

SAMPLING TO DETERMINE UNREPORTED DEER KILL IN TENNESSEE, 1964-1966

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Tennessee, like most states, needs to know the total number of deer killed. The special conditions for determining this in Tennessee may render our experiences of interest. This is an account of a mail survey method with a comparison of results from interview of non-respondents with those from an extrapolation method of estimating success of the same group.

Most states determine deer kill by one of three methods. Some enforce a registration to legalize possession of the trophy, others impose no reporting requirements and then estimate success by using a mail survey, while others set up a legal requirement that all hunters report their success by mail. Open deer hunting in Tennessee falls under the last classification, and here the principal problem is the unreported deer kill.

A substantial proportion of the deer killed in Tennessee are taken on managed hunts where hunters are checked in and out through checking stations and where there is a complete record of the kill. Deer hunting over the rest of the state, outside of the managed areas, is termed "open" hunting. Hunters are required by law to report kills made in open deer hunting and the special big game permit includes a card on which the report can be made. Some hunters report their kill as specified by law and for various reasons other hunters do not. It is the unreported kill which must be determined, and because there are so many who do not report (Table 1), a sampling plan is used with a mail survey.

TABLE 1—BIG GAME PERMITS AND DEER KILL IN TENNESSEE, 1964-1966.

	1964	1965	1966
Total Number of Permits Issued as of 31 March	45,972	49,858	59,437
Permits reported upon before Mail Survey Date	8,062	2,234	3,330
Number Unreported and Sampled in Mail Survey	37,910	47,624	56,107
Deer Killed			
On Managed Hunts	2,469	1,870	2,552
Reported Open Kill	2,205	2,134	3,262
¹ Estimated Open Kill	1,123±118	1,234±250	935±156
Total Kill	5,797±118	5,238±250	6,749±156

Whenever a mail survey is used to estimate hunting success, there are some persons who do not respond even to three mailings. Estimation of the success of these non-respondents is a troublesome question. The best method is to interview a randomly selected portion of the non-respondents, but this may be expensive as a regular procedure. Some states simply assume the same success for the non-respondents as that reported by respondents, even though there is a well-established supposition that ordinarily there are more non-respondents among the less successful hunters. A third solution for the problem is to mail several reminders to non-respondents and to observe the differential success as reported by the hunters responding to succeeding mailings. If reported success follows a trend for successive mailings, then this trend is customarily extrapolated to estimate the success of the non-respondents. Several rules have been suggested to govern this extrapolation.

The method of extrapolation employed by the Southeastern Cooperative Fish and Game Statistics Project in working with a number of the states of the Southeast was originally devised by W. Scott Overton when

¹ Estimated by mail survey and interview of a sample of non-respondents.

employed by Florida, and later included in a report (Chapman, Overton and Finkner, 1959) though to our knowledge the method has not been published in a more formal way. An approximation to this method has been published by Abramson (1963). In this method, a second degree polynomial is fitted to the trend of the cumulative reported success as plotted against cumulative numbers of hunters reporting. At the last point, corresponding ordinarily to results from the third mailing, a tangent is fitted to the curve and the intercept of this tangent read on the y-axis as the estimated cumulative success of the entire sample including non-respondents. Special provision is made that this intercept may not have a value less than the last point. Actual computations in this method are carried out by means of a computer program. Advantages of this method of extrapolation are that its development is reasonable and, given a computer program, it is easy to apply. One of our objectives here was to observe whether use of the less expensive computer method compared satisfactorily with the superior method of interviewing a sample of non-respondents.

METHODS

The Tennessee big game permit (sometimes called big game stamp) is a 3 inch by 7½ inch post card stock booklet containing deer, turkey, bear, and boar kill cards. A printed carbon-back cover slip is attached to the front cover and the front and back covers and four kill cards are fastened in booklet form. At one end of each card is a perforated 1¼ inch by 3 inch tag with a punched hole which must be removed and attached to a kill. It is required that the remaining 3 inch by 5 inch perforated kill card must be completed as to county, date of kill, weight of kill, points, comments, and signature, and mailed (postage free) to the Tennessee Game and Fish Commission within five days of the kill. License agents are instructed to print the hunter's complete name and address on the cover slip. The agent retains the cover slip and sends it to the Commission with his monthly license report. Most of the permit sales are in October and November, with the deer season usually from October 1st through January 31st. By February 10th, the audit of sales is 95 percent complete.

A serial number is printed on each part of a big game permit. The sampling frame for unreturned tags was set up on the basis of the terminal two or three digits of the serial number. For statistical purposes, it was necessary to divide the whole sample into several subsamples. This was done by selecting random sets of terminal digits. For example, in 1966 a 2 percent sample was used, and it was desired that this be divided into somewhere between 4 and 8 independent subsamples. The following sets of digits were drawn at random.

Terminal Digits	Sub-Sample Number				
	1	2	3	4	5
	233	329	437	645	953
	234	330	438	646	954
	235	331	439	647	955
	236	332	440	648	956

The advantage of drawing sets of three-digit random numbers instead of using 2 two-digit numbers is, in general, the flexibility provided in allowing sampling fractions between even percentages, and in particular, in providing the desired numbers of subsets. Clerks learn these sets of random digits quickly and are able to sort through the slips from all permits issued, discarding those not terminating in the chosen digits. By early selection of the sample digits, the task can be spread over several months and kept reasonably current with permit sales. As selected, the sample permit numbers are filed in order. Then, as hunter reports of kills are received, the same sampling digits are watched for, so that the corresponding record of each reporting hunter may be removed from the sampling file. The residual sampling file then constitutes a random sample of the entire file of unreported permits, achieved without the necessity of filing and comparing the entire set of permits which totals several tens of thousands of names.

For each hunter name in the sample, three gummed labels (original and two carbons) were typed and attached to a card bearing the permit serial number, and then filed in order. The first label was used for the first mailing. As returns were received, this card file was purged of respondents' names, and after two weeks the second mailing was sent, using the names remaining in the file. The third mailing was completed in similar fashion. The file which remained after three mailings provided the serial numbers of hunters to be interviewed. Numbers of respondents and non-respondents for each survey are shown in Table 2.

TABLE 2—SAMPLE SIZES, RESPONSES AND SUCCESS REPORTED FOR OPEN HUNTS BY TENNESSEE DEER HUNTERS, 1964-1966.

	1964	1965	1966
Sample Size for Mail Survey	2592	1350	988
First Mailing, Respondents	1211	813	612
Success	0.025	0.031	0.011
Second Mailing, Respondents	583	241	191
Success	0.027	0.021	0.016
Third Mailing, Respondents	350	109	82
Success	0.028	0.018	0.036
Non-respondents, Mail Survey	448	187	103
Sample Size for Interview	140	187	103
Success, Interview Sample	0.046	0.016	0.033
Unable to Locate for Interview	32	58	12

In 1964, the postal reminder cards requested the hunter to return his kill card regardless of whether he did or did not kill a deer. He was reminded on the final card that it was required by law to report a deer killed on an open hunt and he was also requested to notify the Game Management Division about his 1964 hunting success by letter if he had lost or destroyed his big game permit. This request resulted in many letters and led to a change in 1965 and 1966 when a double perforated postal reminder card was used. The hunter was asked to complete and return the attached card indicating whether or not a deer had been killed on an open hunt. Each card was identified by the permit serial number.

Each of the separate subsamples was identified throughout the survey by its own number, and the individuality of these surveys was maintained throughout the whole operation. Thus, with five subsamples it was as though there were five different estimates each based upon a single systematic sample running through the entire file of licenses, always terminating in the same few digits. A sample of non-respondents was interviewed for each subsample and each subsample was separately extrapolated through the computer program. The average of the separate surveys provided the final estimate, and the variability of the separate surveys supported the estimate of sampling error.

The sample sizes used decreased from year to year in number and proportion of the file sampled. The number of permits issued grew rapidly during these three years (Table 1) and consequently a decreasing sampling fraction was required to maintain the same sample size. The absolute sample size was also decreased. In 1964 a 7 percent sample was drawn, in 1965 a 3 percent sample and in 1966 a 2 percent sample.

To obtain personal interviews of non-respondents, their names and addresses were distributed, according to area of residence, among game and fish officers and game biologists. In 1964, when 7 subsamples were used, a sample of 20 non-respondents was chosen from each subsample. In the last two years, with a smaller sample in the mail survey and fewer non-respondents, all non-respondents were interviewed.

Instructions to persons interviewing non-respondents were as follows:

1. Attempt to locate the hunter in the local telephone directory.
2. Call and ask if he killed a deer in (year) on the *open* hunt. Do *not* record a deer killed on a managed hunt.
3. If a kill was made, record name of county and date deer was killed.

4. If the hunter is not listed in the directory, go to the address and complete the form.
5. If you cannot contact the hunter, try to get the information from another reliable adult in the household.
6. If the hunter has moved out of your area, please try to get his address.
7. The issuing agent may be helpful in locating the hunter.
8. Return the form in the enclosed stamped envelope.

No special problems were encountered in the personal interviews. A number of these hunters could not be located (Table 2), but this number was relatively small, ranging between 1 and 4 percent of the original mail survey sample.

RESULTS

Estimates of unreported deer kill, shown in Table 3 for both methods

TABLE 3—ESTIMATE OF UNREPORTED DEER KILL (AND STANDARD ERROR) IN TENNESSEE, 1964-1966, AS MADE BY MAIL SURVEY, WITH TWO METHODS FOR ESTIMATING KILL BY NON-RESPONDENTS.

Method for Estimating Kill by Non-Respondents	1964	1965	1966
Total Kill			
Computer Extrapolation	1,016± 61	1,242±310	910±100
Interview	1,123±118	1,254±250	935±156
¹ Kill by Non-respondent Hunters			
Computer Extrapolation	197	113	172
Interview	304	105	197

of making estimates, seem to indicate that the computer extrapolation method provided about the same results as the interview method, with these data. Certainly, there is no systematic difference between the two methods. In making this comparison on the basis of total estimated kill we must recall that the largest share of each figure is contributed by the responses to the mail survey. The estimates of kill by non-respondents, shown also in Table 3, furnish a better basis for comparison, with the effect of respondent information removed.

A detailed comparison was made along this line by calculating for each subsample each year the amount added beyond the mail questionnaire returns by each method of estimation. There were 18 pairs of these values, which were then examined as a series of differences, always subtracting the computer estimate from the interview estimate. The mean value of this series of differences was 0.53 deer, with a standard error of 0.40, thus revealing no reliable evidence of a difference. The 18 pairs of values did not, however, reveal a significant correlation ($r = 0.41$).

DISCUSSION

It is clear from examining this summary of deer kill as presented in Table 1 that in Tennessee the portion of the kill which is not completely known is a relatively small part of the total, and thus a lower level of precision can be tolerated for this part of the total, and still have useful information. Even in 1965, when the standard error is largest, the information is of greater precision than that provided by most states.

Using a small sample to estimate a small part of the kill in this way, a state can probably afford the use of interviews to determine the kill by hunters not responding to a mail survey. Even when the interview method is used, however, a certain number of hunters will not be found for interview, and these will constitute an irreducible fraction of non-respondents, few as they may be.

¹ Difference between estimate of total kill, and estimate assuming non-respondents to have made zero kill.

We have found no evidence that the method of extrapolation devised by Overton and used here in a computer program, provides information which differs from that given by interviewing non-respondents. We acknowledge that this study does not provide a definitive test of the method but we feel that we do provide here one example where the question was examined and no important differences were found. It is to be hoped that others can make the same kind of test, to the end of accumulating a series of observations.

SUMMARY

1. Methods are described by which the unreported open deer kill in Tennessee has been estimated.
2. A comparison of results from interview of non-respondents, and use of the computer extrapolation method devised by Overton failed to reveal important or consistent differences between the two methods.

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ONE SUCCESSFUL APPROACH TO IMPROVING AND MAINTAINING PUBLIC HUNTING ON INDUSTRIAL LANDS

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A B S T R A C T

It is recognized that there are a number of ways that industrial lands can be administered to develop the wildlife resources and at the same time provide a recreational opportunity for the public. Gulf States Paper explored a number of these possibilities and we fully realize what has worked successfully for us may not for other industries.

The Corporation was founded in 1884, in Marseilles, Illinois, by Herbert Eugene Westervelt. After 44 years of growth and expansion the home office was established in Tuscaloosa, Alabama. In the late 40's and early 50's improved conservation protective systems in Alabama began to show promising results in the rapid build up of game populations. Because of the unique nature of the Alabama trespass laws requiring that one obtain written permission to enter upon the lands of others, and the great increase in the numbers of people requesting this permission, the corporation was forced to employ a permit system. This system was standardized in that all requests were granted. Problems arose at a local level and the policy was changed allowing only bona fide county residents to hunt on Gulf States' land in his county of residence.

For nine years following this change nothing was done to accommodate the increasing numbers of urban hunters. In 1965, to accommodate these additional requests, a fee permit system was initiated. Annual fees for hunting were set up on the following basis: for a hunter who wanted to hunt small game only on Gulf States' land within the county of his residence—\$1.00; all game within the county of his residence—\$3.00; all game on 350,000 acres of Gulf States' land open to the public—\$10.00.

Following two years of this program the results have been highly successful. With reference to the permit system the corporation has