	-	68.7
Schultz	Weekday	49.1	-	50.9	-	61.9	-	38.1	-
	Weekend	51.0	-	47.0	-	52.9	-	47.1	-
Vincent	Weekday	11.3	2.2	20.0	60.0	18.0	3.1	50.0	21.0
	Weekend	14.2	3.0	18.7	64.1	27.0	7.0	39.3	26.7

TABLE XIV

WEEKDAY-WEEKEND COMPARISON OF ANNUAL FISHING CHARACTERISTICS

Lake	Period	Percent Residents	Percent Successful	Percent Males	Number per Hour	Pounds per Hour	Hours Fished	Party Size
Beaver	Weekday	89.9	47.7	75.3	2.90	.17	2.9	2.4
	Weekend	94.4	42.2	77.4	3.00	.20	2.6	2.4
Burtschi	Weekday	96.0	39.4	74.7	.60	.25	2.9	1.9
	Weekend	96.0	31.6	73.7	.30	.10	4.3	2.4
Dahlgren	Weekday	97.0	28.4	78.9	.18	.10	3.7	2.4
	Weekend	98.3	19.0	67.7	.11	.04	3.5	3.1
Hall	Weekday	61.9	67.3	76.2	.50	.04	3.2	2.1
	Weekend	53.0	62.8	69.9	.30	.04	4.0	2.1
Kingfisher	Weekday	98.5	31.9	64.7	.10	.10	2.7	1.7
	Weekend	100.0	14.8	79.3	.10	.10	2.7	1.7
Ozzie Cobb	Weekday	91.8	51.5	64.2	.64	.23	3.8	2.5
	Weekend	88.5	41.6	64.7	.46	.17	3.2	3.2
Roman Nose	Weekday	94.0	24.1	60.4	.30	.12	2.8	2.7
	Weekend	96.4	21.8	67.8	.10	.05	4.3	2.8
Schooler	Weekday	100.0	34.3	67.9	.60	.20	2.3	2.0
	Weekend	100.0	28.7	71.0	.60	.20	2.3	2.2
Schultz	Weekday	79.6	35.2	79.6	.30	.26	4.2	2.0
	Weekend	77.8	34.3	70.0	.24	.18	4.7	2.5
Vincent	Weekday	44.0	51.0	62.0	.36	.16	3.8	2.6
	Weekend	35.0	45.0	67.0	.21	.12	5.8	2.8

TABLE XV

DISTRIBUTION OF PARTIES USING DIFFERENT TYPES AND METHODS OF FISHING

Lake	Period	% of parties using					% of parties using			
		Boat	Bank	Floater	Heated Dock	Other	Lure	Live	Dead	Other
Beaver	Weekday	21.6	74.5	0.0	0.0	3.9	15.7	23.5	19.6	41.2
	Weekend	17.3	81.1	0.0	0.0	1.6	18.9	18.9	14.2	48.0
Burtschi	Weekday	11.4	65.9	18.0	3.9	0.8	33.3	22.9	2.1	41.7
	Weekend	11.8	67.8	15.1	4.0	1.3	37.5	11.1	1.3	50.1
Dahlgren	Weekday	9.5	75.5	7.0	0.0	8.0	22.5	3.5	2.0	72.0
	Weekend	8.6	79.2	5.7	0.0	6.5	19.9	6.3	0.3	73.5
Hall	Weekday	40.0	33.3	26.7	0.0	0.0	26.7	51.1	0.0	22.2
	Weekend	42.9	27.0	27.8	0.0	2.4	25.4	21.4	3.2	50.0
Kingfisher	Weekday	1.3	94.7	0.0	0.0	4.0	0.0	48.0	8.0	44.0
	Weekend	1.9	94.4	0.9	0.0	2.8	.9	22.2	3.7	73.1
Ozzie Cobb	Weekday	27.5	64.9	0.6	0.0	7.0	15.2	39.8	8.6	42.7
	Weekend	31.9	60.6	0.7	0.0	6.8	22.9	50.5	0.4	26.2
Roman Nose	Weekday	0.3	87.3	12.4	13.3	0.0	19.8	22.7	8.6	49.0
	Weekend	0.0	77.6	0.7	0.0	2.1	27.3	25.9	2.1	44.8
Schooler	Weekday	34.3	57.1	0.0	0.0	8.6	17.1	68.6	5.7	8.6
	Weekend	47.1	45.1	2.0	0.0	5.9	25.5	58.8	0.0	15.7
Schultz	Weekday	3.3	78.0	15.4	0.0	3.3	33.0	40.7	3.3	23.0
	Weekend	6.5	78.9	8.5	0.0	6.0	23.1	44.2	10.1	22.6
Vincent	Weekday	7.5	58.0	7.5	0.9	26.1	25.7	11.5	9.3	53.5
	Weekend	19.8	61.0	8.6	0.0	10.6	17.3	9.0	17.9	55.8

TABLE XVI

PERCENT DISTRIBUTION OF FISHING PARTIES
BY TYPE OF FISHING

Lake	Percentage of Total Parties Using			
	Lure %	Live %	Dead %	Other %
Beaver	17.5	20.9	16.6	45.0
Burtschi	36.2	14.9	1.5	47.4
Dahlgren	20.9	5.2	0.9	72.9
Hall	25.7	29.2	2.3	42.7
Kingfisher	0.5	32.8	5.5	61.2
Ozzie Cobb	20.0	46.4	1.1	32.4
Roman Nose	22.1	23.7	6.6	47.6
Schooler	21.8	63.2	2.3	12.7
Schultz	26.2	43.1	7.9	22.8
Vincent	22.3	10.5	12.8	54.5

TABLE XVII

DISTRIBUTION OF FISHING PARTIES BY METHOD OF FISHING

Lake	Percentage of total parties using				
	Boat %	Bank %	Floater %	Heated Dock %	Other %
Beaver	19.2	78.2	-	-	2.6
Burtschi	11.7	67.2	16.0	4.0	1.1
Dahlgren	8.9	77.8	6.2	-	7.1
Hall	42.1	28.7	27.5	-	1.8
Kingfisher	1.6	94.5	0.5	-	3.3
Ozzie Cobb	30.2	62.2	0.7	-	6.9
Roman Nose	4.1	84.4	10.8	-	0.6
Schooler	41.9	50.0	1.2	-	7.0
Schultz	5.5	78.6	10.7	-	5.2
Vincent	29.3	34.3	4.5	0.5	31.4

TABLE XVIII

PARTY SIZE OF DIFFERENT METHODS OF FISHING AND RESULTS OF ANALYSES OF VARIANCE

Lake	Period	Number of Fishermen Using				Significant analysis of variance
		Boat	Bank	Floater	Heated dock	
Beaver	Weekday	3.5	3.4	-	-	no
	Weekend	3.4	2.9	-	-	no
Burtschi	Weekday	3.2	3.0	2.4	3.1	yes
	Weekend	3.8	3.5	2.7	3.0	yes
Dahlgren	Weekday	3.3	3.4	2.4	-	yes
	Weekend	3.7	4.2	2.9	-	no
Hall	Weekday	3.6	2.8	2.6	-	yes
	Weekend	3.1	3.2	2.8	-	no
Kingfisher	Weekday	-	2.8	-	-	-
	Weekend	2.5	2.8	-	-	no
Ozzie Cobb	Weekday	3.2	3.5	-	-	no
	Weekend	4.0	4.2	-	-	no
Roman Nose	Weekday	3.1	3.8	3.1	-	no
	Weekend	3.6	4.0	2.8	-	yes
Schooler	Weekday	3.1	2.9	-	-	no
	Weekend	2.7	3.7	-	-	yes
Schultz	Weekday	-	3.1	2.2	-	yes
	Weekend	3.2	3.6	2.8	-	yes
Vincent	Weekday	3.3	3.5	3.0	-	no
	Weekend	3.5	3.8	3.2	-	no

TABLE XIX

NUMBER CAUGHT BY DIFFERENT METHODS OF FISHING
AND RESULTS OF ANALYSES OF VARIANCE

Lake	Period	Number of Fishermen Using				Significant analysis of variance
		Boat	Bank	Floater	Heated Dock	
Beaver	Weekday	5.4	2.9	-	-	yes
	Weekend	3.5	2.6	-	-	no
Burtschi	Weekday	3.0	4.5	5.8	-	yes
	Weekend	2.6	5.9	3.1	-	yes
Dahlgren	Weekday	2.6	3.5	-	-	no
	Weekend	2.9	1.2	-	-	no
Hall	Weekday	6.5	5.4	3.6	-	no
	Weekend	5.5	1.7	2.9	-	yes
Kingfisher	Weekday	-	1.6	-	-	-
	Weekend	1.0	1.7	-	-	no
Ozzie Cobb	Weekday	8.7	5.6	-	-	yes
	Weekend	10.0	3.4	-	-	-
Roman Nose	Weekday	2.6	3.5	1.9	-	no
	Weekend	1.8	2.3	1.9	-	no
Schooler	Weekday	5.6	2.7	-	-	no
	Weekend	4.3	3.9	-	-	no
Schultz	Weekday	-	2.7	6.4	-	yes
	Weekend	6.8	2.8	9.4	-	yes
Vincent	Weekday	2.8	5.7	2.6	-	no
	Weekend	4.6	3.8	5.3	-	no

TABLE XX

POUNDS CAUGHT BY DIFFERENT METHODS OF FISHING
AND RESULTS OF ANALYSES OF VARIANCE

Lake	Period	Number of Fishermen Using				Significant analysis of variance
		Boat	Bank	Floater	Heated Dock	
Beaver	Weekday	3.7	2.2	-	-	yes
	Weekend	3.1	1.8	-	-	no
Burtschi	Weekday	4.1	1.8	3.1	3.6	yes
	Weekend	3.7	1.5	4.8	2.0	yes
Dahlgren	Weekday	1.6	1.7	4.9	-	yes
	Weekend	1.1	1.5	1.4	-	no
Hall	Weekday	4.1	2.8	4.6	-	no
	Weekend	5.4	1.7	6.4	-	yes
Kingfisher	Weekday	-	1.5	-	-	-
	Weekend	1.0	1.7	-	-	no
Ozzie Cobb	Weekday	3.9	2.8	-	-	no
	Weekend	3.9	2.1	-	-	yes
Roman Nose	Weekday	1.9	1.8	2.2	-	no
	Weekend	1.8	1.6	2.0	-	no
Schooler	Weekday	2.8	1.4	-	-	yes
	Weekend	2.0	1.9	-	-	no
Schultz	Weekday	-	2.2	6.9	-	yes
	Weekend	5.4	2.3	9.5	-	yes
Vincent	Weekday	2.4	2.4	2.5	-	no
	Weekend	3.1	2.0	5.6	-	yes

TABLE XXI

POUNDS CAUGHT PER HOUR BY DIFFERENT METHODS OF FISHING AND RESULTS OF ANALYSES OF VARIANCE

Lake	Period	Number of Fishermen Using				Significant analysis of variance
		Boat	Bank	Floater	Heated Dock	
Beaver	Weekday	1.5	1.2	-	-	yes
	Weekend	1.5	1.1	-	-	no
Burtschi	Weekday	1.9	1.3	1.8	2.1	yes
	Weekend	1.6	1.2	2.2	1.4	yes
Dahlgren	Weekday	1.1	1.1	1.5	-	yes
	Weekend	1.0	1.0	1.1	-	no
Hall	Weekday	1.6	1.5	1.7	-	no
	Weekend	1.7	1.1	2.1	-	yes
Kingfisher	Weekday	-	1.1	-	-	-
	Weekend	1.0	1.1	-	-	no
Ozzie Cobb	Weekday	1.4	1.3	-	-	no
	Weekend	1.4	1.2	-	-	yes
Roman Nose	Weekday	1.3	1.4	3.0	-	yes
	Weekend	1.2	1.1	1.2	-	no
Schooler	Weekday	1.5	1.0	-	-	no
	Weekend	1.3	1.0	-	-	no
Schultz	Weekday	-	1.3	2.7	-	yes
	Weekend	1.4	1.1	2.2	-	yes
Vincent	Weekday	1.1	1.2	1.2	-	no
	Weekend	1.2	1.1	1.4	-	yes

TABLE XXII

NUMBER CAUGHT PER HOUR BY DIFFERENT METHODS OF FISHING AND RESULTS OF ANALYSES OF VARIANCE

Lake	Period	Number of Fishermen Using				Significant analysis of variance
		Boat	Bank	Floater	Heated Dock	
Beaver	Weekday	2.5	1.3	-	-	yes
	Weekend	1.5	1.3	-	-	no
Burtschi	Weekday	3.6	1.8	2.2	3.0	yes
	Weekend	2.6	1.5	2.4	1.8	yes
Dahlgren	Weekday	1.3	1.2	1.3	-	no
	Weekend	1.1	1.1	1.0	-	no
Hall	Weekday	1.9	2.4	1.5	-	no
	Weekend	1.8	1.1	1.4	-	yes
Kingfisher	Weekday	-	1.1	-	-	-
	Weekend	1.0	1.1	-	-	no
Ozzie Cobb	Weekday	1.9	1.7	-	-	no
	Weekend	2.2	1.4	-	-	yes
Roman Nose	Weekday	2.1	3.1	2.3	-	-
	Weekend	1.2	1.2	1.2	-	-
Schooler	Weekday	2.3	1.2	-	-	no
	Weekend	2.2	1.2	-	-	no
Schultz	Weekday	-	1.4	2.5	-	yes
	Weekend	1.5	1.2	2.2	-	yes
Vincent	Weekday	1.1	1.6	1.2	-	no
	Weekend	1.4	1.3	1.3	-	no

TABLE XXIII

HOURS FISHED BY DIFFERENT METHODS OF FISHING AND RESULTS OF ANALYSES OF VARIANCE

Lake	Period	Number of Fishermen Using				Significant analysis of variance
		Boat	Bank	Floater	Heated Dock	
Beaver	Weekday	3.6	3.7	-	-	no
	Weekend	3.5	3.4	-	-	no
Burtschi	Weekday	4.6	4.0	4.0	3.6	no
	Weekend	5.4	4.2	4.4	3.2	yes
Dahlgren	Weekday	4.8	4.6	5.8	-	no
	Weekend	4.4	3.8	4.0	-	no
Hall	Weekday	3.9	3.9	5.1	-	no
	Weekend	4.9	3.9	4.3	-	no
Kingfisher	Weekday	-	5.5	-	-	-
	Weekend	3.0	4.0	-	-	no
Ozzie Cobb	Weekday	5.2	4.7	-	-	no
	Weekend	5.3	3.8	-	-	yes
Roman Nose	Weekday	3.1	3.6	8.4	-	no
	Weekend	4.5	3.8	3.9	-	no
Schooler	Weekday	4.7	5.4	-	-	no
	Weekend	5.3	6.7	-	-	no
Schultz	Weekday	-	4.8	4.6	-	no
	Weekend	5.0	4.3	5.0	-	no
Vincent	Weekday	4.6	5.3	6.9	-	no
	Weekend	7.1	5.2	7.3	-	yes

TABLE XXIV

MANHOURS FISHED BY DIFFERENT METHODS OF FISHING AND RESULTS OF ANALYSES OF VARIANCE

Lake	Period	Number of Fishermen Using				Significant analysis of variance
		Boat	Bank	Floater	Heated Dock	
Beaver	Weekday	7.1	8.0	-	-	no
	Weekend	6.6	5.7	-	-	no
Burtschi	Weekday	8.8	6.5	5.2	5.7	no
	Weekend	14.4	10.2	16.3	5.4	yes
Dahlgren	Weekday	10.5	10.6	7.6	-	no
	Weekend	10.6	10.7	7.2	-	no
Hall	Weekday	7.9	6.3	8.1	-	no
	Weekend	1.2	8.6	7.2	-	no
Kingfisher	Weekday	-	3.5	-	-	-
	Weekend	4.0	6.0	-	-	yes
Ozzie Cobb	Weekday	9.9	10.3	-	-	no
	Weekend	11.7	9.7	-	-	no
Roman Nose	Weekday	5.4	8.7	6.4	-	no
	Weekend	10.0	12.7	9.2	-	no
Schooler	Weekday	9.5	11.1	-	-	no
	Weekend	10.1	22.1	-	-	no
Schultz	Weekday	-	10.0	6.5	-	no
	Weekend	12.9	13.4	9.9	-	no
Vincent	Weekday	9.2	11.8	12.3	-	no
	Weekend	14.4	12.4	15.7	-	no

TABLE XXV

PARTY SIZE BY DIFFERENT TYPES OF FISHING AND RESULTS OF ANALYSES OF VARIANCE

Lake	Period	Lure	Live Bait	Dead Bait	Significant analysis of variance
Beaver	Weekday	3.0	3.3	3.3	no
	Weekend	3.0	2.7	3.3	no
Burtschi	Weekday	2.5	3.1	3.0	yes
	Weekend	3.1	3.4	3.7	no
Dahlgren	Weekday	2.8	3.0	-	no
	Weekend	3.7	4.4	-	no
Hall	Weekday	2.3	3.2	-	yes
	Weekend	2.7	3.2	-	yes
Kingfisher	Weekday	-	2.8	2.6	no
	Weekend	-	2.7	2.5	no
Ozzie Cobb	Weekday	3.4	3.7	3.2	no
	Weekend	4.6	4.1	-	no
Roman Nose	Weekday	3.1	4.1	-	yes
	Weekend	3.4	4.2	-	yes
Schooler	Weekday	3.0	2.9	-	no
	Weekend	3.4	3.3	-	no
Schultz	Weekday	2.7	3.1	-	no
	Weekend	3.0	3.7	3.5	yes
Vincent	Weekday	2.9	4.1	3.7	yes
	Weekend	3.1	4.1	3.1	yes

TABLE XXVI

NUMBER CAUGHT BY DIFFERENT TYPES OF FISHING AND RESULTS OF ANALYSES OF VARIANCE

Lake	Period	Lure	Live Bait	Dead Bait	Significant analysis of variance
Beaver	Weekday	1.0	3.0	1.5	no
	Weekend	2.2	4.1	1.2	yes
Burtschi	Weekday	2.7	5.2	2.1	yes
	Weekend	2.7	5.4	4.8	yes
Dahlgren	Weekday	1.5	2.7	-	no
	Weekend	1.3	4.3	-	yes
Hall	Weekday	3.2	4.0	-	no
	Weekend	2.5	2.9	-	no
Kingfisher	Weekday	-	2.1	1.1	no
	Weekend	-	1.1	1.0	no
Ozzie Cobb	Weekday	2.9	7.8	2.0	yes
	Weekend	3.6	7.4	-	yes
Roman Nose	Weekday	2.1	4.1	-	no
	Weekend	1.8	2.1	-	no
Schooler	Weekday	3.6	4.7	-	no
	Weekend	4.6	3.9	-	no
Schultz	Weekday	4.0	2.4	-	no
	Weekend	4.5	3.5	2.4	no
Vincent	Weekday	2.6	12.3	6.0	yes
	Weekend	3.9	4.5	5.0	no

TABLE XXVII

POUNDS CAUGHT BY DIFFERENT TYPES OF FISHING
AND RESULTS OF ANALYSES OF VARIANCE

Lake	Period	Lure	Live Bait	Dead Bait	Significant analysis of variance
Beaver	Weekday	1.3	1.9	1.8	no
	Weekend	1.5	3.1	1.1	yes
Burtschi	Weekday	1.9	2.1	5.0	yes
	Weekend	2.4	2.3	3.2	no
Dahlgren	Weekday	2.2	2.4	-	no
	Weekend	1.0	1.2	-	no
Hall	Weekday	3.6	2.9	-	no
	Weekend	5.1	2.1	-	yes
Kingfisher	Weekday	-	1.7	1.4	no
	Weekend	-	1.1	1.0	no
Ozzie Cobb	Weekday	1.8	2.9	1.7	no
	Weekend	2.4	2.8	-	no
Roman Nose	Weekday	1.3	1.9	-	no
	Weekend	1.7	1.2	-	yes
Schooler	Weekday	2.0	2.1	-	no
	Weekend	2.8	1.6	-	no
Schultz	Weekday	4.1	2.0	-	yes
	Weekend	4.6	2.7	2.6	yes
Vincent	Weekday	1.8	4.0	8.0	yes
	Weekend	3.6	1.9	4.9	yes

TABLE XXVIII

NUMBER CAUGHT PER HOUR BY DIFFERENT TYPES OF FISHING AND RESULTS OF ANALYSES OF VARIANCE

Lake	Period	Lure	Live Bait	Dead Bait	Significant analysis of variance
Beaver	Weekday	1.0	1.2	1.1	yes
	Weekend	1.2	1.4	1.0	no
Burtschi	Weekday	1.6	2.9	1.5	yes
	Weekend	1.5	2.0	1.7	no
Dahlgren	Weekday	1.1	1.5	-	yes
	Weekend	1.0	1.2	-	yes
Hall	Weekday	1.5	1.5	-	no
	Weekend	1.3	1.2	-	no
Kingfisher	Weekday	-	1.1	1.0	no
	Weekend	-	1.0	1.0	no
Ozzie Cobb	Weekday	1.4	1.9	1.0	no
	Weekend	1.4	1.7	-	no
Roman Nose	Weekday	5.4	2.1	-	no
	Weekend	1.4	1.5	-	no
Schooler	Weekday	3.5	1.3	-	no
	Weekend	2.6	1.5	-	no
Schultz	Weekday	1.6	1.2	-	yes
	Weekend	1.5	1.2	1.1	yes
Vincent	Weekday	1.6	4.2	1.6	yes
	Weekend	1.2	1.5	1.1	no

TABLE XXIX

POUNDS CAUGHT PER HOUR BY DIFFERENT TYPES OF FISHING AND RESULTS OF ANALYSES OF VARIANCE

Lake	Period	Lure	Live Bait	Dead Bait	Significant analysis of variance
Beaver	Weekday	1.0	1.1	1.1	no
	Weekend	1.1	1.4	1.0	no
Burtschi	Weekday	1.3	1.4	3.0	yes
	Weekend	1.4	1.3	1.3	no
Dahlgren	Weekday	1.2	1.4	-	no
	Weekend	1.0	1.1	-	no
Hall	Weekday	1.7	1.3	-	yes
	Weekend	1.8	1.1	-	yes
Kingfisher	Weekday	-	1.1	1.0	no
	Weekend	-	1.1	1.0	no
Ozzie Cobb	Weekday	1.1	1.2	1.1	no
	Weekend	1.3	1.2	-	no
Roman Nose	Weekday	1.2	1.3	-	no
	Weekend	1.4	1.0	-	yes
Schooler	Weekday	1.8	1.1	-	no
	Weekend	1.5	1.1	-	no
Schultz	Weekday	1.6	1.1	-	yes
	Weekend	1.5	1.1	1.2	yes
Vincent	Weekday	1.3	1.7	1.8	no
	Weekend	1.2	1.1	1.2	no

TABLE XXX

HOURS FISHED BY DIFFERENT TYPES OF FISHING AND RESULTS OF ANALYSES OF VARIANCE

Lake	Period	Lure	Live Bait	Dead Bait	Significant analysis of variance
Beaver	Weekday	3.3	3.7	3.6	no
	Weekend	3.2	4.0	3.0	no
Burtschi	Weekday	4.7	6.1	6.9	yes
	Weekend	4.0	4.2	7.5	yes
Dahlgren	Weekday	3.5	3.4	-	no
	Weekend	3.1	4.5	-	yes
Hall	Weekday	4.8	4.1	-	no
	Weekend	4.3	3.7	-	no
Kingfisher	Weekday	-	3.5	4.2	no
	Weekend	-	4.7	5.3	no
Ozzie Cobb	Weekday	3.9	4.6	4.7	no
	Weekend	3.2	4.5	-	yes
Roman Nose	Weekday	2.8	3.1	-	no
	Weekend	3.6	3.3	-	no
Schooler	Weekday	4.3	6.6	-	no
	Weekend	5.5	6.4	-	no
Schultz	Weekday	4.2	5.0	-	yes
	Weekend	4.4	4.6	4.2	no
Vincent	Weekday	5.0	4.4	9.7	yes
	Weekend	5.6	4.9	8.0	yes

TABLE XXXI

MANHOURS FISHED BY DIFFERENT TYPES OF FISHING AND RESULTS OF ANALYSES OF VARIANCE

Lake	Period	Lure	Live Bait	Dead Bait	Significant analysis of variance
Beaver	Weedkay	5.5	7.2	8.2	no
	Weekend	5.4	6.4	5.6	no
Burtschi	Weekday	3.5	3.6	4.0	no
	Weekend	11.3	9.0	20.8	no
Dahlgren	Weekday	5.6	6.0	-	no
	Weekend	7.0	14.5	-	yes
Hall	Weekday	6.2	7.8	-	no
	Weekend	7.2	6.2	-	no
Kingfisher	Weekday	-	5.5	6.8	no
	Weekend	-	3.2	3.7	no
Ozzie Cobb	Weekday	8.3	10.7	9.8	no
	Weekend	6.7	11.8	-	yes
Roman Nose	Weekday	4.7	9.3	-	yes
	Weekend	8.8	15.3	-	no
Schooler	Weekday	7.4	14.6	-	no
	Weekend	16.9	18.8	-	no
Schultz	Weekday	6.6	10.6	-	yes
	Weekend	8.0	14.1	10.1	yes
Vincent	Weekday	7.8	10.7	24.2	yes
	Weekend	11.8	4.0	22.4	yes

TABLE XXXII

COMPARISON OF CREEL STATISTICS OF FISHERMEN USING VARIOUS TYPES OF FISHING

	Lure Avg. (8)[1]	Live Avg. (20)	Dead Avg. (10)
Party Size	3.1	3.5	3.2
Number of fish caught per trip	2.8	4.4	2.7
Weight of fish caught per trip	2.5	2.2	3.1
Number caught per hour	1.8	1.7	1.2
Pounds caught per hour	1.4	1.2	1.4
Manhours fished	7.7	10.0	12.3
Hours fished	4.1	4.5	5.7

[1]Number in parenthesis equals number of weekday-weekend categories containing fishermen using a particular method of fishing.

TABLE XXXIII

COMPARISON OF CREEL STATISTICS OF FISHERMEN USING DIFFERENT METHODS OF FISHING

	Boat Avg. (18)[1]	Bank Avg. (20)	Floater Avg. (12)	Heated Dock Avg. (2)
Party size	3.3	3.4	2.1	3.1
Number of fish caught per trip	4.7	3.2	4.1	4.5
Weight of fish caught per trip	3.1	1.9	4.5	2.8
Number caught per hour	1.8	1.5	1.7	2.4
Pounds caught per hour	1.4	1.2	2.0	1.8
Manhours fished	9.6	9.9	9.3	5.6
Hours fished	4.6	4.4	5.2	3.4

[1]Number in parenthesis equals number of weekday-weekend categories containing fishermen using a particular method of fishing.

TABLE XXXIV

REGRESSION-CORRELATION STATISTICS FOR POUNDS CAUGHT PER HOUR VERSUS HOURS FISHED

Lake	Period	No. Obs.	r	r^2	Linear B	Linear F	Curvi - linear F
Beaver	Weekday	102	0.076	0.005	0.0179	0.59	0.01
	Weekend	129	0.056	0.003	0.0316	0.41	0.00
Burtschi	Weekday	486	0.011	0.0001	0.0034	0.06	0.01
	Weekend	1025	-0.015	0.0002	-0.0085	0.23	0.00
Dahlgren	Weekday	201	0.096	0.009	0.0124	1.85	0.02
	Weekend	336	0.052	0.002	0.0018	0.93	0.03
Hall	Weekday	48	-0.133	0.017	-0.0435	0.83	0.03
	Weekend	126	-0.128	0.016	-0.0474	2.10	0.02
Kingfisher	Weekday	75	0.0002	0.0000	0.0001	0.00	0.03
	Weekend	100	0.226	0.051	0.0466	5.29*	0.08
Ozzie Cobb	Weekday	167	0.005	0.000	0.0011	0.00	0.00
	Weekend	278	0.009	0.000	0.0017	0.03	0.01
Roman Nose	Weekday	143	-0.040	0.001	-0.0089	0.24	0.02
	Weekend	219	0.042	0.001	0.0074	0.40	0.01
Schooler	Weekday	35	-0.163	0.026	-0.0400	0.71	0.91
	Weekend	51	-0.113	0.012	-0.0148	0.64	0.01
Schultz	Weekday	90	0.050	0.002	0.0198	0.22	0.03
	Weekend	204	0.231	0.053	0.0162	11.43*	0.06
Vincent	Weekday	217	-0.014	0.0002	-0.0006	0.05	0.00
	Weekend	504	0.002	0.000	0.0001	0.00	0.00

* = Significant at 0.05 level

TABLE XXXV

REGRESSION-CORRELATION STATISTICS FOR NUMBER CAUGHT PER HOUR VERSUS HOURS FISHED

Lake	Period	No. Obs.	r	r^2	Linear B	Linear F	Curvi - linear F
Beaver	Weekday	102	0.058	0.003	0.0289	0.34	0.01
	Weekend	129	0.132	0.017	0.0614	2.28	0.02
Burtschi	Weekday	486	-0.014	0.0002	-0.0112	0.10	0.01
	Weekend	1025	0.019	0.0003	0.0097	0.38	0.01
Dahlgren	Weekday	201	0.102	0.010	0.0207	2.11	0.02
	Weekend	336	0.028	0.0008	0.0036	0.28	0.01
Hall	Weekday	48	-0.177	0.031	-0.1487	1.49	0.04
	Weekend	126	-0.118	0.014	-0.0600	1.78	0.02
Kingfisher	Weekday	75	0.265	0.070	0.0672	5.53*	0.08
	Weekend	100	0.198	0.039	0.0380	4.02*	0.08
Ozzie Cobb	Weekday	167	-0.072	0.005	-0.0582	0.86	0.01
	Weekend	278	0.031	0.0009	0.0141	0.27	0.01
Roman Nose	Weekday	143	-0.110	0.012	-0.7776	1.74	0.03
	Weekend	219	-0.078	0.006	-0.0364	1.36	0.01
Schooler	Weekday	35	-0.160	0.025	-0.1178	6.44*	0.87
	Weekend	51	-0.126	0.015	-0.0794	0.79	0.02
Schultz	Weekday	90	0.082	0.006	0.0352	0.61	0.05
	Weekend	204	0.249	0.962	0.0764	13.41*	0.07
Vincent	Weekday	217	-0.039	0.001	-0.0063	0.34	0.01
	Weekend	504	-0.049	0.002	-0.0085	1.24	0.00

* = Significant at 0.05 level

TABLE XXXVI

REGRESSION-CORRELATION STATISTICS FOR POUNDS CAUGHT PER HOUR VERSUS HOURS FISHED FOR SUCCESSFUL FISHERMEN

Lake	Period	No. Obs.	r	r^2	Linear B	Linear F	Curvi - linear F
Beaver	Weekday	47	-0.187	0.035	-0.0477	1.64	0.10
	Weekend	53	-0.123	0.015	-0.0967	0.79	0.04
Burtschi	Weekday	193	-0.154	0.023	-0.0581	4.64*	0.03
	Weekend	292	-0.130	0.017	-0.1072	5.05*	0.03
Dahlgren	Weekday	56	-0.214	0.045	-0.0341	2.60	0.08
	Weekend	63	-0.245	0.060	-0.0125	3.92	0.07
Hall	Weekday	33	-0.415	0.173	-0.1369	6.49*	0.23
	Weekend	78	-0.469	0.220	-0.1708	21.50*	0.30
Kingfisher	Weekday	13	-0.571	0.326	-0.4093	5.32*	1.91
	Weekend	14	0.310	0.096	0.1137	1.28	0.14
Ozzie Cobb	Weekday	85	-0.196	0.038	-0.0666	3.33	0.06
	Weekend	119	-0.221	0.048	-0.0521	6.02*	0.07
Roman Nose	Weekday	35	-0.450	0.203	-0.1394	8.42	0.73
	Weekend	48	0.088	0.007	-0.0230	0.36	0.05
Schooler	Weekday	12	-0.371	0.138	-0.1514	1.60	0.52
	Weekend	14	-0.323	0.104	-0.0937	1.40	0.12
Schultz	Weekday	32	-0.336	0.112	-0.1512	3.82	0.14
	Weekend	70	0.061	0.003	0.0150	0.26	0.08
Vincent	Weekday	110	-0.131	0.017	-0.0058	1.91	0.04
	Weekend	226	-0.115	0.013	-0.0114	3.02	0.02

* = Significant at 0.05 level

TABLE XXXVII

REGRESSION-CORRELATION STATISTICS FOR NUMBER CAUGHT PER HOUR VERSUS HOURS FISHED FOR SUCCESSFUL FISHERMEN

Lake	Period	No. Obs.	r	r^2	Linear B	Linear F	Curvi - linear F
Beaver	Weekday	47	-0.146	0.021	-0.0839	0.99	0.05
	Weekend	53	-0.158	0.025	-0.0846	1.32	0.11
Burtschi	Weekday	193	-0.181	0.032	-0.1751	6.48*	0.04
	Weekend	292	-0.208	0.043	-0.1324	13.14*	0.05
Dahlgren	Weekday	56	-0.237	0.056	-0.0568	3.22	0.08
	Weekend	63	-0.212	0.045	-0.0443	2.89	0.06
Hall	Weekday	33	-0.333	0.111	-0.3185	3.88	0.13
	Weekend	78	-0.297	0.088	-0.1691	7.36	0.10
Kingfisher	Weekday	13	-0.343	0.118	-0.1043	1.47	0.15
	Weekend	14	0.185	0.034	0.6568	0.43	0.25
Ozzie Cobb	Weekday	85	-0.281	0.079	-0.2837	7.13*	0.12
	Weekend	119	-0.176	0.031	-0.1085	3.77	0.04
Roman Nose	Weekday	35	-0.295	0.087	-0.7484	3.17	0.27
	Weekend	48	-0.304	0.092	-0.2456	4.69*	0.14
Schooler	Weekday	12	-0.367	0.135	-0.4490	1.56	0.50
	Weekend	14	-0.345	0.119	-0.5019	1.62	0.22
Schultz	Weekday	32	-0.293	0.085	-0.1327	2.82	0.16
	Weekend	70	0.091	0.008	0.0249	0.57	0.09
Vincent	Weekday	110	-0.133	0.017	-0.0218	1.95	0.05
	Weekend	226	-0.188	0.035	-0.0381	8.23*	0.05

* = Significant at 0.05 level

TABLE XXXVIII

REGRESSION-CORRELATION STATISTICS FOR NUMBER CAUGHT PER HOUR VERSUS NUMBER CAUGHT

Lake	Period	No. Obs.	r	r^2	Linear B	Linear F	Curvi - linear F
Beaver	Weekday	102	0.833	0.694	0.1475	227.58*	2.72
	Weekend	129	0.812	0.660	0.1315	246.49*	2.36
Burtschi	Weekday	486	0.844	0.713	0.1684	1204.71*	3.32
	Weekend	1025	0.753	0.567	0.1075	1343.82*	1.87
Dahlgren	Weekday	201	0.830	0.689	0.1222	442.08*	2.59
	Weekend	336	0.609	0.371	0.0702	197.28*	0.96
Hall	Weekday	48	0.802	0.644	0.2382	83.30*	2.05
	Weekend	126	0.662	0.438	0.1751	96.89*	0.82
Kingfisher	Weekday	75	0.837	0.702	0.1169	172.09*	2.19
	Weekend	100	0.942	0.887	0.1585	772.11*	8.07*
Ozzie Cobb	Weekday	167	0.806	0.649	0.1453	311.88*	2.08
	Weekend	278	0.822	0.676	0.1151	584.10*	2.10
Roman Nose	Weekday	143	0.241	0.058	0.5130	8.72*	0.12
	Weekend	219	0.606	0.367	0.1595	125.92*	0.64
Schooler	Weekday	35	0.510	0.260	0.2326	11.60*	0.39
	Weekend	51	0.748	0.560	0.2407	62.58*	1.70
Schultz	Weekday	90	0.826	0.682	0.1478	189.16*	2.85
	Weekend	204	0.836	0.699	0.0958	470.07*	2.56
Vincent	Weekday	217	0.752	0.566	0.0922	280.49*	1.54
	Weekend	504	0.478	0.228	0.0618	149.02*	0.38

* = Significant at 0.05 level

TABLE XXXIX

REGRESSION--CORRELATION STATISTICS FOR NUMBER CAUGHT PER HOUR VERSUS NUMBER CAUGHT FOR SUCCESSFUL FISHERMEN

Lake	Period	No. Obs.	r	r^2	Linear B	Linear F	Curvi - linear F
Beaver	Weekday	47	0.794	0.631	0.7944	76.99*	3.06
	Weekend	53	0.659	0.435	0.1073	39.30*	0.86
Burtschi	Weekday	193	0.792	0.628	0.1566	323.30*	2.21
	Weekend	292	0.646	0.417	0.0905	207.70*	0.96
Dahlgren	Weekday	56	0.715	0.511	0.1089	56.52*	1.20
	Weekend	63	0.373	0.139	0.0460	9.88*	0.30
Hall	Weekday	33	0.780	0.609	0.2401	48.41*	1.89
	Weekend	78	0.608	0.370	0.1722	44.67*	0.63
Kingfisher	Weekday	13	0.702	0.493	0.0889	10.71*	1.00
	Weekend	14	0.862	0.744	0.1400	34.87*	2.95
Ozzie Cobb	Weekday	85	0.051	0.002	0.0099	0.22	0.01
	Weekend	119	0.091	0.008	0.0214	0.89	0.01
Roman Nose	Weekday	35	0.146	0.214	0.4095	.72	0.10
	Weekend	48	0.454	0.206	0.1433	11.95*	0.31
Schooler	Weekday	12	0.391	0.153	0.2335	1.81	0.23
	Weekend	14	0.705	0.498	0.2706	11.91*	1.43
Schultz	Weekday	32	0.463	0.214	0.0992	8.21*	0.43
	Weekend	70	0.547	0.299	0.0697	29.06*	0.43
Vincent	Weekday	110	0.703	0.494	0.0890	105.73*	1.37
	Weekend	226	0.378	0.143	0.0534	37.38*	0.22

* = Significant at 0.05 level

TABLE XL

REGRESSION-CORRELATION STATISTICS FOR NUMBER CAUGHT PER HOUR VERSUS PARTY SIZE

Lake	Period	No. Obs.	r	r^2	Linear B	Linear F	Curvi - linear F
Beaver	Weekday	102	-0.017	0.0003	-0.0113	0.03	0.00
	Weekend	129	0.010	0.0001	0.0050	0.01	0.00
Burtschi	Weekday	486	-0.063	0.004	-0.0940	1.95	0.00
	Weekend	1025	-0.128	0.016	-0.0937	17.08*	0.02
Dahlgren	Weekday	201	-0.136	0.018	-0.0535	3.79	0.03
	Weekend	336	-0.108	0.011	-0.0261	3.95*	0.02
Hall	Weekday	48	-0.014	0.0002	-0.0246	0.01	0.09
	Weekend	126	-0.142	0.020	-0.1458	2.58	0.03
Kingfisher	Weekday	75	-0.074	0.005	-0.0276	0.41	0.01
	Weekend	100	-0.067	0.004	-0.0237	0.44	0.01
Ozzie Cobb	Weekday	167	-0.121	0.014	-0.1481	2.54	0.02
	Weekend	278	-0.095	0.009	-0.0340	2.59	0.03
Roman Nose	Weekday	143	-0.107	0.011	-0.8931	1.65	0.02
	Weekend	219	-0.120	0.014	-0.0624	3.17	0.02
Schooler	Weekday	35	-0.145	0.021	-0.2921	0.71	0.03
	Weekend	51	-0.136	0.018	-0.2328	0.94	0.03
Schultz	Weekday	90	-0.297	0.088	-0.1947	8.53*	0.13
	Weekend	204	-0.292	0.085	-0.1146	18.95*	0.11
Vincent	Weekday	217	-0.073	0.005	-0.0651	1.15	0.01
	Weekend	504	-0.081	0.006	-0.0843	3.35	0.01

* = Significant at 0.05 level

TABLE XLI

REGRESSION-CORRELATION STATISTICS FOR NUMBER CAUGHT PER HOUR VERSUS PARTY SIZE FOR SUCCESSFUL FISHERMEN

Lake	Period	No. Obs.	r	r^2	Linear B	Linear F	Curvi - linear F
Beaver	Weekday	47	-0.126	0.016	-0.1026	0.74	0.02
	Weekend	53	-0.205	0.042	-0.1012	2.24	0.04
Burtschi	Weekday	193	-0.105	0.011	-0.2079	2.14	0.01
	Weekend	292	-0.232	0.054	-0.3028	16.60*	0.06
Dahlgren	Weekday	56	-0.212	0.045	-0.1391	2.55	0.11
	Weekend	63	-0.257	0.066	-0.1382	4.34*	0.11
Hall	Weekday	33	-0.038	0.001	-0.0699	0.05	0.10
	Weekend	78	-0.205	0.042	-0.3131	3.36	0.06
Kingfisher	Weekday	13	-0.405	0.164	-0.3743	2.17	0.20
	Weekend	14	-0.162	0.026	-0.1429	0.33	0.05
Ozzie Cobb	Weekday	85	-0.214	0.046	-0.3194	3.90	0.06
	Weekend	119	-0.271	0.073	-0.2876	9.32*	0.09
Roman Nose	Weekday	35	-0.242	0.058	-4.1792	2.06	0.10
	Weekend	48	-0.116	0.013	-0.1424	0.63	0.02
Schooler	Weekday	12	-0.386	0.149	-1.6165	1.75	0.47
	Weekend	14	-0.361	0.130	-1.1409	1.80	0.36
Schultz	Weekday	32	-0.287	0.082	-0.3277	2.71	0.11
	Weekend	70	-0.306	0.094	-0.2070	7.05*	0.11
Vincent	Weekday	110	-0.168	0.028	-0.1770	3.15	0.04
	Weekend	226	-0.188	0.035	-0.1683	8.22*	0.06

* = Significant at 0.05 level

TABLE XLII

CORRELATION COEFFICIENT FOR THE RELATIONSHIP BETWEEN NUMBER PER HOUR VERSUS PARTY SIZE FOR ALL FISHERMEN AND FOR SUCCESSFUL FISHERMEN ONLY

Lake	Period	r-Total	r-Successful	Difference
Beaver	Weekdays	-0.017	-0.127	-0.110
	Weekends	-0.011	-0.205	-0.194
Burtschi	Weekdays	-0.063	-0.105	-0.012
	Weekends	-0.128	-0.233	-0.105
Dahlgren	Weekdays	-0.137	-0.212	-0.075
	Weekends	-0.108	-0.258	-0.150
Hall	Weekdays	-0.014	-0.382	-0.368
	Weekends	-0.143	-0.206	-0.063
Kingfisher	Weekdays	-0.074	-0.406	-0.332
	Weekends	-0.067	-0.162	-0.105
Ozzie Cobb	Weekdays	-0.127	-0.214	-0.087
	Weekends	-0.096	-0.271	-0.175
Roman Nose	Weekdays	-0.107	-0.242	-0.135
	Weekends	-0.120	-0.116	+0.004
Schooler	Weekdays	-0.145	-0.386	-0.241
	Weekends	-0.136	-0.361	-0.225
Schultz	Weekdays	-0.297	-0.288	+0.008
	Weekends	-0.293	-0.306	+0.013
Vincent	Weekdays	-0.073	-0.168	-0.595
	Weekends	-0.081	-0.188	-0.107

TABLE XLIII

REGRESSION-CORRELATION STATISTICS FOR PARTY SIZE VERSUS HOURS FISHED

Lake	Period	No. Obs.	r	r^2	Linear B	Linear F	Curvi - linear F
Beaver	Weekday	102	0.169	0.002	-0.0364	0.23	0.00
	Weekend	129	0.026	0.000	0.0257	0.09	0.04
Burtschi	Weekday	486	-0.102	0.010	-0.0534	5.18*	0.01
	Weekend	1025	0.062	0.003	0.0429	3.96*	0.00
Dahlgren	Weekday	201	0.117	0.013	0.0605	2.77	0.03
	Weekend	336	0.852	0.007	0.0447	2.44	0.02
Hall	Weekday	48	-0.034	0.001	-0.0170	0.06	0.01
	Weekend	126	0.013	0.000	0.0066	0.02	0.05
Kingfisher	Weekday	75	0.050	0.002	0.0383	0.18	0.03
	Weekend	100	-0.122	0.015	-0.0667	1.50	0.02
Ozzie Cobb	Weekday	167	0.066	0.004	-0.0448	0.75	0.01
	Weekend	278	0.060	0.003	-0.0776	1.01	0.01
Roman Nose	Weekday	143	-0.230	0.053	-0.1959	7.94*	0.06
	Weekend	219	-0.005	0.000	-0.0050	0.01	0.01
Schooler	Weekday	35	0.484	0.235	0.1772	10.14*	0.31
	Weekend	51	0.666	0.443	0.2462	39.07*	0.80
Schultz	Weekday	90	0.046	0.002	-0.0300	0.19	0.00
	Weekend	204	0.151	0.023	-0.1189	4.76*	0.02
Vincent	Weekday	217	-0.040	0.001	-0.0072	0.34	0.00
	Weekend	504	0.019	0.000	0.0056	0.19	0.01

* = Significant at 0.05 level

TABLE XLIV

REGRESSION-CORRELATION STATISTICS FOR PARTY SIZE VERSUS HOURS FISHED FOR SUCCESSFUL FISHERMEN

Lake	Period	No. Obs.	r	r^2	Linear B	Linear F	Curvi - linear F
Beaver	Weekday	47	-0.240	0.057	-0.1698	2.76	0.11
	Weekend	53	-0.141	0.020	-0.1525	1.04	0.04
Burtschi	Weekday	193	-0.131	0.017	-0.0642	3.34	0.04
	Weekend	292	0.033	0.001	0.0163	0.32	0.00
Dahlgren	Weekday	56	-0.044	0.002	-0.0164	0.11	0.00
	Weekend	63	0.109	0.012	0.0426	0.74	0.02
Hall	Weekday	33	-0.111	0.012	-0.0582	0.39	0.09
	Weekend	78	0.026	0.000	0.0098	0.05	0.09
Kingfisher	Weekday	13	0.723	0.523	0.2384	12.09*	1.44
	Weekend	14	-0.296	0.087	-0.1033	1.15	0.13
Ozzie Cobb	Weekday	85	-0.212	0.020	-0.2125	1.70	0.02
	Weekend	119	-0.041	0.001	-0.0710	0.20	0.01
Roman Nose	Weekday	35	-0.214	0.046	-0.1578	1.60	0.06
	Weekend	48	0.172	0.029	0.1138	1.41	0.17
Schooler	Weekday	12	0.693	0.481	0.2024	9.28*	0.93
	Weekend	14	0.750	0.563	0.3455	15.50*	1.36
Schultz	Weekday	32	-0.250	0.000	-0.0010	0.00	0.03
	Weekend	70	0.005	0.000	-0.0022	0.00	0.03
Vincent	Weekday	110	-0.089	0.008	-0.0140	0.87	0.01
	Weekend	226	0.040	0.001	0.0094	0.36	0.01

* = Significant at 0.05 level

TABLE XLV

COMPARISON AMONG AREAS SURVEYED

Hours Fished

Lake	Period	Significant	Aver. Area 1	Aver. Area 2	Aver. Area 3
Beaver	Weekday	No	8.0	7.3	
	Weekend	No	7.5	10.0	
Burtschi	Weekday	No	22.1	30.8	28.2
	Weekend	Yes	50.1	181.6	98.6
Hall	Weekday	No	4.5	3.0	
	Weekend	Yes	15.3	5.3	
Schooler	Weekday	No	6.4	3.0	
	Weekend	No	14.1	9.2	

Pounds Caught

Beaver	Weekday	No	2.62	0.90	
	Weekend	No	1.45	3.29	
Burtschi	Weekday	No	5.85	6.48	9.04
	Weekend	No	9.92	16.20	14.98
Hall	Weekday	Yes	2.69	0.70	
	Weekend	Yes	6.11	2.69	
Schooler	Weekday	No	0.55	0.23	
	Weekend	No	1.16	0.86	

TABLE XLV (Continued)

Lake	Period	Significant	Aver. Area 1	Aver. Area 2	Aver. Area 3
Pounds-per-Hour					
Beaver	Weekday	No	0.23	0.12	
	Weekend	No	0.14	0.23	
Burtschi	Weekday	No	0.44	0.61	0.26
	Weekend	No	0.26	0.27	0.50
Hall	Weekday	Yes	0.20	0.03	
	Weekend	No	0.23	0.21	
Schooler	Weekday	No	0.06	0.33	
	Weekend	No	0.04	0.05	
Number of Parties					
Beaver	Weekday	No	1.2	1.0	
	Weekend	No	1.3	1.5	
Burtschi	Weekday	Yes	3.2	5.8	5.6
	Weekend	No	6.3	13.8	10.6
Hall	Weekday	Yes	0.9	0.3	
	Weekend	Yes	1.7	0.6	
Schooler	Weekday	No	0.5	0.3	
	Weekend	No	0.6	0.4	

TABLE XLVI

AREA DIFFERENCES IN MEAN DAILY VALUES FOR LAKE HALL

Category	Period	Value Area 1	Value Area 2	Significant
Parties	Weekday	0.9	0.3	Yes
	Weekend	1.7	6.6	Yes
Hours	Weekday	4.5	3.0	No
	Weekend	15.3	5.3	Yes
Pounds	Weekday	2.7	0.7	Yes
	Weekend	6.1	2.7	Yes
Pounds per Hour	Weekday	0.20	0.03	Yes
	Weekend	0.23	0.21	No

TABLE XLVII

SIGNIFICANT DIFFERENCES BETWEEN CYCLES

Lake	Period	Parties	Hours	Pounds Caught	Pounds-Per-Hour
Beaver	Weekday	Yes	Yes	No	No
	Weekend	Yes	Yes	Yes	Yes
Burtschi	Weekday	Yes	Yes	Yes	Yes
	Weekend	Yes	No	No	Yes
Dahlgren	Weekday	Yes	Yes	Yes	Yes
	Weekend	Yes	Yes	No	Yes
Hall	Weekday	Yes	Yes	Yes	Yes
	Weekend	Yes	Yes	Yes	Yes
Ozzie Cobb	Weekday	Yes	Yes	Yes	Yes
	Weekend	Yes	Yes	No	Yes
Roman Nose	Weekday	No	No	No	No
	Weekend	No	No	Yes	No
Schooler	Weekday	Yes	Yes	No	Yes
	Weekend	No	No	No	No

TABLE XLVIII

DISTRIBUTION OF NUMBER OF PARTIES BY CYCLES

Lake	Period	Cycle Designation	Mean Number	Date
Beaver	Weekday	1	.2	12-02-64/02-12-65
		2	.7	02-05-65/04-23-65
		3	1.5	04-26-65/07-02-65
		4	2.2	07-05-65/09-10-65
		5	1.1	09-13-65/11-19/65
	Weekend	1	.3	12-12-64/01-03-65
		2	.1	01-09-65/01-31-65
		3	.4	02-06-65/02-28-65
		4	2.1	03-06-65/03-28-65
		5	1.3	04-03-65/04-25-65
		6	2.5	05-01-65/05-23-65
		7	2.6	05-29-65/06-20-65
		8	3.1	06-26-65/07-18-65
		9	2.8	07-24-65/08-15-65
		10	.8	08-21-65/09-12-65
		11	1.3	09-18-65/10-10-65
		12	1.0	10-16-65/11-07-65
Burtschi	Weekday	1	.6	12-07-65/03-20-65
		2	9.9	03-22-65/07-02-65
		3	4.1	07-05-65/10-15-65
	Weekend	1	.3	12-12-65/01-17-65
		2	.3	01-23-65/02-28-65
		3	14.8	03-06-65/04-11-65
		4	24.7	04-17-65/05-23-65
		5	18.3	05-29-65/07-04-65
		6	8.9	07-10-65/08-15-65
		7	6.4	08-21-65/09-26-65
		8	1.6	10-02-65/11-07-65
		9	6.9	11-13-65/12-05-65
Dahlgren	Weekday	1	.7	12-07-65/01-08-65
		2	.7	01-11-65/02-12-65
		3	.5	02-15-65/03-19-65
		4	2.4	03-22-65/04-23-65
		5	2.5	04-26-65/05-28-65
		6	4.6	05-31-65/07-02-65
		7	6.1	07-05-65/08-06-65
		8	2.3	08-09-65/09-10-65
		9	.8	09-13-65/10-15-65
		10	1.6	10-18-65/11-19-65

TABLE XLVIII (Continued)

Lake	Period	Cycle Designation	Mean Number	Date
Dahlgren	Weekend	1	1.5	12-12-64/12-20-64
		2	.8	12-26-64/01-03-65
		3	.8	01-09-65/01-17-65
		4	.5	01-23-65/01-31-65
		5	1.3	02-06-65/02-14-65
		6	10.0	02-20-65/02-28-65
		7	3.5	03-06-65/03-14-65
		8	3.5	03-20-65/03-28-65
		9	14.5	04-03-65/04-11-65
		10	7.5	04-17-65/04-25-65
		11	9.3	05-01-65/05-09-65
		12	12.7	05-15-65/05-23-65
		13	11.7	05-29-65/06-06-65
		14	5.5	06-12-65/06-20-65
		15	5.0	06-26-65/07-04-65
		16	3.0	07-10-65/07-18-65
		17	.3	07-24-65/08-01-65
		18	.8	08-07-65/08-15-65
		19	.3	08-21-65/08-29-65
		20	.3	09-04-65/09-12-65
		21	2.3	09-18-65/09-26-65
		22	.8	10-02-65/10-10-65
		23	.8	10-16-65/10-24-65
		24	.8	10-30-65/11-07-65
		25	.8	11-13-65/11-21-65
Hall	Weekday	1	.2	12-02-64/02-12-65
		2	.4	02-15-65/04-23-65
		3	1.7	04-26-65/07-02-65
		4	.5	07-05-65/09-10-65
		5	.2	09-13-65/11-19-65
	Weekend	1	.1	12-12-64/01-03-65
		2	.2	01-09-65/01-13-65
		3	.9	02-06-65/02-26-65
		4	.4	03-06-65/03-28-65
		5	1.5	04-03-65/04-25-65
		6	2.9	05-01-65/05-23-65
		7	2.1	05-29-65/06-20-65
		8	2.5	06-26-65/07-18-65
		9	1.2	07-24-65/08-15-65
		10	2.0	08-21-65/09-12-65
		11	0.5	09-18-65/10-10-65
		12	1.0	10-16-65/11-07-65
		13	0.2	11-07-65/12-05-65

TABLE XLVIII (Continued)

Lake	Period	Cycle Designation	Mean Number	Date
Ozzie Cobb	Weekday	1	.4	12-07-64/01-08-65
		2	.3	01-11-65/02-12-65
		3	1.3	02-15-65/03-19-65
		4	3.2	03-22-65/04-23-65
		5	5.4	04-26-65/05-28-65
		6	6.8	05-31-65/07-02-65
		7	4.1	07-05-65/08-06-65
		8	2.2	08-09-65/09-10-65
		9	2.6	09-13-65/10-15-65
		10	1.1	10-18-65/11-19-65
	Weekend	1	.3	12-12-64/12-20-64
		2	2.0	12-26-64/01-03-65
		3	1.0	01-09-65/01-17-65
		4	2.3	01-23-65/01-31-65
		5	13.3	02-06-65/02-14-65
		6	10.8	02-20-65/02-28-65
		7	7.3	03-06-65/03-14-65
		8	10.0	03-20-65/03-28-65
		9	11.8	04-03-65/04-11-65
		10	1.5	04-17-65/04-25-65
		11	6.8	05-01-65/05-09-65
		12	4.0	05-15-65/05-23-65
		13	3.0	05-29-65/06-06-65
		14	6.3	06-12-65/06-20-65
		15	2.8	06-26-65/07-04-65
		16	4.0	07-10-65/07-18-65
		17	4.0	07-24-65/08-01-65
		18	3.5	08-07-65/08-15-65
		19	2.8	08-21-65/08-29-65
		20	3.8	09-04-65/09-12-65
		21	2.0	09-18-65/09-26-65
		22	.8	10-02-65/10-10-65
		23	1.3	10-16-65/10-24-65
		24	1.0	10-30-65/11-07-65
Roman Nose	Weekday	1	2.6	07-05-65/08-06-65
		2	3.1	08-09-65/09-10-65
		3	.7	09-13-65/10-15-65
		4	2.1	10-18-65/11-19-65
	Weekend	1	5.0	07-10-65/07-18-65
		2	4.3	07-24-65/08-01-65
		3	10.0	08-07-65/08-15-65
		4	4.3	08-21-65/08-29-65
		5	1.5	09-04-65/09-12-65
		6	.5	09-18-65/09-26-65

TABLE XLVIII (Continued)

Lake	Period	Cycle Designation	Mean Number	Date
Roman Nose	Weekend	7	2.3	10-02-65/10-10-65
		8	3.5	10-16-65/10-24-65
		9	1.5	10-30-65/11-07-65
		10	1.5	11-13-65/11-21-65
		11	.5	11-27-65/12-05-65
Schooler	Weekday	1	.6	02-15-65/04-23-65
		2	1.0	04-26-65/07-02-65
		3	.4	07-05-65/09-10-65
		4	.1	09-13-65/11-19-65
	Weekend	1	.4	02-20-65/03-14-65
		2	.3	03-20-65/04-11-65
		3	1.4	04-17-65/05-09-65
		4	1.5	05-15-65/06-06-65
		5	1.6	06-12-65/07-04-65
		6	.4	07-10-65/08-01-65
		7	.4	08-07-65/07-29-65
		8	.1	09-04-65/09-26-65
		9	.4	10-02-65/10-24-65
		10	.3	10-30-65/11-21-65

TABLE XLIX

DISTRIBUTION OF AVERAGE POUNDS CAUGHT PER HOUR

Lake	Period	Cycle Designation	Mean Pounds	Date
Beaver	Weekday	1	0.061	12-02-64/02-12-65
		2	0.091	02-15-65/04-23-65
		3	0.210	04-26-65/07-02-65
		4	0.348	07-05-65/09-10-65
		5	0.158	09-13-65/11-19-65
	Weekend	1	0.031	12-12-64/01-03-65
		2	0.000	01-09-65/01-13-65
		3	0.156	02-06-65/02-28-65
		4	0.144	03-06-65/03-28-65
		5	0.271	04-03-65/04-25-65
		6	0.463	05-01-65/05-23-65
		7	0.445	05-29-65/06-20-65
		8	0.261	06-26-65/07-18-65
		9	0.490	07-24-65/08-15-65
		10	0.141	08-21-65/09-12-65
		11	0.146	09-18-65/10-10-65
		12	0.125	10-16-65/11-07-65
Burtschi	Weekday	1	0.215	12-07-64/03-20-65
		2	0.827	03-22-65/07-02-65
		3	0.265	07-05-65/10-15-65
	Weekend	1	0.611	12-12-64/01-17-65
		2	0.279	01-23-65/02-28-65
		3	0.172	03-06-65/04-11-65
		4	0.473	04-17-65/05-23-65
		5	0.453	05-29-65/07-04-65
		6	0.293	07-10-65/08-15-65
		7	0.339	08-21-65/09-26-65
		8	0.001	10-02-65/11-07-65
		9	0.124	11-13-65/12-05-65
Dahlgren	Weekday	1	0.016	12-07-64/01-08-65
		2	0.640	01-11-65/02-12-65
		3	0.310	02-15-65/03-19-65
		4	0.340	03-22-65/04-23-65
		5	0.284	04-26-65/05-28-65
		6	0.073	05-31-65/07-02-65
		7	0.278	07-05-65/08-06-65
		8	0.003	08-09-65/09-10-65
		9	0.029	09-03-65/10-15-65
		10	0.097	10-18-65/11-19-65

TABLE XLIX (Continued)

Lake	Period	Cycle Designation	Mean Pounds	Date
Dahlgren	Weekend	1	0.016	12-12-64/12-20-64
		2	0.613	12-26-64/01-03-65
		3	0.322	01-09-65/01-17-65
		4	0.125	01-23-65/01-31-65
		5	0.030	02-06-65/02-14-65
		6	0.252	02-20-65/02-28-65
		7	0.027	03-06-65/03-14-65
		8	0.210	03-20-65/03-28-65
		9	0.084	04-03-65/04-11-65
		10	0.058	04-17-65/04-25-65
		11	0.141	05-01-65/05-09-65
		12	0.139	05-15-65/05-23-65
		13	0.137	05-29-65/06-06-65
		14	0.066	06-12-65/06-20-65
		15	0.006	06-26-65/07-04-65
		16	0.003	07-10-65/07-18-65
		17	0.000	07-24-65/08-01-65
		18	0.006	08-07-65/08-15-65
		19	0.000	08-21-65/08-29-65
		20	0.000	09-04-65/09-12-65
		21	0.156	09-18-65/09-26-65
		22	0.099	10-02-65/10-10-65
		23	0.139	10-16-65/10-24-65
		24	0.031	10-30-65/11-07-65
		25	0.000	11-13-65/11-21-65
Hall	Weekday	1	0.000	12-02-64/02-12-65
		2	0.088	02-15-65/04-23-65
		3	0.371	04-26-65/07-02-65
		4	0.091	07-05-65/09-10-65
		5	0.031	09-13-65/11-19-65
	Weekend	1	0.031	12-12-64/01-03-65
		2	0.000	01-09-65/01-13-65
		3	0.000	02-06-65/02-28-65
		4	0.000	03-06-65/03-28-65
		5	0.618	04-03-65/04-25-65
		6	1.177	05-01-65/05-23-65
		7	0.339	05-29-65/06-20-65
		8	0.206	06-26-65/07-18-65
		9	0.215	07-24-65/08-15-65
		10	0.065	08-21-65/09-12-65
		11	0.063	09-18-65/10-10-65
		12	0.160	10-16-65/11-07-65
		13	0.000	11-07-65/12-05-65

TABLE XLIX (Continued)

Lake	Period	Cycle Designation	Mean Pounds	Date
Ozzie Cobb	Weekday	1	0.010	12-07-64/01-08-65
		2	0.158	01-11-65/02-12-65
		3	0.028	02-15-65/03-19-65
		4	0.333	03-22-65/04-23-65
		5	0.310	04-26-65/05-28-65
		6	1.127	05-31-65/07-02-65
		7	0.566	07-05-65/08-06-65
		8	0.622	08-09-65/09-10-65
		9	0.291	09-13-65/10-15-65
		10	0.545	10-18-65/11-19-65
	Weekend	1	0.000	12-12-64/12-20-64
		2	0.022	12-26-64/01-03-65
		3	0.065	01-09-65/01-17-65
		4	0.125	01-23-65/01-31-65
		5	0.268	02-06-65/02-14-65
		6	0.271	02-20-65/02-28-65
		7	0.977	03-06-65/03-14-65
		8	0.717	03-20-65/03-28-65
		9	0.400	04-03-65/04-11-65
		10	0.220	04-17-65/04-25-65
		11	0.246	05-01-65/05-09-65
		12	0.579	05-15-65/05-23-65
		13	0.647	05-29-65/06-06-65
		14	0.839	06-12-65/06-20-65
		15	0.630	06-26-65/07-04-65
		16	0.481	07-10-65/07-18-65
		17	0.149	07-24-65/08-01-65
		18	0.077	08-07-65/08-15-65
		19	0.310	08-21-65/08-29-65
		20	0.105	09-04-65/09-12-65
		21	0.047	09-18-65/09-26-65
		22	0.021	10-02-65/10-10-65
		23	0.000	10-16-65/10-24-65
		24	0.094	10-30-65/11-07-65
Roman Nose	Weekday	1	0.227	07-05-65/08-06-65
		2	0.224	08-09-65/09-10-65
		3	0.054	09-13-65/10-15-65
		4	0.190	10-18-65/11-19-65
	Weekend	1	0.131	07-10-65/07-18-65
		2	0.015	07-24-65/08-01-65
		3	0.200	08-07-65/08-15-65
		4	0.328	08-21-65/08-29-65
		5	0.000	09-04-65/09-12-65
		6	0.125	09-18-65/09-26-65

TABLE XLIX (Continued)

Lake	Period	Cycle Designation	Mean Pounds	Date
Roman Nose	Weekend	7	0.015	10-02-65/10-10-65
		8	0.351	10-16-65/10-24-65
		9	0.191	10-30-65/11-07-65
		10	0.392	11-13-65/11-21-65
		11	0.062	11-27-65/12-05-65
Schooler	Weekday	1	0.196	02-15-65/04-23-65
		2	0.782	04-26-65/07-02-65
		3	0.000	07-05-65/09-10-65
		4	0.000	09-13-65/11-19-65
	Weekend	1	0.000	02-20-65/03-14-65
		2	0.002	03-20-65/04-11-65
		3	0.314	04-17-65/05-09-65
		4	0.096	05-15-65/06-06-65
		5	0.089	06-12-65/07-04-65
		6	0.000	07-10-65/08-01-65
		7	0.090	08-07-65/08-29-65
		8	0.000	09-04-65/09-26-65
		9	0.000	10-02-65/10-24-65
		10	0.000	10-30-65/11-21-65

TABLE L

MEAN VALUES OF CREEL STATISTICS FOR LAKES
IN WHICH DAYS DIFFERED SIGNIFICANTLY

Category	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
Schooler							
Weekday --Parties	0.1	0.2	0.8	0.6	0.4		
Schultz							
Weekday --Parties	4.2	1.4	2.2	1.6	1.8		
Weekend --Parties						2.9	5.3
Schultz							
Weekend --Pounds						5.4	12.9
Dahlgren							
Weekday -- Pounds/hr	0.37	0.14	0.36	0.04	0.12		

TABLE LI

RESULTS OF ANALYSES OF VARIANCE FOR AVERAGE MORNING VERSUS AFTERNOON FISHERMAN TRIPS COMPLETED FOR NUMBER OF PARTIES (MEAN VALUES GIVEN)

Lake	Period	A.M.	P.M.	Significant
Beaver	Weekday	0.7	1.5	Yes
	Weekend	1.0	1.8	Yes
Burtschi	Weekday	3.0	6.7	Yes
	Weekend	6.6	13.9	Yes
Dahlgren	Weekday	1.3	3.1	Yes
	Weekend	2.8	4.8	Yes
Hall	Weekday	0.04	1.2	Yes
	Weekend	1.4	1.0	Yes
Kingfisher	Weekday	0.04	4.9	Yes
	Weekend	0.08	3.7	Yes
Ozzie Cobb	Weekday	1.7	3.8	Yes
	Weekend	2.6	5.5	Yes
Roman Nose	Weekday	0.9	3.3	Yes
	Weekend	3.2	3.1	No
Schooler	Weekday	0.2	0.6	Yes
	Weekend	--	--	---
Schultz	Weekday	1.7	2.7	No
	Weekend	2.3	5.8	Yes
Vincent	Weekday	2.4	5.4	Yes
	Weekend	5.0	10.6	Yes

TABLE LII

RESULTS OF ANALYSES OF VARIANCE FOR AVERAGE MORNING VERSUS AFTERNOON FISHERMEN TRIPS COMPLETED FOR NUMBER OF HOURS FISHED (MEAN VALUES GIVEN)

Lake	Period	A.M.	P.M.	Significant
Beaver	Weekday	4.4	10.8	Yes
	Weekend	7.1	10.5	No
Burtschi	Weekday	18.4	35.8	Yes
	Weekend	59.7	159.9	Yes
Dahlgren	Weekday	14.1	29.7	Yes
	Weekend	33.4	52.3	No
Hall	Weekday	0.3	7.2	Yes
	Weekend	13.8	6.8	Yes
Kingfisher	Weekday	0.1	26.5	Yes
	Weekend	0.2	16.9	Yes
Ozzie Cobb	Weekday	19.1	37.8	Yes
	Weekend	28.7	59.1	Yes
Roman Nose	Weekday	5.8	24.0	Yes
	Weekend	26.9	44.3	No
Schooler	Weekday	1.8	7.6	Yes
	Weekend	---	---	---
Schultz	Weekday	15.6	24.4	No
	Weekend	37.9	58.4	Yes
Vincent	Weekday	40.8	69.1	No
	Weekend	119.2	160.3	No

TABLE LIII

RESULTS OF ANALYSES OF VARIANCE FOR AVERAGE MORNING VERSUS AFTERNOON FISHERMEN TRIPS COMPLETED FOR POUNDS CAUGHT (MEAN VALUES GIVEN)

Lake	Period	A.M.	P.M.	Significant
Beaver	Weekday	0.75	2.76	Yes
	Weekend	1.98	2.76	No
Burtschi	Weekday	4.78	9.46	No
	Weekend	5.72	21.69	Yes
Dahlgren	Weekday	2.20	2.26	No
	Weekend	0.85	3.34	Yes
Hall	Weekday	0.00	3.40	Yes
	Weekend	5.51	3.29	No
Kingfisher	Weekday	0.05	3.99	Yes
	Weekend	---	1.70	Yes
Ozzie Cobb	Weekday	4.84	10.14	No
	Weekend	2.90	13.69	Yes
Roman Nose	Weekday	0.75	3.10	Yes
	Weekend	2.63	4.00	No
Schooler	Weekday	0.14	0.64	No
	Weekend	--	--	--
Schultz	Weekday	4.35	5.06	No
	Weekend	3.93	12.94	Yes
Vincent	Weekday	6.48	9.85	No
	Weekend	13.58	18.70	No

TABLE LIV

RESULTS OF ANALYSES OF VARIANCE FOR AVERAGE MORNING VERSUS AFTERNOON FISHERMEN TRIPS COMPLETED FOR POUNDS CAUGHT PER HOUR (MEAN VALUES GIVEN)

Lake	Period	A.M.	P.M.	Significant
Beaver	Weekday	0.09	0.25	No
	Weekend	0.15	0.22	No
Burtschi	Weekday	0.38	0.49	No
	Weekend	0.46	0.23	No
Dahlgren	Weekday	0.30	0.11	Yes
	Weekend	0.10	0.10	No
Hall	Weekday	0.00	0.23	Yes
	Weekend	0.27	0.17	No
Kingfisher	Weekday	0.01	0.08	Yes
	Weekend	0.00	0.13	Yes
Ozzie Cobb	Weekday	0.29	0.51	No
	Weekend	0.17	0.39	No
Roman Nose	Weekday	0.09	0.25	Yes
	Weekend	0.07	0.26	No
Schooler	Weekday	0.32	0.07	No
	Weekend	--	--	--
Schultz	Weekday	0.46	0.28	No
	Weekend	0.08	0.31	Yes
Vincent	Weekday	0.43	0.27	No
	Weekend	0.18	0.21	No

TABLE LV

RESULTS OF ANALYSES OF VARIANCE FOR RESIDENT/NONRESIDENT RATIO

Lake	Period	Significant Categories
Beaver	Weekday	Time
		Time x Cycle
Hall	Weekday	Time
	Weekend	Area
Roman Nose	Weekend	Cycle
		Day
		Day x Cycle

TABLE LVI

RESULTS OF ANALYSES OF VARIANCE
FOR SEX RATIOS

Lake	Period	Significant Categories
Beaver	Weekend	Time x Cycle
Burtschi	Weekday	Time
Dahlgren	Weekday	Time
	Weekend	Days
Hall	Weekend	Area
Kingfisher	Weekday	Time
	Weekend	Time
Ozzie Cobb	Weekday	Time
Roman Nose	Weekday	Time
Schooler	Weekday	Area
		Cycle
		Day

TABLE LVII

AVERAGE SEX RATIOS (FEMALE/MALE) OF STATE LAKE FISHING PARTIES

Lake	Period	Morning	Afternoon
Beaver	Weekday	.084	.271
	Weekend	.205	.240
Burtschi	Weekday	.206	.242
	Weekend	.142	.607
Dahlgren	Weekday	.151	.379
	Weekend	.226	.239
Hall	Weekday	.020	.190
	Weekend	.263	.223
Kingfisher	Weekday	.000	.379
	Weekend	.000	.339
Ozzie Cobb	Weekday	.200	.384
	Weekend	.420	.320
Roman Nose	Weekday	.071	.529
	Weekend	.352	.422
Schooler	Weekday	.087	.110
	Weekend	.000	.204
Schultz	Weekday	.147	.202
	Weekend	.312	.459
Vincent	Weekday	.342	.469
	Weekend	.515	.524

TABLE LVIII

NUMBER OF BASS CAUGHT PER HOUR FOR DIFFERENT BASES OF EFFORT

Lake	Catch per hour of					
	Successful fishermen with 50% of the catch		Successful fishermen		All fishermen	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Beaver	0.66	0.31	0.23	0.31	0.03	0.03
Burtschi	1.59	0.34	0.45	0.15	0.08	0.02
Dahlgren	0.45	1.00	0.15	0.21	0.02	0.01
Hall	0.22	0.56	0.22	0.31	0.08	0.12
Kingfisher	-	1.25	-	0.70	0.01	0.01
Ozzie Cobb	0.26	0.34	0.18	0.25	0.04	0.04
Roman Nose	2.90	3.85	0.74	0.26	0.02	0.03
Schooler	0.62	-	0.28	0.07	0.01	0.02
Schultz	1.26	1.00	0.91	0.63	0.15	0.16
Vincent	1.38	0.37	0.23	0.17	0.03	0.04

TABLE LIX

NUMBER OF CRAPPIE CAUGHT PER HOUR FOR DIFFERENT BASES OF EFFORT

Lake	Catch per hour of					
	Successful fishermen with 50% of the catch		Successful fishermen		All fishermen	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Beaver	1.13	0.65	0.56	0.44	0.15	0.13
Burtschi	2.59	1.48	0.26	0.15	0.11	0.05
Dahlgren	3.50	1.64	1.87	1.24	0.03	0.04
Hall	0.68	0.53	0.26	0.34	0.08	0.05
Kingfisher	-	-	-	-	-	-
Ozzie Cobb	1.99	1.96	1.14	1.11	0.20	0.23
Roman Nose	-	-	1.22	0.22	0.04	0.02
Schooler	0.62	-	0.28	0.25	0.04	0.01
Schultz	-	-	-	-	-	-
Vincent	0.83	0.32	0.78	0.12	0.01	0.01

TABLE LX

NUMBER OF CATFISH CAUGHT PER HOUR FOR DIFFERENT BASES OF EFFORT

Lake	Catch per hour of					
	Successful fishermen with 50% of the catch		Successful fishermen		All fishermen	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Beaver	0.32	0.31	0.23	0.31	0.05	0.07
Burtschi	0.69	0.26	0.23	0.15	0.02	0.02
Dahlgren	0.94	0.61	0.38	0.33	0.07	0.03
Hall	0.86	0.43	0.26	0.37	0.04	0.07
Kingfisher	1.61	1.18	0.41	0.71	0.08	0.08
Ozzie Cobb	0.69	0.47	0.41	0.29	0.13	0.06
Roman Nose	0.22	0.20	0.15	0.14	0.03	0.07
Schooler	-	-	-	-	-	-
Schultz	1.22	1.05	0.85	0.52	0.15	0.14
Vincent	0.41	0.24	0.21	0.12	0.06	0.08

TABLE LXI

NUMBER OF SUNFISH CAUGHT PER HOUR FOR DIFFERENT BASES OF EFFORT

Lake	Catch per hour of					
	Successful fishermen with 50% of the catch		Successful fishermen		All fishermen	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Beaver	1.75	0.84	0.65	0.63	0.06	0.06
Burtschi	4.56	3.25	1.99	1.54	0.39	0.21
Dahlgren	2.58	0.91	1.70	0.97	0.06	0.03
Hall	4.45	1.67	2.57	0.67	0.30	0.06
Kingfisher	-	-	0.75	1.00	0.01	0.01
Ozzie Cobb	1.36	1.44	0.76	0.78	0.26	0.12
Roman Nose	2.05	1.15	1.74	0.91	0.21	0.06
Schooler	1.28	2.28	0.66	0.87	0.55	0.57
Schultz	-	-	-	-	-	-
Vincent	2.25	2.24	0.69	0.64	0.17	0.19

TABLE LXII

CORRELATION COEFFICIENTS BETWEEN DIFFERENT MEASURES OF CATCH PER UNIT OF EFFORT

Species	Period	Method 1* & 2**	Method 1 & 3***	Method 2 & 3
Bass	Weekday	0.69+	-0.64	0.59
	Weekend	0.11	0.10	0.91+
Catfish	Weekday	0.65+	0.48	0.21
	Weekend	0.94+	0.34	0.30
Crappie	Weekday	0.67	-0.10	0.20
	Weekend	0.70+	0.52	0.48
Sunfish	Weekday	0.85+	0.12	0.05
	Weekend	0.61	0.57	0.15

*Method 1 Effort of those fishermen catching 50% of the fish

**Method 2 Effort of all successful fishermen

***Method 3 Effort of all fishermen

+Significant at $P < .05$

TABLE LXIII

PERCENT OF SUCCESSFUL FISHERMEN CAPTURING 50 PERCENT OF THE CATCH OF VARIOUS GROUPS OF FISH IN NUMBERS

Lake	Period	Percentage of			
		Bass Fishermen	Crappie Fishermen	Catfish Fishermen	Sunfish Fishermen
Beaver	Weekday	22	23	33	13
	Weekend	42	21	22	11
Burtschi	Weekday	17	9	23	16
	Weekend	10	21	24	18
Dahlgren	Weekday	26	23	23	33
	Weekend	13	19	12	38
Hall	Weekday	33	33	29	33
	Weekend	22	60	23	25
Kingfisher	Weekday	--	--	17	--
	Weekend	33	--	42	--
Ozzie Cobb	Weekday	23	23	17	16
	Weekend	6	16	12	14
Roman Nose	Weekday	36	--	25	27
	Weekend	28	--	29	29
Schooler	Weekday	--	33	--	33
	Weekend	--	--	--	22
Schultz	Weekday	32	--	31	--
	Weekend	29	--	32	--
Vincent	Weekday	22	14	14	12
	Weekend	16	13	22	14

TABLE LXIV

PERCENT DISTRIBUTION OF FISHERMAN TRIP COMPLETION
BY TIME OF DAY FOR WEEKDAYS

	Beaver	Burtschi	Dahlgren	Hall	Kingfisher	Ozzie Cobb	Roman Nose	Schooler	Schultz	Vincent
A.M.										
4:01 - 5:00		3		5						
5:01 - 6:00		2		18	1	1				
6:01 - 7:00		3		4	1	1	3			2
7:01 - 8:00		3		5	2	3	3		3	
8:01 - 9:00		5	1	5	5	3	4		2	5
9:01 -10:00		5	5	4	6	3	4		11	6
10:01 -11:00		9	17	2	14	20	3		20	14
11:01 -12:00			2		14					4
P.M.										
12:01 - 1:00		1	9	26	4	11	21		8	6
1:01 - 2:00		4	6	12	8	9	12		9	7
2:01 - 3:00		10	5	6	9	9	17		8	5
3:01 - 4:00		11	14	5	15	13	12		8	9
4:01 - 5:00		10	12	7	9	10	8		10	11
5:01 - 6:00		10	9		9	11	3		8	16
6:01 - 7:00		19	10			5	9		8	12
7:01 - 8:00			8		2					

Only A.M. and P.M. Data Available

Only A.M. and P.M. Data Available

TABLE LXV

PERCENT DISTRIBUTION OF FISHERMAN TRIP COMPLETION
BY TIME OF DAY FOR WEEKENDS

	Beaver	Burtschi	Dahlgren	Hall	Kingfisher	Ozzie Cobb	Roman Nose	Schooler	Schultz	Vincent
A.M.										
4:01 - 5:00		4		3						1
5:01 - 6:00		2		15			1		3	1
6:01 - 7:00		3	1	5	2	3	5			2
7:01 - 8:00		4	1	7	6	3	5		3	3
8:01 - 9:00		6	2	5	7	4	7		5	3
9:01 -10:00		6	6	6	7	6	9		6	5
10:01 -11:00		9	12	2	5	11	9		14	8
11:01 -12:00			2	1	15					5
P.M.										
12:01 - 1:00		10	6	22	2	16	17		9	5
1:01 - 2:00		6	11	5	2	8	9		6	7
2:01 - 3:00		8	9	11	6	11	7		8	9
3:01 - 4:00		9	17	10	8	10	9		13	10
4:01 - 5:00		12	12	3	13	12	9		16	15
5:01 - 6:00		7	10	4	11	11	7		8	14
6:01 - 7:00		15	7	1	11	2	5		10	12
7:01 - 8:00		1	3		4		1			

Only A.M. and P.M. Data Available

Only A.M. and P.M. Data Available

TABLE LXVI

PERCENTAGE DISTRIBUTION OF THE MONTHLY VARIANCE OF THE CREEL STATISTICS

Month	Hours Fished		Pounds Caught		Pounds Per Hour	
	Weekday Variance %	Weekend Variance %	Weekday Variance %	Weekend Variance %	Weekday Variance %	Weekend Variance %
			Lake Beaver			
January	-	3	-	-	-	1
February	12	-	11	-	21	-
March	17	2	2	3	9	9
April	10	11	8	5	3	2
May	9	19	4	19	6	3
June	8	8	16	29	8	14
July	11	8	31	7	28	4
August	6	10	2	12	1	5
September	4	17	6	15	13	55
October	10	13	12	10	4	6
November	12	7	9	3	7	-
December						
			Lake Burtschi			
January	2	-	1	3	9	50
February	-	4	-	5	-	10
March	6	2	6	2	34	2
April	20	18	42	33	9	4
May	15	35	11	16	5	4
June	16	11	9	17	3	5
July	6	5	5	6	8	3
August	10	6	6	7	3	4
September	7	9	13	2	17	1
October	7	4	3	4	2	2
November	8	1	3	2	4	8
December	2	2	1	3	6	5

TABLE LXVI (Continued)

Month	Hours Fished		Pounds Caught		Pounds-Per-Hour	
	Weekday Variance %	Weekend Variance %	Weekday Variance %	Weekend Variance %	Weekday Variance %	Weekend Variance %
			Lake Dahlgren			
January	1	4	7	4	33	36
February	2	10	4	21	4	9
March	2	1	10	1	7	3
April	22	30	14	37	4	4
May	7	20	8	20	4	3
June	32	10	15	3	3	4
July	20	12	20	2	23	8
August	5	6	5	5	2	6
September	2	-	1	-	2	-
October	3	2	12	3	11	22
November	3	-	2	1	5	4
December	1	3	1	1	2	1
			Lake Hall			
January	-	-	-	-	-	-
February	-	3	-	-	-	-
March	9	3	10	-	5	-
April	7	1	10	6	41	18
May	29	4	36	10	10	24
June	26	8	15	13	1	15
July	10	22	2	21	22	10
August	6	13	14	9	6	19
September	2	22	8	10	5	7
October	10	18	5	28	9	6
November	-	-	-	-	-	-
December	-	4	-	-	-	-

TABLE LXVI (Continued)

Month	Hours Fished		Pounds Caught		Pounds-Per-Hour	
	Weekday Variance %	Weekend Variance %	Weekday Variance %	Weekend Variance %	Weekday Variance %	Weekend Variance %
			Lake Kingfisher			
January						
February						
March						
April						
May						
June	51	-	54	-	12	-
July	2	21	21	42	15	54
August	6	24	3	23	7	15
September	4	9	8	27	27	26
October	22	38	11	7	12	4
November	14	8	2	-	20	-
December	-	-	-	-	-	-
			Lake Ozzie Cobb			
January	-	-	-	-	-	-
February	2	2	11	1	29	1
March	9	5	-	8	-	7
April	8	14	9	24	4	10
May	20	16	24	17	4	12
June	15	20	12	18	14	20
July	15	8	15	8	12	16
August	8	6	2	7	1	13
September	5	18	14	13	11	16
October	9	8	7	3	4	4
November	6	3	4	-	17	-
December	3	-	1	-	2	-

TABLE LXVI (Continued)

Month	Hours Fished		Pounds Caught		Pounds-Per-Hour	
	Weekday Variance %	Weekend Variance %	Weekday Variance %	Weekend Variance %	Weekday Variance %	Weekend Variance %
			Lake Roman Nose			
January	-	-	-	-	-	-
February	5	-	-	-	-	-
March	-	8	-	2	-	1
April	-	-	-	-	-	-
May	-	-	-	-	-	-
June	40	51	40	2	7	2
July	13	16	16	31	53	11
August	17	7	15	17	20	8
September	1	3	-	6	-	21
October	6	2	-	25	5	33
November	17	1	28	6	14	22
December	-	13	-	9	-	2
			Lake Schooler			
January	-	-	-	-	-	-
February	-	-	-	-	-	-
March	-	-	-	-	-	-
April	14	6	62	31	8	60
May	24	38	19	18	88	11
June	43	43	13	31	1	29
July	17	2	6	-	3	-
August	-	5	-	19	-	-
September	-	2	-	-	-	-
October	-	4	-	-	-	-
November	-	-	-	-	-	-
December	-	-	-	-	-	-

TABLE LXVI (Continued)

Month	Hours Fished		Pounds Caught		Pounds-Per-Hour	
	Weekday Variance %	Weekend Variance %	Weekday Variance %	Weekend Variance %	Weekday Variance %	Weekend Variance %
			Lake Schultz			
January						
February						
March						
April						
May						
June	8	12	6	3	3	6
July	21	26	4	25	4	14
August	13	24	13	22	7	15
September	32	15	33	19	13	17
October	16	14	30	18	26	28
November	10	8	13	12	46	21
December	-	-	-	-	-	-
			Lake Vincent			
January	-	-	-	-	-	-
February	1	2	-	-	20	-
March	-	-	-	-	-	-
April	26	14	18	9	13	6
May	22	8	33	7	9	27
June	6	14	6	16	21	13
July	11	16	5	19	6	12
August	8	16	22	14	12	6
September	10	15	4	18	6	10
October	5	8	3	6	7	6
November	11	6	8	10	5	18
December	-	-	-	-	-	-

VITA

3

Bradford Ellsworth Brown

Candidate for the Degree of

Doctor of Philosophy

Thesis: AN ANALYSIS OF THE OKLAHOMA STATE LAKE CREEL SURVEY TO IMPROVE CREEL SURVEY DESIGN

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