Mosby, H. S., and C. O. Handley. 1943. The wild turkey in Virginia. Commission of Game and Inland Fisheries, Richmond, Virginia. 281 pp.
Wheeler, R. J., Jr. 1948. The wild turkey in Alabama. Alabama Department Conservation. 92 pp.

TELEPHONE SURVEY OF DOVE HUNTING IN THE EASTERN MANAGEMENT UNIT

by
DAVID W. TURNER and PAUL H. GEISSLER
Institute of Statistics
North Carolina State University at Raleigh

ABSTRACT

A telephone survey of mourning dove hunting in the Eastern Management Unit covering eight seasons (1966-1973) was carried out for the Southeastern Cooperative Dove Study. The sampling frame, the survey procedures, and the precision of the results are described, and certain comparisons are made with mail surveys. Of the 210,000 randomly selected households, approximately 85 percent were contacted and information on about 12,800 dove hunters was obtained. The number of dove hunters in Management Unit households having listed telephones, the number of their trips and their harvest of doves were estimated with seasonal percentage standard errors ranging between 4.0 and 8.8. For the same number of persons contacted, a telephone survey of dove hunting seems to yield less precise estimates than does a mail survey based on license files, at least partly because only a small fraction of those households reached by telephone include dove hunters.

INTRODUCTION

When we had the task of planning and executing a large-scale telephone survey of dove hunting we found few published accounts of the practical problems. We therefore place on record what we learned, to help others who may wish to use the telephone survey, which has unique advantages for certain applications in wildlife investigations.

Need for this survey arose in 1966 when most of the mourning dove hunting states of the Eastern Management Unit (E. M. U.)[1] joined with the Bureau of Sports Fisheries and Wildlife in a program of cooperative research to evaluate the effects of a change in hunting regulations. As one phase of this research, certain states agreed to support the survey to measure the numbers of dove hunters, hunting trips and the harvest of doves. This survey was conducted for eight years (1966-1973), five as part of the research program and three years more as a monitoring effort. The survey covered the 16 states of the E. M. U. that had established hunting seasons for the mourning dove. While the survey design allowed responses to be expanded on the basis of the telephone system to provide statewide estimates and even district estimates within a state, the prime objective was to obtain research precision only for the estimated total over the E. M. U.

We appreciate the assistance of Southern Bell Telephone Company personnel in providing information for frame construction and most of the telephone directories. Particularly valuable was the earlier work of W. Scott Overton in cooperation with game personnel from Louisiana and Tennessee in adapting the telephone survey method to the study of dove hunting.

Here we describe the methods of this survey in sufficient detail that they may be adapted by others, and we draw some conclusions about the characteristics and potential application of the telephone survey method in fish and game work.

MATERIALS AND METHODS

Some of the methods were originally devised in 1960 by the Institute of Statistics in cooperation with Louisiana and Tennessee, and then intensively developed on a statewide basis with Louisiana. We have refined and modified the original sampling design and operational procedures under the direction of Don W. Hayne.[2]

Our sampling plan was based upon the telephone system using the subscriber listings in the regular published directories. Fortunately for our purposes, most telephone systems are limited by state boundaries, though within any state it is difficult if not impossible to define the exact boundaries of

[1] The Eastern Management Unit included the 16 dove hunting states: Alabama, Delaware, Florida, Georgia, Illinois, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Pennsylvania, Rhode Island, South Carolina, Tennessee, Virginia, West Virgina.
[2] Technical Director, Southeastern Cooperative Fish and Game Statistics Project, in the Institute of Statistics.

any subunit. Telephone directories are assembled from a business point of view, and may overlap in coverage. At the same time, the system has a well-ordered technical framework that is suited to sampling. A contribution here is the description of the system from the sampling point of view.

The hunting states of the E.M.U. were viewed as major strata within the regional telephone system. Within each state a separate sampling sub-frame was developed. The sampling sub-frame for each state consisted of a list (at least conceptually) including each published residential telephone number once, and only once. Table 1 presents a portion of the sub-frame used for Louisiana in 1973-74. Note that while each telephone number is not listed at this stage, it is associated with only one exchange and is listed in at least one directory. Each telephone number is represented in the column entitled "Cumulative Approximate Telephones."

The telephone system of each state was stratified first into geographical districts to coincide as nearly as possible with the wildlife management districts defined by the individual state agencies (but this matching could only be approximate). Responses of hunters within such geographical strata should be less variable than average responses between strata and thus stratification should increase precision. In addition some states expressed interest in using estimates at the state and district level, even though they were expected to be of low statistical precision.

Districts were further stratified into a number of operational units called "zones." Zones were allocated to districts in numbers jointly proportional to each district's number of telephones and estimated dove harvest. Within any district these zones consisted of approximately equal numbers of telephone listings. Zoning provided some additional stratification in that urban exchanges were grouped as nearly as possible into zones separate from those of rural communities.

The sampling design used followed that described by Deming (1960) in that two or more replicated sub-samples were drawn from each state frame. Each replicated sub-sample was made up of one sampling unit in each zone throughout the system; a separate estimate of the total was calculated for each replicated sub-sample. The number of zones in a district and the number of replicated sub-samples used, determined the sample size. In the first five years of the survey the same number of replicated sub-samples were chosen from each state frame (except, rarely, when a state paid for extra calling effort). The number of sub-samples drawn the last three years varied from state to state with states having larger numbers of hunters receiving more of the sampling effort.

In the first year of the survey, telephone numbers were associated and identified on the frame with a town directory name. Since town directories frequently contain merged listings from several towns or communities, the town directory name on the frame was the primary town in the directory and represented all of the listings in that directory. In a sense we attempted to sample town directories. We had difficulty preventing duplication because telephone companies frequently repeat listings for adjacent communities in several town directories. In subsequent years telephone numbers were further identified by the telephone system's area codes (the first set of three digits in every ten-digit telephone number) and exchange codes (the second set of three digits in every ten-digit number).

Exchange codes are unique groups of listings within area codes. In principle, each exchange can be sampled once from a town directory listing that exchange and then ignored when sampling other town directories, thus preventing duplication. Information on exchange codes was obtained from a form supplied by Southern Bell Telephone Company called the "Distance Dialing Reference Guide." This form lists by area code the exchange codes currently in operation in each state and the name of the city served by each exchange.

Our next step was to assemble a list of city or town names, associating with each name one or more exchanges included in the directory of that name, and the number of telephones reported for each of these exchanges. If an exchange occurred in several town directories, it was sampled in only one. Only the directories needed to include each exchange once were listed on the frame. With experience, we accumulated more complete information on what exchanges were included in which directories; this allowed us to construct a frame that was more efficient for selection of sampling units. The approximate number of telephones in any stratum was the sum of these listings (the exact number is never known). These figures were the basis for allocation of zones to districts, directories (or groups of exchanges) to zones, and sampling units to directories.

The approximate numbers of telephones in the exchanges were compiled from two sources, primarily from Bell Telephone Company's Form 4044, which lists by exchange code the number of residential telephones or main residential stations (M.R.S.) for exchanges assigned to Bell and also from "Telephony's Directory of the Telephone Industry,"[3] which lists by town name the total telephones for exchanges assigned to independent (non-Bell) companies.

[3] Publication of the Telephony Publishing Company, Chicago.

Table 1. A reproduction of the computer output for district 3 from the 1973-74 Louisiana sub-frame.

Area Code	*Exchange Code*	*Directory Name*	*State*	*Cumulative Approximate Telephones*	*Sampling Units Included*			*Zone*
318	737	PECAN ISLAND	LA	139	SU	1	1	9
318	939	BIG CANE	LA	159	SU	2	2	
318	642	FORKED ISLAND	LA	271	SU	3	3	
318	566	KROTZ SPRINGS	LA	399	SU	4	5	
504	623	MELVILLE	LA	699	SU	6	8	
318	229	LOREAUVILLE	LA	797	SU	9	12	
318	685	DELCAMBRE	LA	814	SU	13	16	
318	543	LAWTELL	LA	868	SU	17	20	
318	536	GUEYDAN	LA	911	SU	21	25	
318	826	WASHINGTON	LA	913	SU	26	30	
318	856	YOUNGSVILLE	LA	960	SU	31	35	
318	585	PORT BARRE	LA	986	SU	36	40	
318	873	DUSON	LA	1011	SU	41	45	
318	837	BROUSSARD	LA	1140	SU	46	51	
318	754	ARNAUDVILLE	LA	1142	SU	52	57	
318	662	SUNSET	LA	1192	SU	58	63	
318	937	ERATH	LA	1194	SU	64	69	
318	896	CARENCRO	LA	1602	SU	70	77	
318	332	BREAUX BRIDGE	LA	2097	SU	78	87	
318	394	ST. MARTINVILLE	LA	2276	SU	88	98	
318	276	JEANERETTE	LA	2278	SU	99	109	
318	643	KAPLAN	LA	3598	SU	110	127	
ZONE 9 SAMPLING UNITS CHOSEN, RANKS 1,2,ETC.						71,7,97,26		
SAMPLING UNITS PER ZONE 127								
ZONE TOTAL MRS = 25446.								
318	457	EUNICE	LA	4665	SU	1	23	10
318	893	ABBEVILLE	LA	5329	SU	24	50	
318	942	OPELOUSAS	LA	7465	SU	51	87	
318	948	OPELOUSAS	LA	INC 942*				
318	364	NEW IBERIA	LA	11229	SU	88	143	
318	365	NEW IBERIA	LA	INC 364				
318	369	NEW IBERIA	LA	INC 364				
ZONE 10 SAMPLING UNITS CHOSEN, RANKS 1,2,ETC.						23,50,86,65		
SAMPLING UNITS PER ZONE 143								
ZONE TOTAL MRS = 28688.								
318	232	LAFAYETTE	LA	25435	SU	1	127	11
318	233	LAFAYETTE	LA	INC 232				
318	234	LAFAYETTE	LA	INC 232				
318	235	LAFAYETTE	LA	INC 232				
318	984	LAFAYETTE	LA	INC 232				
ZONE 11 SAMPLING UNITS CHOSEN, RANKS 1,2,ETC.						39,98,84,14		
SAMPLING UNITS PER ZONE 127								
ZONE TOTAL MRS = 25435.								
DISTRICT TOTAL MRS = 79569.								

* INC 942 denotes that the number of telephones for exchange 948 are included in the total telephones for exchange 942.

This list of exchanges (with telephone numbers) in a state district was next divided into a predetermined number of zones, this number being set by the proportion of the total calling effort in the state that would be devoted to that district, since from each zone one sampling unit was selected for each replicated sample. At this step the urban and the rural exchanges were grouped into separate zones as nearly as possible. Each zone boundary coincided with an exchange boundary; there might be several exchanges in one zone or a group of several exchanges associated under a town name might constitute several zones.

The final stage of setting up the sampling frame was the subdivision of each zone into sampling units and the drawing of a random sample. Each sampling unit contained about 200 telephone listings. In practice, the computer program listed the exchanges in a zone, grouping them as they were associated with town directories, and listing the number of sampling units allocated to each such directory. Sampling units were included within directory boundaries as whole units; they were never divided, though on occasion a number of small directories might be combined to make up one sampling unit. Then the program drew a simple random sample of size equal to the number of replicated samples, and identified the location of each random sampling unit drawn, as to directory and serial location within the directory. The first random sampling unit chosen was assigned to the first replicated sample and labeled as "Rank 1," the second selected unit was assigned to the second sample and identified as "Rank 2," etc.

The frame information for an exchange was keypunched including the state, district, area code, exchange codes, city directory names and the number of listings included in each. This procedure simplified the process of updating the sampling frame in the annual reallocation of zones, the addition of new exchange codes and the deletion of out-of-service codes. These cards were processed by a computer program which was developed to identify and randomly select the sampling units from this computer-readable representation of the frame.

In selecting listings to be interviewd, the first step was to locate the sampling units in the town directories containing the selected exchange codes specified on the frame. The dimensions of each directory in pages, columns and centimeters per page, the number of sampling units and the serial number of the chosen sampling unit within a directory were supplied to another computer program which printed out the location of the start of the selected sampling unit, the random location to start the systematic sample and the end of the sampling unit specified by directory page, column on the page and centimeters down a column.

Next, part-time personnel, generally students, marked in directories the boundaries of selected sampling units and the location of random starting points. All listings having exchange codes other than those designated on the frame, were excluded. The first listing below the random starting point and every fifth residential listing thereafter were marked until eleven were designated. In order to derive an expansion factor for the sampling unit, a count was made of the total number of telephone listings included within the sampling unit boundaries. Businesses were totally excluded from the sampling unit where convenient but frequently it was more convenient to sample businesses along with residences and later adjust the expansion factor in proportion to the number of businesses encountered in the sample. Listings which were selected as residential numbers but when contracted were found to be used for business only were assigned a response value of zero. The eleven selected listings were cut out and stapled to a "call" sheet which carried the identification of the sampling unit and spaces for recording date, time and result of each attempted contact.

All calls were made from Raleigh, North Carolina, using Wide Area Telephone Service (W.A.T.S.) lines between 10:00 a.m. and 9:00 p.m., local time of the person called. Calling was done from one center under close supervision and by women, mostly wives of students or students themselves because first contacts were often with women who might be apprehensive of male strangers. Operators received instructions on interview procedures and an opportunity to conduct trial interviews during a one-day training session. Operators made a maximum of five attempts to contact a listed number.

The operators were instructed to ask for the individual listed in the directory and to determine from that person the number of resident dove hunters. If this was not possible (some numbers are reassigned to another subscriber after the latest publication date), they were to request this information from a mature person of the household. Where hunters were reported, each was interviewed regarding his dove hunting experience for the past season. When extended discussion developed, a return call was arranged for the male investigator in charge of the operation. Similar call backs were made to confirm any unusual response.

Every effort was made to interview each hunter individually; but in the rare event that this was impossible before the end of the survey (hunter in hospital, away at university, serving in Vietnam,

etc.) information regarding his hunting was accepted from another responsible member of the household if this person appeared to know the answer. There were some intra-directory duplicate listings of the same household in the sampling frame; these increased the probability of selecting any household where the same telephone number was listed under several names or where a household had two or more telephones with different numbers. For example, a household with two telephone listings under different names had twice the chance of coming into our sample, as compared to a household with only one listing. This duplication was determined by asking in hunting households how many times the telephone number called or any other telephones in the household were listed in the telephone directory. Adjustment for this duplication was made in the individual household record prior to expansion, by dividing responses by number of reported listings.

Total hunters, trips and harvest were estimated for each replicated sample (rank) and zone using the following formula:

$$Y_{ij} = n_j F_{ij} X_{ij}$$

where

Y_{ij} = Estimate of total in the jth zone, based upon the ith replicated sample

X_{ij} = Total for responses for all hunters in a household summed over the sample of eleven households in the ith replicated sample in the jth zone

n_j = Total number of sampling units in the jth zone

F_{ij} = An expansion factor defined for the ith replicated sample in the jth zone

$$\frac{\text{Number of residence listings + Number of business listings}}{\text{Number of residences contacted + Number of businesses selected}}$$

Zone level estimates were combined by simple addition to obtain district and state level estimates for each replicated sample. The final estimate reported at district or state level was the average of the estimates for each of the independent replicated samples. In the case of the Management Unit the estimate was the sum of the reported state level estimates.

Variances of state or district estimates were calculated as the variance of the mean of the several estimates for the replicated samples, as:

$$\text{Var}\,(\bar{Y}) = \frac{\Sigma(Y_i - \bar{Y})^2}{n\,(n-1)}$$

where:

Y_i = Total estimated from the ith independent (replicated) sample

$\bar{Y}$ = Average of the n totals estimated from the n independent (replicated) samples

n = Number of independent (replicated) samples

Variances of Management Unit estimates were calculated as the sum of the state level variances. Percentage standard errors were calculated by dividing the standard error (square root of the variance) by the estimate and multiplying by 100.

Turner (1970) in summarizing mail survey data noted that the empirical relationship between proportional standard error and sample size may be stated in a regression form useful in planning other studies. We attempted to derive similar relationships using the results from the telephone survey but found comparable state level estimates were so variable that the resulting regression equations did not appear useful for predicting purposes (low R^2's) even though the regression itself was statistically significant and in the right direction. For the purpose of a rough comparison of the precision of a telephone survey with that for a mail survey we extrapolated the previous relationship beyond the range of data and estimated the proportional standard error to be expected from a mail survey comparable in size to the average number of calls attempted per year for the entire management unit. Table 2 shows the range and average of the annual proportional standard errors resulting from the telephone survey and the predicted proportional standard error for a mail survey of comparable size (26,200 attempted contacts).

RESULTS

During the eight years of the survey, telephone contact was attempted with 209,503 households, resulting in 178,349 households interviewed for an average response rate of 85 percent. Information on a total of 12,783 dove hunters was recorded with an average of 7.2 hunters per one hundred contacted households.

As shown in Table 2, for the Management Unit estimated totals, the precision of the number of dove hunters expressed as a (seasonal) percentage standard error, ranged between 3.2 and 7.6 with an annual average of 4.9. The (seasonal) percentage standard errors of estimated trips ranged between 4.5 and 7.7 with an annual average of 5.9 while those for estimated harvest ranged between 4.2 and 8.8 for the annual average of 6.4.

Table 2. Percentage standard error (seasonal) of management unit estimates and predicted standard error for a mail survey with sample size equal to average size telephone survey (26,200 attempted contacts).

	PERCENTAGE STANDARD ERRORS		
	Telephone Survey		*Mail Survey*
Item	*Range*	*Average*	*Regression Prediction**
Hunter	3.2-7.6	4.9	1.6
Trips	4.5-7.7	5.9	3.0
Harvest	4.2-8.8	6.4	4.0

* Using regression parameters reported by Turner (1970) for dove hunting.

The average cost of a telephone contact was $2.24 the last survey year and $1.56 per contact over the eight year study (or $1.92 per call attempted the last survey year and an average of $1.33 for the eight years). A telephone contact with a hunter is many times as costly because so many of the households do not have hunters ($29.78 the last survey year and an average of $21.87 for the study).

DISCUSSION

Chapman et al. (1959) described various methods of reaching hunters in surveys, comparing interviewing door-to-door with using mail questionnaires or the telephone. Each method requires a sampling frame, and to some extent each frame is incomplete, though the area sampling frame used in personal interview studies comes closest to being complete.

The telephone survey method has several advantages. The sampling frame includes many of the unlicensed hunters. The survey can be carried out immediately after the end of the season and final results can be reported promptly; with dove hunting the results from one year were available well ahead of regulation-setting time for the next season. A telephone survey can be carried out at any time of the year, without considering the license year, calendar year or fiscal year. The survey can cover a wide area yet be carried out by one staff at one point with uniform methods. A telephone survey also appears to yield a relatively high response rate. Our survey achieved a response rate of 85 percent of the calls attempted, which is appreciably higher than the range of 65 to 80 percent response we observe in 3-mailing state mail surveys based on license files.

The telephone survey method does have some undesirable features. As Chapman et al. pointed out, the telephone frame is incomplete in that hunters living in households without a telephone or with an unlisted number are omitted and it is difficult to evaluate the assumption that the attribute being measured is independent of the possession of a telephone. However, Legler, Stern and Overton (1961) found that 92 percent of 340 dove hunters contacted in field studies in Louisiana and Tennessee had telephones in their households. The incompleteness of the telephone frame may be more serious for studies of hunting with species other than the mourning dove since other hunters (e.g. rabbit hunters) may be relatively less affluent and consequently less likely to have telephones. In general, more effort is required to construct and sample a telephone frame than to sample from a license frame (this last is often simplified by random selection of terminal digits of license numbers).

The values in Table 2 may be viewed as crude comparisons of the precision to be expected from a telephone survey and a mail survey of similar size. The absolute values predicted for the mail survey must be viewed with considerable caution because they result from extrapolating well beyond the range of the sample size in the data on which the regression was originally based. However, if the extrapolated values are accepted, the results in Table 2 suggest the reasonable conclusion that for the same sample size mail surveys of dove hunting provide better precision that telephone surveys.

Part of the lesser precision of telephone survey estimates may be a result of sampling rare items; dove hunters are considerably more rare in a sample of households having listed telephones than they

are in a sample of hunters holding licenses. We found 7.2 dove hunters per 100 telephone contacts, in contrast to state mail surveys of the Southeast where dove hunters seem to constitute about 21 to 37 percent of the licensed hunters for several surveys in our files.

Any comparison of these two methods of survey must also consider the costs. We do not have exactly comparable cost data for a mail survey, but one state biologist kindly furnished us with records for a 1973-74 mailing of 10,800 questionnaires from which we have derived an estimate allowing for 6 percent inflation of 88 cents per questionnaire mailed, comparable to our latest cost estimate of $1.92 per call attempted.

LITERATURE CITED

Chapman, D. G., W. S. Overton and H. L. Finkner. 1959. Methods of estimating dove kill. North Carolina State University, Institute of Statistics, Mimeo Series, October. 48 pp.

Deming, W. E. 1960. Sample design in business research. John Wiley and Sons, Inc., New York. 517 pp.

Legler, E., Jr., H. Stern, Jr., and W. S. Overton. 1961. A preliminary evaluation of telephone and field sampling frames. Transactions of the Twenty-sixth North American Wildlife and Natural Resources Conference, Washington, D. C. pp. 405-417.

Turner, D. W. 1970. Mail surveys of hunting-precision and sample size. Proceedings of 24th Annual Conference of the Southeastern Association of Game and Fish Commissioners. pp. 292-303.

ORAL ACCEPTANCE AND ANTIFERTILITY EFFECTS OF MICROENCAPSULATED DIETHYLSTILBESTROL ON WHITE-TAILED DOES[1]

by

GEORGE H. MATSCHKE

U. S. Fish and Wildlife Service

Bldg. 16, Denver Federal Center

Denver, Colorado 80225

ABSTRACT

The acceptance and antifertility action of microencapsulated diethylstilbestrol (DES) administered in feed was investigated with penned female white-tailed deer (*Odocoileus virginianus*). A switchback designed oral acceptance test at 0, 250, 500, 750, and 1,000mg was conducted just before the breeding season. The 1,000mg level was as well accepted as the other three concentrations, but none were as well accepted as the control. Six does were presented 1,000mg of DES, homogenized in 1.362kg of feed, every 17 days throughout the breeding season. Five of the six does demonstrated aversion to the compound. Consumption of 131mg or less did not prevent normal pregnancy. The sixth doe, which consumed 182 and 428mg at the first two feedings, bred again after each feeding indicating that these levels might have interrupted pregnancy. Possible reasons for the poor acceptance of DES during the breeding season are discussed. If the rejection is due to metabolic aversion, microencapsulated DES may never work as a multiple-dose antifertility agent; if it is due to taste or smell, a different microencapsulation formulation might overcome the aversion problem.

INTRODUCTION

Diethylstilbestrol (DES), a biologically active synthetic estrogen, is an effective postcoitum contraceptive (Diczfalusy 1968). However, like the natural estrogens, this compound at high concentrations results in significant reduction in feed intake (Bull et al. 1974). Harder and Peterle (1974) found poor acceptance when they fed DES in a bait carrier to free-ranging white-tailed deer in Ohio. By microencapsulating DES, I hypothesized that its taste and smell would be masked and that its acceptance by white-tailed deer might thus be increased. Microencapsulation is a technique which gives each individual drug particle a protective coat from which the drug can be released at a rate depending upon moisture, pH, physical force, or combinations of these (Luzzi 1970). In this study, DES was microencapsulated with a type of food shellac designed to dissolve and release the compound in the rumen. The manufacturer, Abbott Laboratories, reported that this type of coating was able to increase the acceptance of antibiotics by swine from 3 grams per ton for uncoated to 100 grams per ton for coated (Macy, personal communication, 1975).

[1] A contribution from a cooperative project between the National Park Service and the U. S. Fish and Wildlife Service, U. S. Department of the Interior.