THE RESULTS OF A NON-UNIFORM PROBABILITY CREEL SURVEY ON A SMALL STATE-OWNED LAKE

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ABSTRACT

A non-uniform probability creel survey was conducted in conjunction with a stratified two-hour survey. The methods of each survey are described. Analysis of results in terms of fishing pressure showed that there was no statistically significant difference between the two surveys, but the non-uniform probability survey proved to be 38 percent more efficient.

INTRODUCTION

Each year since 1958 and the inception of the State-owned Lakes Investigations project, some type of creel survey work has been conducted on Shanty Hollow Lake, a 106-acre impoundment located in the Pennyroyal Physiographic Region approximately 14 miles northeast of Bowling Green, Kentucky.

From 1958 to 1964, a two-hour stratified creel survey designed by Bernard T. Carter, Director of Kentucky's Division of Fisheries, was used. In 1961, a complete creel census was initiated in which a creel clerk was employed to interview every angler visiting the lake. This complete census was conducted each year from 1961 through 1964, and it was hoped that the resulting data would provide a test of the validity of the two-hour survey. From an analysis of the total fishing pressure data supplied by the complete census and the concurrent partial survey it was determined that approximately 31.3 percent of the anglers visiting the lake were being missed in the complete census (Pfeiffer, 1965). As a result this more expensive and less reliable census was dropped in 1965.

Upon the suggestion and with the guidance of Professor Don W. Hayne of the Southeastern Cooperative Fish and Game Statistics Project, a non-uniform probability survey was designed and conducted in conjunction with the two-hour survey during 1965 to determine if there was a statistically significant difference in the results of the two surveys in terms of fishing pressure.

CREEL SURVEY METHODS

The Two-hour Survey

This survey employed systematically selected sampling periods and began on April 1 and continued through October 31. Interviews were made during a pre-selected two-hour period between 7:00 a.m. and 7:00 p.m., and each day of the week was sampled once during each month of the survey. There was a total of 49 interview and count periods in the survey.

At the beginning of each survey period the creel clerk boated completely around the lake and made a total count of all fishermen. After making the count he began interviewing fishing parties (a fishing party consists of one or more fishermen), trying first to contact two parties who had completed their trips for the day. After making or failing to make these contacts, the clerk moved around the lake interviewing fishing parties until he had boated completely around the lake, making sure he stayed within the two-hour period. The survey was then complete for that day.

To insure that interviews were taken in all areas of the lake, the clerk, after making the total count, began interviewing at the dam, moving one day to the left and the next day to the right. The third and fourth days after making the count, he began interviewing at the farthermost point from the dam, moving one day to the left and the next day to the right. The fifth and sixth days he returned to the dam and repeated the procedure.

The data from the parties who were interviewed were projected to determine fishing pressure, catch, fishing methods, sex ratios, trip cost, and numbers of resident and non-resident fishermen. Total fishing pressure was obtained by using the formula described by Lambou, 1961:

$$f = C\bar{x}$$

where f = number of time units of fishing
C = number of time units in the population
$\bar{x}$ = mean number observed per count.

The Non-uniform Probability Survey and Requirements

This survey employed randomly selected sampling periods and covered the same time period as the two-hour survey (April 1 - October 31 and from 7:00 a.m. to 7:00 p.m. each day).

Unlike the two-hour survey, however, the non-uniform probability survey makes use of prior knowledge of the fishing pressure on the lake to be sampled. This information may be obtained from several sources:

1. From some type of creel survey previously conducted on the lake.
2. From information solicited from Conservation Officers and boat dock operators assigned to the lake.
3. From your own knowledge, if you had previously worked on the lake.
4. From all three sources or any combination of them.

The information for this particular survey was obtained from a complete creel census previously conducted on the lake and the objective was to establish a sampling probability for each two-hour period in the survey.

The first step was to divide the survey into seven-day segments. Then, each seven-day segment was divided into two-hour periods between the hours 7:00 a.m. - 7:00 p.m. This, however, could be one, three, four or six-hour periods depending on the size of the lake under study, with the thought that a complete count would be made each period. When completed (see Table 1) each two-hour period was assigned a value representing the number of anglers that could be expected to be fishing during that particular time period. It is here that the information concerning past fishing pressure was used. One point concerning the assigning of these values should be made clear. It is not the actual number assigned that is important, but the proportion which this number makes up of the sum of all the assigned numbers in the segment. For example, pressure estimated at 5, 10, and 20 would be in the same proportion as estimates of 1, 2, and 4 and either set of values could be used. It should also be pointed out that a wrong guess on these values will not produce a biased survey, only a less efficient one. In addition, when assigning fishing pressure values, a zero can never be used because this is the same as saying there is absolutely no possibility that anyone will be fishing during that particular time period. If previous data indicates a zero fishing pressure for a particular time period this should be replaced with a fishing pressure estimate of some small number, say one.

TABLE 1. ASSIGNED FISHING PRESSURE VALUES (FISHING TRIPS) FOR THE SECOND SEGMENT IN JULY.

		Time Periods					
Date	Day	7 - 9	9 - 11	11 - 1	1 - 3	3 - 5	5 - 7
11	Mon.	7	3	8	5	8	3
12	Tues.	18	7	5	7	7	3
13	Wed.	11	11	7	6	5	5
14	Thurs.	13	13	11	4	11	1
15	Fri.	5	11	6	7	9	4
16	Sat.	19	17	17	13	10	10
17	Sun.	13	7	4	9	9	6

The second step is to compute the sampling probability for each two-hour period. Using the formula below, add the total number of fishermen in the seven-day segment and divide the number of fishermen in each two-hour period by this total (see Table 2).

$$P_t = \frac{(F_t)}{(F_s)}$$

where P_t = sampling probability for the time period
(F_t) = estimated number of time units of fishing in the time period
(F_s) = estimated number of time units of fishing in the segment.

TABLE 2. CALCULATED SAMPLING PROBABILITIES FOR THE SECOND SEGMENT IN JULY.

Date	Day	Time Periods					
		7 - 9	9 - 11	11 - 1	1 - 3	3 - 5	5 - 7
11	Mon.	.020	.008	.022	0.14	.022	.008
12	Tues.	.051	.020	.014	.020	.020	.008
13	Wed.	.031	.031	.020	.017	.014	.014
14	Thurs.	.037	.037	.031	.011	.031	.003
15	Fri.	.041	.031	.017	.020	.025	.011
16	Sat.	.054	.048	.048	.037	.028	.028
17	Sun.	.037	.020	.011	.025	.025	.017

Finally each two-hour period in the segment was assigned a random number range equal to the value of the sampling probability (see Table 3). After assigning fishing pressure values, computing sampling probabilities, and assigning random number ranges for each time period in each seven-day segment of the survey, one sampling period was randomly selected from each segment. As an example, if the random number selected was 89, the sampling period for this segment would be Monday, July 11, during the 5-7 time period (see Table 3). The fishing probability for this segment would then be .008 (see Table 2).

TABLE 3. ASSIGNED RANGES FOR RANDOM NUMBER SELECTION FOR THE SECOND SEGMENT IN JULY.

Date	Day	Time Periods					
		7 - 9	9 - 11	11 - 1	1 - 3	3 - 5	5 - 7
11	Mon.	001-020	021-028	029-050	051-064	065-086	087-094
12	Tues.	095-145	146-165	166-179	180-199	200-219	220-227
13	Wed.	228-258	259-289	290-309	310-326	327-340	341-354
14	Thurs.	355-391	392-428	429-459	460-470	471-501	502-504
15	Fri.	505-518	519-549	550-566	567-586	587-611	612-622
16	Sat.	623-676	677-724	725-772	773-809	810-837	838-865
17	Sun.	866-902	903-922	923-933	934-958	959-983	984-000

There was a total of 30 sampling periods in the survey (one for each seven-day segment). The actual interviews and total counts were made as described in the two-hour survey. The data from the parties interviewed were then projected for the same categories described in the two-hour survey. However, for purposes of comparison, only the fishing pressure will be used in this report. The fishing pressure for each segment was calculated using the following formula:

$$F_s = \frac{tC_s}{P_s}$$

where F_s = number of time units of fishing per segment
t = sampling time period
C_s = total count per segment
P_s = sampling probability per segment.

The total fishing pressure of the entire survey was then obtained by adding the totals of each segment.

RESULTS AND DISCUSSION

A comparison of the results of the two surveys showed that the two-hour survey yielded an estimate which was 4,388 fisherman-hours higher than the non-uniform probability survey. According to Hayne (personal communication) this amount of difference is well within the range expected as indicated by a consideration of the respective standard errors and a t-test of the difference. The standard error of the difference was 3,610 fisherman-hours. This statistical analysis does not prove that these two surveys are identical and it should not be expected that the two-hour survey would always yield a higher estimate, because if it did then there would be a significant difference present.

Based on the number of fisherman counts involved (49 in the stratified survey; 30 in the non-uniform probability survey), the non-uniform probability survey was roughly 38 percent more efficient than the two-hour survey. The increased efficiency comes from several characteristics. First, the two-hour survey as planned has every day of the week and every time period of the day represented in rotation. This results in a disproportionate amount of effort on the weekdays, since there are five of these to two week-end days. Further, this allocates the same amount of survey effort to every time period of the day, while there are some periods that are far more important than others. Finally, the two-hour survey has some of the characteristics of a systematic survey and may fall victim of somewhat the same problems; that is, it might on occasion be possible for the systematic selection of days and time periods to overemphasize some parts of the season. It is therefore better to include some random selection of sampling periods even if one were not to use the non-uniform probability type survey. (Hayne, personal communication.)

Further consideration of the non-uniform probability survey shows that, although a considerable amount of time and effort will be spent in initially setting it up, once the probabilities have been established they may be used again the following year provided the investigator is satisfied that the proportional distribution of fishing has not significantly changed. The reduced number of sampling periods also lends an appeal to those situations where Conservation Officers serve as creel clerks. On any terms it is much less costly.

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