Agricultural Economics Report No. 180 December 1983

An Analysis of Sportsman Activity Data Collection Methods for North Dakota

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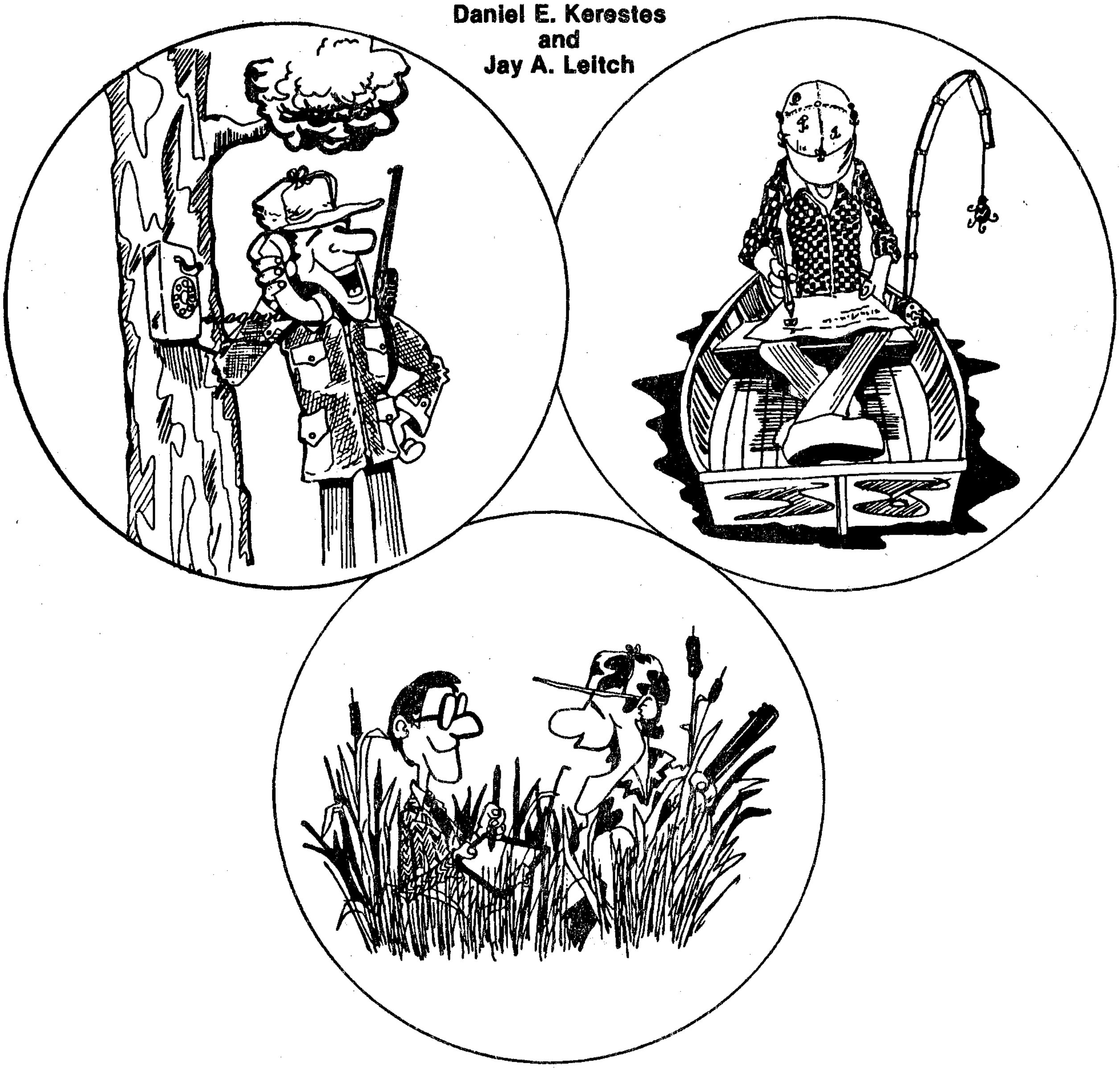

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PREFACE

This study would not have been possible without the cooperation of several thousand North Dakota sportsmen who completed questionnaires or answered questions over the telephone during the past two years. We sincerely appreciate their help and understanding.

Our sponsor's representative, Mr. Arlen Harmoning, provided guidance and assistance throughout the course of the study. Thanks are extended for Mr. Harmoning's unselfish contribution of time and expertise.

Several individuals at North Dakota State University were kind enough to provide guidance along the way. Those whose contributions cannot go unnoted include: Dr. Doris Hertsgaard, for her help with statistical analyses; Dr. Richard Rathge, for his expertise in survey design; and Dr. William C. Nelson, for assistance throughout the study.

For their help in computerizing the many questionnaires and providing countless printouts in a timely and efficient manner, our appreciation is extended to Harvey and Sharon Vreugdenhil. Finally, for their expeditious, accurate typing of the many questionnaires and manuscripts during the course of this study, our thanks go to the secretarial staff of the Department of Agricultural Economics especially Ms. Lori Cullen and Ms. Ona Richards.

We would like to acknowledge the use of Federal Aid funds under Project FW-11-P, Fish and Wildlife Planning; support provided by the North Dakota Agricultural Experiment Station; the North Dakota State University Computer Center; and the Department of Agricultural Economics; each of which was important to the successful completion of this study.

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Highlights

State game and fish departments, conservation departments, and natural resource agencies across the country collect a variety of data to enhance their fish and wildlife management decision making. While most of these information gathering techniques involve principles of biological science coupled with statistical analysis, the sportsmen surveys involve social science as well. A two-year research project was initiated to design efficient and compatible methods to collect harvest, expenditure, and socioeconomic data from North Dakota's licensed sportsmen. Several variations of survey techniques for eliciting information from licensed sportsmen--from field interviews, postseason questionnaire, diaries, to telephone interviews--were tested. The project began in June 1981 and ended in June 1983. The purpose of this report is to outline the procedure, present the results, and recommend an expenditure data collection system.

AN ANALYSIS OF SPORTSMAN ACTIVITY DATA COLLECTION METHODS FOR NORTH DAKOTA

Daniel E. Kerestes and Jay A. Leitch*

Background

Wildlife is an important resource in North Dakota, not only as a part of the natural environment but also as an economic resource. Residents and nonresidents spend millions of dollars annually related to hunting and fishing activities. Game and fish are a common property resource and as such are the responsibility of state and federal agencies. Management of an economic industry which generates cash flows as large as game and fish related activities requires accurate and regular information on the magnitude and distribution of those flows. This information is useful in preparing and justifying departmental budgets and activities.

Day-to-day and season-to-season operations require valid, statistically sound data on use of game and fish products. Without an idea of the use patterns and expenditure flows resulting from outdoor recreation activities, little knowledge of the relative payoffs from alternative management programs would exist. From an economic perspective, the last dollar spent in each program area should yield identical returns in each area. If not, a reallocation of budget dollars could yield a more efficient allocation, with the result being more satisfaction to the fish and wildlife user.

Expenditure estimates are but a small part of the data required to make game and fish management decisions. Decision makers consider current and trend data on populations, license sales and participation rates, land use changes, interdependencies with other species, political pressures, and a host of other factors when making decisions regarding seasons, bag limits, and other management factors (Figure 1). Complicating the decisions are the interactions among variables and the uncertainty of future events. Therefore, decision making is made more efficient with timely, accurate data on as many variables as is possible.

The relative reliability of data may be highly variable. Aerial surveys of deer populations, for example, are affected to a great extent by snow cover conditions. Estimates one year may be highly reliable, while the next year they may be only rough approximations. Efforts can be taken to minimize this variability by trying to census only under comparable snow conditions. Likewise, survey data collected from sportsmen vary in reliability from year to year and within years. Therefore, the first decision that must be made is the desired level of reliability or precision. All other things being equal, it is not efficient to expend resources to gain high reliability in estimates of one data set when another data set is extrapolated from a less reliable data base. It is especially important to have compatable data sets when they are combined in such a way that the errors in each are synergistic. For example, estimates of daily expenditures are a function of seasonal expenditures and number of days hunted. Likewise, dollars spent per

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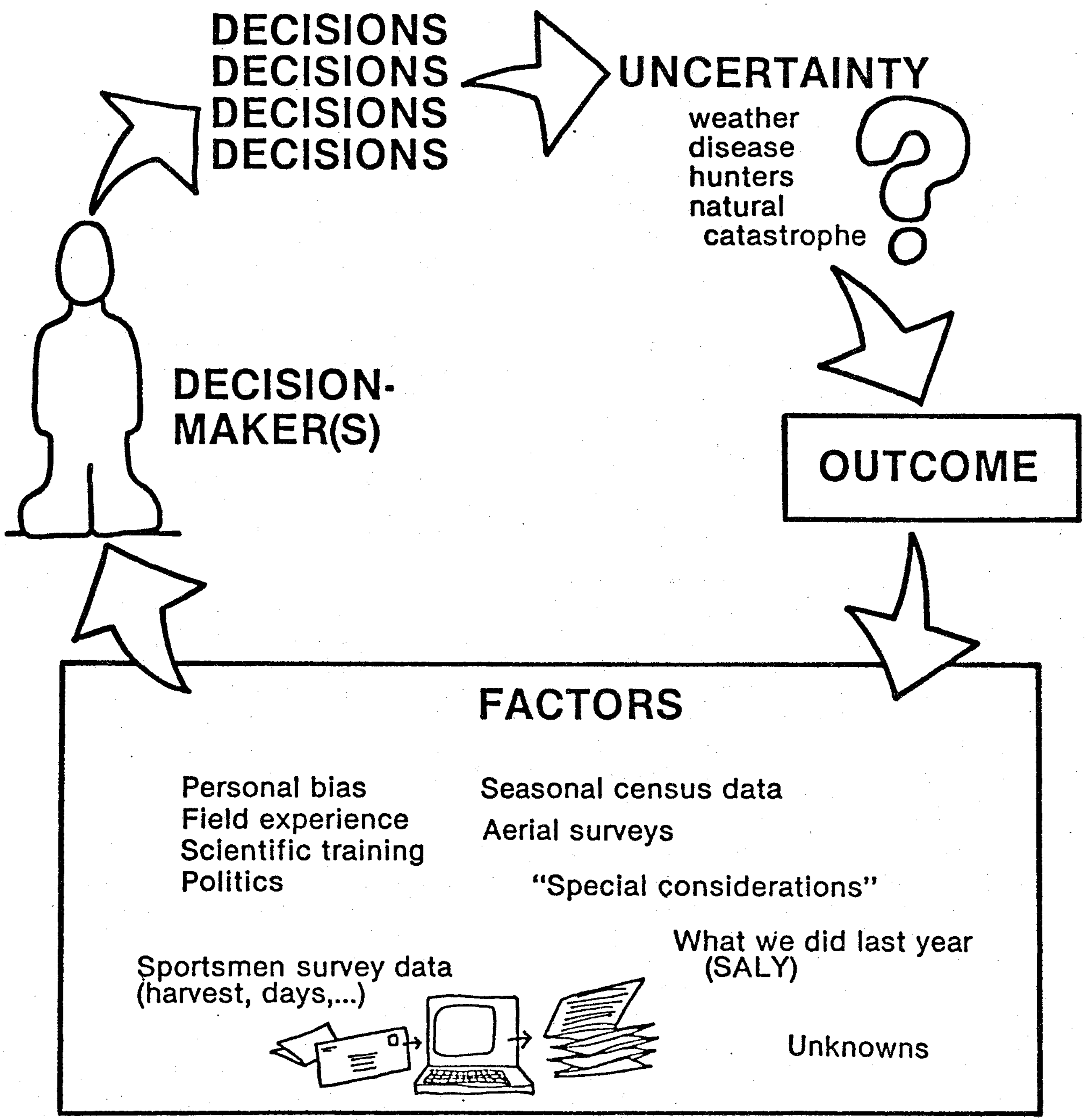

Figure 1. Game and Fish Management Decision-Making

animal harvested is a function of total expenditure and harvest estimates. So, while the primary objective of this paper is to report the results of research to identify methods for timely, efficient expenditures data collection, other variables cannot be ignored.

Activities

Each licensed outdoor recreation activity poses its own set of data collection difficulties. While there is some common ground among activity types, there is much which necessitates that data collection be tailored to activity. Fishing seasons, for example, extend nearly year long, while North Dakota's sage grouse season is only three days long. An upland game license allows the licensee to hunt statewide (within various open season dates), while a turkey or deer license restricts hunters to selected zones, certain species, and sex. These differences and others call for variations in sampling and survey design. There are, however, some common aspects of data collection across license type. For example, differentiating between fixed and variable expenditures is not specific to a single activity; neither is allocating time and expenditures among various species.

The following discussion will first address broad questions of expenditure data collection, then look at data collection peculiar to each of four general categories of license types.

Data Needs

Fish and game managers require estimates of the magnitude and variation of many variables related to fishing and hunting activity. Some of those can be measured directly (e.g., license sales), some are estimated from surveys of the fish and wildlife resource (e.g., census), while estimates of other variables must come from surveys of the activity participants (e.g., harvest, expenditures). The primary purpose of this study was to analyze methods of collecting expenditure data. Although data on other variables were also collected, it will not be reported herein unless applicable to designing surveys to collect expenditure data.[1]

Licensed sportsmen purchase two general categories of goods: durable and nondurable. Nondurable goods are those that are used up over a relatively short time period or that can only be used one time. Examples of nondurable goods or services are boat rental, bait, ammunition, food, and lodging (Table 1). Expenditures for nondurable goods are generally termed "variable expenditures" since the amount spent varies with time spent in the outdoor recreation activity.

Durable goods are those that last for a relatively long time and are not used up with one use. Examples of durable goods are rods and reels, boats, shotguns, tents, and tackle boxes (Table 1). Durable good expenditures are generally termed "fixed expenditures" since the amount spent is fixed at

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[1]The data are presented in their entirety in Leitch and Kerestes, 1982 and Kerestes and Leitch, 1983.

TABLE 1.- DURABLE (FIXED) AND NONDURABLE (VARIABLE) GOODS EXPENDITURE CATEGORIES

Variable Expenditures

Ammunition
Private transportation (gas, oil, repairs)
Commercial transportation (fares, vehicle rentals, charter)
Lodging (motel, cabin, seasonal rental)
Food and drink
Boat and equipment rentals (not including vehicles)
Fish bait
Fees (access, camping, memberships, park sticker)
Services (packers, guides, horses, etc.)
Shipping, locker, and/or meat and fish processing costs
Taxidermy work
Miscellaneous (film, etc.)

Fixed Expenditures

Special clothing for hunting or fishing
Family vehicle
Recreational vehicle (4-wheel drive, pickup, etc., other than above)
Cabin, land, and/or water area
Camping trailer or pickup camper
Camping equipment (tent, sleeping bag)
Boating equipment (boat, canoe, motor)
Hunting weapons
Rods, reels, tackle boxes
Durable equipment (cameras, binoculars)
Dogs
Waterfowl decoys
Other hunting or fishing equipment (game bags, waders, etc.)

the purchase price and does not vary with use (at least in the short run). In other words, the expenditure on a shotgun is fixed at a certain amount whether it is used one day during the season or every day.

Methods Review

North Dakota

The North Dakota Game and Fish Department has conducted mail surveys for the collection of harvest data for over 50 years. The number of days spent hunting and the number of animals bagged are typically collected.

Each program (i.e, Big Game, Waterfowl) within the Game and Fish Department normally collects its own data. Around 50,000 sportsmen are questioned each year through department questionnaires. Names are usually obtained from current and previous year's license stubs. In some cases (e.g., turkey and antelope hunting) all of the license holders are surveyed while for other activities (e.g., deer gun hunting) a random sample is taken. Other samples for such activities as furbearer hunting, fishing, and small game hunting are chosen by selecting a random starting point in the license booklets and then systematically drawing every nth licensee.

No regular collection of sportsmen expenditures has been conducted by the Game and Fish Department. Stuart (1949) did the first study of sportsmen expenditures over 30 years ago. More recently, Harmoning (1977) has looked at the expenditures of bighorn sheep hunters.

In 1981 the Game and Fish Department had a telephone survey (PROBE) conducted to obtain information on the attitudes of North Dakotans toward problems facing wildlife and ratings of Game and Fish Department performance. The PROBE survey was another onetime, ad hoc survey.

Other States

Game and fish departments in 21 western and midwestern states were contacted as to their survey methods. Fifteen replied stating that they had relied on mail surveys for their annual harvest and hunting surveys. One-third of the states replied that they had also conducted attitude or public opinion surveys. Only three of the states had done survey work concerning the impact of fishing on the state.

None of the states had recently conducted survey work in the area of expenditures on a state wide basis and do so only on an ad hoc basis. Random samples selected from telephone books and random samples obtained from license stubs were the two methods most often used to select individuals to be sampled.

A postcard method used by two of the states (Iowa, Missouri) consisted of putting a postcard in the front of the license booklet and having the first buyer of a license in every booklet complete and mail the postcard (Wright, 1974; Lewis, 1981). This yielded a sample of the current license buyers which could be used for sampling purposes. Iowa uses this technique for selecting samples for small game surveys. Licenses are sold in booklets of 20. One postcard is filled out by the vendor and returned to the Game and Fish Department for each booklet sold. The hunter's name, address, and age are put into a computer which sorts and prints mailing labels for bulk mailing of questionnaires.

In previous years Montana collected harvest data through mail surveys. Both telephone and mail surveys were conducted in 1980 on Montana upland game bird and waterfowl hunters and the two methods were compared for accuracy and costs (Wallwork, Lehihan, and Polzin, 1980). Although the telephone method was more complex administratively, it was less costly and had fewer sources of bias errors. This resulted in the majority of Montana's 1981 and subsequent resident surveys being conducted by telephone.

The survey of other states' socioeconomic data collection revealed no unique or innovative data collection schemes. It did identify the postcard method of identifying current hunters and Montana's overwhelming use of telephone surveys.

National

The U.S. Fish and Wildlife Service has conducted fishing and hunting surveys at five-year intervals since 1955 (U.S. Fish and Wildlife Service, 1982a). The most recent (1980) survey was conducted by the U.S. Bureau of the Census in two phases. The first phase consisted of screening more than 11,600 households nationwide to determine who in the household had hunted, fished, or engaged in some nonconsumptive wildlife-associated activity in 1980. An adult member of each household was questioned to obtain information about all members 6 years and older. A response rate of 95 percent was obtained for the screening.

The second phase consisted of detailed in-person interviews conducted with subsamples of fishermen, hunters, and nonconsumptive users identified in the screening process. The individuals interviewed were at least 16 years old because of the complexity and length of the questionnaire. The sample sizes were chosen so that statistically reliable results would be available at the state level for hunting and fishing and at the Census geographic division level for nonconsumptive activities. While the national survey provides reliable results at the state level, it is not useful for analysis at substate levels. State level data are published separate from the national data (U.S. Fish and Wildlife Service, 1982b) and provide excellent data bases for interstate comparative studies and analysis.

Procedure

The overall approach was to experiment with alternative survey designs to evaluate which one or what combination yielded the information at a reasonable cost. Variations in survey design, questionnaire type, timing, and follow-up procedures suggested by project personnel and others (Dillman, 1978) were tested. At least two methods were tested within each sportsmen category, with the exception of moose/elk hunters where only a diary was used (Table 2).

Statistical testing of alternative survey methods relied on tests of differences between means using Z-tests, binomial Z-tests, and t-tests, assuming normal distributions. In addition, point estimates (i.e., average daily expenditures) were analyzed for their degree of variability. The State Game and Fish Department has traditionally strived for estimates with bounds of plus or minus 10 percent at the 95 percent confidence level. We retained the 10 percent bound but lowered the confidence level to 90 percent throughout the study.

Cost per usable return was computed to be used as a variable in selecting optimal survey alternatives. The trade-off between dollar cost and statistical reliability can be significant and should only be made by those using the data.

In addition to cross-section and time-series data collected during this project, annual data sets provided by the State Game and Fish Department were used for comparisons.

TABLE 2. SURVEY METHODS TO TEST SURVEY DESIGN, 1981 AND 1982

Sportsman Group	Mail		Telephone				
	Comprehensive	Brief[a]	Comprehensive	Brief[b]	Special[c]	Diary	Personal Interview
Moose/Elk Hunters	--	--	--	--	--	1981/82	--
Turkey Hunters	1981	1982	--	1982	1982	1981/82	--
Archery Antelope Hunters	--	1982	--	--	1982	--	--
Firearm Antelope Hunters	--	1982	--	1982	--	--	--
Archery Deer Hunters	1981	1982[d]	1981	1982	--	--	--
Firearm Deer Hunters	1981	1982	--	1982	1982	--	--
Furbearer Hunters/Trappers	1981	1982	--	--	--	--	--
Small Game (Including Waterfowl) Hunters	1981	1982[e]	--	--	1981	--	--
Sage Grouse	--	--	--	--	--	--	1982
Fishing	1981	1982	--	--	1982[f]	--	--

[a]Brief mail questionnaires--harvest and days hunted, and expenditure.
[b]Brief telephone surveys concentrate on harvest and days hunted.
[c]Special telephone surveys were designed to find out why nonrespondents did not respond, and collect harvest and days hunted data.
[d]Brief mail questionnaires conducted monthly or bimonthly.
[e]Use of two survey designs.
[f]Reason for not responding only, no harvest data collected.

Diary Surveys

Diaries have been used by both state and federal game management agencies as a data collection tool. Diaries are mailed to sportsmen prior to the start of the season with instructions to keep track of activities as they occur. The rationale for sportsmen diaries is that it should be easier to log events (i.e., expenditures, harvest) as they occur than to wait until postseason. Additionally, daily data entries should be more accurate than postseason memories.

Diaries were used for moose/elk hunters and turkey hunters for both the 1981 and 1982 hunting seasons (Table 2). Since each of these types of hunting licenses is allocated through lottery, the names and addresses of licensees are available prior to the season. This is a prerequisite to the use of diaries and precludes diaries' use for small game hunting or fishing activities.

Moose (and/or elk) diaries were given to licensees at the Game and Fish Department's orientation meeting prior to season opener. All 15 licensees in 1981 and all 25 licensees in 1982 were given diaries. Hunters were asked to keep track of days hunted, expenses, hunting location, and asked about their attitudes and selected socioeconomic characteristics. Examples of diaries can be found in the appendix to Leitch and Kerestes (1982) and Kerestes and Leitch (1983).

Turkey hunting diaries were mailed to 54 hunters in 1981 and to 56 hunters in 1982. Questions were similar to those asked of moose/elk hunters. Examples are in Leitch and Kerestes (1982) and Kerestes and Leitch (1983).

Postseason Surveys

A majority of states use postseason surveys to collect sportsmen information. The two most common methods of postseason data collection are mail questionnaires and telephone interviews. Each requires having names and addresses or telephone numbers of licensees. Mail questionnaires were tested on all types of licensees except moose/elk hunters and telephone interviews were tested on all but moose/elk hunters and furbearer hunters/trappers (Table 2).

Mail Questionnaires

Mail questionnaires can be as short as a post card asking harvest information or lengthy with pages of questions. Both extremes were tested in this study as well as other variations on questionnaire design.

Questionnaire design variables included:

- --length
- --type of postage (first class, bulk rate)
- --order of questions
- --style (post card fold over, envelope return style)

--mailing periodicity (one end-of-season mailing, periodic mailings)
--question style (open-ended, multiple choice, specific, general)
--follow-up mailing(s) and reminders

The test of how design variables affected data collection varied. Response rates were used as an indication of how design affects response. Comparison of means of selected variables (expenditures, harvest, days hunted) was used to test design variations on data statistics. Finally, comparison of data statistics and response rates were made with other studies of the same populations.

The mechanics of postseason mail surveys varied slightly across sample populations. Most frequently, three mailings were conducted at approximate 10-day intervals. Questionnaires were coded to coincide with address label listings. When questionnaires were returned, the respondent's mailing label on a second and/or third mailing list would be removed and placed on the questionnaire. That way a respondent to an earlier mailing would not be sent another questionnaire.

Second questionnaires were not always mailed if there was no response to the first mailing. In some cases reminder post cards were mailed instead of replacement questionnaires. This method is initially less expensive but is about equal in cost per returned questionnaire.

Sample sizes for mail surveys were estimated using selected variables (i.e., harvest, days hunted, expenditures) and adjusting upward for potential nonresponse.

Telephone Interviews

The Montana Department of Game, Fish, and Parks and the U.S. Fish and Wildlife Service rely heavily on postseason telephone interviews for sportsmen data collection. This method was tested with archery antelope hunters in 1981 and turkey, firearm antelope, and archery deer hunters in 1982 (Table 2). Telephone interviews were also used for special surveys to find out why nonrespondents did not respond and collect harvest and days hunted data.

Telephone numbers were obtained from license stubs or from local telephone directories. Telephoning is simplified when telephone numbers are on the license or computerized file as could be the case for lottery-type licenses.

Telephone calls were made primarily in the evening hours when the licensee was expected to be available. In cases of wrong numbers, disconnected telephones, or the licensee not being at the given number, recalls were not made. However, when the licensee was either not at home or did not answer, up to three attempts were made to contact the individual.

Telephone interviews were conducted by only two enumerators. This minimized the possibility for enumerator bias.

The format for telephone interviews followed essentially that of mail questionnaires with appropriate wording changes for the change in method.

Personal Interviews

Given the mobility of hunters and fishermen, personal interviews are not well suited for data collection. Seasons extend for several months, making sampling difficult. In addition, expenditure and harvest data will most often be incomplete when surveys are taken in the field. As such, personal interviews were tested with only the sage grouse hunter population.

The sage grouse season is confined to a limited area in southwest North Dakota and to only three days. Thus, sage grouse hunters provided the best opportunity for testing the use of personal interviews for gathering sportsmen data. A personal interview survey instrument was designed in conjunction with the North Dakota Game and Fish Department sage grouse survey. Joint survey instruments were used by four teams in the area during the sage grouse season. An attempt was made to interview all hunters (groups of hunters) in the area.

Sampling Methods

Sample size estimation is critical in surveys at two extremes. Resources are wasted if too large a sample is taken. Conversely, if too small a sample is taken, data may not be statistically reliable and resources will again have been wasted. Sample size can easily be determined if population variance, response rate, and desired confidence levels are known. Most frequently only the confidence intervals are known and the variance and response must be estimated or one from a pilot survey or similar studies must be used.

Sample size estimation is also complicated when data on several variables are to be collected with the same survey instrument. Each variable has a unique and perhaps independent variance as well as variations in allowable widths of confidence intervals.

Sampling method is frequently a problem with outdoor recreation activities. Once survey design has been determined (i.e., mail, personal interview, etc.) the survey population needs to be identified and appropriate schemes developed for identifying a sample from the population. Of utmost importance is randomness of the sample, ensuring that each and every element (individual) in the population has an equal chance of being selected. Schemes to ensure randomness vary with imagination from numbering each element of the population and using a random number table to drawing license stubs from a hat. The population may need to be stratified in some way before sampling. Stratification designs will be dictated by research needs and the form of available information on the population. For example, stratifying firearms deer hunters by hunting unit is easily accomplished since computer tapes are available. However, stratifying archery deer hunters by county or deer management unit cannot be done until after a survey has been taken. There is no reliable way to prestratify in this case. If a certain number of responses is desired from select management units, then prestratification of the firearms deer hunter population would increase the chance of receiving an adequate sample. However, poststratification will frequently be adequate if a large enough overall sample is taken, since a random sample should result in proportional sampling by unit.

An attempt to prestratify to ensure an adequate sample of a specialty sport, such as sage grouse hunting, would be impossible since there is no way of knowing which small game hunters will be hunting sage grouse. Further, to sample enough of the small game hunter population to ensure an adequate sage grouse hunter sample would require a terribly large sample. There were roughly 72,000 small game stamps sold in 1982, yet only about 100 individuals hunted sage grouse. Therefore, to get a sample of 30 sage grouse hunters would require a small game stamp sample of 21,600, if they all responded!

Sample sizes for the initial year surveys were selected based on the results of previous survey work by the Game and Fish Department. Entire populations were sampled in some instances (moose/elk, selected firearms deer units) to allow for testing of survey design variations. A computer program was developed to facilitate estimating sample size for the second year survey. Names, addresses, and in some cases telephone numbers were available from Game and Fish Department records (previous year's license stubs), computerized listings of license applicants (firearms deer, turkey), or provided through a post card system developed during the 1981 survey year.

Consequences of Error

The primary justification for the use of statistics in survey work is to provide an indication of the degree of confidence in the results. An estimate of the mean expenditure of firearms deer hunters of $400 per year is of little value if a statistical significance is not attached to the estimate. However, the correct number can never be found with a survey due to a variety of reasons, primarily that there is random error present. Therefore, each estimate of the magnitude of a variable is only significant at levels that are a function of sample size and variability. We may estimate the $400 mean is within $40 of the population mean 90 percent of the time. There is always a chance, the degree of which can be somewhat controlled, that the estimate is wrong; that it is either too high or too low. Appendix A provides some guidance on basic statistical procedures for survey design and analysis.

Just how confident we want to be in our estimates depends primarily on the consequences of basing a decision on an incorrect estimate. Two types of errors that can be made regarding basing decisions on survey statistics are Type I errors and Type II errors (Appendix A). A Type I error is made when a researcher rejects a true null hypothesis, and a Type II error occurs when a false null hypothesis is accepted. The chances of making either type of error decrease with sample size and exhibit an inverse relationship between each error type.

The consequences of either type of error are not serious when considering making decisions regarding sportsmen expenditures. These errors become serious when hypotheses concerning the effect of new drugs on humans are being tested, for example, or when large or long-run financial decisions rely on hypothesis testing.

A possible hypothesis one might test would be:

H_o: μ = \$400/year (average expenditures are within a statistically significant range of \$400/year)

H_a: $\mu \neq$ \$400/year (average expenditures are significantly different than \$400/year; either larger or smaller)

If we accept the null hypothesis that average expenditures are \$400/year when in fact they are \$300, then we have made a Type II error. Only the researcher or decision maker can assess the consequences of this error.

On the other hand, if we reject the null hypothesis when it is in fact correct, we have made a Type I error. Again, the consequences can only be assessed by those using the data.

Other statistical hypotheses may include:

--Waterfowl hunters spend more than upland game hunters
--Archery deer hunters hunt more often than firearm deer hunters
--A day of rainbow trout fishing is valued more highly than a day of walleye fishing

Each of these hypotheses would be useful in project selection and ranking.

Game and fish management decision making relies on data from a number of sources (Figure 1). If an error occurs in one aspect there are other checks in the system to mitigate the consequences, including in most instances historical data sets or data trend information.

Results

Two sets of results emanated from this project. A set of descriptive statistics on licensed sportsmen activities during the 1981 and 1982 seasons provided the data base from which a set of comparative statistics on data collection methods were estimated. The descriptive data are presented elsewhere (Leitch and Kerestes, 1982; Kerestes and Leitch, 1983). This section will discuss the results of analysis to identify methods for timely, efficient expenditure data collection.

Response Rates

Responses to telephone interviews and thousands of mail questionnaires resulted in very favorable overall response rates. The highest response rate for any sample was obtained during 1982 for the firearm deer hunters' survey, with 99 percent returns (Table 3). The lowest was during 1981 for both the furbearer hunter and trapper survey and turkey hunter diaries with return rates of 45 percent each. Higher response rates during the second year of the study were a result of increasing the number of mailings and using telephone follow-ups.

TABLE 3. SURVEY RESPONSE RATES[a]

Survey	Postseason						Preseason Diary		
		Mailing			Phone[b]		Mailing		
	Phone	1st	2nd	3rd	Follow-up	Overall[c]	1st	2nd[d]	Overall
					1981				
Moose	--	--	--	--	--	--	40	40	80
Turkey	--	50	12	--	--	62	44	2	45
Archery Deer	57	34	11	--	--	56	--	--	--
Firearms Deer	--	41	14	--	--	55	--	--	--
Small Game	--	--	--	--	--	--	--	--	--
Furbearer	--	33	11	--	--	45	--	--	--
Fishing[e]	--	37	8	--	--	48	--	--	--
					1982				
Moose	--	--	--	--	--	--	48	20	68
Turkey (Early)	92	53	16	--	--	69	--	--	--
Turkey (Late)	95	61	10	9	11	90	48	30	78
Archery Deer	72	33	24	--	--	56	--	--	--
Firearm Deer	81	58	20	9	8	99	--	--	--
Archery Antelope	--	37	22	9	17	84	--	--	--
Firearm Antelope	--	71	--	--	--	71	--	--	--
Small Game	--	33	27	--	--	60	--	--	--
Furbearers	--	41	25	--	--	66	--	--	--
Fishing[f]	--	--	--	--	--	--	--	--	--

[a]Response rate is computed by dividing total returns by number mailed after deleting wrong address returns from both numerator and denominator.

[b]Individuals who were contacted by telephone divided by mail survey population less wrong addresses and those with no telephone number, wrong number or phone not in service.

[c]Overall may not be sum of 1st, 2nd, 3rd and telephone follow-up.

[d]Reminder sent in 1981, whereas a diary was sent in 1982.

[e]Mailed March 3, 1982.

[f]Fishing surveys were conducted monthly, therefore, various response rates were obtained.

Nonrespondents from various surveys over the two years of the study were questioned as to their reason for not returning questionnaires. Replies such as "(they) lost it," "did not feel it was important," "did not receive it," and "did not have time" were received. A special telephone survey was carried out to determine why fishermen failed to respond. Their responses are representative with what other licensee types reported (Table 4).

TABLE 4. REASONS FISHING LICENSE HOLDERS DID NOT RESPOND[a]

Reasons for Not Responding	July Survey Number		July Survey Percent	August Survey Number		August Survey Percent
Did Not Receive A Questionnaire	13		12.15	12		11.21
Lost the Questionnaire	17		15.89	11		10.28
No Time To Do Questionnaire	15		14.02	13		12.15
Did Not Fish So Did Not Return It	5		4.67	12		11.21
Did Not Think It Was Important	6		5.61			
Sent It Back	3		2.80			
Refusal				1		0.93
Unable To Be Reached	48		44.86	58		54.21
Not At Home		5			3	
No Answer		17			22	
Wrong Number		3			4	
Telephone Disconnected		6			10	
No Telephone Number		17			19	
Total	107		100.00	107		100.00

[a]For random sample only. Senior citizen licensees who did not respond were not contacted due to unavailability of telephone numbers. Telephone follow-up of nonrespondents to July and August 1982 monthly fishing surveys.

Response bias must be considered when dealing with mail surveys. Gordon et al. (1973) argue that nonresponse can be important when mail questionnaires are used for expenditure data and that steps should be taken to obtain information from nonrespondents. The concern is whether those who respond to the first mailing and those who respond after a reminder and time lapse come from the same statistical population. For example, one might suspect that successful hunters would be more likely to respond than unsuccessful hunters, or that expenditures of hunters responding to the first mailing would be different than those responding after a reminder.

Wroblewski (1970) argued that nonrespondents in mail surveys present a serious problem because they tend to be different from respondents. He found that the average success rates reported by Minnesota deer hunters decreased from the first to the second mailings and from the second to the third mailings. Gordon (1970) found that responses to expenditure questions posed to Idaho fishermen did not significantly differ between the first and second mailings. Leitch and Scott (1978) concluded that differences in expenditures reported on first and second mailings for waterfowl, firearms deer, and archery deer hunters were either not significant or were very small in absolute terms. On the other hand, Brown et al. (1964) found a considerable difference between responses to expenditure questions posed to Oregon fishermen between the first and second mailings but little difference between the second and third mailings.

Three mailings and a follow-up telephone survey allowed testing for nonresponse bias as well as increasing the overall response rate. A typical response curve is shown in Figure 2 for fishing surveys in 1981. Significant differences were found between selected variables of the initial mailing and the third mailing and follow-up telephone survey for several of the hunting activities (Table 5). The significant differences in the variables between the waves of surveys indicates a need for at least two mailings or a follow-up telephone survey if nonresponse bias is present.

Costs

The concern with response rate extends beyond statistical reliability to economic efficiency. Costs per completed, usable survey were compared across survey designs (Appendix B). Questionnaires returned as a result of reminders were more expensive than those from the original mailing due to a generally lower response rate on follow-up mailings and the added costs of mailing (Table 6). Further, returns as a result of sending postcard reminders were more expensive than those from sending an additional questionnaire as a reminder. Sending another questionnaire also elicits a higher response rate, thus lowering the possibility of nonresponse bias. The per unit cost of sending another questionnaire as a reminder was higher than sending postcard reminders but the response rate was greater and the so actual cost per returned questionnaire was lower. Since the objective of reminders is to increase the response rate, it would follow that sending another questionnaire would be a desired approach.

The per survey costs of telephone surveys were higher than mail surveys. Using the previous year's license stubs for names and telephone numbers was a problem. Some people did not have a license for the current year, had moved, or were not available. The use of a business reply postcard

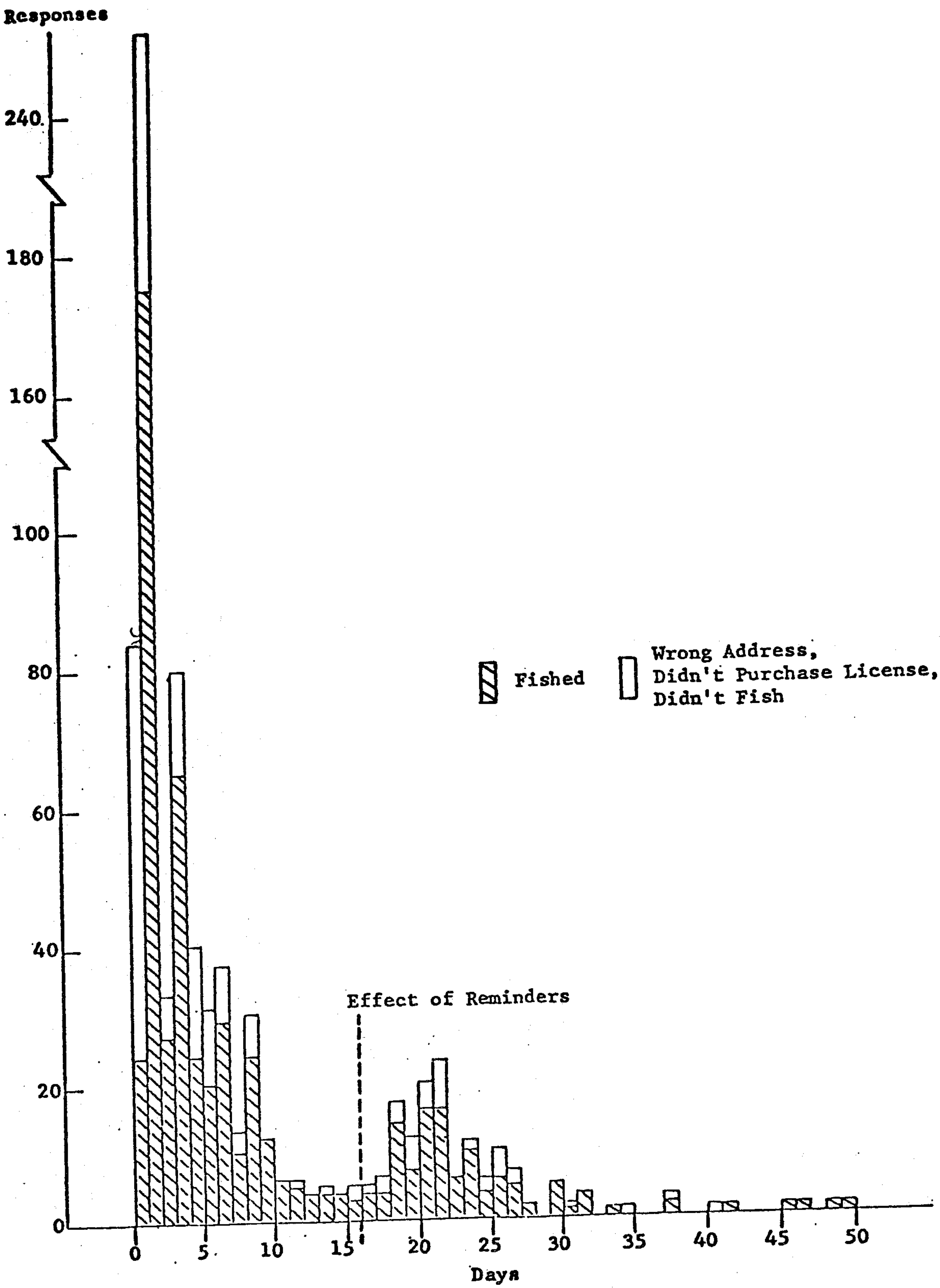

Figure 2. Fish Surveys Received by Day

TABLE 5. RESULTS OF TESTING FOR SIGNIFICANT DIFFERENCES AMONG MAILINGS FOR SELECTED VARIABLES

Species/Variable	Mailing 1 vs 2	Mailing 2 vs 3	All vs Nonrespondent	All vs Control[a]
Archery Deer (Postseason)				
Success	NO	---	---	NO
Days Participated	NO	---	---	NO
Age of Respondent	YES	---	---	---
Sex of Respondent	NO	---	---	---
Firearm Deer				
Success	NO	YES	NO	NO
Days participated	YES	NO	YES	NO
Age of Respondent	NO	NO	NO	YES
Sex of Respondent	NO	NO	NO	NO
Turkey (Early Season)				
Success	YES	---	---	NO
Days Participated	YES	---	---	NO
Age of Respondent	YES	---	---	NO
Sex of Respondent	---	---	---	---
Turkey (Late Season)				
Success	NO	NO	NO	YES
Days Participated	NO	NO	NO	NO
Age of Respondent	NO	NO	NO	NO
Sex of Respondent	NO	NO	NO	NO
Archery Antelope				
Success	NO	NO	YES	---
Days Participated	NO	NO	NO	---
Age of Respondent	YES	NO	---	---
Sex of Respondent	NO	NO	NO	---
Moose Diary				
Success	NO	---	---	---
Days Participated	YES	---	---	---
Age of Respondent	NO	---	---	---
Sex of Respondent	NO	---	---	---
Furbearers				
Days Participated				
Fox Hunting	NO	---	---	---
Fox Trapping	YES	---	---	---
Coyote Hunting	NO	---	---	---
Coyote Trapping	NO	---	---	---
Mink, Muskrat, & Weasel Trapping	YES	---	---	---
Badger/Raccoon Hunting	NO	---	---	---
Badger/Raccoon Trapping	NO	---	---	---

- continued -

TABLE 5. RESULTS OF TESTING FOR SIGNIFICANT DIFFERENCES AMONG MAILINGS FOR SELECTED VARIABLES (CONTINUED)

Species/Variable	Mailing 1 vs 2	Mailing 2 vs 3	All vs Nonrespondent	All vs Control[a]
Upland Game				
Days Hunted				
Ducks	NO	---	---	---
Geese	NO	---	---	---
Sharptail Grouse	NO	---	---	---
Number Harvested				
Ducks	NO	---	---	---
Geese	NO	---	---	---
Sharptail Grouse	YES	---	---	---
Age	YES	---	---	---
Sex	NO	---	---	---

[a]A telephone survey of an independent sample used as a control group for comparison with the mail survey.

system[2] made identification of current license holders easier, but the basic cost of using a telephone to gather data was still high.

Design Considerations

Consistency among survey designs is extremely important if the results of different surveys are used to identify trends or for comparisons. In

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[2]Identifying current year license holders was a problem of all methods. License vendors do not return carbon copies of licenses until well after seasons close. This meant using the prior year's license stubs to draw samples for current year survey work. There may be a considerable turnover in license holders, some who held licenses last year do not buy this year and vice versa. In addition, people move or quit the sport for other reasons. This meant having individuals who had not purchased a current license in the sample and excluding some with current licenses. A solution was to include a business reply postcard after every tenth fishing license and every twenty-fifth license of other over-the-counter licenses. Within days of a license purchase the licensee's name, address, and telephone number were available, reducing the number of wrong addresses and eliminating from the sample those who did not purchase a license. These two categories made up approximately one-fourth of 1981 returns, returns that consume resources, both to send and to receive, that could have been used elsewhere. The postcard system worked very well, with more than an adequate number of current year license buyers from which to draw samples. Approximately 50 percent of the license buyers who should have been asked to return a post card did return one. The other 50 percent may not have cooperated or the vendor failed to ask them to complete the post card.

TABLE 6. ESTIMATED COST PER USABLE QUESTIONNAIRE RETURNED[a]

	Mailing				Mailing			
	1st	2nd	3rd	Overall	1st	2nd	3rd	Overall
	40/10 Response[b]				60/20 Response[c]			
Mail Survey[d]	$1.00	$1.40	---	$1.08	$0.75	$0.83	---	$0.77
Mail Survey[e]	1.00	0.84	---	0.97	---	---	---	---
	35/15 Response							
Telephone Survey[f]	$2.91	$2.85	---	$2.55				
	40/15/10 Response[g]				60/15/10 Response[h]			
Mail Survey[i]	$0.91	$1.54	$1.80	$1.22	$0.69	$1.20	$1.41	$0.86

[a]Exclusive of labor.
[b]40 percent return on initial mailing, 10 percent with reminder.
[c]60 percent return on initial mailing, 20 percent with reminder.
[d]Booklet form, postcard reminder sent, conducted in 1981/82.
[e]Booklet form, duplicate questionnaire sent with reminder, conducted in 1981/82.
[f]Conducted in 1981/82.
[g]40 percent return on initial mailing, 20 percent with second survey, 10 percent with third survey.
[h]60 percent return on initial mailing, 15 percent with second survey, 10 percent with third survey.
[i]Postcard form, initial survey had cover letter, second and third mailings had short reminder note included in questionnaire, conducted in 1982/83.

particular, how several items are interpreted may lead to artificial differences between otherwise similar surveys.

Population Size (N)

When a sample is taken the intention is to obtain a group statistic that is representative of the population. However, in the case of licensed outdoor recreation activities there is a possibility of two separate populations. First, there is the population of individuals who purchase a license, the number of which is known. Second is the population of individuals who actually participate in the activity. There are individuals who buy licenses, then for one reason or another do not participate. The question remains, what is the size of the population?

It is irrelevant which population is selected, but it is highly relevant that the definition of the population be made explicit along with the statistics representing that population. Estimated expenditures per individual, for example, would be lower if the entire population of license holders were used to compute the statistics. On the other hand, it may make more sense to report expenditures by licensed hunter that actually went hunting. In either case, the population needs to be clearly identified.

Zeros or Blanks?

Survey instruments are frequently returned that are incomplete, or apparently incomplete. This is especially troublesome with expenditure data. Does a blank indicate an oversight or a zero? In the case of a respondent's age, a blank obviously indicates an oversight or a desire not to divulge that information. However, in the case of a blank where expenses for food while hunting is left blank, the intention of the respondent is unknown. Since there is no way to force respondents to complete each and every question, rules of thumb need to be developed to handle these situations.

Each survey is unique in the questions asked and need for the information, so no hard and fast rules can be developed. The experience gained on this project has led to the following suggestions on dealing with blanks:

- --when obvious (such as age or miles traveled) treat as blank (no response)
- --if none of a multiple part question is completed (such as itemized expenditures) treat as all blank (no response)
- --if selected portions of a multiple part question are completed treat the blanks as zeros

Itemize or Aggregate?

Especially important when collecting expenditure information is that the respondent recall all pertinent expenditures. This is generally not a problem for short-run events, such as the firearms deer season or the sage grouse season. However, for longer-run activities such as fishing or small game hunting, it may be difficult to recall activities two to six months hence.

Results of this study indicate when respondents are asked to itemize expenditures, the mean total expenditure is higher. This indicates itemizing helps to jog memories and suggest categories of expenses that otherwise might be overlooked by the respondent. Additionally, when asked for aggregate seasonal expenses, licensees may be confused about whether to include durable items such as boats and motors. Itemizing precludes this confusion.

It is clearly advantageous and contributes to reliable data collection to itemize expenditures, first into variable and fixed, and within those categories into six or eight subcategories. While adding to the physical length of the survey instrument, it facilitates completion by helping the respondent remember expenditures.

Allocate to Species/Activity

Expenditures made by outdoor recreationists may be for a variety of purposes. For example, durable goods purchases, such as a tent, can be used over and over for different activities. Allocation of expenditures then becomes problematic. How much of the expenditure should be allocated to a fishing trip in July versus a hunting trip in October. Similarly, several different activities may be participated in on one day during a several day trip. How should the transportation expenses be allocated between early morning goose hunting and afternoon sharptail hunting or between two species that can be hunted at the same time (e.g., sharptail and Hungarian partridge)?

Several approaches may be taken, each with certain shortcomings. Two reasonable, workable approaches include having the respondent allocate the expenditures directly to activities or species or having the respondent indicate the percentage of total expenditures to be allocated to activity or specie. The second approach appeared to work well during this project. Since there is no way to verify allocations--even the recreator does not know for certain--a method that appears to collect the data in an effective, efficient manner is preferred.

Our results indicate respondents react favorably to allocating a percentage of total expenditures among activities or species, while having difficulties allocating expenditures directly. Expenditure data should be collected first on a daily and seasonal basis by license type, then allocated across activities and species by the respondent in the form of percentages of total expenditures for that license type.

Depreciation or Expenditure?

Durable goods purchases for outdoor recreation pose unique analysis problems. Durable goods (e.g., tents, boats, firearms) are reusable and may not depreciate with use. Their purchase, however, represents an injection of dollars into the economy, and thus from a regional or statewide perspective they are important. Expenditure estimates on durable goods may introduce biases when attempts are made to estimate demand curves or values of outdoor recreation experiences from the user's perspective. The durable good purchase may have a real cost that is considerably less than nominal cost. Aside from the conceptual considerations, there is the logistical question of how to collect data on expenditures for durable goods.

Two procedures were examined during this study. First, respondents were asked to estimate the seasonal cost of durable goods used during the activity. While in theory this method should work, it proved to be very difficult to implement. Respondents appeared to have trouble estimating seasonal costs of durable goods that had either depreciated to a low value, do not depreciate, or were only used partially for the activity. For example, the seasonal cost of a shotgun purchased 10 years earlier is difficult to estimate. Likewise, the seasonal cost of a boat purchased two years earlier with a potential resale value higher than purchase price is difficult to estimate. Also, estimating the seasonal cost of a camper used for hunting only because the respondent happened to be an avid camper is hard to estimate.

A second procedure for estimating durable goods expenditures was to ask for only those purchases made during the survey period. This would generally mean during the activity year (e.g., fishing season, hunting season) or during the calendar year for use during the season. However, in one case durable goods expenditures were solicited for monthly periods. This did not work well since respondents reported the same purchases for more than one month.

This second method relies on the assumption that total expenditures for durable goods are invariant with respect to time. In other words, over the long run the average durable goods quantities purchased is not significantly different from year to year. We know this is not strictly correct, since purchases vary with economic conditions. However, there is a lesser chance of being incorrect than if each respondent is asked to estimate seasonal outlays. Annual variations wash out in the long run.

Outliers

Survey data frequently contains observations that appear to be out of place or are "outliers." Statisticians argue whether or not to include these outliers in the analysis. Do they represent deviations from the mean that are important? Or, do they represent deviations that should be excluded from the analysis? The answer depends on the nature of the data and research issue.

Outliers are common in sportsmen activity data collection. For example, one respondent to a recent snowmobile survey (Leitch, West, and Anderson, 1983) indicated snowmobiling an average of over 168 hours per week. That would be snowmobiling every hour of the day and night. Other more common examples of outliers might be respondents reporting expenditures of hundreds or even thousands of dollars for food while on a hunting or fishing trip of only a few days. These types of responses are intuitively wrong. But, if the extreme outliers are excluded from the analysis, where is the line drawn for what to include? If the researcher only includes those observations thought to be reasonable or feasible, it would be just as well to have not conducted the survey and relied on the researcher's judgment.

Outliers may be intentional or may result from misunderstanding the question. Every precaution should be taken during survey design to insure that questions are interpreted the same by all respondents. Understanding that it is very difficult for persons to recall each and every detail of their activities, it must be assumed that respondents answer in good faith and in the aggregate over- and under-estimates balance. Where it is obvious that fictitious data have been reported, they should be excluded from the analysis.

While no good answer exists as to how to handle outliers, common sense would suggest not including impossible estimates, such as more hours than there are in a week or traveling a one-way distance farther than the longest possible one-way distance in the state. Some rules of thumb will need to be developed given each situation. For example, each observation reporting over 84 hours per week of a specific recreational activity might be deleted. This is an arbitrary cut off point but one that is somewhat reasonable. Delineating arbitrary cut off points for expenditure estimates is considerably more difficult. In that case only the truly bizarre observations should be ruled out.

Survey Instrument Appearance

Several items have been suggested as affecting survey response rates, such as color of paper, type of postage, and instrument format. While each of these may influence response, they were found to have no direct influence on reliability of data other than that due to nonresponse. Different colors were used on the 1982 fishing surveys. No significant differences were noted between colors used for either response or variable means.

Postage methods include prestamped envelopes, affixing stamps, using a postage meter, and bulk rate mailing. Cost[3] of materials and labor should be the primary decision factors to consider, rather than the effect of postage type on response.

Many instrument formats were compared (Leitch and Kerestes, 1982; Kerestes and Leitch, 1983) for their influences on response rates and variable values. There was a significant difference in response rates between very long and very short instruments for three of four surveys where length was tested. Longer, booklet-type instruments were found to reduce response by 10 to 30 percentage points. However, length (within reason) should be determined by data needs rather than response rates. If instruments are limited to only those questions that clearly need to be answered, length should not introduce either response or reliability bias.

Summer Fishing

About one-third of the state's population over the age of 15 buy fishing licenses. Estimating expenditures of the state's resident fishermen poses several data collection and analysis problems. As with most other licensed outdoor recreation activities, but even more so with fishing, intensity of participation varies from avid fishermen to those who buy a license and never go fishing. Therefore, variances of some variables are naturally greater than for other activities. Fishing seasons are nearly year around in some instances, making memory bias a consideration. The husband/wife fishing license allows two persons to fish, and their participation may vary. A fishing license allows fishing in almost all of the state's fishing waters and for a wide variety of fish species, introducing problems of allocating time and resources to species or lake. Especially pertinent to this study are the expenditures made by fishermen. Not only do they make purchases of both durable and nondurable items, but many of the items may be used for activities other than fishing.

License Type

A prestratification of licensed fishermen can alleviate sampling or data interpretation problems between license types. A remaining problem is that of activity levels of multiple licensees under one license as is the case with husband/wife licenses. A special postseason mail questionnaire was sent to 150 individuals who purchased husband and wife fishing licenses for the 1982 season

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[3]See Table 6 for cost data.

to gain insights into their fishing participation activity (Kerestes and Leitch, 1983). The characteristics of the buyer(s) of this type of license were unknown and some concern had been expressed regarding area, or statewide, extrapolations made from surveys of such license holders.

Results from this survey indicate the husband is the principal fisherman 65 percent of the time and both husband and wife fish together 29 percent of the time. Only 6 percent of the time was the wife the principal person fishing. Additionally, the wife reported fishing on average one day per year without the husband and 5.6 days with the husband, while the husband fished 10.7 days without the wife. Husbands reported making 87 percent of the fishing equipment and travel expenditures. An average of less than one child under 10 years of age and an average of about one-half a child age 10 through 15 also fished in families where the parents had purchased husband and wife fishing licenses. In the previous five years, no wives reported buying an individual fishing license.

These results imply the husband is the principal fisherman. Although the wife does not participate as often as the husband, they buy a husband and wife fishing license. For all practical purposes it appears that most data with the exception of person days fishing would provide reliable estimates if husband and wife fishing licenses were treated as though they were individual licenses purchased by the husband. The number of fishing days would be biased downward if neither the wife nor the children were included, but fish caught and fishing expenditures should not be significantly affected.

Fishing Expenditures

Game and fish managers are interested in expenditures of fishermen for a variety of reasons. They provide an indication of the overall impact of fishing on the economy. Estimates of fishermen expenditures can be an indicator of the value of certain fisheries, either by geographic area or fish species. Expenditure estimates are important variables in estimating equations regarding fishermen behavior and demands. For these reasons it is necessary to estimate expenditures both in the aggregate and disaggregated by license type, place fished, fish species, harvest, season, local/nonlocal, and on a daily and annual basis. To accomplish these disaggregations, data on other variables must also be collected, including days fished, fish caught, residence location, and place fished. Reliable expenditure estimates necessitate developing reliable estimates of the frequency distributions of these associated variables.

Two basic survey designs tested for the collection of expenditure data were an end-of-season survey and a periodic seasonal survey. Variations were made on survey periodicity, questionnaire design, wording of questions, and reminder/followup techniques.

End-of-season surveys appeared to be the best method of collecting expenditure data from licensed fishermen. That method was used for the 1981 summer fishing season.

There were no significant differences between 1981 and 1982 survey results in most cases (primarily due to the small sample size of the 1982 control group) (Table 7). The relative variation (although a function of sample size and level of significance) is acceptably low for the end-of-season survey (with a higher n) for fish management decision making.

TABLE 7. EXPENDITURES[a] FOR FISHING, 1981 AND 1982 SEASONS

		End-of-1981-Season Survey[b]	Monthly 1982 Survey[c]
Variable:	Season	\$436.43 ± 33.46 (n=533)	\$328.36 ± 95.97 (n=34)
	Daily	\$ 28.84 ± 3.01 (n=508)	\$ 23.32 ± 4.82 (n=34)
Fixed:	Season	\$471.20 ± 59.04 (n=516)	\$357.55 ± 236.59 (n=31)
	Daily	\$ 33.09 ± 5.97 (n=493)	\$ 25.50 ± 8.94 (n=31)
Total:	Season	\$914.40 ± 90.21 (n=512)	\$627.32 ± 291.64 (n=31)
	Daily	\$ 61.33 ± 7.69 (n=490)	\$ 47.77 ± 17.38 (n=31)

[a]Nominal dollars, no adjustments were made.
[b]See Leitch and Kerestes, 1982, for a description of the end-of-season survey.
[c]See Kerestes and Leitch, 1983, for a description of the monthly survey.

Survey Variation

Monthly questionnaires were initially thought to provide more reliable results because respondents would not need to recall expenses and other variables for the entire season. However, for several reasons, the monthly questionnaires did not work well. First, it is more expensive and cumbersome to conduct surveys monthly than at the end-of-season. Second, respondents failed to follow directions specifying to only record activity for the month noted and would apparently report harvest or expenditures for the season when asked for only one month. This was minimized with the control group, however. Monthly questionnaires did not elicit any higher response rates than end-of-season questionnaires.

While end-of-season surveys require that respondents remember what transpired over the past several months, their ease of administration, acceptable response rate, and reasonable variations suggest they are the better alternative.

Prestratifying by license types is essential to ensure each type is represented proportionally in the sample. However, it is only possible to poststratify for place fished, type of fish sought, and other variables that are unknown until questionnaires are returned. Sample sizes drawn according to procedures outlined in Appendix A would normally be adequate for game and fish management decisions involving expenditure variables. If a target species or fishing location is of interest the entire sample can be increased proportionately to ensure an adequate sample is obtained to develop reliable statistics after poststratification.

Conclusion

If steps are taken to collect a random sample, variable estimates from separate surveys may be combined and will be statistically reliable. In other words, expenditure estimates from one random sample of a population could be combined with days fished estimates from another random sample of the same population to develop estimates of expenditures per day. Likewise, harvest and expenditure estimates could be combined to estimate expenditures per harvest. In each instance, however, randomness, appropriate sample size, and nonresponse bias must be controlled or minimized.

Poststratifying responses by fish species or place fished poses some problems. Respondents may have fished for several species on the same day or for "anything that's biting." Expenses can be allocated to species according to stated preferences of respondents, which may be the best way to allocate fishing expenses to species. An alternative method would be to have the respondent specify what percentage of his/her expenses was for each fish species. This was not done for fish but was done for upland game and waterfowl (see below). Allocation of expenditures by fish preference should be an adequate approximation for fish management decisions.

A short, end-of-season questionnaire with expense items itemized, sent to current year license holders according to a sampling scheme based on data needs appears to be the optimal method of collecting expenditure data from fishermen in North Dakota.

Upland Game and Waterfowl Hunting

Approximately 90,000 residents purchase general game licenses in North Dakota each year. Approximately 80 to 90 percent of general game license buyers also purchase a small game stamp entitling them to hunt both upland game and waterfowl[4] within the confines of the hunting proclamation. There are two types of small game licenses: the regular adult license and a separate license for youths.

Only those who have a general game license, a small game stamp, and a federal waterfowl stamp may hunt waterfowl in North Dakota. About 75 percent of the small game stamp holders also hunt waterfowl. Thus one survey problem with this category of hunters is distinguishing hunter types ex ante. Allocating expenditures to species is also encountered. There are 8 species of upland game and over 15 species of huntable waterfowl in North Dakota. The

[4]A federal duck stamp is also required to hunt waterfowl.

time dimension also becomes critical when seasons last from 3 to 120 days and open and close at different times.

Estimation of expenditures by activity and species were areas of greatest concern for small game licensee data collection. However, this license category poses no unique survey problems. Many of the common problems discussed above[5] are present and should be resolved as conditions dictate.

Survey Variations

Questionnaire length, the order of questions, and question wording were each varied to test for effect on responses. An extensive mail questionnaire was used to collect harvest and expenditure data for upland game and waterfowl hunting in 1981. A booklet-type instrument was used that included itemized expenditure questions. A brief version that did not itemize expenditures was used in 1982.

The small game questionnaire had two components; one for upland game and one for waterfowl. It was hypothesized that respondents might become tired or bored with the questionnaire by the time they got to the second section, which would affect the way they answered. One half of the 1982 sample was sent questionnaires with waterfowl harvest and expenditure questions first and upland game questions following. The other half was sent questionnaires with upland game harvest and expenditure questions first and waterfowl questions following. In both questionnaires the sex and age questions were in the same location at the end of the questionnaire. Reversing the order of the waterfowl and upland game questions was done to see if it would affect responses. Two mailings were conducted to check for this bias and to increase the overall response rate.

Several questions on the upland game portion of the questionnaire were varied between being open-ended and having categorical responses provided. For example, in one case age may have been left for the respondent to fill in, and in another a set of age groups was provided.

The results of varying questionnaire designs indicated order of questions did not significantly affect mean values; neither did question wording. The inherent sample variation is perhaps greater than any variation introduced by changing the order. In general, the order of the upland game and waterfowl questions should not have a deleterious effect on estimation of expenditures. Questionnaire length did have an effect on mean values, however that difference may have been manifested through the change from itemized to single value estimates of expenditures done with the shorter format. If expenditure data are needed along with harvest data, then the questionnaire should be long enough to accommodate itemized expenditure questions.

Upland Game Hunter Expenditures

Reported expenditures by upland game hunters during 1981 were significantly higher than in 1982 except for daily variable expenditures (Table

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[5]See the section on Design Considerations.

8). This is thought to be due primarily to itemizing in 1981 versus aggregating in 1982. A list of items helps the respondent remember purchases throughout the season.

TABLE 8. UPLAND GAME HUNTER EXPENDITURES, 1981 AND 1982

		1981[a]	1982[b]
Variable:	Season	$171.92 ± 15.20 (n=357)	$ 91.43 ± 9.50 (n=502)
	Daily	$ 16.54 ± 1.69 (n=353)	$ 14.50 ± 1.53 (n=496)
Fixed:	Season	$204.75 ± 37.39 (n=351)	$ 81.35 ± 20.81 (n=169)
	Daily	$ 24.47 ± 5.59 (n=347)	$ 14.33 ± 4.72 (n=167)
Total:	Season	$379.18 ± 44.85 (n=348)	$156.80 ± 28.62 (n=169)
	Daily	$ 41.00 ± 6.36 (n=344)	$ 29.03 ± 6.74 (n=167)

[a]The 1981 survey was conducted after the season. See Leitch and Kerestes, 1982.
[b]The 1982 survey was conducted after the season. See Kerestes and Leitch, 1983.

Since daily variable expenditures were not significantly different between the two years (1981 and 1982), the differences in seasonal variable expenditures could be due to a difference in average number of days hunted. However, days hunted was not significantly different. Thus, the difference is thought to be a result of the change in questionnaire design.

In every case where aggregate seasonal variable expenditures are compared with itemized expenditures there is a significant difference, with the aggregate estimates being lower (Table 9). This is strong evidence for itemizing expenditure data.

There was a significant difference between upland game hunter seasonal expenditure estimates when the placement of questions was varied within the questionnaire. When placed second, upland game hunter estimates of seasonal expenditures were significantly lower than when placed ahead of waterfowl hunting expenditures (Table 9, row 3 vs. column 2).

Waterfowl Hunter Expenditures

Reported waterfowl hunting expenditures were higher in 1981 than in 1982, for the same reasons as upland game hunter expenditures were higher in

TABLE 9. PAIRWISE SIGNIFICANT[a] DIFFERENCES IN ESTIMATES OF UPLAND GAME HUNTER SEASONAL VARIABLE EXPENDITURES, 1981 AND 1982

Survey	Survey 1	2	3	4
1. 1981 Itemized Expenditures (long form)	NA			
2. 1982 Aggregate Expenditures (short form, upland game first)[b]	less than	NA		
3. 1982 Aggregate Expenditures (short form, upland game second)[c]	less than	less than	NA	
4. 1982 Combined Data	less than	NA	NA	NA

[a]At the 90 percent level of significance, rows vs. columns.
[b]This variation had respondents record their upland game data first, followed by waterfowl hunting expenditures.
[c]This variation had respondents record their waterfowl hunting data first, followed by upland game hunting expenditures.

1981 (Table 10). Adjustments for inflation, which were not made, would not affect the difference significantly in these cases.

In every instance where itemized seasonal expenditures are compared with aggregate, the itemized are greater (Table 11). This is similar to the finding for upland game hunting expenditures. However, varying the questionnaire design by placing waterfowl hunting expenditure questions after upland game hunter expenditures did not have a significant effect on those estimates (row 3 vs. column 2).

Turkey Hunting

North Dakota turkey hunting permits are allocated by unit and by early and late season. Mail questionnaires, both short and long, brief telephone surveys, and diaries were all used to gather data from turkey permit holders.

Significant differences were found among survey designs and between 1981 and 1982 data. While there were not significant differences between estimates of seasonal variable expenditures between 1981 and 1982, most other comparisons showed differences (Table 12). Especially prominent are the differences in estimated fixed expenditures from one year to the next.

Looking only at estimates of seasonal variable expenditures, no difference was found between diary estimates and postseason survey estimates

TABLE 10. WATERFOWL EXPENDITURES FOR 1981 AND 1982 SEASONS

		1981[a]	1982[b]
Variable:	Season	$191.00 ± 19.29 (n=305)	$100.53 ± 10.77 (n=464)
	Daily	$ 21.90 ± 2.26 (n=302)	$ 15.45 ± 1.46 (n=456)
Fixed:	Season	$181.17 ± 31.13 (n=302)	$ 77.78 ± 18.02 (n=465)
	Daily	$ 23.94 ± 4.63 (n=298)	$ 14.36 ± 3.82 (n=457)
Total:	Season	$369.84 ± 42.03 (n=297)	$178.26 ± 23.16 (n=464)
	Daily	$ 46.06 ± 6.00 (n=294)	$ 29.73 ± 23.16 (n=456)

[a]The 1981 survey was conducted after the season. See Leitch and Kerestes, 1982.
[b]The 1982 survey was conducted after the season. See Kerestes and Leitch, 1983.

TABLE 11. PAIRWISE SIGNIFICANT[a] DIFFERENCES IN ESTIMATES OF WATERFOWL HUNTER SEASONAL VARIABLE EXPENDITURES, 1981 AND 1982

Survey	Survey 1	2	3	4
1. 1981 Itemized Expenditures (long form)	NA			
2. 1982 Aggregate Expenditures (short form, waterfowl first)[b]	less than	NA		
3. 1982 Aggregate Expenditures (short form, waterfowl second)[c]	less than	No	NA	
4. 1982 Combined Data	less than	NA	NA	NA

[a]Rows vs. columns, at the 90 percent level of significance.
[b]This variation had respondents record their waterfowl hunting expenditures first, followed by upland game hunting activity data.
[c]This variation had respondents record their waterfowl hunting expenditures after upland game hunting expenditures.

TABLE 12. WILD TURKEY HUNTER EXPENDITURES, 1981 AND 1982

		1981[a]	1982[b]
Variable:	Season	$ 62.74 ± 9.41 (n=185)	$46.43 ± 8.56 (n=90)
	Daily	$ 40.26 ± 7.51 (n=185)	$24.73 ± 6.22 (n=88)
Fixed:	Season	$167.67 ± 75.52 (n=191)	$ 6.39 ± 4.99 (n=90)
	Daily	$103.28 ± 42.54 (n=191)	$ 4.12 ± 4.41 (n=88)
Total:	Season	$288.25 ± 135.48 (n=60)	$52.82 ± 9.99 (n=90)
	Daily	$171.92 ± 99.97 (n=60)	$28.85 ± 7.59 (n=88)

[a]Statewide, both early and late seasons.
[b]Statewide, late season.

in 1981 (Table 13). A difference was found between diary and postseason survey estimates in the 1982 data, however.

Big Game Hunting

North Dakota big game species include whitetail and mule deer, antelope, moose, elk, and bighorn sheep. Fortunately, from a data collection perspective, each species requires a separate permit, with permits allocated by the Bismarck Game and Fish office in most cases. Only archery permits for deer and antelope are sold "over the counter." Because of this licensing system, names of licensees are available even before the current season. It is further possible to prestratify samples by game management unit or other variables included on the license application.

Moose, elk, and bighorn sheep hunting licenses, when there are seasons, are very limited both in numbers and geographic distribution. Therefore it is usually most effective to sample the entire population. For other species, such as deer where the number of permits may exceed 50,000, samples must be drawn. This is greatly facilitated by having the names of applicants for most big game license types in a computer file.

At least one problem arises in collection of expenditure data for big game hunting that was not present for other activities--obtaining reliable results at the game management level. While sample sizes of a few hundred will usually be adequate for state-level expenditure estimates, sample sizes required for a management unit may be almost as large. Thus, with numerous game management units each requiring a sample of three to five hundred, the

TABLE 13. PAIRWISE SIGNIFICANT DIFFERENCES IN ESTIMATES OF TURKEY HUNTER SEASONAL VARIABLE EXPENDITURES, 1981 AND 1982

Survey	Survey 1	2	3	4	5	6	7
1. 1981 Diary (all late)	NA						
2. 1981 Postseason (all late)	No	NA					
3. 1982 Early Season Diary	b	b	NA				
4. 1982 Postseason (Unit 13E)	NA	NA	b	NA			
5. 1982 Postseason (Unit 13L)	NA	NA	NA	NA	NA		
6. 1982 Late Season Diary	More Than	More Than	NA	NA	NA	NA	
7. 1982 Postseason (all)	Less Than	Less Than	NA	NA	NA	Less Than	NA

[a]Rows vs. volumns, at the 90 percent level of significance.
[b]Insufficient survey response.

survey sample becomes quite large. The problem of estimating expenditures at the management unit level is not so serious as the problem of estimating harvest at the management unit level. The consequences of being wrong in an estimate of expenditures are not significant at the micro level, while the consequences of over or under estimating harvests may be much more serious. In most instances, expenditures need only be estimated at the state or substate level and not at the game management level.

Surveys of big game hunting activities are made easier due to the system of allocating permits, the short seasons, and the limit of one species per license with a maximum bag of one animal per year. Exceptions to the short seasons are the archery seasons, which for deer could cover a period of approximately four months.

Archery Deer and Antelope

Archery deer hunters were surveyed during the 1981 and 1982 hunting seasons. Since there was not an archery antelope season in 1981, only 1982 season data were collected.

An extensive postseason mail survey and a telephone survey were used to collect data from archery deer hunters in 1981. Post card reminders were sent to nonrespondents about two weeks after the initial mailing. Data was collected through a postseason mail survey, a periodic mail survey, and a telephone survey in 1982. Different random samples were chosen for each type of surveying method. License stubs from the previous year were used to obtain the names of archery deer hunters.

The 1982 season was divided into three parts for the purpose of conducting the periodic mail survey. Questionnaires were mailed at the end of each period; those individuals who bagged a deer, did not purchase a license for 1982, or had a wrong address were deleted from the next period's mailings.

The brief postseason mail survey collected harvest and expenditure data. One mailing was done to use as a comparison with the periodic mail survey and the telephone survey.

The telephone survey sample consisted of previous year license holders. The year-old names and addresses made it difficult to locate individuals' telephone numbers. Also, individuals who had not purchased a license for the current year were contacted.

Results of the two separate year's surveys, two basic survey approaches (mail and telephone), and variations in time period covered by the questionnaires were compared. Tests for response bias on estimates of hunter success were inconclusive. However, it appeared that there may be an upward influence with mail surveys as compared to telephone surveys (Leitch and Kerestes, 1982; Kerestes and Leitch, 1983). This results from the reasons for nonresponse to telephone surveys being unrelated to hunter success, while response to mail surveys is often correlated with success.

A comparison of reported 1981 and 1982 expenditures by archery deer hunters reveals an apparent drastic reduction in 1982 (Table 14). This

TABLE 14. ARCHERY DEER HUNTER EXPENDITURES, 1981 AND 1982

		1981	1982
Variable:	Season	$158.46 ± 22.32[a] (n=230)	$113.18 ± 25.91 (n=83)
	Daily	$ 20.17 ± 5.18 (n=225)	$ 12.35 ± 3.20 (n=83)
Fixed:	Season	$381.88 ± 123.12 (n=210)	$ 71.11 ± 14.20 (n=66)
	Daily	$ 53.04 ± 19.24 (n=208)	$ 8.31 ± 2.82 (n=64)
Total:	Season	$742.00 ± 204.20 (n=131)	$206.51 ± 37.80 (n=63)
	Daily	$ 77.08 ± 30.20 (n=130)	$ 21.58 ± 9.18 (n=63)

[a]At the 90 percent level of significance.

difference can be traced to a change in questionnaire format. The method of recording outlays for fixed expenditures changed from the allocation method in 1981 to the actual expense in 1982. While in the long run there should be no difference in total or average annual outlay, this significant difference suggests further attention be paid to reporting expenditures for fixed equipment.

A comparison of the variable expenditures between 1981 and 1982 was inconclusive (Table 15). Monthly questionnaires showed significant differences

TABLE 15. PAIRWISE SIGNIFICANT[a] DIFFERENCES IN ARCHERY DEER HUNTERS' ESTIMATES OF SEASONAL VARIABLE EXPENDITURES, 1981 AND 1982

	Survey						
	1	2	3	4	5	6	7
1. 1981 Telephone	NA						
2. 1981 Postseason	No	NA					
3. 1982 Period #1	NA	NA	NA				
4. 1982 Period #2	NA	NA	No	NA			
5. 1982 Period #3	NA	NA	Less Than	Less Than	NA		
6. 1982 Combined Data	No	Less Than	More Than	More Than	More Than	NA	
7. 1982 Postseason	Less Than	Less Than	NA	NA	NA	NA	NA

[a]Rows vs. columns, at the 90 percent level of significance.

between periods in two cases (period #3 vs. both period #1 and period #2). This indicates a potential problem with interpreting and understanding the questionnaire.

No comparisons of expenditure extimates could be made among years or survey designs for archery antelope hunting. Table 16 presents expenditure estimates for archery antelope hunting for the 1982 season. Fixed expenditure estimates could be high because of the season being closed for four years prior (people buying new equipment).

Moose and Elk

Since the moose and/or elk hunting population is generally very small (less than 50 permits), the entire population can be sampled. Diaries were

TABLE 16. ARCHERY ANTELOPE HUNTER EXPENDITURES, 1982[a]

		1982 Season Seasonal
Variable:	Season	$117.94 ± 11.23 (n=283)
	Daily	$ 31.15 ± 4.41 (n=275)
Fixed:	Season	$381.91 ± 190.02 (n=190)
	Daily	$129.25 ± 70.14
Total:	Season	$518.88 ± 191.90 (n=190)
	Daily	$164.67 ± 71.36

[a]There was no archery antelope season in 1981.

used in both 1981 and 1982 to survey this population. The diary method worked well with the exception of obtaining a high response. Twelve of the 15 permitees returned diaries in 1981 (80 percent), but only 17 of 25 returned them in 1982 (68 percent). While the percent response is high, the number received is low, making statistical analysis difficult.

The only seasonal estimate that was different between the two years was variable expenditures (Table 17) being greater in 1982 than 1981.

TABLE 17. MOOSE/ELK HUNTING EXPENDITURES, 1981 AND 1982

		1981	1982
Variable:	Season	$382.08 ± 105.73 (n=12)	$561.53 ± 119.73 (n=17)
	Daily	$109.17 ± 30.21 (n=12)	$219.04 ± 93.50 (n=17)
Fixed:	Season	$185.08 ± 129.02 (n=12)	$135.41 ± 132.00 (n=17)
	Daily	$ 52.88 ± 36.87 (n=12)	$ 70.30 ± 70.30 (n=17)
Total:	Season	$808.90 ± 330.13 (n=10)	$806.53 ± 280.78 (n=15)
	Daily	$212.87 ± 86.89 (n=10)	$346.31 ± 189.35 (n=15)

Firearms Deer and Antelope

The 1981 survey of firearm deer hunters made use of an extensive booklet questionnaire to collect data. Post card reminders were sent two weeks after the initial mailing to those not responding. Replacement surveys were sent to a small group of nonrespondents. The response to the post card reminders was one-half the response achieved from the mailing of another survey.

The 1982 firearm deer survey of the Sheyenne-James Management Unit was conducted in cooperation with the North Dakota Game and Fish Department. Three mailings were sent at three-week intervals to improve the response rate. Those not yet responding were contacted by telephone. Another sample of hunters was contacted through the use of a telephone survey.

Expenditures of 1981 and 1982 firearm deer hunters differed significantly (Tables 18 and 19) for the daily variable expenses, although the survey population was also different. No significant difference was found between the daily fixed or daily grand total of expenses.

TABLE 18. FIREARM DEER HUNTING EXPENDITURES, 1981 AND 1982

		1981[a]	1982[b]
Variable:	Season	\$115.31 ± 5.04 (n=1186)	\$ 94.59 ± 4.82 (n=811)
	Daily	\$ 39.41 ± 2.01 (n=1179)	\$ 33.61 ± 2.08 (n=804)
Fixed:	Season	\$184.78 ± 32.24 (n=1228)	\$160.64 ± 56.45 (n=649)
	Daily	\$ 61.06 ± 11.32 (n=1221)	\$ 56.75 ± 26.75 (n=643)
Total:	Season	\$395.56 ± 59.89 (n=416)	\$272.84 ± 58.83 (n=628)
	Daily	\$120.70 ± 18.87 (n=415)	\$ 94.91 ± 28.08 (n=622)

[a]Postseason statewide mail survey.
[b]Postseason mail survey of Sheyenne-James Management Unit hunters.

No firearms antelope season was held in 1981, therefore no comparisons could be made (Table 20).

Furbearer Hunting/Trapping

The furbearer questionnaire used in 1982 was in booklet form as in 1981. The questionnaire was modified from the previous year to make it easier

TABLE 19. PAIRWISE SIGNIFICANT[a] DIFFERENCES IN ESTIMATES OF FIREARMS DEER HUNTER SEASONAL VARIABLE EXPENDITURES, 1981 AND 1982

Survey	Survey 1	2	3
1. 1981 Postseason Mail, Itemized, Statewide	NA		
2. 1981 Sheyenne-James Management Unit	less than	NA	
3. 1982 Postseason Mail, Itemized, Sheyenne-James Management Unit	less than	No	NA

[a]Rows vs. columns, at the 90 percent level of significance.

TABLE 20. FIREARM ANTELOPE HUNTING EXPENDITURES, 1982

		1982[a]
Variable:	Season	$161.76 ± 9.49 (n=467)
	Daily	$103.95 ± 6.90 (n=467)
Fixed:	Season	$233.48 ± 124.85 (n=339)
	Daily	$161.51 ± 94.99 (n=339)
Total:	Season	$411.78 ± 126.58 (n=336)
	Daily	$272.79 ± 96.96 (n=336)

[a]Postseason mail survey.

to complete. The time period for reporting harvested animals was reduced to aid in having the surveys returned in a timely manner.

The primary problem with collecting expenditure data on furbearer hunting and trapping is that of allocating expenses to one or the other activity. The 1982 survey instrument asked respondents to allocate both the time and money spent between hunting and trapping for each furbearer species. This combined with a species demand index (Kerestes and Leitch, 1983, p. 46) could be used to allocate expenditures to furbearer species.

There were significant differences in the expenditures estimated between the 1981 and 1982 surveys (Table 21). These differences could be due in part to the change in estimating durable goods expenditures and in part to the overall higher response rate in 1982.

TABLE 21. FURBEARER HUNTING/TRAPPING EXPENDITURES, 1981 AND 1982

		1981	1982
Variable:	Season	$383.06 ± 114.05 (n=109)	$201.64 ± 32.06 (n=171)
	Daily	---	---
Fixed:	Season	$499.08 ± 175.84 (n=113)	$357.10 ± 156.49 (n=178)
	Daily	---	---
Total:	Season	$889.68 ± 209.23 (n=109)	$569.05 ± 170.05 (n=171)
	Daily	---	---

Recommendations

Many recommendations regarding survey methods, questionnaire design, and statistical analysis have been made above. Some additional insights and recommendations may be beneficial to implementing an overall survey process. These suggestions are from the perspective of administrative efficiency, economics, and survey design consistency.

1. All data collected from licensed sportsmen through mail surveys should be centrally coordinated to avoid unnecessary repetition of questions. For example, use of the sportsman license number could preclude having to ask the same sportsman his age, income, etc., on each survey.

2. Five-year intervals for collection of expenditure data should be adequate if there are no drastic changes in the national economy. All data could be collected every fifth year or collection could be stepped so a different license type is sampled each year over a five-year period. Price indices (e.g., CPI) could be used in intervening years to inflate (or deflate) expenditure estimates to fit current conditions.

The expenditures estimated during this project should be adequate for use by the Department for 1983 through 1987. Point estimates of expenditures by hunting/fishing/trapping activity are presented in Table 22. These estimates can be adjusted annually by the CPI or until conditions change to warrant collection of primary data.

TABLE 22. AVERAGE EXPENDITURES[a] PER LICENSEE BY ACTIVITY IN NORTH DAKOTA, 1981/1982

License Type	Daily Variable	Daily Total[b]	Seasonal
Fall 1981/1982			
Moose/Elk[c]	$164	$280	$807.72
Turkey	$ 32	$100	$170.53
Archery Antelope	$ 31	$165	$518.88
Archery Deer	$ 16	$ 49	$474.25
Firearm Antelope	$104	$273	$411.78
Firearm Deer	$ 36	$108	$334.20
Furbearer Hunting/Trapping (Season)	($292)	($729)	$729.37
Upland Game	$ 16	$ 35	$267.99
Waterfowl	$ 19	$ 38	$274.05
Fishing[e]	$ 26	$ 56	$770.86

[a]Expenditures represent composites of those reported in Leitch and Kerestes (1982) and Kerestes and Leitch (1983).
[b]Includes expenditures for durable equipment, excludes preseason scouting expenses.
[c]Moose expenditures for 1981. Moose and elk expenditures for 1982.
[d]1982 expenditures only from Sheyenne-James Management Unit.
[e]Expenditures per license, either individual or husband/wife.

3. Contract expenditure data collection outside the Department. (This would preclude implementation of recommendation #1.)

4. Develop a licensing system so that it is possible to timely identify licensees by activity type.

5. Have a space for telephone numbers on licenses so surveys can more easily be conducted by telephone.

6. Estimate statistically desirable sample size for each variable, then decide on sample size based on importance of each variable. Sample sizes based on data from the 1981 and 1982 surveys for statewide estimates of variables range from only 100 for firearms antelope hunters to over 1,200 for upland game hunters, depending on variable and significance level (Table 23).

TABLE 23. SAMPLE SIZES NEEDED TO ESTIMATE CONFIDENCE INTERVALS ±10 PERCENT OF THE MEAN FOR SELECTED VARIABLES[a]

Variable	Significance Level 80	90	95	98
Archery Antelope Hunters:				
Daily Variable Expenditures	338	556	788	1,110
Seasonal Variable Expenditures	158	259	368	517
Firearm Antelope Hunters:				
Daily Variable Expenditures	216	355	503	707
Seasonal Variable Expenditures	100	163	231	325
Archery Deer Hunters:				
Daily Variable Expenditures	341	560	794	1,118
Seasonal Variable Expenditures	267	439	623	877
Firearms Deer Hunters:				
Daily Variable Expenditures	190	311	441	621
Seasonal Variable Expenditures	130	213	302	425
Furbearer Hunter and Trapper:				
Seasonal Variable Expenditures	266	437	619	871
Upland Game Hunters:				
Daily Variable Expenditures	386	634	900	1,266
Seasonal Variable Expenditures	333	547	776	1,093
Waterfowl Hunters:				
Daily Variable Expenditures	251	412	584	822
Seasonal Variable Expenditures	328	538	764	1,075
Fishing:				
Daily Variable Expenditures	340	558	792	1,114
Seasonal Variable Expenditures	193	317	449	632

[a]Sample sizes estimated from expected means and population variances from data collected for 1981 and 1982 seasons.

7. Ask respondents to first estimate expenditures for major catagories of game (e.g., upland game, waterfowl, summer fishing), then allocate expenditures within major catagories to species or activities using simple percentages of total expenditures.

8. Itemize expenditures whenever possible to facilitate recall and secondary impact assessment.

9. Have respondents report current year durable goods expenditures only. Assume these expenditures are invariant with respect to time and that they represent an annual average over time.

10. Unless the other factors in game and fish decision making can be better quantified, using a significance level of 90 percent for expenditure estimates is more than adequate.

11. Questionnaires should be designed so they are easy to understand, read, and complete. Only questions where answers are truly necessary to decision making should be included.

12. Multiple mailings or other devices should be incorporated into the survey procedure to control or correct for potential nonresponse bias.

13. Provide season calendars when asking days hunted/fished to help jog memories.

Summary and Conclusions

Collecting and interpreting data from licensed sportsmen is not an easy task. Many, many factors influence the final estimate, several of which the surveyor has little control over. However, if survey procedures are consistent and explicitly described, independent surveys can be compared or combined to provide useful data for game and fish management decision making.

There are no correct or incorrect estimates of sportsmen expenditures, only probabilities that estimates fall within certain bounds. Both the bounds and probabilities are set by the researcher, but are dependent upon sample size and population variance. If proper survey procedures are followed--including selecting a sample, interpreting the data, and applying the appropriate statistical tools--then we can expect to have developed reliable results a majority of the time.

APPENDIX A

Appendix A: Basic Statistical Procedures for Analyzing Survey Data[1]

This appendix outlines several of the common statistical tools used by fish and wildlife managers for analyzing sportsman survey data. Refer to a statistics text for more detailed information (Hughes and Grawoig, 1971; Huntsberger and Billingsley, 1974; Mendenhall, Ott, and Larson, 1974).

Definitions

Statistical hypothesis: a statement about the population of interest.

Hypothesis test: a test of a statistical hypothesis in order to determine whether to accept or reject the hypothesis.

Type I error: the result of rejecting a true hypothesis. The size of the type I error is the probability that the sample point will fall in the critical region if the null hypothesis (H_o) of no significant difference is true.

Type II error: the result of accepting a false hypothesis. The size of the type II error is the probability that the sample point will fall in the noncritical region if the alternative hypothesis (H_a) of a significant difference is true.

Point estimate: a single value used to estimate a population parameter.

Interval estimate: an estimate of a population parameter formed by an interval of values within which we expect the parameter to fall.

Confidence interval: the interval estimate defined for a specific sample.

Population: the set representing all measurements of interest.

Sample: a subset of measurements selected from the population of interest.

Random sample: a sample in which each of the N population measurements has an equal probability of selection.

Standard deviation: a measure of absolute variability.

Standard Deviation (s)

The standard deviation indicates the spread (variation) of a set of measurements. If the measurements are normally distributed, the percentage of the measurements within m standard deviations of the mean is fixed. For example, $\overline{x}$ is the sample means:

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[1]Mir Ali, research assistant, Department of Agricultural Economics, North Dakota State University, Fargo, contributed the majority of this appendix.

$\bar{x} \pm 1s$ should contain 68 percent of the measurements,

$\bar{x} \pm 2s$ should contain 95 percent of the measurements, and

$\bar{x} \pm 3s$ should contain 99.7 percent of the measurements.

The formula used to calculate the sample standard deviation is:

$$s = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n - 1}}$$

where: s = standard deviation,

Σ = summation,

x_i = value of the i^{th} individual observation of the sample,

$\bar{x}$ = sample mean, and

n = number of measurements.

<u>Choosing a Sample Size for a 90 Percent Confidence Interval</u>

Choosing an appropriate sample size is very important; collecting information involves cost, time, and effort. Correct sample size depends on the type and amount of information needed. If the sample is too large, time and effort are wasted. If the sample is too small, inadequate information is collected. Also, it may be impossible to increase size of the sample at a later point in time.

In choosing a correct sample size, one must decide on the allowable level of error in the estimation. Knowledge of the population standard deviation is also required. We could approximate the value of population standard deviation using information from previous studies. The formula used to calculate sample size for a 90 percent confidence interval is:

$$n = \frac{(1.645)^2 \ (\sigma)^2}{B^2}$$

where: n = size of sample,

σ = population standard deviation or estimate of population standard deviation,

B = bound on error of estimation.

Since we want 90 percent confidence in our estimates we used 1.645. Refer to Table A1, the intersection of infinite degrees of freedom (n-1) and

TABLE A1. STUDENT T-TEST VALUES

d.f.	a = .10	a = .05	a = .025	a = .010	a = .005
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
inf.[1]	1.282	1.645	1.960	2.326	2.576

[1]Values in this row were also used for Z-test statistics.

SOURCE: Mendenhall, W., L. Ott, and R. F. Larson. 1974. Statistics: A Tool for the Social Sciences. Wadsworth Publishing Company, Inc., Belmont, California.

$a = .05 \left(\frac{1 - .90}{2}\right)$, yields gives 1.645. Example: we wish to know the correct sample size to collect information about success of firearm deer hunters. It is known that the standard deviation, (σ), of success rate is 0.4903[2] and the desired bound on the error of estimation, (B), is 0.0625.[3]

$$n = \frac{(1.645)^2(.4903)^2}{(.0625)^2} = 166.78$$

To be conservative, 166.78 is rounded up to 170.[4] By choosing a sample size of 170, we could conclude with 90 percent confidence that the error of the estimate of the mean success rate of a hunter will be within ± 0.0625 of the true mean success rate, if the estimated σ is correct.

Ninety Percent Confidence Interval

Ninety percent of the sample means in repeated sampling will be within 1.64 standard errors of the population mean.[5] We conclude with 90 percent confidence that the true mean lies within the interval. The formula used to compute the 90 percent confidence interval only if n > 30 is:

(i) $B = \frac{1.64\ s}{\sqrt{n}}$

(ii) 90 percent confidence interval:

$$(\bar{x} - B) \leq \mu \leq (\bar{x} + B)$$

---

[2]From a previous study.

[3]Because we want an error less than 10 percent of the mean of 62.5 percent.

[4]If it is anticipated that information is to be collected by mail or telephone, the correct sample size should be adjusted based on the response rate:

$$\text{Adjusted sample size} = \frac{\text{correct sample size}}{\text{percent response expected}}$$

If in a mail survey 55 percent were expected to respond, the adjusted sample size should be $\frac{170}{.55}$ = 309.09, rounded up to 310.

[5]Refer to Table A2, the intersection of the number of standard deviation (z) = 1.6 row with the .04 column gives the area for one side of the mean. The total area for two sides of the mean is 2 x .4495 = .8990 (approximately 90 percent). Therefore, 1.64 is used to calculate the 90 percent confidence interval.

TABLE A2. NORMAL-CURVE AREAS

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

SOURCE: Mendenhall, W., L. Ott, and R. F. Larson. 1974. Statistics: A Tool for the Social Sciences. Wadsworth Publishing Company, Inc., Belmont, California.

where: $B = \frac{1.64s}{\sqrt{n}}$

s = standard deviation,

n = number of measurements,

$\overline{x}$ = sample mean, and

μ = true population mean.

Example: the objective is to calculate a 90 percent confidence interval for a success rate. Statistics given are based on an archery antelope mail survey.

$\overline{x} = 0.2056$,

$s = 0.4048$, and

$n = 287$.

Substituting these values into the formula, we obtain:

$$B = \frac{1.64 \times .4048}{\sqrt{287}} = 0.0392$$

90 percent confidence interval:

$0.1664 \leq \mu \leq 0.2440$

We could conclude with 90 percent confidence that the estimate is within ± 0.0392 of the true success rate. In other words, the true success rate is expected to be within the interval 0.1664 to 0.2440.

Type I and Type II Errors

A decision based on statistical analysis concerning a hypothesis may be correct or incorrect. If the researcher either (1) accepts a true null hypothesis (no significant difference) or (2) rejects a false null hypothesis, the researcher has made the correct decision. However, if the decision is either (1) to reject the null hypothesis when it is, in fact, true or (2) to accept the null hypothesis when it is, in fact, false is incorrect. An error in making a decision of the first type is called a type I error and an error in making a decision of the second type is called a type II error.

It is not possible to eliminate the risk of making an error in hypothesis testing when the decision is based on sample data. Certainly, it is desirable to minimize the risk of committing errors. However, for a specified sample size, there is an inverse relationship between the risk of making a type I and a type II error. Decreasing the risk of committing type I error increases the risk of committing type II error. The converse is also true. The only way to reduce risk of committing both type of errors simultaneously is to increase the size of sample.

When it is recognized that some incorrect decisions are inevitable in hypothesis testing, it is the responsibility of a researcher to estimate the risk of an incorrect decision so that businessmen or policy makers can act with the knowledge of the magnitude of the risk involved in making wrong decisions.

Comparing Two Means

To test the equality of two means, a t-test statistic is used if the sample size is less than 30 and the Z-test statistic is used for sample sizes greater than or equal to 30. The null hypothesis is that two means are equal ($H_0: \mu_1 = \mu_2$). If the null hypothesis is accepted, the conclusion reached is that the means are the same and that difference between them if any is due to sampling difference and is not significant. If the null hypothesis is rejected, a decision has been made that the differences in the two means are too large to explain as a sampling difference and therefore, differences between two means are significant.

Rejection of a null hypothesis depends on a value of alpha (α).[6] Values of alpha generally used are .1, .05, and .01. Use Table A1 to find the table t-value. The degrees of freedom, d.f., (n-1 for one sample, $n_1 + n_2 - 2$ for two sample) is given in left-hand column and values for $a = \left(\frac{\alpha}{2}\right)$[7] are given in the top row. Suppose we wish to find the table t-value, degrees of freedom = 23 and $\alpha = .1$ (or a two-tailed test with 10 percent significance). The intersection of d.f. = 23 and $\alpha = .05$ gives the table t-value = 1.714. If the computed t-value is larger than 1.714 or less than -1.714, the null hypothesis is rejected. Formulas are as follows:

(i) Test statistic used if population variances are equal:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{s \frac{1}{n_1} + \frac{1}{n_2}}}$$

---

[6]The alpha value is a predetermined level of significance that determines the rejection region. If the sample statistic falls within the rejection region, the null hypothesis will be considered to be false and therefore, will be rejected.

[7]If the alternative hypothesis is stated as $H_1: \mu_1 \neq \mu_2$, a two-tailed test should be used and an area equal to $\frac{\alpha}{2}$ should be assigned to each end of the sample distribution. If the alternative hypotheis is stated as $H_1: \mu_1 > \mu_2$ or $H_1: \mu_1 < \mu_2$, a one-tailed test should be used and an entire α area should be assigned to one end of the sample distribution.

where: t = computed t value,

$\overline{x}_1$ = mean of sample 1,

$\overline{x}_2$ = mean of sample 2,

s = pooled standard deviation

$$= \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

where: s_1 = standard deviation of sample 1,

s_2 = standard deviation of sample 2,

n_1 = number of measurements of sample 1, and

n_2 = number of measurements of sample 2.

Example: we wish to test whether two means for days hunted obtained in diary and mail turkey survey are equal. It is known that:

Sample 1 (diary turkey survey)

$\overline{x}_1 = 4.90,\ n_1 = 29,\ s_1^2 = 90.31$

Sample 2 (mail turkey survey)

$\overline{x}_2 = 2.14,\ n_2 = 118,\ s_2^2 = 2.76$

$$s = \sqrt{\frac{(29 - 1)90.31 + (118 - 1)2.76}{29 + 118 - 2}} = 4.435$$

$$t = \frac{4.90 - 2.14}{4.435\left(\sqrt{\frac{1}{29} + \frac{1}{118}}\right)} = 3.003$$

The rejection value for alpha = 0.1 is 1.645 [refer to Table A1, locate t-value corresponds to a = .05 (two-tailed test for 90 percent significance, and degrees of freedom (29 + 118 - 2) = 145]. Note that computed t-value 3.003 is greater than table t-value 1.645, therefore, we reject the null hypothesis and conclude that there is a significant difference between the two means observed in the diary and the mail turkey surveys.

(ii) Test statistic used if population variances are unequal. Sample sizes need to be greater than or equal to 30:

$$Z = \frac{\overline{x}_1 - \overline{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Reject the null hypothesis ($H_0: \mu_1 = \mu_2$) if computed Z-value is larger than $Z_{\frac{\alpha}{2}}$ or less than $-Z_{\frac{\alpha}{2}}$ table value. Table $Z_{\frac{\alpha}{2}}$ values used for $\alpha = .1$, .05, and .01 are 1.645, 1.96, and 2.576, respectively (Table A1).

Example: test the equality of two means for hunter age observed in samples from telephone and mail turkey surveys. It is known that:

Sample 1 (telephone survey)

$\bar{x}_1 = 34.7,\ s_1^2 = 218.04,\ n_1 = 47$

Sample 2 (mail survey)

$\bar{x}_2 = 32.05,\ s_2^2 = 248.0,\ n_2 = 43$

$$Z = \frac{34.7 - 32.05}{\sqrt{\frac{218.04}{47} + \frac{248.0}{43}}} = 0.8215$$

Since the computed Z-value 0.8215 is less than table Z-value 1.645 (Table A1), the null hypothesis is accepted and we conclude with 90 percent confidence that two means observed in the telephone and mail turkey surveys are not significantly different.

Bound on Error in a Binomial Experiment

A binomial experiment results in one of two outcomes: one is success (P) and the other is failure (q = 1 - P). The bound on error (B) is added or subtracted from the binomial experiment result. We conclude with 90 percent confidence that true success rate lies within ± B. The formula used to calculate bound on error is:

$$B = \pm\, 1.64 \sqrt{\frac{Pq}{n}}$$

where: B = bound on error,

P = success rate,

q = failure rate (1 - P), and

n = number of measurements.

Example: we wish to find out the extent of error in estimating true success rate obtained in our archery antelope survey. It is known that:

$P = 0.2056$,

$q = 0.7944$, and

$n = 287$.

$$B = \pm 1.64 \sqrt{\frac{(.2056)(.7944)}{287}}$$

$$= \pm 0.0391.$$

We conclude with 90 percent confidence that our estimate differs from the true success rate by less than ± 0.0391.

Comparing Two Binomial Parameters

We wish to test the equality of two binomial parameters Π_1 and Π_2, where Π_1 = probability of success in population 1, Π_2 = probability of success in population 2. The null hypothesis is that the two binomial parameters are equal ($H_0: \Pi_1 = \Pi_2$). Accepting the null hypothesis means there is no significant difference between the two binomial parameters. The formula used to test the hypothesis for large samples is:[8]

$$Z = \frac{P_1 - P_2}{\sqrt{Pq\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

where: Z = computed Z-value,

P_1 = binomial parameter $\left(\frac{x_1}{n_1}\right)$, where X_1 = success in population 1,

P_2 = binomial parameter $\left(\frac{x_2}{n_2}\right)$, where X_2 = success in population 2,

P = standard error of $(P_1 - P_2)$,

$$= \frac{\text{Total number of success}}{\text{Total number of trials}} = \frac{x_1 + x_2}{n_1 + n_2}$$

$q = 1 - P$.

---

[8]Sample size and value of $P = \frac{\text{number of success}}{\text{number of trials}}$ for each population should meet the requirement that both nP and $n(1-P)$ are equal to or greater than 10.

The null hypothesis is rejected if the computed Z-value is greater than $Z_{\frac{\alpha}{2}}$ or less than $-Z_{\frac{\alpha}{2}}$. Example: we wish to test the hypothesis that two binomial parameters for turkey hunter success observed in a telephone survey and another survey are equal. It is known that:

Sample 1 (telephone survey)

$x_1 = 818, n_1 = 1{,}142, P_1 = 0.83$

Sample 2 (another survey)

$x_2 = 67, n_2 = 81, P_2 = 0.716$

Substituting values into the formula, we obtain:

$$P = \frac{818 + 67}{1{,}142 + 81} = .724$$

$$q = 1 - .724$$

$$= 0.276$$

$$Z = \frac{.83 - .716}{\sqrt{(.724)(.276)\left(\frac{1}{1{,}142} + \frac{1}{81}\right)}}$$

$$= 2.218$$

Since the computed Z-value 2.218 is greater than table Z-value 1.645 (Table A1), we reject the hypothesis that P_1 equals P_2 and conclude that the two binomial parameters for hunter success observed in the two separate surveys are significantly different. The probability of incorrectly rejecting the null hypothesis is .10 in this example.

<u>Precision</u> (<u>Error</u> <u>Factor</u>):

This represents percent variation around mean at 90 percent confidence level. The formula used to calculate precision is:

$$\text{Precision} = \frac{1.64 \text{ (standard error of the mean)}}{\text{mean}} \times 100$$

Example: we are interested in the percent of variation of estimate for a success rate observed in an archery antelope survey. It is known that:

Standard error of the mean = 0.02389, and

Mean = 0.2056.

$$\text{Precision} = \frac{1.64(.02389)}{0.2056} \times 100$$

$$= 19.06 \text{ percent}$$

We conclude with 90 percent confidence that the point estimate has at most a 19 percent variation.

<u>Coefficient of Variation (C.V.)</u>:

The coefficient of variation measures variation as a proportion of the mean. The coefficient of variation has the advantage of allowing a direct comparison in variation with different means. The formula used to calculate coefficient of variation is:

$$\text{C.V.} = \frac{\text{Standard deviation}}{\text{mean}} \times 100$$

Example: we wish to compare the extent of relative variation in days hunted obtained in telephone and mail turkey surveys. It is known that:

Telephone turkey survey:

$\bar{x}$ = 2.01, and

s = 1.26.

$$\text{C.V.} = \frac{1.26}{2.01} \times 100$$

$$= 62.69 \text{ percent}$$

Mail turkey survey:

$\bar{x}$ = 2.14, and

s = 1.661.

$$\text{C.V.} = \frac{1.661}{2.14} \times 100$$

$$= 77.62 \text{ percent}$$

We could conclude that the days hunted for turkey obtained in the telephone survey have 15 percent less variation as compared to that obtained in the mail survey.

Finite Population Correction

A finite population correction (fpc) is used when sampling is from a population of finite size, N, instead of an infinite population. If the sample size is less than 10 percent of the population, the fpc can be omitted. The finite population correction is expressed as:

$$\frac{N - n}{N}$$

where: n = sample size

N = population size

The variance is multiplied by the fpc to improve the precision of the estimate. The standard error is adjusted by the square root of the fpc factor $\sqrt{\frac{N - n}{N}}$.

Appendix B

Appendix B: Models for Estimating Survey Costs

The cost of obtaining a usable survey is very important when deciding what type of survey method to use, the sample size, and if follow-up mailings and/or follow-up telephone surveys should be conducted.

A. Postseason Mail Questionnaire

The three cost models presented below can be used to calculate the costs of brief mail questionnaires and the more extensive mail questionnaires. Models 1, 2, and 3 represent one, two, and three mailings, respectively. The cost of labor is excluded from the models.

Model 1

$$C_1 = X_1 + Y_1\left(\frac{100 - R_1}{R_1}\right)$$

where: C_1 = Cost per usable survey returned,

X_1 = Materials used for the survey, including the postage cost of sending and receiving the survey,

Y_1 = X_1 less the cost of return postage,

R_1 = Response rate of initial mailing.

Example: Brief mail questionnaire, assuming 60 percent response from first mailing.

X_1 = 51.23¢. This includes one sheet of colored paper (8-1/2 x 11") and copying on both sides = 4.98¢, paper and copying of cover letter (one-half sheet) = 1.25¢, stamp = 20¢, and return postage = 25¢.

Y_1 = 26.23¢. (51.23¢ less 25¢ for return postage.)

R_1 = 60 percent return on first mailing.

$$C_1 = X_1 + Y_1\left(\frac{100 - R_1}{R_1}\right)$$

$$= 51.23 + 26.23\left(\frac{100 - 60}{60}\right)$$

$$= 69¢$$

Model 2

$$C_2 = X_2 + Y_2\left(\frac{100 - (R_1 + R_2)}{R_2}\right)$$

where: C_2 = Cost per usable survey returned from second mailing,

X_2 = X_1 + materials used for second survey and postage to send the survey but not the return postage, (see Model 1 for X_1),

Y_2 = Materials used for the second survey, includes postage to send but not to receive the survey, ($X_2 - X_1$),

R_1 = Response rate from first mailing,

R_2 = Response rate from second mailing.

Example: Brief mail questionnaire, assuming 60 percent response from first mailing, 15 percent response from second mailing.

X_2 = 76.84¢. This includes 51.23¢ (X_1) plus one sheet of colored paper (8-1/2 x 11") and copying on both sides = 4.98¢, paper and copying of reminder (one-fourth sheet) = .625¢, and stamp = 20¢.

Y_2 = 25.61¢. (76.84¢ less 51.23¢, X_2 less X_1.)

R_1 = 60 percent response on first mailing.

R_2 = 15 percent response on second mailing.

$$C_2 = X_2 + Y_2\left(\frac{100 - (R_1 + R_2)}{R_2}\right)$$

$$= 76.84 + 25.61\left(\frac{100 - (60 + 15)}{15}\right)$$

$$= \$1.20$$

Model 3

$$C_3 = X_3 + Y_3\left(\frac{100 - (R_1 + R_2 + R_3)}{R_3}\right)$$

where: C_3 = Cost per usable survey returned from the third mailing,

X_3 = X_2 + materials used for the third survey and postage to send the survey but not the return postage, (see Model 2 for X_2),

Y_3 = Materials used for the third survey, includes postage to send but not to receive the survey ($X_3 - X_2$),

R_1 = Response rate from first mailing,

R_2 = Response rate from second mailing,

R_3 = Response rate from third mailing.

Example: Brief mail questionnaire, assuming 60, 15, 10 percent response from the first, second, and third mailing, respectively.

X_3 = \$1.03. This includes 76.84¢ (X_2) plus one sheet of colored paper (8-1/2 x 11") and copying on both sides = 4.98¢, paper and copying of reminder (one-fourth sheet) = .625¢, and stamp = 20¢.

Y_3 = \$.2561. (\$1.03 - \$.7684, X_3 less X_2.)

R_1 = 60 percent response on first mailing.

R_2 = 15 percent response on second mailing.

R_3 = 10 percent response on third mailing.

$$C_3 = X_3 + Y_3 \left(\frac{100 - (R_1 + R_2 + R_3)}{R^3} \right)$$

$$= \$1.03 + .2561 \left(\frac{100 - (60 + 15 + 10)}{10} \right)$$

$$= \$1.41$$

The overall total cost per usable survey weights the cost per usable survey of each mailing against the total response rate.

Continuing with the previous example:

Total response rate is 60 + 15 + 10 = 85

Mailing one	$\frac{60}{85}$ x \$0.69	= \$0.49
Mailing two	$\frac{15}{85}$ x \$1.20	= \$0.21
Mailing three	$\frac{10}{85}$ x \$1.41	= \$0.16
Overall total cost per usable survey		= \$0.86

B. Telephone Survey

The model presented below can be used to calculate the cost of telephone surveys.

Model 4

$$C_4 = X_4 + Y_4 \left(\frac{R_4}{R_5}\right)$$

where: C_4 = Cost per usable survey conducted,

X_4 = Cost of telephone time to talk to individuals who answered the survey,

Y_4 = Cost of telephone time talking to individuals who did not buy a license, had a license and did not hunt, person was not home, or getting a wrong number,

R_4 = Percent of those contacted which had a license and did not hunt, did not buy a license, person was not home, or wrong number,

R_5 = Percent who purchased a license and answered the survey.

Example: Telephone survey assuming R_4 = 30 percent and R_5 = 70 percent.

X_4 = \$2.55. This is the cost of 17 minutes of telephone time.

Y_4 = \$.30. Cost of 2 minutes of telephone time.

R_4 = 30 percent.

R_5 = 70 percent.

$$C_4 = X_4 + Y_4 \left(\frac{R_4}{R_5}\right)$$

$$= 2.55 + .30 \left(\frac{30}{70}\right)$$

$$= \$2.68$$

APPENDIX C

Appendix C: Project Publications

Leitch, Jay A. and Daniel E. Kerestes. 1982. Development and Implementation of a Periodic Data Collection System for Game and Fish Management and Policy Analysis. First year report-summary data and preliminary findings. AE 82017, Department of Agricultural Economics, Agricultural Experiment Station, North Dakota State University, 121 pages.

Kerestes, Daniel E. and Jay A. Leitch. 1983. Development and Implementation of a Periodic Data Collection System for Game and Fish Management and Policy Analysis. Second Annual Report. Ae 83009, Department of Agricultural Economics, Agricultural Experiment Station, North Dakota State University, 160 pages.

Leitch, Jay A. and Daniel E. Kerestes. 1982. "Keeping Track of Sportsmen's Activities." North Dakota Outdoors, 45(4):19-20.

Kerestes, Daniel E. and Jay A. Leitch. 1982. "Profile of North Dakotans Who Go Fishing." North Dakota Outdoors. 45(5):7.

Kerestes, Daniel E. and Jay A. Leitch. 1982. "Small Game Hunters in North Dakota." North Dakota Outdoors. 45(4):21-22.

References

Allred, M. 1976. Condensed Report of the Public Opinion Survey of Fishing and Hunting Activities in Utah. Bureau of Government and Opinion Research, Utah State University, Logan and Utah State Department of Natural Resources, Division of Wildlife Resources.

Brown, William G., Ajmer Singh, and Emery N. Castle. 1964. An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery. Agricultural Experiment Station, Oregon State University, Corvallis.

Dey, Norm. Undated. Hunter Report Card Survey--Upland Game Portion, March 1, 1978 Through February 28, 1979. Nebraska Game and Parks Commission, Wildlife Division.

Dillman, D. A. 1978. Mail and Telephone Surveys, The Total Design Method. Wiley-Interscience Publication, John Wiley and Sons, New York.

Fleener, G. G. 1977. Recreational Use of Grand River. Missouri Department of Conservation, Columbia.

Gilbert, A. H. July 1981. Personal Communication. "Attitude Study of Vermont Hunters." Department of Resource Economics, Agricultural Experiment Station, University of Vermont, Burlington.

Gordon, D. 1970. An Economic Analysis of Idaho Sport Fisheries. University of Idaho Cooperative Fishery Unit, Moscow.

Gordon, D., D. W. Chapman, and T. C. Bjornn. 1973. "Economic Evaluation of Sport Fisheries--What Do They Mean?" Transactions of the American Fisheries Society (2):

Guttman, L. 1944. "A Basis for Scaling Qualitative Data." American Sociological Review, 9:139-50.

Harmoning, A. K. 1978. "Big Bucks $ for Bighorns." North Dakota Outdoors 40(8):2-4.

Hughes, A. and D. Grawoig. 1971. Statistics: A Foundation for Analysis. Addison-Wesley Publishing Company, Inc., Reading, Massachusetts.

Huntsberger, D. V. and P. Billingsly. 1974. Elements of Statistical Inferences. Allyn and Bacon, Inc., Boston.

Kerestes, Daniel E. and Jay A. Leitch. 1983. Development and Implementation of a Periodic Data Collection System for Game and Fish Management and Policy Analysis. Second Annual Report. Ae 83009, Department of Agricultural Economics, Agricultural Experiment Station, North Dakota State University, 160 pages.

Klecka, W. R. and A. J. Tuchfarber. 1978. "Random Digit Dialings: A Comparison to Personal Surveys." Public Opinion Quarterly, 42(1):103-14.

Leitch, Jay A. and Daniel E. Kerestes. 1982. Development and Implementation of a Periodic Data Collection System for Game and Fish Management and Policy Analysis. First year report-summary data and preliminary findings. AE 82017, Department of Agricultural Economics, Agricultural Experiment Station, North Dakota State University, 121 pages.

Leitch, Jay A. and Donald F. Scott. 1978. Nonresident Hunters in North Dakota: Characteristics, Expenditures, Harvest. Department of Agricultural Economics Report No. 126, North Dakota State University, Fargo.

Lewis, J. B. March 1981. Turkey Harvest and Hunting Pressure Analysis. Missouri Department of Conservation, Jefferson City.

Lewis, John B. 1981. Performance Report: Surveys and Investigations Projects. Missouri Department of Conservation, Jefferson City.

Likert, R. 1967. "The Method of Constructing an Attitude Scale." In Readings in Attitude Theory and Measurement. Martin Fishbein. John Wiley and Sons, New York.

Loether, H. J. and D. G. McTavish. 1974. Inferential Statistics for Sociologists. Allyn and Bacon, Inc., Boston.

Mendenhall, W., L. Ott, and R. F. Larson. 1974. Statistics: A Tool for the Social Sciences. Wadsworth Publishing Company, Inc., Belmont, California.

O'Muircheartaigh, C. A. and C. Payne. 1977. The Analysis of Survey Data. Volume 1: Exploring Data Structures. John Wiley and Sons, New York.

Oppenheim, A. N. 1966. Questionnaire Design and Attitude Measurement. Basic Books, New York.

Phillips, C. and S. E. Ferguson. June 1977. Hunting and Fishing Expenditure Values and Participation Preferences in Wyoming, 1975. Water Resources Research Institute, University of Wyoming, Cheyenne.

Porath, W. R., D. J. Witter, and S. L. Sheriff. December 1980. Deer Hunter Information Survey. Missouri Department of Conservation, Jefferson City.

Probe North Dakota--Attitudes Toward Problems Facing Wildlife and Ratings of Game and Fish Department. March 1981. Conducted by Mid-Continent Surveys, Inc., Minneapolis, Minnesota.

Rodgers, R. August 1981. Small Game Hunter Activity Survey--1980. Kansas Fish and Game Commission, Pratt.

Ryel, L. A. September 1981. Personal Communication. "1980 Michigan Small Game Hunter's Report." Surveys and Statistics, Wildlife Division, Department of Natural Resources, Lansing.

Shaw, W. W. and E. H. Zube. November 1981. Wildlife Values. Institutional Series Report No. 1, School of Renewable Natural Resources, University of Arizona, Tucson.

Stuart, R. W. 1949. "How the North Dakota Hunter Spent His Dollar." North Dakota Outdoors, 11:10-12.

Thurstone, L. L. 1928. "Attitudes Can Be Measured." American Journal of Sociology, 33:529-54.

U.S. Department of the Interior, Fish and Wildlife Service. Spring 1976. "National Hunting and Fishing Surveys." Conducted by National Analysts, Philadelphia.

U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, Bureau of the Census. November 1982. 1980 National Survey of Fishing, Hunting, and Wildlife--Associated Recreation. U.S. Government Printing Office, Washington, D.C.

Volk, A. A. and V. E. Montgomery. Fall 1973. The Economic Impact of Sport Fishing in South Dakota, 1972 With Notes on Angler Traits. Business Research Bureau, School of Business, University of South Dakota, Vermillion.

Wallwork, S. S., M. S. Lenihan, and P. E. Polzin. December 1980. Montana Outdoor Recreation Survey. Bureau of Business and Economic Research, School of Business Administration, University of Montana, Missoula.

Witter, D. J. 1981. Personal Communication. "Land and Wildlife in Missouri." Wildlife Division, Missouri Department of Conservation, Jefferson City.

Witter, D. J., P. S. Haverland, L. C. Belusz, and C. E. Hicks. 1981. "Anglers Using Missouri's Trout Parks: Their Moves and Opinions of Management." Paper presented at the 1981 Symposium on Leisure Research, Congress for Recreation and Parks. October 25-29, 1981, Minneapolis, Minnesota.

Wright, V. September 1974. 1973-74 Upland Game Harvest Survey. Iowa Wildlife Research Bulletin No. 12. Iowa Conservation Commission, Wildlife Section, Des Moines.

Wroblewski, Leonard. 1970. "Some Notes on Sampling Surveys." Special Publication No. 86, Minnesota Department of Conservation, Division of Game and Fish, St. Paul.